Observation of Salinity Gradients in the Top Five Meters of the Ocean Surface

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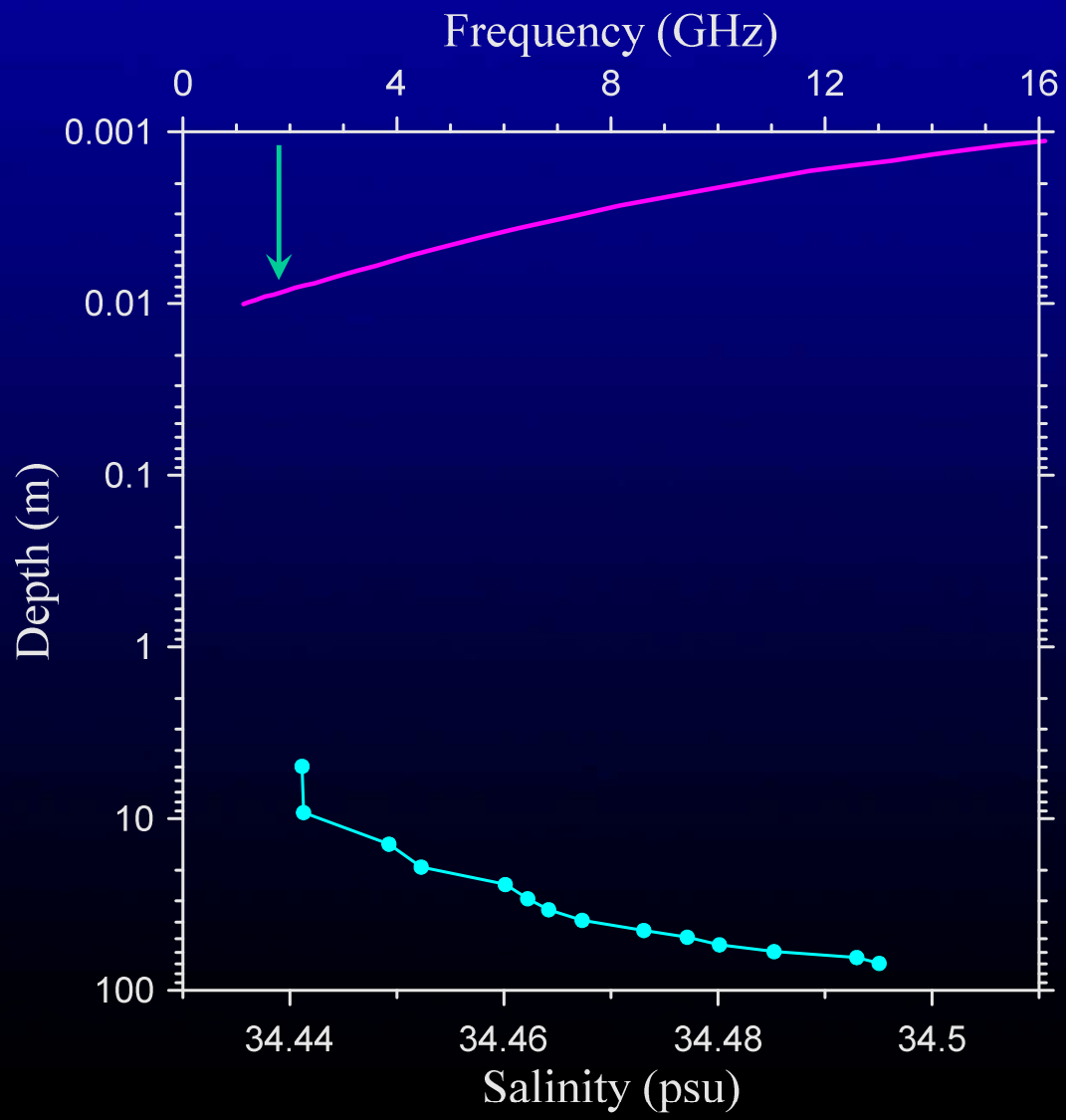
Project funded by NASA Aquarius Program: Grant NNX09AU73G

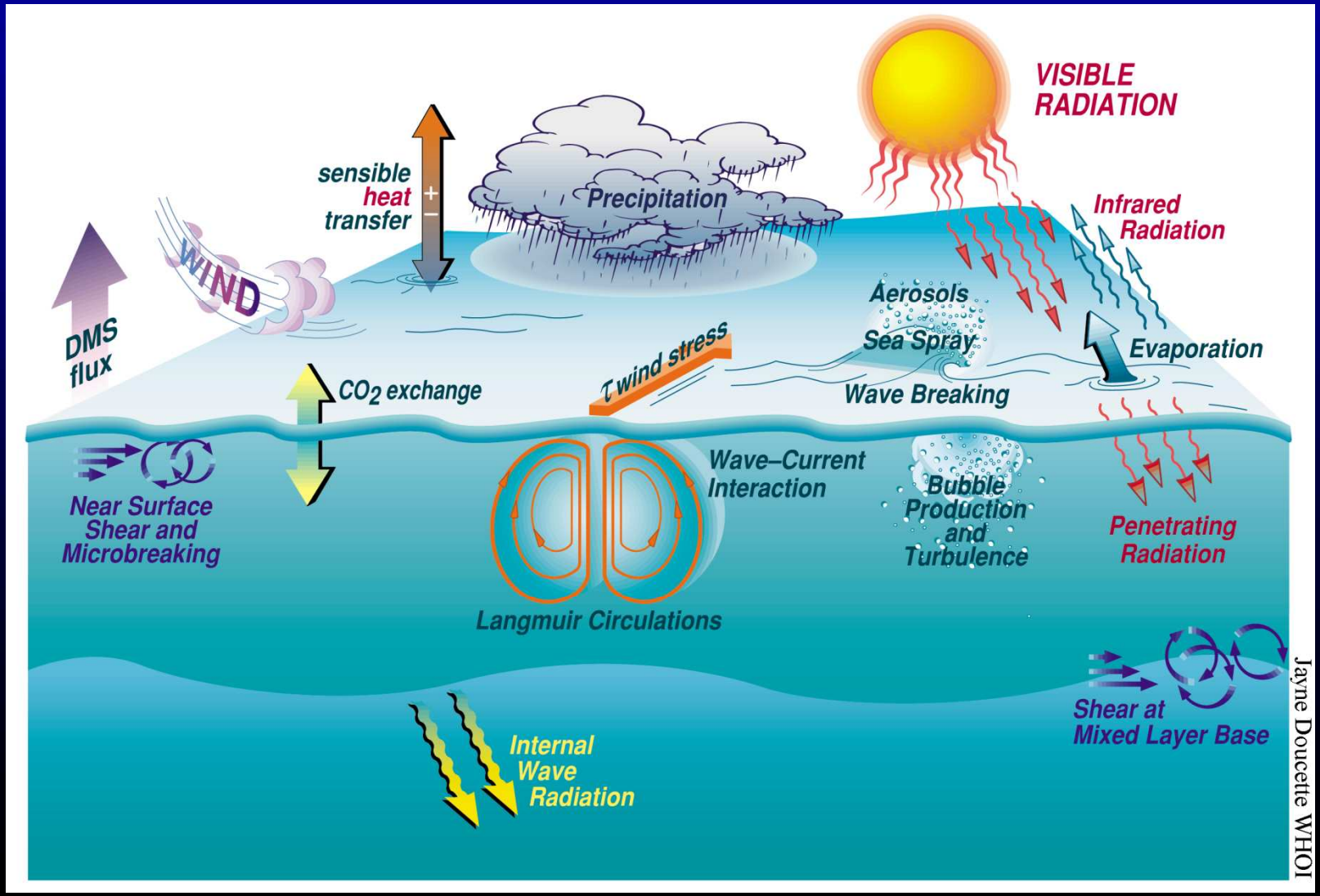
Why are salinity gradients at the ocean surface important?



