SMOS & Aquarius Science Workshop

$\rightsquigarrow$ Upper Ocean Profiles of Surface Salinity from the Air-Sea Interaction Profiler

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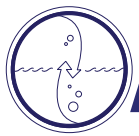
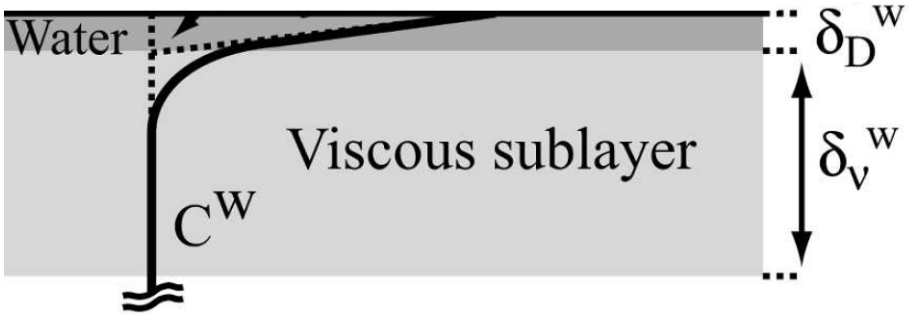


AirSea Lab

NUIG

Upper Ocean Microstructure

- When approaching the air-sea interface turbulent motions become increasingly damped and a viscous sublayer develops
- Sublayer thickness δ_ν^w will depend on the availability of turbulence for erosion of this layer



Viscous (δ_ν^w) and diffusive (δ_D^w) sublayer at the air-sea interface

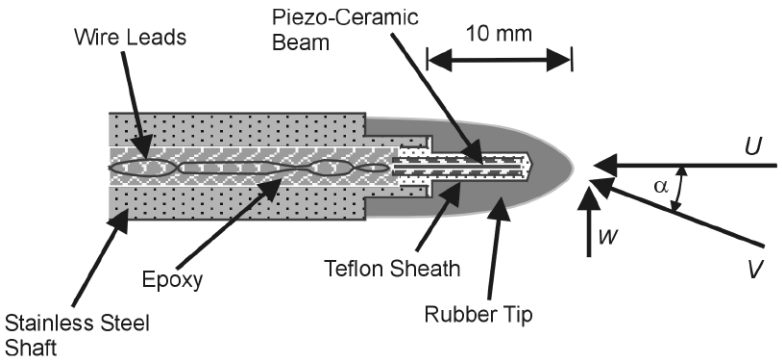
Lorke and Peeters (2006)

- Turbulent mixing at the air-sea interface continually renews the sea surface allowing more effcient transport between ocean and atmosphere
- Understanding these fundamental processes near the ocean surface is critical for modelling the transport of temperature and salinity

Upper Ocean Microstructure

- Levels of near-surface turbulence are diffcult to measure because of waves and a there is a dearth of measurements in this region
- Microstructure profilers are oceanographic tools for measuring turbulence in the ocean, but miss the upper 10m - the most critical region of the ocean for atmosphere-ocean exchange
- We have developed the Air-Sea Interaction Profiler to capture the fundamental processes at the air-sea interface

Shear Probe to measure the dissipation of turbulent kinetic energy

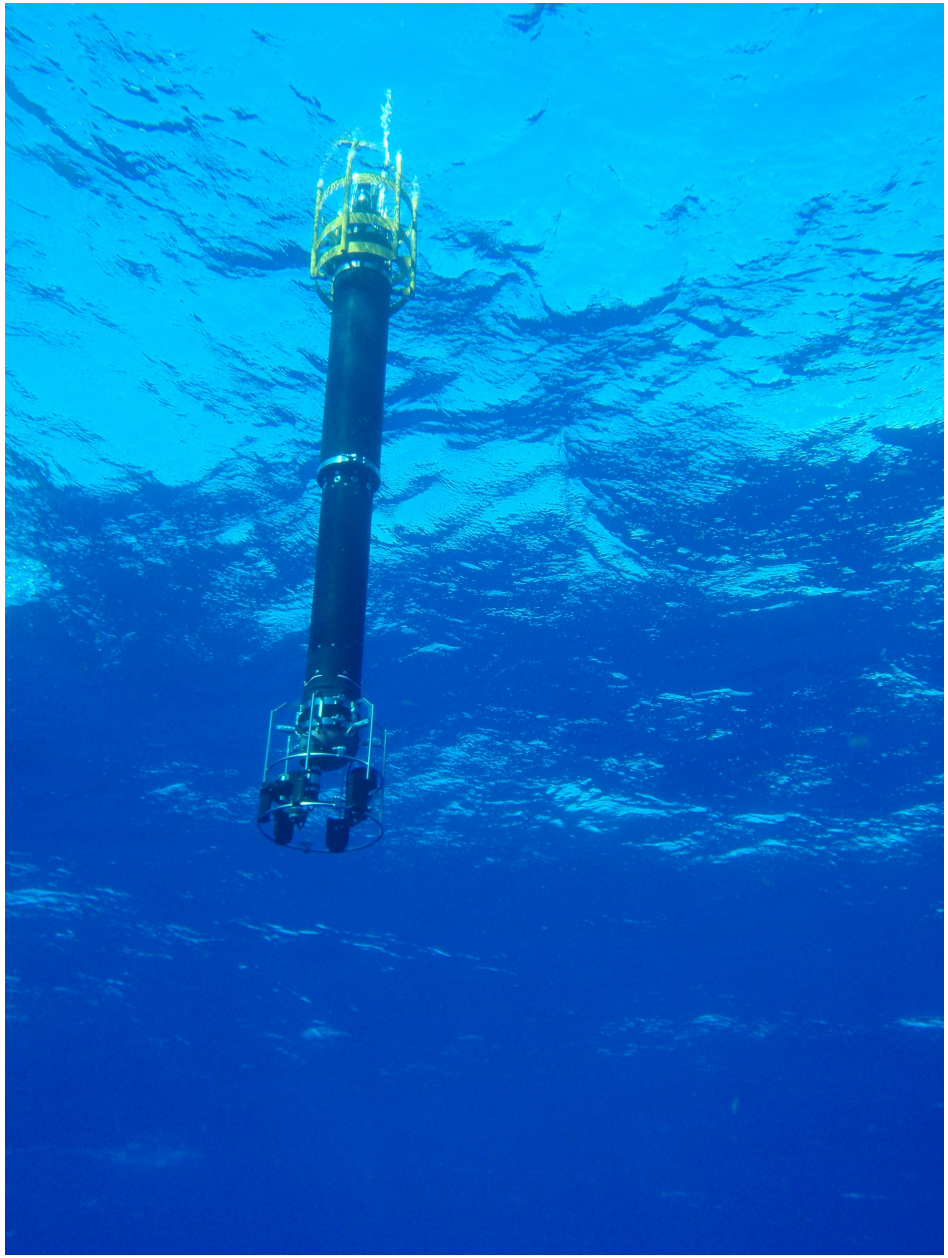


- Bullet-shaped rubber tip which houses a piezo-ceramic beam — a voltage is created as the beam bends from turbulence-induced eddies
- Dissipation rate of kinetic energy is derived from

