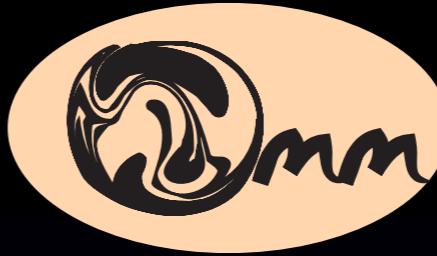


ASIRI

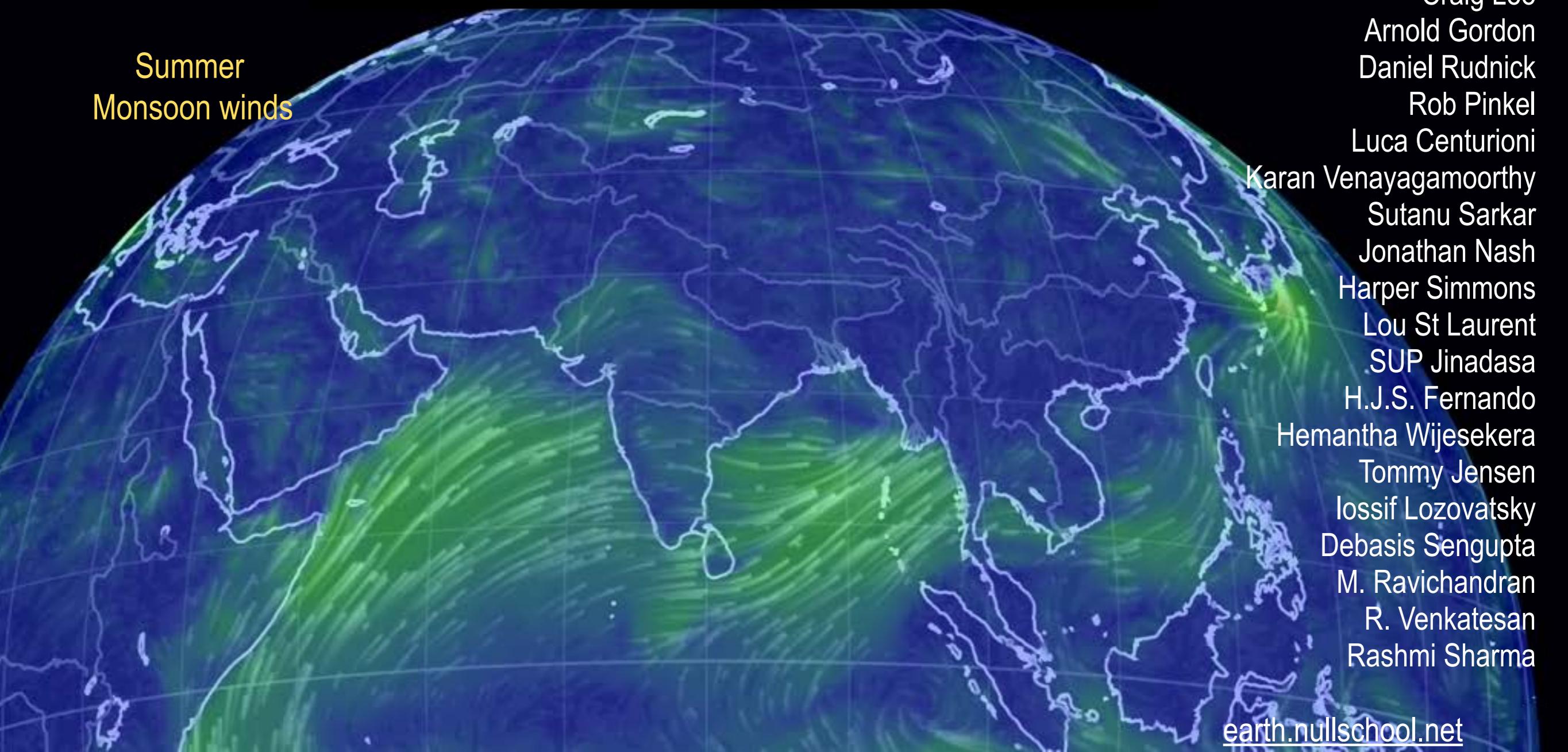


Air-sea Interaction Regional Initiative in the Northern Indian Ocean

Ocean Monsoons
and Mixing



Summer
Monsoon winds



Amala Mahadevan

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Amit Tandon

Tom Farrar

Bob Weller

Jennifer MacKinnon

Andrew Lucas

Emily Shroyer

Eric D'Asaro

Craig Lee

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Luca Centurioni

