

Package ‘BGDB’

September 1, 2020

Type Package

Title Create EU critical load background database

Version 0.3

Date 20200828

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Description All you need for an European background database of S,N critical loads

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LazyData TRUE

Imports

RoxygenNote 7.1.0

Suggests knitr, rmarkdown

VignetteBuilder knitr

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argridd	<i>argridd</i>
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Description

the area of a 'grid cell' on a sphere of radius R in double precision of 'dlon' degrees east-west extension and 'dlat' degrees north-south extension with its southern border at latitude 'ylat' (in degrees).

Usage

```
argridd(ylat, dlon, dlat = dlon, R = 6371)
```

Arguments

ylat	latitude of southern border of grid cell
dlon	east-west extension of grid cell (in degrees)
dlat	north-south extension of grid cell (in degrees)
R	Radius of sphere #Radius of the earth ranges from 6,378 km at the equator to 6,357 km at a pole.

Value

Area

Author(s)

M. Posch, ported to R by jaap slootweg

 claysilt

claysilt

Description

Clay and silt content texture class and texture triangle

Usage

```
claysilt(itex)
```

Arguments

itex Texture class

Details

Clay and silt content (gravity in texture triangle. If peat or unknown take c(5,20)

Value

c(clay,silt,sand) in %

Author(s)

GJ Reinds , ported to R by jaap slootweg

 contBcNP

contBcNP

Description

contents % of N, Ca, Mg, K and P (in eq/kg)

Usage

```
contBcNP(iopt)
```

Arguments

iopt stems (iopt=1) or stems+branches (iopt=2)

Details

Note: For iopt=2 this is NOT the average content of stems+branches, but the content, when multiplied by stem growth, gives the growth of stems+branches (assuming branches have the same growth rate)! Source: Table 5.8 in MapMan and Jacobsen et al (2002) other_c = mean of pine & spruce other_b = mean of oak & beech & birch

Value

rbind(1=pine, 2=spruce, 3=other_c, 4=beech, 5=oak, 6=birch, 7=other_b)

Author(s)

M. Posch, ported to R by jaap slootweg

coslin	<i>coslin</i>
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Description

Function used in PET and AET calculations (IMAGE 2.1) Ref: Federer CA, 1982. Transpirational supply and demand: plant, soil and atmospheric effects evaluated by simulation. Water Resources Research 18(2): 355-362

Usage

```
coslin(u, v)
```

Arguments

u	see ref
v	see ref

Author(s)

M. Posch, ported to R by jaap slootweg

Daycosz	<i>Daycosz</i>
---------	----------------

Description

integral over $\cos(z)$, where z is the Sun's zenith angle (integrated over the length of the day)

Usage

```
Daycosz(jul, lambda)
```

Arguments

jul	Julian day, or Day Of Year (1..365)
lambda	latitude (radian)

Value

maximum (at clear sky) daily downward solar radiation (and NOT length of half of day 'jul', i.e. the time between true noon and sunset) ! tset hours of daylight till sunset after true noon (i.e. length of day = 2*tset)

Author(s)

M. Posch , ported to R by jaap slootweg

declinat

declinat

Description

Returns the solar declination (i.e. the angle between a line joining the centres of Sun and Earth and the Earth's equatorial plane) in radians as function of the Julian day 'jul' (1-365).

Usage

```
declinat(jul)
```

Arguments

jul julian day (DOY = "day of year")

Details

Ref: Spencer JW, 1971. Fourier series representation of the position of the Sun. Search 2(5): 172 quoted in: Iqbal M, 1983. An Introduction to Radiation in the Atmosphere. Academic Press

Author(s)

M. Posch, ported to R by jaap slootweg

EfromLog

EfromLog

Description

Returns the X-Y Exchange constant KXY from its Log10 'lgK' (in 'mol/L') for the Gaines-Thomas (modExc=1), Gapon (modExc=2) or Kerr (modExc=3) cation exchange model.

Usage

```
EfromLog(modExc = 2, lgK, m, n, lit)
```

Arguments

modExc • 1: Gaines-Thomas
 • 2: Gapon
 • 3: Kerr

lgK

m m and n are the charges, see description

n m and n are the charges, see description

lit integer defining the output unit: eq/(10^{lit}*L), e.g. for lit=3 it is eq/m³

Details

Ref: Common Knowledge; see also App.C of the 2003 CCE Status Report.

