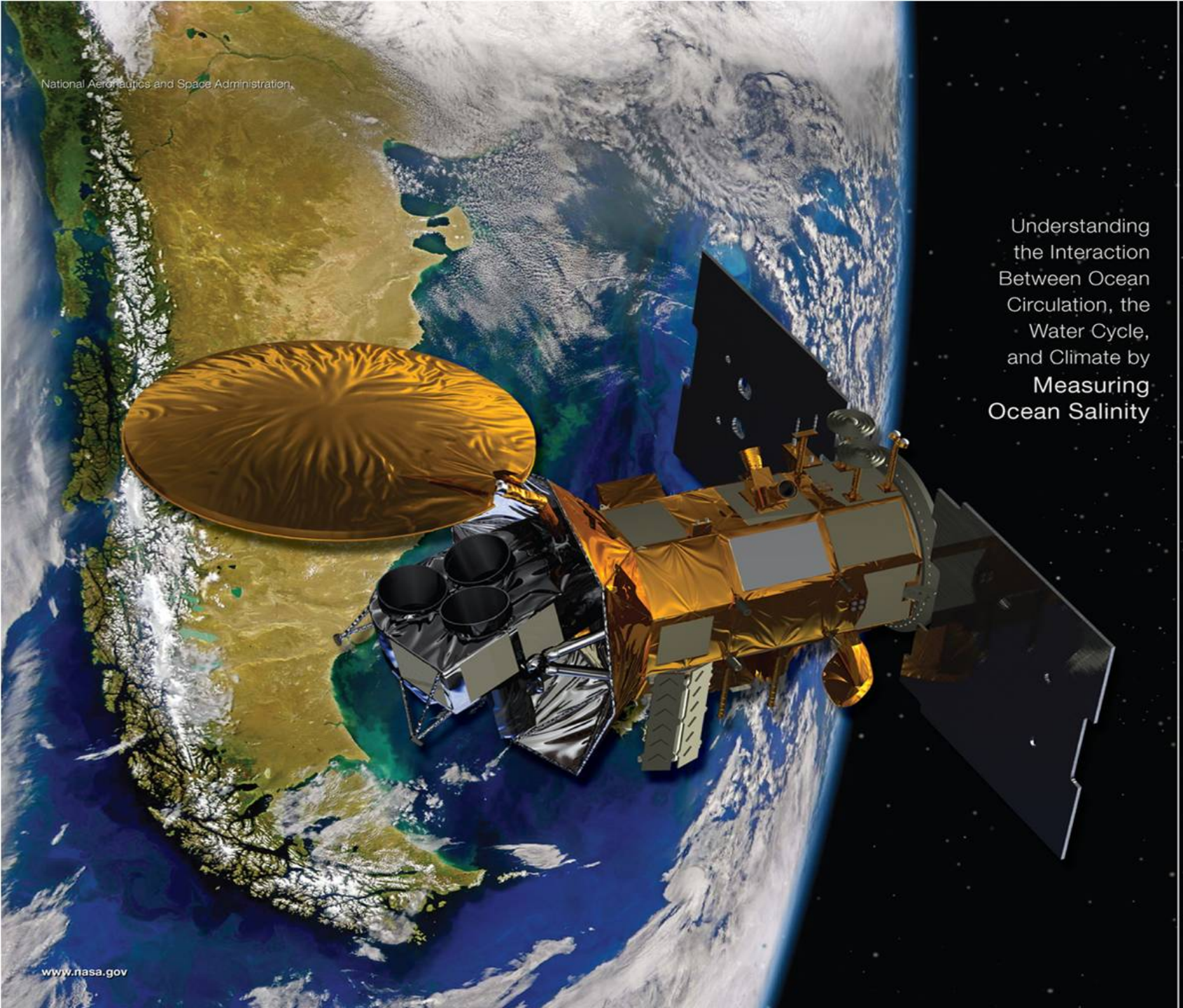


Aquarius/SAC-D

Understanding the Interaction Between Ocean Circulation, the Water Cycle, and Climate by **Measuring Ocean Salinity**

