

Package: SoilR (via r-universe)

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Title Models of Soil Organic Matter Decomposition

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Description Functions for modeling Soil Organic Matter decomposition in terrestrial ecosystems with linear and nonlinear systems of differential equations. The package implements models according to the compartmental system representation described in Sierra and others (2012) <[doi:10.5194/gmd-5-1045-2012](https://doi.org/10.5194/gmd-5-1045-2012)> and Sierra and others (2014) <[doi:10.5194/gmd-7-1919-2014](https://doi.org/10.5194/gmd-7-1919-2014)>.

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Depends R (>= 3.5.0), deSolve,methods

Imports igraph,assertthat,parallel,expm,sets,purrr

Suggests FME,lattice,MASS,knitr,rmarkdown,getopt,tinytex

LazyData TRUE

Collate setGlobalVariables.R setOldClasses.R genericFunctions.R
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| | |
|---------------|--------------|
| SoilR-package | <i>SoilR</i> |
|---------------|--------------|

Description

The package allows you to study compartmental Soil models.

Details

The typical workflow consists of the following steps:

1. Create a model(run)
2. Inspect it

The simplest way of creating a model is to use one of the top level functions for predefined models: [predefinedModels](#). The objects returned by these functions can be of different type, usually either

1. [Model](#)
2. [Model_14](#).

To inspect the behavior of a model object these classes provide several methods to be found in their respective descriptions. If none of the predefined models fits your needs you can assemble your own model. The functions that create it are the constructors of the above mentioned classes. By convention they have the same name as the class and are described here:

1. [Model](#)
2. [Model_14](#).

AbsoluteFractionModern

Conversion of radiocarbon values

Description

Conversion of radiocarbon values

Usage

AbsoluteFractionModern(F)

Arguments

F see method arguments

AbsoluteFractionModern, BoundFc-method

automatic title

Description

automatic title

Usage

```
## S4 method for signature 'BoundFc'  
AbsoluteFractionModern(F)
```

Arguments

F no manual documentation

AbsoluteFractionModern,ConstFc-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'ConstFc'  
AbsoluteFractionModern(F)
```

Arguments

F no manual documentation

AbsoluteFractionModern_from_Delta14C
Conversion of radiocarbon values

Description

Conversion of radiocarbon values

Usage

```
AbsoluteFractionModern_from_Delta14C(delta14C)
```

Arguments

delta14C Object to be converted to AbsoluteFractionModern

AbsoluteFractionModern_from_Delta14C,matrix-method
Conversion of radiocarbon values

Description

Conversion of radiocarbon values

Usage

```
## S4 method for signature 'matrix'  
AbsoluteFractionModern_from_Delta14C(delta14C)
```

Arguments

delta14C Matrix with radiocarbon values in Delta14C

AbsoluteFractionModern_from_Delta14C,numeric-method
Conversion of radiocarbon values, from Delta14C to absolute fraction modern

Description

Conversion of radiocarbon values, from Delta14C to absolute fraction modern

Usage

```
## S4 method for signature 'numeric'  
AbsoluteFractionModern_from_Delta14C(delta14C)
```

Arguments

delta14C radiocarbon value in Delta14C

| | |
|----------|-----------------------------|
| add_plot | <i>Add elements to plot</i> |
|----------|-----------------------------|

Description

Add elements to plot

Usage

```
add_plot(x, ...)
```

Arguments

| | |
|-----|----------------------|
| x | see method arguments |
| ... | see method arguments |

| | |
|--------------------------|------------------------|
| add_plot, TimeMap-method | <i>automatic title</i> |
|--------------------------|------------------------|

Description

automatic title

Usage

```
## S4 method for signature 'TimeMap'  
add_plot(x, ...)
```

Arguments

| | |
|-----|-------------------------|
| x | no manual documentation |
| ... | no manual documentation |

as.character,TimeMap-method

automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TimeMap'
as.character(x, ...)
```

Arguments

| | |
|-----|-------------------------|
| x | no manual documentation |
| ... | no manual documentation |

as.numeric,InFluxList_by_PoolName-method

Convert to a numeric vector with the pool names as names

Description

Convert to a numeric vector with the pool names as names

Usage

```
## S4 method for signature 'InFluxList_by_PoolName'
as.numeric(x, y, t, time_symbol, ...)
```

Arguments

| | |
|-------------|---|
| x | The list of fluxes. Every element contains a function that depends on a combination of of state variables and time. |
| y | A vector indexed by the names of the state variables |
| t | a number representing the current point in time |
| time_symbol | The name of the time argument used in the definition of the flux functions |
| ... | additional arguments |

 as.numeric,InternalFluxList_by_PoolName-method

Convert to a numeric vector with names of the form 'a->b'

Description

Convert to a numeric vector with names of the form 'a->b'

Usage

```
## S4 method for signature 'InternalFluxList_by_PoolName'
as.numeric(x, y, t, time_symbol, ...)
```

Arguments

| | |
|-------------|---|
| x | The list of fluxes. Every element contains a function that depends on a combination of of state variables and time. |
| y | A vector indexed by the names of the state variables |
| t | a number representing the current point in time |
| time_symbol | The name of the time argument used in the definition of the flux functions |
| ... | additional arguments |

as.numeric,InternalFlux_by_PoolName-method

Convert to a numeric value with name of the form 'a->b'

Description

Convert to a numeric value with name of the form 'a->b'

Usage

```
## S4 method for signature 'InternalFlux_by_PoolName'
as.numeric(x, y, t, time_symbol, ...)
```

Arguments

| | |
|-------------|---|
| x | The list of fluxes. Every element contains a function that depends on a combination of of state variables and time. |
| y | A vector indexed by the names of the state variables |
| t | a number representing the current point in time |
| time_symbol | The name of the time argument used in the definition of the flux functions |
| ... | additional arguments |

```
as.numeric,OutFluxList_by_PoolName-method
```

Convert to a numeric vector with the pool names as names

Description

Convert to a numeric vector with the pool names as names

Usage

```
## S4 method for signature 'OutFluxList_by_PoolName'
as.numeric(x, y, t, time_symbol, ...)
```

Arguments

| | |
|-------------|--|
| x | The list of fluxes. Every element contains a function that depends on a combination of state variables and time. |
| y | A vector indexed by the names of the state variables |
| t | a number representing the current point in time |
| time_symbol | The name of the time argument used in the definition of the flux functions |
| ... | additional arguments |

```
availableParticleProperties
```

Available particle properties

Description

Available particle properties

Usage

```
availableParticleProperties(object)
```

Arguments

| | |
|--------|----------------------|
| object | see method arguments |
|--------|----------------------|

availableParticleProperties, MCSim-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'MCSim'  
availableParticleProperties(object)
```

Arguments

object no manual documentation

availableParticleSets Available particle sets

Description

Available particle sets

Usage

```
availableParticleSets(object)
```

Arguments

object see method arguments

availableParticleSets,MCSim-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'MCSim'
availableParticleSets(object)
```

Arguments

object no manual documentation

availableResidentSets *Available resident sets*

Description

Available resident sets

Usage

```
availableResidentSets(object)
```

Arguments

object see method arguments

availableResidentSets,MCSim-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'MCSim'
availableResidentSets(object)
```

Arguments

object no manual documentation

| | |
|----------|---|
| AWBmodel | <i>Implementation of the microbial model AWB (Allison, Wallenstein, Bradford, 2010)</i> |
|----------|---|

Description

This function implements the microbial model AWB (Allison, Wallenstein, Bradford, 2010), a four-pool model with a microbial biomass, enzyme, SOC and DOC pools. It is a special case of the general nonlinear model.

Usage

```
AWBmodel(
  t,
  V_M = 1e+08,
  V_m = 1e+08,
  r_B = 2e-04,
  r_E = 5e-06,
  r_L = 0.001,
  a_BS = 0.5,
  epsilon_0 = 0.63,
  epsilon_s = -0.016,
  Km_0 = 500,
  Km_u0 = 0.1,
  Km_s = 0.5,
  Km_us = 0.1,
  Ea = 47,
  R = 0.008314,
  Temp1 = 20,
  Temp2 = 20,
  ival = c(B = 2.19159, E = 0.0109579, S = 111.876, D = 0.00144928),
  I_S = 0.005,
  I_D = 0.005
)
```

Arguments

| | |
|-----|--|
| t | vector of times (in hours) to calculate a solution. |
| V_M | a scalar representing the maximum rate of uptake (mg DOC cm ⁻³ h ⁻¹). Equivalent to V_maxuptake0 in original paper. |
| V_m | a scalar representing the maximum rate of decomposition of SOM (mg SOM cm ⁻³ h ⁻¹). Equivalent to V_max0 in original paper. |
| r_B | a scalar representing the rate constant of microbial death (h ⁻¹). Equivalent to r_death in original publication. |
| r_E | a scalar representing the rate constant of enzyme production (h ⁻¹). Equivalent to r_EnzProd in original publication. |

| | |
|-----------|--|
| r_L | a scalar representing the rate constant of enzyme loss (h-1). Equivalent to r_EnzLoss in original publication. |
| a_BS | a scalar representing the fraction of the dead microbial biomass incorporated to SOC. MICtoSOC in original publication. |
| epsilon_0 | a scalar representing the intercept of the CUE function (mg mg-1). CUE_0 in original paper. |
| epsilon_s | a scalar representing the slope of the CUE function (degree-1). CUE_slope in original paper. |
| Km_0 | a scalar representing the intercept of the half-saturation constant of SOC as a function of temperature (mg cm-3). |
| Km_u0 | a scalar representing the intercept of the half saturation constant of uptake as a function of temperature (mg cm-3). |
| Km_s | a scalar representing the slope of the half saturation constant of SOC as a function of temperature (mg cm-3 degree-1). |
| Km_us | a scalar representing the slope of the half saturation constant of uptake as a function of temperature (mg cm-3 degree-1). |
| Ea | a scalar representing the activation energy (kJ mol-1). |
| R | a scalar representing the gas constant (kJ mol-1 degree-1). |
| Temp1 | a scalar representing the temperature in the output vector. |
| Temp2 | a scalar representing the temperature in the transfer matrix. |
| ival | a vector of length 4 with the initial values for the pools (mg cm-3). |
| I_S | a scalar with the inputs to the SOC pool (mg cm-3 h-1). |
| I_D | a scalar with the inputs to the DOC pool (mg cm-3 h-1). |

Details

This implementation contains default parameters presented in Allison et al. (2010).

Value

An object of class NIModel that can be further queried.

References

Allison, S.D., M.D. Wallenstein, M.A. Bradford. 2010. Soil-carbon response to warming dependent on microbial physiology. *Nature Geoscience* 3: 336-340.

Examples

```
hours=seq(0,800,0.1)

#Run the model with default parameter values
bcmode1=AWBmodel(t=hours)
Cpools=getC(bcmode1)
##Time solution
# fixme mm:
```



```
# the next line causes trouble on Rforge Windows patched build
# matplot(hours,Cpools,type="l",ylab="Concentrations",xlab="Hours",lty=1,ylim=c(0,max(Cpools)*1.2))
##State-space diagram
plot(as.data.frame(Cpools))
```

bacwaveModel

Implementation of the microbial model Bacwave (bacterial waves)

Description

This function implements the microbial model Bacwave (bacterial waves), a two-pool model with a bacterial and a substrate pool. It is a special case of the general nonlinear model.

Usage

```
bacwaveModel(
  t,
  umax = 0.063,
  ks = 3,
  theta = 0.23,
  Dmax = 0.26,
  kd = 14.5,
  kr = 0.4,
  Y = 0.44,
  ival = c(S0 = 0.5, X0 = 1.5),
  BGF = 0.15,
  ExuM = 8,
  ExuT = 0.8
)
```

Arguments

| | |
|-------|--|
| t | vector of times (in hours) to calculate a solution. |
| umax | a scalar representing the maximum relative growth rate of bacteria (hr-1) |
| ks | a scalar representing the substrate constant for growth (ug C/ml soil solution) |
| theta | a scalar representing soil water content (ml solution/cm ³ soil) |
| Dmax | a scalar representing the maximal relative death rate of bacteria (hr-1) |
| kd | a scalar representing the substrate constant for death of bacteria (ug C/ml soil solution) |
| kr | a scalar representing the fraction of death biomass recycling to substrate (unitless) |
| Y | a scalar representing the yield coefficient for bacteria (ug C/ugC) |
| ival | a vector of length 2 with the initial values for the substrate and the bacterial pools (ug C/cm ³) |
| BGF | a scalar representing the constant background flux of substrate (ug C/cm ³ soil/hr) |

| | |
|------|--|
| ExuM | a scalar representing the maximal exudation rate (ug C/(hr cm ³ soil)) |
| ExuT | a scalar representing the time constant for exudation, responsible for duration of exudation (1/hr). |

Details

This implementation contains default parameters presented in Zelenev et al. (2000). It produces nonlinear damped oscillations in the form of a stable focus.

Value

An object of class NIModel that can be further queried.

References

Zelenev, V.V., A.H.C. van Bruggen, A.M. Semenov. 2000. "BACWAVE," a spatial-temporal model for traveling waves of bacterial populations in response to a moving carbon source in soil. *Microbial Ecology* 40: 260-272.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
hours=seq(0,800,0.1)
#
#Run the model with default parameter values
bcmodel=bacwaveModel(t=hours)
Cpools=getC(bcmodel)
#
#Time solution
matplot(hours,Cpools,type="l",ylab="Concentrations",xlab="Hours",lty=1,ylim=c(0,max(Cpools)*1.2))
legend("topleft",c("Substrate", "Microbial biomass"),lty=1,col=c(1,2),bty="n")
#
#State-space diagram
plot(Cpools[,2],Cpools[,1],type="l",ylab="Substrate",xlab="Microbial biomass")
#
#Microbial biomass over time
plot(hours,Cpools[,2],type="l",col=2,xlab="Hours",ylab="Microbial biomass")
```

bind.C14curves

Binding of pre- and post-bomb Delta14C curves

Description

This function takes a pre- and a post-bomb curve, binds them together, and reports the results back either in years BP or AD.

Usage

```
bind.C14curves(prebomb, postbomb, time.scale)
```

Arguments

| | |
|------------|---|
| prebomb | A pre-bomb radiocarbon dataset. They could be either IntCal09 or IntCal13 . |
| postbomb | A post-bomb radiocarbon dataset. They could be any of the datasets in Hua2013 . |
| time.scale | A character indicating whether to report the results in years before present BP or anno domini AD. |

Value

A data.frame with 3 columns: years in AD or BP, the atmospheric Delta14C value, the standard deviation of the Delta14C value.

| | |
|---------|------------------------|
| BoundFc | <i>Bound Fc object</i> |
|---------|------------------------|

Description

Bound Fc object

Usage

```
BoundFc(format, ...)
```

Arguments

| | |
|--------|----------------------|
| format | see method arguments |
| ... | see method arguments |

| | |
|---------------------------|------------------------|
| BoundFc, character-method | <i>automatic title</i> |
|---------------------------|------------------------|

Description

automatic title

Usage

```
## S4 method for signature 'character'
BoundFc(format, ...)
```

Arguments

| | |
|--------|-------------------------|
| format | no manual documentation |
| ... | no manual documentation |

BoundFc,missing-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'missing'
BoundFc(format, ...)
```

Arguments

| | |
|--------|-------------------------|
| format | no manual documentation |
| ... | no manual documentation |

| | |
|---------------|--|
| BoundFc-class | <i>S4-class to represent atmospheric 14C concentration as scalar function of time.</i> |
|---------------|--|

Description

As time dependent scalar function which remembers its domain (see [ScalarTimeMap](#)) and its format.

| | |
|---------------|--------------------------------------|
| BoundInFluxes | <i>constructor for BoundInFluxes</i> |
|---------------|--------------------------------------|

Description

The method internally calls [TimeMap](#) and expects the same kind of arguments

Usage

```
BoundInFluxes(...)
```

Arguments

| | |
|-----|--------------------------------------|
| ... | passed on to TimeMap |
|-----|--------------------------------------|

BoundInFluxes-class *automatic title*

Description

automatic title

BoundLinDecompOp *Generic constructor for the class with the same name*

Description

Generic constructor for the class with the same name

Usage

BoundLinDecompOp(map, ...)

Arguments

| | |
|-----|---|
| map | A map |
| ... | Additional arguments passed to function |

BoundLinDecompOp, ANY-method
Creates an object of class BoundLinDecompOp

Description

Creates an object of class BoundLinDecompOp

Usage

```
## S4 method for signature 'ANY'
BoundLinDecompOp(map, ...)
```

Arguments

| | |
|-----|--|
| map | An object of class different than UnBoundLinDecompOp |
| ... | Additional arguments to pass to TimeMap |

BoundLinDecompOp, UnBoundLinDecompOp-method
A converter

Description

The distinction between the classes BoundLinDecompOp and UnboundLinDecompOp exist for those functions, that should be only defined for objects of class UnBoundLinDecomp.

Many functions however do not need extra methods for objects of class UnBoundLinDecompOp and just treat it as a BoundLinDecompOp which is defined on the complete timeline (-Inf,+Inf). With its default arguments this function converts its map argument to a BoundLinDecompOp with just this domain. This is the most frequent internal use case. If starttime and endtime are provided the domain of the operator will be restricted [starttime,endtime].

Usage

```
## S4 method for signature 'UnBoundLinDecompOp'
BoundLinDecompOp(map, starttime = -Inf, endtime = Inf)
```

Arguments

| | |
|-----------|--|
| map | An object of class UnBoundLinDecompOp |
| starttime | Begin of time interval map will be restricted to |
| endtime | End of time interval map will be restricted to |

BoundLinDecompOp-class
A S4 class to represent a linear compartmental operator defined on time interval

Description

A S4 class to represent a linear compartmental operator defined on time interval

| | |
|--------------|------------------------|
| by_PoolIndex | <i>automatic title</i> |
|--------------|------------------------|

Description

automatic title

Usage

by_PoolIndex(obj, poolNames, timeSymbol)

Arguments

| | |
|------------|----------------------|
| obj | see method arguments |
| poolNames | see method arguments |
| timeSymbol | see method arguments |

by_PoolIndex, ConstantInFluxRate_by_PoolName, ANY, ANY-method
new object with the source pool id converted to a PoolIndex if necessary

Description

new object with the source pool id converted to a PoolIndex if necessary

new object with the source pool id converted to a PoolIndex if necessary

Usage

```
## S4 method for signature 'ConstantInFluxRate_by_PoolName,ANY,ANY'
by_PoolIndex(obj, poolNames)
```

```
## S4 method for signature 'ConstantInFluxRate_by_PoolName,ANY,ANY'
by_PoolIndex(obj, poolNames)
```

Arguments

| | |
|-----------|--|
| obj | and object of class ConstantInFluxRate_by_PoolName |
| poolNames | names of pools |

by_PoolIndex,ConstantInternalFluxRateList_by_PoolName,ANY,ANY-method
convert to a list indexed by pool names

Description

convert to a list indexed by pool names

Usage

```
## S4 method for signature 'ConstantInternalFluxRateList_by_PoolName,ANY,ANY'
by_PoolIndex(obj, poolNames)
```

Arguments

| | |
|-----------|--|
| obj | object of class ConstantInternalFluxRateList_by_PoolName |
| poolNames | names of pools |

by_PoolIndex,ConstantInternalFluxRate_by_PoolName,ANY,ANY-method
new object with the source pool id converted to a PoolName if necessary

Description

new object with the source pool id converted to a PoolName if necessary

Usage

```
## S4 method for signature 'ConstantInternalFluxRate_by_PoolName,ANY,ANY'
by_PoolIndex(obj, poolNames)
```

Arguments

| | |
|-----------|---|
| obj | an object of class ConstantInternalFluxRate_by_PoolName |
| poolNames | names of the pools |

by_PoolIndex,ConstantOutFluxRateList_by_PoolName,ANY,ANY-method
convert to a list indexed by pool names

Description

convert to a list indexed by pool names

Usage

```
## S4 method for signature 'ConstantOutFluxRateList_by_PoolName,ANY,ANY'  
by_PoolIndex(obj, poolNames)
```

Arguments

| | |
|-----------|--|
| obj | an object of class ConstantOutFluxRateList_by_PoolName |
| poolNames | names of the pools |

by_PoolIndex,ConstantOutFluxRate_by_PoolName,ANY,ANY-method
new object with the source pool id converted to a PoolIndex if necessary

Description

new object with the source pool id converted to a PoolIndex if necessary

Usage

```
## S4 method for signature 'ConstantOutFluxRate_by_PoolName,ANY,ANY'  
by_PoolIndex(obj, poolNames)
```

Arguments

| | |
|-----------|---|
| obj | object of class ConstantOutFluxRate_by_PoolName |
| poolNames | names of pools |

by_PoolIndex, function, character, character-method
convert a function f of to f_vec

Description

convert a function f of to f_vec

Usage

```
## S4 method for signature '`function`,character,character'
by_PoolIndex(obj, poolNames, timeSymbol)
```

Arguments

| | |
|------------|---|
| obj | For this method a function, whose formal arguments must have names that are elements of the union of poolNames and timeSymbol |
| poolNames | The ordered poolnames |
| timeSymbol | The name of the argument of obj that represents time. |

Value

f_vec(vec,t) A new function that extracts the arguments of obj from a complete vector of state variables and the time argument t and applies the original function to these arguments The ode solvers used by SoilR expect a vector valued function of the state vector and time that represents the derivative. The components of this vector are scalar functions of a vector argument and time. It is possible for the user to define such functions directly, but the definition always depends on the order of state variables. Furthermore these functions usually do not use the complete state vector but only some parts of it. It is much clearer more intuitive and less error prone to be able to define functions that have only formal arguments that are used. This is what this method is used for.

Examples

```
leaf_resp=function(leaf_pool_content){leaf_pool_content*4}
leaf_resp(1)
poolNames=c(
  "some_thing"
  ,"some_thing_else"
  ,"some_thing_altogether"
  ,"leaf_pool_content"
)
leaf_resp_vec=by_PoolIndex(leaf_resp,poolNames,timeSymbol='t')
# The result is the same since the only the forth position in the vector
leaf_resp_vec(c(1,27,3,1),5)
```

by_PoolIndex,InFluxList_by_PoolName,character,character-method
Transform pool names to indices

Description

Transform pool names to indices

Usage

```
## S4 method for signature 'InFluxList_by_PoolName,character,character'  
by_PoolIndex(obj, poolNames, timeSymbol)
```

Arguments

| | |
|------------|-------------------------|
| obj | no manual documentation |
| poolNames | no manual documentation |
| timeSymbol | no manual documentation |

by_PoolIndex,InFlux_by_PoolName,character,character-method
Convert the pool names to indices

Description

Convert the pool names to indices

Usage

```
## S4 method for signature 'InFlux_by_PoolName,character,character'  
by_PoolIndex(obj, poolNames, timeSymbol)
```

Arguments

| | |
|------------|-------------------------|
| obj | no manual documentation |
| poolNames | no manual documentation |
| timeSymbol | no manual documentation |

by_PoolIndex,InternalFluxList_by_PoolName,character,character-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'InternalFluxList_by_PoolName,character,character'
by_PoolIndex(obj, poolNames, timeSymbol)
```

Arguments

| | |
|------------|-------------------------|
| obj | no manual documentation |
| poolNames | no manual documentation |
| timeSymbol | no manual documentation |

by_PoolIndex,InternalFlux_by_PoolName,character,character-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'InternalFlux_by_PoolName,character,character'
by_PoolIndex(obj, poolNames, timeSymbol)
```

Arguments

| | |
|------------|-------------------------|
| obj | no manual documentation |
| poolNames | no manual documentation |
| timeSymbol | no manual documentation |

by_PoolIndex,OutFluxList_by_PoolName,character,character-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'OutFluxList_by_PoolName,character,character'  
by_PoolIndex(obj, poolNames, timeSymbol)
```

Arguments

| | |
|------------|-------------------------|
| obj | no manual documentation |
| poolNames | no manual documentation |
| timeSymbol | no manual documentation |

by_PoolIndex,OutFlux_by_PoolName,character,character-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'OutFlux_by_PoolName,character,character'  
by_PoolIndex(obj, poolNames, timeSymbol)
```

Arguments

| | |
|------------|-------------------------|
| obj | no manual documentation |
| poolNames | no manual documentation |
| timeSymbol | no manual documentation |

```
by_PoolIndex, PoolConnection_by_PoolName, ANY, ANY-method
    constructor from strings of the form 'x->y' new object with the source
    pool id and the destination pool id guaranteed to be of class PoolIndex
```

Description

converts the ids if necessary otherwise returns an identical object

Usage

```
## S4 method for signature 'PoolConnection_by_PoolName,ANY,ANY'
by_PoolIndex(obj, poolNames)
```

Arguments

| | |
|-----------|---|
| obj | an object of class PoolConnection_by_PoolName |
| poolNames | names of pools |

| | |
|-------------|------------------------|
| by_PoolName | <i>automatic title</i> |
|-------------|------------------------|

Description

automatic title

Usage

```
by_PoolName(obj, poolNames)
```

Arguments

| | |
|-----------|----------------------|
| obj | see method arguments |
| poolNames | see method arguments |

by_PoolName,ConstantInFluxList_by_PoolIndex-method
convert to a list indexed by pool names

Description

convert to a list indexed by pool names

Usage

```
## S4 method for signature 'ConstantInFluxList_by_PoolIndex'  
by_PoolName(obj, poolNames)
```

Arguments

| | |
|-----------|---|
| obj | object of class ConstantInFluxList_by_PoolIndex |
| poolNames | names of pools |

by_PoolName,ConstantInFluxRate_by_PoolIndex-method
new object with the source pool id converted to a PoolIndex if necessary

Description

new object with the source pool id converted to a PoolIndex if necessary

Usage

```
## S4 method for signature 'ConstantInFluxRate_by_PoolIndex'  
by_PoolName(obj, poolNames)
```

Arguments

| | |
|-----------|--|
| obj | an object of class ConstantInFluxRate_by_PoolIndex |
| poolNames | names of pools |

by_PoolName,ConstantInFlux_by_PoolIndex-method

new object with the source pool id converted to a PoolIndex if necessary

Description

new object with the source pool id converted to a PoolIndex if necessary

Usage

```
## S4 method for signature 'ConstantInFlux_by_PoolIndex'
by_PoolName(obj, poolNames)
```

Arguments

| | |
|-----------|--|
| obj | an object of class ConstantInFlux_by_PoolIndex |
| poolNames | names of pools |

by_PoolName,ConstantInternalFluxRateList_by_PoolIndex-method

convert to a list indexed by pool names

Description

convert to a list indexed by pool names

Usage

```
## S4 method for signature 'ConstantInternalFluxRateList_by_PoolIndex'
by_PoolName(obj, poolNames)
```

Arguments

| | |
|-----------|--|
| obj | an object of class ConstantInternalFluxRateList_by_PoolIndex |
| poolNames | names of pools |

by_PoolName,ConstantOutFluxRateList_by_PoolIndex-method
convert to a list indexed by pool names

Description

convert to a list indexed by pool names

Usage

```
## S4 method for signature 'ConstantOutFluxRateList_by_PoolIndex'
by_PoolName(obj, poolNames)
```

Arguments

| | |
|-----------|---|
| obj | an object of class ConstantOutFluxRateList_by_PoolIndex |
| poolNames | names of pools |

by_PoolName,ConstantOutFluxRate_by_PoolIndex-method
new object with the source pool id converted to a PoolName if necessary

Description

This method exists only for classes that do not contain functions of the state_variables since we cannot automatically translate functions with a state vector arguments to functions of the respective state variables which would require symbolic computations. The reverse direction is always possible and is therefore the preferred way to input rate functions that depend on state variables.

Usage

```
## S4 method for signature 'ConstantOutFluxRate_by_PoolIndex'
by_PoolName(obj, poolNames)
```

Arguments

| | |
|-----------|---|
| obj | an object of class ConstantOutFluxRate_by_PoolIndex |
| poolNames | names of pools |

| | |
|--------|---------------------------------|
| C14Atm | <i>Atmospheric 14C fraction</i> |
|--------|---------------------------------|

Description

Atmospheric 14C fraction in units of Delta14C for the bomb period in the northern hemisphere.

@note This dataset will be deprecated soon. Please use [C14Atm_NH](#) or [Hua2013](#) instead.

Usage

```
data(C14Atm)
```

Format

A data frame with 108 observations on the following 2 variables.

1. V1 a numeric vector

Examples

```
#Notice that C14Atm is a shorter version of C14Atm_NH
require("SoilR")
data("C14Atm_NH")
plot(C14Atm_NH, type="l")
lines(C14Atm, col=2)
```

| | |
|-----------|---|
| C14Atm_NH | <i>Post-bomb atmospheric 14C fraction</i> |
|-----------|---|

Description

Atmospheric 14C concentrations for the post-bomb period expressed as Delta 14C in per mil. This dataset contains a combination of observations from locations in Europe and North America. It is representative for the Northern Hemisphere.

Usage

```
data(C14Atm_NH)
```

Format

A data frame with 111 observations on the following 2 variables.

1. YEAR a numeric vector with year of measurement.
2. Atmosphere a numeric vector with the Delta 14 value of atmospheric CO2 in per mil.

Examples

```
plot(C14Atm_NH,type="l")
```

CenturyModel

Implementation of the Century model

Description

This function implements the Century model as described in Parton et al. (1987).

Usage

```
CenturyModel(
  t,
  ks = c(STR.surface = 0.076, MET.surface = 0.28, STR.belowgroun = 0.094, MET.belowground
        = 0.35, ACT = 0.14, SLW = 0.0038, PAS = 0.00013),
  C0 = rep(0, 7),
  surfaceIn,
  soilIn,
  LN,
  Ls,
  clay = 0.2,
  silt = 0.45,
  xi = 1,
  xi_lag = 0,
  solver = deSolve.lsoda.wrapper
)
```

Arguments

| | |
|-----------|---|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 7 containing the values of the decomposition rates for the different pools. Units in per week. |
| C0 | A vector of length 7 containing the initial amount of carbon for the 7 pools. |
| surfaceIn | A scalar or data.frame object specifying the amount of aboveground litter inputs to the soil surface by time (mass per area per week). |
| soilIn | A scalar or data.frame object specifying the amount of belowground litter inputs to the soil by time (mass per area per week). |
| LN | A scalar representing the lignin to nitrogen ratio of the plant residue inputs. |
| Ls | A scalar representing the fraction of structural material that is lignin. |
| clay | Proportion of clay in mineral soil. |
| silt | Proportion of silt in mineral soil. |
| xi | A scalar, data.frame, function or anything that can be converted to a scalar function of time ScalarTimeMap object specifying the external (environmental and/or edaphic) effects on decomposition rates. |

| | |
|---------------------|--|
| <code>xi_lag</code> | A time shift/delay for the automatically created time dependent function <code>xi(t)</code> |
| <code>solver</code> | A function that solves the system of ODEs. This can be <code>euler</code> or <code>deSolve.lsoda.wrapper</code> or any other user provided function with the same interface. |

Details

This is one of the few examples that internally make use of the new infrastructure for flux based descriptions of models (see examples).

Value

A Model Object that can be further queried

References

Parton, W.J., D.S. Schimel, C.V. Cole, and D.S. Ojima. 1987. Analysis of factors controlling soil organic matter levels in Great Plain grasslands. *Soil Science Society of America Journal* 51: 1173–1179. Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

`RothCModel`. There are other `predefinedModels` and also more general functions like `Model`.

Examples

```

mnths=seq(0,100)
APPT=50 # Assume 50 cm annual precipitation
Pmax=-40+7.7*APPT # Max aboveground production
Rmax=100+7.0*APPT # Max belowground production
abvgIn=Pmax/(Pmax+Rmax)
blgIn=Rmax/(Pmax+Rmax)

cm=CenturyModel(t=mnths, surfaceIn = abvgIn, soilIn = blgIn, LN=0.5, Ls=0.1)
Ct=getC(cm)

poolNames=c("Surface structural", "Surface metabolic", "Belowground structural",
            "Belowground metabolic", "Active SOM", "Slow SOM", "Passive SOM")
matplot(mnths,Ct, type="l", lty=1, col=1:7, xlab="Time (months)", ylab="Carbon stock ")
legend("topleft", poolNames, lty=1, col=1:7, bty="n")

```

Description

This function implements a radiocarbon version of the Century model as described in Parton et al. (1987).

Usage

