From V1 to V4
V1.3 - August 2012

- Initial adjustment to ND brightness to align TAs to mean global ocean model
- Correction to gain drift using noise diode ratio constraint (e.g. DR method)
- Update to APC cross-pol parameters to mitigate observed spurious coupling between polarizations
  - Initial APC based on scale model patterns
  - V1.3 update basically zeroed out cross-pol terms (diagonal terms untouched)
- Roughness correction coefficients updated
  - Parameterization for excess emission and backscatter as a function of WS and WD
  - Only NCEP wind speed used
- Only V-pol TBs used for salinity retrieval
Aquarius Radiometer Counts
Earth + Calibration View

Radiometer Calibration Algorithm

Total Antenna Temperature

Remove Space Contributions: Galaxy, Sun, Moon, CS

Earth Antenna Temperature

Remove the Antenna Pattern Effect

Earth Brightness Temperature

Correct for Faraday Rotation

Top of the Atmosphere Brightness Temperature

Remove Atmospheric Contribution

Sea-Surface Brightness Temperature

Remove Surface Roughness Effects

Specular Brightness Temperature

Find Salinity for which emissivity of Meissner-Wentz dielectric model matches specular TB (v-pol only for now)

Salinity
• S/C pointing calibration based on RSS and JPL analysis
  – Roll: -0.51 deg, Pitch: 0.16 deg, Yaw: 0 deg
  – Updated correction tables that were impacted by new pointing (e.g. land/sea ice fraction, reflected galaxy etc)
• APC coefficients updated to use new 2012 GRASP patterns
  – Cross-pol coupling parameters still empirically tuned based on pitch maneuver polarization rotation data
  – Spill-over about 1% higher than previous, thought to be too high
• Updated drift correction
  – Exponential gain correction fit to HYCOM ocean residuals
  – Wiggles implemented as a moving offset correction based on method to extract instrument component from residuals (e.g. common component between N/S hemisphere, A/D passes)
Roughness correction algorithm updated to use both NCEP wind vector and scatterometer sigma0-VV
- Sigma-0 used as a residual roughness correction look-up table

\[ \Delta E_w = R'(W_{NCEP}, \sigma_{vv}) + A_0(W_{NCEP}) + [A_1(W_{NCEP}) \cos(\varphi_{rel}) + A_2(W_{NCEP}) \cos(2 \varphi_{rel})] \quad \text{(III.1)} \]
• Update to RFI algorithm parameters
  – Removed short accumulation 1 due to anomalous bias and noise
  – Detection thresholds tuned using measured ocean data to equalize false alarm rate between channels

• Land mask updated to use 1km mask
  – Biggest impact near islands
**V3 - June 2014**

- Updated APC parameters
  - Adjusted spill-over downward for V/H-pol only based on cold sky transects over land/sea transition
  - Spill-over from scale model, cross-pol from 2012 GRASP pattern
  - 3rd stokes coupling adjusted to remove biases over ocean and amazon

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Roughness correction updated to use both scatterometer data and H-pol TA

- HH uses only scatterometer sigma0-HH
- HHH uses scatterometer sigma0-HH plus TA Hpol with ancillary SST and climatological SSS inputs
- NCEP also used in both and WD comes form NCEP
- HH used for computation of drift correction

\[
\chi^2_{HH}(W) = \frac{\left[ \sigma_{0,HH}^{\text{measured}} - \sigma_{0,HH}^{\text{GMF}}(W, \varphi_r) \right]^2}{\text{var}\left(\sigma_{0,HH}^{\text{measured}}\right)} + \frac{[W - W_{\text{NCEP}}]^2}{\text{var}(W_{\text{NCEP}})}
\] (2).

The SOS in the MLE for the HHH wind speed algorithm is:

\[
\chi^2_{HHH}(W) = \frac{\left[ \sigma_{0,HH}^{\text{measured}} - \sigma_{0,HH}^{\text{GMF}}(W, \varphi_r) \right]^2}{\text{var}\left(\sigma_{0,HH}^{\text{measured}}\right)} + \frac{\left[ T_{B,\text{surf},H}^{\text{measured}} - T_{B,\text{surf},H}^{\text{GMF}}(W, \varphi_r) \right]^2}{\text{var}(T_{B,\text{surf},H}^{\text{measured}})} + \frac{[W - W_{\text{NCEP}}]^2}{\text{var}(W_{\text{NCEP}})}
\] (3).

\[
\Delta E_{\text{rough}} = \Delta E_{W0}(W_{HHH}, \varphi_r, T_S) + \Delta E_{W1}(W_{HHH}, \sigma_{0,VV}^{\prime}) + \Delta E_{W2}(W_{HHH}, \text{SWH})
\]
V3 - June 2014 (2 of 5)

• Salinity retrieval algorithm updated to use both V-pol and H-pol TBs
  – Retrievals use computed specular TBs

\[
\chi^2 = \frac{\left[ T_{\text{measured}}^{B,\text{spec},V} - T_{\text{RTM}}^{B,\text{spec},V} \left( T_S, SSS \right) \right]^2}{\text{var} \left( T_{B,\text{spec},V} \right)} + \frac{\left[ T_{\text{measured}}^{B,\text{spec},H} - T_{\text{RTM}}^{B,\text{spec},H} \left( T_S, SSS \right) \right]^2}{\text{var} \left( T_{B,\text{spec},H} \right)}
\]
Empirical ascending/descending symmeterization to remove biases suspected from reflected galaxy correction

- Correction removes observed zonal asc/dsc biases
- Partitions error based on strength of reflected galaxy
• Empirical SST salinity bias adjustment
  – Polynomial correction directly to SSS derived from residual HYCOM biases
• Drift correction simplified
  – Same exponential ND correction used
  – 7-day global mean ocean differences from HYCOM removed from data as an offset
• Developed hybrid antenna pattern to adjust excess spill-over in 2012 GRASP patterns
  – Tapered sidelobe envelop in backlobes
  – Used to derived new correction tables (solar, land, ice)
  – Galaxy correction tables and APC parameters unchanged
• Empirical SST bias correction applied at TB level instead of SSS level
  – Basically an additional dTB that is removed during the excess roughness correction process
  – Independent for each channel

Figure 8: Value of $\Delta T_{B1}(T_S)$ for horn2 H-pol. Full line: $W = 0$ m/s, dashed line: $W = 7.0$ m/s, dashed-dot line: $W = 12$ m/s.
• Empirical correction for observed non-linear I/Q coupling
  – Cause not understood