Monitoring SMOS data at ECMWF

ECMWF

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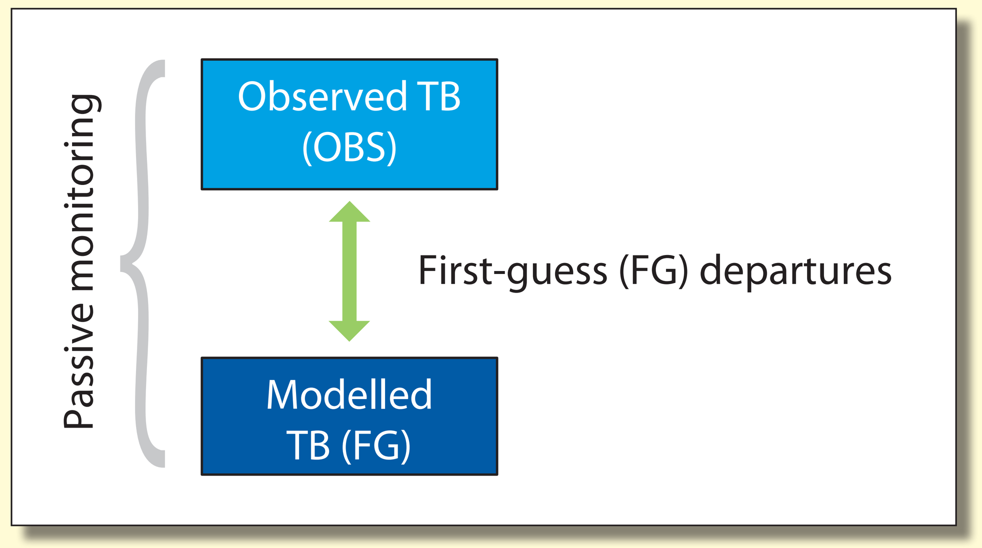
Main objectives

1 Global monitoring of Near Real Time brightness temperatures at the satellite antenna reference frame.

2 Assimilation of SMOS brightness temperatures in the Integrated Forecasting System ➞ investigate the impact on the forecast skill.



Towards an operational monitoring chain

SMOS data has been implemented in the Integrated Forecasting System [1], [2]. The main steps of the monitoring chain are:

- Operational acquisition and archiving of SMOS data,
- Quality control,
- Thinning SMOS data,
- Creation of a SMOS data base,
- Collocation to the model grid and screening of SMOS data,
- Computation of a model equivalent in model grid points for 'active' observations,
- Computation of first-guess departures,
- Production of statistics with SMOS data and the model equivalent in NRT

