Application of the AQ Rain Accumulation Product for Investigation of Rain Effects on AQ Sea Surface Salinity Measurements

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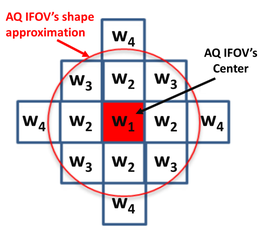
ABSTRACT

This paper presents results of a recent empirical investigation into the impact of rain on the Aquarius (AQ) Sea Surface Salinity (SSS) measurements. Results demonstrate that AQ SSS measurements are realistic characterizations of a transient dilution of the surface salinity, but they are NOT representative of the bulk salinity at 5 m depth given by HYCOM. We believe that, during recent rain events, careful interpretation of AQ Level-2 (L-2) data is required, and as a result, the Rain Impact Model (RIM) product has been developed. It is available to AQ science users to promote the understanding of the relationship between precipitation and the corresponding AQ SSS measurement. This paper presents the description of RIM and comparisons between RIM and AQ L-2 SSS are presented for a number of rain events along the Pacific ITCZ (Inter-tropical Convergence Zone). Results demonstrate high correlation between RIM and AQ SSS for moderate to strong rain events that occurred within a few hours of the AQ observation time.

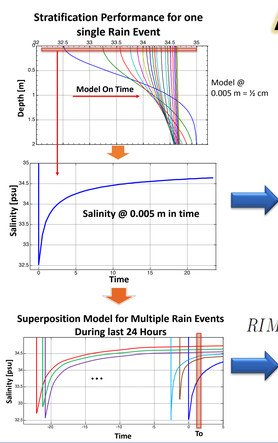
The RIM model is based on the temporal superposition of rain events (integrated rain history for the last 24 hours) using a one-dimensional stratification model and HYCOM as initialization. It estimates SSS in a quarter degree spatial resolution and integrates over the AQ IFOV (100 km) using a weighted average based on the antenna beam efficiency. Thus, the RIM predicts the modeled surface salinity that can be compared to the observed SSS as an overly to the AQ L-2 data product. In addition, the RIM provides the corresponding rain beam-fill fraction and the probability of salinity stratification. This latter parameter can be used as a "rain impact" quality flag to identify SSS that are affected by near surface stratification.

INTRODUCTION

- CFRSL has investigated the Impact of rain on the AQ Sea Surface Salinity
  - **"Investigation of Rain Effects on Aquarius Sea Surface Salinity Measurements"** (Published at AQ Special issue JGR/Oceans)
- The Rain Impact Model (RIM) is an overlay for the AQ-L2 product that simulates the SSS under rain conditions
  - Global coverage between ±60°lat (Due to CMORPH - Precipitation Source for RA Product)
- Spatial integration over AQ IFOV
  - Assumes circular foot print of 100 km
  - Uses 13 x 0.25° boxes weighted average based on antenna beam efficiency
- **RIM_{SSS}** (SSS estimated based on RIM) is an empirical model that estimates the SSS under rainy conditions at 0.005 meters depth.
  - Model is superposition of rain events using 1D stratification model
  - Uses HYCOM as initialization
- **Other ancillary parameters provided are:**
  - **BF** (Rain Beam Fill Fraction) represents area weighted percentage of the beam that exceeds an IRR threshold (0.25 mm/hr)
  - **PS** (Probability of Salinity Stratification) is normalized delta-SSS per orbit between RIM at 10 m and RIM at 0.05 m



APPROACH



$$S(z,t) = S_0 d_0 * \left(d_0 + \frac{R}{\sqrt{K_z * t}} e^{(-z^2/4K_z t)} \right)^{-1}$$

Depth = 0.5 cm

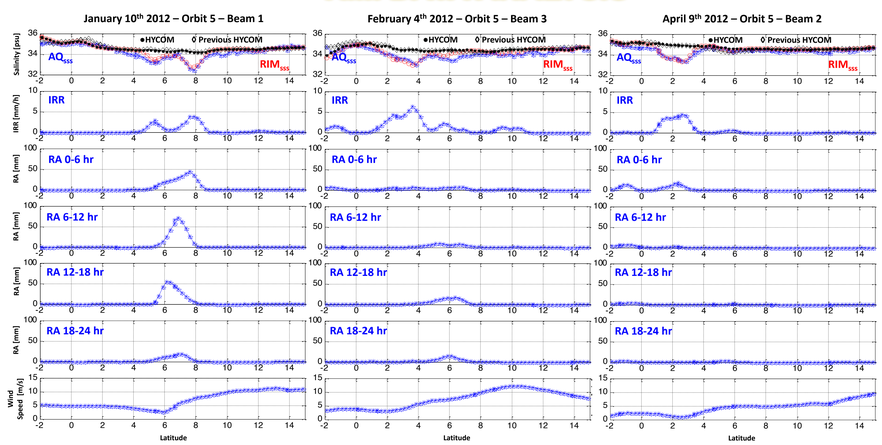
$$RIM_{SSS} = S_0 \left[\left(\prod_{i=1}^{n} \left[1 + \frac{R_{1i}}{\sqrt{K_z * t_i}} e^{(-z^2/4K_z t_i)} \right] \right) * \left[1 + \frac{R_2}{\sqrt{K_z * t}} e^{(-z^2/4K_z t)} \right] \right]^{-1}$$