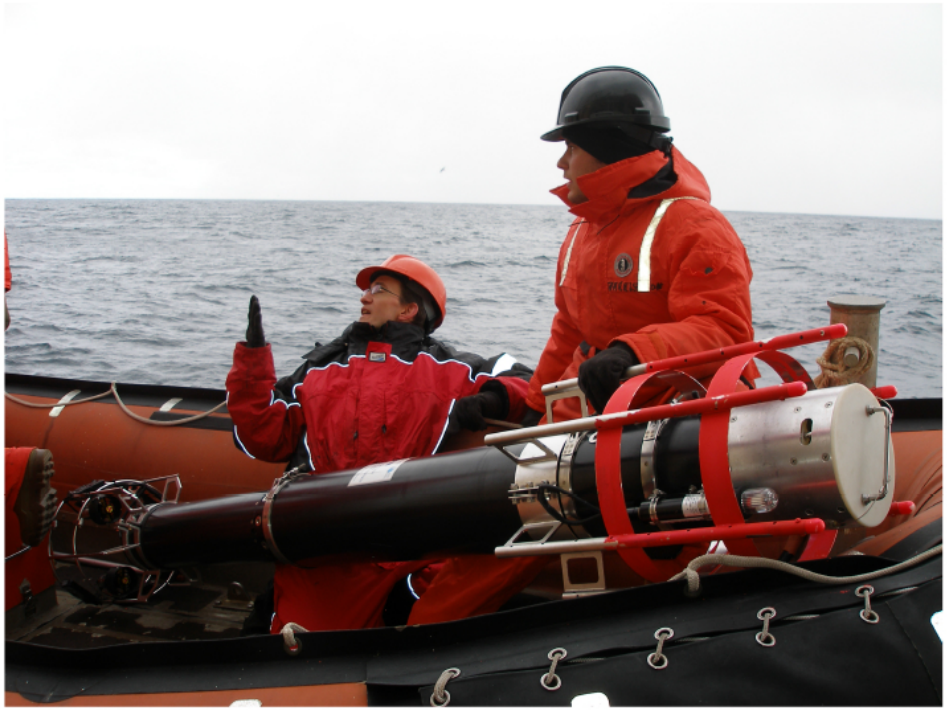
$$\varepsilon = \frac{15}{2}\nu\overline{\left(\frac{\partial u'}{\partial z}\right)^2}$$

Air-Sea Interaction Profiler ASIP

- By profiling vertically towards the air-sea interface, ASIP provides detailed measurements of the undisturbed water
  - Buoyant instrument submerged with a thruster
  - Measurements made during ascent only
  - Maximum depth 100m
  - Onboard power 1000 Whr from Li–ion batteries
  - GPS/Iridium transreceiver



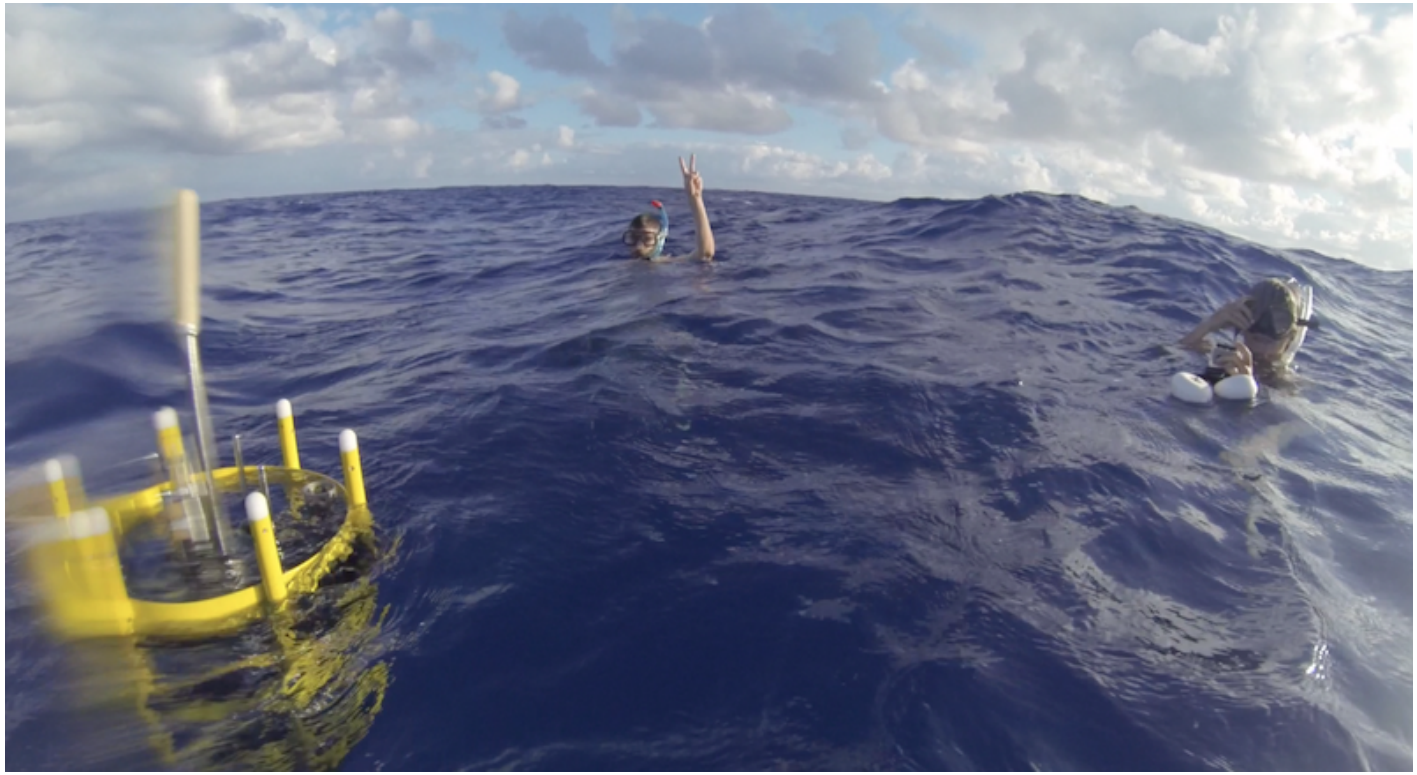
ASIP Deployment



- ASIP usually deployed and recovered in a small inflatable
- Have also deployed with the A-frame and by simply dropping from the fantail

