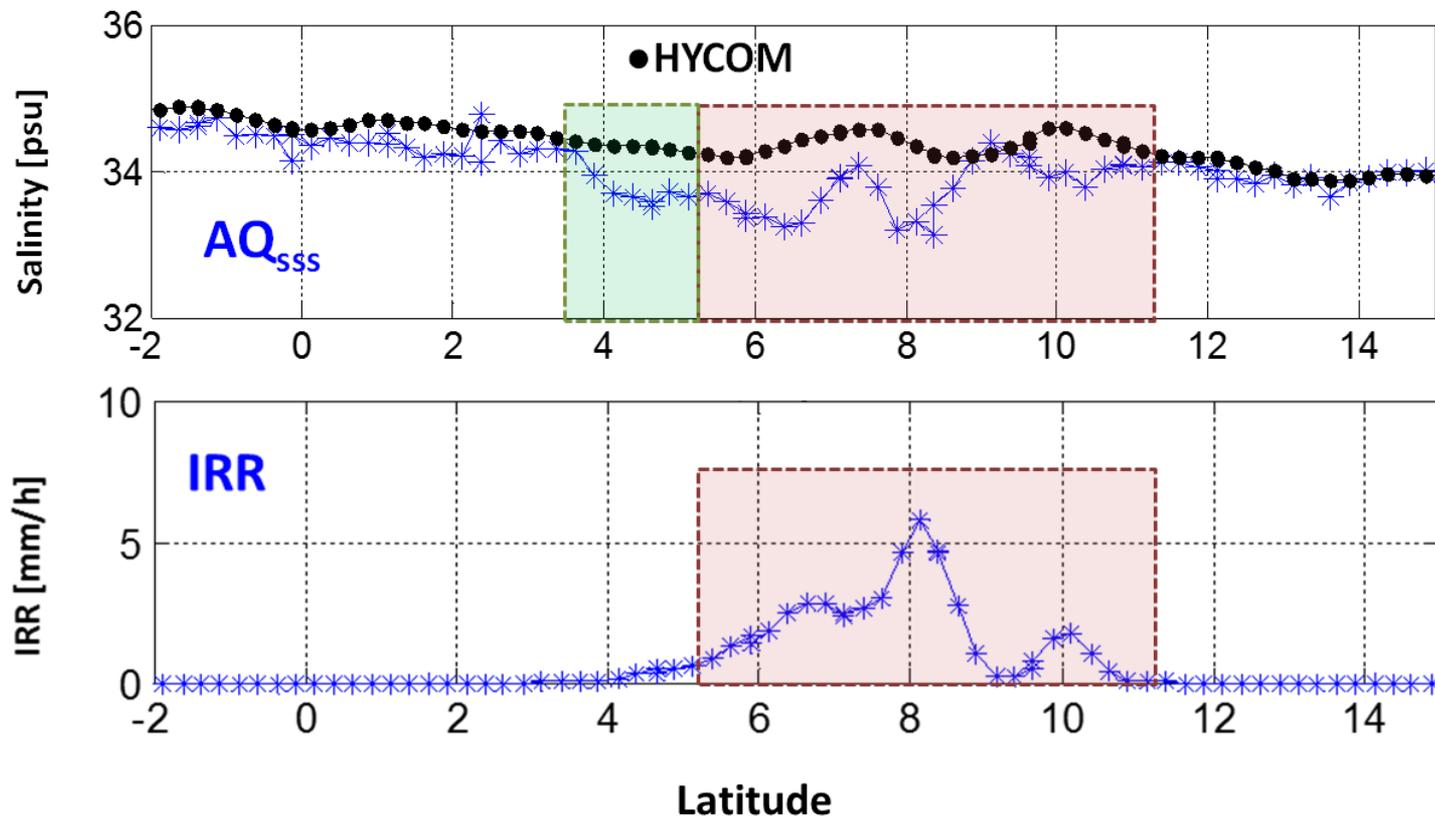


# Rain Effects on SMAP Sea Surface Salinity Artifacts

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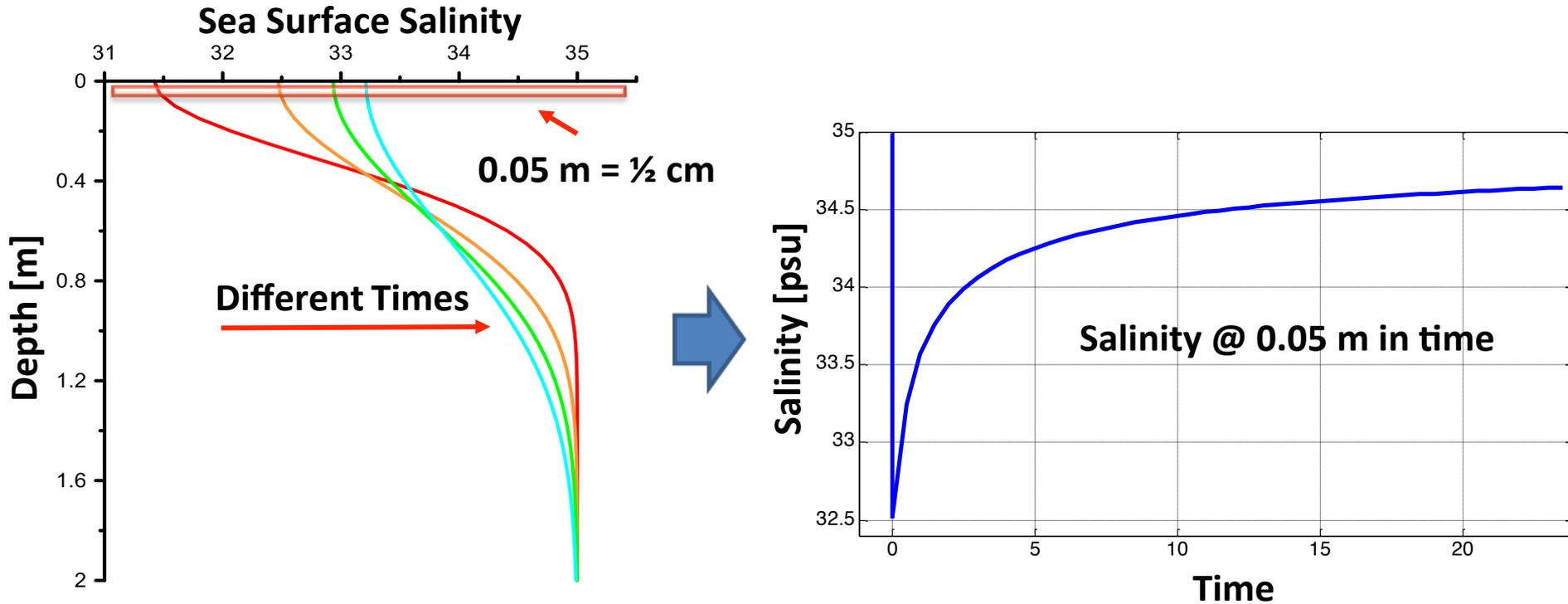
March Jacob, Andrea Santos-Garcia,  
and Linwood Jones,

- First, SSS differences ( $\Delta SSS = AQ - HYCOM$ ) have been observed during simultaneous rain events
  - Significant reductions in the satellite measured SSS for a majority of these events

January 23<sup>rd</sup> 2012 – Orbit 2 – Beam 1

- Instantaneous rainfall causes strong SSS reduction and salinity stratification at the surface