```
CenturyModel14(
  t,
  ks = 52 * c(STR.surface = 0.076, MET.surface = 0.28, STR.belowground = 0.094,
    MET.belowground = 0.35, ACT = 0.14, SLW = 0.0038, PAS = 0.00013),
  C0 = rep(0, 7),
  surfaceIn,
  soilIn,
  F0_Delta14C,
  LN,
  Ls,
  clay = 0.2,
  silt = 0.45,
  xi = 1,
  inputFc,
  lag = 0,
  lambda = -0.0001209681,
  xi_lag = 0,
  solver = deSolve.lsoda.wrapper
)
```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 7 containing the values of the decomposition rates for the different pools. Units in per year. |
| C0 | A vector of length 7 containing the initial amount of carbon for the 7 pools. |
| surfaceIn | A scalar or data.frame object specifying the amount of aboveground litter inputs to the soil surface by time (mass per area per year). |
| soilIn | A scalar or data.frame object specifying the amount of belowground litter inputs to the soil by time (mass per area per year). |
| F0_Delta14C | A vector of length 7 containing the initial fraction of radiocarbon for the 7 pools in Delta14C format. |
| LN | A scalar representing the lignin to nitrogen ratio of the plant residue inputs. |
| Ls | A scalar representing the fraction of structural material that is lignin. |
| clay | Proportion of clay in mineral soil. |
| silt | Proportion of silt in mineral soil. |
| xi | A scalar, data.frame, function or anything that can be converted to a scalar function of time ScalarTimeMap object specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| inputFc | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |
| lag | A time shift/delay for the radiocarbon inputs |

| | |
|--------|--|
| lambda | Radioactive decay constant. By default $\lambda = -0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. |
| xi_lag | A time shift/delay for the automatically created time dependent function $\xi(t)$ |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |

Value

A Model Object that can be further queried

References

Parton, W.J, D.S. Schimel, C.V. Cole, and D.S. Ojima. 1987. Analysis of factors controlling soil organic matter levels in Great Plain grasslands. Soil Science Society of America Journal 51: 1173–1179. Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. Geoscientific Model Development 5, 1045-1060.

See Also

[RothCModel](#). There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
cal_yrs=seq(1900,2015, by=1/12)
APPT=50 # Assume 50 cm annual precipitation
Pmax=-40+7.7*APPT # Max aboveground production
Rmax=100+7.0*APPT # Max belowground production
abvgIn=52*Pmax/(Pmax+Rmax)
blgIn=52*Rmax/(Pmax+Rmax)
AtmC14=Graven2017[,c("Year.AD", "NH")]

cm=CenturyModel14(t=cal_yrs, surfaceIn = abvgIn, soilIn = blgIn,
                  F0_Delta14C=rep(0,7), inputFc=AtmC14, LN=0.5, Ls=0.1)
C14t=getF14(cm)

poolNames=c("Surface structural", "Surface metabolic", "Belowground structural",
            "Belowground metabolic", "Active SOM", "Slow SOM", "Passive SOM")
plot(AtmC14, type="l", ylab="Delta 14C (per mil)")
matlines(cal_yrs,C14t, lty=1, col=2:8)
legend("topleft", poolNames, lty=1, col=2:8, bty="n")
```

check_duplicate_pool_names
helper function

Description

Check that poolNames are unique

Usage

```
check_duplicate_pool_names(poolNames)
```

Arguments

poolNames character vector which will be tested for duplicats

check_id_length *helper function to check that the length of the argument is exactly 1*

Description

helper function to check that the length of the argument is exactly 1

Usage

```
check_id_length(id)
```

Arguments

id Either a string or a number

check_pool_ids *Check pool ids*

Description

Check pool ids

Usage

```
check_pool_ids(obj, pools)
```

Arguments

obj see method arguments

pools see method arguments

check_pool_ids, PoolConnection_by_PoolIndex, integer-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'PoolConnection_by_PoolIndex, integer'  
check_pool_ids(obj, pools)
```

Arguments

| | |
|-------|-------------------------|
| obj | no manual documentation |
| pools | no manual documentation |

computeResults *Computes results*

Description

Computes results

Usage

```
computeResults(object)
```

Arguments

| | |
|--------|----------------------|
| object | see method arguments |
|--------|----------------------|

computeResults,MCSim-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'MCSim'  
computeResults(object)
```

Arguments

object no manual documentation

ConstantInFluxList_by_PoolIndex
Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
ConstantInFluxList_by_PoolIndex(object)
```

Arguments

object see methods

ConstantInFluxList_by_PoolIndex,ConstInFluxes-method
constructor from ConstInFluxes

Description

constructor from ConstInFluxes

Usage

```
## S4 method for signature 'ConstInFluxes'
ConstantInFluxList_by_PoolIndex(object)
```

Arguments

object An object of class [ConstInFluxes](#)

Value

An object of class [ConstantInFluxList_by_PoolIndex](#)

ConstantInFluxList_by_PoolIndex,list-method
constructor from a normal list

Description

constructor from a normal list

Usage

```
## S4 method for signature 'list'
ConstantInFluxList_by_PoolIndex(object)
```

Arguments

object A list. Either a list of elements of type [ConstantInFlux_by_PoolIndex](#) or a list where the names of the elements are strings of the form '1->3' (for the flux rate from pool 1 to 2)

Value

An object of class [ConstantInFluxList_by_PoolIndex](#)

The function checks if the elements are of the desired type or can be converted to it. It is mainly used internally and usually called by the front end functions to convert the user supplied arguments.

ConstantInFluxList_by_PoolIndex,numeric-method
constructor from numeric vector

Description

constructor from numeric vector

Usage

```
## S4 method for signature 'numeric'  
ConstantInFluxList_by_PoolIndex(object)
```

Arguments

object no manual documentation

ConstantInFluxList_by_PoolIndex-class
*Subclass of list that is guaranteed to contain only elements of type
[ConstantInFlux_by_PoolIndex](#)*

Description

Subclass of list that is guaranteed to contain only elements of type [ConstantInFlux_by_PoolIndex](#)

ConstantInFluxList_by_PoolName
Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
ConstantInFluxList_by_PoolName(object)
```

Arguments

object see methods

ConstantInFluxList_by_PoolName-class

*Subclass of list that is guaranteed to contain only elements of type
[ConstantInFlux_by_PoolName](#)*

Description

Subclass of list that is guaranteed to contain only elements of type [ConstantInFlux_by_PoolName](#)

ConstantInFluxRate_by_PoolIndex-class

Describes a flux rates.

Description

The purpose is to avoid creation of negative rates or in accidental confusion with fluxes. Instances are usually automatically created from data. If the state variables are known indices can be converted to pool names.

ConstantInFluxRate_by_PoolName

Constructor for the class with the same name

Description

Constructor for the class with the same name

Usage

ConstantInFluxRate_by_PoolName(destinationName, rate_constant)

Arguments

destinationName

Index of the receiving pool (positive integer)

rate_constant Rate (Flux/content) positive real number

ConstantInFluxRate_by_PoolName-class

Describes a flux rates.

Description

The purpose is to avoid creation of negative rates or in accidental confusion with fluxes. Instances are usually automatically created from data. If the state variables are known indices can be converted to pool names.

The purpose is to avoid creation of negative rates or in accidental confusion with fluxes. Instances are usually automatically created from data. If the state variables are known indices can be converted to pool names.

The purpose is to avoid creation of lists that contain negative rates or in accidental confusion with list of fluxes. Instances are usually automatically created from data

The purpose is to avoid creation of lists that contain negative rates or in accidental confusion with list of fluxes. Instances are usually automatically created from data

ConstantInFlux_by_PoolIndex-class

class for a constant influx to a single pool identified by index

Description

class for a constant influx to a single pool identified by index

ConstantInFlux_by_PoolName-class

class for a constant influx to a single pool identified by pool name

Description

class for a constant influx to a single pool identified by pool name

ConstantInternalFluxRateList_by_PoolIndex

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

ConstantInternalFluxRateList_by_PoolIndex(object)

Arguments

object see methods

ConstantInternalFluxRateList_by_PoolIndex,list-method

constructor from a normal list

Description

constructor from a normal list

Usage

```
## S4 method for signature 'list'
ConstantInternalFluxRateList_by_PoolIndex(object)
```

Arguments

object A list. Either a list of elements of type [ConstantInternalFluxRate_by_PoolIndex](#) or a list where the names of the elements are strings of the form '1->3' (for the flux rate from pool 1 to 2)

Value

An object of class [ConstantInternalFluxRateList_by_PoolIndex](#)

The function checks if the elements are of the desired type or can be converted to it. It is mainly used internally and usually called by the front end functions to convert the user supplied arguments.

ConstantInternalFluxRateList_by_PoolIndex,numeric-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'numeric'  
ConstantInternalFluxRateList_by_PoolIndex(object)
```

Arguments

object no manual documentation

ConstantInternalFluxRateList_by_PoolIndex-class
Describes a list of flux rates.

Description

The purpose is to avoid creation of lists that contain negative rates or in accidental confusion with list of fluxes. Instances are usually automatically created from data

ConstantInternalFluxRateList_by_PoolName
Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
ConstantInternalFluxRateList_by_PoolName(object)
```

Arguments

object see methods

ConstantInternalFluxRateList_by_PoolName, list-method
Constructor from a normal list of fluxes

Description

Constructor from a normal list of fluxes

Usage

```
## S4 method for signature 'list'  
ConstantInternalFluxRateList_by_PoolName(object)
```

Arguments

object A list. Either a list of elements of type [ConstantInternalFluxRate_by_PoolName](#) or a list where the names of the elements are strings of the form 'somePool->someOtherPool' (for the flux rate from pool somePool to someOtherPool)

Value

An object of class [ConstantInternalFluxRateList_by_PoolName](#)

The function checks if the elements are of the desired type or can be converted to it. It is mainly used internally and usually called by the front end functions to convert the user supplied arguments.

ConstantInternalFluxRateList_by_PoolName-class
Describes a list of flux rates.

Description

The purpose is to avoid creation of lists that contain negative rates or in accidental confusion with list of fluxes. Instances are usually automatically created from data

 ConstantInternalFluxRate_by_PoolIndex

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
ConstantInternalFluxRate_by_PoolIndex(
  sourceIndex,
  destinationIndex,
  src_to_dest,
  rate_constant
)
```

Arguments

| | |
|------------------|---------------------------|
| sourceIndex | index of source pool |
| destinationIndex | index of destination pool |
| src_to_dest | flux rate |
| rate_constant | rate constant |

 ConstantInternalFluxRate_by_PoolIndex,numeric,numeric,missing,numeric-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'numeric,numeric,missing,numeric'
ConstantInternalFluxRate_by_PoolIndex(
  sourceIndex,
  destinationIndex,
  rate_constant
)
```

Arguments

| | |
|------------------|-------------------------|
| sourceIndex | no manual documentation |
| destinationIndex | no manual documentation |
| rate_constant | no manual documentation |

ConstantInternalFluxRate_by_PoolIndex-class

S4 class representing a constant internal flux rate

Description

The class is used to dispatch specific methods for the creation of the compartmental matrix which is simplified in case of constant rates.

ConstantInternalFluxRate_by_PoolName

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
ConstantInternalFluxRate_by_PoolName(
  sourceName,
  destinationName,
  src_to_dest,
  rate_constant
)
```

Arguments

| | |
|-----------------|------------------------------|
| sourceName | name of the source pool |
| destinationName | name of the destination pool |
| src_to_dest | flux rate |
| rate_constant | rate constant |

ConstantInternalFluxRate_by_PoolName,character,character,missing,numeric-method
constructor with argument conversion

Description

constructor with argument conversion

Usage

```
## S4 method for signature 'character,character,missing,numeric'  
ConstantInternalFluxRate_by_PoolName(  
  sourceName,  
  destinationName,  
  rate_constant  
)
```

Arguments

sourceName name of source pool
destinationName
 name of destination pool
rate_constant a value of the rate constant

ConstantInternalFluxRate_by_PoolName,missing,missing,character,numeric-method
constructor from strings of the form 'a->b'

Description

constructor from strings of the form 'a->b'

Usage

```
## S4 method for signature 'missing,missing,character,numeric'  
ConstantInternalFluxRate_by_PoolName(src_to_dest, rate_constant)
```

Arguments

src_to_dest a string indicating the source to destination pools
rate_constant a value of the rate constant

ConstantInternalFluxRate_by_PoolName-class

S4-class to represent a constant internal flux rate with source and target indexed by name

Description

S4-class to represent a constant internal flux rate with source and target indexed by name

ConstantOutFluxRateList_by_PoolIndex

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

ConstantOutFluxRateList_by_PoolIndex(object)

Arguments

object see methods

ConstantOutFluxRateList_by_PoolIndex,list-method

constructor from a normal list

Description

constructor from a normal list

Usage

```
## S4 method for signature 'list'
ConstantOutFluxRateList_by_PoolIndex(object)
```

Arguments

object A list. Either a list of elements of type [ConstantOutFluxRate_by_PoolIndex](#) or a list where the names of the elements are integer strings of the form '3' (for the flux rate from pool 3)

Value

An object of class [ConstantOutFluxRateList_by_PoolIndex](#)

The function checks if the elements are of the desired type or can be converted to it. It is mainly used internally and usually called by the front end functions to convert the user supplied arguments.

ConstantOutFluxRateList_by_PoolIndex,numeric-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'numeric'
ConstantOutFluxRateList_by_PoolIndex(object)
```

Arguments

object no manual documentation

ConstantOutFluxRateList_by_PoolIndex-class
Describes a list of flux rates.

Description

The purpose is to avoid creation of lists that contain negative rates or in accidental confusion with list of fluxes. Instances are usually automatically created from data

ConstantOutFluxRateList_by_PoolName
Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
ConstantOutFluxRateList_by_PoolName(object)
```

Arguments

object see methods

ConstantOutFluxRateList_by_PoolName, list-method
constructor from a normal list

Description

constructor from a normal list

Usage

```
## S4 method for signature 'list'
ConstantOutFluxRateList_by_PoolName(object)
```

Arguments

| | |
|--------|---|
| object | A list. Either a list of elements of type ConstantOutFluxRate_by_PoolName or a list where the names of the elements are integer strings of the form '3' (for the flux rate from pool 3) |
|--------|---|

Value

An object of class [ConstantOutFluxRateList_by_PoolName](#)

The function checks if the elements are of the desired type or can be converted to it. It is mainly used internally and usually called by the front end functions to convert the user supplied arguments.

ConstantOutFluxRateList_by_PoolName,numeric-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'numeric'
ConstantOutFluxRateList_by_PoolName(object)
```

Arguments

| | |
|--------|-------------------------|
| object | no manual documentation |
|--------|-------------------------|

ConstantOutFluxRateList_by_PoolName-class
Describes a list of flux rates.

Description

The purpose is to avoid creation of lists that contain negative rates or in accidental confusion with list of fluxes. Instances are usually automatically created from data

ConstantOutFluxRate_by_PoolIndex
Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

ConstantOutFluxRate_by_PoolIndex(sourceIndex, rate_constant)

Arguments

sourceIndex index of the source pool
rate_constant rate of output flux

ConstantOutFluxRate_by_PoolIndex,numeric,numeric-method
automatic title

Description

automatic title

Usage

S4 method for signature 'numeric,numeric'
ConstantOutFluxRate_by_PoolIndex(sourceIndex, rate_constant)

Arguments

sourceIndex no manual documentation
rate_constant no manual documentation

ConstantOutFluxRate_by_PoolIndex-class

S4 Class to represent a single constant out-flux rate with the source pool specified by an index

Description

S4 Class to represent a single constant out-flux rate with the source pool specified by an index

ConstantOutFluxRate_by_PoolName-class

S4 Class to represent a single constant out-flux rate with the source pool specified by name

Description

S4 Class to represent a single constant out-flux rate with the source pool specified by name

ConstFc

creates an object containing the initial values for the 14C fraction needed to create models in SoilR

Description

The function returns an object of class ConstFc which is a building block for any 14C model in SoilR. The building blocks of a model have to keep information about the formats their data are in, because the high level function dealing with the models have to know. This function is actually a convenient wrapper for a call to R's standard constructor new, to hide its complexity from the user.

Usage

```
ConstFc(values = c(0), format = "Delta14C")
```

Arguments

| | |
|--------|--|
| values | a numeric vector |
| format | a character string describing the format e.g. "Delta14C" |

Value

An object of class ConstFc that contains data and a format description that can later be used to convert the data into other formats if the conversion is implemented.

| | |
|---------------|--|
| ConstFc-class | <i>S4 class representing a constant 14C fraction</i> |
|---------------|--|

Description

S4 class representing a constant 14C fraction

| | |
|---------------|------------------------------|
| ConstInFluxes | <i>Constant input fluxes</i> |
|---------------|------------------------------|

Description

Constant input fluxes

Usage

ConstInFluxes(map, numberOfPools)

Arguments

| | |
|---------------|----------------------|
| map | see method arguments |
| numberOfPools | see method arguments |

| | |
|--|------------------------|
| ConstInFluxes,ConstantInFluxList_by_PoolIndex,numeric-method | <i>automatic title</i> |
|--|------------------------|

Description

automatic title

Usage

```
## S4 method for signature 'ConstantInFluxList_by_PoolIndex,numeric'
ConstInFluxes(map, numberOfPools)
```

Arguments

| | |
|---------------|-------------------------|
| map | no manual documentation |
| numberOfPools | no manual documentation |

ConstInFluxes,numeric,ANY-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'numeric,ANY'
ConstInFluxes(map)
```

Arguments

map no manual documentation

ConstInFluxes-class *S4 class for a constant influx vector*

Description

It is mainly used to dispatch S4-methods for computations that are valid only if the influx is constant. This knowledge can either be used to speed up computations or to decide if they are possible at all. E.g. the computation of equilibria for a model run requires autonomy of the model which requires the influxes to be time independent. If the model is linear and compartmental then the (unique) equilibrium can be computed. Accordingly a method with ConstInFluxes in the signature can be implemented, whereas none would be available for a general InFluxes argument.

ConstLinDecompOp *Generic constructor for the class with the same name*

Description

Generic constructor for the class with the same name

Usage

```
ConstLinDecompOp(
  mat,
  internal_flux_rates,
  out_flux_rates,
  numberOfPools,
  poolNames
)
```

Arguments

mat a square compartmental matrix
 internal_flux_rates rates of internal transfers among pools
 out_flux_rates rates of transfer out of pools
 numberOfPools total number of pools in the system
 poolNames names of all pools

ConstLinDecompOp,matrix,missing,missing,missing,missing-method
Constructor of object of ConstLinDecompOp class

Description

Constructor of object of ConstLinDecompOp class

Usage

```
## S4 method for signature 'matrix,missing,missing,missing,missing'
ConstLinDecompOp(mat)
```

Arguments

mat a compartmental matrix

ConstLinDecompOp-class
A class to represent a constant (=nonautonomous,linear) compartmental matrix or equivalently a combination of ordered constant internal flux rates and constant out flux rates.

Description

A class to represent a constant (=nonautonomous,linear) compartmental matrix or equivalently a combination of ordered constant internal flux rates and constant out flux rates.

ConstLinDecompOpWithLinearScalarFactor

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
ConstLinDecompOpWithLinearScalarFactor(
    mat,
    internal_flux_rates,
    out_flux_rates,
    numberOfPools,
    xi
)
```

Arguments

| | |
|---------------------|-------------------------------------|
| mat | a square compartmental matrix |
| internal_flux_rates | internal transfer rates among pools |
| out_flux_rates | rates out of pools |
| numberOfPools | number of pools in the system |
| xi | rate modifier for the entire matrix |

ConstLinDecompOpWithLinearScalarFactor-class

A class to represent a constant (=nonautonomous,linear) compartmental matrix with a time dependent (linear) scalar pre factor This is a special case of a linear compartmental operator/matrix

Description

A class to represent a constant (=nonautonomous,linear) compartmental matrix with a time dependent (linear) scalar pre factor This is a special case of a linear compartmental operator/matrix

 ConstLinDecompOp_by_PoolName

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

ConstLinDecompOp_by_PoolName(internal_flux_rates, out_flux_rates, poolNames)

Arguments

| | |
|---------------------|-------------------------------|
| internal_flux_rates | |
| | rates of transfer among pools |
| out_flux_rates | rates out of pools |
| poolNames | names of the pools |

 cycling

Cycling analysis of compartmental matrices

Description

Computes the fundamental matrix N, and the expected number of steps from a compartmental matrix A

Usage

cycling(A)

Arguments

| | |
|---|---|
| A | A compartmental linear square matrix with cycling rates in the diagonal and transfer rates in the off-diagonal. |
|---|---|

Value

A list with 2 objects: the fundamental matrix N, and the expected number of steps Et.

See Also

[systemAge](#)

DecompOp-class *S4-class to represent compartmental operators*

Description

S4-class to represent compartmental operators

DecompositionOperator-class
automatic title

Description

automatic title

Delta14C *Conversion of radiocarbon values*

Description

Conversion of radiocarbon values

Usage

Delta14C(F)

Arguments

F see method arguments

Delta14C, BoundFc-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'BoundFc'
Delta14C(F)
```

Arguments

F no manual documentation

Delta14C,ConstFc-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'ConstFc'  
Delta14C(F)
```

Arguments

F no manual documentation

Delta14C_from_AbsoluteFractionModern
Conversion of radiocarbon values

Description

Conversion of radiocarbon values

Usage

```
Delta14C_from_AbsoluteFractionModern(AbsoluteFractionModern)
```

Arguments

AbsoluteFractionModern
see method arguments

Delta14C_from_AbsoluteFractionModern,matrix-method
Conversion of radiocarbon values

Description

Conversion of radiocarbon values

Usage

```
## S4 method for signature 'matrix'  
Delta14C_from_AbsoluteFractionModern(AbsoluteFractionModern)
```

Arguments

AbsoluteFractionModern
Matrix of radiocarbon values in absolute fraction modern

Delta14C_from_AbsoluteFractionModern,numeric-method
Conversion of radiocarbon values

Description

Conversion of radiocarbon values

Usage

```
## S4 method for signature 'numeric'  
Delta14C_from_AbsoluteFractionModern(AbsoluteFractionModern)
```

Arguments

AbsoluteFractionModern
radiocarbon value in absolute fraction modern

 deSolve.lsoda.wrapper *deSolve.lsoda.wrapper*

Description

The function serves as a wrapper for lsoda using a much simpler interface which allows the use of matrices in the definition of the derivative. To use lsoda we have to convert our vectors to lists, define tolerances and so on. This function does this for us , so we don't need to bother about it.

Usage

```
deSolve.lsoda.wrapper(t, ydot, startValues)
```

Arguments

| | |
|-------------|---|
| t | A row vector containing the points in time where the solution is sought. |
| ydot | The function of y and t that computes the derivative for a given point in time and a column vector y. |
| startValues | A column vector with the starting values. |

Value

A matrix. Every column represents a pool and every row a point in time

 eC02 *Soil CO2 efflux from an incubation experiment*

Description

A dataset with soil CO2 efflux measurements from a laboratory incubation at controlled temperature and moisture conditions.

Usage

```
data(eC02)
```

Format

A data frame with the following 3 variables.

Days A numeric vector with the day of measurement after the experiment started.

eC02mean A numeric vector with the release flux of CO2. Units in ug C g-1 soil day-1.

eC02sd A numeric vector with the standard deviation of the release flux of CO2-C. Units in ug C g-1 soil day-1.

Details

A laboratory incubation experiment was performed in March 2014 for a period of 35 days under controlled conditions of temperature (15 degrees Celsius), moisture (30 percent soil water content), and oxygen levels (20 percent). Soil CO₂ measurements were taken using an automated system for gas sampling connected to an infrared gas analyzer. The soil was sampled at a boreal forest site (Caribou Poker Research Watershed, Alaska, USA). This dataset presents the mean and standard deviation of 4 replicates.

Examples

```
head(eC02)

plot(eC02[,1:2],type="o",ylim=c(0,50),ylab="CO2 efflux (ug C g-1 soil day-1)")
arrows(eC02[,1],eC02[,2]-eC02[,3],eC02[,1],eC02[,2]+eC02[,3], angle=90,length=0.3,code=3)
```

| | |
|--------------------|------------------------------|
| entropyRatePerJump | <i>Entropy rate per jump</i> |
|--------------------|------------------------------|

Description

Computes the entropy rate per jump of the Markov chain generated by the compartmental system

Usage

```
entropyRatePerJump(A, u)
```

Arguments

| | |
|---|---|
| A | A constant compartmental square matrix with cycling rates in the diagonal and transfer rates in the off-diagonal. |
| u | A one-column matrix defining the amount of inputs per compartment. |

Value

A scalar value with the entropy rate per jump

References

Metzler, H. (2020). Compartmental systems as Markov chains : age, transit time, and entropy (T. Oertel-Jaeger, I. Pavlyukevich, and C. Sierra, Eds.) [PhD thesis](<https://suche.thulb.uni-jena.de/Record/1726091651>)

Examples

```
B6=matrix(c(-1,1,0,0,-1,1,0,0,-1),3,3); u6=matrix(c(1,0,0))
entropyRatePerJump(A=B6, u=u6)
```

entropyRatePerTime *Entropy rate per time*

Description

Computes the entropy rate per time of the Markov chain generated by the compartmental system

Usage

```
entropyRatePerTime(A, u)
```

Arguments

| | |
|---|---|
| A | A constant compartmental square matrix with cycling rates in the diagonal and transfer rates in the off-diagonal. |
| u | A one-column matrix defining the amount of inputs per compartment. |

Value

A scalar value with the entropy rate per time

References

Metzler, H. (2020). Compartmental systems as Markov chains : age, transit time, and entropy (T. Oertel-Jaeger, I. Pavlyukevich, and C. Sierra, Eds.) [PhD thesis](<https://suche.thulb.uni-jena.de/Record/1726091651>)

Examples

```
B6=matrix(c(-1,1,0,0,-1,1,0,0,-1),3,3); u6=matrix(c(1,0,0))
entropyRatePerTime(A=B6, u=u6)
```

euler *euler*

Description

This function can solve arbitrary first order ode systems with the euler forward method and an adaptive time-step size control given a tolerance for the deviation of a coarse and fine estimate of the change in y for the next time step. It is an alternative to [deSolve.lsoda.wrapper](#) and has the same interface. It is much slower than ode and should probably be considered less capable in solving stiff ode systems. However it has one main advantage, which consists in its simplicity. It is quite easy to see what is going on inside it. Whenever you don't trust your implementation of another (more efficient but probably also more complex) ode solver, just compare the result to what this method computes.

Usage

```
euler(times, ydot, startValues)
```

Arguments

| | |
|-------------|---|
| times | A row vector containing the points in time where the solution is sought. |
| ydot | The function of y and t that computes the derivative for a given point in time and a column vector y. |
| startValues | A column vector with the initial values. |

```
example.2DBoundInFluxesFromFunction
```

```
example.2DBoundInFluxesFromFunction
```

Description

Create a 2-dimensional example of a BoundInFluxes object

Usage

```
example.2DBoundInFluxesFromFunction()
```

Value

The returned object represents a time dependent Influx into a two pool model.

```
example.2DBoundLinDecompOpFromFunction
```

```
example.2DBoundLinDecompOpFromFunction
```

Description

An example used in tests and other examples.

Usage

```
example.2DBoundLinDecompOpFromFunction()
```

`example.2DConstFc.Args`
example.2DConstFc.Args

Description

Create a 2-dimensional examples of a Influx objects from different arguments

Usage

`example.2DConstFc.Args()`

`example.2DConstInFluxesFromVector`
2D example for constant Influx

Description

An example used in tests and other examples.

Usage

`example.2DConstInFluxesFromVector()`

Value

The returned object represents a time invariant constant influx into a two pool model.

`example.2DGeneralDecompOpArgs`
example.2DGeneralDecompOpArgs

Description

We present all possibilities to define a 2D [DecompOp-class](#)

Usage

`example.2DGeneralDecompOpArgs()`

```
example.2DInFluxes.Args
```

```
example.2DInFluxes.Args
```

Description

Create a 2-dimensional examples of a Influx objects from different arguments

Usage

```
example.2DInFluxes.Args()
```

```
example.2DUnBoundLinDecompOpFromFunction
```

```
example.2DUnBoundLinDecompOpFromFunction
```

Description

An example used in tests and other examples.

Usage

```
example.2DUnBoundLinDecompOpFromFunction()
```

```
example.ConstlinDecompOpFromMatrix
```

```
example.ConstlinDecompOpFromMatrix
```

Description

An example used in tests and other examples.

Usage

```
example.ConstlinDecompOpFromMatrix()
```

`example.nestedTime2DMatrixList`
create an example nested list that can be

Description

An example used in tests and other examples.

Usage

`example.nestedTime2DMatrixList()`

`example.Time2DArrayList`
create an example TimeMap from 2D array

Description

An example used in tests and other examples.

Usage

`example.Time2DArrayList()`

`example.Time3DArrayList`
create an example TimeFrame from 3D array

Description

An example used in tests and other examples.

Usage

`example.Time3DArrayList()`

```
example.TimeMapFromArray
```

create an example TimeFrame from 3D array

Description

The function creates an example TimeMap that is used in other examples and tests.

Usage

```
example.TimeMapFromArray()
```

Fc-class

automatic title

Description

automatic title

FcAtm.from.DataFrame

FcAtm.from.DataFrame

Description

This function is deprecated constructor of the deprecated class FcAtm

Usage

```
FcAtm.from.DataFrame(dframe, lag = 0, interpolation = splinefun, format)
```

Arguments

| | |
|---------------|---|
| dframe | A data frame containing exactly two columns: the first one is interpreted as time the second one is interpreted as atmospheric C14 fraction in the format mentioned |
| lag | a scalar describing the time lag. Positive Values shift the argument of the interpolation function forward in time. (retard its effect) |
| interpolation | A function that returns a function the default is splinefun. Other possible values are the linear interpolation approxfun or any self made function with the same interface. |
| format | a string that specifies the format used to represent the atmospheric fraction. Possible values are "Delta14C" which is the default or "afn" the Absolute Fraction Normal representation |

Value

An object of the new class BoundFc that replaces FcAtm

| | |
|--------------|---|
| fT.Arrhenius | <i>Effects of temperature on decomposition rates according the Arrhenius equation</i> |
|--------------|---|

Description

Calculates the effects of temperature on decomposition rates according to the Arrhenius equation.

Usage

```
fT.Arrhenius(Temp, A = 1000, Ea = 75000, Re = 8.3144621)
```

Arguments

| | |
|------|--|
| Temp | A scalar or vector containing values of temperature (in degrees Kelvin) for which the effects on decomposition rates are calculated. |
| A | A scalar defining the pre-exponential factor. |
| Ea | A scalar defining the activation energy in units of J mol ⁻¹ . |
| Re | A scalar defining the universal gas contents in units of J K ⁻¹ mol ⁻¹ . |

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

| | |
|-------------|--|
| fT.Century1 | <i>Effects of temperature on decomposition rates according the the CENTURY model</i> |
|-------------|--|

Description

Calculates the effects of temperature on decomposition rates according to the CENTURY model.

Usage

```
fT.Century1(Temp, Tmax = 45, Topt = 35)
```

Arguments

| | |
|------|--|
| Temp | A scalar or vector containing values of temperature for which the effects on decomposition rates are calculated. |
| Tmax | A scalar defining the maximum temperature in degrees C. |
| Topt | A scalar defining the optimum temperature for the decomposition process in degrees C. |

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

References

Burke, I. C., J. P. Kaye, S. P. Bird, S. A. Hall, R. L. McCulley, and G. L. Sommerville. 2003. Evaluating and testing models of terrestrial biogeochemistry: the role of temperature in controlling decomposition. Pages 235-253 in C. D. Canham, J. J. Cole, and W. K. Lauenroth, editors. Models in ecosystem science. Princeton University Press, Princeton.

 fT.Century2

Effects of temperature on decomposition rates according the the CENTURY model

Description

Calculates the effects of temperature on decomposition rates according to the CENTURY model.

Usage

fT.Century2(Temp, Tmax = 45, Topt = 35)

Arguments

| | |
|------|--|
| Temp | A scalar or vector containing values of temperature for which the effects on decomposition rates are calculated. |
| Tmax | A scalar defining the maximum temperature in degrees C. |
| Topt | A scalar defining the optimum temperature for the decomposition process in degrees C. |

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

References

Adair, E. C., W. J. Parton, S. J. D. Grosse, W. L. Silver, M. E. Harmon, S. A. Hall, I. C. Burke, and S. C. Hart. 2008. Simple three-pool model accurately describes patterns of long-term litter decomposition in diverse climates. *Global Change Biology* 14:2636-2660.

| | |
|-------------|---|
| fT.Daycent1 | <i>Effects of temperature on decomposition rates according to the DAYCENT model</i> |
|-------------|---|

Description

Calculates the effects of temperature on decomposition rates according to the DAYCENT model.

Usage

fT.Daycent1(Temp)

Arguments

| | |
|------|--|
| Temp | A scalar or vector containing values of soil temperature for which the effects on decomposition rates are calculated |
|------|--|

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

References

Kelly, R. H., W. J. Parton, M. D. Hartman, L. K. Stretch, D. S. Ojima, and D. S. Schimel (2000), Intra-annual and interannual variability of ecosystem processes in shortgrass steppe, *J. Geophys. Res.*, 105.

| | |
|-------------|---|
| fT.Daycent2 | <i>Effects of temperature on decomposition rates according to the DAYCENT model</i> |
|-------------|---|

Description

Calculates the effects of temperature on decomposition rates according to the Daycent/Century models.

Usage

fT.Daycent2(Temp)

Arguments

| | |
|------|---|
| Temp | A scalar or vector containing values of soil temperature for which the effects on decomposition rates are calculated. |
|------|---|

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

References

Del Grosso, S. J., W. J. Parton, A. R. Mosier, E. A. Holland, E. Pendall, D. S. Schimel, and D. S. Ojima (2005), Modeling soil CO₂ emissions from ecosystems, *Biogeochemistry*, 73(1), 71-91.

| | |
|------------|---|
| fT.Demeter | <i>Effects of temperature on decomposition rates according to the DEMETER model</i> |
|------------|---|

Description

Calculates the effects of temperature on decomposition rates according to the DEMETER model.