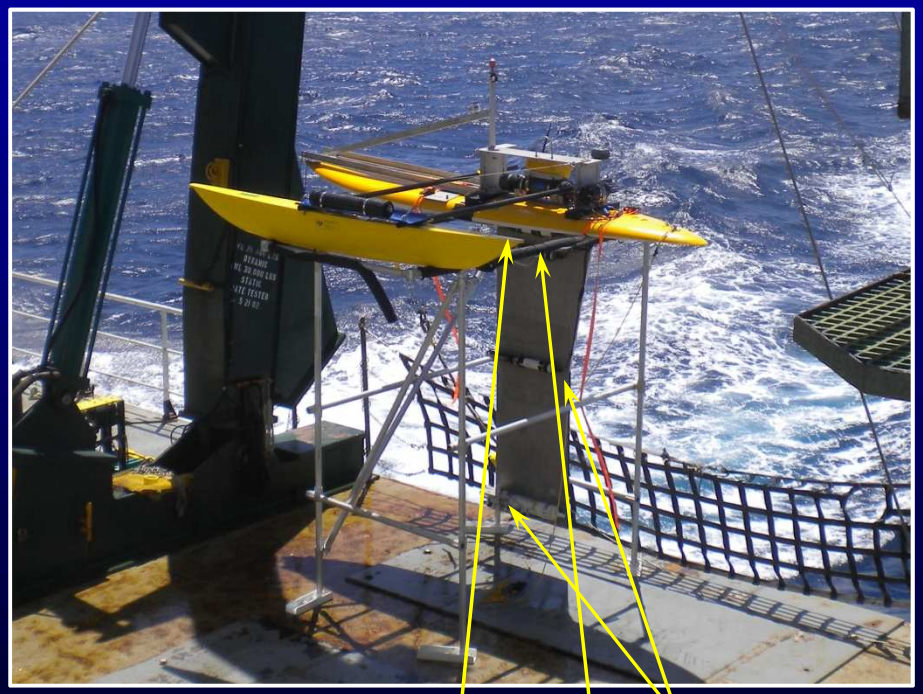
Microwave penetration depth as a function of frequency

Typical ARGO float salinity profile

How do salinity gradients form?



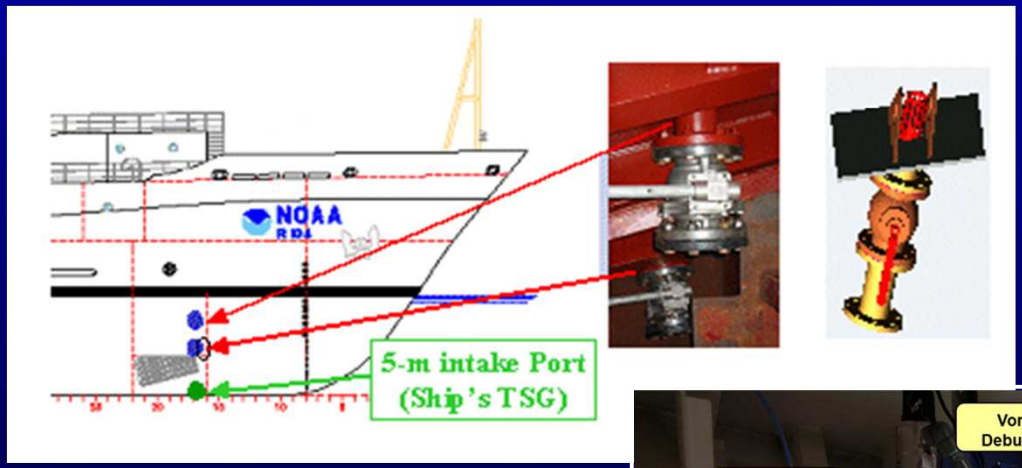
Measuring salinity gradients: The Surface Salinity Profiler (SSP)