- Following the rain event, wave mixing and diffusion reduce the salinity over a time period of several hours
- AQ SSS measurements in the presence of rain can be significantly fresher than the bulk salinity at  $> 1$  m depth
- Salinity model to assess the impact of rain developed originally for AQ
  - SMAP salinity reductions also observed
    - Apply AQ salinity model to SMAP

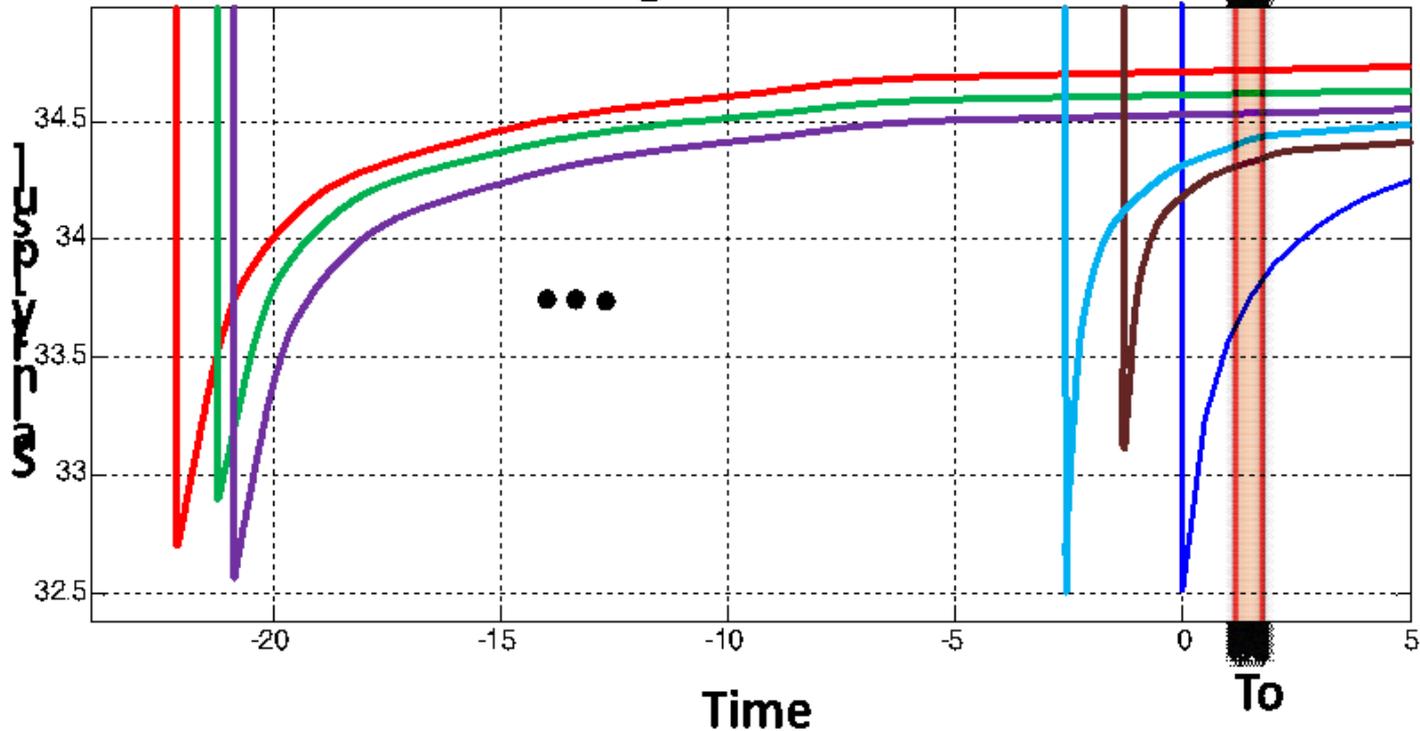
# Stratification - single Rain Event (Based on In-Situ Measurements)



$$S(z, t) = S_0 d_0 * \left( d_0 + \frac{R}{\sqrt{K_z * t}} e^{\left(\frac{-z^2}{4K_z t}\right)} \right)^{-1} \quad z = 0.5 \text{ cm}$$



