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A temporal-spatial postprocessing model for probabilistic run-off forecast. With a case study from Ulla-Førre with five catchments and ten lead times

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This work is driven by the needs of next generation short term optimization methodology for hydro power production. Stochastic optimization are about to be introduced; i.e. optimizing when available resources (water) and utility (prices) are uncertain. In this paper we focus on the available resources, i.e. water, where uncertainty mainly comes from uncertainty in future runoff. When optimizing a water system all catchments and several lead times have to be considered simultaneously. Depending on the system of hydropower reservoirs, it might be a set of headwater catchments, a system of upstream /downstream reservoirs where water used from one catchment /dam arrives in a lower catchment maybe days later, or a combination of both. The aim of this paper is therefore to construct a simultaneous probabilistic forecast for several catchments and lead times, i.e. to provide a predictive distribution for the forecasts. Stochastic optimization methods need samples/ensembles of run-off forecasts as input. Hence, it should also be possible to sample from our probabilistic forecast.

A post-processing approach is taken, and an error model based on Box- Cox transformation, power transform and a temporal-spatial copula model is used. It accounts for both between catchment and between lead time dependencies. In operational use it is strait forward to sample run-off ensembles from this models that inherits the catchment and lead time dependencies.

The methodology is tested and demonstrated in the Ulla-Førre river system, and simultaneous probabilistic forecasts for five catchments and ten lead times are constructed. The methodology has enough flexibility to model operationally important features in this case study such as hetroscadasety, lead-time varying temporal dependency and lead-time varying inter-catchment dependency. Our model is evaluated using CRPS for marginal predictive distributions and energy score for joint predictive distribution. It is tested against deterministic run-off forecast, climatology forecast and a persistent forecast, and is found to be the better probabilistic forecast for lead time grater then two. From an operational point of view the results are interesting as the between catchment dependency gets stronger with longer lead-times.