

Package ‘sitreeE’

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Title Sitree Extensions

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Depends R (>= 3.1.0), sitree, data.table

Description Provides extensions for package 'sitree' for allometric variables, growth, mortality, recruitment, management, tree removal and external modifiers functions.

License GPL (>= 2)

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 AM2016ClimateSensitiveSINorway

Climate-sensitive site index models for Norway

Description

Implementation of models for climate-sensitive site index models for Norway as described in Antón-Fernández et al. (2016).

Usage

```
AM2016ClimateSensitiveSINorway(soilquality, t.early.summer, waterbal, SI.spp)
```

Arguments

| | |
|----------------|---|
| soilquality | A factor with levels 1 to 5 indicating the soilquality category. 1 being the poorest soils and 5 the best soils |
| t.early.summer | A vector with sum temperatures (in C) in spring and early summer (april, june and july) |
| waterbal | A vector with the montly moisture surplus in June (difference between the 30-year mean precipitation in June and mean potential evapotranspiration in June.). |
| SI.spp | SI species, that is, the species for which SI should be calculated. 1 = spruce, 2 = pine, 3 = birch. |

Value

Returns a vector with the estimated SI.

Author(s)

Clara Anton-Fernandez

References

Anton-Fernandez, Clara, Blas Mola-Yudego, Lise Dalsgaard, and Rasmus Astrup. 2016. "Climate-Sensitive Site Index Models for Norway." *Canadian Journal of Forest Research* 46 (6)

Examples

```
AM2016ClimateSensitiveSINorway (soilquality = as.factor(c(1,2,3,4)),
                                t.early.summer = c(10,20,30,10),
                                waterbal = c(-40, 20,10,10),
                                SI.spp = c(1,2,2,3))
```

biomass.birch.M1988 *Marklund's biomass equations*

Description

Implements Marklund's (1988) biomass equations for above-ground biomass and Petersson and Ståhl (2006) for below-ground biomass.

Usage

```
biomass.spruce.M1988(dbh.cm, H.m)
biomass.pine.M1988(dbh.cm, H.m)
biomass.birch.M1988(dbh.cm, H.m)
```

Arguments

| | |
|--------|--|
| dbh.cm | A vector with the dbh (diameter at breast height) of the trees, in cm. |
| H.m | A vector with the heights of the trees, in meters. |

Value

It returns a data.frame with the following biomass components in kg: living.branches, dead.branches, stem.wood, stump.roots, bark, usoil, rot1, rot2, and foliage.

Author(s)

Clara Anton Fernandez <caf@nibio.no>

References

Marklund, L. G. 1988. "Biomassfunktioner för tall, gran och björk i Sverige [Biomass functions for pine, spruce and birch in Sweden]." Report 45. Umeå, Sweden: Swedish University of Agricultural Sciences. Department of Forest Survey. Petersson, Hans, and Göran Ståhl. 2006. "Functions for Below-Ground Biomass of Pinus Sylvestris, Picea Abies, Betula Pendula and Betula Pubescens in Sweden." Scandinavian Journal of Forest Research 21 (S7): 84–93.

Examples

```
biomass.spruce.M1988(dbh.cm = c(10, 20), H.m = c(8, 12))
```

biomass.birch.S2014 *Implements biomass functions for birch for Norway from Smith et al (2014, 2016)*

Description

Implements biomass functions for birch for Norway from Smith et al (2014, 2016). Total biomass aboveground does include stump calculated using biomass.birch.M1988. Total biomass belowground does not include stump.

Usage

```
biomass.birch.S2014(dbh.cm, H.m)
```

Arguments

dbh.cm

H.m

Details

It uses stump.roots from biomass.birch.M1988 to calculate aboveground biomass (in kg) and belowground biomass (in kg). Aboveground biomass is calculated as Smith's aboveground biomass (2014) + stump.roots. Belowground biomass is calculated as Smith's belowground biomass (2016) - stump.roots.

