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

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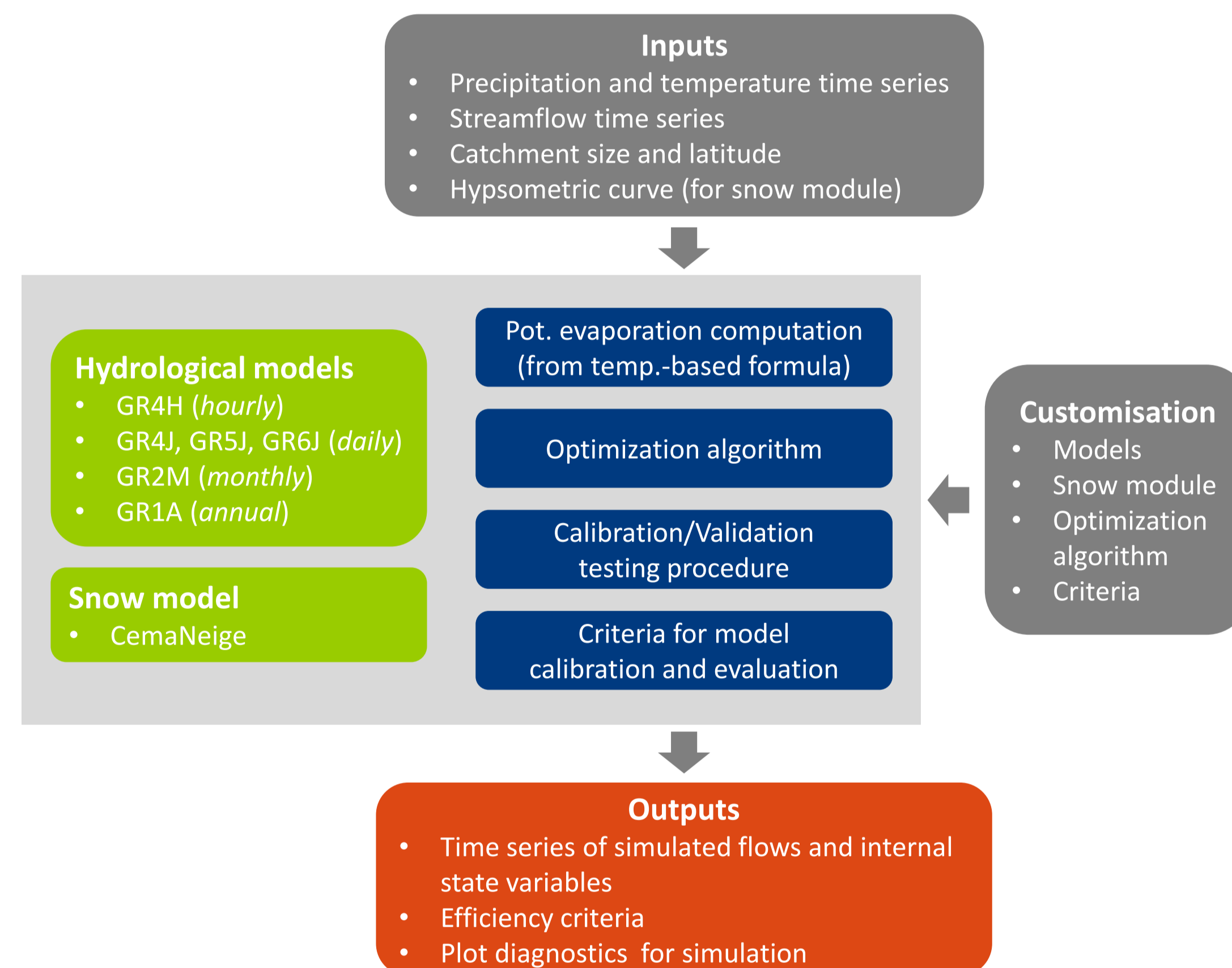[2] EDF – PMC Hydrometeorological Center – Toulouse, France

