Desarrollo de una herramienta software para la simulación de sistemas fotovoltaicos con R

Trabajo de Fin de Grado

Francisco Delgado López

Universidad Politécnica de Madrid

Objetivo principal

Desarrollo de un paquete en R

```
library(solaR2)
```

Objetivos secundarios

GNU Emacs

- `Org mode`
- `ESS`

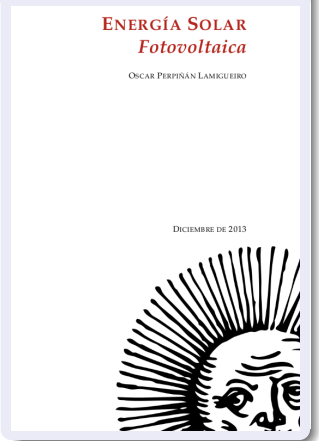
Paquetes de R

- `solaR`
- `zoo`
- `data.table`
- `microbenchmark`
- `profvis`
- `lattice`

LaTeX

- Documento
- Presentación

Energía Solar Fotovoltaica



Soluciones actuales

PVsyst

SISIFO

PVGIS

System Advisor Model

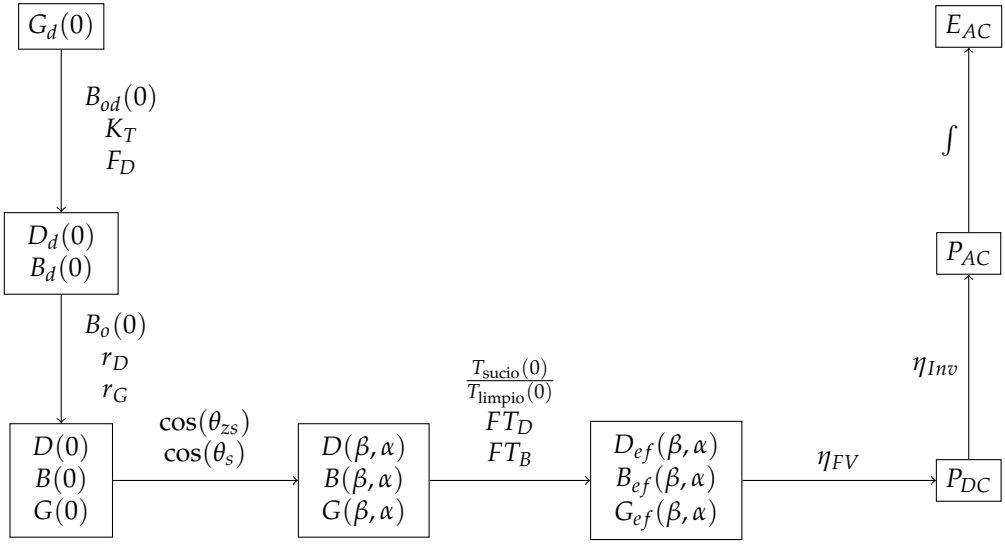
Funcionamiento

- Geometría solar
- Datos meteorológicos
- Radiación en el plano horizontal
- Radiación en el plano del generador
- Simulación de SFCR
- Simulación de SFB
- Optimización de distancias
- Métodos de visualización