Value

Returns a data.frame with the following biomass components: biomass.total.kg, biomass.aboveground.kg.S2014, biomass.belowground.kg.S2014, biomass.belowground.kg, biomass.aboveground.kg, living.branches, dead.branches, stem.wood, stump.roots, bark, usoil, rot1, rot2, foliage)

Author(s)

Clara Anton Fernandez (caf@nibio.no)

References

Smith, Aaron, Aksel Granhus, and Rasmus Astrup. 2016. "Functions for Estimating Belowground and Whole Tree Biomass of Birch in Norway." *Scandinavian Journal of Forest Research* 31 (6): 568–82. Smith, Aaron, Aksel Granhus, Rasmus Astrup, Ole Martin Bollandsås, and Hans Petersson. 2014. "Functions for Estimating Aboveground Biomass of Birch in Norway." *Scandinavian Journal of Forest Research* 29 (6): 565–78.

See Also

[biomass.Norway](#), [biomass.birch.M1988](#)

Examples

```
biomass.birch.S2014(dbh.cm = c(10, 20), H.m = c(12, 16))
```

 biomass.M1988

Biomass functions of Marklund (1988) and Petterson and Sthål (2006)

Description

It implements Marklund (1988) -G20, G12, G16, G8, G5, G26, G31, G28- and Petterson & Sthål (2006) equation for roots < 2mm.

Usage

```
biomass.M1988(tr, spp, this.period)
```

Arguments

| | |
|-------------|---|
| tr | A trList or trListDead object. |
| spp | A vector with the species for each tree in the tr object. The species can be "spruce", "pine", "birch", or "other" (which is treated as birch). |
| this.period | The period for which biomass should be calculated, e.g. "t1". |

Value

It returns a data frame with columns for living branches, dead branches, stem, stump, bark, stump roots, roots1, roots2, and foliage. Units are kg.

Author(s)

Clara Anton Fernandez (caf@nibio.no)

References

Marklund, L. G. 1988. "Biomassfunktioner för tall, gran och björk i Sverige (Biomass functions for pine, spruce and birch in Sweden)." Report 45. Umeå, Sweden: Swedish University of Agricultural Sciences. Department of Forest Survey.

Petersson, Hans, and Göran Ståhl. 2006. "Functions for Below-Ground Biomass of Pinus Sylvestris, Picea Abies, Betula Pendula and Betula Pubescens in Sweden." Scandinavian Journal of Forest Research 21 (S7): 84–93. doi:10.1080/14004080500486864.

Examples

```

res <- sitree (tree.df = tr,
              stand.df = fl,
              functions = list(
                fn.growth = 'grow.dbhinc.hgtinc',
                fn.dbh.inc = "dbhi.BN2009",
                fn.hgt.inc = "height.korf",
                fn.mort = 'mort.B2007',
                fn.recr = 'recr.BBG2008',
                fn.management = 'management.prob',
                fn.tree.removal = 'mng.tree.removal',
                fn.modif = NULL,
                fn.prep.common.vars = 'prep.common.vars.fun'
              ),
              n.periods = 5,
              period.length = 5,
              mng.options = NA,
              print.comments = FALSE,
              species.spruce = c(1, 2, 3),
              species.pine = c(10, 11, 20, 21, 29),
              species.harw = c(30, 31),
              fun.final.felling = "harv.prob",
              fun.thinning = "thin.prob",
              'BN2009',
              'BBG2008', 'SBA.m2.ha', 'spp', 'pr.spru.ba', 'QMD.cm',
              per.vol.harv = 0.83
            )

spp <- sp.classification(tree.sp = tr$tree.sp,
                        species.spruce = c(1, 2, 3),
                        species.pine = c(10, 11, 20, 21, 29),
                        species.harw = c(30, 31)
                      )

biomass.kg <- biomass.M1988(res$live, spp , this.period = "t1")

```

biomass.Norway

Biomass functions for Norway

Description

Implements the currently used functions to estimate biomass in Norway.