- 1: Gaines-Thomas: $EX^n / EY^m = KXY * [Xm+]^n / [Yn+]^m$
- 2: Gapon: $EX / EY = KXY * [Xm+]^{1/m} / [Yn+]^{1/n}$
- 3: Kerr: $EX / EY = KXY * [Xm+] / [Yn+]$

Value

The output unit is eq/(10^{lit}*L), e.g. for lit=3 it is eq/m³.

Author(s)

M. Posch, ported to R by jaap slootweg

Falbedo

Falbedo

Description

Returns 'interpolated' albedo depending on snow cover.

Usage

```
Falbedo(albsno, albveg, snow)
```

Arguments

albsno	albedo of snow cover
albveg	albedo of vegetation (surface) under snow cover
snow	snow cover expressed as mm of water

Author(s)

M. Posch, ported to R by jaap slootweg

fK_{HCO3}*fK_{HCO3}***Description**

Returns the bicarbonate equilibrium constant in (mol/m³)²/atm

Usage

```
fKHCO3(temp)
```

Arguments

```
temp          Temperature (oC)
```

Details

[HCO₃] = pCO₂*K_{HCO3}/[H], as a function of temperature (in oC), where K_{HCO3} = K_H*K₁ ...
Henry's law constant * first dissociation constant [= 10^{-1.8} = 0.0158489 (mol/m³)²/atm at 25oC]
Ref: Harned and Davis (1943), quoted in Cosby et al. (1985).

Value

K_{HCO3}

Author(s)

M. Posch, ported to R by jaap slootweg

FlgK_{Al_{ox}}*FlgK_{Al_{ox}}***Description**

Returns log₁₀(K_{Al_{ox}}) (Al-H equilibrium constant) as a function of temperature (oC) and the log₁₀ of the ref-value at 10oC.

Usage

```
FlgKAlox(lgKAlox, temp)
```

Arguments

```
lgKAlox  
temp
```

Value

log₁₀(K_{Al_{ox}})

Author(s)

M. Posch, ported to R by jaap slootweg

fOliver	<i>fOliver</i>
---------	----------------

Description

fOliver

Usage

```
fOliver(cH, mDOC, pKpar)
```

Arguments

cH	[H+] (eq/m ³ =mol/m ³)
mDOC	total concentration of organic acids (m*DOC) (mol/m ³)
pKpar	parameter(s) for the equation; can be of length 1 or 3

Details

If length(pKpar)==1: simple mono-protic model with $pK = pKpar[1]$,
 else $pK = par[1]+par[2]*pH-par[3]*pH^2$

Value

concentration of mono-protic organic anions in mol/m³=eq/m³

Author(s)

M. Posch, ported to R by jaap slootweg

F_DOC	<i>F_DOC</i>
-------	--------------

Description

Derived from FIMCI data, not including NL data (8-Oct-03) Confirmed for 0-20 cm and derived for 0-40 cm on 28-Sep-16

Usage

```
F_DOC(pH, itex)
```

Arguments

pH	pH
itex	texture class

Value

DOC in molC/m3.

Author(s)

GJ Reinds , ported to R by jaap slootweg

get1BCdep *get1BCdep*

Description

BC & Cl deposition based on function of distance to coast

Usage

```
get1BCdep(xlonylat, d2coast)
```

Arguments

<code>xlonylat</code>	coordinates (vector of length 2, or matrix with 2 columns) for which depositions are required named variables are expected : c(lon,lat)
<code>d2coast</code>	distance to the coast

Details

returns BC & Cl deposition based on distance to coast

Value

Deposition BC and Cl as the Ions "structure"

Author(s)

M. Posch, ported to R by jaap slootweg

getKAlox *getKAlox*

Description

Returns log10(KAlox) and expAl as function of:
ialfa =1: variable alfa in $[Al]=KAlox*[H]^{\text{alfa}}$
ialfa =2: alfa=3 (gibbsite equilibrium)
itex texture class (1,2,[>=]3)

