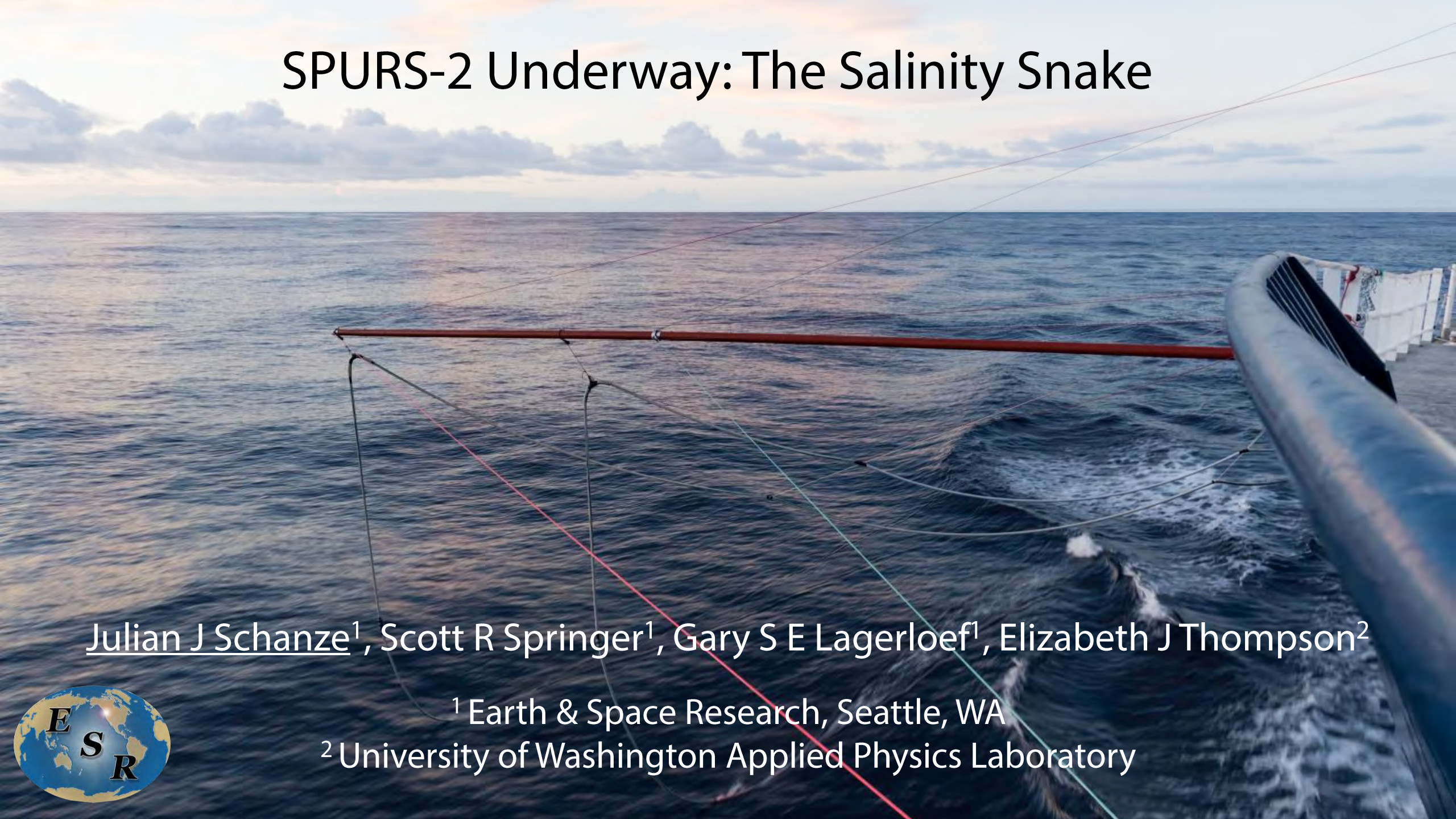
SPURS-2 Underway: The Salinity Snake



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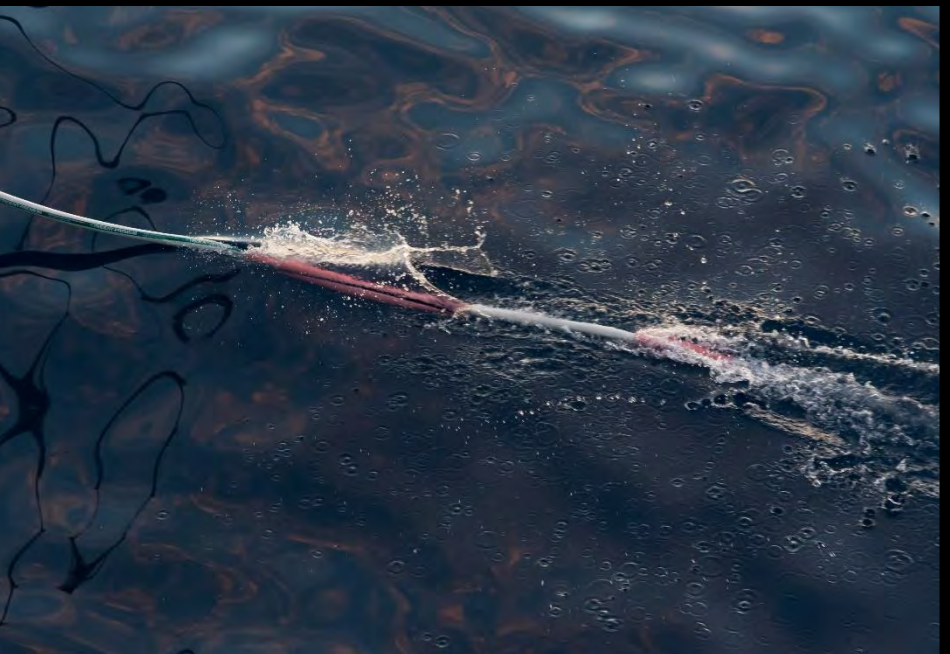
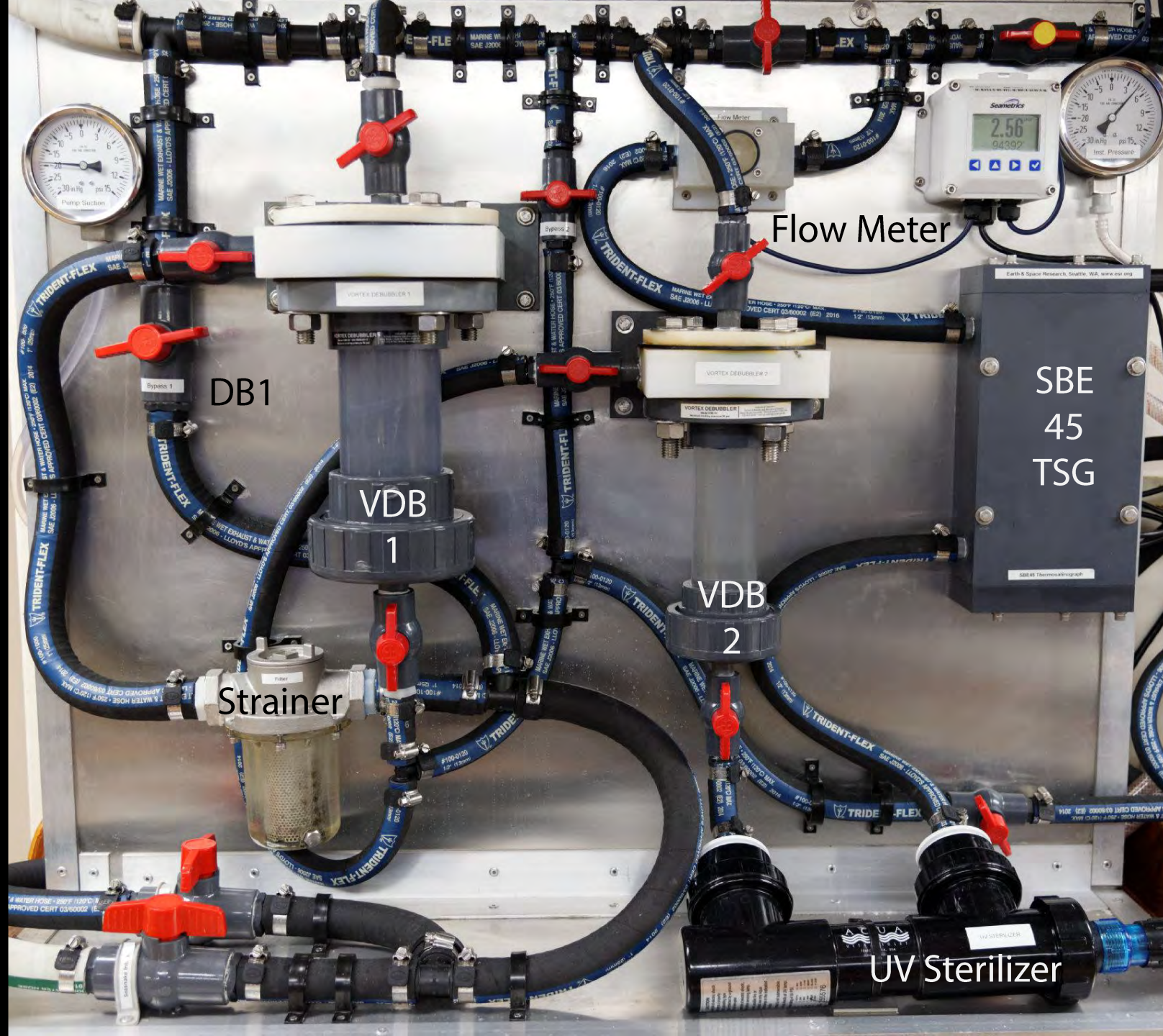
The Salinity Snake

