→ ESA'S WATER MISSION

smos newsletter

Issue 16 | November 2018

SMOS satellite
launched on 2 November 2009

In this issue:

Highlights

Improved Level 3 sea surface salinity product now available

The Centre Aval de Traitement des Données SMOS (CATDS) has released an improved version (V3) of the CEC-Locean level 3 de-biased sea surface salinity product.

Adjustments in the "de-biasing" technique have mainly impacted sea surface salinity in very dynamic areas such as the river plumes and high latitudes improving consistency with SMAP data (see Figure-1). A general description of the de-biasing method is in Boutin J. et al., "New SMOS Sea Surface Salinity with reduced systematic errors and improved variability", Remote Sensing of Environment, 2018-09 Vol 214, P. 115-134 accessible here (*http://archimer.ifremer.fr/doc/00441/55254*). The version 3 adjustments and the product access are detailed on *http://www.catds.fr/Products/Available-products-from-CEC-OS/CEC-Locean-L3-Debiased-v3*. Figure-2 shows an example of this new dataset.

SMOS severe winds over ocean – first operational data products tested

ESA in collaboration with OceanDataLab (ODL) and IFREMER has started the implementation of a SMOS wind data service, which will provide, in near real time (3-6 hours from sensing), ocean surface wind speeds derived

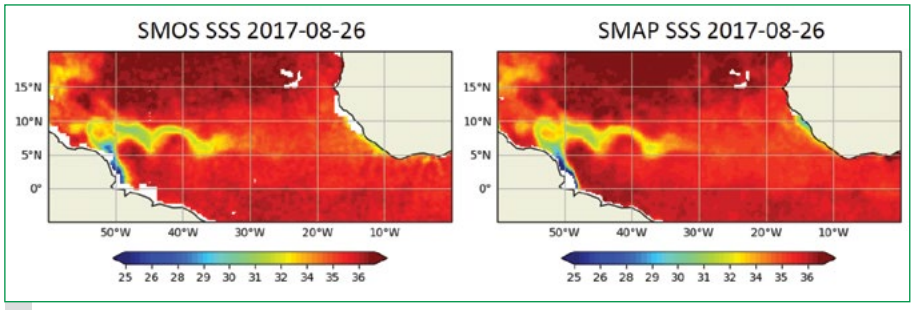
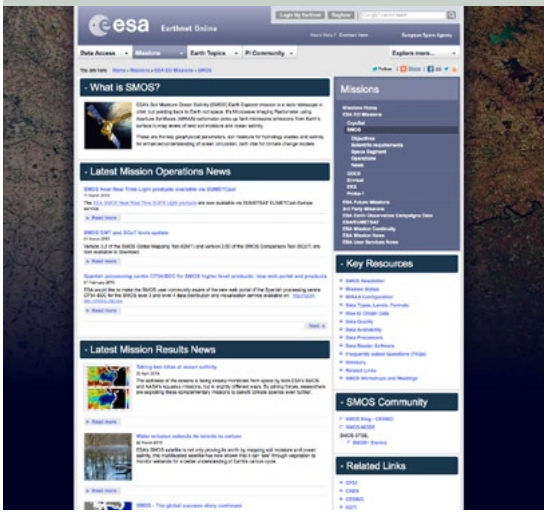


Figure-1: SMOS (9-day CATDS de-biased V3) (left) and SMAP (weekly CAP V4) (right) sea surface salinity over mid Atlantic Ocean. Data acquired on 26 August 2017. Credit: LOCEAN.

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.**



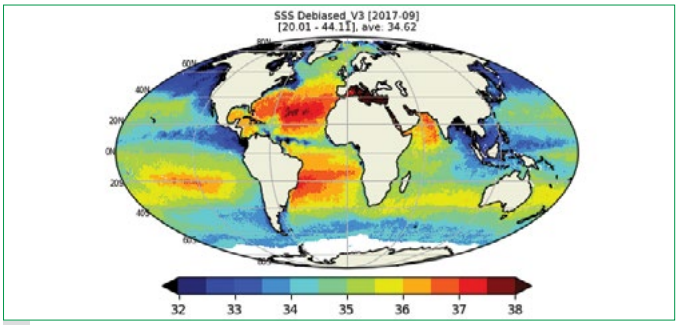


Figure-2: Example of SMOS sea surface salinity (SSS) CATDS CEC LOCEAN de-biased V3 product over the global Ocean (September 2017). Credit: Boutin J., Vergely J.L., Khvorostyanov D. (2018). SMOS SSS L3 maps generated by CATDS CEC LOCEAN. debias V3.0. SEANOE. *http://doi.org/10.17882/52804#57467*