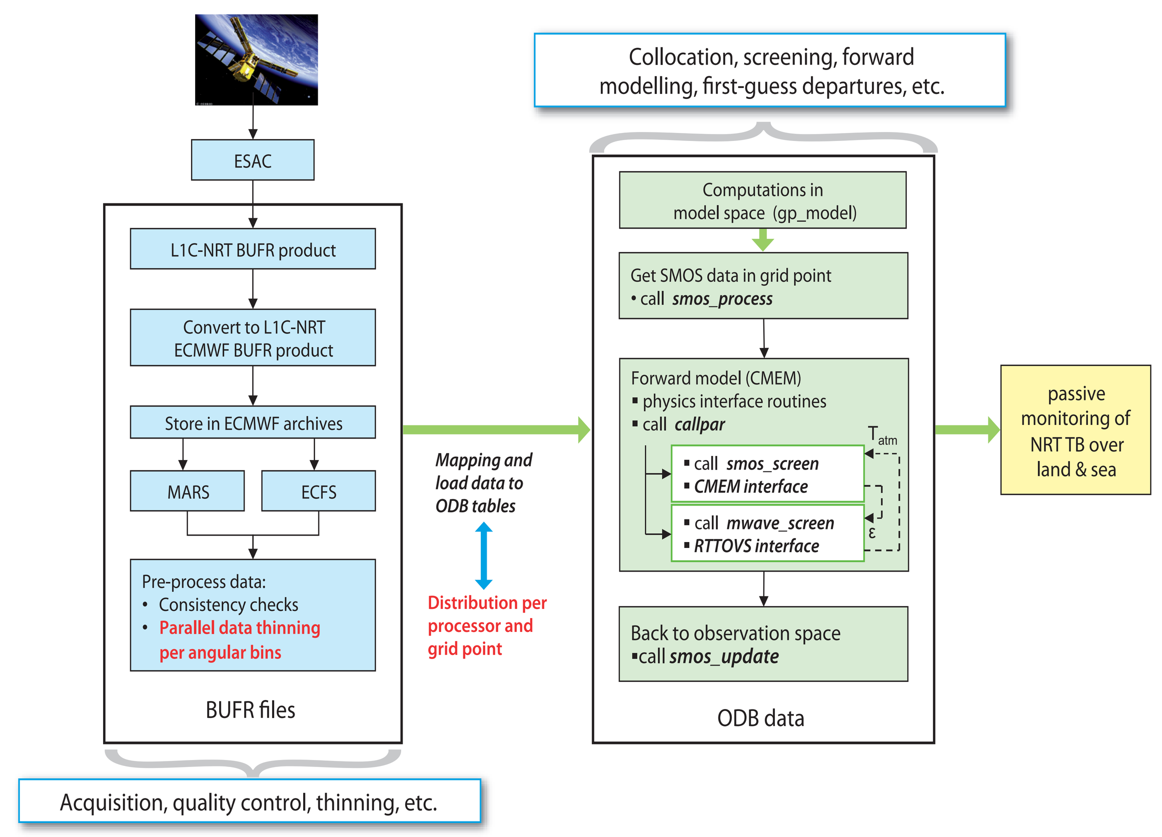


Figure 1 *Organigram of the SMOS monitoring chain*

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Monitoring products and support to CAL/VAL teams

- Since the launch of SMOS, continuous monitoring of global brightness temperatures at incidence angles of 10, 20, 30, 40, 50 and 60 degrees for the XX and YY polarization states.
  Available at: http://www.ecmwf.int/research/ESA_projects/SMOS/monitoring/smos_monitor.html
- Since Nov. 2011 statistics between SMOS brightness temperatures and a model equivalent are also available in NRT, and separately for land and oceans.
- Statistical products:
  – Time series of area averages,
  – Time-averaged geographical mean fields,
  – Hovmoeller zonal mean fields,
  – First-guess departures as function of the incidence angle.
- Support to CAL/VAL teams by producing time series of statistical variables over targeted areas at:
  – SCAN sites: Lancaster, Chase, Nemaha, Darlington, Little River, Little Washita, Reynolds Creek,
  – Australia: AACES,
  – ESA sites: VAS, Danube catchment,
  – Antarctica: Dome-C,
  – France: SMOSmania, SMOSREX,
  – Finland: Sodankylae,
  – Denmark: HOBE,
  – Africa: Niamey (Niger), Loueme (Benin)

Bibliography

1 **Sabater, J.M., P.de Rosnay, A.Fouilloux, M. Dragosavac** & **A.Hofstadler**, 2009: IFS interface. M1TNP2 *ESA Technical Report*. http://www.ecmwf.int/publications/library/do/references/show?id=89524.

2 **Sabater, J.M., P. de Rosnay** & **A. Fouilloux**, 2010: Operational Pre-processing chain, Collocation software development and Offline monitoring suite. M2TNP1/2/3 *ESA Technical Reports*. http://www.ecmwf.int/publications/library/do/references/show?id=89972

3 **Drusch M., K. Scipal, P. de Rosnay, G. Balsamo, E. Andersson, P. Bougeault, P. Viterbo**, 2009: Towards a Kalman Filter based soil moisture analysis system for the operational ECMWF Integrated Forecast System, *Geophys. Res. Lett.*, **36**, L10401, doi:10.1029/2009GL037716.

