



MISSION EXPERTS DIVISION (EOP-SM)  
DIRECTORATE OF EARTH OBSERVATION PROGRAMMES

<b>Date</b>	<b>reference</b>	<b>number of pages</b>
30 January 2006	EOP-SM/1423/MB-dr	Page 1 of 16
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<b>c.c.:</b>	ESRIN: V. Liebig (D/EOP), S. Briggs (EOP-S), W. Lengert (EOP-GM), J. Benveniste (EOP-SER), N. Wright (EOP-GDM), R. Crapolicchio  ESTEC: R. Zobl (EOP-P), E.A. Herland (EOP-SM), M. Rast (EOP-SML), E. Attema (EOP-PW), N. Floury (TEC-EEP), P. Wursteisen (EOP-SMS), M. Martin-Neira (TEC-ETP), P. Baptista (TEC-SN), H. Rebhan (EOP-SMO), A. Hahne (EOP-PS), M. Drinkwater (EOP-SMO), S. Delwart (EOP-PEL), M. Zundo (EOP-PEP), C. Garrido (EOP-PE), J.-P. Huot (TEC-EES), P. V. Oevelen (EOP-SML)	
<b>Subject:</b>	<b>Minutes of the 18<sup>th</sup> SMOS SAG Meeting held at ESA-ESTEC, Noordwijk, The Netherlands, 10-11 October 2005</b>	

Dear Colleague,

Enclosed you will find the minutes of the eighteenth SMOS SAG meeting held at ESA-ESTEC, Noordwijk, The Netherlands, on 10 and 11 October 2005. Please note that this document including viewgraphs used during the meeting is available for downloading on the SMOS SAG ftp server.

The next SAG meeting is scheduled for 18 & 19 May 2006, consecutive to the 6<sup>th</sup> SMOS Workshop, hosted by the TUD, Copenhagen, Denmark. The main objectives will be to review the SMOS cal/val plan, and to discuss the outcome of the WS. It is also expected that first validation results based on coSMOS data will be available at this time.

In case you have additional topics please inform me in-time.

For the time being I would like to remind you to complete agreed actions in particular actions related to the ATBD, as the ESLs need to finalise the retrieval scheme in short time.

Remains to wish you and your families a Healthy, Happy and Prosperous New Year.

Yours sincerely,

Dr. M. Berger  
Land/Surfaces Unit  
Mission Experts Division

**MINUTES OF THE  
EIGHTEENTH  
SOIL MOISTURE AND OCEAN SALINITY (SMOS) MISSION  
SCIENCE ADVISORY GROUP MEETING**

**10 & 11 October 2005**

**ESA ESTEC, Noordwijk, The Netherlands**

**Participants**

- SAG:** Y. Kerr (YK), J. Font (JF), P. Waldteufel (PhW), M. Peichl (MP), N. Skou (NS), E. Anterrieu (ErA), N. Reul (NR), G. Lagerloef (GL), W. Wagner (WW),
- Excused:** C. Mätzler (CM), M. Drusch (MDr), B. vd. Hurk (BvdH), I. Corbella (IC), J. Grandell (JG), A. vd. Griend (AvdG), D. Stammer (DS), P.Y. LeTraon (PYT), T. Jackson (TJ), D. LeVine (DLV)
- ESA:** A. Hahne (AH), P. Wursteisen (PW), M. Zundo (MZ), S. Delwart (SD), N. Wright (NW), J. Benveniste (JB), H. Rebhan (HR), M. Drinkwater (MD), M. Martin-Neira (MMN), N. Floury (NF), M. Berger (MB)
- Guests:** G. Macelloni, F. Cabot

***List of Recommendations:***

No :	Description/description
R18.1	<i>Substituting R17.1: The SAG recommends to include surface brightness temperature at one angle (browse product) in the L2 products list.</i>
R18.2	<i>The SAG recommends that the Cal/Val teams have access to the prototype processor to access intermediate products/files.</i>