from SMOS data. The service is now pre-operational and has been tested with some expert users such as: the NOAA National Hurricane Centre, the U.S. Naval Research Laboratory (NRL) and the Joint Typhoon Warning Centre (JTWC) in order to assess potential benefit to use SMOS wind data for operational storm forecasting. First feedback from these operational users has been very positive: *http://www.esa.int/Our_Activities/Observing_the_Earth/SMOS/SMOS_offers_new_perspective_on_hurricanes*.

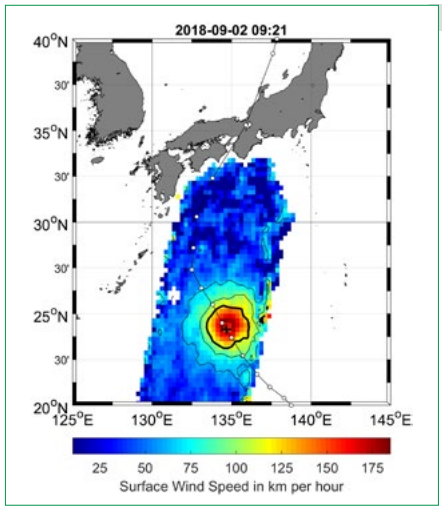


Figure-3: Wind speeds at the base of Typhoon Jebi near Japan measured by ESA's SMOS mission on 2 September 2018. Credit: IFREMER/OceanDataLab

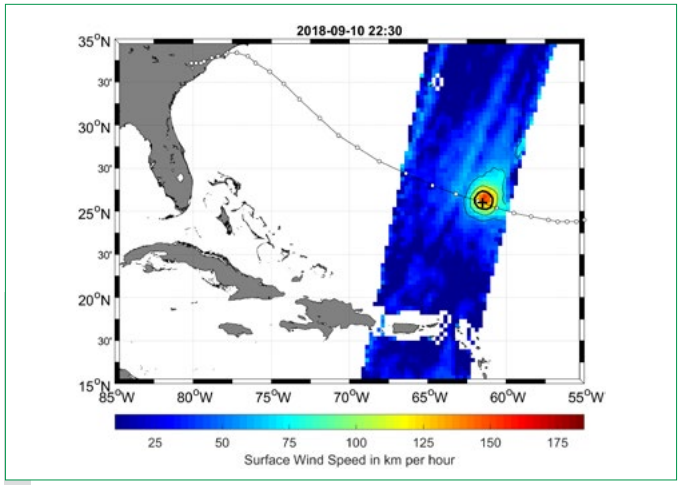


Figure-4: Wind speeds at the base of Hurricane Florence near the US measured by ESA's SMOS mission on 10 September 2018. Credit: IFREMER/OceanDataLab.

As an example, SMOS wind speeds were used to track the wind under the Typhoon Mangkhut, the Typhoon Jebi (see Figure-3) and the Hurricane Florence (see Figure-4).
The SMOS wind speeds will become available for all users end 2018.

Continued SMOS operations beyond 2019

The SMOS mission is currently undergoing a mission extension review to confirm funding beyond 2019. The review meeting is planned for end of October 2018, an update will be given in the next newsletter

How much water is used for irrigation?

Soil moisture derived from observation from satellites such as ESA's SMOS mission have been used in a recent research published in the "International Journal of Applied Earth Observation and Geoinformation". The study has demonstrated the applicability of consecutive soil moisture measurements from space to derive the amount of water applied for irrigation between the two sensing date. Figure-5 shows the difference for the estimated water used for irrigation between in situ data and remote sensed data for three test-sites in Spain.
For further reading access the ESA web story: *http://www.esa.int/Our_Activities/Observing_the_Earth/SMOS/How_much_water_is_used_for_irrigation*