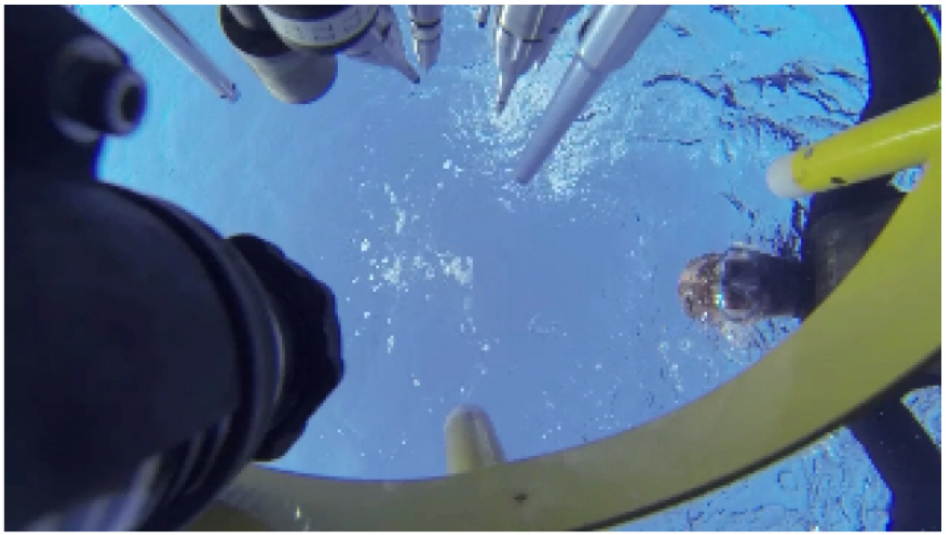
ASIP Iridium Satellite Communications

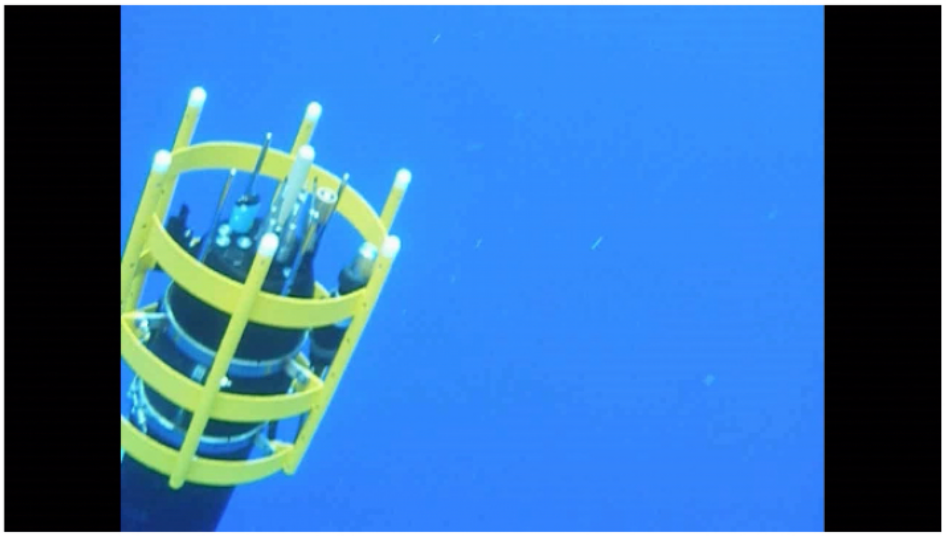
- Antenna must clear the water surface - extendable



- ASIP sends its GPS position to iridium via Short Burst message (SBD), which is delivered to an e-mail address
- This position is relayed to ship via Iridium providing real-time information on location