Usage

```
biomass.Norway(tr, spp, this.period)
```

Arguments

| | |
|--------------------------|---|
| <code>tr</code> | A <i>trList</i> class object. |
| <code>spp</code> | A vector with the species classification. It can only contain "spruce", "pine", "birch" or "other". |
| <code>this.period</code> | The period for which to calculate biomass. |

Details

If *tr* is of class *trListDead* biomass is estimated for the last measurement. It uses *biomass.spruce.M1988*, *biomass.pine.M1988*, *biomass.birch.S2014*, *biomass.birch.M1988* (to add the stump to aboveground biomass and remove it from belowground biomass from *biomass.birch.S2014* equations).

Value

Returns a list

| | |
|------------------------------------|--|
| <code>biomass.kg</code> | A data.frame with total biomass, biomass aboveground, biomass belowground, all in kg |
| <code>biomass.kg.components</code> | A data.frame with biomass components (see <i>biomass.birch.M1988</i>) in kg |

Author(s)

Clara Anton Fernandez <caf@nibio.no>

References

Marklund, L. G. 1988. "Biomassfunktioner för tall, gran och björk i Sverige (Biomass functions for pine, spruce and birch in Sweden)." Report 45. Umeå, Sweden: Swedish University of Agricultural Sciences. Department of Forest Survey.

Petersson, Hans, and Göran Ståhl. 2006. "Functions for Below-Ground Biomass of *Pinus Sylvestris*, *Picea Abies*, *Betula Pendula* and *Betula Pubescens* in Sweden." *Scandinavian Journal of Forest Research* 21 (S7): 84–93. doi:10.1080/14004080500486864. Smith, Aaron, Aksel Granhus, and Rasmus Astrup. 2016. "Functions for Estimating Belowground and Whole Tree Biomass of Birch in Norway." *Scandinavian Journal of Forest Research* 31 (6): 568–82. Smith, Aaron, Aksel Granhus, Rasmus Astrup, Ole Martin Bollandsås, and Hans Petersson. 2014. "Functions for Estimating Aboveground Biomass of Birch in Norway." *Scandinavian Journal of Forest Research* 29 (6): 565–78.

See Also

[biomass.birch.S2014](#), [biomass.birch.M1988](#)

Examples

```
res <- sitree (tree.df = tr,
              stand.df = fl,
              functions = list(
                fn.growth = 'grow.dbhinc.hgtinc',
```

```

        fn.dbh.inc = "dbh.BN2009",
        fn.hgt.inc = "height.korf",
        fn.mort     = 'mort.B2007',
        fn.recr     = 'recr.BBG2008',
        fn.management = 'management.prob',
        fn.tree.removal = 'mng.tree.removal',
        fn.modif     = NULL,
        fn.prep.common.vars = 'prep.common.vars.fun'
    ),
    n.periods = 5,
    period.length = 5,
    mng.options = NA,
    print.comments = FALSE,
    species.spruce = c(1, 2, 3),
    species.pine = c(10, 11, 20, 21, 29),
    species.harw = c(30, 31),
    fun.final.felling = "harv.prob",
    fun.thinning      = "thin.prob",
    'BN2009',
    'BBG2008', 'SBA.m2.ha', 'spp', 'pr.spru.ba', 'QMD.cm',
    per.vol.harv = 0.83
)
biomass.Norway (tr = res$live,
               spp = sp.classification(res$live$data$tree.sp,
                                       species.spruce = c(1, 2, 3),
                                       species.pine = c(10, 11, 20, 21, 29),
                                       species.harw = c(30, 31)) ,
               this.period = "t1")

```

height.of.X.tallest.trees

Mean height of X tallest trees

Description

It calculates the mean height of the X tallest trees by grouping variable (e.g. the plot ID)

Usage

```
height.of.X.tallest.trees(height, uplotID, num.trees)
```

Arguments

| | |
|-----------|--|
| height | A vector with heights |
| uplotID | A vector with the grouping variable, most often this would be the plot ID. |
| num.trees | Number of trees used to calculate the mean height. |

Value

It returns a data.frame with two columns containing the uplotID and the mean height of the X tallest trees.

