Geophysical Research Abstracts
Vol. 20, EGU2018-15294, 2018
EGU General Assembly 2018

The development of the water-energy nexus component of the hydrological distributed LISFLOOD model. Application to the Iberian Peninsula.

Marko Adamovic, Berny Bisselink, and Ad De Roo

European Commission, Joint Research Centre; Directorate D – Sustainable Resources; Water and Marine Resources Unit (D.02)

In order to progress in understanding of the impacts of hydrological variations and restrictions resulting from hydrological models, it is interesting to couple the latter with energy models.

This work is two-folded: assessing the potential of hydropower in past and in the coming decades due to the effects of climate change, which is expected to produce mixed impacts on the European Power System; and analysing the Water-Energy Nexus against the background of the EU initiatives towards a low-carbon energy system.

We use a LISFLOOD distributed hydrological model driven by meteorological data and a new developed energy model LISENGY. The LISFLOOD model calculates a complete water balance at a daily time simulating complex physical processes such as surface runoff, and thus including the behaviour of reservoirs. LISENGY model bounded by operational and physical constraints simulates water levels and discharges at a daily time step.

These two models are so far coupled external/offline, meaning that outputs from the hydrological model become inputs to the energy model. The coupling is established with assumption that reservoirs operate for a profit maximization, which is the natural state of their functioning. Water level fluctuations in reservoirs are hard to obtain even though the operators have those data but are not willing to distribute them openly. This is mainly because of the competiveness among the different operators where everyone is trying to operate in an individual hidden manner to keep its operations secret and maximize profit as much as possible. Therefore, storage-head relationship is established using the proxy for reservoir morphometry and more rarely by actual data resulting from dam operators.

The optimized turbine discharge and power production are then compared to actual power generation, by analysing the statistical relation between discharge and hydropower generation which, thus provides the water-energy nexus capacity overview of Iberian Peninsula.

The approach was successfully tested on several reservoirs at Iberian Peninsula, where reduced runoff is expected to decrease hydropower generation, while higher temperatures are due to increase summer electricity demand when water scarcity is more presented.
The model also allows for an insight of how water levels change with different climate change scenarios and sheds the light on the impacts of the limitations of the water system on the hydropower operations, ecosystem, change in residual flows and water availability for other water usages.