Usage

```
fT.Demeter(Temp, Q10 = 2)
```

Arguments

| | |
|------|---|
| Temp | A scalar or vector containing values of temperature for which the effects on decomposition rates are calculated |
| Q10 | A scalar. Temperature coefficient Q10 |

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

References

Foley, J. A. (1995), An equilibrium model of the terrestrial carbon budget, *Tellus B*, 47(3), 310-319.

| | |
|-------|--|
| fT.KB | <i>Effects of temperature on decomposition rates according to a model proposed by M. Kirschbaum (1995)</i> |
|-------|--|

Description

Calculates the effects of temperature on decomposition rates according to a model proposed by Kirschbaum (1995).

Usage

fT.KB(Temp)

Arguments

| | |
|------|--|
| Temp | a scalar or vector containing values of soil temperature for which the effects on decomposition rates are calculated |
|------|--|

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

References

Kirschbaum, M. U. F. (1995), The temperature dependence of soil organic matter decomposition, and the effect of global warming on soil organic C storage, *Soil Biology and Biochemistry*, 27(6), 753-760.

| | |
|----------|--|
| fT.LandT | <i>Effects of temperature on decomposition rates according to a function proposed by Lloyd and Taylor (1994)</i> |
|----------|--|

Description

Calculates the effects of temperature on decomposition rates according to a function proposed by Lloyd and Taylor (1994).

Usage

fT.LandT(Temp)

Arguments

| | |
|------|--|
| Temp | A scalar or vector containing values of soil temperature for which the effects on decomposition rates are calculated |
|------|--|

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

References

Lloyd, J., and J. A. Taylor (1994), On the Temperature Dependence of Soil Respiration, *Functional Ecology*, 8(3), 315-323.

| | |
|-----------|--|
| fT.linear | <i>Effects of temperature on decomposition rates according to a linear model</i> |
|-----------|--|

Description

Calculates the effects of temperature on decomposition rates according to a linear model.

Usage

```
fT.linear(Temp, a = 0.198306, b = 0.036337)
```

Arguments

| | |
|------|--|
| Temp | A scalar or vector containing values of temperature for which the effects on decomposition rates are calculated. |
| a | A scalar defining the intercept of the linear function. |
| b | A scalar defining the slope of the linear function. |

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

References

Adair, E. C., W. J. Parton, S. J. D. Grosse, W. L. Silver, M. E. Harmon, S. A. Hall, I. C. Burke, and S. C. Hart. 2008. Simple three-pool model accurately describes patterns of long-term litter decomposition in diverse climates. *Global Change Biology* 14:2636-2660.

| | |
|--------|--|
| fT.Q10 | <i>Effects of temperature on decomposition rates according to a Q10 function</i> |
|--------|--|

Description

Calculates the effects of temperature on decomposition rates according to the modified Van't Hoff function (Q10 function).

Usage

fT.Q10(Temp, k_ref = 1, T_ref = 10, Q10 = 2)

Arguments

| | |
|-------|--|
| Temp | A scalar or vector containing values of temperature for which the effects on decomposition rates are calculated. |
| k_ref | A scalar representing the value of the decomposition rate at a reference temperature value. |
| T_ref | A scalar representing the reference temperature. |
| Q10 | A scalar. Temperature coefficient Q10. |

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

| | |
|----------|---|
| fT.RothC | <i>Effects of temperature on decomposition rates according to the functions included in the RothC model</i> |
|----------|---|

Description

Calculates the effects of temperature on decomposition rates according to the functions included in the RothC model.

Usage

fT.RothC(Temp)

Arguments

| | |
|------|--|
| Temp | A scalar or vector containing values of temperature for which the effects on decomposition rates are calculated. |
|------|--|

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

Note

This function returns NA for Temp <= -18.3

References

Jenkinson, D. S., S. P. S. Andrew, J. M. Lynch, M. J. Goss, and P. B. Tinker (1990), The Turnover of Organic Carbon and Nitrogen in Soil, Philosophical Transactions: Biological Sciences, 329(1255), 361-368.

fT.Standcarb

Effects of temperature on decomposition rates according to the Stand-Carb model

Description

Calculates the effects of temperature on decomposition rates according to the StandCarb model.

Usage

```
fT.Standcarb(Temp, Topt = 45, Tlag = 4, Tshape = 15, Q10 = 2)
```

Arguments

| | |
|--------|--|
| Temp | A scalar or vector containing values of temperature for which the effects on decomposition rates are calculated. |
| Topt | A scalar representing the optimum temperature for decomposition. |
| Tlag | A scalar that determines the lag of the response curve. |
| Tshape | A scalar that determines the shape of the response curve. |
| Q10 | A scalar. Temperature coefficient Q10. |

Value

A scalar or a vector containing the effects of temperature on decomposition rates (unitless).

References

Harmon, M. E., and J. B. Domingo (2001), A users guide to STANDCARB version 2.0: A model to simulate carbon stores in forest stands. Oregon State University, Corvallis.

| | |
|----------|--|
| fW.Candy | <i>Effects of moisture on decomposition rates according to the Candy model</i> |
|----------|--|

Description

Calculates the effects of water content and pore volume on decomposition rates.

Usage

fW.Candy(theta, PV)

Arguments

| | |
|-------|--|
| theta | A scalar or vector containing values of volumetric soil water content. |
| PV | A scalar or vector containing values of pore volume. |

References

J. Bauer, M. Herbst, J.A. Huisman, L. Weihermüller, H. Vereecken. 2008. Sensitivity of simulated soil heterotrophic respiration to temperature and moisture reduction functions. *Geoderma*, Volume 145, Issues 1-2, 15 May 2008, Pages 17-27.

| | |
|------------|--|
| fW.Century | <i>Effects of moisture on decomposition rates according to the CENTURY model</i> |
|------------|--|

Description

Calculates the effects of precipitation and potential evapotranspiration on decomposition rates.

Usage

fW.Century(PPT, PET)

Arguments

| | |
|-----|---|
| PPT | A scalar or vector containing values of monthly precipitation. |
| PET | A scalar or vector containing values of potential evapotranspiration. |

Value

A scalar or a vector containing the effects of precipitation and potential evapotranspiration on decomposition rates (unitless).

References

Adair, E. C., W. J. Parton, S. J. D. Grosso, W. L. Silver, M. E. Harmon, S. A. Hall, I. C. Burke, and S. C. Hart (2008), Simple three-pool model accurately describes patterns of long-term litter decomposition in diverse climates, *Global Change Biology*, 14(11), 2636-2660. Parton, W. J., J. A. Morgan, R. H. Kelly, and D. S. Ojima (2001), Modeling soil C responses to environmental change in grassland systems, in *The potential of U.S. grazing lands to sequester carbon and mitigate the greenhouse effect*, edited by R. F. Follett, J. M. Kimble and R. Lal, pp. 371-398, Lewis Publishers, Boca Raton.

 fW.Daycent1

Effects of moisture on decomposition rates according to the DAYCENT model

Description

Calculates the effects of Soil Water Content on decomposition rates according to the Daycent Model.

Usage

```
fW.Daycent1(
  swc,
  a = 0.6,
  b = 1.27,
  c = 0.0012,
  d = 2.84,
  partd = 2.65,
  bulkd = 1,
  width = 1
)
```

Arguments

| | |
|-------|--|
| swc | A scalar or vector with soil water content of a soil layer (cm). |
| a | Empirical coefficient. For fine textured soils a = 0.6. For coarse textured soils a = 0.55. |
| b | Empirical coefficient. For fine textured soils b = 1.27. For coarse textured soils b = 1.70. |
| c | Empirical coefficient. For fine textured soils c = 0.0012. For coarse textured soils c = -0.007. |
| d | Empirical coefficient. For fine textured soils d = 2.84. For coarse textured soils d = 3.22. |
| partd | Particle density of soil layer. |
| bulkd | Bulk density of soil layer (g/cm ³). |
| width | Thickness of a soil layer (cm). |

Value

A data frame with values of water filled pore space (wfps) and effects of soil water content on decomposition rates. Both vectors are unitless.

References

Kelly, R. H., W. J. Parton, M. D. Hartman, L. K. Stretch, D. S. Ojima, and D. S. Schimel (2000), Intra-annual and interannual variability of ecosystem processes in shortgrass steppe, *J. Geophys. Res.*, 105.

| | |
|-------------|--|
| fW.Daycent2 | <i>Effects of moisture on decomposition rates according to the DAYCENT model</i> |
|-------------|--|

Description

Calculates the effects of volumetric water content on decomposition rates according to the Daycent/Century models.

Usage

fW.Daycent2(W, WP = 0, FC = 100)

Arguments

| | |
|----|---|
| W | A scalar or vector of volumetric water content in percentage. |
| WP | A scalar representing the wilting point in percentage. |
| FC | A scalar representing the field capacity in percentage. |

Value

A data frame with values of relative water content (RWC) and the effects of RWC on decomposition rates (fRWC).

References

Del Grosso, S. J., W. J. Parton, A. R. Mosier, E. A. Holland, E. Pendall, D. S. Schimel, and D. S. Ojima (2005), Modeling soil CO₂ emissions from ecosystems, *Biogeochemistry*, 73(1), 71-91.

| | |
|------------|--|
| fW.Demeter | <i>Effects of moisture on decomposition rates according to the DEMETER model</i> |
|------------|--|

Description

Calculates the effects of soil moisture on decomposition rates according to the DEMETER model.

Usage

fW.Demeter(M, Msat = 100)

Arguments

| | |
|------|--|
| M | A scalar or vector containing values of soil moisture for which the effects on decomposition rates are calculated. |
| Msat | A scalar representing saturated soil moisture. |

Value

A scalar or a vector containing the effects of moisture on decomposition rates (unitless).

References

Foley, J. A. (1995), An equilibrium model of the terrestrial carbon budget, *Tellus B*, 47(3), 310-319.

| | |
|-------------|--|
| fW.Gompertz | <i>Effects of moisture on decomposition rates according to the Gompertz function</i> |
|-------------|--|

Description

Calculates the effects of water content on decomposition rates.

Usage

fW.Gompertz(theta, a = 0.824, b = 0.308)

Arguments

| | |
|-------|--|
| theta | A scalar or vector containing values of volumetric soil water content. |
| a | Empirical parameter |
| b | Empirical parameter |

References

I. Janssens, S. Dore, D. Epron, H. Lankreijer, N. Buchmann, B. Longdoz, J. Brossaud, L. Montagnani. 2003. Climatic Influences on Seasonal and Spatial Differences in Soil CO₂ Efflux. In Valentini, R. (Ed.) Fluxes of Carbon, Water and Energy of European Forests. pp 235-253. Springer.

| | |
|-----------|--|
| fW.Moyano | <i>Effects of moisture on decomposition rates according to the function proposed by Moyano et al. (2013)</i> |
|-----------|--|

Description

Calculates the effects of water content on decomposition rates.

Usage

fW.Moyano(theta, a = 3.11, b = 2.42)

Arguments

| | |
|-------|--|
| theta | A scalar or vector containing values of volumetric soil water content. |
| a | Empirical parameter |
| b | Empirical parameter |

References

F. E. Moyano, S. Manzoni, C. Chenu. 2013 Responses of soil heterotrophic respiration to moisture availability: An exploration of processes and models. Soil Biology and Biochemistry, Volume 59, April 2013, Pages 72-85

| | |
|----------|--|
| fW.RothC | <i>Effects of moisture on decomposition rates according to the RothC model</i> |
|----------|--|

Description

Calculates the effects of moisture (precipitation and pan evaporation) on decomposition rates according to the RothC model.

Usage

fW.RothC(P, E, S.Thick = 23, pClay = 23.4, pE = 0.75, bare = FALSE)

Arguments

| | |
|---------|---|
| P | A vector with monthly precipitation (mm). |
| E | A vector with same length with open pan evaporation or evapotranspiration (mm). |
| S.Thick | Soil thickness in cm. Default for Rothamsted is 23 cm. |
| pClay | Percent clay. |
| pE | Evaporation coefficient. If open pan evaporation is used pE=0.75. If Potential evaporation is used, pE=1.0. |
| bare | Logical. Under bare soil conditions, bare=TRUE. Default is set under vegetated soil. |

Value

A data.frame with accumulated top soil moisture deficit (Acc.TSMD) and the rate modifying factor b.

References

Coleman, K., and D. S. Jenkinson (1999), RothC-26.3 A model for the turnover of carbon in soil: model description and windows user guide (modified 2008), 47 pp, IACR Rothamsted, Harpenden.

fW. Skopp

Effects of moisture on decomposition rates according to the function proposed by Skopp et al. 1990

Description

Calculates the effects of relative soil water content on decomposition rates.

Usage

fW.Skopp(rwc, alpha = 2, beta = 2, f = 1.3, g = 0.8)

Arguments

| | |
|-------|------------------------|
| rwc | relative water content |
| alpha | Empirical parameter |
| beta | Empirical parameter |
| f | Empirical parameter |
| g | Empirical parameter |

References

J. Skopp, M. D. Jawson, and J. W. Doran. 1990. Steady-state aerobic microbial activity as a function of soil water content. Soil Sci. Soc. Am. J., 54(6):1619-1625

| | |
|--------------|--|
| fW.Standcarb | <i>Effects of moisture on decomposition rates according to the StandCarb model</i> |
|--------------|--|

Description

Calculates the effects of moisture on decomposition rates according to the StandCarb model.

Usage

```
fW.Standcarb(
  Moist,
  MatricShape = 5,
  MatricLag = 0,
  MoistMin = 30,
  MoistMax = 350,
  DiffuseShape = 15,
  DiffuseLag = 4
)
```

Arguments

| | |
|--------------|---|
| Moist | A scalar or vector containing values of moisture content of a litter or soil pool (%). |
| MatricShape | A scalar that determines when matric limit is reduced to the point that decay can begin to occur. |
| MatricLag | A scalar used to offset the curve to the left or right. |
| MoistMin | A scalar determining the minimum moisture content. |
| MoistMax | A scalar determining the maximum moisture content without diffusion limitations. |
| DiffuseShape | A scalar that determines the range of moisture contents where diffusion is not limiting. |
| DiffuseLag | A scalar used to shift the point when moisture begins to limit diffusion. |

Value

A data frame with limitation due to water potential (MatricLimit), limitation due to oxygen diffusion (DiffuseLimit), and the overall limitation of moisture on decomposition rates (MoistDecayIndex).

References

Harmon, M. E., and J. B. Domingo (2001), A users guide to STANDCARB version 2.0: A model to simulate carbon stores in forest stands. Oregon State University, Corvallis.

GaudinskiModel14 *Implementation of a the six-pool C14 model proposed by Gaudinski et al. 2000*

Description

This function creates a model as described in Gaudinski et al. 2000. It is a wrapper for the more general functions [GeneralModel_14](#) that can handle an arbitrary number of pools.

Usage

```
GaudinskiModel14(
  t,
  ks = c(kr = 1/1.5, koi = 1/1.5, koeal = 1/4, koeah = 1/80, kA1 = 1/3, kA2 = 1/75, kM =
    1/110),
  C0 = c(FR0 = 390, C10 = 220, C20 = 390, C30 = 1370, C40 = 90, C50 = 1800, C60 = 560),
  F0_Delta14C = rep(0, 7),
  LI = 150,
  RI = 255,
  xi = 1,
  inputFc,
  lambda = -0.0001209681,
  lag = 0,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. It must be specified within the same period for which the Delta 14 C of the atmosphere is provided. The default period in the provided dataset C14Atm_NH is 1900-2010. |
| ks | A vector of length 7 containing the decomposition rates for the 6 soil pools plus the fine-root pool. |
| C0 | A vector of length 7 containing the initial amount of carbon for the 6 pools plus the fine-root pool. |
| F0_Delta14C | A vector of length 7 containing the initial amount of the radiocarbon fraction for the 7 pools as Delta14C values in per mil. |
| LI | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| RI | A scalar or a data.frame object specifying the amount of root inputs by time. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| inputFc | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |

| | |
|--------|--|
| lambda | Radioactive decay constant. By default $\lambda = -0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. |
| lag | A positive integer representing a time lag for radiocarbon to enter the system. |
| solver | A function that solves the system of ODEs. An alternative to the default is euler or any other user provided function with the same interface. |
| pass | if TRUE Forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

References

Gaudinski JB, Trumbore SE, Davidson EA, Zheng S (2000) Soil carbon cycling in a temperate forest: radiocarbon-based estimates of residence times, sequestration rates and partitioning fluxes. *Biogeochemistry* 51: 33-69

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
years=seq(1901,2010,by=0.5)

Ex=GaudinskiModel14(
  t=years,
  ks=c(kr=1/3, koi=1/1.5, koeal=1/4, koeah=1/80, kA1=1/3, kA2=1/75, kM=1/110),
  inputFc=C14Atm_NH
)
R14m=getF14R(Ex)
C14m=getF14C(Ex)

plot(
  C14Atm_NH,
  type="l",
  xlab="Year",
  ylab=expression(paste(Delta^14,"C (per mille)")),
  xlim=c(1940,2010)
)
lines(years,C14m,col=4)
points(HarvardForest14C02[1:11,1],HarvardForest14C02[1:11,2],pch=19,cex=0.5)
points(HarvardForest14C02[12:173,1],HarvardForest14C02[12:173,2],pch=19,col=2,cex=0.5)
points(HarvardForest14C02[158,1],HarvardForest14C02[158,2],pch=19,cex=0.5)
lines(years,R14m,col=2)
legend(
  "topright",
  c("Delta 14C Atmosphere",
    "Delta 14C SOM",
    "Delta 14C Respired")
```

```

),
lty=c(1,1,1),
col=c(1,4,2),
bty="n"
)
## We now show how to bypass soilR s parameter sanity check if necessary
## (e.g in for parameter estimation ) in functions
## which might call it with unreasonable parameters
years=seq(1800,2010,by=0.5)
Ex=GaudinskiModel14(
t=years,
ks=c(kr=1/3,koi=1/1.5,koeal=1/4,koeah=1/80,kA1=1/3,kA2=1/75,kM=1/110),
inputFc=C14Atm_NH,
pass=TRUE
)

```

GeneralDecompOp *A generic factory for subclasses of GeneralDecompOp*

Description

A generic factory for subclasses of GeneralDecompOp

Usage

```
GeneralDecompOp(object)
```

Arguments

object A SoilR object

GeneralDecompOp,DecompOp-method

Pass through factory for objects of subclasses of [DecompOp](#)

Description

This method takes and returns an (identical) object that inherits from [DecompOp](#). It's purpose it to be able to call the generic function on arguments that are already

Usage

```
## S4 method for signature 'DecompOp'
GeneralDecompOp(object)
```

Arguments

object An object that already is of class DecompOp

GeneralDecompOp,function-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature ``function``  
GeneralDecompOp(object)
```

Arguments

object no manual documentation

GeneralDecompOp,list-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'list'  
GeneralDecompOp(object)
```

Arguments

object no manual documentation

GeneralDecompOp, matrix-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'matrix'  
GeneralDecompOp(object)
```

Arguments

object no manual documentation

GeneralDecompOp, TimeMap-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TimeMap'  
GeneralDecompOp(object)
```

Arguments

object no manual documentation

GeneralModel *additional function to create Models*

Description

In previous SoilR Version GeneralModel was the function to create linear models, a task now fulfilled by the function [Model](#). To ensure backward compatibility this function remains as a wrapper. In future versions it might take on the role of an abstract factory that produces several classes of models (i.e autonomous or non-autonomous and linear or non-linear) depending on different combinations of arguments. It creates a Model object from any combination of arguments that can be converted into the required set of building blocks for a model for n arbitrarily connected pools.

Usage

```
GeneralModel(
  t,
  A,
  ivList,
  inputFluxes,
  solverfunc = deSolve.lsoda.wrapper,
  pass = FALSE,
  timeSymbol
)
```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. |
| A | Anything that can be converted by GeneralDecompOp to any of the available DecompositionOperator classes |
| ivList | A vector containing the initial amount of carbon for the n pools. The length of this vector is equal to the number of pools and thus equal to the length of k. This is checked by an internal function. |
| inputFluxes | something that can be converted to any of the available InFluxes classes |
| solverfunc | The function used by to actually solve the ODE system. This can be deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | Forces the constructor to create the model even if it is invalid |
| timeSymbol | A string (character vector of length 1) identifying the variable name |

Value

A model object that can be further queried.

See Also

[TwopParallelModel](#), [TwopSeriesModel](#), [TwopFeedbackModel](#)

GeneralModel_14 *create objects of class [Model_14](#)*

Description

At the moment this is just a wrapper for the actual constructor [Model_14](#) with additional support for some now deprecated parameters for backward compatibility. This role may change in the future to an abstract factory where the actual class of the created model will be determined by the supplied parameters.

Usage

```
GeneralModel_14(
    t,
    A,
    ivList,
    initialValF,
    inputFluxes,
    Fc = NULL,
    inputFc = Fc,
    di = -0.0001209681,
    solverfunc = deSolve.lsoda.wrapper,
    pass = FALSE
)
```

Arguments

| | |
|-------------|--|
| t | A vector containing the points in time where the solution is sought. |
| A | something that can be converted by GeneralDecompOp to any of the available subclasses of DecompOp . |
| ivList | A vector containing the initial amount of carbon for the n pools. The length of this vector is equal to the number of pools and thus equal to the length of k. This is checked by an internal function. |
| initialValF | An object equal or equivalent to class <code>ConstFc</code> containing a vector with the initial values of the radiocarbon fraction for each pool and a format string describing in which format the values are given. |
| inputFluxes | something that can be converted by InFluxes to any of the available subclasses of InFluxes . |
| Fc | deprecated keyword argument, please use <code>inputFc</code> instead |
| inputFc | An object describing the fraction of C ₁₄ in per mille (different formats are possible) |
| di | the rate at which C ₁₄ decays radioactively. If you don't provide a value here we assume the following value: $k=-0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. Thus beside time itself it also affects decay rates the inputrates and the output |

| | |
|-------------------------|---|
| <code>solverfunc</code> | The function used by to actually solve the ODE system. This can be deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| <code>pass</code> | Forces the constructor to create the model even if it is invalid |

Value

A model object that can be further queried.

See Also

[TwopParallelModel](#), [TwopSeriesModel](#), [TwopFeedbackModel](#)

| | |
|-----------------------------|--|
| <code>GeneralNIModel</code> | <i>Use this function to create objects of class NIModel.</i> |
|-----------------------------|--|

Description

The function creates a numerical model for n arbitrarily connected pools. It is one of the constructors of class NIModel. It is used by some more specialized wrapper functions, but can also be used directly.

Usage

```
GeneralNIModel(
  t,
  T0,
  ivList,
  inputFluxes,
  solverfunc = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|--------------------------|--|
| <code>t</code> | A vector containing the points in time where the solution is sought. |
| <code>T0</code> | A object describing the model decay rates for the n pools, connection and feedback coefficients. The number of pools n must be consistent with the number of initial values and input fluxes. |
| <code>ivList</code> | A numeric vector containing the initial amount of carbon for the n pools. The length of this vector is equal to the number of pools. |
| <code>inputFluxes</code> | A TimeMap object consisting of a vector valued function describing the inputs to the pools as functions of time TimeMap.new . |
| <code>solverfunc</code> | The function used by to actually solve the ODE system. |
| <code>pass</code> | Forces the constructor to create the model even if it is invalid. If set to TRUE, does not enforce the requirements for a biologically meaningful model, e.g. does not check if negative values of respiration are calculated. |

Value

```

Tr=getTransferMatrix(Anl) #this is a function of C and t
#####
# build the two models (linear and nonlinear) mod=GeneralModel( t, A,iv, inputrates, deSolve.lsoda.wrapper)
modnl=GeneralNIModel( t, Anl, iv, inputrates, deSolve.lsoda.wrapper)
Ynonlin=getC(modnl) lt1=2 lt2=4 plot(t,Ynonlin[,1],type="l",lty=lt1,col=1, ylab="Concentrations",xlab="Time",ylim=c(mi
lines(t,Ynonlin[,2],type="l",lty=lt2,col=2) legend("topleft",c("Pool 1", "Pool 2"),lty=c(lt1,lt2),col=c(1,2))

```

See Also

[GeneralModel.](#)

Examples

```

t_start=0
t_end=20
tn=100
timestep=(t_end-t_start)/tn
t=seq(t_start,t_end,timestep)
k1=1/2
k2=1/3
Km=0.5
nr=2

alpha=list()
alpha[["1_to_2"]]=function(C,t){
  1/5
}
alpha[["2_to_1"]]=function(C,t){
  1/6
}

f=function(C,t){
# The only thing to take care of is that we release a vector of the same
# size as C
S=C[[1]]
M=C[[2]]
O=matrix(byrow=TRUE,nrow=2,c(k1*M*(S/(Km+S)),
k2*M))
return(O)
}
Anl=new("TransportDecompositionOperator",t_start,Inf,nr,alpha,f)

c01=3
c02=2
iv=c(c01,c02)
inputrates=new("TimeMap",t_start,t_end,function(t){return(matrix(
nrow=nr,
ncol=1,
c( 2, 2)

```



```

)))
#####
# we check if we can reproduce the linear decomposition operator from the
# nonlinear one

```

| | |
|---------------|------------------------|
| GeneralPoolId | <i>General pool Id</i> |
|---------------|------------------------|

Description

General pool Id

General pool Id

Usage

GeneralPoolId(id)

GeneralPoolId(id)

Arguments

id see method arguments

| |
|---------------------------------|
| GeneralPoolId, character-method |
| <i>automatic title</i> |

Description

automatic title

Usage

S4 method for signature 'character'

GeneralPoolId(id)

Arguments

id no manual documentation

GeneralPoolId,numeric-method
generic factory for this virtual class

Description

the class returned depends on the method dispatched depending on the supplied arguments

Usage

```
## S4 method for signature 'numeric'  
GeneralPoolId(id)
```

Arguments

id a numerical id

getAccumulatedRelease *Accumulated release flux out of the pools*

Description

Accumulated release flux out of the pools

Usage

```
getAccumulatedRelease(object)
```

Arguments

object see method arguments

getAccumulatedRelease,Model-method

Compute the time integral of the release fluxes over time

Description

The definite integral of the vector of release fluxes over time from start to t, computed for all t in the times argument the modelrun has been created with.

Usage

```
## S4 method for signature 'Model'  
getAccumulatedRelease(object)
```

Arguments

object A modelrun as produced by the constructors: [Model](#), [Model_by_PoolNames](#), [Model_14](#) the function [GeneralModel](#) or the functions listed in [predefinedModels](#). A model represents the initial value problem (IVP) for the contents of the pool consisting of

- The initial values of the pool content
- The system of ordinary differential equations, as dictated by the fluxes
- The times for which the solution of the IVP is evaluated.

Value

A matrix with as many columns as there are pools and as many rows as there are entries in the times argument the model has been build with.

getC

Calculates the content of the pools

Description

This function computes the content of the pools as function of time. In the original (and most of the present) Models these are Carbon pools hence the name. Have a look at the methods for details.

Usage

```
getC(object, as.closures = F)
```

Arguments

| | |
|-------------|--|
| object | A modelrun as produced by the constructors: Model , Model_by_PoolNames , Model_14 the function GeneralModel or the functions listed in predefinedModels . A model represents the initial value problem (IVP) for the contents of the pool consisting of <ul style="list-style-type: none"> • The initial values of the pool content • The system of ordinary differential equations, as dictated by the fluxes • The times for which the solution of the IVP is evaluated. |
| as.closures | a logical variable. Default to FALSE |

Value

A matrix with m columns representing where m is the number of pools, and n rows where n is the number times as specified by the times of the model.

| | |
|-------------------|------------------------------------|
| getC,Model-method | <i>Pool Contents for all times</i> |
|-------------------|------------------------------------|

Description

Pool Contents for all times

The solution of the initial value problem (IVP) for the pool contents. Since the first models in SoilR had only Carbon pools the function name getC could be interpreted as referring to the C content. If the model includes other element cycles e.g. N or P this interpretation is no longer valid. In this case the C in 'getC' stands for 'content' since the function will always return the solution for all pools, regardless of the chemical element the author of the model associated them with.

Usage

```
## S4 method for signature 'Model'
getC(object)
```

Arguments

| | |
|--------|--|
| object | A modelrun as produced by the constructors: Model , Model_by_PoolNames , Model_14 the function GeneralModel or the functions listed in predefinedModels . A model represents the initial value problem (IVP) for the contents of the pool consisting of <ul style="list-style-type: none"> • The initial values of the pool content • The system of ordinary differential equations, as dictated by the fluxes • The times for which the solution of the IVP is evaluated. |
|--------|--|

Value

A matrix with as many columns as there are pools and as many rows as there are entries in the times argument the model has been build with.

getC,Model_by_PoolNames-method
Pool Contents for all times

Description

Pool Contents for all times

The solution of the initial value problem (IVP) for the pool contents. Since the first models in SoilR had only Carbon pools the function name getC could be interpreted as referring to the C content. If the model includes other element cycles e.g. N or P this interpretation is no longer valid. In this case the C in 'getC' stands for 'content' since the function will always return the solution for all pools, regardless of the chemical element the author of the model associated them with.

Usage

```
## S4 method for signature 'Model_by_PoolNames'
getC(object)
```

Arguments

object A modelrun as produced by the constructors: [Model](#), [Model_by_PoolNames](#), [Model_14](#) the function [GeneralModel](#) or the functions listed in [predefinedModels](#). A model represents the initial value problem (IVP) for the contents of the pool consisting of

- The initial values of the pool content
- The system of ordinary differential equations, as dictated by the fluxes
- The times for which the solution of the IVP is evaluated.

Value

A matrix with as many columns as there are pools and as many rows as there are entries in the times argument the model has been build with.

getC,NlModel-method *Pool Contents for all times*

Description

Pool Contents for all times

The solution of the initial value problem (IVP) for the pool contents. Since the first models in SoilR had only Carbon pools the function name getC could be interpreted as referring to the C content. If the model includes other element cycles e.g. N or P this interpretation is no longer valid. In this case the C in 'getC' stands for 'content' since the function will always return the solution for all pools, regardless of the chemical element the author of the model associated them with.

Usage

```
## S4 method for signature 'N1Model'
getC(object, as.closures = FALSE)
```

Arguments

| | |
|-------------|---|
| object | no manual documentation |
| as.closures | If TRUE will return the result as a list of approximating functions of time indexed by the pool number. |

Value

If `as.closures` is FALSE (the default) the return value is a matrix with as many columns as there are pools and as many rows as there are entries in the `times` argument the model has been built with.

| | |
|--------|--|
| getC14 | <i>Generic that yields the 14C content for all pools and all times</i> |
|--------|--|

Description

Generic that yields the 14C content for all pools and all times

Usage

```
getC14(object)
```

Arguments

| | |
|--------|----------------|
| object | a SoilR object |
|--------|----------------|

| | |
|------------------------|------------------------|
| getC14,Model_14-method | <i>automatic title</i> |
|------------------------|------------------------|

Description

automatic title

Usage

```
## S4 method for signature 'Model_14'
getC14(object)
```

Arguments

| | |
|--------|-------------------------|
| object | no manual documentation |
|--------|-------------------------|

`getCompartmentalMatrixFunc`
Compartmental matrix function

Description

Compartmental matrix function

Usage

`getCompartmentalMatrixFunc(object, timeSymbol, state_variable_names)`

Arguments

`object` see method arguments
`timeSymbol` see method arguments
`state_variable_names`
 see method arguments

`getCompartmentalMatrixFunc, BoundLinDecompOp-method`
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'BoundLinDecompOp'  
getCompartmentalMatrixFunc(object)
```

Arguments

`object` no manual documentation

`getCompartmentalMatrixFunc,ConstLinDecompOp-method`
Compartmental matrix function

Description

Compartmental matrix function

Usage

```
## S4 method for signature 'ConstLinDecompOp'  
getCompartmentalMatrixFunc(object)
```

Arguments

object a ConstLinDecompOp object

`getCompartmentalMatrixFunc,TransportDecompositionOperator-method`
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TransportDecompositionOperator'  
getCompartmentalMatrixFunc(object)
```

Arguments

object no manual documentation

`getCompartmentalMatrixFunc, UnBoundNonLinDecompOp-method`

Extract the matrix valued function of time and state vector for the compartmental matrix

Description

Extract the matrix valued function of time and state vector for the compartmental matrix
automatic title

Usage

```
## S4 method for signature 'UnBoundNonLinDecompOp'  
getCompartmentalMatrixFunc(object)
```

```
## S4 method for signature 'UnBoundNonLinDecompOp'  
getCompartmentalMatrixFunc(object)
```

Arguments

object no manual documentation

`getConstantCompartmentalMatrix`

Constant compartmental matrix

Description

Constant compartmental matrix

Usage

```
getConstantCompartmentalMatrix(object)
```

Arguments

object see method arguments

`getConstantCompartmentalMatrix,ConstLinDecompOp-method`
Constant compartmental matrix

Description

Constant compartmental matrix

Usage

```
## S4 method for signature 'ConstLinDecompOp'  
getConstantCompartmentalMatrix(object)
```

Arguments

object a ConstLinDecompOp object

`getConstantCompartmentalMatrix,ConstLinDecompOpWithLinearScalarFactor-method`
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'ConstLinDecompOpWithLinearScalarFactor'  
getConstantCompartmentalMatrix(object)
```

Arguments

object no manual documentation

getConstantInFluxVector
Input flux vector

Description

Input flux vector

Usage

getConstantInFluxVector(object)

Arguments

object see method arguments

getConstantInFluxVector, ConstInFluxes-method
automatic title

Description

automatic title

Usage

S4 method for signature 'ConstInFluxes'
getConstantInFluxVector(object)

Arguments

object no manual documentation

`getConstantInternalFluxRateList_by_PoolIndex`
Constant internal flux rate list by pool index

Description

Constant internal flux rate list by pool index

Usage

`getConstantInternalFluxRateList_by_PoolIndex(object)`

Arguments

object see method arguments

`getConstantInternalFluxRateList_by_PoolIndex,ConstLinDecompOp-method`
Constant internal flux rate list by pool index

Description

Constant internal flux rate list by pool index

Usage

```
## S4 method for signature 'ConstLinDecompOp'  
getConstantInternalFluxRateList_by_PoolIndex(object)
```

Arguments

object a ConstLinDecompOp object

getConstantOutFluxRateList_by_PoolIndex
Constant out flux rate list by pool index

Description

Constant out flux rate list by pool index

Usage

`getConstantOutFluxRateList_by_PoolIndex(object)`

Arguments

object see method arguments

getConstantOutFluxRateList_by_PoolIndex, ConstLinDecompOp-method
Constant out flux rate list by pool index

Description

Constant out flux rate list by pool index

Usage

```
## S4 method for signature 'ConstLinDecompOp'  
getConstantOutFluxRateList_by_PoolIndex(object)
```

Arguments

object a ConstLinDecompOp object

getConstLinDecompOp *Constant linear decomposition operator*

Description

Constant linear decomposition operator

Usage

`getConstLinDecompOp(object)`

Arguments

object see method arguments

getConstLinDecompOp,ConstLinDecompOpWithLinearScalarFactor-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'ConstLinDecompOpWithLinearScalarFactor'  
getConstLinDecompOp(object)
```

Arguments

object no manual documentation

getCumulativeC *Cummulative pool contents*

Description

Cummulative pool contents

Usage

```
getCumulativeC(object)
```

Arguments

object see method arguments

`getCumulativeC,NlModel-method`
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'NlModel'  
getCumulativeC(object)
```

Arguments

object no manual documentation

`getDecompOp` *Decomposition operator of a model*

Description

Decomposition operator of a model

Usage

```
getDecompOp(object)
```

Arguments

object see method arguments

getDecompOp, Model-method

Extract the Compartmental Operator

Description

The method is usually used internally by other methods operating on models. The information it yields has either been provided by the user in creating the modelrun or can be obtained by directly transforming the arguments that were used.