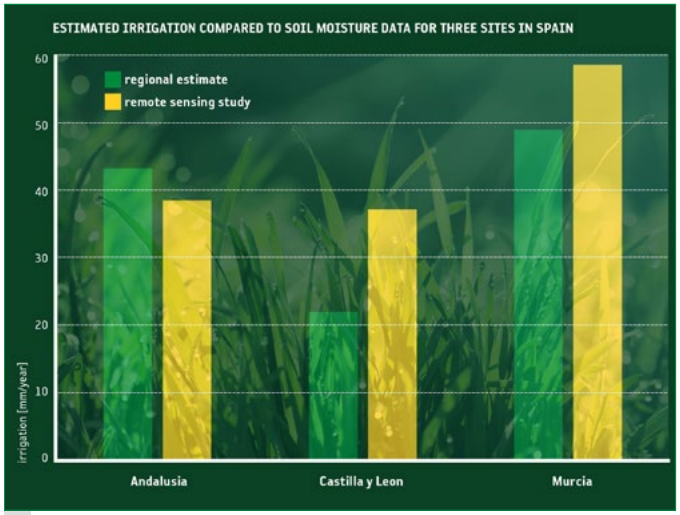


Figure-5: Difference [mm/year] between estimated water used for irrigation derived from in situ measurements (green) and same quantity derived from space based soil moisture measurements (yellow) for three test-sites located in Spain. Credit: L. Brocca et al., "How much water is used for irrigation? A new approach exploiting coarse resolution satellite soil moisture products", International Journal of Applied Earth Observation and Geoinformation volume 73, pages 752–766 (2018).

Improved Level 2 soil moisture near real time product now available

ESA has released an improved SMOS Level 2 near-real time soil moisture neural network product. The near-real time soil moisture product version v200 is now based on a neural network schema trained using the level 2 soil moisture data set generated by the operational Level 2 soil moisture processor v650. In term of statistical comparisons, the two products have very similar performances as shown in Figure-6 for the mean soil moisture bias. Further information about the near real time soil moisture v200 product is available in the read-me-first note (*https://earth.esa.int/documents/10174/1854503/SMOS-level-2-Soil-Moisture-NRT-V200-release-note*).

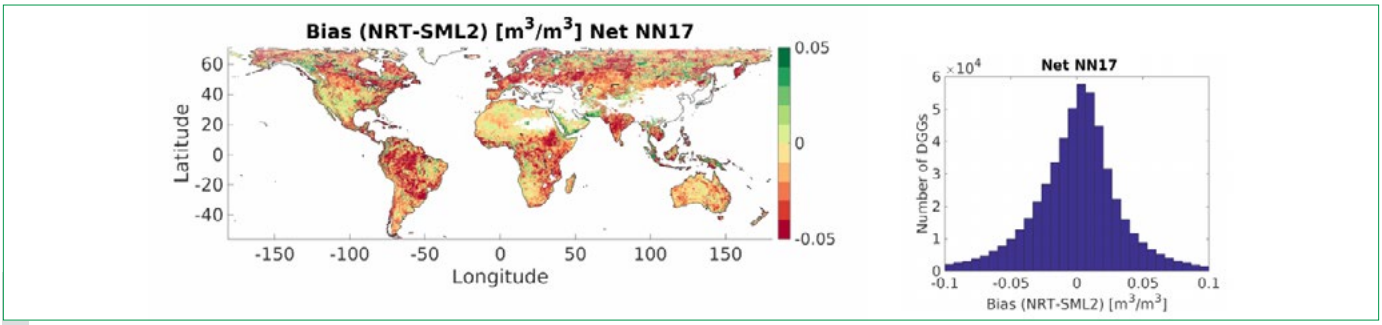
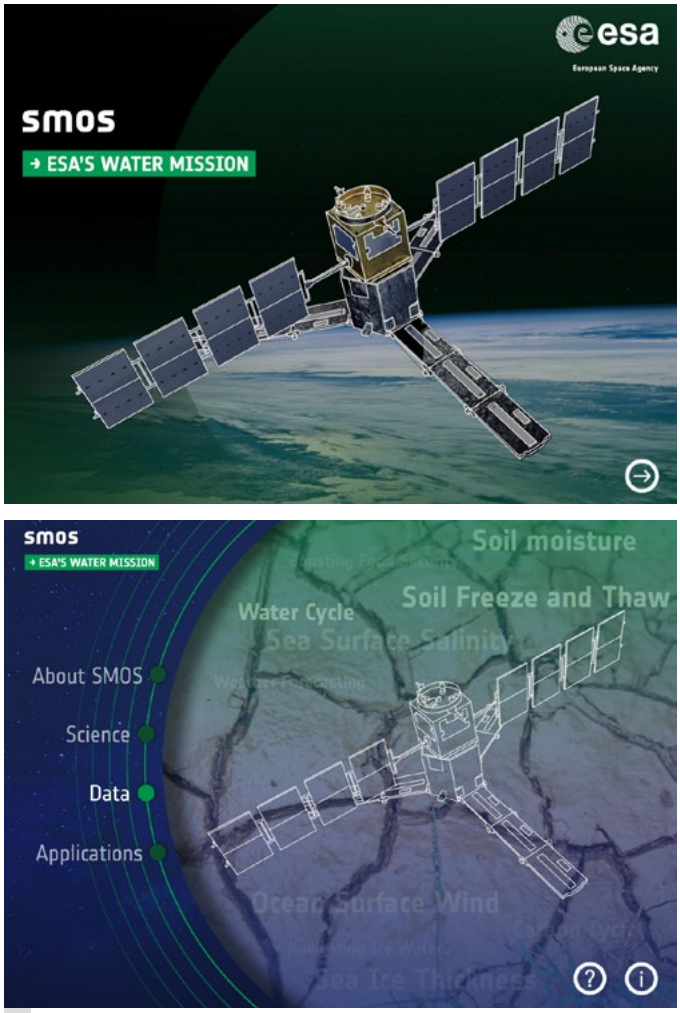


