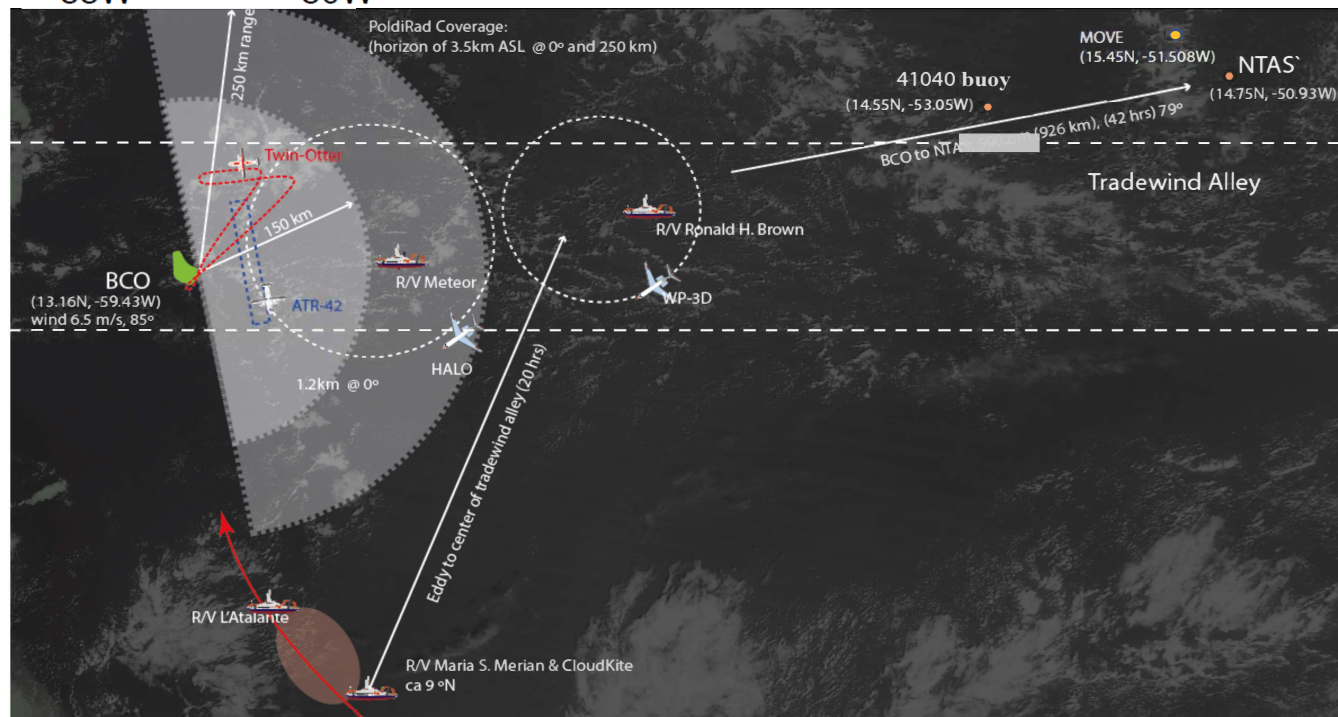
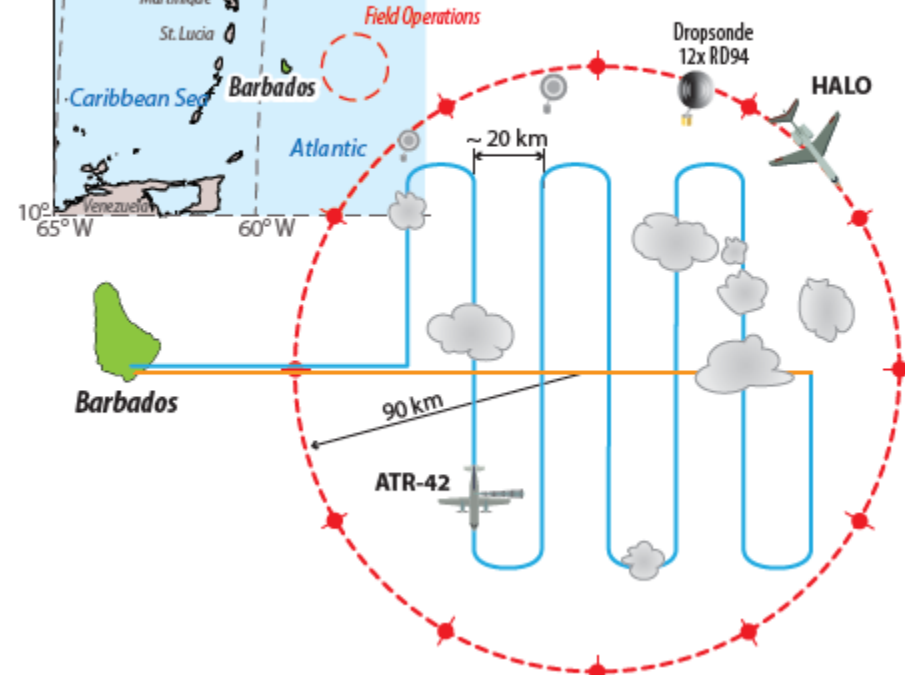
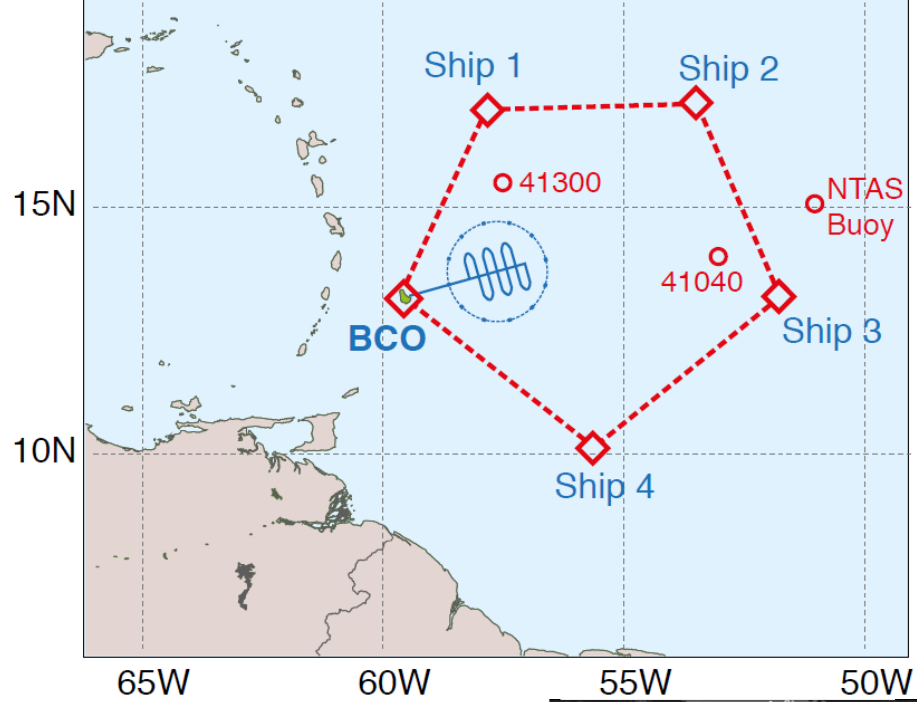