- Why measure open-ocean salinity at 1-2 cm depth?
  - L-Band satellite measurements vs. 'bulk' salinity (Argo, 5m TSGs)
  - Upper ocean physics
  - Air-sea interaction
- No/very little dedicated ship time required
- Works at all ship speeds (automated 'slow snake')
- Measurement depth identical to L-Band (~1.4 GHz) radiometric depth

The Salinity Snake

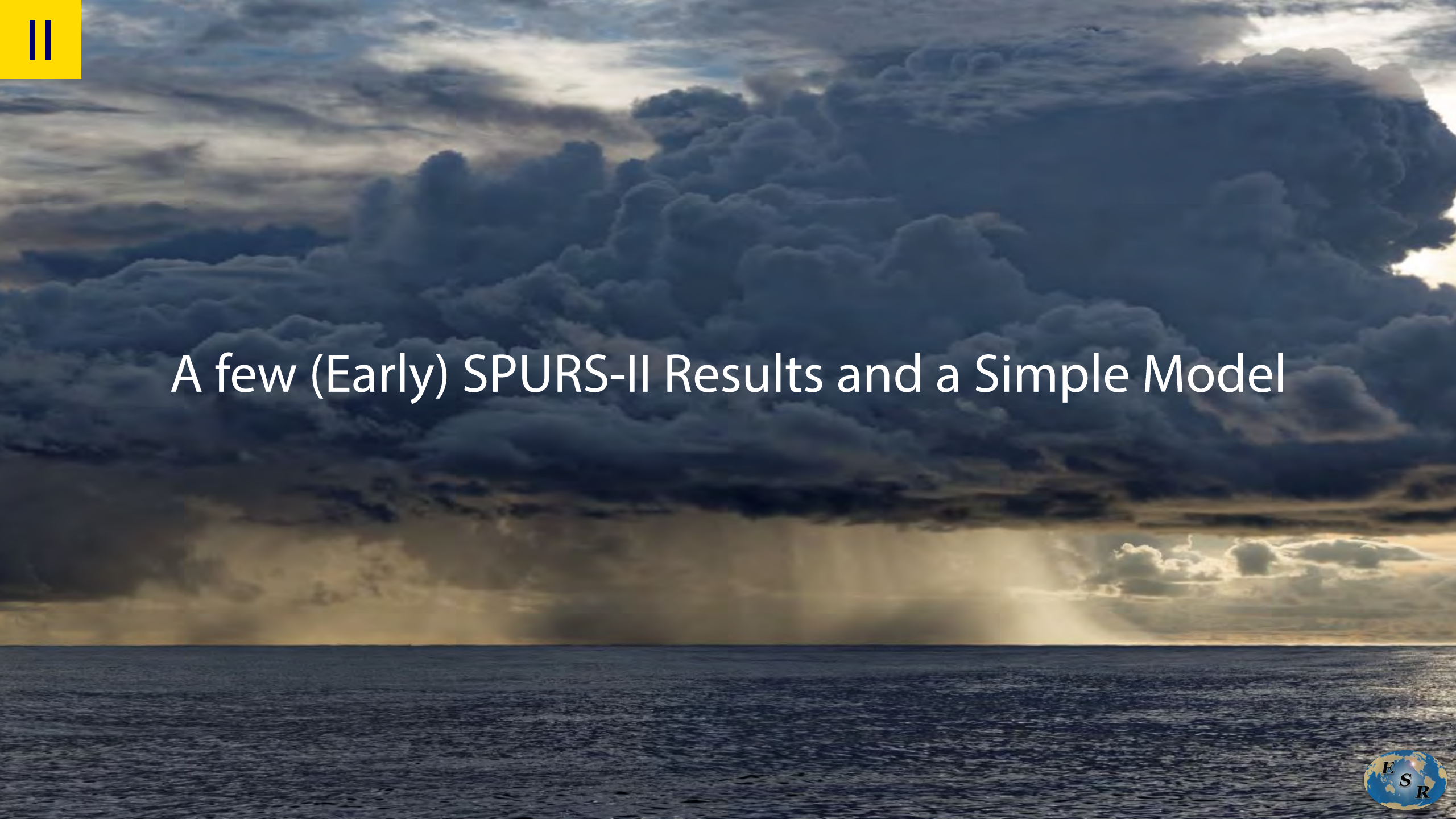
- 42-ft boom ensures undisturbed water is sampled away from the ship
- Peristaltic pump capable of 60 l/min, 9 m suction lift
- Triple de-bubbling (Gravity + 2 Cascaded vortex de-bubblers)
- SBE56 temperature recorders in both hoses, WOCE-grade temperature measurements at running depth of 1-2 cm
- Fully automated system, GPS and Sensor controlled
- Verified through regular salinity samples (salinometer)
- Used for analyzing pCO_2, DIC, pH, O_2 (D. Ho, U. Hawaii), Plankton, CDOM, Scattering (S. Clayton, APL-UW)




