L-BAND DATA FOR NUMERICAL WEATHER PREDICTION AND EMERGENCY SERVICES AT ECMWF

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ABSTRACT

In this paper we present L-band data usage for Numerical Weather Prediction applications and Emergency Services at the European Centre for Medium-Range Weather Forecasts (ECMWF).

Index Terms— SMOS L-Band, soil moisture, NWP, Copernicus

1. L-BAND DATA FOR NWP

The Soil Moisture and Ocean Salinity (SMOS, [1]) brightness temperature data is currently used operationally in the ECMWF Integrated Forecasting System (IFS). SMOS operational monitoring consists in near real time (NRT) comparison between SMOS observations and ECMWF forward brightness temperature data [2,3]. Long term SMOS monitoring statistics available for the past 11 years show consistent improvements in the SMOS data quality through its lifetime [4]. Current developments related to Soil Moisture Active Passive (SMAP) monitoring implementation and comparison to SMOS are on-going. Since July 2019, a SMOS neural network soil moisture product has been assimilated into the ECMWF operational soil moisture simplified extended Kalman filter (SEKF) as part of the land data assimilation system [5,6]. There are two versions of SMOS neural network soil moisture products produced routinely at ECMWF. The first, is the SMOS NRT soil moisture product; it has been trained on the SMOS level 2 soil moisture product and is delivered to ESA [7]. The second is trained on the ECMWF operational model soil moisture values and this is the one that is then assimilated into the operational SEKF for NWP [5,6]. The SMOS-ECMWF NN soil moisture product captures the SMOS signal variability in time and space, while by design its climatology is consistent with that of the ECMWF soil moisture, which makes it suitable for data assimilation purposes. SMOS data assimilation results and NWP impact will be presented for configurations using either neural network soil moisture or brightness temperature data in the IFS [5,8] or in the offline land assimilation system [6]. SMOS data assimilation is shown to slightly improve root zone soil moisture and independent verification against aircraft humidity profiles also shows that SMOS data assimilation improves humidity in the northern hemisphere during summer (Figure 1). These results illustrate the value of the SMOS soil moisture observations for operational NWP.

2. L-BAND DATA FOR CEMS

We will present activities conducted to improve fire and flood forecasting, in the context of ECMWF activities with the Copernicus Emergency Management Service (CEMS). The impact of SMOS Soil Moisture Data Assimilation within the Operational Global Flood Awareness System (GloFAS). Results suggest that SMOS data assimilation mainly affects the generation of surface runoff during high flow events but may have less impact on baseflow generation during the remainder of the hydrograph [9]. The potential of SMOS soil moisture data to predict fire ignition from lightning forecasts is currently investigated using a machine learning approach with operational plans to enhance information for fire management [10].

3. PERSPECTIVES

Based on the current achievements and results using the data sets from the SMOS mission we will discuss the need for L-band observations and the potential usage of the future Copernicus Imaging Microwave Radiometer (CIMR) mission.

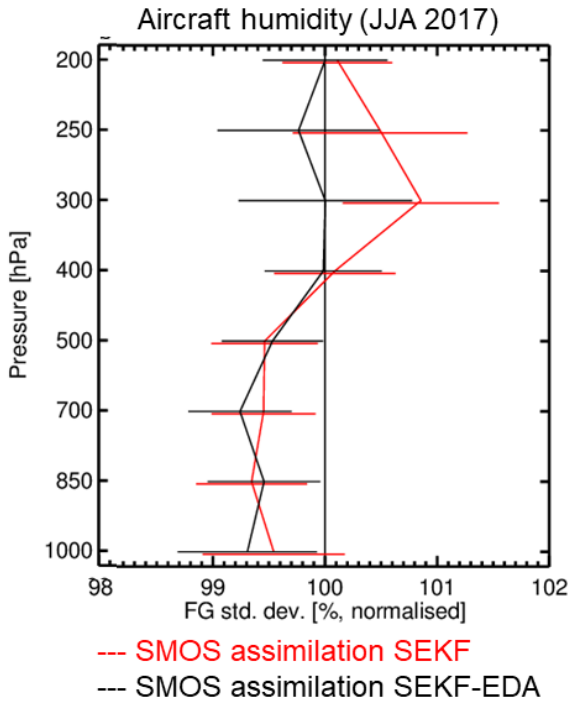

Figure 1: Normalised differences in standard deviation of the aircraft humidity observations first guess departure at different atmospheric vertical levels (hPa) when SMOS neural network soil moisture is assimilated in the IFS compared to a control without SMOS data assimilation. The red and black lines show SMOS data assimilation impact in two different configurations of the Simplified Extended Kalman Filter (with Jacobians computed using Finite difference of Ensemble Data Assimilation, respectively) compared to the control vertical black line. Statistics were computed for June-July-August 2017.

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