→ ESA'S WATER MISSION

smos newsletter

Issue 11 | May 2016

SMOS satellite
launched on 2 November 2009

In this issue:

Highlights

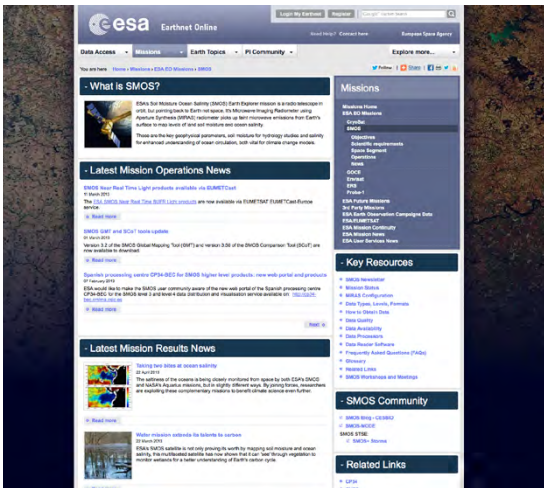
SMOS reprocessed soil moisture and sea surface salinity data now available

The second SMOS mission reprocessing campaign for the level 2 soil moisture and sea surface salinity data has been completed and the dataset covering the period from 1 June 2010 to 15 July 2015 is now available to users in both ESA Earth Explorer Format (EEF) and NetCDF format from the new ESA SMOS Online Dissemination service (*https://smos-ds-02.eo.esa.int/oads/access*). This reprocessing provides a consistent archive of the level 2 data aligned with the algorithm baseline v6 already running operationally in the SMOS ground processing facility since 2015. Read-me-first notes for both soil moisture *L2SM-read-me-first-note* and sea surface salinity products *L2OS-read-me-first-note* are available with detailed information about the modifications implemented in the product format; the description of the improved algorithms; and list of caveats that should be considered to ensure an optimal use and exploitation of this new v6 dataset.

The level 2 reprocessed dataset has been investigated by ESA and user expert teams and detailed data quality reports are available on the *ESA SMOS quality web-page*. The sea surface salinity dataset shows a slight improvement in terms of both salinity mean difference and standard deviation (SMOS measurements vs interpolated ARGO buoys data - ISAS) and a decrease in the ascending/descending salinity differences (see Figure-1). The land-sea contamination (i.e. within 1000Km from the coast) and the impact of the Sun (L-band signal / thermal effects) during the November-January eclipse period are still the main issues in the v6 dataset. For the land-sea contamination, the ESA Expert Support Laboratories (ESLs) are working on an empirical correction to be applied in the next version of the level 2 processor. As a result of this work, a new version of the sea surface salinity products is expected to be available late 2016 with noticeable improvements.

Stay up-to-date with the ESA SMOS web portal
http://earth.esa.int/SMOS

The ESA SMOS web portal provides a comprehensive access point for all SMOS related information. Users are encouraged to visit the SMOS portal for announcements, updates on ground segment operations and scientific mission achievements. Recent SMOS newsletters are available on the ESA web portal:
https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/newsletter



