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A comprehensive data assimilation approach for reliable hydrological predictions in data-scarce endorheic basins, Tibetan Plateau

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Hydrological predictions under the constraints of the remote and unique environment of the Tibetan Plateau are highly uncertain since suitable input data representing spatio-temporal patterns with a sufficient resolution are limited. Moreover, a great challenge for successful water balance calculations in this data-scare region is the balance between model complexity in order to reproduce all the important underlying hydro-meteorological processes and simplicity by using as few parameters as possible attributable to the limited data availability. To characterize dominant processes and lake response on the Tibetan Plateau a process-oriented model which is parametrically efficient and applicable to ungauged or poorly gauged basins is required.

The main goal of this study is to identify and quantify factors controlling the hydrological system dynamics of endorheic drainage basins on the Tibetan Plateau related to varying spatio-temporal patterns. In the context of a changing climate and monsoon dynamic a comprehensive data assimilation approach integrating in-situ monitoring data, remote sensing data, meteorological and hydrological modeling is applied to analyze lake level fluctuations and to contribute to a better understanding of the implications of climatic and hydrological dynamics on the regional water balance. Various basin indices including hydro-climatic and physical basin characteristics are derived to provide knowledge of similarities or differences among lake catchments across the Tibetan Plateau. The spatial relations between indices and lake level variations are examined using statistical analysis. Lake basins being considered representative (benchmark basins) are investigated by merging top-down modeling (data-based and conceptual) and bottom-up (physical) modeling approaches. The modeling approach focuses on i) integrating available ground and earth observations in a meaningful way and ii) defining a minimum data set required for reliable predictions in catchments where we have little or no hydrological data. A meteorological data set for a period of ten years (2001-2010) generated by the numerical Weather Research and Forecasting (WRF) model with daily time step and spatial resolution up to 10 km is used to drive the conceptual hydrological model built within the Jena Adaptable Modeling System (JAMS). The impact of changes in the model parameters or input on the model output at different points in time is analyzed to assess the dynamic sensitivity and to quantify the related modeling uncertainties.

Further data assimilation and cross validation of independent parameters will lead to an improvement in reliability of hydrological simulations. With the successful validation of this integrated system analysis approach, information, tools and data will be provided by a web-based data information system to the research community allowing a better understanding of changing hydro-climatological dynamics and its influence on the living environment on the Tibetan Plateau.