

Package: agriwater (via r-universe)

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Title Evapotranspiration and Energy Fluxes Spatial Analysis

Version 1.0.2

Description Spatial modeling of energy balance and actual evapotranspiration using satellite images and meteorological data. Options of satellite are: Landsat-8 (with and without thermal bands), Sentinel-2 and MODIS. Respectively spatial resolutions are 30, 100, 10 and 250 meters. User can use data from a single meteorological station or a grid of meteorological stations (using any spatial interpolation method). Silva, Teixeira, and Manzione (2019) <[doi:10.1016/j.envsoft.2019.104497](https://doi.org/10.1016/j.envsoft.2019.104497)>.

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Depends R (>= 3.2.0)

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Encoding UTF-8

BugReports <https://github.com/cesarofs/agriwater/issues>

Imports terra

LazyDataCompression xz

RoxygenNote 7.2.2

Suggests knitr, rmarkdown

VignetteBuilder knitr

Repository <https://cesarofs.r-universe.dev>

RemoteUrl <https://github.com/cesarofs/agriwater>

RemoteRef HEAD

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albedo_18	<i>Surface Albedo using Landsat-8 images.</i>
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Description

Surface Albedo using Landsat-8 images.

Usage

albedo_18(doy)

Arguments

doy is the Day of Year (DOY)

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24").

albedo_modis	<i>Surface Albedo using MODIS images.</i>
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Description

Surface Albedo using MODIS images.

Usage

```
albedo_modis()
```

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24").

Examples

```
library(agriwater)

# dependencies of package 'agriwater'
library(terra)

# Using a temporary folder to run example
wd <- tempdir()
initial = getwd()
setwd(wd)

# creating raster which simulate Sentinel-2 reflectances - for using
# real data, please download:
# https://drive.google.com/open?id=14E1wHNLxG7_Dh4I-GqNYakj8YJDgKLzk

xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B2.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.01),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B1.tif"),filetype = "GTiff", overwrite=TRUE)

# creating mask of study area
mask <- as.polygons(rast)
writeVector(mask, file.path(getwd(),"mask.shp"), overwrite=TRUE)

# using "agriwater"
albedo_modis()
```

```
#Exiting temporary folder and returning to previous workspace
setwd(initial)
```

albedo_s2

Surface Albedo using Sentinel-2 images.

Description

Surface Albedo using Sentinel-2 images.

Usage

```
albedo_s2()
```

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24").

Examples

```
library(agriwater)

# dependencies of package 'agriwater'
library(terra)

# Using a temporary folder to run example
wd <- tempdir()
initial = getwd()
setwd(wd)

# creating raster which simulate Sentinel-2 reflectances - for using
# real data, please download:
# https://drive.google.com/open?id=14E1wHNLxG7_Dh4I-GqNYakj8YJDgKLzk

xy <- matrix(rnorm(4, mean = 0.07, sd = 0.01), 2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B2.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B3.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.03, sd = 0.018),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B4.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
```

```

writeRaster(rast, file.path(wd, "B8.tif"), filetype = "GTiff", overwrite=TRUE)
mask <- as.polygons(rast)
writeVector(mask, file.path(getwd(), "mask.shp"), overwrite=TRUE)

# using "agriwater"
albedo_s2()

#Exiting temporary folder and returning to previous workspace
setwd(initial)

```

evapo_18	<i>Actual evapotranspiration (ETa) using Landsat-8 images with single agrometeorological data.</i>
----------	--

Description

Actual evapotranspiration (ETa) using Landsat-8 images with single agrometeorological data.

Usage

```
evapo_18(doy, RG, Ta, ET0, a, b)
```

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
ET0	is the reference evapotranspiration
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

evapo_18t	<i>Actual evapotranspiration (ETa) using Landsat-8 (including thermal bands) images with single agrometeorological data.</i>
-----------	--

Description

Actual evapotranspiration (ETa) using Landsat-8 (including thermal bands) images with single agrometeorological data.

