A STUDY OF THE INTERACTION BETWEEN SALINITY, RAIN AND WIND USING RIM

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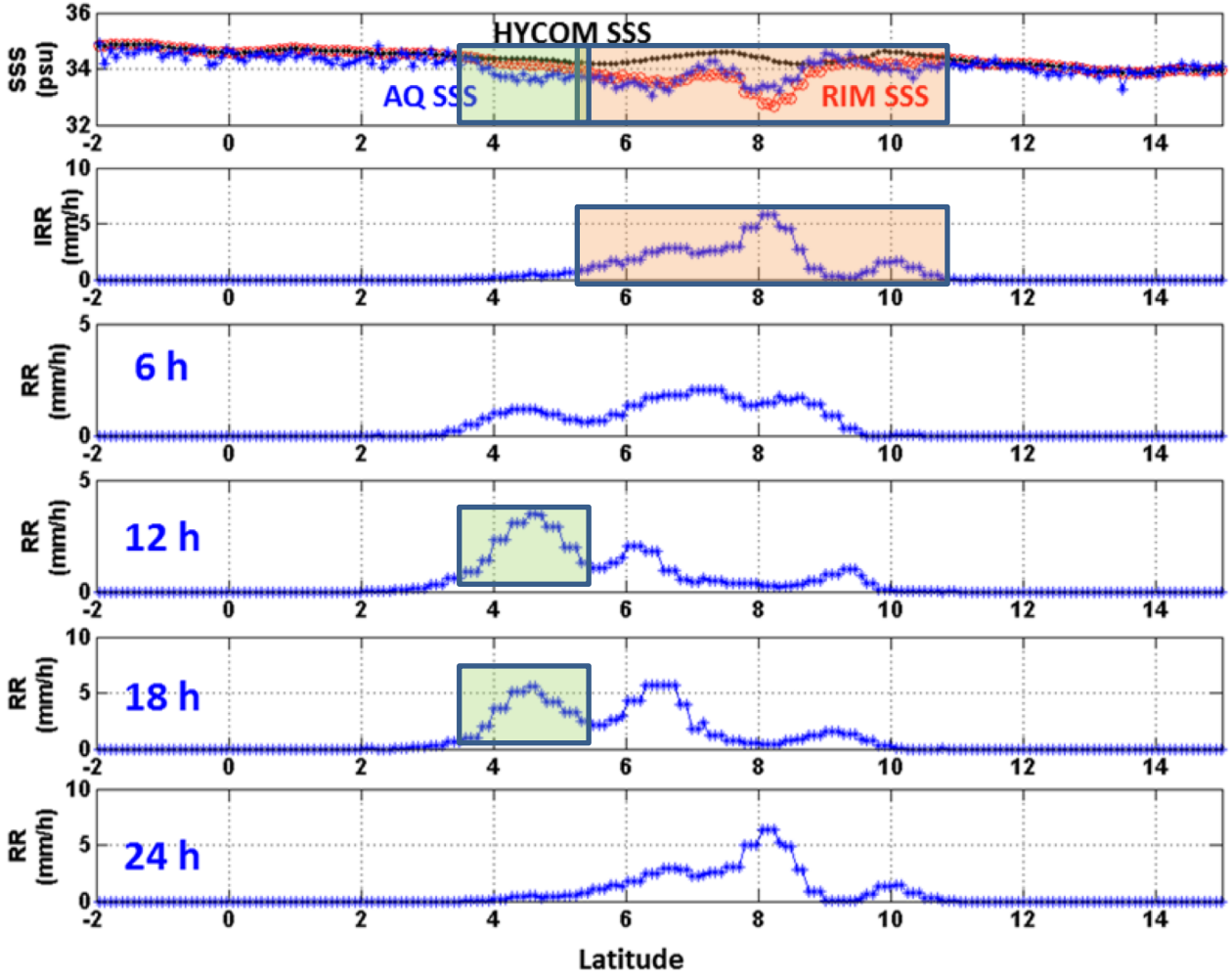
Aquarius: FIRST SSS OBSERVATIONS in RAIN

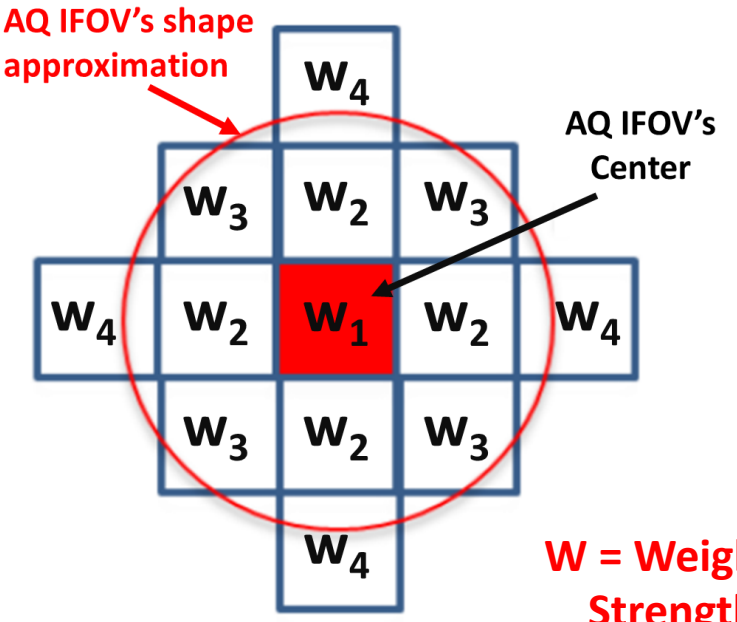
CFRSL

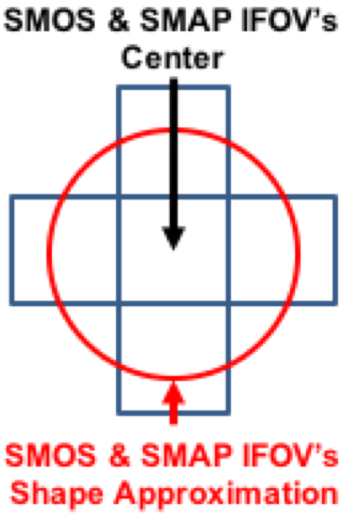
Motivation:

