Towards the validation of SMOS ocean surface salinity

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ESA SMOS Cal/Val Proposal 3265

- Submitted 2005

- From an oceanographic user perspective, it is based on 4 components:
  - hydrographic cruise data
  - Argo
  - Surface fluxes climatologies
  - Data-assimilating operational models

- All proposed activities were based on expected SMOS launch end 2007/early 2008

- All funding was still to be secured
Some OS Validation Issues

- Low sensitivity of L-band Tb to SSS, strong sensitivity to roughness
- Synopticity/sampling, biases and random errors
- SMOS single-pass accuracy is \( \sim 1 \) psu; in situ SSS accuracy is typical 0.01 psu or better!
- Instantaneous (L2) match-ups are of little value
- Multi-pass averaging over large boxes for 0.1 psu rms \( \Rightarrow \) OS validation needs L3!
More OS Validation Issues

- In situ datasets
  - Are they good enough (biases, drifts, sensor type)?
  - How representative are point measurements?
  - How to compare in situ, satellite and model data?
  - Vertical salinity gradients?
  - In situ data availability?
  - Data access?
In situ SSS data availability

- TAO, PIRATA arrays
- Argo
  - 3000 floats, 1 float per 3x3 deg box, 10-day profiles
- Hydrographic cruises, Voluntary Observing Ships, underway TSG
- Surface drifters, gliders,...
In situ SSS data access

- Significant improvement in data access over past few years
- e.g. Argo, GODAE, CLIVAR, Coriolis, GOSUD, ICES, NODC, BODC,…
- Many databases already exist!
Comparing models and data

- Operational oceanography in Europe e.g. NCOF, Mersea, MyOcean

- Different models, different resolutions, different assimilation schemes, different input data
Climatologies

- Variability of freshwater flux (E-P) in N. Atlantic & Labrador with NCEP/NCAR, ERA40 and observations

- The greatest contribution of SMOS over the ocean may be to provide a more robust estimate of precipitation!
Climatologies

- The methodology to produce monthly climatologies with meaningful uncertainty estimates already exists!

Berry & Kent, 2009
Current Status

Progress since 2005
NERC EO Mission Support

- UK Natural Environment Research Council award for support to SMOS Cal/Val
- 24 months project, start 1 Oct 2008
- Post-doc starting end April 2009
NERC EO Mission Support

- **Task 1**: to characterise ocean variability in the North Atlantic in preparation for SMOS Cal/Val
  - Pre-launch activities (don’t depend on SMOS data)
  - Identify SSS data, QC assessment, existing climatologies, review scales of variability in SST, SSS, wind & wave conditions in Atlantic, examine/build assimilating model-based climatologies, identify high variability regions, evaluate model/data discrepancies

- **Task 2**: “Real-time” comparisons in situ, model and SMOS
  - Validation of SMOS products (Level 3)
  - Basic checks of spatial gradients, biases, ...
Related activities
1 – HiWASE at Station Mike

- Continuous instrumented deployment on Norwegian Weather Ship Polarfront since 2006
- Funded to continue until Sept 2012
1- HiWASE on Polarfront

Autoflux:
Wind speed, direction, humidity, air temp, atm. CO2, 20Hz continuously

Standard Met:
Met.no (DNMI)

Wavex X-band marine radar:
2D wave spectrum and derived spectral parameters, every 5 min & 32-image sequence every 30 minutes

Shipborne Wave recorder:
Significant wave height, wave period, every 30 minutes

2 Digital cameras:
Photographs of sea surface, fore & beam, every 5 min

ΔpCO2
Bjerknes Centre, Bergen

SSS, SST

Near-real time data on http://www.noc.soton.ac.uk/ooc/CRUises/HiWASE
2- GNSS-R for ocean roughness

- Signals of opportunity from Global Navigation Satellite Systems reflected off the ocean provide useful information on ocean roughness at L-band

- 2003: Proof-of-concept by Surrey Satellite Technology Ltd (SSTL) for measuring mean square slope variance from satellite (Gleason et al., 2005)
2- Directional mss

- 2008: reanalysis of UK-DMC GPS-R datasets using 2D Delay-Doppler maps, to retrieve also direction (Clarizia, M. P., et al., 2009, GRL)

- Current fast-track project to build next-generation spaceborne GNSS-R receiver with SSTL

- Possible space flight in next 2 years
Conclusions

- OS validation is a daunting task
  - L2 will offer only basic checks
  - L3 needed for OS validation, but not in 6 months!

- Huge recent investments in operational oceanography and improvements in data access should make it easier
  - but there is a lot to do and the issues are complex
  - Getting enough of the right people is key!

- Coordination and communication are essential, within SVRT/ESA, but especially with “real” oceanographers and meteorologists!