Flow Meter
DB1
VDB
1
VDB
2
SBE
45
TSG
Strainer
UV Sterilizer

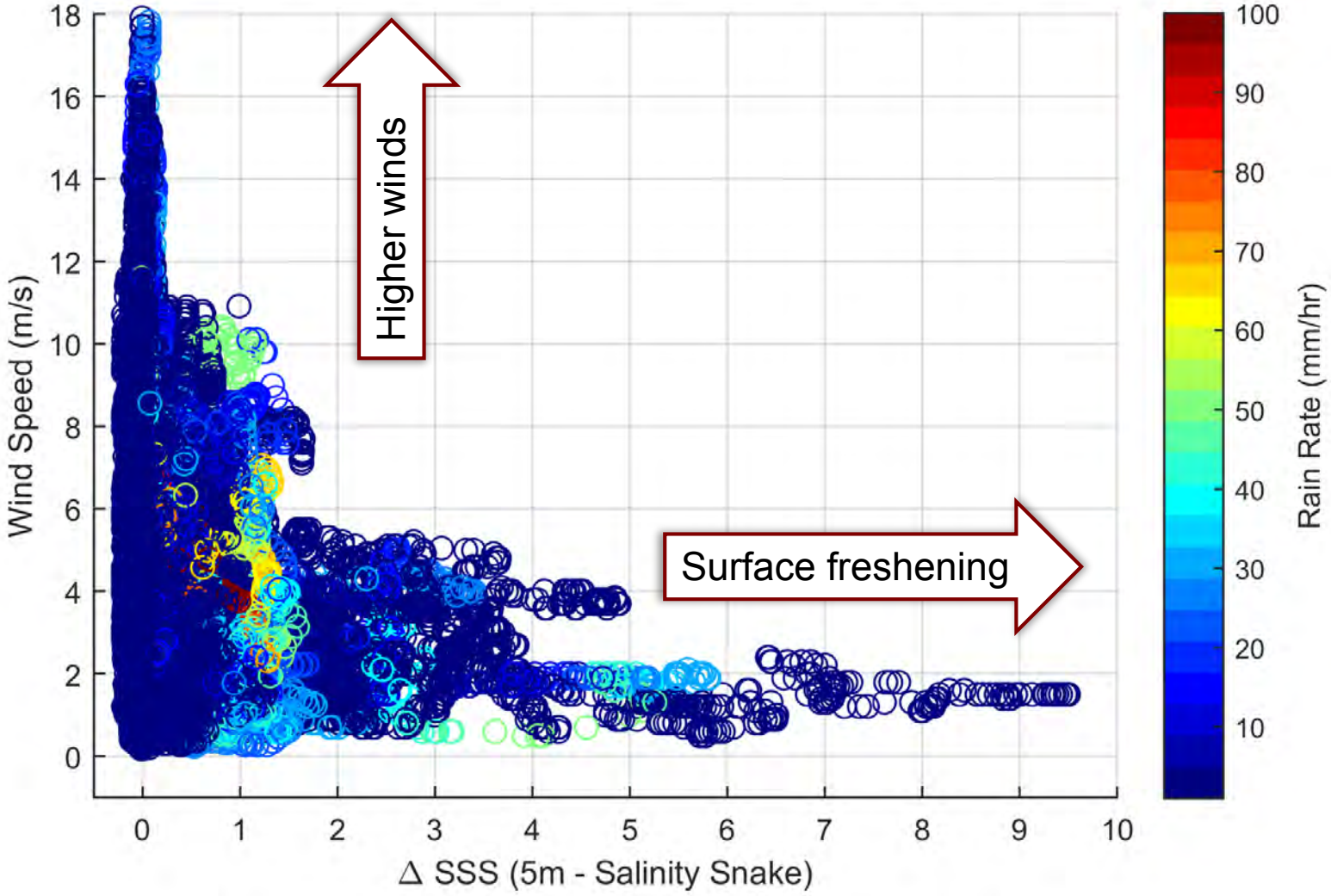
II

A few (Early) SPURS-II Results and a Simple Model



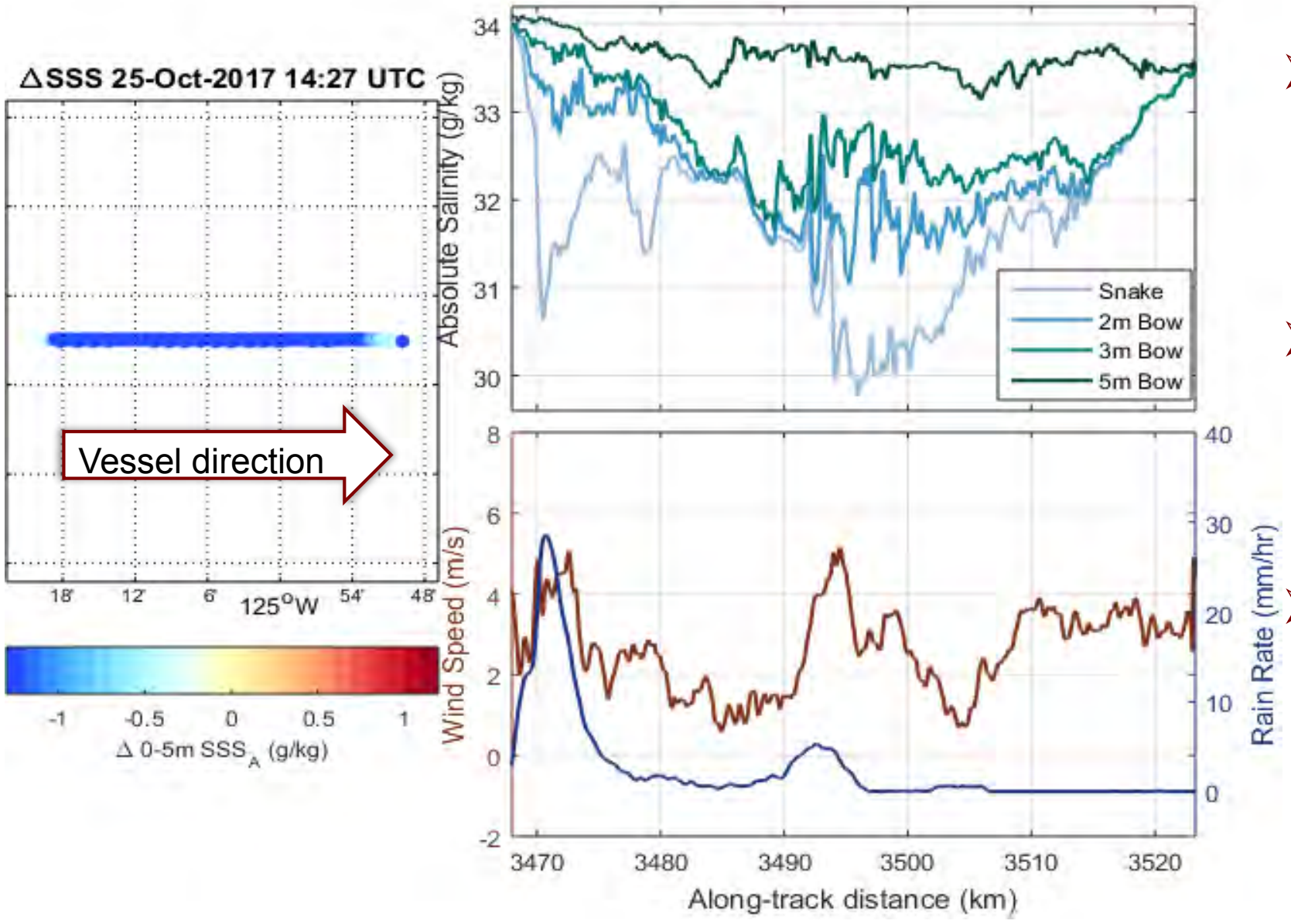
Wind, Rain, and SSS (5m-0m) Difference

SPURS-II: 20,000 km / 2+ months of Salinity Snake data



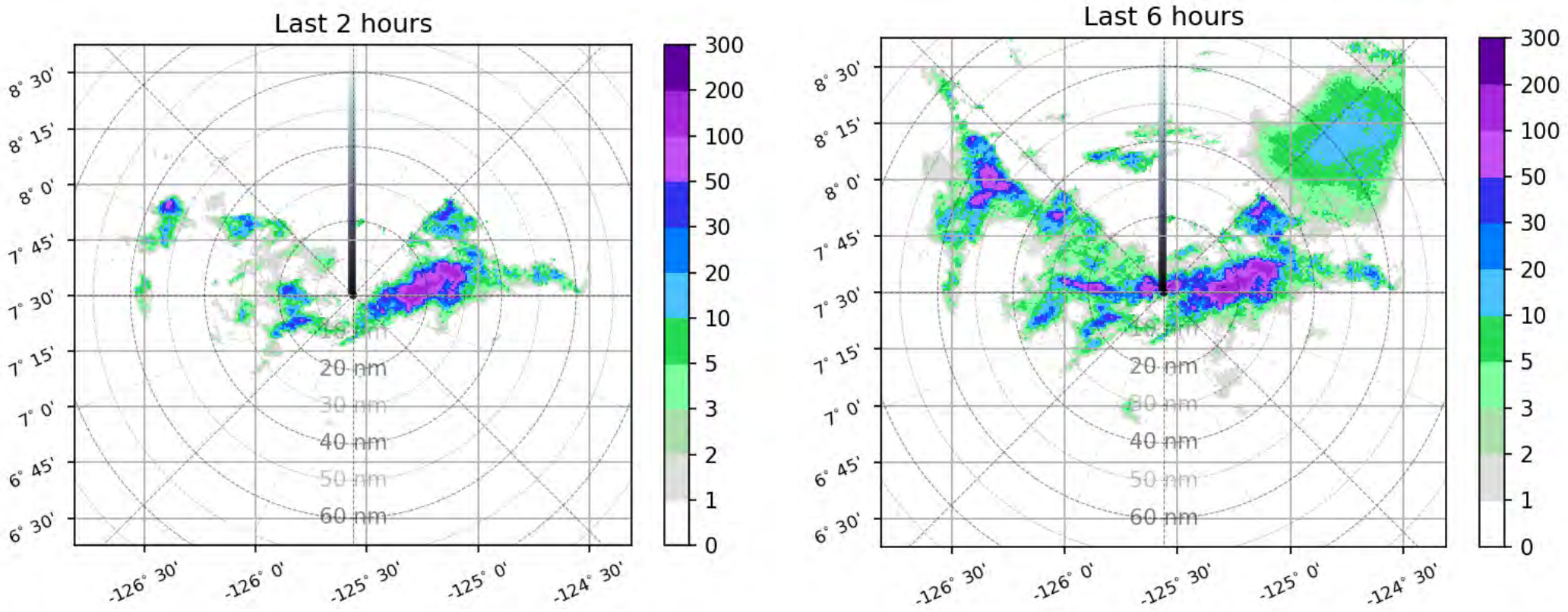
- Wind speeds of over 10 m/s cause only minor ΔSSS, even during high precipitation
- ~200 hrs at >10 m/s wind speeds
