



Oil Transport along the Northern Coastline of the Gulf of Mexico

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Membership Meeting
Central Texas Chapter, Air & Waste Management Association
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Who Are We?

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Department of Computer Science,
Univ. of North Carolina at Charlotte

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Texas Advanced Computing Center,
University of Texas at Austin

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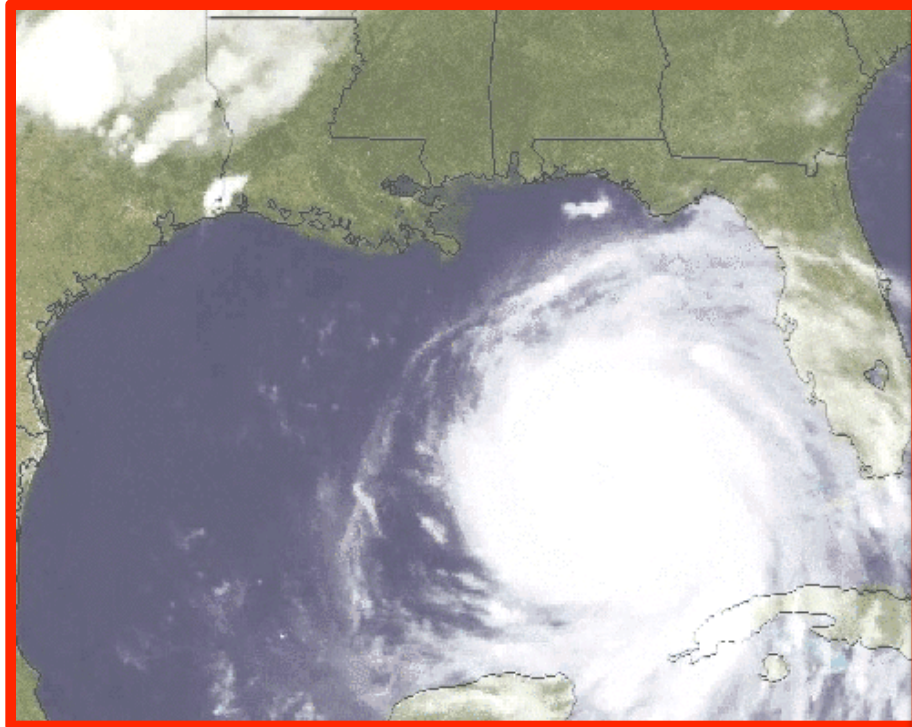
Dept. of Oceanography and Coastal
Sciences, Louisiana State University

RR Twilley

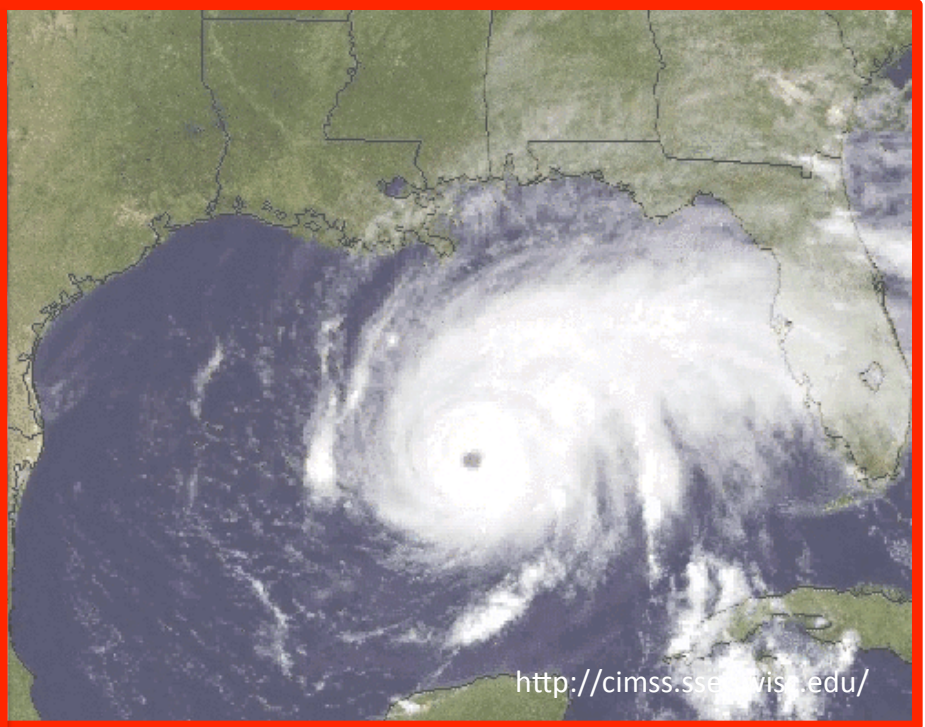
Vice President for Research,
University of Louisiana at Lafayette

