Geophysical Research Abstracts
Vol. 16, EGU2014-11782, 2014
EGU General Assembly 2014

Hydrological drought forecasting and skill assessment for the Limpopo river basin, Southern Africa

Patricia Trambauer (1), Micha Werner (1,2), Hessel Winsemius (2), Shreedhar Maskey (1), and Emanuel Dutra (3)

(1) UNESCO-IHE, Water Science and Engineering, Delft, The Netherlands, (2) Deltares, Delft, The Netherlands, (3) ECMWF, Reading, United Kingdom

Ensemble hydrological predictions are normally obtained by forcing hydrological models with ensembles of atmospheric forecasts produced by climate models, and frequently applied for flood-forecasting purposes. The approach can be equally applied to forecasting drought at the seasonal time scale. Although this approach has to date not been applied widely, the importance of the subject is recognised and is gaining attention by the research community. The semi-arid Limpopo river basin in Southern Africa has experienced severe droughts in the past, which resulted in crop failures, high economic losses and the need for humanitarian aid. This paper addresses the seasonal prediction of hydrological drought for the Limpopo river basin by testing three forecasting systems. We seek to provide operational guidance to farmers and water mangers within the basin at the seasonal time scale by predicting the availability of water for irrigation and water supply, which are the most important water uses in the basin. In the first system (FS_S4) the PCR-GLOBWB hydrological model was forced with the output of a global atmospheric model, the ECMWF seasonal forecast system S4 (atmosphere-ocean coupled), which has a spatial resolution of about 70 km. An ensemble of hindcasts from the meteorological forecasting system was first obtained for the summer rainfall season over southern Africa for the period 1981 to 2010 to allow for testing of the system. The second forecasting system (FS_ESP) is based on the Ensemble Streamflow Prediction (ESP) procedure. In the ESP procedure the ensemble meteorological forecast is generated with re-sampled historical meteorological data. The hydrological model is then forced with this re-sampled data. FS_ESP allows measuring the skill that can be expected from initial states combined with climatology, and the comparison with the first system allows measuring the improvement when using the ECMWF seasonal forecast S4 compared to using the ESP forecast. A third system (FS_ESPcond) is proposed given that the El Niño-Southern Oscillation (ENSO) is clearly responsible for interannual climate variability over the Limpopo river basin. This system is equivalent to the second system but the ESP is "conditional to ENSO years": the ensemble meteorological forecast is generated with re-sampled historical meteorological data corresponding to past ENSO years. The skill of the three systems in predicting drought indices and streamflow (as simulated by the hydrological model) was determined. Moreover, the skill of the model in predicting indicators that are meaningful to the local end users in the basin (e.g. Water Level Anomaly in reservoirs) was assessed. FS_S4 shows relatively good skill (ROCS higher than 0.7) for all lead times. FS_ESP also performs well, but with a lower skill than FS_S4. FS_ESPcond show comparative skills to FS_S4. Rank histograms for FS_S4 and FS_ESP show that the true variability (uncertainty) of the observations is well represented by the ensemble spread of the forecasts. The hydrological forecasts of streamflow (represented by SRI) during the summer wet season are shown to be skilful (ROCS>0.7 for FS_S4), a result that is encouraging in the context of providing operational guidance to users.