Aquarius Mission Status, Overview and Phase-F Data Reprocessing

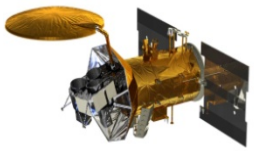
Gary Lagerloef, PI

NASA KDP-F

5 October 2015

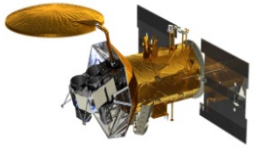
NASA HQ / ESD

Aquarius Mission Status



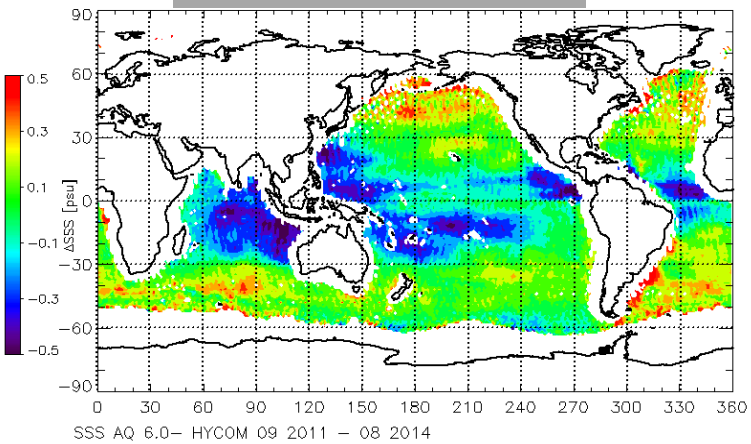
- Completed 3-year Prime Mission Nov 2014.
- Mission Extension Proposal, to fund operations through Sep 2017, was approved.
- Data release (V4.0) for Prime Mission was released June 2015 (monthly global rms error is 0.17).
- Mission failure on June 7, 2015 due to spacecraft power supply electronics. Full mission data record 3 years & 9 months (Sep 2011 – May 2015).
- NASA Phase F (Mission Closeout) Oct. 2015 – June 2017 has begun.
- *Final Project data version (5.0) will be to improve the accuracy and quality as far as we are able with our present knowledge and experience.*

Aquarius V4.0 Updates

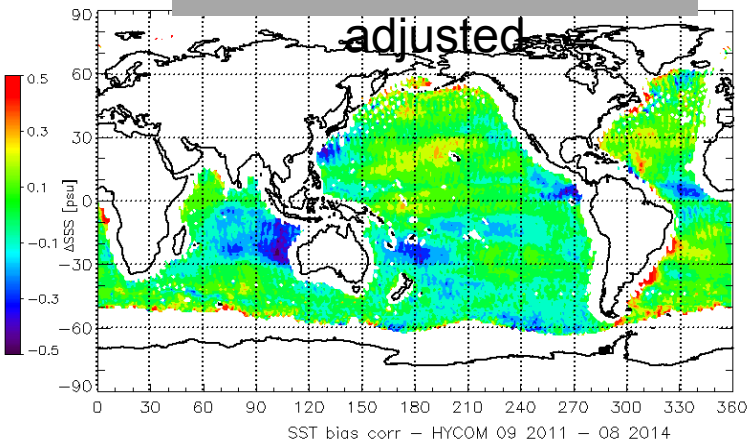


Improved Geophysical Model Function to mitigate latitude dependent bias.

