# Surface Trajectories of Oil Transport along the Northern Coastline of the Gulf of Mexico

Joel “Casey” Dietrich, Clint Dawson

**Institute for Computational Engineering and Sciences**

**University of Texas at Austin**

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JC Dietrich, et al. (2012). “Surface Trajectories of Oil Transport along the Northern Coastline of the Gulf of Mexico.” *Continental Shelf Research*, in revision.

# Who Are We?


JC Dietrich, CJ Trahan, CN Dawson

Institute for Computational Engineering and Sciences,

University of Texas at Austin

MT Howard, G Wells

Center for Space Research,

University of Texas at Austin

JG Fleming

Seahorse Coastal Consulting,
Morehead City, North Carolina

RJ Weaver, RA Luettich Jr

Institute of Marine Sciences,

Univ. of North Carolina at Chapel Hill

S Tanaka, JJ Westerink

Dept. of Civil Engineering and Geological Sciences,

University of Notre Dame

L Yu, A Lu

Department of Computer Science,

Univ. of North Carolina at Charlotte

K Vega, A Kubach

Texas Advanced Computing Center,
University of Texas at Austin

KM Dresback, RL Kolar

School of Civil Engineering and Environmental Science,

University of Oklahoma

C Kaiser

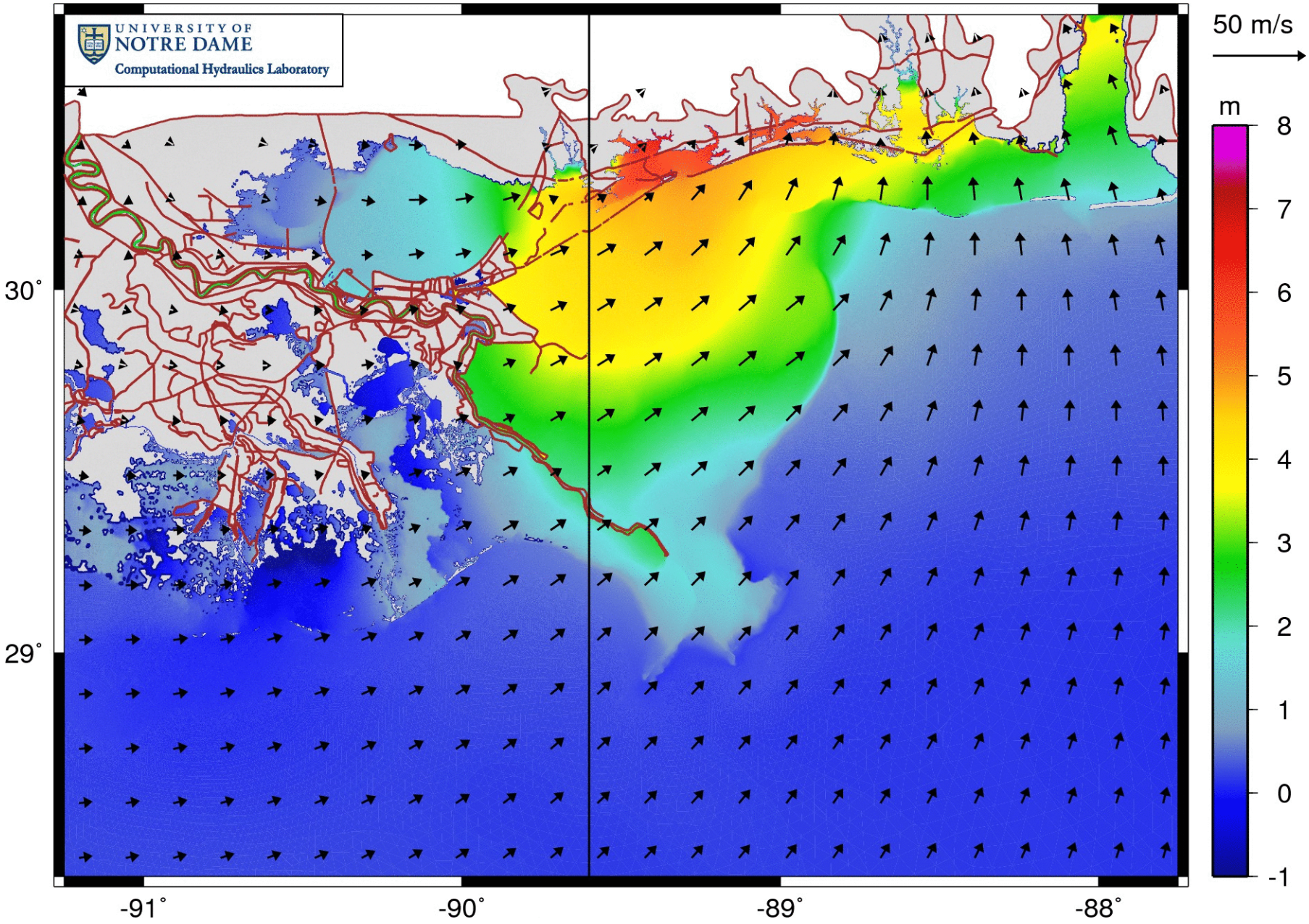
Dept. of Oceanography and Coastal Sciences, Louisiana State University