***List of Actions:***

description/description	action/action	due date/date butoir
to provide comments on the SM ATBD as presented by YK	18.1: to SAG and in particular to TJ, AvG, MDr, JG, WW, BdH, CM	end Oct
to provide comments on the OS ATBD as presented by JF	18.2: to SAG and in particular to NS, DS, PYL, DIV, GL	end Oct
to draft requirements for a SMOS toolbox and circulate it to the SAG for further comments	18.3: JB	end Nov
to elaborate the list of measurement requirements for the SM validation	18.4: YK	10 Nov
to elaborate the list of measurement requirements for the OS validation	18.5:JF	10 Nov
to circulate the list to the SAG for further comments	18.6: SD	10 Nov

**1. Welcome and Introduction – Objectives of the Meeting – Approval of Draft Agenda**

MB, YK and JF welcomed the SAG to their 18<sup>th</sup> meeting. Unfortunately many SAG members could not attend the meeting because of other commitments. The importance of SAG meetings for the mission implementation was emphasised again.

Objectives of the meeting were:

- to update the group on the status of the project and the ground segment development,
- to discuss the SMOS product refinements,
- to review the current versions of the ATBDs,
- to report on the preparations of the coSMOS campaign.

The draft agenda was agreed and is attached below. Due to the absence of key SAG members involved in OS, the discussion of the OS assimilation was postponed to the next meeting.

## 2. *Actions from the Last Meeting*

Actions from the last meeting were reviewed and their status updated:

description/description	action/action	due date/date butoir
<del>to distribute the technical note describing the Flat Target Transformation Technique</del>	<del>17.1: MMN</del>	<del>June</del>
<del>to distribute draft ATBDs/VGs as presented by the L2 prototype team</del>	<del>17.2: MB</del>	<del>10 April</del>
to provide comments on the retrieval concept as presented by the OS L2 prototype team	17.3: NS, DS, PYL, DIV, GL	20 April
to provide comments on the draft ATBDs as presented by the SM L2 prototype team	17.4: TJ, AvG, MDr, JG, WW, BdH, CM	20 April
<del>to review the dielectric constant product as presented by PhW and to provide comments on its usefulness</del>	<del>17.5: SAG</del>	<del>20 April</del>
<del>to check accessibility of NREN and GEANT backbone network</del>	<del>17.6: SAG</del>	<del>Mai</del>
<del>to generate a table summarising the baselines of the different SMOS products and to distribute it together with the detailed product definition document to the SAG</del>	<del>17.7: MB, MZ</del>	<del>15 April</del>
<del>to provide feedback on the Level-1c/Level-2 multiangular Tb product (see also recommendation 14.1)</del>	<del>17.8: SAG</del>	<del>20 April</del>
SMOS Science Report (SSR): to fulfil actions as defined at the 16th SMOS SAG meeting	17.9: all	22 May
<del>to contact the HYDROS team to find out the status of the prep activities for the next joint WS</del>	<del>17.10: YK</del>	<del>August</del>

### *Remarks:*

**Action 17.3 and 17.4:** inputs to the draft ATBDs are requested -> see action 18.1 and 18.2

**Action 17.9:** SMOS Science Report (SSR) -> The SMOS Project Team was asked to fulfil their actions related to the SMOS Science Report.

### **3. *Project Status, Issues for the Upcoming CDR***

AH reported that the structural and thermal model qualification programme was recently completed. All mechanical tests went very well. Thermal test results are still under evaluation. A detailed review of the test results will be performed at the CDR scheduled for October to beginning of December.

AH informed the group that the production of the flight model subsystems is at full swing. Open issues include parts of the optical harness and some internal communication problems between the optical receivers and the correlator-board. Further, the oscillator of the X-band transmitter needs to be replaced which already has been ordered.

The antenna measurement campaign at TUD is under preparation. The first antenna arm will be shipped end of October. An impressive picture of the anechoic chamber at TUD was shown to the SAG. All three antenna arms will be measured individually and also the hub with the inner antenna arm segments attached will be measured. It is planned to commence this testing by June 2006.