Note

This function can be used to calculate the average of the X largest values of any variable grouped by a grouping variable. It is mostly a wrapper for aggregate.

Author(s)

Clara Antón Fernández (caf@nibio.no)

See Also

[lorey.height](#)

Examples

```
height.of.X.tallest.trees(height = tr$height,  
                           uplotID = tr$plot.id, 5)
```

| | |
|--------------|-----------------------|
| lorey.height | <i>Lorey's height</i> |
|--------------|-----------------------|

Description

Calculates Lorey's height (mean height weighted by basal area). If group.id is not NULL, it will calculate Lorey's height for each group.

Usage

```
lorey.height(BA, height, group.id = NULL)
```

Arguments

| | |
|----------|--|
| BA | A vector with the basal areas of the trees |
| height | A vector with the height of the trees |
| group.id | An optional vector with a grouping variable. |

Value

If a grouping variable is provided it returns a data frame with two columns (group.id, and lorey.height).
If a grouping variable is not provided it will return the Lorey's height.

Author(s)

Clara Anton Fernandez (caf@nibio.no)

See Also

[height.of.X.tallest.trees](#)

Examples

```
BA <- pi*(tr$dbh/2)^2
lorey.height(BA, tr$height)
lorey.height(BA, tr$height, tr$plot.id)
```

PBAL

Basal area of larger trees

Description

It calculates the basal area of larger trees for a plot.

Usage

```
PBAL(BA)
```

Arguments

BA A vector of trees basal area

Value

It returns a vector with the sum of the basal areas of larger trees. Trees with similar BA are not considered larger.

Examples

```
PBAL(c(1, 2, 3, 4, 4))
```

| | |
|------------------|--|
| PBAL.dbh.greater | <i>Basal area of larger trees which are at least X cm larger than the tree of interest</i> |
|------------------|--|

Description

Calculates the basal area (in cm² if dbh is in mm) of trees that are at least X (in the same units as dbh) larger than the tree of interest for a list of trees.

Usage

```
PBAL.dbh.greater(dbh.mm, dbh.mm.diff)
```

Arguments

| | |
|-------------|---|
| dbh.mm | a vector of dbh in mm |
| dbh.mm.diff | minimum dbh difference between the tree and the tree of interest to be considered |

Details

It estimates the basal area (in cm²) of trees that are at least dbh.mm.diff mm larger than the tree of interest.

Value

It returns a list with the basal area of larger trees.

Author(s)

Cara Antón-Fernández (email: caf@nibio.no)

See Also

[PBAL](#)

Examples

```
PBAL.dbh.greater(c(100,89,51,74,4), 3)
aggregate(dbh ~ plot.id, data = tr, FUN = PBAL.dbh.greater, dbh.mm.diff = 2)
```

picea.abies.vol *Volumes for Norwegian species*

Description

These functions calculate tree volume with or without bark for the main species in Norway, that is, Norway spruce, Scots pine, Sitka spruce, birch, and ... following Braastad (1966), Brantseg (1967), and Vestjordet (1967).

Usage

```
picea.abies.vol(dbh, trh, bark, units)
picea.abies.volV(dbh, trh, bark, units)
pinus.sylvestris.vol(dbh, trh, bark, units)
pinus.sylvestris.volV(dbh, trh, bark, units)
sitka.vol(dbh, trh, bark, units)
harw.nor.vol(tsl, dbh, trh, bark, units)
```

Arguments

| | |
|-------|---|
| dbh | A vector with diameters at breast height in mm with bark. |
| trh | A vector with tree heights in cm. |
| bark | If tree volume should be calculated with bark, "mb", or without bark, "ub". |
| units | "l" in liters, "c" in cubic centimeters. |
| tsl | Tree species 30 (), 31(), 32 (), 40(), 41(), 50(), NA. This only affects the calculations of diameter without bark. |

Value

Returns tree volume in the selected units.

