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# Quantifying Impact of Anthropogenic Disturbances on Water Availability and Water Stress in Mongolian Urban and Mining Hubs by Using Process-Based Eco-Hydrology Model

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## Abstract

In Mongolia, overuse and degradation of groundwater is a serious issue, mainly in the urban and economic hub, Ulaanbaatar, and the Southern Gobi mining hub. In order to explicitly quantify spatio-temporal variations in water availability, a process-based eco-hydrology model, NICE (National Integrated Catchment-based Eco-hydrology) (Nakayama and Watanabe, 2004), was applied to two contrasting river basins including these hubs. The authors built a high-resolution grid data representing water use for livestock, urban populations, and mining by combining a global dataset, statistical data, GIS data, observation data, and field surveys. The model simulated the effects of climatic change and human-induced disturbances on water resources during 1980-2018 (Nakayama et al., 2021). Although drinking by herders' livestock had some impact on the hydrologic change, the groundwater level in the Tuul River was shown to have been extremely degraded by water use in Ulaanbaatar over the last few decades whereas that in the Galba River has declined markedly as a result of Oyu Tolgoi mining since 2010. Analysis of the relative contribution of environmental factors also helped us to separate the effects of climatic change and human activities on spatio-temporal change in the groundwater level. Further, they extended NICE to couple with inverse method for sensitivity analysis and parameter estimation of anthropogenic water uses (NICE-INVERSE). This new model quantified the spatio-temporal variations of

livestock water use in these river basins (Nakayama, et al., in press). The livestock water use was generally small for each *soum* (district), and could also be heavily returned back to the ecosystems. The result also showed a temporal decreasing trend of unit water use in some typical livestock (cattle, sheep, and goats), suggesting a substantial increase in water stress due to local-regional eco-hydrological degradation by urbanization and mining. Sensitivity analysis and inverse estimation of model parameters helped to improve the accuracy of hydrologic budgets in basins. This methodology is powerful for evaluating spatio-temporal variations of water availability and supporting water management in regions with fewer inventory data.