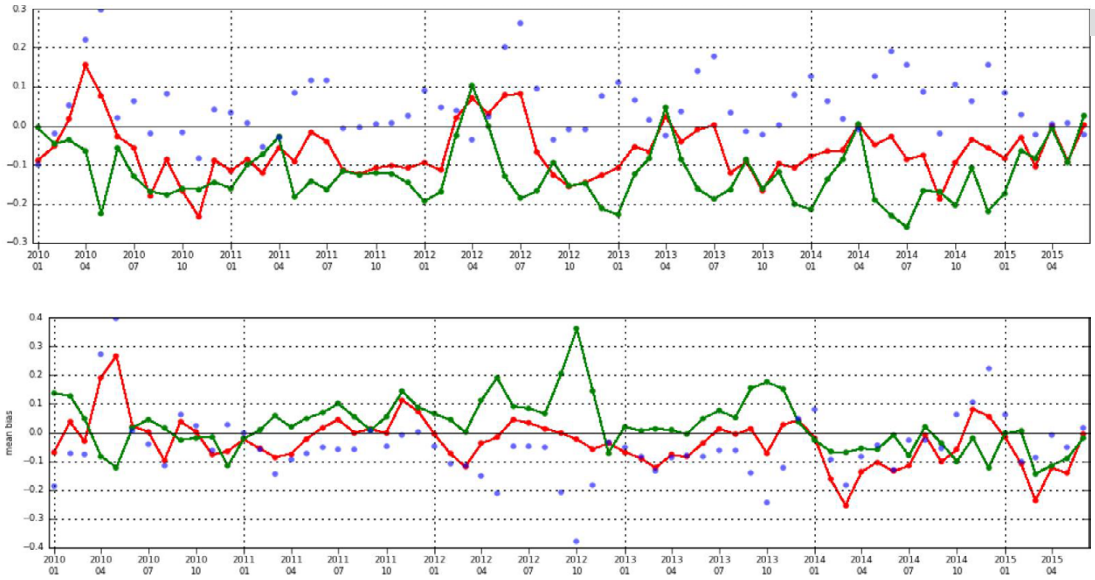


Figure 1:

Comparison of SMOS sea surface salinity (SSS1) minus ISAS for global region 45N-45S, far from coast (>800km). Reduction of mean bias can be noted by comparing SMOSv6 (red curve) with SMOSv5 (green curve) for ascending (top panel) and descending (bottom panel) overpasses. The Blue dots represent SMOSv6 - SMOSv5 differences.

Credit: LOCEAN/ESA.

The soil moisture dataset shows an increase in successful retrievals on nominal (bare soil and low vegetation surfaces) and forest area clean by Radio Frequency Interference (RFI) (see Figure-2). A decrease in retrievals in RFI-contaminated areas is due to a better RFI flagging. Overall, the soil moisture product version 6 is slightly drier on low vegetated surfaces and is slightly wetter on high vegetated areas when compared with the previous version 5.

SMOS soil moisture product in near real time

A new level 2 soil moisture product generated in near real time (NRT) by using a neural network approach is available since March 2016. The product is disseminated within four hours from sensing in netCDF format through the ESA SMOS Online Dissemination service (*https://smos-ds-02.eo.esa.int/oads/access*), EUMETCAST and GTS (from May onwards). The SMOS soil moisture in the NRT product compares well to and is of equal quality to the geophysical level 2 soil moisture product generated in the operational processing chain (see Figure-3). Further information about the neural network approach used in the generation of the product, the product content, the product validation and how to ensure optimum exploitation of the new dataset are available in the read-me-first note (*https://earth.esa.int/documents/10174/1854503/L2-SM-NRT-NN_release_note_20160316.pdf*).

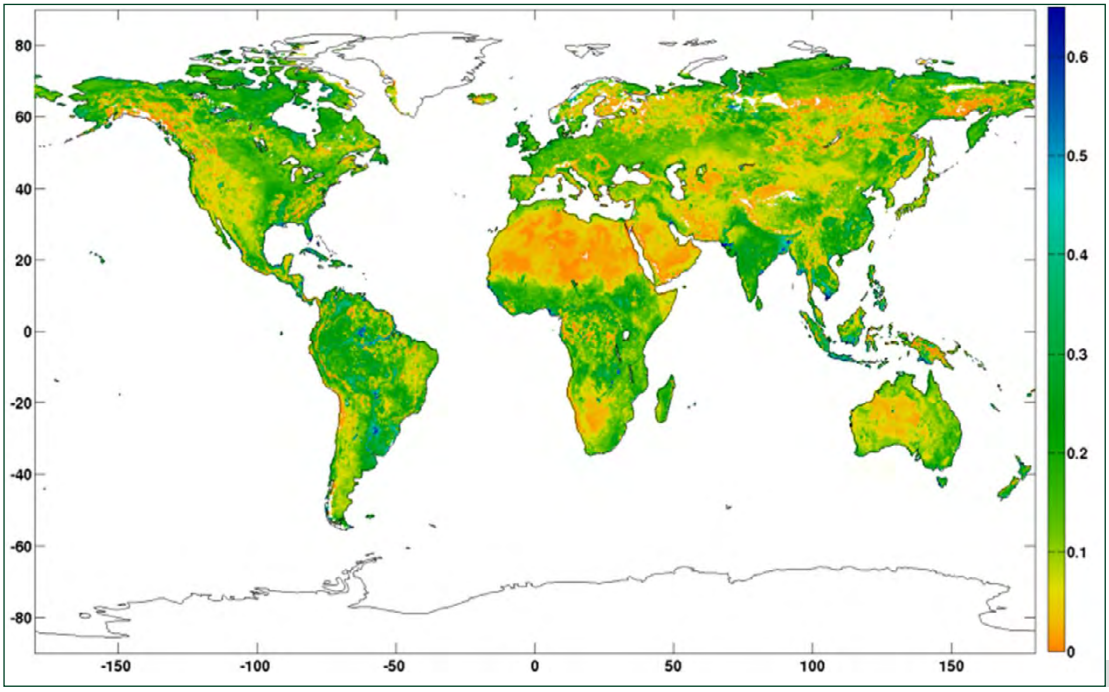


Figure 2:

