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Global Calibration and Validation of the Jason-2 and SARAL Geophysical Data Records

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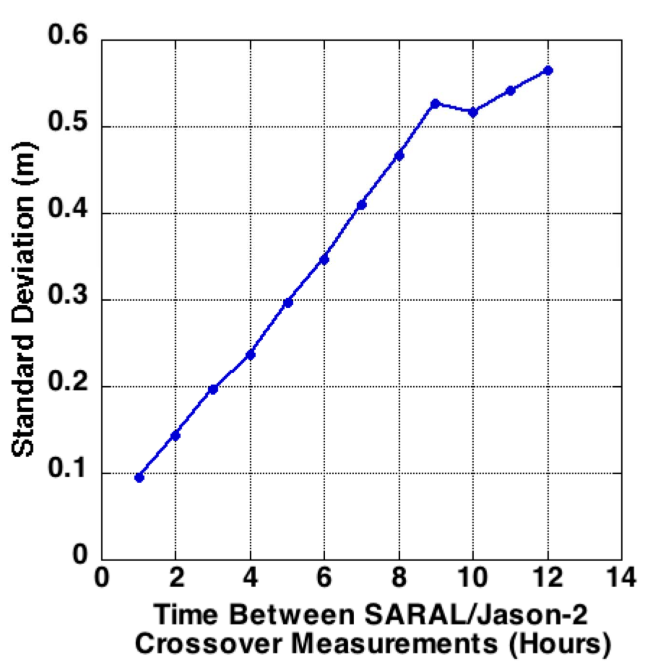
Abstract

We present updated results on the global calibration and validation of the first test release of SARAL/Altika Geophysical Data Records (GDRs) with respect to the Jason-2 version D GDRs. We focus in particular on systematic and geographically correlated errors, and the analysis of inter-satellite differences of various components of the two sea surface height measurement systems at ground-track crossing locations (crossovers). We consider systematic differences in the altimeter measurements as a function of significant wave height and wind speed, noting that calibration of the backscatter coefficient, wind speed, and sea state bias is most likely needed for the SARAL/AltiKa measurements at this early stage of the mission. In doing so, one of our objectives is to develop an estimate for the overall sea surface height measurement system error budget for SARAL.

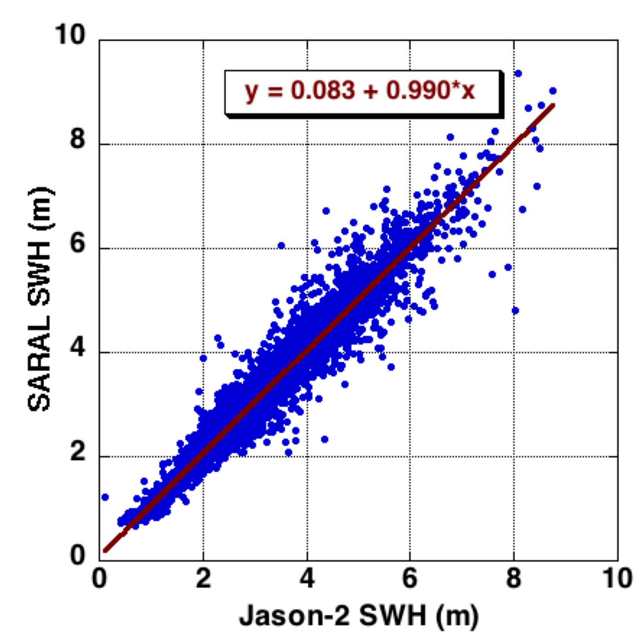
Approach

- Compare measurements from Jason-2 and SARAL/ALTiKa at geographical locations where ground tracks cross (crossover locations).
- Bin crossover differences by time between measurements from each satellite.
- SARAL GDR-T cycles 1-4 (Jason-2 GDR-D cycles 172-187) provide ~ 1100 crossovers for each additional hour between measurements, with global distribution.
- Perform weighted (by time between measurements) linear regression between measurements to determine correlation, sigma0 calibration for wind speed model, and parametric sea state bias model.