Karan Venayagamoorthy

Sutanu Sarkar

Jonathan Nash

Harper Simmons

Lou St Laurent

SUP Jinadasa

H.J.S. Fernando

Hemantha Wijesekera

Tommy Jensen

Iossif Lozovatsky

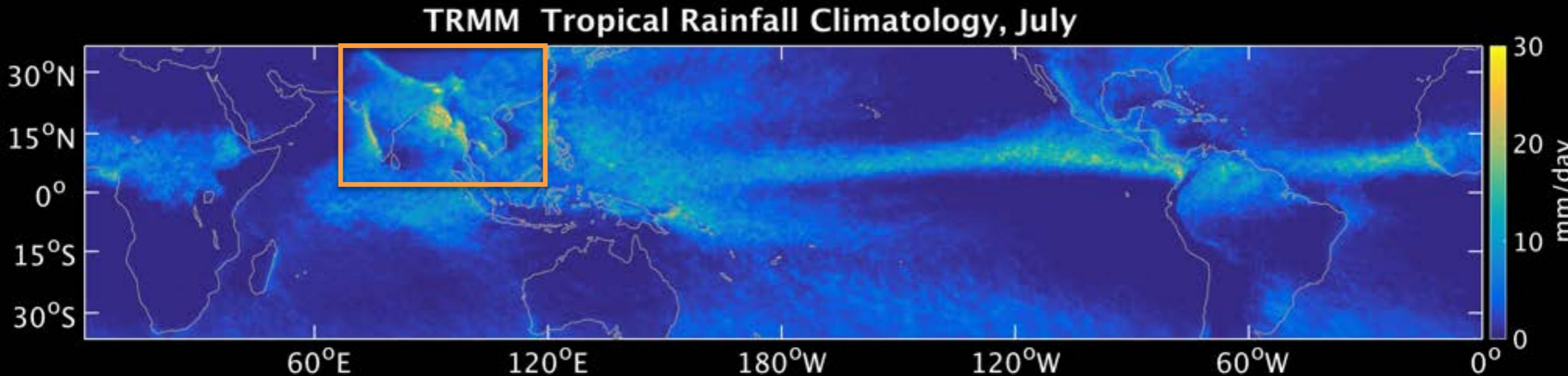
Debasis Sengupta

M. Ravichandran

R. Venkatesan

Rashmi Sharma

More than half the world's population in this region



World Population as a function of Longitude

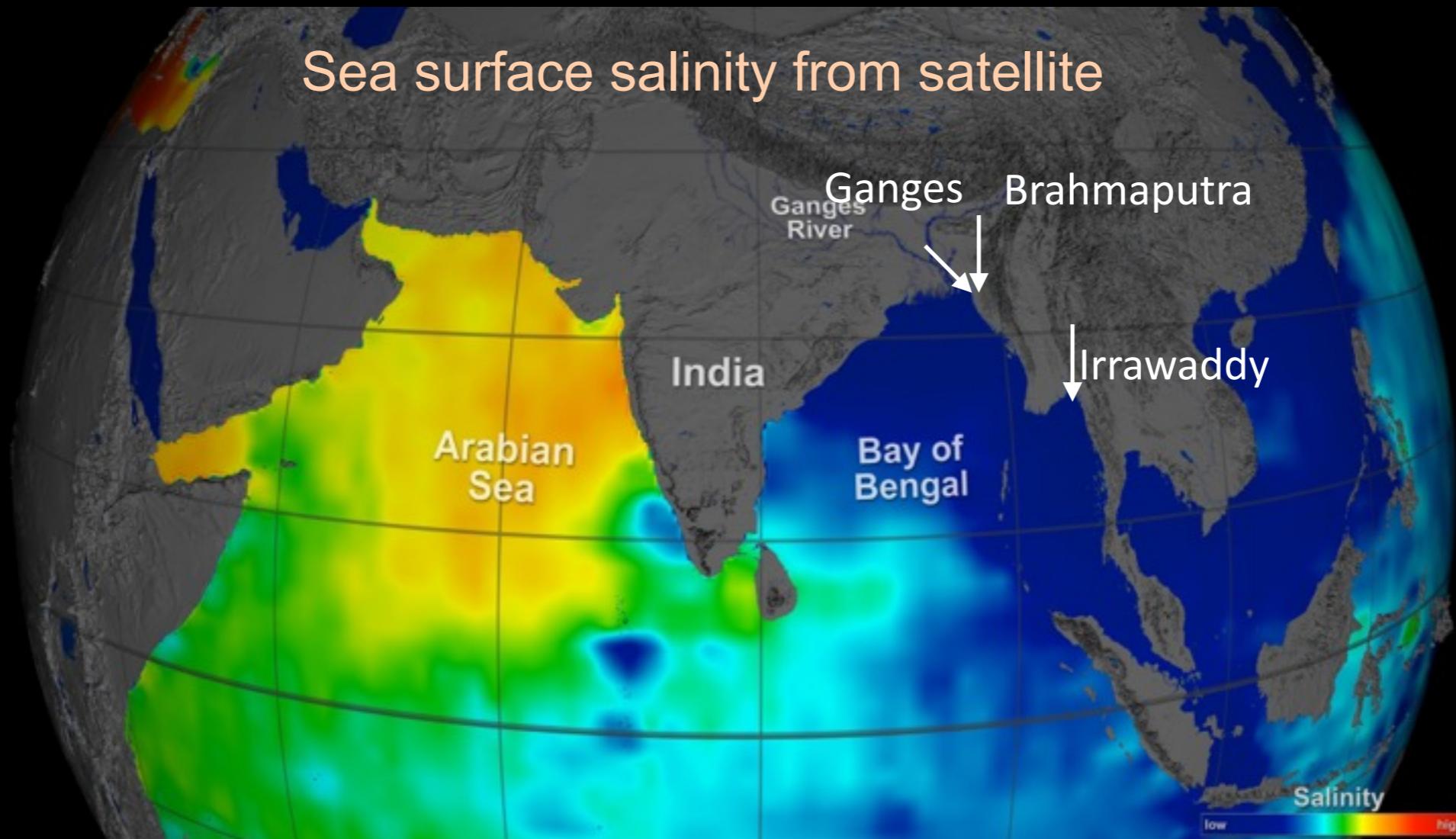