- ~100 unique events with ΔSSS>0.5 g/kg

October 25, 2017



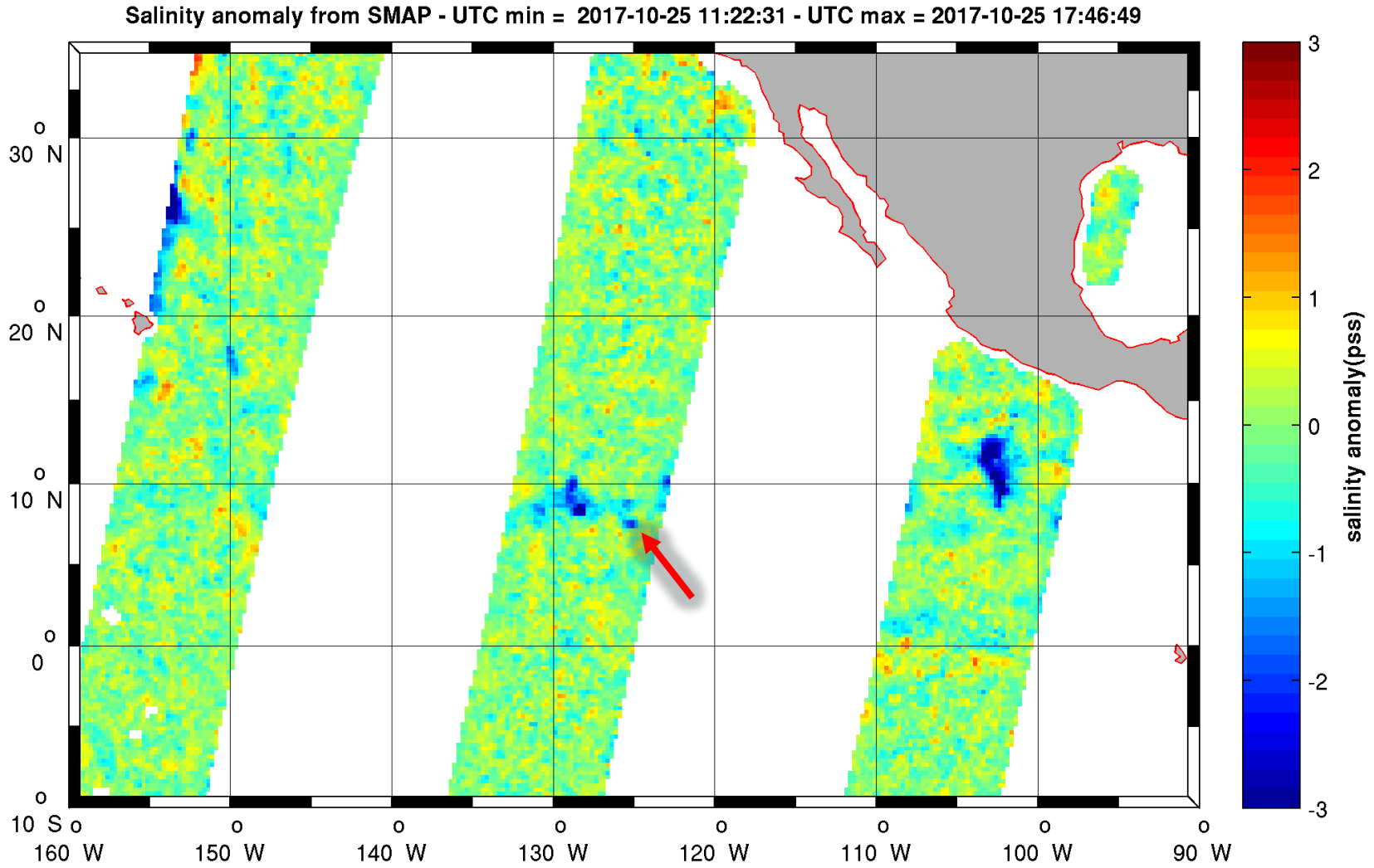
- 50 km feature with <4 g/kg peak freshening
- Caused significant anomaly in SMAP
- Enhanced mixing and interleaving

SEAPOL Radar, Oct 25, 2017, 13:10:00Z



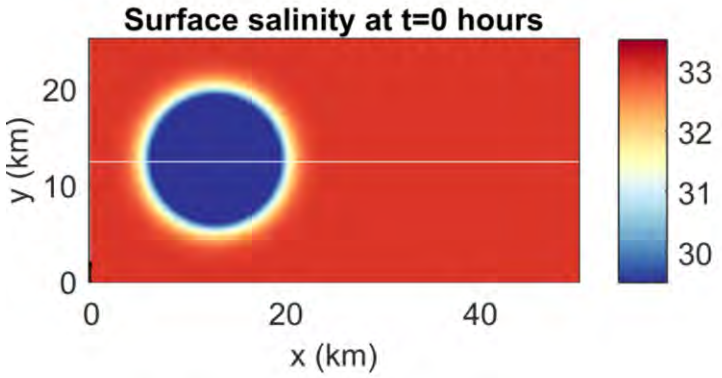
- Very good match-up with snake observations and SMAP
- Visible in IMERG, other products based on GPM
- Low wind speeds (2-5 m/s)