Figure-6: Soil moisture bias maps (left) and histogram (left) for the level 2 soil moisture near real time neural network v200 product (SM-NRT-NN) with respect to the level 2 soil moisture v650 product (L2SM) product. Credit: CESBIO.

SMOS multimedia book is now available

A new ESA multimedia publication dedicated to SMOS mission is now available. The SMOS multimedia book, through the usage of explanatory texts, images, interactive diagrams and videos, presents in great detail the various SMOS mission components (the flight and ground segment), the mission scientific background, the data products and the main SMOS mission's scientific and applications achievements. The SMOS multimedia book can be viewed by using different platform (personal computer, tablet, smartphone) and it is accessible here (*https://adobe.ly/2JAQFue*).



SMOS multimedia book. SMOS multimedia book front page (top panel) and list of content (bottom panel).

SMOS simplified data access

SMOS data can now be accessed and downloaded with a single ESA *EO-SSO account (https://earth.esa.int/web/guest/general-registration*) without needing to take additional registration steps. The SMOS data collections are accessible from the *ESA SMOS Online Dissemination Service (https://smos-ds-02.eo.esa.int/oads/access/*).

Pi-MEP - SMOS Pilot Mission Exploitation Platform for Salinity: update

The SMOS Pilot Mission Exploitation Platform (Pi-MEP) for Salinity project, launched in 2017, aims to: i) serve as an enhanced sea surface salinity validation platform, complementing the efforts of the SMOS Expert Support Laboratories (e.g. exploring satellite performances at different spatial/ temporal scales or against various ground-truth data) and ii) offer a testbed to enable and monitor oceanographic process studies, capitalising on SMOS salinity data in synergy with additional satellite products (e.g. sea surface temperature, winds speed, currents, rain rates). The Pi-MEP Salinity is a one-stop shop for scientific validation, monitoring, assessment and exploitation of SMOS salinity data. The consortium is constantly liaising with a dedicated Scientific Advisory Group. A test-platform was made available for early adopters in May 2018. Following interest from NASA, options to enlarge the scope of the platform under joint ESA-NASA activities have been discussed. The platform will be demonstrated at the upcoming *Ocean Salinity Science conference* in Paris with an official release to the wider user community planned at the *ESA Living Planet Symposium 2019* in Milan.

A parallel dedicated effort for a Pilot SMOS Mission Exploitation Platform (SMOS Pi-MEP) for soil moisture is under preparation and due to start towards the end of 2018.

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*). This is an open call, and therefore G-POD SMOS proposals can be submitted at any time, directly through the following website: *http://eopi.esa.int/G-POD*.

Data and Processors

Data availability

The SMOS instrument MIRAS is operating nominally with the exception of some known on-board anomalies described in the *MIRAS anomaly document*. The cumulative data loss due to MIRAS instrument unavailability since the beginning of the routine operational phase (May 2010) amounts to 0.09% and the degraded data amounts to 0.59% (see Figure-7). 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 at *https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/content/-/asset_publisher/t5Py/content/mission-status-7060*.