Usage

```
getKAlox(ialfa = 2, itex)
```

Arguments

<code>ialfa</code>	see description
<code>itex</code>	texture index

Value

Deposition BC and Cl as Ions

Author(s)

M. Posch, ported to R by jaap slootweg

`get_inp`*get_inp*

Description

set input constants, possibly depending on other constants

Usage

```
get_inp(iNopt)
```

Arguments

<code>iNopt</code>	see EUpaR.R
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Details

The following variables are set in the global environment!! notice «- ztop, cont, Alox0, expH, ibc, ialsp, Sadmax, Sadh, modOrg, chdens, KOrgv, KAIOrgv, fdev, cmin, cNaccv This needs improving for readability

Value

Side effects only, but a lot!!

Author(s)

M. Posch, ported to R by jaap slootweg

Intcosz	<i>Intcosz</i>
---------	----------------

Description

Returns for a given Julian day 'jul' the Integral over $\cos(z)$, where z is the Sun's zenith angle (integrated over the length of the day) It also returns the length of half of day 'jul', i.e. the time between true noon and sunset (see routine 'sunset')

Usage

```
Intcosz(jul, lambda)
```

Arguments

jul number of Julian day (1-366)
lambda latitude (radian)

Value

coszint ..., integral over $\cos(z)$ (hours) AND tset hours of daylight till sunset after true noon

Author(s)

M. Posch, ported to R by jaap slootweg

Ions	<i>Ions</i>
------	-------------

Description

Initialise an Ions matrix, or vector (if asMatrix == F, see below)

Usage

```
Ions(asMatrix = T, ...)
```

Arguments

asMatrix	should the function return a matrix [,length(ionNames)] or a vector.
...	named numeric (singular or vector), with name one of ionNames

Details

use of Ions in this package

Value

Matrix or vector of Ions 'type'

Author(s)

jaap slootweg

llemep

llemep

Description

This subroutine computes for a point (xlon,ylat), where xlon is the longitude (<0 west of Greenwich) and ylat is the latitude (<0 south of the Equator) in degrees, its EMEP coordinates (emepi,emepj) with parameters given in par().

Usage

```
llemep(xlon, ylat, cellSizeKM = 50, xp = 8, yp = 110)
```

Arguments

xlon	(vector of) longitude
ylat	(vector of) latitude
cellSizeKM	= size of grid cell (km)
xp	EMEP coordinates of the North Pole
yp	EMEP coordinates of the North Pole

Details

See Appendix a in the 2003 CCE Status Report

Value

matrix[length(xlon),2] of emepi, emepj

Author(s)

M. Posch, ported to R by jaap slootweg

MualvGen

MualvGen

Description

Computes soil water content at saturation and soil water content at the given pressure head from soil properties using the Mualem-vanGenuchten equation. Refs: Van Genuchten MT, 1980. A closed-form equation for predicting the hydraulic conductivity of unsaturated soils. SSSA Journal 44: 892-898 Woesten JHM, Lilly A, Nemes A, Le Bas C, 1999. Development and use of a database of hydraulic properties of European soils. Geoderma 90:169-185 (Table 5)

Usage

```
MualvGen(rhoOMclaysilt, topsoil, head)
```

Arguments

topsoil	1=topsoil, 0=subsoil
head	pressure head (cm) (can be given as positive or negative value!)
rho	bulk density (g/cm ³)
OM	percent organic matter
clay	percent clay
silt	percent silt

Value

data.frame with thetas (soil water content at saturation) and theta(soil water content)

Author(s)

M. Posch, ported to R by jaap slootweg

pedo_rho

pedo_rho

Description

Returns soil bulk density (in Mg/m³=g/cm³) as a function of organic C, clay and silt (all in %) for the model chosen by iopt (1-5).

Usage

```
pedo_rho(orgCclaysilt, iopt = NULL)
```

Arguments

orgCclaysilt data.frame-ish with orgC clay silt
 iopt

- 1: Manrique & Jones (1991)
- 2: Kaur et al. (2002)
- 3: Adams (1973)
- 4: Harrison & Boccock (1981)
- 5: Jeffrey (1970)

Details

For an overview see: De Vos B, Van Meirvenne M, Quataert P, Deckers J, Muys B, 2005. Predictive quality of pedotransfer functions for estimating bulk density of forest soils. Soil Science Society of America Journal 69: 500-510

If iopt is not set (NULL), which is the default, than iopt = 2 if clay is present, else iopt = 1 if OrgC is present, otherwise the value is returned.

