

Package ‘WCM’

April 1, 2020

Type Package

Title Water Cloud Model (WCM) for the Simulation of Leaf Area Index (LAI) and Soil Moisture (SM) from Microwave Backscattering

Version 0.2.2

Author Ujjwal Singh <ujjwalrsmt@gmail.com>
Prashant K Srivastava <prashant.just@gmail.com>
Dharmendra Kumar Pandey <Dkp@sac.isro.gov.in>
Sumit Kumar Chaudhary <sumit.mathe@gmail.com>
Dileep Kumar Gupta <dileepgupta85@gmail.com>

Maintainer Ujjwal Singh <ujjwalrsmt@gmail.com>

Description Retrieval the leaf area index (LAI) and soil moisture (SM) from microwave backscattering data using water cloud model (WCM) model . The WCM algorithm attributed to Per-vot et al.(1993) <doi:10.1016/0034-4257(93)90053-Z>. The authors are grateful to SAC, ISRO, Ahmedabad for providing financial support to Dr. Prashant K Srivastava to conduct this research work.

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Encoding UTF-8

LazyData true

RoxygenNote 7.0.2

Imports pracma,stats,raster

Suggests rmarkdown

NeedsCompilation no

Repository CRAN

Date/Publication 2020-04-01 14:00:08 UTC

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lai_inversion_lut	<i>Inversion of LAI from look up table generated by WCM</i>
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Description

Inversion of LAI from look up table generated by WCM

Usage

```
lai_inversion_lut(img, lookuptable)
```

Arguments

img	raster object
lookuptable	Look up table simulated from 'wcm_sim' function

Value

a raster object (pixel value represents LAI)

Examples

```
radar <- raster::raster(ncol=10, nrow=10)
val <- seq(-12,-7, length.out=100)
radar[] <- val
A= -9.596695
B= -0.005331
C= -11.758309
D= 0.011344
lut <- lut_wcm(LAI=seq(1,6,0.1), SM=seq(0,.6,.01),coeff=c(A,B,C,D))
example(out_lai <- lai_inversion_lut(img = radar,lookuptable = lut))
```

lut_wcm	<i>Look up table of WCM</i>
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Description

Look up table of WCM

Usage

```
lut_wcm(LAI, SM, coeff)
```

Arguments

LAI	one dimensional row vector or a range of LAI value
SM	one dimensional row vector or a range of SM value
coeff	Generated A, B, C, D fitted coefficient for WCM using non linear least square using in situ data

Value

look up table for WCM for given range of LAI and SM

Examples

```
A= -9.596695
B=-0.005331
C=-11.758309
D=0.011344
lookuptable <- lut_wcm(LAI=seq(1,6,0.1), SM=seq(0,.6,.01),coeff=c(A,B,C,D))
```

sm_inversion_lut *Inversion of SM from look up table generated by WCM*

Description

Inversion of SM from look up table generated by WCM

Usage

```
sm_inversion_lut(img, lookuptable)
```

Arguments

img	raster object
lookuptable	Look up table simulated from 'wcm_sim' function

Value

a raster object (pixel value represents SM)

Examples

```
radar1 <- raster::raster(ncol=10, nrow=10)
val <- seq(-12,-7, length.out=100)
radar1[] <- val
A= -9.596695
B= -0.005331
C= -11.758309
D= 0.011344
lut1 <- lut_wcm(LAI=seq(1,6,0.1), SM=seq(0,.6,.01),coeff=c(A,B,C,D))
example(out_sm <- sm_inversion_lut(img = radar1,lookuptable = lut1))
```

wcm_sim

*Simulate backscattering coefficient using WCM model***Description**

This function can be used to simulate the backscattering coefficient using WCM. This function can be called in nls function for generation of model coefficients (A,B,C,D).

Usage

```
wcm_sim(X, Y, theta, A, B, C, D)
```

Arguments

X	In situ LAI or vegetation descriptor
Y	In situ SM soil moisture
theta	incident angle of Satellite sensor
A	fitted coefficient for WCM using non linear least square using in situ data
B	fitted coefficient for WCM using non linear least square using in situ data
C	fitted coefficient for WCM using non linear least square using in situ data
D	fitted coefficient for WCM using non linear least square using in situ data
wcm_sim	is simulated backscattering coefficient

Value

simulated backscattering coefficient

Examples

```
# For single value.
n <- wcm_sim(4, .3, 48.9, -9.596695, -0.005331, -11.758309, 0.011344)

#For list of value
X<-c(5.34, 4.34, 4.32, 4.12, 4.17, 3.58, 5.39, 5.66, 5.47, 5.73, 5.76, 5.93, 4.91, 5.36, 6.15,
     4.56, 5.44, 6.54, 6.20, 6.34, 5.56, 5.88, 7.34, 5.74, 4.81, 5.73, 3.63, 4.61, 4.76, 4.02)
Y<-c(35.0, 26.0, 18.0, 13.0, 18.0, 22.0, 19.0, 16.5, 20.0, 24.0, 24.0, 21.0, 13.0, 22.0, 25.0,
     24.0, 30.0, 23.0, 18.0, 17.6, 15.0, 17.0, 27.0, 22.0, 21.0, 15.0, 15.0, 18.0, 31.0, 10.0)

w<-c(-9.604, -11.648, -11.556, -11.556, -11.090, -10.444, -10.444, -10.042, -9.200, -9.750,
     -9.200, -9.200, -9.812, -9.972, -8.938, -9.200, -8.198, -7.722, -7.348, -7.348,
     -8.198, -10.082, -6.870, -8.104, -8.732, -7.830, -10.686, -10.964, -10.976, -10.976)

theta<-48.9
example(nlc<-nls.control(maxiter = 50000, tol = 1e-05, minFactor = 1/100000000000,
printEval = FALSE, warnOnly = FALSE))
example(k<-nls(w~wcm_sim(X,Y,theta,A,B,C,D),control=nlc,
start=list(A= 0.01,B=0.01,C=-21,D= 0.00014),trace = T))
```

```
example(y<-predict(k))  
n <- wcm_sim(X,Y,theta,-9.596695,-0.005331,-11.758309,0.011344)
```

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