# → ESA'S WATER MISSION

## smos newsletter

Issue 7 | April 2014

SMOS satellite
launched on 2 November 2009

**In this issue:**



## Highlights

### SMOS mission extension

The first part of the SMOS mission extension review has taken place with the science review led by ESA's Earth Science Advisory Committee in October 2013. CNES, who operates the satellite platform, will hold its SMOS extension review in April 2014. Recommendations will be presented to the relevant ESA member state boards in April and June 2014 for final decision regarding the mission extension.

### SMOS level 2 sea surface salinity 2013 "catch-up" reporcessing completed

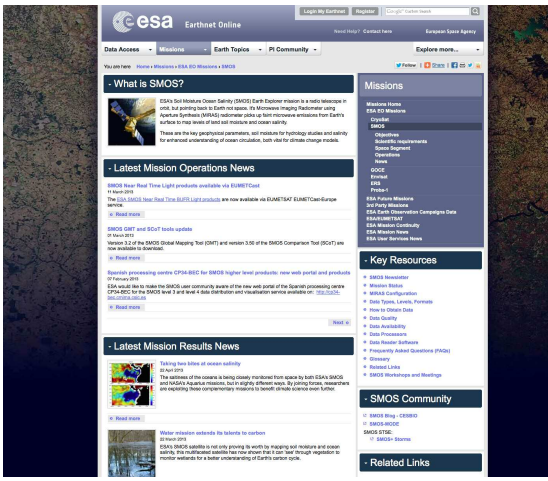
The SMOS L2 sea surface salinity 2013 "catch-up" reprocessing campaign has been completed and the data set covering the period from 1 January 2013 to 31 December 2013 is now available to the SMOS user community. With the release of this data set the SMOS users now have a consistent set of Level 2 sea surface salinity products from the beginning of the SMOS mission till December 2013 (REPR data type). For further details see the level 2 sea surface salinity data release note available here:
*https://earth.esa.int//documents/10174/127856/SMOS_Level-2_Ocean_Salinity_RN*

### SMOS continues to track super storms: Haiyan Typhoon case

Typhoon Haiyan (known in the Philippines as Typhoon Yolanda) was active in the East Pacific close to the Philippines between 4 and 9 November 2013. On 6 November, the Joint Typhoon Warning Center (JTWC) assessed the system as a Category 5-equivalent super typhoon on the Saffir-Simpson hurricane wind scale. SMOS intercepted the typhoon several times along its track, as illustrated by Figure 1. The processing of the SMOS brightness temperature acquired during the morning pass of the 7th of November by the French Research Institute for Exploration of the Sea (IFREMER) and Collect Localisation Satellites, (CLS) has detected an impressive amount of excesses in signal from the ocean (i.e. after correcting for atmosphere, extra-terrestrial sources, salinity and temperature contributions). This is due to surface roughness and foam-formation development under the Typhoon overpass. The estimated excess in L-band brightness temperature Tb has reached a record value of 41K.
In order to put the value in perspective of other natural oceanic signals, see Figure 2 which shows the excess Tb measured during

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.**



the passage of Hurricane Category 4-5 Igor in 2010, which was only 22 K.
Global changes of surface salinity (32-38 pss) and temperature (0°C-30°C) generally modify the Tb by ~5 K. Strong signal for Haiyan is very likely a natural extreme of sea surface emission at L-band radiation ever measured over the oceans.
The change in the emitted radiation is used to retrieve information on the strength of the wind over sea: the 41 K jump at the typhoon centre corresponds to a 150 knots wind speed, confirmed by other observations.
This new information derived from SMOS data will complement the existing satellite observation and can be operationally used in the numerical weather forecast model to improve forecasting of Tropical Cyclone intensification and evolution. For further information see:
*https://sites.google.com/a/salinityremotesensing.ifremer.fr/public/news/haiyantyphoon*
*thebrightestnaturalsourceofl-bandradiationevermeasuredovertheoceans*