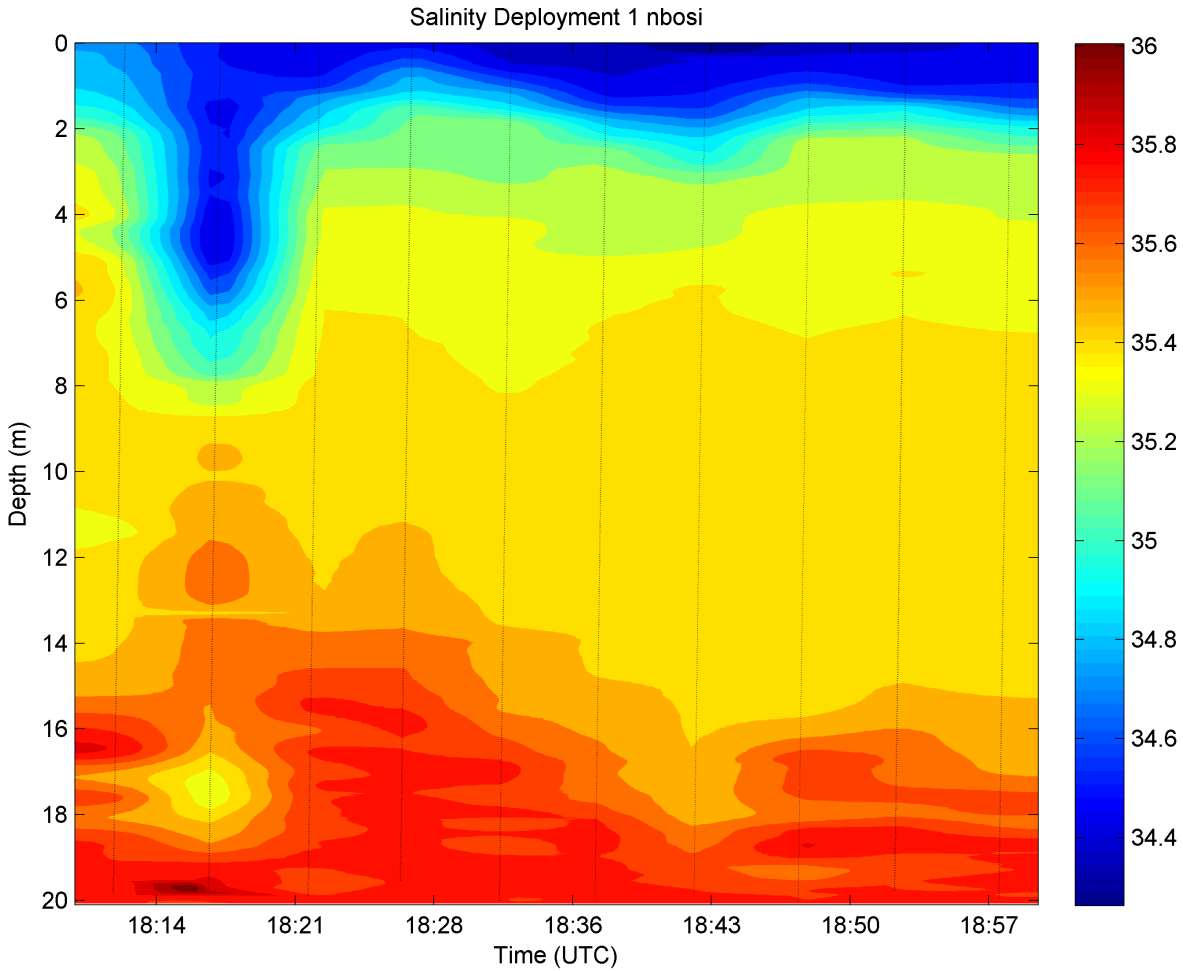
ASIP Sensors

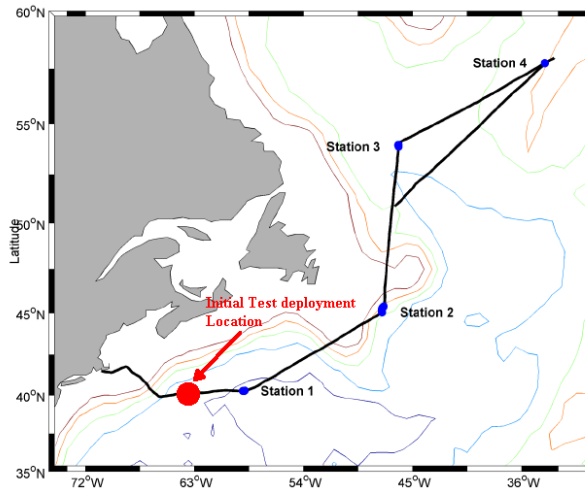




- 2x Shear probes for estimates of dissipation
- 2x Microstructure temperature
- 2x Pressure - depth/rise velocity
- 1x Microstructure conductivity
- Accurate temperature & conductivity for calibration
- Photo-synthetically Active Radiation (light)
- Oxygen optode sensor