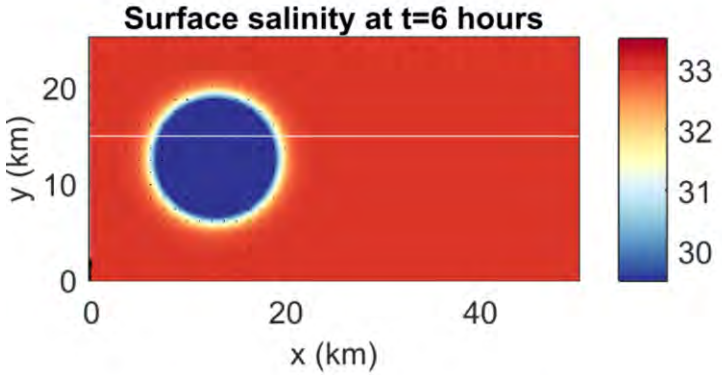
October 25, 2017

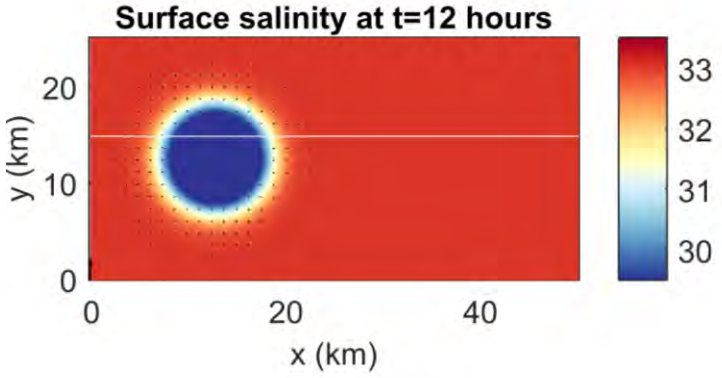


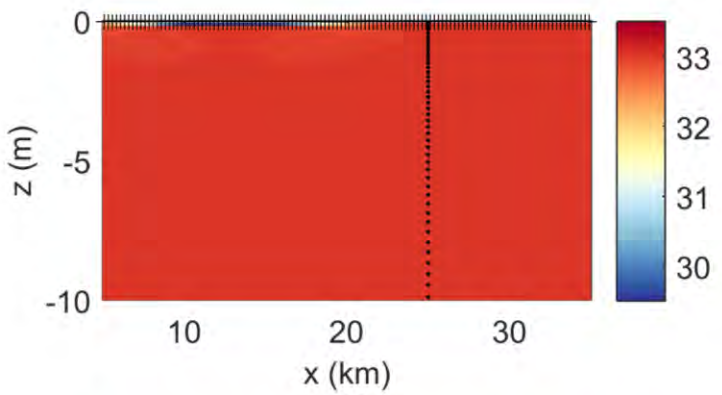
- SMAP SSS anomalies (A. Supply)
- Overall good agreement with snake observations
- Visible in IMERG, other products based on GPM

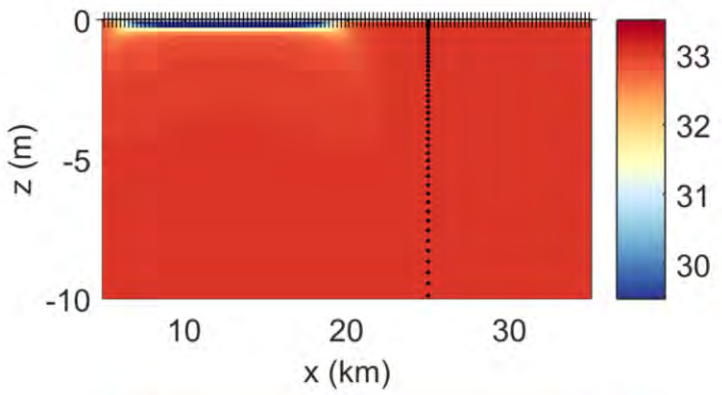
ROMS with Generic Length Scale (GLS) Turbulence

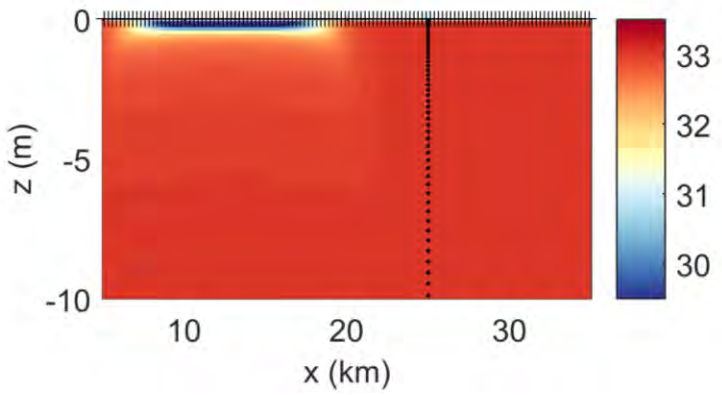






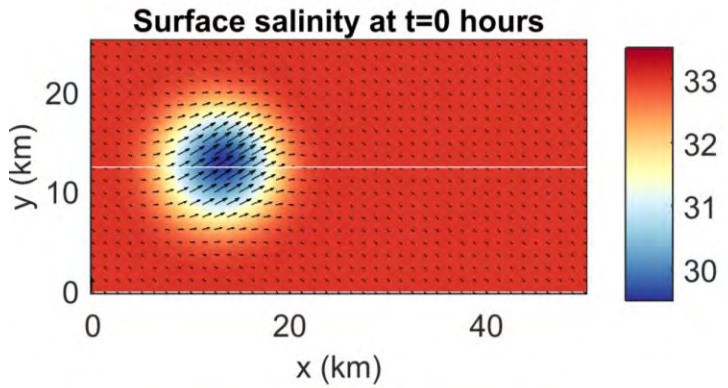


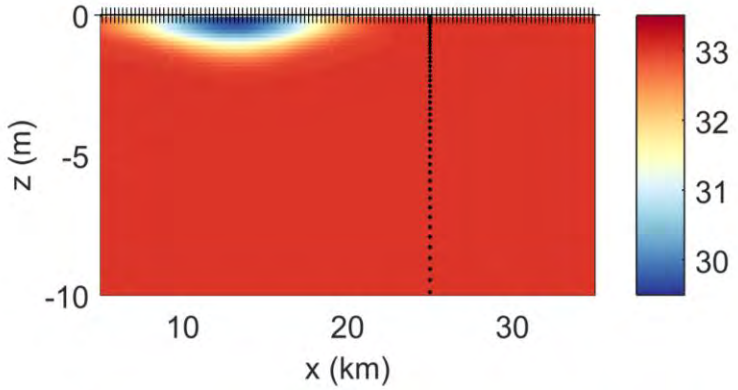


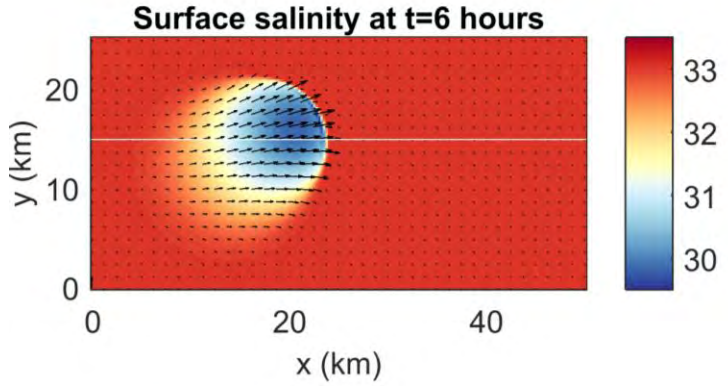


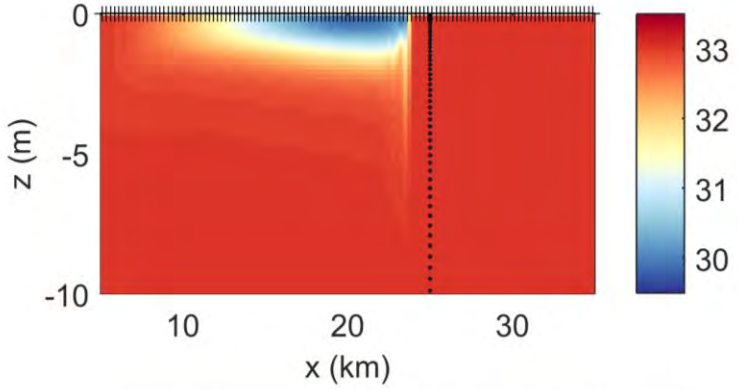
- No wind
- Initialized with Gaussian patch of rain, peaking at 150 mm/hr
- Low mixing rates
- Low velocities
- Symmetrical spreading