## Superposition Model for Multiple Rain Events During last 24 Hours

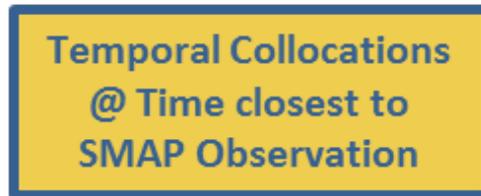


$$RIM_{SSS} = S_0 \left[ \left( \prod_{i=1}^n \left[ 1 + \frac{R_1 i}{\sqrt{K_z * t_i}} e^{(-z^2/4K_z t_i)} \right] \right) * \left[ 1 + \frac{R_2}{\sqrt{K_z * t}} e^{(-z^2/4K_z t)} \right] \right]^{-1}$$

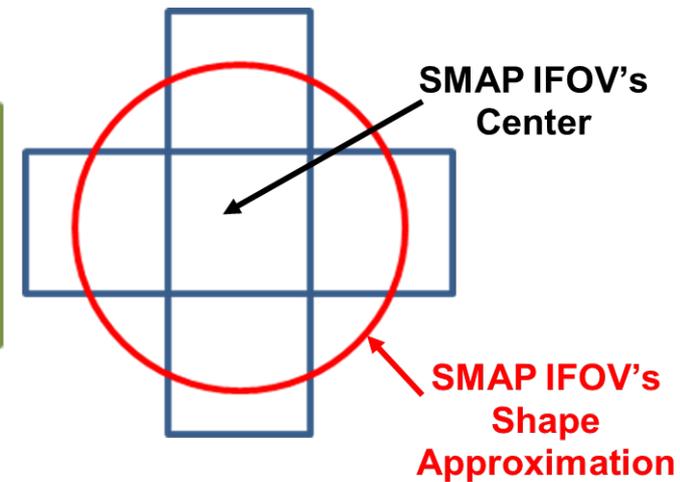
**HYCOM**
**Vertical Diffusivity**
**Rain Impulse Functions**
**Depth = 0.5 cm**

– **RIM<sub>SSS</sub>** is an empirical model that estimates the SSS under rainy conditions at 0.005 meters depth.

- Uses HYCOM as initialization (From SMAP CAP L2)
- April – May 2015
- Uses CMORPH to build the Rain History (CMORPH\_V1.0)