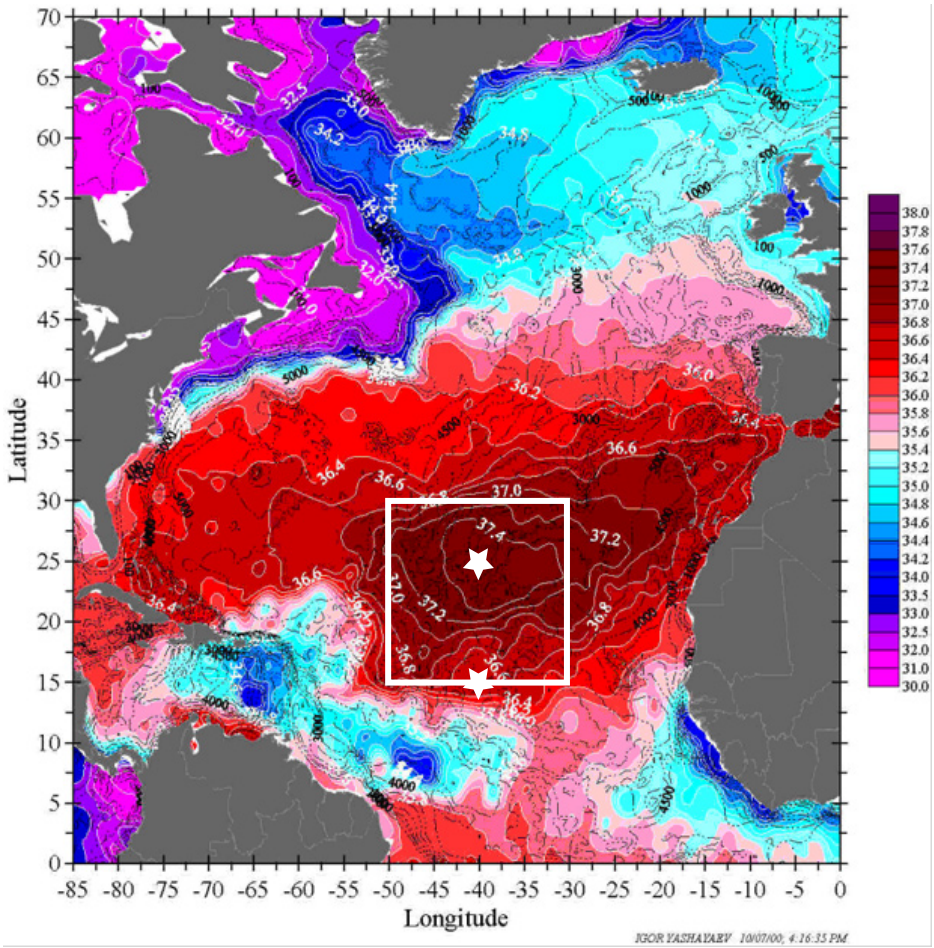
Upper Ocean Salinity Variability





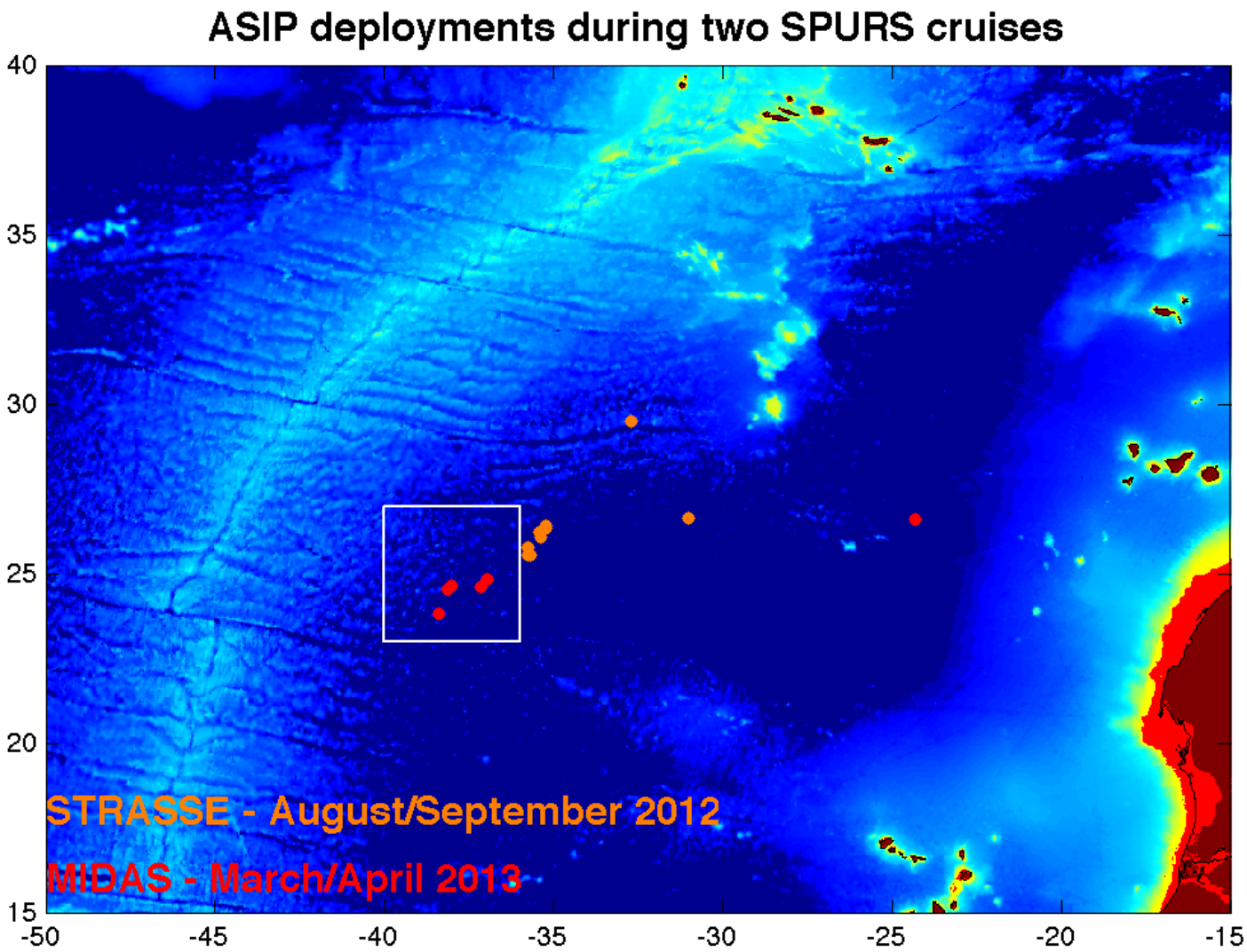
- Each cruise has an initial test deployment - 10 profiles over 1 hour here — 1 $\mathrm{g\,kg^{-1}}$ in the upper 2m

SPURS Experiment

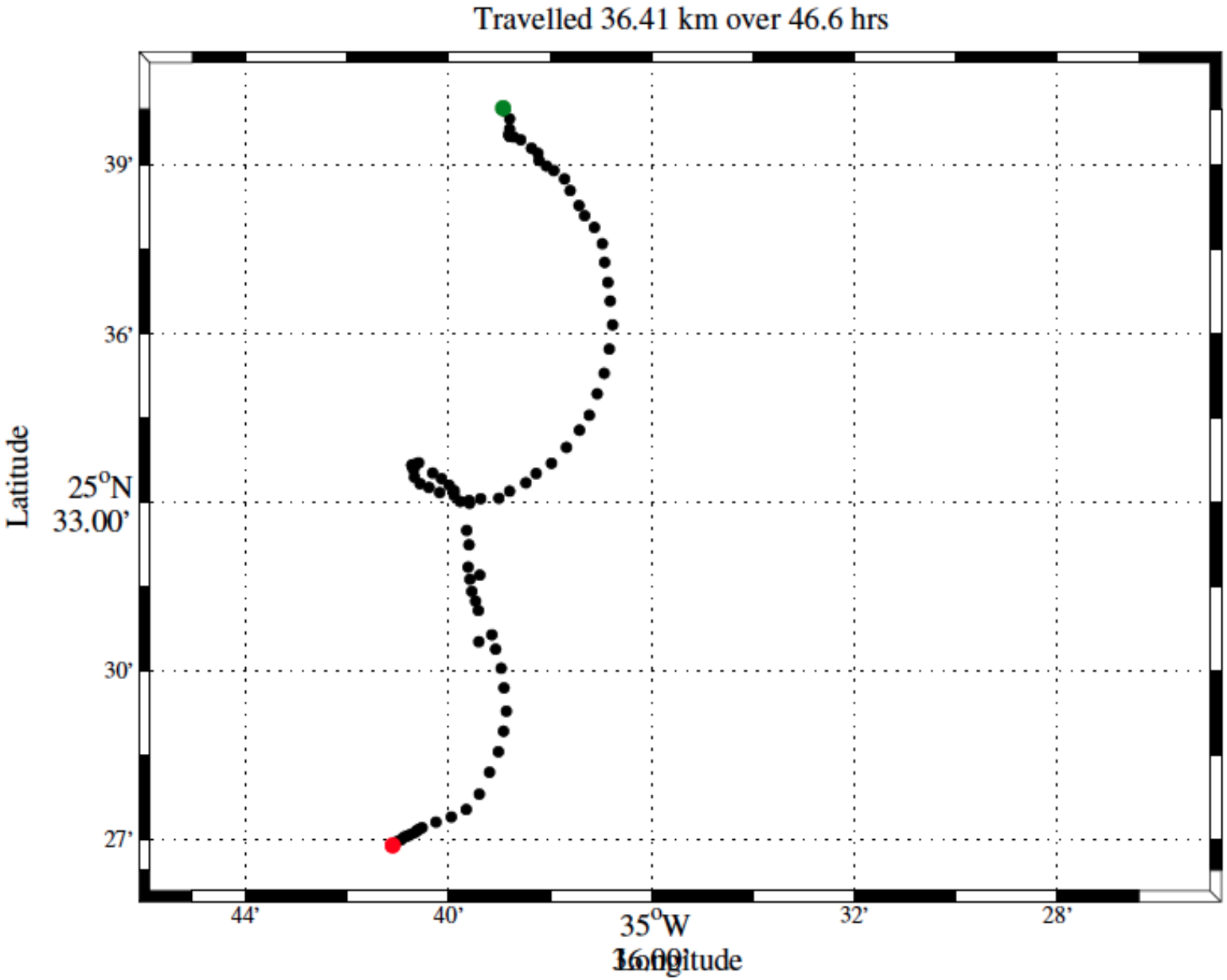


- Salinity Processes in the Upper-Ocean Regional Study (SPURS): a multi-scale field experiment which would concentrate on the processes controlling the North Atlantic Salinity Maximum (NASM).
- One of the objectives of SPURS is to provide a method for relating remotely sensed SSS measurements to the GHC

