Fact-sheet GR4J and GR5J

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1. General Information	
Model name	GR4J (modèle du Génie Rural à 4 paramètres Journalier) GR5J (modèle du Génie Rural à 4 paramètres Journalier)
Version	2003 for GR4J 2008 for GR5J
Author(s) / First publication	Edijatno et al. (1999); Perrin et al. (2003) for GR4J Le Moine (2008) for GR4J
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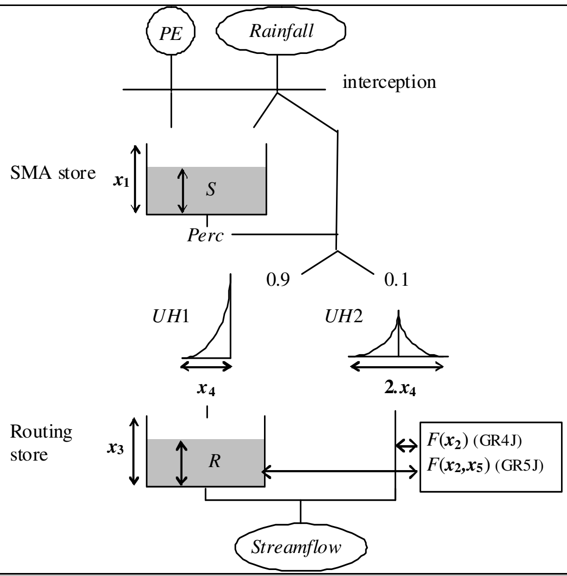
General modelling objectives	flow simulation, flood estimation, flood and low flow forecasting, detection of trends
Domain of applicability (catchment types and climate conditions)	Model largely applied in France and tested in various climate conditions in many other countries (Brazil, Mexico, the United States, Canada, the United Kingdom, Sweden, Switzerland, Slovenia, Australia, the Ivory Coast, etc.)
2. Model description	
Model type (empirical, conceptual, physically-based, others)	Empirical model with a storage type structure
Continuous or event-based	Continuous
Possible running time steps	Built for the daily time step; Can be applied to shorter time steps after modifying a few fixed model parameters
Spatial discretization (lumped, semi-distributed, distributed)	Lumped
Short description of model structure detailing main function (evaporation, soil moisture accounting, groundwater, routing, snowmelt, etc.)	The two model structures differ only on the groundwater exchange function. The model structures can be divided into a production module and a transfer module. The production module consists of three functions: - an interception phase using an interception store with zero capacity (potential evapotranspiration directly acts on input rainfall); - a soil moisture accounting (SMA) store to determine (i) the part of raw rainfall that will become effective rainfall and (ii) the actual evapotranspiration; - a water-exchange function that can simulate import or export of water from/to groundwater or neighbouring catchments. It acts on the two flow components simulated by the transfer module. It is non linear in the case of GR4J and linear in GR5J. In GR5J, the sign of exchanges can change along the year (from ground to surface water or vice versa).

	The transfer module consists of: - a percolation from the SMA store; - a constant volumetric split of effective rainfall into a direct flow component (10%) and a indirect flow component (90%); - two unit hydrographs (UH), each one acting on one flow component; - a non-linear routing store that routes the indirect flow component. A degree-day snowmelt module is used for application in catchments influenced by snow.
Scheme of model structure	
3. Model parameters	
Distribution of model parameters (yes/no)	No
Number of free parameters	• 4 free parameters in GR4J (x1: maximum capacity of the production store (mm); x2: groundwater exchange coefficient (mm); x3: one-day-ahead maximum capacity of the routing store (mm); x4: time base of unit hydrograph UH1 (days)) • 5 free parameters in GR5J (the four first parameters are the same as in GR4J; x5: threshold for change of groundwater exchange sign)
Procedure of model parameter estimation (measurement, manual or automatic algorithm, etc.)	Automatic calibration
4. Model inputs / Model outputs	
List and characteristics of input variables (type, time step, spatial resolution, etc.)	Daily series of potential evapotranspiration and catchment areal rainfall Daily series of temperature for snowmelt
List and characteristics of output variables (type, time step, spatial resolution, etc.)	Daily streamflow
5. Examples of previous model applications	
Catchments, objectives, etc.	A number of sensitivity analysis and applications were carried out in various catchments (see model website for a review)
Results of existing	Many comparative evaluation with other models (e.g. Perrin et

comparisons with other models	al., 2001; Le Moine et al., 2008)
6. List of 5 selected references	

Edijatno, N. O. Nascimento, X. Yang, Z. Makhlouf, and C. Michel (1999), GR3J: a daily watershed model with three free parameters, *Hydrol. Sci. J.*, *44*(2), 263-277.

Le Moine, N. (2008). Le bassin versant de surface vu par le souterrain : une voie d'amélioration des performances et du réalisme des modèles pluie-débit ? PhD Thesis, Université Pierre et Marie Curie, Paris, 324 pp.

Perrin, C., C. Michel, and V. Andréassian (2001), Does a large number of parameters enhance model performance? Comparative assessment of common catchment model structures on 429 catchments, J. Hydrol., 242(3-4), 275-301.

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