Recent Advances in the Salinity Retrieval Algorithms for Aquarius and SMAP

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	radiometer center frequency	scan geometry	sampling time for 1 footprint	spatial resolution (half-power footprint)	noise of salinity retrieval (single footprint)	calibration accuracy requirement	sun	reflector	surface roughness correction
Aquarius	1.41 GHz (L-band)	Pushbroom: 3 horns staring at fixed angles.	1.44 sec	100 – 150 km	≈ 0.15 psu	0.1 K	Always looking away from the sun. Minimal sun intrusion.	Not emissive.	Use radar observations, which match radiometer observation in space and time.
SMAP		Full 360° scan: Observes each Earth location fore and aft.	17 msec	40 km	≈ 1.2 psu	1.3 K	Sun intrusion when looking left of forward. Needs to be filtered out.	Emissive (≈1%). Needs to be corrected.	Radar failed in July 2015. Need to use ancillary wind field (WindSat, F17 SSMIS, NCEP) for surface roughness correction.

RSS SMAP Salinity Version 2 Validated Release

Data Access

http://www.remss.com/missions/smap
also available at PO.DAAC salinity site
Release Date: September 13, 2016

Products

1. Level 2.
   - Optimum interpolated onto fixed 0.25° Earth grid.
   - 40 km resolution.
   - Separated into fore and aft look.
   - Keeps track of most swath and pointing variables (incidence angle, azimuth angle, solar angles, orbital position, …).
   - Contains all radiometer measurements and corrections from antenna temperature (TA) to surface brightness temperatures (TB).
   - Contains all ancillary fields used in the algorithm.
   - **Contains quality control (Q/C) flag.**
2. Level 3 8-day running average maps.
   - 0.25° Earth grid.
   - 40 km resolution.
   - Centered on each day of the year.
   - **Contains average land fraction, sea ice fraction and SST for Q/C.**
3. Level 3 monthly average maps.
   - 0.25° Earth grid.
   - 40 km resolution.
   - **Contains average land fraction, sea ice fraction and SST for Q/C.**

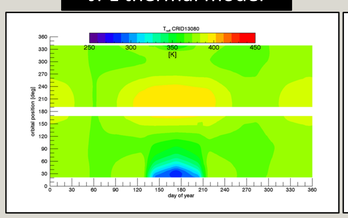
Format

netCDF4
compliant with CF and ACDD

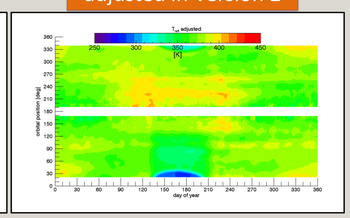
Major Updates from Version 1 (BETA Release)

1. Correction for emissive reflector.
   - The real reflector emissivity is about 4 times as large as the pre-launch value.
   - The JPL thermal model for the physical temperature of the reflector is inaccurate, in particular during eclipse season, and needs to be adjusted.
   - This leads to significant reduction of zonal biases, which were observed in Version 1.
2. Correction for reflected galaxy.
   - The 360° look capability of SMAP allows to improve the reflected galaxy correction by taking the difference between fore and aft look.
3. Correction for land intrusion.
   - The land correction in Version 1 was found to over-correct in some instances leading to salty biases around the continents mainly in the S hemisphere.
   - A mitigation has been implemented in Version 2.

Reflector Temperature JPL thermal model

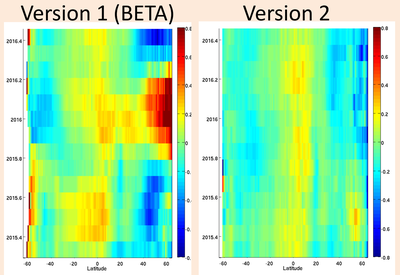


Reflector Temperature adjusted in Version 2

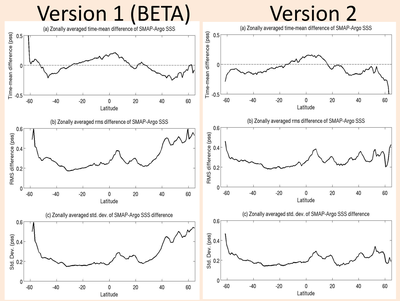


Validation: SMAP – ARGO

Version 1 (BETA) Version 2



Version 1 (BETA) Version 2

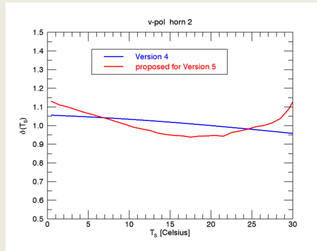


Progress towards Aquarius Version 5 Final Release

Planned Updates from Version 4

1. Ancillary SST input field.
   - V4: NOAA OI (Reynolds) V5: Canadian Meteorological Center (CMC)
2. Correction for reflected galaxy based on SMAP fore – aft.
   - An empirical "symmetrization" between ascending and descending swaths is still necessary in Version 5 but its size is only half the size of what we need in Version 4.
3. Temperature dependence of O_2 atmospheric absorption.
   - V5 will use the non-resonant oxygen absorption from Liebe et al. (1989/1992).
4. Temperature dependence of wind induced excess emissivity.
5. No other "empirical" geophysical adjustments.
   - E.g. SST, wave height, air-sea temperature difference, …

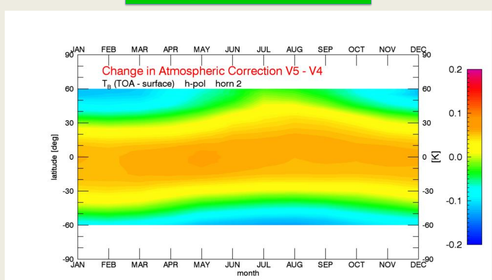
Wind Induced Emissivity (Temperature Coefficient)



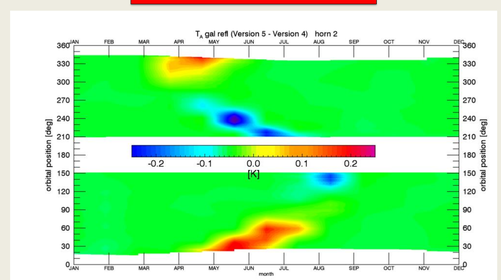
$$\Delta E_W(W,\varphi_{rel};T_S) = \alpha(W,\varphi_{rel}) \cdot \delta(T_S)$$
$$\alpha = \alpha_0(W) + \cos(\varphi_{rel})\cdot\alpha_1(W) + \cos(2\varphi_{rel})\cdot\alpha_2(W)$$

W: wind speed φ_{rel}: relative wind direction T_S: SST

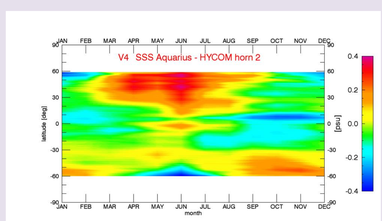
Oxygen Absorption



Reflected Galaxy



Seasonal and Regional Biases



Main Improvements

1. N mid/high latitudes MAR – JUN (O2 absorption).
2. high S latitudes MAY – JUL (galaxy).