Towards an Operational Groundwater Level Forecasting System in Switzerland

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Abstract:

Groundwater is among the most important sources of freshwater for drinking water production and irrigation purposes across Switzerland. Recent drought events have shown that these groundwater resources, traditionally considered a safe source of water supply, are affected by prolonged periods with limited or no rainfall and high evaporation. Early warning systems may help inform groundwater resource managers about the possible future state of groundwater levels in different aquifers across Switzerland. Such a system could provide crucial support by enabling timely responses to mitigate the potential consequences of droughts on groundwater resources.

This study aims to investigate the feasibility of forecasting groundwater levels in Switzerland up to 32 days into the future using sub-seasonal meteorological forecasts provided by MeteoSwiss. This study employs lumped-parameter models from the Pastas software (Collenteur et al., 2019) to simulate groundwater levels at seven strategically selected monitoring wells across Switzerland. These models are driven by ensembles of daily meteorological forecasts to generate ensemble daily groundwater level predictions. A noise model is applied to enhance forecast accuracy, a step that was found critical to improving forecast quality. The forecast quality is verified using weekly re-forecasts from 2012-2023 and compared against two naive benchmarks: persistence and climatology-based forecasts. The results indicate that skilful forecasts of groundwater levels can be made for the entire forecast period. Whether the ensemble groundwater predictions outperform, the naive forecasts are related to the response time of the groundwater system.

References:

Collenteur, R. A., Bakker, M., Caljé, R., Klop, S. A., & Schaars, F. (2019). Pastas: open source software for the analysis of groundwater time series. Groundwater 57 (6): 877–885.