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Passive and active microwave for soil moisture retrieval

Introduction

In spite of many years of acquisitions and a large number of studies showing that passive and active microwave sensors have relevant capabilities to monitor the soil moisture, only recently the first attempts were made to obtain global soil moisture maps from radiometer and scatterometer data and to operationally use these products. The main reason is that microwave emission and scattering are sensitive not only to soil moisture variations but also to other disturbing surface parameters, such as soil roughness, vegetation water content, canopy structural properties and surface temperature, leading often to inaccurate soil moisture estimates.

As the disturbing factors affect differently the microwave emission and scattering, the information obtained from active and passive microwave sensors can be complementary in the soil moisture retrieval process. In this context we propose to develop a new method for the retrieval of soil moisture based on the synergistic use of active and passive microwave data. This will allow to increase the number of inputs and to reduce the degree of freedom of retrieved variables during the implementation of the inversion process.

Objectives

A comparison between two global soil moisture products obtained from radiometer and scatterometer data have been carried out with the purpose to investigate similarities and differences and to understand where active and passive microwave data can provide complementary information for the soil moisture retrieval.

Method

Two existing global soil moisture datasets have been used:
1) water content from AQUA AMSR-E C-band data by the Department of Hydrology and Geo-Environmental Sciences of the Vrije Universiteit of Amsterdam;
2) surface wetness from ERS-2 C-band scatterometer data by the Institute of Photogrammetry and Remote Sensing of the Vienna University of Technology.
The time series of soil moisture information reported by these two datasets have been compared over some areas different for climatic conditions.

Preliminary results obtained over Spain, an area of approximately 1300 km2 near Salamanca, and over Oklahoma, an area of approximately 10000 km2 covering Osage, Kay, Noble and Pawn counties, are reported. The former site is characterised by a semi-arid Mediterranean climate with a mean annual rainfall of 385 mm and mean temperature of 12°C. The latter is characterised by a continental climate with a mean annual rainfall of 900 mm and a mean temperature of 14°C.

The temporal behaviour, the seasonal trend and the autocorrelation (with and without seasonal trend) of the two soil moisture products were compared were computed over the two sites from September 2003 to March 2007.