Atlantic Tradewind Ocean-Atmosphere Mesoscale Interaction Campaign – ATOMIC

A study of shallow convection and ocean coupling in the N Atlantic

- EUREC4A - a field campaign to elucidate the couplings between clouds, convection and circulation
 - European effort of Barbados winter 2020
 - Aircraft, ships, Island-based systems
 - Extensive regional LES modeling effort
 - Emphasis on the role of shallow convection in climate model CO2 warming sensitivity
- US involvement (ATOMIC)
 - Leverage EUREC4A effort
 - Take advantage of unique capabilities of NOAA observing assets
 - Take advantage of historical collaboration of Universities and Fed Labs
 - Emphasis on shallow convection, mesoscale coupling with the ocean, aerosol-cloud
- EU Ocean-Atmosphere Component – EUREC4A-OA



Observational Keys

- Ship-island rawinsonde array – forcing on 500-km scale/budgets
- Aircraft dropsonde array – snapshots of 100-km scale forcing/budgets
- Aircraft inside the 100 km circle
 - cloud and mass flux statistics
 - Precipitation coverage
 - Cloud – aerosol microphysics
- Ship-borne aerosols
- Ship-borne air-sea fluxes, cloud/BL profiling
- Ship-borne ocean mesoscale sampling
- Gliders, Drifters, Spar buoys, UAV, Saildrone
- NOAA aircraft: dropsondes, AXBT, clouds, precipitation, waves