...highest (per capita) impact of air-sea processes and largest human susceptibility to climate change

Motivation: Monsoon Prediction

Global models have biases — various aspects of the Monsoon:

- Oceanic Mixed layers not well represented (deep cold bias)
- Sub-seasonal variability is important, but not captured by models.



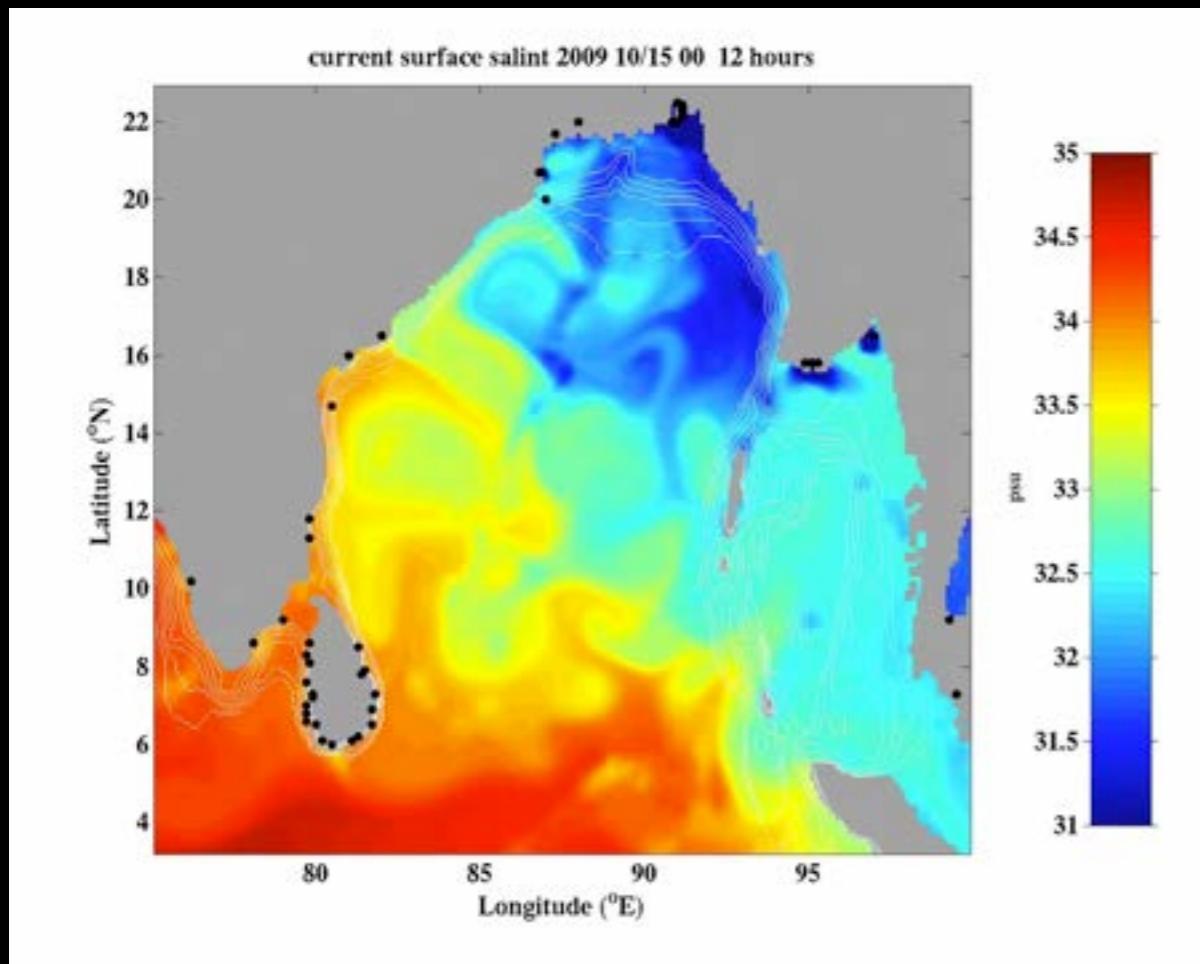
- Air-sea fluxes of heat and moisture?
- Sea surface temperature, MLD?
- Ocean boundary layer processes not well understood

