The Vertical Dependence in the Horizontal Variability of Salinity and Temperature From the Tropics to Sub-Tropics

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Why are variability and vertical gradients important?

![Diagram showing variability and vertical gradients](image)
The Underway Salinity Profiling System
Typical Sampling Depths of the USPS*

*As inferred from the pressures measured by the thru-hull SBE-39s

![Graph showing sensor depths over time](image-url)
Pre-SPURS2 Datasets From the USPS
Rain and Wind Forcing for TN305 and JOCMS

- Rainfall intensity (R) in mm/hr
- Wind speed (U) in m/s

**Count**
- TN305-2014 S. Pacific
- JOCMS-2011 N. Pacific
Causes of Horizontal Variability Over Small Scales
Relationship Between Averaging Distance and Variability
The Effect of Averaging Distance on Variability
The Effect of Wind Speed on Horizontal Variability

75 km Averaging Interval

TN305-2014 S. Pacific

- $U_{10} > 7$ m/s
- $4$ m/s $< U_{10} < 7$ m/s
- $U_{10} < 4$ m/s

The Effect of Wind Speed on Horizontal Variability

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What SPURS-2 Adds to the USPS Datasets
Measurement Depths of SSP and USPS

YearDay (UTC 2016)

Sensor Depth (m)

0.0
1.0
2.0
3.0

SSP - 0.1 m
SSP - 0.3 m
SSP - 0.5 m
SSP - 1 m
SSP - 0.3 m
SSP - 0.1 m

USPS - 3 m
USPS - 2 m

SBE-39 Thru-Hull
SBE-39 Thru-Hull
SBE-49 SSP
SBE-49 SSP
SBE-49 SSP
SBE-49 SSP
Comparing Salinity Measurements From USPS and SSP

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Comparing Temperature Measurements From USPS and SSP

USPS SPURS-2
YD255 2016

SSP SPURS-2
YD255 2016
Comparing USPS With SSP in Detail

Rain
Wind speed

Rain
Wind speed

SSP SPURS-2
YD255 2016
S₂(USPS)
S₀.03(SSP)
S₀.3(SSP)
S₀.5(SSP)
S₁.1(SSP)

SSP SPURS-2
YD255 2016
S₂(USPS)
S₀.3(SSP)
Correlation of Salinity Between 2-m USPS and SSP

Correlation of Salinity Between 2-m USPS and 0.3-m SSP

Correlation of Salinity Between 2-m USPS and 1-m SSP
Correlation of Salinity Between 3-m USPS and SSP

3-m USPS

0.5-m SSP

1-m SSP
And you see the same thing for temperature …
Apparent Sampling Depths of USPS 2-m and 3-m Ports

Standard Error of Fit
2016 SPURS-2
YD 255, SSP Run 12

- 2-m USPS
- 3-m USPS

SSP Sensor Depth (m)

σ_{FIT} (psu)
Conclusions

1. There is a vertical gradient in horizontal variability of both salinity and temperature

2. These gradients are wind-speed dependent so they are smaller at higher latitudes where average wind speeds are higher

3. The pressure sensors on the USPS do not give an accurate estimate of its sampling depths (at least at 2 m/s, the tow speed of the USPS)