Usage

```
## S4 method for signature 'Model'
getDecompOp(object)
```

Arguments

object A modelrun as produced by the constructors: [Model](#), [Model_by_PoolNames](#), [Model_14](#) the function [GeneralModel](#) or the functions listed in [predefinedModels](#). A model represents the initial value problem (IVP) for the contents of the pool consisting of

- The initial values of the pool content
- The system of ordinary differential equations, as dictated by the fluxes
- The times for which the solution of the IVP is evaluated.

Value

The actual class of the result can vary. It will be a subclass of [DecompOp](#). These objects are an abstraction for a complete description of the fluxes in the pool system regardless of the form it is provided in. The information contained in these objects is equivalent to the set of internal and outward fluxes as functions of pool contents and time and sufficient to infer the "Compartmental Matrix" as a matrix valued function of the same arguments. In the general case of a nonautonomous nonlinear Model this function is a true function of both, the pool contents and time. In the case of an non-autonomous linear model it is a function of time only, and in case of a autonomous linear model it is a constant matrix. The vector valued function can be inferred by the generic function [getFunctionDefinition](#).

getDecompOp, NlModel-method

Extract the Compartmental Operator

Description

Extract the Compartmental Operator

Usage

```
## S4 method for signature 'NlModel'
getDecompOp(object)
```

Arguments

object A modelrun as produced by the constructors: [Model](#), [Model_by_PoolNames](#), [Model_14](#) the function [GeneralModel](#) or the functions listed in [predefinedModels](#). A model represents the initial value problem (IVP) for the contents of the pool consisting of

- The initial values of the pool content
- The system of ordinary differential equations, as dictated by the fluxes
- The times for which the solution of the IVP is evaluated.

Value

The actual class of the result can vary. It will be a subclass of [DecompOp](#). These objects are an abstraction for a complete description of the fluxes in the pool system regardless of the form it is provided in. The information contained in these objects is equivalent to the set of internal and outward fluxes as functions of pool contents and time and sufficient to infer the "Compartmental Matrix" as a matrix valued function of the same arguments. In the general case of a nonautonomous nonlinear Model this function is a true function of both, the pool contents and time. In the case of a non-autonomous linear model it is a function of time only, and in case of a autonomous linear model it is a constant matrix. The vector valued function can be inferred by the generic function [getFunctionDefinition](#).

| | |
|------------------------|----------------|
| <code>getDotOut</code> | <i>Dot out</i> |
|------------------------|----------------|

Description

Dot out

Usage

```
getDotOut(object)
```

Arguments

object see method arguments

getDotOut,TransportDecompositionOperator-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TransportDecompositionOperator'
getDotOut(object)
```

Arguments

object no manual documentation

getF14 *Generic that yields the 14C fraction for the content all pools and all times*

Description

Generic that yields the 14C fraction for the content all pools and all times

Usage

```
getF14(object)
```

Arguments

object A SoilR object of class Model14

getF14,Model_14-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'Model_14'  
getF14(object)
```

Arguments

object no manual documentation

getF14C *Generic that yields the 14C fraction for the cumulative content of all
pools and all times*

Description

Generic that yields the 14C fraction for the cumulative content of all pools and all times

Usage

```
getF14C(object)
```

Arguments

object a SoilR object of class Model 14

getF14C,Model_14-method

automatic title

Description

automatic title

Usage

```
## S4 method for signature 'Model_14'  
getF14C(object)
```

Arguments

object no manual documentation

getF14R

*Generic that yields the 14C fraction for the release flux of all pools
and all times*

Description

Generic that yields the 14C fraction for the release flux of all pools and all times

Usage

```
getF14R(object)
```

Arguments

object a SoilR object of class Model14

getF14R,Model_14-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'Model_14'  
getF14R(object)
```

Arguments

object no manual documentation

getFormat *Get format of SoilR object*

Description

Get format of SoilR object

Usage

```
getFormat(object)
```

Arguments

object see method arguments

getFormat,Fc-method *automatic title*

Description

automatic title

Usage

```
## S4 method for signature 'Fc'  
getFormat(object)
```

Arguments

object no manual documentation

`getFunctionDefinition` *Function definition of SoilR model*

Description

Function definition of SoilR model

Usage

```
getFunctionDefinition(object, timeSymbol, poolNames, numberOfPools)
```

Arguments

| | |
|----------------------------|----------------------|
| <code>object</code> | see method arguments |
| <code>timeSymbol</code> | see method arguments |
| <code>poolNames</code> | see method arguments |
| <code>numberOfPools</code> | see method arguments |

`getFunctionDefinition,ConstInFluxes-method`
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'ConstInFluxes'  
getFunctionDefinition(object)
```

Arguments

| | |
|---------------------|-------------------------|
| <code>object</code> | no manual documentation |
|---------------------|-------------------------|

getFunctionDefinition,ConstLinDecompOp-method
Function describing an object of class ConstLinDecompOp

Description

Function describing an object of class ConstLinDecompOp

Usage

```
## S4 method for signature 'ConstLinDecompOp'  
getFunctionDefinition(object)
```

Arguments

object object of class ConstLinDecompOp

getFunctionDefinition,ConstLinDecompOpWithLinearScalarFactor-method
*convert names of vectors or lists to class ConstantOutFluxRate con-
vert names of vectors or lists to class ConstantInternalFluxRate helper
function*

Description

convert names of vectors or lists to class ConstantOutFluxRate convert names of vectors or lists to class ConstantInternalFluxRate helper function

Usage

```
## S4 method for signature 'ConstLinDecompOpWithLinearScalarFactor'  
getFunctionDefinition(object)
```

Arguments

object an object of class ConstLinDecompOpWithLinearScalarFactor

getFunctionDefinition,DecompositionOperator-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'DecompositionOperator'  
getFunctionDefinition(object)
```

Arguments

object no manual documentation

getFunctionDefinition,InFluxList_by_PoolIndex-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'InFluxList_by_PoolIndex'  
getFunctionDefinition(object, numberOfPools)
```

Arguments

object no manual documentation
numberOfPools no manual documentation

getFunctionDefinition,InFluxList_by_PoolName-method
automatic title

Description

automatic title
automatic title

Usage

```
## S4 method for signature 'InFluxList_by_PoolName'  
getFunctionDefinition(object, timeSymbol, poolNames)  
  
## S4 method for signature 'InFluxList_by_PoolName'  
getFunctionDefinition(object, timeSymbol, poolNames)
```

Arguments

| | |
|------------|-------------------------|
| object | no manual documentation |
| timeSymbol | no manual documentation |
| poolNames | no manual documentation |

getFunctionDefinition,StateDependentInFluxVector-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'StateDependentInFluxVector'  
getFunctionDefinition(object)
```

Arguments

| | |
|--------|-------------------------|
| object | no manual documentation |
|--------|-------------------------|

getFunctionDefinition,TimeMap-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TimeMap'  
getFunctionDefinition(object)
```

Arguments

object no manual documentation

getFunctionDefinition,TransportDecompositionOperator-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TransportDecompositionOperator'  
getFunctionDefinition(object)
```

Arguments

object no manual documentation

getFunctionDefinition,UnBoundInFluxes-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'UnBoundInFluxes'  
getFunctionDefinition(object)
```

Arguments

object no manual documentation

getFunctionDefinition,UnBoundLinDecompOp-method
Extracts the time dependent matrix valued function (compartmental matrix)

Description

Extracts the time dependent matrix valued function (compartmental matrix)

Usage

```
## S4 method for signature 'UnBoundLinDecompOp'  
getFunctionDefinition(object)
```

Arguments

object no manual documentation

See Also

Other UnBoundLinDecompOp_constructor: [UnBoundLinDecompOp, function-method](#)

| | |
|-------------|-----------------------------|
| getInFluxes | <i>Extract the influxes</i> |
|-------------|-----------------------------|

Description

Extract the influxes

Usage

```
getInFluxes(object)
```

Arguments

| | |
|--------|----------------------|
| object | see method arguments |
|--------|----------------------|

| |
|--------------------------|
| getInFluxes,Model-method |
|--------------------------|

Extract the InFluxes as provided during creation of the model

Description

Since the influxes had to be provided to create the model this method yields no new information that can not be obtained simpler. It is usually called internally by other functions.

Usage

```
## S4 method for signature 'Model'
getInFluxes(object)
```

Arguments

| | |
|--------|---|
| object | <p>A modelrun as produced by the constructors: Model, Model_by_PoolNames, Model_14 the function GeneralModel or the functions listed in predefinedModels. A model represents the initial value problem (IVP) for the contents of the pool consisting of</p> <ul style="list-style-type: none"> • The initial values of the pool content • The system of ordinary differential equations, as dictated by the fluxes • The times for which the solution of the IVP is evaluated. |
|--------|---|

getInFluxes,NlModel-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'NlModel'  
getInFluxes(object)
```

Arguments

object no manual documentation

getInitialValues *Initial values of SoilR object*

Description

Initial values of SoilR object

Usage

```
getInitialValues(object)
```

Arguments

object a SoilR object

getInitialValues, N1Model-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'N1Model'  
getInitialValues(object)
```

Arguments

object no manual documentation

getLinearScaleFactor *Linear scale factor*

Description

Linear scale factor

Usage

```
getLinearScaleFactor(object)
```

Arguments

object see method arguments

getLinearScaleFactor,ConstLinDecompOpWithLinearScalarFactor-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'ConstLinDecompOpWithLinearScalarFactor'  
getLinearScaleFactor(object)
```

Arguments

object no manual documentation

getMeanTransitTime *Mean transit time for SoilR objects*

Description

Mean transit time for SoilR objects

Usage

```
getMeanTransitTime(object, inputDistribution)
```

Arguments

object see method arguments
inputDistribution see method arguments

getMeanTransitTime, ConstLinDecompOp-method

Mean transit time obtained through a numerical simulation. It produces an estimate with numerical errors. We recommend to use the function transitTime instead.

Description

Mean transit time obtained through a numerical simulation. It produces an estimate with numerical errors. We recommend to use the function transitTime instead.

Usage

```
## S4 method for signature 'ConstLinDecompOp'
getMeanTransitTime(object, inputDistribution)
```

Arguments

object a ConstLinDecompOp object
inputDistribution a distribution of input contents among pools

getNumberOfPools *Number of pools in a model*

Description

Number of pools in a model

Usage

```
getNumberOfPools(object)
```

Arguments

object see method arguments

getNumberOfPools,MCSim-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'MCSim'  
getNumberOfPools(object)
```

Arguments

object no manual documentation

getNumberOfPools,NlModel-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'NlModel'  
getNumberOfPools(object)
```

Arguments

object no manual documentation

getNumberOfPools,TransportDecompositionOperator-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TransportDecompositionOperator'
getNumberOfPools(object)
```

Arguments

object no manual documentation

getOutputFluxes *Generic Function to obtain the fluxes out of of the pools*

Description

Generic Function to obtain the fluxes out of of the pools

Usage

```
getOutputFluxes(object, as.closures = F)
```

Arguments

object a SoilR object
as.closures a logical variable. Default to FALSE

getOutputFluxes,NlModel-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'NlModel'  
getOutputFluxes(object, as.closures = F)
```

Arguments

| | |
|-------------|-------------------------|
| object | no manual documentation |
| as.closures | no manual documentation |

getOutputReceivers *Pools receiving outputs from other pools*

Description

Pools receiving outputs from other pools

Usage

```
getOutputReceivers(object, i)
```

Arguments

| | |
|--------|----------------------|
| object | see method arguments |
| i | see method arguments |

getOutputReceivers,TransportDecompositionOperator,numeric-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TransportDecompositionOperator,numeric'  
getOutputReceivers(object, i)
```

Arguments

| | |
|--------|-------------------------|
| object | no manual documentation |
| i | no manual documentation |

getParticleMonteCarloSimulator
automatic title

Description

automatic title

Usage

```
getParticleMonteCarloSimulator(object)
```

Arguments

| | |
|--------|----------------------|
| object | see method arguments |
|--------|----------------------|

getParticleMonteCarloSimulator,NlModel-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'NlModel'  
getParticleMonteCarloSimulator(object)
```

Arguments

object no manual documentation

getReleaseFlux *Generic Function to obtain the vector of release fluxes out of the pools for all times.*

Description

Generic Function to obtain the vector of release fluxes out of the pools for all times.

Usage

```
getReleaseFlux(object)
```

Arguments

object A SoilR object

getReleaseFlux,Model-method

The release fluxes $\frac{[content]}{[time]}$ for all pools.

Description

The release fluxes $\frac{[content]}{[time]}$ for all pools.

Usage

```
## S4 method for signature 'Model'
getReleaseFlux(object)
```

Arguments

object A modelrun as produced by the constructors: [Model](#), [Model_by_PoolNames](#), [Model_14](#) the function [GeneralModel](#) or the functions listed in [predefinedModels](#). A model represents the initial value problem (IVP) for the contents of the pool consisting of

- The initial values of the pool content
- The system of ordinary differential equations, as dictated by the fluxes
- The times for which the solution of the IVP is evaluated.

Value

A matrix with as many columns as there are pools and as many rows as there are entries in the times argument the model has been build with.

getReleaseFlux,Model_by_PoolNames-method

automatic title

Description

automatic title

Usage

```
## S4 method for signature 'Model_by_PoolNames'
getReleaseFlux(object)
```

Arguments

- object A modelrun as produced by the constructors: [Model](#), [Model_by_PoolNames](#), [Model_14](#) the function [GeneralModel](#) or the functions listed in [predefinedModels](#). A model represents the initial value problem (IVP) for the contents of the pool consisting of
- The initial values of the pool content
 - The system of ordinary differential equations, as dictated by the fluxes
 - The times for which the solution of the IVP is evaluated.

getReleaseFlux,NlModel-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'NlModel'
getReleaseFlux(object)
```

Arguments

object no manual documentation

getReleaseFlux14 *Generic that yields the 14C fraction in the release flux*

Description

Generic that yields the 14C fraction in the release flux

Usage

```
getReleaseFlux14(object)
```

Arguments

object see method arguments

getReleaseFlux14,Model_14-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'Model_14'  
getReleaseFlux14(object)
```

Arguments

object no manual documentation

getRightHandSideOfODE *Right hand side of ODE of a SoilR model*

Description

Right hand side of ODE of a SoilR model

Usage

```
getRightHandSideOfODE(object, timeSymbol, poolNames, numberOfPools)
```

Arguments

object see method arguments
timeSymbol see method arguments
poolNames see method arguments
numberOfPools see method arguments

`getRightHandSideOfODE,Model-method`*Derivative of the state variables as function*

Description

For non-linear models or models with state dependent influxes the returned function is a true function of state and time For linear models with state independent influxes the returned function is in fact a function of time only.

Usage

```
## S4 method for signature 'Model'  
getRightHandSideOfODE(object)
```

Arguments

object no manual documentation

Value

A function $f(t)$

`getRightHandSideOfODE,Model_by_PoolNames-method`*Provide the (vector valued) derivative of the stocks with respect to time*

Description

This function is required by the ODE solvers.

Usage

```
## S4 method for signature 'Model_by_PoolNames'  
getRightHandSideOfODE(object)
```

Arguments

object The model

| | |
|-------------|---|
| getSolution | <i>Calculates all stocks all fluxes to ,in and out of the compartment system and also their integrals over time</i> |
|-------------|---|

Description

Have a look at the methods for details.

Usage

```
getSolution(object, params, as.closures = F)
```

Arguments

| | |
|-------------|---|
| object | A modelrun as produced by the constructors: Model , Model_by_PoolNames , Model_14 the function GeneralModel or the functions listed in predefinedModels . A model represents the initial value problem (IVP) for the contents of the pool consisting of <ul style="list-style-type: none"> • The initial values of the pool content • The system of ordinary differential equations, as dictated by the fluxes • The times for which the solution of the IVP is evaluated. |
| params | parameter values |
| as.closures | a logical variable. Default to FALSE |

Value

A matrix with columns representing the name of the statevariable, flux and accumulated flux for every time

as specified by the times of the model.

| | |
|---------------------------------------|--|
| getSolution,Model_by_PoolNames-method | <i>All Fluxes and stocks for all times</i> |
|---------------------------------------|--|

Description

All Fluxes and stocks for all times

Usage

```
## S4 method for signature 'Model_by_PoolNames'
getSolution(object, params)
```

Arguments

| | |
|--------|---|
| object | A modelrun as produced by the constructors: Model , Model_by_PoolNames , Model_14 the function GeneralModel or the functions listed in predefinedModels . A model represents the initial value problem (IVP) for the contents of the pool consisting of <ul style="list-style-type: none"> • The initial values of the pool content • The system of ordinary differential equations, as dictated by the fluxes • The times for which the solution of the IVP is evaluated. |
| params | parameter values |

Value

A matrix with as many columns as there are pools and as many rows as there are entries in the times argument the model has been build with.

| | |
|--------------|---|
| getTimeRange | <i>Time range of a model simulation</i> |
|--------------|---|

Description

Time range of a model simulation

Usage

```
getTimeRange(object)
```

Arguments

| | |
|--------|----------------------|
| object | see method arguments |
|--------|----------------------|

| | |
|------------------------------------|------------------------|
| getTimeRange, ConstInFluxes-method | <i>automatic title</i> |
|------------------------------------|------------------------|

Description

automatic title

Usage

```
## S4 method for signature 'ConstInFluxes'
getTimeRange(object)
```

Arguments

| | |
|--------|-------------------------|
| object | no manual documentation |
|--------|-------------------------|

getTimeRange,ConstLinDecompOp-method

Time range of a simulation described in an object of class ConstLinDecompOp

Description

Time range of a simulation described in an object of class ConstLinDecompOp

Usage

```
## S4 method for signature 'ConstLinDecompOp'  
getTimeRange(object)
```

Arguments

object no manual documentation

getTimeRange,ConstLinDecompOpWithLinearScalarFactor-method

automatic title

Description

automatic title

Usage

```
## S4 method for signature 'ConstLinDecompOpWithLinearScalarFactor'  
getTimeRange(object)
```

Arguments

object no manual documentation

getTimeRange,DecompositionOperator-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'DecompositionOperator'  
getTimeRange(object)
```

Arguments

object no manual documentation

getTimeRange,TimeMap-method
The time interval where the function is defined

Description

The time interval where the function is defined

Usage

```
## S4 method for signature 'TimeMap'  
getTimeRange(object)
```

Arguments

object a TimeMap object

getTimeRange,UnBoundInFluxes-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'UnBoundInFluxes'  
getTimeRange(object)
```

Arguments

object no manual documentation

getTimeRange,UnBoundLinDecompOp-method
Extracts the time interval for which the function is valid.

Description

Extracts the time interval for which the function is valid.

Usage

```
## S4 method for signature 'UnBoundLinDecompOp'  
getTimeRange(object)
```

Arguments

object no manual documentation

| | |
|----------|------------------------------------|
| getTimes | <i>Time vector of SoilR object</i> |
|----------|------------------------------------|

Description

Time vector of SoilR object

Usage

```
getTimes(object)
```

Arguments

| | |
|--------|----------------|
| object | a SoilR object |
|--------|----------------|

getTimes,Model-method *Extract the times vector*

Description

Since the times had to be provided to create the model this method yields no new information. It is usually called internally by other functions that deal with models.

Usage

```
## S4 method for signature 'Model'  
getTimes(object)
```

Arguments

| | |
|--------|---|
| object | <p>A modelrun as produced by the constructors: Model, Model_by_PoolNames, Model_14 the function GeneralModel or the functions listed in predefinedModels. A model represents the initial value problem (IVP) for the contents of the pool consisting of</p> <ul style="list-style-type: none">• The initial values of the pool content• The system of ordinary differential equations, as dictated by the fluxes• The times for which the solution of the IVP is evaluated. |
|--------|---|

`getTimes,Model_by_PoolNames-method`

Extract the times vector

Description

Since the times had to be provided to create the model this method yields no new information. It is usually called internally by other functions that deal with models.

Usage

```
## S4 method for signature 'Model_by_PoolNames'
getTimes(object)
```

Arguments

| | |
|--------|---|
| object | <p>A modelrun as produced by the constructors: Model, Model_by_PoolNames, Model_14 the function GeneralModel or the functions listed in predefinedModels. A model represents the initial value problem (IVP) for the contents of the pool consisting of</p> <ul style="list-style-type: none"> • The initial values of the pool content • The system of ordinary differential equations, as dictated by the fluxes • The times for which the solution of the IVP is evaluated. |
|--------|---|

`getTimes,NlModel-method`

automatic title

Description

automatic title

Usage

```
## S4 method for signature 'NlModel'
getTimes(object)
```

Arguments

| | |
|--------|-------------------------|
| object | no manual documentation |
|--------|-------------------------|

getTransferCoefficients
Transfer coefficients

Description

Transfer coefficients

Transfer coefficients

Usage

getTransferCoefficients(object, as.closures = F)

getTransferCoefficients(object, as.closures = F)

Arguments

object see method arguments

as.closures see method arguments

getTransferCoefficients,NlModel-method
automatic title

Description

automatic title

Usage

S4 method for signature 'NlModel'
getTransferCoefficients(object, as.closures = F)

Arguments

object no manual documentation

as.closures no manual documentation

getTransferCoefficients,TransportDecompositionOperator-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TransportDecompositionOperator'
getTransferCoefficients(object)
```

Arguments

object no manual documentation

getTransferMatrix *deprecated, use getTransferMatrixFunc instead*

Description

deprecated, use getTransferMatrixFunc instead

Usage

```
getTransferMatrix(object)
```

Arguments

object A compartmental operator

getTransferMatrixFunc *Transfer matrix function*

Description

Transfer matrix function

Usage

```
getTransferMatrixFunc(object)
```

Arguments

object see method arguments

getTransferMatrixFunc,TransportDecompositionOperator-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TransportDecompositionOperator'  
getTransferMatrixFunc(object)
```

Arguments

object no manual documentation

getTransitTimeDistributionDensity
Transit time distribution for SoilR objects

Description

Transit time distribution for SoilR objects

Usage

```
getTransitTimeDistributionDensity(object, inputDistribution, times)
```

Arguments

object see method arguments
inputDistribution see method arguments
times see method arguments

getTransitTimeDistributionDensity,ConstLinDecompOp-method

Transit time distribution obtained through a numerical simulation. It introduces numerical errors. We recommend to use the function transitTime instead

Description

Transit time distribution obtained through a numerical simulation. It introduces numerical errors. We recommend to use the function transitTime instead

Usage

```
## S4 method for signature 'ConstLinDecompOp'
getTransitTimeDistributionDensity(object, inputDistribution, times)
```

Arguments

| | |
|-------------------|--|
| object | a ConstLinDecompOp object |
| inputDistribution | an input distribution among pools |
| times | a variable with times to obtain the distribution |

getValues *Get values of SoilR object*

Description

Get values of SoilR object

Usage

```
getValues(object)
```

Arguments

| | |
|--------|----------------------|
| object | see method arguments |
|--------|----------------------|

getValues,ConstFc-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'ConstFc'
getValues(object)
```

Arguments

object no manual documentation

| | |
|------------|--|
| Graven2017 | <i>Compiled records of radicarbon in atmospheric CO2 for historical simulations in CMIP6</i> |
|------------|--|

Description

Historical Delta-14C in atmospheric CO2 used as forcing dataset for CMIP6 simulation experiments. Data is reported for three hemispheric zones, for the period 1850-2015.

Usage

```
data(Graven2017)
```

Format

A data frame with 166 rows and 4 variables.

Year.AD Year (AD).

NH Delta14C for the northern hemisphere, between 30N to 90N latitude. Values in per mil.

Tropics Delta14C for the tropics, between 30N to 30S latitude. Values in per mil.

SH Delta14C for the southern hemisphere, between 30S to 90S latitude. Values in per mil.

Details

All details about the derivation of this dataset are provided in Graven et al. (2017)

Author(s)

Carlos Sierra <csierra@bgc-jena.mpg.de>

Source

<<https://doi.org/10.22033/ESGF/input4MIPs.1602>>

References

Graven, Heather; Allison, Colin; Etheridge, David; Hammer, Samuel; Keeling, Ralph; Levin, Ingeborg; Meijer, Harro A. J.; Rubino, Mauro; Tans, Pieter; Trudinger, Cathy; Vaughn, Bruce; White, James (2017). Compiled Historical Record of Atmospheric Delta14CO2 version 2.0. Earth System Grid Federation. <https://doi.org/10.22033/ESGF/input4MIPs.1602>

Graven, H., Allison, C. E., Etheridge, D. M., Hammer, S., Keeling, R. F., Levin, I., Meijer, H. A. J., Rubino, M., Tans, P. P., Trudinger, C. M., Vaughn, B. H., and White, J. W. C. 2017. Compiled records of carbon isotopes in atmospheric CO2 for historical simulations in CMIP6, Geosci. Model Dev., 10, 4405–4417, <https://doi.org/10.5194/gmd-10-4405-2017>.

Examples

```
matplot(Graven2017[,1], Graven2017[,-1], type="l",
        lty=1, xlab="Year AD", ylab="Delta14C (per mil)", bty="n")
legend("topleft", names(Graven2017[,-1]), lty=1, col=1:3, bty="n")
```

HarvardForest14CO2 *Delta14C in soil CO2 efflux from Harvard Forest*

Description

Measurements of Delta14C in soil CO2 efflux conducted at Harvard Forest, USA, between 1996 and 2010.

Usage

HarvardForest14CO2

Format

A data frame with the following 3 variables.

1. Year A numeric vector with the date of measurement in years
2. D14C A numeric vector with the value of the Delta 14C value measured in CO2 efflux in per mil
3. Site A factor indicating the site where measurements were made. NWN: Northwest Near, Drydown: Rainfall exclusion experiment.

Details

Samples for isotopic measurements of soil CO2 efflux were collected from chambers that enclosed an air headspace in contact with the soil surface in the absence of vegetation using a closed dynamic chamber system to collect accumulated CO2 in stainless steel traps with a molecular sieve inside. See Sierra et al. (2012) for additional details.

References

Sierra, C. A., Trumbore, S. E., Davidson, E. A., Frey, S. D., Savage, K. E., and Hopkins, F. M. 2012. Predicting decadal trends and transient responses of radiocarbon storage and fluxes in a temperate forest soil, *Biogeosciences*, 9, 3013-3028, doi:10.5194/bg-9-3013-2012

Examples

```
plot(HarvardForest14C02[,1:2])
```

| | |
|---------|--|
| Hua2013 | <i>Atmospheric radiocarbon for the period 1950-2010 from Hua et al. (2013)</i> |
|---------|--|

Description

Atmospheric radiocarbon for the period 1950-2010 reported by Hua et al. (2013) for 5 atmospheric zones.

Usage

```
data(Hua2013)
```

Format

A [list](#) containing 5 data frames, each representing an atmospheric zone. The zones are: NHZone1: northern hemisphere zone 1, NHZone2: northern hemisphere zone 2, NHZone3: northern hemisphere zone 3, SHZone12: southern hemisphere zones 1 and 2, SHZone3: southern hemisphere zone 3. Each data frame contains a variable number of observations on the following 5 variables.

Year.AD Year AD

mean.Delta14C mean value of atmospheric radiocarbon reported as Delta14C

sd.Delta14C standard deviation of atmospheric radiocarbon reported as Delta14C

mean.F14C mean value of atmospheric radiocarbon reported as fraction modern F14C

sd.F14 standard deviation of atmospheric radiocarbon reported as fraction modern F14C

Details

This dataset corresponds to Table S3 from Hua et al. (2013). For additional details see the original publication.

Source

[doi:10.2458/azu_js_rc.v55i2.16177](https://doi.org/10.2458/azu_js_rc.v55i2.16177)

References

Hua Q., M. Barbetti, A. Z. Rakowski. 2013. Atmospheric radiocarbon for the period 1950-2010. *Radiocarbon* 55(4):2059-2072.

Examples

```
plot(Hua2013$NHZone1$Year.AD, Hua2013$NHZone1$mean.Delta14C,
     type="l", xlab="Year AD", ylab=expression(paste(Delta^14, "C (per mille)")))
lines(Hua2013$NHZone2$Year.AD, Hua2013$NHZone2$mean.Delta14C, col=2)
lines(Hua2013$NHZone3$Year.AD, Hua2013$NHZone3$mean.Delta14C, col=3)
lines(Hua2013$SHZone12$Year.AD, Hua2013$SHZone12$mean.Delta14C, col=4)
lines(Hua2013$SHZone3$Year.AD, Hua2013$SHZone3$mean.Delta14C, col=5)
legend(
  "topright",
  c(
    "Norther hemisphere zone 1",
    "Norther hemisphere zone 2",
    "Norther hemisphere zone 3",
    "Southern hemisphere zones 1 and 2",
    "Southern Hemisphere zone 3"
  ),
  lty=1,
  col=1:5,
  bty="n"
)
```

Hua2021

Atmospheric radiocarbon for the period 1950-2019 from Hua et al. (2021)

Description

Atmospheric radiocarbon for the period 1950-2019 reported by Hua et al. (2020) for 5 atmospheric zones.

Usage

```
data(Hua2013)
```

Format

A [list](#) containing 5 data frames, each representing an atmospheric zone. The zones are: NHZone1: northern hemisphere zone 1, NHZone2: northern hemisphere zone 2, NHZone3: northern hemisphere zone 3, SHZone1-2: southern hemisphere zones 1 and 2, SHZone3: southern hemisphere zone 3. Each data frame contains a variable number of observations on the following 5 variables.

Year Year AD

mean.Delta14C mean value of atmospheric radiocarbon reported as Delta14C

sd.Delta14C standard deviation of atmospheric radiocarbon reported as Delta14C
mean.F14C mean value of atmospheric radiocarbon reported as fraction modern F14C
sd.F14C standard deviation of atmospheric radiocarbon reported as fraction modern F14C

Details

This dataset corresponds to Supplementary Material 2 from Hua et al. (2021). For additional details see the original publication.