Hurricane Waves and Storm Surge

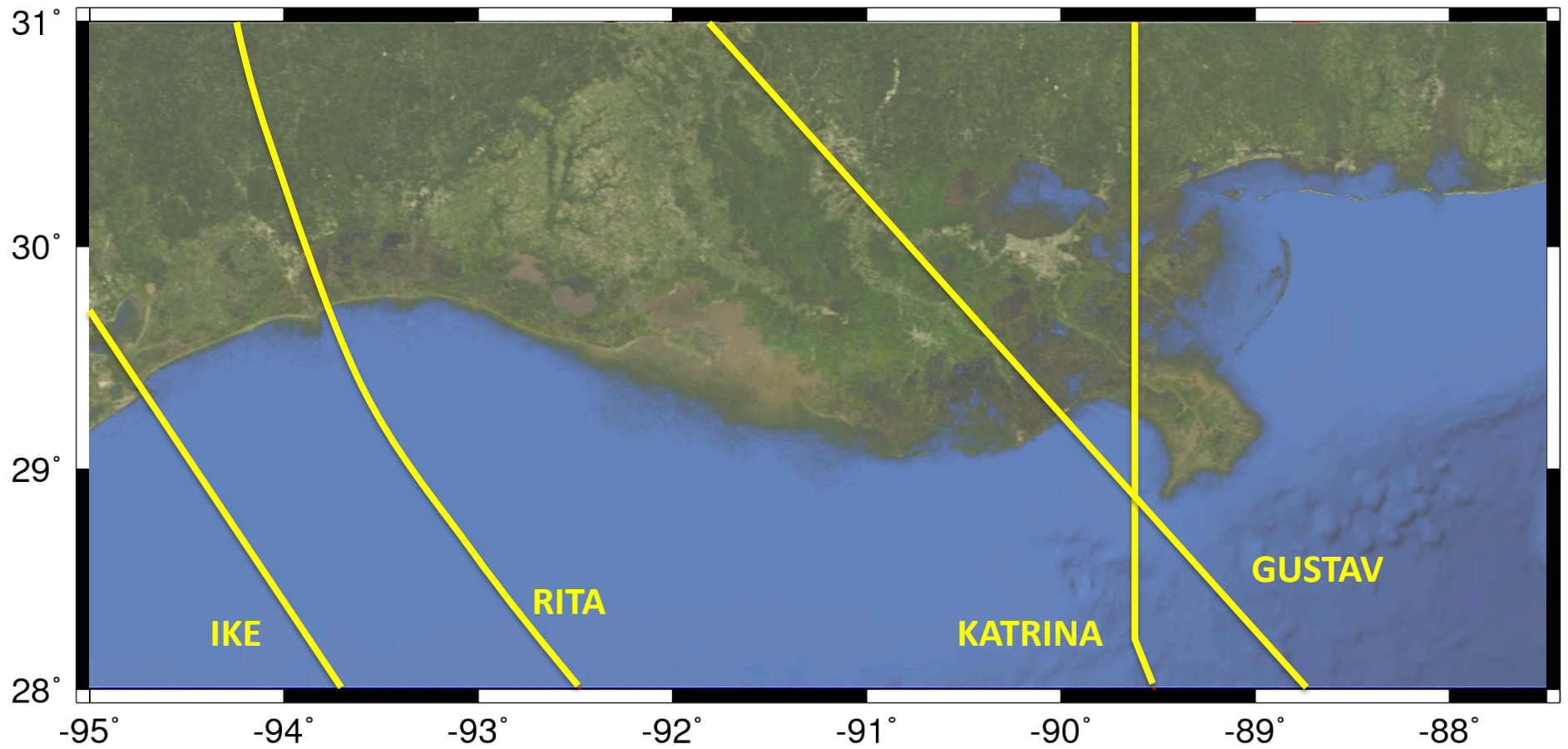
Katrina : 2005 / 08 / 28 – 29



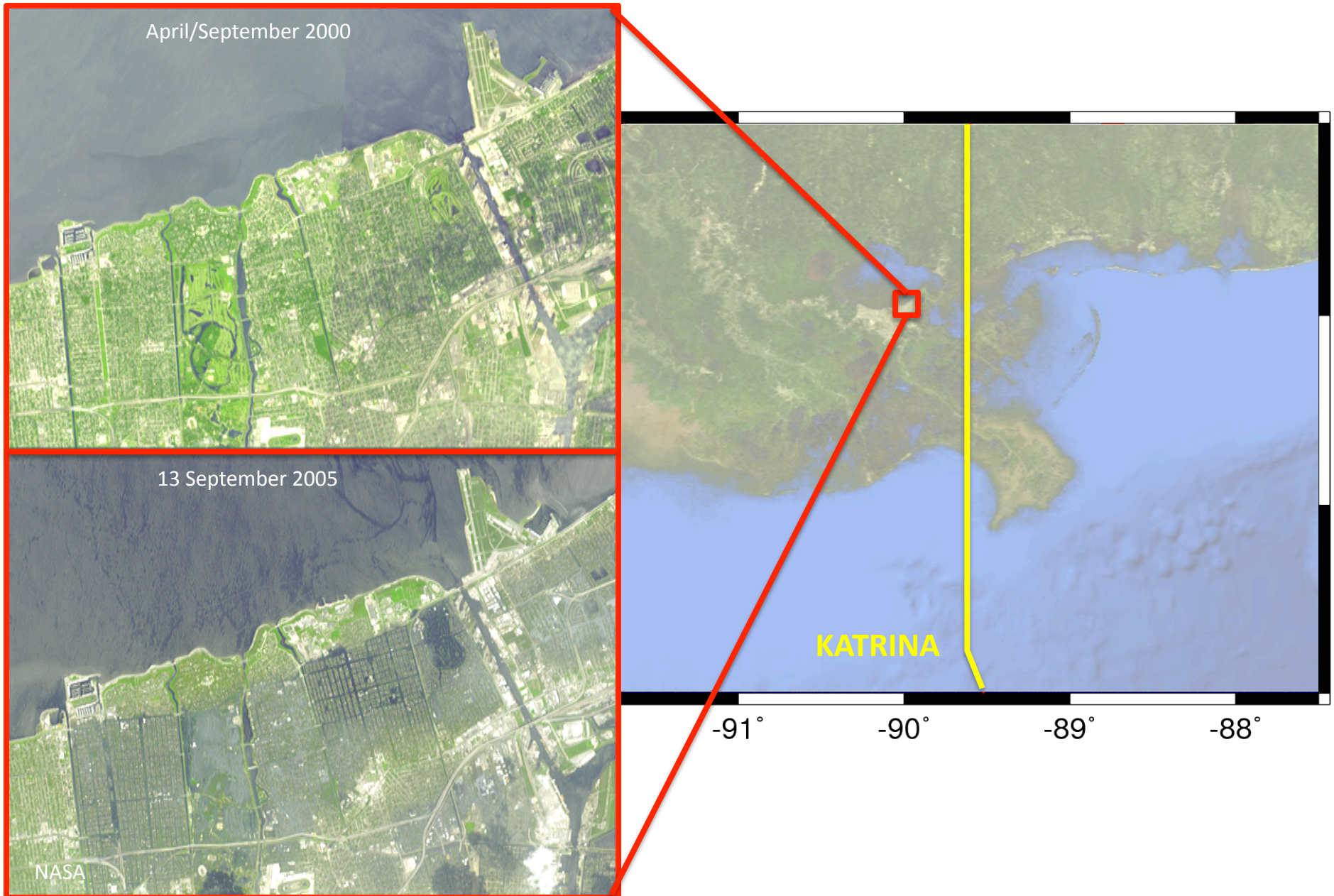
Rita : 2005 / 09 / 22 – 24



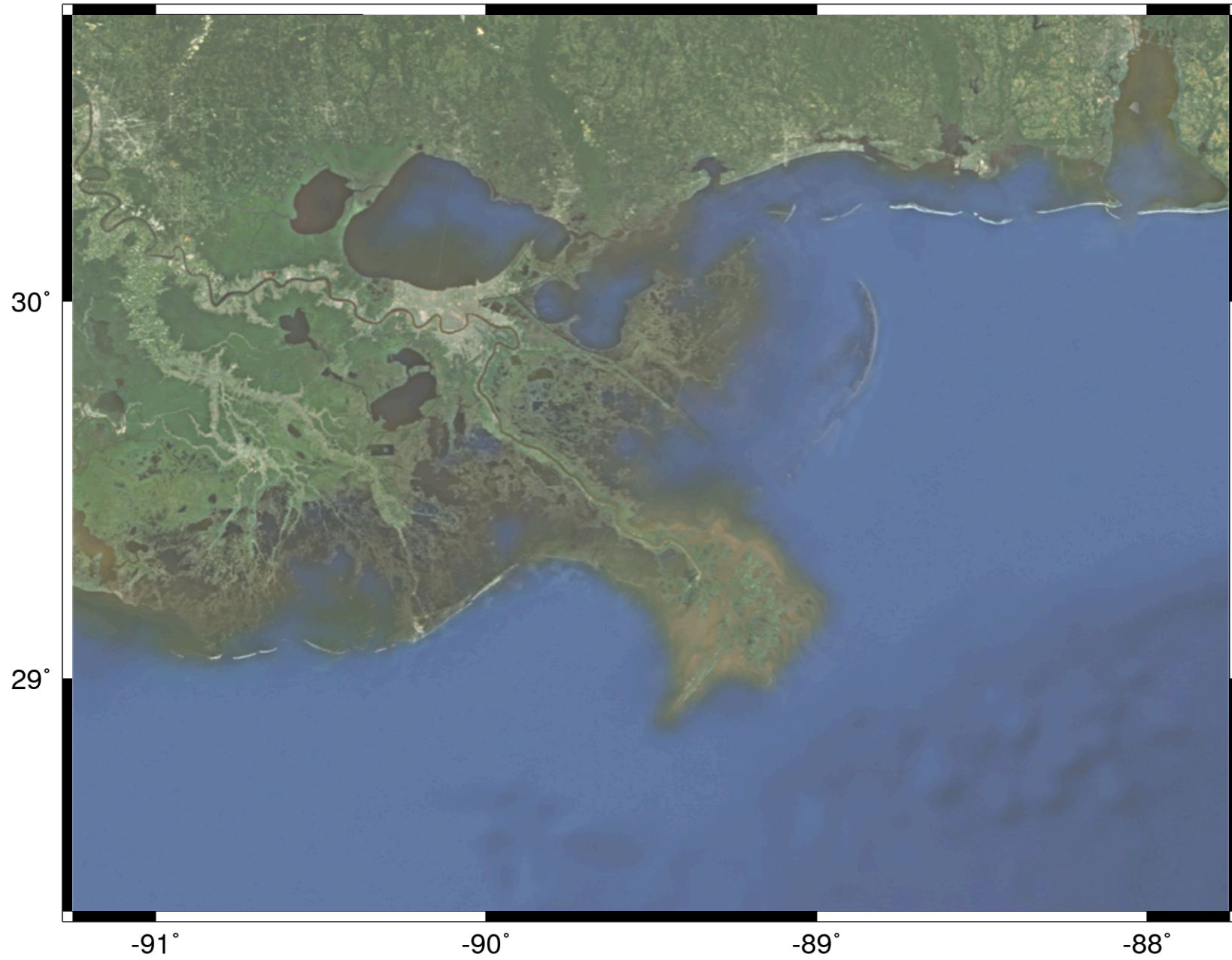
Hurricane Waves and Storm Surge



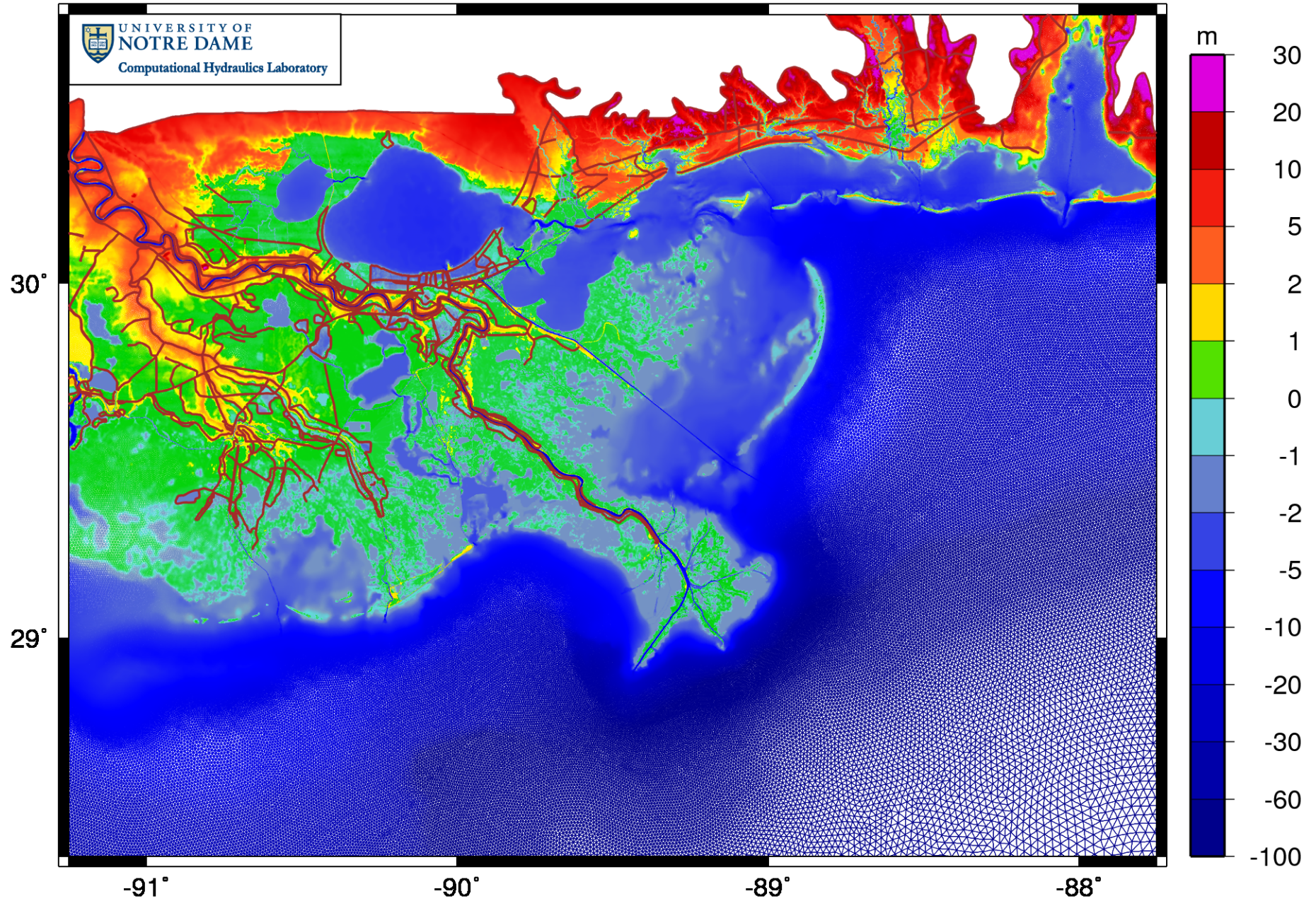
Hurricane Waves and Storm Surge



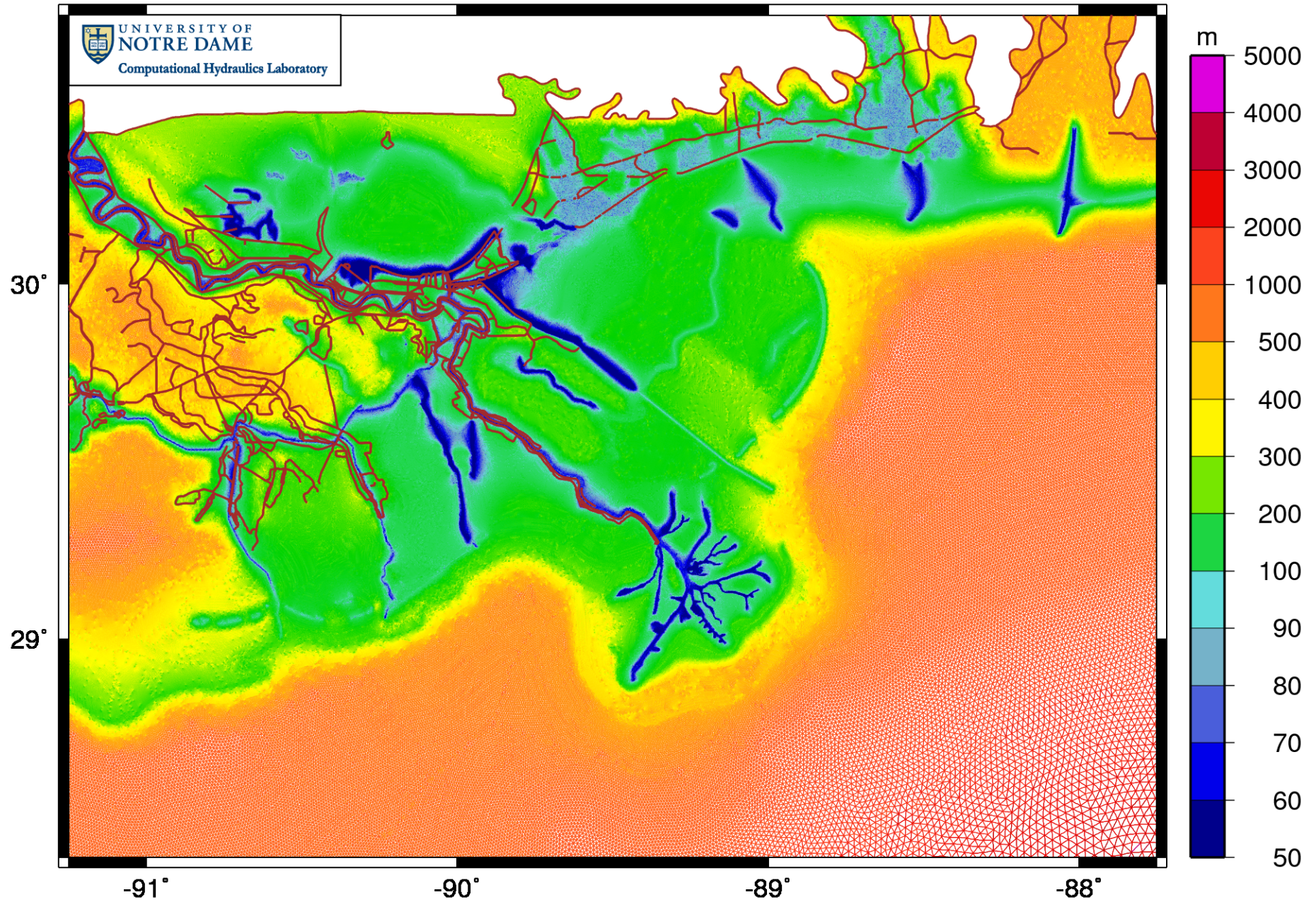
Southeastern Louisiana



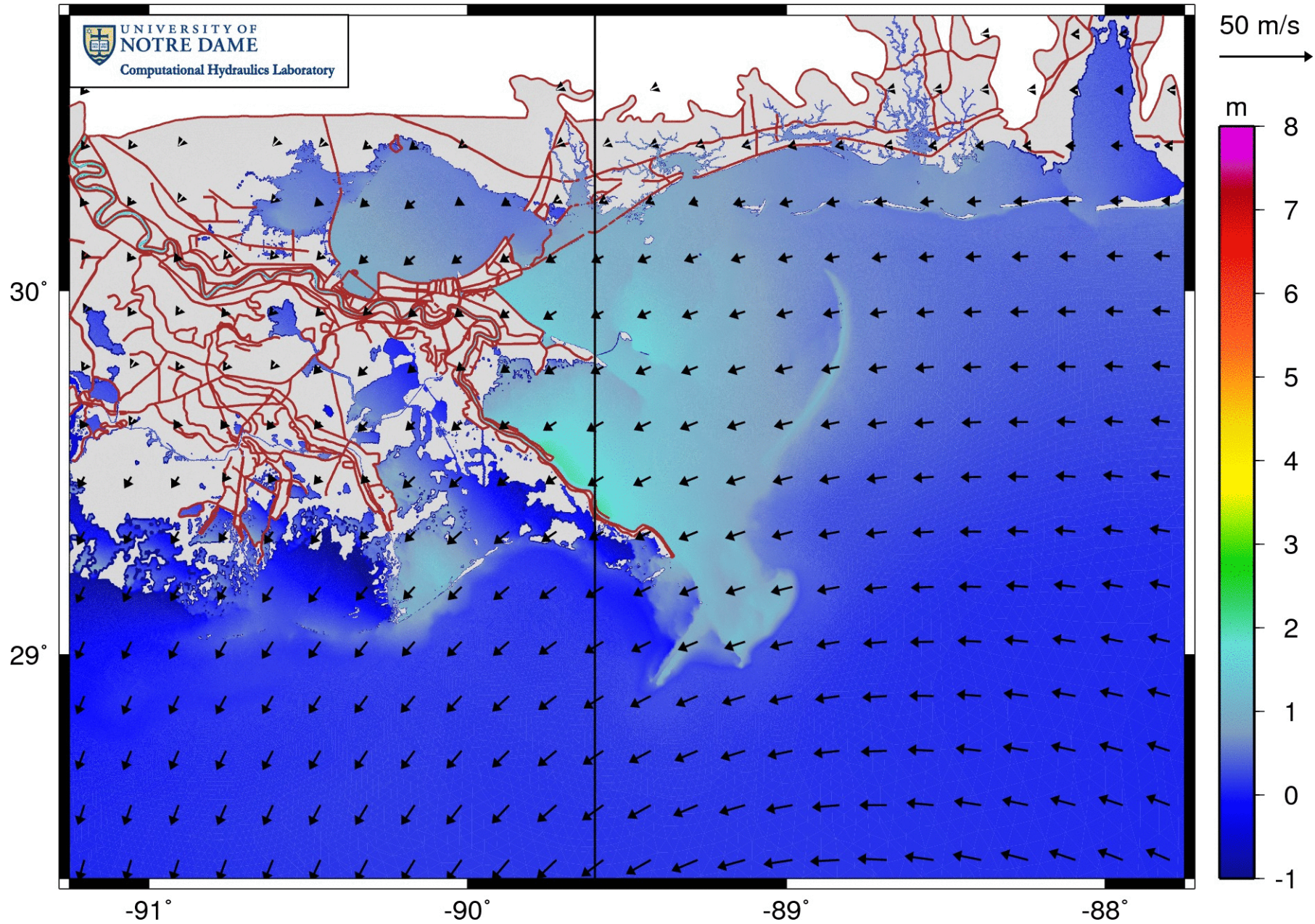
Model : Bathymetry and Topography



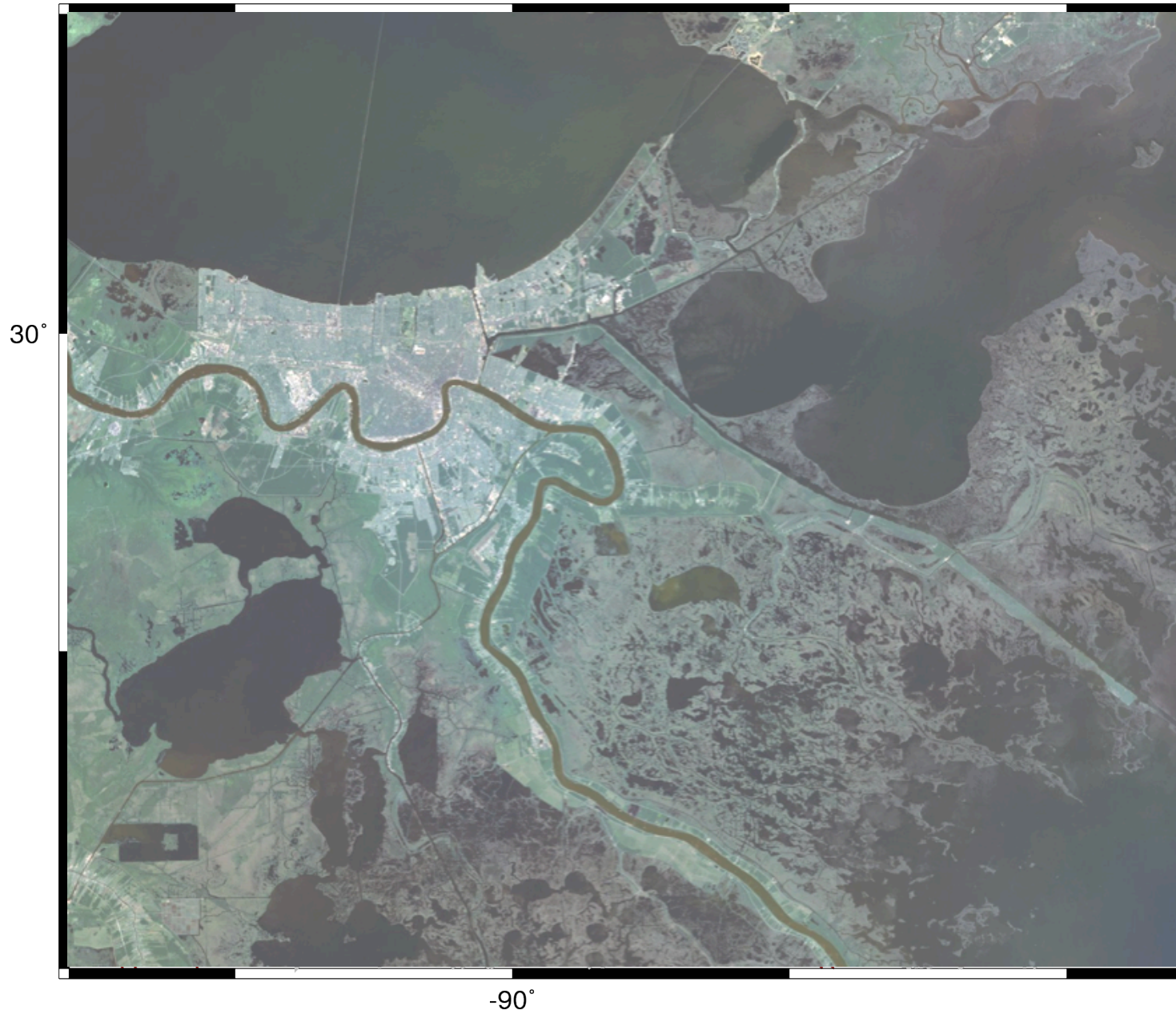
Model : Mesh Sizes



Katrina : Water Levels : Day of Landfall



Applications : Surge Barrier Design : USACE



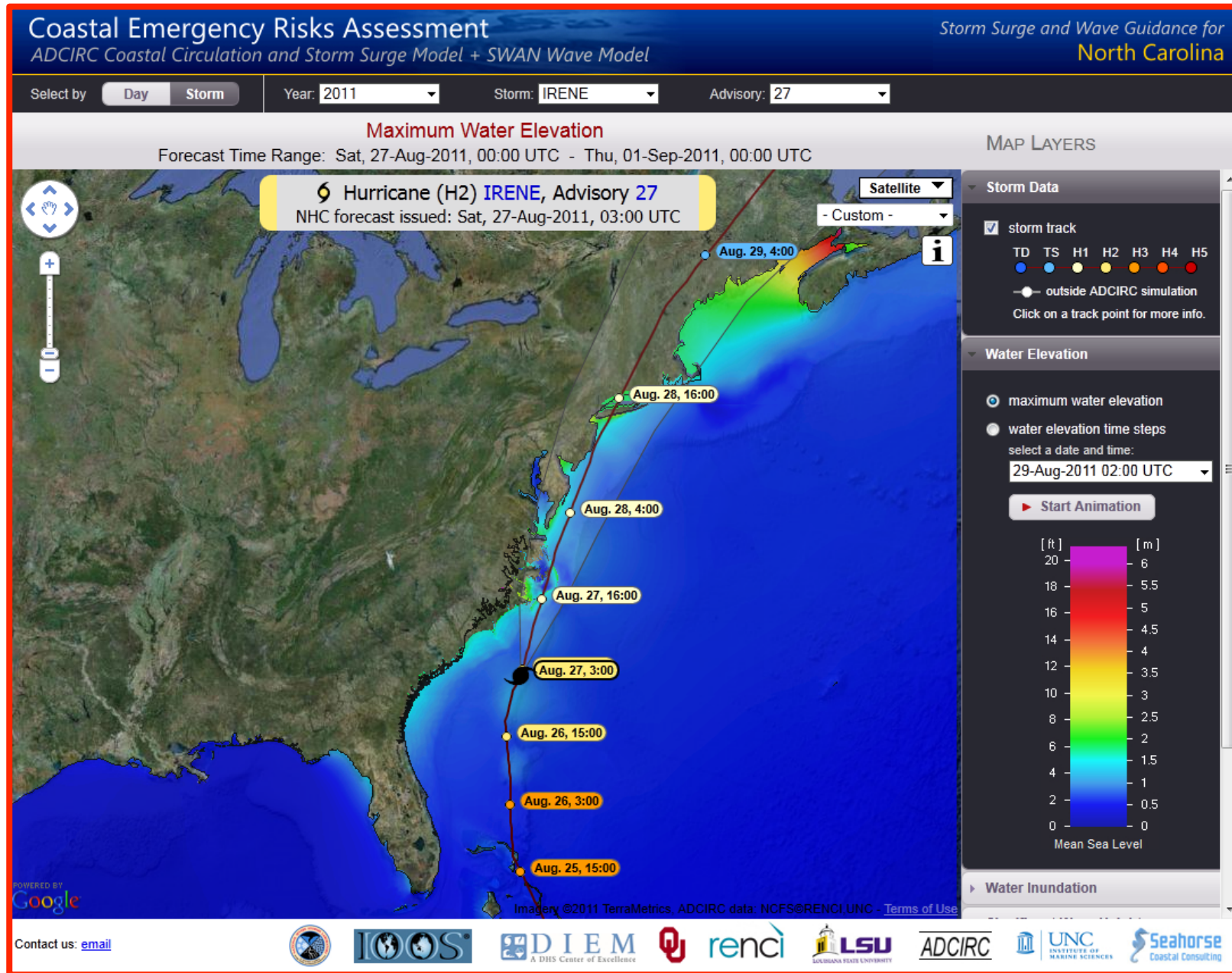
Applications : Surge Barrier Design : USACE



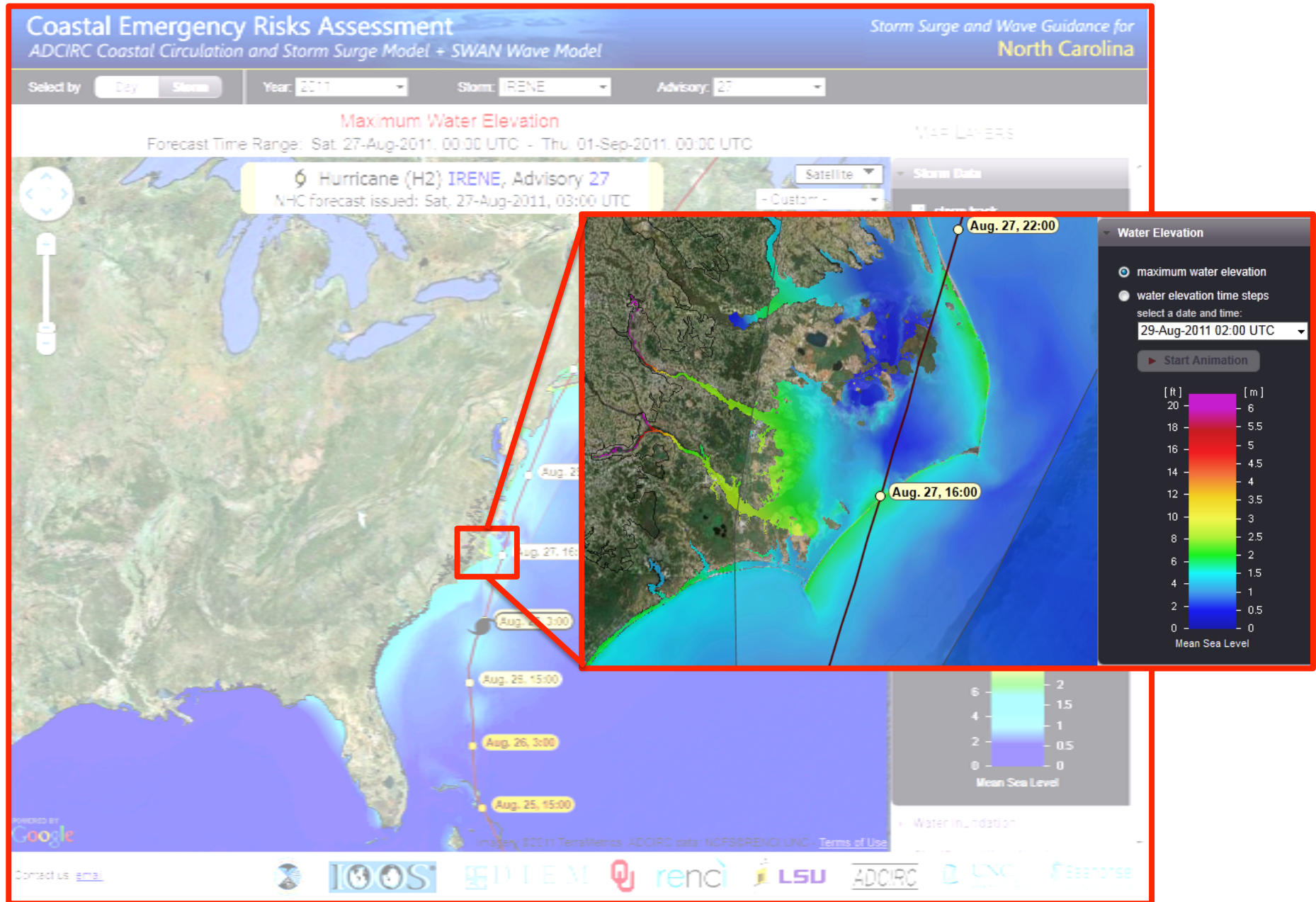
Applications : Surge Barrier Design : USACE



Applications : Hurricane Forecasting



Applications : Hurricane Forecasting



Applications : Nearshore Oil Transport : NSF / DHS

Deepwater Horizon was a 9-year-old,
mobile offshore drilling unit

Located 66km from the Louisiana coastline,
in 1500m of water

Platform was engulfed on 20 April by an
explosion of methane gas; structure
burned for more than 24hr before
sinking on 22 April

Explosion killed 11 workers and injured 17

Oil spill flow rates:

- Estimated to have begun at a rate
of $9900 \text{ m}^3 \text{ d}^{-1}$
- Diminished over time to a final rate
of $8400 \text{ m}^3 \text{ d}^{-1}$ on 15 July 2010

Emergency responders relied on satellite
and aerial imagery



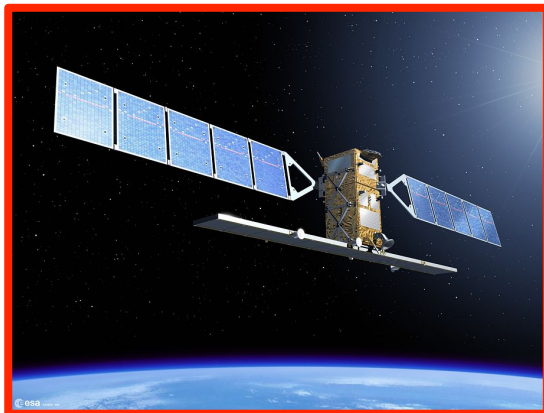
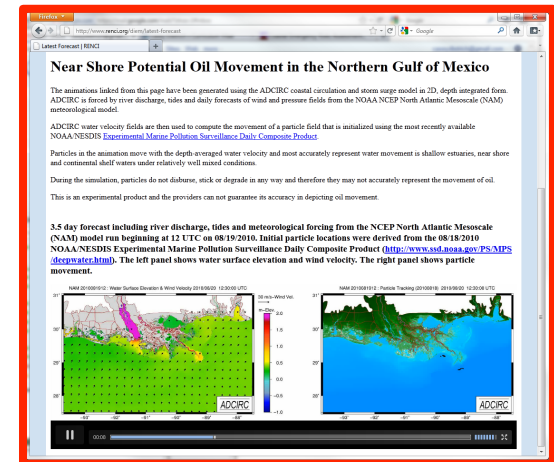
Nearshore Oil Transport : Motivation

Satellite imagery can only show current location of the slick

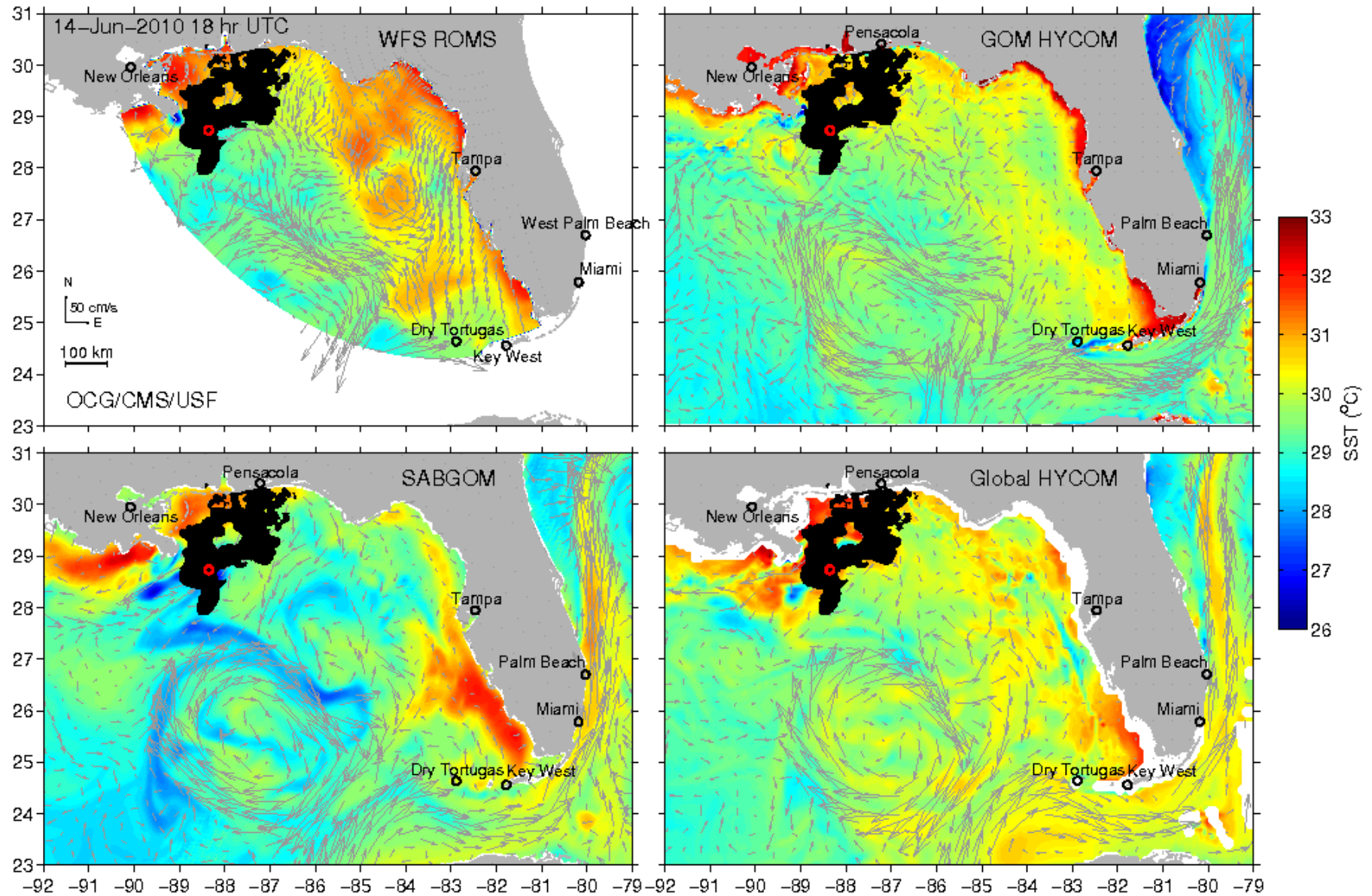
- Where will the oil move?
- What happens if a hurricane approaches?