ASIP Deployments on Two SPURS Experiments



ASIP STRASSE Deployment



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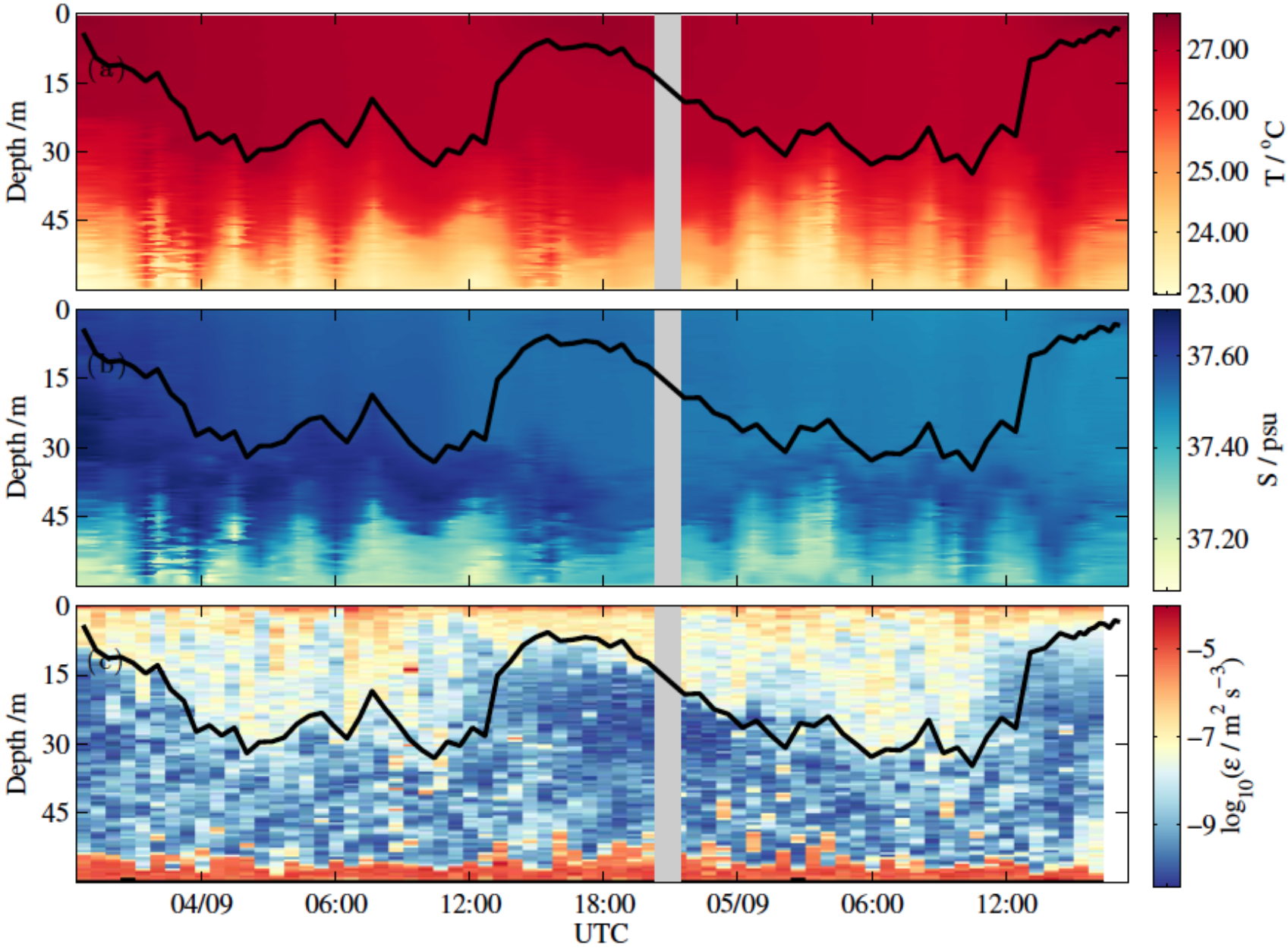

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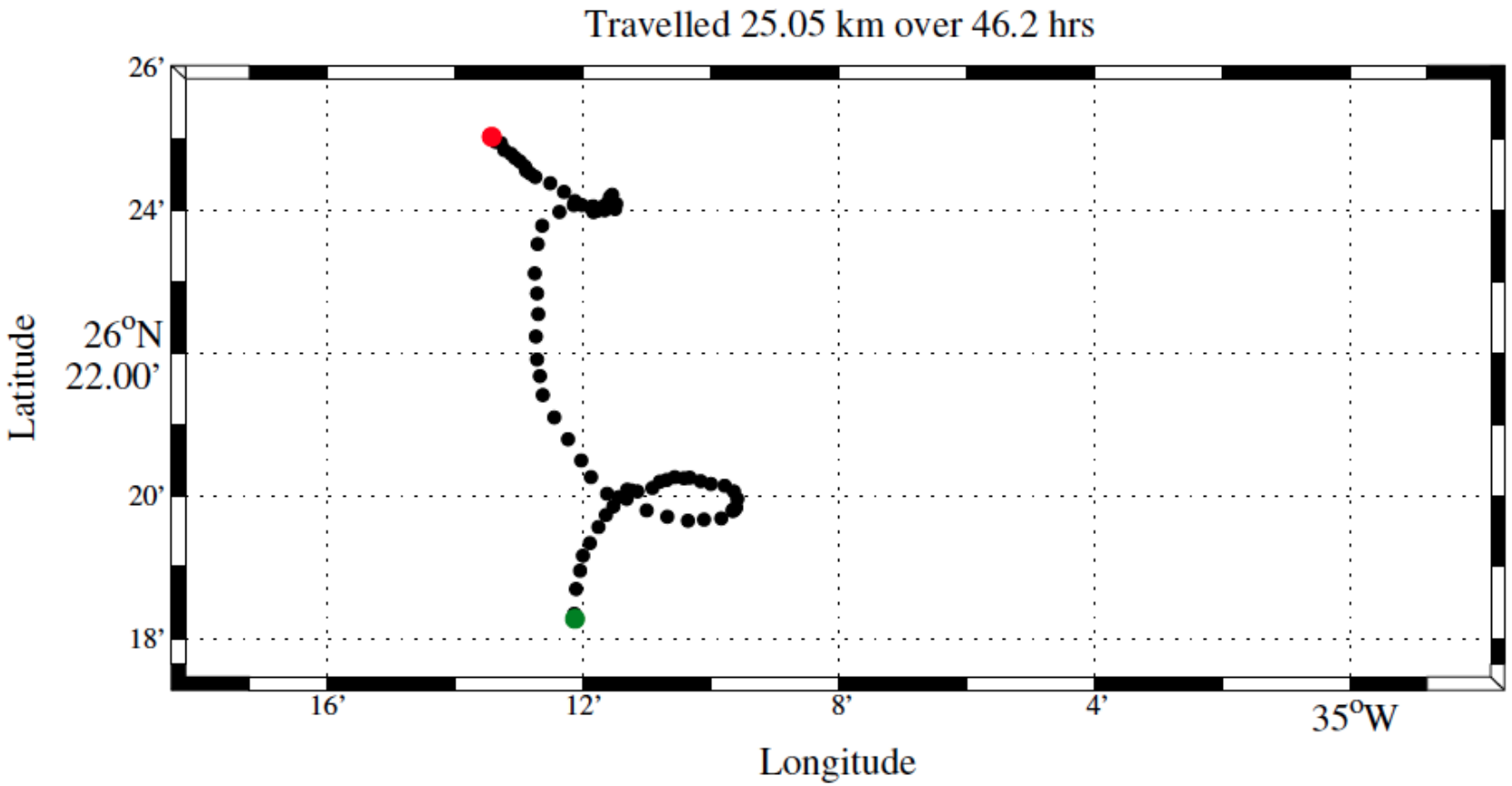

