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Latest developments of the airGR rainfall-runoff modelling R package: new calibration procedures and other features

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

### GR hydrological models
- Designed with the objective to be as efficient as possible for flow simulation at various time steps (from hourly to interannual)
- Warranted complexity structures and limited data requirements
- Can be applied on a wide range of conditions, including snowy catchments (CemaNeige snow routine included)

### How to use other R packages to perform parameters estimation
- Definition of the necessary function:
  - transformation of parameters to real space (available in airGR)
  - computation of the value of the performance criterion (e.g. RMSE)

```r
OptimGR4J <- function(Param_Optim) {
  Param_Optim_Vre <- airGR::TransfoParam_GR4J(ParamIn = Param_Optim,
                                           Direction = "TR")
  OutputModel <- airGR::RunModel_GR4J(InputModel = InputParamGR4J,
                                       Direction = "TR")
  return(OutputCrit$CritValue)
}
```

- Definition of the lower and upper bounds of the four GR4J parameters in the transformed parameter space

```r
lowerGR4J <- rep(-9.99, times = 4)
upperGR4J <- rep(+9.99, times = 4)
```

- Local optimisation
  - Single-start (here) or multi-start approach to test the consistency of the local optimisation

```r
startGR4J <- c(4.1, 3.9, -0.9, -8.7)
```

- Global optimisation
  - Most often used when facing a complex response surface, with multiple local minima

- Differential Evolution
  - Particle Swarm
  - MA-LS-Chains algorithm

### News since EGU 2017 – airGR 1.0.9.64 vs airGR 1.0.5.12
- The ParaSes GR4J dataset was added. It contains generalist parameter sets for the GR4J model
- Vignettes were added. They explain how to perform parameters estimation with:
  - Differential Evolution calibration algorithm
  - Particle Swarm calibration algorithm
  - MA-LS-Chains calibration algorithm
  - Bayesian MCMC framework

- A new airGRteaching package (Delaigue et al., 2018) provides tools to simplify the use of the new airGR hydrological package for education, including a ‘Shiny’ interface

### Future developments
- New version of CemaNeige that allows to use satellite snow cover area for calibration (Riboü et al., accepted)
- Parameters maps on France for GR4J, GR5J & GR6J models for ungauged basins (Poncelet et al., submitted)

### References

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