# TRIPLE COLLOCATION – A NEW TOOL TO DETERMINE THE ERROR STRUCTURE OF GLOBAL SOIL MOISTURE PRODUCTS

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## ABSTRACT

Soil moisture is considered to be one of the keys to our understanding of the interaction between the continental surfaces and the atmosphere as it determines the interaction between the portions of energy between the different water fluxes. As a consequence in its 16$^{th}$ session the GCOS Steering Committee endorsed soil moisture as an Essential Climate Variable (ECV) and the latest IPCC assessment report stressed the need to foster activities to “assemble, quality check, reprocess and re-analyse” soil moisture datasets “relevant to decadal prediction”. The ESA Water Cycle Multi-mission Observation Strategy (WACMOS) project directly responds to this need by assembling and evaluating a homogeneous, global, multi-decadal (30+ years) database of soil moisture records.

The WACMOS database uses data collected by passive sensors (the Scanning Multi-channel Microwave Radiometer (SMMR) on board the Nimbus-7 satellite, the Special Sensor Microwave/Imager (SSM/I) on the F8, F11 and F13 satellites from the Defense Meteorological Satellite Program (DMSP), the Microwave Imager from the Tropical Rainfall Measuring Mission (TRMM), Coriolis Windsat, the Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) aboard the Aqua satellite) and active sensors (the scatterometers aboard of ERS-1/2 and MetOp). Although these sensors are not designed for soil moisture applications, retrieval results suggest that they can provide reliable soil moisture information. Fig.1 shows time periods from the different instruments that have been used in the past for soil moisture retrieval.

An important task in WACMOS is the assessment of systematic differences between these datasets. In this paper we will present results from the triple collocation error estimation technique to assess the errors associated to each dataset. Triple collocation is based on the combination of three data sets to estimate the error in each under the assumption of independent errors. The method was originally developed for ocean wind calibration and error estimation [1]. [2] adopted the method to asses the error of global soil moisture data. Recently the method was used by [3] to effectively account for scaling errors in the evaluation of a space borne soil moisture product using in-situ observations. In this study we investigate the error structure of AMSR-E and MetOp ASCAT soil moisture products. As third independent data set soil moisture from the ECMWF ERA Interim reanalysis program is used.

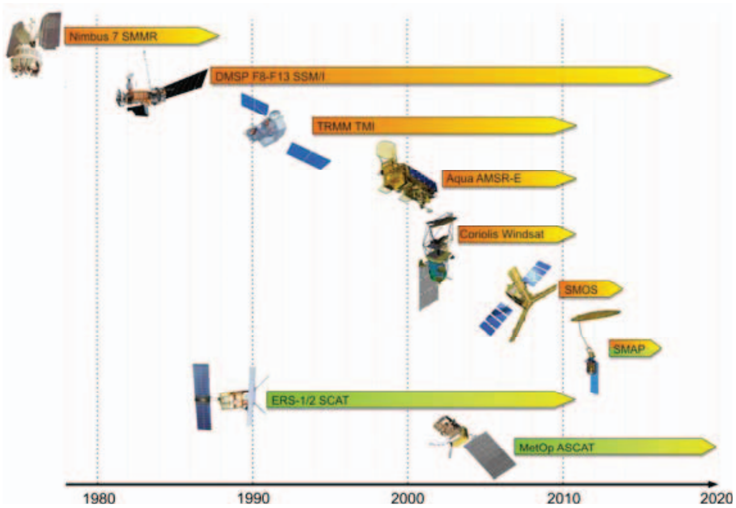
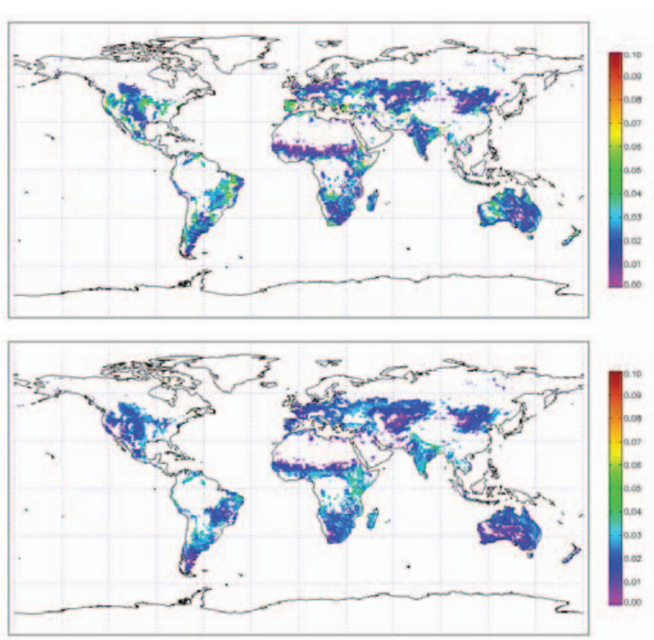



*Figure 1. Time span of available (and future) soil moisture estimates retrieved from different satellites.*

Results suggest that the method provides realistic error estimates and allow us to identify systematic differences between the active and passive microwave derived soil moisture products, e.g. with respect to varying land cover or climatological zones. The errors of each dataset displayed in Fig. 2 reveal some clear spatial patterns. Generally, error estimates are lowest in semi-arid regions such as Southern Africa, mainland Australia or Central Asia. These areas are typically characterized by a limited vegetation cover while still showing pronounced seasonal soil moisture dynamics. In other regions the data sets clearly complement each other. For AMSR-E based retrievals, the errors are significantly higher over densely vegetated regions (e.g. Central Africa, Northeast India), whereas ASCAT data is less effected. Contrary in very dry climates the AMSR-E product outperforms the ASCAT product. These results also suggest that a combined active/passive retrieval could lead to a more homogeneous soil moisture product with reduced errors.



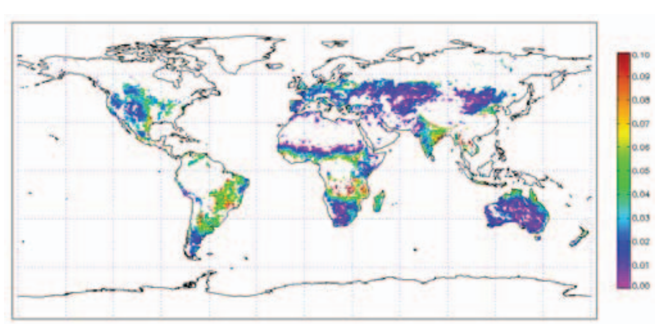


**Figure 3**. Spatial errors of derived soil moisture estimates ($m^3m^{-3}$): (top left) MetOp ASCAT; (top right) AMSR-E, (bottom left) ERA-Interim. White areas on the land surface indicate regions where the triple collocation error model cannot be applied, because the number of collocated observations is too small to guarantee a robust error estimation.

**Bibliography**

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