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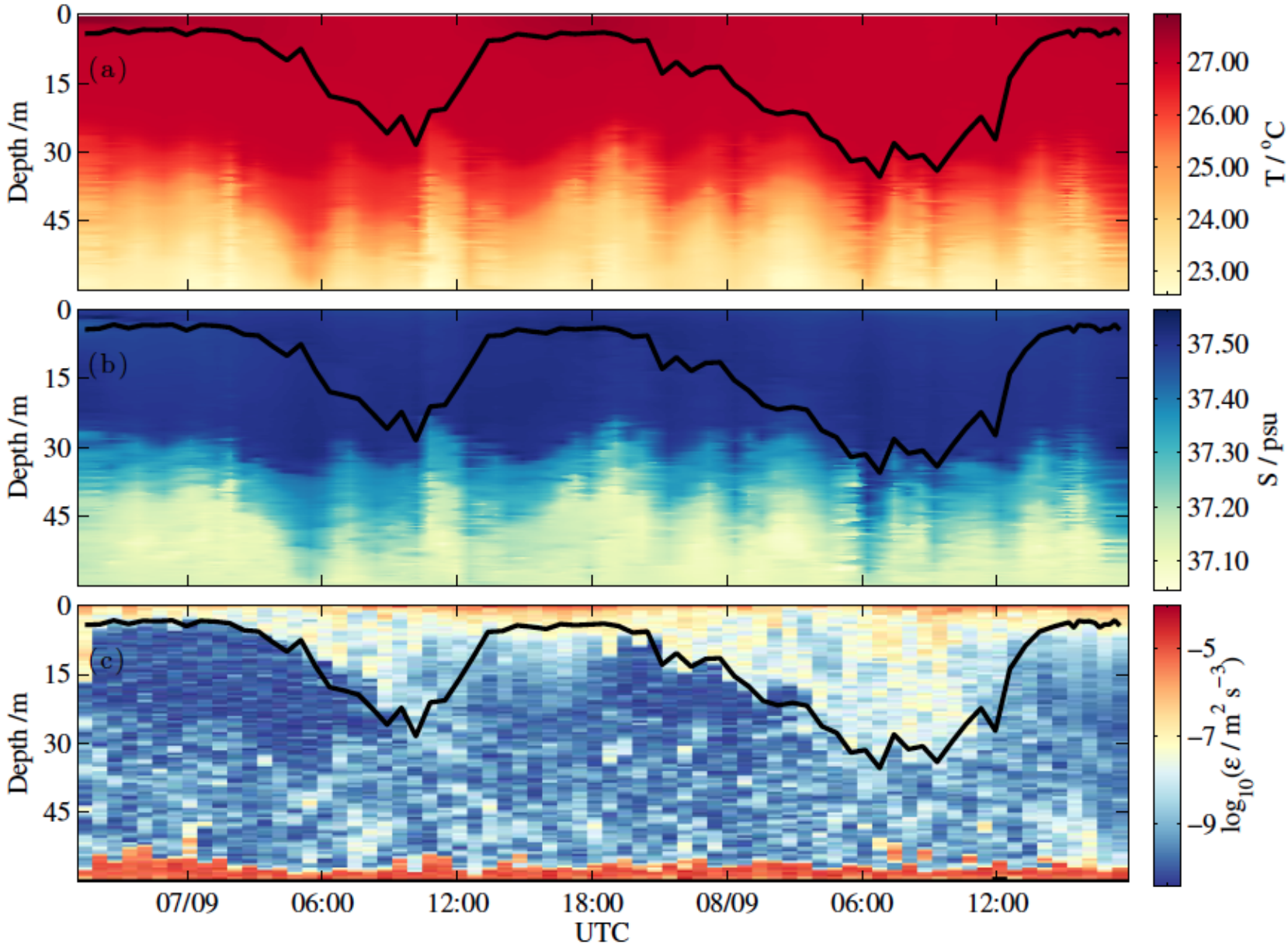