Usage

```
evapo_18t(doy, RG, Ta, ET0, a, b)
```

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
ET0	is the reference evapotranspiration
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

evapo_18t_grid	<i>Actual evapotranspiration (ETa) using Landsat-8 (including thermal bands) images with a grid of agrometeorological data.</i>
----------------	---

Description

Actual evapotranspiration (ETa) using Landsat-8 (including thermal bands) images with a grid of agrometeorological data.

Usage

```
evapo_18t_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

evapo_l8_grid	<i>Actual evapotranspiration (ETa) using Landsat-8 images with a grid of agrometeorological data.</i>
---------------	---

Description

Actual evapotranspiration (ETa) using Landsat-8 images with a grid of agrometeorological data.

Usage

```
evapo_l8_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

evapo_modis	<i>Actual evapotranspiration (ETa) using MODIS with single agrometeorological data.</i>
-------------	---

Description

Actual evapotranspiration (ETa) using MODIS with single agrometeorological data.

Usage

```
evapo_modis(doy, RG, Ta, ET0, a, b)
```

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
ET0	is the reference evapotranspiration
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

Examples

```
library(agriwater)

# dependencies of package 'agriwater'
library(terra)

# Using a temporary folder to run example
wd <- tempdir()
initial = getwd()
setwd(wd)

# creating raster which simulate Sentinel-2 reflectances - for using
# real data, please download:
# https://drive.google.com/open?id=14E1wHNLxG7_Dh4I-GqNYakj8YJDgKLzk

xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
```



```

writeRaster(rast, file.path(wd, "B2.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B1.tif"),filetype = "GTiff", overwrite=TRUE)

mask <- as.polygons(rast)
writeVector(mask, file.path(getwd(),"mask.shp"), overwrite=TRUE)

# using "agriwater" - it's the same procedure as the used for
# evapo_l8(), evapo_l8t(), evapo_modis_grid(), evapo_l8_grid(),
# evapo_l8t_grid(), evapo_s2() and evapo_s2_grid()
evapo_modis(doy = 134, RG = 17.6, Ta = 27.9, ET0 = 3.8, a = 1.8, b = -0.008)

#Exiting temporary folder and returning to previous workspace
setwd(initial)

```

evapo_modis_grid	<i>Actual evapotranspiration (ETa) using MODIS with a grid of agrometeorological data.</i>
------------------	--

Description

Actual evapotranspiration (ETa) using MODIS with a grid of agrometeorological data.

Usage

```
evapo_modis_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

evapo_s2	<i>Actual evapotranspiration (ETa) using Sentinel-2 images with single agrometeorological data.</i>
----------	---

Description

Actual evapotranspiration (ETa) using Sentinel-2 images with single agrometeorological data.

Usage

```
evapo_s2(doy, RG, Ta, ET0, a, b)
```

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
ET0	is the reference evapotranspiration
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

Examples

```
library(agriwater)

# dependencies of package 'agriwater'
library(terra)

# Using a temporary folder to run example
wd <- tempdir()
initial = getwd()
setwd(wd)

# creating raster which simulate Sentinel-2 reflectances - for using
# real data, please download:
# https://drive.google.com/open?id=14E1wHNLxG7_Dh4I-GqNYakj8YJDgKLzk

xy <- matrix(rnorm(4, mean = 0.07, sd = 0.01), 2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5, -40.45, -9.5, -9.45)
```

```

writeRaster(rast, file.path(wd, "B2.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B3.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.03, sd = 0.018),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B4.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B8.tif"),filetype = "GTiff", overwrite=TRUE)
mask <- as.polygons(rast)
writeVector(mask, file.path(getwd(),"mask.shp"), overwrite=TRUE)

# using "agriwater"
evapo_s2(doy = 134, RG = 17.6, Ta = 27.9, ET0 = 3.8, a = 1.8, b = -0.008)

#Exiting temporary folder and returning to previous workspace
setwd(initial)

```

evapo_s2_grid	<i>Actual evapotranspiration (ETa) using Sentinel-2 images with a grid of agrometeorological data.</i>
---------------	--

Description

Actual evapotranspiration (ETa) using Sentinel-2 images with a grid of agrometeorological data.

Usage

```
evapo_s2_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

kc_18	<i>Crop coefficient (ETa / ET0) using Landsat-8 images with single agrometeorological data.</i>
-------	---

Description

Crop coefficient (ETa / ET0) using Landsat-8 images with single agrometeorological data.