**SMOS Ice 2014 campaign concluded on 28 March 2014**

The SMOS Ice 2014 campaign took place in March 2014 and focused on verifying sea-ice forecast and satellite derived products over the Arctic Sea. The campaign brought together scientists working on different types of sea-ice observations; specialists working on computer models generating ice forecasts; and engineers studying the suitability of thin ice for ship-routing applications. The Norwegian Research Vessel 'Lance' (see Figure 3) was used to host the science team and the various observation systems, including a helicopter on board that carried the EM-bird instrument. This instrument was used to infer ice thickness, by using electromagnetic induction techniques. Aircraft carrying an airborne instrument was used as a demonstrator for the sensor on SMOS and snow radar was also used to collect data. By combining information from all the different sensors operated on buoys; Research Vessel 'Lance'; the helicopter; the plane; and the satellite, the science team aim to verify model predictions and to improve sea ice products derived from SMOS. For further details on the SMOS Ice 2014 campaign see:
*http://blogs.esa.int/campaignearth/*

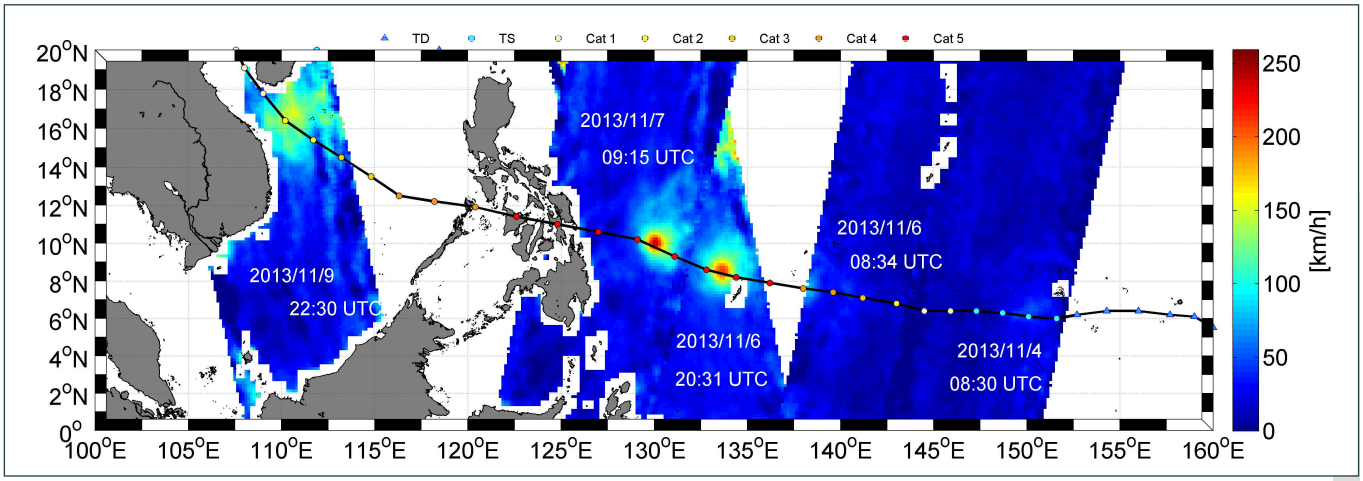



*Figure 1:*
SMOS retrieved surface wind speed [km/h] along the eye track of super typhoon Haiyan from 4 to 9 Nov 2013. Credits ESA-IFREMER-CLS.

