

→ ESA'S WATER MISSION

smos newsletter

Issue 17 | April 2019



SMOS satellite
launched on 2 November 2009

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Highlights

SMOS operations beyond 2019 approved

The Programme Board for Earth Observation approved the **extension of SMOS mission operations** based on its excellent technical and scientific performance in February 2019 at its 177th meeting. The main recommendation made by the Advisory Committee for Earth Observation (ACEO) was that: ***“ACEO in recognizing the diversity and high quality of the scientific outcome of the mission, the breadth of new applications as well as the contribution by SMOS to operational applications strongly recommends the extension of the SMOS mission until end of 2021 and beyond. This will further enable new science opportunities in particular with regards to the Earth's water and carbon cycle, expand the already substantial portfolio of operational applications and provide L-band measurement continuity essential for the generation of Fundamental Climate Data Records.”***

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:

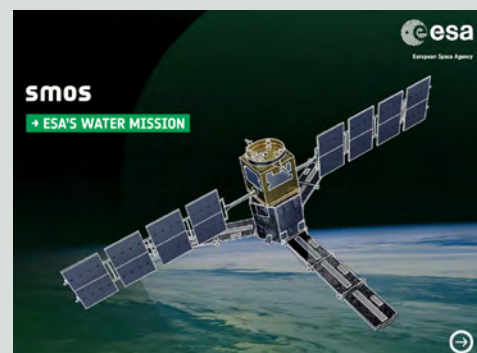


<https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/newsletter>.

SMOS multimedia book

The SMOS multimedia book, through the usage of explanatory texts, images, interactive diagrams and videos, presents in great detail the SMOS mission. The SMOS multimedia book can be viewed by using different platform/devices (personal computer, tablet, smartphone) and it is accessible here:

<https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/multimedia-book>.



Ocean Salinity Science Conference's report now available

The 5th "Ocean Salinity Science Conference" took place at Sorbonne University, Paris, France, on 6-9 November 2018. It was attended by more than 100 international scientists and representatives of operational services. A major highlight of the conference was the large variety of scientific studies and operational applications being presented demonstrating the unprecedented skill of currently available L-band measurement from space through SMOS, SMAP and formerly also Aquarius. The conference's report and presentations are now available from the conference's web site: www.oceansalinityconference2018.org under the tab "Presentations and Report".



SMOS Mission events at ESA LPS-2019

Dedicated SMOS mission talks will be part of the programme of the next ESA Living Planet Symposium (LPS-19) which will take place in Milan, Italy on 13-17 May 2019. On **Monday 13 May** inside the scientific programme a session about "10 years of SMOS in orbit – from technology demonstrator to operational applications" will be held in room Brown-1 from 13.30 to 15.10. On **Tuesday 14 May** a SMOS 10-year event will be held at 13.00 as part of the Agorá programme, This Agorá event will focus on the SMOS mission technological excellence and scientific achievements leading to operational applications providing benefit to society.

Over the full week, at the ESA booth, demonstration of the SMOS Pilot Mission Exploitation Platform (Pi-MEP) for Salinity will be held to accompany the official release of the platform in its operational flavor. The Pi-MEP Salinity serves as an enhanced sea surface salinity validation platform and offers a testbed to enable and monitor oceanographic process studies, capitalising on SMOS salinity data in synergy with additional satellite products. Joint ESA-NASA activities are also being implemented in the Pi-MEP Salinity project.