Usage

kc_18(doy, RG, Ta, a, b)

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc") and net radiation ("Rn_MJ").

kc_18t	<i>Crop coefficient (ETa / ET0) using Landsat-8 images (including thermal bands) with single agrometeorological data.</i>
--------	---

Description

Crop coefficient (ETa / ET0) using Landsat-8 images (including thermal bands) with single agrometeorological data.

Usage

kc_18t(doy, RG, Ta, a, b)

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc") and net radiation ("Rn_MJ").

kc_l8t_grid	<i>Crop coefficient (ETa / ET0) using Landsat-8 images (including thermal bands) with a grid of agrometeorological data.</i>
-------------	--

Description

Crop coefficient (ETa / ET0) using Landsat-8 images (including thermal bands) with a grid of agrometeorological data.

Usage

```
kc_l8t_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc") and net radiation ("Rn_MJ").

kc_l8_grid	<i>Crop coefficient (ETa / ET0) using Landsat-8 images with a grid of agrometeorological data.</i>
------------	--

Description

Crop coefficient (ETa / ET0) using Landsat-8 images with a grid of agrometeorological data.

Usage

```
kc_l8_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc") and net radiation ("Rn_MJ").

kc_modis	<i>Crop coefficient (ETa / ET0) using MODIS with single agrometeorological data.</i>
----------	--

Description

Crop coefficient (ETa / ET0) using MODIS with single agrometeorological data.

Usage

```
kc_modis(doy, RG, Ta, a, b)
```

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc") and net radiation ("Rn_MJ").

Examples

```
library(agriwater)

# dependencies of package 'agriwater'
library(terra)

# Using a temporary folder to run example
wd <- tempdir()
initial = getwd()
setwd(wd)

# creating raster which simulate MODIS reflectances - for using
# real data, please download:
# https://drive.google.com/open?id=14E1wHNLxG7_Dh4I-GqNYakj8YJDgKLzk

xy <- matrix(rnorm(4, mean = 0.07, sd = 0.01), 2, 2)
```

```

rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B2.tif"), filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B1.tif"), filetype = "GTiff", overwrite=TRUE)

mask <- as.polygons(rast)
writeVector(mask, file.path(getwd(),"mask.shp"), overwrite=TRUE)

# using "agriwater"
kc_modis(doy = 134, RG = 17.6, Ta = 27.9, a = 1.8, b = -0.008)

#Exiting temporary folder and returning to previous workspace
setwd(initial)

```

kc_modis_grid	<i>Crop coefficient (ETa / ET0) using MODIS with a grid of agrometeorological data.</i>
---------------	---

Description

Crop coefficient (ETa / ET0) using MODIS with a grid of agrometeorological data.

Usage

```
kc_modis_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc") and net radiation ("Rn_MJ").

kc_s2	<i>Crop coefficient (ETa / ET0) using Sentinel-2 images with single agrometeorological data.</i>
-------	--

Description

Crop coefficient (ETa / ET0) using Sentinel-2 images with single agrometeorological data.

Usage

```
kc_s2(doy, RG, Ta, a, b)
```

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc") and net radiation ("Rn_MJ").

Examples

```
library(agriwater)

# dependencies of package 'agriwater'
library(terra)

# Using a temporary folder to run example
wd <- tempdir()
initial = getwd()
setwd(wd)

# creating raster which simulate Sentinel-2 reflectances - for using
# real data, please download:
# https://drive.google.com/open?id=14E1wHNLxG7_Dh4I-GqNYakj8YJDgKLzk

xy <- matrix(rnorm(4, mean = 0.07, sd = 0.01), 2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B2.tif"), filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015), 2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
```