Five years of global average soil moisture from SMOSv6 reprocessed dataset. The map shows the achieved data coverage which has slightly improved from SMOSv5 version in particular over dense vegetated areas.

Credits: CESBIO

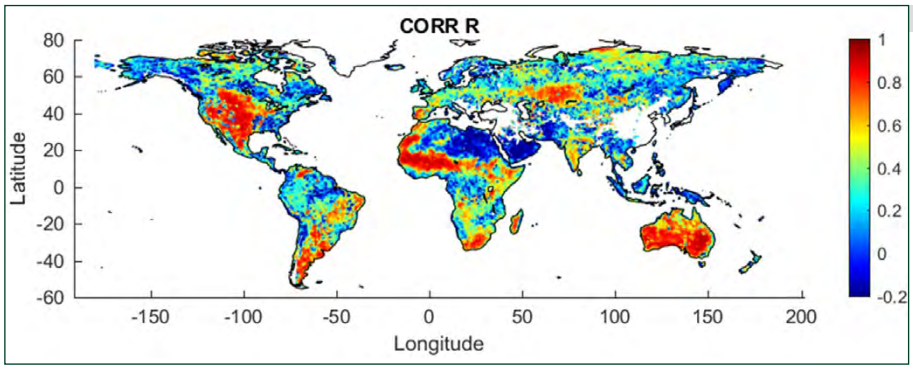


Figure3:

Pearson correlation between SMOS soil moisture product in NRT (SM-NRT-NN) and soil moisture obtained with version 6.20 of the SMOS operational processor (SM L2) in the period from 15 May 2015 to 25 November 2015. The correlation between both products is above 0.7 over most areas. Lower correlation is over dense forest areas (both tropical and boreal) and over desert (Sahara) where soil moisture variance is low and mainly driven by noise in the retrieval.

Credits: CESBIO/ECMWF/ESA

Level 2 sea surface salinity and soil moisture products generated with the new ECMWF forecast cycle 41r2

ESA SMOS Expert Support Laboratories (ESLs) have analysed the impact of the use of the new ECMWF IFS forecast cycle 41r2 (for details see the ECMWF web-page: *www.ecmwf.int/en/about/media-centre/news/2016/new-forecast-model-cycle-brings-highest-ever-resolution*) in the generation of sea surface salinity and soil moisture estimations from the SMOS measurements. The detailed reports are accessible here: *https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/news/-/article/impact-of-ecmwf-forecast-cycle-41r2-on-smos-level-2-sea-surface-salinity-and-soil-moisture-products*. In summary, the observed variability in the level 2 sea surface salinity and soil moisture data cannot be associated to better or worse retrievals due to IFS cycle change. Only a long term data analysis supported by field experiments (in situ data) can provide some additional elements to better understand the impact of new IFS cycle on the SMOS level 2 product quality.

SMOS gets help from Tibet

In situ measurements are important to interpret results from the SMOS mission and to further improve the level 2 algorithms through a continuous validation exercise. To address the soil moisture part of the mission, measurements have to be taken from places that have different types of soil and vegetation cover. One 'Elbara' L-band radiometer was recently placed on the Tibetan Plateau (see Figure-4) in order to validate measurements in that area. This also helps to better understand the Tibetan Plateau's water cycle, which plays an important role in Asia's water resource management since major rivers such as the Ganges, Brahmaputra, Mekong, Yangtze and the Yellow River are all fed from the plateau. For further information about the placement of 'Elbara' on the Tibetan Plateau, see *www.esa.int/Our_Activities/Observing_the_Earth/SMOS/SMOS_gets_help_from_Tibet*.

Figure 4:

An 'Elbara' L-band radiometer placed on the Tibetan Plateau to help interpret measurements from ESA's SMOS mission. In situ measurements form an important part of the mission. To include different soil types and vegetation cover, validation measurements are made in many parts of the world, from Spain to Antarctica.

