Quality Improvement of ERS Scatterometer Data for Soil Moisture Retrieval

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INTRODUCTION

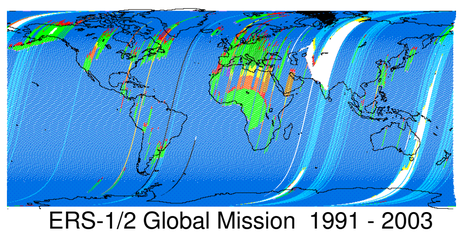
Soil moisture is recognized as a key variable in different hydrological and ecological processes as it controls the exchange of water and heat energy between land surface and the atmosphere. Long-term homogeneous datasets with global coverage are essential to assimilate soil moisture information into hydrological and climatic models.

Different studies have demonstrated that both active and passive microwave satellite sensors are able to retrieve soil moisture of the surface layer at a global scale.

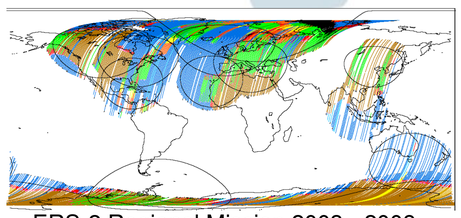
The Scatterometer has been originally designed for wind retrieval over the ocean but now it is proved that Scatterometer data may be also useful for other applications over land such as soil moisture, vegetation and ice cover which require high spatial resolution products and long term backscatter information.

ESA has developed the ASPS (Advanced Scatterometer Processing System) project with the aim to reprocess the entire ERS1-2 Scatterometer mission and provide data with improved radiometric quality and products with enhanced resolution (25km).

The aim of this research activity is to use this new ASPS Scatterometer products in order to improve the soil moisture retrieval from Scatterometer backscattering measurements. The proposed approach is based on the comparison of these new products, in terms of sigma nought and soil moisture index retrieved with the algorithm developed by TU Wien, with the available soil moisture data from other satellite instruments.



ERS-1/2 Global Mission 1991 - 2003



ERS-2 Regional Mission 2003 - 2008

SCATTEROMETER SOIL MOISTURE RETRIEVAL

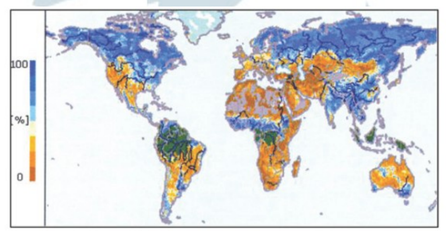
The ERS C-Band ***Scatterometer*** has characteristics that are very valuable for long term monitoring of the global land surface parameters: it covers the globe with a spatial resolution and sampling rates that are comparable with the regional to global applications.

Two approaches have been attempted to retrieve soil moisture information form Scatterometer measurements:

- ***Backscattering modelling approach*** (Pulliainen 1998; Woodhouse & Hoekman 2000; Jarlan 2002, Grippa & Woodhouse 2002): it allows to better understand the measurements processes but it is difficult to implement on a regional scale, requires local calibration and many ancillary information

- ***Change detection method****: An* extensive work performed by Wagner et all (TU Wien) demonstrated the sensitivity of ERS Scatt measurements to variation in soil moisture at a global scale. The method developed by TU Wien considers the min (dry) and max (saturated) backscattering values of the analyzed dataset, to define a surface soil moisture index, named *Surface Soil Degree of Saturation*, but cannot directly estimates quantitative soil moisture information. A measure of the profile soil moisture content, Soil Water Index, is also obtained by filtering the SSDS with an exponential function.

The first multi-year global soil moisture dataset derived from ERS Scatterometer data (with a nominal resolution 50km) has been developed by Wagner et all (2003).



SCATT DATA QUALITY IMPROVEMENT: ASPS PRODUCTS

A long dataset of Scatterometer measurements is available since the beginning of the ERS mission in 1991. Since then the Scatterometer measurements have been processed with a spatial resolution of 50km.

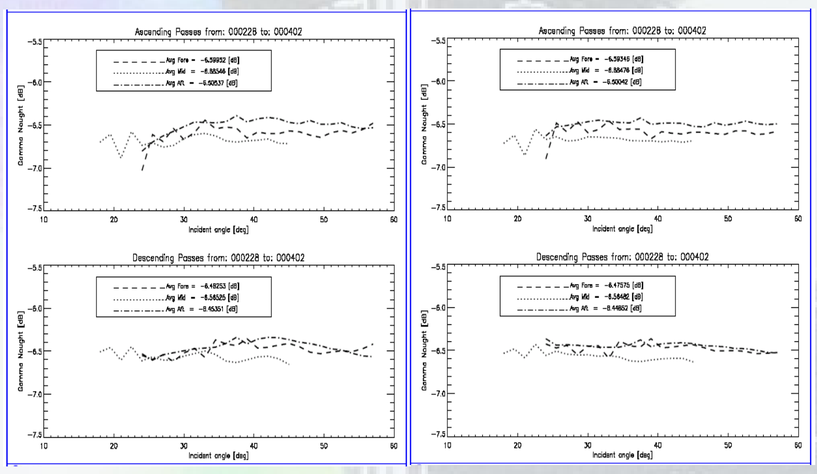
In order to fulfill the scientific community requirements of higher quality products and of an homogeneous set of measurements, ESA has developed the project ***Advanced Scatterometer Processing System (ASPS).***