Bob Weller, Tom Farrar,
Debasis Sengupta, M. Ravichandran, R. Venkatesan



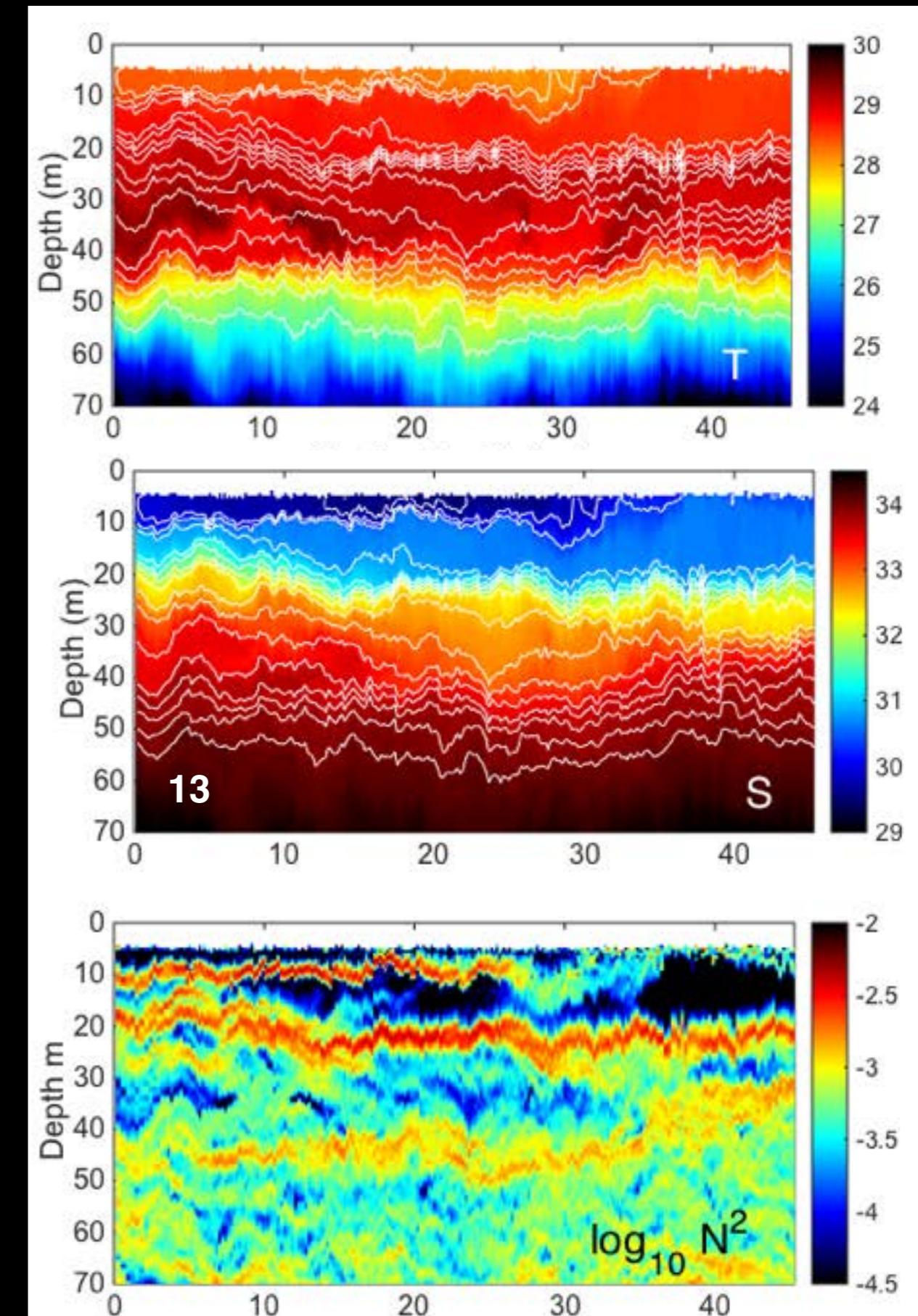
- WHOI Mooring at 18N
- 2015 Upper ocean structure - A-S flux estimates
- 2016 Eddy co-variance flux measurements

Mesoscale circulation N-S salinity gradient

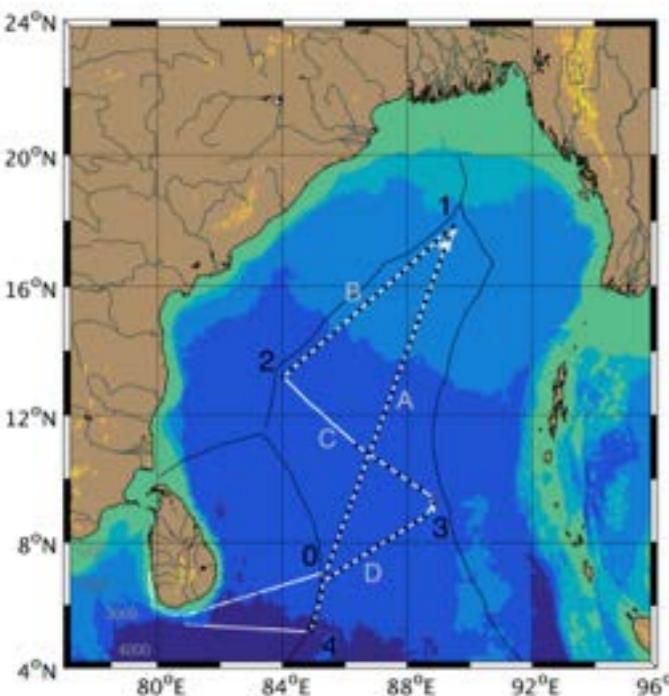


Model: Tommy Jensen, NRL

Strong stratification
Observations: ASIRI cruise 2015. Lucas et al.

