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Considering obvious landscape features as a basis for hypothesis rejection in a poorly gauged catchment

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Any hydrological model designed to reflect our current process understanding implies a plethora of hypotheses concerning the water transport. Very recently, generic model frameworks, like the Catchment Modelling Framework (CMF) that we present in this study, are available to facilitate the formulation of hypotheses and implementation of processes. With such frameworks, the number of possible model structures, as well as the number of sensitive parameters is only limited by imagination and time of the scientist. But does this help to reject model structures as inappropriate, or is the freedom to create any model structure with its own parameter set just the next level of equifinality?

Our study area, the upper Xilin catchment in Inner Mongolia, China, is a large, remote catchment that is poorly gauged. The available data sets are short, incomplete and have a low spatial resolution. Precipitation and other hydrological drivers are highly uncertain in space and time. To understand the catchment behaviour in face of this poor "hard" data quality, qualitative observations can be used for model rejection and hypotheses testing. In our study area, all year water saturated wetlands in the riparian zone of the river in a semiarid steppe environment can be used as such an observation.

We are using CMF to set up a process based explicit model structure and include the wetland and the potential water sources which may feed the wetlands. In addition, we implemented different hypotheses about the importance of the sources, and rejected any model not capable to feed the evapotranspiration demand of the wetlands. The hypotheses were also tested against other robust, criteria, like base flow conditions, results of tracer derived flow path understanding and energy balance considerations. Most model structures could not fulfil all of these objectives, independent of the parameterization. Only those model structures including a strong interbasin flow proved to be plausible, a result that we were not able to proof by classical rainfall-runoff model simulations. We see multi-objective hypotheses testing against different types of quantitative and qualitative observations as an extremely useful tool to improve our process understanding.