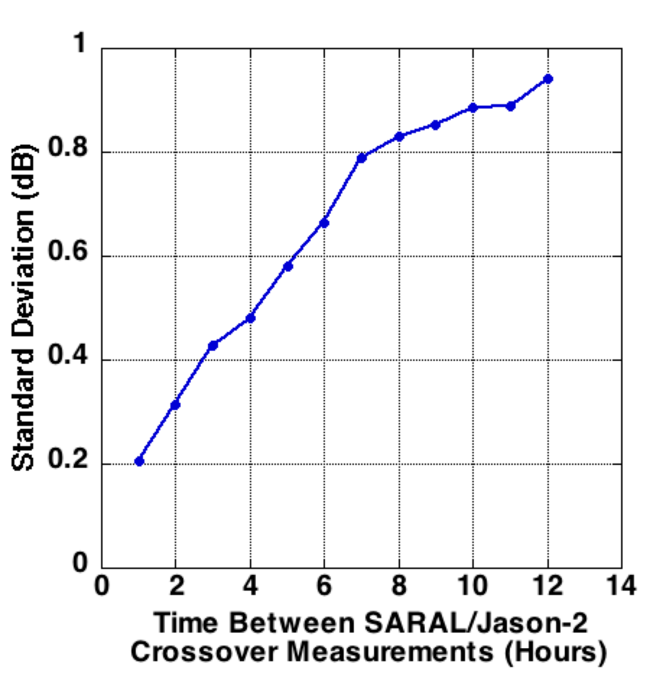
Significant Wave Height (SWH)



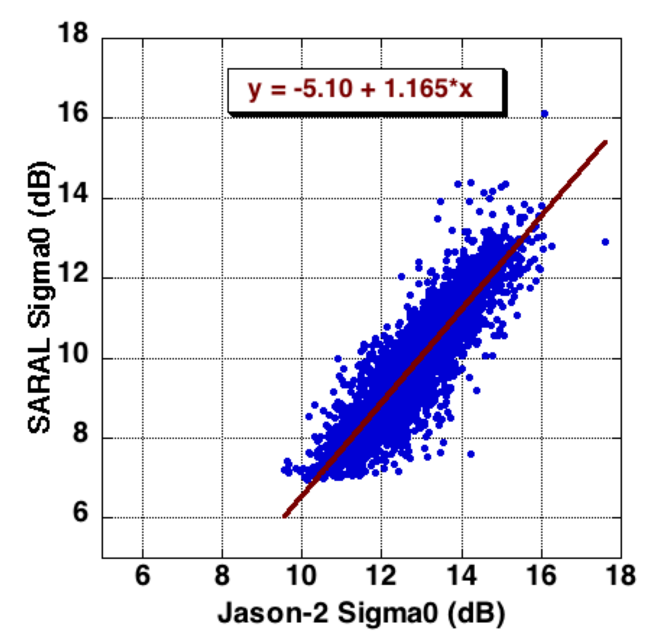
- Standard deviation of differences between SARAL and Jason-2 is <10 cm.
- SARAL SWH biased by + 8 cm relative to Jason-2, with > 99% correlation.
  - Using measurements < 6 hours apart, and weighted fit to scatter.
  - Weighting function = 1/Δt
  - Δt = abs(t(SARAL) – t (Jason-2))