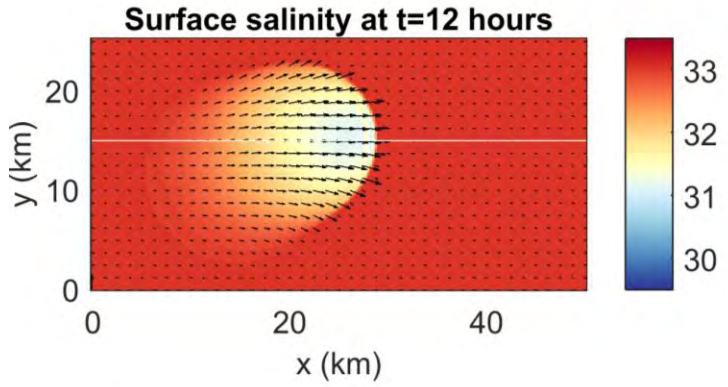
OSST Proposal: Lens Modelling

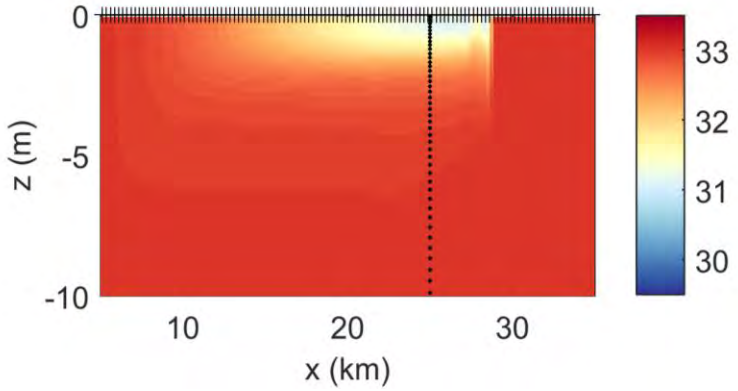






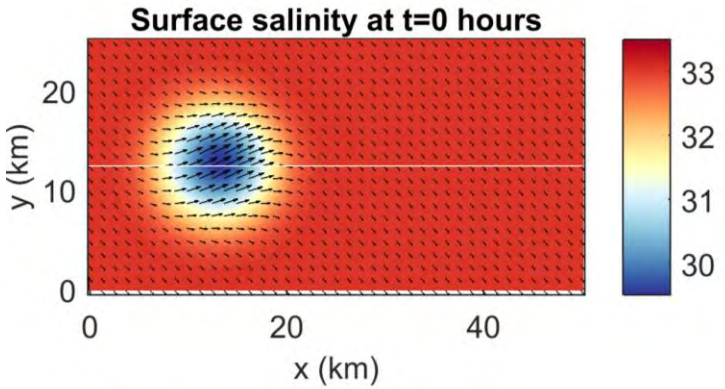


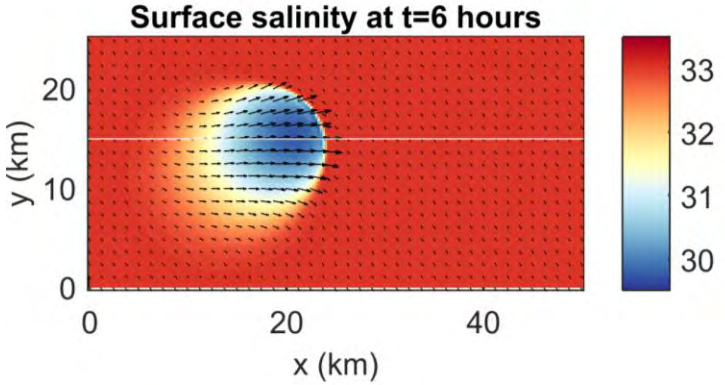


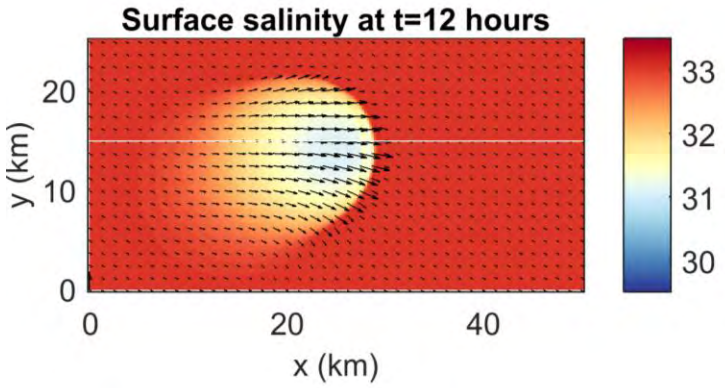


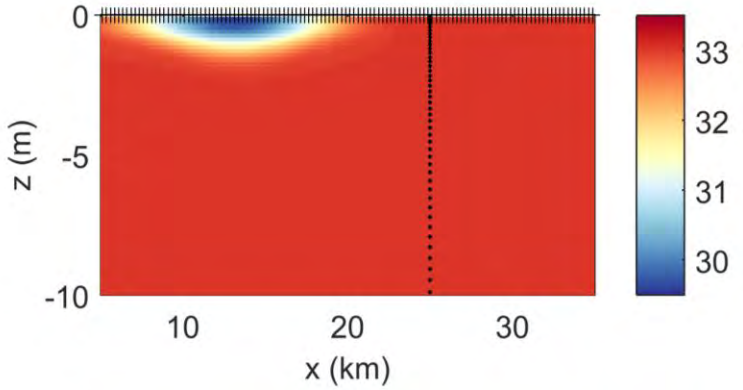
- Set up with 4 m/s wind from SE
- Sharp front with enhanced mixing replicated
- (Ekman) velocities highly asymmetrical (see vectors)