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.
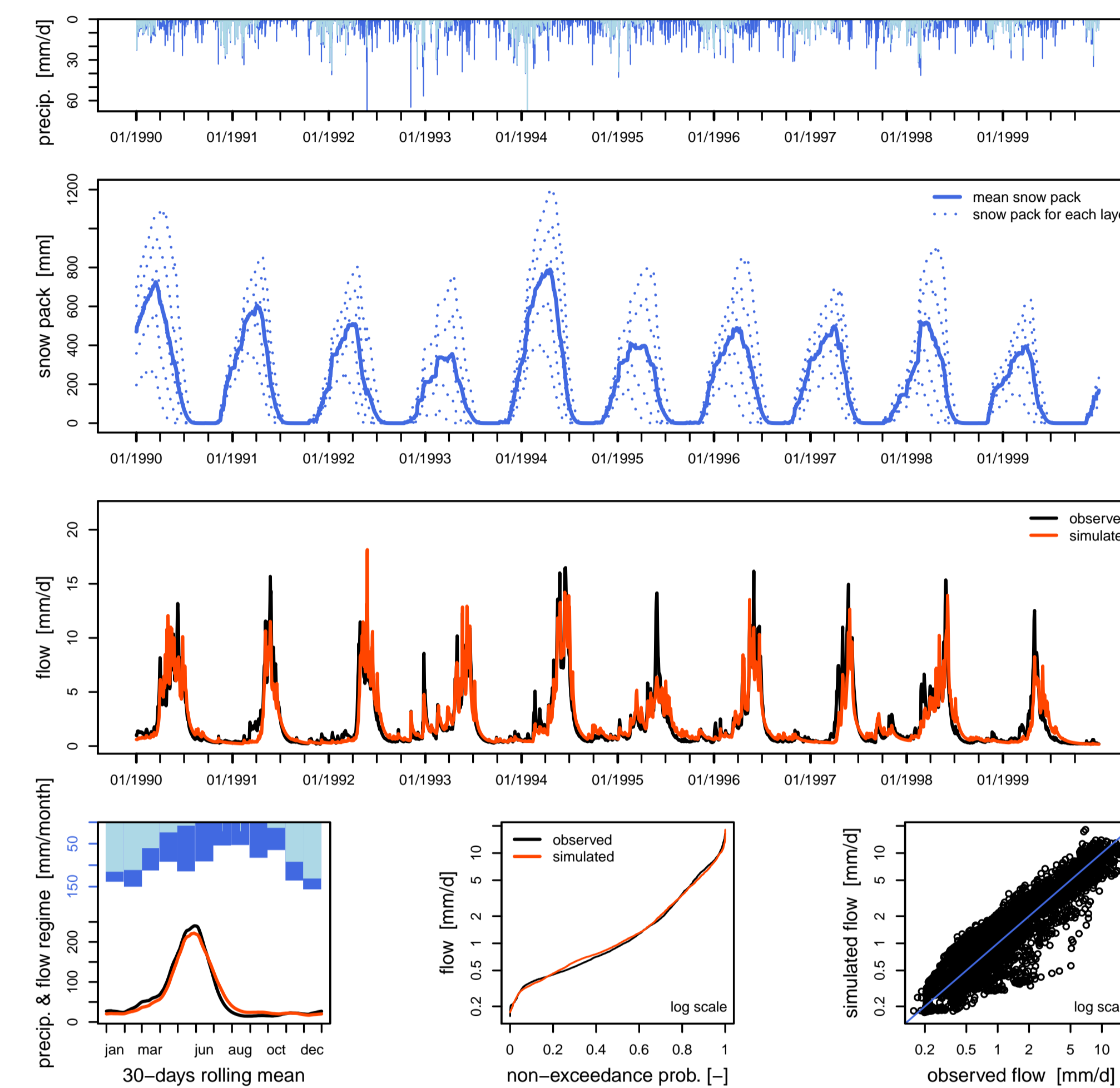
The GR hydrological models

▶ 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

Inputs
• Precipitation and temperature time series
• Streamflow time series
• Catchment size and latitude
• Hypsometric curve (for snow module)

Hydrological models
• GR4H (*hourly*)
• GR4J, GR5J, GR6J (*daily*)
• GR2M (*monthly*)
• GR1A (*annual*)

Snow model
• CemaNeige

• Pot. evaporation computation (from temp.-based formula)
• Optimization algorithm
• Calibration/Validation testing procedure
• Criteria for model calibration and evaluation

