SMOS – Mission Status and Cal / Val Experience I

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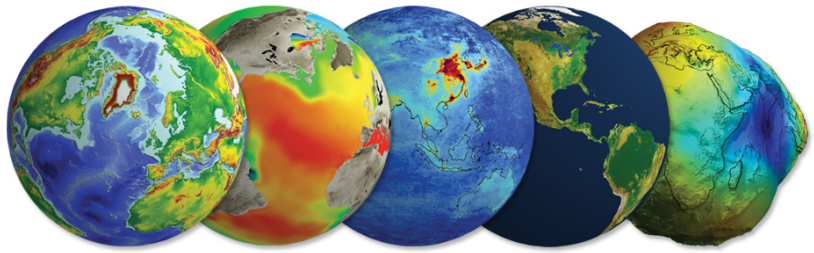
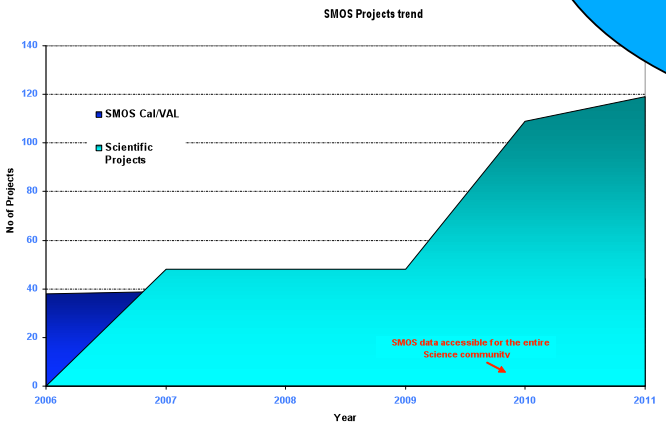


MISSION STATUS AND DATA AVAILABILITY

- **SMOS successfully launched on 2 Nov 2009**
- Commissioning phase of first 6 months successfully completed and SMOS now in routine operations as of May 2011
- Expected life time 3+2 years

- **Level 1 and 2 data products available to science community since July/October 2010**
- First complete reprocessing of SMOS data up to level 2 foreseen for Q4 of 2011
- Data available via subscriptio
  or online via EOLI-SA catalogu



A total of 160 scientists and research groups have presently access to SMOS data, for both cal&val activities and science projects, tendency increasing.

- The **space segment** -payload and platform- is functioning well with minor anomalies
- For example, for April to December 2010 anomalies caused on-board data loss of 0.25% and degraded data of 0.38% lying well within the system performance requirement of 98% for generating observation data
- Calibration activities amount to 1.7 % of the mission time

SMOS operations

= reliable instrument operations
= reliable data processing up to L2/NRT
= data delivery to users in timely fashion

The **ground segment** is acquiring and processing data up to level 2 and providing data in Near-Real Time to ECMWF

A few facts

- No data loss at acquisition
- Level 1 data production successful at 96%, level 2 soil moisture and ocean salinity at 95% and NRT at 97% (April-Dec 2010)
- Delivery of NRT product within 3 hours from sensing improved from 62% for April-Dec 2010 to 87% in Q1/2011
- Data for subscription users available within 1-3 days after sensing

CALIBRATION, VALIDATION AND QUALITY ASSURANCE

Science Objectives
- Improve weather forecasts & operational hydrology
- Contribute to environmental & climate monitoring
- Advance the understanding of the global water cycle

Mission Requirements
Provide surface SM
with *N* % accuracy

System Requirements
Measure TB
with *M* K accuracy

- QA / Data monitoring FG Dep
- Data assimilation AN Dep
- Sensor inter-comparisons
- Sensor inter-calibration
- FCDRs
- New products & QA

- Algorithm tuning
- Product validation
- Level 2 QA
- QA for re-processing

- Instrument calibration
- Level 1 QA

CALIBRATION & VALIDATION ACTIVITIES

1. **Close collaboration with key scientific groups: Expert Support Laboratories (ESL)**

2. **Working with international teams on calibration & validation (approx. 40 PIs) covering a variety of climate zones**

