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Assessing the large-scale spatial representativeness of temporal dynamics of soil moisture over the United States using point and global scale data sets

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Several studies highlight the important role of soil moisture in the water and energy cycles. Soil moisture is variable on both temporal and spatial scale, which is characterized by small- and large-scale variability as well as short- and long-term processes within the system. Several soil moisture data sets ranging from the point to the global scales are available and provide a promising tool to investigate the spatio-temporal variability as well as spatial representativeness of soil moisture. In the current study we assess the large-scale spatial representativeness of soil moisture over the United States using point as well as global scale soil moisture data sets. The following three data sets are used: (i) point scale in-situ measurements obtained through the International Soil Moisture Network (ISMN), provide soil moisture measurements at different depths and are defined as reference data set; at the global scale the (ii) remote sensing based Essential Climate Variable soil moisture data set (ECV-SM) from the European Space Agency (ESA), representing surface soil moisture for the period 1978 to 2010, as well as (iii) soil moisture estimates from the land surface model ERA Interim/Land, including soil moisture for four different soil layers over the period 1979 to 2010. Following Orlowsky and Seneviratne (in press) the spatial representativeness at the point scale is determined by defining an area surrounding a station in which other stations exhibit similar temporal dynamics, according to a given cutoff of similarity. Consequently, the areal extent of this area gives the measure of spatial representativeness. This method is similarly applied to the gridded data sets, where the area is then defined by the areal extent of the grid cells that comply with the similarity criteria. The spatial representativeness is calculated for the period April to September for absolute values, as well as for short- and long-term anomalies. We use the top soil layer for all three products, and in addition the root zone soil layer for ERA Interim/Land and the in-situ measurements. First results show that the spatial pattern of ERA Interim/Land representativeness compares better to in-situ for the absolute values of soil moisture while for the anomalies of soil moisture the ECV-SM compares better. Additionally, for the absolute values of soil moisture, ERA Interim/Land compares better to in-situ for areas of large spatial representativeness, while for the anomalies of soil moisture ECV-SM compares better to in-situ for small spatial representativeness. Further investigation will link the identified spatial patterns to, among others, large-scale circulation.

References

Orlowsky, B. and S.I. Seneviratne (in press), Short Communication: On the spatial representativeness of temporal dynamics at European weather stations, Int. J. of Climatology.