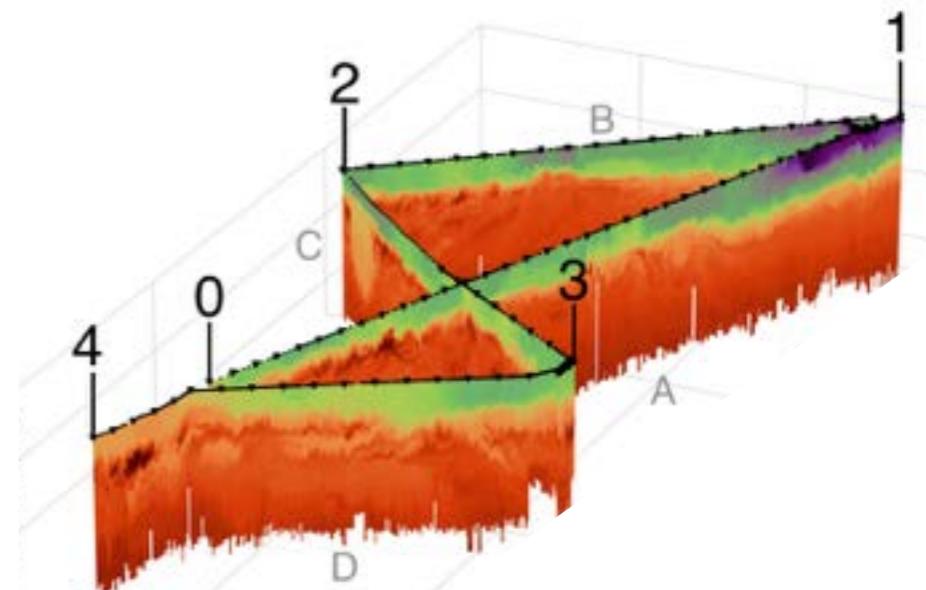


Multiple layers
Stratification (T-s structure)
affects air-sea interactions



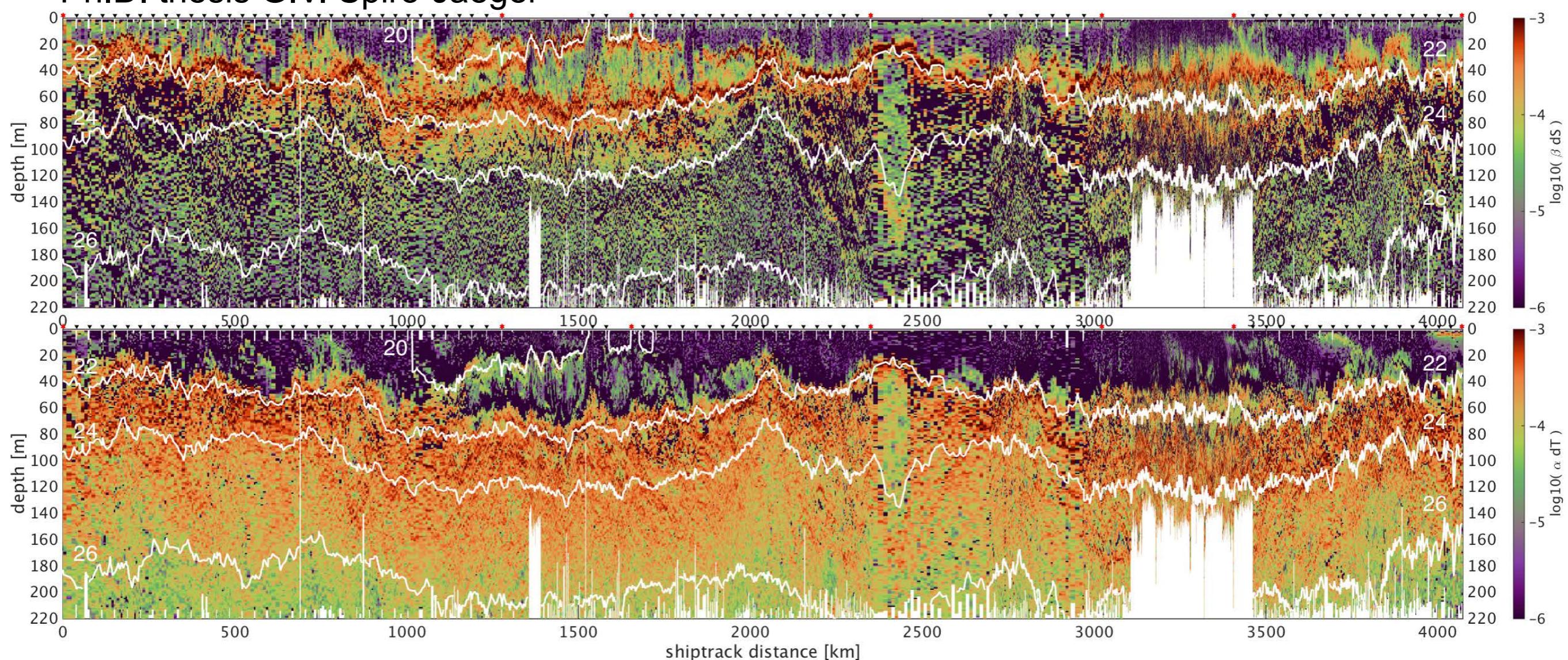
Observations: ASIRI cruise 2013
Shroyer et al. 2015

