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Water cycle analysis over Twente and Maqu using large scale synergistic datasets

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Soil moisture is a key state variable in hydrology. It plays an important role in distributing precipitation into evapotranspiration, run off and percolation. Understanding the dynamics and variability is therefore of crucial importance for characterizing the influence of the land surface on the atmosphere and climate change. In that context soil moisture has been identified as an essential climate variable in the last IPCC assessment report. The importance of soil moisture is reflected by the number of current of future satellite, such as SMOS and SMAP that are designed to retrieve soil moisture. However before any climate study can be performed with this important variable a uniform homogenized long term dataset has to be produced. However remote sensing sensors only have a limited operational life span and use different techniques (passive vs. active) to retrieve soil moisture.

In this perspective a large scale long term soil moisture dataset has been developed within ESA‘s STSE WACMOS project. In particular passive and active microwave observations have been combined to provide a 30 year homogenized global dataset. This product has been validated using different soil moisture networks around the world, such as the Twente (the Netherlands) and Maqu (China) soil moisture networks. However no intercomparison has been performed with other components of the water cycle.

The goal of this research was to evaluate the spatio-temporal patterns in the WACMOS soil moisture against remote sensing observations of different water cycle components. In particular precipitation (from TRMM, CMORPH and ECMWF) and evapotranspiration (from WACMOS) are used as these variables are the two largest components within the water cycle. All the products were collocated to a common grid and temporally aggregated to 8 days, 16 days, and one Month. Afterwards the products were compared against each other in two steps. First the individual water balance components were compared against the soil moisture product and afterwards a simple water balance by combining the WACMOS ET with the different Precipitation products. The two study sites (Twente and Maqu) were chosen to make optimum use of the previously performed validation at these locations.

When comparing individual component for both areas the temporal correlations between the ET and SM/Pt are not very high and correlations between SM and Pt are moderate. For the temporal investigation the level of aggregation does not influence the correlation coefficient significantly. The correlation coefficients found over the Netherlands were higher than those over the Tibetan Plateau which is caused due to the less intense nature of the precipitation events over the Netherlands. After combining the Precipitation products with the WACMOS ET product correlation values in general increased. The investigation shows a higher degree of variability which arises because of the high resolution of the WACMOS ET product. This leads to higher correlations for all aggregates especially over the Twente region.