RR Twilley

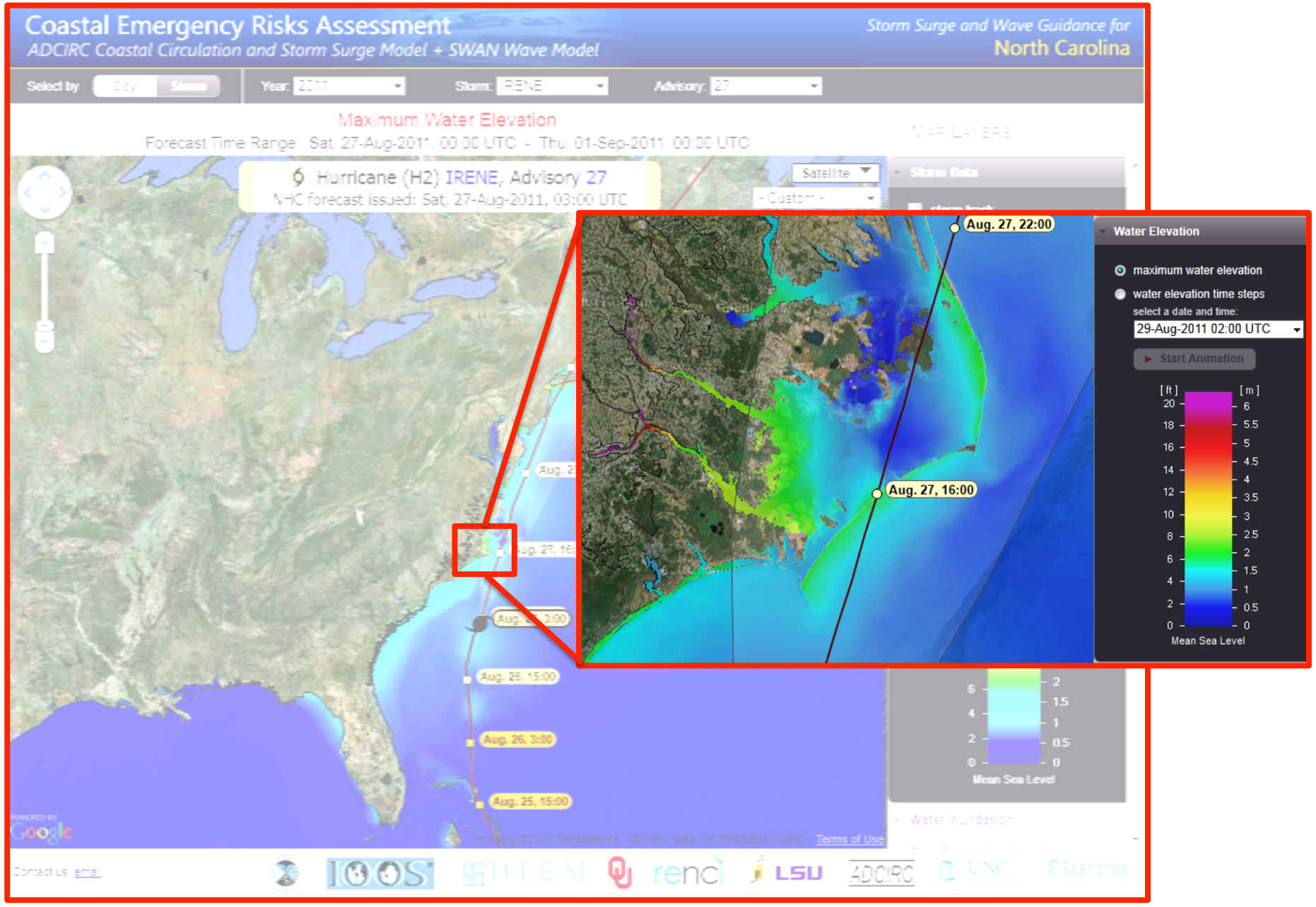
Vice President for Research,

University of Louisiana at Lafayette

# Katrina : Water Levels : Day of Landfall



# Applications : Hurricane Forecasting



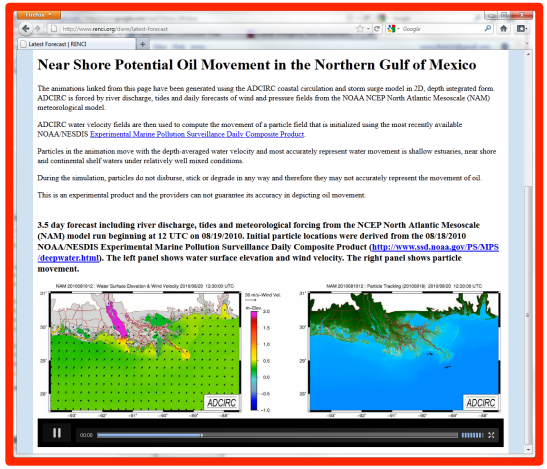
# Nearshore Oil Transport : Motivation

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 : Lagrangian Particles

Particle positions are tracked through the unstructured mesh:

$$\vec{x}_p(t+\Delta t) = \vec{x}_p(t) + \vec{u}\left(\vec{x}_p, t\right)\Delta t + \vec{D}$$

- where the dispersion uses a stochastic perturbation (Proctor et al., 1994):

$$\vec{D} = (2R-1)\sqrt{\vec{c}\vec{E}_v \Delta t}$$

- with: $0 < R < 1$ is a random number,

$\vec{E}_v = 10$ m²/s are turbulent coefficients, and

$\vec{c} = 12$ are scaling coefficients;

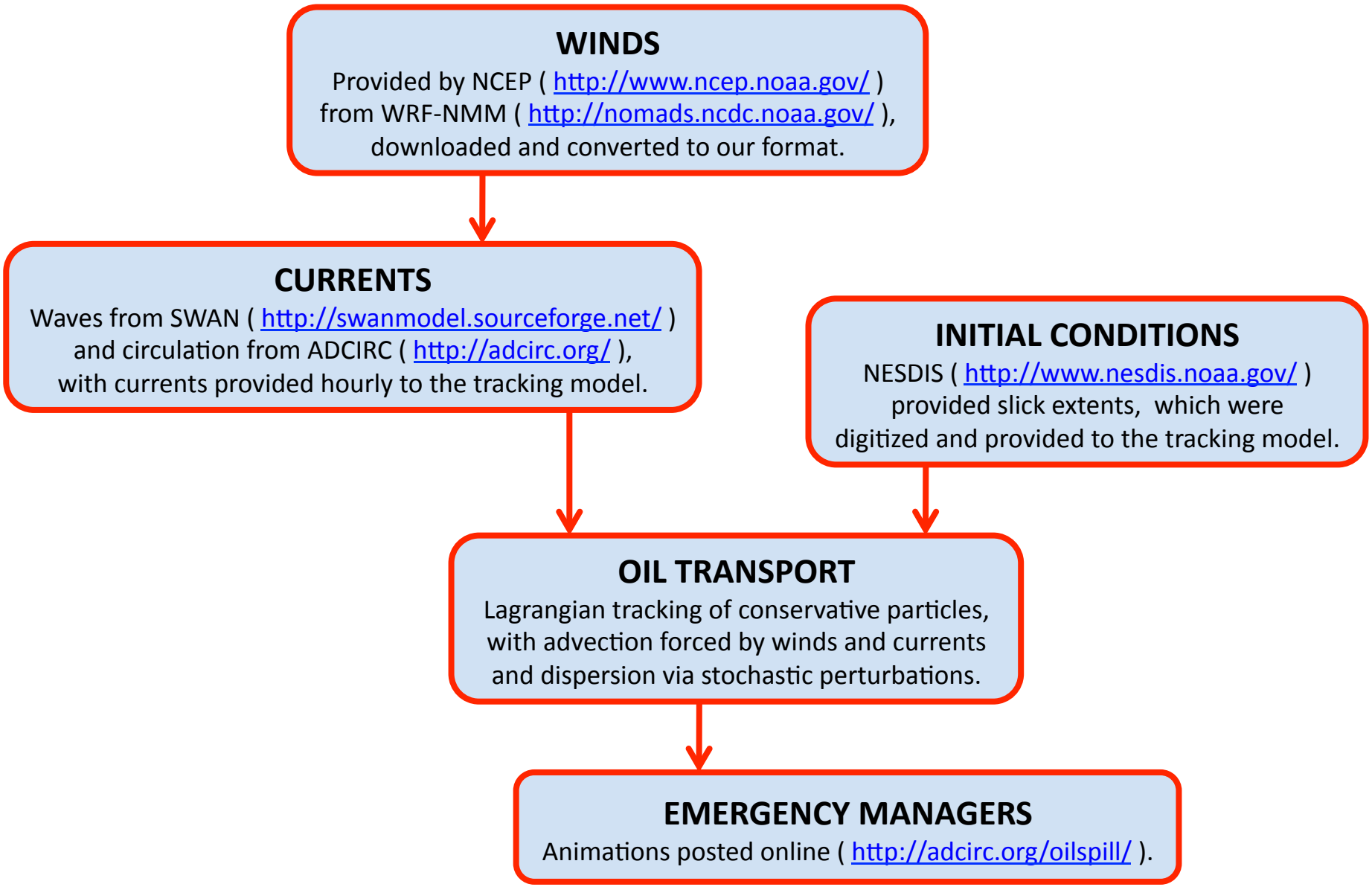
- and where the velocities are the currents from ADCIRC.