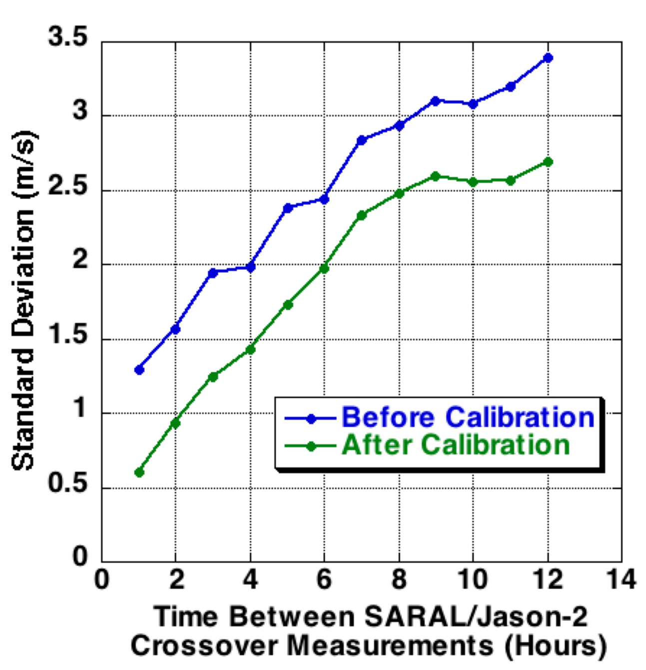
Backscatter Coefficient (Sigma0)

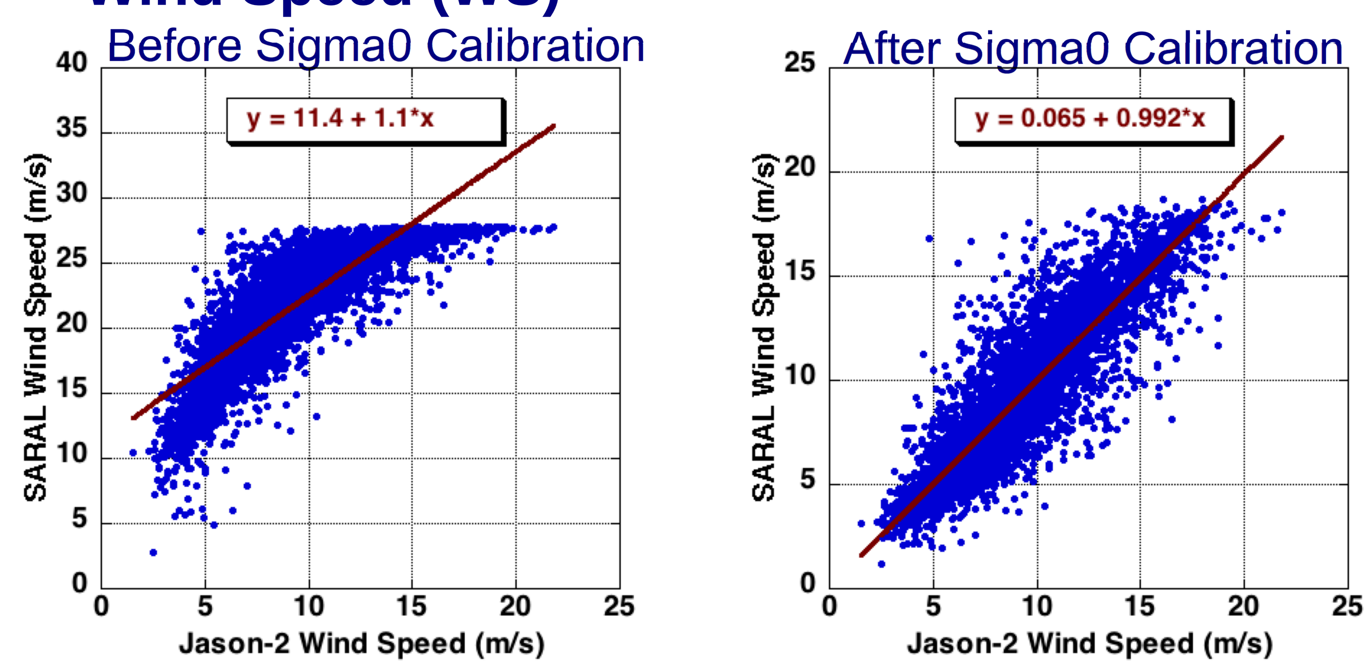


- Standard deviation of differences between SARAL and Jason-2 is < 0.2 dB.
- SARAL Sigma0 biased by -5.1 dB and scaled by +16.5% relative to Jason-2.
  - Using measurements < 6 hours apart, and weighted fit to scatter.
  - Weighting function = 1/Δt
  - Δt = abs(t(SARAL) – t (Jason-2))