Customisation
• Models
• Snow module
• Optimization algorithm
• Criteria

Outputs
• Time series of simulated flows and internal state variables
• Efficiency criteria
• Plot diagnostics for simulation

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

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/

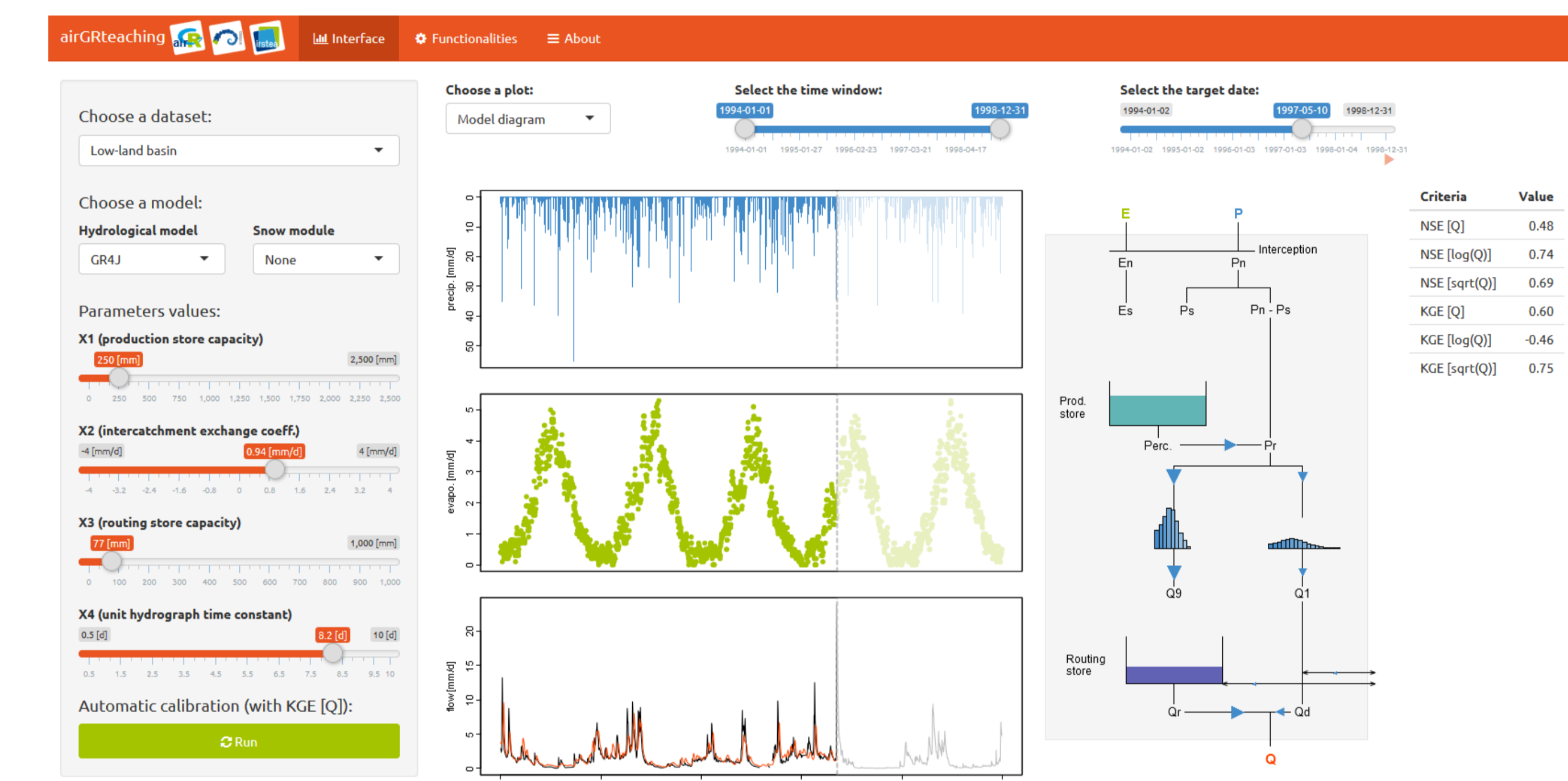### airGR website (tutorial page)

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.

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