Using hybrid OpenMP/MPI, 11M particles can be tracked on a 10M-element mesh in about **5.5 min/day** using 256 cores on TACC Ranger.

Again, there are limitations:

- Tracking model does not account for source at the wellhead or sinks due to biological and chemical processes.
- Transport only along water surface due to depth-averaged currents.

# Nearshore Oil Transport : Flow Chart



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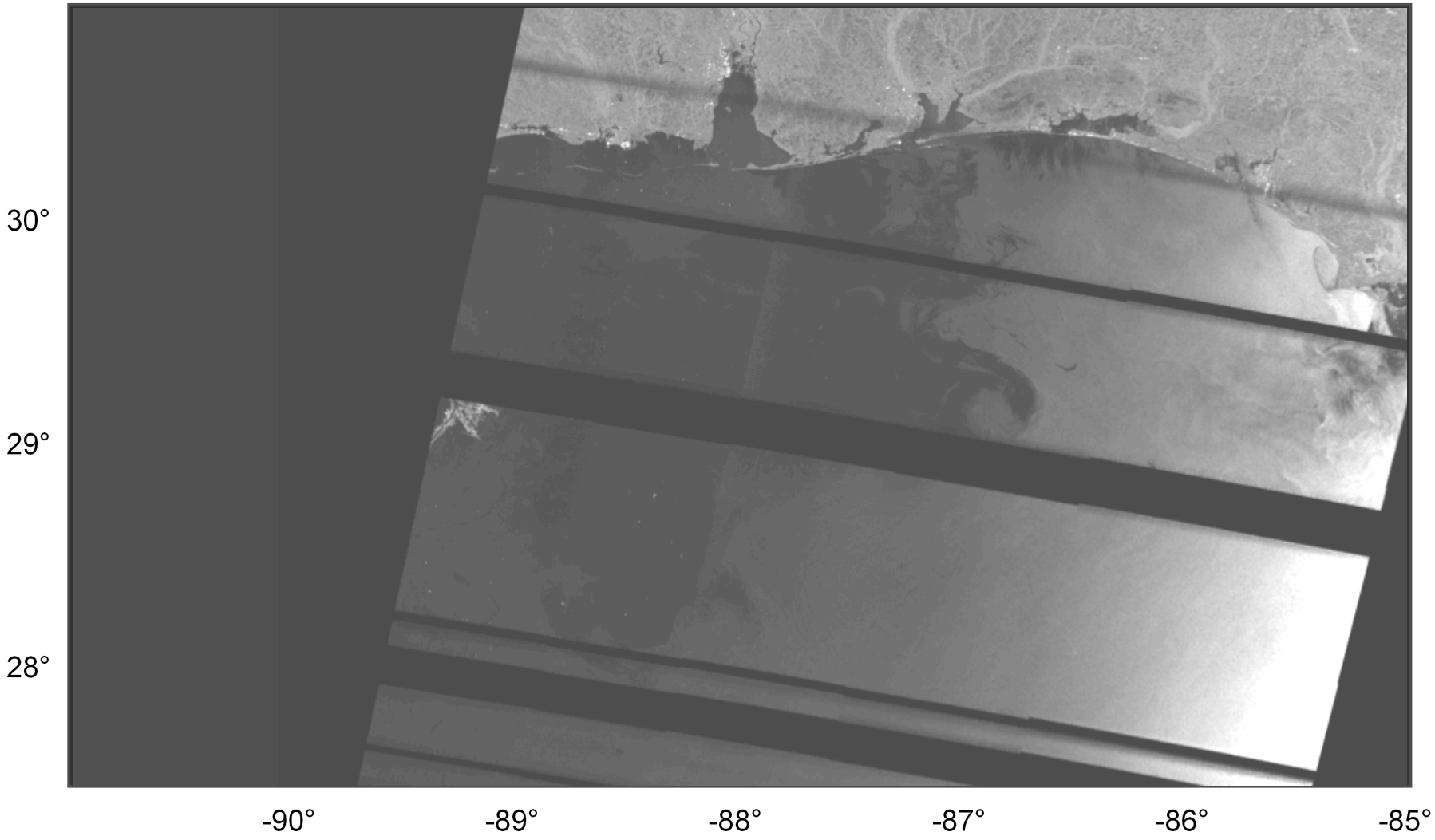

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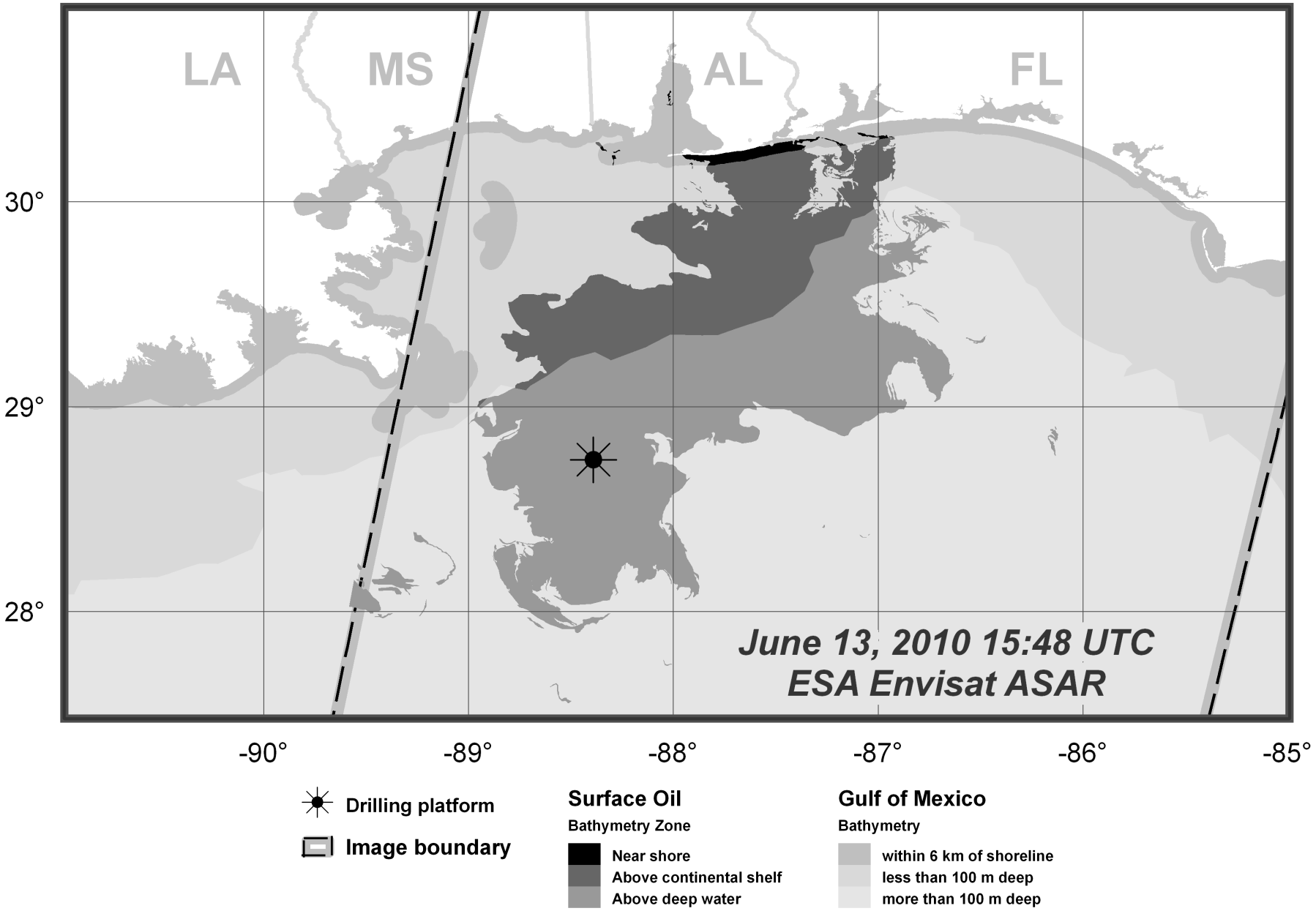