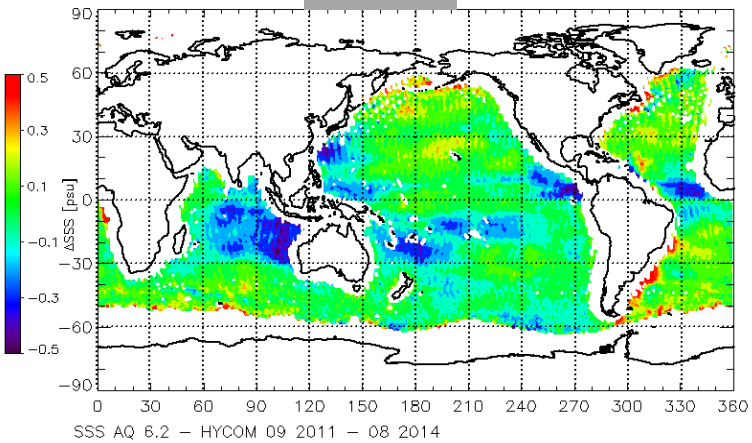
V3.0 standard

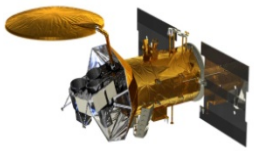


V3.0 bias SST-adjusted



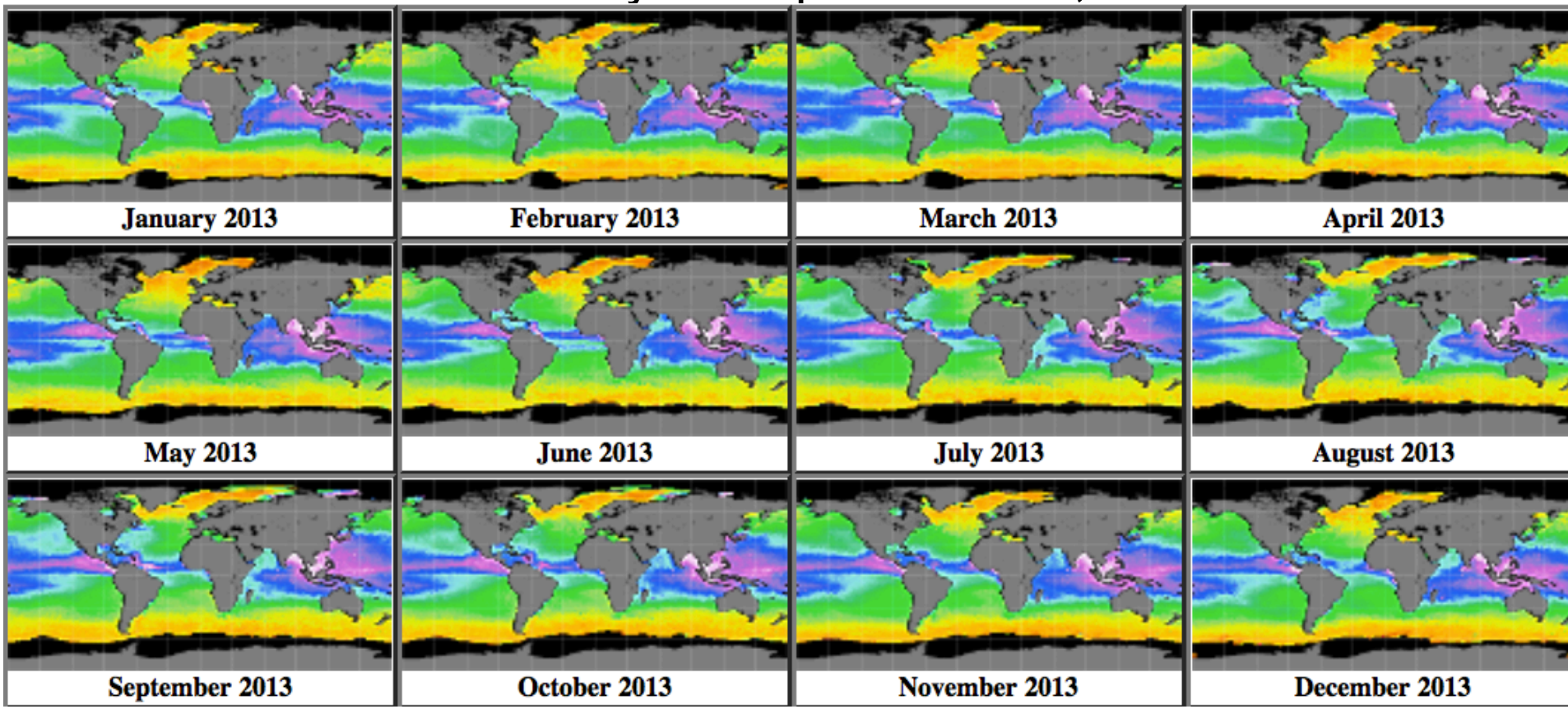
V4.0



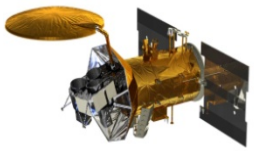


V4.0 Includes Density [TEOS-10] (and Spice in V5.0)

Density example for 2013;

