Aquarius/SAC-D Mission Update

Joint venture between NASA USA & CONAE Argentina. Launched June 10, 2011; data since Aug. 2011; distributed by PO.DAAC (http://podaac.jpl.nasa.gov) along with all documentations.
Mission Design

- Global Coverage in 7 Days
- 4 Repeat Cycles per Month

Sun-synchronous exact repeat orbit
6pm ascending node

Beams point toward the night side to avoid sun glint

Science Data Validation

More than 300 surface validation observations per day

Salinity Data
150km, Monthly, 0.2 (psu)
Mission Requirement
Data Versions Update

- **Version 1:** (Sep 2011) Initial calibration, but showed a calibration drift in the following months.
- **Version 1.3:** (Apr 2012) Deflection Ratio (DR) calibration algorithm corrected drift and some variations, but left residual quasi-monthly oscillations.
- **Version 2.0:** (Feb 2013) Current operational version. Pointing correction applied. Empirical calibration method corrected quasi monthly oscillations. SSS errors are primarily seasonal residuals of the galaxy correction.
- **Version 3.0:** (June 2014) Corrects galaxy residual error. Improved wind roughness correction. Updated data quality flags. Reduced warm and cold end calibration biases. Next key problem is RFI.
- **Version 4.0** (Nov 2014) Add MWR rain correction. Address RFI (somehow). Improve L3 gridding algorithms (resolution, de-biasing, ...), other updates.
Early Science Publications Emphasize Unexpectedly Detailed Features

Tropical Instability Waves; Lee, et al, 2012 GRL
Amazon Plume and Hurricane Salinity Wakes; Grodsky, et al, GRL, 2012
Aquarius captures Tropical Atlantic TIWs & Eddies

*(Lee, Lagerloef, Kao, McPhaden, Willis, 2014, JGR)*

- SST signature strongest in central equatorial Atlantic.
- SSS signature remains strong in the west despite the diminishing SST signature.
- Highlights influence of Amazon outflow & NBC retroflection into NECC & Congo River outflow.
Ignoring SSS effects under-estimates perturbation potential energy (a measure of TIW strength) by a factor of 2-3 in central equatorial Atlantic.
E-P & SSS associated with MJO

(Guan, Lee, Halkides, and Waliser 2014, GRL, Apr.; also Grunseich et al. 2013)

8-phase MJO life cycle composite based on the “Wheeler & Hendon Index”, showing canonical eastward propagation from Indian to Pacific sectors.
S has comparable or larger influence than T on MJO-related surface density

From linear equation of state at surface:
\[ \rho' = (-\alpha T' + \beta S') \rho_0 \]
\( \alpha \) – thermal expansion coefficient
\( \beta \) – saline contraction coefficient

- S' generally has larger contribution to \( \rho' \) than T' does.
- Implications to T' & air-sea interaction if barrier layer is formed.
- Western & central IO: Partially compensating effects of S' & T'.
- Eastern IO & western Pacific: Re-enforcing effects by S' & T'.
Aquarius publications: the following, plus more than 30 papers for the JGR Special Section

NASA Science Mission Timeline

2011
- Launch 10 June 2011
- Aquarius on 25 Aug 2011
- First Image 22 Sep 2011
- NASA PLAR 10 Nov 2011
- Dec 2011

2012
- 7th Aquarius/SAC-D Science Meeting 11-13 April 2012
- Aquarius V1.3 Data Apr 2012
- Aquarius 1 Year of Data 25 Aug 2012

2013
- Webinar 22-30 Jan 2013
- Aquarius V2.0 Validated Data 25 Feb 2013
- Joint SMOS-Aquarius Workshops, Brest 15-17 April 2013
- Aquarius 2 Years of Data 25 Aug 2013
- 8th Aquarius/SAC-D Science Meeting 12-14 Nov 2013

2014
- 10 Month Interim Extension
- Aquarius V3.0 Validated Data June 2014
- Aquarius V4.0 Validated Data target Nov. 2014

2015
- NASA End of Prime Mission Seattle Nov. 2014
- NASA Extended Mission 30 Nov 2014
- NASA Extended Mission Spring 2015
- NASA Review Proposal 1 Oct 2015

2016
- NASA 2-Year Extended Mission Begins 1 Oct 2015
• Two-year mission, scheduled to be launched to the ISS Aug. 2014.
• A speedy and cost-effective replacement of NASA’s QuikSCAT.
• Used QuikSCAT spared parts with modified hardware (e.g., smaller antenna).
• A gap filler to provide ocean vector wind measurements.
• Enhanced capability to capture diurnal wind in the tropics.
ISS-RapidScat Science Objectives

- Provide direct wind cross-calibration for the international ocean vector winds constellation.
  - The ISS orbit will enable coincident measurements in space and time with each of the satellites in the constellation (ASCAT, OSCAT, QuikSCAT, and, potentially, OSCAT 2)

- Improve estimates of the global diurnal ocean vector wind cycle and determine the semi-diurnal cycle.
  - Variation of wind across different times of the day may be the cause of major discrepancies between measurements and models.

- Provide ocean vector winds to improve weather forecasting and complement data collected by the international ocean vector winds constellation.
  - The tropical coverage of the ISS will provide additional observations of storms that may develop into hurricanes or other tropical cyclones (typhoons, etc.)
RapidScat vs. QuikSCAT

- RapidScat will have similar performance as QuikScat.
- Narrower swath wide (800-900 km vs 1800 of QuikSCAT).
- Limited to $\pm 51.6^\circ$, will cover 90% of this in 48 hours.
ASCAT Enhanced Coverage
The local time sampling characteristics of the ISS are to revisit the same latitude at slightly different local times each orbit. To fully sample the diurnal and semi-diurnal cycles once globally requires at least 2 months of data. To estimate diurnal and semi-diurnal cycles accurately, on the order of 10 sets of observations (~2 years) will be required.
More Information on RapidSCAT

http://www.jpl.nasa.gov/missions/iss-rapidscat/