Credit: CAREERI/UT-ITC

New ESA SMOS Online Dissemination service

The new ESA SMOS Online Dissemination service is operational since March 2016. The service is accessible here: *https://smos-ds-02.eo.esa.int/oads/access*. The online dissemination portal allows users registered to SMOS data on the ESA Earth Online portal to access SMOS level 1, level 2 and near real time data (both level 1c and soil moisture neural network products) by https and ftp/ftps transfer protocols. The online service facilitates the data access with enhanced catalogue functionality (see Figure-5) for data navigation and selection by data type, acquisition time, geographical area and data format (i.e. ESA Earth Explorer (EEF) or NetCDF format). Once selected the data can be downloaded immediately using different protocols. Level 1c and level 2 quick-look images are also available for reference. For further information on accessing SMOS data see: *https://earth.esa.int/smos/how-to-obtain-data*.

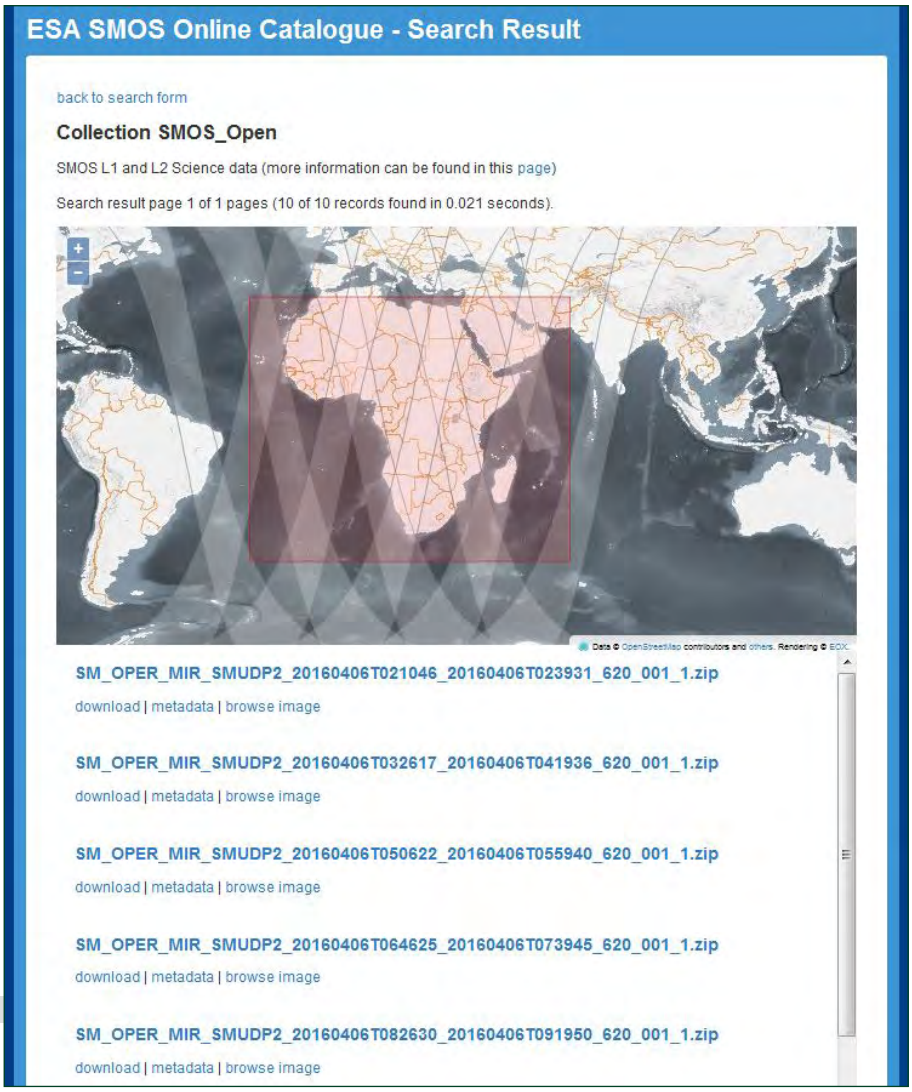


Figure5:

ESA SMOS Online Dissemination catalogue search. Example of a query result on SMOS level 2 soil moisture data acquired on 6 April 2016 over Africa. The list of filenames can be also obtained as a list of URLs to be used for automatic data download.