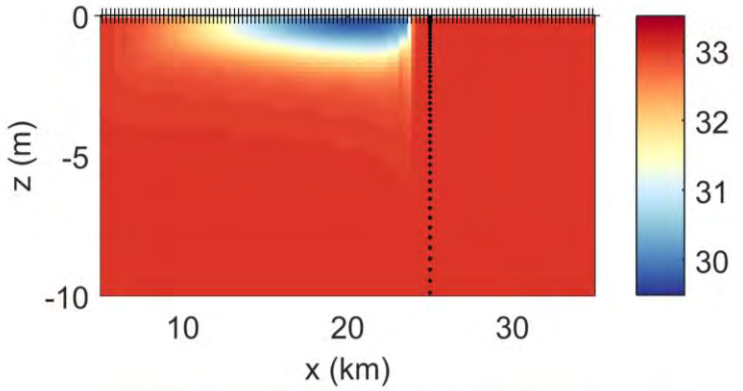
ROMS with GLS: 4 m/s wind and SBL

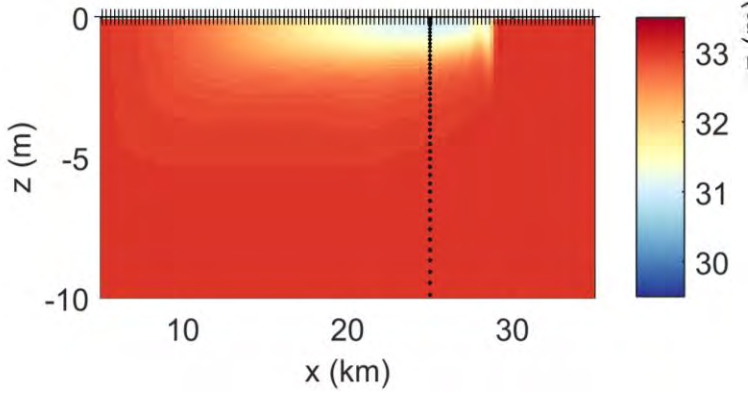




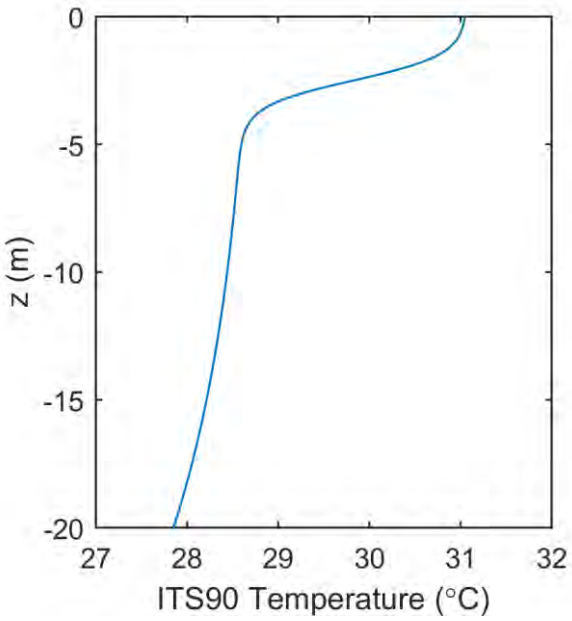








- Mixing below 2-3m reduced
- Surface freshening more persistent
- Stable B.L.



Conclusions

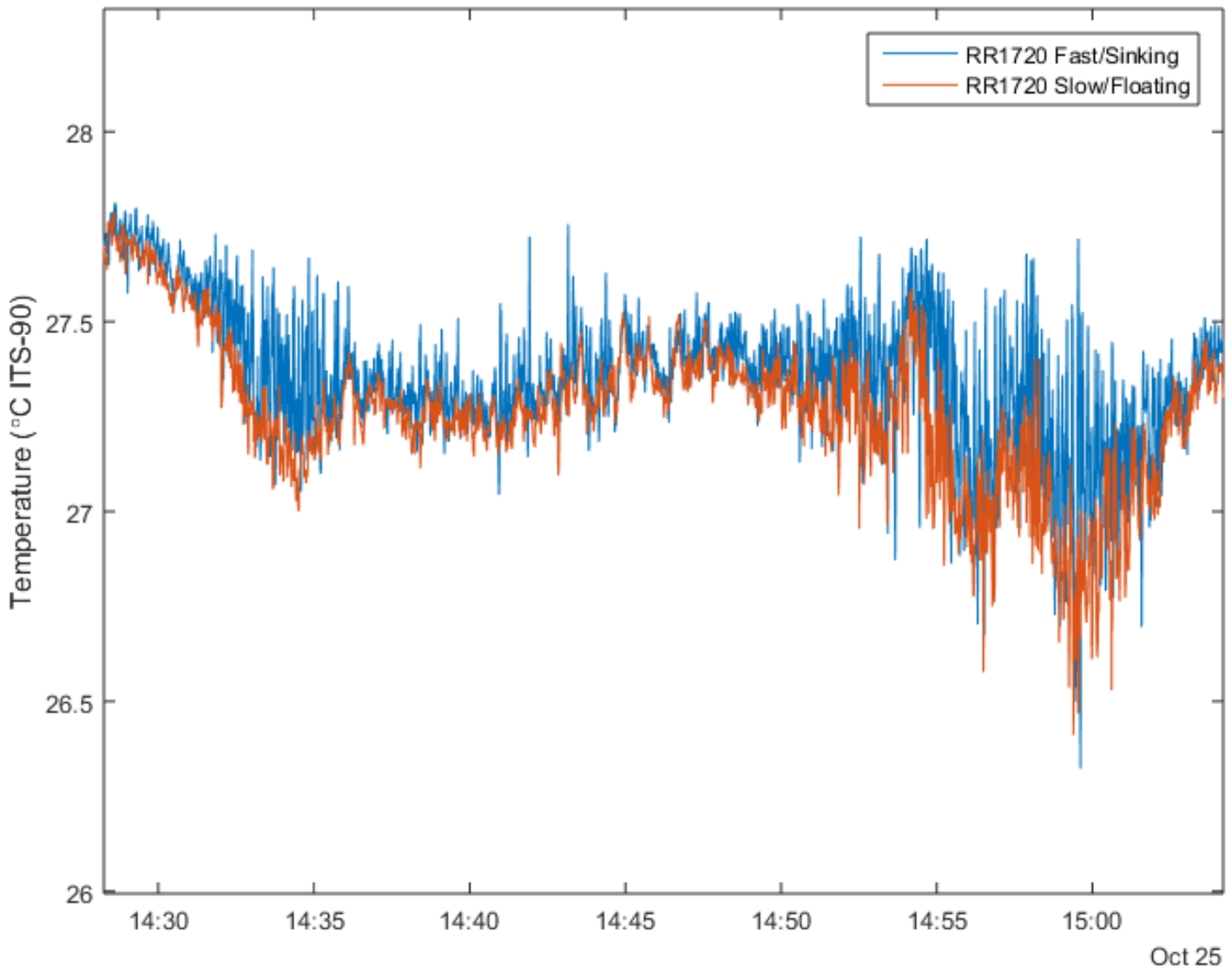
- Salinity Snake has collected close to 40,000 km of very-near surface salinity data so far
- USPS 2m/3m intakes provide vertical resolution in addition to 0m and 5m
- UCTD could provide data below 5m, compile full underway dataset?
- Surface freshening is heavily dependent on mixing (wind speed, waves, fetch duration)
- Simple model suggests asymmetry and deepening fronts are likely driven by freshwater-disrupted Ekman layers

What we hope to do for OSST

- Modelling of Rain Lenses to inform dissipation rates, persistence times
- Combining Furuno X-Band and SEAPOL to provide the best possible rain forcing (Elizabeth)
- Realistic model forcing: *In situ* data-driven modelling of rain induced freshening to inform Cal-Val, upper ocean physics