For further information and final Symposium programme please visit: <https://lps19.esa.int>



SMOS Level 3 freeze and thaw soil state product now available

Level 3 SMOS Freeze and Thaw (F/T) soil state product (SMOS L3FT) is now available from the Finnish Meteorological Institute (FMI). The SMOS L3FT product is daily generated based on SMOS observations from CATDS (Centre Aval de Traitement des Données SMOS) daily gridded level 3 brightness temperatures products as input

SMOS soil status over northern hemisphere on 02-Mar-2019

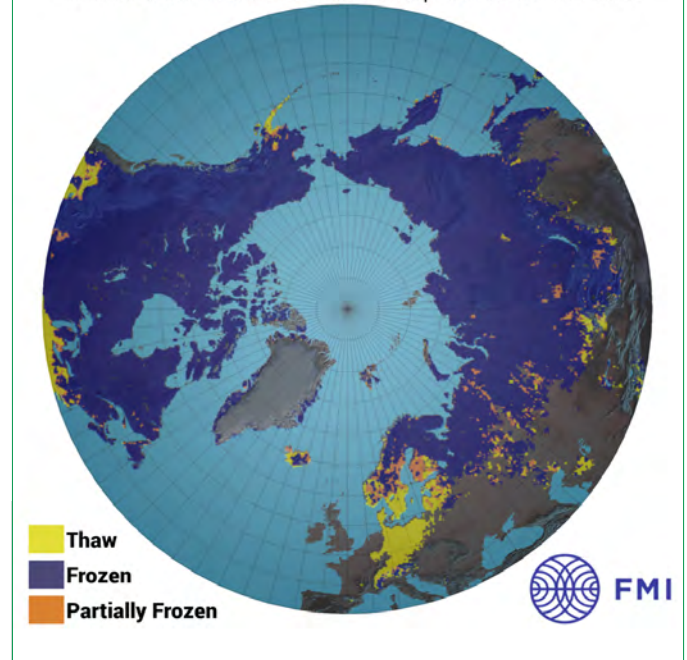


Figure 1: Soil state over northern hemisphere on 2 March 2019 as sensed by SMOS. Credits: FMI

and associated ancillary data. The SMOS L3FT product is based on the earlier work performed within the frame of SMOS+ Innovation Permafrost and SMOS+ Frost2 studies. Further information on the product are included in the Algorithm Theoretical Basis document, in the Product Description document and in the readme first Technical Note available from the SMOS service portal: <http://nsdc.fmi.fi/services/SMOSService/>. The dataset from year 2010 onwards can be accessed from the ftp service: <ftp://litdb.fmi.fi/outgoing/SMOS-FTService>. This dataset will be also available on the ESA SMOS Data Dissemination server in the coming months.

SMOS-CryoSat2 Level 4 merged sea-ice thickness product now available

SMOS-CryoSat-2 Level 4 merged sea-ice thickness product is now available from the Alfred-Wegener Institute (AWI). The products are weekly generated based on SMOS daily sea-ice thickness product and weekly CryoSat-2 sea-ice thickness product. The SMOS-CryoSat2 Level 4 merged sea-ice thickness estimations are based on optimal interpolation scheme that weighted differently SMOS and CryoSat-2 dataset based on known uncertainties of the individual products and modeled spatial covariances. Further information on the product are included in the Product Description document and in the readme first Technical Note available from the AWI SMOS processing and dissemination service portal: <https://spaces.awi.de/confluence/display/CS2SMOS/CryoSat-SMOS+Merged+Sea+Ice+Thickness>. The dataset from November 2010 onwards can be accessed from the ftp service: ftp://ftpsrv2.awi.de/sea_ice.

Due to melting season, the SMOS-CryoSat-2 Level 4 merged sea ice thickness product is not produced between May and September. This dataset will be also available on the ESA SMOS Data Dissemination server in the coming months.