Forecasts need to be accurate and fast

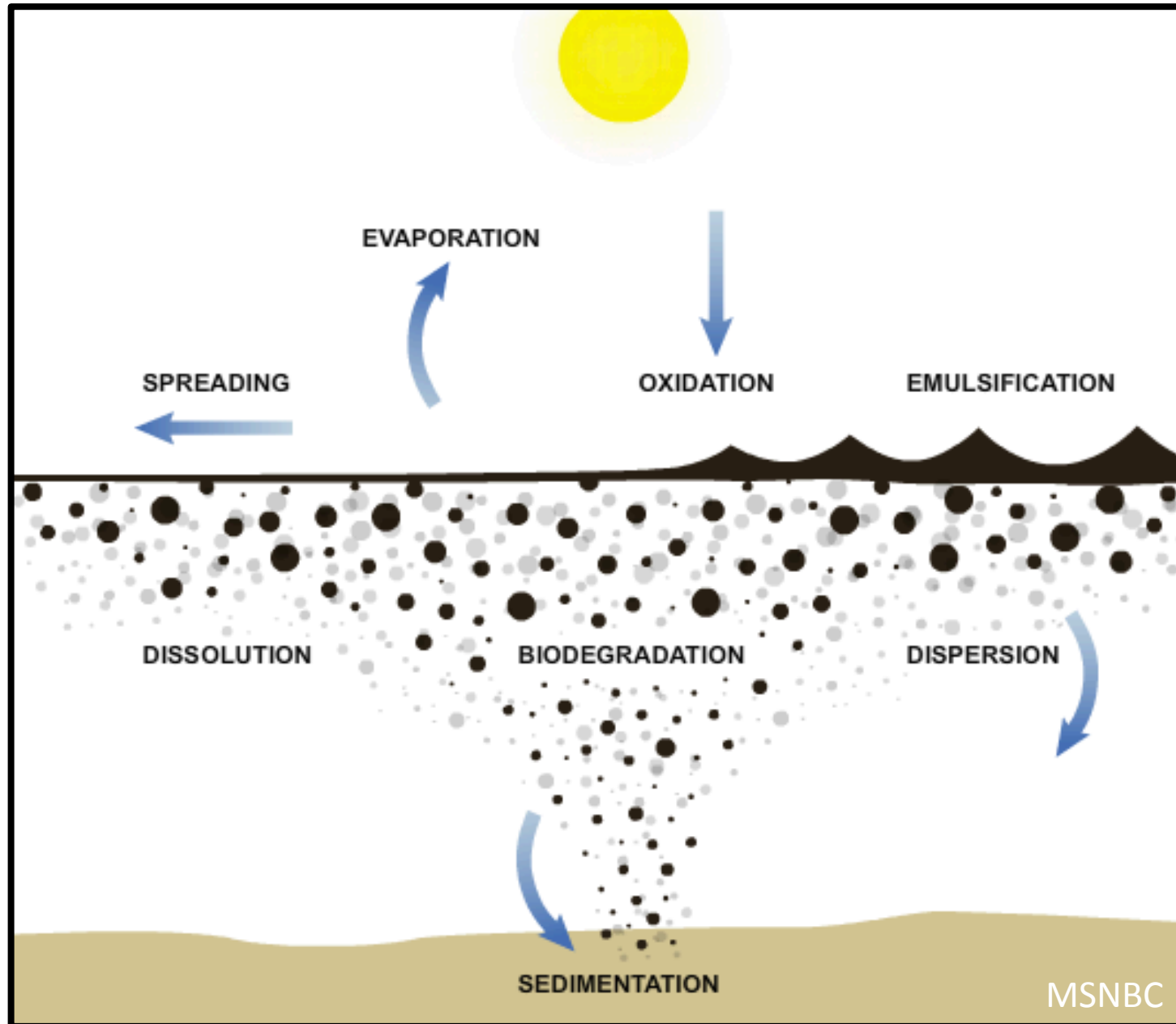
- Share computed circulation with NOAA, other spill modelers
- Share oil transport with emergency managers in real time (<http://adcirc.org/oilspill>)