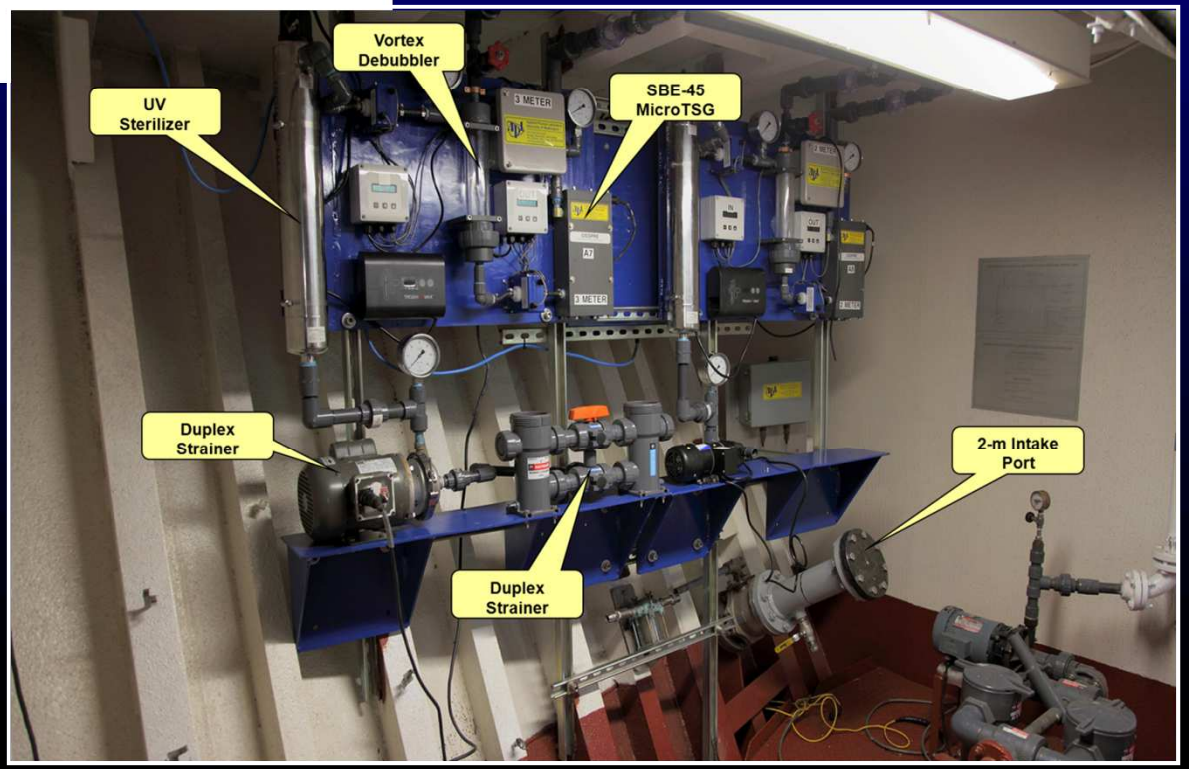


Instrumented with:
0.05 m Seabird 49 CTD
0.20 m Seabird 49 CTD
1.00 m Seabird 49 CTD
2.00 m Seabird 19 CTD

Towed from ship
Follows surface at tow speeds of 2 m/s
Rides outboard of wake
Instruments mounted on rigid keel

The underway salinity gradient instrument package on the *R/V Thomas G. Thompson*