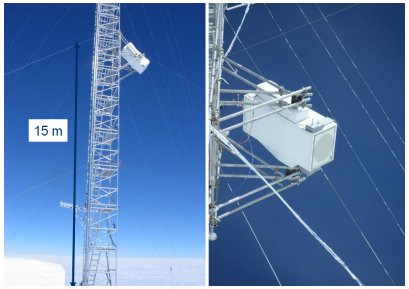
3. **Support core validation sites through**
   - **Operations of three ground-based L-Band radiometers**
   - **Airborne campaigns**

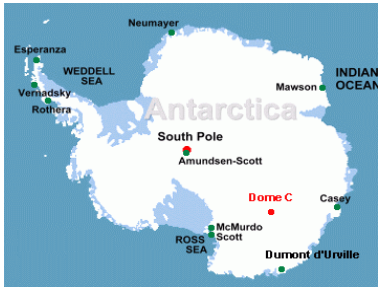
4. **Support ground-based L-Band radiometer measurements at DOME-C in 2010**

5. **Support to international in-situ soil moisture network**

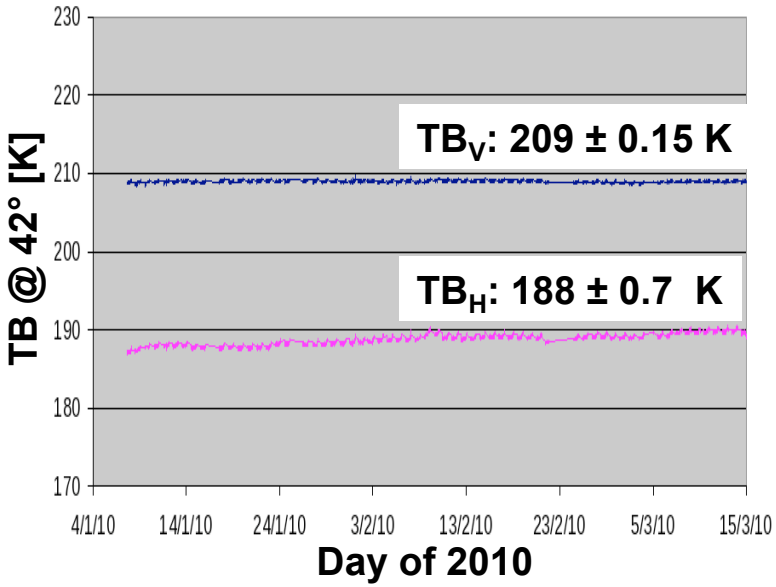
6. **Collaboration with NASA's Aquarius and SMAP teams**

VALIDATION OF BRIGHTNESS TEMPERATURES
LONG-TERM MONITORING

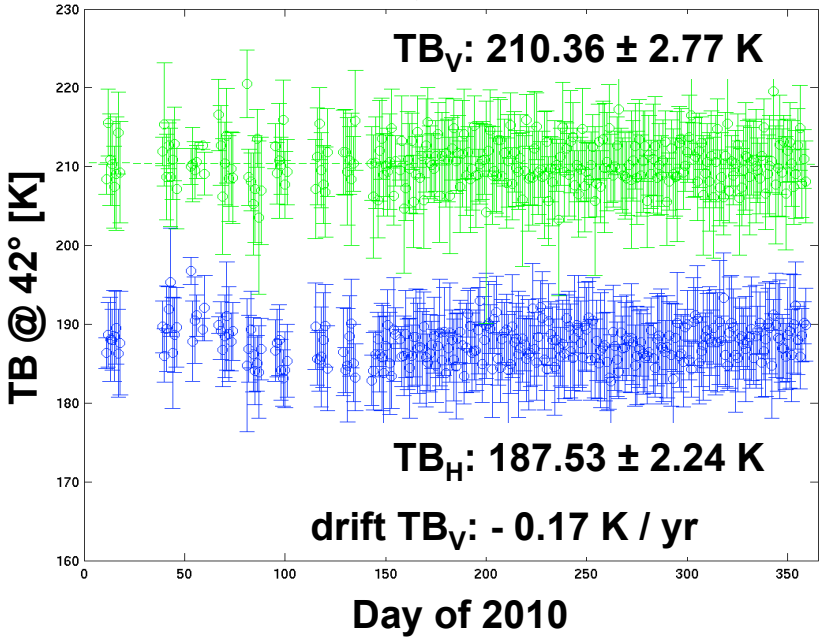




RADOMEX



SMOS



- SMOS TBs compare well with ground-based observations.
- Agreement is within uncertainty estimates.
- DOMEX needed for long term monitoring.