```

writeRaster(rast, file.path(wd, "B3.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.03, sd = 0.018),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B4.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B8.tif"),filetype = "GTiff", overwrite=TRUE)
mask <- as.polygons(rast)
writeVector(mask, file.path(getwd(),"mask.shp"), overwrite=TRUE)

# using "agriwater"
kc_s2(doy = 134, RG = 17.6, Ta = 27.9, a = 1.8, b = -0.008)

#Exiting temporary folder and returning to previous workspace
setwd(initial)

```

kc_s2_grid

Crop coefficient (ETa / ET0) using Sentinel-2 images with a grid of agrometeorological data.

Description

Crop coefficient (ETa / ET0) using Sentinel-2 images with a grid of agrometeorological data.

Usage

```
kc_s2_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc") and net radiation ("Rn_MJ").

radiation_l8	<i>Energy balance using Landsat-8 images with single agrometeorological data.</i>
--------------	---

Description

Energy balance using Landsat-8 images with single agrometeorological data.

Usage

radiation_l8(doy, RG, Ta, ET0, a, b)

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
ET0	is the reference evapotranspiration
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc"), Actual Evapotranspiration (evapo), latent heat flux "LE_MJ", net radiation ("Rn_MJ"), ground heat flux ("G_MJ") and the sensible heat flux ("H_MJ").

radiation_l8t	<i>Energy balance using Landsat-8 images (including thermal bands) with single agrometeorological data.</i>
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Description

Energy balance using Landsat-8 images (including thermal bands) with single agrometeorological data.

Usage

radiation_l8t(doy, RG, Ta, ET0, a, b)

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
ET0	is the reference evapotranspiration
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc"), Actual Evapotranspiration (evapo), latent heat flux "LE_MJ"), net radiation ("Rn_MJ"), ground heat flux ("G_MJ") and the sensible heat flux ("H_MJ").

radiation_l8t_grid	<i>Energy balance using Landsat-8 images (including thermal bands) with a grid of agrometeorological data.</i>
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Description

Energy balance using Landsat-8 images (including thermal bands) with a grid of agrometeorological data.

Usage

```
radiation_l8t_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc"), Actual Evapotranspiration (evapo), latent heat flux "LE_MJ"), net radiation ("Rn_MJ"), ground heat flux ("G_MJ") and the sensible heat flux ("H_MJ").

radiation_l8_grid	<i>Energy balance using Landsat-8 images with a grid of agrometeorological data.</i>
-------------------	--

Description

Energy balance using Landsat-8 images with a grid of agrometeorological data.

Usage

```
radiation_l8_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc"), Actual Evapotranspiration (evapo), latent heat flux "LE_MJ", net radiation ("Rn_MJ"), ground heat flux ("G_MJ") and the sensible heat flux ("H_MJ").

radiation_modis	<i>Energy balance using Landsat-8 images with single agrometeorological data.</i>
-----------------	---

Description

Energy balance using Landsat-8 images with single agrometeorological data.

Usage

```
radiation_modis(doy, RG, Ta, ET0, a, b)
```

Arguments

doy	is the Day of Year (DOY)
RG	is the global solar radiation
Ta	is the average air temperature
ET0	is the reference evapotranspiration
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc"), Actual Evapotranspiration (evapo), latent heat flux "LE_MJ"), net radiation ("Rn_MJ"), ground heat flux ("G_MJ") and the sensible heat flux ("H_MJ").

Examples

```
library(agriwater)

# dependencies of package 'agriwater'
library(terra)

# Using a temporary folder to run example
wd <- tempdir()
initial = getwd()
setwd(wd)

# creating raster which simulate Sentinel-2 reflectances - for using
# real data, please download:
# https://drive.google.com/open?id=14E1wHNLxG7_Dh4I-GqNYakj8YJDgKLzk

xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B2.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B1.tif"),filetype = "GTiff", overwrite=TRUE)

# creating mask of study area
mask <- as.polygons(rast)
writeVector(mask, file.path(getwd(),"mask.shp"), overwrite=TRUE)

# using "agriwater" - it's the same procedure as the used for
# radiation_l8(), radiation_l8t(), radiation_s2(),
# radiation_l8_grid(), radiation_l8t_grid(),
# radiation_s2_grid(), radiation_s2() and radiation_modis_grid()
radiation_modis(doy = 134, RG = 17.6, Ta = 27.9, ET0 = 3.8, a = 1.8, b = -0.008)

#Exiting temporary folder and returning to previous workspace
setwd(initial)
```