Measuring salinity gradients in the equatorial Pacific Ocean using the SSP

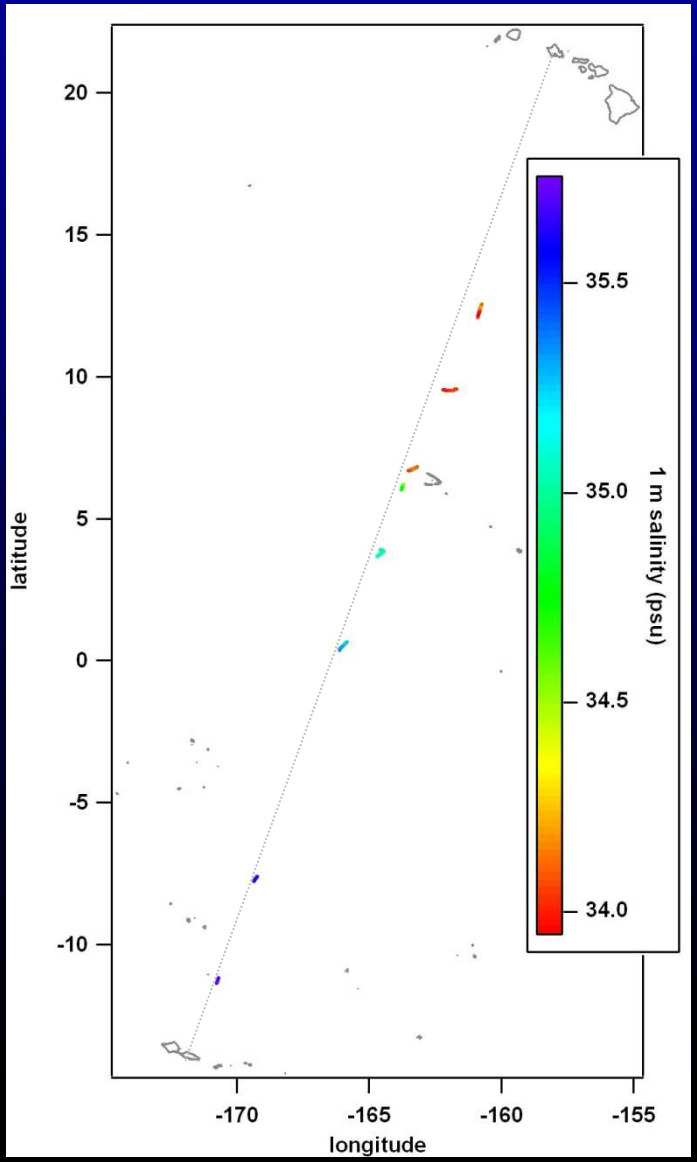
SSP deployed from the *R/V Kilo Moana*

Cruise conducted December 6-16, 2011

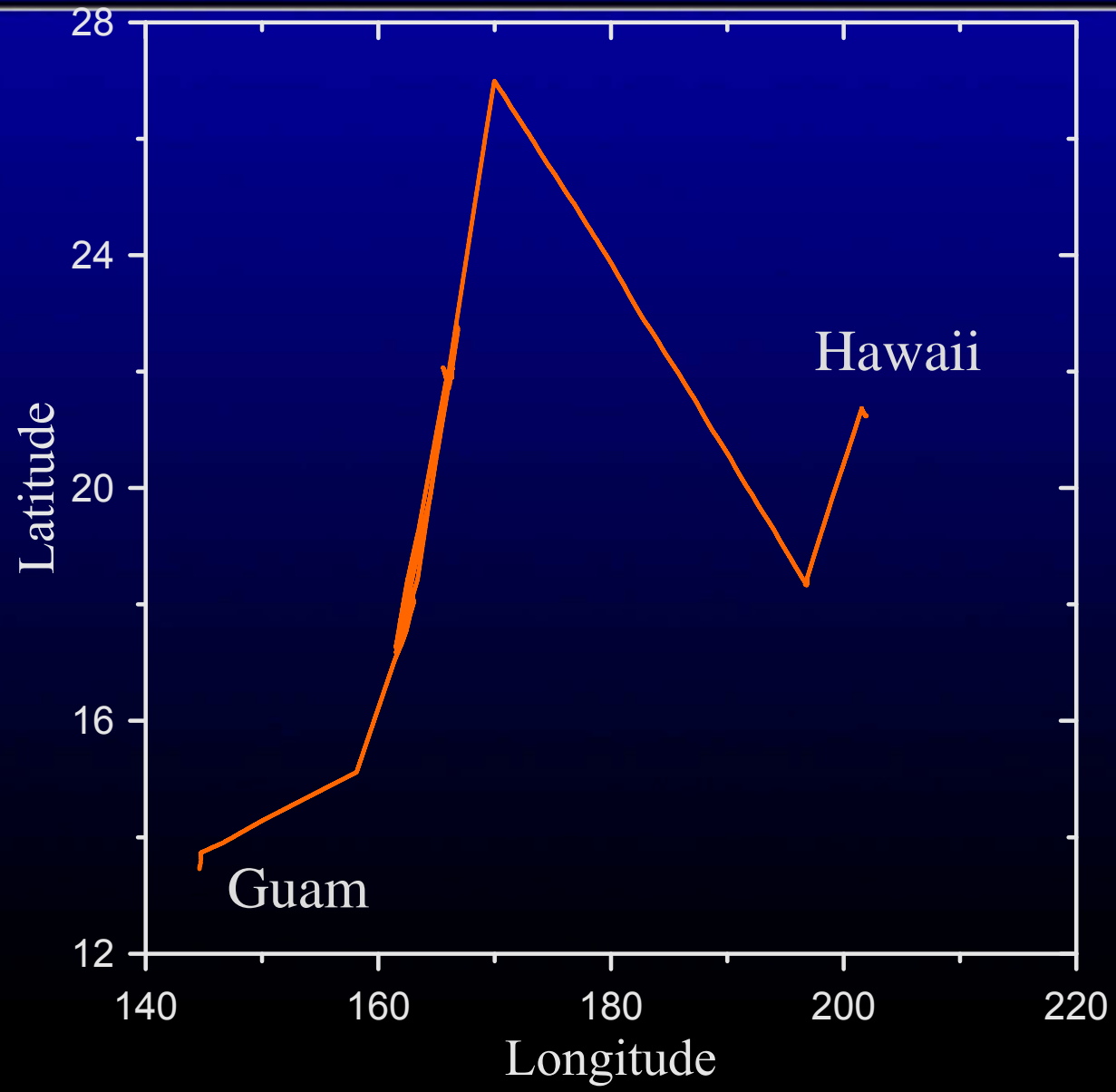
Sailed from Apia, Western Samoa to Honolulu, Hawaii