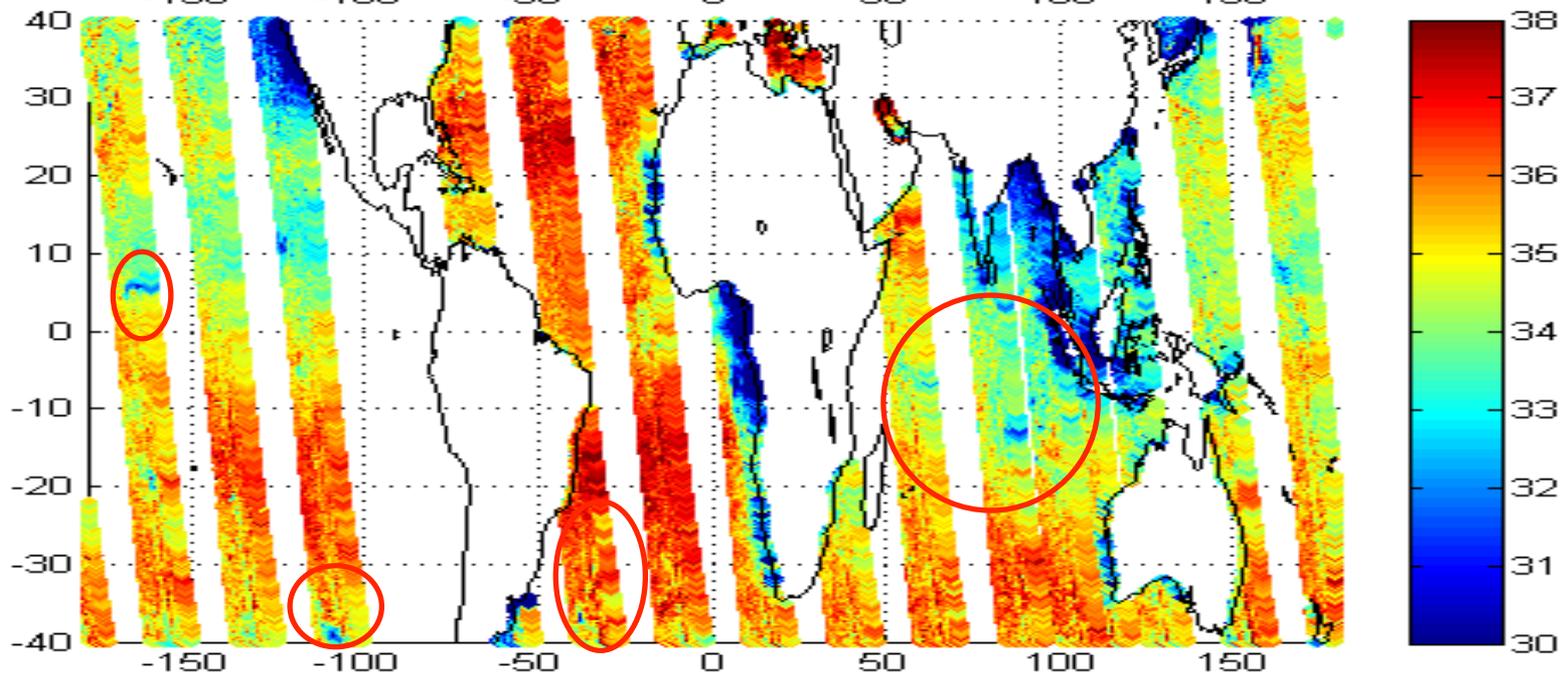
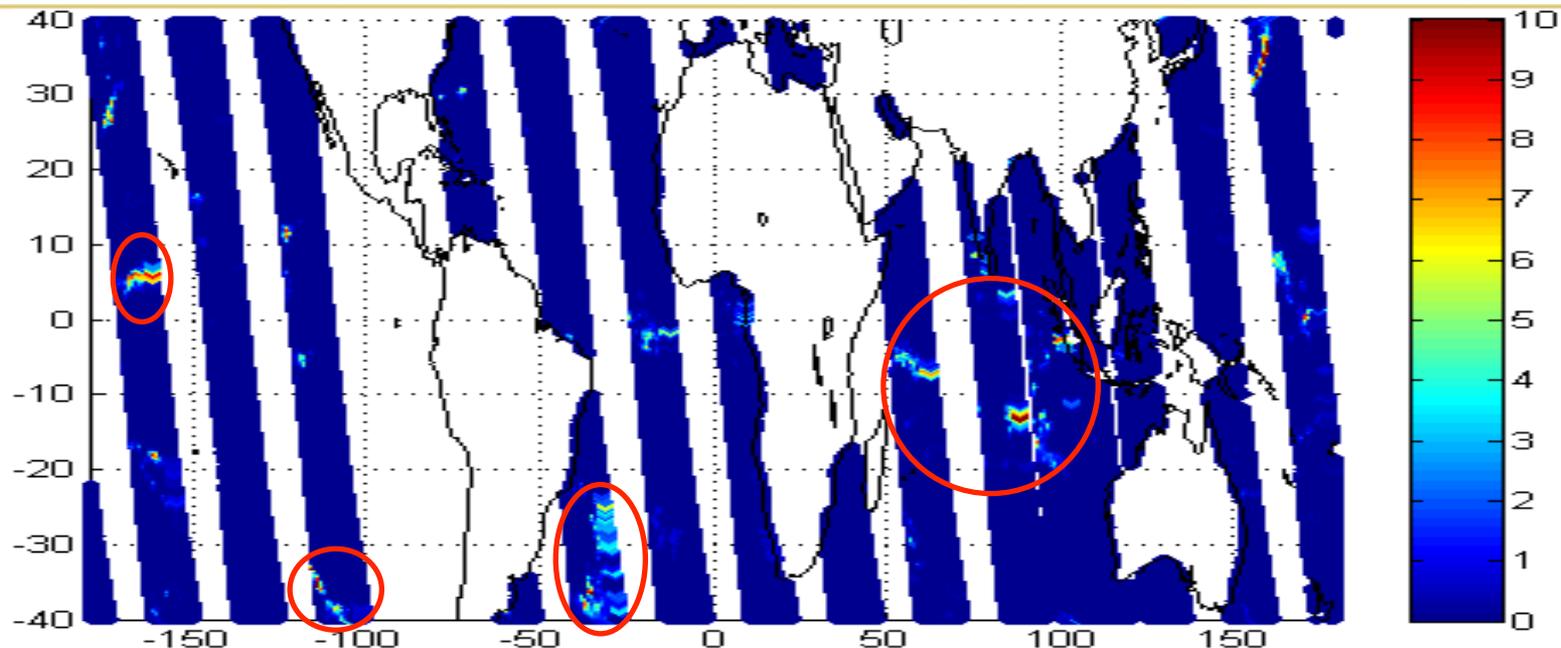
SMAP CAP Level 2 Ocean Salinity