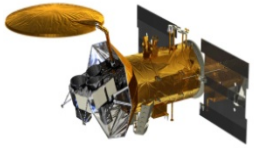


Algorithm Updates, Part 1



- Calibration
  - Radiometer internal gain and offset model (Misra and Brown, JPL)
  - Absolute cold-warm end-to-end calibration (LeVine, Dinnat, Brown, Misra, Piepmeier)
  - SSS static bias (Hong, GSFC)
- Geophysics
  - Rain Impact Model [RIM] (Jones, et al, UCF)
  - Higher quality SST CDR in place of operational NOAA SST
  - Improved meteorological fields in place of operational NCEP
  - Density and Spice – key to studying water mass formation in higher latitudes. [Code already tested in V4.0, and needing added validation]
- Updated expected Land TAs to be consistent with SMOS and SMAP land retrievals (LeVine, Gales, Bindlish, Soldo, Wentz).

Algorithm Updates, Part 2

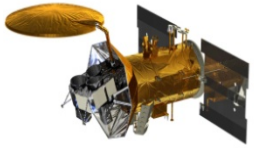


- Updated algorithm elements based on SMAP/SSS results (Wentz)
  - Galaxy
  - Land TA [to improve near-shore SSS correction]
  - RFI
  - Other (TBD)
- Air-sea interaction and high latitude effects to correct remaining bias (S.Brown)
- Uncertainty analysis [formal random and systematic uncertainty analysis for L2 and L3 SSS retrievals (Meissner, RSS)].

➢ *Each stage above will be separately implemented and validated via a standard set of in situ co-location analyses to assess performance.*

➢ *This will yield a series of interim updates (V4.1, V4.2, ...) for separate OSST and/or public release as appropriate.*

Algorithm Updates, Part 2



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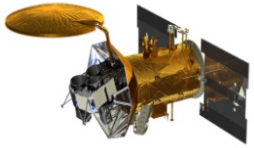
  - Galaxy
  - Land TA [to improve near-shore SSS correction]
  - RFI
  - Other (TBD)
- Air-sea interaction and high latitude effects to correct remaining bias (S.Brown)
- Uncertainty analysis [formal random and systematic uncertainty analysis for L2 and L3 SSS retrievals (Meissner, RSS)].
- Regional and temporal bias adjustment using analyzed Argo SSS fields; L4 analysis (Hacker, Melnichenko, U. Hawaii).

➢ *Each stage above will be separately implemented and validated via a standard set of in situ co-location analyses to assess performance.*

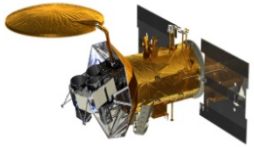
Supplementary Tasks



Science budget includes ongoing science analysis for Q&A purposes, and the following:

- **User guides:** Use of video to help introduce the user to the subtleties of Aquarius data are being worked. The idea is to a video with “speakers” explaining things such as what is RFI and what the RFI flag means. (Lead: Annette deCharon)

Aquarius Phase F Schedule



Phase-F starts 1 Oct 2015

Phase-F ends 30 Jun 2017

FY 2016				FY 2017		
Q1	Q2	Q3	Q4	Q1	Q2	Q3

MO (ACCS)

ACCS Ends 31 Dec 2016

- Finalize all mission event, maneuver, activity logs
- Data and telemetry files & analyses reconciled
- All documents, memos, reports reconciled and archived
- Reconcile all final actions from Mission Ops Review
- Support ongoing analyses & data trending for final V5 instrument-based calibration

DA (ADPS, Science)

- Calibration Updates
- Geophysical Updates
- SMAP-based Updates
- Supplemental Updates
- Analysis & Documents
- Reprocessing & Review
- V5 Release & Closeout

Aquarius/SACD Joint Science Meeting, Argentina 17-19 Nov 2015

1

Aq Cal/Val Meeting, March 2016; V5 progress & final processing review.

2

Final SAC-D/ Aquarius Mission Ops Review, May 2016, Argentina

3

Cal/Val/OSST Review, July 2016

V5 pre-release to OSST, Oct 2016

4

OSST final review, Nov

Aq Cal/Val Meeting, March; Final Review of V5.0.

