D4.4 Release of modelling tools: Lumped parameter modelling

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User Guide

Description

Lumped parameter models were used as part of Deliverable D4.2 to model time series of karst spring discharge. The models were developed within KarstMod, which provides a platform for global modelling of the precipitation-level-discharge relationship in karst catchments. The models also benefited from the use of a snow routine during the preprocessing of the data. The snow routine helped to simulate snow accumulation and melt on the catchment, providing better and more accurate simulation of the springs discharges. The use of the snow routine function requires a little knowledge in R.

This repository contains the following elements:

- KarstMod files for each KARMA test site
- R script for performing the snow routine
- This user guide, which provides the context and guidelines for the modelling

Workflow

Snow routine

The snow routine is detailed in the section 2.3 of the Deliverable D4.2. The routine is inspired from the work of Chen et al. (2018), which successfully simulated spring discharge of a mountainous karst system heavily influenced by snow accumulation and melt. The workflow is:

1. Get time series of (i) precipitation, (ii) temperature, and (iii) potential clear-sky solar radiation (if needed)
2. Define subcatchment (if needed) then calculate their areas and their relative proportion to the whole catchment
3. Apply the snow routine function for each subcatchment. We recommend to shift the temperature time series according to an appropriate temperature gradient scaling with altitude. The inputs for the snow routine function are:
    - temperature vector (T,1)
    - precipitation vector (T,1)
    - potential clear-sky solar radiation vector (T,1)
    - model parameters vector: temperature threshold, melt factor, refreezing factor, water holding capacity of snow and radiation coefficient (T,5)
4. Apply the relative proportion of each subcatchment to their corresponding P time series (output of the snow routine)
5. Sum up the P time series of each subcatchment

If you work without solar radiation, radiation coefficient parameter needs to be `0` and potential clear-sky solar radiation must be a vector of `0` of the same length as temperature and precipitation time series.

KarstMod

The KarstMod platform is detailed in the User manual. The main workflow is:

1. Prepare the input data
2. Open the appropriate KARMA KarstMod file (if needed)
3. Import the input data
4. Define warm-up/calibration/validation periods
5. Define Output directory
6. Run calibration

You can modify the model parameters, the objective function, the number of iterations, the maximum time, etc... If you want to save the new modifications, just press `Save` and you will get a new KarstMod file.

Resources

For more details about the KarstMod platform, please refer to the User manual provided below.

For more details about the snow routine and KARMA models, please refer to the Deliverable D4.2 provided below.

Download KarstMod: https://sokarst.org/en/softwares-en/karstmod-en/

Download KarstMod User manual: https://hal.archives-ouvertes.fr/hal-01832693

Download Deliverable D4.2: http://karma-project.org/index.php/downloads/deliverables-publications

KARMA project

KARMA is implemetend under the umbrella of the Partnership for Research and Innovation in the Mediterranean Area (PRIMA), which aims to develop new R&I approaches to improve water availability and sustainable agriculture production in a region heavily distressed by climate change, urbanisation and population growth.

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Partnership for Research and Innovation in the Mediterranean Area (PRIMA)

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Ministry of Economy, Industry and Competitiveness – through the State Research Agency - Spain

Agence Nationale de la Recherche (ANR) - France

MIUR – Ministry or Education, University and Research - Italy

National Council for Scientific Research - Lebanon (CNRS-L) - Lebanon

Ministry of Higher Education and Scientific Research (ANPR) - Tunisia

References

Chen, Z., Hartmann, A., Wagener, T., Goldscheider, N., 2018. Dynamics of water fluxes and storages in an Alpine karst catchment under current and potential future climate conditions. Hydrology and Earth System Sciences 22, 3807–3823. https://doi.org/10.5194/hess-22-3807-2018