NOAA Observational Assets*

Ship-based observations			
Ronald H. Brown	System	Group	PI
	Air-sea flux	PSD	Blomquist
	Sondes	PSD	De Szoeke
	Ocean mixing	UW/APL	Thompson/Thomson
	Cloud Obs	PSD	De Szoeke/Fairall
	Doppler Lidar	CSD	Brewer
	Aerosols	PMEL	Quinn
	Isotopes	OSU	Noone
	UAS	PMEL	Quinn/de Boer
	Flux buoys	UW/APL	Thompson/Thomson

Aircraft-based observations			
P-3 Aircraft	System	Group	PI
	TDR	AOML/PSD	E. Thompson
	AXBT	NRL/TAMU	Chen/Shinoda
	Cloud microphysics	PSD	Fairall
	Drop Buoy	PSD	De Boer
	Wband cloud radar	PSD	Fairall/Thompson
	WSRA wave spectra	PSD	Walsh
	Dropsonde	AOML/PSD	Bariteau/de Szoeke

*NOAA process essentially complete.

Ronald H. Brown: 37 days, 2 legs, Barbados-Barbados-Barbados.

23 cruise (WBTS) prior to ATOMIC Ft. Lauderdale-Barbados

P-3: 110 hours, Jan5 – Feb 15, based Barbados

NOAA UAS: On board

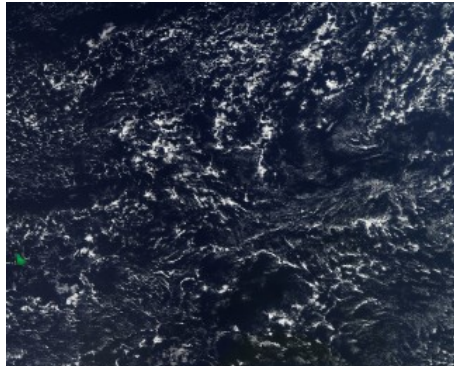
Saildrones

Day-to-day variability of mesoscale patterns

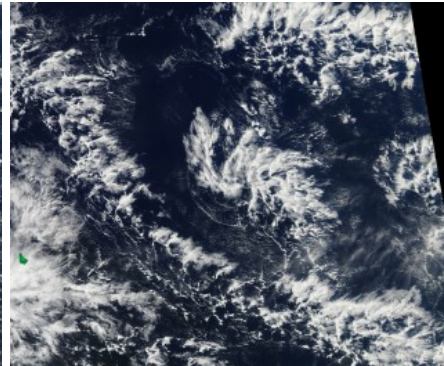
Flowers



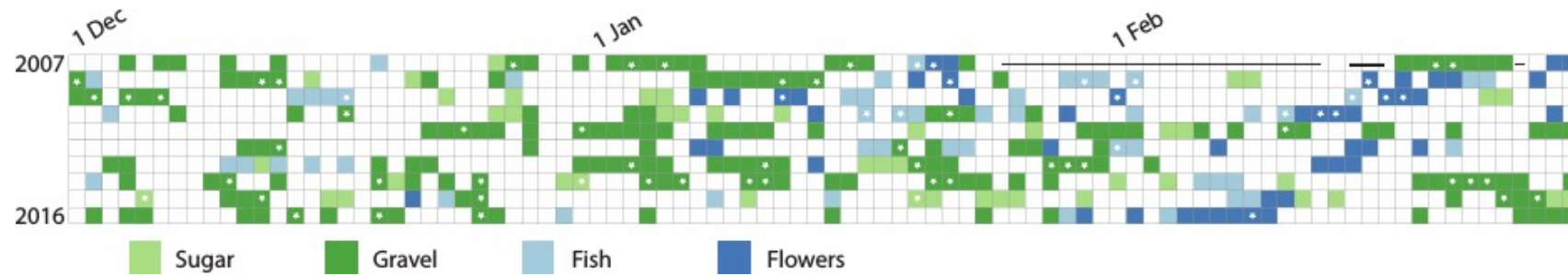
Gravel



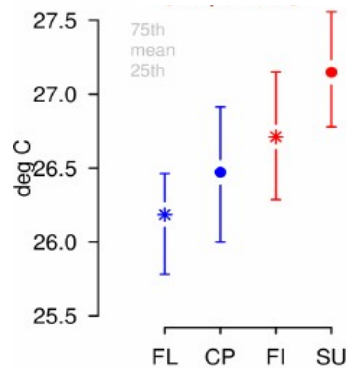
Fish



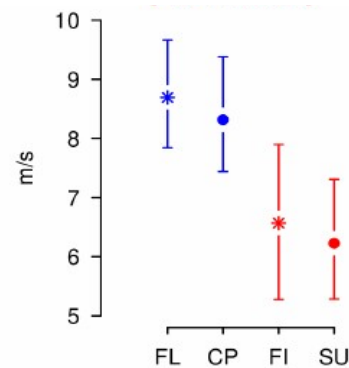
Sugar



SST

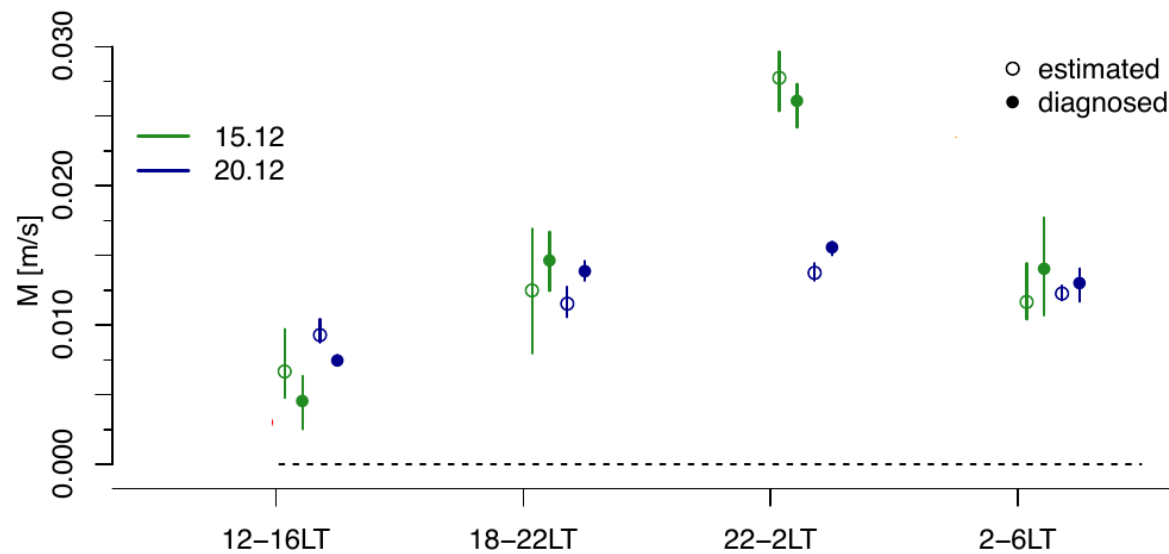
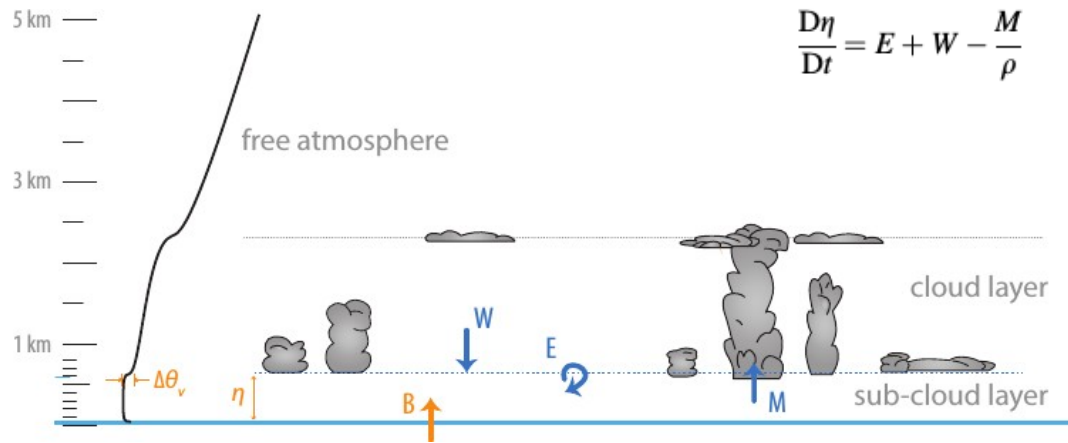


Surface wind speed



- Strong variability of mesoscale organization
 - Some relationship with the large-scale environment
- Day-to-day variations: opportunity to investigate the link between LS environment –organization - clouds

The convective mass flux at cloud base can be estimated from the mass budget of the subcloud layer