References

Braastad, H. 1966. Volumtabeller for bjoerk [Volume tables for birch]. Meddelelser fra Det norske Skogforsøksvesen 21: 23–78. Brantseg, A. 1967. Furu sønnafjells. Kubering av staaende skog. Funksjoner og tabeller [Volume functions and tables for Scots pine. South Norway]. Meddelelser fra Det norske Skogforsøksvesen 22: 695–739. Vestjordet, E. 1967. Funksjoner og tabeller for kubering av staaende gran [Functions and tables for volume of standing trees. Norway spruce]. Meddelelser fra Det norske Skogforsøksvesen 22. Ås, Norway: Norwegian Forest and Landscape Institute.

Examples

```
harw.nor.vol(tsl = c(30,31), dbh = c(45, 25), trh = c(120, 80), bark = "ub", units = "l")
```

| | |
|----------------|--|
| PlotDataToLong | <i>Convert Plot data to a data.frame/data.table format</i> |
|----------------|--|

Description

It attempts to convert the plot level information to a data.frame/data.list format. For example, if management is an element of the plot list (pd) it will melt it to a long format.

Usage

```
PlotDataToLong(pd)
```

Arguments

| | |
|----|--|
| pd | A list with plot information. It specifically looks for two elements 'stand.age.years' and 'management'. |
|----|--|

Value

It returns a data.table with all vector from pd as columns, and dataframes melted.

Examples

```
result.sitree <- sitree (tree.df = tr,stand.df = fl,
  functions = list(fn.growth = 'grow.dbhinc.hgtinc',
  fn.dbh.inc = "dbh.BN2009",
  fn.hgt.inc = "height.korf",
  fn.mort = 'mort.B2007',
  fn.recr = 'recr.BBG2008',
  fn.management = 'management.prob',
  fn.tree.removal = 'mng.tree.removal',
  fn.modif = NULL,
  fn.prep.common.vars = 'prep.common.vars.fun'),
  n.periods = 5,
  period.length = 5,mng.options = NA,
  print.comments = FALSE,
  species.spruce = c(1, 2, 3),
  species.pine = c(10, 11, 20, 21, 29),species.harw = c(30, 31),
  fun.final.felling = "harv.prob",fun.thinning =
  "thin.prob",'BN2009','BBG2008',
  'SBA.m2.ha','spp','pr.spru.ba','QMD.cm',per.vol.harv = 0.83)

PlotDataToLong(result.sitree$plot.data)
```

| | |
|------------|---|
| top.height | <i>Top height of the n thickest trees</i> |
|------------|---|

Description

Average height of the n thickest trees per ha

Usage

```
top.height(thickness, height, num.trees.per.ha, plot.id, plot.size.m2)
```

Arguments

| | |
|------------------|--|
| thickness | A vector with the thickness for every tree. Other variables can be used instead to thickness. This is only used to order the trees. |
| height | Height of the trees. |
| num.trees.per.ha | Number of trees per ha that the top height should correspond to. E.g. 100 trees per ha. |
| plot.id | Vector with the plot.id to which every tree corresponds to. |
| plot.size.m2 | Plot size in square meters. It can be either a single number if all plots have the same size or a vector of equal length as thickness, height, and plot.id with the corresponding plot size for each tree. |

Details

thickness, height, and plot.id should have the same length, that is, one value per tree.

Value

It returns a data.frame with two columns: top.heights in the same units as height, and plot.id.

Examples

```
top.height(thickness = runif(100, 10,40), height = runif(100, 12, 45),  
           num.trees.per.ha = 100, plot.id = 1, plot.size.m2 = 250)
```

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