ASIRI 2013 Leg 2



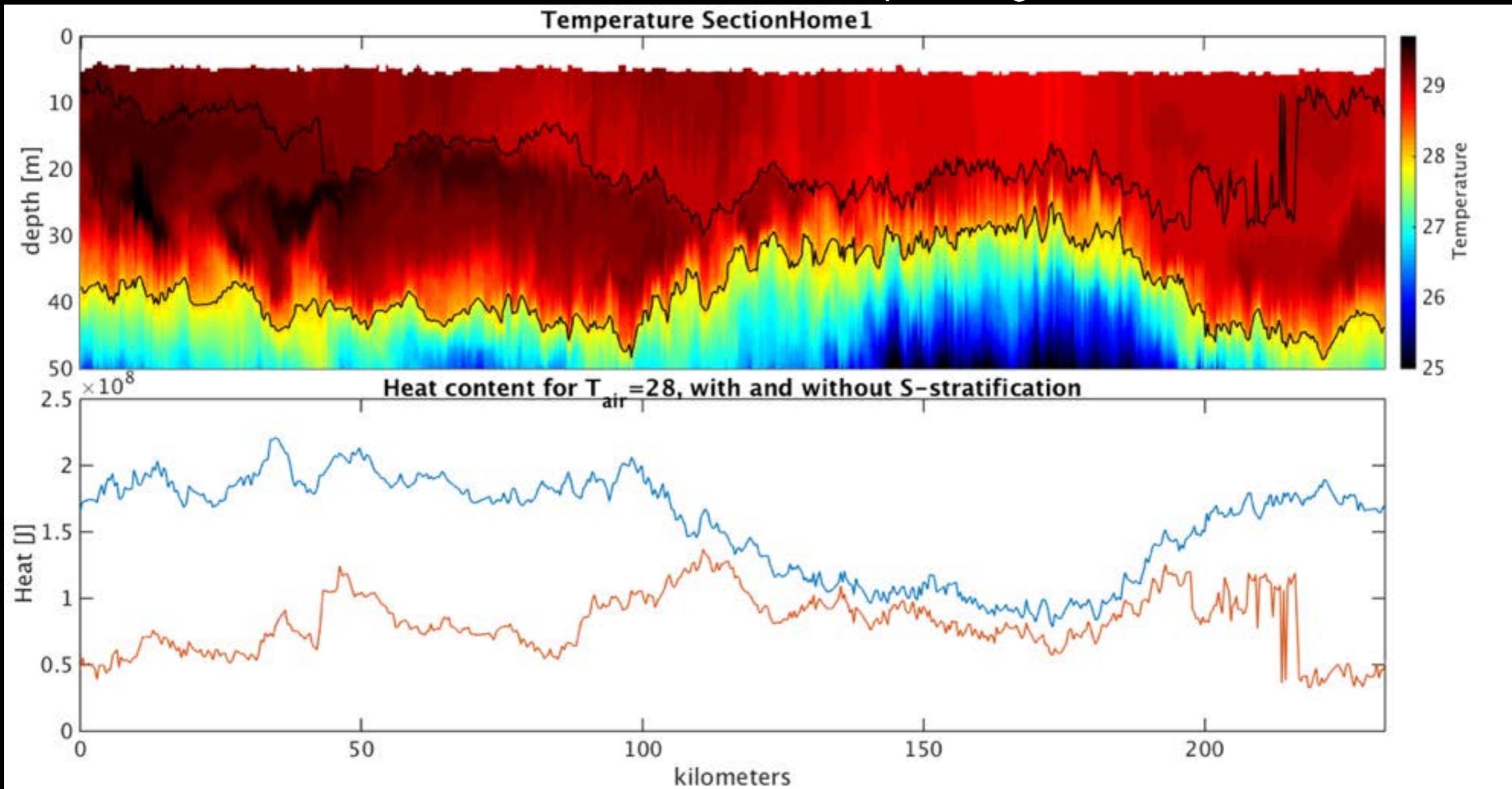
Density stratification due to
Top: Salinity
Lower: Temperature