NOAA Funded Investigator Matrix

	Type	RHB	P-3	Saildrone	Shallow Q dynamics	Surface Fluxes	Eddies/Fronts	Cloud Organization	Aerosols
DeSzoeke	Obs	x			x	x		x	
Fairall	Obs	x	x		x	x		x	
Feingold	Mod		x		x				x
Folz	Obs	Atalante					x		
McWilliams	Mod	x					x		
Quinn	Obs	x				x		x	x
Seo	Mod					x	x	x	
Thomson	Obs	x				x	x		
Zhang	Obs			x		x	x		
Zuidema	Obs	x	x		x			x	

ATOMIC Implementation Plan, September 20 2019

Executive Summary

The Atlantic Tradewind Ocean-Atmosphere Mesoscale Interaction Campaign (**ATOMIC, US**) and Elucidating the Role of Clouds-Circulation Coupling in Climate (**EUREC⁴A , Europe**) initiatives will take place during six weeks in January-February 2020 to address the Northwest Tropical Atlantic ocean-atmosphere interactions at the mesoscale and their relation to the regional oceanic boundary layer (OBL), air-sea interactions and atmospheric shallow-convection. EUREC⁴A is designed to test critical hypotheses related to the interplay between clouds, (atmospheric) convection and circulation, and their role in climate sensitivity. It will in particular focus on the shallow marine cumulus prevalent over the world's trade-wind belts and tropical oceans. ATOMIC is a US initiative designed to complement EUREC⁴A with additional observations focused on mesoscale OBL and ABL processes. The field work will involve 4 research vessels, 4 research aircraft, land-based observations from Barbados, and panoply of robotic platforms combined with a comprehensive modeling program.



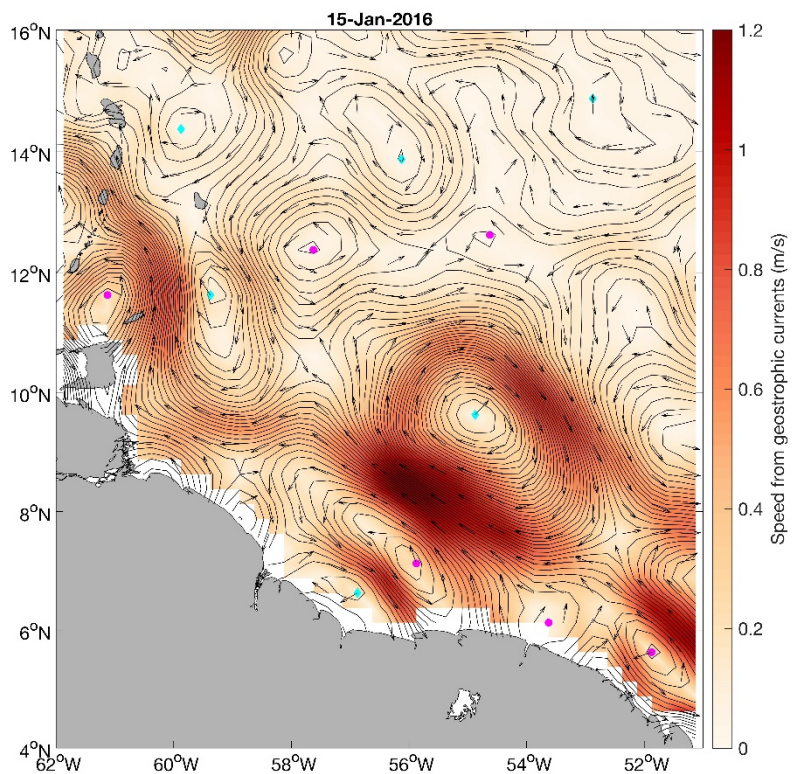
Figure 1.1 ATOMIC/EUREC⁴A field program operating region. NTAS is a NOAA climate reference buoy; BCO is the Barbados Cloud Observatory. Circle labeled *HALO* denotes the operations area of EUREC⁴A aircraft. The yellow line is for NOAA ship-based UAS.