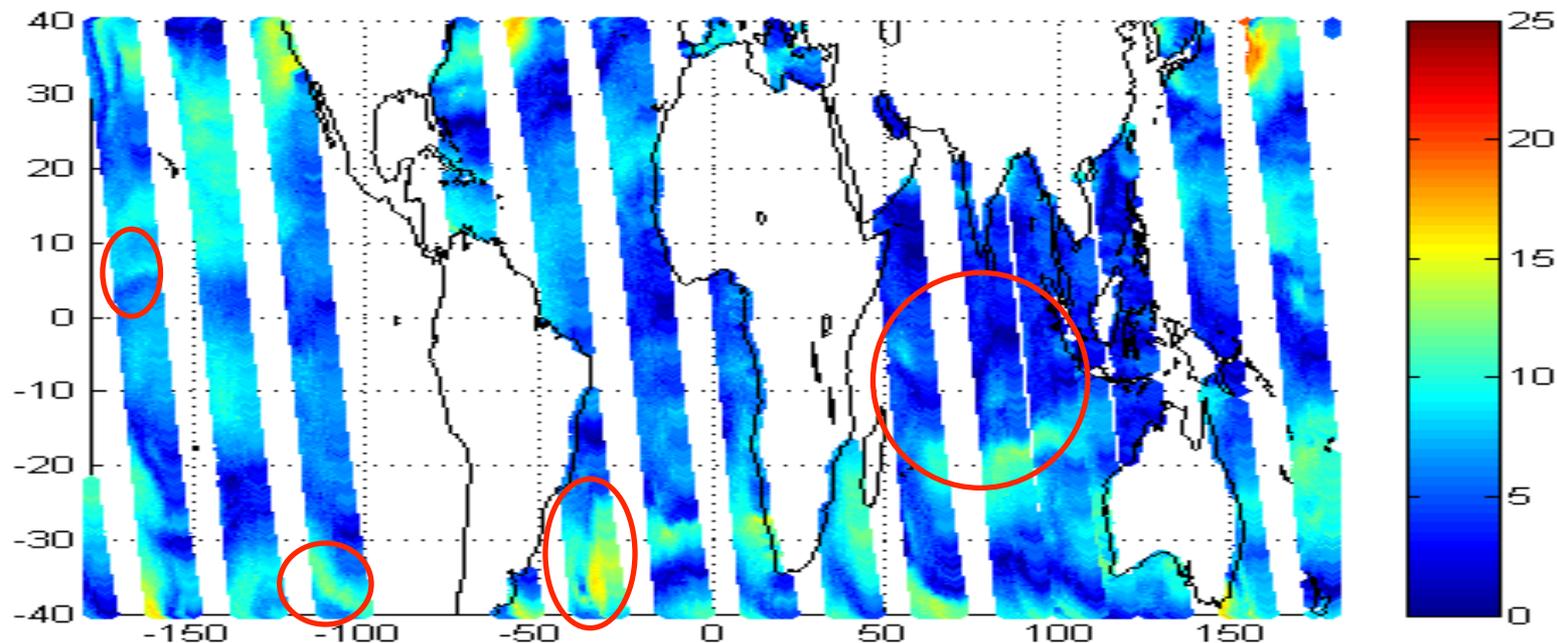
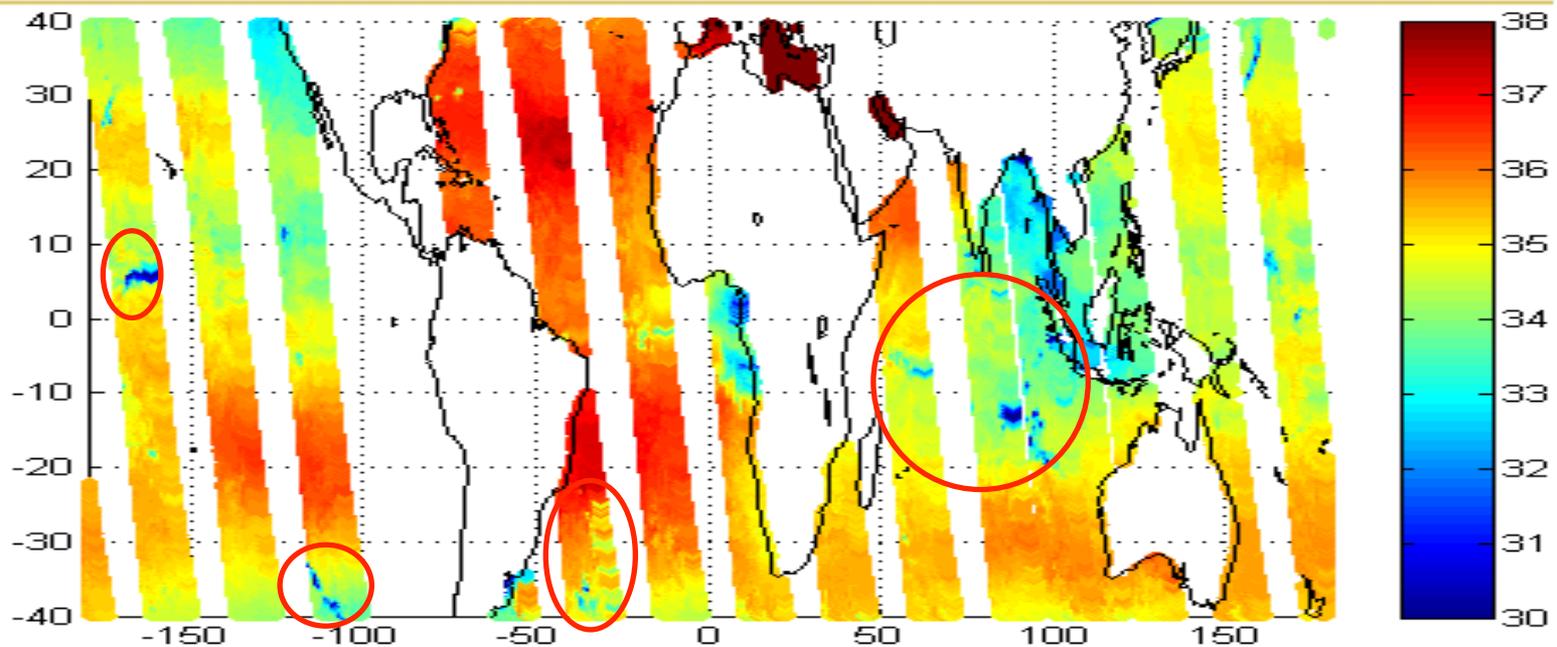
~40 km resolution