Credit: ESA

Using G-POD for processing SMOS data: reminder for call for proposals

ESA would like to remind the SMOS user community of the availability of the Grid Processing-on-Demand (G-POD) service (*http://gpod.eo.esa.int*) for conducting Earth Science research activities. G-POD is offered by ESA's Research and Service Support (*http://wiki.services.eoportal.org/tiki-custom_home.php*). G-POD SMOS proposals need to be submitted directly through the following website: *http://eopi.esa.int/G-POD*. This is an open call, i.e. proposals can be submitted at any time.

Data and Processors

Data availability

The SMOS instrument MIRAS is operating nominally with the exception of some known on-board anomalies (see the anomaly description here). The cumulative data loss due to MIRAS instrument unavailability since the beginning of the routine operational phase (May 2010) amounts to 0.15% and the degraded data amounts to 0.79% (see Figure-6). No data loss has occurred during the acquisition of MIRAS raw data at the ground stations since the beginning of the routine operational phase (May 2010). This result has been achieved by implementing an on-board data recording overlap strategy.

SMOS Flight Operations Segment (FOS) reports and the detailed list of instrument anomalies compiled on a weekly basis are available here.

No orbit correction manoeuvres and two collision avoidance manoeuvres were successfully executed since the issue of newsletter #10 (October 2015). The collision avoidance manoeuvres were executed on 20 December 2015 and 14 March 2016. During the manoeuvres (about 30 minutes) MIRAS instrument data was regularly acquired but not processed due to the degraded satellite

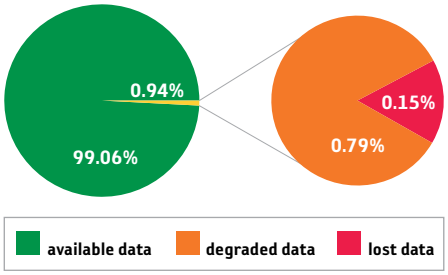


Figure 6:

SMOS mission data availability percentage since May 2010. Instrument data availability is extremely high, about 99%. Only 0.15% of data is lost due to MIRAS anomalies

Credits SMOS FOS/ESA

pointing. Gyroscope calibration was performed on 31 March 2016. During the gyroscope calibration (about 100 minutes) the MIRAS instrument data was regularly acquired but not processed.

Instrument Calibration

Several calibration activities are regularly performed on board and an overview of the calibration strategy implemented for the MIRAS instrument can be found in the SMOS calibration summary document available here. During calibration activities science data are not available, therefore data users should consult the calibration plan for data availability. This can be found at *https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/available-data-processing*.

The Noise Injection Radiometer (NIR) calibration has been executed, since October 2014, in the so called "warm-NIR" configuration with the Sun slightly in front of the antenna plane, in order to maintain a better stable thermal environment for the NIRs receiver. This new configuration, together with the calibration processor version 620, allows a more stable retrieval of the calibration coefficients and improves the overall data calibration for version 620.

Since the issue of newsletter #10 (October 2015), calibration activities were performed in accordance with the routine calibration plan and calibration results are within the nominal range. The winter 2015 Flat Target Response (FTR) has been acquired and used only for monitoring purposes.

The evolution of calibration parameters since the beginning of the mission is available in the SMOS quality reports accessible at *https://earth.esa.int/web/guest/-/data-quality-7059.*

Data quality

Monthly reports summarising significant events in the SMOS flight, the ground segment and SMOS data quality can be found at *https://earth.esa.int/web/guest/-/data-quality-7059*.

Further information on SMOS data quality can be found in the products read-me-first notes available here: *https://earth.esa.int/web/guest/-/data-processors-7632*. SMOS data users are invited to consult the read-me-first note before using SMOS data for their research activities. Since the issue of newsletter #10 (October 2015) the SMOS data quality is nominal with a short period of data unavailability from 14 March 2016 (04:00UTC) to 16 March 2016 (12:04UTC). This data unavailability period was due to a planned on-board platform software update for the GPS receiver. During the software update the MIRAS instrument was operating nominally but data was acquired without platform ancillary information (e.g. time, position, velocity), therefore nominal data processing was not possible. The off-line processing of this dataset with reconstructed time, platform pointing and position information from CNES is under evaluation.