Deployed the SSP a total of eight times

Sampled 3 main rain events

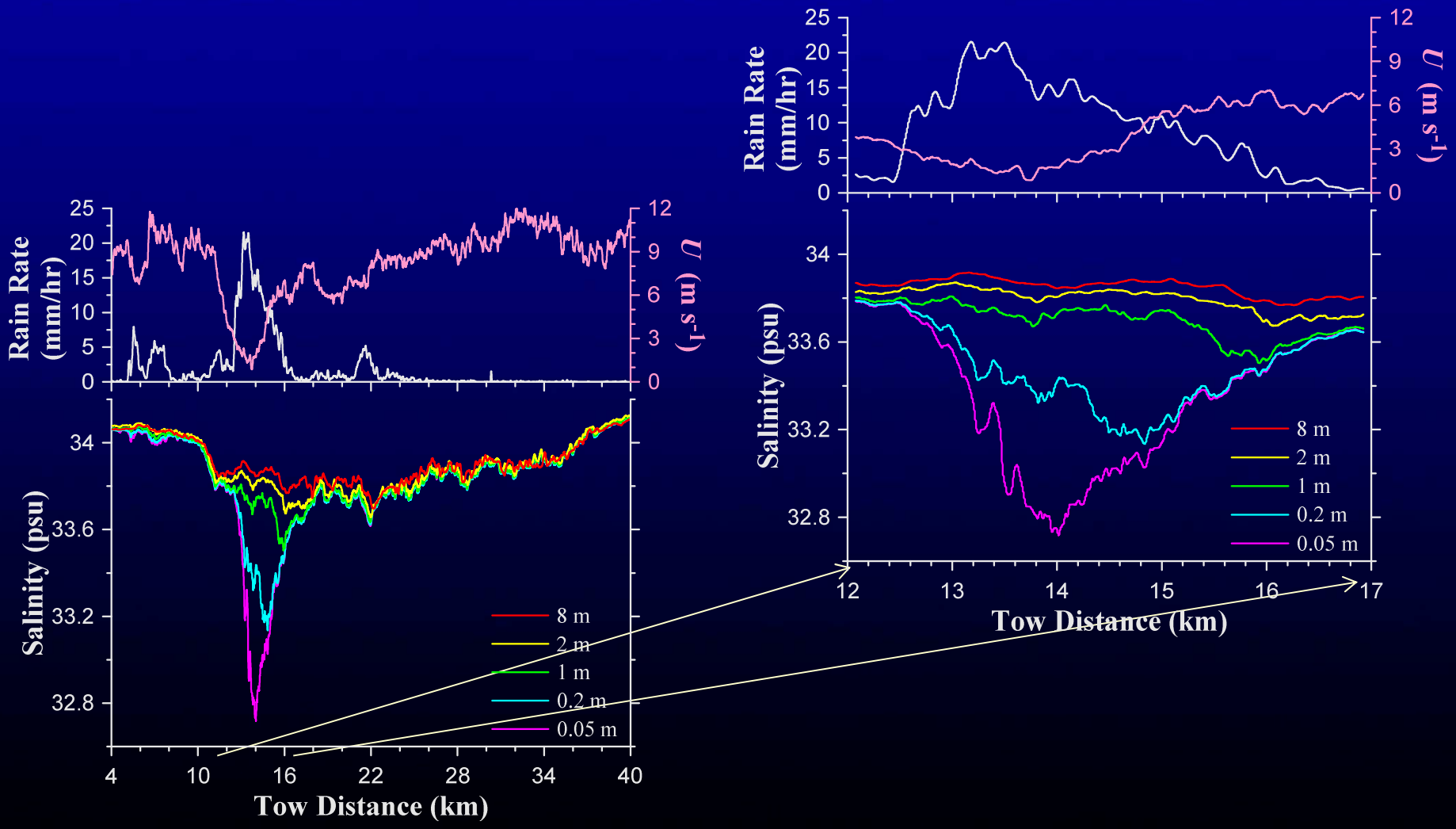


Ship Track for *R/V Thompson* During JOCMS November-December, 2011, North Pacific Ocean

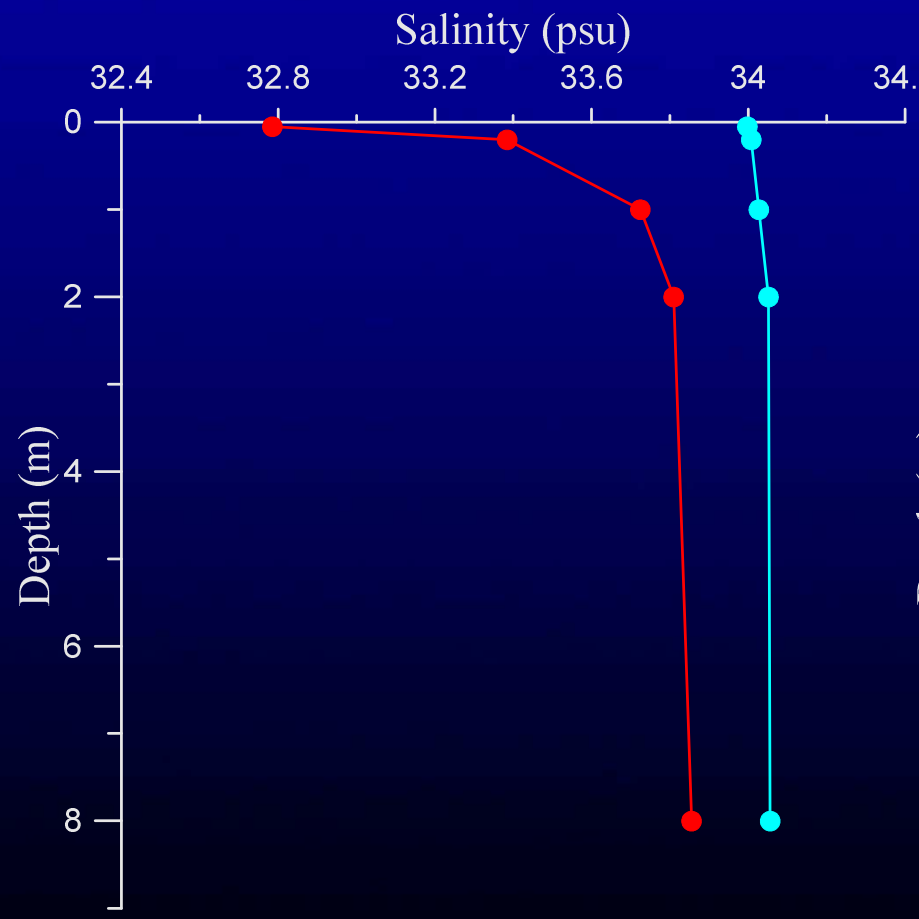


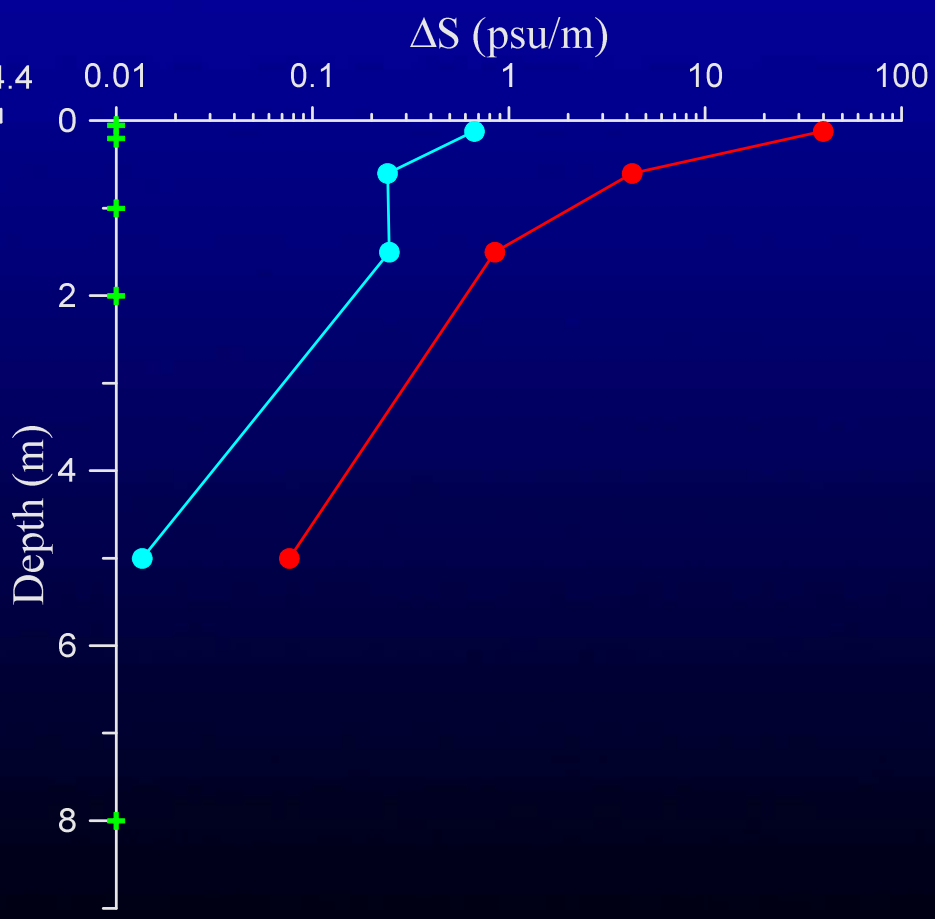
SSP Observation of Rain, Equatorial Pacific