IV

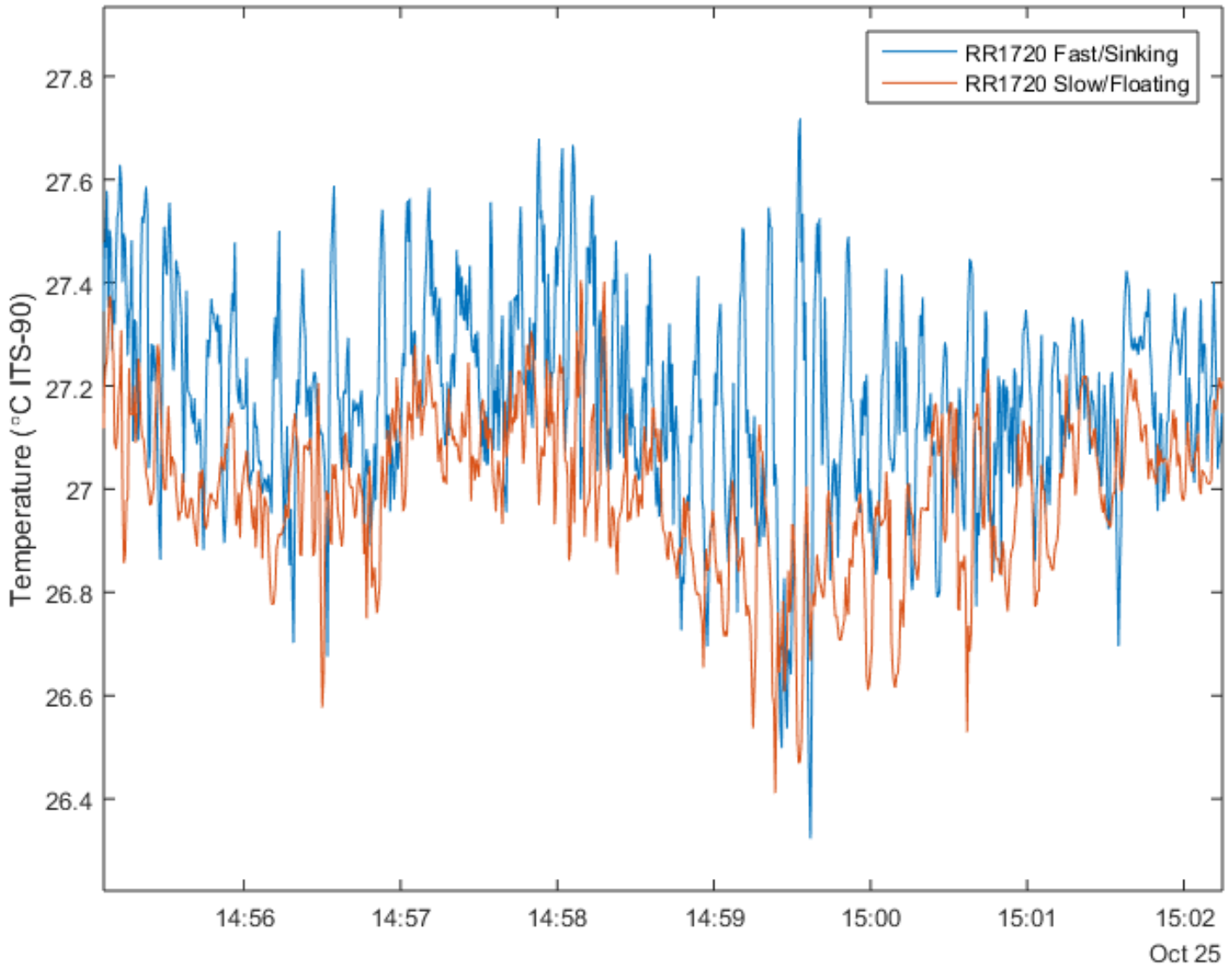
In-Situ Temperature - Food for Thought?



- Raw temperature data looks "noisy" during rain
- But there may be something interesting here
- If we zoom in…

IV

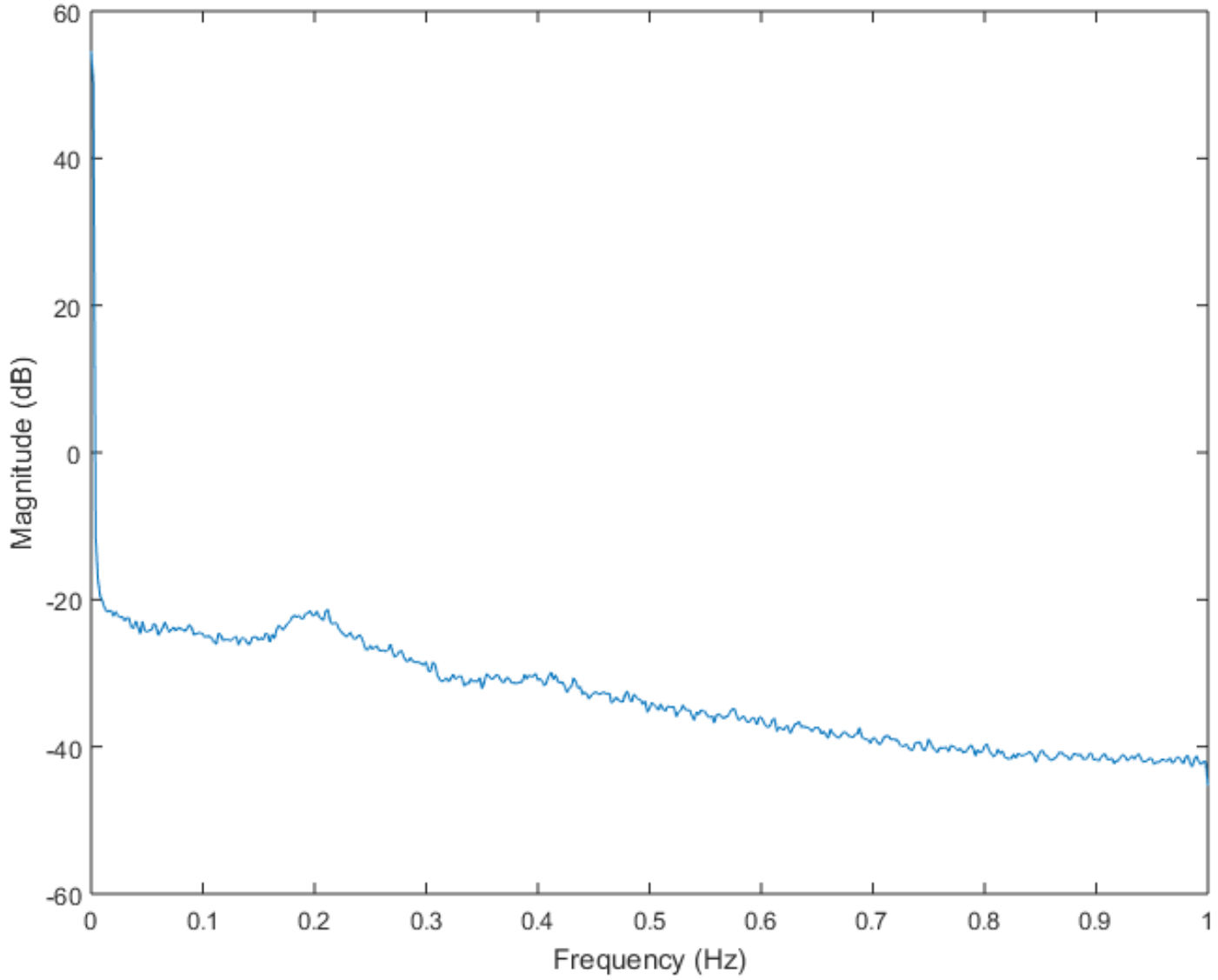
In-Situ Temperature - Food for Thought?



- Approximately 10-12 peaks per minute at 2 m/s
- A quick periodogram reveals…

IV

In-Situ Temperature - Food for Thought?



- 2 Hz in-situ slow snake temperature has peak at 0.2 Hz
- At 2 m/s, this corresponds to 10 m horizontal distance between peaks
- Will confirm if ship-roll is a factor
- Compare with IR

V

SPURS-II Analysis – A Few Ideas

- Compile a complete and coherent dataset of underway (salinity) observations (Ship, USPS, UCTD, Snake, SSP…)
- Estimate horizontal variances and its dependence on depth (can be used to estimate dissipation if surface forcing is known)
- Complete statistical comparisons with SMAP and SMOS overpasses in L2 / Quantification of impact on retrievals
- What sets the scales for the ~10m T/S variance we are seeing during rain? Too small for Langmuir?

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