

# Package ‘GR2MSemiDistr’

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**Type** Package

**Title** A package for hydrological modeling with a semi-distribute GR2M model adaptation

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**Description** This package run a semi-distributed GR2M model adaptation using the Weighted Flow Accumulation algorithm in TauDEM\_537 (required)

**License** HLL-16

**Encoding** UTF-8

**Depends** R (>= 3.6),

**Imports** airGR, foreach, hydroGOF, ncdf4, raster, rgdal, rgeos, rtop, tictoc, lubridate, abind, sf, exactextractr,

**LazyData** true

**RoxygenNote** 7.1.0

## R topics documented:

Create_Forcing_Inputs	1
Optim_GR2MSemiDistr	3
Routing_GR2MSemiDistr	4
Run_GR2MSemiDistr	5
<b>Index</b>	<b>7</b>

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Create_Forcing_Inputs	<i>Extract and prepare model's inputs data in the airGR format (DatesR, P and E) from gridded P and E monthly data.</i>
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## Description

Extract and prepare model's inputs data in the airGR format (DatesR, P and E) from gridded P and E monthly data.



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Optim\_GR2MSemiDistr      *Model parameter optimization with the SCE-UA algorithm.*

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## Description

Model parameter optimization with the SCE-UA algorithm.

## Usage

```
Optim_GR2MSemiDistr(Data, Subbasins, RunIni, RunEnd, WarmUp = NULL,
  Parameters, Parameters.Min, Parameters.Max, Max.Functions = 5000,
  Optimization = "NSE", No.Optim = NULL)
```

## Arguments

Data	Dataframe with model input's data in airGR format from Create_Forcing_Inputs. (DatesR, P_1, P_2,...,P_n, E_1, E_2, ...E_n, Q). If Q is not available please provide only DatesR, P, and E.
Subbasins	Subbasins' shapefile. Must contain the following attributes: 'Area' (in km2), 'Region' (in letters), and 'COMID' (identifier number).
RunIni	Initial date of the model simulation in 'mm/yyyy' format.
RunEnd	Ending date of the model simulation in 'mm/yyyy' format.
WarmUp	Number of months for the warm-up period. NULL as default.
Parameters	Vector of initial model parameters (X1 and X2) and correction factors of P (fp) and E (fpe) in the following order: c(X1, X2, fp, fpe). In the case of existing more than one 'Region' (e.g. regions A and B) please provide model parameters in the following order: c(X1_A, X1_B, X2_A, X2_B, Fp_a, Fp_B, Fpe_A, Fpe_B).
Parameters.Min	Vector of minimum values of GR2M model parameters and correction factors in the following order: c(X1_min, X2_min, fp_min, fpe_min).
Parameters.Max	Vector of maximum values of GR2M model parameters and correction factors in the following order: c(X1_max, X2_max, fp_max, fpe_max).
Max.Functions	Maximum number of function evaluation for optimization. 5000 as default.
Optimization	Objective function for optimization (NSE, KGE, or RMSE).
No.Optim	Regions not to be optimized. NULL as default.

## Value

List of optimal GR2M model parameters for each 'Region'.

Param: Best set of GR2M model parameters (sorted by 'Region').

Value: Final value of the objective function.

## Examples

```
# Optimize GR2M model parameters for a single 'Region' using the KGE metric
optim <- Optim_GR2MSemiDistr(Data=data,
                             Subbasins=roi,
                             RunIni='01/1981',
                             RunEnd='12/2002',
                             WarmUp=36,
                             Parameters=c(1000, 1, 1, 1),
                             Parameters.Min=c(1, 0.01, 0.8, 0.8),
                             Parameters.Max=c(2000, 2, 1.2, 1.2),
                             Max.Functions=1000,
                             Optimization='KGE')

best_param <- optim$Param
```

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Routing\_GR2MSemiDistr    *Routing discharges for each subbasin.*

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## Description

Routing discharges for each subbasin.