Concerning the bus AH reported that the recurrent PROTEUS platform assembly is planned to commence in January 2006. Merging of the platform and the payload is scheduled for December 2006 followed by the satellite test programme. Flight acceptance review is planned for July 2007. The current planning foresees a launch on 19 September 2007.

AH further reported on the status of the ground segment development. The activities related to the flight operations segment have started including ESA elements for mission planning and payload commanding. Furthermore, core activities for the data processing ground segment have started. Concerning the ground segment L1 and L2 prototype processor development see point 5.

Furthermore, the group was informed of the outcome of the cal/val AO. Out of 38 proposals 37 were accepted. The proposals reflect a wide international distribution and close links to the Hydros and Acquarius activities. Basically all items addressed in the call were covered by the proposals. The proposals cover a large variety of methods spanning from ground truth, airborne and inter-comparison experiments with complimentary satellite systems. Currently a Cal/Val plan is being drafted which will be finalised after the first SVRT meeting planned for end of November in Avila, Spain.

It was stressed that ESA unfortunately is not able to financially support all cal/val activities, however, ESA member state delegates were informed and encouraged to support proposals through their national programmes.

#### **4. *Aquarius and Hydros: Status Report***

GL reported on the status of the US Aquarius mission and informed the group that the Mission Confirmation Review was approved in September. With this approval Aquarius will now enter into the implementation phase. The CDR is planned to take place in the second half of 2006. Launch date is currently scheduled for March 2009.

In the presentation outlining the different mission elements, GL stressed that cooperation with SMOS in particular for validation activities would be very viable for both missions.

He also addressed requirements changes which were introduced during the risk mitigation phase. These include the salinity accuracy which is now defined as 0.2 psu global rms error. The spatial resolution was degraded from 100 to 150 km. As indicated by impact analysis, both changes should not have any impact on the science return of the mission. The adopted scientific requirements led to a range of changes of the instrument design which are summarised in the viewgraphs attached to the minutes (downloadable version only).

GL also informed the group that an US CLIVAR salinity working group to evaluate the role of salinity in climate was established. The next Aquarius/SAC-D meeting is likely to take place back-to-back with the CLIVAR SWG workshop on 8-12 May 2006. He also informed the SAG that NASA plans to issue an AO for an Ocean Salinity Science Team in 2007 with selections made one year prior to the launch.

#### **5. *SMOS Ground Segment Development***

MZ, SD, YK and JF reported on the status of the L1 and L2 prototype processor activities.

MZ informed that the SMOS products have been further refined (see viewgraphs). The SMOS products are outlined in detail in the SMOS Product Definition Baseline document (SO-TN-ESA-1250 – Issue 1.6). Major changes after the CDR refer to the L1b product which now only contains brightness temperature Fourier components and no spatial information.

MZ further reported that L1 prototype activities are subdivided into three main phases, the feasibility and preparation phase (Phase-1) which is already completed, the data and algorithm definition phase (Phase-2) including the prototype processor implementation, which is currently on-going and the scientific test bench including support to the operational processor development (Phase-3). Phase 3 is planned to start in January 2006.

SD reported on the status of the soil moisture and ocean salinity L2 prototype processor development. Both activities completed successfully the system requirement review. Open issues include the efficient computation of the weighting function for disaggregating, an efficient computation of the galactic glint and for ocean salinity the baseline definition of the different products.

YK presented the current outline of the soil moisture retrieval scheme. Pre-processing includes re-sampling of auxiliary data (Ecoclimap, ECMWF, FAO Soil maps...) to the SMOS ISEA grid. A decision tree is used to select main cover fractions within the SMOS pixels and to select appropriate sub-models and their parameterisation. The retrieval itself is based on an iterative forward model which is stopped as soon as convergence is reached. Post-processing includes the computation of posterior variances and a re-modelled brightness temperature at one angle (42.5 deg). SMOS data products will be accompanied by a data analysis report including flags, as well as a processing and confidence descriptor. In all cases the dielectric constant will be computed. Current issues followed by the study team are related to mixed pixels and their element parameterisation in particular to water and their variability (e.g. rivers, ponds, floods, and their seasonal effects), snow and ice (also sea ice), dew, litter and water interception, topography, galactic, Sun and RFI. Furthermore, ECMWF fields are analysed for their quality/compatibility and adequacy. In order to parameterise the retrieval the soil moisture validation activities are considered essential which rely on well-equipped sites within various eco-climatic zones.

