Impact of weather systems on coastal ocean processes in the northern Gulf

Chunyan Li, Louisiana State University

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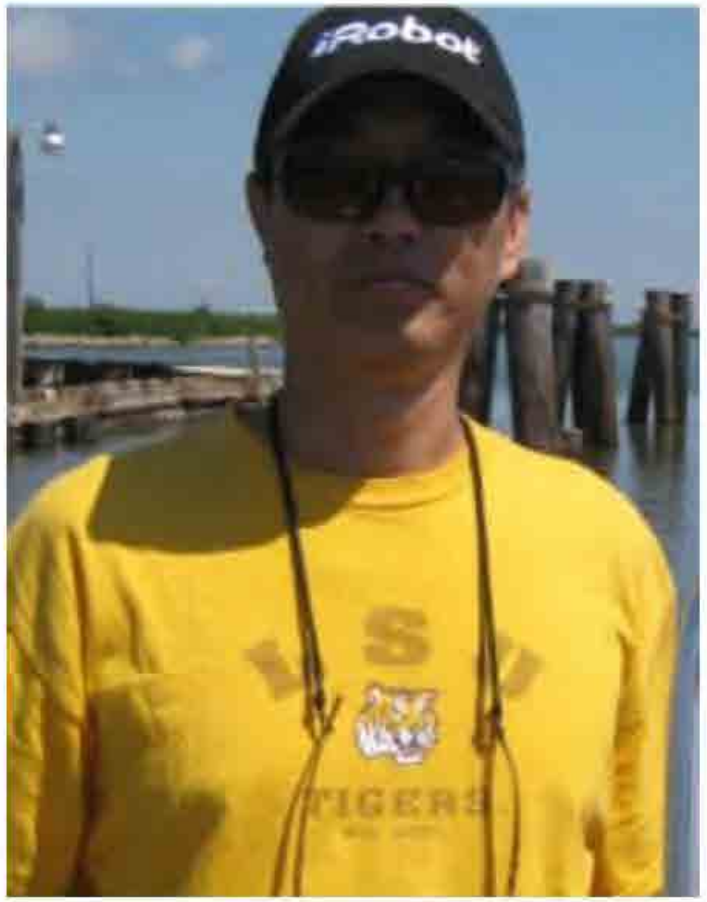
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Physical Oceanography
Coastal Meteorology



Chunyan Li

Position: Professor and Mobil Distinguished Professor of Marine Geology, Department c
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Phone: 225-578-3619
E-mail: cli@lsu.edu
Office: 208C Howe-Russell Geoscience Complex West
Lab: Coastal Ocean Estuarine Dynamics Lab, 331 Howe-Russell Geoscience Complex

Classes Taught

OCS 4170: Physical Oceanography
OCS 7120: Dynamical Oceanography
OCS 7123: Oceanographic Data Analysis
OCS 7125: Estuarine Dynamics
OCS 4021: Forecasting Coastal Weather
MATH 1554: Calculus II for Life Science

WAVCIS

https://www.wavcis.lsu.edu

WAVCIS
Wave-Current- surge Information System
Coastal Ocean Estuarine Dynamics Lab
Department of Oceanography and Coastal Sciences, College of Coast and Environment, Louisiana State University

Program Director: Dr. Chunyan Li
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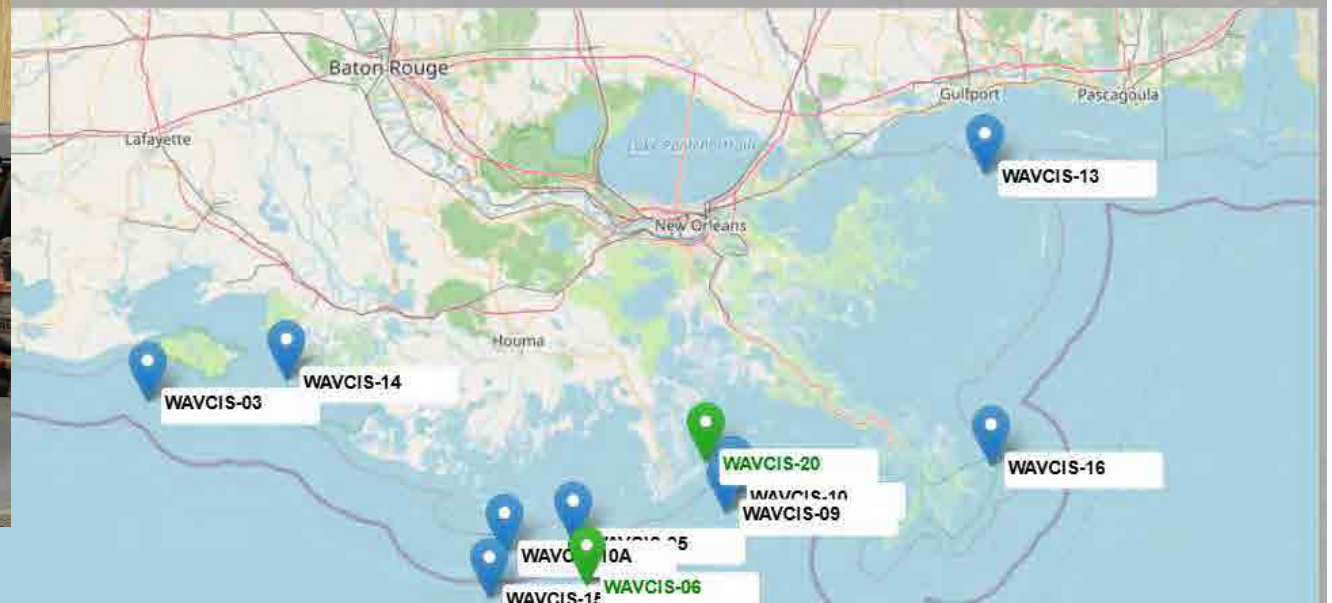
Congratulations to WAVCIS Lab Ph.D. student Mimon Morsheduzzaman for receiving the First Place Best Coastal Student Poster Presentation Award at the 106th American Meteorological Society (AMS) Annual Meeting held in Houston, Texas (January 25–29, 2026).

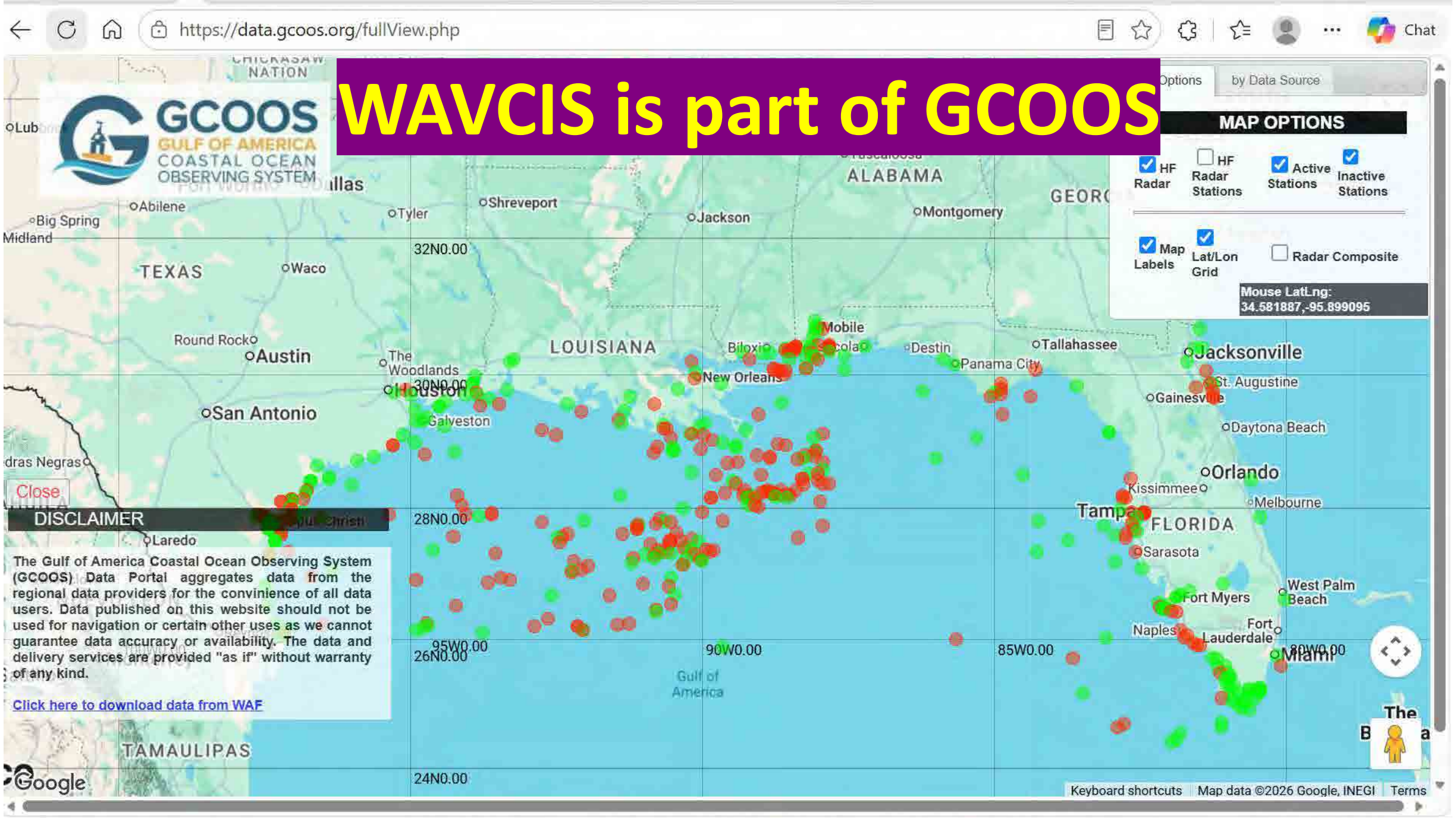
Morsheduzzaman, A. K. M. N. A. (Mimon), Li, C., Xu, K., & Howden, S. (2026). *HF Radar Observations of Cold Front Impacts on Shelf Circulation. 106th AMS Annual Meeting, Jan. 25-29, 2026.*





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HF Radar Stations
Active Stations
Inactive Stations
Map Labels
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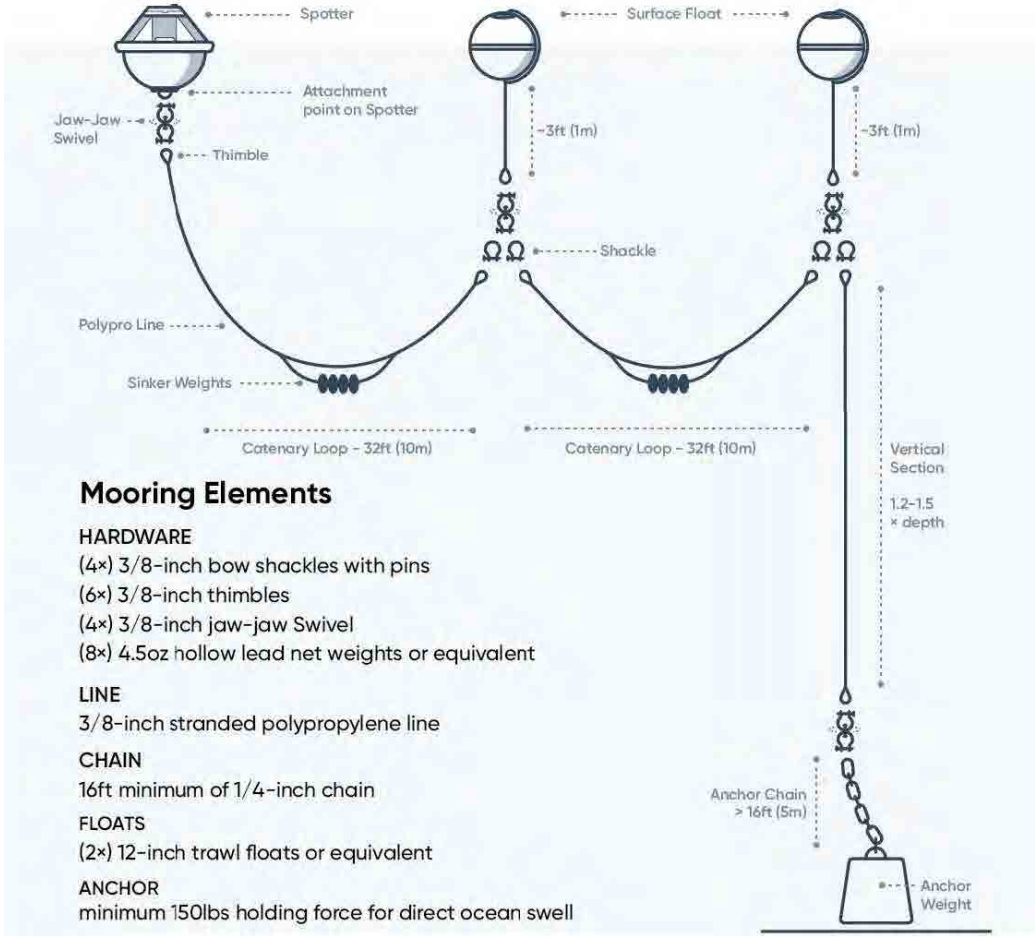
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Mooring Elements