# Observations: Concatenated Cases IRR & SMAP SSS



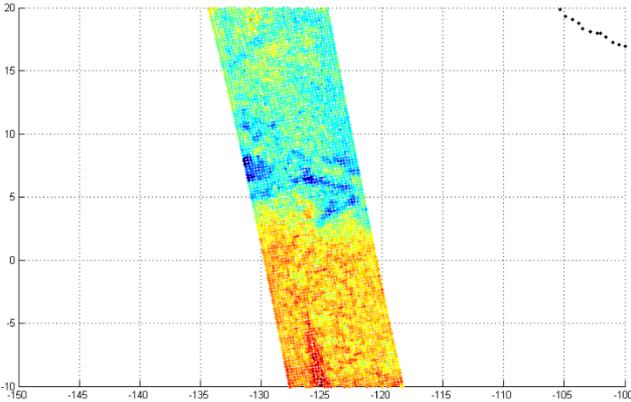
# Observations: Concatenated Cases RIM SSS & SMAP WS



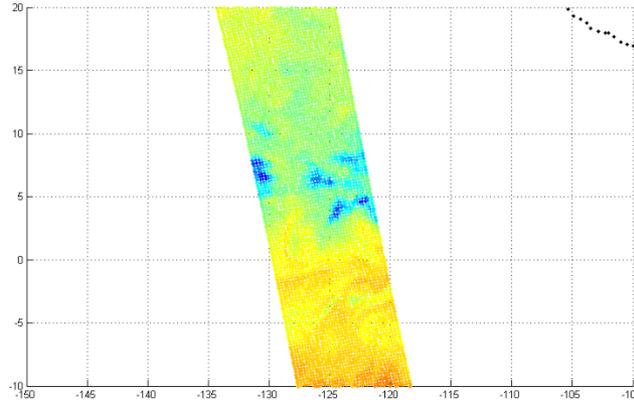
# Observations – Medium WS (<10 m/s)



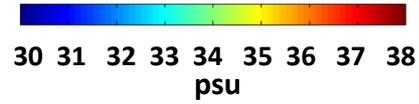
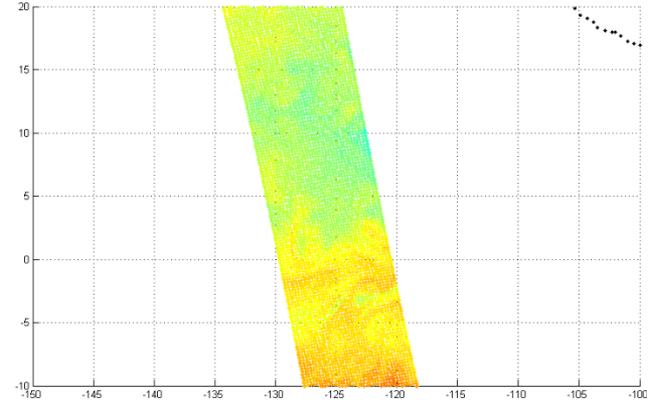
### SMAP SSS



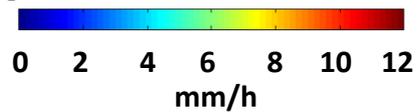
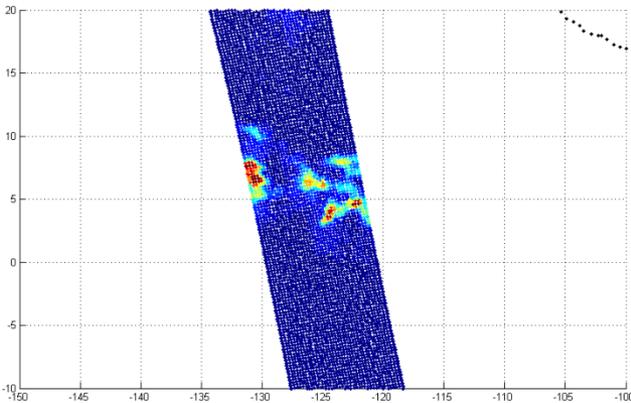
### RIM



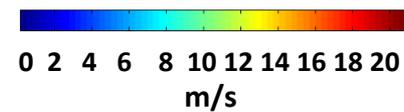
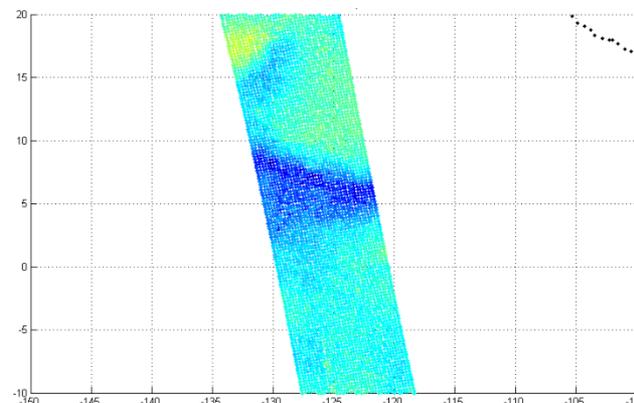
### HYCOM