In the discussion it was noted that the retrieval scheme for soil moisture as currently implemented looks rather complex. It heavily relies on the decision tree and the accuracies provided by the auxiliary data sets. The question was raised whether a simpler retrieval concept based on a statistical approach should be followed in parallel (see minutes of the 17<sup>th</sup> meeting: EOP-SM-SMOS-SAG-MIN-0017).

**WW argued that there is a mismatch between the complexity of physical models used for the SMOS retrieval and the number of independent observations provided by SMOS. He also expressed concerns related to the appropriateness of satellite-derived LAI and ECMWF soil temperature fields as additional input parameters.**

YK responded that if such a simple and robust algorithm could be provided in a timely fashion then the SM ESL are prepared to implement it into the SM processor. He further noted that some of the sub-models used in the current retrieval approach are based on empirical relationships. They would need to be parameterised once the mission is in orbit. Additional statistical approaches may not bring any advantages. MB noted that the most critical component is the decision tree which guides but also constrains the freedom of the retrieval. The current design may jeopardise an improvement of the retrieval accuracy by using improved parameterisation from SMOS data itself. This concern was shared by other SAG members, too. YK acknowledges this but emphasises that this 'uncertainty' is intrinsic to SMOS data due to the spatial resolution. There are no other means for the time being than relying on a parameterisation controlled by a decision tree. He further emphasised that the parameterisation is only a first guess which iteratively is being changed within the retrieval. It would be one of the main tasks during the commissioning phase to analyse the retrieval biases for different parameterisations.

At the end of the discussion the SAG was encouraged again to provide feedback to the current retrieval baseline. Since the coding activities would need to start beginning of 2006 there is only little time left to implement changes and therefore the group was asked to respond to the current design as soon as possible.



JF reported on the status of the Ocean Salinity ATBD. In comparison to the SM retrieval the OS retrieval is less complex because of the more homogeneous medium, however because of the low sensitivity, high radiometric accuracy and thus also stringent requirement on the correction schemes is being posed. The processing scheme includes the pre-processing of auxiliary data (SST, wind), several tests for flagging and two retrieval options; a forward model run iteratively and making use of different sub-models for accounting for sea state and foam contributions and a neural network approach. Outputs are SSS, SST, wind and TEC (depending on the model). Issues currently being followed within the ESL include the analysis of the auxiliary data requirements and provision, model selection and parameterisation to correct for perturbing effects. This also includes the testing and tuning of the iterative retrieval making use of different retrieval configurations and scenarios. In parallel the implementation of the neural network approach is being followed. Furthermore, scientific analysis related to the scene dependent bias is being followed. As reported by JF mainly three sources of the scene dependent bias were identified, namely: instrument inaccuracies in the NIR related to thermal noise, offset and linearity error; the inherent difference between the antenna temperature measured by NIR and the average brightness temperature in the alias-free FOV (this error has been found to be more important in inhomogeneous scenes); and residual errors remaining from the Sun correction algorithm.

Since many OS experts could not attend the SAG meeting it was agreed to discuss the current retrieval approach with the community offline.

Also under this agenda point F. Cabot presented an analysis of the impact of the calibration sequences on the science data acquisition and the retrieval accuracies due to the loss of angular information (see viewgraphs for details).

## **6. Studies and Campaigns**

### *OS Synergy Study*

At the time when writing these minutes the study was completed. The final presentations took place at ESTEC on 2 December.