Updates on operational processors

The current versions of the operational processors installed in the SMOS ground segment are:

Processor	Current version In operations since	Previous version In operations since
Level 1A	**V6.20** **5 May 2015**	V5.04 14 November 2011
Level 1B	**V6.21** **5 May 2015**	V5.04 14 November 2011
Level 1C	**V6.20** **5 May 2015**	V5.05 21 March 2012
Near Real Time processor (NRTP)	**V6.20** **5 May 2015**	V5.05 7 March 2012
Level 2 soil moisture	**V6.20** **5 May 2015**	V5.51 24 April 2012
Level 2 ocean salinity	**V6.22** **5 May 2015**	V5.50 15 December 2011

Below are further details on the current versions of the operational processors:

Level 1/NRTP: No new version has been implemented in the level 1 and NRTP processors since the issue of the previous newsletter #10 (October 2015). Detailed descriptions of the current v6.20 algorithms are presented in the Detailed Processing Module (DPM) documents available here: *https://earth.esa.int/web/guest/-/data-processors-7632*. The next upgrade of the level 1 processor (version 7 algorithm) will include improvements to calibration stability, image reconstruction algorithms and direct Sun estimation.

Level 2 Soil Moisture: No new version has been implemented in the level 2 soil moisture processor since the issue of the previous newsletter #10 (October 2015). A detailed description of the current v6.20 algorithm is presented in the Algorithm Theoretical Basis Document (ATBD) available here: *https://earth.esa.int/web/guest/-/data-processors-7632*. The next upgrade of the level 2 soil moisture processor (version 7 algorithm) is under definition, with investigations focusing on forward radiative transfer models in particular.

Level 2 Ocean Salinity: No new version has been implemented in the level 2 sea surface salinity processor since the issue of the previous newsletter #10 (October 2015). A detailed description of the current v6.22 algorithm is presented in the Algorithm Theoretical Basis Document (ATBD) available here: *https://earth.esa.int/web/guest/-/data-processors-7632*. The next upgrade of the level 2 sea surface salinity processor (version 6.60) is planned for end 2016. The main foreseen improvements are the mitigation of the land-sea contamination in the sea surface salinity and the usage of a single roughness model for the sea surface salinity retrieval.

Radio Frequency Interference (RFI)

RFI sources operating in the L-band adversely affect the SMOS measurements, rendering the affected SMOS data products largely unusable for scientific applications. Users can check whether level 1C measurements are corrupted by RFI using the RFI flags available in the SMOS data products. Details about the level 1C RFI flags can be found in the level

1 product specification document (*https://earth.esa.int/web/guest/-/data-types-levels-formats-7631*) and in the SMOS newsletter #9 (May 2015) which contains a summary of the RFI flagging approach used for the V6.20 data.

Information regarding the evolution of the RFI contamination can be found on the frequently updated RFI probability maps, generated fortnightly by CESBIO and available on the SMOS blog (*www.cesbio.ups-tlse.fr/SMOS_blog/smos_rfi*).