V5.0 Release to PO.DAAC Apr

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1. Ocean Sciences Meeting, New Orleans, 21-26 Feb 2016; (Special Session Water Mass Studies
2. MicroRad, April, 2016
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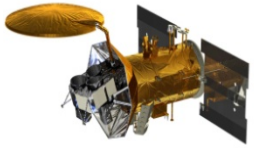
4. American Geophysical Union, Fall Meeting; *Special Sessions;* December, 2016

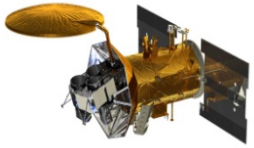
Muchas Gracias



Backup Material

- Algorithm update details

V5.0 Algorithm Details, page 1



1. Radiometer internal gain and offset model (Misra and Brown, JPL)

   This is a mathematical model of the radiometer calibration which accounts for the time-varying gain and offset calibration as observed with external (ocean target) calibration.

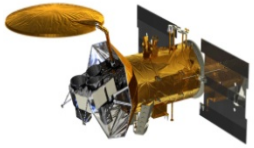
2. Absolute cold-warm end-to-end calibration (LeVine, Dinnat, Brown, Misra, Piepmeier)

   Calibration adjustments for cold sky and warm (land, ice) targets.

3. SSS de-bias (L. Hong)

   An algorithm consistency check of the forward and retrieval algorithm using the ancillary fields in the retrieval code. This results in a global mean offset of a few hundredths psu.

V5.0 Algorithm Details, page 2



4. Rain Impact Model [RIM] (Jones, et al, UCF)

   An empirical model to estimate the difference between skin SSS and buoy-depth salinity based on rain rate data.

5. Higher quality SST CDR in place of operational NOAA SST

   Trials using alternate SST products to assess improvements in retrieval accuracy (candidates are microwave SST fields and other GHRSST options).

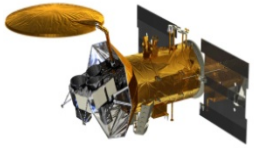
6. Improved meteorological fields in place of operational NCEP

   Replace NCEP operational numerical analysis fields with an alternate, such as GEOS5, to assess accuracy gains.

7. Density and Spice (derived from SSS and SST using the latest Thermodynamic Equation of State, 2010 [TEOS-10])

   These are key to studying water mass formation in higher latitudes. The code is already tested in V4.0, and needs added validation. Density was included in V4.0, and Spice will be added in V5.0. These parameters also serve as an extra quality indicators for both the SSS retrievals and the SST ancillary data.

V5.0 Algorithm Details, page 3



8. SMAP-based updates (based on developing SMAP SSS algorithm; improvements will then be used in both Aquarius and SMAP SSS algorithms.)

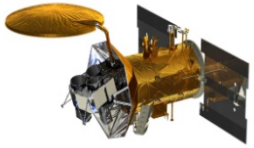
   a) Galaxy: New galaxy reflection tables being derived from inverse calculation of SMAP ocean data.

   b) Land brightness temperatures (TAs) to be used to improve the near-shore salinity correction.

   c) RFI: Possible gains in modeling Aquarius RFI from SMAP RFI processor.

9. Update expected Land TAs to be consistent with SMOS and SMAP land retrievals (LeVine, Gales, Bindlish, Soldo, Wentz). This overlaps with 8b above. The purpose is to obtain inter-calibration between the three sensors over land to improve soil moisture data consistency.

V5.0 Algorithm Details, page 4



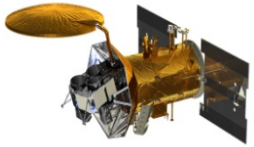
10. Air-sea interaction and high latitude effects to correct remaining bias (S.Brown)

A simple parameterized model using air-sea temperature difference and wind speed to estimate the latitude-dependent bias seen if V3.0. Although most of this bias is corrected in the V4.0 improved model functions, this additional correction will be evaluated in V5.0 after all the algorithm updates have been implemented.

11. Uncertainty analysis [formal random and systematic uncertainty analysis for L2 and L3 SSS retrievals (Meissner, RSS)]

This is a formal error analysis developed by T. Meissner to give an uncertainty estimate for each data point, both random and systematic, and accumulated errors for Level 3 gridded maps.

Aquarius Phase F Schedule



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