Monitoring results

Daily monitoring of brightness temperatures

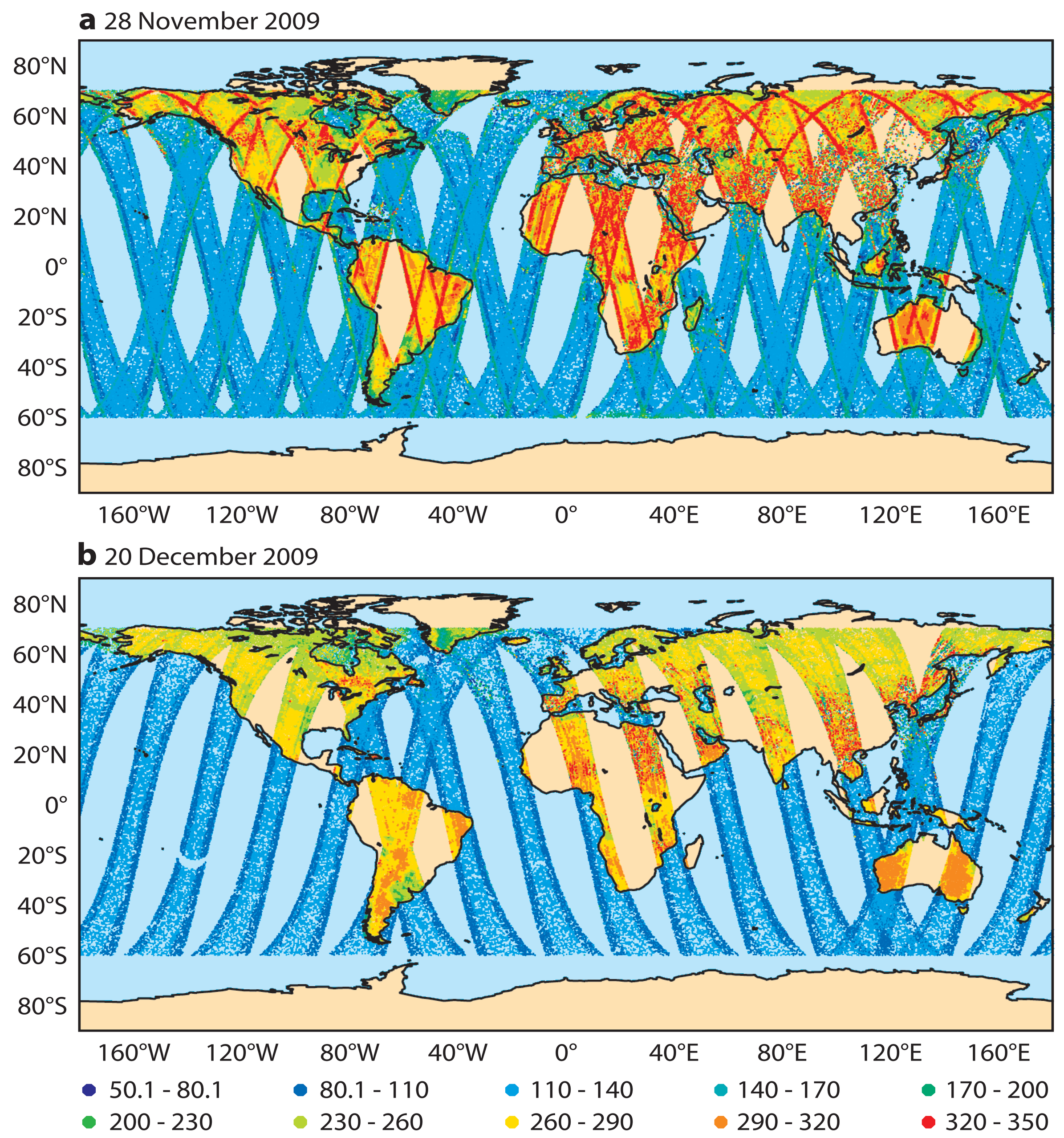

Figure 2 *Observed SMOS brightness temperatures at 50 degrees incidence angle and YY polarisation on a) 28 November 2009, b) 20 December 2009. The data in a) is presented as very noisy, whereas the quality of the data has clearly improved everywhere in b) after a calibration event took place in December 2009.*

