Package 'cropwatMUL'

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Title Crop Water Requirement and Irrigation Scheduling Across Multiple Locations

Version 0.1.0

Description Estimates reference evapotranspiration, crop evapotranspiration, effective rainfall, crop water requirements, root-zone water balance, and irrigation schedules across multiple locations. The calculations use temperature-based procedures described in Food and Agriculture Organization Irrigation and Drainage Paper No. 56 and a workflow inspired by the 'CROPWAT' software for monthly-to-daily interpolation, aggregation into 10-day periods, and irrigation scheduling. Further details of the evapotranspiration calculations are provided by Allen, R.G., Pereira, L.S., Raes, D. and Smith, M. (1998, ISBN:92-5-104219-5) ``Crop Evapotranspiration: Guidelines for Computing Crop Water Requirements" <https://www.fao.org/4/X0490E/X0490E00.htm>. The package is an independent implementation and is not affiliated with or endorsed by the Food and Agriculture Organization of the United Nations.

License GPL (>= 3)

Encoding UTF-8

LazyData true

Depends R (>= 4.2.0)

Imports dplyr, lubridate, openxlsx, purrr, readxl, stats, tibble, tidyr, utils

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Author Manish Naskar [aut, cre, cph] (ORCID: <https://orcid.org/0000-0003-1919-192X>), Debasish Chakraborty [aut] (ORCID: <https://orcid.org/0000-0002-1799-6188>), Koushik Bag [aut] (ORCID: <https://orcid.org/0009-0008-6433-951X>), Shariti Syiem [aut] (ORCID: <https://orcid.org/0009-0003-7377-6686>), Akmaul Hoque [aut] (ORCID: <https://orcid.org/0009-0002-4475-566X>)

Maintainer Manish Naskar <manishkumarnaskar@gmail.com>

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Contents

`cropwat_example_data` *Representative multilocation input data*

Description

A synthetic example generated with `rnorm()` for demonstrating the required input structure. The object is a named list containing `climate`, `soil`, and `crop` data frames.

Usage

```
cropwat_example_data
```

Format

A list with three components:

climate Monthly maximum and minimum temperature, rainfall, coordinates, altitude, wind speed, and radiation coefficient for three fictional locations.

soil Soil texture and available water capacity for each location.

crop Planting date, growth-stage duration, crop coefficients, and maximum rooting depth for potato.

Source

Simulated specifically for `cropwatMUL`; not observed data.

`pm_temp_estimated` *Estimate reference evapotranspiration from temperature*

Description

Estimates daily reference evapotranspiration using the FAO-56 Penman–Monteith equation with vapour pressure and solar radiation inferred from minimum and maximum air temperature.

Usage

```
pm_temp_estimated(
  tmax,
  tmin,
  lat,
  doy,
  altitude_m = 0,
  u2 = 2,
  krs = 0.16,
  albedo = 0.23
)
```

Arguments

`tmax`	Numeric maximum air temperature in degrees Celsius.
`tmin`	Numeric minimum air temperature in degrees Celsius.
`lat`	Numeric latitude in decimal degrees.
`doy`	Integer day of year, from 1 to 365 or 366.
`altitude_m`	Numeric elevation above mean sea level in metres.
`u2`	Numeric wind speed at 2 m height in m s-1.
`krs`	Numeric temperature-based radiation adjustment coefficient.
`albedo`	Numeric surface albedo.

Value

A numeric vector of reference evapotranspiration in mm day-1.

Examples

```
pm_temp_estimated(25, 15, 25.7, 15, altitude_m = 1000)
```

`run_cropwat_one_crop_multilocation` *Run a CROPWAT-inspired multilocation simulation*

Description

Reads `climate`, `soil`, and `crop` worksheets from an Excel workbook and calculates daily, dekadal, monthly, and seasonal crop-water and irrigation indicators for one crop across multiple locations.

Usage

```
run_cropwat_one_crop_multilocation(
  input_file,
  crop_name = "Potato",
  output_year = NULL,
  irrigation_efficiency = 0.7,
  critical_depletion = 0.35,
  root_initial_m = 0.15,
  u2 = 2,
  krs = 0.16,
  altitude_m = 0,
  initial_depletion_mm = 0
)
```

Arguments

`input_file`	Path to an Excel workbook containing the required sheets.
`crop_name`	Crop name appearing in the `crop` worksheet.
`output_year`	Optional simulation year. Defaults to the planting year.
`irrigation_efficiency`	Fractional field application efficiency.
`critical_depletion`	Fraction of total available water that triggers irrigation.
`root_initial_m`	Initial effective rooting depth in metres.
`u2`	Wind speed at 2 m height in m s-1 when not supplied in the workbook.
`krs`	Radiation adjustment coefficient when not supplied in the workbook.
`altitude_m`	Elevation in metres when not supplied in the workbook.
`initial_depletion_mm`	Initial root-zone water depletion in millimetres.

Value

A named list containing input data, settings, and simulation outputs.

Examples

```
input <- system.file("extdata", "cropwat_example.xlsx", package = "cropwatMUL")
if (nzchar(input)) {
  result <- run_cropwat_one_crop_multilocation(input, crop_name = "Potato")
  result$summaries
}
```

`usda_scs_effective_rain` *Estimate monthly effective rainfall*

Description

Applies the USDA Soil Conservation Service monthly effective rainfall relationship used in CROPWAT-style calculations.

Usage

```
usda_scs_effective_rain(P)
```

Arguments

`P`	Numeric monthly rainfall in millimetres.

Value

Numeric effective rainfall in millimetres.

Examples

```
usda_scs_effective_rain(c(50, 150, 300))
```

`validate_cropwat_input` *Validate a cropwatMUL input workbook*

Description

Checks worksheet names, required columns, monthly completeness, location matching, crop-stage parameters, and the principal numeric constraints required by the simulation.

Usage

```
validate_cropwat_input(input_file, crop_name = NULL)
```

Arguments

input_file	Path to the input Excel workbook.
crop_name	Optional crop to validate.

Value

Invisibly returns TRUE; otherwise stops with an informative error.

Examples

```
input <- system.file("extdata", "cropwat_example.xlsx", package = "cropwatMUL")
if (nzchar(input)) validate_cropwat_input(input, "Potato")
```

---

write_cropwat_outputs *Export cropwatMUL results*

Description

Writes one Excel workbook and location-specific text files from an object returned by run_cropwat_one_crop_multilocati

Usage

```
write_cropwat_outputs(
  results,
  output_dir,
  prefix = "CROPWAT_one_crop_multiple_locations"
)
```

Arguments

results	A cropwatMUL result object.
output_dir	Character path to the directory in which outputs will be written. This argument must be supplied explicitly. The directory is created recursively when it does not already exist.
prefix	File-name prefix.

Value

Invisibly returns paths to the Excel workbook and text directory.

Examples

```
input <- system.file(
  "extdata",
  "cropwat_example.xlsx",
  package = "cropwatMUL"
)

if (nzchar(input)) {
  result <- run_cropwat_one_crop_multilocation(
    input_file = input,
    crop_name = "Potato"
  )

  output_dir <- tempfile("cropwatMUL-example-")
  dir.create(output_dir)

  output_files <- write_cropwat_outputs(
    results = result,
    output_dir = output_dir,
    prefix = "potato_example"
  )

  output_files


}
```

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