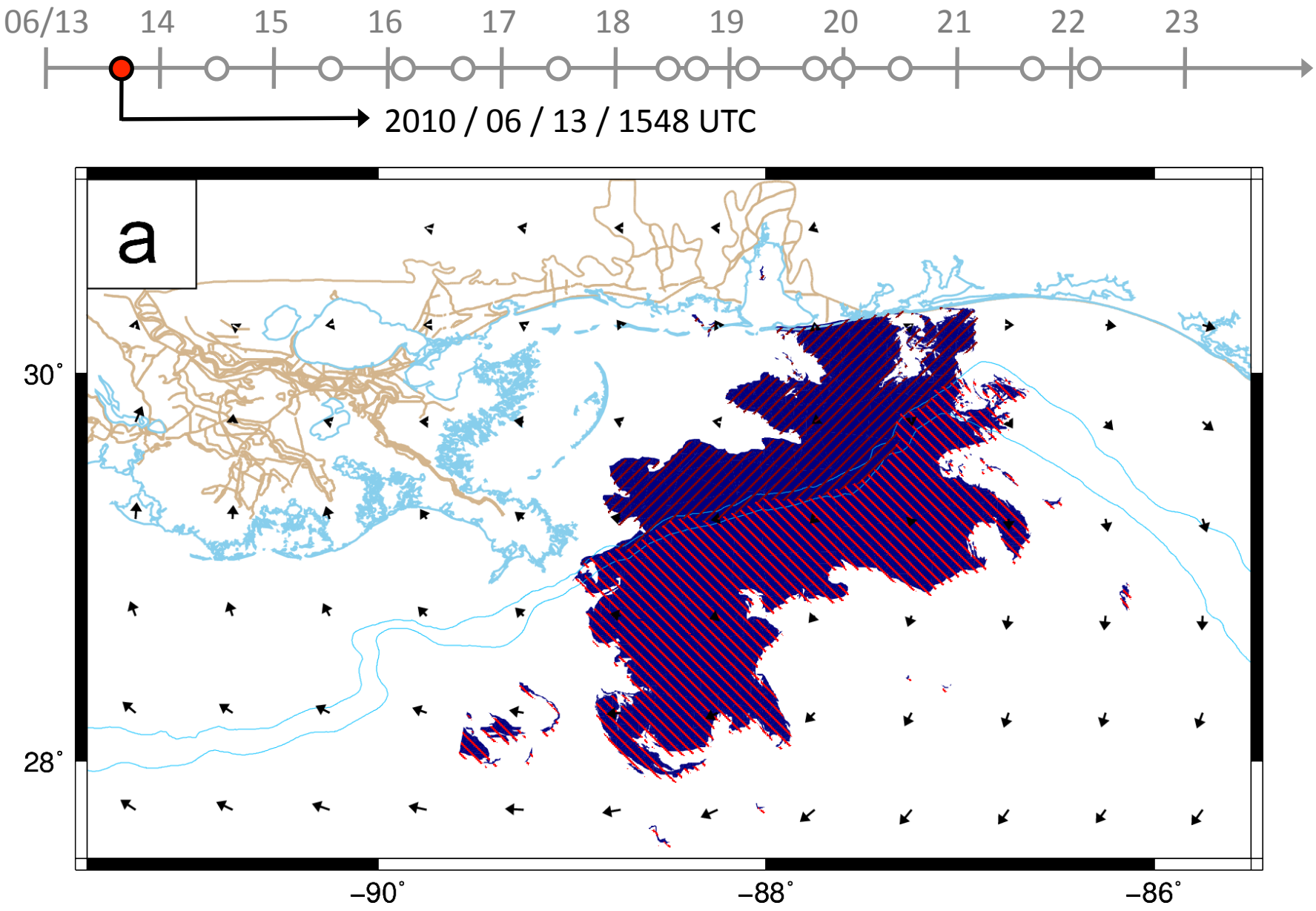
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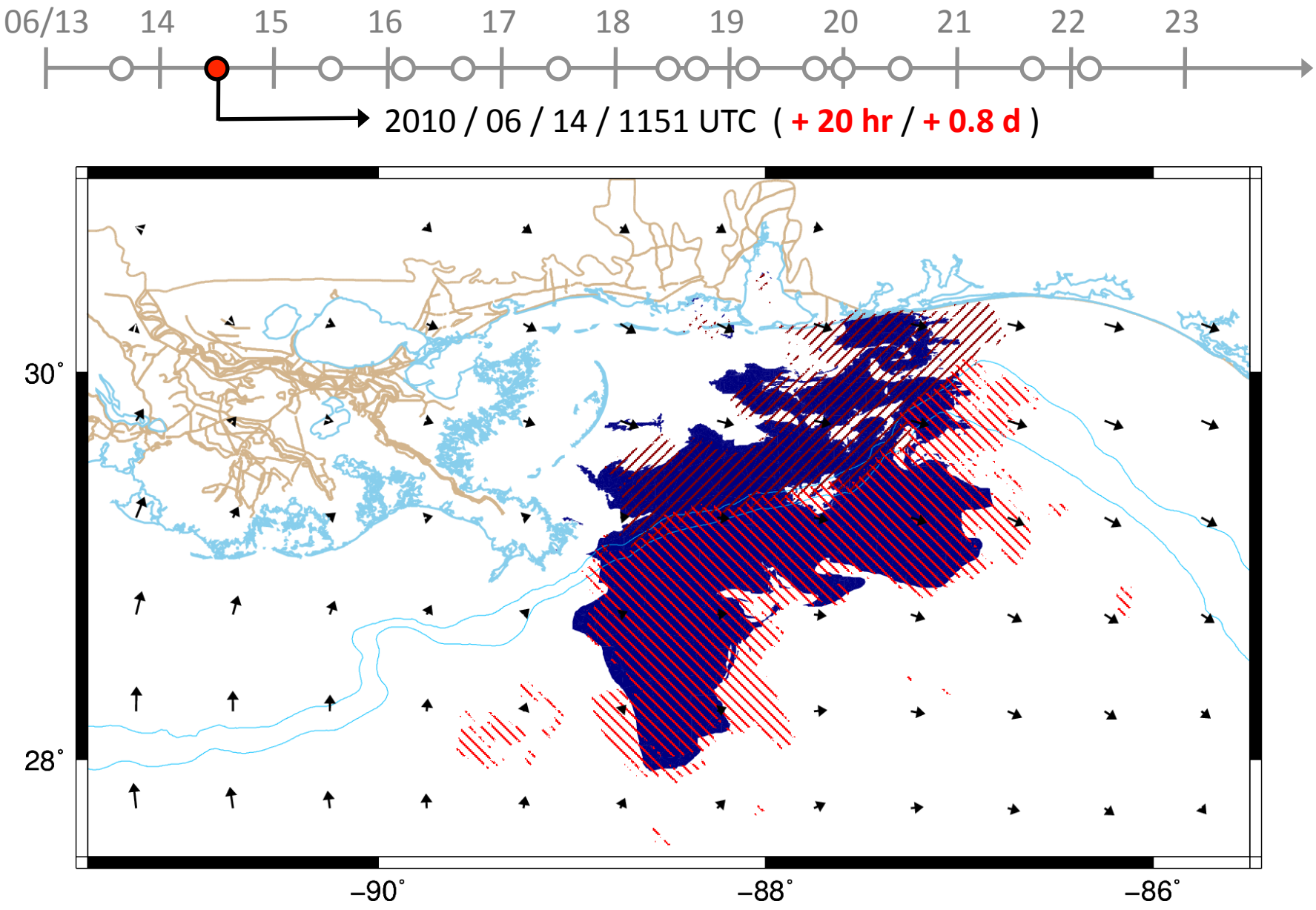
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