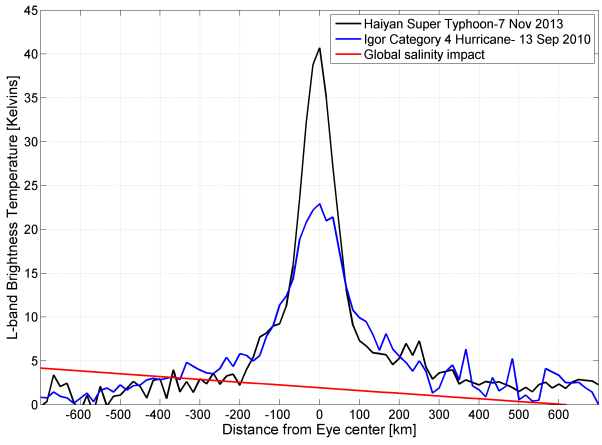



*Figure 2:*
North-south section through the Haiyan Typhoon showing the excess of brightness temperature (Th+Tv)/2 reconstructed from SMOS data at longitude of 130.05°E on the 7 Nov 2013 at 09:15Z Typhoon (black). The blue curve shows an equivalent section through the Igor Category 4 hurricane in 2010. The red line is illustrating the range of brightness temperature variation expected on Earth due to sea surface salinity and temperature changes. Credits ESA-IFREMER-CLS.

*Figure 3:*
Research Vessel Lance from the Polar-5 aircraft. The ship carries instruments for measuring sea ice and the helicopter carrying EM-bird flies from the ship. Credits: Stefan Hendricks, AWI – ESA


*Figure 4:*
Polar-5 aircraft in Svalbard ready to take part in the SMOS-Ice campaign. Credits: S. Hendricks, AWI - ESA

**SMOS data reprocessing**
The 2nd mission reprocessing is planned for 2014 with Level 1 data to be reprocessed by autumn 2014 and Level 2 soil moisture and sea surface salinity data to be reprocessed by beginning of 2015. Details on the improvements in the new Level 1 and Level 2 processors can found in the section on "data and processors".

**New information and tools available on line**
A new version (1.6.6) of the SMOS Data Viewer (SDV) is available for the user community. This version of the tool includes an upgrade of the visualization functionality for the new Discrete Global Grid (DGG) auxiliary data files (AUX_DGGxxx file type) that will be used by the next baseline version V6xx of the SMOS L2 soil moisture operational processors. For more information and to download the tool, go to: *https://earth.esa.int/web/guest/-/data-reader-software-7633*

**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 onto the following Web site: *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 well-known on-board anomalies [see description of anomalies *https://earth.esa.int/c/document_library/get_file?folderId=118493&name=DLFE-5407.pdf*]. The cumulative data loss due to instrument unavailability since the beginning of the routine operations phase in May 2010 amounts to 0.10% and the degraded data amounts to 1.16%. A detailed list of instrument anomalies is compiled on a weekly basis and is available on *https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/content?p_r_p_564233524_assetIdentifier=mission-status-7060*.

No data loss has occurred during the acquisition of MIRAS raw data at the ground stations since the beginning of the routine operations phase in May 2010. This result has been achieved by implementing an on-board data recording overlap strategy.

### Instrument Calibration

Several calibration activities are regularly performed on board and an overview on the calibration strategy implemented for the MIRAS instrument can be found on *https://earth.esa.int/c/document_library/get_file?folderId=118493&name=DLFE-1732.pdf*.
During calibration activities, science data are not available hence data users should consult the calibration plan for data availability, available from:
*https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/available-data-processing*

Since the issue of newsletter #6, calibration activities were performed in accordance with the routine calibration plan and calibration results are within the nominal range. The winter Flat Target Response (FTR) has been acquired and used only for monitoring purposes.

The evolution of the calibration parameters since the beginning of the mission is available in the SMOS quality reports accessible on the following web page:

*https://earth.esa.int/web/guest/-/data-quality-7059*

### Data quality

A monthly report summarising significant events in the SMOS flight and ground segment and the SMOS data quality status can be found on:
*https://earth.esa.int/web/guest/-/data-quality-7059*

Since the issue of newsletter #6, no new anomaly has been identified in the level 1 and level 2 data generated by the Data Processing Ground Segment.

