



## Recent developments of the airGR R package, an open source software for rainfall-runoff modelling

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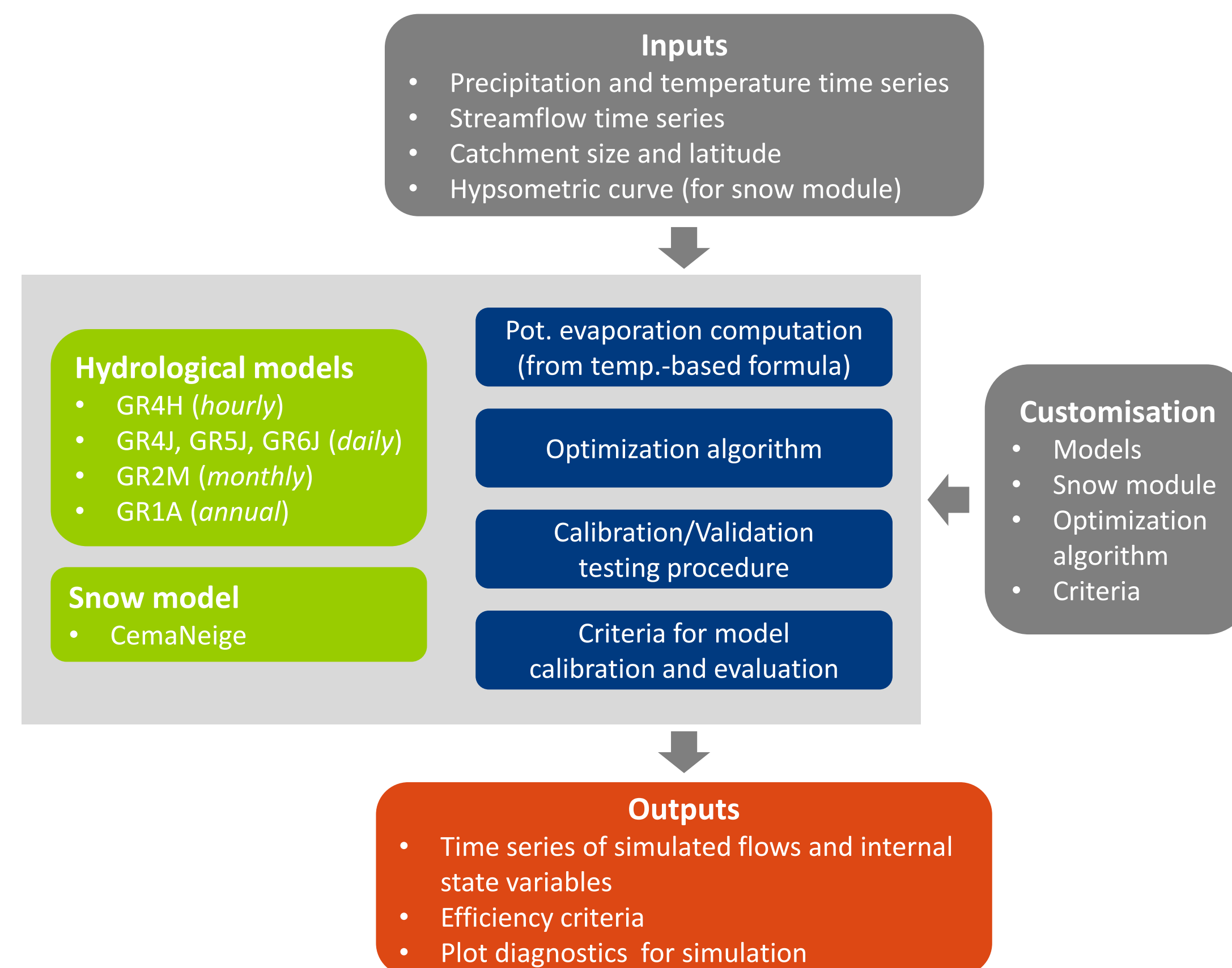


GR is a family of lumped hydrological models designed for flow simulation at various time steps. The models are now available in a flexible R package called airGR (Coron *et al.*, 2017, submitted). The models can easily be implemented on a set of catchments with limited data requirements.