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CONTINUITY - POINTS FOR CONSIDERATION

1. **Concordia Station Steering Committee meets annually in September to decide on project to start Sept + 14 months**

   → long lead times for decision to get access to DOME-C
   → next possibility to submit proposal to Steering Committee is Sept 2011 for access to station in Nov 2012

2. **With this schedule work on RADOMEX needs to start immediately (1-1.5 year prior to shipment), even before approval by Concordia Station Steering Committee**

3. **We need an Italian (or French group) to submit the proposal to the Concordia Station Steering Committee (I/F owned) with letter of support by ESA and NASA**

4. **Funding within ESA: until 2012 funding commitment can be made, beyond 2012 contingent on EOEP-4 subscription**

NEXT STEPS

1. **Agree on NASA-ESA collaboration for DOME-C observations (proposal presented at NASA – ESA bi-lateral)**

2. **Agree on instrumentation to be deployed by ESA and NASA**

3. **Agree on funding horizon + method (in kind contribution) for collaborative project**

4. **Submit proposal to Concordia Station Steering Committee in Sept 2011**

→ NEED TO MOVE FAST!

ONGOING CAL/VAL ACTIVITIES: ELBARA

Sodankyla

1. Site characteristics: Boreal forest

2. Objectives:
   1) Relate the L-band signal to boreal soil parameters.
   2) study the influence of soil free/thaw processes and snow cover on Tb
   3) test if L-band emission is a good indicator of the soil freezing state.

1. PI responsible: Jouni Pulliainen (Jouni.Pulliainen@fmi.fi)

2. Time allocation: From Sept 2009 till December 2011

3. Results so far:
   - Winter: High correlation between Elbara-II signal and soil freezing.
   - Summer: the signal at L-band is strongly correlated with rainfall events and resulting soil moisture.

ONGOING CAL/VAL ACTIVITIES: ELBARA

Valencia

1. Site characteristics: vineyards and bare soil

2. Objectives: To monitor soil moisture and environmental conditions during the validation of SMOS. Objectives not explicitly stated in reporting.

3. PI responsible: Ernesto Lopez-Baeza (Ernesto.Lopez@uv.es)

1. Time allocation: From Sept 2009 till December 2011

2. Results so far: Data processing and analysis carried out by other groups (M. Schwank, J. P. Wigneron, respectively).
   - Changes in SM can be well related to the precipitations (comparisons with retrieved SM with actual measurements of SM is ongoing).
   - Time variations of TAU followed the vegetation time cycle.

ONGOING CAL/VAL ACTIVITIES: ELBARA

Vercors (in the French Alps)

1. Site characteristics: mountainous (~ 1000m a.s.l.), with grassland, crop land cover, coniferous and broadleaf forest. Snow from Dec-Apr.

2. Objectives:
   1) observe correlation between SMOS L-band Tb (30×30 km^2) and L-Band Tb at the 0.1 km^2 scale.
   2) study the effect of heterogeneity of the field of view
   3) study topography effect
   4) analyse the snow effect on the radiometric signal.