- Rain creates a fresh lens on the ocean surface
  - Then AQ SSS may be fresher than HYCOM



- Rain Accumulation based on NOAA CMORPH Rain data
  - Global coverage between ±60°lat
- Spatial integration over satellite remote sensor IFOV
  - Assumes circular footprint of 100 km
  - Uses 13 x 0.25° (AQ) boxes or 5 x 0.25° boxes (SMOS/SMAP)
  - Weighted average based on antenna beam efficiency

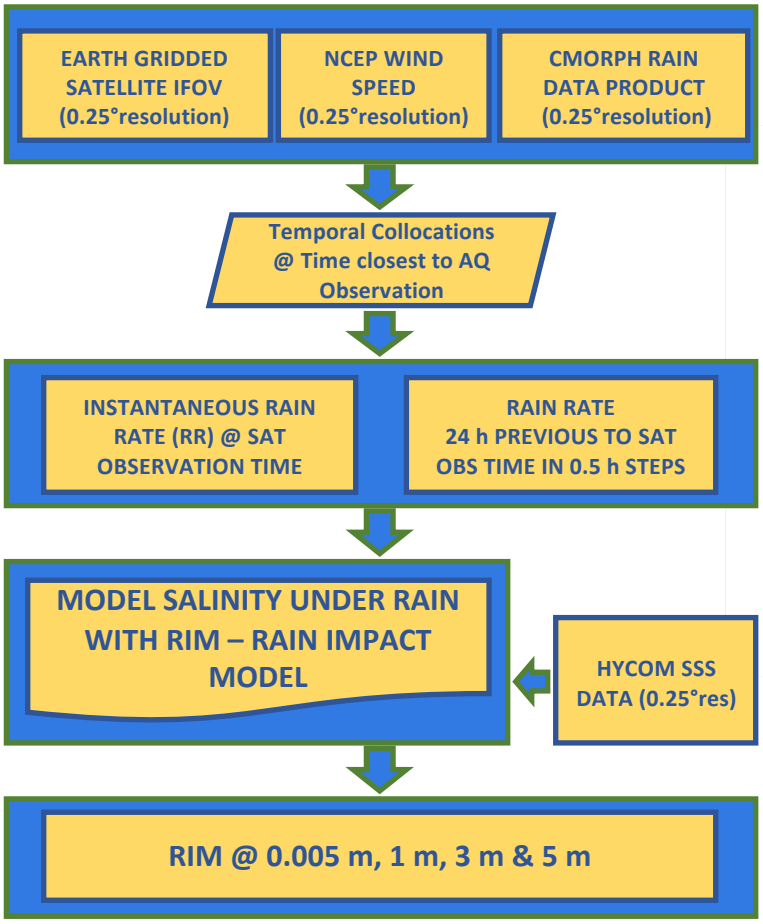


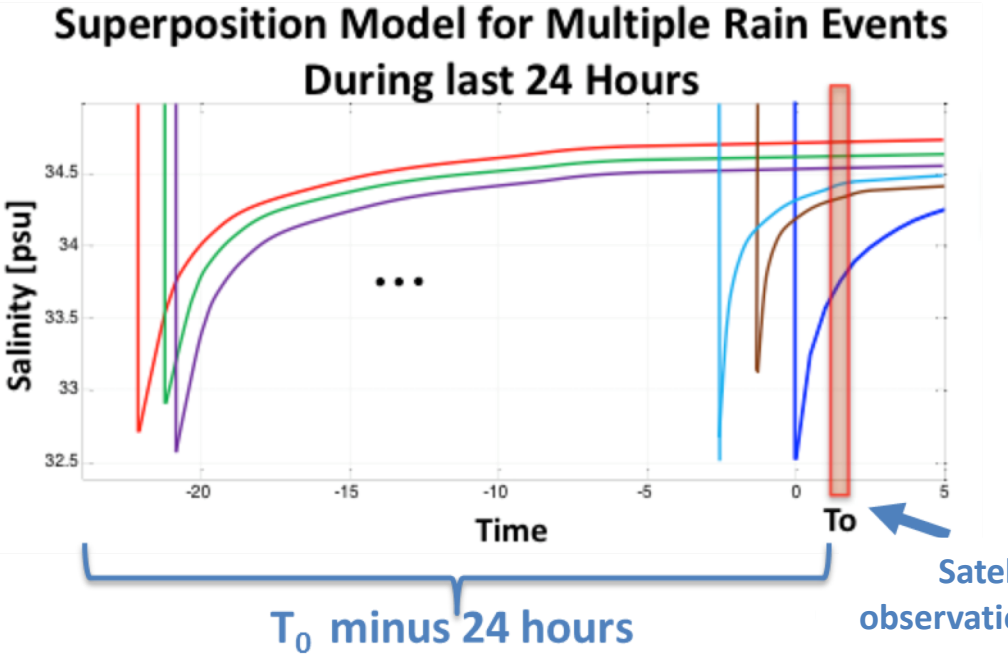


W = Weighted average Strength of signal

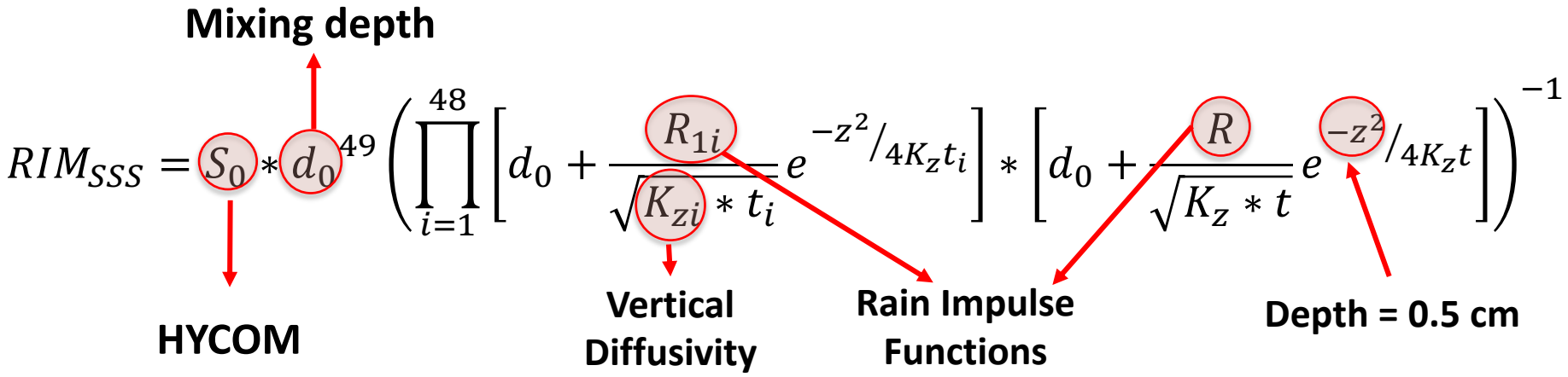
W1 > W2 > W3 > W4

APPROACH


EARTH GRIDDED SATELLITE IFOV (0.25°resolution)