Author(s)

Carlos A. Sierra <csierra@bgc-jena.mpg.de>

Source

[doi:10.1017/RDC.2021.95](https://doi.org/10.1017/RDC.2021.95)

References

Hua, Q., Turnbull, J., Santos, G., Rakowski, A., Ancapichun, S., De Pol-Holz, R., . . . Turney, C. (2021). ATMOSPHERIC RADIOCARBON FOR THE PERIOD 1950–2019. Radiocarbon, 1-23. doi:10.1017/RDC.2021.95

Examples

```
plot(Hua2021$NHZone1[,1:2], type="l")
lines(Hua2021$NHZone2[,1:2], col=2)
lines(Hua2021$NHZone3[,1:2], col=3)
lines(Hua2021$`SHZone1-2`[,1:2], col=4)
lines(Hua2021$SHZone3[,1:2], col=5)
legend("topright", names(Hua2021), col=1:5, lty=1, bty="n")
```

Description

This function is an implementation of the Introductory Carbon Balance Model (ICBM). This is simply a two pool model connected in series.

Usage

```
ICBMModel(
  t,
  ks = c(k1 = 0.8, k2 = 0.00605),
  h = 0.13,
  r = 1.32,
  c0 = c(Y0 = 0.3, O0 = 3.96),
  In = 0,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|--------|--|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 2 with the decomposition rates for the young and the old pool. |
| h | Humufication coefficient (transfer rate from young to old pool). |
| r | External (environmental or edaphic) factor. |
| c0 | A vector of length 2 with the initial value of carbon stocks in the young and old pool. |
| In | Mean annual carbon input to the soil. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE forces the constructor to create the model even if it is invalid |

References

Andren, O. and T. Katterer. 1997. ICBM: The Introductory Carbon Balance Model for Exploration of Soil Carbon Balances. *Ecological Applications* 7:1226-1236.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
# examples from external files
# inst/examples/exICBMModel.R exICBMModel_paper:

# This example reproduces the simulations
# presented in Table 1 of Andren and Katterer (1997).
# First, the model is run for different values of the
# parameters representing different field experiments.
times=seq(0,20,by=0.1)
Bare=ICBMModel(t=times) #Bare fallow
pNpS=ICBMModel(t=times, h=0.125, r=1, c0=c(0.3,4.11), In=0.19+0.095) #+N +Straw
mNpS=ICBMModel(t=times, h=0.125, r=1.22, c0=c(0.3, 4.05), In=0.19+0.058) #-N +Straw
mNmS=ICBMModel(t=times, h=0.125, r=1.17, c0=c(0.3, 3.99), In=0.057) #-N -Straw
```

```

pNmS=ICBMModel(t=times, h=0.125, r=1.07, c0=c(0.3, 4.02), In=0.091) #+N -Straw
FM=ICBMModel(t=times, h=0.250, r=1.10, c0=c(0.3, 3.99), In=0.19+0.082) #Manure
SwS=ICBMModel(t=times, h=0.340, r=0.97, c0=c(0.3, 4.14), In=0.19+0.106) #Sewage Sludge
SS=ICBMModel(t=times, h=0.125, r=1.00, c0=c(0.25, 4.16), In=0.2) #Steady State

#The amount of carbon for each simulation is recovered with the function getC
CtBare=getC(Bare)
CtpNpS=getC(pNpS)
CtmNpS=getC(mNpS)
CtmNmS=getC(mNmS)
CtpNmS=getC(pNmS)
CtFM=getC(FM)
CtSwS=getC(SwS)
CtSS=getC(SS)

#This plot reproduces Figure 1 in Andren and Katterer (1997)
plot(times,
      rowSums(CtBare),
      type="l",
      ylim=c(0,8),
      xlim=c(0,20),
      ylab="Topsoil carbon mass (kg m-2)",
      xlab="Time (years)"
)
lines(times,rowSums(CtpNpS),lty=2)
lines(times,rowSums(CtmNpS),lty=3)
lines(times,rowSums(CtmNmS),lty=4)
lines(times,rowSums(CtpNmS),lwd=2)
lines(times,rowSums(CtFM),lty=2,lwd=2)
lines(times,rowSums(CtSwS),lty=3,lwd=2)
#lines(times,rowSums(CtSS),lty=4,lwd=2)
legend("topleft",
      c("Bare fallow",
        "+N +Straw",
        "-N +Straw",
        "-N -Straw",
        "+N -Straw",
        "Manure",
        "Sludge"
      ),
      lty=c(1,2,3,4,1,2,3),
      lwd=c(1,1,1,1,2,2,2),
      bty="n"
)

```

Description

This implementations follows the description in Katterer and Andren (2001, *Eco Mod* 136:191).

Usage

```
ICBM_N(
  i = 0.47,
  k_Y = 0.259,
  k_O = 0.0154,
  r_e = 1,
  e_Y = 0.362,
  h = 0.243,
  q_i = 18.8,
  q_b = 5
)
```

Arguments

| | |
|-----|--|
| i | carbon input to the soil from plant production |
| k_Y | decomposition rate of young pool Y |
| k_O | decomposition rate of old pool O |
| r_e | external effects on decomposition rates |
| e_Y | yield efficiency of the soil organism community |
| h | humification coefficient. Fraction of outflux from Y that is not respired and enters O |
| q_i | C:N ratio of plant inputs |
| q_b | C:N ratio of soil organism biomass |

incubation_experiment *Soil CO₂ efflux from an incubation experiment, along with the soil mass and carbon concentration measurements.*

Description

A dataset with soil CO₂ efflux measurements from a laboratory incubation at controlled temperature and moisture conditions.

Usage

```
data(incubation_experiment)
```

Format

A list with 3 variables.

eCO₂ A data.frame with the flux data.

c_concentrations a vector with 3 measurement of the concentration of carbon in the soil.

soil_mass the mass of the soil column in g

Details

The data.frame `incubation_experiment$eCO2` has 3 columns.

`Days` A numeric vector with the day of measurement after the experiment started.

`eCO2mean` A numeric vector with the release flux of CO₂. Units in ug C g⁻¹ soil day⁻¹.

`eCO2sd` A numeric vector with the standard deviation of the release flux of CO₂-C. Units in ug C g⁻¹ soil day⁻¹.

A laboratory incubation experiment was performed in March 2014 for a period of 35 days under controlled conditions of temperature (15 degrees Celsius), moisture (30 percent soil water content), and oxygen levels (20 percent). Soil CO₂ measurements were taken using an automated system for gas sampling connected to an infrared gas analyzer. The soil was sampled at a boreal forest site (Caribou Poker Research Watershed, Alaska, USA). This dataset presents the mean and standard deviation of 4 replicates.

Examples

```
eCO2=incubation_experiment$eCO2
head(eCO2)

plot(eCO2[,1:2],type="o",ylim=c(0,50),ylab="CO2 efflux (ug C g-1 soil day-1)")
arrows(eCO2[,1],eCO2[,2]-eCO2[,3],eCO2[,1],eCO2[,2]+eCO2[,3], angle=90,length=0.3,code=3)
```

InFlux

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
InFlux(map, ...)
```

Arguments

| | |
|------------------|----------------------------------|
| <code>map</code> | a SoilR map |
| <code>...</code> | additional arguments to function |

| | |
|----------|---|
| InFluxes | <i>A generic factory for subclasses of InFluxes</i> |
|----------|---|

Description

A generic factory for subclasses of [InFluxes](#)

Usage

```
InFluxes(object, numberOfPools)
```

Arguments

| | |
|---------------|------------------------------|
| object | a SoilR object |
| numberOfPools | number of pools in the model |

| | |
|---|------------------------|
| InFluxes,ConstantInFluxList_by_PoolIndex-method | <i>automatic title</i> |
|---|------------------------|

Description

automatic title

Usage

```
## S4 method for signature 'ConstantInFluxList_by_PoolIndex'
InFluxes(object, numberOfPools)
```

Arguments

| | |
|---------------|-------------------------|
| object | no manual documentation |
| numberOfPools | no manual documentation |

InFluxes,function-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature ``function``  
InFluxes(object)
```

Arguments

object no manual documentation

InFluxes,InFluxes-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'InFluxes'  
InFluxes(object)
```

Arguments

object no manual documentation

InFluxes,list-method *automatic title*

Description

automatic title

Usage

```
## S4 method for signature 'list'  
InFluxes(object)
```

Arguments

object no manual documentation

InFluxes,numeric-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'numeric'  
InFluxes(object)
```

Arguments

object no manual documentation

InFluxes,StateIndependentInFluxList_by_PoolIndex-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'StateIndependentInFluxList_by_PoolIndex'
InFluxes(object, numberOfPools)
```

Arguments

| | |
|---------------|---|
| object | no manual documentation |
| numberOfPools | no manual documentation basically produces a vector valued function from a list of scalar functions |

InFluxes,TimeMap-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TimeMap'
InFluxes(object)
```

Arguments

| | |
|--------|-------------------------|
| object | no manual documentation |
|--------|-------------------------|

InFluxes-class *A virtual S4-class representing (different subclasses) of in-fluxes to the system*

Description

A virtual S4-class representing (different subclasses) of in-fluxes to the system

InFluxList_by_PoolIndex

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

InFluxList_by_PoolIndex(object)

Arguments

object see methods

InFluxList_by_PoolIndex,list-method

constructor from a normal list after checking the elements

Description

constructor from a normal list after checking the elements

Usage

```
## S4 method for signature 'list'  
InFluxList_by_PoolIndex(object)
```

Arguments

object list

InFluxList_by_PoolIndex-class

Describes a list of flux rates.

Description

The purpose is to avoid creation of lists that contain negative rates or in accidental confusion with list of fluxes. Instances are usually automatically created from data

InFluxList_by_PoolName

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

InFluxList_by_PoolName(object)

Arguments

object see methods

InFluxList_by_PoolName, list-method

constructor from a normal list

Description

after checking the elements

Usage

```
## S4 method for signature 'list'
```

```
InFluxList_by_PoolName(object)
```

Arguments

object no documentation

InFluxList_by_PoolName-class

Class for a list of influxes indexed by the names of the target pools

Description

Class for a list of influxes indexed by the names of the target pools

InFlux_by_PoolIndex *Generic constructor for the class with the same name*

Description

Generic constructor for the class with the same name

Usage

```
InFlux_by_PoolIndex(func, destinationIndex)
```

Arguments

| | |
|------------------|---------------------------|
| func | function with influx |
| destinationIndex | index of destination pool |

InFlux_by_PoolIndex,function,numeric-method
Constructor from an ordered pair of PoolIndex (integer like) objects

Description

Constructor from an ordered pair of PoolIndex (integer like) objects

Usage

```
## S4 method for signature ``function`,numeric`  
InFlux_by_PoolIndex(func, destinationIndex)
```

Arguments

| | |
|------------------|--|
| func | A function $f(X,t)$ where X is a vector of the state variables. |
| destinationIndex | index of destination pool This form is required internally by the solvers and supported for backward compatibility with earlier versions of SoilR. Note that the function func given in this form can not be transformed to a different ordering of state variables, since the location of a state variable in the vector argument depends on a specific order and will be 'hardcoded' into your function. See InFlux_by_PoolName for the new, more powerful interface which allows subsequent reordering of the state variables by using the names of the state variables as formal arguments for func. In this case SoilR can infer (and later adapt) the vector argument form needed for the solvers. |

 InFlux_by_PoolIndex-class

S4 class for the influx to a single pool identified by the index

Description

S4 class for the influx to a single pool identified by the index

 InFlux_by_PoolName

Generic constructor for an influx to a single pool from an ordered pair of PoolName (string like) and function objects

Description

Generic constructor for an influx to a single pool from an ordered pair of PoolName (string like) and function objects

Usage

```
InFlux_by_PoolName(func, destinationName)
```

Arguments

| | |
|-----------------|------------------------------|
| func | function with input flux |
| destinationName | name of the destination pool |

 InFlux_by_PoolName, function, character-method

Constructor from an ordered pair of PoolName (string like) and function objects

Description

Constructor from an ordered pair of PoolName (string like) and function objects

Usage

```
## S4 method for signature '`function`,character'
InFlux_by_PoolName(func, destinationName)
```

Arguments

| | |
|-----------------|--|
| func | A function. The names of the formal arguments have to be a subset of the state variable names and the time symbol This allows subsequent automatic reordering of the state variables. In the presence of a vector of state-variable-names the formulation can automatically be transformed to a function of a state VECTOR argument and time |
| destinationName | PoolName (string like) object and a function |

InFlux_by_PoolName-class

S4 class for the influx to a single pool identified by the name

Description

S4 class for the influx to a single pool identified by the name

initialize,ConstLinDecompOp-method

automatic title

Description

automatic title

Usage

```
## S4 method for signature 'ConstLinDecompOp'
initialize(.Object, mat = matrix())
```

Arguments

| | |
|---------|-------------------------|
| .Object | no manual documentation |
| mat | no manual documentation |

initialize,DecompositionOperator-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'DecompositionOperator'  
initialize(  
  .Object,  
  starttime = numeric(),  
  endtime = numeric(),  
  map = function(t) {  
    t  
  },  
  lag = 0  
)
```

Arguments

| | |
|-----------|-------------------------|
| .Object | no manual documentation |
| starttime | no manual documentation |
| endtime | no manual documentation |
| map | no manual documentation |
| lag | no manual documentation |

initialize,MCSim-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'MCSim'  
initialize(.Object, model = new(Class = "N1Model"), tasklist = list())
```

Arguments

| | |
|----------|-------------------------|
| .Object | no manual documentation |
| model | no manual documentation |
| tasklist | no manual documentation |

initialize,Model-method

Internal method to supervise creation of objects of this class

Description

It is usually not necessary for user code to call this method. It's purpose is to enforce some sanity checks since it gets automatically called by new whenever an object of this class is created

Usage

```
## S4 method for signature 'Model'
initialize(
  .Object,
  times = c(0, 1),
  mat = ConstLinDecompOp(matrix(nrow = 1, ncol = 1, 0)),
  initialValues = numeric(),
  inputFluxes = BoundInFluxes(function(t) {
    return(matrix(nrow = 1, ncol = 1, 1))
  }, 0, 1),
  solverfunc = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|---------------|-------------------------|
| .Object | no manual documentation |
| times | no manual documentation |
| mat | no manual documentation |
| initialValues | no manual documentation |
| inputFluxes | no manual documentation |
| solverfunc | no manual documentation |
| pass | no manual documentation |

 initialize,Model_14-method

Internal method to supervise creation of objects of this class

Description

It is usually not necessary for user code to call this method. It's purpose is to enforce some sanity checks since it gets automatically called by new whenever an object of this class is created

Usage

```
## S4 method for signature 'Model_14'
initialize(
  .Object,
  times = c(0, 1),
  mat = ConstLinDecompOp(matrix(nrow = 1, ncol = 1, 0)),
  initialValues = numeric(),
  initialValF = ConstFc(values = c(0), format = "Delta14C"),
  inputFluxes = BoundInFluxes(function(t) {
    return(matrix(nrow = 1, ncol = 1, 1))
  }, 0, 1),
  c14Fraction = BoundFc(function(t) {
    return(matrix(nrow = 1, ncol = 1, 1))
  }, 0,
  1),
  c14DecayRate = 0,
  solverfunc = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|---------------|-------------------------|
| .Object | no manual documentation |
| times | no manual documentation |
| mat | no manual documentation |
| initialValues | no manual documentation |
| initialValF | no manual documentation |
| inputFluxes | no manual documentation |
| c14Fraction | no manual documentation |
| c14DecayRate | no manual documentation |
| solverfunc | no manual documentation |
| pass | no manual documentation |

```
initialize,Model_by_PoolNames-method
      automatic title
```

Description

automatic title

Usage

```
## S4 method for signature 'Model_by_PoolNames'
initialize(
  .Object,
  times,
  mat,
  initialValues,
  inputFluxes,
  timeSymbol,
  pass = FALSE,
  solverfunc = deSolve.lsoda.wrapper
)
```

Arguments

| | |
|---------------|-------------------------|
| .Object | no manual documentation |
| times | no manual documentation |
| mat | no manual documentation |
| initialValues | no manual documentation |
| inputFluxes | no manual documentation |
| timeSymbol | no manual documentation |
| pass | no manual documentation |
| solverfunc | no manual documentation |

```
initialize,NIModel-method
      automatic title
```

Description

automatic title

Usage

```
## S4 method for signature 'N1Model'
initialize(
  .Object,
  times = c(0, 1),
  DepComp = new(Class = "TransportDecompositionOperator", 0, 1, function(t) {

    return(matrix(nrow = 1, ncol = 1, 0))
  }, function(t) {
    return(matrix(nrow = 1,
      ncol = 1, 0))
  }),
  initialValues = numeric(),
  inputFluxes = BoundInFluxes(function(t) {
    return(matrix(nrow = 1, ncol = 1, 1))

  }, 0, 1),
  solverfunc = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|---------------|-------------------------|
| .Object | no manual documentation |
| times | no manual documentation |
| DepComp | no manual documentation |
| initialValues | no manual documentation |
| inputFluxes | no manual documentation |
| solverfunc | no manual documentation |
| pass | no manual documentation |

initialize,TimeMap-method

automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TimeMap'
initialize(
  .Object,
  starttime = numeric(),
```

```

    endtime = numeric(),
    map = function(t) {
      t
    }
  )

```

Arguments

| | |
|-----------|-------------------------|
| .Object | no manual documentation |
| starttime | no manual documentation |
| endtime | no manual documentation |
| map | no manual documentation |

initialize,TransportDecompositionOperator-method
automatic title

Description

automatic title

Usage

```

## S4 method for signature 'TransportDecompositionOperator'
initialize(
  .Object,
  starttime = numeric(),
  endtime = numeric(),
  numberOfPools = 1,
  alpha = list(),
  f = function(t, 0) {
    t
  },
  lag = 0
)

```

Arguments

| | |
|---------------|-------------------------|
| .Object | no manual documentation |
| starttime | no manual documentation |
| endtime | no manual documentation |
| numberOfPools | no manual documentation |
| alpha | no manual documentation |
| f | no manual documentation |
| lag | no manual documentation |

initialize,UnBoundInFluxes-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'UnBoundInFluxes'  
initialize(  
  .Object,  
  map = function() {  
  }  
)
```

Arguments

| | |
|---------|-------------------------|
| .Object | no manual documentation |
| map | no manual documentation |

initialize,UnBoundLinDecompOp-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'UnBoundLinDecompOp'  
initialize(  
  .Object,  
  matFunc = function() {  
  }  
)
```

Arguments

| | |
|---------|-------------------------|
| .Object | no manual documentation |
| matFunc | no manual documentation |

| | |
|----------|--|
| IntCal09 | <i>Northern Hemisphere atmospheric radiocarbon for the pre-bomb period</i> |
|----------|--|

Description

Northern Hemisphere atmospheric radiocarbon calibration curve for the period 0 to 50,000 yr BP.

Usage

```
data(IntCal09)
```

Format

A data frame with 3522 observations on the following 5 variables.

CAL.BP Calibrated age in years Before Present (BP).

C14.age C14 age in years BP.

Error Error estimate for C14.age.

Delta.14C Delta.14C value in per mil.

Sigma Standard deviation of Delta.14C in per mil.

Details

Delta.14C is age-corrected as per Stuiver and Polach (1977). All details about the derivation of this dataset are provided in Reimer et al. (2009).

References

P. Reimer, M. Baillie, E. Bard, A. Bayliss, J. Beck, P. Blackwell, C. Ramsey, C. Buck, G. Burr, R. Edwards, et al. 2009. IntCal09 and Marine09 radiocarbon age calibration curves, 0 - 50,000 years cal bp. *Radiocarbon*, 51(4):1111 - 1150.

M. Stuiver and H. A. Polach. 1977. Reporting of C-14 data. *Radiocarbon*, 19(3):355 - 363.

Examples

```
par(mfrow=c(2,1))
plot(IntCal09$CAL.BP, IntCal09$C14.age, type="l")
polygon(x=c(IntCal09$CAL.BP, rev(IntCal09$CAL.BP)),
        y=c(IntCal09$C14.age+IntCal09$Error, rev(IntCal09$C14.age-IntCal09$Error)),
        col="gray", border=NA)
lines(IntCal09$CAL.BP, IntCal09$C14.age)

plot(IntCal09$CAL.BP, IntCal09$Delta.14C, type="l")
polygon(x=c(IntCal09$CAL.BP, rev(IntCal09$CAL.BP)),
        y=c(IntCal09$Delta.14C+IntCal09$Sigma, rev(IntCal09$Delta.14C-IntCal09$Sigma)),
        col="gray", border=NA)
```

```
lines(IntCal09$CAL.BP,IntCal09$Delta.14C)  
par(mfrow=c(1,1))
```

IntCal13

Atmospheric radiocarbon for the 0-50,000 yr BP period

Description

Atmospheric radiocarbon calibration curve for the period 0 to 50,000 yr BP.

Usage

```
data(IntCal13)
```

Format

A data frame with 5140 observations on the following 5 variables.

CAL.BP Calibrated age in years Before Present (BP).

C14.age C14 age in years BP.

Error Error estimate for C14.age.

Delta.14C Delta.14C value in per mil.

Sigma Standard deviation of Delta.14C in per mil.

Details

Delta.14C is age-corrected as per Stuiver and Polach (1977). All details about the derivation of this dataset are provided in Reimer et al. (2013).

References

Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck CE, Cheng H, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Hafliðason H, Hajdas I, Hatte C, Heaton TJ, Hogg AG, Hughen KA, Kaiser KF, Kromer B, Manning SW, Niu M, Reimer RW, Richards DA, Scott EM, Southon JR, Turney CSM, van der Plicht J. 2013. IntCal13 and MARINE13 radiocarbon age calibration curves 0-50000 years calBP. Radiocarbon 55(4): 1869-1887. DOI: 10.2458/azu_js_rc.55.16947

M. Stuiver and H. A. Polach. 1977. Reporting of C-14 data. Radiocarbon, 19(3):355 - 363.

Examples

```
plot(IntCal13$CAL.BP,IntCal13$C14.age-IntCal13$Error,type="l",col=2,
     xlab="cal BP",ylab="14C BP")
lines(IntCal13$CAL.BP,IntCal13$C14.age+IntCal13$Error,col=2)

plot(IntCal13$CAL.BP,IntCal13$Delta.14C+IntCal13$Sigma,type="l",col=2,
     xlab="cal BP",ylab="Delta14C")
lines(IntCal13$CAL.BP,IntCal13$Delta.14C-IntCal13$Sigma,col=2)
```

IntCal20

The IntCal20 northern hemisphere radiocarbon curve for the 0-55,000 yr BP period

Description

Atmospheric radiocarbon calibration curve for the period 0 to 55,000 yr BP for the northern hemisphere. This is the most recent update to the internationally agreed calibration curve and supersedes [IntCal13](#).

Usage

```
data(IntCal20)
```

Format

A data frame with 9501 rows and 5 variables.

CAL.BP Calibrated age in years Before Present (BP).

C14.age C14 age in years BP.

Sigma.C14.age Standard deviation for C14.age.

Delta.14C Delta.14C value in per mil.

Sigma.Delta.14C Standard deviation of Delta.14C in per mil.

Details

All details about the derivation of this dataset are provided in Reimer et al. (2020).

Author(s)

Ingrid Chanca <ichanca@bgc-jena.mpg.de>

Source

<<https://doi.org/10.1017/RDC.2020.41>>

References

Reimer, P., Austin, W., Bard, E., Bayliss, A., Blackwell, P., Bronk Ramsey, C., . . . Talamo, S. (2020). The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0–55 cal kBP). *Radiocarbon*, 62(4), 725-757. doi:10.1017/RDC.2020.41

Examples

```
plot(IntCal20$CAL.BP, IntCal20$Delta.14C, type="l",
     xlab="cal BP", ylab="Delta14C (per mil)")
```

InternalFluxList_by_PoolIndex

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
InternalFluxList_by_PoolIndex(object)
```

Arguments

object see methods

InternalFluxList_by_PoolIndex, list-method

Constructor from a normal list after checking the elements

Description

Constructor from a normal list after checking the elements

Usage

```
## S4 method for signature 'list'
InternalFluxList_by_PoolIndex(object)
```

Arguments

object a list

InternalFluxList_by_PoolIndex-class

S4-class for a list of internal fluxes with source and destination pool indices

Description

S4-class for a list of internal fluxes with source and destination pool indices

InternalFluxList_by_PoolName

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

InternalFluxList_by_PoolName(object)

Arguments

object see methods

InternalFluxList_by_PoolName,list-method

constructor from a normal list

Description

constructor from a normal list

Usage

```
## S4 method for signature 'list'
InternalFluxList_by_PoolName(object)
```

Arguments

object A list. Either a list of elements of type [InternalFlux_by_PoolName](#) or a list where the names of the elements are strings of the form '1->3' (for the flux rate from pool 1 to 2)

Value

An object of class [ConstantInFluxList_by_PoolIndex](#)

The function checks if the elements are of the desired type or can be converted to it. It is mainly used internally and usually called by the front end functions to convert the user supplied arguments.

InternalFluxList_by_PoolName-class

S4-class for a list of internal fluxes with indexed by (source and destination pool) names

Description

S4-class for a list of internal fluxes with indexed by (source and destination pool) names

InternalFlux_by_PoolIndex

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
InternalFlux_by_PoolIndex(func, sourceIndex, destinationIndex, src_to_dest)
```

Arguments

| | |
|------------------|-------------------------------|
| func | function with flux rate |
| sourceIndex | index of the source pool |
| destinationIndex | index of the destination pool |
| src_to_dest | source to destination |

InternalFlux_by_PoolIndex, function, numeric, numeric, missing-method
*constructor from an ordered pair of PoolIndex (integer like) objects
 and a function with vector argument*

Description

constructor from an ordered pair of PoolIndex (integer like) objects and a function with vector argument

Usage

```
## S4 method for signature ``function``, numeric, numeric, missing'
InternalFlux_by_PoolIndex(func, sourceIndex, destinationIndex)
```

Arguments

| | |
|------------------|---------------------------|
| func | function |
| sourceIndex | index of source pool |
| destinationIndex | index of destination pool |

InternalFlux_by_PoolIndex-class
*S4-class for a single internal flux with source and destination pools
 specified by indices*

Description

S4-class for a single internal flux with source and destination pools specified by indices

InternalFlux_by_PoolName
Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
InternalFlux_by_PoolName(func, sourceName, destinationName, src_to_dest)
```

Arguments

| | |
|-----------------|--------------------------|
| func | function with flux rate |
| sourceName | name of source pool |
| destinationName | name of destination pool |
| src_to_dest | source to destination |

InternalFlux_by_PoolName,function,character,character,missing-method
*constructor from an ordered pair of PoolName (string like) objects and
a function with the set of formal argument names forming a subset of
the state_variable_names*

Description

constructor from an ordered pair of PoolName (string like) objects and a function with the set of formal argument names forming a subset of the state_variable_names

Usage

```
## S4 method for signature '`function`,character,character,missing'  
InternalFlux_by_PoolName(func, sourceName, destinationName)
```

Arguments

| | |
|-----------------|--|
| func | A real valued function describing the flux (mass/time) as function of (some of) the state variables and time. |
| sourceName | A string identifying the source pool of the flux |
| destinationName | A string identifying the destination pool of the flux |

InternalFlux_by_PoolName,function,missing,missing,character-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature '`function`,missing,missing,character'  
InternalFlux_by_PoolName(func, src_to_dest)
```

Arguments

| | |
|-------------|-------------------------|
| func | no manual documentation |
| src_to_dest | no manual documentation |

InternalFlux_by_PoolName-class

S4-class for a single internal flux with source and destination pools specified by name

Description

S4-class for a single internal flux with source and destination pools specified by name

linearScalarModel

Implementation of a general model for linear non-autonomous systems with scalar modifiers

Description

This function implements a linear model with scalar modifier for inputs and compartmental matrix.

Usage

```
linearScalarModel(
  t,
  A,
  C0,
  u,
  gamma,
  xi,
  xi_lag = 0,
  solver = deSolve.lsoda.wrapper
)
```

Arguments

| | |
|-------|---|
| t | A vector containing the points in time where the solution is sought. |
| A | A square (n x n) matrix with compartmental structure |
| C0 | A vector of length n containing the initial amount of carbon for the n pools. |
| u | A vector of length n with constant mass inputs for the n pools. |
| gamma | A scalar or data.frame object specifying the modifier for the mass inputs. |
| xi | A scalar, data.frame, function or anything that can be converted to a scalar function of time ScalarTimeMap object specifying the external (environmental and/or edaphic) effects on decomposition rates. |

| | |
|--------|--|
| xi_lag | A time shift/delay for the automatically created time dependent function xi(t) |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |

Value

A Model Object that can be further queried

References

C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. Geoscientific Model Development 5, 1045-1060.

See Also

[RothCModel](#). There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
t=seq(0,52*200,1) # Fix me! Add an example.
```

| | |
|------------|---|
| linesCPool | <i>Add lines with the output of getC14, getC, or getReleaseFlux to an existing plot</i> |
|------------|---|

Description

This function adds lines to a plot with the C content, the C release, or Delta 14C value of each pool over time. Needs as input a matrix obtained after a call to [getC14](#), [getC](#), or [getReleaseFlux](#).

Usage

```
linesCPool(t, mat, col, ...)
```

Arguments

| | |
|-----|--|
| t | A vector containing the time points for plotting. |
| mat | A matrix object obtained after a call to getC14 , getC , or getReleaseFlux . |
| col | A color palette specifying color lines for each pool (columns of mat). |
| ... | Other arguments passed to plot. |

listProduct *tensor product of lists*

Description

Creates a list of all combinations of the elements of the inputlists (like a "tensor product list " The list elements can be of any class. The function is used in examples and tests to produce all possible combinations of arguments to a function. look at the tests for example usage

Usage

```
listProduct(...)
```

Arguments

... lists

Value

a list of lists each containing one combinations of the elements of the input lists

Examples

```
listProduct(list('a', 'b'),list(1,2))
```

MCSim-class *Experimental Class for a Monte Carlo Simulation of particles leaving the pool*

Description

Experimental Class for a Monte Carlo Simulation of particles leaving the pool

| | |
|-------|--|
| Model | <i>Constructor for class Model</i> |
|-------|--|

Description

This function creates an object of class [Model](#), The arguments can be given in different form as long as they can be converted to the necessary internal building blocks. (See the links)

Usage

```
Model(
    t,
    A,
    ivList,
    inputFluxes,
    solverfunc = deSolve.lsoda.wrapper,
    pass = FALSE
)
```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. |
| A | something that can be converted by GeneralDecompOp to any of the available subclasses of DecompOp . |
| ivList | A numeric vector containing the initial amount of carbon for the n pools. The length of this vector is equal to the number of pools. This is checked by an internal function. |
| inputFluxes | something that can be converted by InFluxes to any of the available subclasses of InFluxes . |
| solverfunc | The function used to actually solve the ODE system. The default is deSolve.lsoda.wrapper but you can also provide your own function that the same interface. |
| pass | Forces the constructor to create the model even if it does not pass internal sanity checks |

Details

This function `Model` wraps the internal constructor of class [Model](#). The internal constructor requires the argument `A` to be of class [DecompOp](#) and argument `inputFluxes` to be of class [InFluxes](#). Before calling the internal constructor `Model` calls [GeneralDecompOp](#) on its argument `A` and [InFluxes](#) on its argument `inputFluxes` to convert them into the required classes. Both are generic functions. Follow the links to see for which kind of inputs conversion methods are available. The attempted conversion allows great flexibility with respect to arguments and independence from the actual implementation. However if your code uses the wrong argument the error will most likely occur in the delegate functions. If this happens inspect the error message (or use `traceback()`) to see which function was called and try to call the constructor of the desired subclass explicitly with

your arguments. The subclasses are linked in the class documentation [DecompOp](#) or [InFluxes](#) respectively.

Note also that this function checks its arguments quite elaborately and tries to detect accidental unreasonable combinations, especially concerning two kinds of errors.

1. unintended extrapolation of time series data
2. violations of mass balance by the `DecompOp` argument.

SoilR has a lot of unit tests which are installed with the package and are sometimes instructive as examples. To see example scenarios for parameter check look at:

Value

An object of class [Model](#) that can be queried by many methods to be found there.

See Also

This function is called by many of the [predefinedModels](#).

Package functions called in the examples:

[example.2DInFluxes.Args](#),

[example.2DGeneralDecompOpArgs](#),

Examples

```
# vim:set ff=unix expandtab ts=2 sw=2:
test.all.possible.Model.arguments <- function(){
  # This example shows different kinds of arguments to the function Model.
  # The model objects we will build will share some common features.
  # - two pools
  # - initial values

  iv<- c(5,6)
  times <- seq(1,10,by=0.1)

  # The other parameters A and inputFluxes will be different
  # The function Model will transform these arguments
  # into objects of the classes required by the internal constructor.
  # This leads to a number of possible argument types.
  # We demonstrate some of the possibilities here.
  # Let us first look at the choices for argument 'A'.

