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Comparative Diagnostic Evaluation of eight Large Scale Hydrological Models Across Europe

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An ensemble of eight global hydrology models (GHM) and land surface models (LSM) was evaluated with respect to their ability to reproduce the hydroclimatic regime, defined as the mean annual cycle of observed monthly runoff. The ensemble was build as a joint effort within the European Union Framework program WATCH (eu-watch.org). All models are run using the WATCH forcing data (WFD) as meteorological input. Models differ in their process formulations as well as in their parameterizations. The models are evaluated against a pan-European data set of more than 400 observed runoff series from small near-natural catchments. The diagnostic model evaluation was based on decomposing the mean squared error into bias, variance and a component attributed to errors in correlation. Each component has its own hydrological interpretation. The bias measures error in mean. The variance measures whether the amplitude of the annual cycle is reproduced accurately. The correlation-error quantifies differences in hydrograph shape and is thus sensitive to differences in timing between the observed and the modeled annual cycles. The model performance differs significantly among the different models and hydroclimatic regimes. On average, the ensemble mean provided the most reliable estimate for the mean annual cycle. The signature of the decomposed mean square error varies systematically between the different hydroclimatic regimes and the best performing models differ for the different error components. In this talk we will present how an systematic analysis of variations in the error components allows for a diagnostic evaluation of the model structures included in the comparison. In summary, we found that deficiencies in the modeling of complex but relevant hydrological processes, such as snow melt, does not only lead to significant differences in performance between different models, but also causes systematic differences in the error structure, depending on the hydroclimatic conditions.