3. PI responsible: Thierry Pellarin (thierry.pellarin@ujf-grenoble.fr)

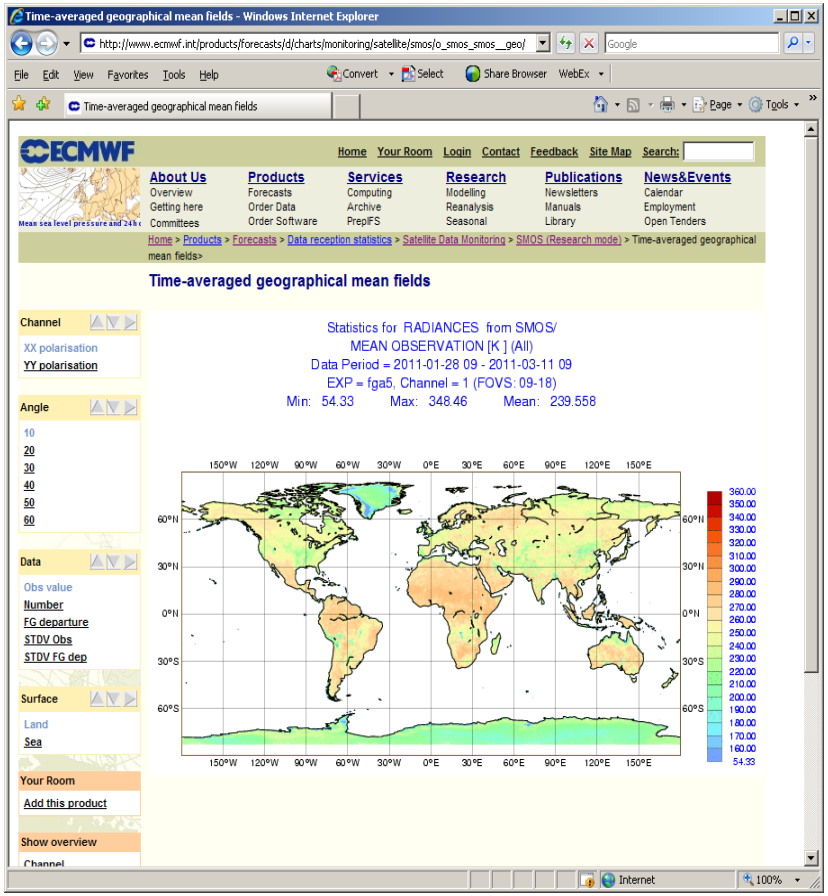
4. Time allocation: Loan agreement signed in Sep 2010, ending in December 2011.

5. Results so far: Still need to install ELBARA at the top of the mountain. It requires the use of an helicopter and to built a platform. They are also testing the possibility to use solar panels for the power supply. If last 2 options fail, they will install ELBARA down the cliff, in the S-band footprint. Installation expected spring 2011.

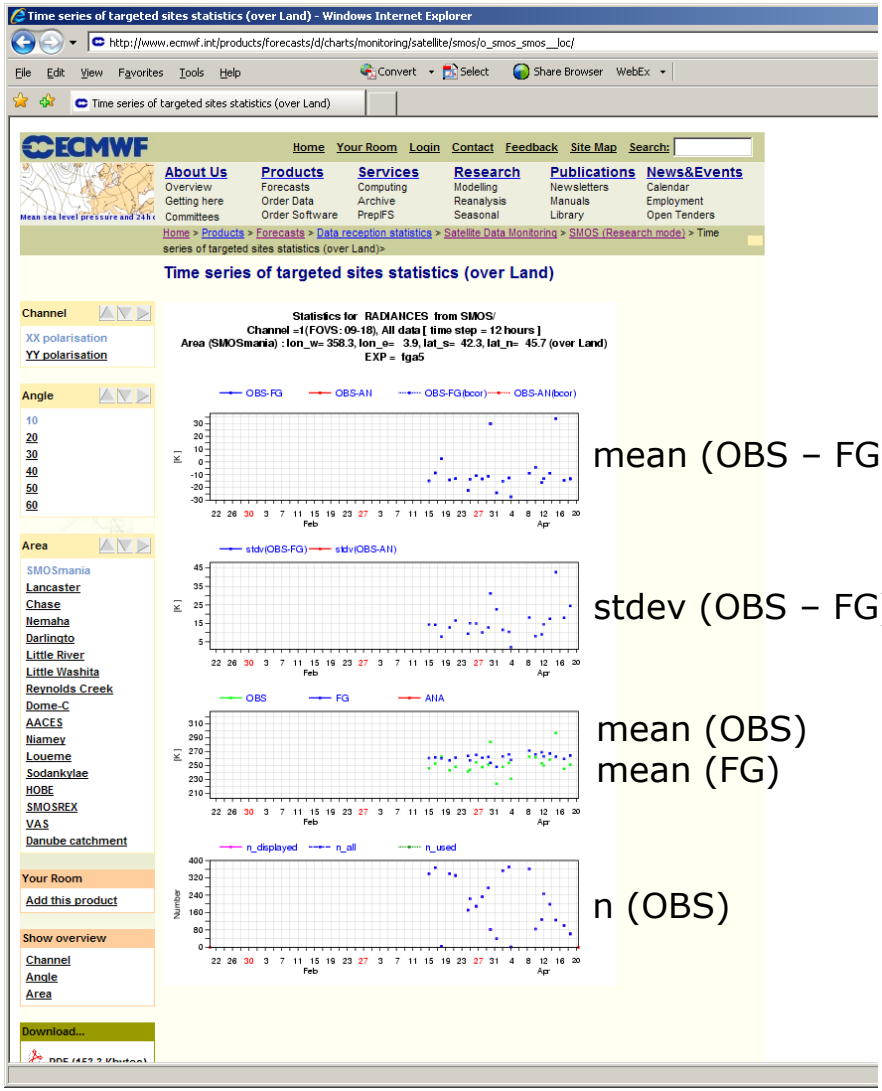
ECMWF study (2007 to 2012)

