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The impact of dry and wet periods on profile soil moisture calibration and validation in catchments characterised by vertical fluxes

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In order to explore the factors involved in profile soil moisture dynamics, this study analyses the impact of climate on vegetation and soil parameters on profile soil moisture. For this study a one-dimensional model is applied for two climate periods: wet and dry. Three catchments located in the upper Hunter Valley, NSW, Australia, have been monitored as part of the Scaling and Assimilation of Soil Moisture and Streamflow (SASMAS) project (Rüdiger et al., 2007). The catchments have, predominately, grassland cover and are located in a temperate region, characterised by vertical fluxes. This study uses the in-situ profile soil moisture data (0-30 cm) from eighteen stations placed in these three catchments. Eleven years of soil moisture data (2005-2015) with 20 minutes resolution were collected from Campbell Scientific CS616 water content reflectometers. Local rainfall was measured in fourteen stations. To make the simulations, the one-dimensional vertical flow model, HYDRUS-1D, was used. The model is adequate for the region, characterised by vertical fluxes, and was proved to be appropriate for one of the catchments by Chen et al. (2014) for the years of 2005 to 2007. The key parameters affecting HYDRUS-1D performance are soil parameters and vegetation, expressed by the leaf area index (LAI). Those are also main drivers of the soil moisture patterns in the area. The stations were calibrated and validated for two distinct periods: dry and wet. A Monte Carlo (GLUE) approach associated to HYDRUS-1D, followed by a statistical and visual analysis were used to obtain the parameters set for calibration and validation. Firstly, we made a comparison with one station calibrated by Chen et al. (2014) in her period of study (2005-2007) that was drought affected against the same station but with a calibration in a wet period. We then analysed how the vegetation (LAI) and soil parameters changed from a dry period to a wet period. We made this same analysis for the other seventeen stations, and we evaluated statistically the changes on soil parameters and vegetation between dry and wet periods. Secondly, we swapped the parameters sets. That is we used the parameters found in the dry calibration period in a wet period simulation and vice-versa, to evaluate the model's performance. Thirdly, we explored the vegetation parameter changes between the stations in a catchment, in a defined period. As we have two catchments that have a denser vegetated area, we were able to compare how the LAI changed in the wet period, for instance, from the stations located in the grassland part from the ones in the forested part.