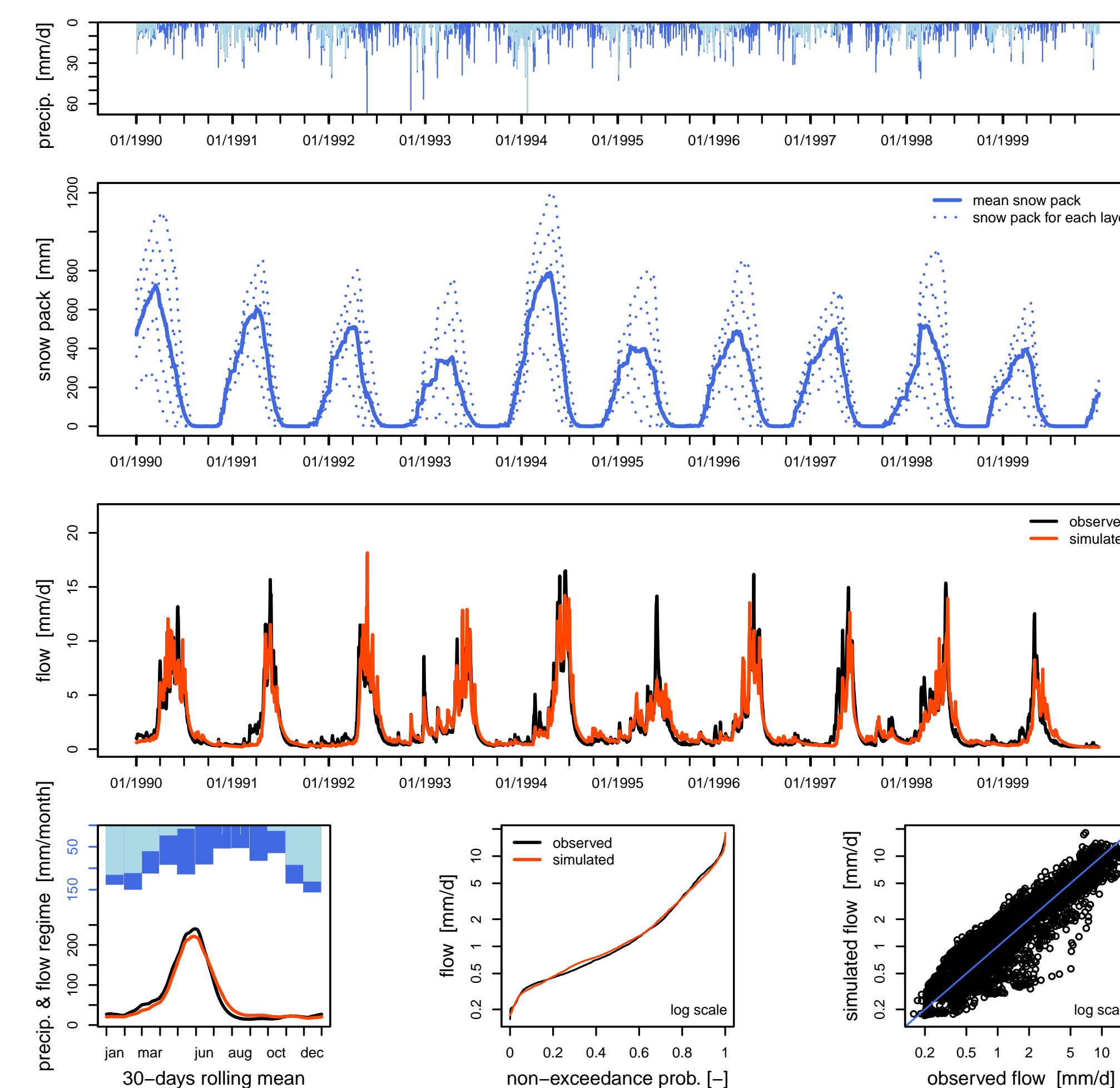
## The GR hydrological models

- Designed with the objective to be as efficient as possible for flow simulation at various time steps (from hourly to interannual) (Perrin *et al.*, 2009)
- Their structures were developed to have warranted complexity and limited data requirements
- Can be applied on a wide range of conditions, including snowy catchments (thanks to the CemaNeige snow routine)