### Updates on operational processors

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

| Processor | Current version | In operations since |
|---|---|---|
| Level 1A | V5.04 | 14 November 2011 |
| Level 1B | V5.04 | 14 November 2011 |
| Level 1C | V5.05 | 21 March 2012 |
| Near Real Time processor (NRTP) | V5.05 | 7 March 2012 |
| Level 2 soil moisture | V5.51 | 24 April 2012 |
| Level 2 ocean salinity | 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 processor during the period December 2013 – March 2014. Therefore, the algorithm baseline and data quality are as reported for the SMOS newsletter #3 issued in October 2012.

Level 2 Soil Moisture: No change has been implemented in the Level 2 Soil Moisture processor during the period December 2013 – March 2014 . Therefore, the algorithm baseline and data quality are as reported for the SMOS newsletter #3 issued in October 2012.

Level 2 Ocean Salinity: No change has been implemented in the Level 2 Ocean Salinity processor during the period December 2013 – March 2014. Therefore, the algorithm baseline and data quality are as reported for the SMOS newsletter #3 issued in October 2012.

Further information on the SMOS data quality can be found in the products read-me-first notes available on the web page:
*https://earth.esa.int/web/guest/missions-/esa-operational-eo-missions/smos/content?p_r_p_564233524_assetIdentifier=data-processors-7632.*

The SMOS data users are invited to consult the read-me-first note before using the SMOS data for their research activities.

### Summary of improvements to level 1 and 2 processors for 2nd mission reprocessing (planned to be deployed in the operational chain over the course of 2014)

Level 1

The next version of the SMOS Operational Processor (baseline V6xx) will be deployed in the ground segment in the second half of 2014. The foreseen major improvements for the L1OP are the following:

- Better RFI flagging of the level 1C data based on:
  - an RFI detection algorithm that uses both NIR brightness temperature and system temperature measurements to signal the presence of the RFI in the data
  - improved maps of potential RFI detected on the Earth surface to signal the presence of the RFI at the level of the discrete ground grid point.
- Better radiometric stability, in particular long term, of the brightness temperature on antenna frame (level 1C data)
- Improved spatial bias after several improvements at calibration and image reconstruction level
- Improved accuracy in the computation of the 3rd and 4th Stokes parameters by a full cross-polarization data processing approach

The same improvements will be introduced, simultaneously, in the near real time products disseminated in BUFR format to the operational meteorological centres.

For the Level 2 soil moisture operational processor the foreseen major improvements are the following:

- Better characterization of the auxiliary files generated by the post-processor by splitting the values of Tau, Roughness and RFI probability for ascending and descending orbit, and improved utilization of these data in the L2SM processor
- Enhancement of soil moisture retrieval in

forest areas
- Enhancement in the computation of the RFI probability, used to adjust radiometric uncertainty in the retrieval of the soil moisture, by using most recent SMOS observations instead of historical data
- Improvements to UDP reported fields, including enhanced reporting for modelled TB at 42.5°, reporting the distance of the observed target from the satellite track, and several bug fixes with minor impacts on reported values.

For the L2 sea surface salinity operational processor the foreseen major improvements are the following:
- Ocean Target Transformation (OTT) correction applied on daily basis to better track level 1 radiometric drift and spatial biases
- Estimation through level 1C Stokes 3 measurements of the Vertical Total Electron Content (VTEC) for the descending passes and usage in the retrieval of the sea surface salinity (ascending passes still use the predicted VTEC value from IGS)
- Better RFI detection and flagging, including use of cumulative RFI probability to adjust radiometric accuracy
- Improved roughness model 3

Further information on the improvements achieved with this processor baseline V6xx will be provided in the software release note of the operational processors and in the data release note that will be available just after the deployment of the processors in the operational ground segment.