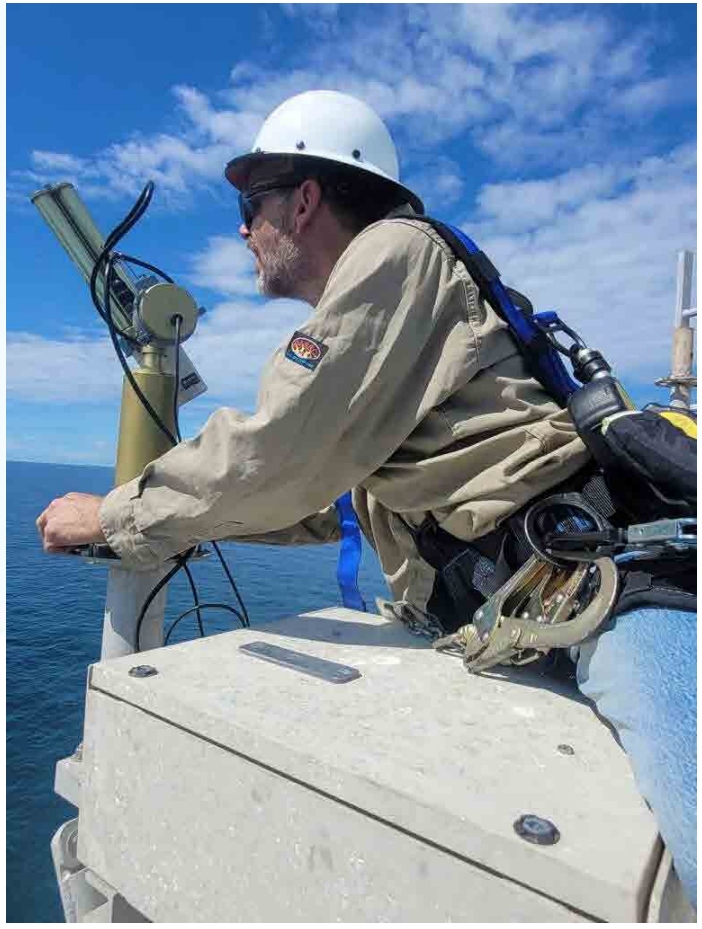
HARDWARE
(4×) 3/8-inch bow shackles with pins
(6×) 3/8-inch thimbles
(4×) 3/8-inch jaw-jaw Swivel
(8×) 4.5oz hollow lead net weights or equivalent

LINE
3/8-inch stranded polypropylene line

CHAIN
16ft minimum of 1/4-inch chain

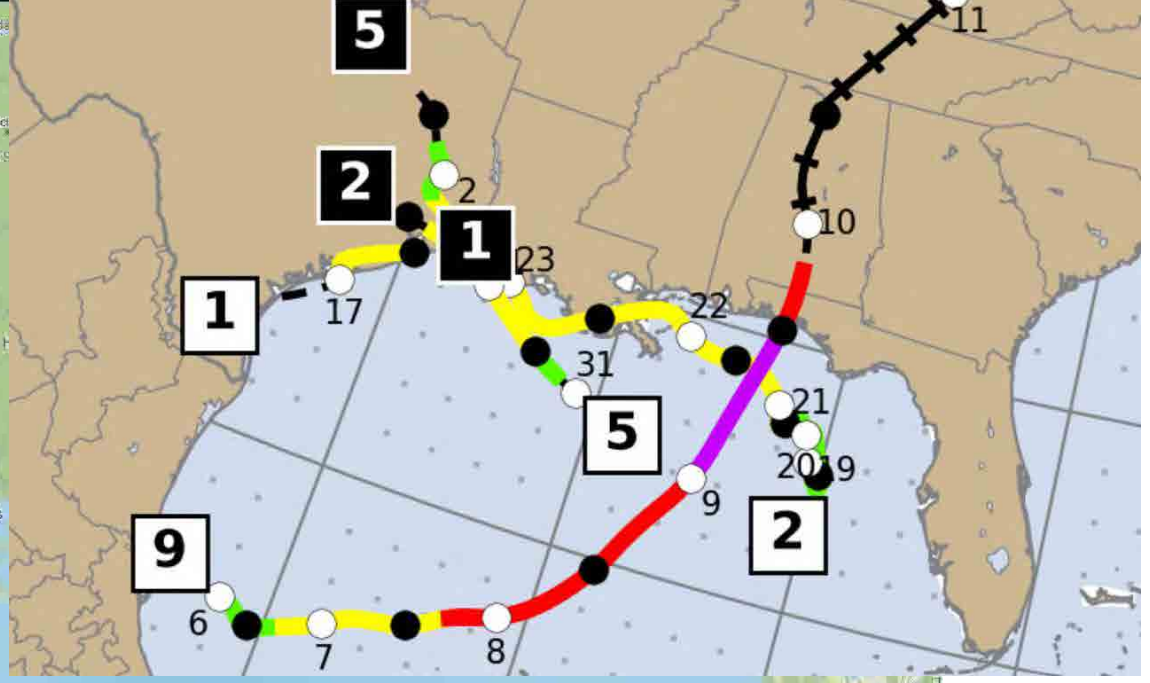
FLOATS
(2×) 12-inch trawl floats or equivalent

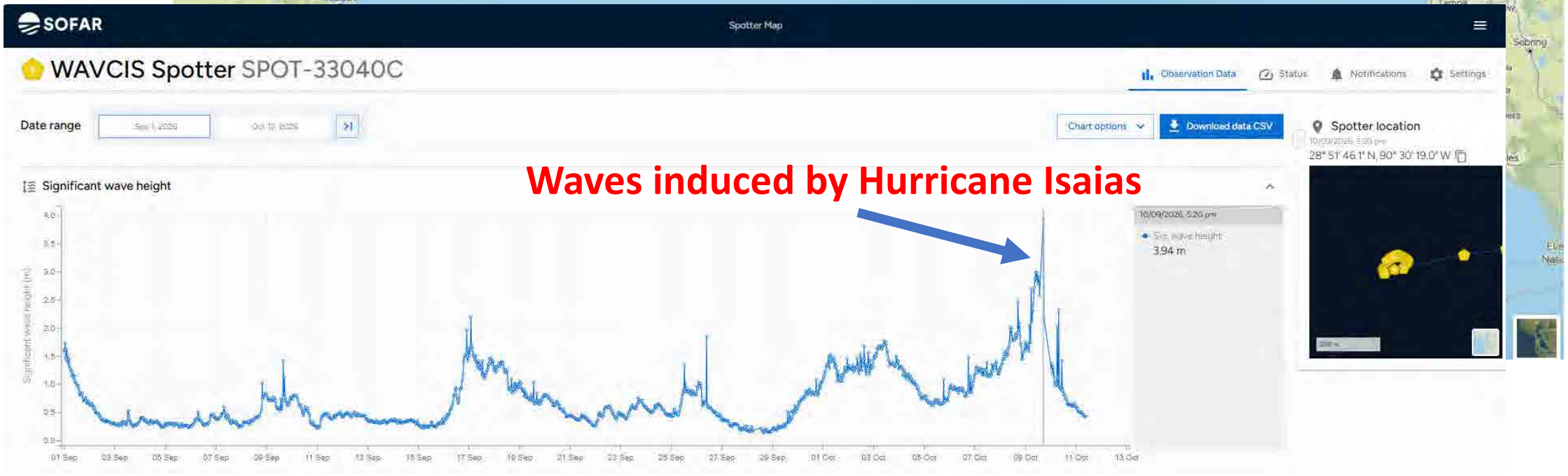
ANCHOR
minimum 150lbs holding force for direct ocean swell



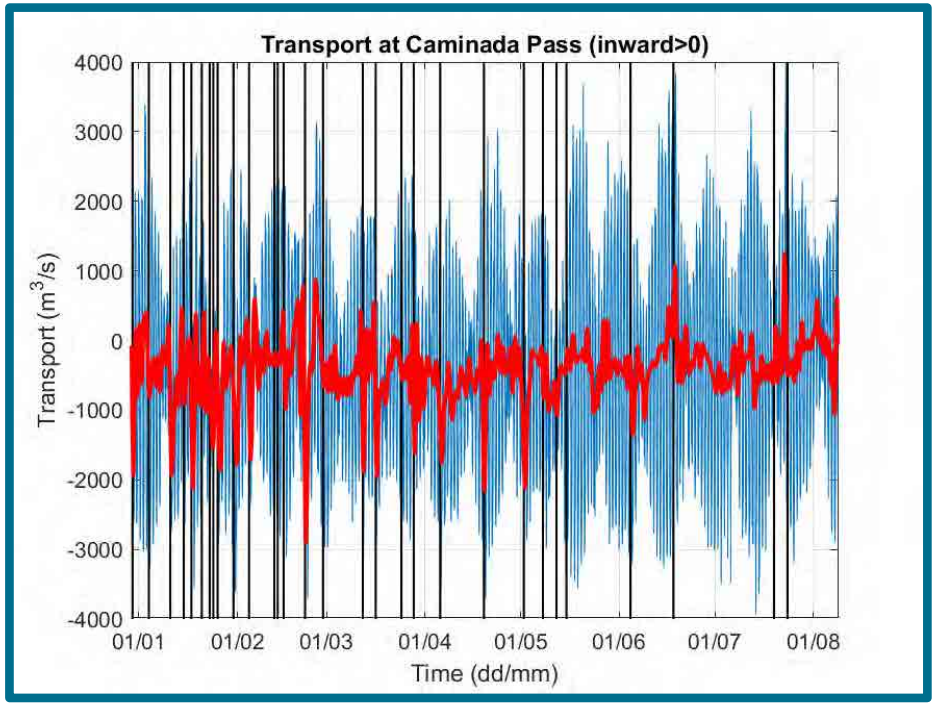
Using Oil Platforms and moorings

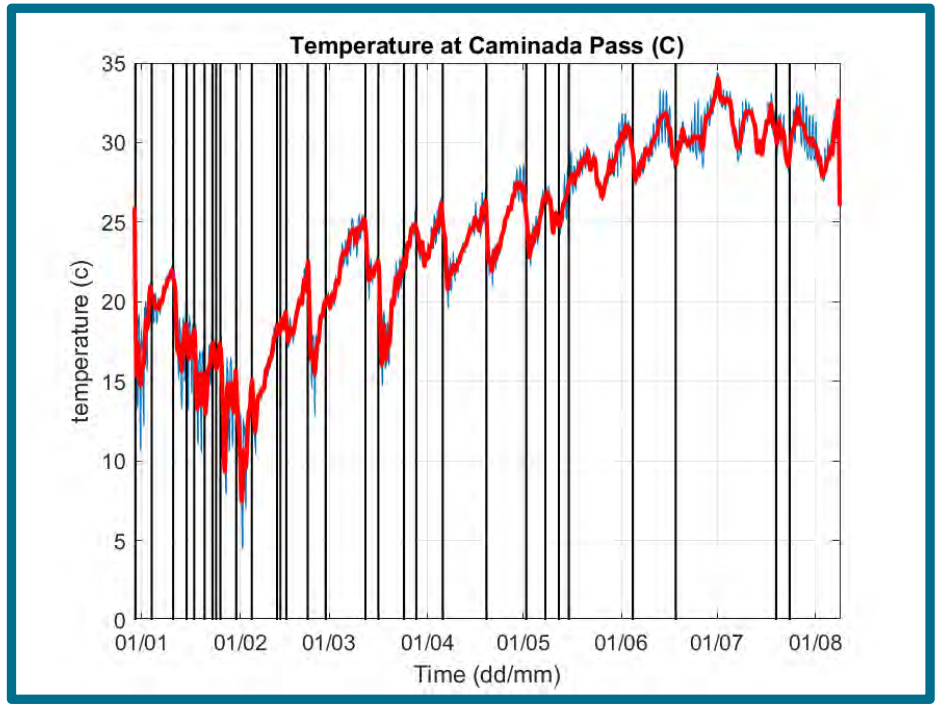
Examples of observations from WAVCIS (1)











Examples of observations from WAVCIS (2)

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Examples of observations from WAVCIS (3)

Mesoscale storms

OCTOBER 2024 FORECASTER'S FORUM 1503

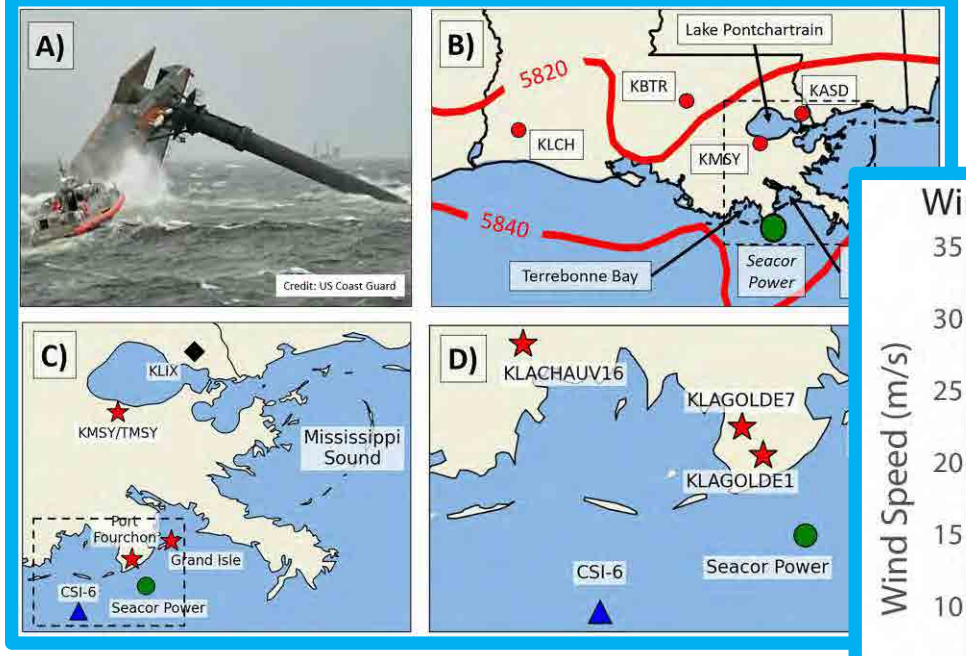
The Evolution of the 2021 *Seacor Power* Tragedy in Coastal Louisiana

