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Use of medium range rainfall and temperature forecasts for agrohydrological forecasting using the ACRU agrohydrological model

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South Africa is inherently characterised by a highly variable climate both spatially and temporally. Sporadic rainfall and frequent droughts, coupled with the country's already scarce water resources, are expected to have a significant effects on all sectors of the economy, particularly agriculture which contributes approximately 2.6 percent of the country's GDP. Sugarcane production and processing are important sources of employment and foreign exchange for the country but are associated with potentially intense demands on water for irrigation especially in northern KwaZulu-Natal production areas, due to increasing rainfall uncertainty and drought risk. The South African Sugarcane Research Institute (SASRI) is mandated to serve the agricultural research needs of the sugar industry, encompassing both commercial and small growers. It was found that a need exists for the development of irrigation water availability forecasts at medium range time scales to support irrigation scheduling in the northern KwaZulu-Natal production areas. This study aims to translate seven day weather (rainfall and temperature) forecasts generated using the variable resolution global atmospheric conformal-cubic atmospheric model (CCAM) model into agrohydrological forecasts of reservoir storage levels and irrigation water demand for commercial sugarcane production in the Mhlatuze catchment in KwaZulu-Natal, South Africa. The rainfall forecasts are firstly compared to observed rainfall at gauging stations with the aim of evaluating how well the forecasts capture both the occurrence of rainfall threshold events and wet dry sequences for various 7 day periods. The ACRU agrohydrological model, a daily time-step, process based model developed in South Africa is configured and verified for the catchment with the consideration of the Goedertrouw Dam, inter-basin transfers and associated canals used to supply water to the main commercial sugarcane and citrus production areas, over a 15 year historical period (1994-2009). The model is then run for a seven year period (2009-2016) prior to the forecast start date to initialize state variable (e.g. soil moisture, baseflow or dam storage). Seven day rainfall and temperature forecasts are then forced into the model to generate agrohydrological forecasts including streamflows, forecasts of the level of the Goedertrouw Dam and irrigation water demands which allow for an improvement to the current relatively simple assumptions made about the availability of irrigation water in SASRI's sugarcane yield forecasts. The study also evaluates the sensitivity of the hydrological forecast outputs (irrigation water demand, streamflow, soil moisture content) to weather/climate forecast inputs (rainfall, temperature) given both the non-linearity of hydrological systems and associated errors of temporal variability in the forcing data, in order to assess the impact of uncertainties/errors associated with the forecasts. This is done through statistical comparisons of the forecasted hydrological variables against the simulated variables generated through the use of observed weather measurements.