NCEP WIND SPEED (0.25°resolution)
CMORPH RAIN DATA PRODUCT (0.25°resolution)
Temporal Collocations @ Time closest to AQ Observation
INSTANTANEOUS RAIN RATE (RR) @ SAT OBSERVATION TIME
RAIN RATE 24 h PREVIOUS TO SAT OBS TIME IN 0.5 h STEPS
MODEL SALINITY UNDER RAIN WITH RIM – RAIN IMPACT MODEL
HYCOM SSS DATA (0.25°res)
RIM @ 0.005 m, 1 m, 3 m & 5 m


Superposition Model for Multiple Rain Events During last 24 Hours
Salinity [psu]
34.5
34
33.5
33
32.5
-20
-15
-10
-5
0
5
Time
To
Satellite observation time
T0 minus 24 hours

RAIN IMPACT MODEL (RIM)

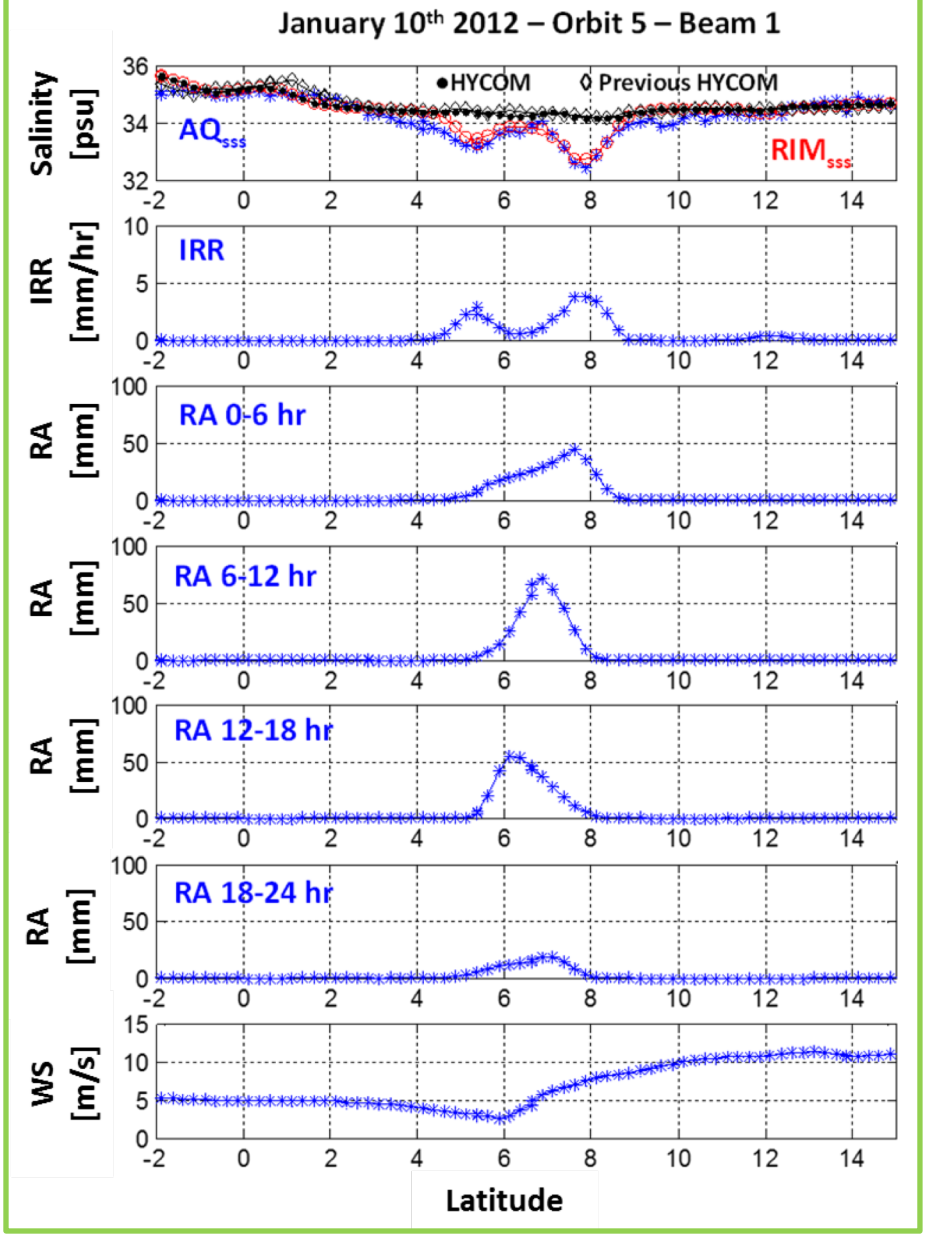


Ancillary paramenters:

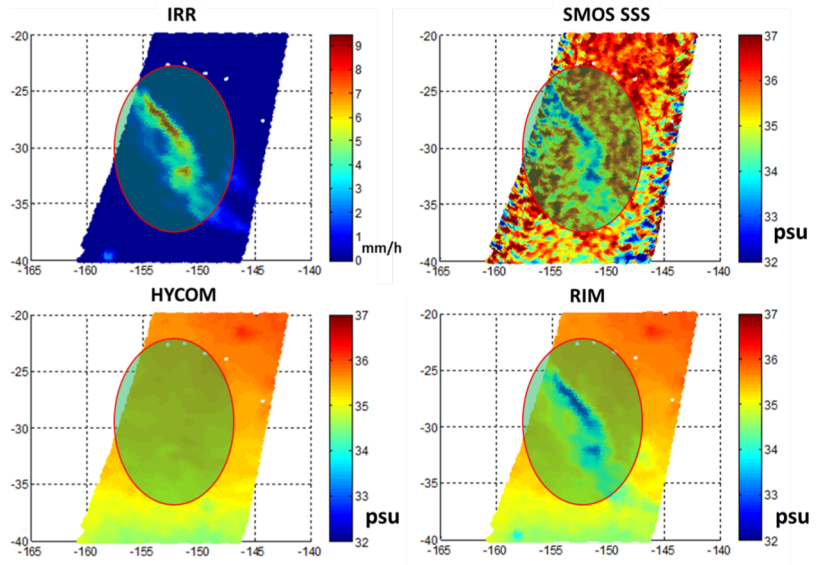
- **BF** (Rain Beam Fill Fraction): area weighted % of the beam with IRR > 0.25 mm/hr
  - how much it rains in each of the boxes
- **PSS** (Probability of Salinity Stratification): normalized ΔSSS per orbit between RIM at 10 m and RIM at 0.005 m