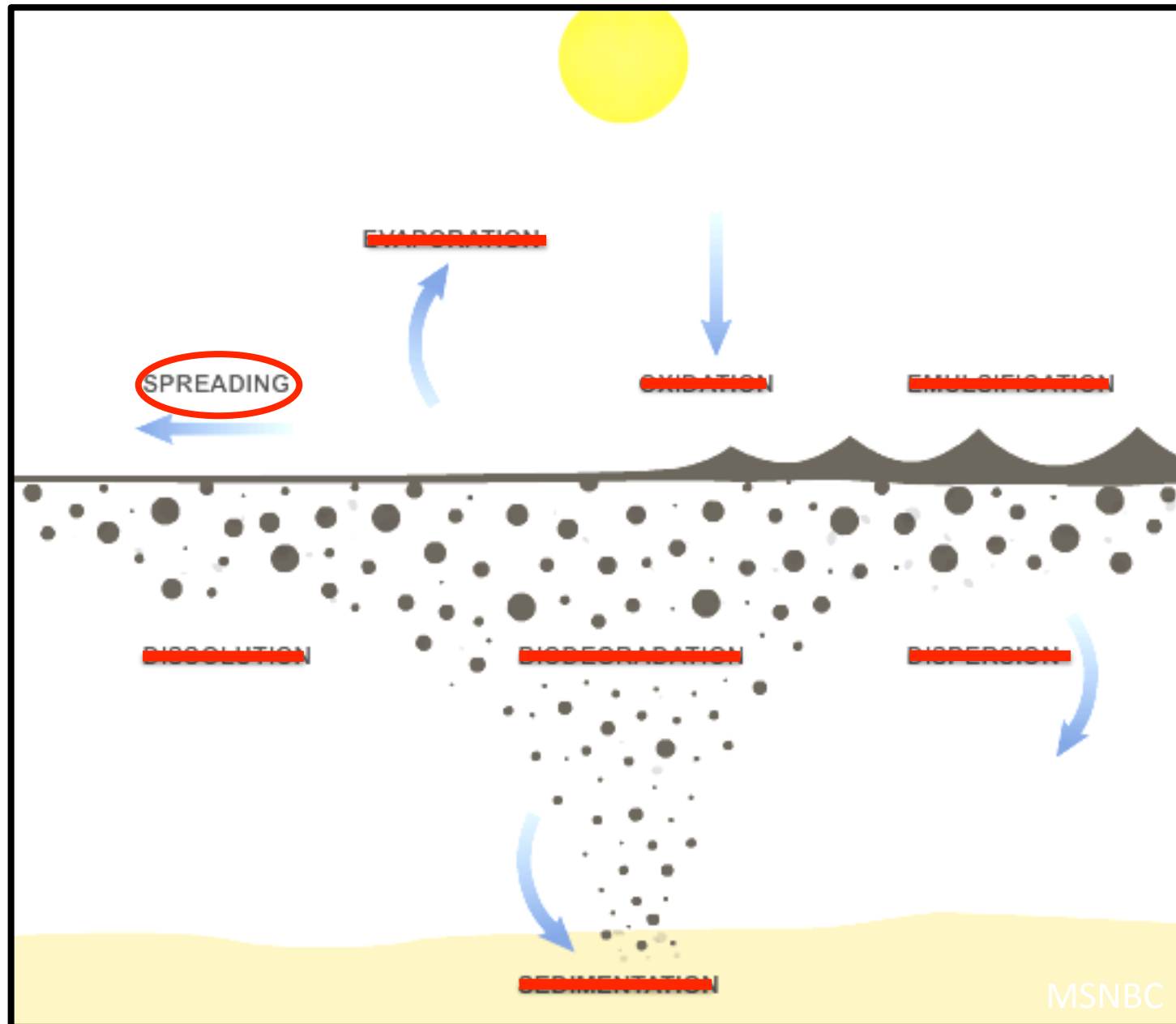
Nearshore Oil Transport : Motivation



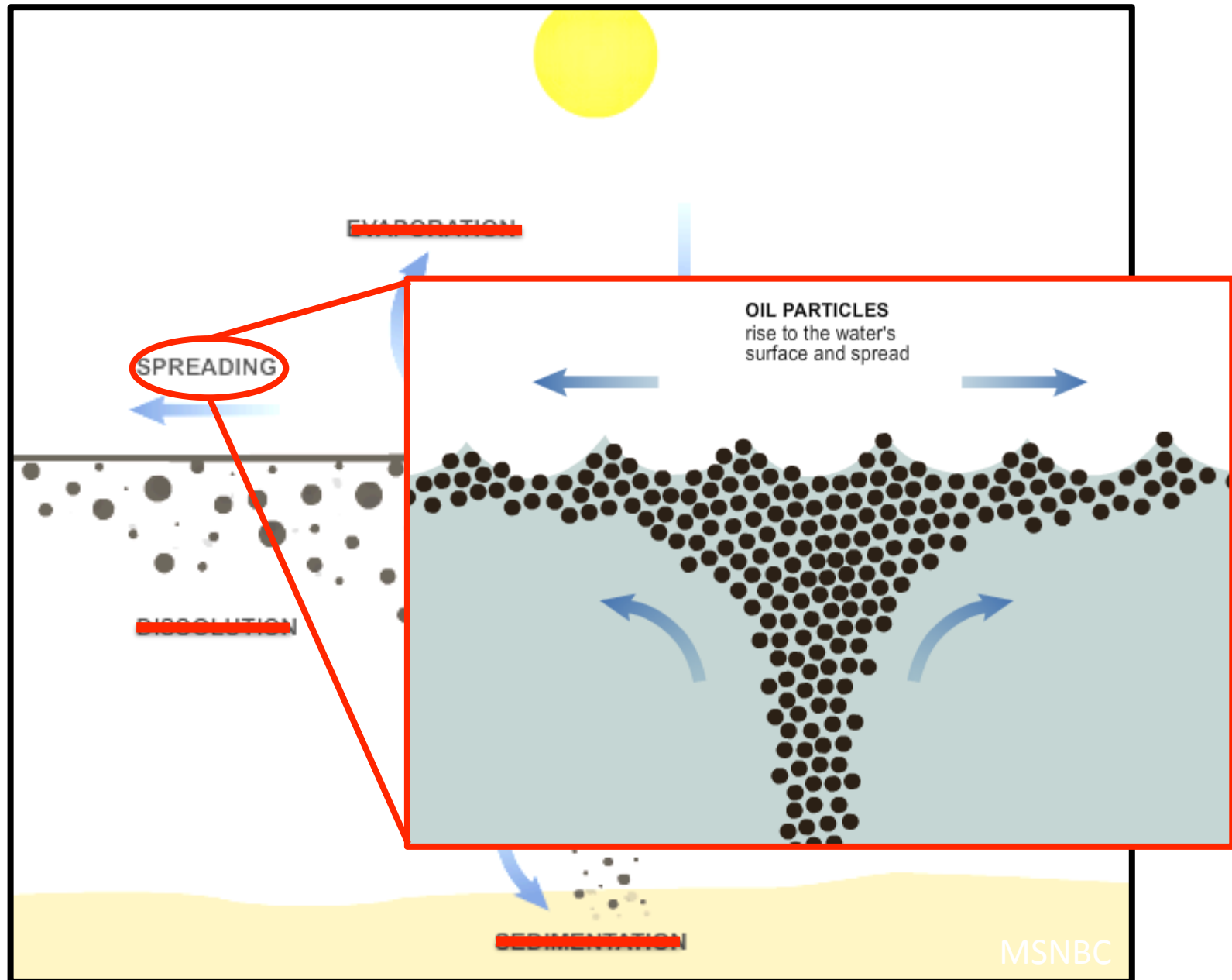
Nearshore Oil Transport : Challenges



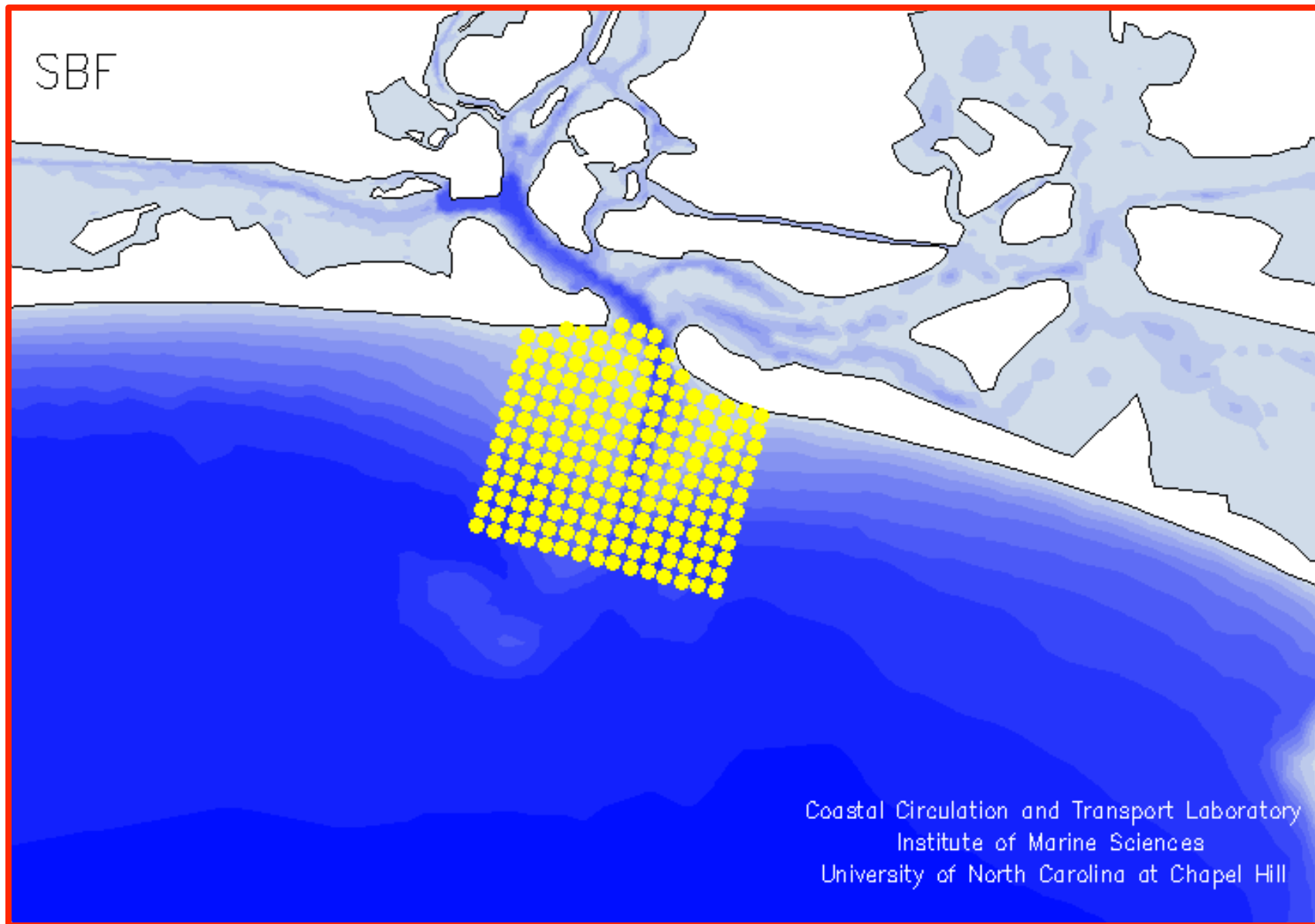
Nearshore Oil Transport : Challenges



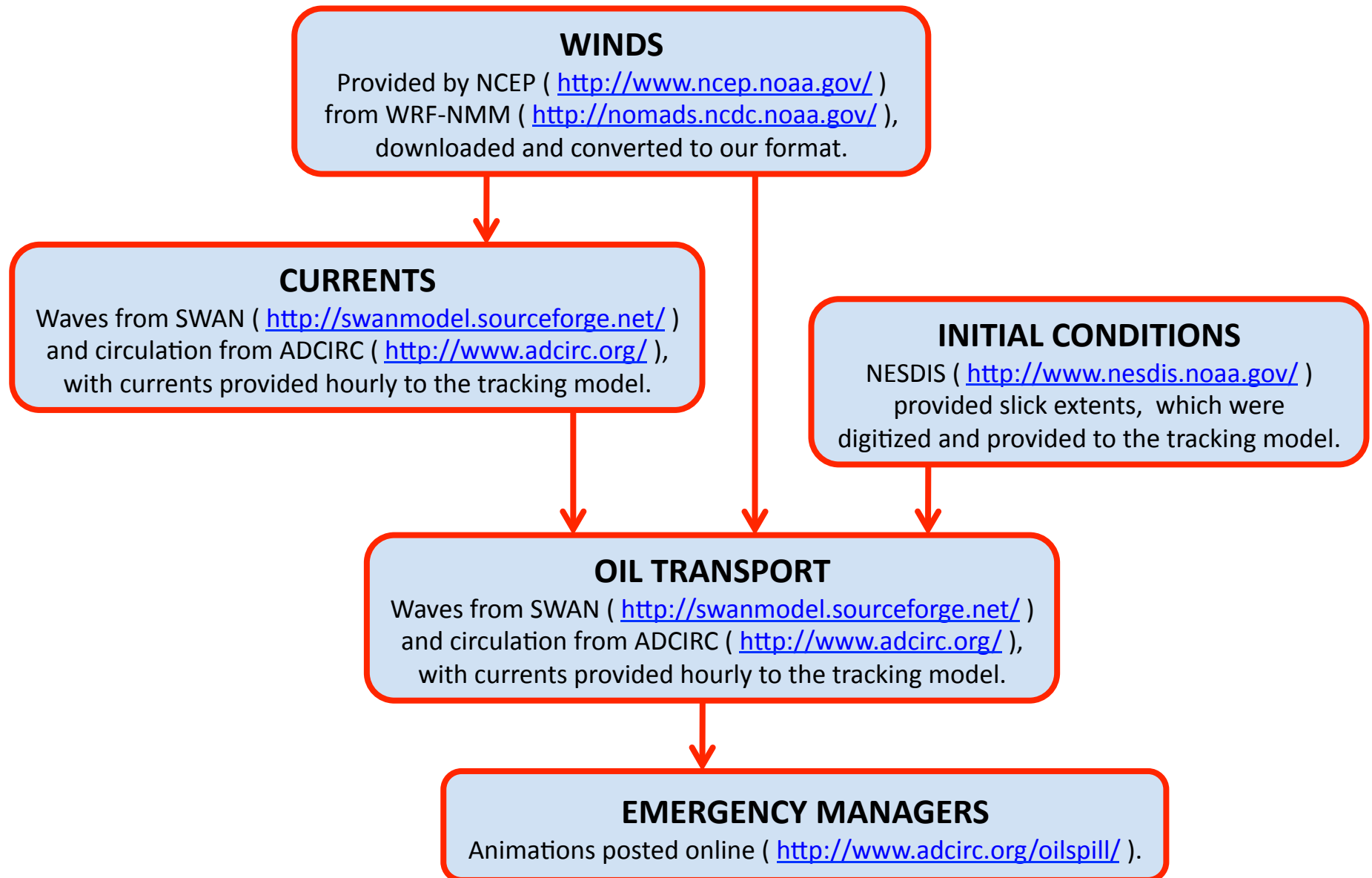
Nearshore Oil Transport : Challenges



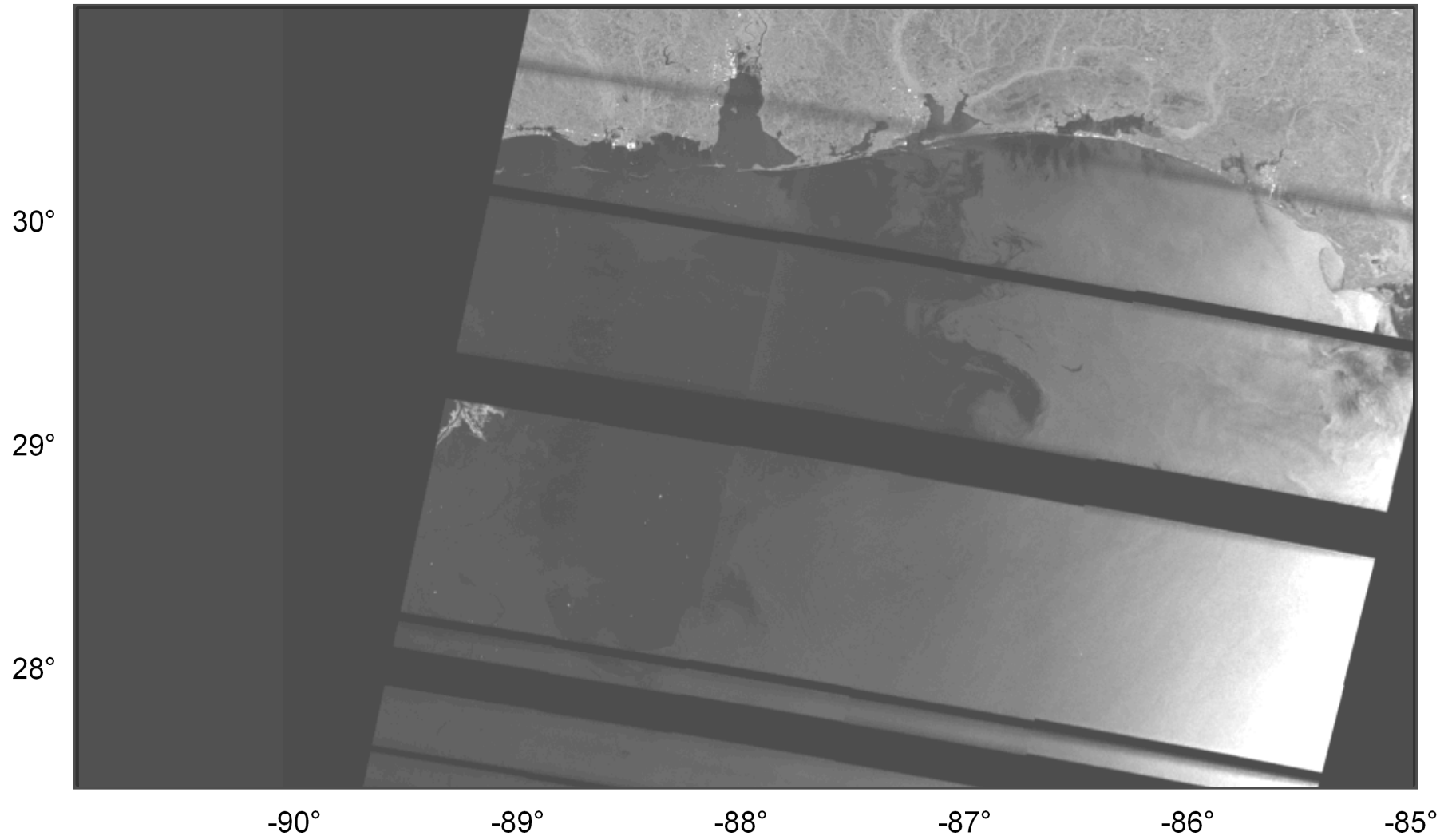
Nearshore Oil Transport : Methods



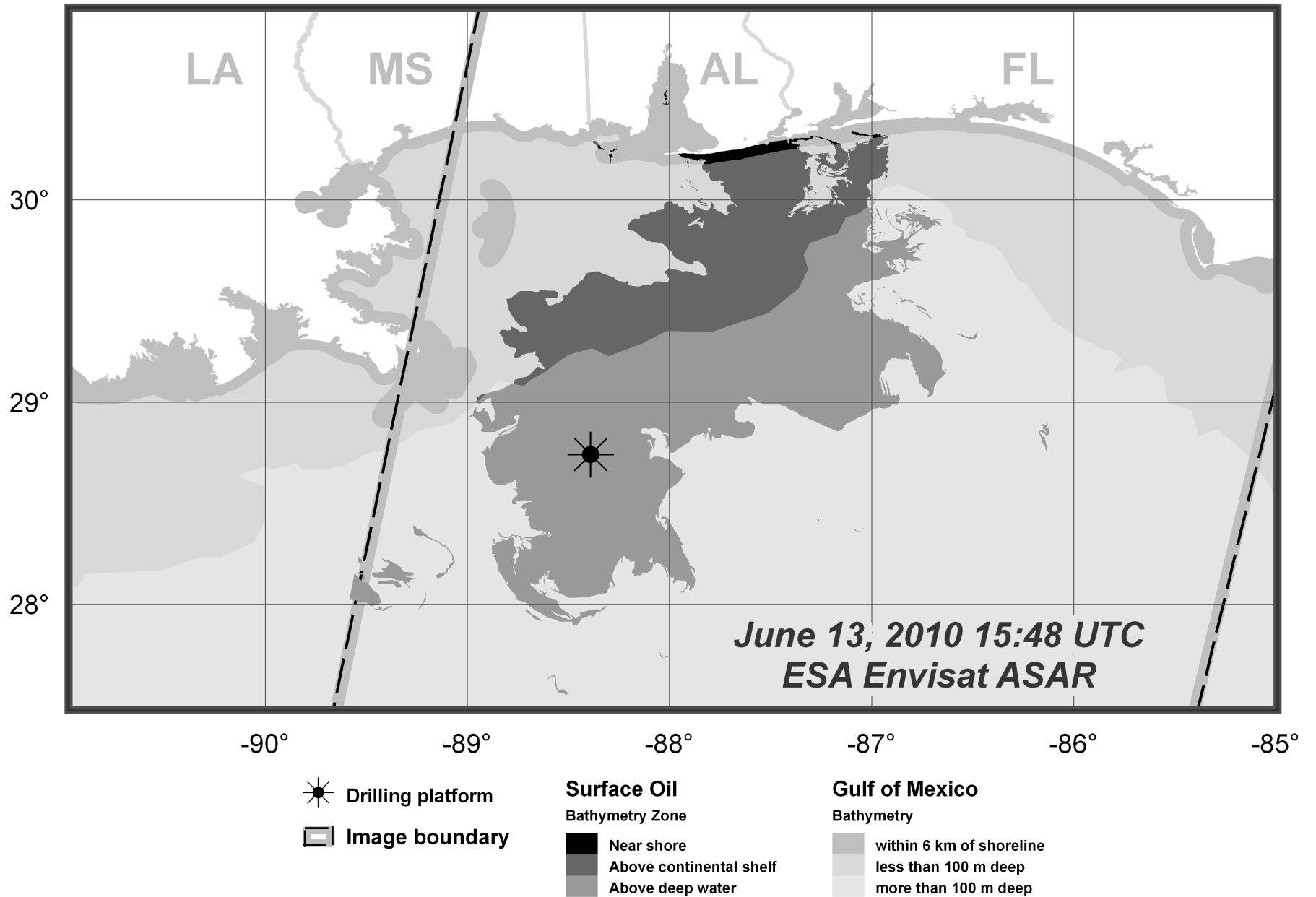
Nearshore Oil Transport : Methods

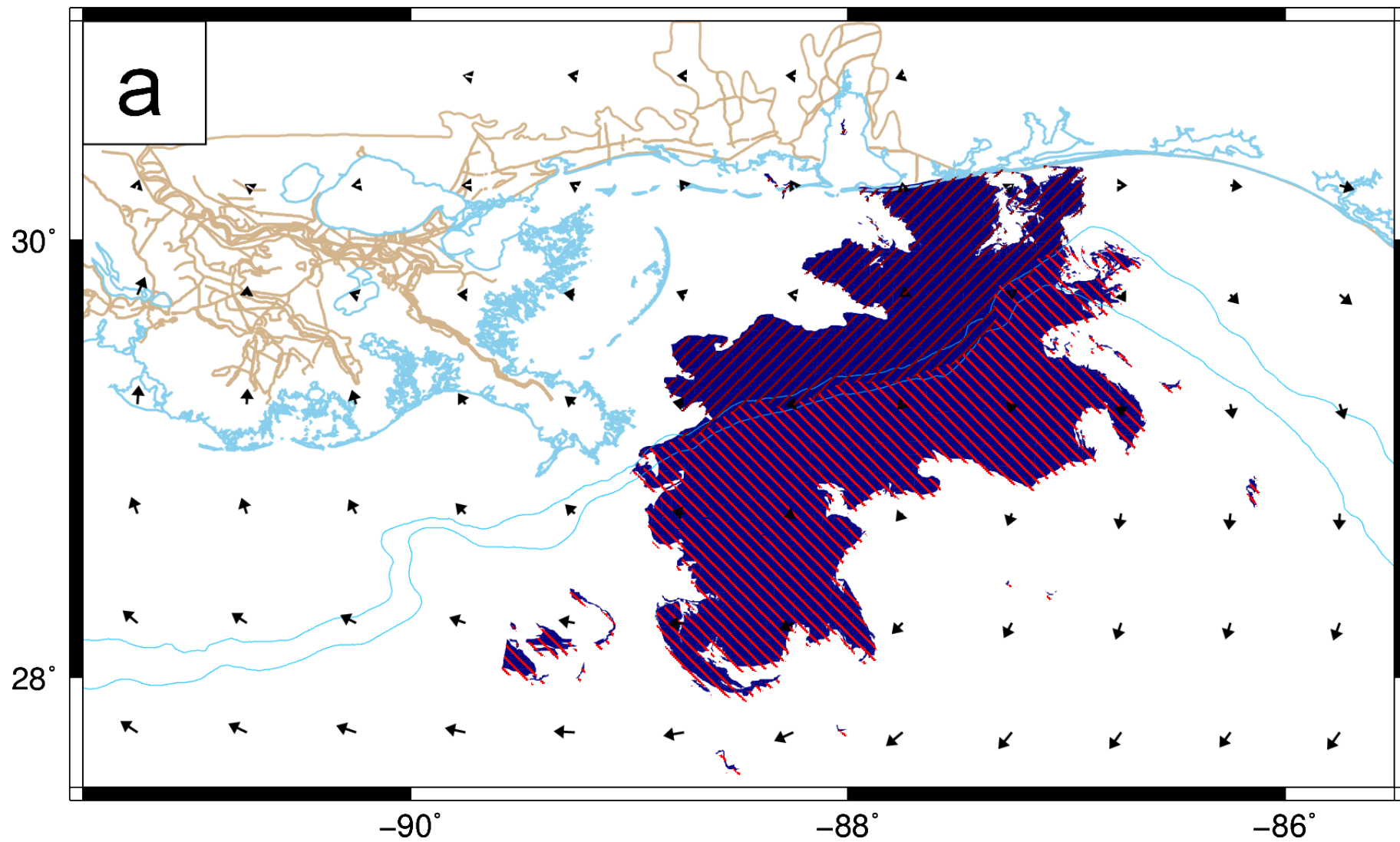
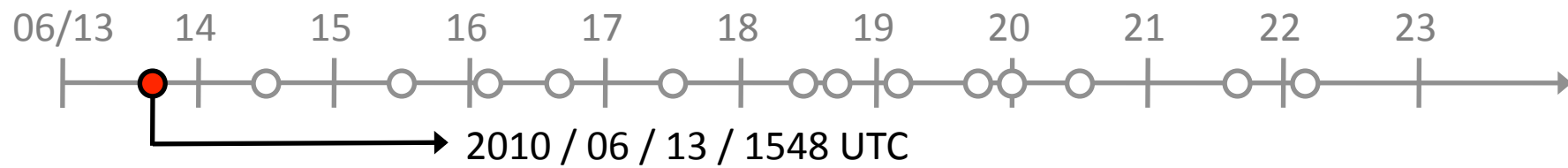


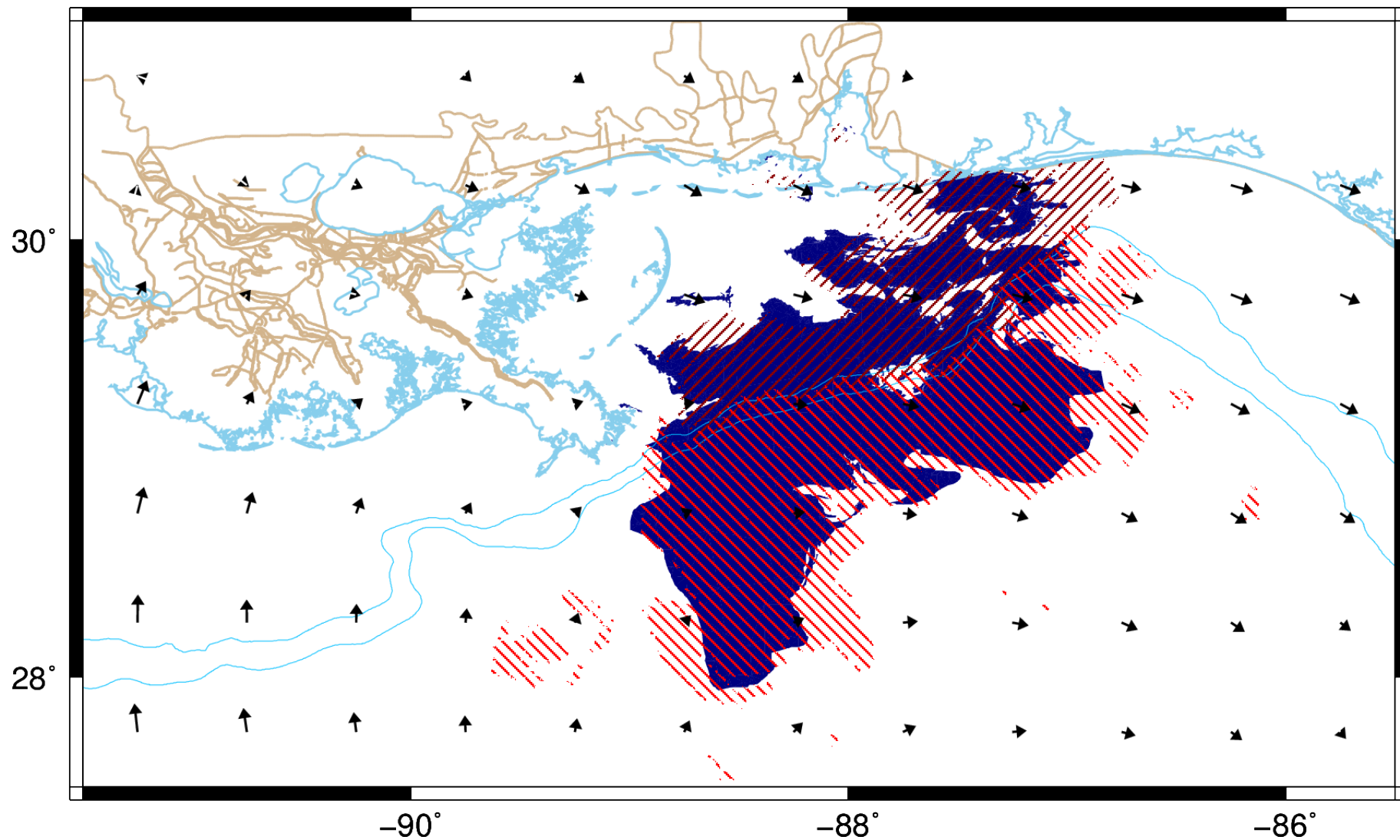
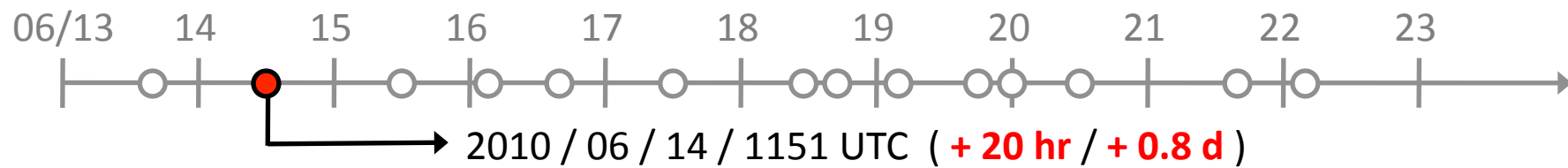
Validation : Mid-June

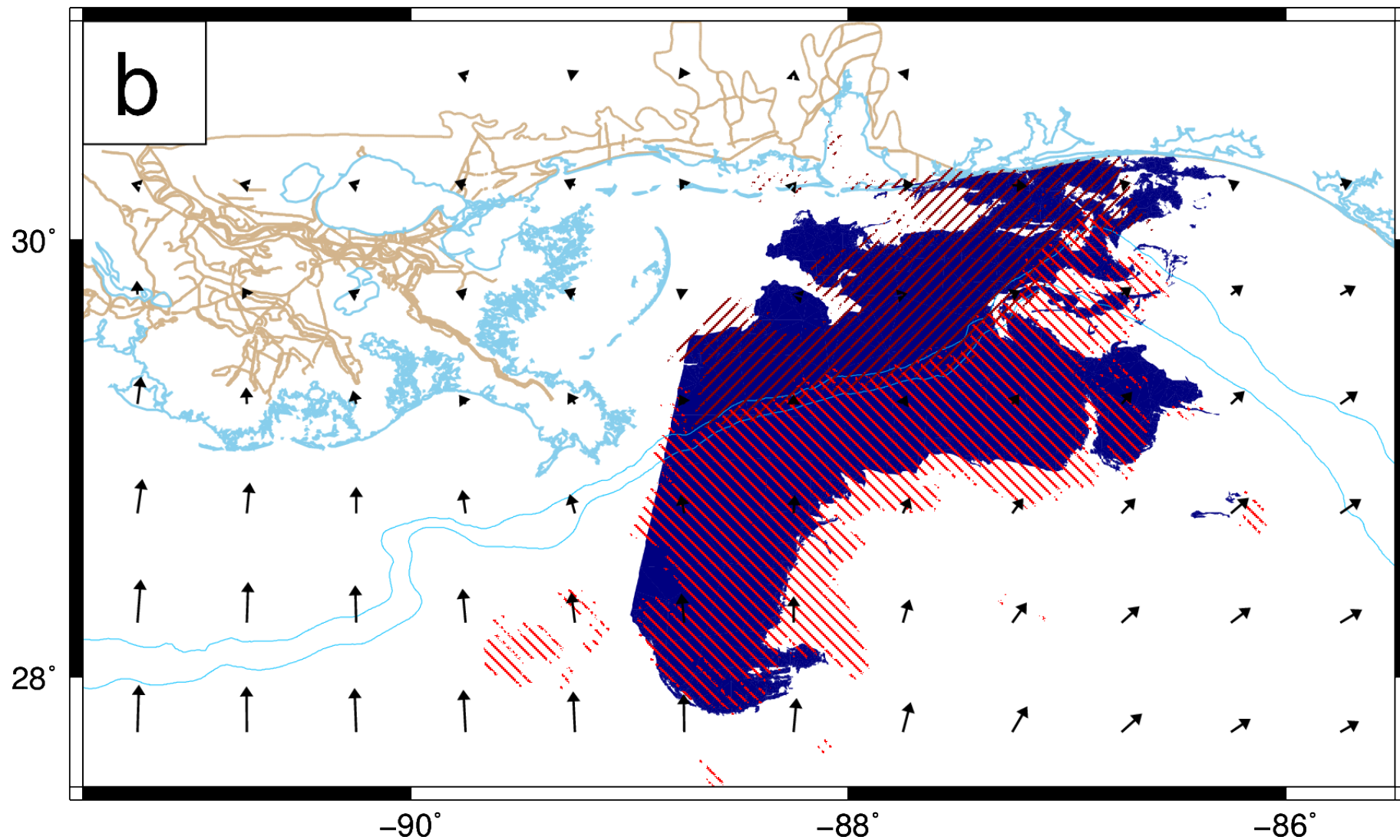
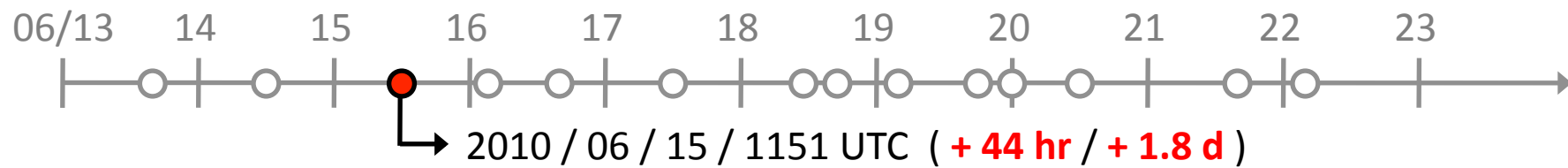


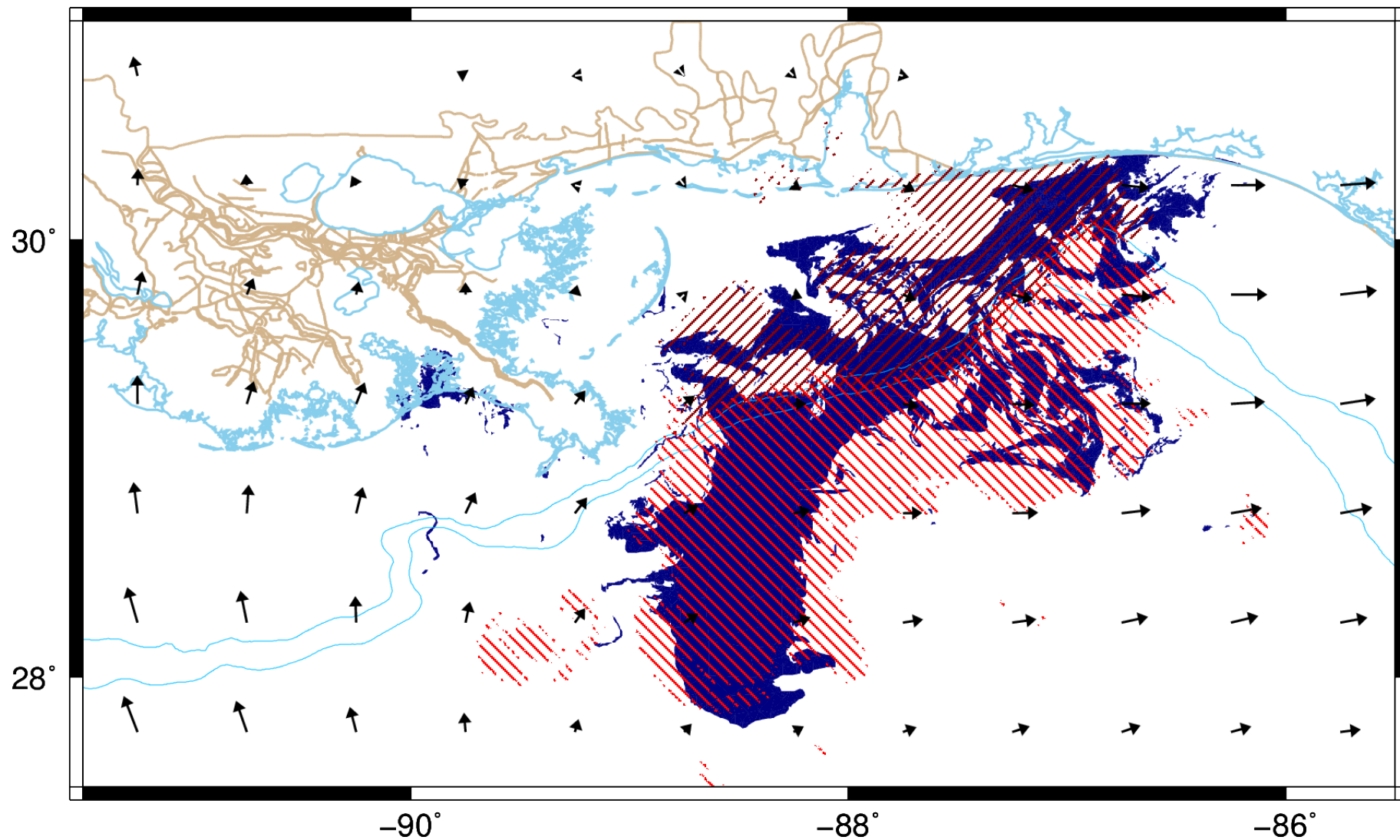
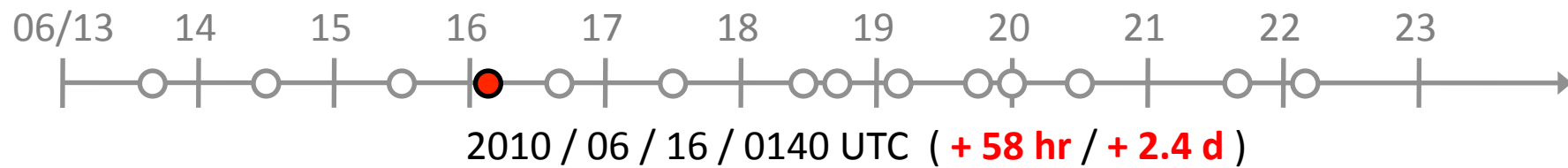
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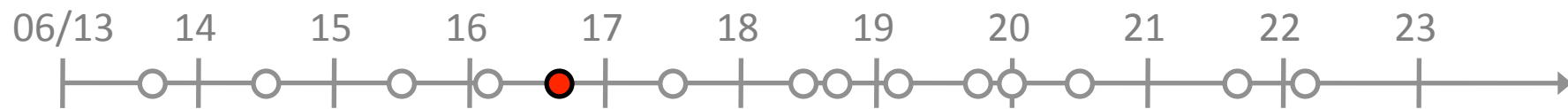




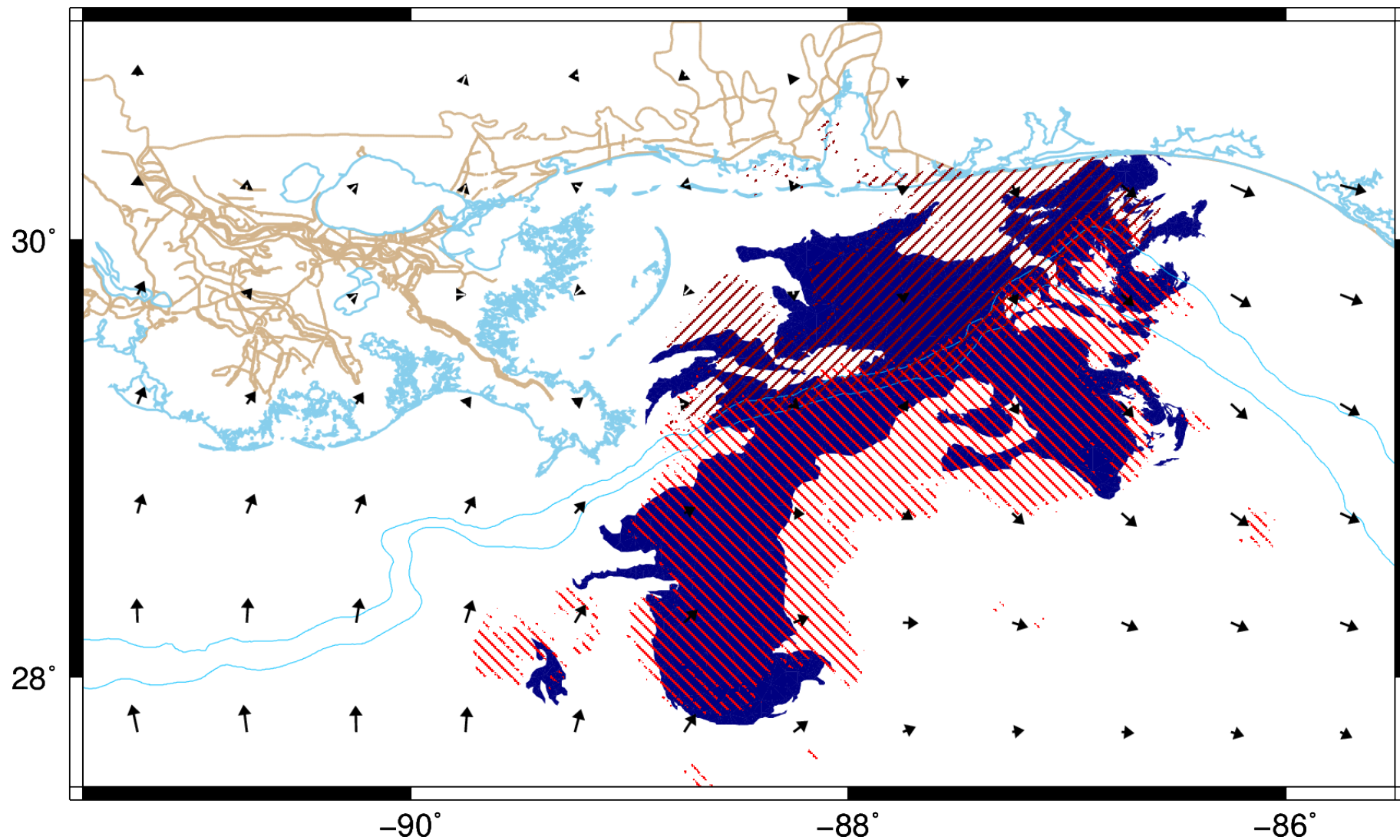


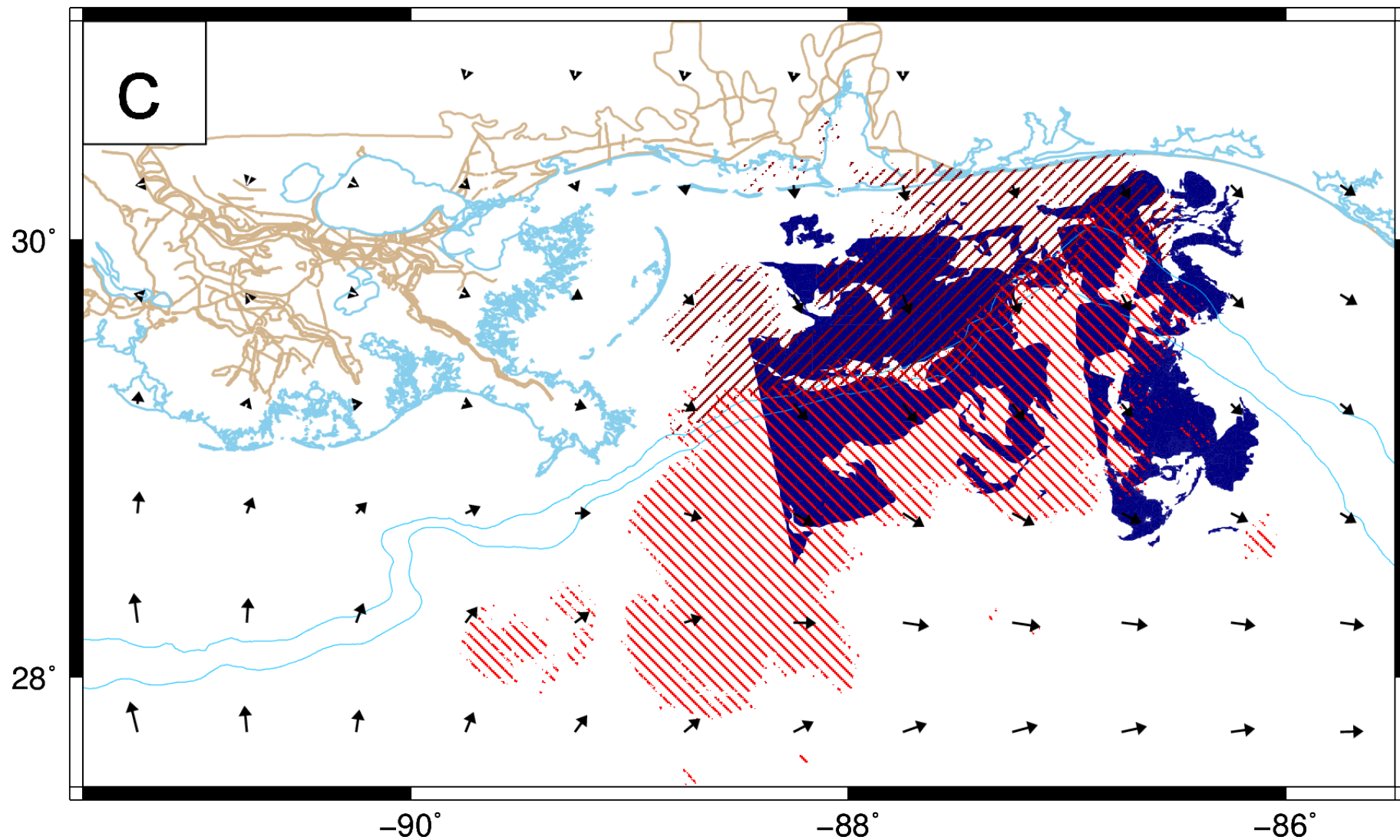
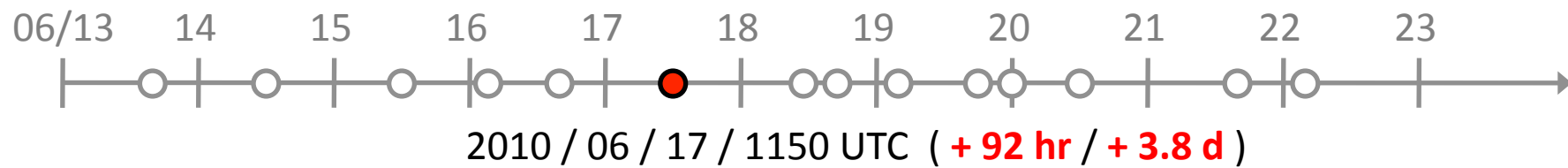