***R/V Kilo Moana*, December 13, 2011 12.07 N, 160.9 W**



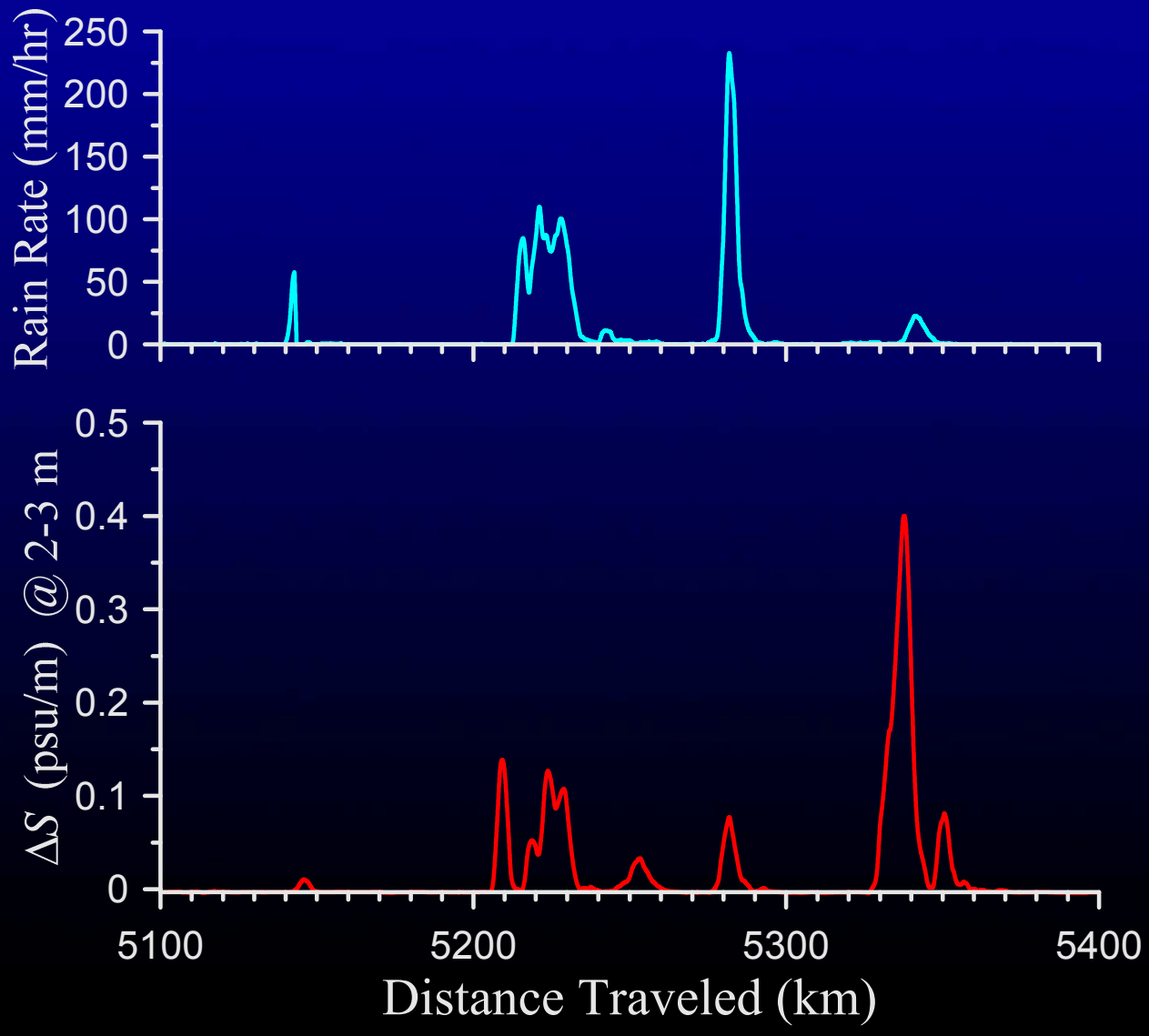
Salinity profiles and gradients



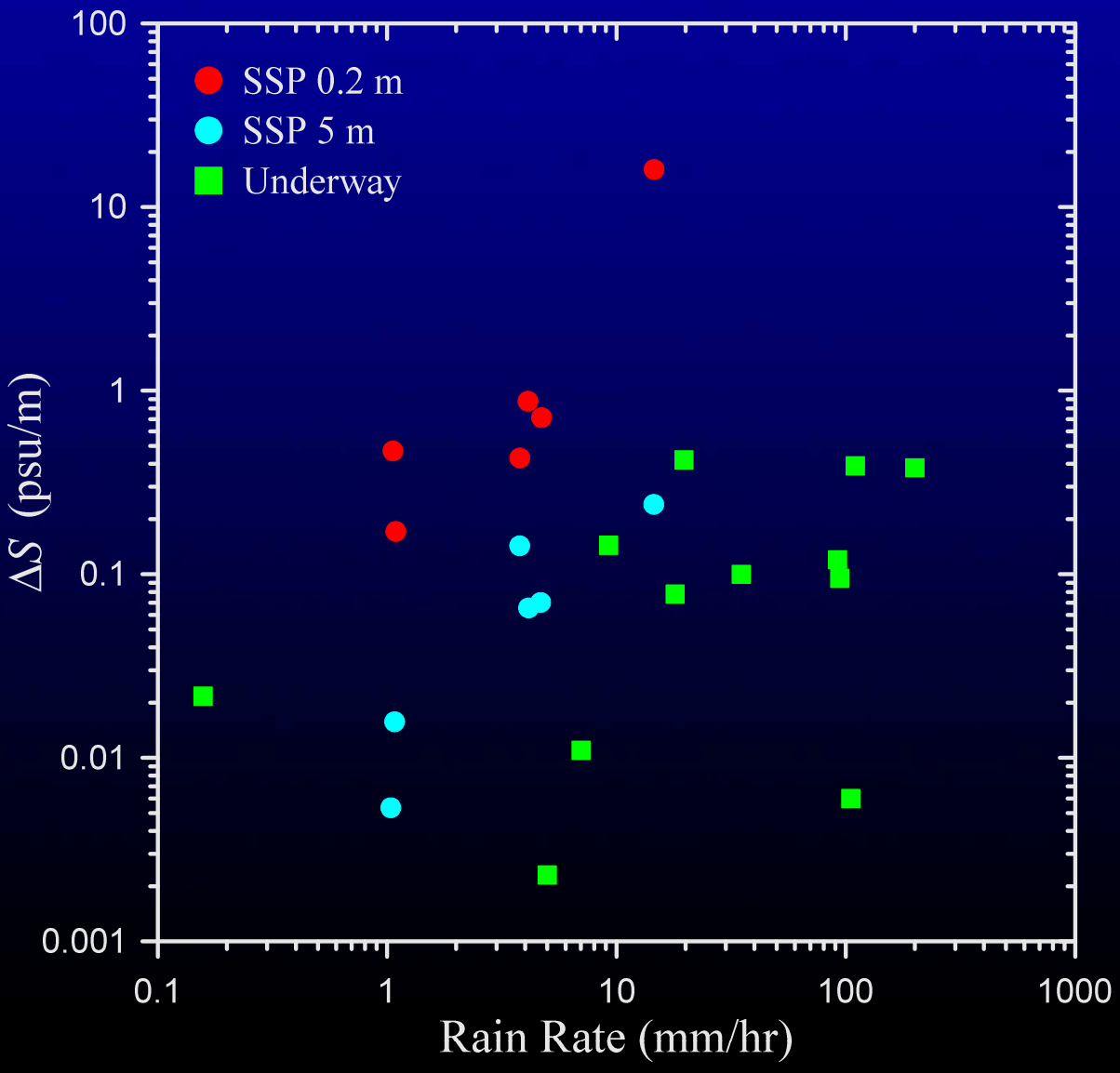