RESULTS: RIM v1

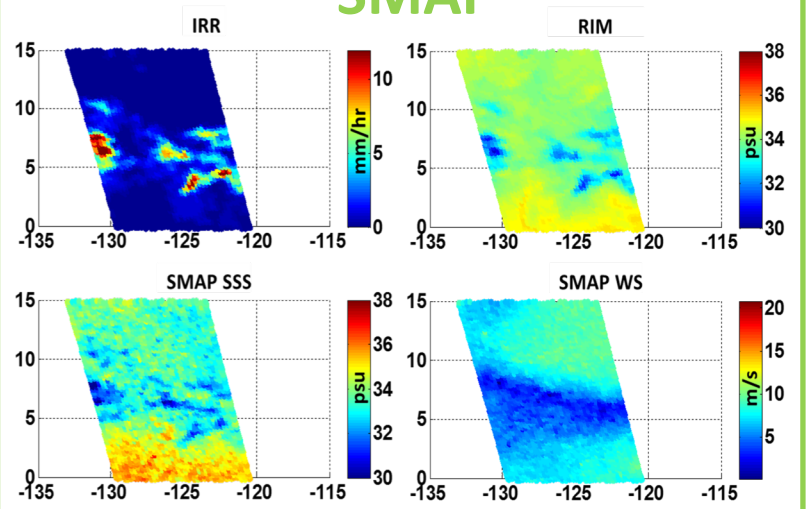
AQUARIUS



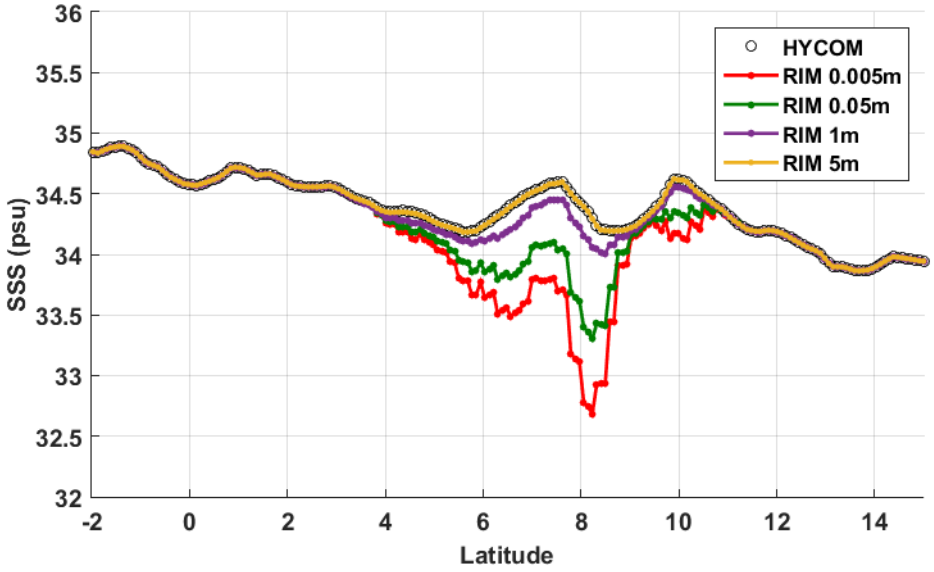
SMOS

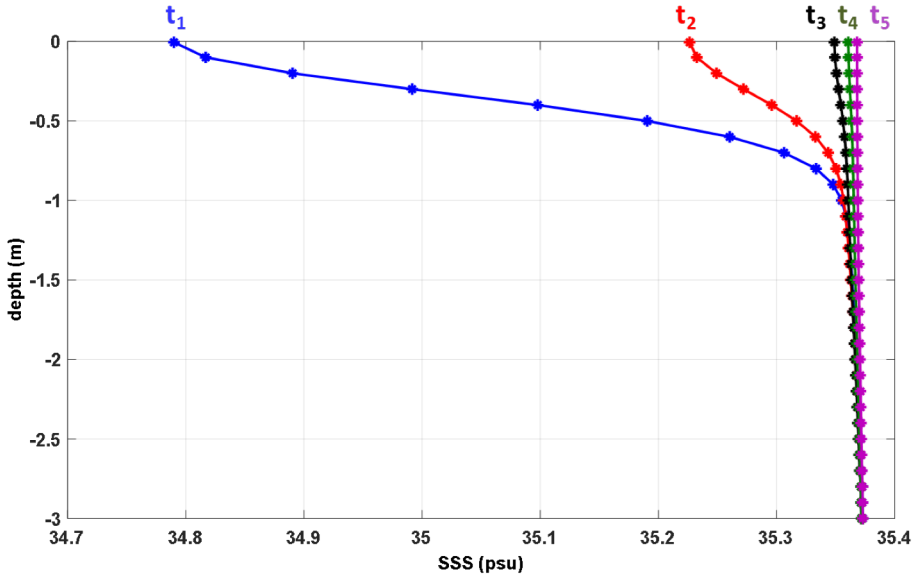


