Title: Review of satellite data usage for soil moisture analyses at ECMWF

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Assimilation of satellite data is a key component of current Numerical Weather Prediction (NWP) systems. For land surfaces, initialisation of soil moisture is particularly important to ensure accurate forecast of surface and near surface weather conditions at short range, medium range and seasonal range. Satellite data from active and passive microwave sensors, such as ASCAT, SMOS and SMAP provide relevant information on soil moisture at global scale. They are being increasingly used for data assimilation and monitoring in NWP systems, and scatterometer soil moisture data is already assimilated in operational NWP systems at the UK MetOffice and at the European Centre for Medium-Range Weather Forecasts (ECMWF). A critical prerequisite for NWP applications is the availability of the observations in Near-Real-Time (NRT), which is preferably within three hours after sensing. The ASCAT soil moisture product and the ESA SMOS brightness temperature products have been available in NRT since several years via EUMETCAST and ESA, respectively. More recently a new SMOS NRT soil moisture product, based on a neural network approach was developed by the Centre d'Etudes Spatiales de la Biosphère (CESBIO) and it is being implemented by ECMWF and ESA. It will ensure the NRT availability of a high quality SMOS soil moisture product, for the scientific community as well as for the operational hydrological and NWP communities.

This paper gives a review of the large range of activities related to the use of satellite data for soil moisture analysis and reanalyses at ECMWF. Firstly, the status of the operational ECMWF soil moisture data assimilation is described. ASCAT soil moisture is assimilated together with in situ SYNOP observations of air temperature and relative humidity. We show the complementarity between these different types of observations and the impact of the soil analysis on NWP. Secondly, developments of SMOS brightness temperature data assimilation is presented and SMOS impact on NWP is assessed. Furthermore results of recent investigations on a SMOS soil moisture neural network product data assimilation are presented. The different data assimilation approaches using either SMOS brightness temperature or soil moisture are compared. Finally, this paper presents applications involving longer time scale processes, to produce and to use soil moisture data records in the context of H-SAF, ESA-CCI and future reanalysis activities. Perspectives to use data from future missions, such as SWOT, to consistently constrain NWP and flood forecast systems are also discussed. Keywords: Data assimilation, soil moisture

Satellites: SMOS, ERS, future missions