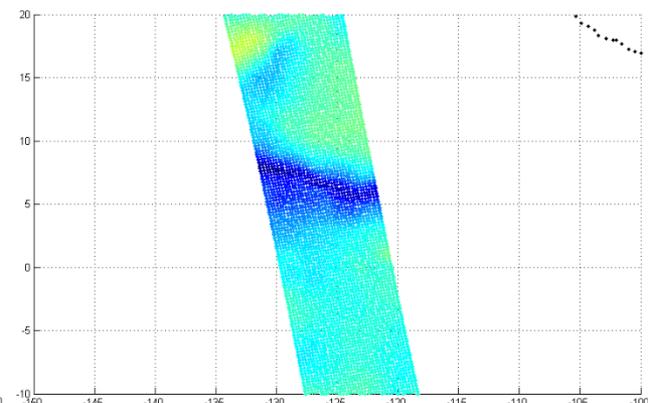
### IRR



### SMAP WS

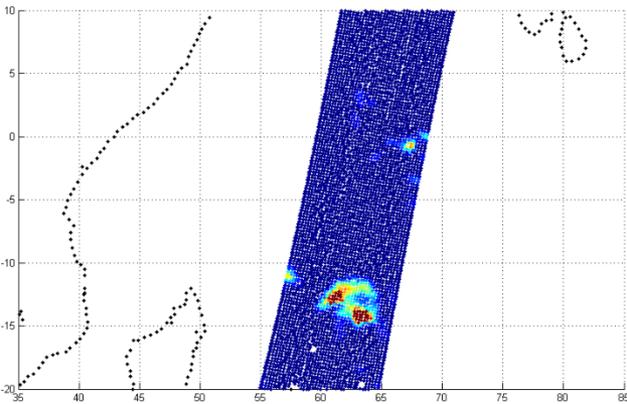


### NCEP WS

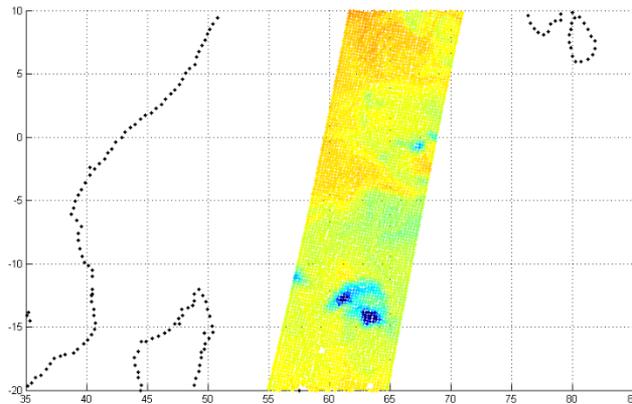


# Observations – High WS (>10 m/s)

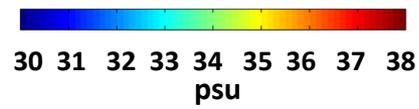
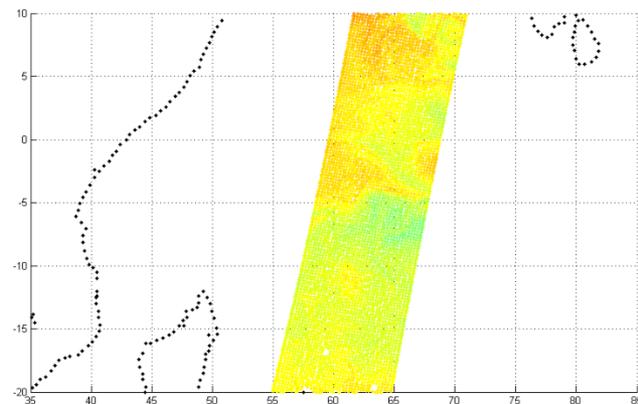
### IRR



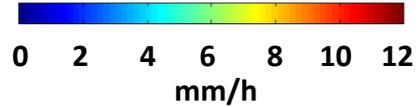
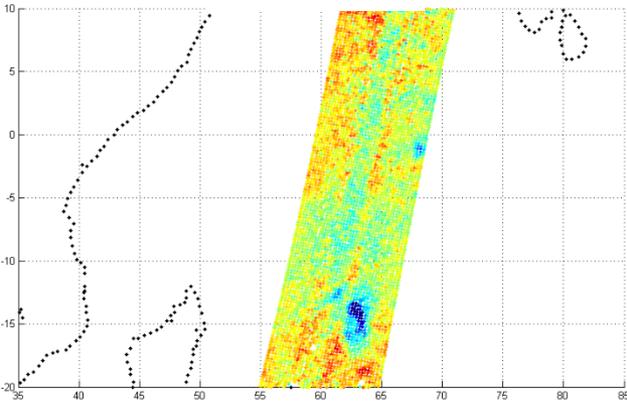
### RIM



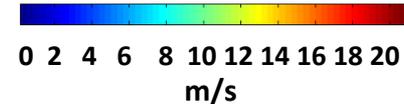
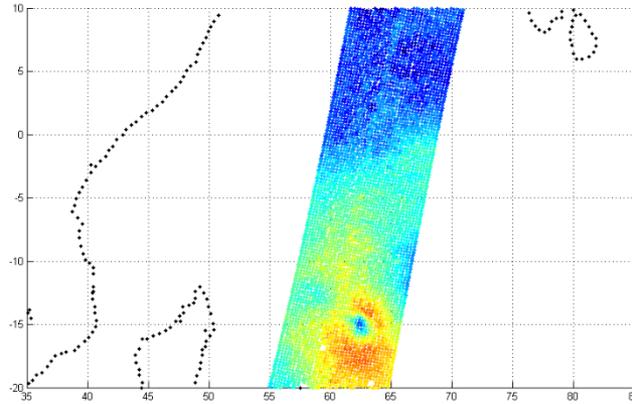
### HYCOM