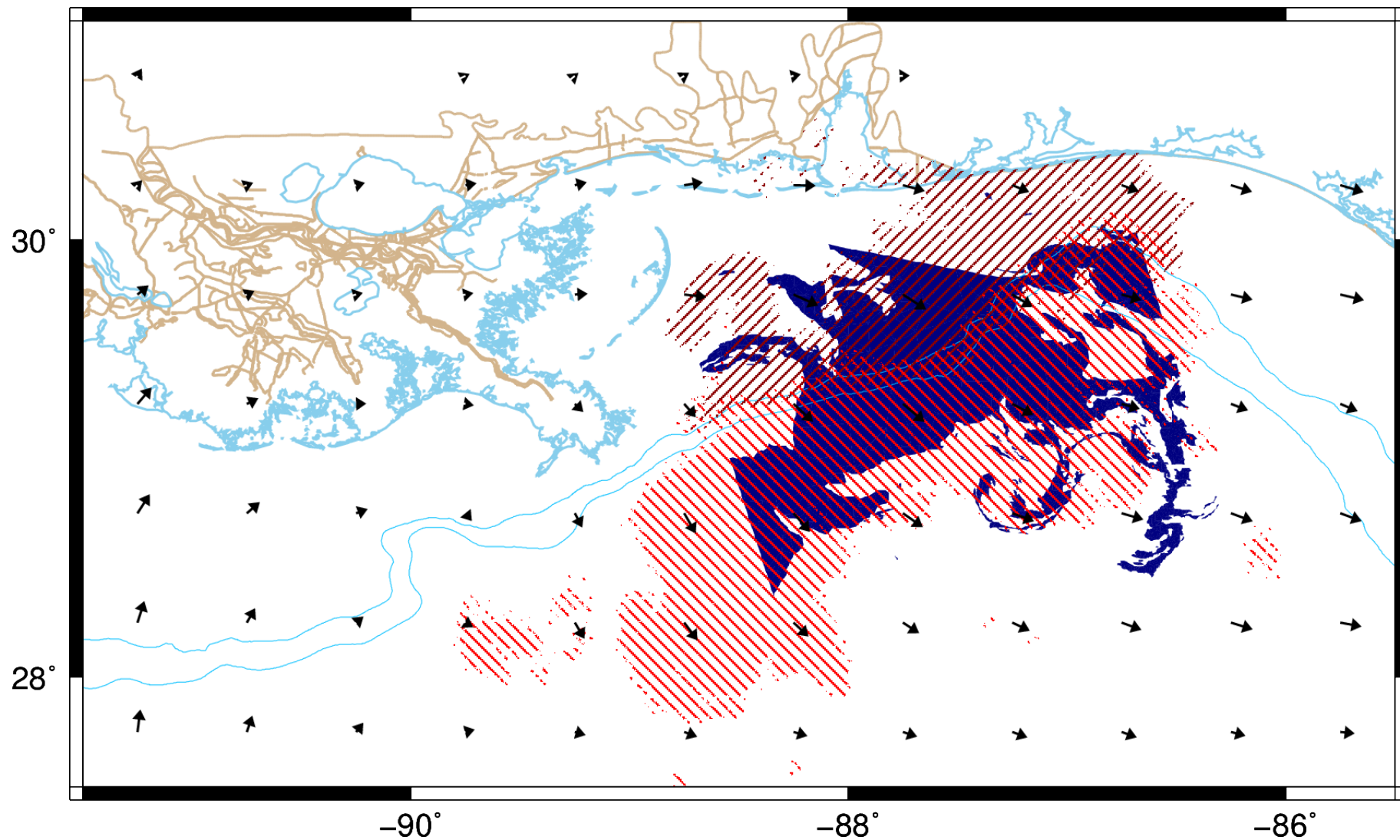
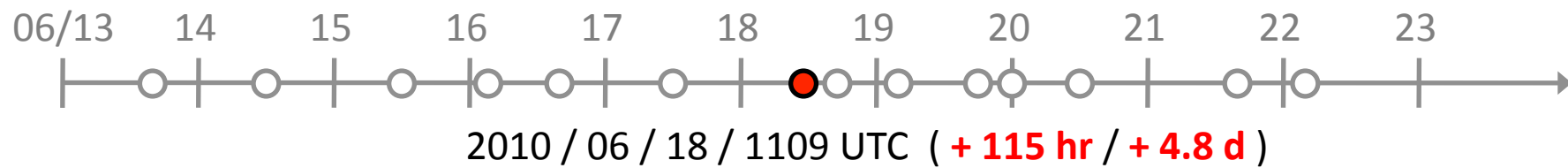


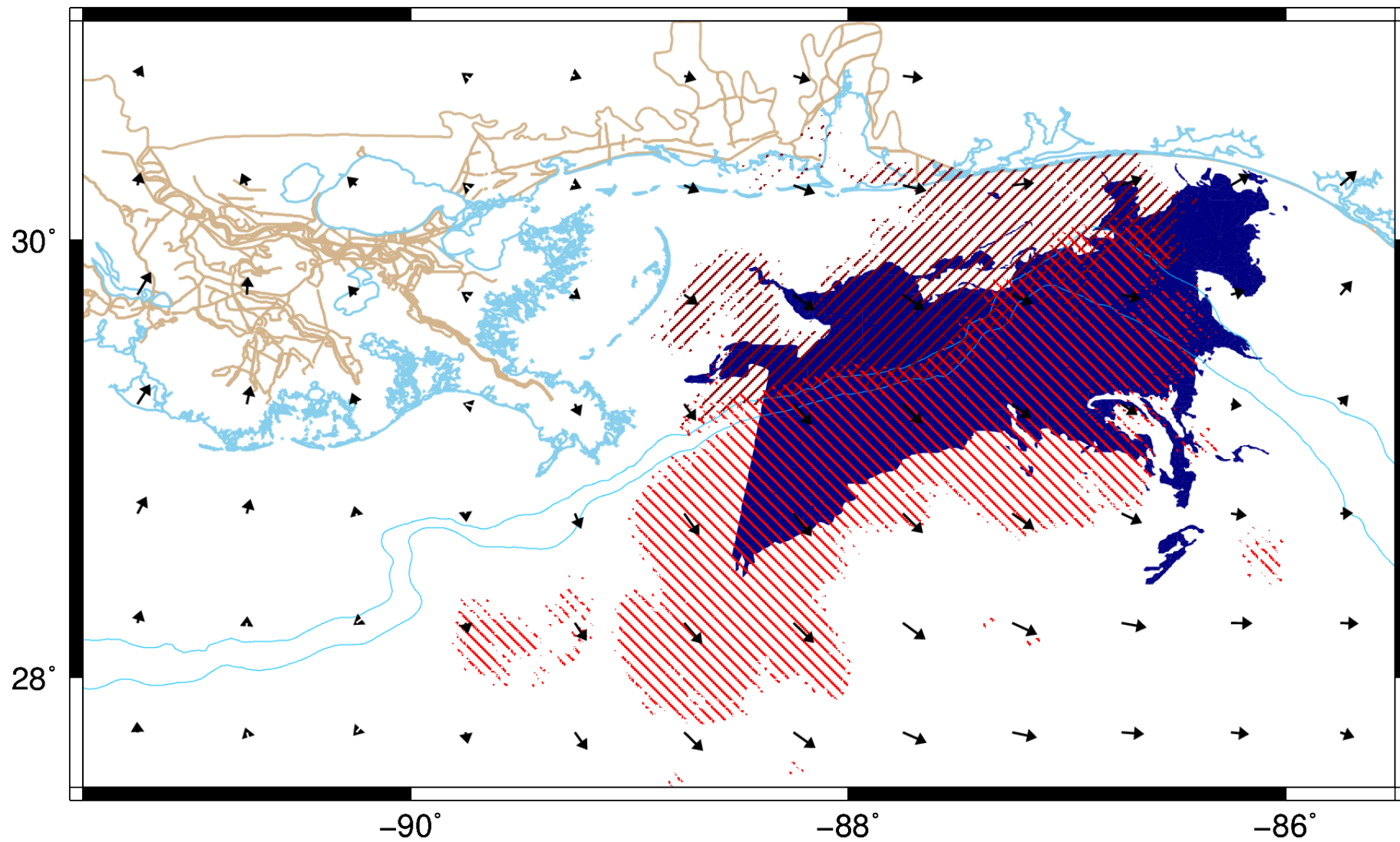
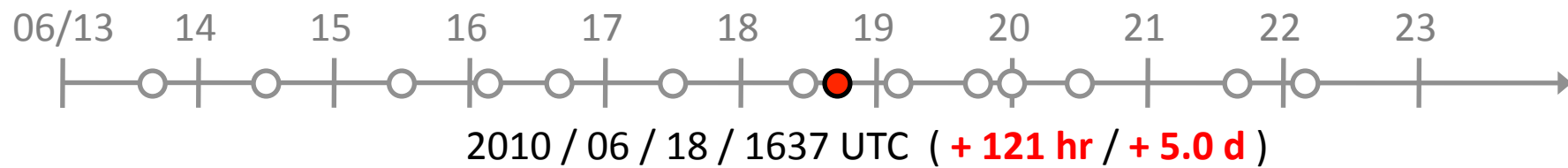


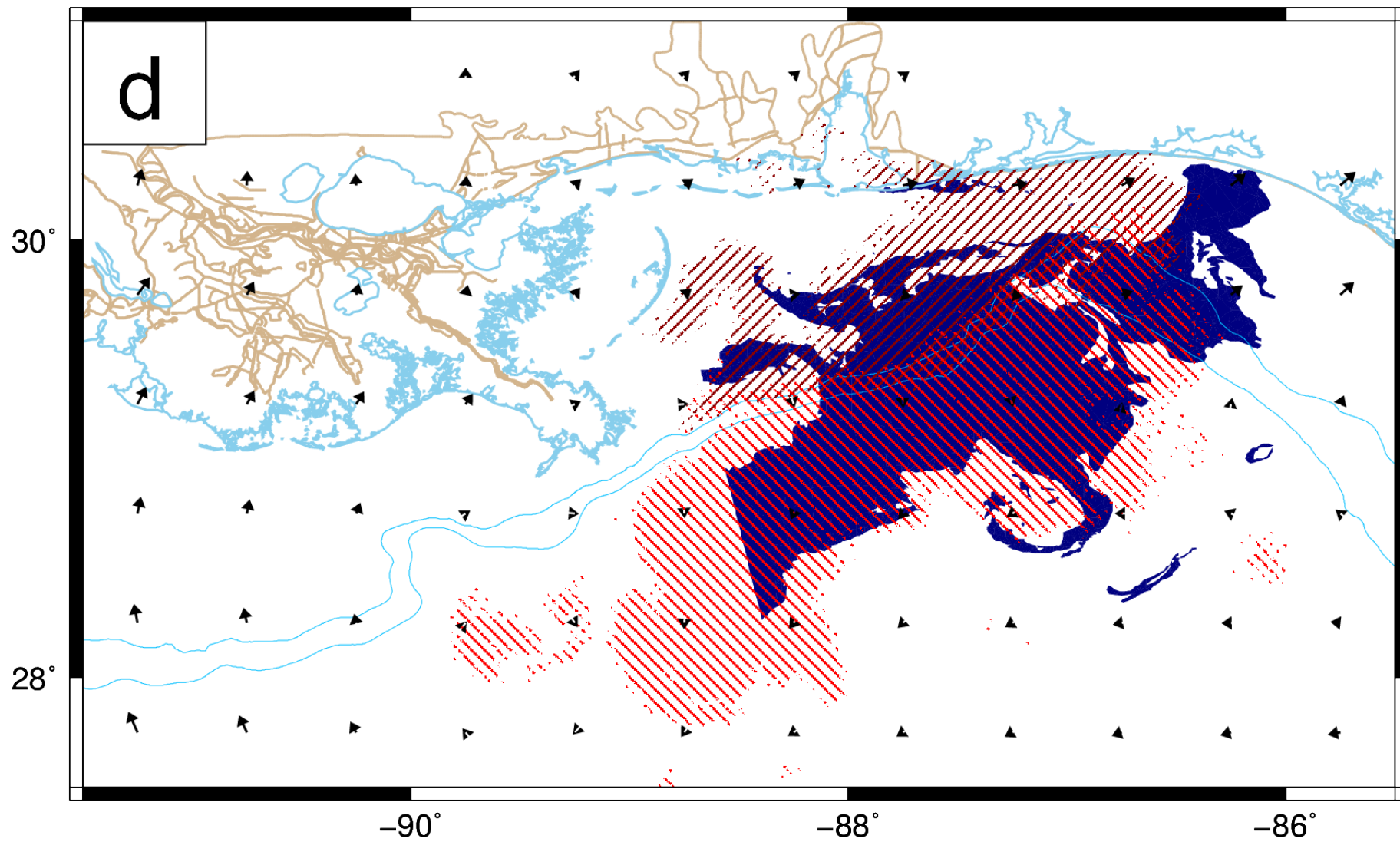
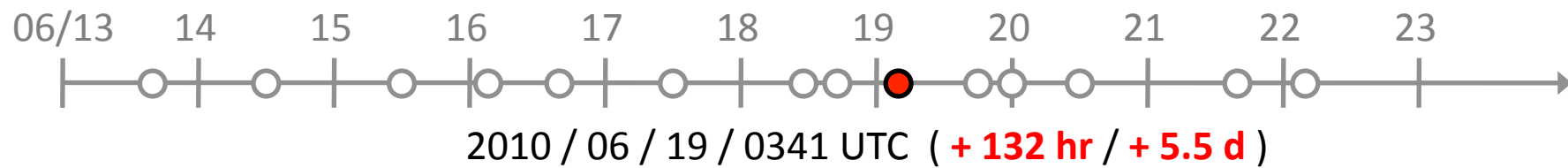
2010 / 06 / 16 / 1555 UTC (+ 72 hr / + 3.0 d)

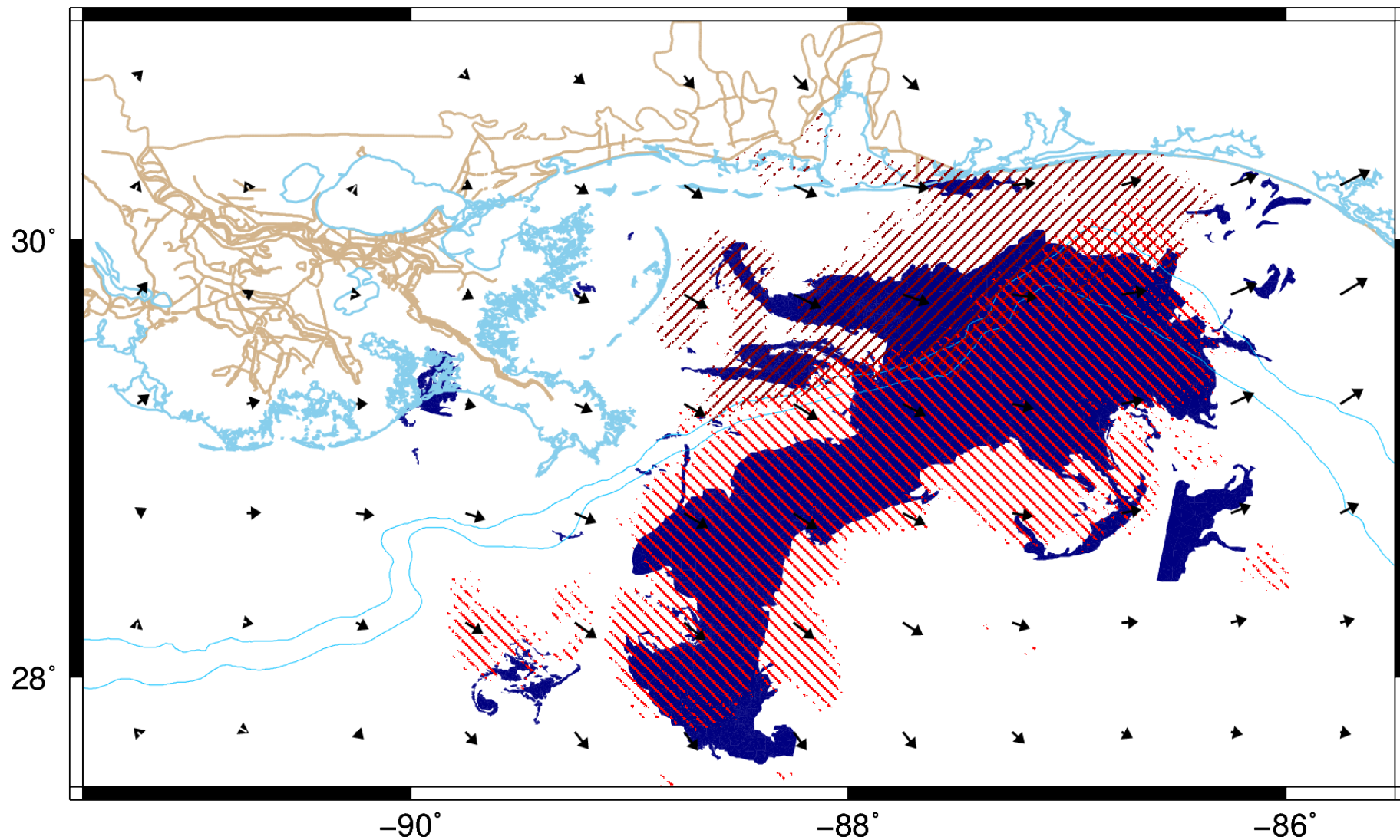
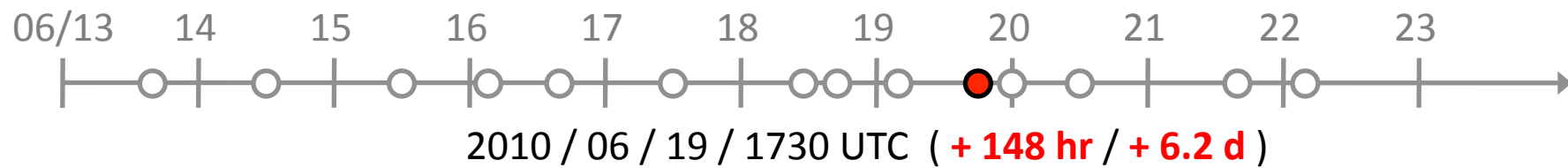


