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Combining Multiple Data-driven Models for Spatiotemporal Groundwater Forecasts in The High Plains Aquifer

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Groundwater modelling and forecasting are key for the development of water management plans and for groundwater allocation in agriculture. However, there is a complex and still poorly understood nonlinear relationship between climate, management, surface water availability and groundwater level variation. In addition, restricted computational power has become one of the major challenges in the development of complex hydrogeological models. To better understand this relationship, and to provide accurate forecasts, we developed a parallel ensemble-multi model framework based on artificial neural network and support vector machines to forecast seasonal (one to six month) groundwater level changes in response to climate, surface water availability and human intervention in more than three hundred wells in the High Plains aquifer (USA). The human intervention component was addressed by estimating the crop water demand using both the AquaCrop model and remote sensing data. Model-free and model-based input variable selection methods were used to select the most relevant input variables and lags. For predicting groundwater table at ungauged locations, a spatiotemporal multi-model approach was employed: geospatial models built for the neighboring correlated wells were optimally combined to form a model committee. An association algorithm was developed to understand causalities between forecasting capability, land-use system, and agricultural water demand. The results show a high potential of the multi-model data-driven committee approach for spatiotemporal groundwater table forecasts.