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Assessing representative soil moisture at watershed scale of Maqu catchment using spatio-temporal statistical analysis

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In this study the temporal stability concept by Vachaud et al. (1985) is selected to evaluate a soil moisture measuring network in the Maqu catchment (3200 km2) in the north eastern part of the Tibetan plateau. The network serves for validation of coarse scale (25-50 km) satellite soil moisture products and comprises 20 stations with probes installed at depths of 5, 10, 20, 40, 80 cm. Besides identifying the Representative Mean Soil Moisture (RMSM) station for each respective probe depth, we applied the concept to a time series of satellite based moisture products from the Advance Microwave Scanning Radiometer (AMSR-E) to evaluate if a RMSM pixel can be identified from the pixels that overlay the catchment. Analysis in this study serve to evaluate how well the satellite based moisture estimates match to observation at the RMSM stations for respective depths. We aim to evaluate if the RMSM can be estimated by the satellite product so to broaden the procedure to validate satellite images.
We used moisture data for the year 2009 for which data is available at 15 minutes interval using ECH_2O EC-TM probes. For each probe depth a Mean Relative Difference (MRD) plot is created to identify stations that are characterized by mean, wet and dry moisture conditions. The spearman non-parametric test and pearson's correlation coefficient test are used to analyze the temporal persistence of the ranks of the measuring stations. The analysis is applied to each probe depth to evaluate the effect of the measuring depth on determining the catchment RMSM. Similar analysis is carried out on the satellite soil moisture observations that cover a full hydrological year to identify a RMSM pixel.
The result of the analysis on the network showed that the station that indicates RMSM changes for each probe depth and thus a single station that indicates the catchment RMSM cannot be identified. Results on identifying a RMSM pixel shows that such pixel can be identified, however in our case, a station is not available in the pixel footprint area to evaluate if a RMSM station coincides with the RMSM pixel. Therefore, the network may require optimization to represent catchment average moisture conditions. So to evaluate how well station based RMSM is represented by a satellite time series, we inter-compared the time series of the RMSM station at respective probe depths to the time series of the single pixels that overlay the station. We calculated the Root Mean Square Error and Bias for all probe depth and results indicate that satellite observations best match to observations indicating RMSM for probes installed at 20 cm depth. The study also showed that for selecting the RMSM station in the Maqu catchment a minimum observation period should cover an annual cycle with clear dry and wet seasons.