Objectives:

- Global **monitoring of brightness temperatures** in NRT.
- Data pre-processing and thinning.
- Assimilation of brightness temperatures for the soil moisture analysis.
- Quantification of the data impact on analysed soil moisture and weather forecast skill.



MONITORING FOR TARGETED SITES



mean (OBS – FG)

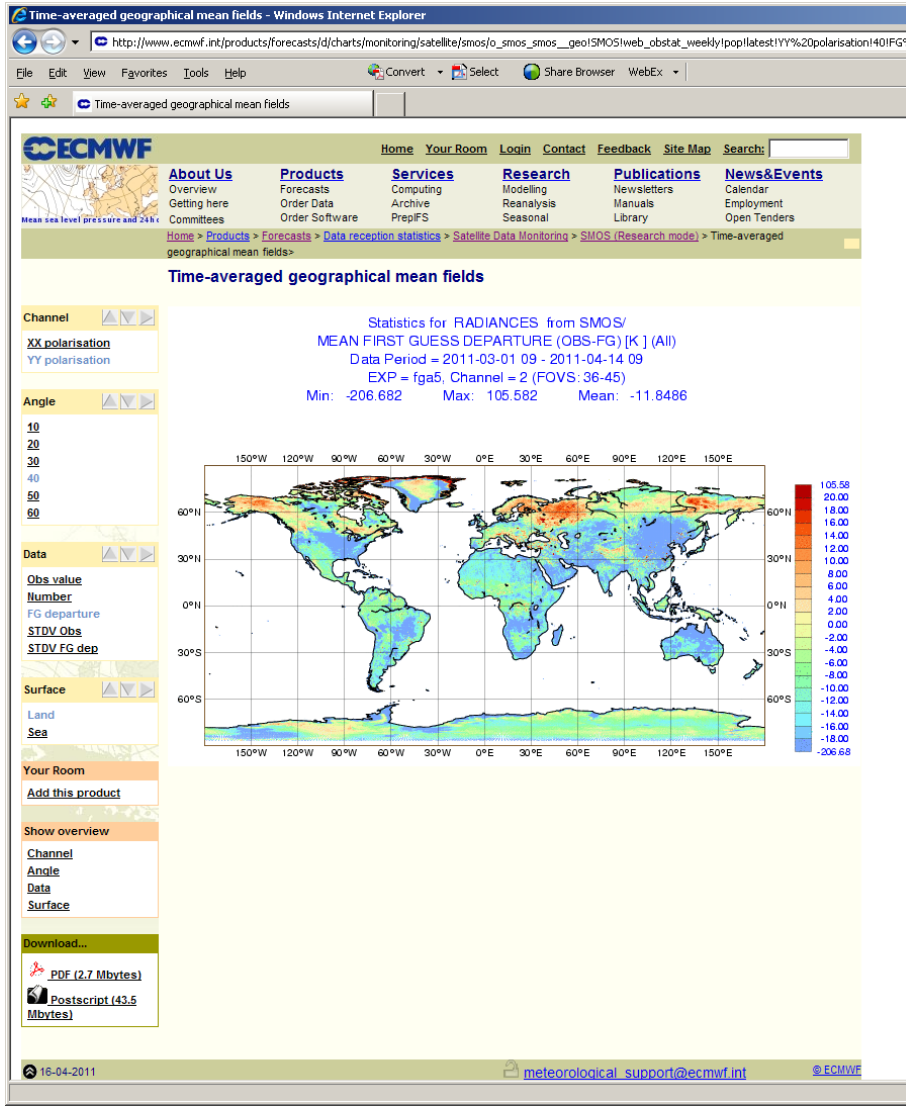
stdev (OBS – FG)

