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 subscription or online via EOLI-SA catalogue

- 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

- Data available via subscription or online via EOLI-SA catalogue
- 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

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

- 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
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!
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.
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.
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 km²) and L-Band Tb at the 0.1 km² 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

- 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

<table>
<thead>
<tr>
<th>ECMWF reduced Gaussian Grid</th>
<th>Number of nodes</th>
<th>% of DGG grid</th>
<th>% of DGG over land (threshold = 50%)</th>
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</thead>
<tbody>
<tr>
<td>T511</td>
<td>348.528 (100%)</td>
<td>13.3%</td>
<td>101.197 (3.9%)</td>
</tr>
<tr>
<td>T799</td>
<td>843.490 (100%)</td>
<td>32.2%</td>
<td>244.428 (9.32%)</td>
</tr>
</tbody>
</table>

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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