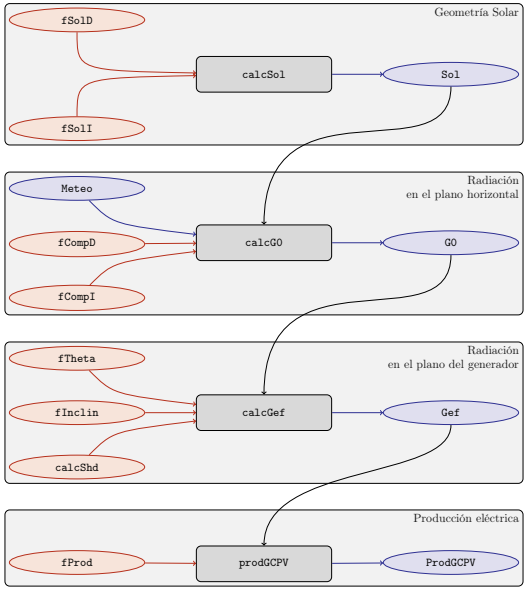
Carencias

- Modularidad
- Eficiencia y rendimiento
- Manipulación de datos

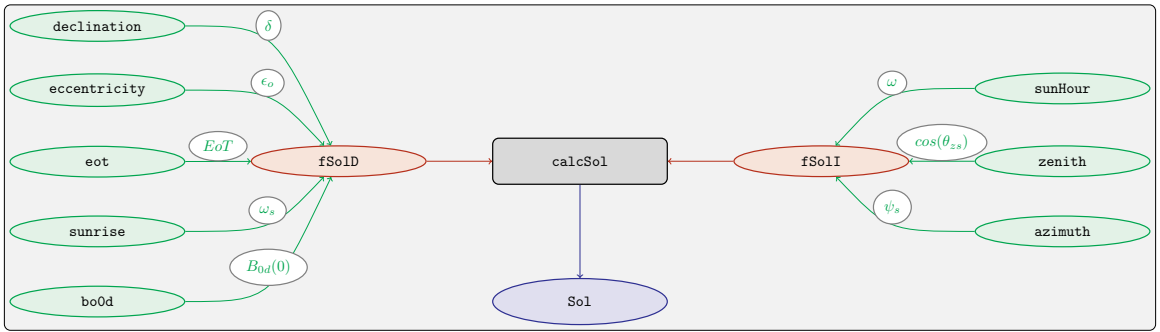
Procedimiento de cálculo



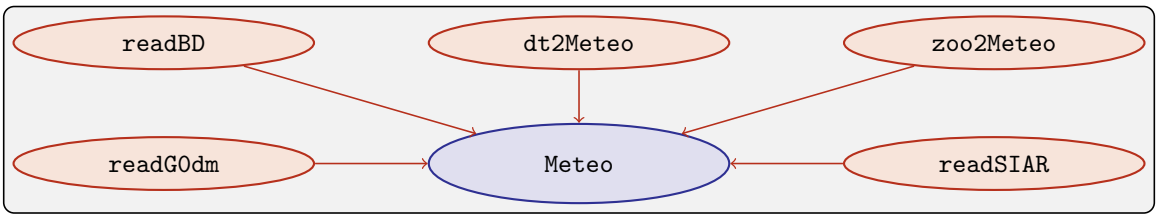
Algoritmo de cálculo



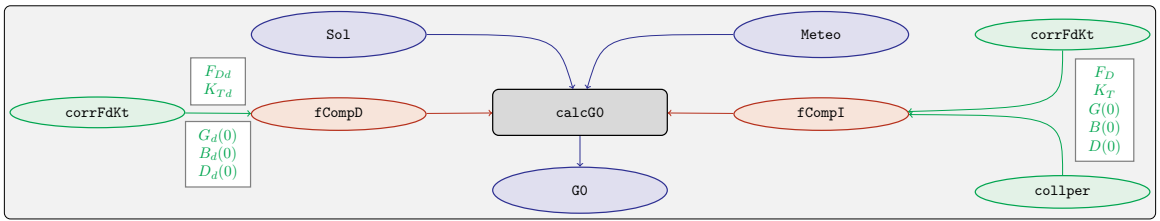
calcSol


declination
δ
eccentricity
ϵ_o
EoT
eot
fSolD
ω_s
sunrise
$B_{0d}(0)$
bo0d
calcSol
Sol
ω
sunHour
$cos(\theta_{zs})$
fSolI
zenith
ψ_s
azimuth