mean (OBS)
mean (FG)

n (OBS)

- Monitoring = Comparisons between modelled TB and observations (over selected sites).
- "Service" for cal / val PIs.
- Useful tool for algorithm development and parameter adjustment.
- Potential extension of "match-up data base" providing in-situ data and the corresponding L2 satellite products.
- Quality control for DA / bias correction schemes.

GLOBAL MONITORING



- Mandatory for data assimilation.
- Important contribution to quality control and product accuracy assessment.
- Intercomparisons of observations from different sensors against a common, consistent, and stable baseline.
- Useful tool for algorithm development and parameter adjustment.

SMOS "spin offs" at ECMWF

1. **Improved land surface hydrology including revised soil map. (H-TESSEL implementation & revision in 11/2010)**

2. **Community Microwave Emission Model (CMEM) addressing emissivities under 19 GHz over land and complementing FASTEM / RTTOVS.**

3. **Improved task scheduling separating the land surface analysis from the atmospheric 4-D var tasks.**

4. **New and flexible Kalman filter based land surface analysis system for the optimized use of satellite observations.**

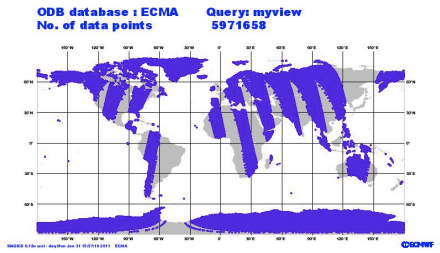
5. **Identified need for "online data pre-processing" rather than having fixed cut-off times.**

6. **Investments in DA need to be accompanied by investments in model developments.**

Integrating new data into operational systems takes time – start as early as you can.

SMOS NRT "light" BUFR product: under development

Scientific Requirements / QWG Recommendations:
- full angular resolution
- no averaging of TBs in the antenna reference frame
- regular grid
- land coverage



ECMWF reduced Gaussian Grid	Number of nodes	% of DGG grid	% of DGG over land (threshold = 50%)
T511	348.528 **(100%)**	**13.3%**	**101.197 (3.9%)**
T799	843.490 **(100%)**	**32.2%**	244.428 **(9.32%)**

Specifications:
- T511 spectral resolution / N265 reduced Gaussian Grid
- land points only
- no interpolation, processor will use a "light" NRT AUX_DGG file
- dissemination through the GTS as half orbit files (< 30 MB)

Summary

1. **DOMEX continuity should to be ensured – preferably through NASA/ESA collaboration. Proposal should be ready by September 2011.**

2. **Airborne campaign to investigate spatial stability over the DOME-C area should be planned (as part of DOMEX?).**

3. **ELBARA loan agreements end in 2011. Locations and research plans could (should) be reviewed based on results and recommendations from the community.**

4. **International Soil Moisture Network has been successful (presentation tomorrow). SMOS and SMAP cal / val sites should continue to share their data. Long-term funding strategy needed.**

5. **Operational monitoring and data assimilation contributes significantly to quality assurance, cal / val and algorithm development. ITT for new study released to address operational hydrology.**

6. **Flexibility for the cal / val activities for potential new products needed (e.g. sea ice thickness and freeze/ thaw).**

THANK YOU

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