Radio Frequency Interference

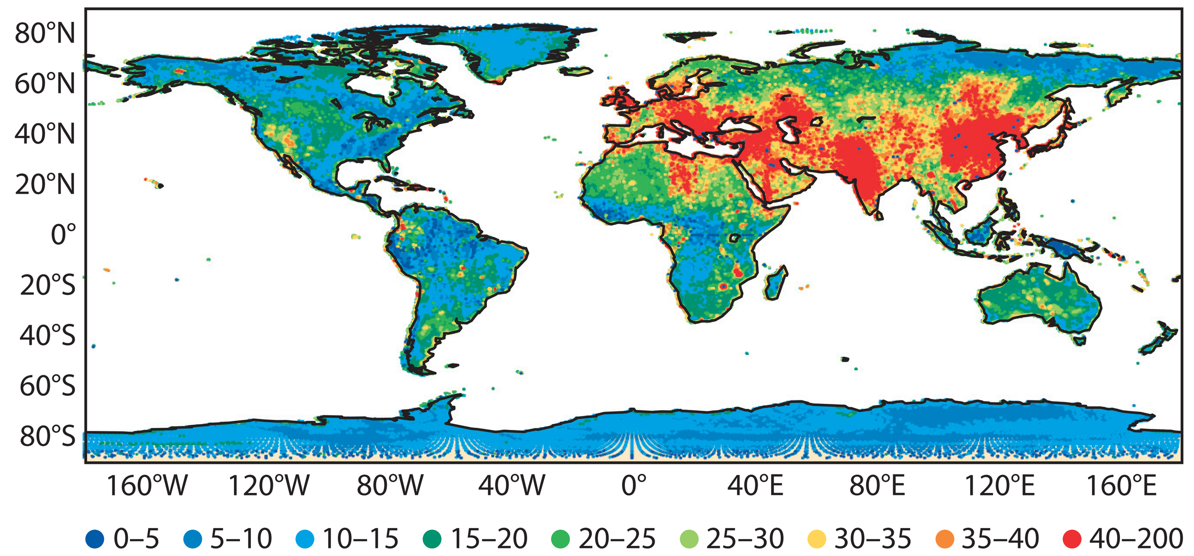

Figure 3 *Average standard deviation of the SMOS observed brightness temperatures the first week of October 2010 at XX polarization and 40 degrees incidence angle. Data in dark red presents abnormal strong variation over one week. Despite being L-band a protected band, illegal emissions in this band and contamination from fixed and mobile emissions in neighbouring bands, significantly perturb the SMOS signal in several areas of Europe and Asia. This phenomenon is called Radio Frequency Interference (RFI) and it is currently the biggest problem affecting the SMOS signal.*