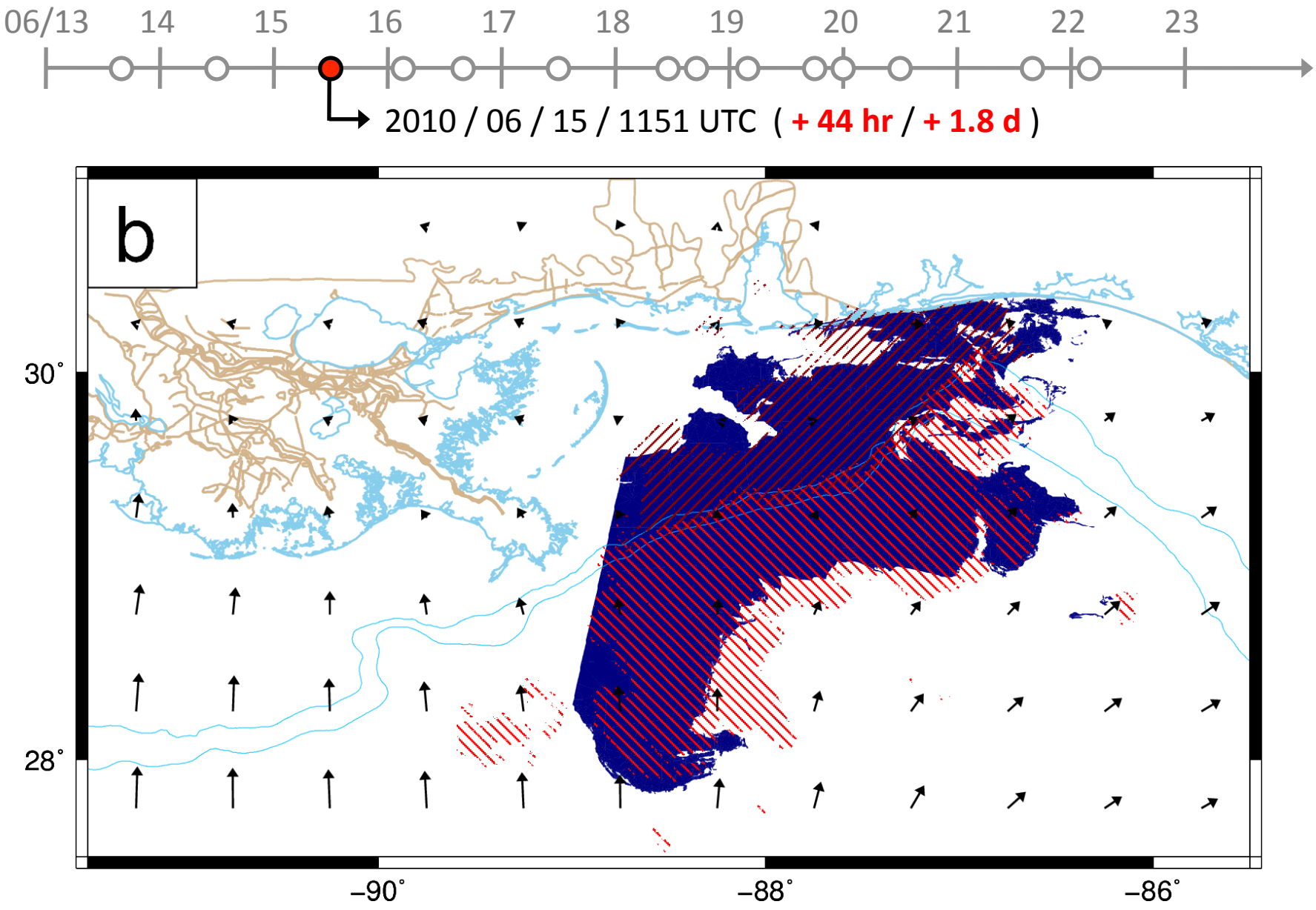
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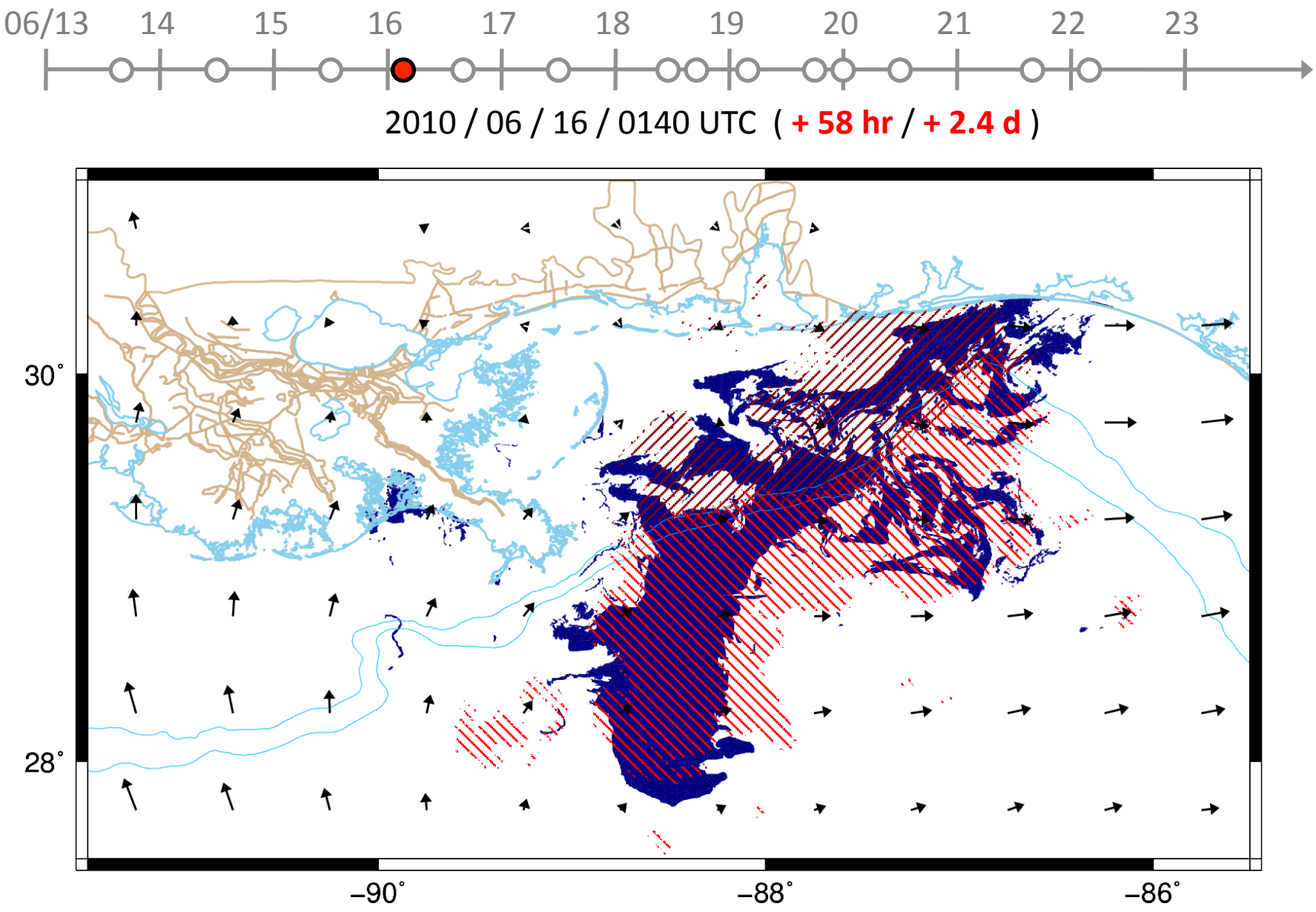
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