Package 'agriwater'

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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>.

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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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`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").

---

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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