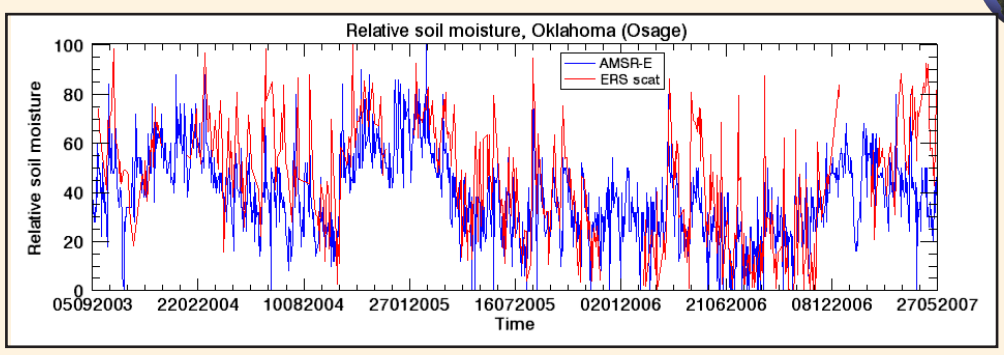
Results

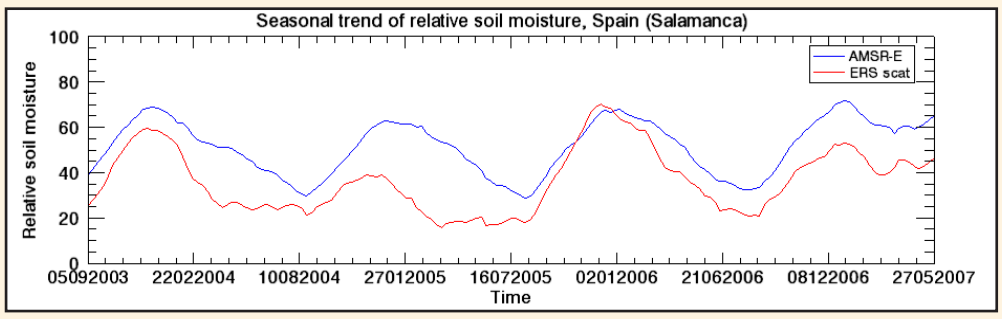
There is a general good agreement between the temporal behaviour and between the autocorrelation functions of the two datasets, notwithstanding the fact that two different sensors and retrieval algorithm were applied.
Site in Spain
AMSR-E: mean 50%, stddev 19%; ERS scat: mean 36%, stddev 25%
Site in Oklahoma
AMSR-E: mean 39%, stddev 17%; ERS scat: mean 44%, stddev 24%

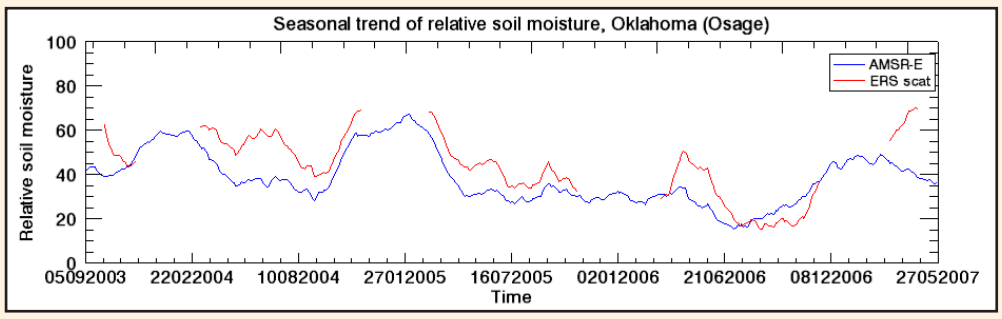
The correlation between the two products is 0.66 over both the Spanish and American site.

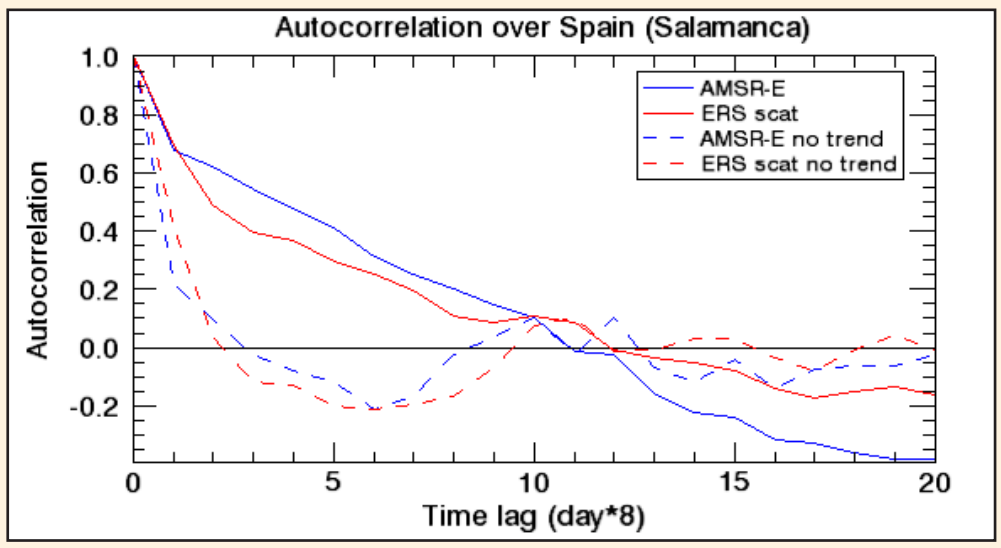
The ERS product shows a wider range of variability. Low values are estimated from ERS scat at the end of winters-beginning of springs in Spain, which affect then the average trend. The autocorrelation of both AMSR-E and ERS data is significantly above zero for longer time lag in Oklahoma than in Spain, which should be due to a smoother seasonal trend in the former site. If the seasonal trend is subtracted before computing the autocorrelation, then the AMSR-E and ERS data over Spain site are correlated for longer time lags than the Oklahoma site, which should be due to the drier climatic conditions of the former site.

