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

Maria Jacob, Linwood Jones, William Asher, Kyla Drushka, and Marcelo Scavuzzo
Motivation:

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

- 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

\[ W = \text{Weighted average} \]
\[ \text{Strength of signal} \]
\[ W_1 > W_2 > W_3 > W_4 \]
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]

T₀ minus 24 hours

Satellite observation time
Ancillary parameters:

- **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

January 10th 2012 – Orbit 5 – Beam 1

Selinity [psu]

IRR [mm/hr]

RA [mm]

SMOS

SMAP
RESULTS: STRATIFICATION ANALYSIS

- Cross correlation = 0.9148/0.91936

Graphs showing:
- Salinity [psu] vs. Latitude
- Probability of Stratification vs. Latitude
- Depth vs. SSS (psu)
RESULTS: RIM v3

- SSS (psu)
- IRR (mm/hr)
- RA (mm)
- WS (m/s)

Latitude

0 – 3 h
3 – 6 h
6 – 9 h
9 – 12 h
12 – 18 h
18 – 24 h
RESULTS: RIM v3 – cont.

- **SSS (psu)**
  - HYCOM
  - RIM
  - AQ

- **IRR (mm/hr)**
  - 0 – 3 h
  - 3 – 6 h
  - 6 – 9 h
  - 9 – 12 h
  - 12 – 18 h
  - 18 – 24 h

- **RA (mm)**
  - 0 – 3 h
  - 3 – 6 h
  - 6 – 9 h
  - 9 – 12 h
  - 12 – 18 h
  - 18 – 24 h

- **WS (m/s)**

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RAIN from SSS

- 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.

\[ RA_{\text{reg}} = -3.70 \times \Delta S - 0.04^{++} \]

• 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?

MEDIUM WINDS (< 10 m/s)

CAP V4

IRR

SMAP SSS

RSS V2

RR

SMAP SSS for

NCEP Wind Speed

SMAP Wind Speed

HYCOM SSS

HIGH WINDS (> 12 m/s)

CAP V4

IRR

SMAP SSS

RSS V2

RR

SMAP SSS for

NCEP Wind Speed