Package 'agriwater'

June 8, 2023

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>.

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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

RoxygenNote 7.2.2

Suggests knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation no

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Repository CRAN

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R topics documented:

`albedo_l8` *Surface Albedo using Landsat-8 images.*

Description

Surface Albedo using Landsat-8 images.

Usage

```
albedo_l8(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 *Surface Albedo using MODIS images.*

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_l8` *Actual evapotranspiration (ETa) using Landsat-8 images with single agrometeorological data.*

Description

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

Usage

```
evapo_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"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

`evapo_l8t` *Actual evapotranspiration (ETa) using Landsat-8 (including thermal bands) images with single agrometeorological data.*

Description

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

Usage

```
evapo_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"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

---

evapo_l8t_grid *Actual evapotranspiration (ETa) using Landsat-8 (including thermal bands) images with a grid of agrometeorological data.*

Description

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

Usage

```
evapo_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"), net radiation ("Rn_MJ"), Crop Coefficient ("kc") and Actual Evapotranspiration (evapo).

`evapo_l8_grid` *Actual evapotranspiration (ETa) using Landsat-8 images with a grid of agrometeorological data.*

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

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

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

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

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_l8 *Crop coefficient (ETa / ET0) using Landsat-8 images with single agrometeorological data.*

Description

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

Usage

```
kc_l8(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` *Crop coefficient (ETa / ET0) using Landsat-8 images (including thermal bands) with single agrometeorological data.*

Description

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

Usage

```
kc_l8t(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` *Crop coefficient (ETa / ET0) using Landsat-8 images (including thermal bands) with a grid of agrometeorological data.*

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

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

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

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

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

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

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

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

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").

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radiation_s2 *Energy balance using Sentinel-2 images with single agrometeorological data.*

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_l8 *Reflectancies from Landsat-8 images.*

Description

Reflectancies from Landsat-8 images.

Usage

```
reflectance_l8(doy)
```

Arguments

doy	is the Day of Year (DOY)

Value

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

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