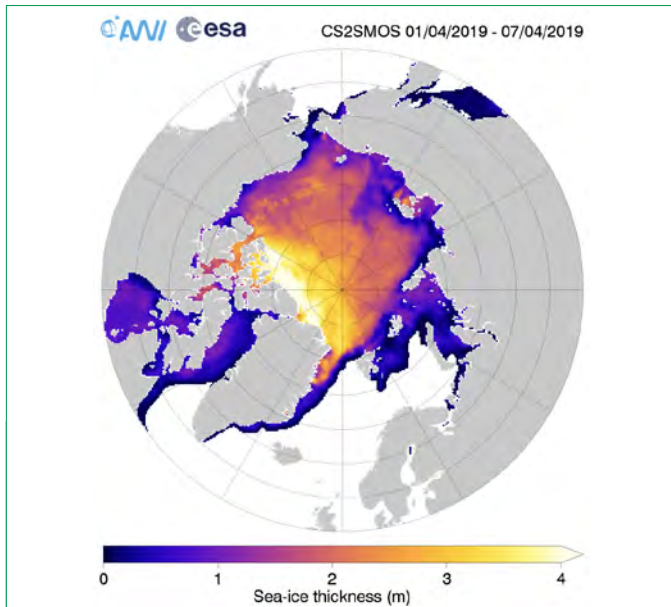


Figure 2: Sea-ice thickness over northern hemisphere on first week of April 2019 as sensed by SMOS and CryoSat-2. Credits: AWI

Idai Tropical cyclone tracked by SMOS winds pre-operational service
 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 from SMOS data. The service, since September 2018, is in pre-operational phase providing data to selected expert users such as: the NOAA National Hurricane Centre, the U.S. Naval Research Laboratory (NRL) and the Joint Typhoon Warning Centre (JTWC) which are assessing the potential benefit to use SMOS wind data for operational storm forecasting. Recently a new product: SMOS near real time Tropical Cyclone (TC) wind radii has been introduced on top of the sea surface wind speed product by the SMOS wind service. The TC wind radii product is provided on a standard format in order to be directly ingested by the Automated Tropical Cyclone Forecasting (ATCF™) systems at the US Navy.

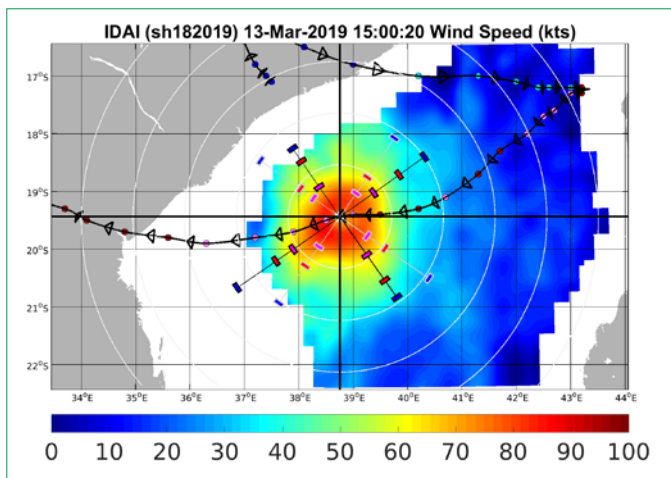


Figure 3: Tropical Cyclone Idai: wind speed and wind radii as sensed by SMOS on 13 March 2019. The wind radii is provided for the 34 kt (blue mark), 50 kt (red mark), and 64 kt (violet mark) winds. Black solid lines represent SMOS estimated wind radii, grey lines represents Automated Tropical Cyclone Forecasting (ATCF) estimated wind radii. Idai best track from ATFC is also shown. Credit: IFREMER/OceanDataLab.

The TC wind radii product has been used to track the Tropical Cyclone Idai which struck Mozambique and several other countries in southern Africa in mid-March 2019, causing widespread flooding and destruction across the southeast corner of the continent in particular for the port city of Beira in Mozambique where hundreds of casualties occurred. Figure-2 shows an example of TC wind radii product for Idai as sensed by SMOS on 13 March 2019 over the Mozambique Channel.