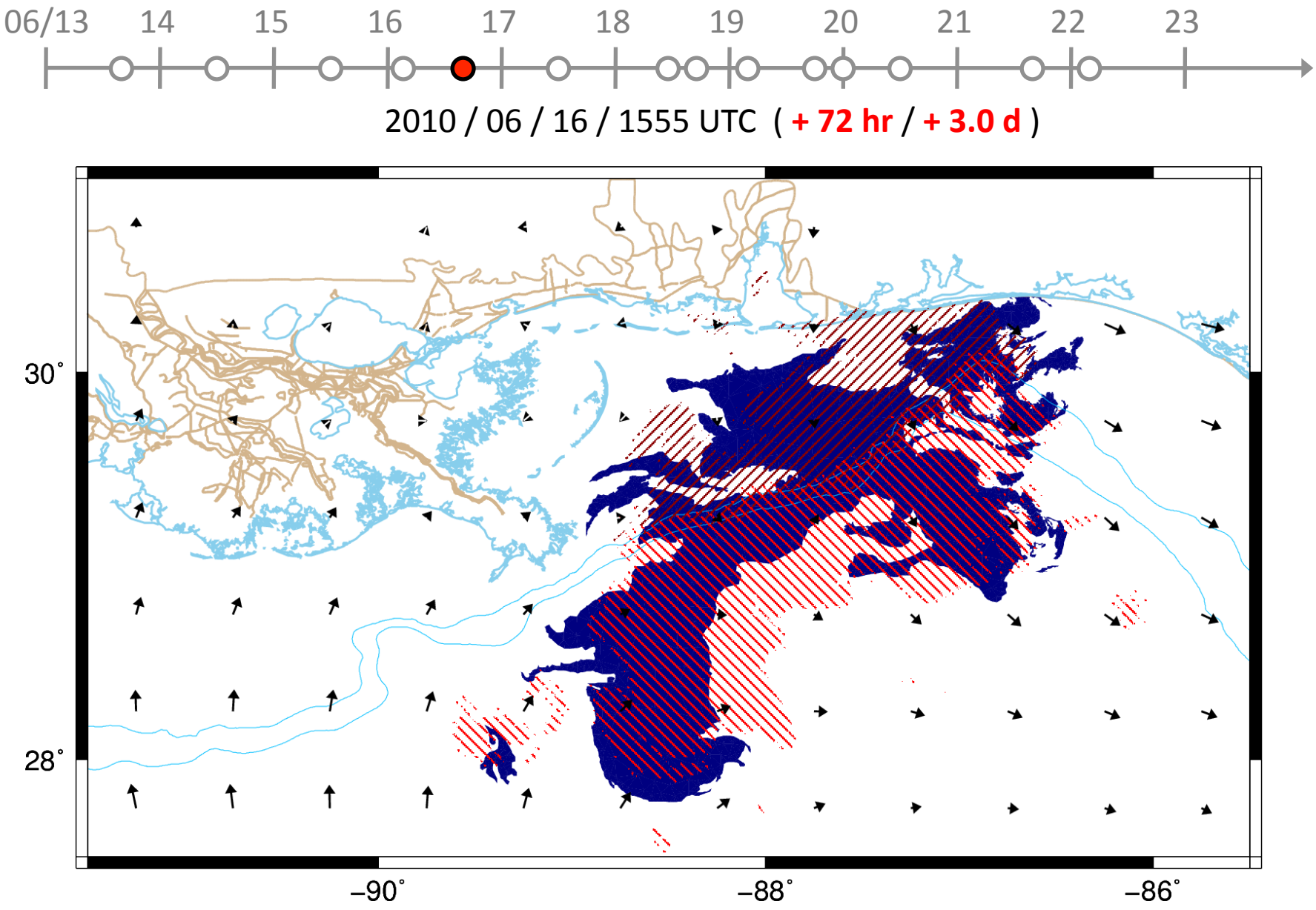
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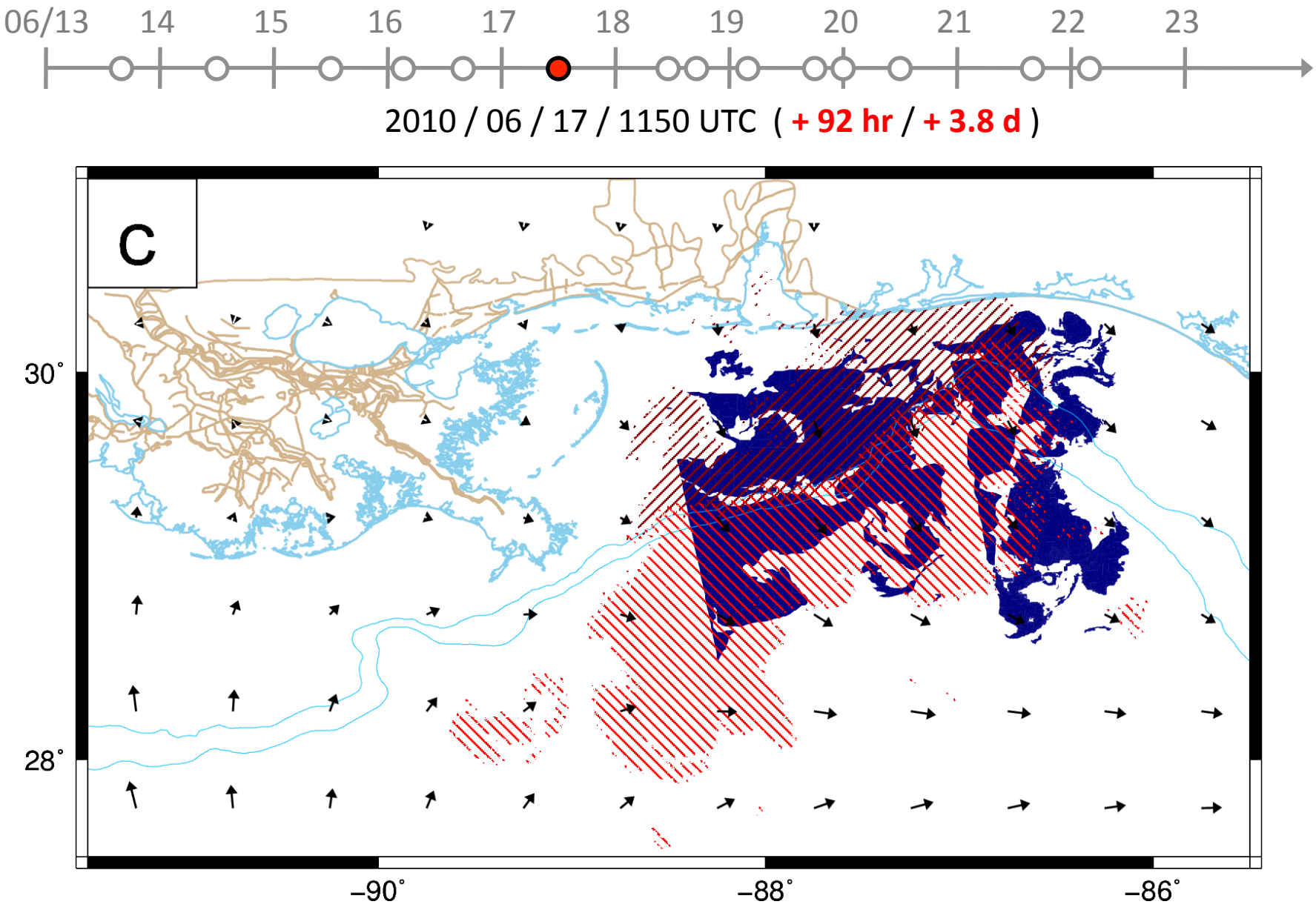