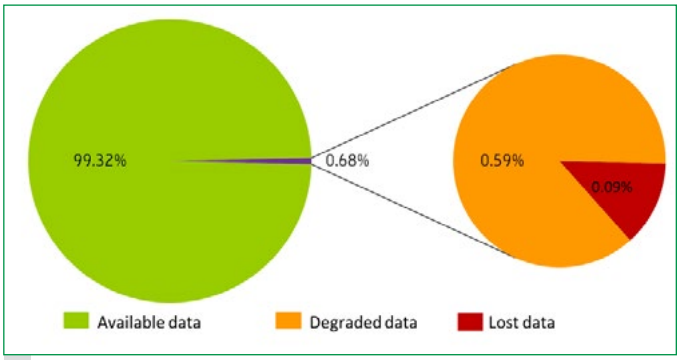


Figure-7: SMOS mission data availability percentage since May 2010. Instrument data availability is extremely high, about 99%. Only 0.09% of data is lost due to MIRAS anomalies. Credit: SMOS FOS/ESA

Instrument calibration and data quality

Several on-board calibration activities are performed regularly and an overview of the calibration strategy implemented for the MIRAS instrument can be found in the SMOS calibration *summary document*. During calibration activities science data are not generated, therefore data users should consult the *calibration plan* for expected data unavailability.

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

Further information on SMOS data performance can be found in the level 1 and level 2 products read-me-first notes available at *https://earth.esa.int/web/guest/-/data-processors-7632*. SMOS data users are invited to consult the read-me-first notes before using SMOS data for their research activities.

Status of the SMOS operational processors

The current versions of the operational processors installed in the SMOS ground segment are listed below.

A detailed description of the current baseline algorithms used to process the SMOS data are presented in the Algorithm Theoretical Basis Documents (ATBDs) available here: *https://earth.esa.int/web/guest/-/data-processors-7632*.

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	**V6.50 15 November 2017**	V6.20 5 May 2015
Level 2 ocean salinity	**V6.62 10 May 2017**	V6.22 5 May 2015
Level 2 soil moisture Near Real Time Neural Network (NRT-NN)	**V2.00 8 August 2018**	V1.00 16 March 2016

Future evolutions planned for the operational processors include:

Level 1/NRTP: The next upgrade of the level 1 processor (version 7) will include improvements for the data calibration stability, image reconstruction, direct Sun estimation and Radio Frequency Interference (RFI) flagging.

Level 2 Soil Moisture: The next upgrade of the level 2 soil moisture processor (version 7) will include improvements for characterisation of retrieval parameters uncertainties (DQX), refinement parameterisation (omega, roughness) for specific land classes, possible usage of simplified retrieval algorithms, and implementation of a better dielectric constant model for organic soil.

Level 2 Ocean Salinity: The next upgrade of the level 2 sea surface salinity processor (version 7) will include improvements for the estimation of an unbiased sea surface salinity anomaly based on SMOS measurements, Sun and galaxy correction, wind speed characterisation (source and uncertainties) and upgrade of the dielectric constant model for cold waters.

Radio Frequency Interference (RFI)

Active RFI sources are continues monitored in term of intensity and geographical distribution as illustrated in Figure-8 and Figure-9.

Information about the evolution of the RFI contamination can be found on the frequently updated RFI probability maps for land surfaces, generated fortnightly by CESBIO and available on the SMOS blog (*http://www.cesbio.ups-tlse.fr/SMOS_blog/smos_rfi/*). Weekly maps of the 3rd and 4th Stokes parameter over ocean surfaces can be found on the SMOS data quality web page (*https://earth.esa.int/web/guest/-/data-quality-7059*). The user can visually inspect the maps to identify RFI contamination over land and over the oceans (areas with weekly averaged 3rd and 4th Stokes parameters above the natural variability of ±10K). The level 1C product contains several RFI flags that can be

used to remove contaminated measurements. 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 level 1 v620 read-me-first note (*https://earth.esa.int/documents/10174/1854503/SMOS_L1OPv620_release_note*)

