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

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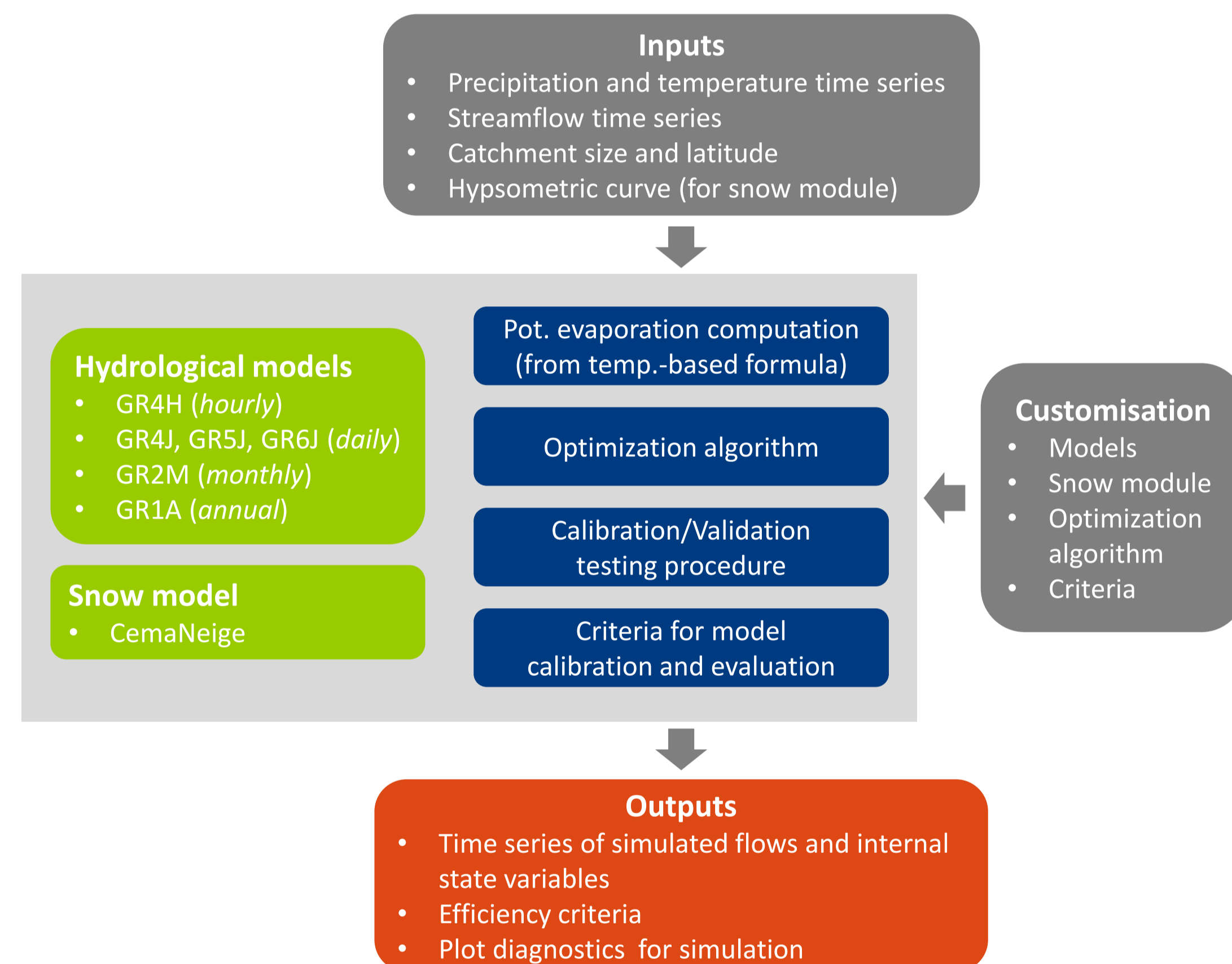
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GR is a family of lumped hydrological models designed for flow simulation at various time steps. The models are now available in a flexible R package called airGR (Coron *et al.*, 2017, submitted). The models can easily be implemented on a set of catchments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

