

Package: linkages (via r-universe)

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Type Package

Title A Linked Forest Productivity - Soil Process Model

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Description LINKAGES is a forest gap model originally written in FORTRAN by Pastor and Post in 1985.

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LazyData TRUE

Imports reshape2,ggplot2,Matrix,microbenchmark

RoxygenNote 6.0.1

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birth	<i>LINKAGES birth function</i>
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Description

BIRTH CALCULATES SEEDLING AND SPROUT BIRTH BASED ON SPECIES FECUNDITY, SEEDBED CONDITIONS, SUSCEPTIBILITY TO BROWSING, AND THE DEGREE TO WHICH LIGHT, SOIL MOISTURE, AND DEGREE DAYS ARE LESS THAN OPTIMUM FOR GROWTH. SOIL MOISTURE AND DEGREE DAY MULTIPLIERS ARE SUPPLIED BY SUBROUTINE GMULT. A SPECIES CAN HAVE SPROUTS IF AT LEAST ONE TREE WITH DIAMETER BETWEEN SPRTMN AND SPRTMX DIED LAST YEAR (KSPRT INCREMENTED BY 1 IN KILL). RANDOM NUMBERS USED TO DETERMINE OCCURENCE OF BROWSING, NUMBERS OF SEEDLINGS AND SPROUTS, AND DBH SUPPLIED BY rand.

Usage

```
birth(nspec, ntrees, frt, iage, slta, sltb, dbh, fwt, switch.mat, degd, dmin,
      dmax, frost, rt, itol, mplant, nogro, ksprt, sprtnd, max.ind, smgf, degdgf)
```

Arguments

nspec	number of species
ntrees	number of trees of each species
frt	foliage retention time
iage	age of each individual
slta	parameter to calculate crown area from diameter
sltb	parameter to calculate crown area from diameter
dbh	diameter of each individual
fwt	leaf weight per unit crown area
switch.mat	TRUE/FALSE switches for each species
degd	growing degree days from tempe.R
dmin	degree day minimum for each species
dmax	degree day maximum for each species
frost	minimum January temperature tolerated
rt	current monthly temperatures
itol	shade tolerance code for each species
mplant	maximum seeding in rate per plot
nogro	flags individuals that aren't growing well
ksprt	flags individuals that could sprout
sprtnd	number of sprouts per stump
max.ind	maximum number of individuals in a plot
smgf	soil moisture growing factor from gmult.R
degdgf	growing degree day growing factor from gmult.R

Value

iage age of each individual
 dbh diameter of each individual
 nogro flags individuals growing slowly
 ntrees number of trees of each species
 newtr records species considered 'eligible'
 ksprt flags individuals that could sprout

Author(s)

Ann Raiho

decomp	<i>LINKAGES decomp function</i>
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Description

DECOMP CALCULATES CARBON AND NITROGEN FLOWS THROUGH SOIL. AVAILABLE N (AVAILN) IS USED IN GMULT TO CALCULATE SOIL NITROGEN GROWTH MULTIPLIERS. AET IS FED IN FROM MOIST. THIS YEAR'S LEAF, TWIG, ROOT, AND WOOD LITTER IS FED IN FROM KILL (ARRAY TYL). THE SIMULATION STARTS ON BARE GROUND (ONLY HUMUS PRESENT. BASESC AND BASESN ARE STARTING HUMUS WEIGHT AND N CONTENTS READ IN INPUT). THREE TYPES OF SOIL ORGANIC MATTER ARE RECOGNIZED: COHORTS EITHER IMMOBILIZING OR RAPIDLY MINERALIZING NITROGEN AND A HOMOGENOUS HUMUS POOL SLOWLY MINERALIZING N.

Usage

decomp(fdat, aet, ncohort, fc, dry, tyl, C.mat)

Arguments

fdat	current year
aet	average temperature by month for current year
ncohort	average precipitation by month for current year
fc	field capacity
dry	wilting point
tyl	total yearly litter
C.mat	carbon matrix

Value

ff weights and n content of forest floor by litter type
 availn available N
 tyln leaf litter N content
 hcn humus C:N ratio
 sco2 total soil co2-c
 ncohort number of cohorts
 C.mat matrix for data on litter cohorts

Author(s)

Ann Raiho

gmult

LINKAGES gmult function

Description

GMULT CALCULATES DEGREE DAY, SOIL MOISTURE, AND SOIL NITROGEN MULTIPLIERS USED IN SUBROUTINES BIRTH AND GROW BASED ON ON DEGD (SUPPLIED BY TEMPE), FJ (SUPPLIED BY MOIST), AND AVAILN (SUPPLIED BY DECOMP), RESPECTIVELY.