## Main components of the airGR R package



Plot diagnostics produced by the airGR package (GR4J model + CemaNeige model)



## Getting started with the package

- Documentation available with the R command : `vignette("airGR")`
- A website provides information to get started with the airGR functions and to be up to date on the recent developments  
<https://webgr.irstea.fr/airGR-website/>

## airGR website (tutorial page)

**2.2 RunOptions object**

The `CreateRunOptions()` function allows to prepare the options required to the `RunModel*()` functions, which are the actual models functions.

The user must at least define the following arguments:

- `FUN_MOD`: the name of the model function to run
- `InputModel`: the associated input data
- `IndPeriod_Run`: the period on which the model is run

To select a period for which the user wants to run the model, select the corresponding indexes for different time periods (not the POSIXt dates), as follows:

```
Ind_Run <- seq(which(format(BasinObs$DatesR, format = "%d/%m/%Y %H:%M")=="01/01/1990 00:00"),
               which(format(BasinObs$DatesR, format = "%d/%m/%Y %H:%M")=="31/12/1999 00:00"))
str(Ind_Run)
```

```
## int [1:3652] 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 ...
```

The initialisation of hydrological models is of the utmost importance. Indeed, an inaccurate initialisation causes poor quality streamflow simulations during the earliest stages of the running period. For example, in the GR models, the reservoirs levels are by default set to 50 % of their capacity, which may be far from their ideal value. Two solutions are offered to accurately initialize the GR models in airGR: manually predefining the initial states or running the models during a warm up period before the actual running period. It is generally advised to set up this warm up period to be equal or superior to one year.

As a consequence, it is possible to define in `CreateRunOptions()` the following arguments:

- `IniStates`: the initial states of the 2 unit hydrographs (20 + 40 = 60 units)
- `IniResLevels`: the initial levels of the production and routing stores
- `IndPeriod_WarmUp`: the warm-up period used to run the model, to be defined in the same format as `IndPeriod_Run`

```
RunOptions <- CreateRunOptions(FUN_MOD = RunModel_GR4J,
                               InputModel = InputModel, IndPeriod_Run = Ind_Run,
                               IniStates = NULL, IniResLevels = NULL, IndPeriod_WarmUp = NULL)
```

## In progress [see EGU2017-11789 - PICO spot 1 - EOS9 Wednesday 10:30]

The airGRteaching package (Delaigue *et al.*, 2017) provides tools to simplify the use of the airGR hydrological package for education including:

- simplified functions
- pre-defined graphical plots
- mouse events and interactive graphics
- graphical interface based on a Shiny application



## Shiny interface of the airGRteaching package



## Download the airGR package

The airGR package is available on the Comprehensive R Archive Network:  
<https://CRAN.R-project.org/package=airGR/>

## References

- Coron L., Thirel G., Delaigue O., Perrin C. & Andréassian V. (submitted). The Suite of Lumped GR Hydrological Models in an R package.
- Coron, L., Perrin, C. & Michel, C. 2017. airGR: Suite of GR Hydrological Models for Precipitation-Runoff Modelling. R package version 1.0.5.12  
<https://webgr.irstea.fr/airGR/?lang=en>.
- Delaigue, O., Coron, L. & Brigode, P. (2017). airGRteaching: Tools to Simplify the Use of the airGR Hydrological Package for Education (Including a Shiny Application). R package version 0.1.2.38.
- Perrin, C., Michel C. & Andréassian V. , 2009. A set of hydrological models (Chapter 16). Environmental Hydraulics. J. M. Tanguy. Paris, ISTE Ltd, John Wiley & Sons. Volume 2 Mathematical models: 493-509.