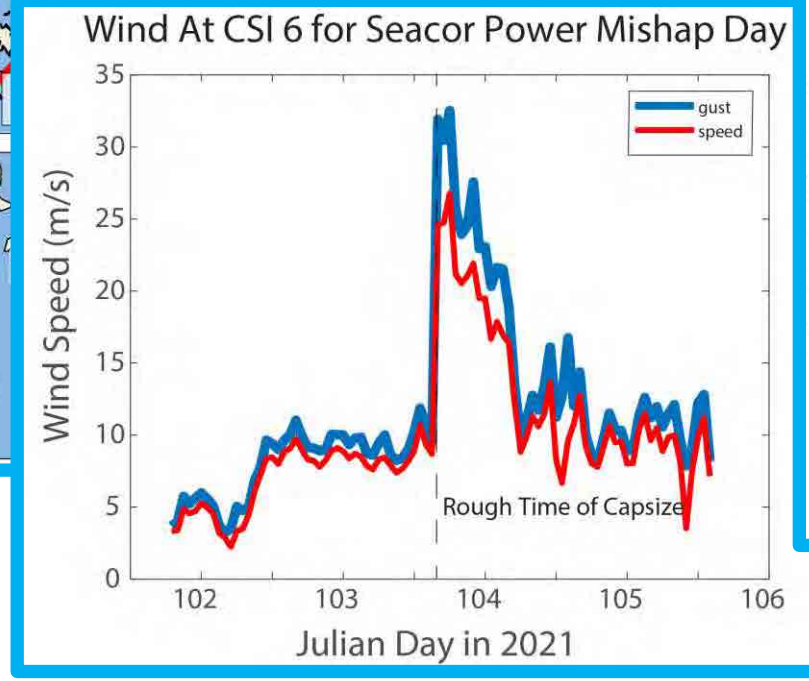
P. W. MILLER,[a,b] C. LI,[a,b] K. XU,[a,b] S. CAPAROTTA,[c] AND R. V. ROHLI[a,b]

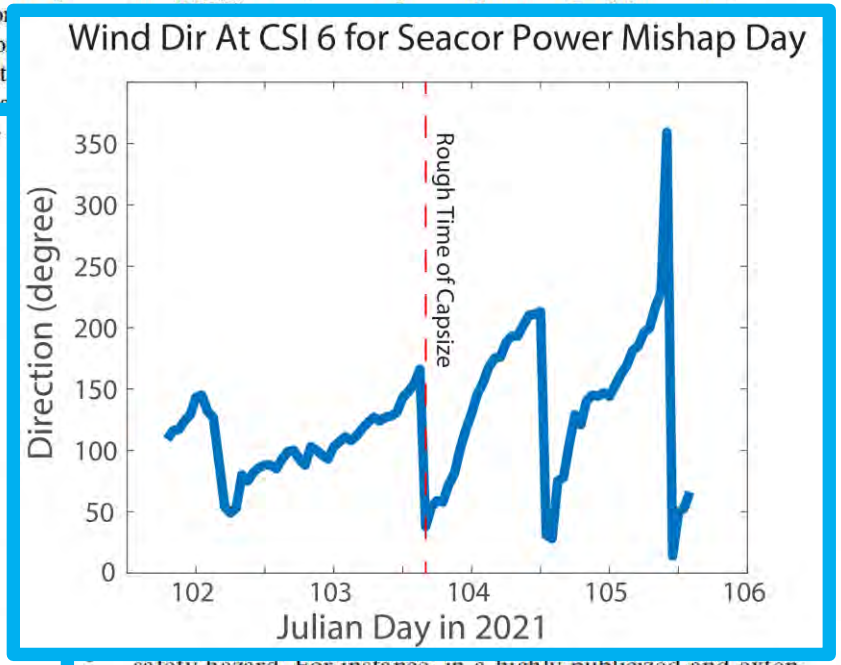
[a] *Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, Louisiana*
[b] *Coastal Studies Institute, Louisiana State University, Baton Rouge, Louisiana*
[c] *WAFB-TV, Baton Rouge, Louisiana*

(Manuscript received 27 October 2023, in final form 6 June 2024, accepted 3 July 2024)

ABSTRACT: On 13 April 2021, a mesoscale co
capsizing the 39-m *Seacor Power* roughly 7 km fro
severe straight-line winds that sank the vessel, sust







safety hazard. For instance, in a highly publicized and extensively litigated event on 19 July 2018, an amphibious water-

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What do we do with our observations?

- Relay to GCOOS/IOOS/NOAA for forecasting and archiving
- Use in oil spill studies (e.g., 2010 Deepwater Horizon)
- Use in operational or process modeling
- Use by students for their theses and dissertations
- Use in classroom training of next generation
- Use in textbooks
- Use in research


















Time Series Data Analysis in Oceanography
Applications using MATLAB
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Meteorology for Coastal Scientists
Robert V. Rohli
Chunyan Li
Springer
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Record Weather Data with Arduino and Solar Power
Use Sensors to Record and Analyze Meteorological Data
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(A)
5V
GND
(B)
Pot1
(C)
Pot2
LCD
(D)
(E)
Arduino UNO
(F)
GPS Module
(G)
SD-Card breakout board
(H)
BMP280
Pressure Sensor
(I)
(J) toggle switch
DC-DC Step-down converter
5 days
(event dependent)
computation (30 sec)
(distance, speed)
statistics
visualization (5 hours)
days
bandpass filter
12V rechargeable battery
7.5V
to Arduino's input
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Arctic study

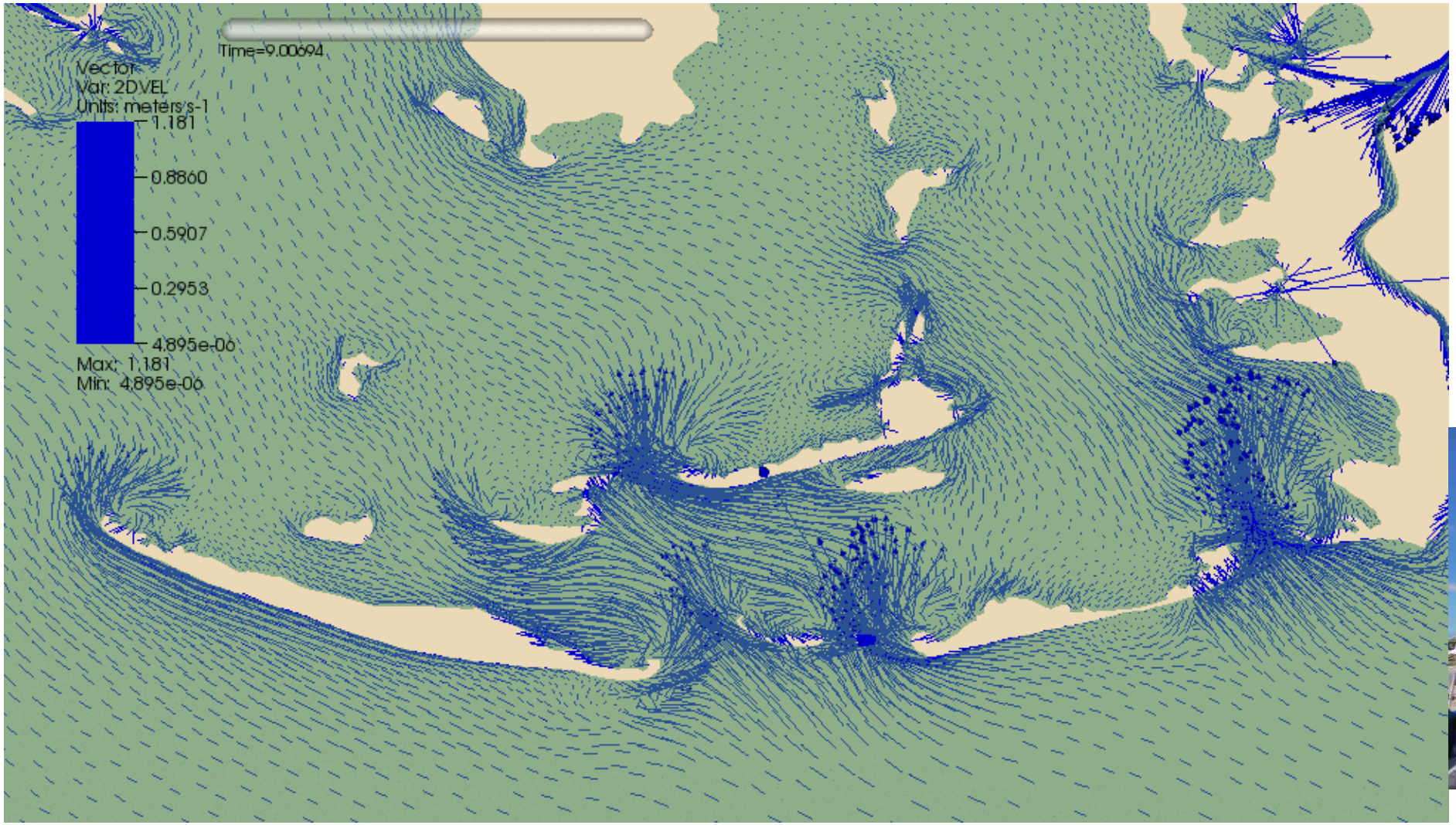
HFR Project













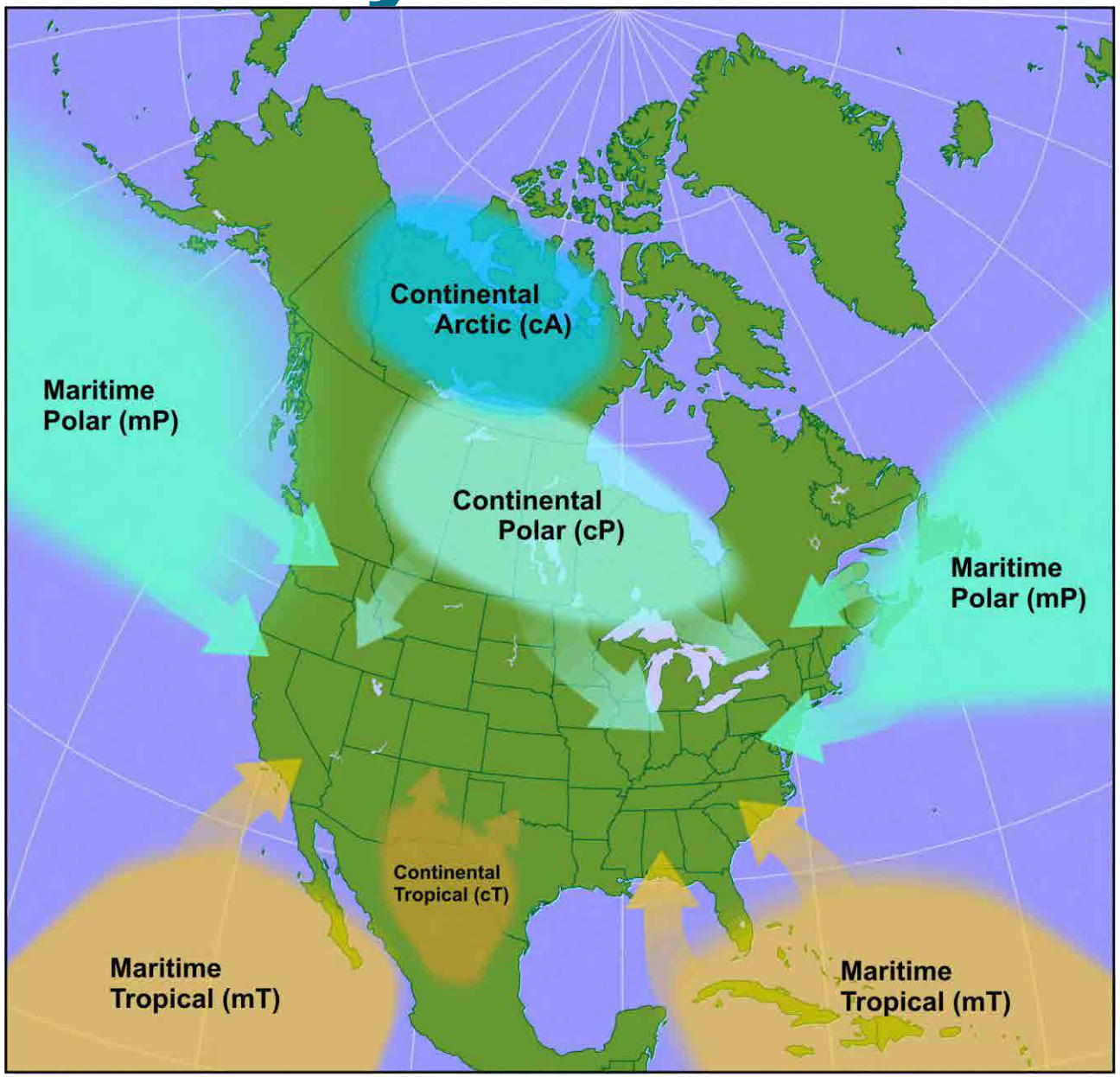


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What are weather systems?