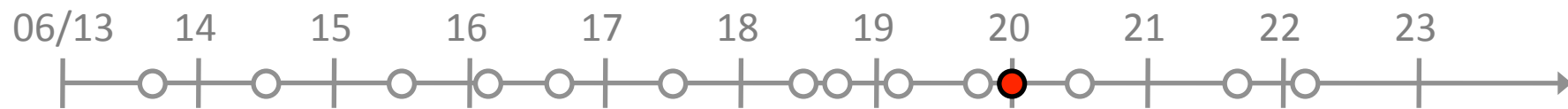




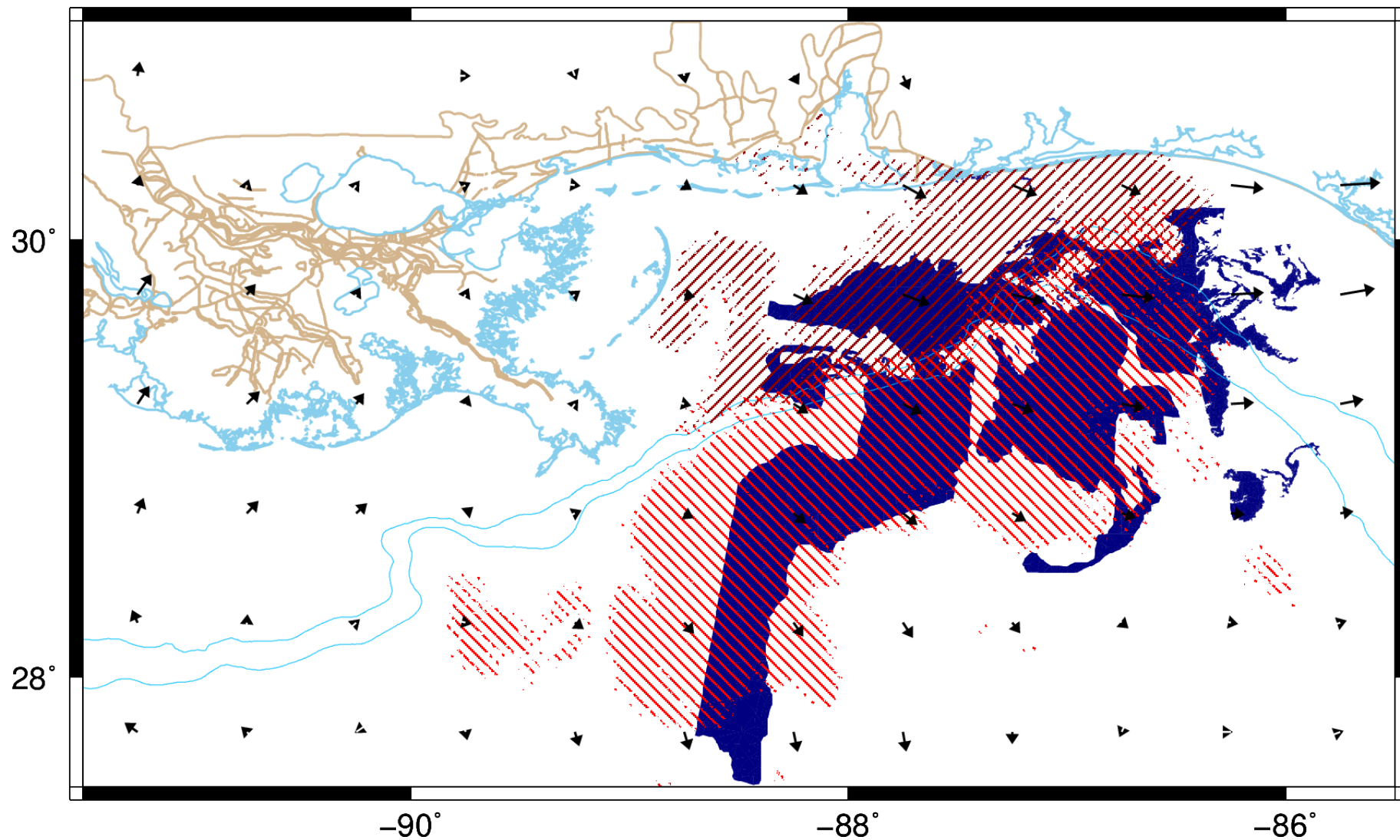


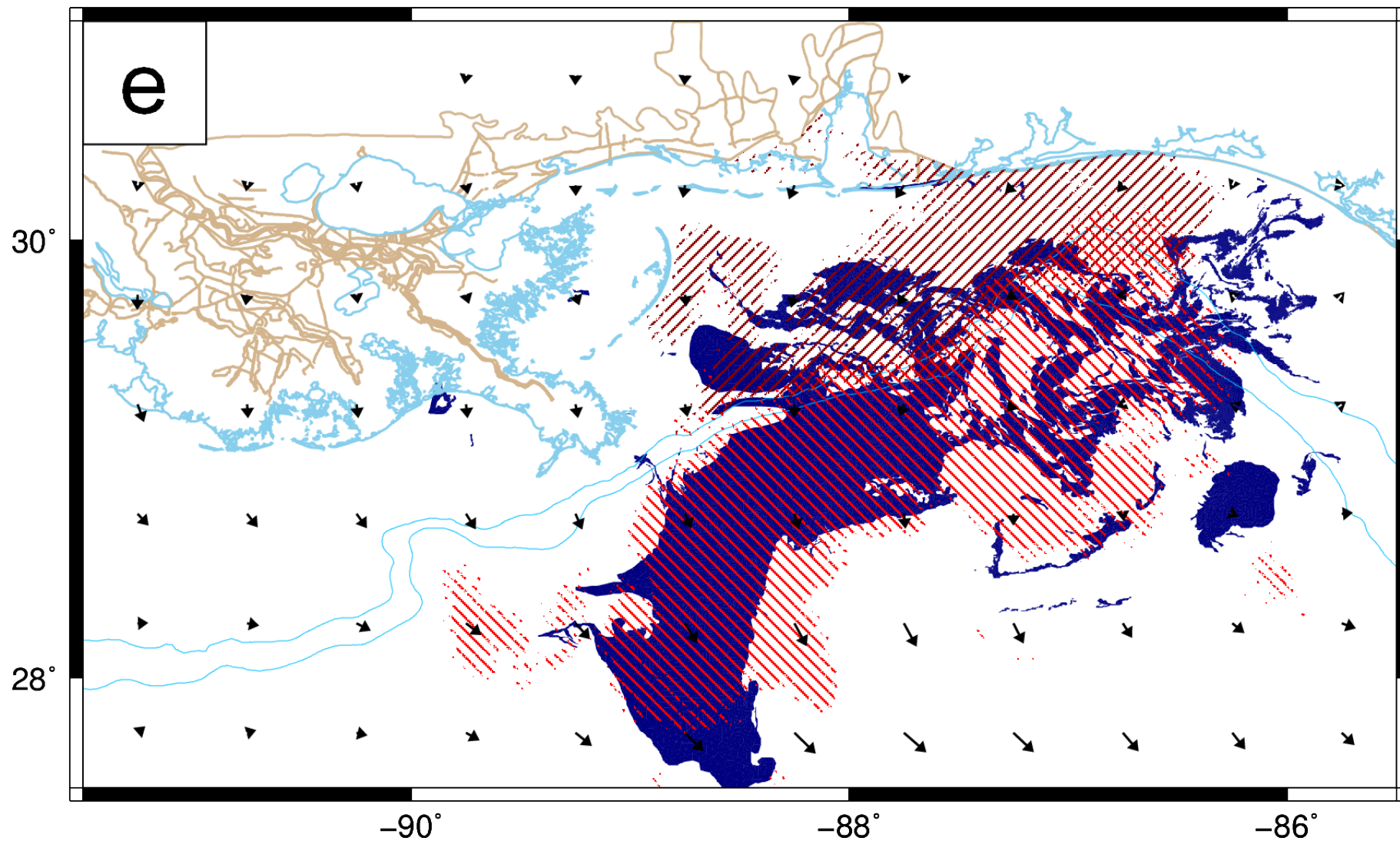
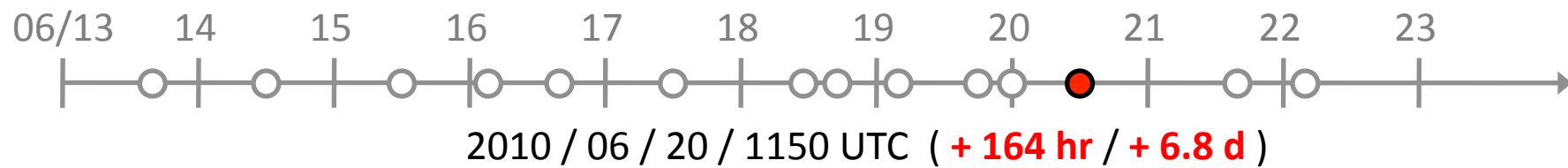


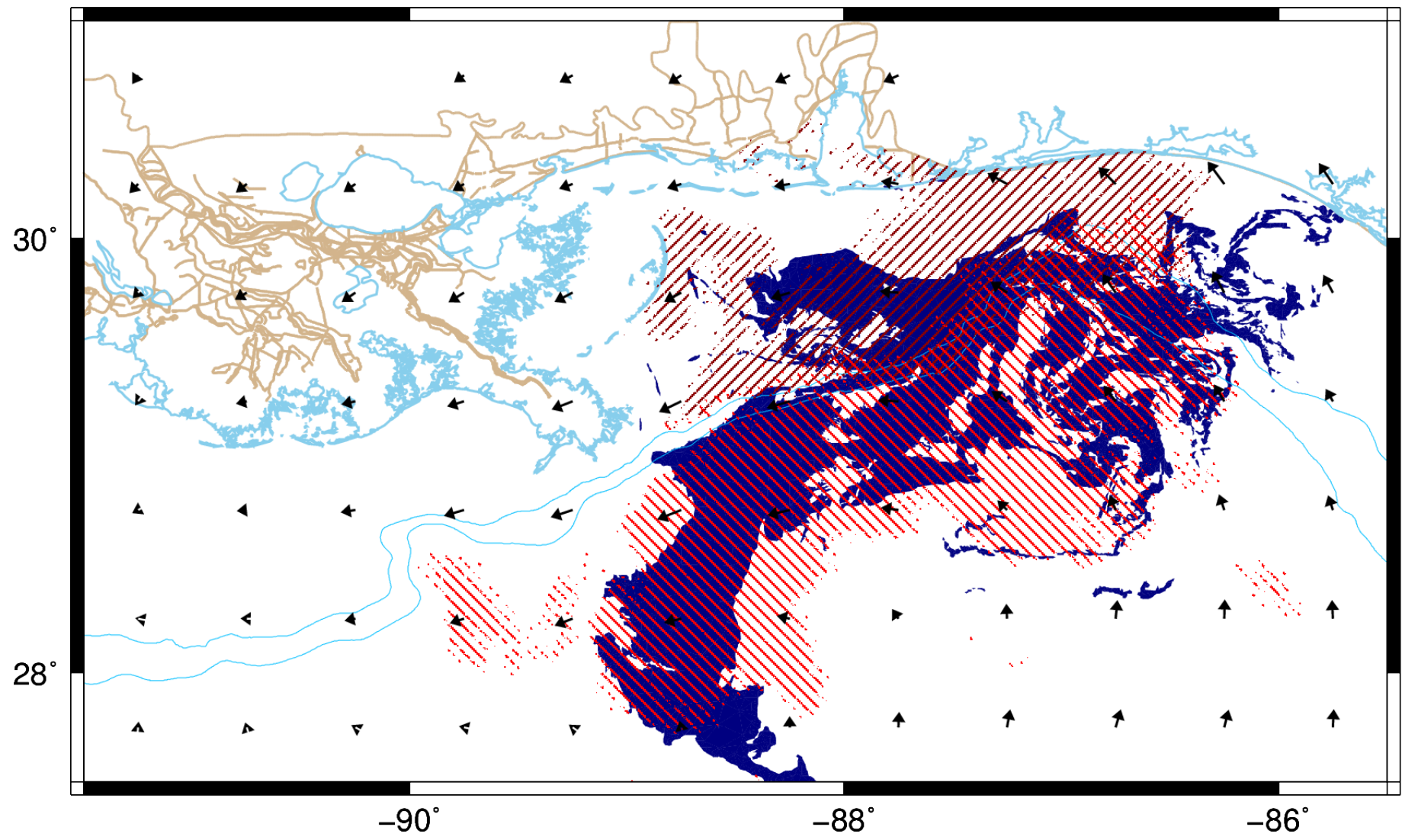
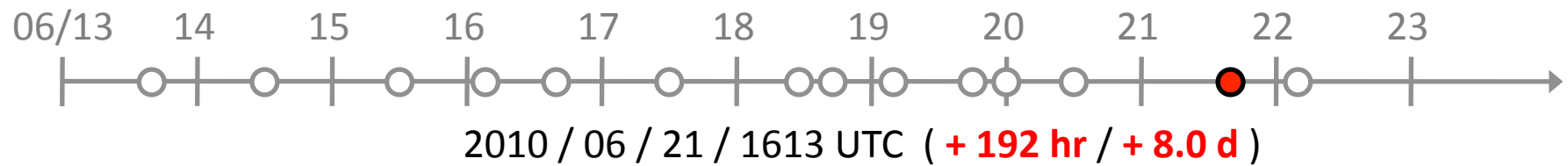


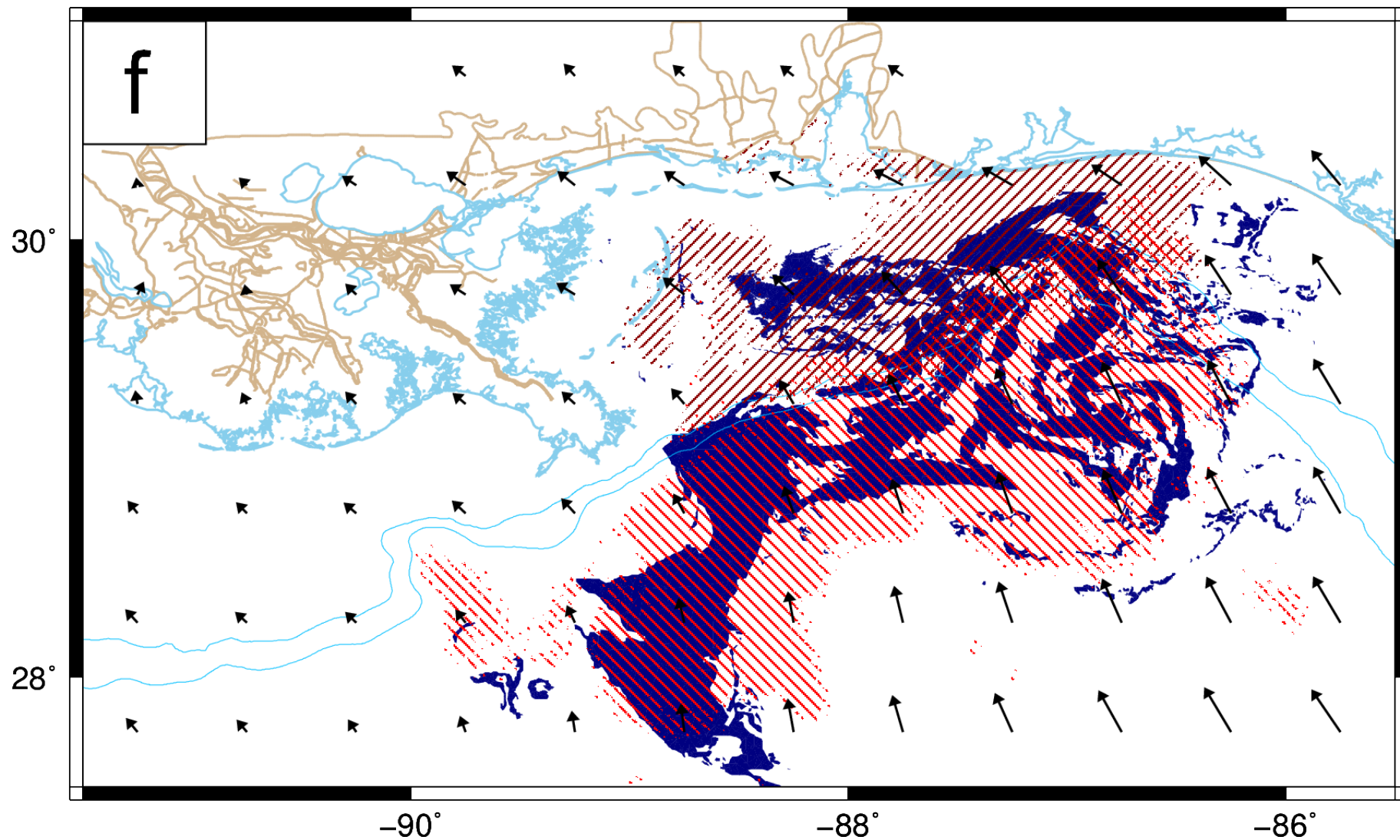
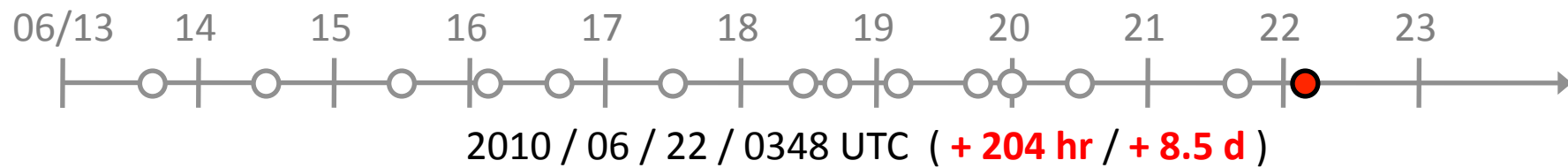


2010 / 06 / 19 / 2330 UTC (+ 152 hr / + 6.3 d)







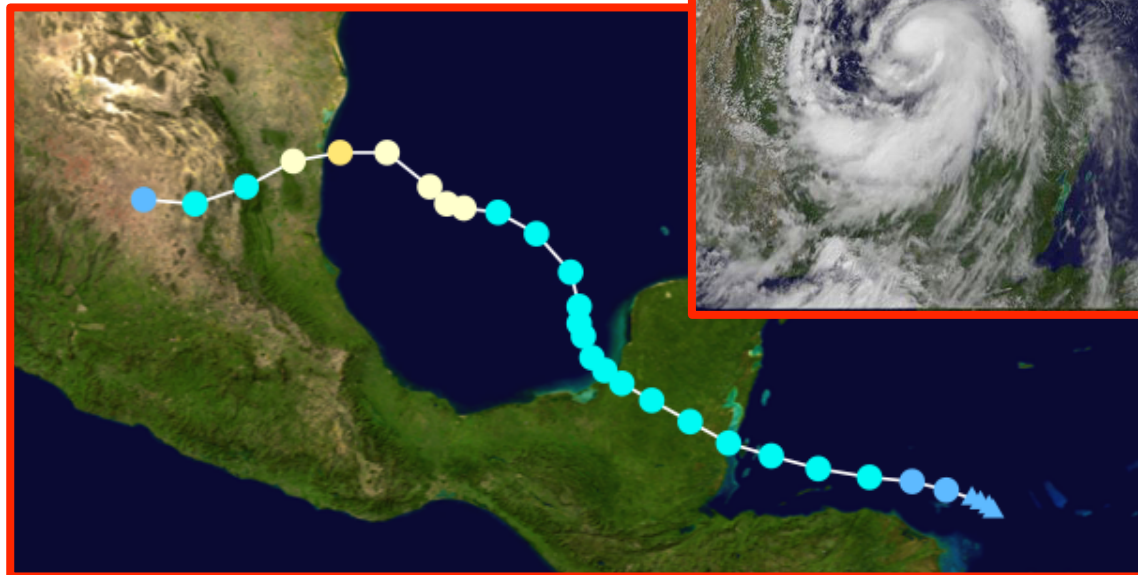
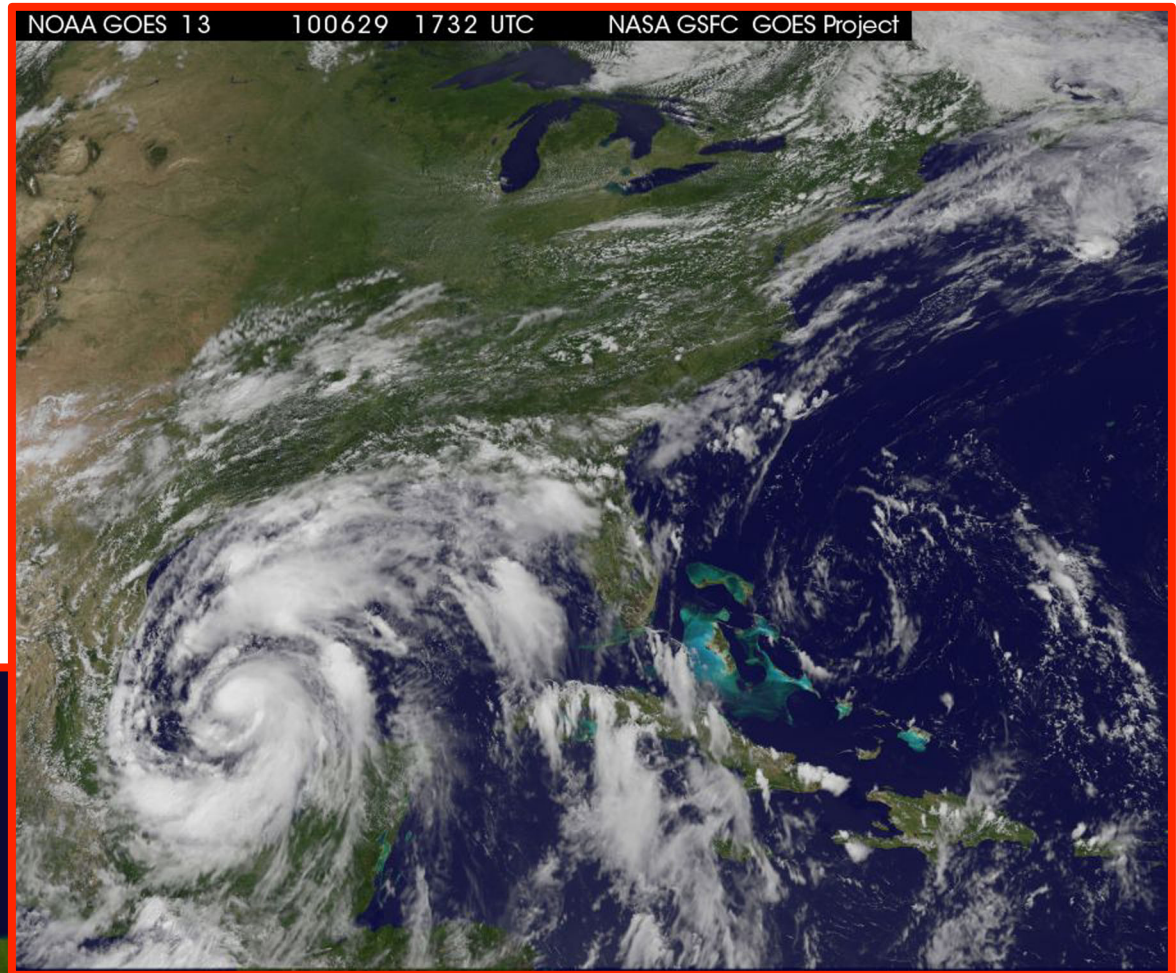


Validation : Hurricane Alex (2010)

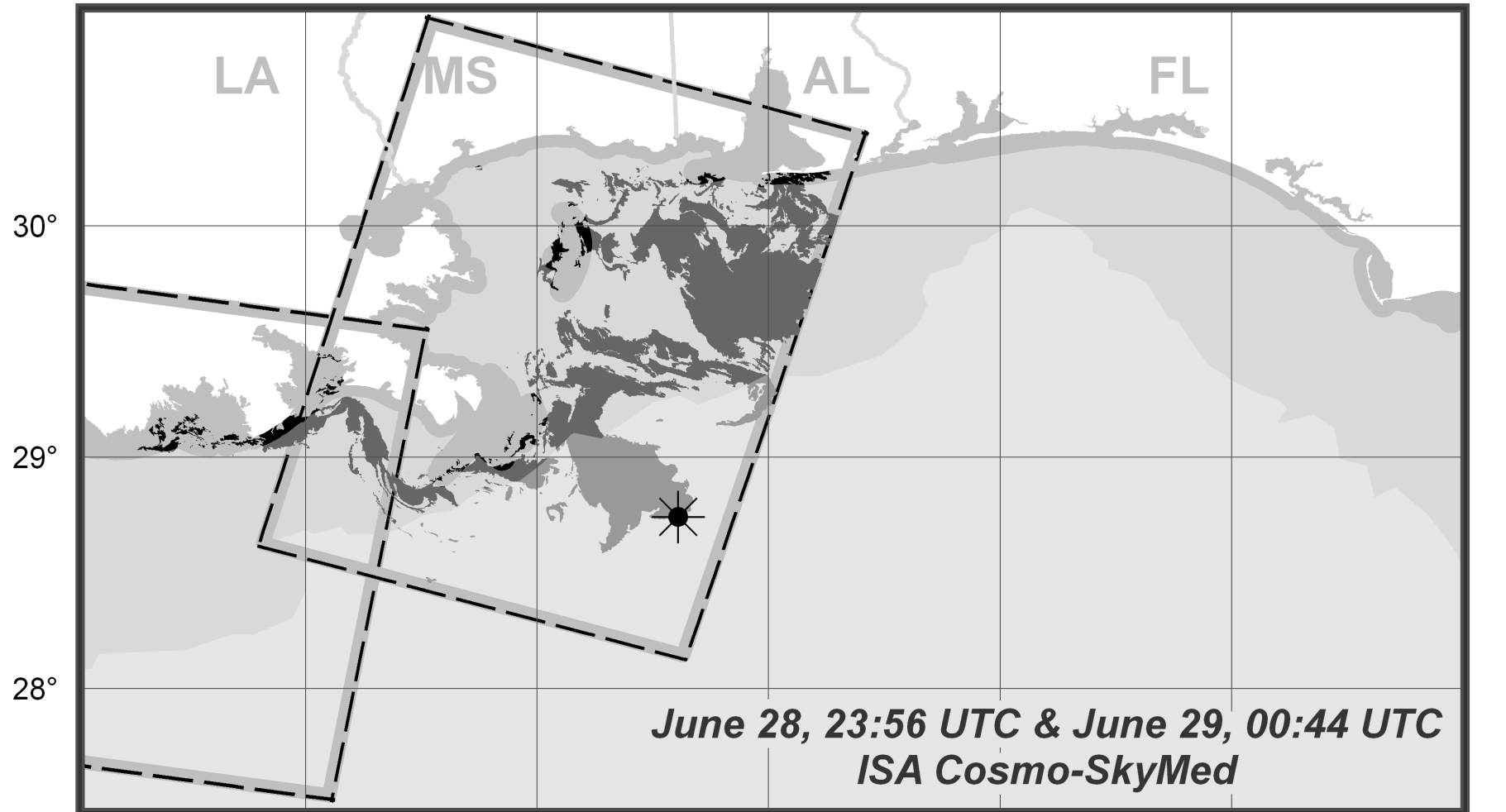
Made initial landfall in Belize and tracked over Yucatan Peninsula

