Monitoring climate-driven and anthropogenic impacts on hydrology and agriculture in South-Eastern Australia in the 21st century

Maike Schumacher\textsuperscript{1}, Ehsan Forootan\textsuperscript{2,3}, Russell Crosbie\textsuperscript{4}, Theresa Mallschützke\textsuperscript{1}, and Jonas Rothermel\textsuperscript{1}

\textsuperscript{1}University of Hohenheim, Institute of Physics and Meteorology, Data Assimilation in the Earth System, Stuttgart, Germany (maike.schumacher@uni-hohenheim.de)
\textsuperscript{2}School of Earth and Ocean Sciences, Cardiff University, UK
\textsuperscript{3}Robert Bosch GmbH, Abstatt, Germany
\textsuperscript{4}CSIRO, Adelaide, Australia

With the climate change, drought events likely become more frequent and severe in Australia, where the worst droughts were recorded during the 21st century. Particularly, in the South-East of the country, the so called “Millennium Drought” showed below average annual precipitation for an entire decade. The precipitation record was then increased by extreme precipitation events generated from the La Niña events in 2010 and 2011. Afterwards, dry conditions began again to develop. The climate-driven events and anthropogenic adaptions to the circumstances resulted in strong impacts on the hydrological resources and agricultural production. In fact, simulating hydrological processes within the (semi-)arid region of South-East Australia is very challenging especially during extreme events. In previous studies, we found a strong underestimation of the decline of total terrestrial water storage (TWS) and of groundwater in comparison to remote sensing data and in-situ station networks. Thus, we successfully calibrated the W3RA water balance model and simultaneously assimilated TWS anomalies obtained from the Gravity Recovery And Climate Experiment (GRACE) satellite mission to improve the model's skill during extreme meteorological conditions. In this presentation, we focus on the comparison of remote sensing observations and W3RA simulations after implementing the calibration and data assimilation with existing data records on anthropogenic intervention into the water cycle, as well as on agricultural production. Our results indicate high correlations between meteorological, hydrological and agricultural variables, and we observe strong similarities in the long-term trends and break points.