  #)
  possibleAs <- example.2DGeneralDecompOpArgs()

  # Since "Model" will call "InFluxes" on its "inputFluxes"
  # argument there are again different choices
  # we have included a function in SoilR that produces 2D examples

  possibleInfluxes <- example.2DInFluxes.Args()
  print(possibleInfluxes$I.vec)
```

```

# We can build a lot of models from the possible combinations
# for instance
#m1 <- Model(
#   t=times,
#   A=matrix(nrow=2,byrow=TRUE,c(-0.1,0,0,-0.2)),
#   ivList=iv,
#   inputFluxes=possibleInfluxes$I.vec)
## We now produce all combinations of As and InputFluxes
combinations <- listProduct(possibleAs,possibleInfluxes)
print(length(combinations))
# and a Model for each
models <- lapply(
  combinations,
  function(combi){
    #Model(t=times,A=combi$A,ivList=iv,inputFluxes=combi$I)
    Model(t=times,A=combi[[1]],ivList=iv,inputFluxes=combi[[2]])
  }
)
## lets check that we can compute something#
lapply(models,getC)
}

```

Model-class

S4 class representing a model run

Description

S4 class representing a model run

Model_14

general constructor for class Model_14

Description

This method tries to create an object from any combination of arguments that can be converted into the required set of building blocks for the Model_14 for n arbitrarily connected pools.

Usage

```

Model_14(
  t,
  A,
  ivList,
  initialValF,
  inputFluxes,
  inputFc,
  c14DecayRate = -0.0001209681,

```

```

    solverfunc = deSolve.lsoda.wrapper,
    pass = FALSE
  )

```

Arguments

| | |
|--------------|---|
| t | A vector containing the points in time where the solution is sought. |
| A | something that can be converted by GeneralDecompOp to any of the available subclasses of DecompOp . |
| ivList | A vector containing the initial amount of carbon for the n pools. The length of this vector is equal to the number of pools and thus equal to the length of k. This is checked by an internal function. |
| initialValF | An object equal or equivalent to class <code>ConstFc</code> containing a vector with the initial values of the radiocarbon fraction for each pool and a format string describing in which format the values are given. |
| inputFluxes | something that can be converted by InFluxes to any of the available subclasses of InFluxes . |
| inputFc | An object describing the fraction of C_14 in per mille (different formats are possible) |
| c14DecayRate | the rate at which C_14 decays radioactively. If you don't provide a value here we assume the following value: $k=-0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. Thus beside time itself it also affects decay rates the inputrates and the output |
| solverfunc | The function used by to actually solve the ODE system. This can be deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | Forces the constructor to create the model even if it is invalid |

Value

A model object that can be further queried.

See Also

[TwopParallelModel](#), [TwopSeriesModel](#), [TwopFeedbackModel](#)

Examples

```

# examples from external files
# inst/tests/requireSoilR/runit.all.possible.Model.arguments.R test.all.possible.Model.arguments:

# This example shows different kinds of arguments to the function Model.
# The model objects we will build will share some common features.
# - two pools
# - initial values

    iv<- c(5,6)

# - times

```

```

times <- seq(1,10,by=0.1)

# The other parameters A and inputFluxes will be different
# The function Model will transform these arguments
# into objects of the classes required by the internal constructor.
# This leads to a number of possible argument types.
# We demonstrate some of the possibilities here.
# Let us first look at the choices for argument 'A'.

#)
possibleAs <- example.2DGeneralDecompOpArgs()

# Since "Model" will call "InFluxes" on its "inputFluxes"
# argument there are again different choices
# we have included a function in SoilR that produces 2D examples

possibleInfluxes <- example.2DInFluxes.Args()
print(possibleInfluxes$I.vec)
# We can build a lot of models from the possible combinations
# for instance
#m1 <- Model(
#   t=times,
#   A=matrix(nrow=2,byrow=TRUE,c(-0.1,0,0,-0.2)),
#   ivList=iv,
#   inputFluxes=possibleInfluxes$I.vec)
## We now produce that all combinations of As and InputFluxes
combinations <- listProduct(possibleAs,possibleInfluxes)
print(length(combinations))
# an a Model for each
models <- lapply(
  combinations,
  function(combi){
    #Model(t=times,A=combi$A,ivList=iv,inputFluxes=combi$I)
    Model(t=times,A=combi[[1]],ivList=iv,inputFluxes=combi[[2]])
  }
)
## lets check that we can compute something#
lapply(models,getC)

# inst/examples/ModelExamples.R CorrectNonautonomousLinearModelExplicit:

# This example describes the creation and use of a Model object that
# is defined by time dependent functions for decomposition and influx.
# The constructor of the Model-class (see ?Model)
# works for different combinations of
# arguments.
# Although Model (the constructor function for objects of this class
# accepts many many more convenient kinds of arguments,
# we will in this example call the constructor with arguments which
# are of the same type as one of the current internal
# representations in the
# Model object and create these arguments explicitly beforehand

```

```

# to demonstrate the approach with the most flexibility.
# We start with the Decomposition Operator.
# For this example we assume that we are able to describe the
# decomposition operator by explicit R functions that are valid
# for a finite time interval.
# Therefore we choose the appropriate sub class BoundLinDecompOp
# of DecompOp explicitly. (see '?BoundLinDecompOp-class')
A=BoundLinDecompOp(
  ## We call the generic constructor (see '?BoundLindDcompOp)
  ## which has a method
  ## that takes a matrix-valued function of time as its first argument.
  ## (Although Model accepts time series data directly and
  ## will derive the internally used interpolating for you,
  ## the function argument could for instance represent the result
  ## of a very sophisticated interpolation performed by yourself)
  function(t){
    matrix(nrow=3,ncol=3,byrow=TRUE,
      c(
        -1,    0,    0,
        0.5,  -2,    0,
        0,    1, sin(t)-1
      )
    )
  },
  ## The other two arguments describe the time interval where the
  ## function is valid (the domain of the function)
  ## The interval will be checked against the domain of the InFlux
  ## argument of Model and against its 't' argument to avoid
  ## invalid computations outside the domain.
  ## (Inf and -Inf are possible values, but should only be used
  ## if the function is really valid for all times, which is
  ## especially untrue for functions resulting from interpolations,
  ## which are usually extremely misleading for arguments outside the
  ## domain covered by the data that has been used for the interpolation.)
  ## This is a safety net against wrong results origination from unitendet EXTRApolation )
  starttime=0,
  endtime=20
)
I=BoundInFluxes(
  ## The first argument is a vector-valued function of time
  function(t){
    matrix(nrow=3,ncol=1,byrow=TRUE,
      c(-1, 0, 0)
    )
  },
  ## The other two arguments describe the time interval where the
  ## function is valid (the domain of the function)
  starttime=0,
  endtime=40
)
## No we specify the points in time where we want
## to compute results
t_start=0

```

```

t_end=10
tn=50
timestep <- (t_end-t_start)/tn
times <- seq(t_start,t_end,timestep)
## and the start values
sv=c(0,0,0)
mod=Model(t=times,A,sv,I)

## No we use the model to compute some results
getC(mod)
getReleaseFlux(mod)
#also look at the methods section of Model-class

```

Model_14-class

S4-class to represent a 14C model run

Description

S4-class to represent a 14C model run

Model_by_PoolNames

Constructor for [Model_by_PoolNames](#)

Description

Constructor for [Model_by_PoolNames](#)

Usage

```

Model_by_PoolNames(
  smod,
  times,
  mat,
  initialValues,
  inputFluxes,
  internal_fluxes,
  out_fluxes,
  timeSymbol,
  solverfunc
)

```

Arguments

| | |
|-----------------|---|
| smod | see methods |
| times | a vector of times |
| mat | a compartmental matrix |
| initialValues | a vector of initial values |
| inputFluxes | a vector of input fluxes |
| internal_fluxes | flux rate among pools |
| out_fluxes | flux rates out of pools |
| timeSymbol | character symbol used to represent time |
| solverfunc | function used to solve system of ODEs |

Value

A possibly nonlinear Model(run) that contains information about the pool names and connectivity of the pools and is therefore the preferred representation for new code.

Model_by_PoolNames-class

A model run based on flux functions

Description

A model run based on flux functions

NlModel-class

deprecated class for a non-linear model run.

Description

deprecated class for a non-linear model run.

OnepModel *Implementation of a one pool model*

Description

This function creates a model for one pool. It is a wrapper for the more general function [GeneralModel](#).

Usage

```
OnepModel(t, k, C0, In, xi = 1, solver = deSolve.lsoda.wrapper, pass = FALSE)
```

Arguments

| | |
|--------|--|
| t | A vector containing the points in time where the solution is sought. |
| k | A scalar with the decomposition rate of the pool. |
| C0 | A scalar containing the initial amount of carbon in the pool. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE forces the constructor to create the model even if it is invalid |

References

Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
t_start=0
t_end=10
tn=50
timestep=(t_end-t_start)/tn
t=seq(t_start,t_end,timestep)
k=0.8
C0=100
In = 30
```

```
Ex=OnepModel(t,k,C0,In)
Ct=getC(Ex)
Rt=getReleaseFlux(Ex)
```

```
Rc=getAccumulatedRelease(Ex)

plot(
  t,
  Ct,
  type="l",
  ylab="Carbon stocks (arbitrary units)",
  xlab="Time (arbitrary units)",
  lwd=2
)

plot(
  t,
  Rt,
  type="l",
  ylab="Carbon released (arbitrary units)",
  xlab="Time (arbitrary units)",
  lwd=2
)

plot(
  t,
  Rc,
  type="l",
  ylab="Cumulative carbon released (arbitrary units)",
  xlab="Time (arbitrary units)",
  lwd=2
)
```

OnepModel14

Implementation of a one-pool C14 model

Description

This function creates a model for one pool. It is a wrapper for the more general function [GeneralModel_14](#).

Usage

```
OnepModel14(
  t,
  k,
  C0,
  F0_Delta14C,
  In,
  xi = 1,
  inputFc,
  lambda = -0.0001209681,
  lag = 0,
  solver = deSolve.lsoda.wrapper,
```

```

    pass = FALSE
  )

```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. It must be specified within the same period for which the Delta 14 C of the atmosphere is provided. The default period in the provided dataset C14Atm_NH is 1900-2010. |
| k | A scalar with the decomposition rate of the pool. |
| C0 | A scalar containing the initial amount of carbon in the pool. |
| F0_Delta14C | A scalar containing the initial amount of the radiocarbon fraction in the pool in Delta_14C format. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| inputFc | A Data Frame object consisting of a function describing the fraction of C_14 in per mille. The first column will be assumed to contain the times. |
| lambda | Radioactive decay constant. By default $\lambda = -0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. |
| lag | A (positive) scalar representing a time lag for radiocarbon to enter the system. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE Forces the constructor to create the model even if it is invalid |

See Also

There are other [predefinedModels](#) and also more general functions like [Model_14](#).

Examples

```

years=seq(1901,2009,by=0.5)
LitterInput=700

Ex=OnepModel14(t=years,k=1/10,C0=500, F0=0,In=LitterInput, inputFc=C14Atm_NH)
C14t=getF14(Ex)

plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years, C14t[,1], col=4)
legend(
  "topright",
  c("Delta 14C Atmosphere", "Delta 14C in SOM"),
  lty=c(1,1),
  col=c(1,4),
  lwd=c(1,1),
  bty="n"
)

```

| | |
|---------|---|
| OutFlux | <i>Generic constructor for the class with the same name</i> |
|---------|---|

Description

Generic constructor for the class with the same name

Usage

```
OutFlux(map, ...)
```

Arguments

| | |
|-----|----------------------|
| map | a SoilR map |
| ... | additional arguments |

| | |
|--------------------------|---|
| OutFluxList_by_PoolIndex | <i>Generic constructor for the class with the same name</i> |
|--------------------------|---|

Description

Generic constructor for the class with the same name

Usage

```
OutFluxList_by_PoolIndex(object)
```

Arguments

| | |
|--------|-------------|
| object | see methods |
|--------|-------------|

OutFluxList_by_PoolIndex,list-method
constructor from a normal list

Description

after checking the elements

Usage

```
## S4 method for signature 'list'  
OutFluxList_by_PoolIndex(object)
```

Arguments

object a list

OutFluxList_by_PoolIndex-class
A list of outfluxes

Description

A list of outfluxes

OutFluxList_by_PoolName
Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
OutFluxList_by_PoolName(object)
```

Arguments

object see methods

OutFluxList_by_PoolName, list-method
constructor from a normal list

Description

constructor from a normal list

Usage

```
## S4 method for signature 'list'
OutFluxList_by_PoolName(object)
```

Arguments

object A list. Either a list of elements of type [OutFlux_by_PoolName](#) or a list where the names of the elements are integer strings.

Value

An object of class [ConstantInFluxList_by_PoolIndex](#)

The function checks if the elements are of the desired type or can be converted to it. It is mainly used internally and usually called by the front end functions to convert the user supplied arguments.

OutFluxList_by_PoolName-class
S4 class for a list of out-fluxes indexed by source pool name

Description

S4 class for a list of out-fluxes indexed by source pool name

OutFlux_by_PoolIndex *Generic constructor for the class with the same name*

Description

Generic constructor for the class with the same name

Usage

```
OutFlux_by_PoolIndex(func, sourceIndex)
```

Arguments

| | |
|-------------|---------------------------|
| func | function with output flux |
| sourceIndex | index of the source pool |

OutFlux_by_PoolIndex,function,numeric-method
constructor from a PoolIndex (integer like) objects and a function with vector argument

Description

constructor from a PoolIndex (integer like) objects and a function with vector argument

Usage

```
## S4 method for signature '`function`,numeric'
OutFlux_by_PoolIndex(func, sourceIndex)
```

Arguments

| | |
|-------------|---|
| func | A function $f(X,t)$ where X is a vector of the state variables. |
| sourceIndex | index of source pool This form is required internally by the solvers and supported for backward compatibility with earlier versions of SoilR. Note that the function func given in this form can not be transformed to a different ordering of state variables, since the location of a state variable in the vector argument depends on a specific order and will be 'hardcoded' into your function. See OutFlux_by_PoolName for the new, more powerful interface which allows subsequent reordering of the state variables by using the names of the state variables as formal arguments for func. In this case SoilR can infer (and later adapt) the vector argument form needed for the solvers. constructor from an ordered pair of PoolIndex (integer like) objects |

OutFlux_by_PoolIndex-class
S4 class for a single out-flux with source pool index

Description

S4 class for a single out-flux with source pool index

OutFlux_by_PoolName *Generic constructor for the class with the same name*

Description

Generic constructor for the class with the same name

Usage

```
OutFlux_by_PoolName(func, sourceName)
```

Arguments

| | |
|------------|---------------------------|
| func | function with output flux |
| sourceName | name of the source pool |

OutFlux_by_PoolName,function,character-method
constructor from a PoolName (integer like) object and a function

Description

constructor from a PoolName (integer like) object and a function

Usage

```
## S4 method for signature '`function`,character'  
OutFlux_by_PoolName(func, sourceName)
```

Arguments

| | |
|------------|---|
| func | A function. The names of the formal arguments have to be a subset of the state variable names and the time symbol |
| sourceName | the name of the source pool This allows subsequent automatic reordering of the state variables. In the presence of a vector of state variable names the formulation can automatically be transformed to a function of a state VECTOR argument and #' time constructor from an ordered pair of PoolName (integer like) objects |

 OutFlux_by_PoolName-class

S4 class for a single out-flux with source pool name

Description

S4 class for a single out-flux with source pool name

 ParallelModel

models for unconnected pools

Description

This function creates a (linear) numerical model for n independent (parallel) pools that can be queried afterwards. It is used by the convenient wrapper functions [TwoParallelModel](#) and [ThreepParallelModel](#) but can also be used independently.

Usage

```
ParallelModel(
  times,
  coeffs_tm,
  startvalues,
  inputrates,
  solverfunc = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|-------------|---|
| times | A vector containing the points in time where the solution is sought. |
| coeffs_tm | A TimeMap object consisting of a vector valued function containing the decay rates for the n pools as function of time and the time range where this function is valid. The length of the vector is equal to the number of pools. |
| startvalues | A vector containing the initial amount of carbon for the n pools. «The length of this vector is equal to the number of pools and thus equal to the length of k. This is checked by the function. |
| inputrates | An object consisting of a vector valued function describing the inputs to the pools as functions of time TimeMap.new |
| solverfunc | The function used to actually solve the ODE system. This can be deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE forces the constructor to create the model even if it is invalid |

Examples

```

t_start=0
t_end=10
tn=50
timestep=(t_end-t_start)/tn
t=seq(t_start,t_end,timestep)
k=TimeMap(
function(times){c(-0.5,-0.2,-0.3)},
t_start,
t_end
)
c0=c(1, 2, 3)
#constant inputrates
inputrates=BoundInFluxes(
function(t){matrix(nrow=3,ncol=1,c(1,1,1))},
t_start,
t_end
)
mod=ParallelModel(t,k,c0,inputrates)
Y=getC(mod)
lt1=1 ;lt2=2 ;lt3=3
col1=1; col2=2; col3=3
plot(t,Y[,1],type="l",lty=lt1,col=col1,
ylab="C stocks",xlab="Time")
lines(t,Y[,2],type="l",lty=lt2,col=col2)
lines(t,Y[,3],type="l",lty=lt3,col=col3)
legend(
"topleft",
c("C in pool 1",
"C in 2",
"C in pool 3"
),
lty=c(lt1,lt2,lt3),
col=c(col1,col2,col3)
)
Y=getAccumulatedRelease(mod)
plot(t,Y[,1],type="l",lty=lt1,col=col1,ylab="C release",xlab="Time")
lines(t,Y[,2],lty=lt2,col=col2)
lines(t,Y[,3],type="l",lty=lt3,col=col3)
legend("topright",c("R1","R2","R3"),lty=c(lt1,lt2,lt3),col=c(col1,col2,col3))

```

pathEntropy

Path Entropy

Description

Computes the entropy of particles passing through the whole network of compartments for a model at equilibrium

Usage

```
pathEntropy(A, u)
```

Arguments

A A constant compartmental square matrix with cycling rates in the diagonal and transfer rates in the off-diagonal.

u A one-column matrix defining the amount of inputs per compartment.

Value

A scalar value with the path entropy

References

Metzler, H. (2020). Compartmental systems as Markov chains : age, transit time, and entropy (T. Oertel-Jaeger, I. Pavlyukevich, and C. Sierra, Eds.) [PhD thesis](<https://suche.thulb.uni-jena.de/Record/1726091651>)

Examples

```
B6=matrix(c(-1,1,0,0,-1,1,0,0,-1),3,3); u6=matrix(c(1,0,0))
pathEntropy(A=B6, u=u6)
```

```
plot,MCSim-method      automatic title
```

Description

automatic title

Usage

```
## S4 method for signature 'MCSim'
plot(x, y, ...)
```

Arguments

x no manual documentation

y no manual documentation

... no manual documentation

plot,Model-method *Create an overview plot*

Description

The method solves the model and plots the solutions It is intended to provide a quick overview.

Usage

```
## S4 method for signature 'Model'  
plot(x)
```

Arguments

x The model (run) the results of which are plotted

plot,Model_by_PoolNames-method
Plot the graph of pool connections

Description

Plot the graph of pool connections

Usage

```
## S4 method for signature 'Model_by_PoolNames'  
plot(x)
```

Arguments

x a model

plot,NlModel-method *automatic title*

Description

automatic title

Usage

```
## S4 method for signature 'NlModel'  
plot(x)
```

Arguments

x no manual documentation

plot,TimeMap-method *automatic title*

Description

automatic title

Usage

```
## S4 method for signature 'TimeMap'  
plot(x, y, ...)
```

Arguments

x no manual documentation

y no manual documentation

... no manual documentation

plotC14Pool *Plots the output of [getF14](#) for each pool over time*

Description

This function produces a plot with the Delta14C in the atmosphere and the Delta14C of each pool obtained after a call to [getF14](#).

Usage

```
plotC14Pool(t, mat, inputFc, col, ...)
```

Arguments

| | |
|---------|---|
| t | A vector containing the time points for plotting. |
| mat | A matrix object obtained after a call to getF14 |
| inputFc | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |
| col | A color palette specifying color lines for each pool (columns of mat). |
| ... | Other arguments passed to plot. |

plotCPool *Plots the output of [getC](#) or [getReleaseFlux](#) for each pool over time*

Description

This function produces a plot with the C content or released C for each pool over time. Needs as input a matrix obtained after a call to [getC](#) or [getReleaseFlux](#).

Usage

```
plotCPool(t, mat, col, ...)
```

Arguments

| | |
|-----|---|
| t | A vector containing the time points for plotting. |
| mat | A matrix object obtained after a call to getC or getReleaseFlux |
| col | A color palette specifying color lines for each pool (columns of mat). |
| ... | Other arguments passed to <code>link{plot}</code> . |

| | |
|---------------|------------------------|
| plotPoolGraph | <i>Generic plotter</i> |
|---------------|------------------------|

Description

Generic plotter

Usage

```
plotPoolGraph(x)
```

Arguments

| | |
|---|--|
| x | An argument containing sufficient information about the connections between the pools as well as from and to the exterior. |
|---|--|

| |
|--|
| plotPoolGraph, SymbolicModel_by_PoolNames-method |
| <i>Plot the graph of pool connections</i> |

Description

Plot the graph of pool connections

Usage

```
## S4 method for signature 'SymbolicModel_by_PoolNames'  
plotPoolGraph(x)
```

Arguments

| | |
|---|---|
| x | The modelrun the connection graph of which is plotted |
|---|---|

```
plotPoolGraphFromTupleLists
```

Helper function to draw connectivity graphs

Description

Helper function to draw connectivity graphs

Usage

```
plotPoolGraphFromTupleLists(
    internalConnections,
    inBoundConnections,
    outBoundConnections
)
```

Arguments

`internalConnections`

A list of tuples(source,dest) where src and dest are either both integers or both strings(poolnames)

`inBoundConnections`

A list of either integers or strings (poolnames)

`outBoundConnections`

A list of either integers or strings (poolnames) The function is used by the [plotPoolGraph](#) generic of the newer model classes [SymbolicModel_by_PoolNames](#).

```
PoolConnection_by_PoolIndex
```

Pool connection by pool index

Description

Pool connection by pool index

Usage

```
PoolConnection_by_PoolIndex(source, destination, src_to_dest)
```

Arguments

`source` see method arguments

`destination` see method arguments

`src_to_dest` see method arguments

PoolConnection_by_PoolIndex,ANY,ANY,missing-method
constructor from an ordered pair of PoolId objects

Description

constructor from an ordered pair of PoolId objects

Usage

```
## S4 method for signature 'ANY,ANY,missing'
PoolConnection_by_PoolIndex(source, destination)
```

Arguments

| | |
|-------------|---------------------------|
| source | index of source pool |
| destination | index of destination pool |

PoolConnection_by_PoolIndex,missing,missing,character-method
constructor from strings of the form '1_to_2'

Description

constructor from strings of the form '1_to_2'

Usage

```
## S4 method for signature 'missing,missing,character'
PoolConnection_by_PoolIndex(src_to_dest)
```

Arguments

| | |
|-------------|---|
| src_to_dest | character string describing the source to destination pools |
|-------------|---|

PoolConnection_by_PoolIndex-class
Objects that have a source and a destination described by integer like objects (of class PoolIndex)

Description

Examples are internal Fluxes and Fluxrates Their 'topologic' part and many related sanity checks are implemented here rather than in every function that uses fluxes or rates The methods are also essential for the translation from (internal) flux lists to the respective parts of compartmental matrices and back

PoolConnection_by_PoolName

Pool connection by pool name

Description

Pool connection by pool name

Usage

PoolConnection_by_PoolName(source, destination, src_to_dest)

Arguments

source see method arguments

destination see method arguments

src_to_dest see method arguments

PoolConnection_by_PoolName,ANY,ANY,missing-method

constructor from an ordered pair of PoolName objects

Description

constructor from an ordered pair of PoolName objects

Usage

```
## S4 method for signature 'ANY,ANY,missing'  
PoolConnection_by_PoolName(source, destination)
```

Arguments

source name of source pool

destination name of destination pool

PoolConnection_by_PoolName-class

Objects that have a source and a destination determined by a string like object of class PoolName

Description

Examples are internal Fluxes and Fluxrates Their 'topologic' part and many related sanity checks are implemented here rather than in every function that uses fluxes or rates The methods are also essential for the translation from (internal) flux lists to the respective parts of compartmental matrices and back

PoolId-class

common class for pool ids

Description

examples for ids are index or name

PoolIndex

Pool index

Description

Pool index

Usage

PoolIndex(id, ...)

Arguments

id see method arguments

... see method arguments

PoolIndex,character-method

construct from number string like '1' or '3'

Description

construct from number string like '1' or '3'

Usage

```
## S4 method for signature 'character'  
PoolIndex(id)
```

Arguments

id pool id

PoolIndex,numeric-method

construct from number

Description

construct from number

Usage

```
## S4 method for signature 'numeric'  
PoolIndex(id)
```

Arguments

id pool id

 PoolIndex,PoolIndex-method

pass through constructor from an object of the same class

Description

This is here to be able to call PoolIndex on a PoolIndex object without having to check before if it is necessary. the unnecessary poolNames argument will be ignored.

Usage

```
## S4 method for signature 'PoolIndex'
PoolIndex(id, poolNames)
```

Arguments

| | |
|-----------|----------------|
| id | pool id |
| poolNames | names of pools |

PoolIndex,PoolName-method

convert to number like object

Description

convert to number like object

Usage

```
## S4 method for signature 'PoolName'
PoolIndex(id, poolNames)
```

Arguments

| | |
|-----------|----------------|
| id | pool id |
| poolNames | names of pools |

PoolIndex-class

S4 class for pool indices

Description

used to dispatch pool index specific methods like conversion to names.

| | |
|----------|------------------|
| PoolName | <i>Pool name</i> |
|----------|------------------|

Description

Pool name

Usage

```
PoolName(id, ...)
```

Arguments

| | |
|-----|----------------------|
| id | see method arguments |
| ... | see method arguments |

| | |
|---------------------------|--|
| PoolName,character-method | <i>construct from string with checks</i> |
|---------------------------|--|

Description

construct from string with checks

Usage

```
## S4 method for signature 'character'
PoolName(id)
```

Arguments

| | |
|----|---------|
| id | pool id |
|----|---------|

PoolName,PoolIndex-method
convert to string like object

Description

convert to string like object

Usage

```
## S4 method for signature 'PoolIndex'
PoolName(id, poolNames)
```

Arguments

| | |
|-----------|---------------|
| id | pool id |
| poolNames | name of pools |

PoolName,PoolName-method
pass through constructor from an object of the same class

Description

This is here to be able to call PoolName on a PoolName object without having to test before if we have to. This makes the calling code easier to read.

Usage

```
## S4 method for signature 'PoolName'
PoolName(id, poolNames)
```

Arguments

| | |
|-----------|----------------|
| id | pool id |
| poolNames | names of pools |

PoolName-class *class for pool-name-strings*

Description

used to control the creation of PoolName objects which have to be valid R identifiers and to dispatch pool name specific methods like conversion to pool indices

```
predefinedModels
```

```
PREDEFINED MODELS
```

Description

```
GaudinskiModel14
ICBModel
OnepModel
OnepModel14
RothCModel
ThreepFeedbackModel
ThreepFeedbackModel14
ThreepParallelModel
ThreepParallelModel14
ThreepSeriesModel
ThreepSeriesModel14
TwopFeedbackModel
TwopFeedbackModel14
TwopParallelModel
TwopParallelModel14
TwopMMmodel
ThreepairMMmodel
TwopSeriesModel
TwopSeriesModel14
YassoModel
bacwaveModel
Yasso07Model
SeriesLinearModel
SeriesLinearModel14
CenturyModel
```

```
print,NlModel-method  automatic title
```

Description

```
automatic title
```

Usage

```
## S4 method for signature 'NlModel'
print(x)
```


Arguments

x no manual documentation

RespirationCoefficients

helper function to compute respiration coefficients

Description

This function computes the respiration coefficients as function of time for all pools according to the given matrix function A(t)

Usage

RespirationCoefficients(A)

Arguments

A A matrix valued function representing the model.

Value

A vector valued function of time containing the respiration coefficients for all pools.

RothCModel

Implementation of the RothCModel

Description

This function implements the RothC model of Jenkinson et al. It is a wrapper for the more general function [GeneralModel](#).

Usage

```
RothCModel(
  t,
  ks = c(k.DPM = 10, k.RPM = 0.3, k.BIO = 0.66, k.HUM = 0.02, k.IOM = 0),
  C0 = c(0, 0, 0, 0, 2.7),
  In = 1.7,
  FYM = 0,
  DR = 1.44,
  clay = 23.4,
  xi = 1,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|--------|--|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 5 containing the values of the decomposition rates for the different pools |
| C0 | A vector of length 5 containing the initial amount of carbon for the 5 pools. |
| In | A scalar or data.frame object specifying the amount of litter inputs by time. |
| FYM | A scalar or data.frame object specifying the amount of Farm Yard Manure inputs by time. |
| DR | A scalar representing the ratio of decomposable plant material to resistant plant material (DPM/RPM). |
| clay | Percent clay in mineral soil. |
| xi | A scalar or data.frame object specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

References

Jenkinson, D. S., S. P. S. Andrew, J. M. Lynch, M. J. Goss, and P. B. Tinker. 1990. The Turnover of Organic Carbon and Nitrogen in Soil. *Philosophical Transactions: Biological Sciences* 329:361-368. Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
t=0:500
Ex=RothCModel(t)
Ct=getC(Ex)
Rt=getReleaseFlux(Ex)

matplot(t,Ct,type="l",col=1:5, ylim=c(0,25),
ylab=expression(paste("Carbon stores (Mg C ", ha^-1, ")")),
xlab="Time (years)", lty=1)
lines(t,rowSums(Ct),lwd=2)
legend("topleft",
c("Pool 1, DPM",
"Pool 2, RPM",
"Pool 3, BIO",
```

```
"Pool 4, HUM",  
"Pool 5, IOM",  
"Total Carbon"),  
lty=1,  
lwd=c(rep(1,5),2),  
col=c(1:5,1),  
bty="n"  
)
```

ScalarTimeMap

Constructor for [ScalarTimeMap-class](#)

Description

Constructor for [ScalarTimeMap-class](#)

Usage

```
ScalarTimeMap(  
  map,  
  starttime,  
  endtime,  
  times,  
  data,  
  lag = 0,  
  interpolation = splinefun,  
  ...  
)
```

Arguments

| | |
|---------------|----------------------|
| map | see method arguments |
| starttime | see method arguments |
| endtime | see method arguments |
| times | see method arguments |
| data | see method arguments |
| lag | see method arguments |
| interpolation | see method arguments |
| ... | see method arguments |

```
ScalarTimeMap,data.frame,missing,missing,missing,missing-method
  constructor for data given as 2 column data.frame
```

Description

constructor for data given as 2 column data.frame

Usage

```
## S4 method for signature 'data.frame,missing,missing,missing,missing'
ScalarTimeMap(map, lag = 0, interpolation = splinefun)
```

Arguments

| | |
|---------------|--|
| map | In this case a data.frame. Only the first two columns will be used |
| lag | a (scalar) delay |
| interpolation | the interpolation, usually splinefun or approxfun |

```
ScalarTimeMap,function,missing,missing,missing,missing-method
  manual constructor for just a function
```

Description

The interval will be set to [-Inf,Inf]

Usage

```
## S4 method for signature '`function`,missing,missing,missing,missing'
ScalarTimeMap(map, lag = 0)
```

Arguments

| | |
|-----|------------|
| map | a function |
| lag | a time lag |

ScalarTimeMap,function,numeric,numeric,missing,missing-method
manual constructor for a function and an interval

Description

manual constructor for a function and an interval

Usage

```
## S4 method for signature ``function`,numeric,numeric,missing,missing`
ScalarTimeMap(map, starttime, endtime, lag = 0)
```

Arguments

| | |
|-----------|----------------------------|
| map | a function |
| starttime | initial time of simulation |
| endtime | end time of simulation |
| lag | a time lag |

ScalarTimeMap,missing,missing,missing,missing,numeric-method
special case for a time map from a constant

Description

special case for a time map from a constant

Usage

```
## S4 method for signature 'missing,missing,missing,missing,numeric'
ScalarTimeMap(starttime = -Inf, endtime = +Inf, data, lag = 0)
```

Arguments

| | |
|-----------|----------------------------|
| starttime | initial time of simulation |
| endtime | end time of simulation |
| data | data |
| lag | a time lag |

ScalarTimeMap,missing,missing,missing,numeric,numeric-method
constructor for data and times given as vectors

Description

constructor for data and times given as vectors

Usage

```
## S4 method for signature 'missing,missing,missing,numeric,numeric'
ScalarTimeMap(times, data, lag = 0, interpolation = splinefun)
```

Arguments

| | |
|---------------|---|
| times | (the times for the values in data) |
| data | the values at times |
| lag | a (scalar) delay |
| interpolation | the interpolation, usually splinefun or approxfun |

ScalarTimeMap-class *S4 class for a scalar time dependent function on a finite time interval*

Description

S4 class for a scalar time dependent function on a finite time interval

SeriesLinearModel *General m-pool linear model with series structure*

Description

This function creates a model for m number of pools connected in series. It is a wrapper for the more general function [GeneralModel](#).