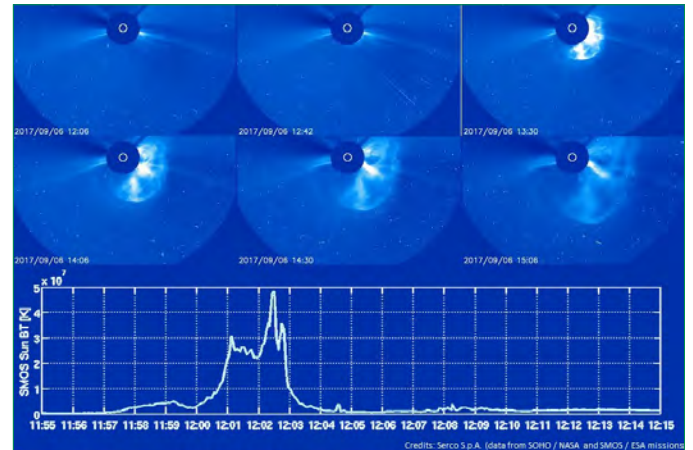


Figure 4: X-class Coronal Mass Ejection (CME) event occurred on 6 September 2017. Upper panels CME images from SOHO, lower panel temporal evolution of the L-band Sun brightness temperature (proxy of Solar flux) derived from SMOS data during the associated Solar Radio Burst (SRB) event. Time annotation is in UTC. Credit: Serco Italia S.p.A., SOHO/NASA.

SMOS dataset to support Space Weather studies

Recent studies performed by the SMOS payload calibration team, presented at IGARSS-2018 and at the last European Space Weather Week (ESWW-15) in November 2018 have demonstrated that the SMOS “removed Sun signal” as available inside the level 1B product, is a valuable source of information to better understand polarimetry L-band emission from the Sun. This result will be further explored in a project proposed in the framework of the ESA open call: E04Society. The project aims to have a synergetic usage of SMOS data in Sun flare detection and analysis and to explore SMOS data correlation with measurements of solar flares currently used in Space Weather, as GOES X-ray flux.

These ongoing studies are of great importance, in the context of Space Weather applications, since the forecasting of perturbations in the Earth’s ionosphere due to Sun Activity (Microwave Radio Burst, flare and its associated Coronal Mass Ejection) can affect much of the modern lifestyle and society in term of transportation (e.g. flight radar anomalies), communication (e.g. GPS signal anomaly) and electricity power management (e.g. power grids unavailability).

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 0.56% (see Figure-5). 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.

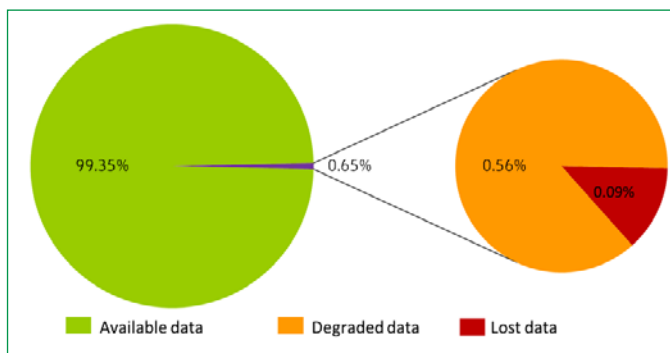


Figure 5: SMOS mission data availability percentage since May 2010. Instrument data availability is extremely high, about 99%. Only 0.09% of data is lost due to MIRAS anomalies. Credit: SMOS FOS/ESA

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 (albedo, 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-6 and Figure-7.

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 $\pm 10K$). 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).

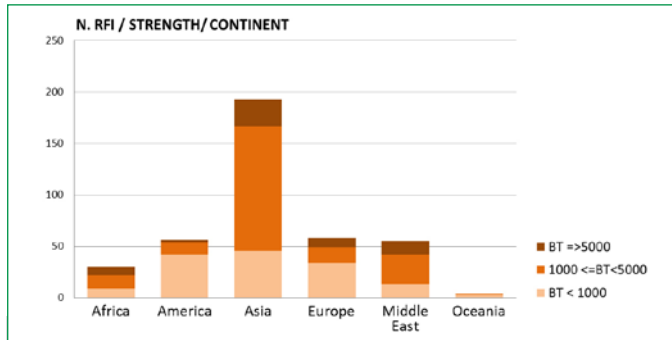


Figure 6: Worldwide number of active RFI sources per continent and intensity. Credit: SMOS RFI team at ESA ESAC