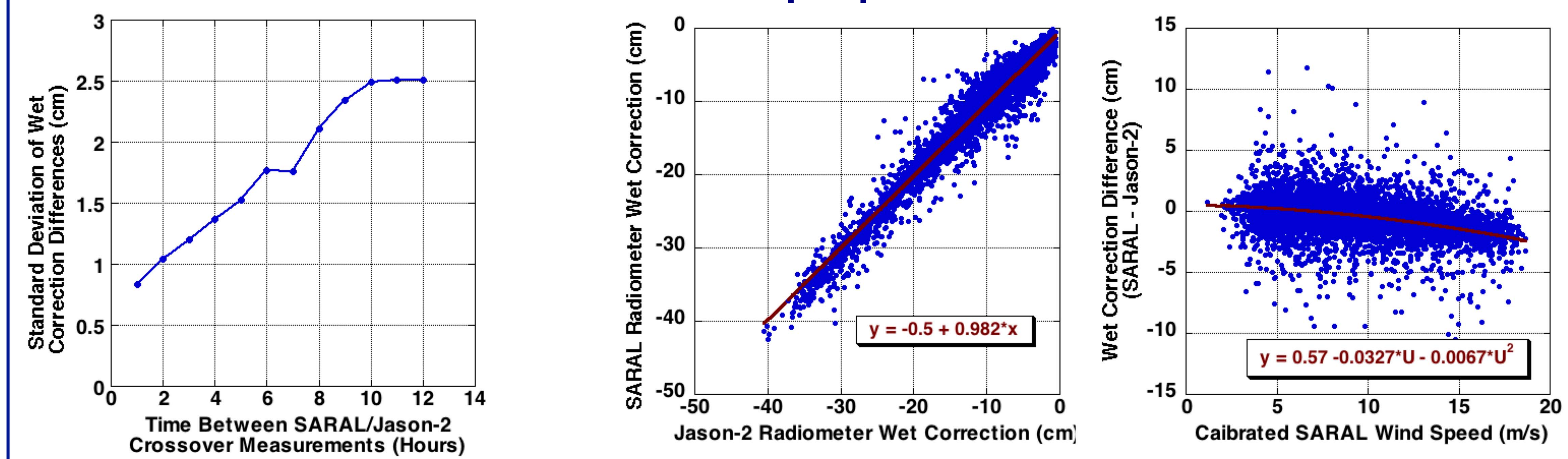
Wind Speed (WS)





