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Integrated Multi-Scale Hydrological System Analysis Approach in Data-Scarce High Elevation Basins, Central Asia

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Accurate hydrologic predictions are an enormous challenge in the remote and poorly gauged Tibetan Plateau. The lack of detailed knowledge of underlying hydrological processes and parameters as well as the limited availability of observed climate input data are strong controlling factors for the uncertainty of the hydrological model performance. To reduce these uncertainties, an integrated multi-scale approach comprising ground observations, remote sensing data, atmospheric and hydrological modelling within the Jena Adaptable Modelling System (JAMS) is applied to benchmark basins located on the Tibetan Plateau.

To test this approach, we focus on two regions of contrasting climatic conditions: the closed lake Nam Co basin and the Nepalese Dudh Kosi river basin where validation data is available (lake level changes and runoff measurements). A meteorological data set generated by the numerical Weather Research and Forecasting (WRF) model with spatial resolution up to 10 km is used to drive the process-oriented hydrological model for monthly and daily time steps for a period of ten years (2001-2010). Basin characteristics like glacier and permafrost distribution as well as land cover, topographical and soil information are derived from remote sensing and GIS data analysis.

The J2000 hydrological model sensitivity to the atmospheric model resolution is assessed and discussed. This integrated approach offers new analysis methods to identify the most relevant forces (such as glacier balance, permafrost and monsoon dynamics) driving the hydrology of Tibetan Plateau basins. This work forms the knowledge base for the regionalisation to other closed inland lake basins along the Tibetan Plateau with different climate conditions and associated monsoon dynamics.