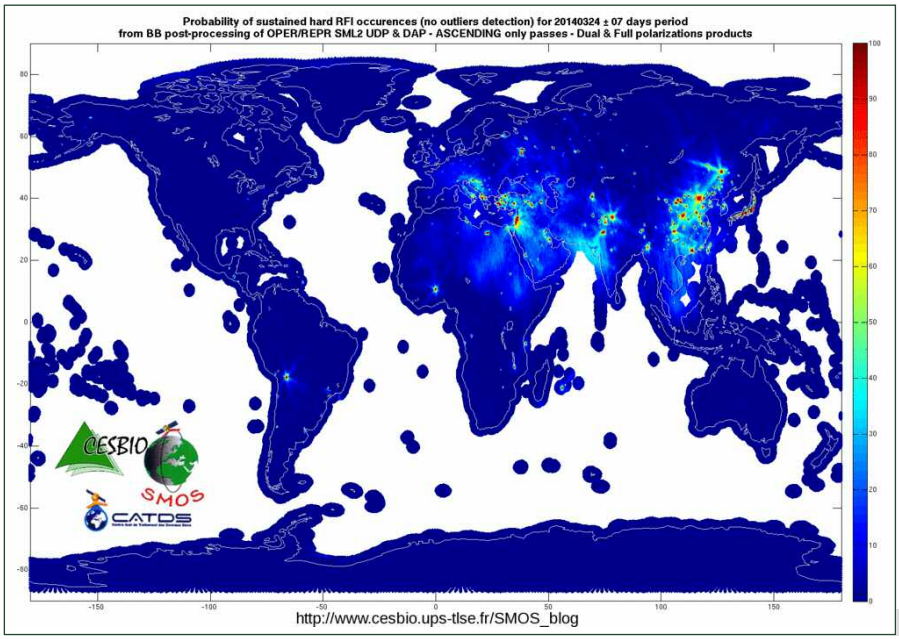



*Figure 5:*
Probability of sustained RFI occurrences during the period 17 - 31 March 2014 for ascending passes. Credits CESBIO, CATDS.

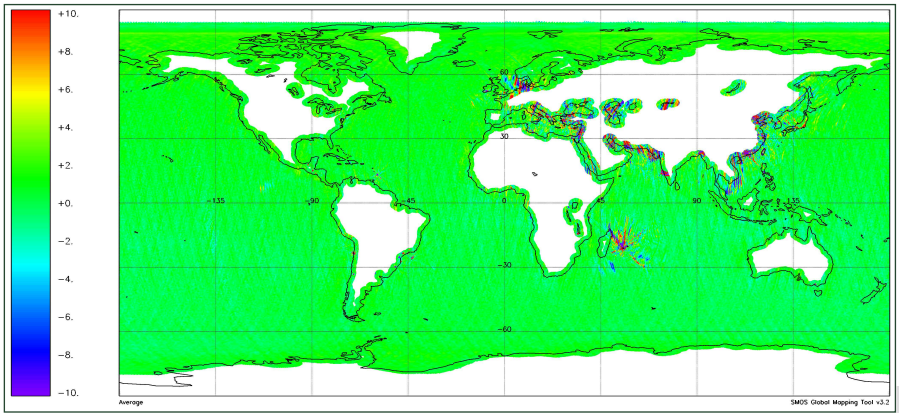


*Figure 6:*
Weekly average of the 4th Stokes parameter over the Ocean during the period of 23 – 30 March 2014. Areas affected by strong RFI show a 4th Stokes parameter above 10K in absolute value as shown in the map, for example, for the West Indian Ocean close to the Madagascar coast. Credits ESA.

**Radio Frequency Interference (RFI)**

Illegal 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 data are corrupted by RFI by using the quality flags, available in the SMOS data products, as indicators. A detailed description of these flags was included in the SMOS newsletter #1 issued in May 2012. Additional information with regard to RFI contamination can be found on the RFI probability maps, generated fortnightly by CESBIO and available on the SMOS blog *http://www.cesbio.ups-tlse.fr/SMOS_blog/smos_rfi/*].

Figure 5 shows an example of the map generated for the period centred on 24 March 2014. Thus the user can visually inspect the map to identify areas with strong RFI presence over land.