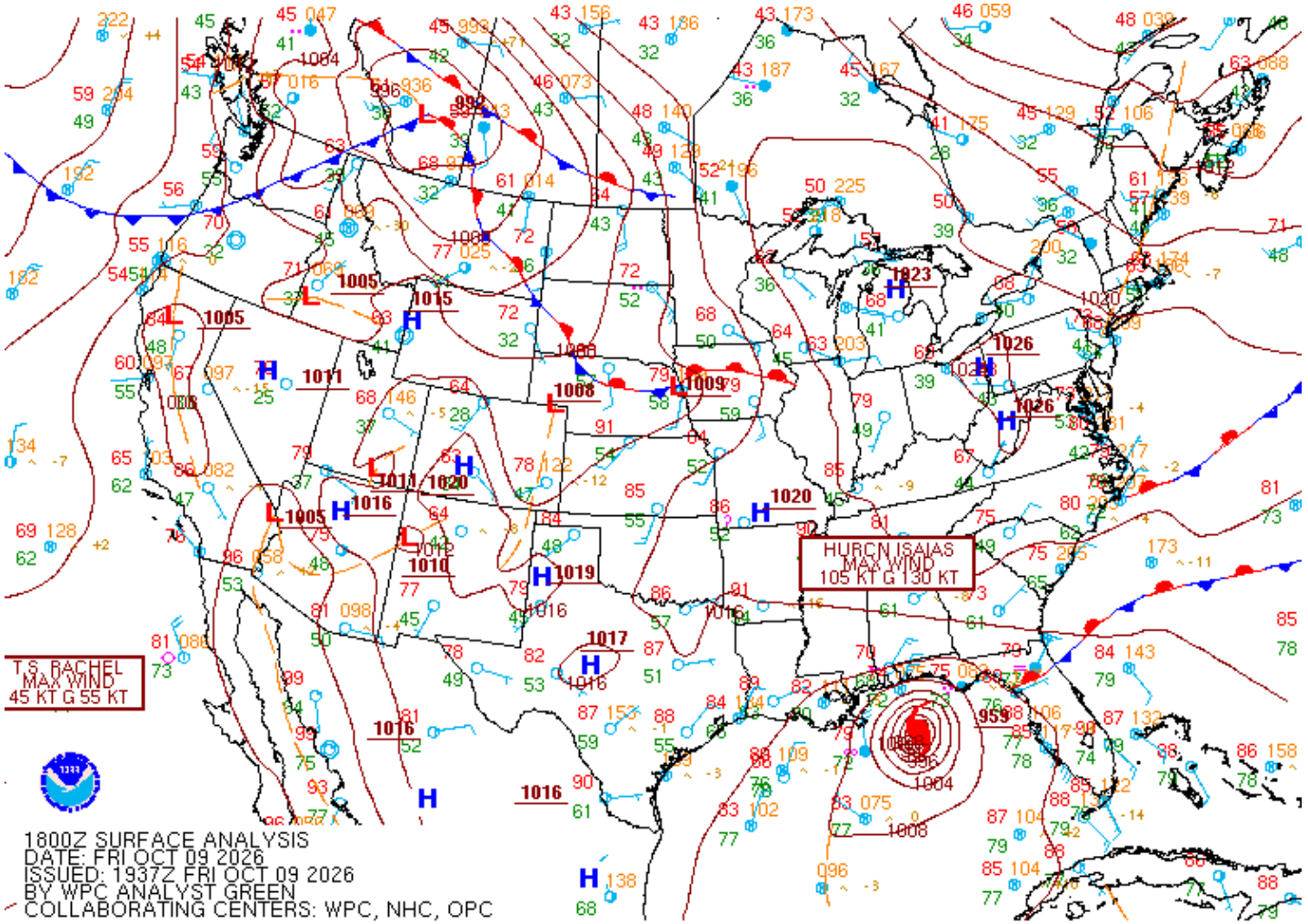
- Air masses as High-Pressure Systems (measured at Sea-level)
- Air masses interact with each other with “collisions”
- The boundaries are low pressure zones (troughs)



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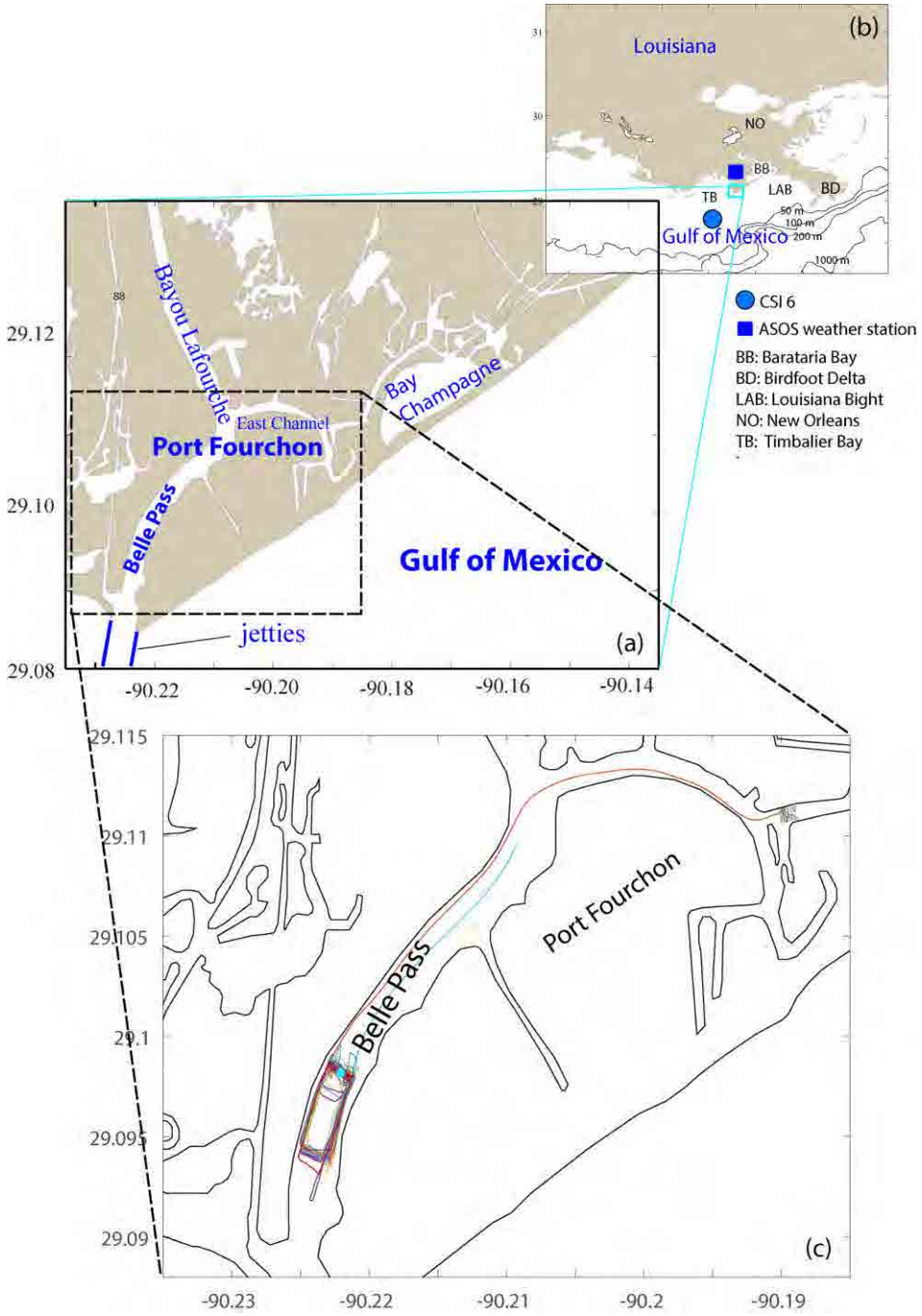
Extra-tropical & Tropical Cyclones

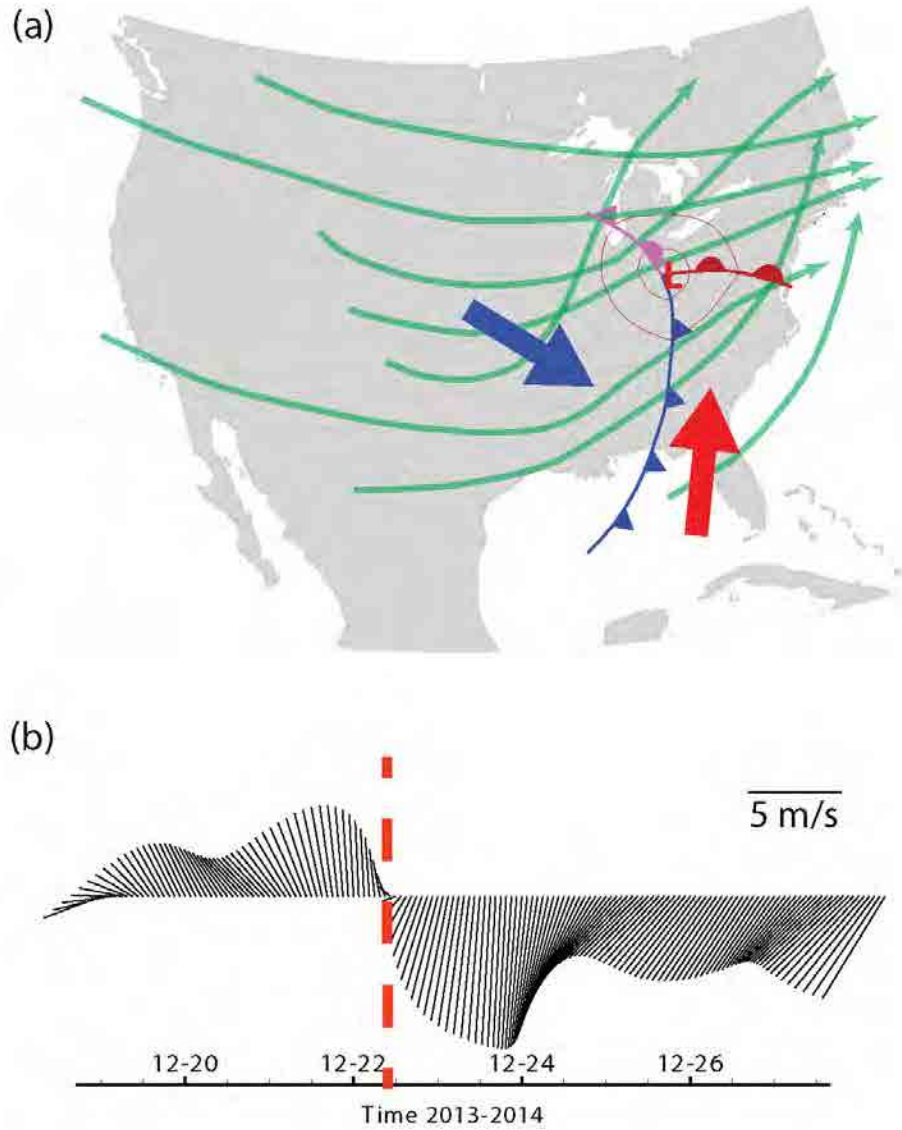
- **Extra-tropical: fronts, multiple air masses**
- **Tropical: no fronts, one air mass from the tropical or subtropical region**



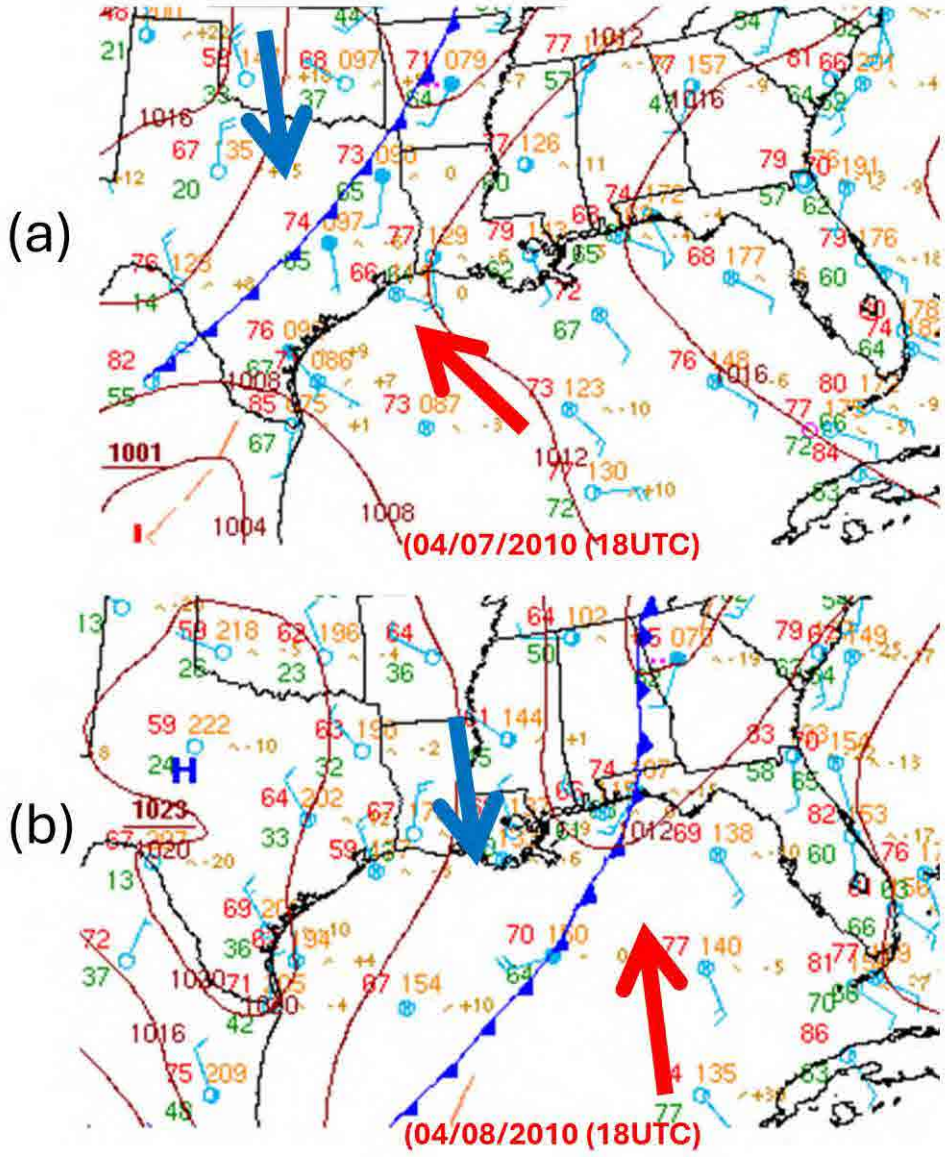
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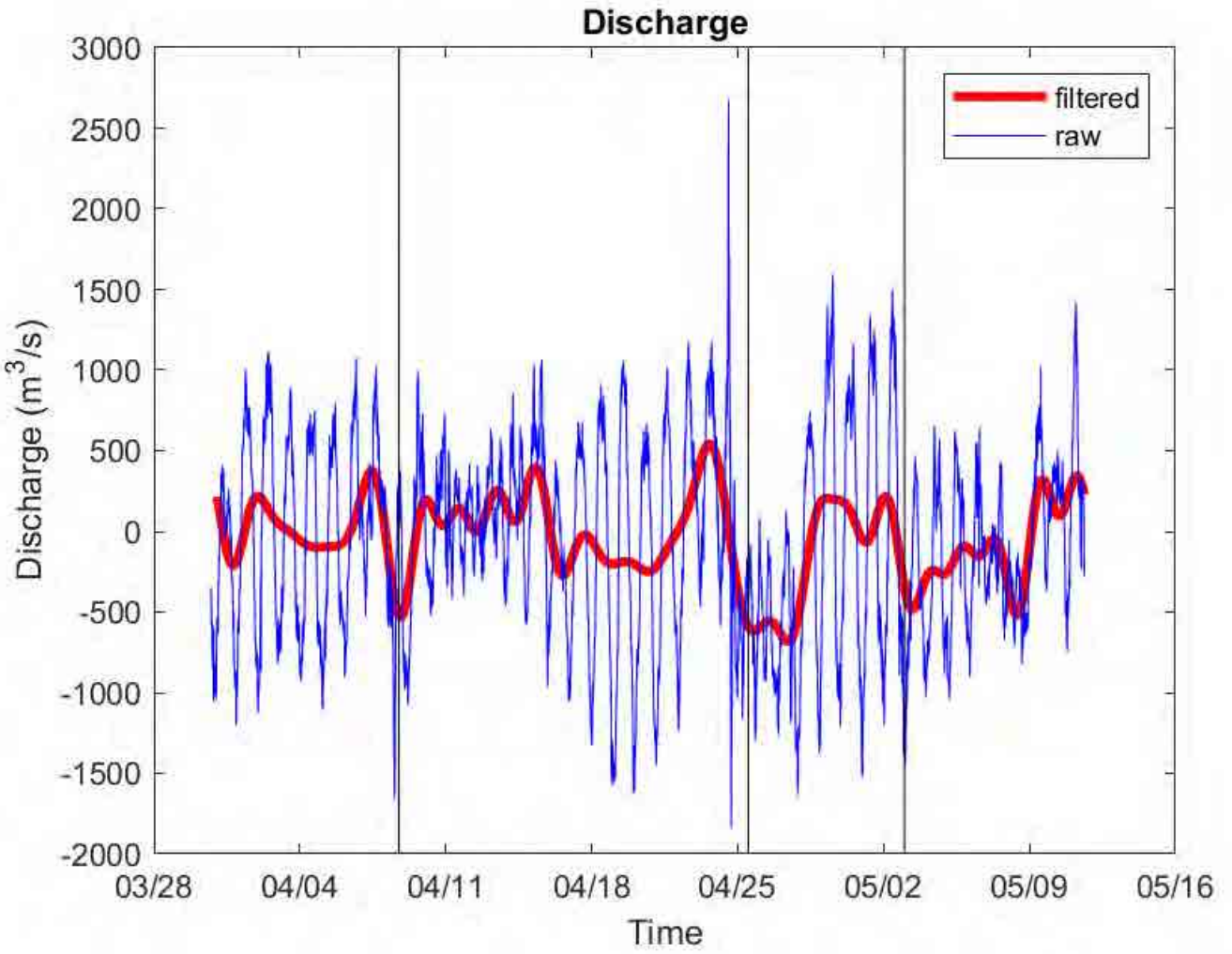
Cold front impact at Port Fourchon