The point is a gradient at 2-3 m is much bigger at the surface.

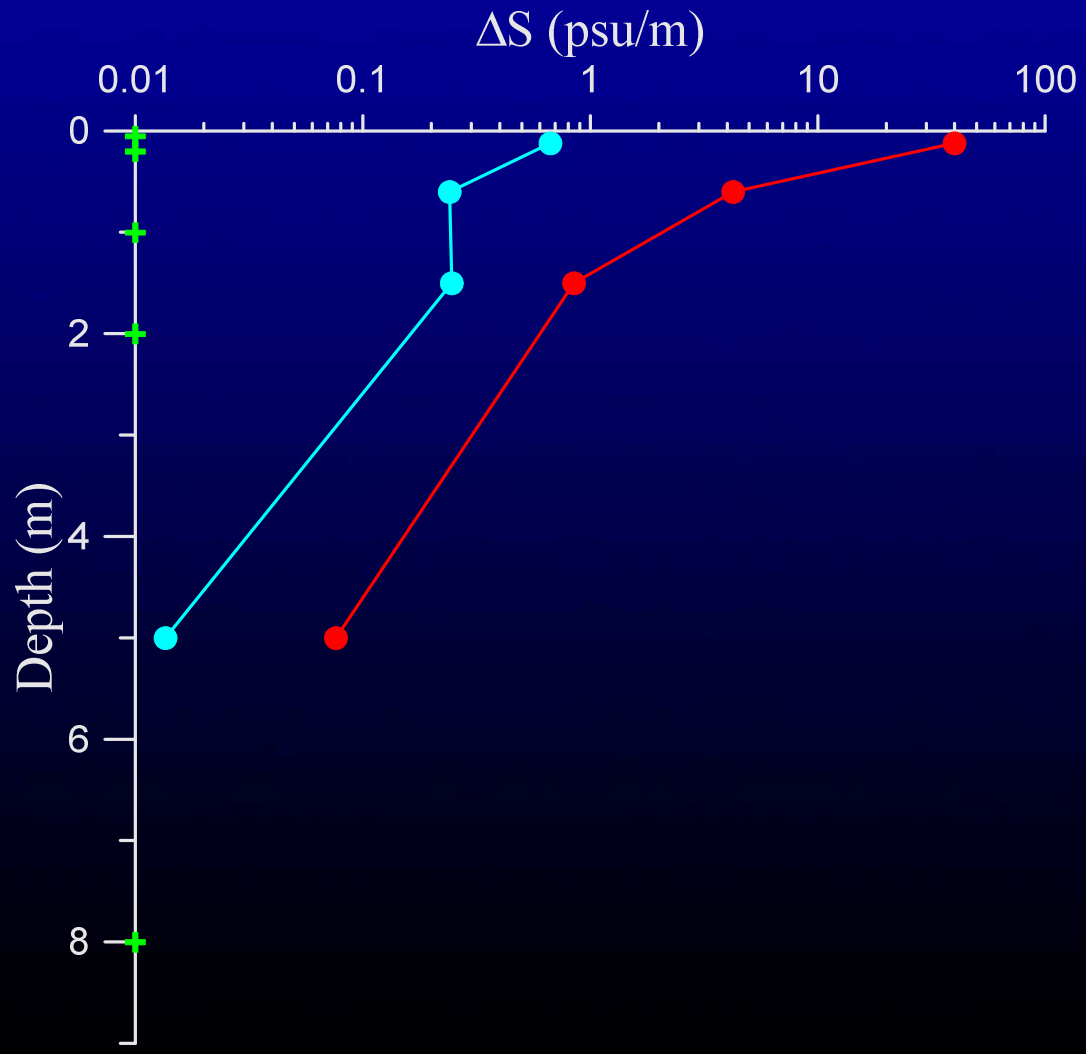
Underway salinity measurements: *R/V Thomson*