`radiation_modis_grid` *Energy balance using Landsat-8 images with a grid of agrometeorological data.*

Description

Energy balance using Landsat-8 images with a grid of agrometeorological data.

Usage

```
radiation_modis_grid(doy, a, b)
```

Arguments

doy is the Day of Year (DOY)
 a is one of the regression coefficients of SAFER algorithm
 b is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc"), Actual Evapotranspiration (evapo), latent heat flux "LE_MJ"), net radiation ("Rn_MJ"), ground heat flux ("G_MJ") and the sensible heat flux ("H_MJ").

radiation_s2	<i>Energy balance using Sentinel-2 images with single agrometeorological data.</i>
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Description

Energy balance using Sentinel-2 images with single agrometeorological data.

Usage

```
radiation_s2(doy, RG, Ta, ET0, a, b)
```

Arguments

doy is the Day of Year (DOY)
 RG is the global solar radiation
 Ta is the average air temperature
 ET0 is the reference evapotranspiration
 a is one of the regression coefficients of SAFER algorithm
 b is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc"), Actual Evapotranspiration (evapo), latent heat flux "LE_MJ"), net radiation ("Rn_MJ"), ground heat flux ("G_MJ") and the sensible heat flux ("H_MJ").

Examples

```

library(agriwater)

# dependencies of package 'agriwater'
library(terra)

# Using a temporary folder to run example
wd <- tempdir()
initial = getwd()
setwd(wd)

# creating raster which simulate Sentinel-2 reflectances - for using
# real data, please download:
# https://drive.google.com/open?id=14E1wHNLxG7_Dh4I-GqNYakj8YJDgKLzk

xy <- matrix(rnorm(4, mean = 0.07, sd = 0.01), 2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B2.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B3.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.03, sd = 0.018),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B4.tif"),filetype = "GTiff", overwrite=TRUE)
xy <- matrix(rnorm(4, mean = 0.05, sd = 0.015),2, 2)
rast <- rast(xy, crs="+proj=longlat +datum=WGS84")
ext(rast) <- c(-40.5,-40.45,-9.5,-9.45)
writeRaster(rast, file.path(wd, "B8.tif"),filetype = "GTiff", overwrite=TRUE)
mask <- as.polygons(rast)
writeVector(mask, file.path(getwd(),"mask.shp"), overwrite=TRUE)

# using "agriwater"
radiation_s2(doy = 134, RG = 17.6, Ta = 27.9, ET0 = 3.8, a = 1.8, b = -0.008)

#Exiting temporary folder and returning to previous workspace
setwd(initial)

```

radiation_s2_grid

Energy balance using Sentinel-2 images with a grid of agrometeorological data.

Description

Energy balance using Sentinel-2 images with a grid of agrometeorological data.

Usage

```
radiation_s2_grid(doy, a, b)
```

Arguments

doy	is the Day of Year (DOY)
a	is one of the regression coefficients of SAFER algorithm
b	is one of the regression coefficients of SAFER algorithm

Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24"), NDVI, Surface Temperature ("LST"), Crop Coefficient ("kc"), Actual Evapotranspiration (evapo), latent heat flux "LE_MJ"), net radiation ("Rn_MJ"), ground heat flux ("G_MJ") and the sensible heat flux ("H_MJ").

reflectance_18	<i>Reflectancies from Landsat-8 images.</i>
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Description

Reflectancies from Landsat-8 images.

Usage

```
reflectance_18(doy)
```

Arguments

doy	is the Day of Year (DOY)
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Value

It returns in raster format (.tif) the Surface Albedo at 24h scale ("Alb_24").

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