Read-me-first note for the release of the SMOS Level 1 Brightness Temperature data products	
Processor version	Level 1C V5.05
Release date by ESA	28 January 2013
Authors	SMOS Calibration team and Expert Support Laboratory Level 1
Further information	Details on the processing algorithms can be found in the Algorithm Theoretical Baseline Document (ATBD, version 2.10), and on the L1 products structure in the SMOS Level 1 and Auxiliary Data Products Specifications (SO-TN-IDR-GS-0005, Issue 5.21, May 20, 2011), available from ESA http://earth.esa.int/smos
Contact for helpline	For all issues related to data access, formats and read/write, processors contact ESA's HelpDesk on eohelp@eo.esa.int .

1. Introduction

We would like to make you aware of a minor update to the previously available data set.

The V5.05 of the Level 1 Operational Processor (L1OP) which has been in operation since 21 March 2012 in the ESA ground segment, corrects an anomaly that was found in the L1OP V5.04 which affects all the level 1C Sea data above 72º latitude North and South. Further details on the anomaly were given in the previous release note dated 21 March 2012 and available here:
https://earth.esa.int/c/document_library/get_file?folderId=127856&name=DLFE-1513.pdf

In summary the reprocessed data are for the following periods and data types:

- V5.04 of the level 1C reprocessed data set (SM_REPR data type) from 12 January 2010 to 22 December 2011 has been re-processed with the V5.05 of the Level 1 Operational Processor (L1OP);
- V5.04 of the level 1C operational data set (SM_OPER data type) from 23 December 2011 to 21 March 2012 has been re-generated with the V5.05 of the Level 1 Operational Processor (L1OP);

This anomaly only affects users basing their research on level 1C data to study sea-ice conditions and users retrieving salinity over the Arctic Sea in the areas above 72º latitude North and South. Those users should now use level 1C data from newly reprocessed level 1C data of data processor version V5.05 (i.e. this announcement) for their studies.

The following sections describe the MIRAS instrument configuration, the adopted calibration baseline for both SM_REPR and SM_OPER data type and the

improvements and known limitations in the quality of the SMOS Level 1C data products generated by V5.05 of the Level 1 Operational Processor (L1OP).

Users are also invited to consult the SMOS QC monthly report to stay up-to-date on the SMOS data quality. The reports are available on https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/content?p_r_p_564233524_assetIdentifier=data-quality-7059

2. Instrument configuration

To date, MIRAS has been in two different configurations due to an on-board anomaly in one segment of Arm B.

Therefore, the instrument configuration has been:

- arm A on the nominal side and arm B and C on the redundant side from January 11, 2010 until January 12, 2011;
- arm A and arm B on the nominal side and arm C on the redundant side from January 12, 2011, onwards.

To take into account the change in the instrument configuration, several auxiliary data files and new calibration files have been introduced for this mission reprocessing to take into account the instrument configuration transition in order to have stable results throughout this instrument anomaly.

3. Processor version and calibration baseline

The data has been processed with the operational processor L1OP V5.04, with the following agreements for calibration activities:

Please note the differences in calibration approaches for the data being continuously provided by the operations processing chain and the reprocessed data set

3.1 Operations Processing Chain Calibration

The data provided by the operations processing chain (with filename "SM_OPER") have been processed with the following agreements for calibration activities:

a) Noise Injection Radiometer (NIR) calibrations are acquired, in general, every two weeks and calibrate the absolute measurements of the instrument. They are applied for data calibration as soon as they are generated in the ground segment.

b) Power Measurement System (PMS) Gain calibrations are acquired, in general, every 2 months according to the routine calibration plan. They are applied for data calibration as soon as they are generated in the ground segment.

c) PMS Offset calibrations are acquired together with the PMS Gain calibration every 2 months, but since March 24th, 2011, they are also refreshed every week since the

PMS Offset was observed to be less stable than first predicted. They are applied for data calibration as soon as they are generated in the ground segment.

d) Visibility offset calibrations are acquired together with the PMS Gain Calibrations, every 2 months. They are applied for data calibration as soon as they are generated in the ground segment.

e) Local-Oscillator calibrations are acquired every 10 minutes to update the phase of the Fringe Washing Function at the origin FWF(0), and are performed according to the routine calibration plan. They are applied for data calibration as soon as they are generated in the ground segment.

f) A fixed calibration baseline from 2 February 2010 is used for the instrument response function (G/J matrix).

g) A Flat Target Correction (FTT) is acquired roughly every six months. This calibration is applied on the operational data after analysis by the calibration team and consultation with the L2 Expert Support Laboratories.