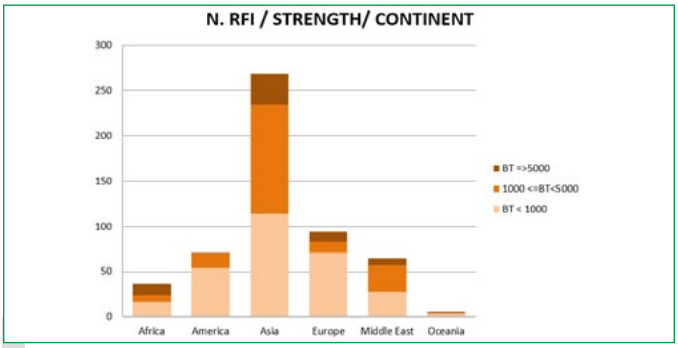


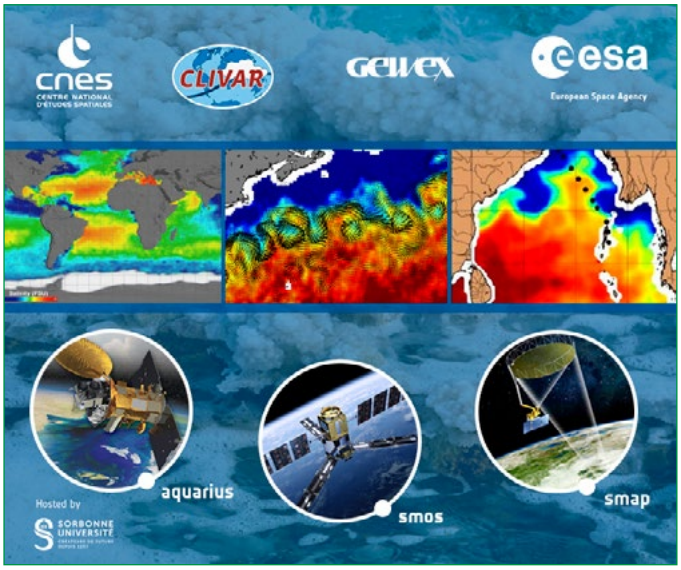
Figure-8: Worldwide number of active RFI sources per continent and intensity in September 2018. Credit: SMOS RFI team at ESA ESAC

Figure-9: Map of Europe showing the probability of SMOS persistent RFI occurrences during September 2018. Credit: SMOS RFI team at ESA ESAC

Upcoming Meetings & Announcements

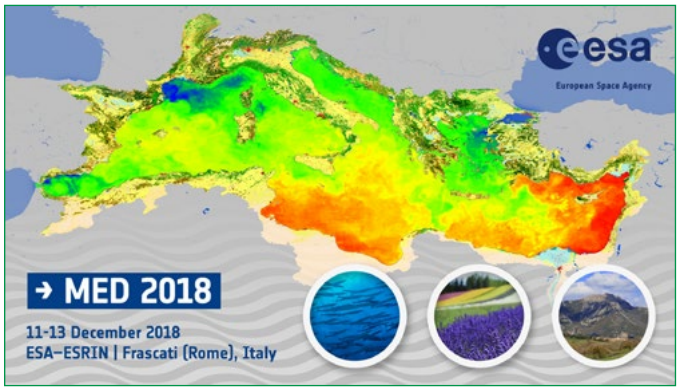
2018 Ocean Salinity Science workshop

The workshop will take place in Paris, France on 6 – 9 November 2018. The workshop aims to review progress and ongoing work and to identify the next frontiers in the fields of ocean salinity and freshwater cycle science. For further details please visit the 2018 Ocean Salinity Science workshop web page: *https://nikal.eventsair.com/QuickEventWebsitePortal/2018-ocean-salinity-science-conference/esa-2018*



MED 2018

A user consultation meeting will take place in ESA-ESRIN, Frascati (Italy) on 11-13 December to define a roadmap for a Mediterranean initiative within ESA's EO Science for Society Programme Element. The workshop will focus on topics such as atmosphere, oceanography, climate and land research and applications for the Mediterranean area. Workshop registration closes on 3 December 2018. For further details please visit: *http://med2018.esa.int*



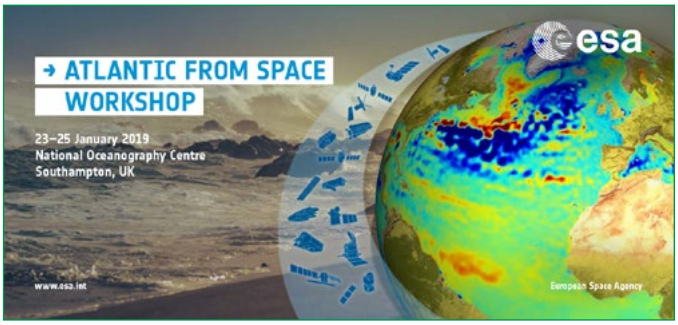
AGU 2018 Fall Meeting

The AGU 2018 Fall Meeting will take place in Washington DC, USA on 14 – 15 December 2018. A session on "The global water cycle: linkages of ocean salinity with the atmosphere and terrestrial hydrology" has been organized. The session highlights water cycle research that describes linkages between the ocean, atmosphere, and land hydrology. Contributions are invited on all aspects of water cycle research including analyses undertaken using in situ and satellite missions observations, estimates based on numerical models, data assimilation systems, and climate model projections. For further details please visit: *https://fallmeeting.agu.org/2018*.