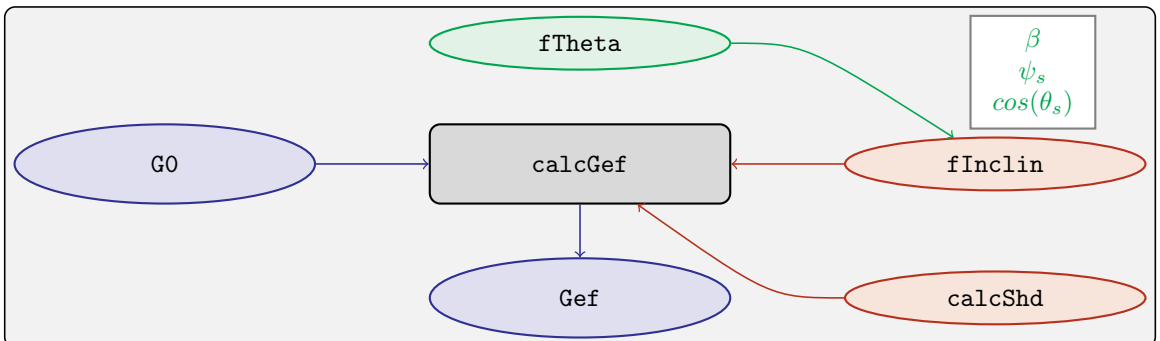
Meteo



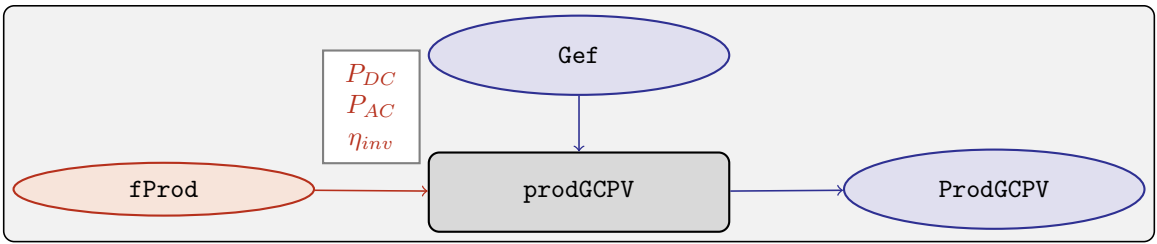
calcG0


Sol
Meteo
corrFdKt
F_{Dd}
K_{Td}
corrFdKt
fCompD
calcG0
fCompI
F_D
K_T
$G(0)$
$B(0)$
$D(0)$
$G_d(0)$
$B_d(0)$
$D_d(0)$
G0
collper