The 3rd and 4th Stokes parameters can also be used to detect RFI. Nominal values for the 3rd and 4th Stokes parameters are expected to be very small for natural targets at L-band. Hence a larger deviation in the 3rd and 4th Stokes parameters, i.e. beyond a few Kelvin, would indicate the presence of RFI. Figure 6 shows an example of the weekly map of the 4th Stokes parameter for the week of 23 - 30 March 2014. The map, for example, identifies the presence of a strong RFI over the West Indian Ocean (see SMOS newsletter #6). The user can visually inspect the map to identify areas with possible RFI presence over Sea (i.e. 3rd and 4th Stokes parameters above 10 K in absolute value). Weekly maps of 3rd and 4th Stokes parameter are presented in the SMOS Monthly QC Report available on the following web page: https://earth.esa.int/web/guest/-/data-quality-7059.

## Upcoming Meetings & Publications

**European Geoscience Union (EGU) General Assembly 2014 27 April – 2 May, Vienna, Austria**

A dedicated session on 'ESA's SMOS and NASA's SMAP missions: providing global observations of soil moisture and ocean salinity and beyond' has been organized and will take place on Tuesday 29 April. A detailed description of the programme and organization is available here: *http://meetingorganizer.copernicus.org/EGU2014/session/15052.*

**Soil moisture validation and application workshop, Amsterdam, 10-11 July 2014 The Netherlands**

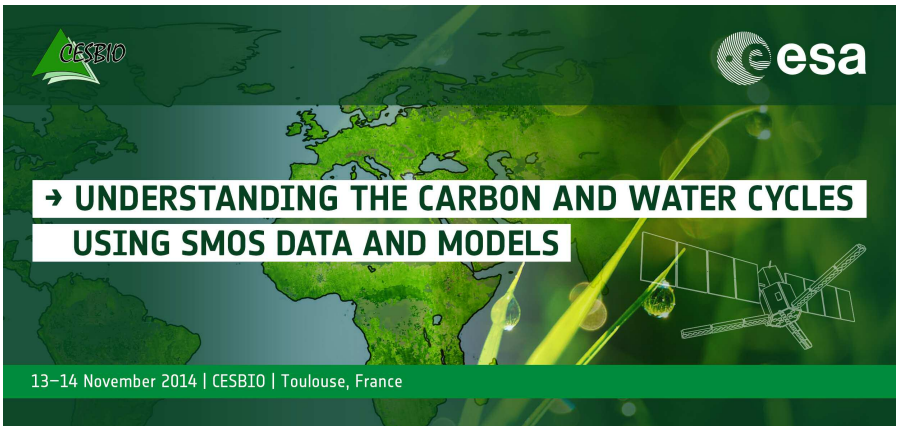
The workshop will take place on July 10-11, 2014 in the building of the Dutch Royal Academy of Arts and Sciences in the Centre of Amsterdam. The main objective of this workshop is to explore the methodological advances in the validation and application of global satellite soil moisture datasets. The workshop aims to bring satellite soil moisture users and developers together and focus on both the derivation and exploration of soil moisture from passive and active microwave satellite missions. A detailed description of the programme and organization is available here *http://www.hydrology-amsterdam.nl/SoilMoistureWS_Adam14/Home.html*
Deadline for abstract submission is 7 April 2014

**IGARSS 2014 13 - 18 July, Québec, Canada.**

A dedicated SMOS session 'ESA's SMOS and NASA's SMAP missions: providing global observations of soil moisture and ocean salinity and beyond' has been organised, please see details on *http://www.igarss2014.org*

**Earth Observation for Ocean-Atmosphere Interactions Science 2014 Conference, 28 – 31 October, ESA-ESRIN, Italy**

This joint ESA-SOLAS Conference aims at bringing together the EO and SOLAS communities, as well as scientific institutions and space agencies involved in the observation, characterisation and forecasting of ocean-atmosphere interactions and their impacts. A detailed description of the programme and organization is available here: *http://www.eo4oceanatmosphere2014.info*
Deadline for abstract submission is 16 May 2014