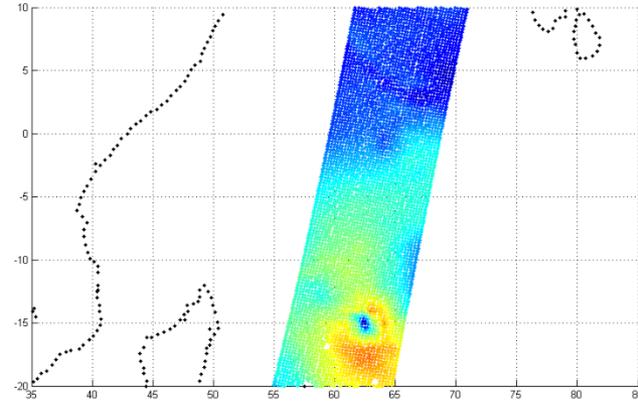
### SMAP SSS

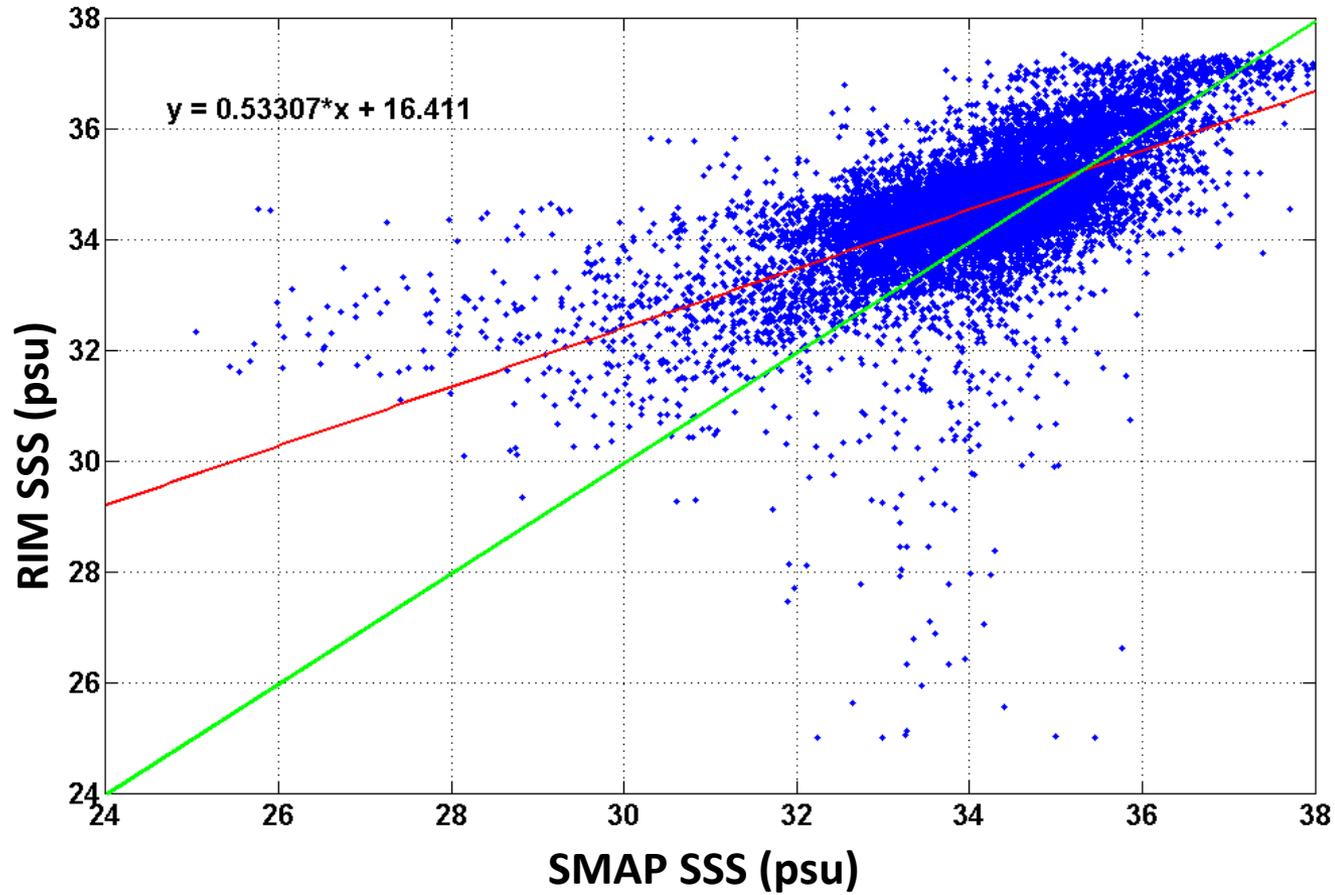


### SMAP WS



### NCEP WS





- Rain Impact Model (RIM), previously tuned and validated with Aquarius and SMOS, exhibits an equivalent performance using SMAP data
  - RIM provides positive identification of the existence of a transient salinity stratification due to rain accumulation over previous 6 – 12 hours
- Very good performance of RIM predicted sea surface salinity, compared to AQ and SMOS retrievals, provides a robust quality flag for identification of salinity stratification
- Further improvements can be achieved using RIM V2.0 (rain and wind speed effects)

# BACKUP