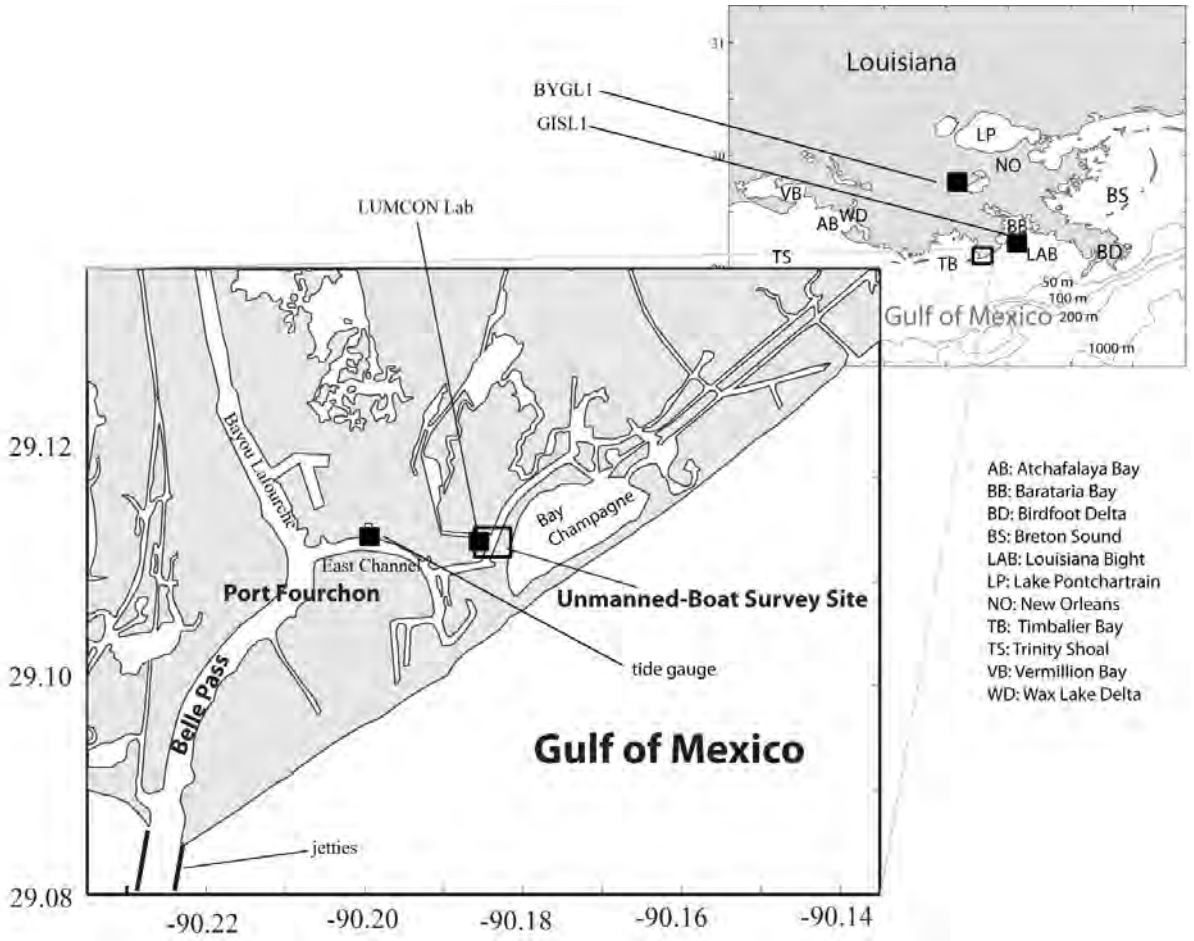
Li, C. (2025). Determining meteorological tidal transport through a channel on the coast. *Continental Shelf Research*, Vol. 285: 105394. https://doi.org/10.1016/j.csr.2024.105394





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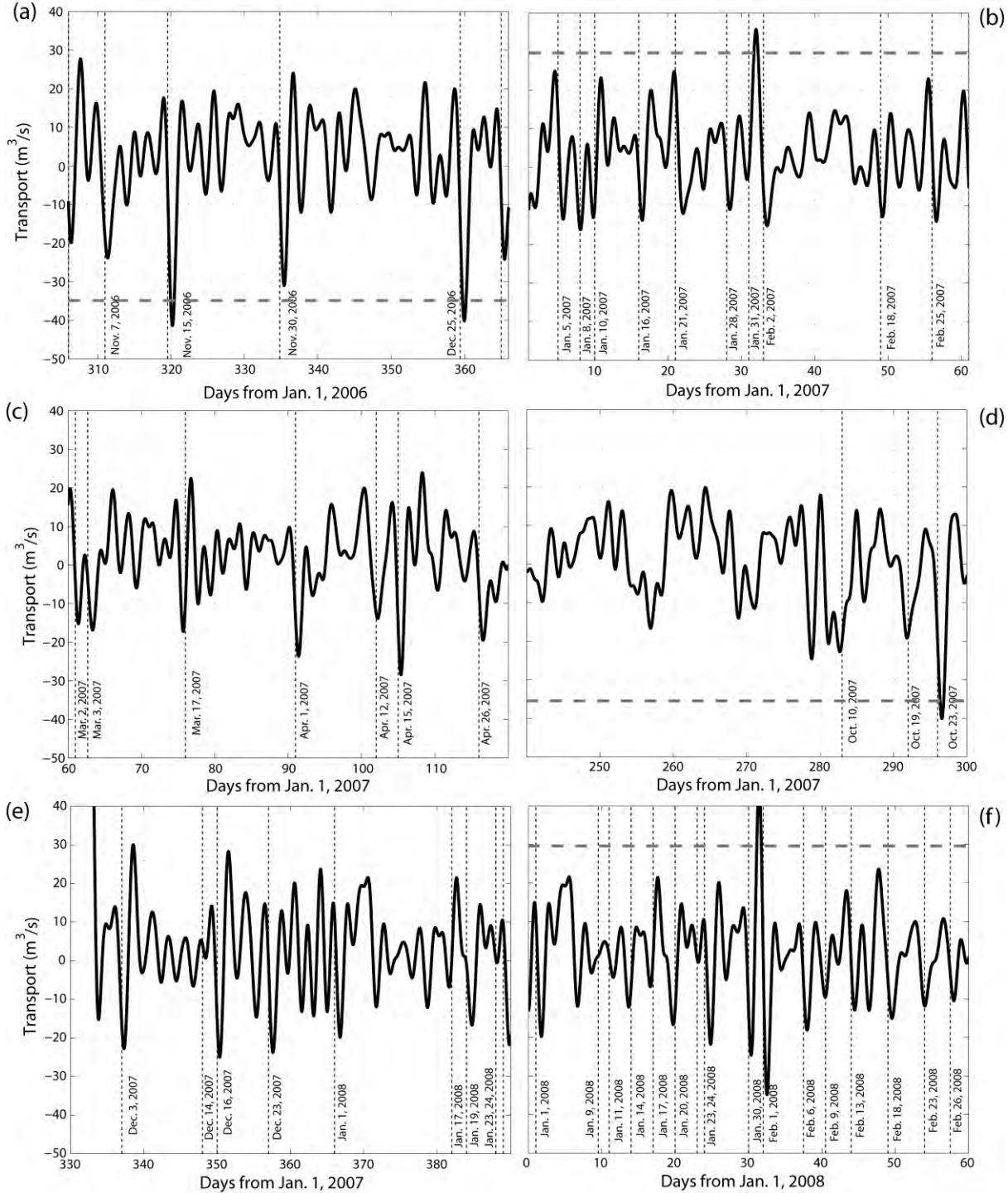
Impact of Frontal Passage at Port Fourchon