The aims of the ASPS project are:

- *Re-processing of the entire global ERS-1/2 Scatterometer mission in order to provide a homogeneous data set of the measurements of the Earth surface at C-band through the different phases of the ERS mission.*
- *Reprocessing of ZGM data 2001 – 2003*
- *Provide yaw correction information.*
- *Provide new products with an enhanced spatial resolution (25km) and Sea Ice detection algorithm.*

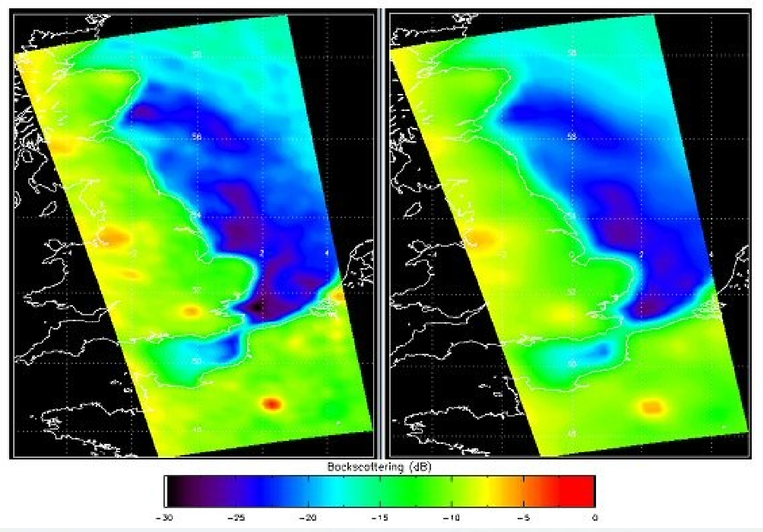
Radiometric Quality Improvement

The radiometric quality of the ASPS re-processed data has been improved by computation of a refined antenna pattern.
The following figures compare the Gamma nought (γ0) across the swath (over the rain forest) for the current data (left) and the ASPS re-processed one (right).



Spatial Resolution Improvement

High resolution backscattering **Nominal resolution backscattering**

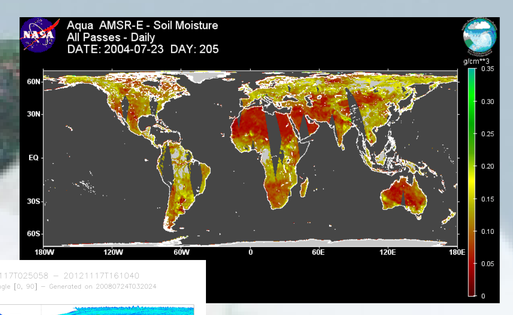


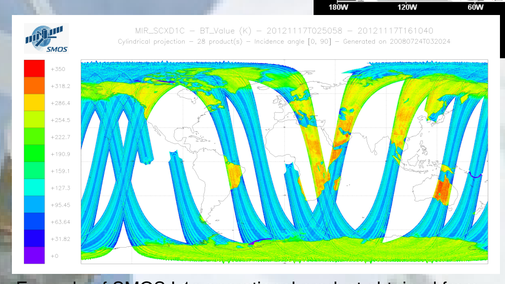
The geometrical resolution of the node is about 50x50 Km2 in nominal resolution (on the right), 25x25 Km2 in high resolution (on left). The distance between two adjacent nods is constant and equal to about 25 Km in nominal resolution (12.5 km in High resolution). The product covers one orbit from ascending node crossing.

FURTHER STEPS

The next steps in this research project will analyze the reprocessed ERS ASPS data in terms of:

- Comparison of ERS sigma nought (25Km resolution) with ASCAT sigma nougth in order to assess the homogeneity of a data set that potentially could span over about 30 years. This is a key element for long-term studies
- Comparison of ERS sigma nought (25Km resolution) with AMSR-E soil moisture over selected areas to understand the real sensibility of this data to the soil moisture evolution
- In collaboration with TU Wien, the ERS High Resolution data will be processed with the *change detection method* to retrieve the "ASPS Soil Moisture Index"
- Comparison of "ASPS Soil Moisture Index" with AMSR-E soil moisture to derive a relationship between the two parameters and derive a kind of calibration curve
- Comparison of "ASPS Soil Moisture Index" with SMOS Brightness temperature and Soil Moisture to derive a kind of inter-sensor soil moisture calibration curve





Example of SMOS L1c operational product obtained from simulated data. Qualitative Brightness Temperature map to show mainly the orbit data coverage (ESA-Esrin)