Strengthened in southern Gulf of Mexico to Category 2 storm before making landfall in Mexico

Available overhead imagery was spotty in Gulf



Validation : Hurricane Alex (2010)

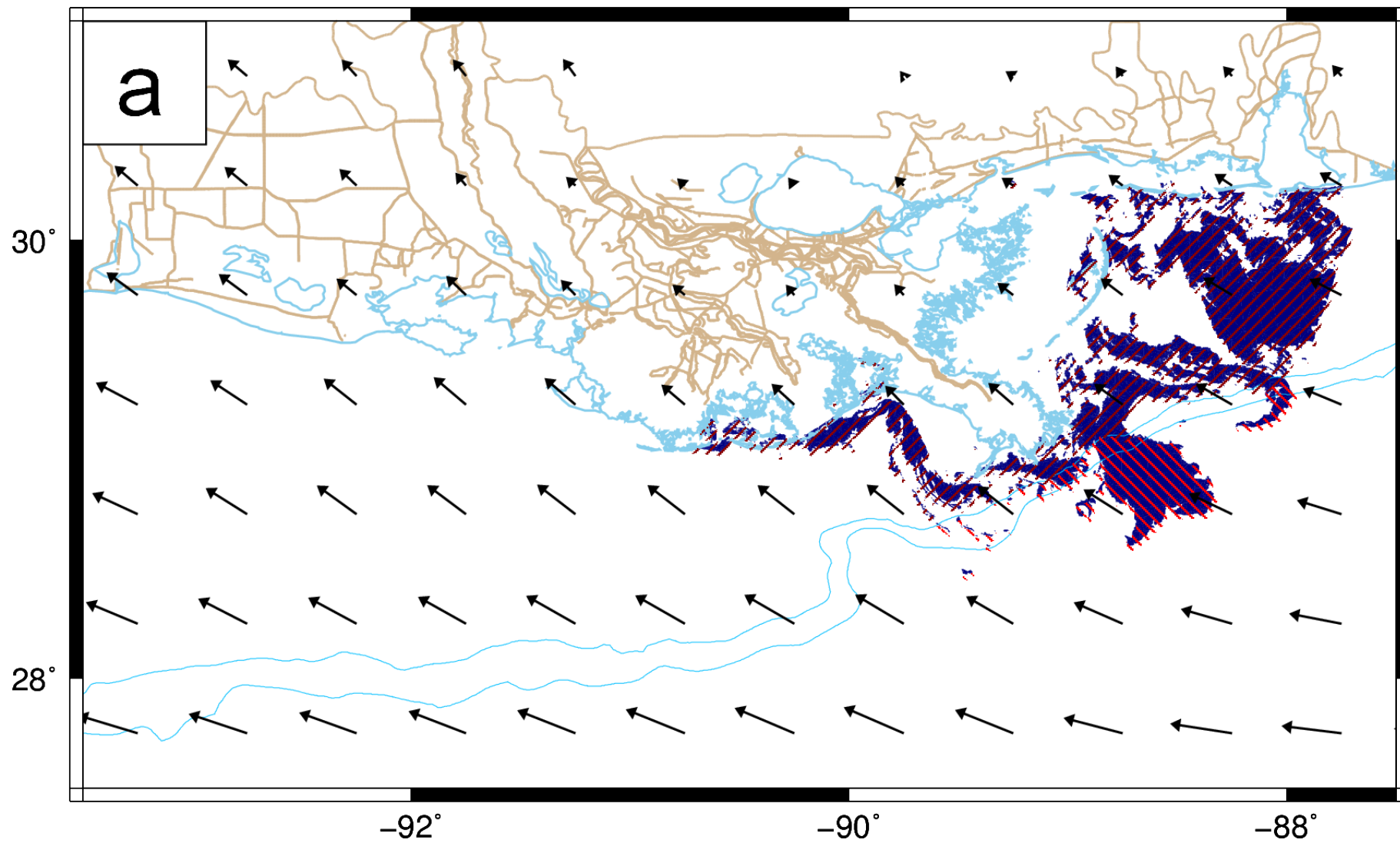
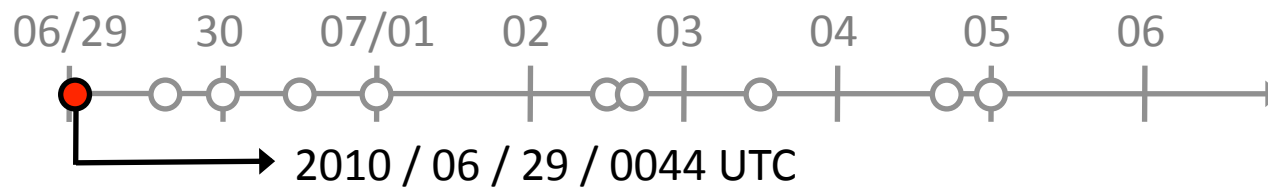


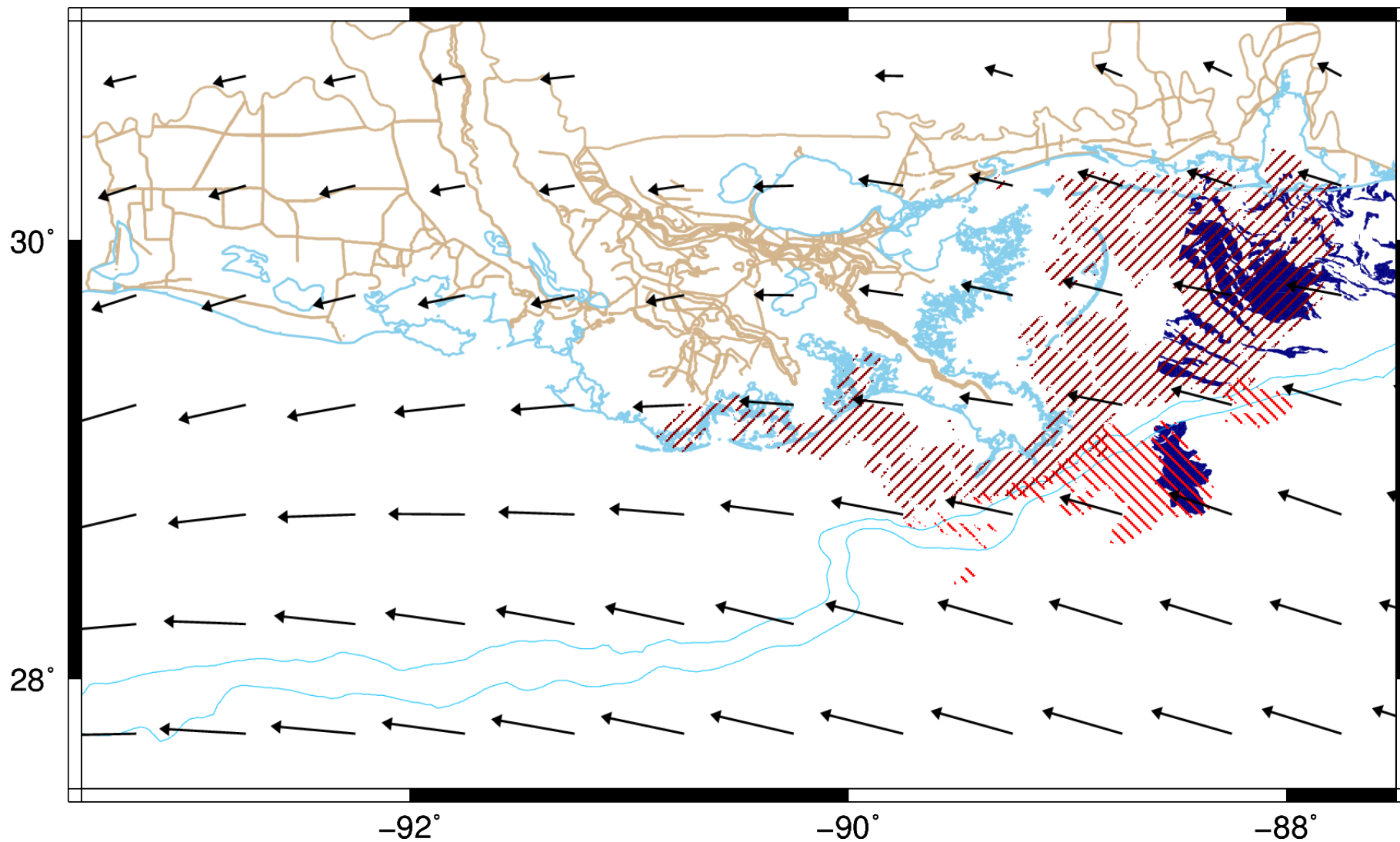
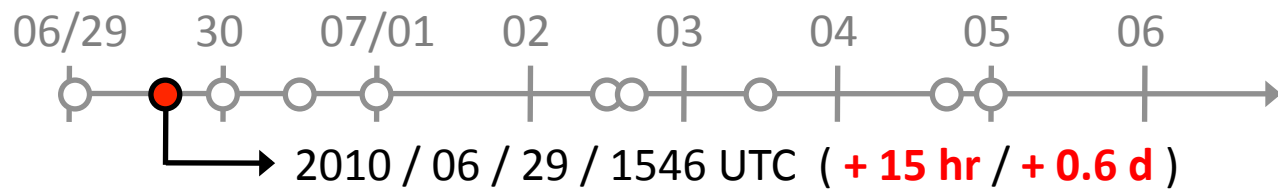
-90° -89° -88° -87° -86° -85°

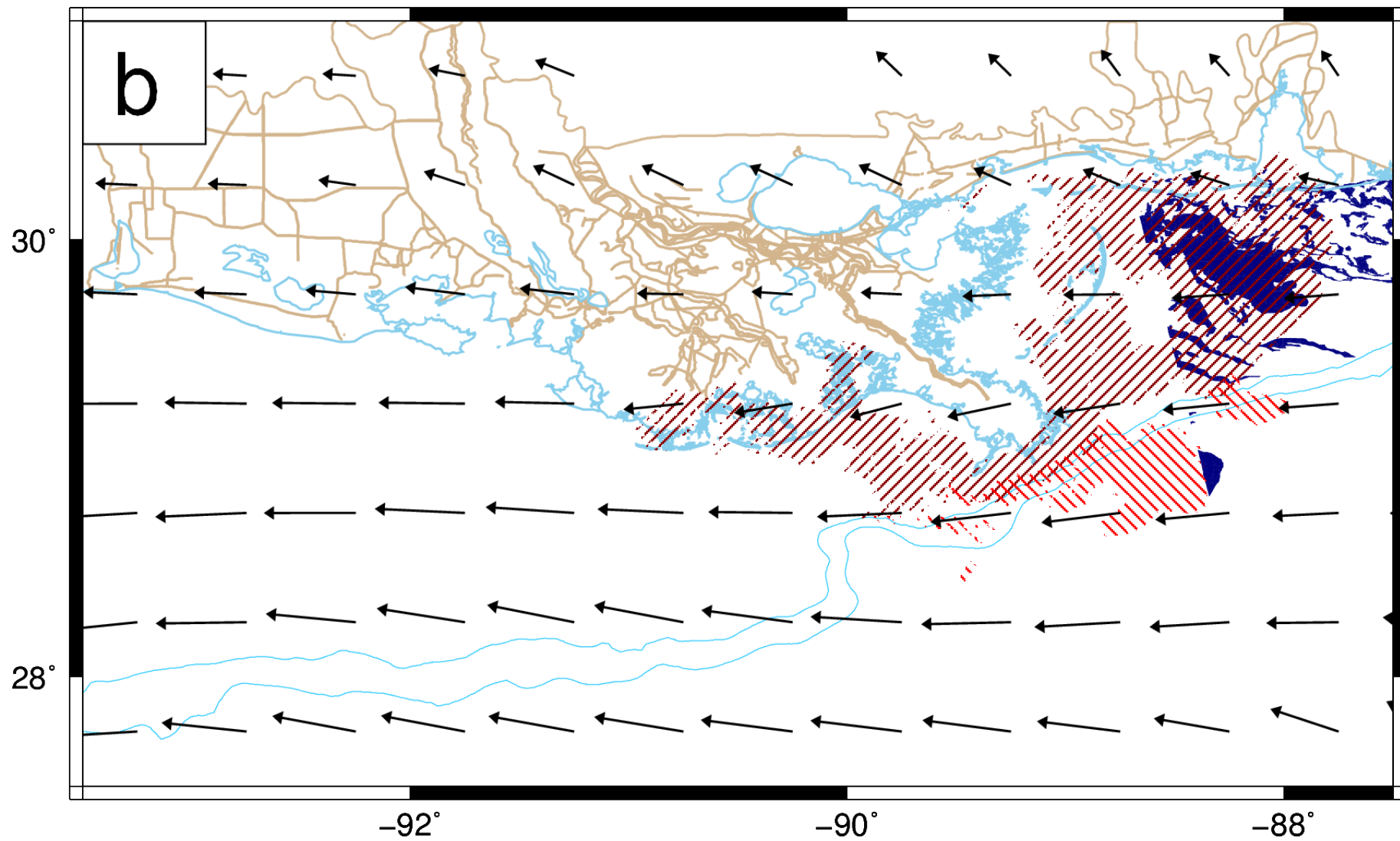
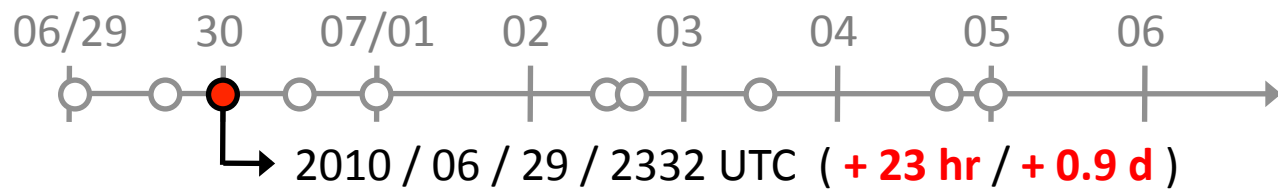
- ☼ Drilling platform
- ▭ Image boundary

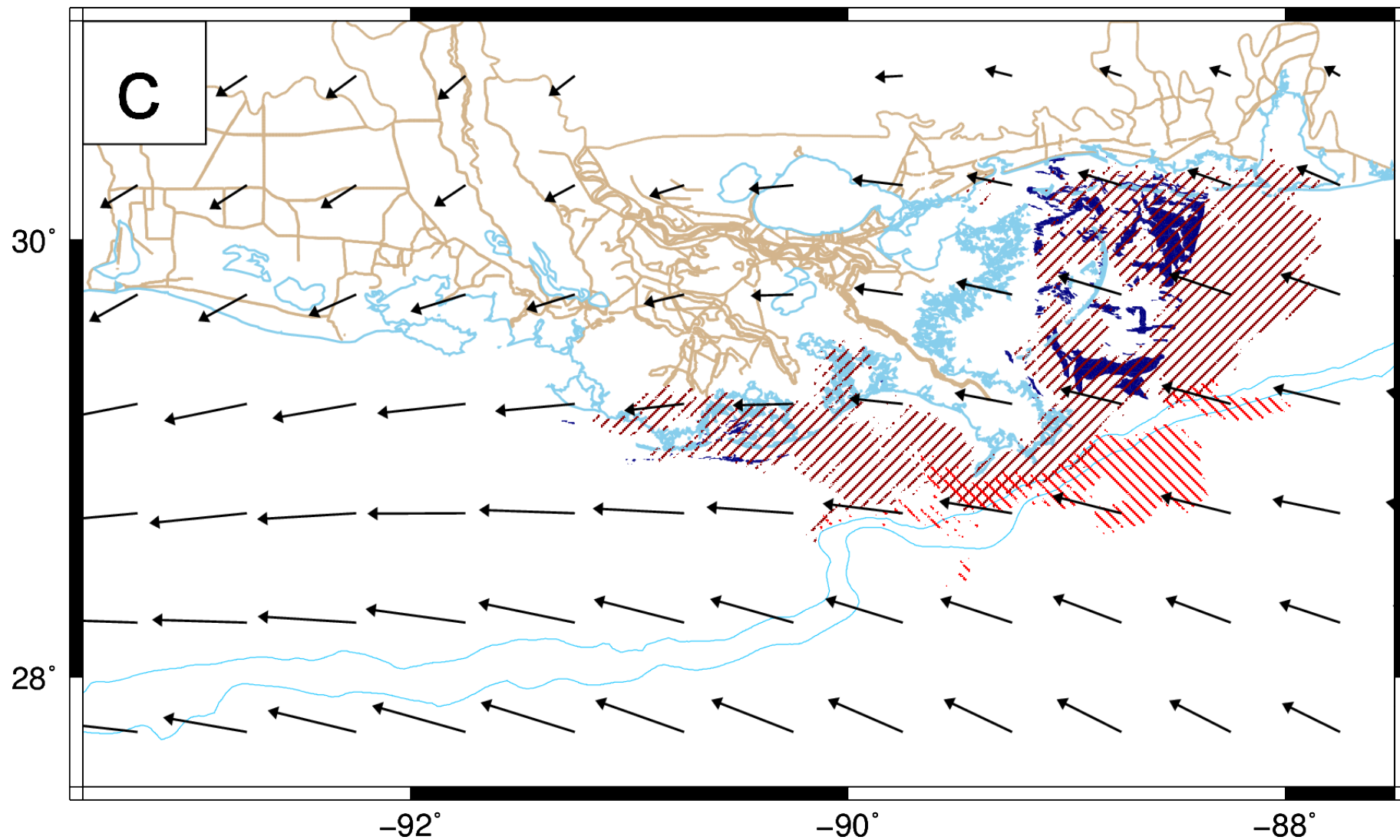
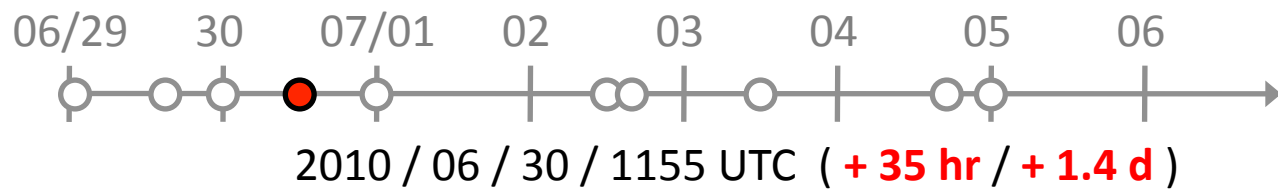
- Surface Oil**
Bathymetry Zone
- Near shore
 - Above continental shelf
 - Above deep water

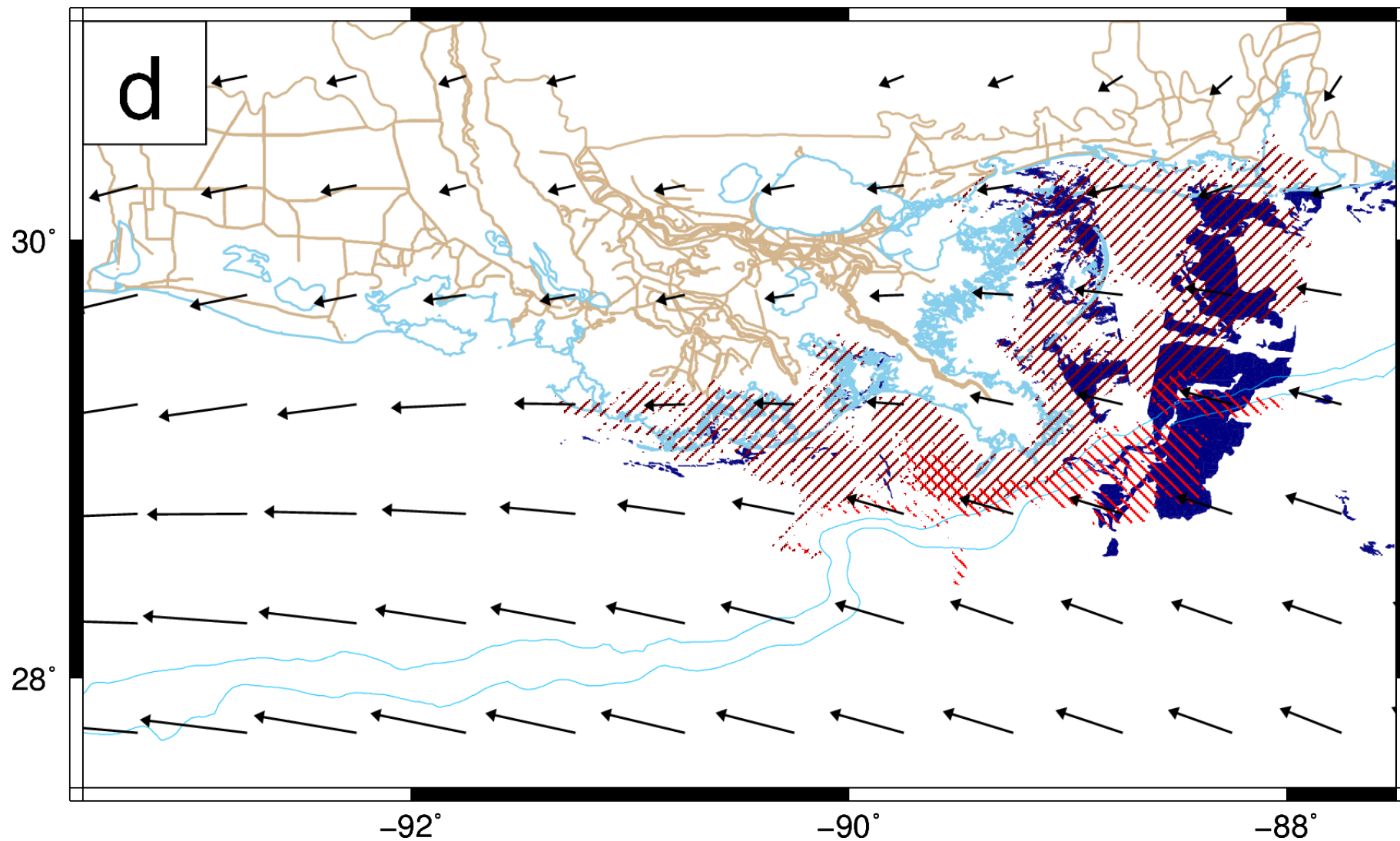
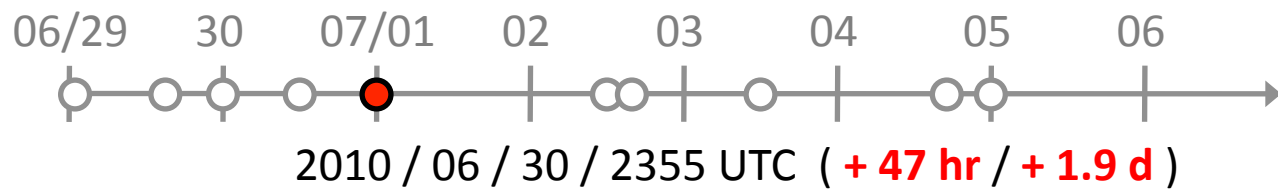
- Gulf of Mexico**
Bathymetry
- within 6 km of shoreline
 - less than 100 m deep
 - more than 100 m deep