## Usage

```
Routing_GR2MSemiDistr(Model, Subbasins, Dem, AcumIni = NULL,
                       AcumEnd = NULL, Save = FALSE, Update = FALSE)
```

## Arguments

Model	List of model results from Run_GR2MSemiDistr.
Subbasins	Subbasins' shapefile. Must contain the following attributes: 'Area' (in km2), 'Region' (in letters), and 'COMID' (identifier number).
Dem	Digital elevation model raster for the extent of the basin.
AcumIni	Initial date of the model routing in 'mm/yyyy' format. NULL as default
AcumEnd	Ending date of the model routing in 'mm/yyyy' format. NULL as default
Save	Boolean to save results as a text file in the 'Outputs' location. FALSE as default.
Update	Boolean for the updating mode where only the last month's values will be returned. FALSE as default.

## Value

List of model routing outputs.

QR: Routed discharge timeseries for all subbasins in [m3/s].

Dates: Vector of dates of the simulation period.

COMID: Vector of identifier numbers for each subbasin.

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Run_GR2MSemiDistr	<i>Run the GR2M model for 'n' subbasins.</i>
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## Description

Run the GR2M model for 'n' subbasins.

## Usage

```
Run_GR2MSemiDistr(Data, Subbasins, RunIni, RunEnd, WarmUp = NULL,
  Parameters, IniState = NULL, Save = FALSE, Update = FALSE)
```

## Arguments

Data	Dataframe with model input's data in airGR format from Create_Forcing_Inputs. (DatesR, P_1, P_2,...,P_n, E_1, E_2, ...E_n, Q). If Q is not available please provide only DatesR, P, and E.
Subbasins	Subbasins' shapefile. Must contain the following attributes: 'Area' (in km2), 'Region' (in letters), and 'COMID' (identifier number).
RunIni	Initial date of the model simulation in 'mm/yyyy' format.
RunEnd	Ending date of the model simulation in 'mm/yyyy' format.
WarmUp	Number of months for warm-up. NULL as default.
Parameters	Vector of model parameters (X1 and X2) and correction factors of P (fp) and E (fpe) in the following order: c(X1, X2, fp, fpe). In the case of existing more than one 'Region' (e.g. regions A and B) please provide model parameters in the following order: c(X1_A, X1_B, X2_A, X2_B, Fp_a, Fp_B, Fpe_A, Fpe_B).
IniState	Initial states variables. NULL as default.
Save	Boolean to save results as a text file in the 'Outputs' location. FALSE as default.
Update	Boolean for the updating mode where only the last month's values will be returned. FALSE as default.

## Value

List of GR2M model outputs.

PR: Precipitation timeseries for all subbasins in [mm/month].

AE: Actual evapotranspiration timeseries for all subbasins in [mm/month].

SM: Soil Moisture timeseries for all subbasins in [mm/month].

RU: Runoff timeseries for all subbasins in [mm/month].

QS: Discharge timeseries for all subbasins in [m3/s] (not routed).

Dates: Vector of dates of the simulation period.

COMID: Vector of identifier numbers for each subbasin.

EndState: List of end model states of each subbasin.

SINK: Basin outlet which contains qsim and qobs data time series in [m3/s].

**Examples**

```
# Run the GR2M model for each subbasin
model <- Run_GR2MSemiDistr(Data=data,
                           Subbasins=roi,
                           RunIni='01/1981',
                           RunEnd='12/2016',
                           Parameters=c(10.976, 0.665, 1.186, 1.169))

# Extract model results
View(model$PR) # precipitation [mm/month]
View(model$AE) # actual evapotranspiration [mm/month]
View(model$SM) # soil moisture [mm/month]
View(model$RU) # runoff in [mm/month]
print(model$SINK$obs) # observed discharge in [m3/s] at basin outlet
print(model$SINK$sim) # simulated discharge in [m3/s] at basin outlet
```

# Index

Create\_Forcing\_Inputs, [1](#)

Optim\_GR2MSemiDistr, [3](#)

Routing\_GR2MSemiDistr, [4](#)

Run\_GR2MSemiDistr, [5](#)