Usage

```
SeriesLinearModel(
  t,
  m.pools,
  ki,
  Tij,
  C0,
  In,
  xi = 1,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|---------|--|
| t | A vector containing the points in time where the solution is sought. |
| m.pools | An integer with the total number of pools in the model. |
| ki | A vector of length m containing the values of the decomposition rates for each pool i. |
| Tij | A vector of length m-1 with the transfer coefficients from pool j to pool i. The value of these coefficients must be in the range [0, 1]. |
| C0 | A vector of length m containing the initial amount of carbon for the m pools. |
| In | A scalar or data.frame object specifying the amount of litter inputs by time. |
| xi | A scalar or data.frame object specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE Forces the constructor to create the model even if it is invalid |

References

Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
#A five-pool model
t_start=0
t_end=10
tn=50
timestep=(t_end-t_start)/tn
t=seq(t_start,t_end,timestep)
ks=c(k1=0.8,k2=0.4,k3=0.2, k4=0.1,k5=0.05)
```

```

Ts=c(0.5,0.2,0.2,0.1)
C0=c(C10=100,C20=150, C30=50, C40=50, C50=10)
In = 50
#
Ex1=SeriesLinearModel(t=t,m.pools=5,ki=ks,Tij=Ts,C0=C0,In=In,xi=fT.Q10(15))
Ct=getC(Ex1)
#
matplot(t,Ct,type="l",col=2:6,lty=1,ylim=c(0,sum(C0)))
lines(t,rowSums(Ct),lwd=2)
legend("topright",c("Total C", "C in pool 1", "C in pool 2", "C in pool 3",
"C in pool 4", "C in pool 5"),
lty=1,col=1:6,lwd=c(2,rep(1,5)),bty="n")

```

SeriesLinearModel14 *General m-pool linear C14 model with series structure*

Description

This function creates a radiocarbon model for m number of pools connected in series. It is a wrapper for the more general function [GeneralModel_14](#).

Usage

```

SeriesLinearModel14(
  t,
  m.pools,
  ki,
  Tij,
  C0,
  F0_Delta14C,
  In,
  xi = 1,
  inputFc,
  lambda = -0.0001209681,
  lag = 0,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)

```

Arguments

| | |
|---------|---|
| t | A vector containing the points in time where the solution is sought. |
| m.pools | An integer with the total number of pools in the model. |
| ki | A vector of length m containing the values of the decomposition rates for each pool i. |
| Tij | A vector of length m-1 with the transfer coefficients from pool j to pool i. The value of these coefficients must be in the range [0, 1]. |

| | |
|--------------------------|--|
| <code>C0</code> | A vector of length <code>m</code> containing the initial amount of carbon for the <code>m</code> pools. |
| <code>F0_Delta14C</code> | A vector of length <code>m</code> containing the initial amount of the radiocarbon fraction for the <code>m</code> pools. |
| <code>In</code> | A scalar or <code>data.frame</code> object specifying the amount of litter inputs by time. |
| <code>xi</code> | A scalar or <code>data.frame</code> object specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| <code>inputFc</code> | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |
| <code>lambda</code> | Radioactive decay constant. By default <code>lambda=-0.0001209681 y^-1</code> . This has the side effect that all your time related data are treated as if the time unit was year. |
| <code>lag</code> | A positive scalar representing a time lag for radiocarbon to enter the system. |
| <code>solver</code> | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| <code>pass</code> | if TRUE Forces the constructor to create the model even if it is invalid |

References

Sierra, C.A., M. Mueller, S.E. Trumbore. 2014. Modeling radiocarbon dynamics in soils: SoilR version 1.1. Geoscientific Model Development 7, 1919-1931.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
years=seq(1901,2009,by=0.5)
LitterInput=700

Ex=SeriesLinearModel14(
  t=years,ki=c(k1=1/2.8, k2=1/35, k3=1/100), m.pools=3,
  C0=c(200,5000,500), F0_Delta14C=c(0,0,0),
  In=LitterInput, Tij=c(0.5, 0.1),inputFc=C14Atm_NH
)
R14m=getF14R(Ex)
C14m=getF14C(Ex)
C14t=getF14(Ex)

par(mfrow=c(2,1))
plot(C14Atm_NH,type="l",xlab="Year",
ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years, C14t[,1], col=4)
lines(years, C14t[,2],col=4,lwd=2)
lines(years, C14t[,3],col=4,lwd=3)
legend(
"topright",
```

```

c("Delta 14C Atmosphere", "Delta 14C pool 1", "Delta 14C pool 2", "Delta 14C pool 3"),
lty=rep(1,4),col=c(1,4,4,4),lwd=c(1,1,2,3),bty="n")

plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years,C14m,col=4)
lines(years,R14m,col=2)
legend("topright",c("Delta 14C Atmosphere","Delta 14C SOM", "Delta 14C Respired"),
lty=c(1,1,1), col=c(1,4,2),bty="n")
par(mfrow=c(1,1))

```

SHCal20

The SHCal20 southern hemisphere radiocarbon curve for the 0-55,000 yr BP period

Description

Atmospheric radiocarbon calibration curve for the period 0 to 55,000 yr BP for the southern hemisphere.

Usage

```
data(SHCal20)
```

Format

A data frame with 9501 rows and 5 variables.

CAL.BP Calibrated age in years Before Present (BP).

C14.age C14 age in years BP.

Sigma.C14.age Standard deviation for C14.age.

Delta.14C Delta.14C value in per mil.

Sigma.Delta.14C Standard deviation of Delta.14C in per mil.

Details

All details about the derivation of this dataset are provided in Hogg et al. (2020).

Author(s)

Ingrid Chanca <ichanca@bgc-jena.mpg.de>

Source

<<https://doi.org/10.1017/RDC.2020.59>>

References

Hogg, A., Heaton, T., Hua, Q., Palmer, J., Turney, C., Southon, J., . . . Wacker, L. (2020). SHCal20 Southern Hemisphere Calibration, 0–55,000 Years cal BP. *Radiocarbon*, 62(4), 759-778. doi:10.1017/RDC.2020.59

Examples

```
plot(SHCal20$CAL.BP, SHCal20$Delta.14C, type="l",
     xlab="cal BP", ylab="Delta14C (per mil)")
```

show,NIModel-method *automatic title*

Description

automatic title

Usage

```
## S4 method for signature 'NIModel'
show(object)
```

Arguments

object no manual documentation

SoilR.F0.new *deprecated function that used to create an object of class SoilR.F0*

Description

The function internally calls the constructor of the replacement class [ConstFc-class](#).

Usage

```
SoilR.F0.new(values = c(0), format = "Delta14C")
```

Arguments

values a numeric vector
format a character string describing the format e.g. "Delta14C"

Value

An object of class [ConstFc-class](#) that contains data and a format description that can later be used to convert the data into other formats if the conversion is implemented.

StateDependentInFluxVector-class

Input vector that is a function of the pool content and time

Description

Input vector that is a function of the pool content and time

StateIndependentInFluxList_by_PoolIndex

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

StateIndependentInFluxList_by_PoolIndex(object)

Arguments

object see methods

StateIndependentInFluxList_by_PoolIndex,list-method

constructor from a normal list

Description

constructor from a normal list

Usage

```
## S4 method for signature 'list'
StateIndependentInFluxList_by_PoolIndex(object)
```

Arguments

object A list. Either a list of elements of type [StateIndependentInFlux_by_PoolIndex](#) or a list where the names of the elements are strings of the form '3' (for an in flux connected to pool 3)

Value

An object of class [StateIndependentInFluxList_by_PoolIndex](#)

The function checks if the elements are of the desired type or can be converted to it. It is mainly used internally and usually called by the front end functions to convert the user supplied arguments.

StateIndependentInFluxList_by_PoolIndex-class

Subclass of list that is guaranteed to contain only elements of type [StateIndependentInFlux_by_PoolIndex](#)

Description

Subclass of list that is guaranteed to contain only elements of type [StateIndependentInFlux_by_PoolIndex](#)

StateIndependentInFluxList_by_PoolName

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

StateIndependentInFluxList_by_PoolName(object)

Arguments

object see methods

StateIndependentInFlux_by_PoolIndex-class

Constructor for the class with the same name

Description

Constructor for the class with the same name

Slots

destinationIndex

flux

state_variable_names *determine the minimum set of statevariables*

Description

determine the minimum set of statevariables

Usage

state_variable_names(object)

Arguments

object The symbolic model description

SymbolicModel_by_PoolNames-class

A symbolic model description based on flux functions

Description

The set of flux functions along with the timesymbol is complete description of the structure

systemAge

System and pool age for constant compartment models

Description

Computes the density distribution and mean for the system and pool ages of a constant compartmental model in matrix representation

Usage

systemAge(A, u, a = seq(0, 100), q = c(0.05, 0.5, 0.95))

Arguments

A A constant compartmental square matrix with cycling rates in the diagonal and transfer rates in the off-diagonal.

u A one-column matrix defining the amount of inputs per compartment.

a A sequence of ages to calculate density functions

q A vector of probabilities to calculate quantiles of the system age distribution

Value

A list with 5 objects: mean system age, system age distribution, quantiles of system age distribution, mean pool-age, and pool-age distribution.

See Also

[transitTime](#)

ThreepairMMmodel *Implementation of a 6-pool Michaelis-Menten model*

Description

This function implements a 6-pool Michaelis-Menten model with pairs of microbial biomass and substrate pools.

Usage

```
ThreepairMMmodel(t, ks, kb, Km, r, Af = 1, ADD, ival)
```

Arguments

| | |
|------|---|
| t | vector of times to calculate a solution. |
| ks | a vector of length 3 representing SOM decomposition rate ($\text{m}^3 \text{d}^{-1} (\text{gCB})^{-1}$) |
| kb | a vector of length 3 representing microbial decay rate (d^{-1}) |
| Km | a vector of length 3 representing the Michaelis constant (g m^{-3}) |
| r | a vector of length 3 representing the respired carbon fraction (unitless) |
| Af | a scalar representing the Activity factor; i.e. a temperature and moisture modifier (unitless) |
| ADD | a vector of length 3 representing the annual C input to the soil ($\text{g m}^{-3} \text{d}^{-1}$) |
| ival | a vector of length 6 with the initial values of the SOM pools and the microbial biomass pools (g m^{-3}) |

Value

An object of class NIModel that can be further queried.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```

days=seq(0,1000)
#Run the model with default parameter values
MMmodel=ThreepairMMmodel(t=days,ival=rep(c(100,10),3),ks=c(0.1,0.05,0.01),
kb=c(0.005,0.001,0.0005),Km=c(100,150,200),r=c(0.9,0.9,0.9),
ADD=c(3,1,0.5))
Cpools=getC(MMmodel)
#Time solution
matplot(days,Cpools,type="l",ylab="Concentrations",xlab="Days",lty=rep(1:2,3),
ylim=c(0,max(Cpools)*1.2),col=rep(1:3,each=2),
main="Multi-substrate microbial model")
legend("topright",c("Substrate 1", "Microbial biomass 1",
"Substrate 2", "Microbial biomass 2",
"Substrate 3", "Microbial biomass 3"),
lty=rep(1:2,3),col=rep(1:3,each=2),
bty="n")
#State-space diagram
plot(Cpools[,2],Cpools[,1],type="l",ylab="Substrate",xlab="Microbial biomass")
lines(Cpools[,4],Cpools[,3],col=2)
lines(Cpools[,6],Cpools[,5],col=3)
legend("topright",c("Substrate-Enzyme pair 1","Substrate-Enzyme pair 2",
"Substrate-Enzyme pair 3"),col=1:3,lty=1,bty="n")
#Microbial biomass over time
plot(days,Cpools[,2],type="l",col=2,xlab="Days",ylab="Microbial biomass")

```

ThreepFeedbackModel *Implementation of a three pool model with feedback structure*

Description

This function creates a model for three pools connected with feedback. It is a wrapper for the more general function [GeneralModel](#).

Usage

```

ThreepFeedbackModel(
  t,
  ks,
  a21,
  a12,
  a32,
  a23,
  C0,
  In,
  xi = 1,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)

```


Arguments

| | |
|--------|--|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 3 containing the values of the decomposition rates for pools 1, 2, and 3. |
| a21 | A scalar with the value of the transfer rate from pool 1 to pool 2. |
| a12 | A scalar with the value of the transfer rate from pool 2 to pool 1. |
| a32 | A scalar with the value of the transfer rate from pool 2 to pool 3. |
| a23 | A scalar with the value of the transfer rate from pool 3 to pool 2. |
| C0 | A vector containing the initial concentrations for the 3 pools. The length of this vector is 3 |
| In | A data.frame object specifying the amount of litter inputs by time. |
| xi | A scalar or data.frame object specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE forces the constructor to create the model even if it is invalid |

References

Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
t_start=0
t_end=10
tn=50
timestep=(t_end-t_start)/tn
t=seq(t_start,t_end,timestep)
ks=c(k1=0.8,k2=0.4,k3=0.2)
C0=c(C10=100,C20=150, C30=50)
In = 60

Temp=rnorm(t,15,1)
TempEffect=data.frame(t,fT.Daycent1(Temp))

Ex1=ThreepFeedbackModel(t=t,ks=ks,a21=0.5,a12=0.1,a32=0.2,a23=0.1,C0=C0,In=In,xi=TempEffect)
Ct=getC(Ex1)
Rt=getReleaseFlux(Ex1)

plot(
  t,
  rowSums(Ct),
```

```

type="l",
ylab="Carbon stocks (arbitrary units)",
xlab="Time (arbitrary units)",
lwd=2,
ylim=c(0,sum(Ct[51,]))
)
lines(t,Ct[,1],col=2)
lines(t,Ct[,2],col=4)
lines(t,Ct[,3],col=3)
legend(
"topleft",
c("Total C", "C in pool 1", "C in pool 2", "C in pool 3"),
lty=c(1,1,1,1),
col=c(1,2,4,3),
lwd=c(2,1,1,1),
bty="n"
)

plot(
t,
rowSums(Rt),
type="l",
ylab="Carbon released (arbitrary units)",
xlab="Time (arbitrary units)",
lwd=2,
ylim=c(0,sum(Rt[51,]))
)
lines(t,Rt[,1],col=2)
lines(t,Rt[,2],col=4)
lines(t,Rt[,3],col=3)
legend(
"topleft",
c("Total C release",
"C release from pool 1",
"C release from pool 2",
"C release from pool 3"),
lty=c(1,1,1,1),
col=c(1,2,4,3),
lwd=c(2,1,1,1),
bty="n"
)

Inr=data.frame(t,Random.inputs=rnorm(length(t),50,10))
plot(Inr,type="l")

Ex2=ThreepFeedbackModel(t=t,ks=ks,a21=0.5,a12=0.1,a32=0.2,a23=0.1,C0=C0,In=Inr)
Ctr=getC(Ex2)
Rtr=getReleaseFlux(Ex2)

plot(
t,
rowSums(Ctr),
type="l",

```

```

ylab="Carbon stocks (arbitrary units)",
xlab="Time (arbitrary units)",
lwd=2,
ylim=c(0,sum(Ctr[51,]))
)
lines(t,Ctr[,1],col=2)
lines(t,Ctr[,2],col=4)
lines(t,Ctr[,3],col=3)
legend("topright",c("Total C", "C in pool 1", "C in pool 2", "C in pool 3"),
lty=c(1,1,1,1),col=c(1,2,4,3),lwd=c(2,1,1,1),bty="n")

plot(t,rowSums(Rtr),type="l",ylab="Carbon released (arbitrary units)",
xlab="Time (arbitrary units)",lwd=2,ylim=c(0,sum(Rtr[51,])))
lines(t,Rtr[,1],col=2)
lines(t,Rtr[,2],col=4)
lines(t,Rtr[,3],col=3)
legend(
"topright",
c("Total C release",
"C release from pool 1",
"C release from pool 2",
"C release from pool 3"
),
lty=c(1,1,1,1),
col=c(1,2,4,3),
lwd=c(2,1,1,1),
bty="n")

```

ThreepFeedbackModel14 *Implementation of a three-pool C14 model with feedback structure*

Description

This function creates a model for three pools connected with feedback. It is a wrapper for the more general function [GeneralModel_14](#) that can handle an arbitrary number of pools with arbitrary connections. [GeneralModel_14](#) can also handle input data in different formats, while this function requires its input as Delta14C. Look at it as an example how to use the more powerful tool [GeneralModel_14](#) or as a shortcut for a standard task!

Usage

```

ThreepFeedbackModel14(
  t,
  ks,
  C0,
  F0_Delta14C,
  In,
  a21,
  a12,

```

```

    a32,
    a23,
    xi = 1,
    inputFc,
    lambda = -0.0001209681,
    lag = 0,
    solver = deSolve.lsoda.wrapper,
    pass = FALSE
  )

```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. It must be specified within the same period for which the Delta 14 C of the atmosphere is provided. The default period in the provided dataset C14Atm_NH is 1900-2010. |
| ks | A vector of length 3 containing the decomposition rates for the 3 pools. |
| C0 | A vector of length 3 containing the initial amount of carbon for the 3 pools. |
| F0_Delta14C | A vector of length 3 containing the initial fraction of radiocarbon for the 3 pools in Delta14C format. The format will be assumed to be Delta14C, so please take care that it is. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| a21 | A scalar with the value of the transfer rate from pool 1 to pool 2. |
| a12 | A scalar with the value of the transfer rate from pool 2 to pool 1. |
| a32 | A scalar with the value of the transfer rate from pool 2 to pool 3. |
| a23 | A scalar with the value of the transfer rate from pool 3 to pool 2. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| inputFc | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |
| lambda | Radioactive decay constant. By default $\lambda = -0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. |
| lag | A positive scalar representing a time lag for radiocarbon to enter the system. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE forces the constructor to create the model even if it is invalid. This is sometimes useful when SoilR is used by external packages for parameter estimation. |

See Also

There are other [predefinedModels](#) and also more general functions like [Model_14](#).

Examples

```

#years=seq(1901,2009,by=0.5)
years=seq(1904,2009,by=0.5)
LitterInput=100
k1=1/2; k2=1/10; k3=1/50
a21=0.9*k1
a12=0.4*k2
a32=0.4*k2
a23=0.7*k3

Feedback=ThreepFeedbackModel14(
t=years,
ks=c(k1=k1, k2=k2, k3=k3),
C0=c(100,500,1000),
F0_Delta14C=c(0,0,0),
In=LitterInput,
a21=a21,
a12=a12,
a32=a32,
a23=a23,
inputFc=C14Atm_NH
)
F.R14m=getF14R(Feedback)
F.C14m=getF14C(Feedback)
F.C14t=getF14(Feedback)

Series=ThreepSeriesModel14(
t=years,
ks=c(k1=k1, k2=k2, k3=k3),
C0=c(100,500,1000),
F0_Delta14C=c(0,0,0),
In=LitterInput,
a21=a21,
a32=a32,
inputFc=C14Atm_NH
)
S.R14m=getF14R(Series)
S.C14m=getF14C(Series)
S.C14t=getF14(Series)

Parallel=ThreepParallelModel14(
t=years,
ks=c(k1=k1, k2=k2, k3=k3),
C0=c(100,500,1000),
F0_Delta14C=c(0,0,0),
In=LitterInput,
gam1=0.6,
gam2=0.2,
inputFc=C14Atm_NH,
lag=2
)
P.R14m=getF14R(Parallel)

```

```

P.C14m=getF14C(Parallel)
P.C14t=getF14(Parallel)

par(mfrow=c(3,2))
plot(
  C14Atm_NH,
  type="l",
  xlab="Year",
  ylab=expression(paste(Delta^14,"C ","(per mille)")),
  xlim=c(1940,2010)
)
lines(years, P.C14t[,1], col=4)
lines(years, P.C14t[,2],col=4,lwd=2)
lines(years, P.C14t[,3],col=4,lwd=3)
legend(
  "topright",
  c("Atmosphere", "Pool 1", "Pool 2", "Pool 3"),
  lty=rep(1,4),
  col=c(1,4,4,4),
  lwd=c(1,1,2,3),
  bty="n"
)

plot(C14Atm_NH,type="l",xlab="Year",
  ylab=expression(paste(Delta^14,"C ","(per mille)")),xlim=c(1940,2010))
lines(years,P.C14m,col=4)
lines(years,P.R14m,col=2)
legend("topright",c("Atmosphere","Bulk SOM", "Respired C"),
  lty=c(1,1,1), col=c(1,4,2),bty="n")

plot(C14Atm_NH,type="l",xlab="Year",
  ylab=expression(paste(Delta^14,"C ","(per mille)")),xlim=c(1940,2010))
lines(years, S.C14t[,1], col=4)
lines(years, S.C14t[,2],col=4,lwd=2)
lines(years, S.C14t[,3],col=4,lwd=3)
legend("topright",c("Atmosphere", "Pool 1", "Pool 2", "Pool 3"),
  lty=rep(1,4),col=c(1,4,4,4),lwd=c(1,1,2,3),bty="n")

plot(C14Atm_NH,type="l",xlab="Year",
  ylab=expression(paste(Delta^14,"C ","(per mille)")),xlim=c(1940,2010))
lines(years,S.C14m,col=4)
lines(years,S.R14m,col=2)
legend("topright",c("Atmosphere","Bulk SOM", "Respired C"),
  lty=c(1,1,1), col=c(1,4,2),bty="n")

plot(C14Atm_NH,type="l",xlab="Year",
  ylab=expression(paste(Delta^14,"C ","(per mille)")),xlim=c(1940,2010))
lines(years, F.C14t[,1], col=4)
lines(years, F.C14t[,2],col=4,lwd=2)
lines(years, F.C14t[,3],col=4,lwd=3)
legend("topright",c("Atmosphere", "Pool 1", "Pool 2", "Pool 3"),
  lty=rep(1,4),col=c(1,4,4,4),lwd=c(1,1,2,3),bty="n")

```

```

plot(C14Atm_NH,type="l",xlab="Year",
ylab=expression(paste(Delta^14,"C ", "(per mille)")),xlim=c(1940,2010))
lines(years,F.C14m,col=4)
lines(years,F.R14m,col=2)
legend("topright",c("Atmosphere","Bulk SOM", "Respired C"),
lty=c(1,1,1), col=c(1,4,2),bty="n")

par(mfrow=c(1,1))

```

ThreepParallelModel *Implementation of a three pool model with parallel structure*

Description

The function creates a model for three independent (parallel) pools. It is a wrapper for the more general function [ParallelModel](#) that can handle an arbitrary number of pools.

Usage

```

ThreepParallelModel(
  t,
  ks,
  C0,
  In,
  gam1,
  gam2,
  xi = 1,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)

```

Arguments

| | |
|--------|--|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 3 containing the decomposition rates for the 3 pools. |
| C0 | A vector of length 3 containing the initial amount of carbon for the 3 pools. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| gam1 | A scalar representing the partitioning coefficient, i.e. the proportion from the total amount of inputs that goes to pool 1. |
| gam2 | A scalar representing the partitioning coefficient, i.e. the proportion from the total amount of inputs that goes to pool 2. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | Logical that forces the Model to be created even if the check suggest problems. |

References

Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
t_start=0
t_end=10
tn=50
timestep=(t_end-t_start)/tn
t=seq(t_start,t_end,timestep)

Ex=ThreepParallelModel(t,ks=c(k1=0.5,k2=0.2,k3=0.1),
C0=c(c10=100, c20=150,c30=50),In=20,gam1=0.7,gam2=0.1,xi=0.5)
Ct=getC(Ex)

plot(t,rowSums(Ct),type="l",lwd=2,
ylab="Carbon stocks (arbitrary units)",xlab="Time",ylim=c(0,sum(Ct[1,])))
lines(t,Ct[,1],col=2)
lines(t,Ct[,2],col=4)
lines(t,Ct[,3],col=3)
legend("topright",c("Total C","C in pool 1", "C in pool 2","C in pool 3"),
lty=c(1,1,1,1),col=c(1,2,4,3),lwd=c(2,1,1,1),bty="n")

Rt=getReleaseFlux(Ex)
plot(t,rowSums(Rt),type="l",ylab="Carbon released (arbitrary units)",
xlab="Time",lwd=2,ylim=c(0,sum(Rt[1,])))
lines(t,Rt[,1],col=2)
lines(t,Rt[,2],col=4)
lines(t,Rt[,3],col=3)
legend("topright",c("Total C release","C release from pool 1",
"C release from pool 2","C release from pool 3"),
lty=c(1,1,1,1),col=c(1,2,4,3),lwd=c(2,1,1,1),bty="n")
```

ThreepParallelModel14 *Implementation of a three-pool C14 model with parallel structure*

Description

This function creates a model for two independent (parallel) pools. It is a wrapper for the more general function [GeneralModel_14](#) that can handle an arbitrary number of pools.

Usage

```

ThreepParallelModel14(
  t,
  ks,
  C0,
  F0_Delta14C,
  In,
  gam1,
  gam2,
  xi = 1,
  inputFc,
  lambda = -0.0001209681,
  lag = 0,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)

```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. It must be specified within the same period for which the Delta 14 C of the atmosphere is provided. The default period in the provided dataset C14Atm_NH is 1900-2010. |
| ks | A vector of length 3 containing the decomposition rates for the 3 pools. |
| C0 | A vector of length 3 containing the initial amount of carbon for the 3 pools. |
| F0_Delta14C | A vector of length 3 containing the initial amount of the radiocarbon fraction for the 3 pools in Delta14C values in per mil. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| gam1 | A scalar representing the partitioning coefficient, i.e. the proportion from the total amount of inputs that goes to pool 1. |
| gam2 | A scalar representing the partitioning coefficient, i.e. the proportion from the total amount of inputs that goes to pool 2. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| inputFc | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |
| lambda | Radioactive decay constant. By default $\lambda = -0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. |
| lag | A positive scalar representing a time lag for radiocarbon to enter the system. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE Forces the constructor to create the model even if it is invalid |

See Also

There are other [predefinedModels](#) and also more general functions like [Model_14](#).

Examples

```

years=seq(1903,2009,by=0.5) # note that we
LitterInput=700

Ex=ThreepParallelModel14(
  t=years,
  ks=c(k1=1/2.8, k2=1/35, k3=1/100),
  C0=c(200,5000,500),
  F0_Delta14C=c(0,0,0),
  In=LitterInput,
  gam1=0.7,
  gam2=0.1,
  inputFc=C14Atm_NH,
  lag=2
)
R14m=getF14R(Ex)
C14m=getF14C(Ex)
C14t=getF14(Ex)

par(mfrow=c(2,1))
plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years, C14t[,1], col=4)
lines(years, C14t[,2],col=4,lwd=2)
lines(years, C14t[,3],col=4,lwd=3)
legend(
  "topright",
  c(
    "Delta 14C Atmosphere",
    "Delta 14C pool 1",
    "Delta 14C pool 2",
    "Delta 14C pool 3"
  ),
  lty=rep(1,4),
  col=c(1,4,4,4),
  lwd=c(1,1,2,3),
  bty="n"
)

plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years,C14m,col=4)
lines(years,R14m,col=2)
legend("topright",c("Delta 14C Atmosphere","Delta 14C SOM", "Delta 14C Respired"),
  lty=c(1,1,1), col=c(1,4,2),bty="n")
par(mfrow=c(1,1))

```

ThreepSeriesModel *Implementation of a three pool model with series structure*

Description

This function creates a model for three pools connected in series. It is a wrapper for the more general function [GeneralModel](#).

Usage

```
ThreepSeriesModel(
  t,
  ks,
  a21,
  a32,
  C0,
  In,
  xi = 1,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|--------|--|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 3 containing the values of the decomposition rates for pools 1, 2, and 3. |
| a21 | A scalar with the value of the transfer rate from pool 1 to pool 2. |
| a32 | A scalar with the value of the transfer rate from pool 2 to pool 3. |
| C0 | A vector of length 3 containing the initial amount of carbon for the 3 pools. |
| In | A scalar or data.frame object specifying the amount of litter inputs by time. |
| xi | A scalar or data.frame object specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE Forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

References

Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
t_start=0
t_end=10
tn=50
timestep=(t_end-t_start)/tn
t=seq(t_start,t_end,timestep)
ks=c(k1=0.8,k2=0.4,k3=0.2)
C0=c(C10=100,C20=150, C30=50)
In = 50

Ex1=ThreepSeriesModel(t=t,ks=ks,a21=0.5,a32=0.2,C0=C0,In=In,xi=fT.Q10(15))
Ct=getC(Ex1)
Rt=getReleaseFlux(Ex1)

plot(t,rowSums(Ct),type="l",ylab="Carbon stocks (arbitrary units)",
xlab="Time (arbitrary units)",lwd=2,ylim=c(0,sum(Ct[1,])))
lines(t,Ct[,1],col=2)
lines(t,Ct[,2],col=4)
lines(t,Ct[,3],col=3)
legend("topright",c("Total C","C in pool 1", "C in pool 2","C in pool 3"),
lty=c(1,1,1,1),col=c(1,2,4,3),lwd=c(2,1,1,1),bty="n")
```

ThreepSeriesModel14 *Implementation of a three-pool C14 model with series structure*

Description

This function creates a model for three pools connected in series. It is a wrapper for the more general function [GeneralModel_14](#) that can handle an arbitrary number of pools.

Usage

```
ThreepSeriesModel14(
  t,
  ks,
  C0,
  F0_Delta14C,
  In,
  a21,
  a32,
  xi = 1,
  inputFc,
  lambda = -0.0001209681,
  lag = 0,
```

```

    solver = deSolve.lsoda.wrapper,
    pass = FALSE
  )

```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. It must be specified within the same period for which the Delta 14 C of the atmosphere is provided. The default period in the provided dataset C14Atm_NH is 1900-2010. |
| ks | A vector of length 3 containing the decomposition rates for the 3 pools. |
| C0 | A vector of length 3 containing the initial amount of carbon for the 3 pools. |
| F0_Delta14C | A vector of length 3 containing the initial amount of the radiocarbon fraction for the 3 pools. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| a21 | A scalar with the value of the transfer rate from pool 1 to pool 2. |
| a32 | A scalar with the value of the transfer rate from pool 2 to pool 3 as Delta14C values in per mil. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| inputFc | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |
| lambda | Radioactive decay constant. By default $\lambda = -0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. |
| lag | A positive scalar representing a time lag for radiocarbon to enter the system. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE Forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

See Also

There are other [predefinedModels](#) and also more general functions like [Model_14](#).

Examples

```

years=seq(1901,2009,by=0.5)
LitterInput=700

Ex=ThreepSeriesModel14(
  t=years,ks=c(k1=1/2.8, k2=1/35, k3=1/100),
  C0=c(200,5000,500), F0_Delta14C=c(0,0,0),

```

```

In=LitterInput, a21=0.1, a32=0.01,inputFc=C14Atm_NH
)
R14m=getF14R(Ex)
C14m=getF14C(Ex)
C14t=getF14(Ex)

par(mfrow=c(2,1))
plot(C14Atm_NH,type="l",xlab="Year",
ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years, C14t[,1], col=4)
lines(years, C14t[,2],col=4,lwd=2)
lines(years, C14t[,3],col=4,lwd=3)
legend(
"topright",
c("Delta 14C Atmosphere", "Delta 14C pool 1", "Delta 14C pool 2", "Delta 14C pool 3"),
lty=rep(1,4),col=c(1,4,4,4),lwd=c(1,1,2,3),bty="n")

plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years,C14m,col=4)
lines(years,R14m,col=2)
legend("topright",c("Delta 14C Atmosphere","Delta 14C SOM", "Delta 14C Respired"),
lty=c(1,1,1), col=c(1,4,2),bty="n")
par(mfrow=c(1,1))

```

TimeMap

Constructor for TimeMap-class

Description

Constructor for [TimeMap-class](#)

Usage

```

TimeMap(
  map,
  starttime,
  endtime,
  times,
  data,
  lag = 0,
  interpolation = splinefun,
  ...
)

```

Arguments

| | |
|-----------|----------------------|
| map | see method arguments |
| starttime | see method arguments |

| | |
|---------------|----------------------|
| endtime | see method arguments |
| times | see method arguments |
| data | see method arguments |
| lag | see method arguments |
| interpolation | see method arguments |
| ... | see method arguments |

TimeMap,data.frame,missing,missing,missing,missing-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'data.frame,missing,missing,missing,missing'
TimeMap(map, lag = 0, interpolation = splinefun)
```

Arguments

| | |
|---------------|-------------------------|
| map | no manual documentation |
| lag | no manual documentation |
| interpolation | no manual documentation |

TimeMap,function,missing,missing,missing,missing-method
manual constructor for just a function

Description

The interval will be set to [-Inf,Inf]

Usage

```
## S4 method for signature '`function`,missing,missing,missing,missing'
TimeMap(map, lag = 0)
```

Arguments

| | |
|-----|------------|
| map | a function |
| lag | a time lag |

TimeMap,function,numeric,numeric,missing,missing-method
manual constructor for a function and an interval

Description

manual constructor for a function and an interval

Usage

```
## S4 method for signature '`function`,numeric,numeric,missing,missing'
TimeMap(map, starttime, endtime, lag = 0)
```

Arguments

| | |
|-----------|--------------------------|
| map | a function |
| starttime | start time of simulation |
| endtime | end time of simulation |
| lag | a time lag |

TimeMap,list,missing,missing,missing,missing-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'list,missing,missing,missing,missing'
TimeMap(map, lag = 0, interpolation = splinefun)
```

Arguments

| | |
|---------------|--|
| map | A nested list of the form list(times=l1,data=l2) where l1 is a vector or list of the time values and l2 is a list of numbers, vectors, matrices or arrays. |
| lag | Time delay for the created function of time |
| interpolation | The function used to compute the interpolation e.g splinefun Interprets the received list as value table of a time dependent function |

TimeMap,missing,missing,missing,numeric,array-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'missing,missing,missing,numeric,array'  
TimeMap(times, data, lag = 0, interpolation = splinefun)
```

Arguments

| | |
|---------------|-------------------------|
| times | no manual documentation |
| data | no manual documentation |
| lag | no manual documentation |
| interpolation | no manual documentation |

TimeMap,missing,missing,missing,numeric,list-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'missing,missing,missing,numeric,list'  
TimeMap(times, data, lag = 0, interpolation = splinefun)
```

Arguments

| | |
|---------------|-------------------------|
| times | no manual documentation |
| data | no manual documentation |
| lag | no manual documentation |
| interpolation | no manual documentation |

TimeMap,missing,missing,missing,numeric,matrix-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'missing,missing,missing,numeric,matrix'
TimeMap(times, data, lag = 0, interpolation = splinefun)
```

Arguments

| | |
|---------------|-------------------------|
| times | no manual documentation |
| data | no manual documentation |
| lag | no manual documentation |
| interpolation | no manual documentation |

TimeMap,missing,missing,missing,numeric,numeric-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'missing,missing,missing,numeric,numeric'
TimeMap(times, data, lag = 0, interpolation = splinefun)
```

Arguments

| | |
|---------------|-------------------------|
| times | no manual documentation |
| data | no manual documentation |
| lag | no manual documentation |
| interpolation | no manual documentation |

Interpolates the data as function of times and remembers the limits of the time domain.