Using the first realistic error statistic for simulated SMOS salinity several assimilation experiments have been conducted to analyse the impact of SMOS salinity for oceanographic models. The results demonstrate the improvements for modelling in the tropic oceans and mid-latitude waters. Combining SMOS with Aquarius data has a rather small effect on improving the modelling based on the current (rather incomplete) knowledge of Aquarius performances and orbit configuration.

The final report will be available in mid December.

### *SM Synergy Study*

MB reported on the status of the SM Synergy study which was kicked-off before the summer break. Task 1 which is related to the analysis of the auxiliary data requirements including potential data sources has been delayed. The technical report summarising the findings of task 1 is expected to be delivered soon. Analysis of alternative soil moisture retrieval approaches based on complementary remote sensing data is on-going. The next progress meeting is planned for end January 2006.

#### *SM Assimilation Study*

SD reported on the status of the ECMWF assimilation study. A preliminary proposal was received. A clarification meeting to discuss open issues is planned for end of October. The study is planned for two years with a kick-off in June 2006.

#### *SMOS Toolbox*

JB outlined to the group what a SMOS toolbox (SUITS – SMOS User Interactive Toolbox Specification) could offer to the science community by presenting examples of the BEST and BEAM toolbox generated for the Envisat ASAR, MERIS and AATSR instruments. He stressed that a SMOS User Toolbox could be used not only to visualise SMOS products but also to compute self-designed variations and enhancements of standard products. It would allow the integration of additional auxiliary and in-situ data which are not used in the standard product. So far groups identified to potentially be interested in a SMOS toolbox are the SMOS SAG and the SMOS Validation and Retrieval Team (SVRT). SUITS would be implemented by a 2-step approach, starting with the consolidation of the user requirements and followed by a detailed design, coding and testing. He stressed, in order to further the idea and in order to have the toolbox available in time for SMOS, it is high-time to start discussing the user requirements. JB was asked to draft a list of requirements and to distribute it to the SAG for further discussions.

#### *CoSMOS-2 Status*

MB, PW and NS presented the status of the coSMOS-2 preparations. MB summarised the background and outlined the scientific justification to piggy-back with the Australian NAFExperiment. The cooperation with NAFE offers the opportunity to have data available in-time for the soil moisture retrieval approach validation and to make use of a well-monitored and equipped site with a guaranteed maintenance up to 2008.

Preliminary analysis in preparation of the campaign revealed that the site is very suitable for the original CoSMOS objectives. RFI analysis based on AMSR-E data showed no concerns. MB also outlined the specific experiments which are planned for the campaign. These include special flights for analysing the root zone soil moisture assimilation approach, the brightness

temperature characterisation in preparation for SMOS validation activities, the effect of sunglint and water intercepted by vegetation and dew effects.

PW presented to the group the status of the campaign implementation and NS outlined the status of the instrument preparation, including aircraft modifications. It was reported that certification flights are scheduled for 17 and 18 October and the campaign start is likely being delayed by one week.

### *CoSMOS-OS*

Since an OS component had to be dropped for the CoSMOS-2 experiment, different alternative options for a CoSMOS-OS campaign were discussed. JF and NS outlined the open scientific issues which need to be addressed with priority. This includes roughness and wind dependence analysis under different wind conditions, validation of the galactic radiation correction scheme including the bistatic scattering problem which is also important to correct for the sun- and moon-glint, as well as the 'wiggles' effect which is still not understood.

In the discussion it was stated that it is essential to acquire data at well-monitored sites. If feasible several buoys should be deployed. Measurements from ships should be performed parallel to the over-flights. Due to cost reasons piggy packing on routine measurement operations from ships should be analysed. Furthermore, it was stressed that a CoSMOS-OS campaign needs to deploy an aircraft radiometer together with an instrument suited to quantify the roughness effect. This could be a scatterometer preferably operating at L-band or a GPS reflectometry (PARIS concept). Since the Skyvan would be available for the envisaged timeframe (spring 2006) a campaign together with the HUT-2D and the refurbished EMIRAD, flying together with GPS reflectometry receivers has been favoured by the SAG.