**Understanding the Carbon and Water Cycles using SMOS Data and Models, 13 – 14 November 2014, CESBIO Toulouse, France**

This land orientated workshop is planned for 13-14 November 2014 at CESBIO, Toulouse, France. The workshop aims at bringing together the EO, SMOS, Earth system science and modelling communities involved in the observation, characterization and forecasting of land surface processes and their impacts. A detailed description of the programme and organization is available here: *www.smos4waterandcarbon.info*

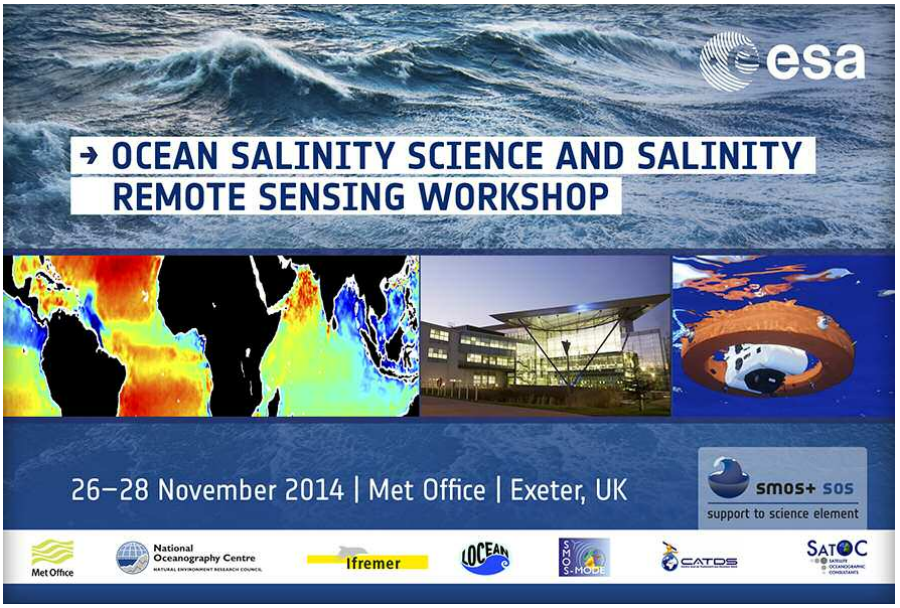
Deadline for abstract submission is 4 July 2014.

**Ocean salinity science and salinity remote sensing workshop, 26 – 28 November 2014 Exeter, UK**

A dedicated meeting focussing on sea surface salinity, the "Ocean salinity science and salinity remote sensing workshop" is planned for 26-28 November 2014 at the UK Met Office in connection with the STSE SOS study. A detailed description of the programme and organization is available here:

http://oceansalinityscience2014.org/.

Deadline for abstract submission is 30 June 2014.



**SMOS training course, 18 – 22 May 2015 ESA-ESAC, Spain**

A SMOS training course, will be organized by CESBIO and held at the ESA-ESAC premises near Madrid on 18 – 22 May 2015 a week before the 2nd SMOS science conference. The course will provide an opportunity to learn how to work with level 1 (brightness temperature) and level 2 (soil moisture and sea surface salinity) data provided by ESA's SMOS mission.

The deadline for applications and contact details will be announced over the course of 2014 on the science conference webpage www.smos2015.info and/or on the SMOS blog:

http://www.cesbio.ups-tlse.fr/SMOS_blog

**2nd SMOS science conference, 25 – 29 May 2015 ESA-ESAC, Spain**

The 2nd SMOS science conference jointly organised by ESA, CNES, SMOS-MODE is planned for 25-29 May 2015, together with a further SMOS training course led by the CESBIO team for 18-22 May, at ESAC, Spain. A detailed description of the programme and organization is available here: www.smos2015.info

Deadline for abstract submission is 16 January 2015.


## Data Access

If you wish to access science data, please see the following link for 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 (by a standard Digital Video Broadcast technology to acquire data over the European region) see *http://www.eumetsat.int/Home/Main/DataAccess/EUMETCast/index.htm?l=en*
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.*