Ph.D. thesis G.V. Spiro-Jaeger

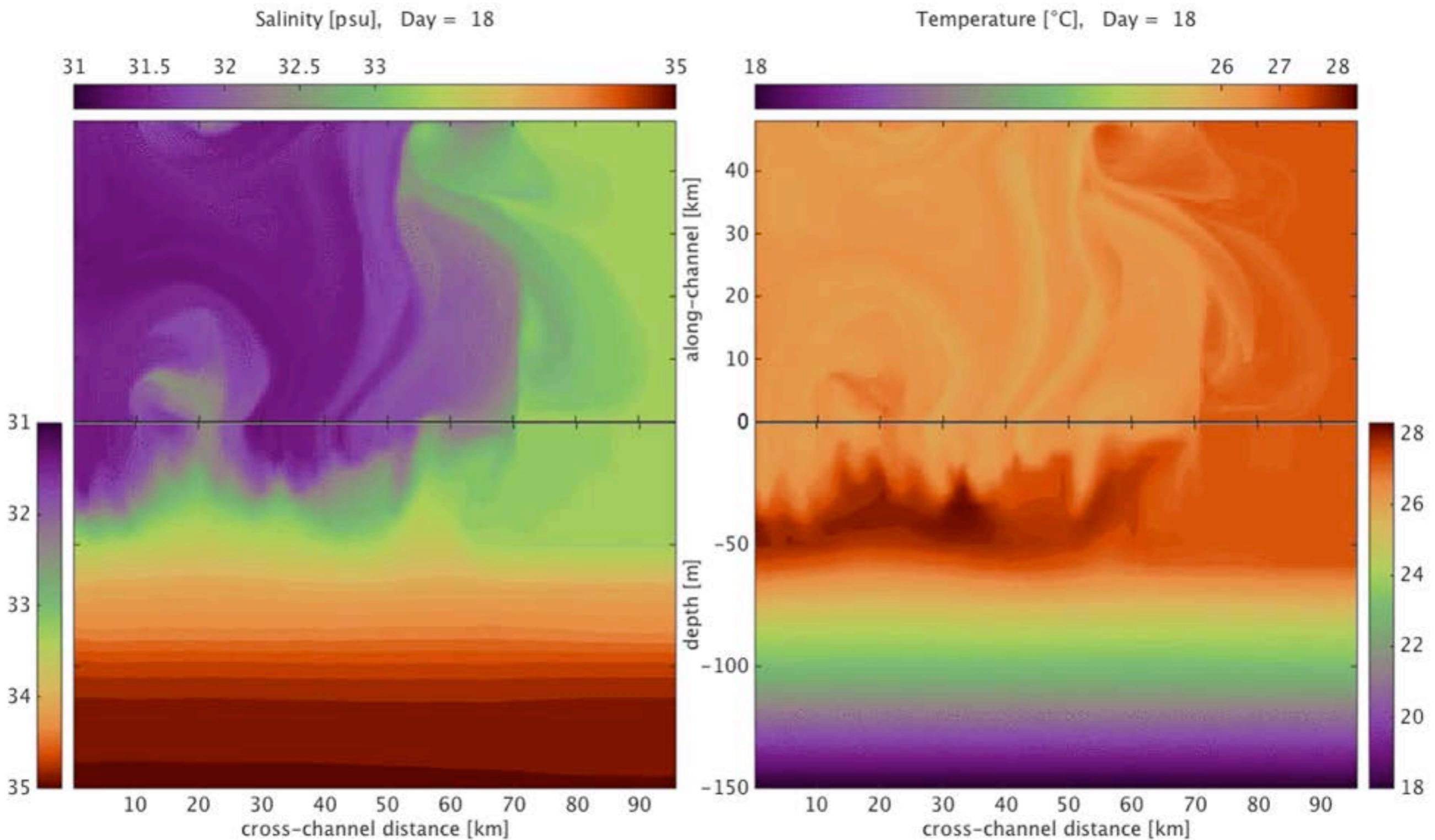


Difficult to extract heat from freshwater stratified ocean

Observations: ASIRI cruise 2015. Spiro-Jaeger, Ph.D. thesis



-150 W/m² cooling: 18-days from a process study ocean model

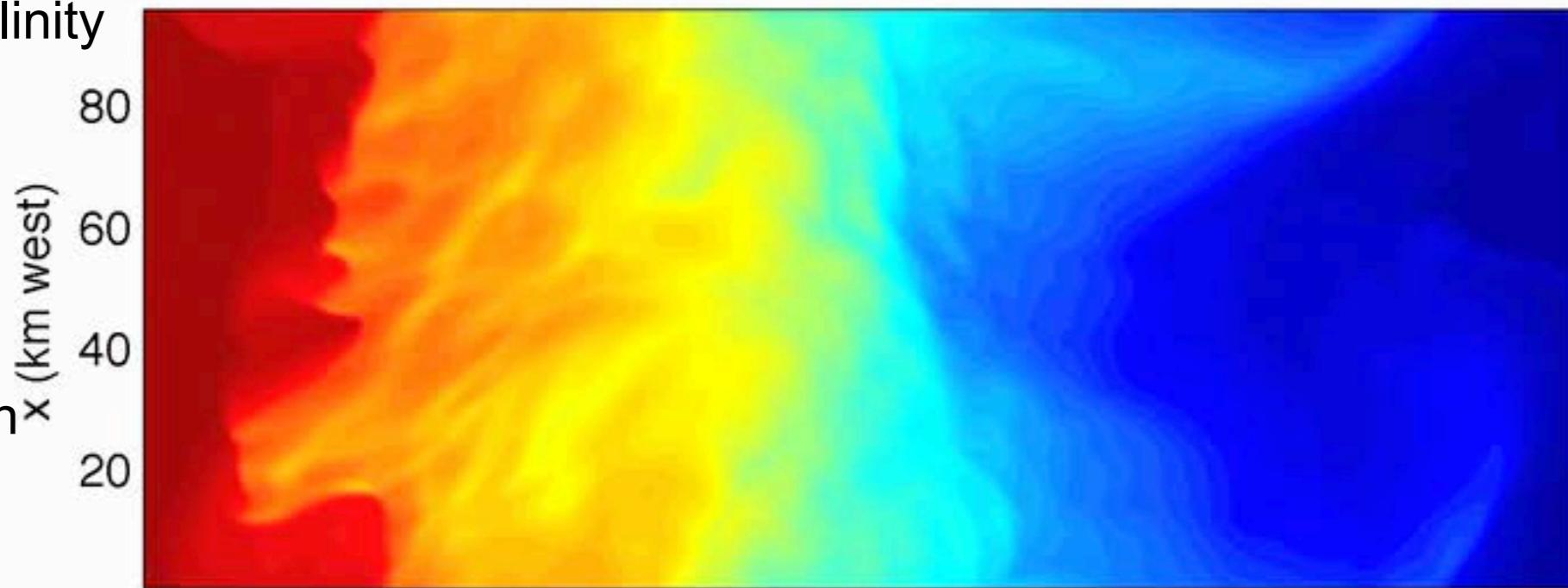


Modeling: Spiro-Jaeger, Ph.D. thesis

Process Study Ocean Model
Mixed layer instability of a freshwater front responding to wind-driven Ekman transport
(Mahadevan et al.)

Surface Salinity

0.05
-0.05 0 0.05
Wind direcn