3.2 Reprocessed Data Set Calibration

The calibration of the data for the reprocessing campaign (with filename "SM_REPR") is implemented by the following activities:

a) Noise Injection Radiometer (NIR) calibrations are acquired, in general, every two weeks and calibrate the absolute measurements of the instrument.
They are applied to the closest-in-time measurements.

b) Power Measurement System (PMS) Gain calibrations are acquired, in general, every 2 months according to the routine calibration plan. They are applied to the nearest in the future measurements.

c) PMS Offset calibrations are acquired together with the PMS Gain calibration every 2 months, but since March 24th, 2011, they are also refreshed every week since the PMS Offset was observed to be less stable than first predicted. They are applied to the nearest in the future measurements.

d) Visibility offset calibrations are acquired together with the PMS Gain Calibrations, every 2 months. They are applied to the closest-in-time measurements.

e) Local-Oscillator calibrations are acquired every 10 minutes to update the phase of the Fringe Washing Function at the origin FWF(0), and are performed according to the routine calibration plan. The FWF(0) phase is interpolated over the measurements times and applied for data calibration.

f) Using a fixed calibration baseline for the instrument response function (G/J matrix) calibrated on 2 February 2010.

g) Using a fixed calibration baseline for the Flat Target Correction (FTT) since May 1st, 2010; but updating twice this correction to mitigate a transitory problem observed in the instrument at the beginning of the Mission. These two other updates were applied at the beginning of the Reprocessing data, and in March 16th, 2010.

4. Caveats

The main known limitations that affect the presently available Level 1 data product are:

a) Fixed Spatial bias:
The snapshot images at L1 are affected by a fixed spatial bias that scales with Brightness Temperature. The RMS of this spatial bias is 2.8 K over the ocean, and 5.6 K over Land/Ice regions.
This problem is corrected for the ocean scenes in a pre-processor stage of the L2 OS.

b) Flat Target drift
A transitory period in the instrument was observed that affected data from March 2010 until May 2010.

The consequence of this problem affects the stability of the image depending on its distribution within the snapshot. In the alias-free field of view, the stability of the image can account for up to 1-2 K throughout this period in horizontal and vertical polarisation, the fluctuations in each polarisation being slightly different. In the extended field of view region this drift can account to up to 4 K in the opposite direction to the drift in the alias-free region. The corresponding drift in Stokes 3 is less than 2 K in the alias-free field of view, and smaller than 0.6 K in Stokes 4.

After this transition period, the instrument has been stable.

c) Residual land-sea contamination
Land-sea contamination refers to an unexpected increase or decrease of Brightness Temperature observed in the coastal area around continental masses. Although this problem has been greatly mitigated with respect to the previous processor version (V346), a residual effect is still observed in certain areas with an amplitude of about 1-1.5 K in horizontal and vertical polarisation, and in Stokes 3 and 4.

d) Residual Seasonal variations
The NIR, and to a lesser extent the LICEF receivers, are affected by a seasonal variation due to the change of the antenna patch temperature through the year. A new antenna model was incorporated in the processing to account for these variations, but a residual variation is still observed. The amplitude of this residual seasonal variation has been observed to be less than 1 K.

e) Residual Short-term drift
The NIR and LICEF measurements that provide the absolute level of the brightness temperature in the scene are affected by an orbital variation due to the evolution of the antenna patch temperature around the orbit. This variation was incorporated in the antenna model used by the L1OP V5.04 and V5.05. The residual amplitude observed

due to these orbital variations does not exceed 0.4 K (average value between horizontal and vertical polarisation) between descending and ascending passes.

In addition, a similar short term drift in Stokes 4 is observed only in descending passes. Variations observed in Stokes 1 were correlated to the antenna temperature, but the Stokes 4 signal follows the Total Electron Content (TEC) measurements of the atmosphere. It could be related to signal leakage between cross-polar antenna patterns which it has not been possible to fully correct. The amplitude of this orbital variation in Stokes 4 may reach up to 2-3 K (maximum average value of different incidence angles in one single grid-point) during the periods with highest TEC signal.

f) Radio Frequency Interference (RFI)
RFI affects both land and ocean data. Some very strong sources have been observed to affect data up to 3000 km away from the position of the interfering antenna through the secondary lobes. Pixels suspected to be affected by RFI are flagged. Although the flagging has been greatly improved with respect to previous versions, it does not prevent the possibility of RFI that is present but not detected and flagged.

g) L1c pixel consolidation
Due to a consolidation problem in the L0 data, the consolidation of the measurements at Discrete Ground Grid pixels in the L1c product is not performed as described in the L1 Product Specification. In particular, users could find the same pixel delivered in two different files, with an incomplete number of measurements for one of the cases. The "duplicated" pixels are located in the polar regions.

h) *L1c Sun glint flag*
Due to a software anomaly in the L1OP V5.04 and V5.05 processor, the Sun Glint Flag available in the L1c Product is not correctly set. This flag aims to indicate measurements affected by Sun glint over ocean. The major impact of this anomaly is on the users who are using L1c data to retrieve Sea Surface Salinity. Those users need to discard the information provided by the Sun glint flag in their retrieval algorithms. This anomaly does not impact the ESA Level 2 Ocean salinity product because the Sun glint flag from L1c input data is not used by the retrieval algorithm. Information on Sun glint are directly computed by the L2 processor and used for the retrieval of the Sea Surface Salinity.

5. Data Quality Information

The information relative to the data quality is provided in the product following the L1OP Product Quality Flag definition (XSMS-GSEG-EOPG-TN-08-0016) document as:

- A summary flag in the header of the products
- Various quality flags per data set records (snapshot) in the binary part of the product to be used to filter degraded measurements.

One of the most common degradation in the data is the saturated NIR measurements due to RFI. This degradation is tracked at the level of data set record (snapshot) in the quality flag: *Instrument_error_flag*