Atlantic from space workshop

The Atlantic for space workshop will take place at National Oceanography Centre in Southampton (UK) on 23 – 25 January 2019. The workshop will focused on: i) the review of the main activities, projects and initiatives taking place in the Atlantic region where Earth

Observation may contribute; ii) the assessment of the potential of the increasing observation capacity offered by satellites to address the needs for science, applications and future information services; iii) the definition of the basis for developing an Atlantic Regional Earth Observation Exploitation Platform. The workshop is organised around invited oral presentations and discussions. An interactive session will be organised around selected posters. Poster authors are required to submit abstracts, 200-250 words, by 19 November 2018. For further details please visit: *https://www.eo4atlantic.info*.



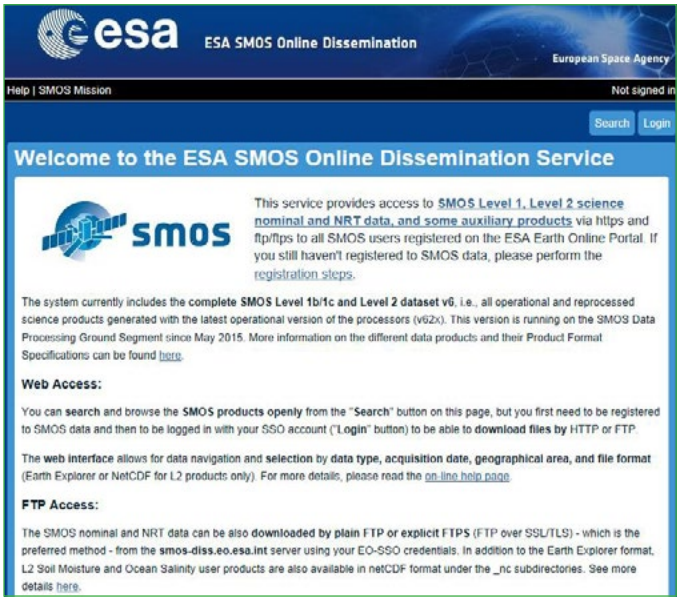
2019 Living Planet Symposium

The Living Planet Symposium will take place in Milan, Italy on 13 – 17 May 2019. The Symposium will focused on latest scientific findings on Earth's environment and climate derived from satellite data, and on Earth observation's role in building a sustainable future and a resilient society. The deadline for abstract submission is 11 November 2018. For further details please visit: *https://lps19.esa.int*

Data Access

ESA SMOS Online Dissemination service

Since March 2016, the SMOS online dissemination portal has been providing a single point entry for all SMOS level 1 and level 2 data products, including both Near Real Time (NRT) level 1C and soil moisture neural network products. The online service facilitates data access with enhanced catalogue functionality for data navigation and selection by data type, acquisition time, geographical area and data format (i.e. ESA Earth Explorer Format (EEF) or NetCDF format for level 2). Once selected the data can be downloaded immediately using different protocols. Level 1C and level 2 quick-look images are also available for reference. The ESA SMOS Online Dissemination service is accessible here: *https://smos-diss.eo.esa.int*. Further information on accessing SMOS data is available here: *https://earth.esa.int/web/guest/-/how-to-obtain-data-7329*.



SMOS Near Real Time Data through EUMETCast

SMOS Near Real Time (NRT) "Light" (BUFR) and soil moisture neural network products can be accessed via EUMETSAT's EUMETCast service based on standard Digital Video Broadcast (DVB)-S2 technology. For service details and a coverage map please visit: *(https://www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/index.html)* SMOS registered users will be granted access to the service after registration on the EUMETSAT *(https://eoportal.eumetsat.int/userMgmt)* Earth Observation Portal.

If you wish to access SMOS NRT "Full" (BUFR) products by network, please send an email to SMOS mission manager: *Susanne.Mecklenburg@esa.int*.