Data over oceans

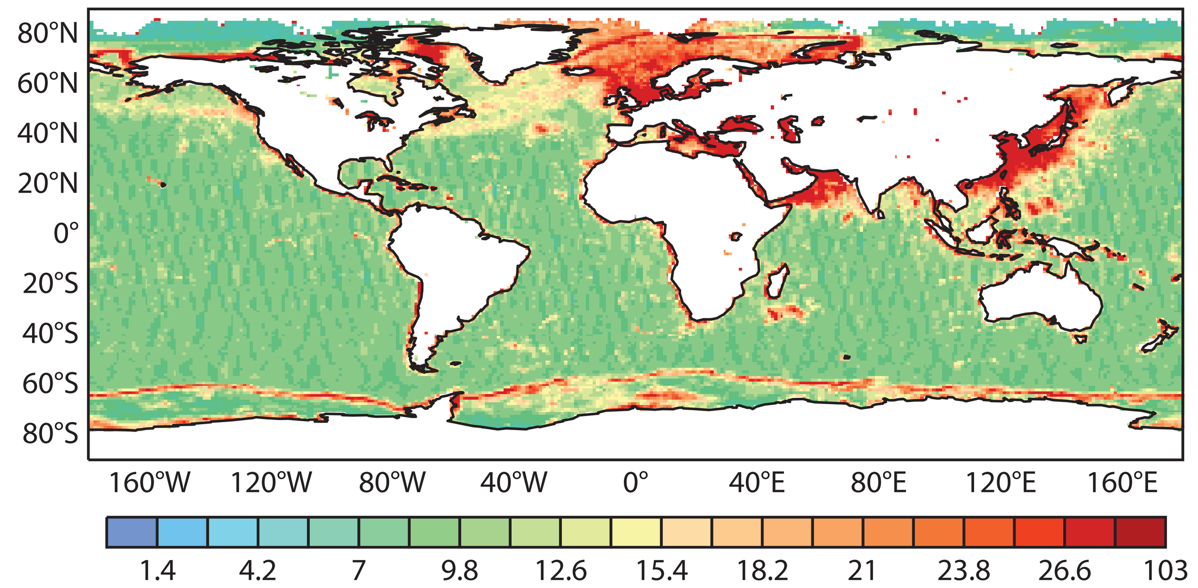

Figure 4 *Average standard deviation of the SMOS observed brightness temperatures the first week of October 2010 at XX polarisation and 40 degrees incidence angle. RFI sources over land can contaminate the SMOS signal several hundred kilometres off-shore, as it can be observed in several areas of the East-Asian coast and the Mediterranean Sea. The interface between frozen and open sea water is clearly seen in the South Pole, presenting strong dynamics.*

Support to CAL/VAL teams

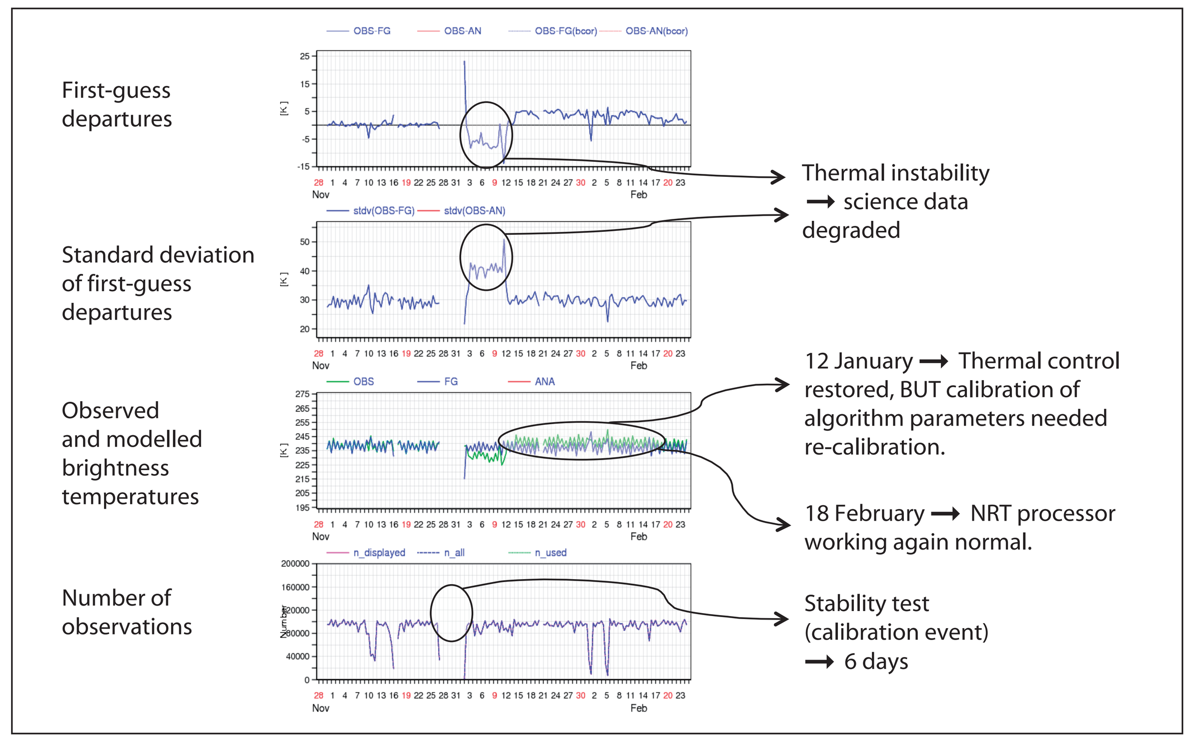

Figure 5 *Time series of statistical variables at global scale for the XX polarisation state. Data corresponds to the period 28 November 2010 – 28 February 2011. In this example perturbations of the time series are explained by routine calibration tests performed by ESA. This tool generates the time series in near-real-time.*

The way forward

- Development of an approach to reduce noise from SMOS data,
- Development of a bias correction scheme,
- Investigate the potential benefit of assimilating SMOS data within the EKF [3].
  – Assimilation of SYNOP and SMOS data to correct the soil moisture state,
  – Feedback to the atmosphere ➞ impact on the forecast skill.