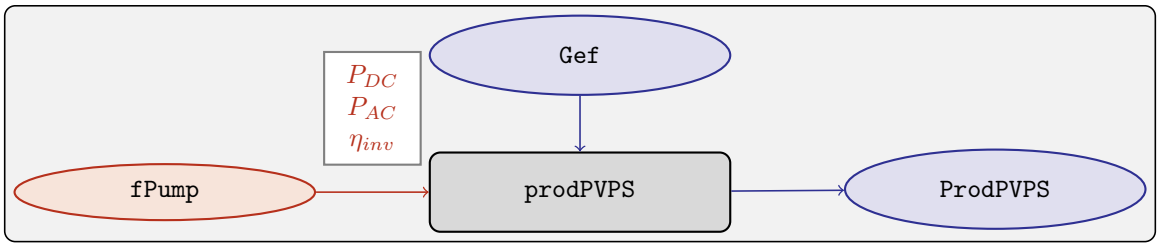
calcGef



prodGCPV

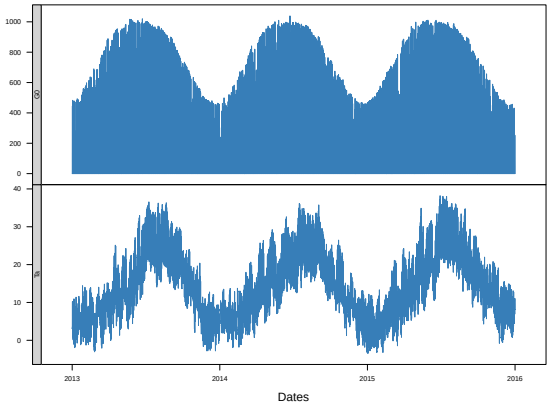


prodPVPS



Información meteorológica

```
etsidi_1315 <- readBDi(file = "TFG/data/PVGIS_1315.csv",
                       lat = 40.4, dates.col = "Dates",
                       format = "%Y-%m-%d %H:%M:%S")
```



Producción de diferentes sistemas

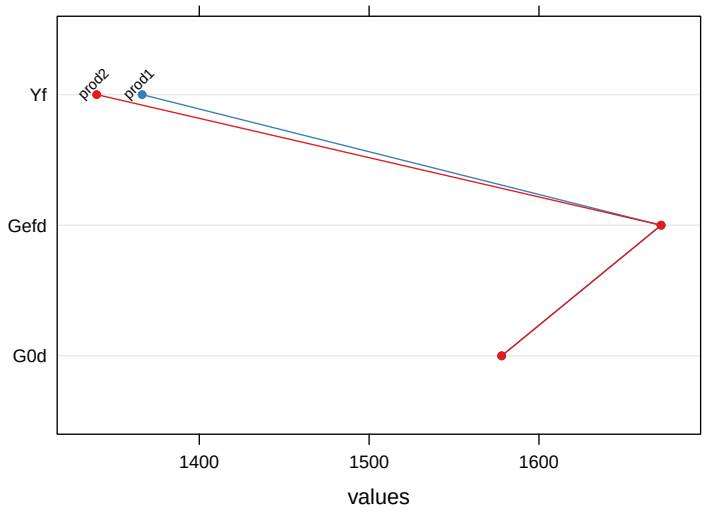
```
prod1 <- prodGCPV(lat = 40.4, modeTrk = 'fixed', modeRad = 'bdI',
                  dataRad = etsidi_1315, beta = 30, alpha = -19,
                  module = module1, generator = generator1,
                  inverter = inverter)
show(as.data.tableY(prod1))
```

```
   Dates      Eac      Edc       Yf
   <int>    <num>    <num>    <num>
1:  2013 1681.077 1757.235 1343.449
2:  2014 1698.613 1775.426 1357.463
3:  2015 1749.536 1828.569 1398.158
```

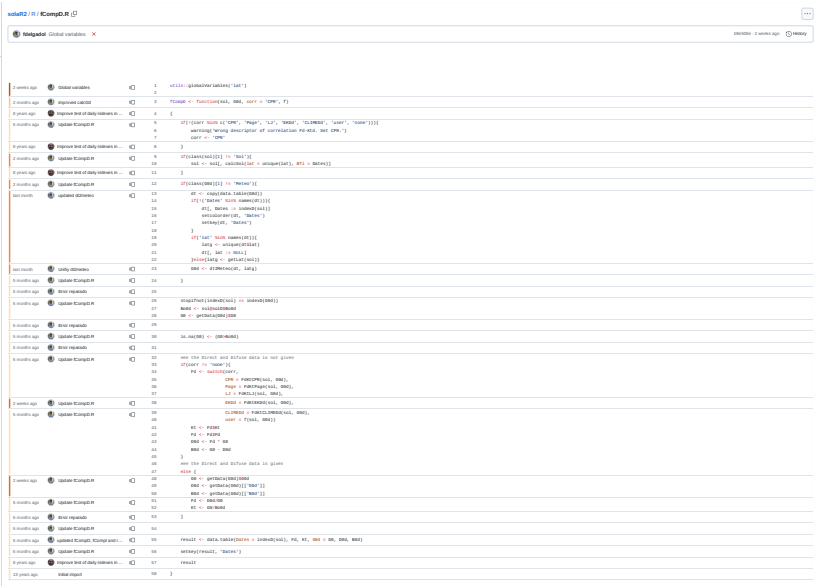
```
prod2 <- prodGCPV(lat = 40.4, modeTrk = 'fixed', modeRad = 'bdI',
                  dataRad = etsidi_1315, beta = 30, alpha = -19,
                  module = module2, generator = generator2,
                  inverter = inverter)
show(as.data.tableY(prod2))
```

```
   Dates      Eac      Edc       Yf
   <int>    <num>    <num>    <num>
1:  2013 1451.873 1517.779 1319.225
2:  2014 1464.483 1530.833 1330.683
3:  2015 1506.544 1574.704 1368.901
```