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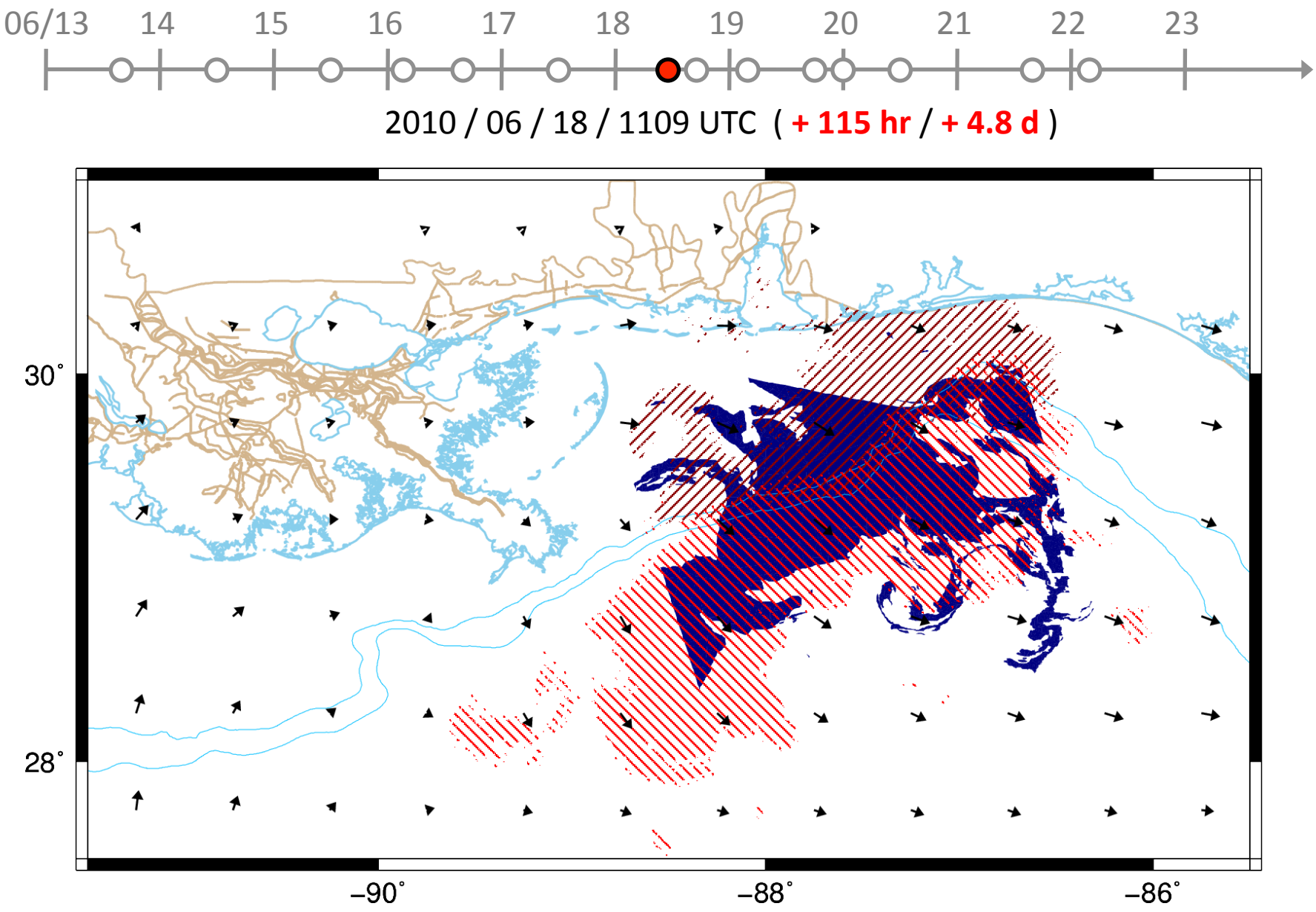
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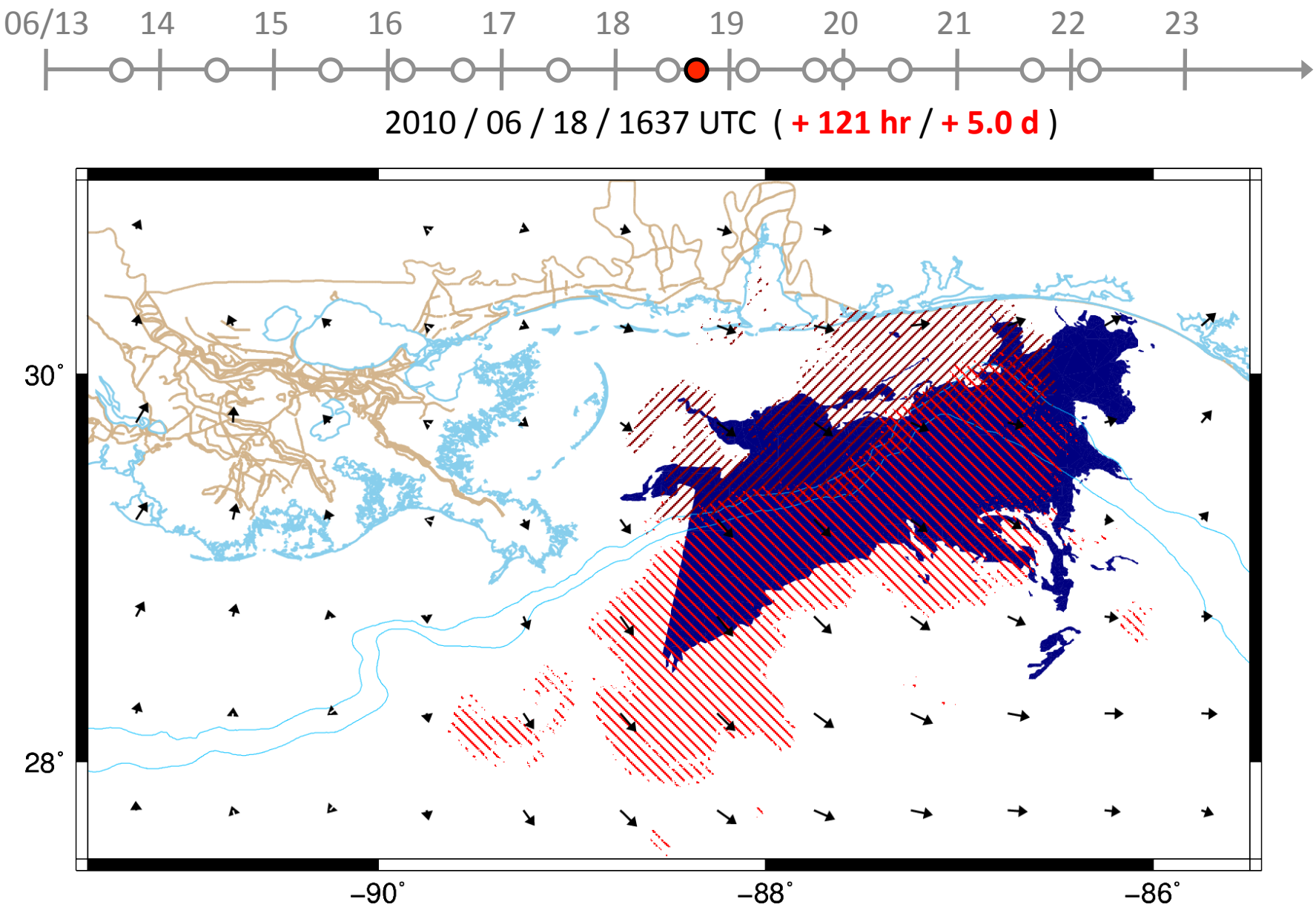