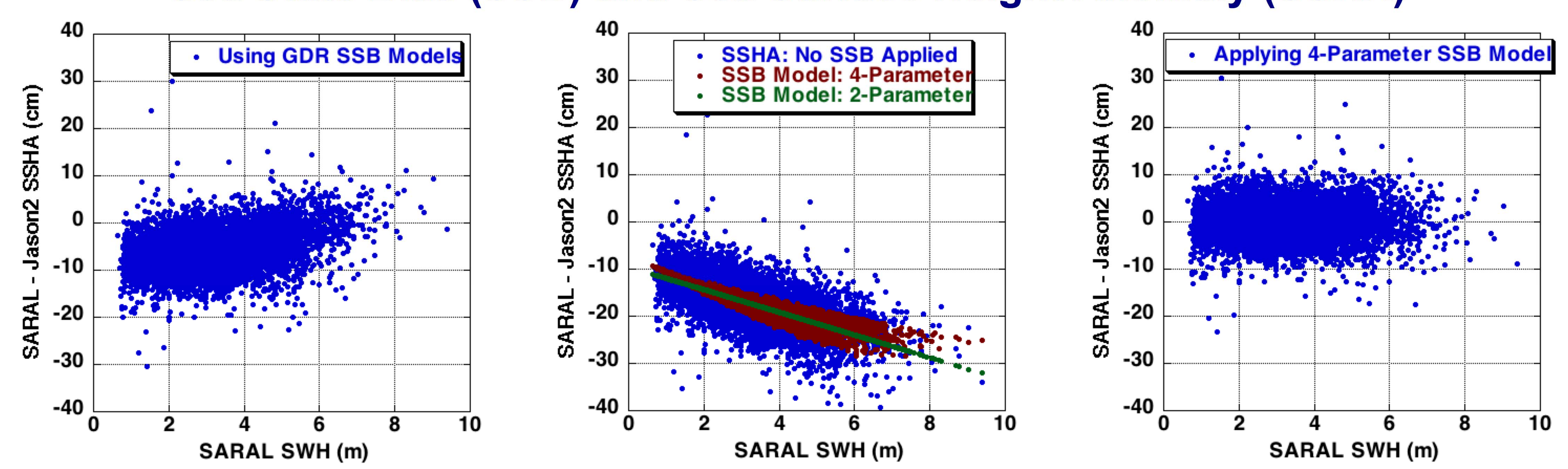
- **Calibrate SARAL Sigma0 before applying Jason-2 GDRD windspeed algorithm (Collard).**
  - Sigma0(calibrated) = 0.32 + (Sigma0(uncalibrated) +5.1)/1.165
    - 0.32 dB is Jason-2 Sigma0 calibration.
- After calibration, SARAL wind speeds show expected linear scatter (>99% correlation) versus Jason-2.
  - Standard deviation reduced to < 0.6 m/s.
  - Bias reduced to 0.07 m/s.

Radiometer Wet Troposphere Correction

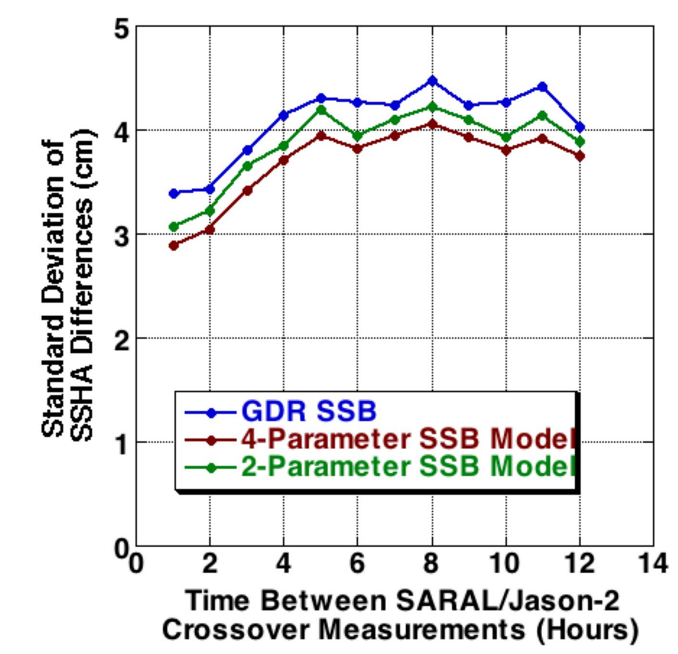


- Standard Deviation of differences between SARAL and Jason-2 is < 1 cm.
- SARAL/Jason-2 radiometer wet troposphere correction differences have dependency on wind speed.

