Using SMOS Near-Real Time Brightness Temperatures in ECMWF's Land Surface Analysis: An Overview of Recent Developments, Results and Future Challenges

Matthias Drusch[a], Joaquin Munoz Sabater[b], Patricia de Rosnay[b], Susanne Mecklenburg[c], and Y. Kerr[d]

[a] *ESTEC, The Netherlands, matthias.drusch@esa.int,* [b] *ECMWF, UK,* [c] *ESRIN, Italy,* [d] *CESBIO, France.*

SMOS is ESA's water mission observing key-elements of the Earth's water cycle, i.e. soil moisture and ocean salinity. It features a novel instrument – MIRAS – that is the first synthetic aperture L-band radiometer ever operated on an EO space mission. High quality measurements representing the full Stokes vector have been made since 2009 and operationally delivered to a large user community. SMOS is also the first Earth Explorer mission with a dedicated Near-Real-Time (NRT) processing chain for its Level 1 observations in the operational ground segment [1].
Operational weather forecasting centers have been the prime customers for the NRT product as the brightness temperatures over land are very sensitive to soil moisture and therefore potentially useful for the corresponding analysis [2]. However, a number of challenges associated to introducing an entirely novel product in the land surface analysis have been addressed by ECMWF:

1) Until recently, the soil moisture analysis has been based on screen level parameters, namely two-meter temperature and relative humidity at synoptic observation times. The Optimal Interpolation analysis was replaced by an Extended Kalman Filter to accommodate the satellite observations [3].
2) A forward operator for the generation of model-based polarized brightness temperatures in the antenna reference frame has been implemented [4].
3) ECMWF's Integrated Forecasting System has been revised optimizing task scheduling following the computational demands of the EKF and the large volume of SMOS brightness temperature observations [5].

Results from data assimilation experiments reflecting the operational set up show a positive impact on the soil moisture analysis and the forecast of low-level air temperatures and relative humidity up to day 5 for large parts of the Northern Hemisphere. Especially over North America the improvement of forecast skill has been highly significant. Densely vegetated areas and large parts of Asia with a strong contamination of the signal through Radio Frequency Interference pose problems. The presentation will provide an overview of the mission status, recent and ongoing developments for the land surface analysis, and the SMOS potential for operational applications related to soil frost, sea ice, and high wind speeds over the ocean.

References

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