Usage

```
gmult(egs, bgs, availn, degd, dmin, dmax, d3, fj, cm1, cm3, cm2, cm4, cm5,
      nspec)
```

Arguments

egs	end of growing season day of year
bgs	beginning of growing season day of year
availn	available nitrogen
degd	total growing degree days
dmin	degree day minimum for each species
dmax	degree day maximum for each species
d3	drought tolerance (fraction of the growing season)
fj	number of dry days
cm1	parameter for nitrogen growth multipliers
cm3	parameter for nitrogen growth multipliers
cm2	parameter for nitrogen growth multipliers
cm4	parameter for nitrogen growth multipliers
cm5	parameter for nitrogen growth multipliers
nspec	number of species

Value

smgf soil moisture growth factor
 sngf soil nitrogen growth factor
 degdgf growing degree day growth factor
 availn available nitrogen

Author(s)

Ann Raiho

grow

LINKAGES growth function

Description

GROW CALCULATES DIAMETER GROWTH FOR EACH TREE BY DECREASING MAXIMAL GROWTH TO THE EXTENT THAT THE MOST LIMITING RESOURCE IS LESS THAN OPTIMAL.

Usage

```
grow(max.ind, nspec, ntrees, frt, slta, sltb, dbh, fwt, b2, b3, itol, g, degdgf,
     smgf, sngf, frost, rt, iage, nogro)
```

Arguments

max.ind	maximum number of individuals
nspec	number of species
ntrees	number of trees of each species
frt	foliage retention time
slta	parameter to calculate crown area from diameter
sltb	parameter to calculate crown area from diameter
dbh	diameter of each tree
fwt	leaf weight per unit crown area
b2	growth scaling parameter
b3	growth scaling parameter
itol	shade tolerance code for each species
g	scalar for species maximum diameter increment
degdgf	growing degree day growth factor from gmult.R
smgf	soil moisture growth factor from gmult.R
sngf	soil nitrogen growth factor from gmult.R

frost	minimum January temperature tolerated
rt	current monthly temperature
iage	age of each individual
nogro	flags slow growing individuals

Value

dbh diameter of each individual
 ntrees number of trees of each species
 awp aboveground woody production

Author(s)

Ann Raiho

hello	<i>Hello, World!</i>
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Description

Prints 'Hello, world!'.

Usage

hello()

Examples

hello()

kill	<i>LINKAGES kill function</i>
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Description

KILL KILLS TREES BY AGE DEPENDENT MORTALITY (ONLY 1 REACH MAXIMUM AGE) AND AGE INDEPENDENT MORTALITY (PROBABILITY OF SURVIVING 10 CONSECUTIVE YEARS OF SLOW GROWTH (SEE GROW) = 1 DECISIONS ON WHETHER OR NOT TO KILL A TREE ARE PARTLY BASED ON RANDOM NUMBERS SUPPLIED BY rand. KILL ALSO CALCULATES LITTER AMOUNTS, WHICH ARE DECAYED IN SUBROUTINE DECOMP.

Usage

kill(nspec, ntrees, slta, sltb, dbh, agemx, ksprt, sptm, sptmx, iage, nogro, tl, rtst, fwt, max.ind, frt)

Arguments

<i>n</i> spec	number of species
<i>n</i> trees	number of trees of each species
<i>s</i> lta	parameter to calculate crown area from diameter
<i>s</i> ltb	parameter to calculate crown area from diameter
<i>dbh</i>	diameter of each individual
<i>age</i> mx	max age
<i>ks</i> prt	flags if stump can sprout
<i>s</i> prtmn	minimum diameter for a stump to sprout
<i>s</i> prtmx	maximum diameter for a stump to sprout
<i>i</i> age	age of each individual
<i>no</i> gro	flags slow growing individuals
<i>t</i> l	leaf litter quality class
<i>r</i> tst	root-shoot ratio for each species
<i>f</i> wt	leaf weight per unit crown area
<i>max</i> .ind	maximum number of individuals
<i>f</i> rt	foliage retention time
<i>n</i> cohort	number of cohorts