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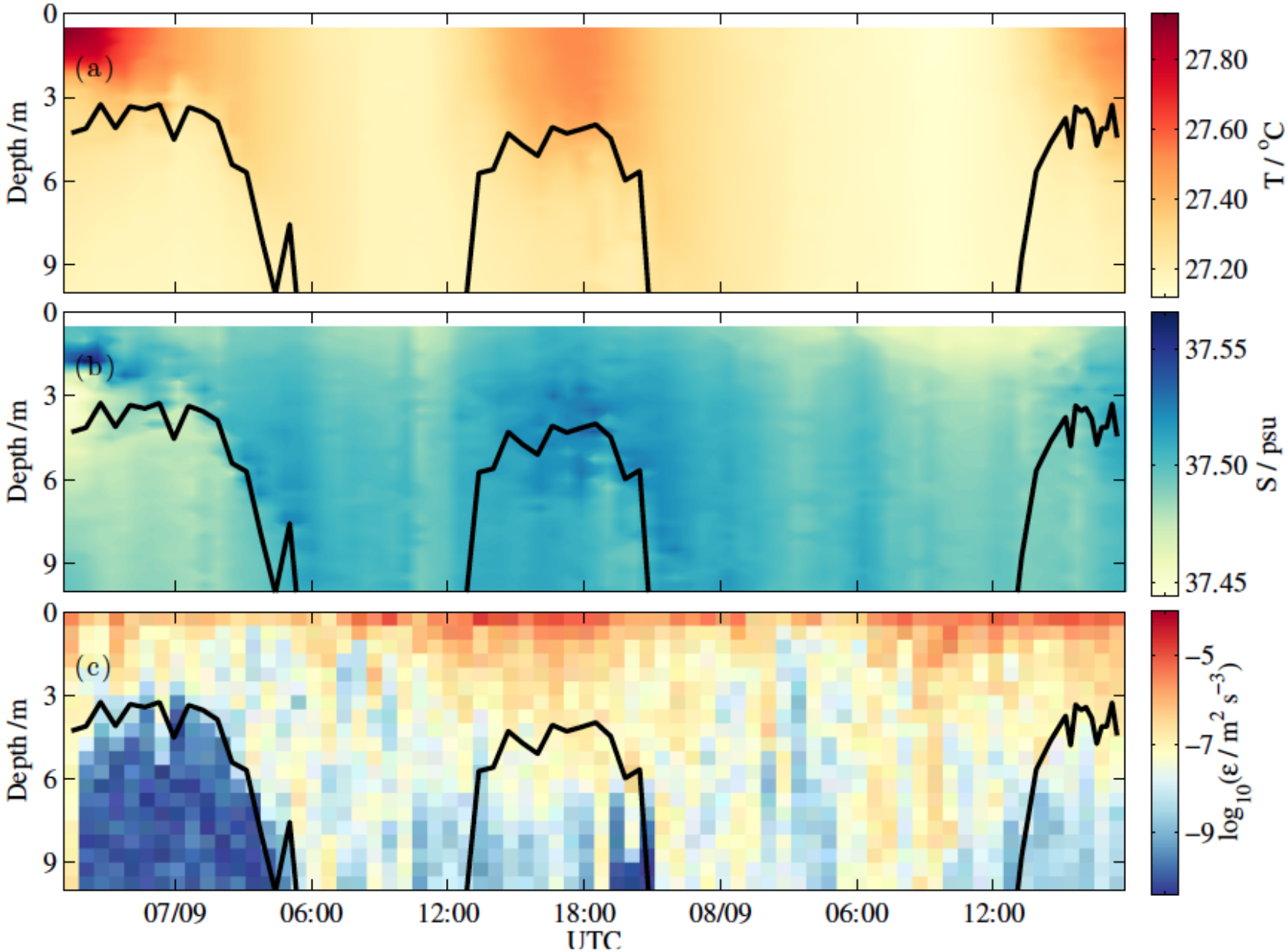
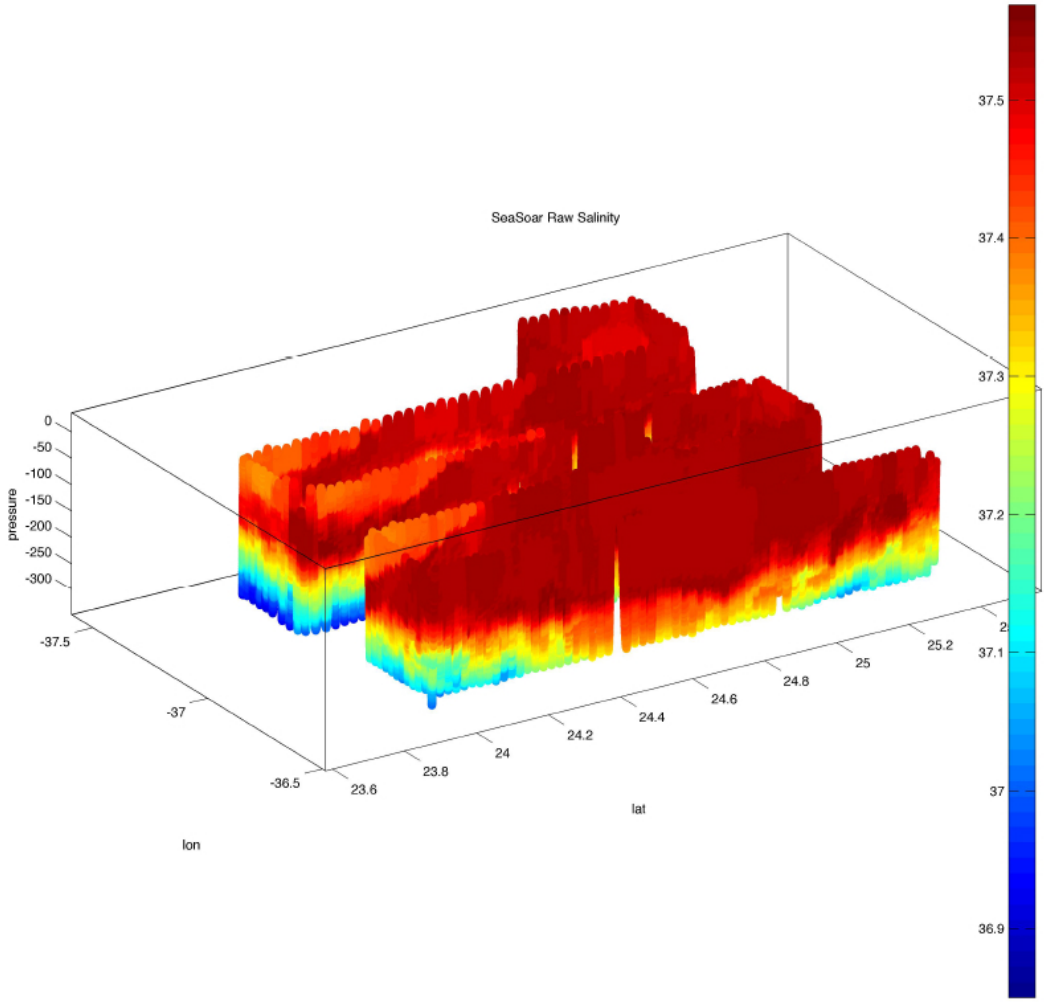


MIDAS-SPURS Sea Soar salinity data



- Sea soar survey to map out the salinity of the SPURS area
- Patches of fresh water in the salinity survey data

Thanks to Julius Busceke, LDEO

Conclusions

- In-situ Salinity is a hard measurement to make
- With SMOS and Aquarius we can now collect salinity data from space.
- ASIP is a state-of-the-art, one of a kind instrument, that offers an unprecedented level of detail in mixing processes at the air-sea interface
- Objective is to understand how mixing processes at the air-sea interface effect the air-sea exchange of water, and therefore SSS - improve the satellite-derived estimates