Value

soil bulk density (in Mg/m³=g/cm³)

Author(s)

M. Posch, ported to R by jaap slootweg

petaet

petaet

Description

Returns daily PET, AET, soil moisture, percolation and quickflow, using daily input data for one year (365 days)

Usage

```
petaet (
  ylat,
  SolConstv,
  declicosv,
  declisinv,
  tset,
  coszintv,
  temp,
  prec,
  rads,
  fsun,
  albveg,
  swwilt,
  swfcap,
  swsat,
  snow,
  smold
)
```

Arguments

ylat	latitude
SolConstv	solar constant (W/m2) for Julian days 1-365
declisinv	sine of solar declination for Julian days 1-365
tset	hours of daylight till sunset after true noon (i.e. length of day = 2*tset)
coszintv	integral over cos(z) (z=Sun's zenith angle) (hours) for Julian days 1-365
temp	mean temperature on day j (oC)
rads	daily downward short-wave radiation (W/m2)
fsun	sunshine fraction on day j (0-1)
albveg	albedo of vegetation
swwilt	soil water at wilting point (mm)
swfcap	soil water at field capacity (mm)
swsat	soil water at saturation (mm)
snow	depth of snow in water equivalents (mm) and watin; is now data.frame; watin = prec+-snow
smold	initial soil moisture (mm)

Details

Refs: Prentice IC, Sykes MT, Cramer W (1993) A simulation model for the transient effects of climate change on forest landscapes. *Ecological Modelling* 65: 51-70 Federer CA (1982) Transpirational supply and demand: Plant, soil, and atmospheric effects evaluated by simulation. *Water Resources Research* 18(2): 355-362

Value

a data.frame of pet potential evapotranspiration (ET) on day j (mm/day), aet actual ET (mm/day), soilm soil moisture on day j (mm), perc percolation on day j (mm), qickf

Author(s)

M. Posch, ported to R by jaap slootweg

petuv

petuv

Description

daily potential evapotranspiration (PET in mm/day) as calculated in the IMAGE 2.1 model. However, 'rads' is now an input! Ref: Prentice IC, Sykes MT, Cramer W, 1993. A simulation model for the transient effects of climate change on forest landscapes. *Ecological Modelling* 65: 51-70

Usage

```
petuv(SolConst0, declicos, declisin, coszint, ylat, temp, rads, fsun, albedo)
```

Arguments

SolConst0	solar constant (W/m ²) for today
declcos	cosine of solar declination for today
declsin	sine of solar declination for today
coszint	integral over cos(z) (z=Sun's zenith angle) for today (hours)
ylat	latitude (degrees)
temp	daily mean temperature (oC)
rads	daily downward short-wave radiation (W/m ²)
fsun	sunshine fraction (0-1)
albedo	(average) albedo (0-1)

Value

potential evapotranspiration (mm/day) and
 u,v u = a-c; c = constant instantaneous upward flux (mm)

Author(s)

M. Posch, ported to R by jaap slootweg

RegGrow

RegGrow

Description

reading RegGrow data

Usage

RegGrow(icol)

Value

data.frame with RegGrow data (_RegGrow.Tab)

Author(s)

M. Posch, ported to R by jaap slootweg

 RegGrown

RegGrown

Description

read EFIsцен data

Usage

```
RegGrown(KnownSpecies, efiFile = "PreData/_EFIsцен.csv")
```

Arguments

KnownSpecies of trees
 efiFile input csv-file with efiscen data

Value

data.frame with RegGrown data (_EFIsцен.csv)

Author(s)

M. Posch, ported to R by jaap slootweg

SeaSalts

SeaSalts

Description

fractions of relevant Ions corrected for sea-salt

Usage

```
SeaSalts(iopt, Dep)
```

Arguments

iopt option for selection of the tracer element (with only sea as origen)
 Dep vector of Ions (= matrix)

Details

For base cation and Cl depositions (given in eq in Dep), this subroutine returns their sea-salt fractions, assuming – for iopt=1,2,3,4,5 – that all Cl(iopt=1),Na,Mg,Ca,K(iopt=5) is sea-salt derived. [Seasalt-corrected depositions can then be computed as Dep* = Dep-Depss.] Also returned is an estimate of the sulfate originating from seasalts.