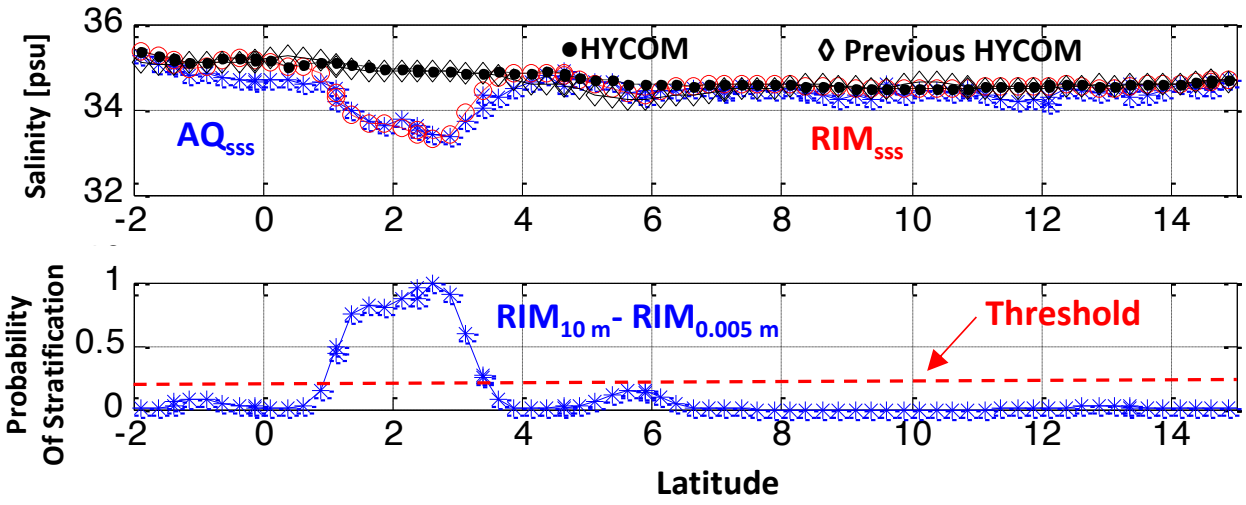
SMAP



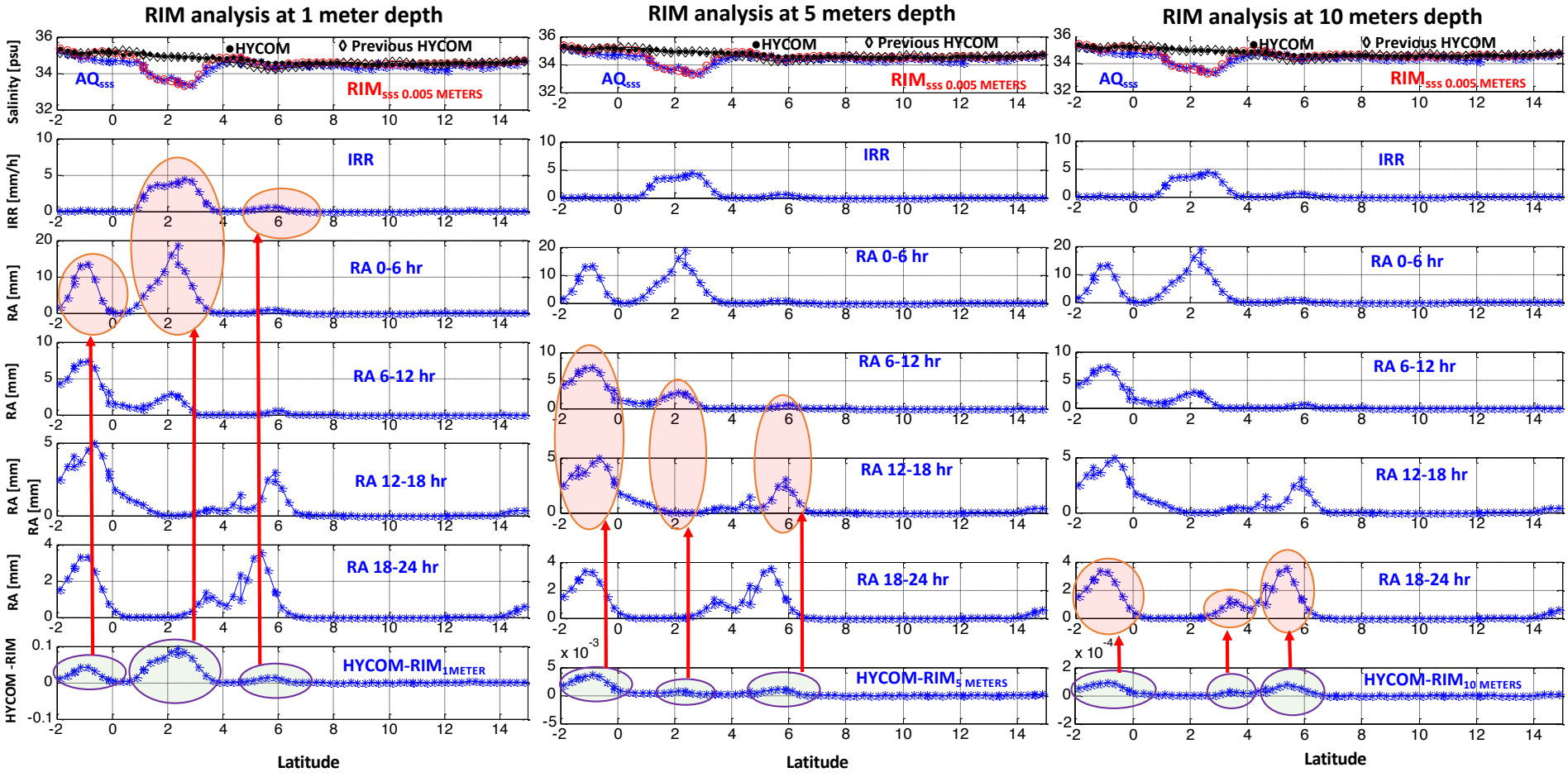
RESULTS: STRATIFICATION ANALYSIS



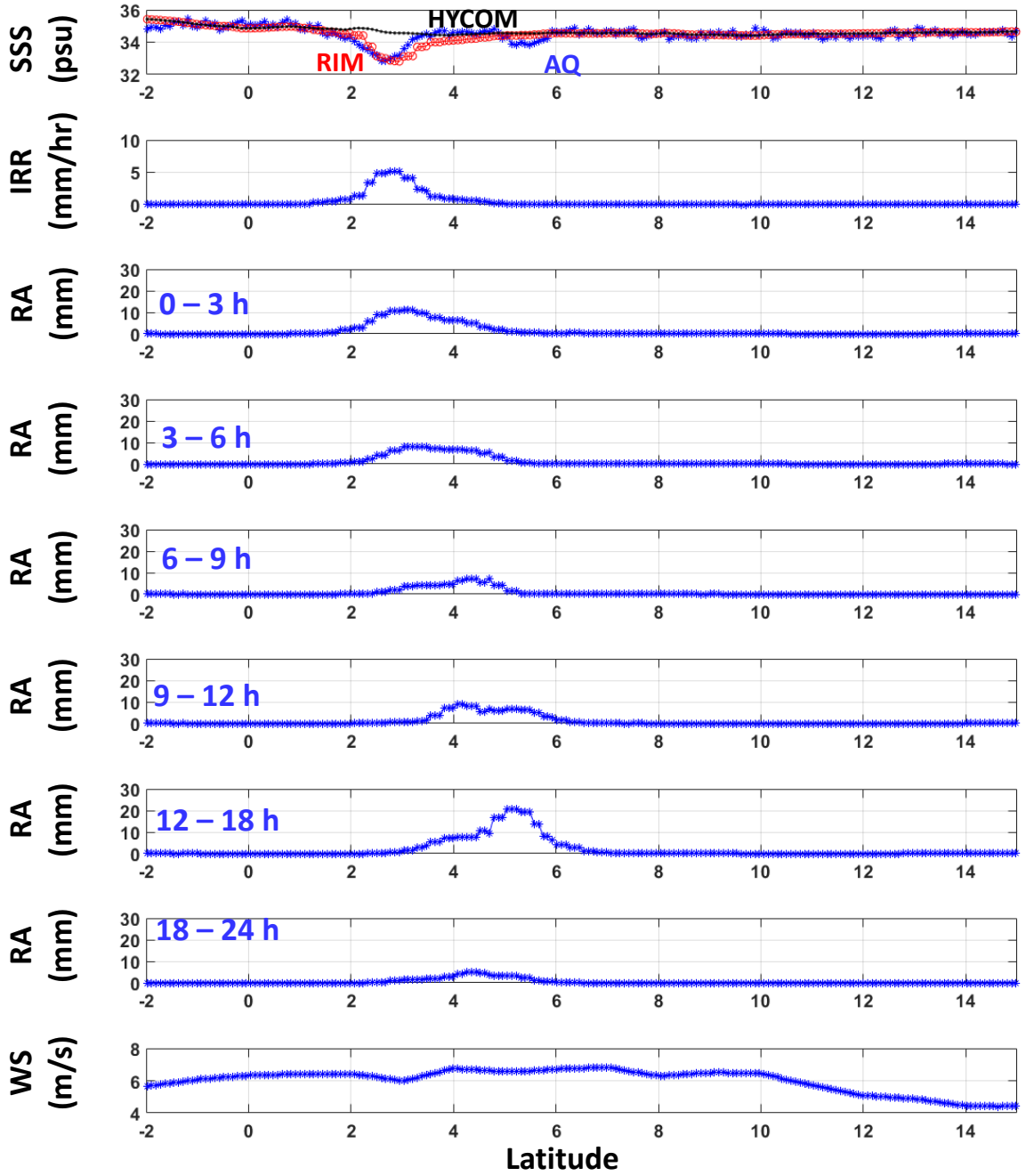