HYCOM

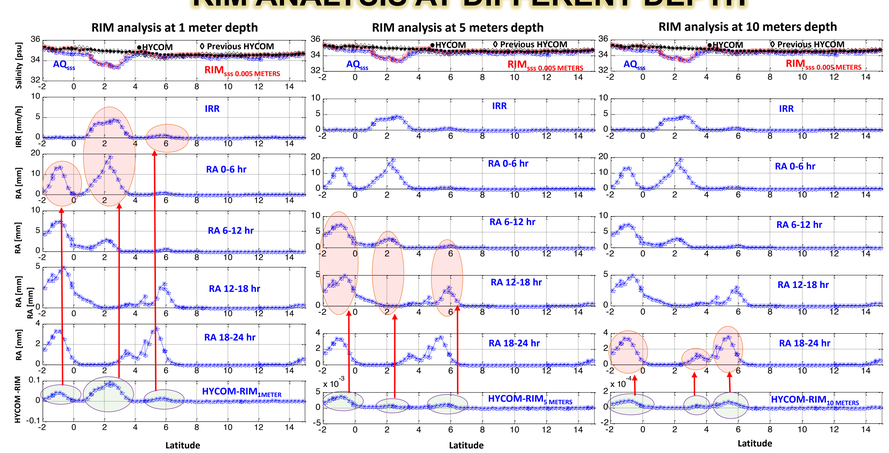
Vertical Diffusivity

Rain Impulse Functions

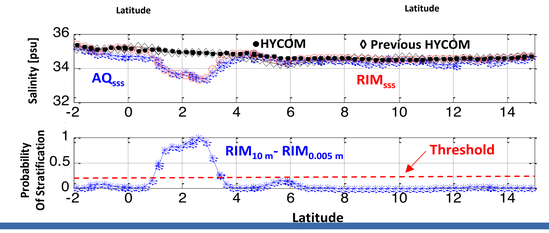
RIM DATA ANALYSIS



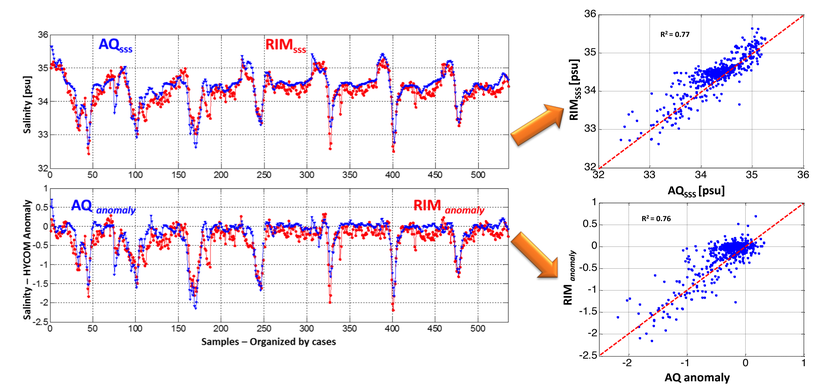
RIM ANALYSIS AT DIFFERENT DEPTH



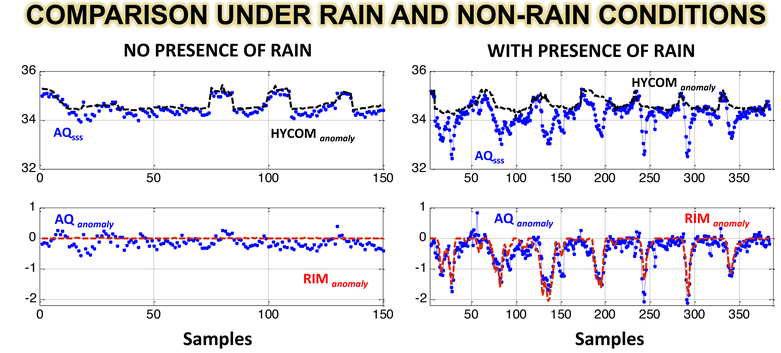
PROBABILITY OF STRATIFICATION



CONCATENATED RESULTS



COMPARISON UNDER RAIN AND NON-RAIN CONDITIONS



SUMMARY

- The salinity gradient (surface to 1 – 2 m depth) is time dependent and depends upon the rainfall accumulation
  - In our analysis we find no evidence of SSS radiometric retrievals errors due to rain effects
- The analysis of AQ SSS measurements in the presence of rain, requires careful interpretation to account for near-surface salinity stratification
- A beta version of our AQ Rain Impact Model product will be released summer 2015
  - We solicit constructive criticism for our AQ RIM and seek collaboration with ocean modelers