Comparación de producciones



Blame


solaR2 / R / fCompD.R
fdelgadol Global variables
2 weeks ago Global variables
2 months ago improved calc30
8 years ago improve lint of daily indexes in ...
5 months ago Update fCompD.R
8 years ago improve lint of daily indexes in ...
2 months ago Update fCompD.R
8 years ago improve lint of daily indexes in ...
2 months ago Update fCompD.R
last month updated dSZmenko
last month Unify dSZmenko
5 months ago Update fCompD.R
5 months ago Error reparado
5 months ago Update fCompD.R
5 months ago Error reparado
5 months ago Update fCompD.R
5 months ago Update fCompD.R
5 months ago Error reparado
5 months ago Update fCompD.R
2 weeks ago Update fCompD.R
5 months ago Update fCompD.R
2 weeks ago Update fCompD.R
5 months ago Update fCompD.R
5 months ago Error reparado
5 months ago Update fCompD.R
5 months ago updated fCompD.fCompD and r...
5 months ago Update fCompD.R
8 years ago improve lint of daily indexes in ...
23 years ago Initial import

Blame

2 weeks ago	Global variables		1	`utils::globalVariables('lat')`
			2	
2 months ago	improved calcG0		3	`fCompD <- function(sol, G0d, corr = 'CPR', f)`
8 years ago	Improve test of daily indexes in …		4	`{`
5 months ago	Update fCompD.R		5	`    if(!(corr %in% c('CPR', 'Page', 'LJ', 'EKDd', 'CLIMEDd', 'user', 'none'))){`
			6	`        warning('Wrong descriptor of correlation Fd-Ktd. Set CPR.')`
			7	`        corr <- 'CPR'`
8 years ago	Improve test of daily indexes in …		8	`    }`
2 months ago	Update fCompD.R		9	`    if(class(sol)[1] != 'Sol'){`
			10	`        sol <- sol[, calcSol(lat = unique(lat), BTi = Dates)]`
8 years ago	Improve test of daily indexes in …		11	`    }`
2 months ago	Update fCompD.R		12	`    if(class(G0d)[1] != 'Meteo'){`
last month	updated dt2meteo		13	`        dt <- copy(data.table(G0d))`
			14	`        if(!('Dates' %in% names(dt))){`
			15	`            dt[, Dates := indexD(sol)]`
			16	`            setcolorder(dt, 'Dates')`
			17	`            setkey(dt, 'Dates')`
			18	`        }`
			19	`        if('lat' %in% names(dt)){`
			20	`            latg <- unique(dt$lat)`
			21	`            dt[, lat := NULL]`
			22	`        }else{latg <- getLat(sol)}`