Sea State Bias (SSB) and Sea Surface Height Anomaly (SSHA)

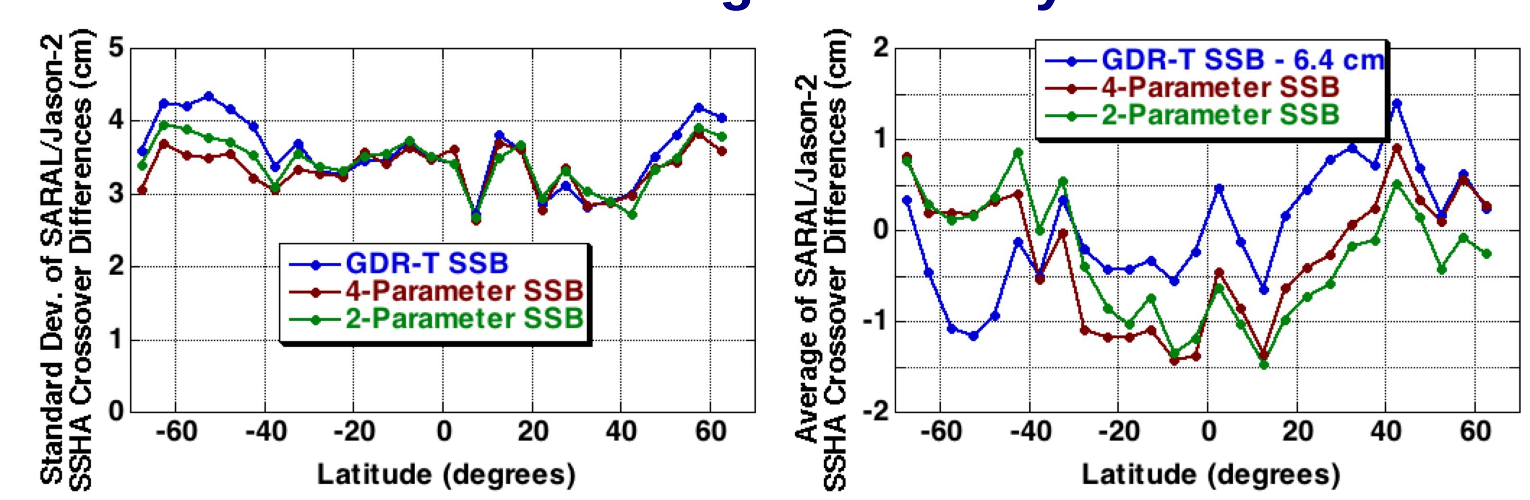


- SARAL/Jason-2 sea surface height anomaly (SSHA) differences reveal errors mainly in SARAL GDR-T SSB model.
- Estimate two parametric SSB models for SARAL from inter-satellite SSHA differences:
  - Each model includes term for inter-satellite bias.
  - Two parameter model (units are meters for SSB and SWH): **SARAL SSB = -0.096 - 0.024*SWH**
  - Four parameter model (units are meters for SSB and SWH): **SARAL SSB = -0.065 + (-0.048+0.001*SWH+0.001*U)*SWH**
    U = calibrated wind speed in m/s (sigma0)
- **SARAL SSHA measurements biased low (relative to Jason-2) by 6-10 cm, and standard deviation of differences < 3 cm.**