TimeMap, TimeMap, ANY, ANY, ANY, ANY-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'TimeMap,ANY,ANY,ANY,ANY'
TimeMap(map)
```

Arguments

map no manual documentation

TimeMap-class *S4 class for a time dependent function*

Description

The class represents functions which are defined on a (possibly infinite) interval from [starttime,endtime]. Instances are usually created internally from data frames or lists provided by the user in the high level interfaces.

Details

The class is necessary to be able to detect unwanted extrapolation of time line data which might otherwise occur for some of the following reasons: SoilR allows to specify measured data for many of its arguments and computes the interpolating functions automatically. The functions returned by the standard R interpolation mechanisms like `splinefun` or `approxfun` do not provide a safeguard against accidental extrapolation. Internally SoilR converts nearly all data to time dependent functions e.g. to be used in ode solvers. So the information of the domain of the function has to be kept.

TimeMap.from.DataFrame

TimeMap.from.DataFrame

Description

This function is a deprecated constructor of the class TimeMap.

Usage

```
TimeMap.from.DataFrame(dframe, lag = 0, interpolation = splinefun)
```

Arguments

| | |
|---------------|--|
| dframe | A data frame containing exactly two columns: the first one is interpreted as time |
| lag | a scalar describing the time lag. Positive Values shift the argument of the interpolation function forward in time. (retard its effect) |
| interpolation | A function that returns a function the default is splinefun. Other possible values are the linear interpolation approxfun or any self made function with the same interface. |

Value

An object of class TimeMap that contains the interpolation function and the limits of the time range where the function is valid. Note that the limits change according to the time lag this serves as a safeguard for Model which thus can check that all involved functions of time are actually defined for the times of interest

TimeMap.new

deprecated constructor of the class TimeMap.

Description

deprecated functions ##### use the generic TimeMap(...) instead

Usage

```
TimeMap.new(t_start, t_end, f)
```

Arguments

| | |
|---------|---|
| t_start | A number marking the begin of the time domain where the function is valid |
| t_end | A number the end of the time domain where the function is valid |
| f | The time dependent function definition (a function in R's sense) |

Value

An object of class TimeMap that can be used to describe models.

TimeRangeIntersection *The time interval where both functions are defined*

Description

The time interval where both functions are defined

Usage

TimeRangeIntersection(obj1, obj2)

Arguments

| | |
|------|---|
| obj1 | An object on which getTimeRange can be called |
| obj2 | An object on which getTimeRange can be called |

transitTime *Transit times for compartment models*

Description

Computes the density distribution and mean for the transit time of a constant compartmental model

Usage

transitTime(A, u, a = seq(0, 100), q = c(0.05, 0.5, 0.95))

Arguments

| | |
|---|---|
| A | A constant compartmental square matrix with cycling rates in the diagonal and transfer rates in the off-diagonal. |
| u | A one-column matrix defining the amount of inputs per compartment. |
| a | A sequence of ages to calculate density functions |
| q | Vector of probabilities to calculate quantiles of the transit time distribution |

Value

A list with 3 objects: mean transit time, transit time density distribution, and quantiles.

See Also

[systemAge](#)

TransportDecompositionOperator-class
automatic title

Description

automatic title

turnoverFit *Estimation of the turnover time from a radiocarbon sample.*

Description

This function finds two possible values of turnover time from radiocarbon sample assuming a one pool model with carbon at equilibrium.

Usage

```
turnoverFit(obsC14, obsyr, yr0, Fatm, plot = TRUE, by = 0.5)
```

Arguments

| | |
|--------|--|
| obsC14 | a scalar with the observed radiocarbon value in Delta14C |
| obsyr | a scalar with the year in which the sample was taken. |
| yr0 | The year at which simulations will start. |
| Fatm | an atmospheric radiocarbon curve as data.frame. First column must be time. |
| plot | logical. Should the function produce a plot? |
| by | numeric. The increment of the sequence of years used in the simulations. |

Details

This algorithm takes an observed radiocarbon value and runs [OnepModel14](#), calculates the squared difference between predictions and observations, and uses [optimize](#) to find the minimum difference.

Value

A numeric vector with two values of the turnover time that minimize the difference between the prediction of a one pool model and the observed radiocarbon value.

TwoPoolFeedbackModel *Implementation of a two pool model with feedback structure*

Description

This function creates a model for two pools connected with feedback. It is a wrapper for the more general function [GeneralModel](#).

Usage

```
TwoPoolFeedbackModel(
  t,
  ks,
  a21,
  a12,
  C0,
  In,
  xi = 1,
  solver = deSolve::lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|--------|---|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 2 with the values of the decomposition rate for pools 1 and 2. |
| a21 | A scalar with the value of the transfer rate from pool 1 to pool 2. |
| a12 | A scalar with the value of the transfer rate from pool 2 to pool 1. |
| C0 | A vector of length 2 containing the initial amount of carbon for the 2 pools. |
| In | A data.frame object specifying the amount of litter inputs by time. |
| xi | A scalar or data.frame object specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve::lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

References

Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
#This example show the difference between the three types of two-pool models
times=seq(0,20,by=0.1)
ks=c(k1=0.8,k2=0.00605)
C0=c(C10=5,C20=5)

Temp=rnorm(times,15,2)
WC=runif(times,10,20)
TempEffect=data.frame(times,fT=fT.Daycent1(Temp))
MoistEffect=data.frame(times, fW=fW.Daycent2(WC)[2])

Inmean=1
InRand=data.frame(times,Random.inputs=rnorm(length(times),Inmean,0.2))
InSin=data.frame(times,Inmean+0.5*sin(times*pi*2))

Parallel=TwopParallelModel(t=times,ks=ks,C0=C0,In=Inmean,gam=0.9,
xi=(fT.Daycent1(15)*fW.Demeter(15)))
Series=TwopSeriesModel(t=times,ks=ks,a21=0.2*ks[1],C0=C0,In=InSin,
xi=(fT.Daycent1(15)*fW.Demeter(15)))
Feedback=TwopFeedbackModel(t=times,ks=ks,a21=0.2*ks[1],a12=0.5*ks[2],C0=C0,
In=InRand,xi=MoistEffect)

CtP=getC(Parallel)
CtS=getC(Series)
CtF=getC(Feedback)

RtP=getReleaseFlux(Parallel)
RtS=getReleaseFlux(Series)
RtF=getReleaseFlux(Feedback)

par(mfrow=c(2,1),mar=c(4,4,1,1))
plot(times,rowSums(CtP),type="l",ylim=c(0,20),ylab="Carbon stocks (arbitrary units)",xlab=" ")
lines(times,rowSums(CtS),col=2)
lines(times,rowSums(CtF),col=3)
legend("topleft",c("Two-pool Parallel","Two-pool Series","Two-pool Feedback"),
lty=c(1,1,1),col=c(1,2,3),bty="n")

plot(times,rowSums(RtP),type="l",ylim=c(0,3),ylab="Carbon release (arbitrary units)", xlab="Time")
lines(times,rowSums(RtS),col=2)
lines(times,rowSums(RtF),col=3)
par(mfrow=c(1,1))
```


Description

This function creates a model for two pools connected with feedback. It is a wrapper for the more general function [GeneralModel_14](#) that can handle an arbitrary number of pools.

Usage

```
TwoPoolFeedbackModel14(
  t,
  ks,
  C0,
  F0_Delta14C,
  In,
  a21,
  a12,
  xi = 1,
  inputFc,
  lambda = -0.0001209681,
  lag = 0,
  solver = deSolve::lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. It must be specified within the same period for which the Delta 14 C of the atmosphere is provided. The default period in the provided dataset C14Atm_NH is 1900-2010. |
| ks | A vector of length 2 containing the decomposition rates for the 2 pools. |
| C0 | A vector of length 2 containing the initial amount of carbon for the 2 pools. |
| F0_Delta14C | A vector of length 2 containing the initial amount of the radiocarbon fraction for the 2 pools as Delta14C values in per mil. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| a21 | A scalar with the value of the transfer rate from pool 1 to pool 2. |
| a12 | A scalar with the value of the transfer rate from pool 2 to pool 1. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| inputFc | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |
| lambda | Radioactive decay constant. By default $\lambda = -0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. |
| lag | A positive integer representing a time lag for radiocarbon to enter the system. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve::lsoda.wrapper or any other user provided function with the same interface. |
| pass | Forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

See Also

There are other [predefinedModels](#) and also more general functions like [Model_14](#).

Examples

```
years=seq(1901,2009,by=0.5)
LitterInput=700

Ex=TwopFeedbackModel14(t=years,ks=c(k1=1/2.8, k2=1/35),C0=c(200,5000),
F0_Delta14C=c(0,0),In=LitterInput, a21=0.1,a12=0.01,inputFc=C14Atm_NH)
R14m=getF14R(Ex)
C14m=getF14C(Ex)
C14t=getF14(Ex)

par(mfrow=c(2,1))
plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years, C14t[,1], col=4)
lines(years, C14t[,2],col=4,lwd=2)
legend("topright",c("Delta 14C Atmosphere", "Delta 14C pool 1", "Delta 14C pool 2"),
lty=c(1,1,1),col=c(1,4,4),lwd=c(1,1,2),bty="n")

plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years,C14m,col=4)
lines(years,R14m,col=2)
legend("topright",c("Delta 14C Atmosphere","Delta 14C SOM", "Delta 14C Respired"),
lty=c(1,1,1), col=c(1,4,2),bty="n")
par(mfrow=c(1,1))
```

TwopMMmodel

Implementation of a two-pool Michaelis-Menten model

Description

This function implements a two-pool Michaelis-Menten model with a microbial biomass and a substrate pool.

Usage

```
TwopMMmodel(
  t,
  ks = 1.8e-05,
  kb = 0.007,
  Km = 900,
  r = 0.6,
  Af = 1,
```

```

    ADD = 3.2,
    ival
  )

```

Arguments

| | |
|------|---|
| t | vector of times (in days) to calculate a solution. |
| ks | a scalar representing SOM decomposition rate ($\text{m}^3 \text{d}^{-1} (\text{gCB})^{-1}$) |
| kb | a scalar representing microbial decay rate (d^{-1}) |
| Km | a scalar representing the Michaelis constant (g m^{-3}) |
| r | a scalar representing the respired carbon fraction (unitless) |
| Af | a scalar representing the Activity factor; i.e. a temperature and moisture modifier (unitless) |
| ADD | a scalar representing the annual C input to the soil ($\text{g m}^{-3} \text{d}^{-1}$) |
| ival | a vector of length 2 with the initial values of the SOM pool and the microbial biomass pool (g m^{-3}) |

Details

This implementation is similar to the model described in Manzoni and Porporato (2007).

Value

Microbial biomass over time

References

Manzoni, S, A. Porporato (2007). A theoretical analysis of nonlinearities and feedbacks in soil carbon and nitrogen cycles. *Soil Biology and Biochemistry* 39: 1542-1556.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```

days=seq(0,1000,0.5)
MMmodel=TwopMMmodel(t=days,ival=c(100,10))
Cpools=getC(MMmodel)
matplot(days,Cpools,type="l",ylab="Concentrations",xlab="Days",lty=1,ylim=c(0,max(Cpools)*1.2))
legend("topleft",c("SOM-C", "Microbial biomass"),lty=1,col=c(1,2),bty="n")
ks=0.000018
kb=0.007
r=0.6
ADD=3.2
#Analytical solution of fixed points
#Cs=kb/((1-r)*ks) wrong look at the sympy test print twopMMmodel.pdf
Km=900
Af=1

```

```

Cs=kb*Km/(Af*ks*(1-r)-kb)
abline(h=Cs,lty=2)
Cb=(ADD*(1-r))/(r*kb)
abline(h=Cb,lty=2,col=2)
#State-space diagram
plot(Cpools[,2],Cpools[,1],type="l",ylab="SOM-C",xlab="Microbial biomass")
plot(days,Cpools[,2],type="l",col=2,xlab="Days",ylab="Microbial biomass")

#The default parameterization exhaust the microbial biomass.
#A different behavior is obtained by increasing ks and decreasing kb
MMmodel=TwopMMmodel(t=days,ival=c(972,304),Af=3,kb=0.000001)
Cpools=getC(MMmodel)

matplot(days,Cpools,type="l",ylab="Concentrations",xlab="Days",lty=1,ylim=c(0,max(Cpools)*1.2))
legend("topleft",c("SOM-C", "Microbial biomass"),lty=1,col=c(1,2),bty="n")

plot(Cpools[,2],Cpools[,1],type="l",ylab="SOM-C",xlab="Microbial biomass")

plot(days,Cpools[,2],type="l",col=2,xlab="Days",ylab="Microbial biomass")

```

TwopParallelModel

Implementation of a linear two pool model with parallel structure

Description

This function creates a model for two independent (parallel) pools. It is a wrapper for the more general function [ParallelModel](#) that can handle an arbitrary number of pools.

Usage

```

TwopParallelModel(
  t,
  ks,
  C0,
  In,
  gam,
  xi = 1,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)

```

Arguments

| | |
|----|---|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 2 containing the decomposition rates for the 2 pools. |
| C0 | A vector of length 2 containing the initial amount of carbon for the 2 pools. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |

| | |
|--------|--|
| gam | A scalar representing the partitioning coefficient, i.e. the proportion from the total amount of inputs that goes to pool 1. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | Forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

References

Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
t_start=0
t_end=10
tn=50
timestep=(t_end-t_start)/tn
t=seq(t_start,t_end,timestep)
Ex=TwoParallelModel(t,ks=c(k1=0.5,k2=0.2),C0=c(c10=100, c20=150),In=10,gam=0.7,xi=0.5)
Ct=getC(Ex)
plot(t,rowSums(Ct),type="l",lwd=2,
ylab="Carbon stocks (arbitrary units)",xlab="Time",ylim=c(0,sum(Ct[1,])))
lines(t,Ct[,1],col=2)
lines(t,Ct[,2],col=4)
legend("topright",c("Total C","C in pool 1", "C in pool 2"),
lty=c(1,1,1),col=c(1,2,4),lwd=c(2,1,1),bty="n")

Rt=getReleaseFlux(Ex)
plot(t,rowSums(Rt),type="l",ylab="Carbon released (arbitrary units)",
xlab="Time",lwd=2,ylim=c(0,sum(Rt[1,])))
lines(t,Rt[,1],col=2)
lines(t,Rt[,2],col=4)
legend("topleft",c("Total C release","C release from pool 1", "C release from pool 2"),
lty=c(1,1,1),col=c(1,2,4),lwd=c(2,1,1),bty="n")
```

TwopParallelModel14 *Implementation of a two-pool C14 model with parallel structure*

Description

This function creates a model for two independent (parallel) pools. It is a wrapper for the more general function [GeneralModel_14](#) that can handle an arbitrary number of pools.

Usage

```
TwopParallelModel14(
  t,
  ks,
  C0,
  F0_Delta14C,
  In,
  gam,
  xi = 1,
  inputFc,
  lambda = -0.0001209681,
  lag = 0,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|-------------|---|
| t | A vector containing the points in time where the solution is sought. It must be specified within the same period for which the Delta 14 C of the atmosphere is provided. The default period in the provided dataset C14Atm_NH is 1900-2010. |
| ks | A vector of length 2 containing the decomposition rates for the 2 pools. |
| C0 | A vector of length 2 containing the initial amount of carbon for the 2 pools. |
| F0_Delta14C | A vector of length 2 containing the initial amount of the fraction of radiocarbon for the 2 pools as Delta14C values in per mil. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| gam | A scalar representing the partitioning coefficient, i.e. the proportion from the total amount of inputs that goes to pool 1. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| inputFc | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |
| lambda | Radioactive decay constant. By default $\lambda = -0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. |

| | |
|--------|--|
| lag | A positive scalar representing a time lag for radiocarbon to enter the system. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE Forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

See Also

There are other [predefinedModels](#) and also more general functions like [Model_14](#).

Examples

```
lag <- 2
years=seq(1901+lag,2009,by=0.5)
LitterInput=700
Ex=TwopParallelModel14(t=years,ks=c(k1=1/2.8, k2=1/35),C0=c(200,5000),
F0_Delta14C=c(0,0),In=LitterInput, gam=0.7,inputFc=C14Atm_NH,lag=lag)
R14m=getF14R(Ex)
C14m=getF14C(Ex)
C14t=getF14(Ex)
par(mfrow=c(2,1))
plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years, C14t[,1], col=4)
lines(years, C14t[,2],col=4,lwd=2)
legend("topright",c("Delta 14C Atmosphere", "Delta 14C pool 1", "Delta 14C pool 2"),
lty=c(1,1,1),col=c(1,4,4),lwd=c(1,1,2),bty="n")
plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years,C14m,col=4)
lines(years,R14m,col=2)
legend("topright",c("Delta 14C Atmosphere","Delta 14C SOM", "Delta 14C Respired"),
lty=c(1,1,1), col=c(1,4,2),bty="n")
par(mfrow=c(1,1))
```

TwopSeriesModel

Implementation of a two pool model with series structure

Description

This function creates a model for two pools connected in series. It is a wrapper for the more general function [GeneralModel](#).

Usage

```
TwopSeriesModel(
  t,
  ks,
  a21,
  C0,
  In,
  xi = 1,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)
```

Arguments

| | |
|--------|--|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 2 with the values of the decomposition rate for pools 1 and 2. |
| a21 | A scalar with the value of the transfer rate from pool 1 to pool 2. |
| C0 | A vector of length 2 containing the initial amount of carbon for the 2 pools. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE Forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

References

Sierra, C.A., M. Mueller, S.E. Trumbore. 2012. Models of soil organic matter decomposition: the SoilR package version 1.0. *Geoscientific Model Development* 5, 1045-1060.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
t_start=0
t_end=10
tn=50
timestep=(t_end-t_start)/tn
t=seq(t_start,t_end,timestep)
ks=c(k1=0.8,k2=0.4)
a21=0.5
```



```

C0=c(C10=100,C20=150)
In = 30
#
Temp=rnorm(t,15,1)
TempEffect=data.frame(t,FT.Daycent1(Temp))
#
Ex1=TwopSeriesModel(t,ks,a21,C0,In,xi=TempEffect)
Ct=getC(Ex1)
Rt=getReleaseFlux(Ex1)
#
plot(t,rowSums(Ct),type="l",ylab="Carbon stocks (arbitrary units)",
xlab="Time (arbitrary units)",lwd=2,ylim=c(0,sum(Ct[1,])))
lines(t,Ct[,1],col=2)
lines(t,Ct[,2],col=4)
legend("bottomright",c("Total C","C in pool 1", "C in pool 2"),
lty=c(1,1,1),col=c(1,2,4),lwd=c(2,1,1),bty="n")

```

TwopSeriesModel14

Implementation of a two-pool C14 model with series structure

Description

This function creates a model for two pools connected in series. It is a wrapper for the more general function [GeneralModel_14](#) that can handle an arbitrary number of pools.

Usage

```

TwopSeriesModel14(
  t,
  ks,
  C0,
  F0_Delta14C,
  In,
  a21,
  xi = 1,
  inputFc,
  lambda = -0.0001209681,
  lag = 0,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)

```

Arguments

| | |
|----|---|
| t | A vector containing the points in time where the solution is sought. It must be specified within the same period for which the Delta 14 C of the atmosphere is provided. The default period in the provided dataset C14Atm_NH is 1900-2010. |
| ks | A vector of length 2 containing the decomposition rates for the 2 pools. |

| | |
|-------------|--|
| C0 | A vector of length 2 containing the initial amount of carbon for the 2 pools. |
| F0_Delta14C | A vector of length 2 containing the initial amount of the radiocarbon fraction for the 2 pools as Delta14C values in per mil. |
| In | A scalar or a data.frame object specifying the amount of litter inputs by time. |
| a21 | A scalar with the value of the transfer rate from pool 1 to pool 2. |
| xi | A scalar or a data.frame specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| inputFc | A Data Frame object containing values of atmospheric Delta14C per time. First column must be time values, second column must be Delta14C values in per mil. |
| lambda | Radioactive decay constant. By default $\lambda = -0.0001209681 \text{ y}^{-1}$. This has the side effect that all your time related data are treated as if the time unit was year. |
| lag | A (positive) scalar representing a time lag for radiocarbon to enter the system. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE Forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

See Also

There are other [predefinedModels](#) and also more general functions like [Model_14](#).

Examples

```
years=seq(1901,2009,by=0.5)
LitterInput=700
#
Ex=TwopSeriesModel14(t=years,ks=c(k1=1/2.8, k2=1/35),
C0=c(200,5000), F0_Delta14C=c(0,0),
In=LitterInput, a21=0.1,inputFc=C14Atm_NH)
R14m=getF14R(Ex)
C14m=getF14C(Ex)
C14t=getF14(Ex)
#
par(mfrow=c(2,1))
plot(C14Atm_NH,type="l",xlab="Year",
ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years, C14t[,1], col=4)
lines(years, C14t[,2],col=4,lwd=2)
legend("topright",c("Delta 14C Atmosphere", "Delta 14C pool 1", "Delta 14C pool 2"),
lty=c(1,1,1),col=c(1,4,4),lwd=c(1,1,2),bty="n")
#
plot(C14Atm_NH,type="l",xlab="Year",ylab="Delta 14C (per mil)",xlim=c(1940,2010))
lines(years,C14m,col=4)
```

```

lines(years,R14m,col=2)
legend("topright",c("Delta 14C Atmosphere","Delta 14C SOM", "Delta 14C Respired"),
lty=c(1,1,1), col=c(1,4,2),bty="n")
par(mfrow=c(1,1))

```

| | |
|-----------------|-----------------------------|
| UnBoundInFluxes | <i>Unbound input fluxes</i> |
|-----------------|-----------------------------|

Description

Unbound input fluxes

Usage

UnBoundInFluxes(map)

Arguments

map see method arguments

UnBoundInFluxes, function-method
automatic title

Description

automatic title

Usage

```

## S4 method for signature ``function``
UnBoundInFluxes(map)

```

Arguments

map no manual documentation

UnBoundInFluxes-class *automatic title*

Description

automatic title

UnBoundLinDecompOp *Generic constructor for the class with the same name*

Description

Generic constructor for the class with the same name

Usage

UnBoundLinDecompOp(matFunc)

Arguments

matFunc function providing a compartmental matrix

UnBoundLinDecompOp, function-method
Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

```
## S4 method for signature ``function``
UnBoundLinDecompOp(matFunc)
```

Arguments

matFunc no manual documentation

See Also

Other UnBoundLinDecompOp_constructor: [getFunctionDefinition](#), [UnBoundLinDecompOp-method](#)

UnBoundLinDecompOp-class
An S4 class to represent a linear nonautonomous compartmental matrix

Description

An S4 class to represent a linear nonautonomous compartmental matrix

UnBoundNonLinDecompOp *Generic constructor for the class with the same name*

Description

Generic constructor for the class with the same name

Usage

```
UnBoundNonLinDecompOp(
  matFunc,
  internal_fluxes,
  out_fluxes,
  numberOfPools,
  state_variable_names,
  timeSymbol,
  operator
)
```

Arguments

| | |
|----------------------|---|
| matFunc | function providing a compartmental matrix |
| internal_fluxes | fluxes among pools |
| out_fluxes | fluxes out of the pools |
| numberOfPools | number of pools in the system |
| state_variable_names | names of the pools |
| timeSymbol | character used to represent time |
| operator | a SoilR operator |

UnBoundNonLinDecompOp, function, missing, missing, missing-method
Constructor for the class with the same name

Description

Constructor for the class with the same name

Usage

```
## S4 method for signature ``function`,missing,missing,missing`
UnBoundNonLinDecompOp(matFunc)
```

Arguments

matFunc A matrix valued function of the state vector and time

See Also

Other UnBoundNonLinDecompOp_constructor: [UnBoundNonLinDecompOp,missing,vector,vector,numeric-method](#)

UnBoundNonLinDecompOp,missing,vector,vector,numeric-method
Constructor for the class with the same name

Description

Constructor for the class with the same name

Usage

```
## S4 method for signature 'missing,vector,vector,numeric'
UnBoundNonLinDecompOp(internal_fluxes, out_fluxes, numberOfPools)
```

Arguments

internal_fluxes vector of elements of type InternalFlux_by_PoolName
 out_fluxes vector of elements of type OutFlux_by_PoolName
 numberOfPools number of pools in a model

See Also

Other UnBoundNonLinDecompOp_constructor: [UnBoundNonLinDecompOp,function,missing,missing,missing-method](#)

UnBoundNonLinDecompOp-class
An S4 class to represent a nonlinear nonautonomous compartmental matrix

Description

An S4 class to represent a nonlinear nonautonomous compartmental matrix

 UnBoundNonLinDecompOp_by_PoolNames

Generic constructor for the class with the same name

Description

Generic constructor for the class with the same name

Usage

UnBoundNonLinDecompOp_by_PoolNames(internal_fluxes, out_fluxes, timeSymbol)

Arguments

| | |
|-----------------|----------------------------------|
| internal_fluxes | flux rates among pools |
| out_fluxes | output flux rates from pools |
| timeSymbol | character used to represent time |

 UnBoundNonLinDecompOp_by_PoolNames-class

An S4 class to represent the of nonlinear nonautonomous compartmental system independently of the order of state variables

Description

An S4 class to represent the of nonlinear nonautonomous compartmental system independently of the order of state variables

 Yasso07Model

Implementation of the Yasso07 model

Description

This function creates a model for five pools as described in Tuomi et al. (2009)

Usage

```

Yasso07Model(
  t,
  ks = c(kA = 0.66, kW = 4.3, kE = 0.35, kN = 0.22, kH = 0.0033),
  p = c(p1 = 0.32, p2 = 0.01, p3 = 0.93, p4 = 0.34, p5 = 0, p6 = 0, p7 = 0.035, p8 =
    0.005, p9 = 0.01, p10 = 5e-04, p11 = 0.03, p12 = 0.92, pH = 0.04),
  C0,
  In,
  xi = 1,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)

```

Arguments

| | |
|--------|--|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 5 containing the values of the decomposition rates for each pool. |
| p | A vector of length 13 containing transfer coefficients among different pools. |
| C0 | A vector containing the initial amount of carbon for the 5 pools. The length of this vector must be 5. |
| In | A single scalar or data.frame object specifying the amount of litter inputs by time |
| xi | A scalar or data.frame object specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| solver | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| pass | if TRUE forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

References

Tuomi, M., Thum, T., Jarvinen, H., Fronzek, S., Berg, B., Harmon, M., Trofymow, J., Sevanto, S., and Liski, J. (2009). Leaf litter decomposition-estimates of global variability based on Yasso07 model. *Ecological Modelling*, 220:3362 - 3371.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```

years=seq(0,50,0.1)
C0=rep(100,5)
In=0

Ex1=Yasso07Model(t=years,C0=C0,In=In)
Ct=getC(Ex1)
Rt=getReleaseFlux(Ex1)

plotCPool(years,Ct,col=1:5,xlab="years",ylab="C pool",
ylim=c(0,max(Ct)))
legend("topright",c("xA","xW","xE","xN","xH"),lty=1,col=1:5,bty="n")

plotCPool(years,Rt,col=1:5,xlab="years",ylab="Respiration",ylim=c(0,50))
legend("topright",c("xA","xW","xE","xN","xH"),lty=1,col=1:5,bty="n")

```

YassoModel

Implementation of the Yasso model.

Description

This function creates a model for seven pools as described in Liski et al. (2005). Model not yet implemented due to lack of data in original publication: values of vector p not completely described in paper. 0.1 was assumed.

Usage

```

YassoModel(
  t,
  ks = c(a_fwl = 0.54, a_cwl = 0.03, k_ext = 0.48, k_cel = 0.3, k_lig = 0.22, k_hum1 =
    0.012, k_hum2 = 0.0012),
  p = c(fwl_ext = 0.1, cwl_ext = 0.1, fwl_cel = 0.1, cwl_cel = 0.1, fwl_lig = 0.1,
    cwl_lig = 0.1, pext = 0.05, pcel = 0.24, plig = 0.77, phum1 = 0.51),
  C0,
  In = c(u_fwl = 0.0758, u_cwl = 0.0866, u_nwl_cnwl_ext = 0.251 * 0.3, u_nwl_cnwl_cel =
    0.251 * 0.3, u_nwl_cnwl_lig = 0.251 * 0.3, 0, 0),
  xi = 1,
  solver = deSolve.lsoda.wrapper,
  pass = FALSE
)

```

Arguments

| | |
|------|---|
| t | A vector containing the points in time where the solution is sought. |
| ks | A vector of length 7 containing the values of the exposure and decomposition rates for each pool. |
| p | A vector of containing transfer coefficients among different pools. |

| | |
|---------------------|--|
| <code>C0</code> | A vector containing the initial amount of carbon for the 7 pools. The length of this vector must be 7. |
| <code>In</code> | A vector of constant litter inputs. |
| <code>xi</code> | A scalar or data.frame object specifying the external (environmental and/or edaphic) effects on decomposition rates. |
| <code>solver</code> | A function that solves the system of ODEs. This can be euler or deSolve.lsoda.wrapper or any other user provided function with the same interface. |
| <code>pass</code> | if TRUE forces the constructor to create the model even if it is invalid |

Value

A Model Object that can be further queried

References

Liski, J., Palosuo, T., Peltoniemi, M., and Sievanen, R. (2005). Carbon and decomposition model Yasso for forest soils. *Ecological Modelling*, 189:168-182.

See Also

There are other [predefinedModels](#) and also more general functions like [Model](#).

Examples

```
years=seq(0,500,0.5)
C0=rep(100,7)
#
Ex1=YassoModel(t=years,C0=C0)
Ct=getC(Ex1)
Rt=getReleaseFlux(Ex1)
#
plotCPool(years,Ct,col=1:7,xlab="years",ylab="C pool",ylim=c(0,200))
legend("topright",c("fwl","cwl","ext","cel","lig","hum1","hum2"),lty=1,col=1:7,bty="n")
#
plotCPool(years,Rt,col=1:7,xlab="years",ylab="Respiration",ylim=c(0,50))
legend("topright",c("fwl","cwl","ext","cel","lig","hum1","hum2"),lty=1,col=1:7,bty="n")
```

[,Model,character,missing,missing-method

Experimentally overloaded index operator

Description

The method provides shortcuts and a unified interface to some of the methods that can be applied to a model. For a given model 'M' the code 'M['C']' is equivalent to 'getC(M)' and 'M['ReleaseFlux']' is equivalent to 'getReleaseFlux(M)' 'M['AccumulatedRelease']' is equivalent to 'getAccumulatedRelease(M)'

Usage

```
## S4 method for signature 'Model,character,missing,missing'  
x[i]
```

Arguments

| | |
|---|-------------------------|
| x | no manual documentation |
| i | no manual documentation |

[,NlModel,character,ANY,ANY-method
automatic title

Description

automatic title

Usage

```
## S4 method for signature 'NlModel,character,ANY,ANY'  
x[i]
```

Arguments

| | |
|---|-------------------------|
| x | no manual documentation |
| i | no manual documentation |

[[,MCSim-method *automatic title*

Description

automatic title

Usage

```
## S4 method for signature 'MCSim'  
x[[i]]
```

Arguments

| | |
|---|-------------------------|
| x | no manual documentation |
| i | no manual documentation |

[[<- ,MCSim-method *automatic title*

Description

automatic title

Usage

```
## S4 replacement method for signature 'MCSim'
x[[i, j, ...]] <- value
```

Arguments

| | |
|-------|-------------------------|
| x | no manual documentation |
| i | no manual documentation |
| j | no manual documentation |
| ... | no manual documentation |
| value | no manual documentation |

\$,NlModel-method *automatic title*

Description

automatic title

Usage

```
## S4 method for signature 'NlModel'
x$name
```

Arguments

| | |
|------|-------------------------|
| x | no manual documentation |
| name | no manual documentation |

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