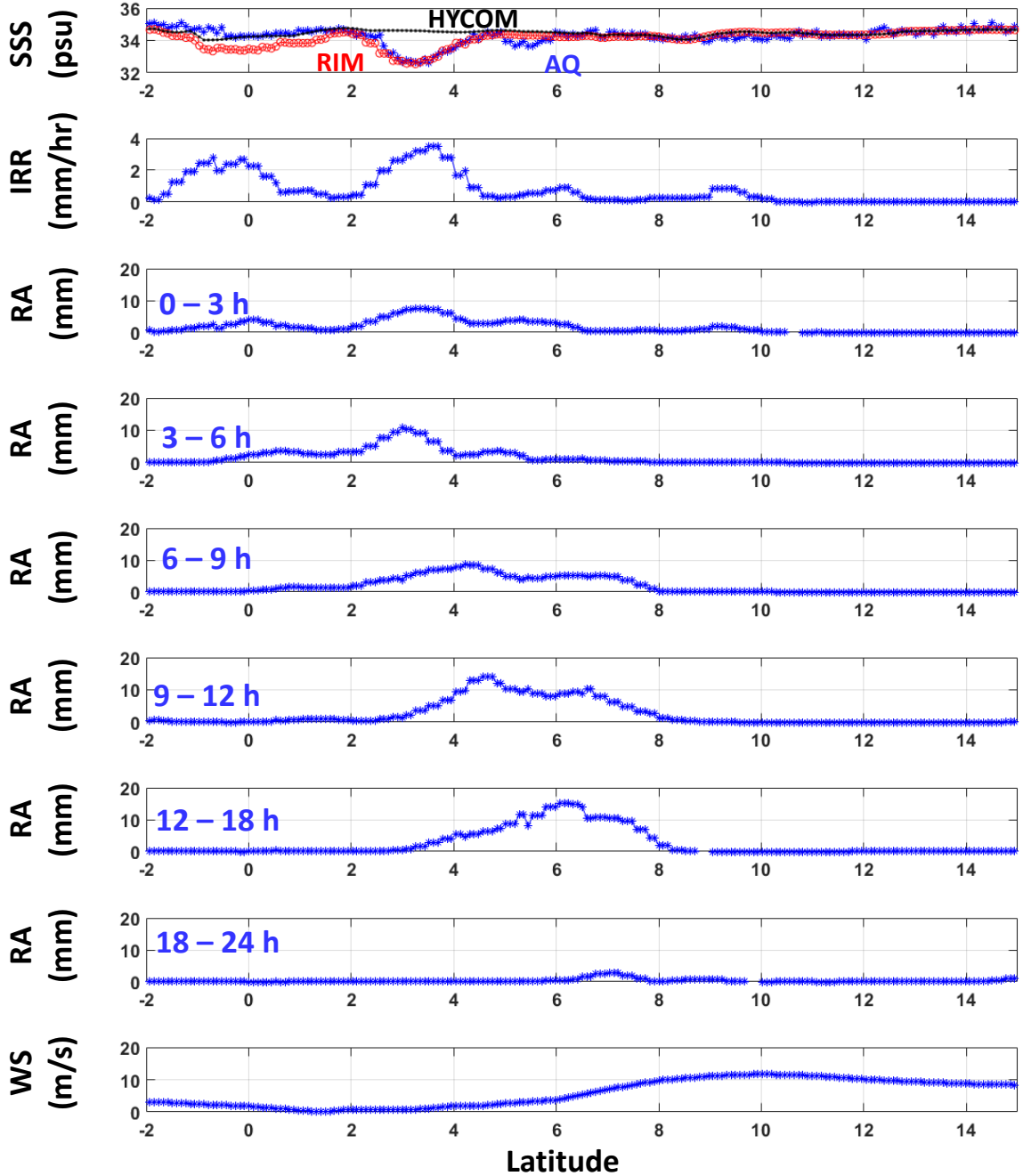
RESULTS: STRATIFICATION ANALYSIS – cont.



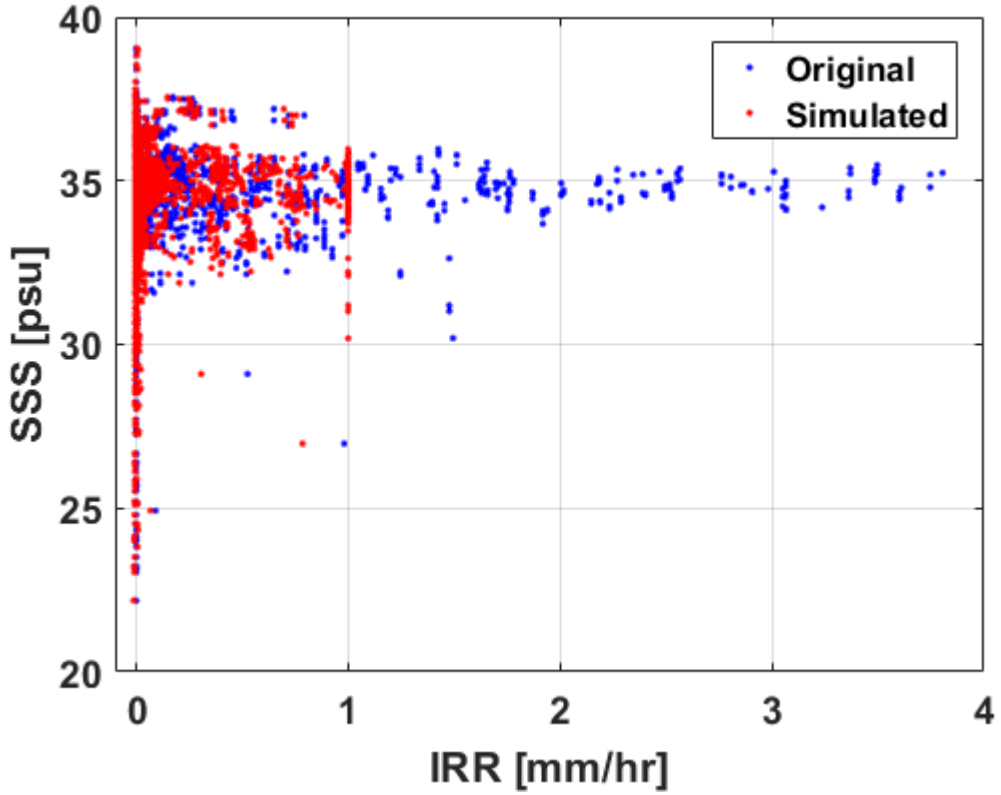
RESULTS: RIM v3



RESULTS: RIM v3 – cont.