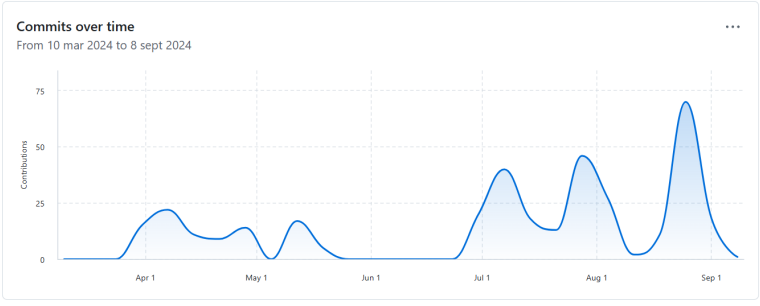
Insights

Contributors

Beta Give feedback

Period: Last 6 months | Contributions: Commits

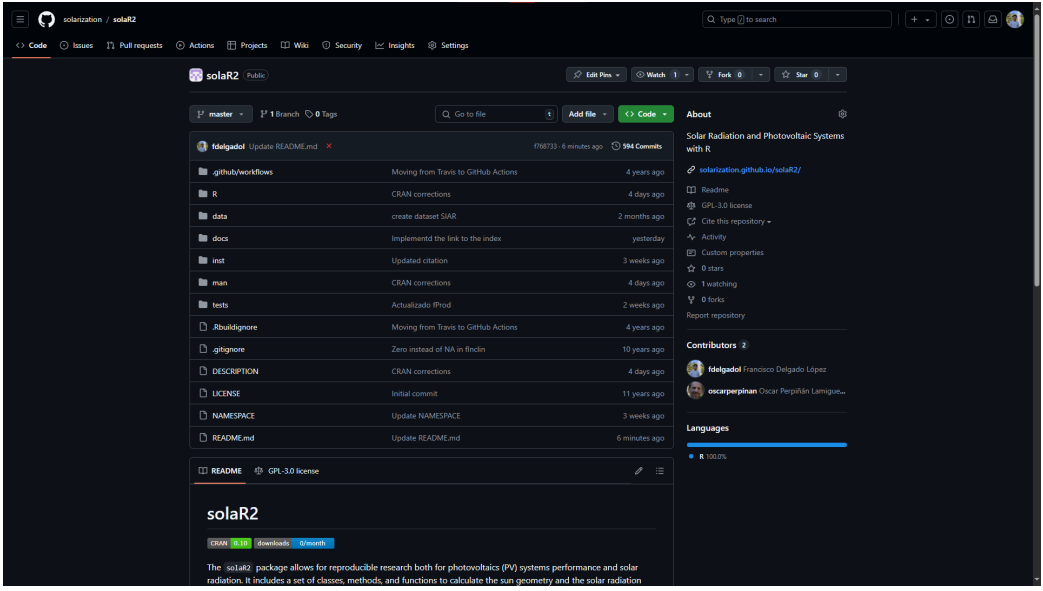
Contributions per week to master, excluding merge commits



Desarrollo a futuro

- Interfaz de usuario
- Mejora de funciones
- Toma de datos
- Uso de paquete especializados en datos espaciales
  - `terra`

GitHub


solarization / solaR2
Type / to search
Code
Issues
Pull requests
Actions
Projects
Wiki
Security
Insights
Settings
solaR2
Public
Edit Pins
Watch 1
Fork 0
Star 0
master
1 Branch
0 Tags
Go to file
Add file
Code
fdelgadol Update README.md
f768733 · 6 minutes ago
594 Commits
.github/workflows
Moving from Travis to GitHub Actions
4 years ago
R
CRAN corrections
4 days ago
data
create dataset SIAR
2 months ago
docs
Implementd the link to the index
yesterday
inst
Updated citation
3 weeks ago
man
CRAN corrections
4 days ago
tests
Actualizado fProd
2 weeks ago
.Rbuildignore
Moving from Travis to GitHub Actions
4 years ago
.gitignore
Zero instead of NA in flnclin
10 years ago
DESCRIPTION
CRAN corrections
4 days ago
LICENSE
Initial commit
11 years ago
NAMESPACE
Update NAMESPACE
3 weeks ago
README.md
Update README.md
6 minutes ago
README
GPL-3.0 license
solaR2
CRAN 0.10
downloads 0/month
The solaR2 package allows for reproducible research both for photovoltaics (PV) systems performance and solar radiation. It includes a set of classes, methods, and functions to calculate the sun geometry and the solar radiation
About
Solar Radiation and Photovoltaic Systems with R
solarization.github.io/solaR2/
Readme
GPL-3.0 license
Cite this repository
Activity
Custom properties
0 stars
1 watching
0 forks
Report repository
Contributors 2
fdelgadol Francisco Delgado López
oscarperpinan Oscar Perpiñán Lamigue...
Languages
R 100.0%