Value

matrix with same dimension as input Dep

Author(s)

M. Posch, ported to R by jaap slootweg

SMB

SMB

Description

Computes critical loads (CLF) of acidity for selected criteria with the SMB model.

Usage

```
SMB (
  iAci = 1,
  critAci = 1,
  KAlOx,
  expAl = 3,
  thick,
  modExc = 2L,
  KAlBc,
  KHBc,
  fde,
  KHCO3,
  pCO2,
  ps,
  coacid,
  pKpar,
  cmin,
  Nimacc,
  Wea,
  Upt,
  Dep
)
```

Arguments

<code>iAci</code>	option for computing CLmaxS, CLminN and CLmaxN: <ul style="list-style-type: none"> • 1: critAci = molar [Al]:[Bc] • 2: critAci = [Al] (eq/m3) • 3: critAci = EBc (base saturation) (fraction, NOT %) Note: Only for Gapon exchange (modExc=2) and, in this case, expAl=3 (gibbsite) • 4: critAci = pH • 5: critAci = [ANC] (eq/m3) • 6: critAci = molar [Bc]:[H] ([Al]=0 => not compatible with VSD!) • 7: critAci = Alw ! no Al depletion • 8: critAci = molar [Al]:[Ca]
<code>critAci</code>	limit value, see iAci
<code>KAlOx</code>	Al equilibrium constant (mol/l)^(1-expAl)

expAl	exponent in $[Al] = K_{AlOx} * [H]^{\text{expAl}}$ (>0); (3=gibbsite equilibrium)
thick	soil thickness (m)
modExc	cation exchange model option: 1=Gaines-Thomas, 2=Gapon
KAlBc	selectivity constant for Al-Bc exchange
KHBc	selectivity constant for H-Bc exchange
fde	denitrification factor ($0 \leq fde < 1$); If $fde < 0$, $-fde$ is a denitrification flux N_{de} (eq/m ² /a)
KHCO3	bicarbonate equilibrium constant in $[HCO_3] = pCO_2 * KHCO_3 / [H]$ ((mol/m ³) ² /atm)
pCO2	CO ₂ pressure in soil solution (atm)
ps	precipitation surplus (m/a)
coacid	total concentration of organic acids (m*DOC) (mol/m ³)
cmin	minimum[X] in soil leachate (X=Ca,Mg,K) (eq/m ³); see ionNames
Nimacc	... acceptable N immobilisation (eq/m ² /a)
Wea	weathering rate of X (X=Ca,Mg,K,Na) (eq/m ³ /a)
Upt	net uptake of X (X=Ca,Mg,K,NO ₃) (eq/m ² /a)
Dep	deposition of X (X=Ca,Mg,K,Na,Cl) (eq/m ² /a)
pKpar()	... 1-3 parameters of (Oliver-type) mono-protic organics model: $pK = pK_{par}(1) + pK_{par}(2) * pH - pK_{par}(3) * pH^2$

Value

c(ANCl_e, CLmaxS, CLminN, CLmaxN)

- ANCl_e critical ANC leaching (eq/m²/a)
- CLmaxS maximum critical load of S (eq/m²/a)
- CLminN minimum critical load of N (eq/m²/a)
- CLmaxN maximum critical load of N (eq/m²/a)

Author(s)

M. Posch, ported to R by jaap slootweg

snowam

snowam

Description

Computes snow accumulation and melting Ref: Rekolainen S, Posch M, 1993. Adapting the CREAMS model for Finnish conditions. Nordic Hydrology 24: 309-322

Usage

snowam(prec, temp, snow_i)

Arguments

<code>prec</code>	daily precipitation (mm/day)
<code>temp</code>	daily mean temperature (oC)
<code>snow_i</code>	initial (and iterative) depth of snow in water equivalents (mm)

Value

water arriving at the soil (mm/day)

Author(s)

M. Posch, ported to R by jaap slootweg

<code>soilchar</code>	<i>soilchar</i>
-----------------------	-----------------

Description

read, slightly curate and save SoilChar in data

Usage

```
soilchar()
```

Value

data.frame with slightly curated SoilChar data (`_SoilChar.Tab`)

Author(s)

M. Posch, ported to R by jaap slootweg

<code>SolConst</code>	<i>SolConst</i>
-----------------------	-----------------

Description

Returns value of Solar Constant (W/m²) for Julian day 'jul' taking into account Earth's orbital eccentricity.