Science Themes

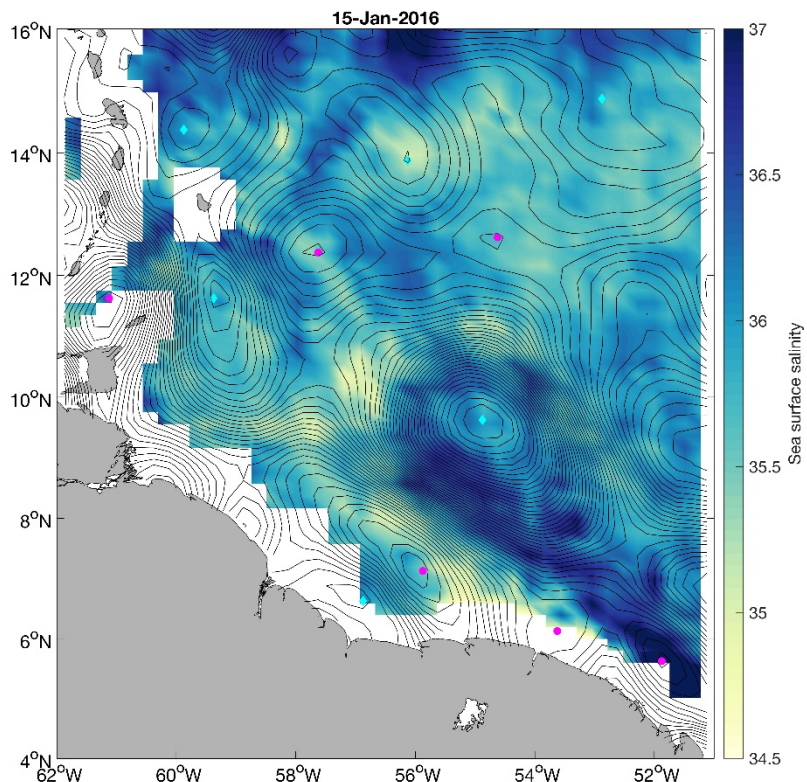
- 1 The cloudy lower atmosphere
 - What boundary layer conditions are conducive to cloudiness?
 - Through which processes does the environment influence the clouds, and conversely, do clouds influence their environment?
- 2 Air-Sea Interactions
 - How do clouds and the atmospheric boundary layer influence the upper ocean mixed layer?
 - How do SST gradients affect ABL circulations and shallow clouds?
- 3 The Ocean Mixed Layer
 - How do ocean mixing processes at different time and spatial scales influence the surface fluxes and atmospheric boundary layer?

Examples from Sabrina Speich

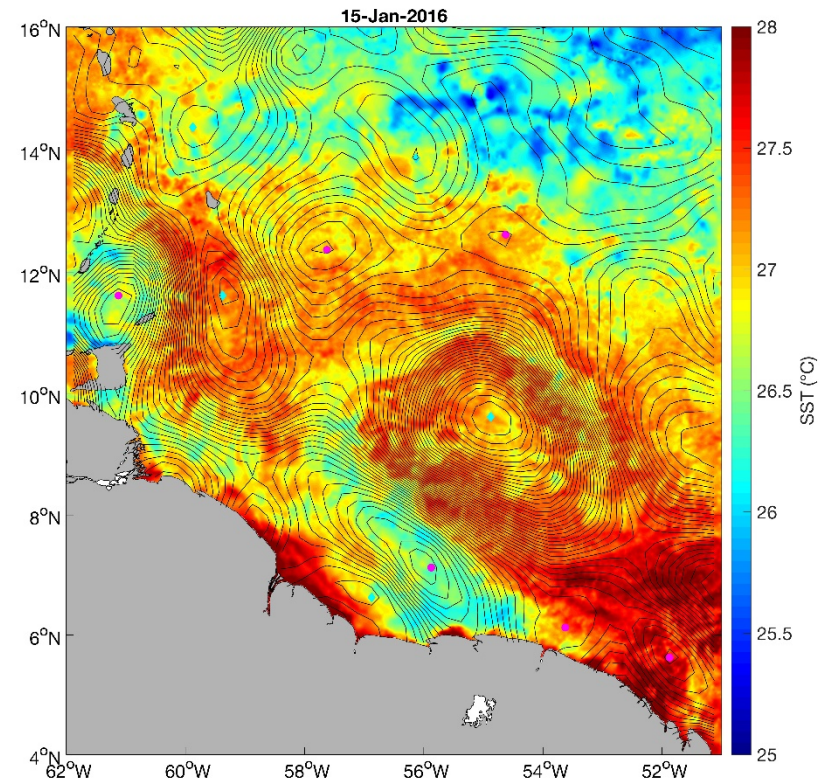
Surface Currents



Surface Salinity



Surface Temperature



Mesoscale coupling: Monthly mean anomaly curl stress and sst gradient.

R. M. Samelson, L. W. O'Neill, D. B. Chelton, E. D. Skillingstad, P. L. Barbour, and S. M. Durski