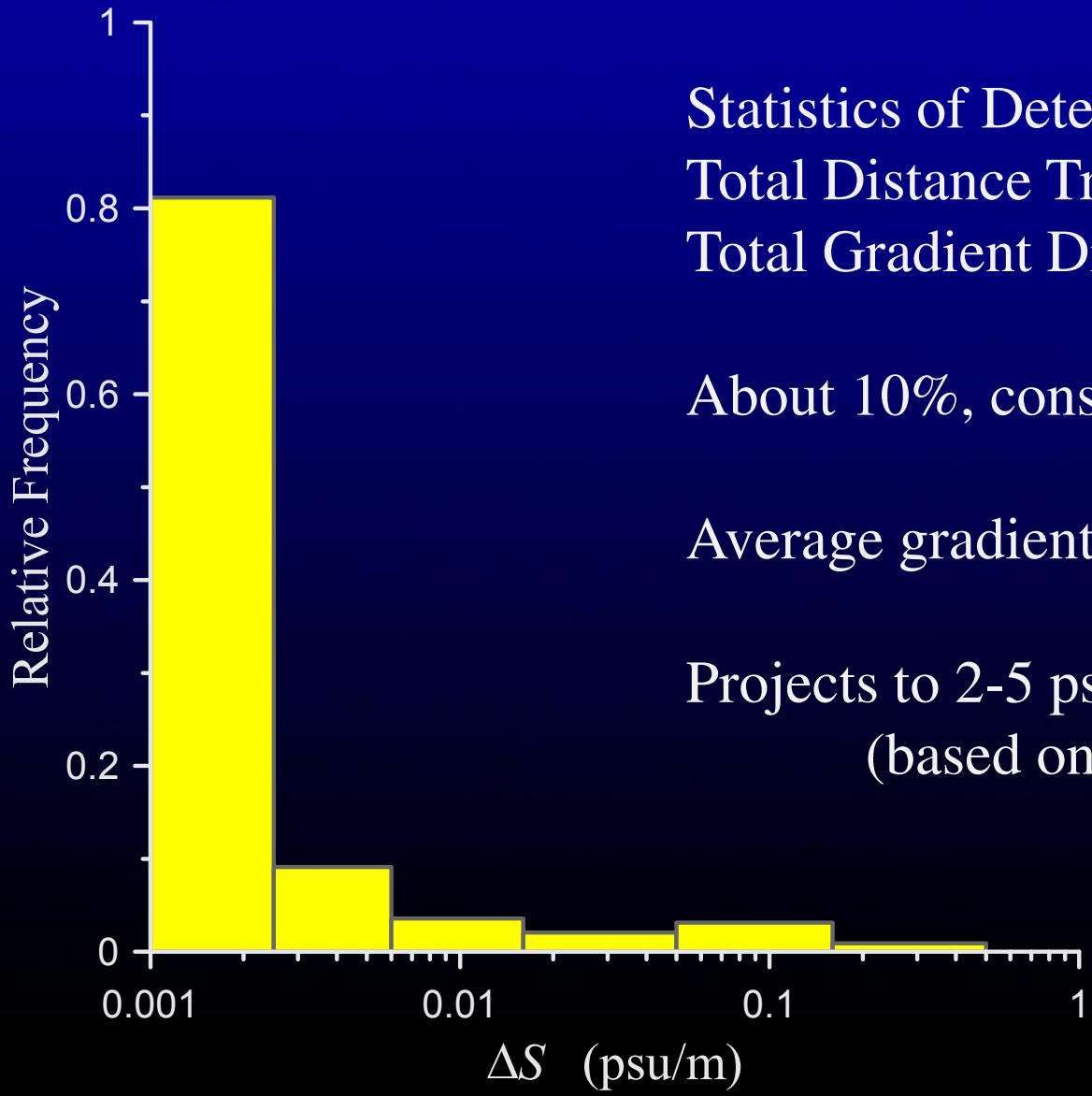
Comparing SSP and Underway salinity data



Why Might 0.04 psu/m Be a Magic Number?



Statistics of Gradients from the Underway System



Statistics of Detected Gradients
Total Distance Traveled: 8644 km
Total Gradient Distance: 816 km

About 10%, consistent with ARGO

Average gradient: 0.03 psu/m @ 2-3 m

Projects to 2-5 psu offset at surface
(based on SSP)

Estimating the Effect of Gradients on Salinity

Using the SSM Model:

$S_{EFF} = S_{GRAD}A_{GRAD} + S_{TRUE}(1- A_{GRAD})$

$S_{EFF} = 34.5$ psu for $S_{TRUE} = 35$ psu $A_{GRAD} = 0.095$

Using the SAWSM get:

$S_{EFF} = 34.8$ psu

Conclusions, Future Directions

1. Rain generates measurable near-surface (top 0.5 m) salinity gradients that can form at wind speeds up to 10 m/s

2. These gradients are large enough (in terms of their area-weighted ΔS) to affect Aquarius

3. Extend over large enough areas to affect satellite measurements

4. The 2-m and 3-m ports on the *R/V Thomson* can detect the presence of near-surface salinity gradients relevant for Aquarius

The Surface Salinity Profiler (SSP) in tow from the *R/V Thomas G. Thompson*