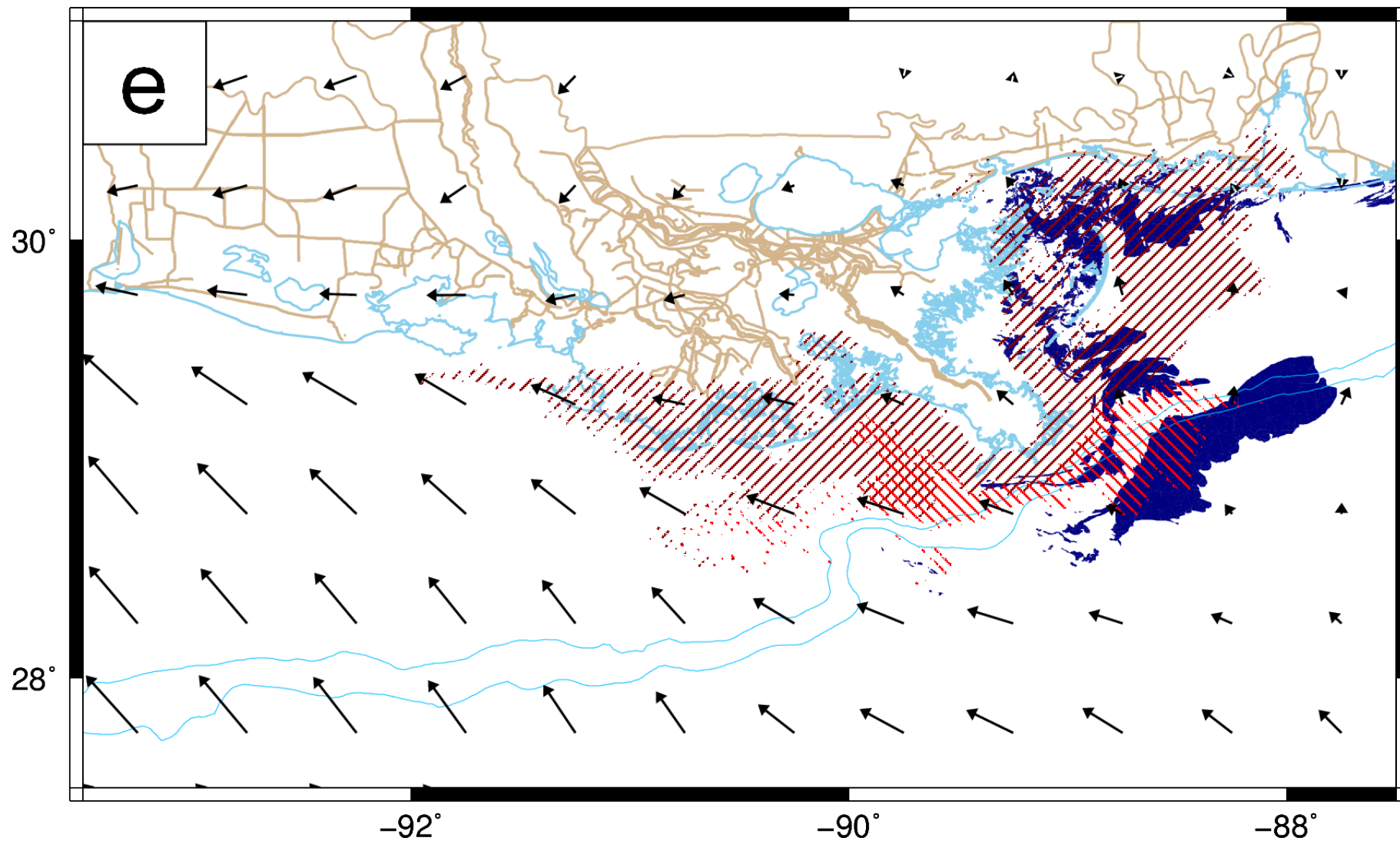
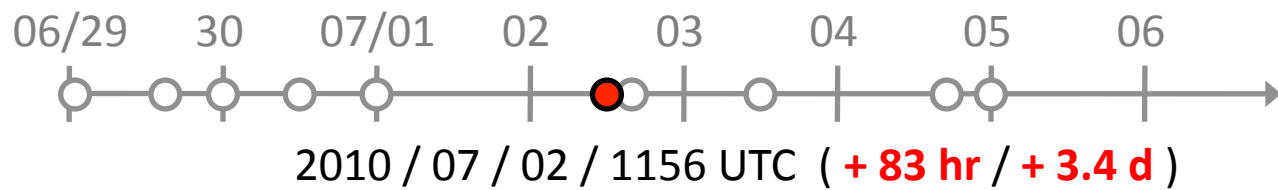


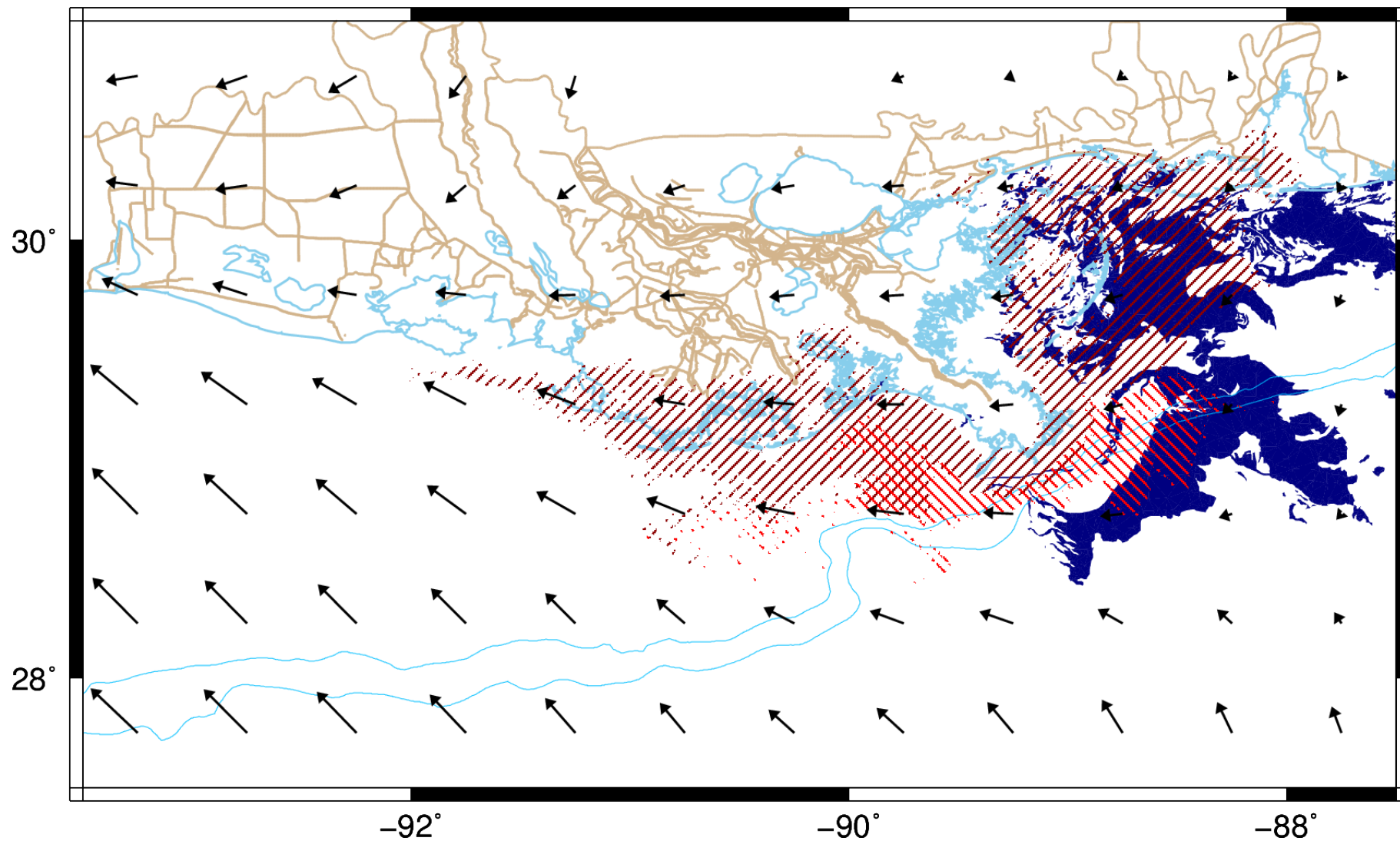
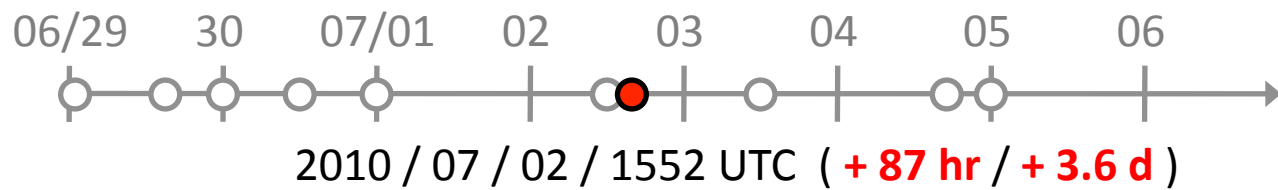


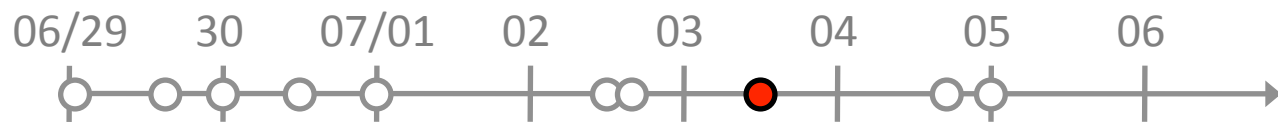




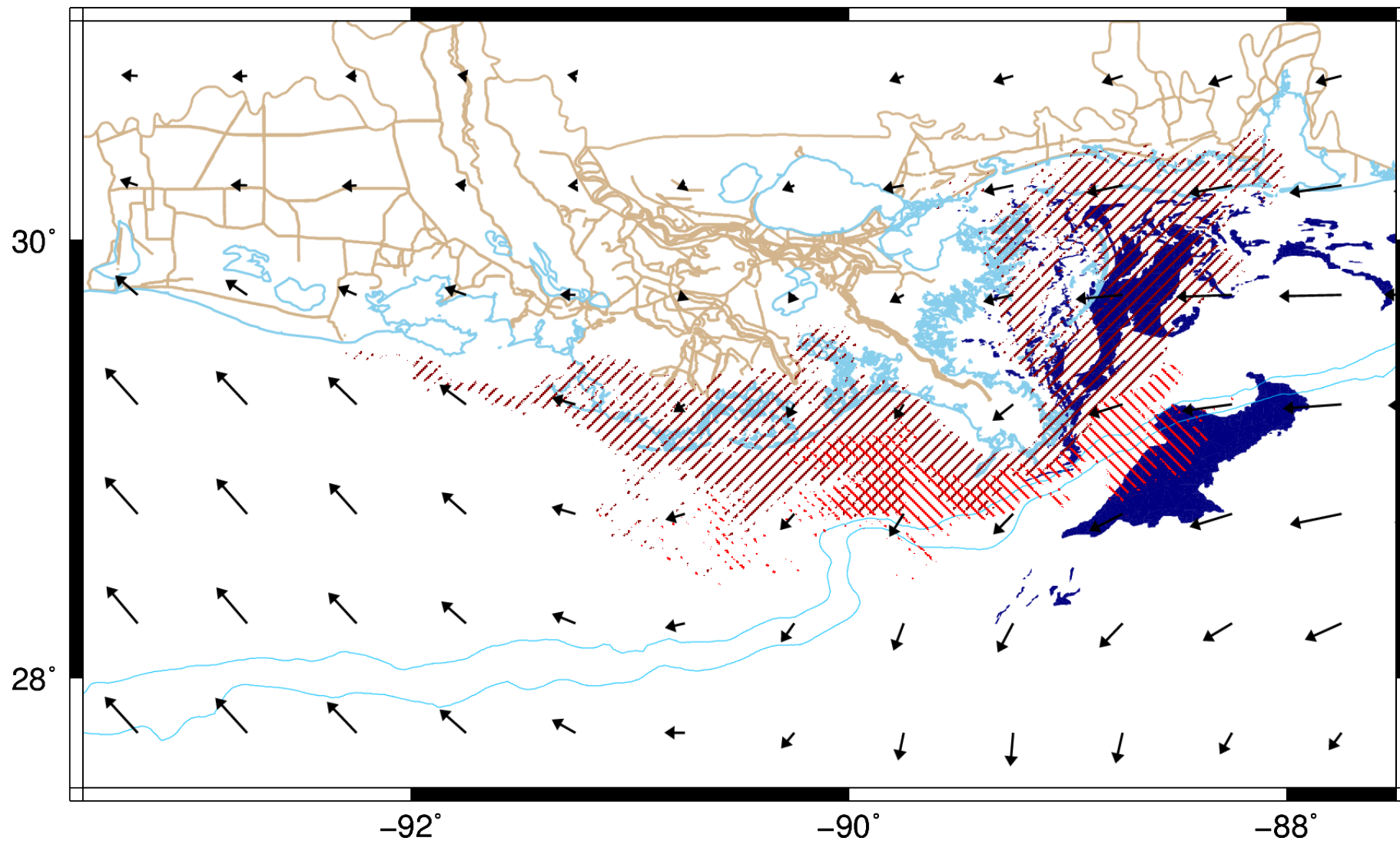


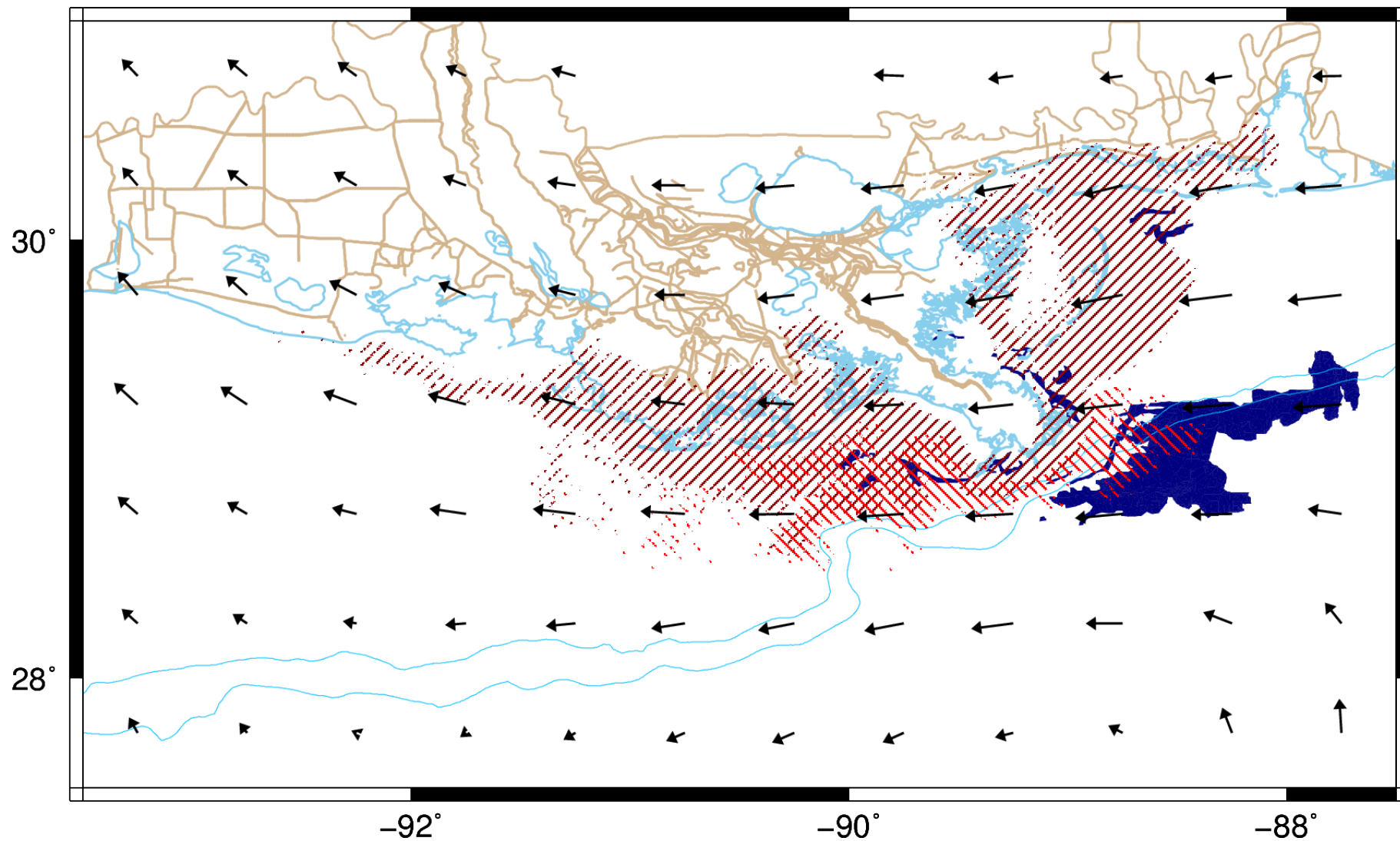
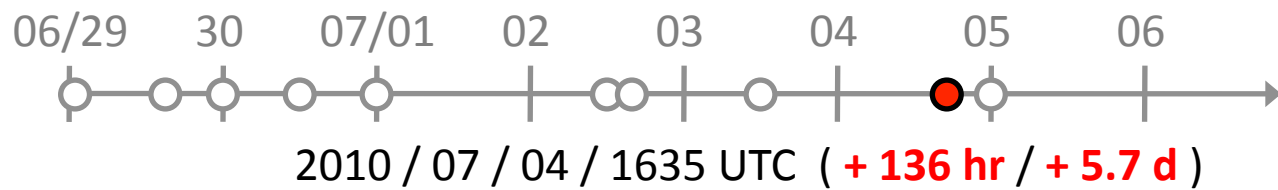


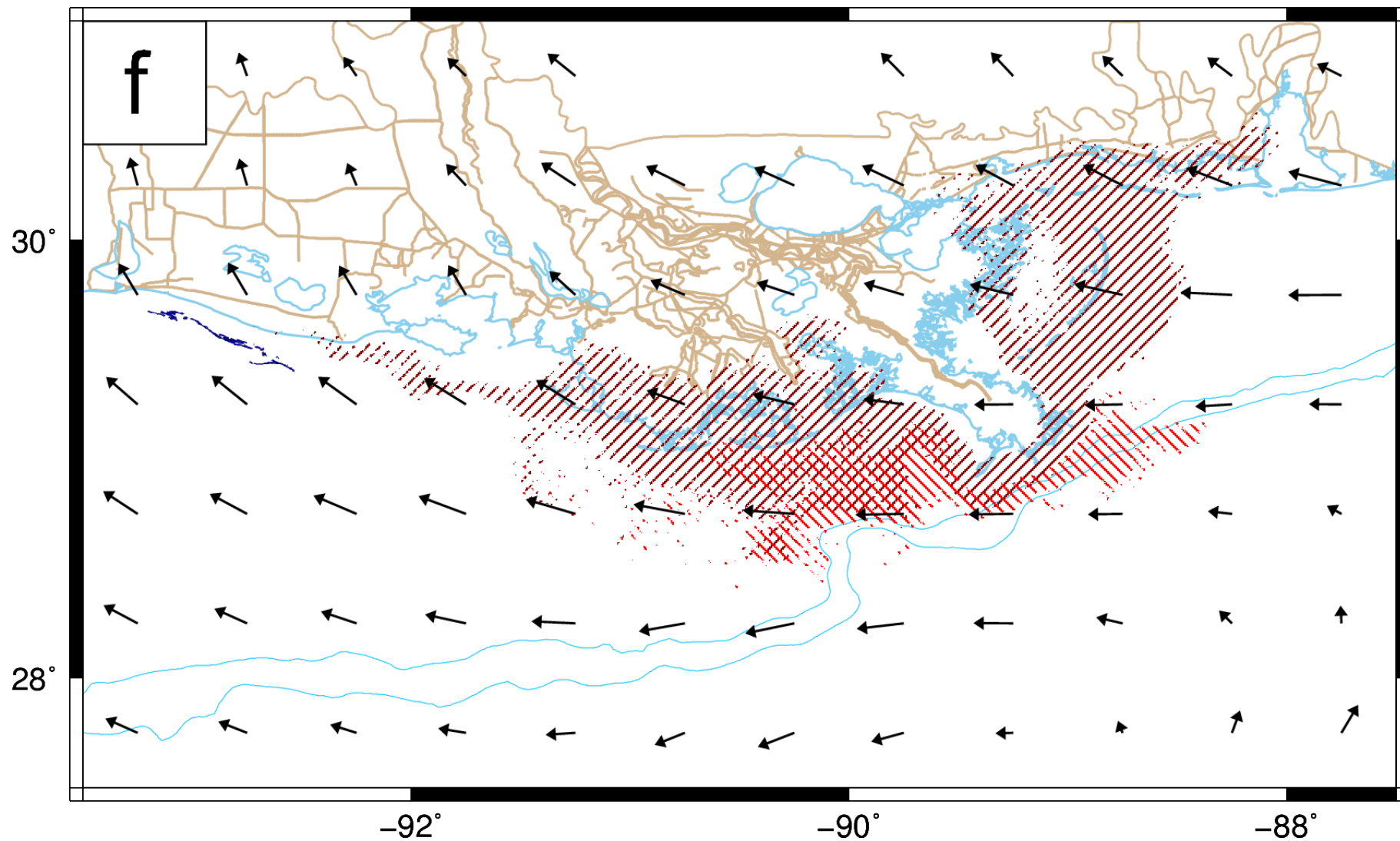
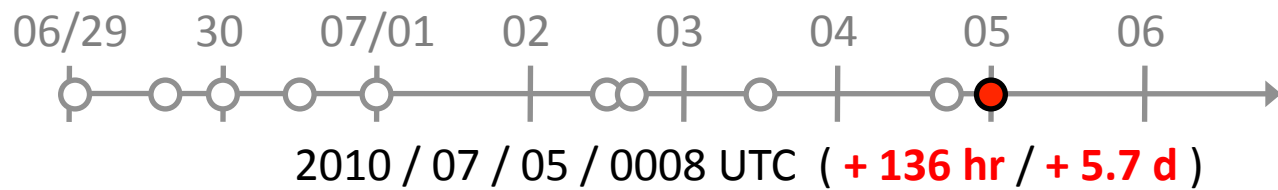




2010 / 07 / 03 / 1156 UTC (+ 107 hr / + 4.4 d)







Conclusions

Automated system runs successfully in real-time

Good match to overall movement of oil spill

- Small-scale features are modeled successfully

Validation is highly sensitive to quality of overhead imagery

Oil would have been influenced heavily by a hurricane in the region

- Movement into marshes of southern Louisiana
- Movement along the coastline toward Texas