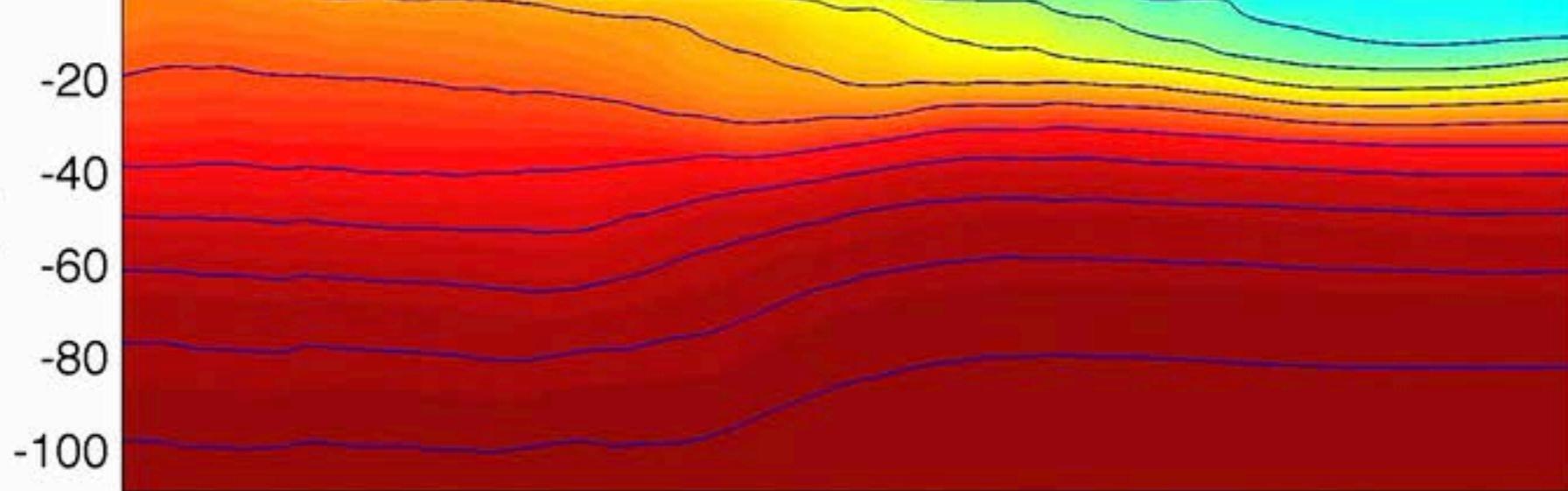


Day 21.5

salinity
32
31
30
29

Vertical
Section
(salinity)

z (m)



salinity
34
32
30
28
26

Wind stress

0.1
0
-0.1

Eastward
Northward



Air-sea fluxes of heat /moisture depend on the upper ocean vertical structure

- Shallow layers, strong stratification, freshwater
- Dispersal of surface freshwater - generation of stratification, fronts play a role, wind direction matters
- Mixing (or the lack of it)

What are the processes that set the upper ocean structure?