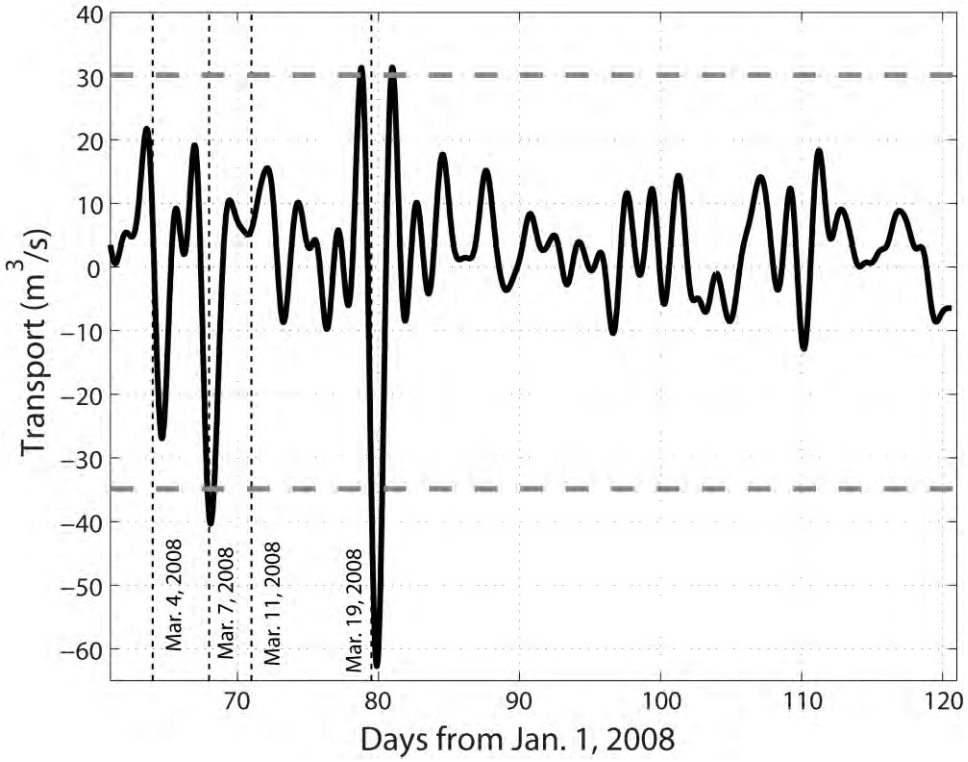




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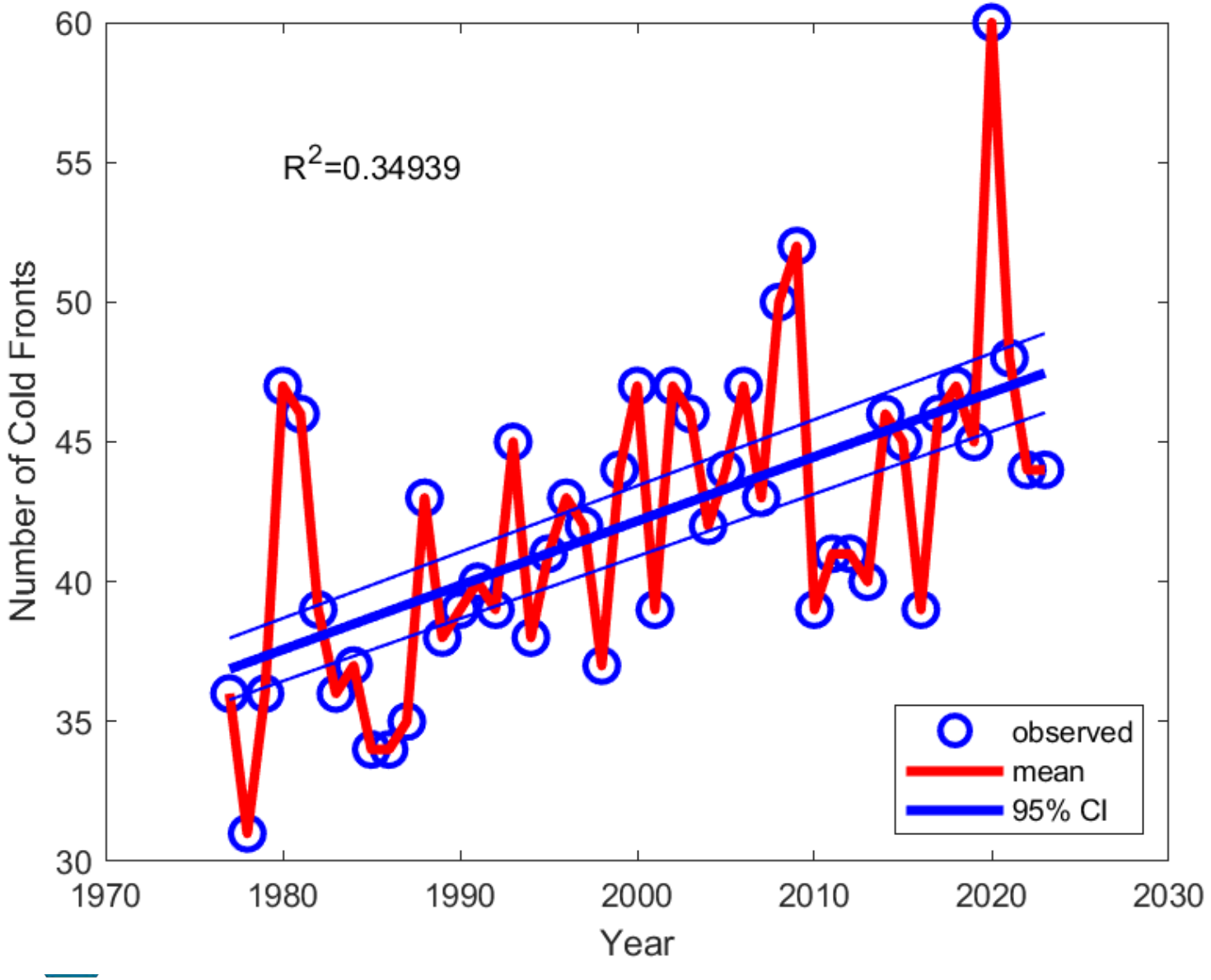
Li, C., E. Weeks, B. Milan, W. Huang, R. Wu. (2018). Weather Induced Transport through a Tidal Channel Calibrated by an Unmanned Boat, *Journal of Atmospheric and Oceanic Technology*, Vol. 35 (2): 261-279, 10.1175/JTECH-D-17-0130.1.





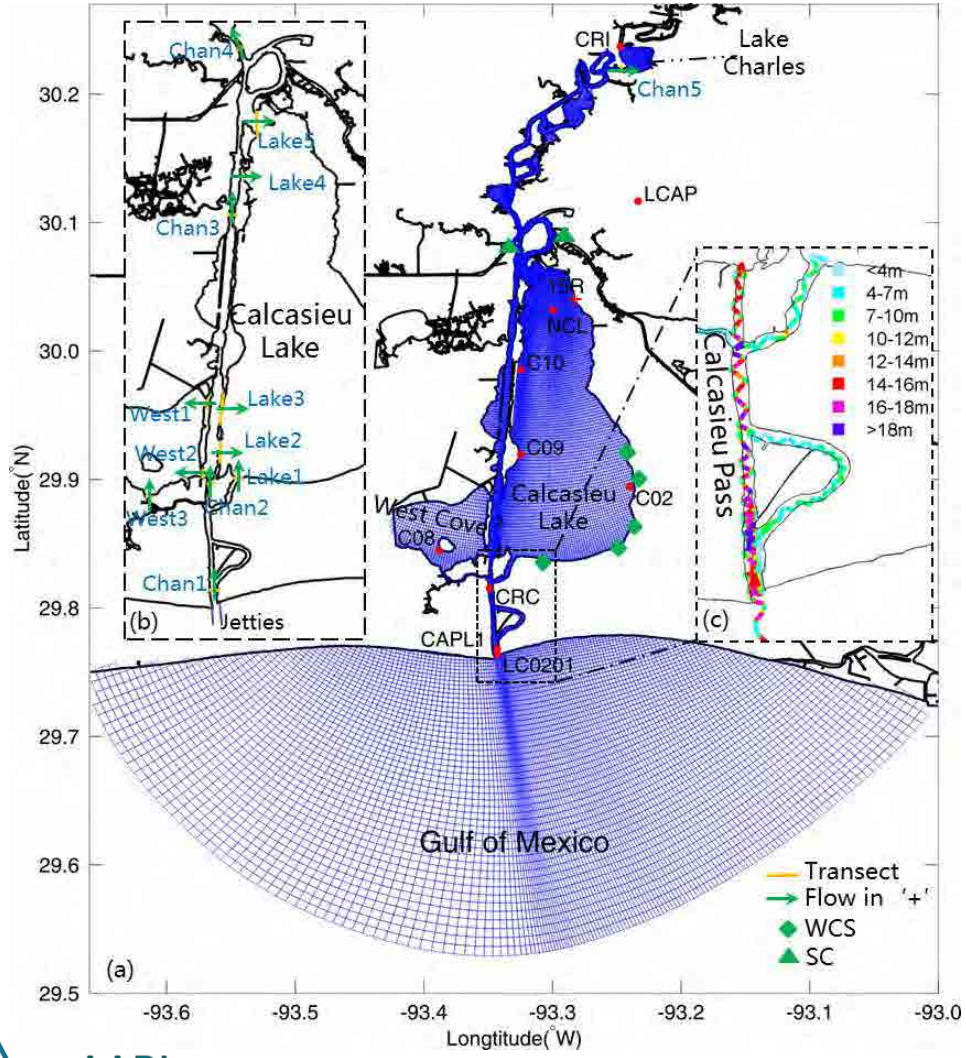
Li, C., E. Weeks, B. Milan, W. Huang, R. Wu. (2018). Weather Induced Transport through a Tidal Channel Calibrated by an Unmanned Boat, *Journal of Atmospheric and Oceanic Technology*, Vol. 35 (2): 261-279, 10.1175/JTECH-D-17-0130.1.

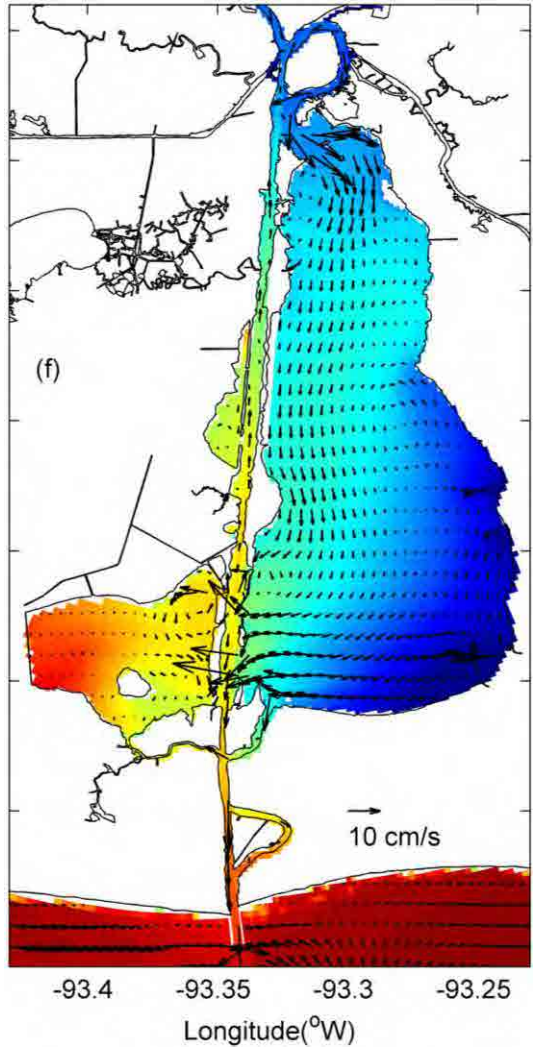
Long-term variation of frontal passage at LA



Modified from: Li, C., W. Huang, R. Wu, A. Sheremet. (2020). Weather Induced Quasi-periodic Motions in Estuaries and Bays: Meteorological Tide, *China Ocean Engineering*, Vol. 34, No. 3, 299-313, doi: https://doi.org/10.1007/s13344-020-0028-2.

Saltwater intrusion in Calcasieu Lake



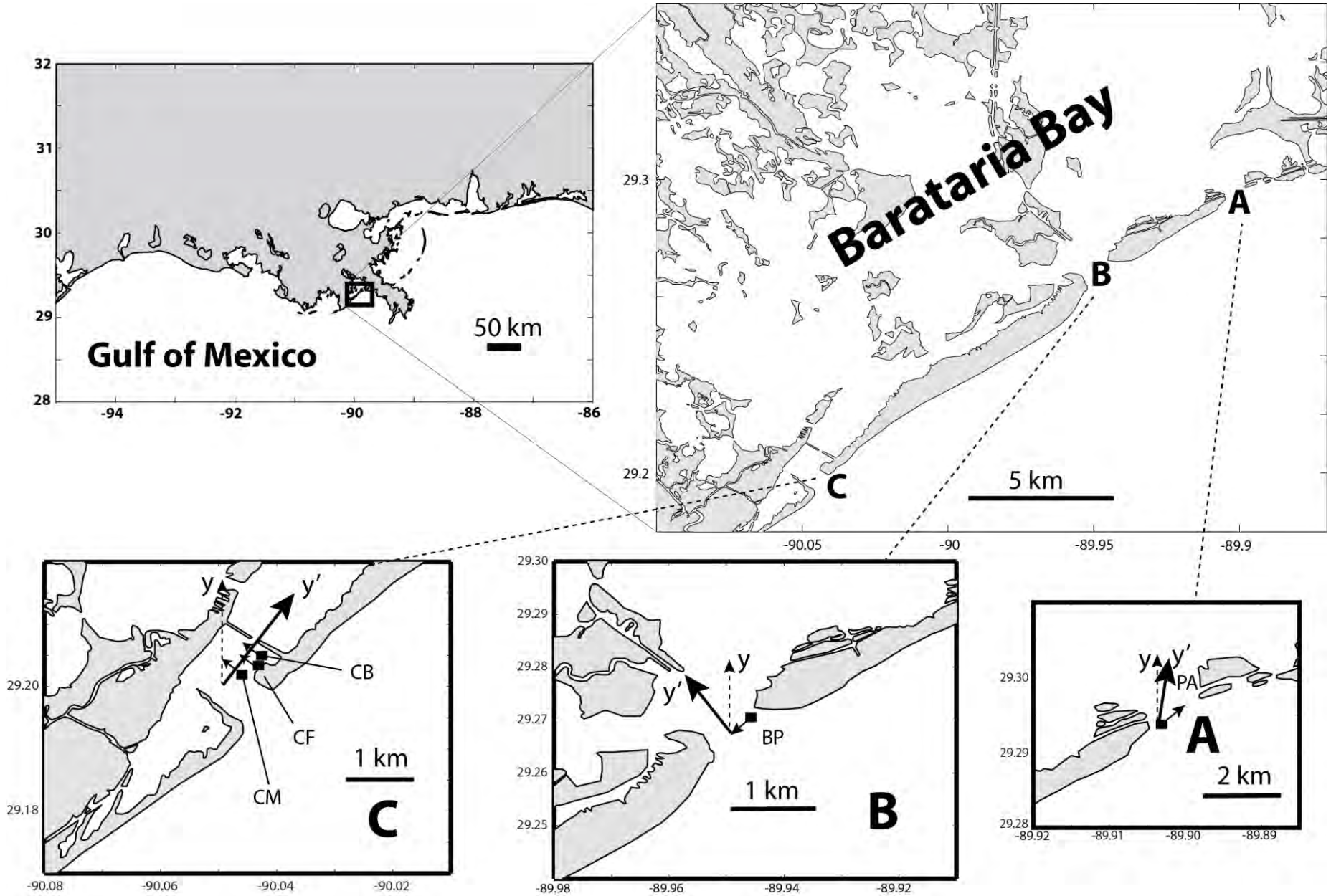


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Lin, J., C. Li, K. M. Boswell, M. Kimball, L. Rozas. (2016). Examination of Winter Circulation in a Northern Gulf of Mexico Estuary, *Estuaries and Coasts*, Vol. 39, 1-21.