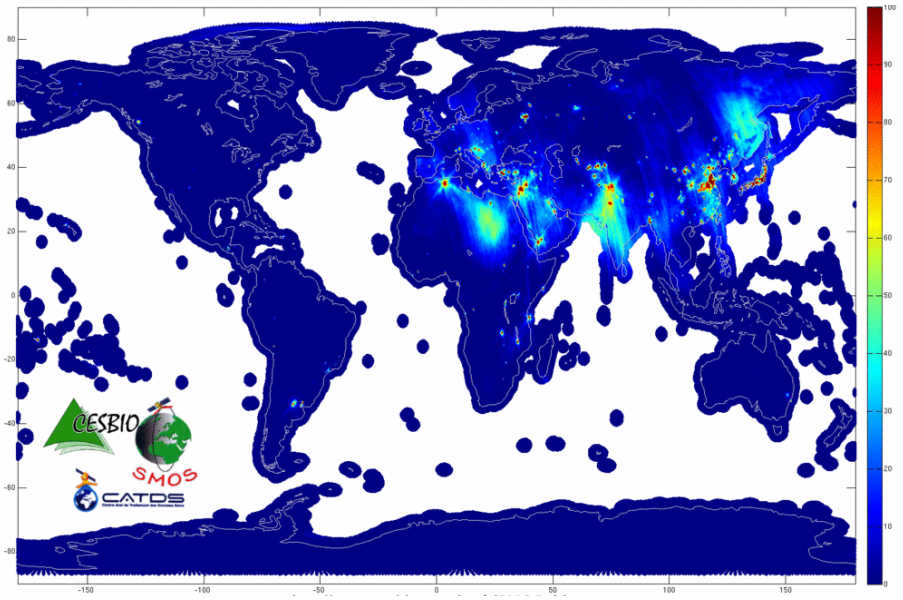
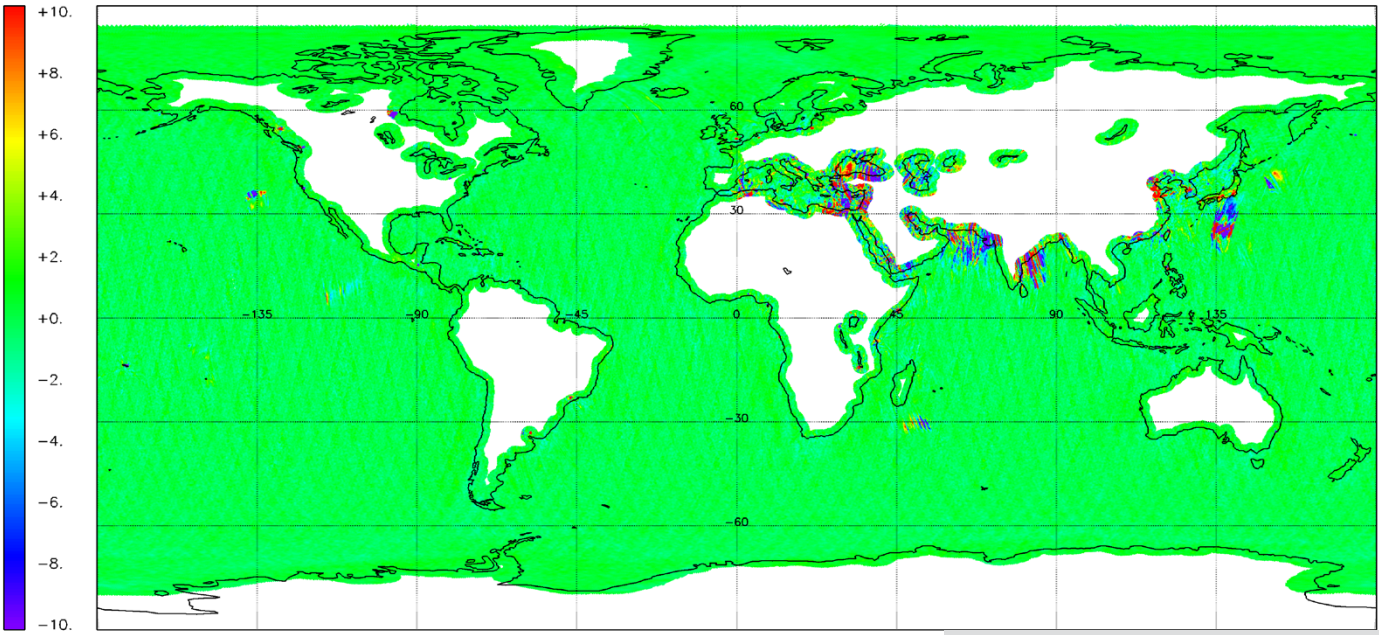


Figure 7:

Probability of sustained RFI occurrences during the period 27 March – 10 April 2016 for ascending passes.

Credit: CESBIO, CATDS



The 3rd and 4th Stokes parameters can also be used to detect RFI. Nominal values for these parameters are expected to be very small for natural targets at L-band, therefore a larger deviation in the parameters, i.e. beyond a few Kelvin, would indicate the presence of RFI. Figure-8 shows an example of the 4th Stokes parameter for the week of 27 March – 3 April 2016 over Sea. The map indicates the presence of several RFI sources over Pacific and Indian Oceans and two passes affected by very strong RFI along the South-East coast of Japan. The user can visually inspect the map to identify areas with possible RFI presence over ocean (i.e. 3rd and 4th Stokes parameters above 10K in absolute value). Weekly maps of 3rd and 4th Stokes parameter are presented in video format since the beginning of the SMOS mission on the SMOS data quality web page (*https://earth.esa.int/web/guest/-/data-quality-7059*).

Figure8:

Weekly average of the 4th Stokes parameter over the ocean during the period of 27 March – 3 April 2016. Areas affected by strong RFI show a 4th Stokes parameter above 10K in absolute value, for example off the South-East coast of Japan.