Usage

```
SolConst(jul)
```

Arguments

<code>jul</code>	julian day
------------------	------------

Details

Ref. for eccentricity correction factor (eccofa): Spencer JW (1971) Fourier series representation of the position of the Sun. Search 2(5): 172 Ref. for recent' Solar Constant: Kopp, G, Lean JL (2011) A new, lower value of total solar irradiance: Evidence and climate significance. Geophysical Research Letters 38: L01706, doi:10.1029/2010GL045777

Author(s)

M. Posch, ported to R by jaap slootweg

sunset

sunset

Description

Computes the length of half of day, i.e. the time between true noon and sunset (in the northern hemisphere).

Usage

```
sunset(jul, lambda)
```

Arguments

jul	Julian day, or Day Of Year (1..365)
lambda	latitude (radian)

Details

Ref.: Iqbal, M. (1983) "An Introduction to Radiation in the Atmosphere", Academic Press

Value

hours of daylight till sunset after true noon (i.e. length of day = 2*tset)

Author(s)

M. Posch , ported to R by jaap slootweg

`trunclin`*trunclin*

Description

Returns the value of the following truncated linear interpolation function (xleft<xrite):

- yleft for $x < xleft$
- linear for $xleft \leq x < xrite$
- yrite for $x \geq xrite$

Usage

```
trunclin(x, xleft, xrite, yleft, yrite)
```

Arguments

<code>x</code>	see description
<code>xleft</code>	see description
<code>xrite</code>	see description
<code>yleft</code>	see description
<code>yrite</code>	see description

Value

y with x

Author(s)

M. Posch, ported to R by jaap slootweg

`uptake`*uptake*

Description

calculate (Ions) uptake

Usage

```
uptake(growth, Q, thick, cont, cmin, Dep, Wea)
```

Arguments

growth	annual growth (m ³ /m ² /a)
Q	runoff (m/a)
thick	soil depth (m)
cont	content of Ions in tree (eq/m ³)
cmin	min concentration of Ions in leaching flux (eq/m ³)
Dep	deposition of Ions (eq/m ² /a)
Wea	weathering of Ions (eq/m ³ /a)

Value

balanced actual Upt

Author(s)

M. Posch, ported to R by jaap slootweg

weasplit

weasplit

Description

Splits a given BC weathering rate into 4 constituents (Ca,Mg,K,Na); Wea

Usage

```
weasplit(BCwe, itex, clay, silt)
```

Arguments

BCwe	weathering as sum of Bc
itex	texture class
clay	percent clay for all sites
silt	percent silt for all sites

Details

Note: clay and silt have to lie in the polygon defined by the texture class! loess/silt, C.v.d.Salm et al., Geoderma 85:41-62 (1998) C.v.d.Salm's thesis, chap.3.3 for sand (see W.deVries' thesis, p.305; but also for itex=9 (peat))

Value

Wea (as Ions)

Author(s)

M. Posch, ported to R by jaap slootweg

wrate	<i>wrate</i>
-------	--------------

Description

weathering rates in eq/m³

Usage

```
wrate(soil, itex, ipm, clay, silt, temp)
```

Arguments

soil	soil type
itex	texture class
ipm	parent material class
clay	percent
silt	percent
temp	erature [deg.C]

Value

data.frame

Author(s)

M. Posch, ported to R by jaap slootweg

wratecl	<i>wratecl</i>
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Description

Assignes a weathering rate class for each soil type depending on parent material class and texture.

Usage

```
wratecl(soil, itex, ipm)
```

Arguments

soil	soil type
itex	texture
ipm	parent mat.

Value

vector of weathering class with the same length as soil, itex and ipm

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