CRAN

solaR2: Radiation and Photovoltaic Systems

Provides tools for calculating solar geometry, solar radiation on horizontal and inclined planes, and simulating the performance of various photovoltaic (PV) systems. Supports daily and intradaily irradiation data, enabling detailed analysis of grid-connected and water-pumping PV systems, including shading effects and solar angle calculations.

Version:	0.10
Depends:	R (≥ 4.0.0), data.table, lattice, latticeExtra
Imports:	RColorBrewer, graphics, grDevices, stats, methods, utils
Suggests:	zoo, sp, raster, rasterVis, tdr, meteoForecast, httr2, jsonlite, testthat (≥ 3.0.0)
Published:	2024-09-16
Author:	Oscar Perpiñán-Lamigueiro [aut], Francisco Delgado-López [aut, cre]
Maintainer:	Francisco Delgado-López <f.delgadol at alumnos.upm.es>
BugReports:	https://github.com/solarization/solaR2/issues
License:	GPL-3
URL:	https://solarization.github.io/solaR2/
NeedsCompilation:	no
Citation:	solaR2 citation info
Materials:	README
CRAN checks:	solaR2 results

Documentation:

Reference manual:	solaR2.pdf

Downloads:

Package source:	solaR2_0.10.tar.gz
Windows binaries:	r-devel: not available, r-release: not available, r-oldrel: not available
macOS binaries:	r-release (arm64): not available, r-oldrel (arm64): not available, r-release (x86_64): not available, r-oldrel (x86_64): not available

Linking:

Please use the canonical form `https://CRAN.R-project.org/package=solaR2` to link to this page.

Página web

solaR2: Solar Radiation and Photovoltaic Systems with R 2

Introduction

The `solaR2` package allows for reproducible research both for photovoltaics (PV) systems performance and solar radiation. It includes a set of classes, methods, and functions to calculate the sun geometry and the solar radiation incident on a photovoltaic generator, as well as to simulate the performance of various photovoltaic energy applications. This package performs the entire calculation procedure from both daily and intradaily global horizontal irradiation to the final productivity of grid-connected PV systems and water pumping PV systems.

It is designed using a set of S4 classes that handle multivariate time series efficiently and are optimized for high-performance data manipulation. The classes share a variety of methods to access the information and several visualization methods. Additionally, the package provides tools for the visual statistical analysis of the performance of large PV plants composed of multiple systems.

Although `solaR2` is primarily designed for time series associated with a location defined by its latitude/longitude values and temperature and irradiation conditions, it can be easily combined with spatial packages for space-time analysis.

Software

The stable version of `solaR2` is hosted at CRAN. The development version is available at GitHub.

Citation

If you use `solaR2`, please cite it in any publication reporting results obtained with this software:

```
Delgado López, Francisco y Perpiñán Lamigueiro, Oscar (2024).
solaR2: Radiation and Photovoltaic Systems with R version 2.
R package version 0.10.
Disponible en: https://solarization.github.io/solaR2/
```

A BibTeX entry for LaTeX users is

```
@Manual{,
  title     = {solaR2: Radiation and Photovoltaic Systems with R version 2},
  author    = {Francisco Delgado L{\'o}pez and Oscar Perpi{\~n}{\'a}n Lamigueiro},
  year      = {2024},
  url       = {https://solarization.github.io/solaR2/},
  note      = {R package version 0.10},
}
```

Gracias por su atención