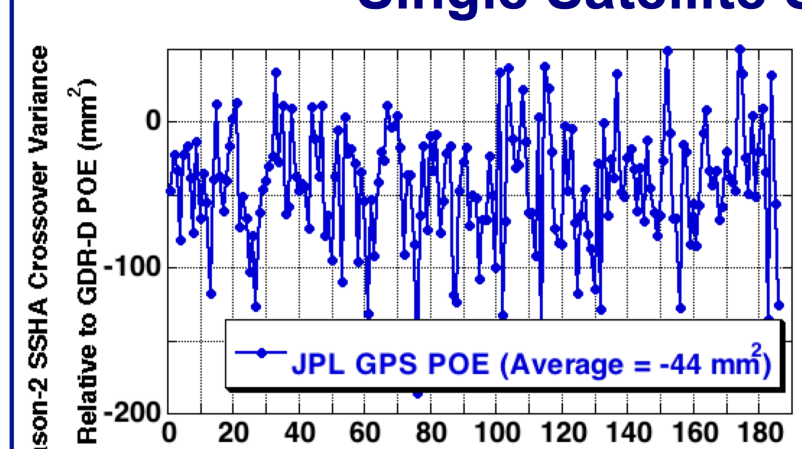


Inter-Satellite SARAL/Jason-2 Sea Surface Height Anomaly Crossovers

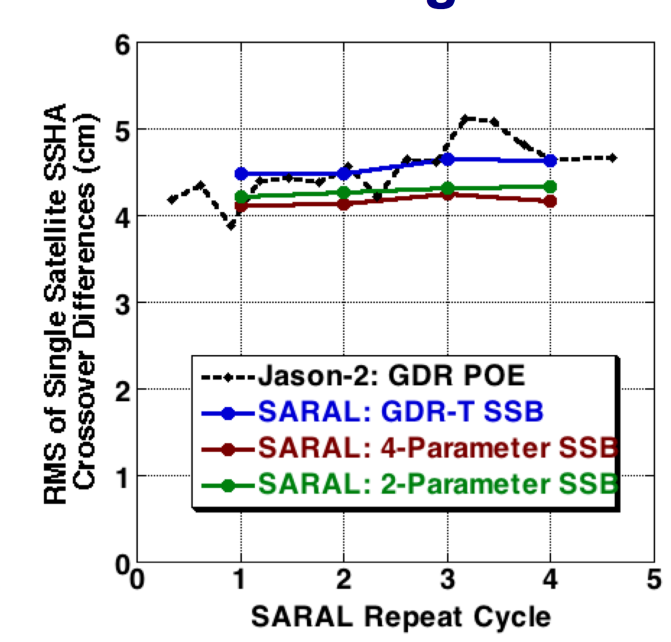
- Empirical SSB models primarily reduce SSHA crossover variance at high and low latitudes.
- **Expose geographically correlated differences between SARAL and Jason-2 with +/- 1 cm latitude dependence.**

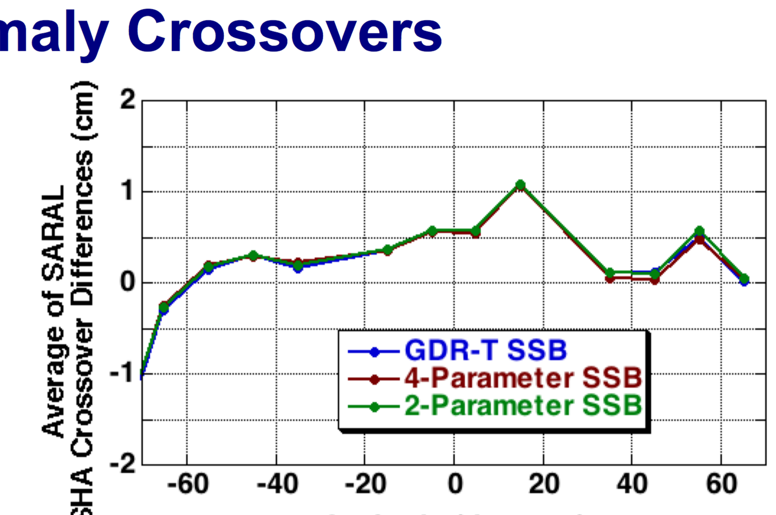


Single Satellite Sea Surface Height Anomaly Crossovers



- JPL's GPS-based POE for Jason-2 provides lower SSHA crossover variance by 44 mm^2.
- Potential for improving accuracy of Jason-2 GDR POE.





- RMS SARAL SSHA crossover differences are very similar to that observed by Jason-2, particularly after SSB calibration.
- Latitude dependence smaller than from inter-satellite crossovers.