### *DOMEX Results*

G. Macelloni presented preliminary results of the DOMEX campaign. The SAG was also invited to the final presentations which were organised for the day following the SAG meeting.

In summary the first L-band emission data acquired in Antarctica revealed a good temporal stability at a monthly scale, both at L- and C-band. Accompanying snow measurements confirmed the spatial homogeneity of the site. A good agreement of ground data with AMSR-E data was found. Brightness temperature fluctuations as observed were related to system temperature variations and partially could be corrected for by post-processing.

A DOMEX follow-on activity should extend the sampling period and also look into the spatial variability of the site. An improved instrument covering L-, C- and Ku-band with improved thermal stability operated with varying incidence angles for the duration of the Antarctic summer in addition to a L-band radiometer installed on a flex-mobile (alternatively to an aircraft campaign) in order to cover a spatial extend was proposed in addition to the

deployment of a radiometer on a tower at a fixed incidence angle (e.g. 40 deg) operating during the Antarctic winter. These radiometer measurements should be accompanied by in-situ snow measurements. A possible date of the experiment could be in winter 2007/8 and would offer the 'real-time' comparison with SMOS data as test-bed for a permanent station.

## **7. Cal/Val**

SD outlined the measurement requirements for L2 product validation. The group was asked if additional measurements are considered essential. SD agreed to draft a list for further inputs by the SAG.

## **8. AOB**

### 6<sup>th</sup> SMOS WS

The SAG was informed that due to time constraints the idea to have a joint Aquarius-Hydros-SMOS workshop in 2006 was dropped. It was therefore agreed to organise a SMOS workshop only. NS kindly offered to host the workshop at TUD. 15-17 May 2006 was identified as a suitable timeframe. YK will distribute the announcement in short time.

### SurfSat

JF presented the SurfSat proposal to the SAG as recently forwarded to ESA. A review panel including SMOS SAG members will discuss the scientific value added to the SMOS mission shortly.

### SMOS Poster

JB presented a draft SMOS poster which is in line with the style used for posters of other Earth Explore missions. Minor modifications were proposed.

## **9. Date & Place of Next Meeting**

It was agreed to schedule the 19<sup>th</sup> SMOS SAG meeting consecutive to the 6<sup>th</sup> SMOS WS. The meeting therefore will take place at TUD on 18 and 19 May 2006. The main objectives of this meeting would be to discuss the outcome of the Workshop, the Cal/Val plan, and

OS assimilation. It is also expected that first results of coSMOS-2 will be available by this time.



**18th SMOS SAG Meeting****10 / 11 October 2005****ESA-ESTEC, Noordwijk, The Netherlands****starting 10 October at 10:00, room EINSTEIN****Draft Agenda**

1. Welcome and Introduction - Objectives, approval of the draft agenda
2. Actions from the last meeting
3. Project Status (A. Hahne)
  - Project status report
  - Issues for the upcoming CDR
  - Cal/Val AO results
4. Aquarius and Hydros: Status Report
5. SMOS GS development
  - Level 1 prototype processor development: status report (M. Zundo)
  - Level 2 prototype processor development; status report (S. Delwart)
  - SM ATBD with detailed discussion (Y. Kerr)
  - OS ATBD with detailed discussion (J. Font)
  - Projection issues (Y. Kerr)
  - Impact of calibration periods (F. Cabot)
6. Studies and Campaigns
  - CoSMOS status (M. Berger / P. Wursteisen / N. Skou)
  - CoSMOS-OS ?
  - DOMEX results (G. Marcelloni)
  - Study activities (Synergy Study, Assimilation Study)
  - SMOS toolbox (J. Benveniste)
7. Cal/Val
  - Required measurements for validation (S. Delwart / Y. Kerr / J. Font)
8. AOB
  - Next SMOS WS
9. Date/Place/Objectives of next meetings
  - 19<sup>th</sup> SMOS SAG: combined with next WS (15-19 May 2005)?
  - Cal/Val plan, OS assimilation, CoSMOS first results