PRACTICAL 3: GR4J

PREPARATION QUIZ

Answers are in the comments, so use 'No Markup' mode to test yourself.

**Information**

The hydrological model [GR4J](https://webgr.irstea.fr/en/models/daily-hydrological-model-gr4j) (modèle du Génie Rural à 4 paramètres Journalier) is one of a suite of "lumped" catchment rainfall-runoff models developed by the [Catchment Hydrology Research Group of INRAE](https://webgr.inrae.fr/) in France. Lumped catchment models consider the catchment as a whole, rather than simulating spatial patterns.

We will use an Excel version, slightly adapted from the one [available here](https://webgr.irstea.fr/en/models/daily-hydrological-model-gr4j/) which is the version used by Perrin et al. (2003):

Perrin, C., Michel, C., Andréassian, V. (2003). [Improvement of a parsimonious model for streamflow simulation](https://www.sciencedirect.com/science/article/abs/pii/S0022169403002257). Journal of Hydrology 279(1-4), 275-289.

There is also an online version for teaching, and R versions (both research level and educational), which are also [available here](https://webgr.irstea.fr/en/models/daily-hydrological-model-gr4j/).

Download Perrin et al. (2003) for your reference.

Now download the GR4J model from KEATS.

**Q1. A picture of the river we are modelling is shown on KEATS. Find the basin name in the Excel file (GR4J worksheet) and search for it in an online map. Where is it?**

* Swiss Alps
* Northwest France
* Northern Belgium
* Eastern Canada

**Information**

The two forcings for this model (shown at the top of the model diagram in the Excel file, and also in Lecture 1) are:

* precipitation (P)
* potential evapotranspiration (E).

**Potential evapotranspiration** (full acronym: PET) is the rate that water could potentially be lost to **evaporation or transpiration** (loss by vegetation). It depends on weather conditions such air temperature, solar radiation, wind speed, and humidity.

The balance between precipitation and PET on a given day determines whether the catchment gains or loses water.

**Q2. Which Excel cells in the GR4J worksheet show the first daily value of these two forcings?**

* E16 and E17
* B40 and C40
* E20 and E21

**Information**

Study the parameters x1-x4 in the diagram and their names in the Excel file (cells A10-13 in the GR4J worksheet) and/or [this wiki page](https://wiki.ewater.org.au/display/SD41/GR4J+-+SRG) to get an idea of what they control.

**Q3. Match each parameter with what it controls in the model:**

* x1
* x2
* x3
* x4

and

* Maximum amount of water in the soil
* Maximum amount of water that can then be routed to runoff
* Timescale of the two runoff peaks (slow and fast)
* Groundwater contribution to runoff

**Information.**

Write down in your own notes the minimum and maximum possible values for each parameter from this wiki (Table 2):

<https://wiki.ewater.org.au/display/SD41/GR4J+-+SRG>

Now compare these with the ranges in the online version of the model.

<https://sunshine.irstea.fr/app/airGRteaching>

**Q4. What do you notice?**

**Q5. Which two state variables of the system must be given initial values?**

* The amount of water in the production and routing stores
* The precipitation and potential evapotranspiration
* x1 and x3

**Q6. What is the name of the state variable that is calibrated (i.e. evaluated with observations) in this model?**

* Streamflow
* Precipitation
* Potential evaporation
* Fill rate of the production store
* Fill rate of the routing store

**Q7. Which** **Excel cell in the GR4J worksheet show the first daily value of the calibration data?**

* B40
* C40
* D40
* E40

**Q8. What are the names of the two in-built metrics used to evaluate model performance?**

* Nash-Sutcliffe
* Bias
* Implausibility
* Distance