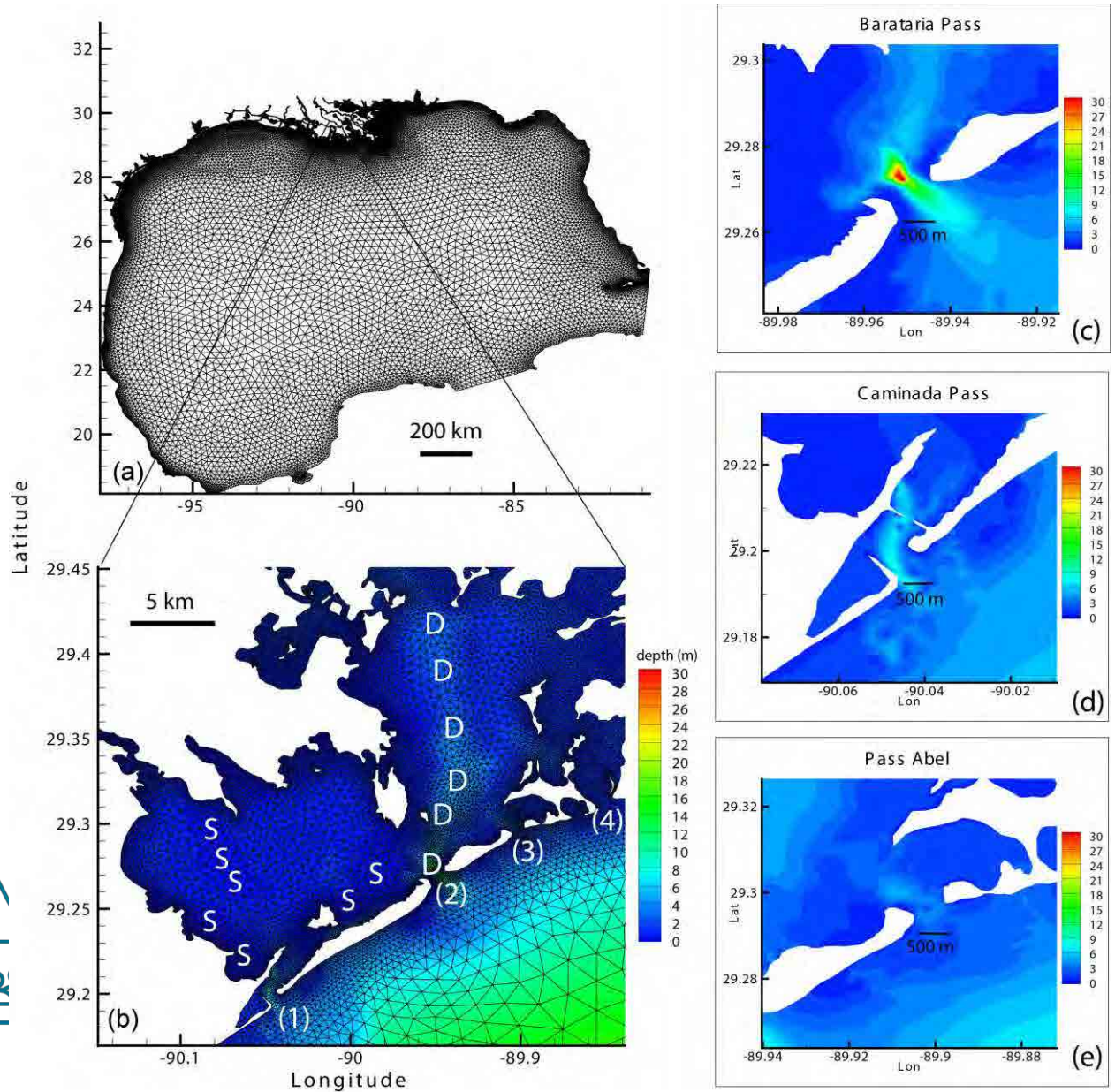
Stations in Tidal Passes of Barataria Bay

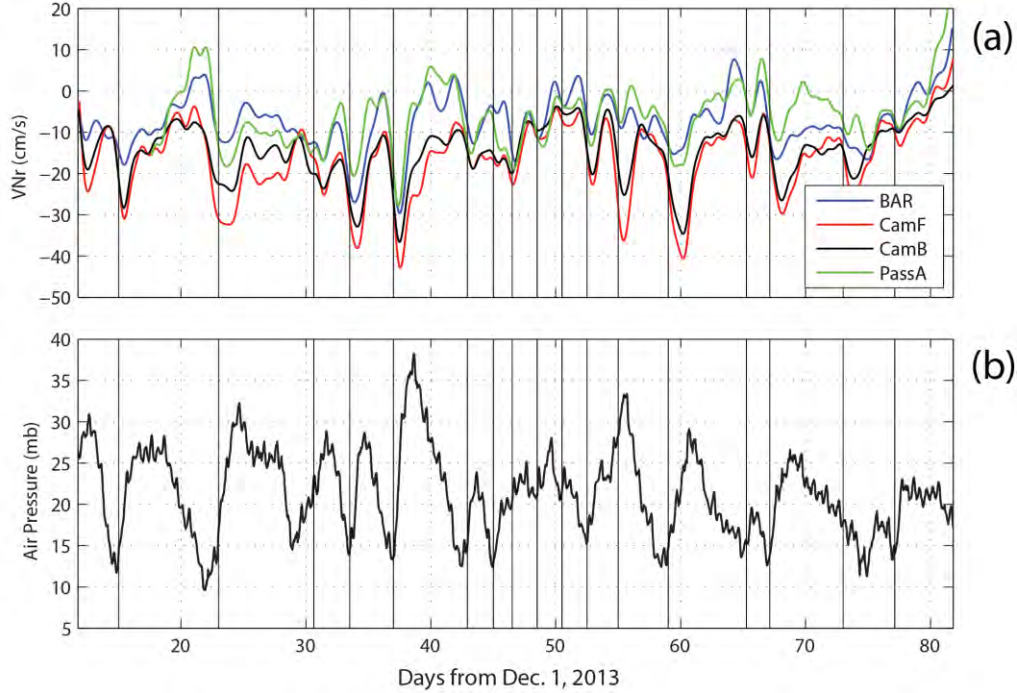
Li, C., W. Huang, B. Milan. (2019). Atmospheric Cold Front Induced Exchange Flows through a Microtidal Multi-inlet Bay: Analysis using Multiple Horizontal ADCPs and FVCOM Simulations, *Journal of Atmospheric and Oceanic Technology*, Vol. 36: 443-472.

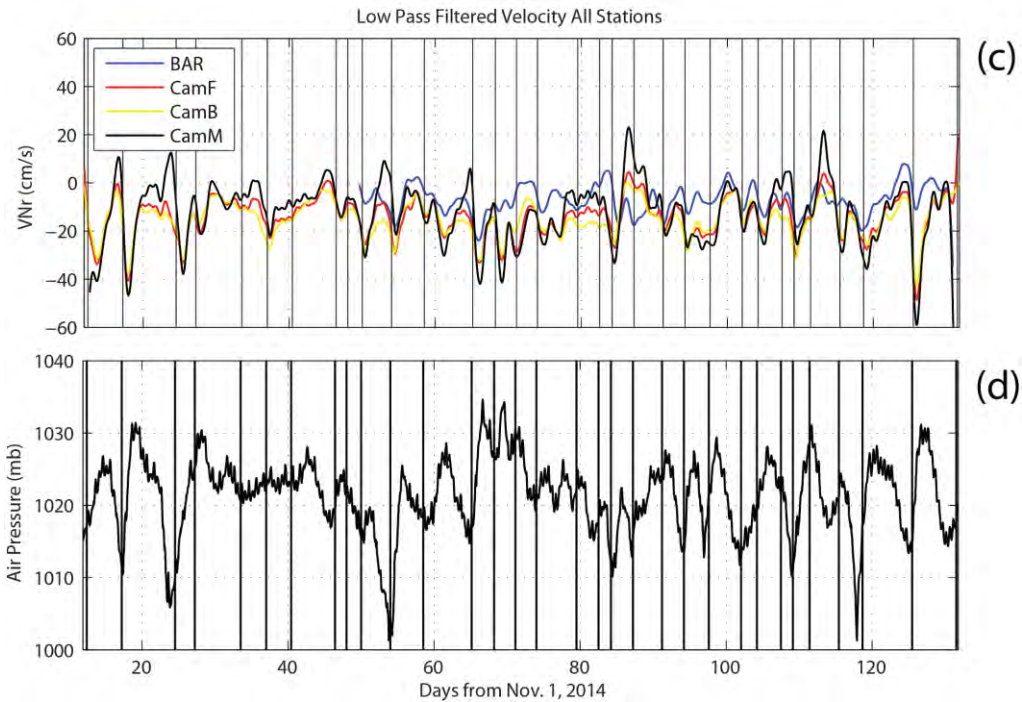


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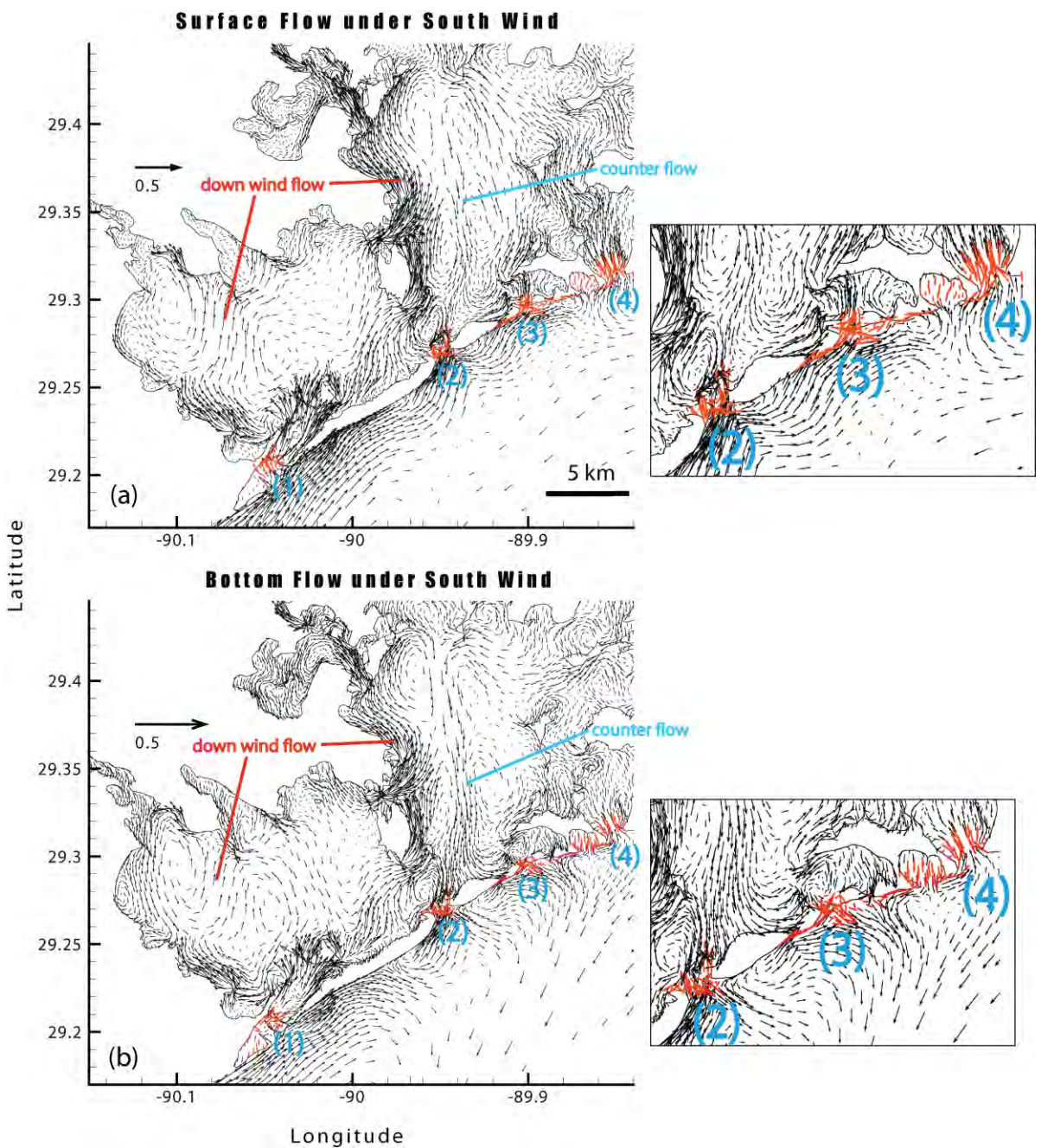
Li, C., W. Huang, B. Milan. (2019). Atmospheric Cold Front Induced Exchange Flows through a Microtidal Multi-inlet Bay: Analysis using Multiple Horizontal ADCPs and FVCOM Simulations, *Journal of Atmospheric and Oceanic Technology*, Vol. 36: 443-472.