Credit: ESA

Upcoming Meetings & Announcements

SMOS session, Living Planet Symposium 2016: 9-13 May, Prague, Czech Republic

A dedicated session on the SMOS mission's status and performance assessment has been organized for the ESA Living Planet Symposium 2016. The session is scheduled for 11 May 2016, the detailed SMOS' session programme is available at: *http://lps16.esa.int/page_session110.php*.

IGARSS-16, 10–15 July 2016, Beijing, China

IGARSS-16 will be a good opportunity to discuss remote sensing with Chinese colleagues and to learn about Chinese Earth Observation programs such as the Feng-Yun meteorological satellite series, the Hai-Yang oceanographic satellite series, and the Huang-Jing environmental remote sensing satellite. The theme of this symposium is "Advancing the understanding of our living planet". For further information please visit: *www.igarss2016.org*.

3rd Satellite Soil Moisture Validation and Application Workshop, 21-22 September 2016, New York, NY (USA)

This workshop is a continuation of the first two soil moisture validation and application workshops held at ESA in Frascati, in 2013 and at the Royal Netherlands Academy of Arts and Sciences, in Amsterdam, in 2014. The objective of this workshop series is to discuss and reconcile methodological advances in the validation and application of global satellite soil moisture data. The workshop is unique in bringing together satellite soil moisture users and developers to focus on both the derivation and exploration of soil moisture data from both passive and active microwave satellite missions (SMAP, SMOS, ASCAT, AMSR-2, Sentinel-1, and other legacy missions).

For further information please visit: *http://smap.jpl.nasa.gov/events/46*.

SPIE remote sensing, 26–29 September 2016, Edinburgh, United Kingdom

SPIE Remote Sensing 2016 is the event that offers engineers, scientists, programme managers and policy-makers access to the latest developments in earth observing systems, technologies and applications. For further information please visit

http://spie.org/conferences-and-exhibitions/remote-sensing.

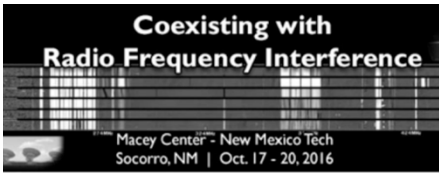
EUMETSAT Meteorological Satellite Conference 2016, 26-30 September, Darmstadt, Germany

The 2016 EUMETSAT Meteorological Satellite Conference will take place in EUMETSAT's home town of Darmstadt, Germany from 26 to 30 September 2016. The conference is a forum that brings together meteorologists, scientists and researchers from around the world to share their experience and knowledge during plenary, poster and workshop sessions. In 2016, the conference will discuss advances in nowcasting and short-range numerical weather prediction ("limited area modelling"), marine meteorology and oceanography, amongst other topics and have a special session on the Arctic challenge. For further information please visit

www.eumetsat.int/website/home/News/ConferencesandEvents/DAT_2833302.html.

RFI 2016, 17-20 October 2016, Socorro, New Mexico, USA

Radio Frequency Interference (RFI) has become a critical issue for many users of the electromagnetic spectrum. This is especially true for observational sciences such as radio astronomy, microwave remote sensing of the Earth, and Solar and ionospheric studies, where highly sensitive measurements are necessary. Following the previous successful workshops held in Bonn (Germany, 2001), Penticton (Canada, 2004) and Groningen (The Netherlands, 2010), RFI 2016 aims to bring together researchers, engineers and users from all radio science disciplines to consider how RFI affects their respective fields, to develop mitigation strategies, and to foster cooperation and collaboration. Attention will also be given to the impact of new and future sources of RFI, spectrum management challenges, and new technology developments. RFI 2016 will make positive steps towards making meaningful scientific observations in the presence of significant and growing Radio Frequency Interference. The paper submission deadline is 20 June 2016. For further information please visit: *http://go.nrao.edu/rfi2016*.



Data Access

If you wish to access science data, please see the following link for the instructions: *https://earth.esa.int/web/guest/-/how-to-obtain-data-7329*.

If you wish to access SMOS Near Real Time (NRT) "Light" (BUFR) products via EUMETSAT's EUMETCast service based on standard Digital Video Broadcast DVB-S2 technology please refer to *www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/index.html* for service details and coverage map.

SMOS registered users will be granted access to the service after registration on the EUMETSAT Earth Observation Portal: *https://eoportal.eumetsat.int/userMgmt*.

If you wish to access SMOS Near Real Time (NRT) "Full" (BUFR) or "Light" (BUFR) product by network over the entire Earth region, please send an email to *Susanne.Mecklenburg@esa.int*.