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Input features importance to hydrological indices simulated by Land Surface and Global Hydrological Models

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A solid understanding of the global water cycle and how land surface processes respond to both changes in climate and pressure due to water use is essential for society. Although Land Surface Models (LSM) and Global Hydrological Models (GHM) are able to simulate the spatiotemporal variability of the water balance relatively reliably, intercomparison studies have indicated considerable differences between the models. Each LSM and GHM present a unique set of equations, parameters and configurations that contribute to the spread of simulated hydrological responses to meteorological forcings. In order to improve our understanding of modeling uncertainties, we propose a variable importance assessment for 5 LSM/GHM (JULES, HTESSEL, PCR-GLOBWB, SURFEX and ORCHIDEE) from the EartH2Observe (E2O) project. The output of the models and the meteorological forcings were collected from the Water Resources Reanalysis Tier 2 of the E2O project, which consists of a global dataset with spatial resolution of 0.25^{o}x0.25^{o}. We used soil texture and land cover datasets that most resemble the inputs used by each LSM/GHM during the E2O project. The models' outputs were used to estimate 6 hydrological indices for every land cell: Evaporation-Precipitation ratio; Runoff-Precipitation ratio; Surface Runoff-Total Runoff ratio; median Soil Moisture variation caused by a Rainfall event; median Surface Runoff caused by a Rainfall event; and Soil Moisture temporal autocorrelation. Then, we evaluate the input features (meteorological, land cover, and soil texture) importance to the hydrological indices of each model using machine learning. With the analysis we aim to examine a) How much the models differ and why? b) To what extent are the output differences related to the input features or/and to the models formulation? and c) How significant is each feature to the respective hydrological index?