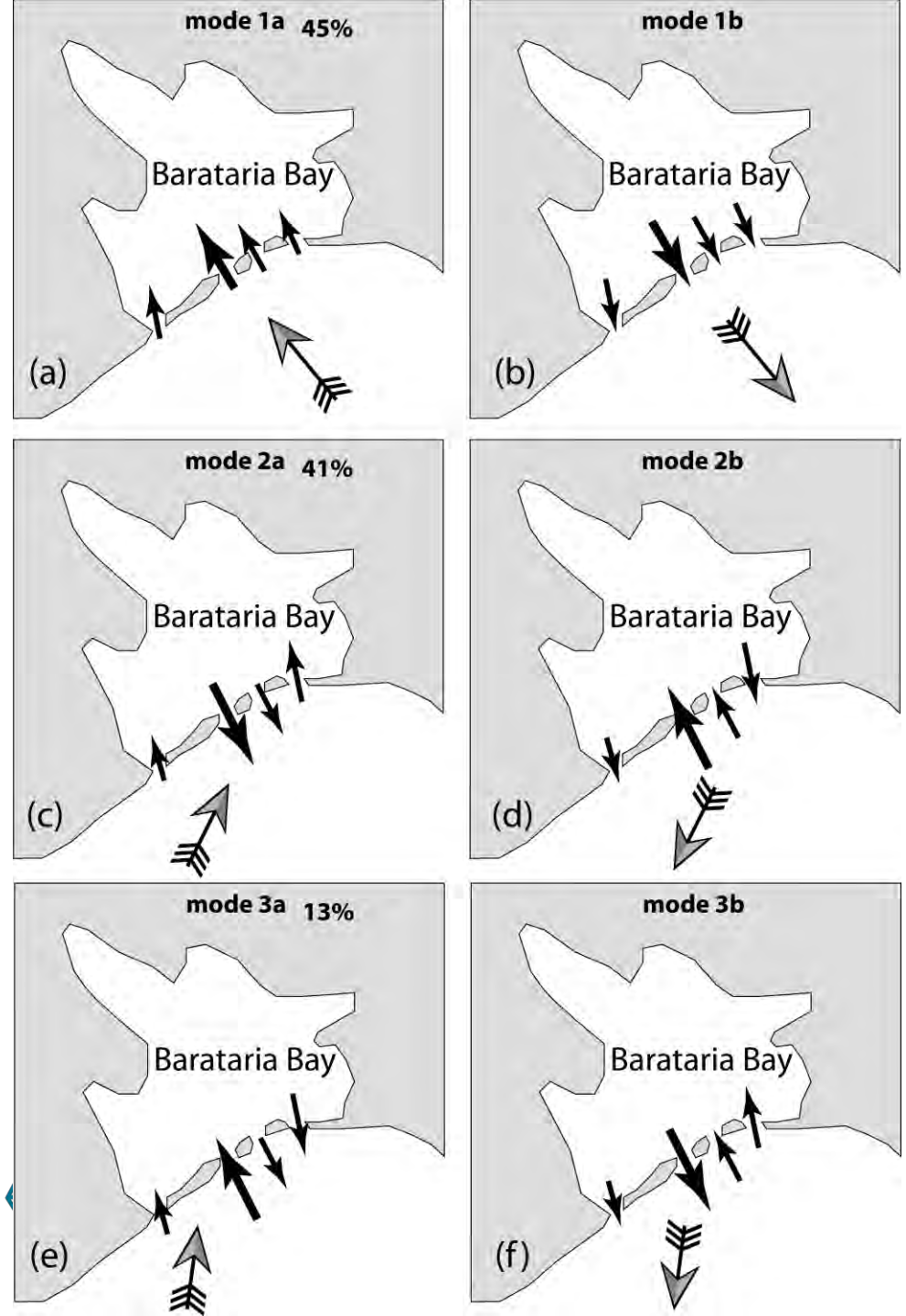


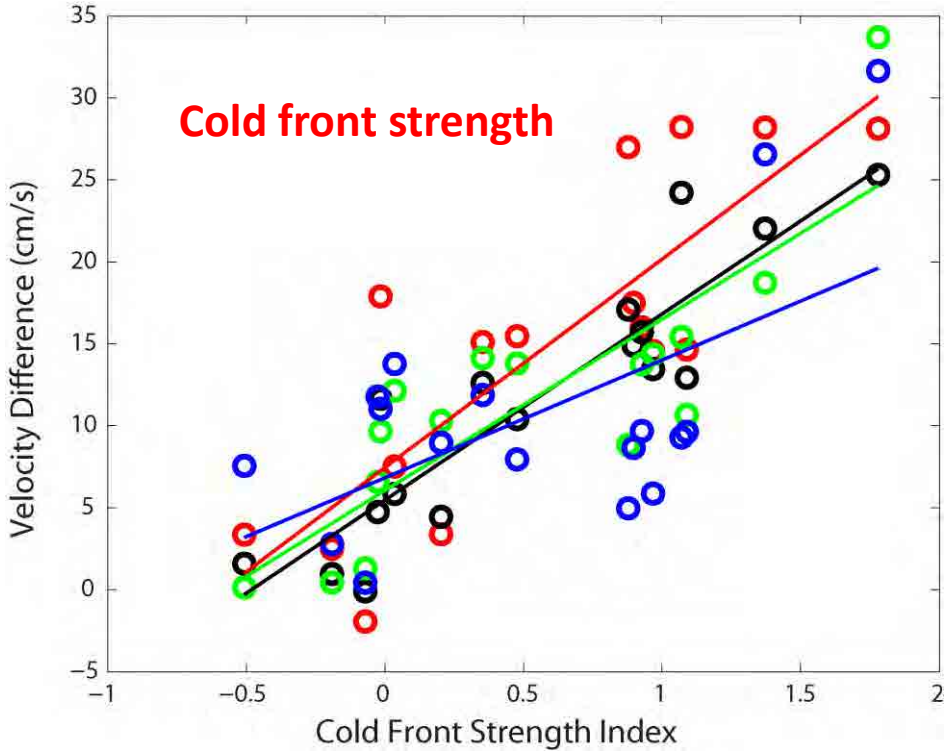




Li, C., W. Huang, B. Milan. (2019). Atmospheric Cold Front Induced Exchange Flows through a Microtidal Multi-inlet Bay: Analysis using Multiple Horizontal ADCPs and FVCOM Simulations, *Journal of Atmospheric and Oceanic Technology*, Vol. 36: 443-472.

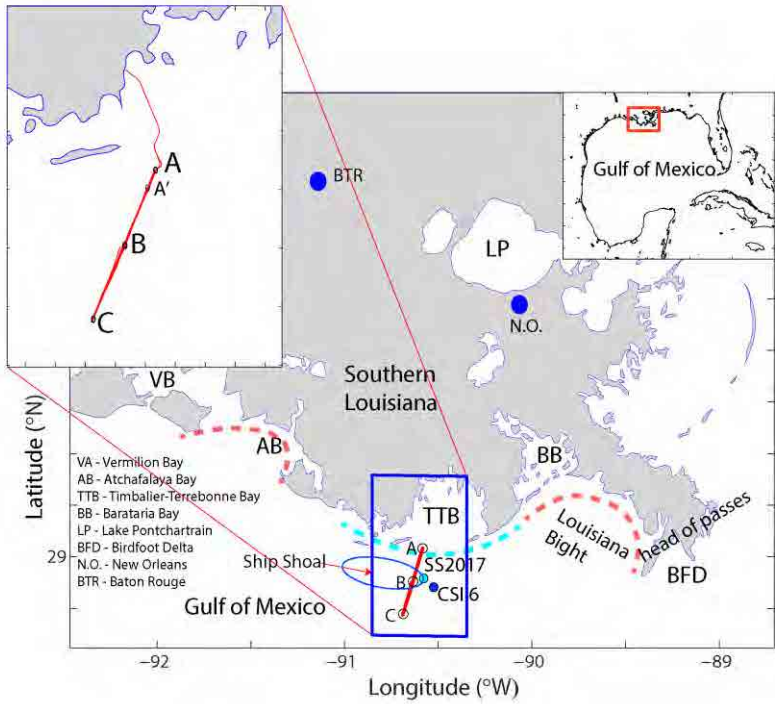


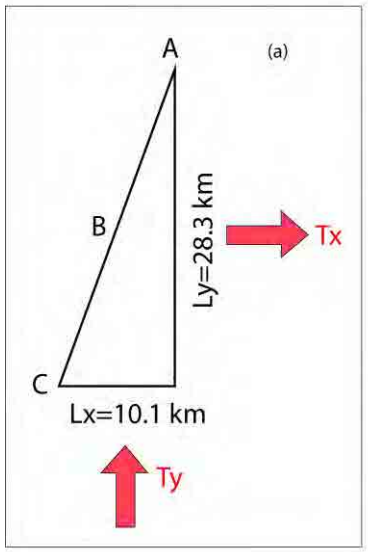


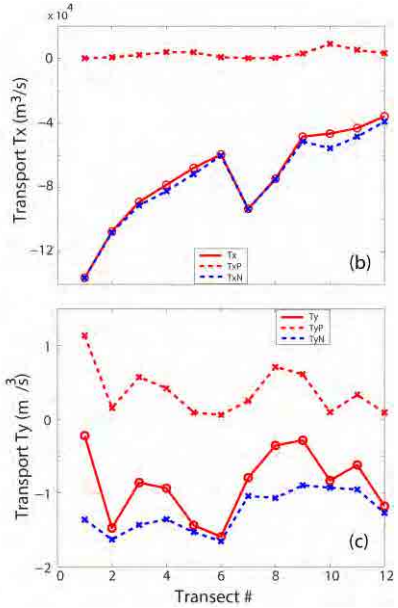


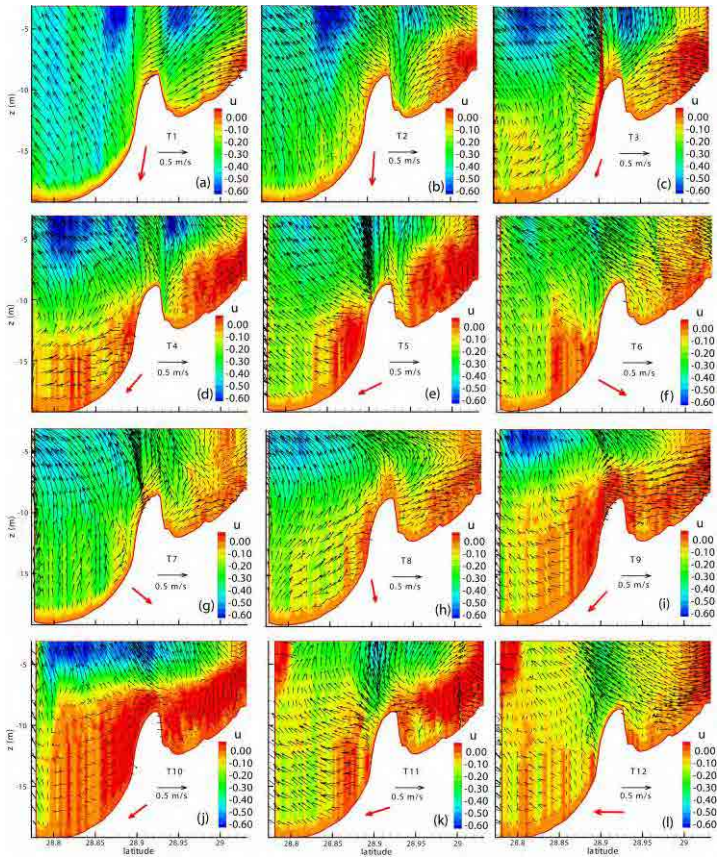
Li, C., W. Huang, B. Milan. (2019). Atmospheric Cold Front Induced Exchange Flows through a Microtidal Multi-inlet Bay: Analysis using Multiple Horizontal ADCPs and FVCOM Simulations, *Journal of Atmospheric and Oceanic Technology*, Vol. 36: 443-472.

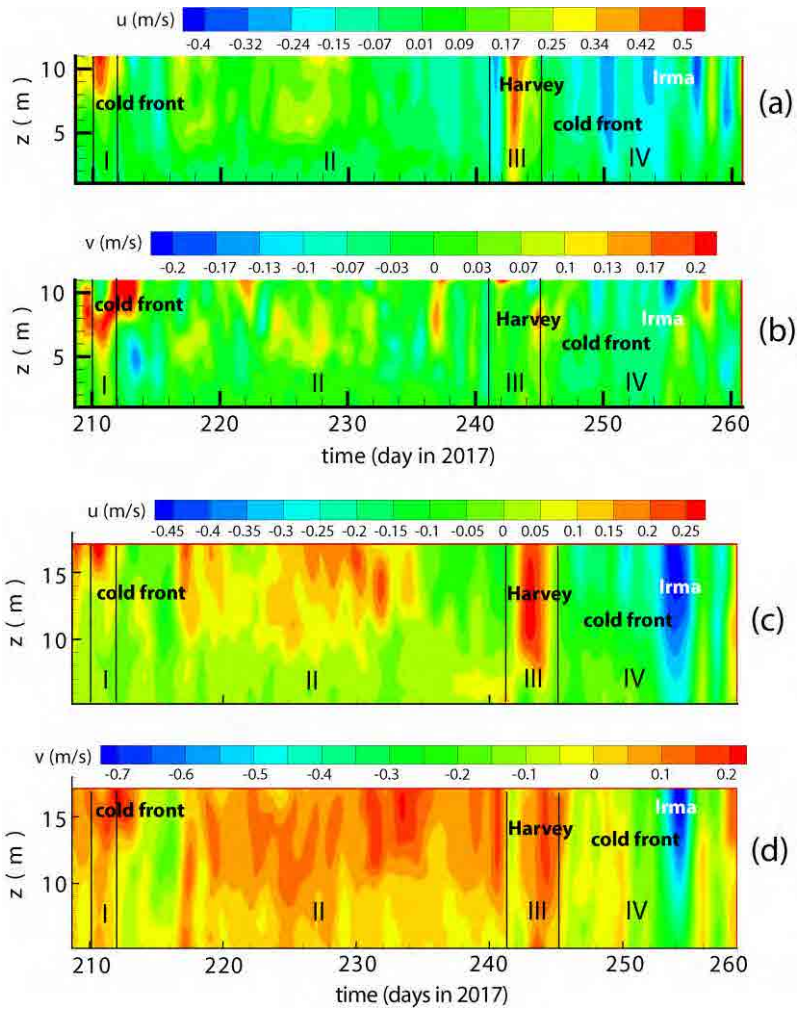
Multi-inlet Bays & winter storms











Li, C. A. Sheremet, W. Huang, P. Dash, A. Katkar, M. N. Allahdadi, N. Chaichitehrani, C. M. Bachmann, V. H. Rivera-Monroy. (2024). Dynamic impact of transiting weather systems on coastal currents in the northern Gulf of Mexico, Deep Sea Research Part II: Topical Studies in Oceanography, Volume 216, 2024, 105395,

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STUDY OF WINTER EVENTS

==========

SEVERE FREEZE EVENTS SUMMARY (T <= -3.0 °C)

==========

Total Severe Events Identified: 37

Central_Date	Start_Time	End_Time	Duration (Hours)_	Max_Area __(km^2)_	Min_T _(C)__
22-Jan-2025 16:00:00	21-Jan-2025 18:00:00	23-Jan-2025 14:00:00	45	16178	-12.9
17-Jan-2018 10:00:00	17-Jan-2018 03:00:00	17-Jan-2018 17:00:00	15	16178	-8.3
29-Jan-2014 07:00:00	29-Jan-2014 00:00:00	29-Jan-2014 14:00:00	15	2022	-3.4
16-Feb-2021 10:00:00	16-Feb-2021 03:00:00	16-Feb-2021 16:00:00	14	14830	-7
24-Dec-2022 09:00:00	24-Dec-2022 02:00:00	24-Dec-2022 15:00:00	14	12134	-5
18-Jan-2018 09:00:00	18-Jan-2018 03:00:00	18-Jan-2018 14:00:00	12	11460	-6.2
17-Jan-2024 10:00:00	17-Jan-2024 05:00:00	17-Jan-2024 15:00:00	11	12808	-6.5
11-Jan-2010 09:00:00	11-Jan-2010 04:00:00	11-Jan-2010 14:00:00	11	10111	-7.3
30-Jan-2014 08:00:00	30-Jan-2014 03:00:00	30-Jan-2014 13:00:00	11	8763	-6.2

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Thank you!

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