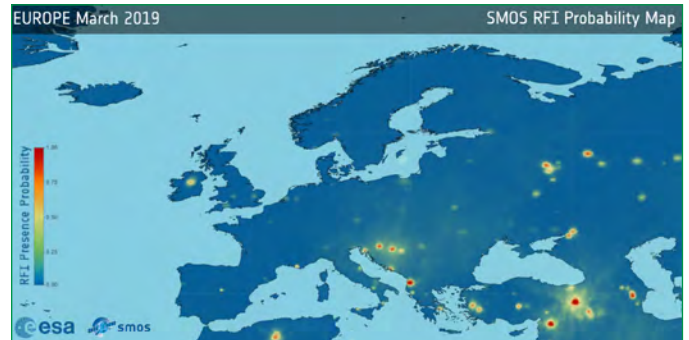


Figure 7: Map of Europe showing the probability of SMOS persistent RFI occurrences during March 2019. Credit: SMOS RFI team at ESA ESAC

Upcoming Meetings & Announcements

OceanObs'19 Conference

The conference will take place in Hawaii Convention Center, Honolulu, HI, USA on 16–20 September 2019. OceanObs'19 will strive to improve the governance of a global ocean observing system, including advocacy, funding, and alignment with best practices and to designate responsibility for product definition, including production and timely delivery at the appropriate scales (global, basin, regional, national) to serve user needs. Poster submission deadline is 27 June 2019. For poster submission, registration and further information please visit: <http://www.oceanobs19.net>.



RFI 2019 Workshop

The workshop will take place at CLS (Collect Localisation Satellites) in Ramonville Saint-Agne, Toulouse, France on 23 – 26 September 2019. RFI 2019 workshop will once again provide an opportunity for the scientific community such as radio astronomy, microwave remote sensing of the Earth and space weather applications, affected by Radio Frequency Interference (RFI) to meet, report and discuss recent

achievements and developments in instrumentation, methodology, and applications in tackling this problem. Abstract submission deadline is 31 May 2019. For abstract submission, registration and further information please visit: <http://www.rfi2019.org>.



World soils user consultation meeting

The world soil user consultation meeting will take place at ESA-ESRIN (Frascati, Italy) on 2–3 July 2019. The consultation meeting aims to bring together stakeholders from the policy and user domain with remote sensing experts to discuss the necessary steps to develop a space-based Earth Observation (EO) tools for mapping and monitoring soils. Abstract submission deadline is 31 May 2019. For abstract submission, registration and further information please visit: <http://worldsoils2019.esa.int/index.php>.



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://eportal.eumetsat.int/userMgmt>) Earth Observation Portal.

The screenshot shows the ESA SMOS Online Dissemination Service interface. At the top, there is a navigation bar with the ESA logo, the text 'ESA SMOS Online Dissemination', and 'European Space Agency'. Below this, there are links for 'Help | SMOS Mission' and 'Not signed in'. On the right side of the navigation bar, there are buttons for 'Collections' and 'Login'. The main content area is titled 'Welcome to the ESA SMOS Online Dissemination Service' and features the SMOS logo. The text below the logo states: 'This service provides free access to all SMOS Level 1 and Level 2 Science and NRT data, to some auxiliary data products and to daily L3C Sea Ice Thickness organized by collections.' It also mentions that operational and reprocessed science products can be searched and browsed following guidelines in the 'Help Page'. For downloading products, it instructs users to login with their own ESA EO-SSO account or follow instructions for creating one. More information on data products and their specifications is available on the 'ESA Earth Online website'. The 'Web Access' section explains that users can search and browse SMOS products openly from the 'Collections' button, but they need to be logged in with their SSO account to download files. The 'Catalogue' allows for data navigation and selection by data type, acquisition date, geographical area, and file format. For more details, it refers to the on-line 'Help Page'. The 'FTP Access' section is also present but its content is not fully visible in the screenshot.

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