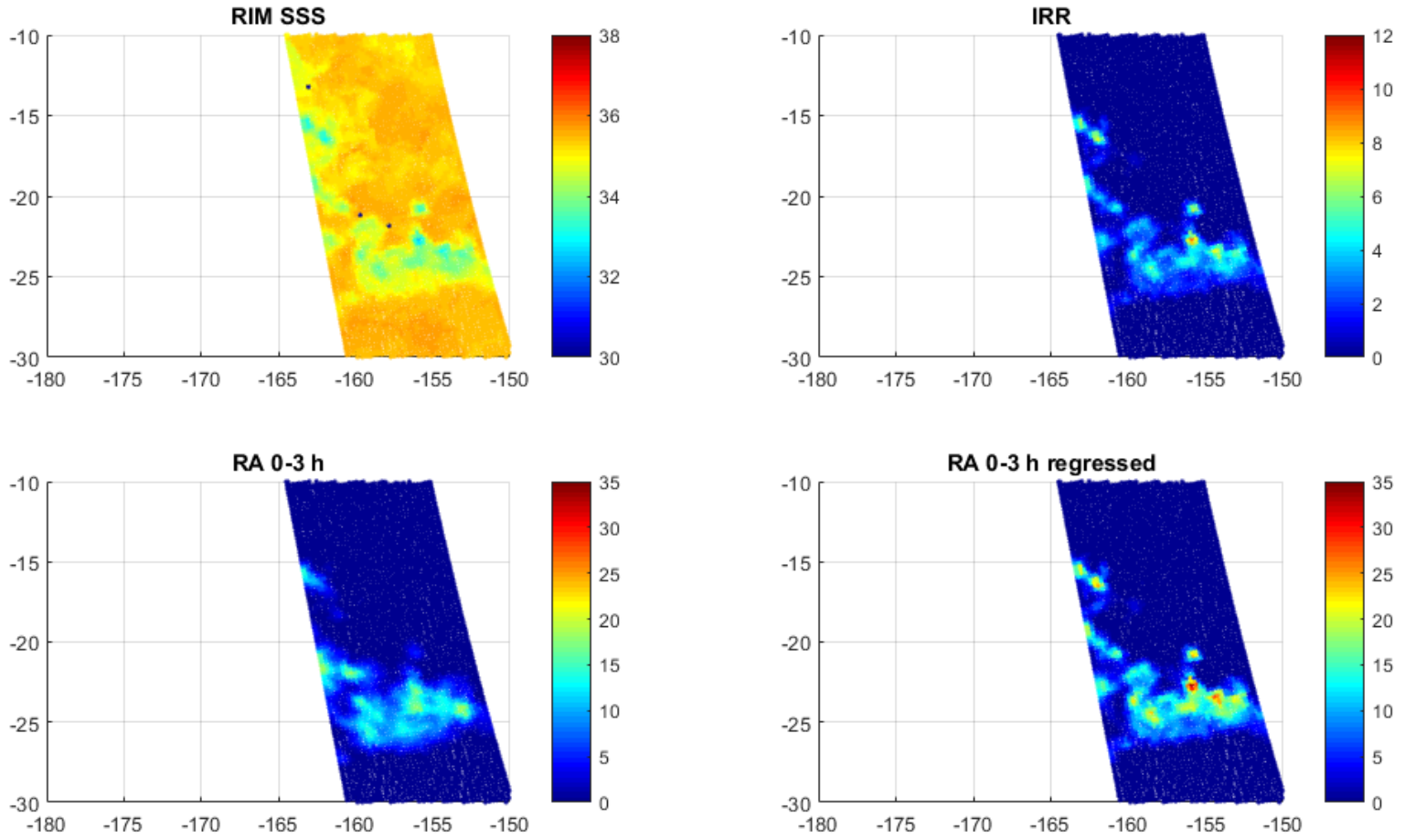


- Neural Networks
  - 2 hidden layers, each with 5 neurons
  - Inputs: SSS, lat, lon, HYCOM, RIM, time
  - Outputs: RR
  - Training dataset: 1 week
  - Testing dataset: 1 day



RAIN from SSS – cont.

$$RA_{reg} = -3.70 \times \Delta S - 0.04^{\dagger\dagger}$$



[††] Supply, A., Boutin, J., Vergely, J., Martin, N., Hasson, A., Reverdin, G., Mallet, C. and Viltard, N. (2017), Precipitation estimates from SMOS sea-surface salinity, *Q.J.R. Meteorol. Soc*. doi:10.1002/qj.3110.

SUMMARY

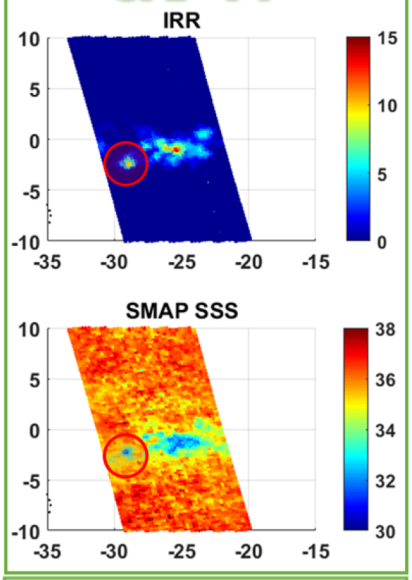
- RIM has been demonstrated to work for Aquarius, SMAP & SMOS
  - RIM for AQ available with AQ v5
- RIM provides positive identification of the existence of a transient salinity stratification due to rain accumulation
  - RIM provides a robust quality flag for identification of salinity stratification
- Work in progress
  - Kz parametrized using GOTM model
  - Field measurements
    - SPURS 2
  - IMERG Rainfall data

RAIN ISSUES?

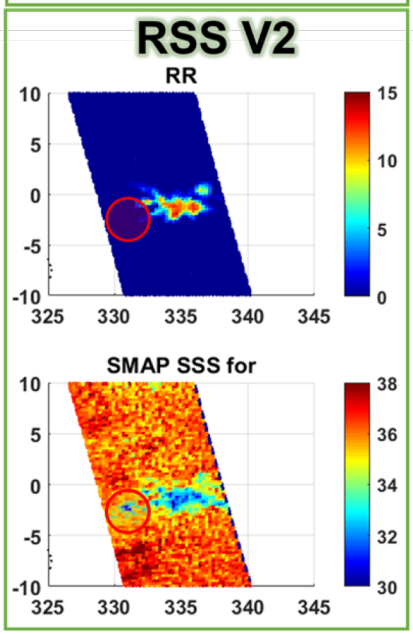
CFRSL

MODERATE WINDS (< 10 m/s)

CAP V4

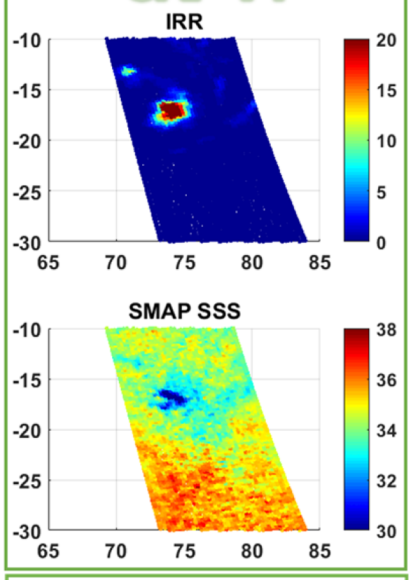


RSS V2



HIGH WINDS (> 12 m/s)

CAP V4



RSS V2