Value

<i>dbh</i>	diameter of each individual
<i>n</i> trees	number of trees of each species
<i>i</i> age	age of each individual
<i>no</i> gro	flags individuals growing slowly
<i>n</i> cohort	number of cohorts
<i>t</i> yl	total yearly litter,
<i>ks</i> prt	flags stumps that could sprout

Author(s)

Ann Raiho

 linkages

LINKAGES main function

Description

Main function for running all LINKAGES subroutines

Usage

```
linkages(linkages.input, outdir, restart = NULL, linkages.restart = NULL)
```

Arguments

iplot	PEcAn settings object
nyear	number of years
nspec	number of species
fc	field capacity
dry	wilting point
bgs	beginning of growing season
egs	end of growing season
max.ind	maximum number of individuals allowed to grow in a plot
plat	latitude
temp.mat	monthly temperature matrix (nyear x 12)
precip.mat	monthly precipitation matrix (nyear x 12)
spp.params	species parameter matrix
switch.mat	species switches matrix
fdat	underground parameter matrix
clat	climate correction factor matrix
basesc	initial humus weight
basesn	initial N in soil

Value

year vector of years
 ag.biomass above ground biomass in kgC/m²
 total.soil.carbon soil organic matter + leaf litter in kgC/m²
 leaf.litter leaf litter in kgC/m²
 ag.npp above ground net primary production in kgC/m²/second
 hetero.resp heterotrophic respiration in kgC/m²/second
 nee net ecosystem exchange in kgC/m²/second

et annual evapotranspiration kgC/m2/s
 agb.pft = agb.pft above ground biomass by plant functional type (species in LINKAGES)
 f.comp = f.comp fractional composition (sums to 1 each year)
 ntrees.birth=ntrees.birth number of trees born of each species each year
 ntrees.kill = ntrees.kill number of trees killed of each species each year
 tstem=tstem stem density
 tab=tab total aboveground biomass without unit conversion
 fl=fl total leaf litter without unit conversion
 totl=totl leaf litter nitrogen
 tnap=tnap total net above ground production without unit conversion
 avln=avln available nitrogen
 cn=cn carbon to nitrogen ratio
 sco2c=sco2c soil respiration without unit conversion
 som=som soil organic matter
 bar=bar biomass by species without unit conversion
 aet.save=aet.save annual evapotranspiration without unit conversion
 nogro.save=nogro.save matrix of trees not growing each year
 dbh.save=dbh.save matrix of dbh increment of trees each year
 iage.save=iage.save matrix of age of each tree each year

Author(s)

Ann Raiho

moist

LINKAGES moist function

Description

Calculates actual evapotranspiration (AET) for the current year

Usage

moist(kyr, temp.vec, precip.vec, fc, dry, bgs, egs, plat, clat)

Value

atot total number of trees per ha
 tbar total aboveground biomass
 tyln leaf litter N content
 tynap total aboveground production
 availn available N
 bar species biomass t/ha

Author(s)

Ann Raiho

plotin *LINKAGES plotin function*

Description

Sets up initial conditions for LINKAGES

Usage

plotin(iplot, basesc, basesn, max.ind, nspec)

Arguments

iplot	number of plots
basesc	initial humus weight
basesn	initial humus nitrogen content
max.ind	maximum number of individuals
nspec	number of species in simulation

Value

ntrees matrix for number of trees for each species
 dbh matrix for diameter at breast height for each tree
 nogro used to flag slow growing trees
 ksprt used to flag trees eligible to sprout
 iage matrix for age of each tree
 C.mat matrix for data on litter cohorts
 ncohort number of cohorts
 tyl total yearly litter

Author(s)

Ann Raiho

tempe

LINKAGES tempe function

Description

Calculates total growing degree days for each year, i

Usage

tempe(temp.vec)

Arguments

temp.vec mean temperature for each month

Value

degd total growing degree days for each year

Author(s)

Ann Raiho

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