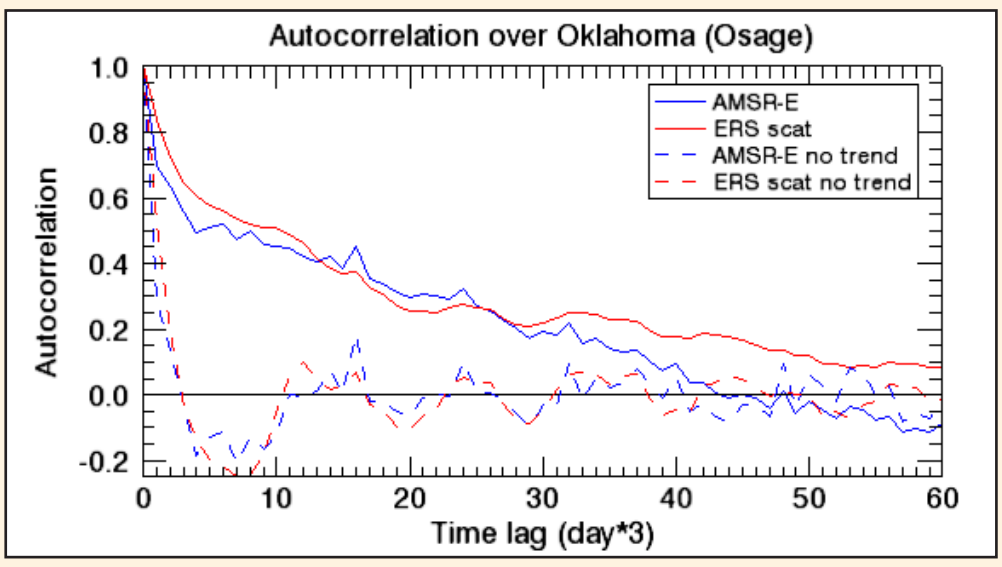
Further investigation is needed. Other sites characterised by different climatic conditions and vegetation cover will be analysed and if possible comparison with temporal statistics of in-situ data will be carried out. Global land cover maps and multi-temporal NDVI information will be also used.

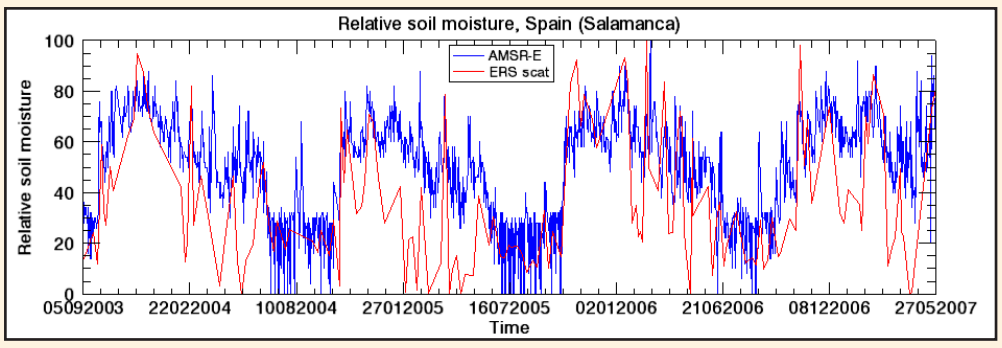












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