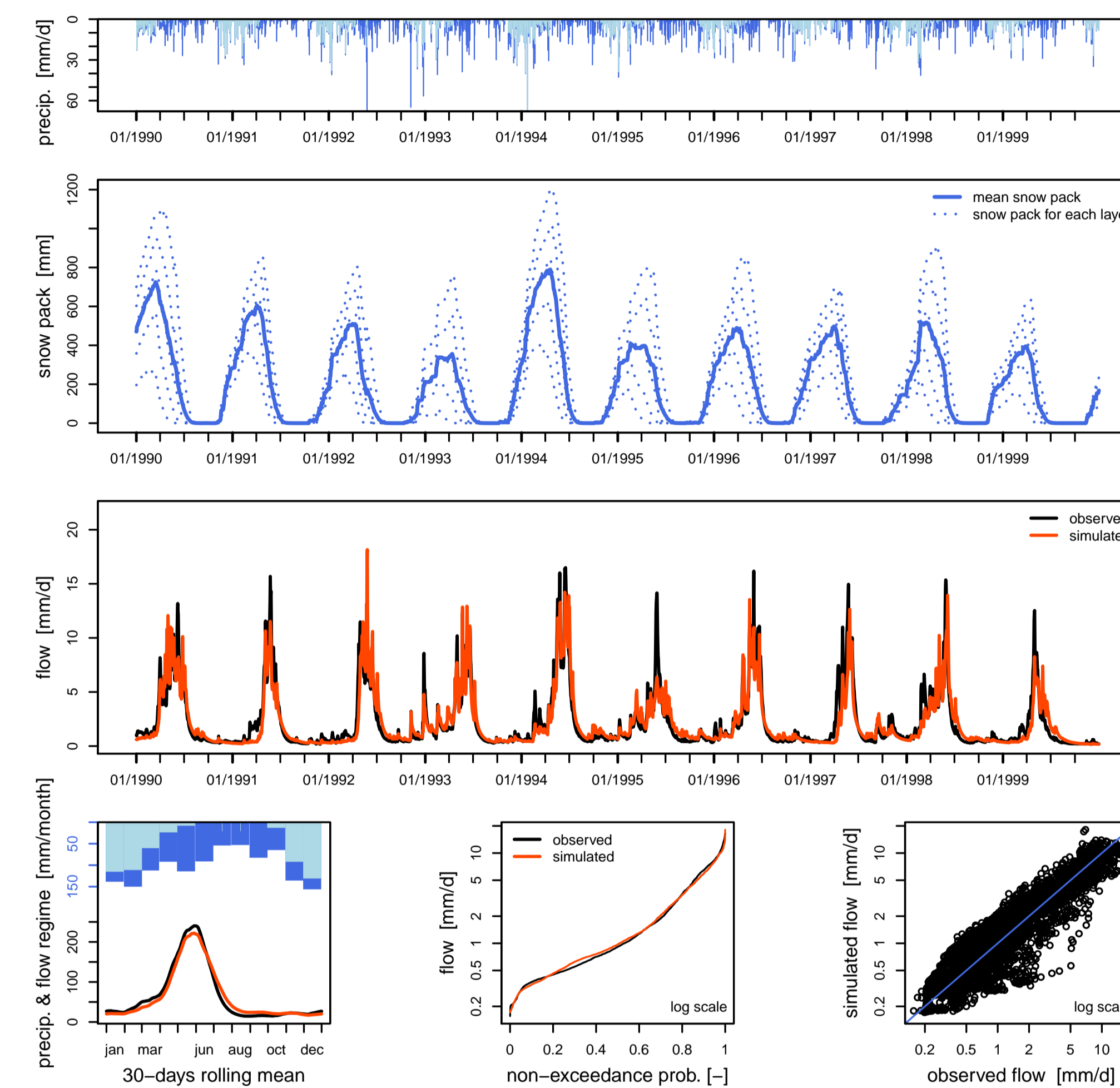
The GR hydrological models

- ▶ 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)

The screenshot shows the airGR website tutorial page. It includes a navigation menu (airGR, Home, Getting started, Customization, Docs, Download) and a table of contents with 6 items: 1 Loading data, 2 Preparation of functions inputs, 2.1 InputsModel object, 2.2 RunOptions object, 2.3 InputsCrit object, 2.4 CalibOptions object, 3 Criteria, 4 Calibration, 5 Validation, 6 Simulation. The main content is titled '2.2 RunOptions object' and explains the `CreateRunOptions()` function. It lists arguments: `FUN_MOD` (name of the model function), `InputsModel` (input data), and `IndPeriod_Run` (run period). It provides R code for creating the `RunOptions` object and lists additional arguments like `IniStates`, `IniResLevels`, and `IndPeriod_WarmUp`.

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

The screenshot shows the Shiny interface of the airGRteaching package. It features a 'Choose a dataset' dropdown (Low-land basin), 'Choose a model' (GR4J, Snow module), and 'Parameters values' for X1 (production store capacity), X2 (intercatchment exchange coeff), X3 (routing store capacity), and X4 (unit hydrograph time constant). It includes a '30-days rolling mean' plot, a 'flow [mm/d]' plot, and a 'precip. & flow regime [mm/month]' plot. A 'Criteria' table is visible on the right with values for NSE [Q], NSE [log(Q)], KGE [Q], and KGE [log(Q)].

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.

The airGR functionalities

- ▶ Easy implementation on numerous catchments
- ▶ Data requirements limited to lumped precip., temp. and streamflow time series
- ▶ One automatic calibration procedure
- ▶ A set of efficiency criteria
- ▶ Limited computation times (use of Fortran routines to run the models)
- ▶ Pre-defined graphical plots
- ▶ Outputs include simulated flow time series and internal variables
- ▶ User can implements its own models, efficiency criteria or optimization algorithms

News since EGU 2017 – airGR 1.0.5.12 vs airGR 1.0.1

- ▶ `RunModel_*GR6J()` modified to improve efficiency criteria values
- ▶ `plot.OutputsModel()` has new features (log scale for flows, layer temp. time series)
- ▶ `RunModel_CemaNeigeGR*` functions now return air temp. for each elevation layer
- ▶ Elevation gradients for air temp. returned by `CreateInputsModel()` are improved
- ▶ CemaNeige now allows for rescaling precip. when interpolated on the elevation layers
- ▶ Data preparation for CemaNeige now runs 500 times faster