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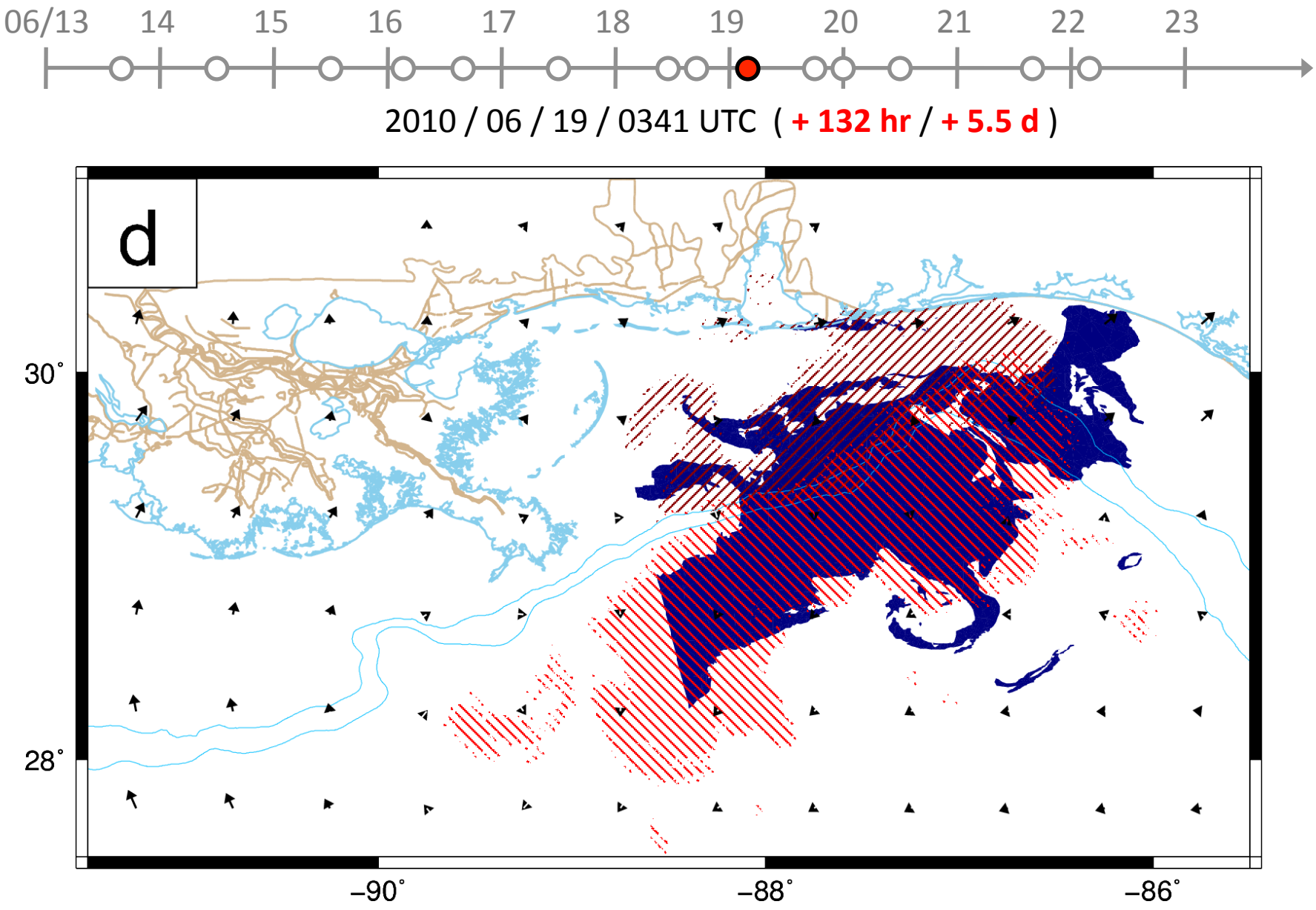
Satellite Imagery
Predicted Particle Locations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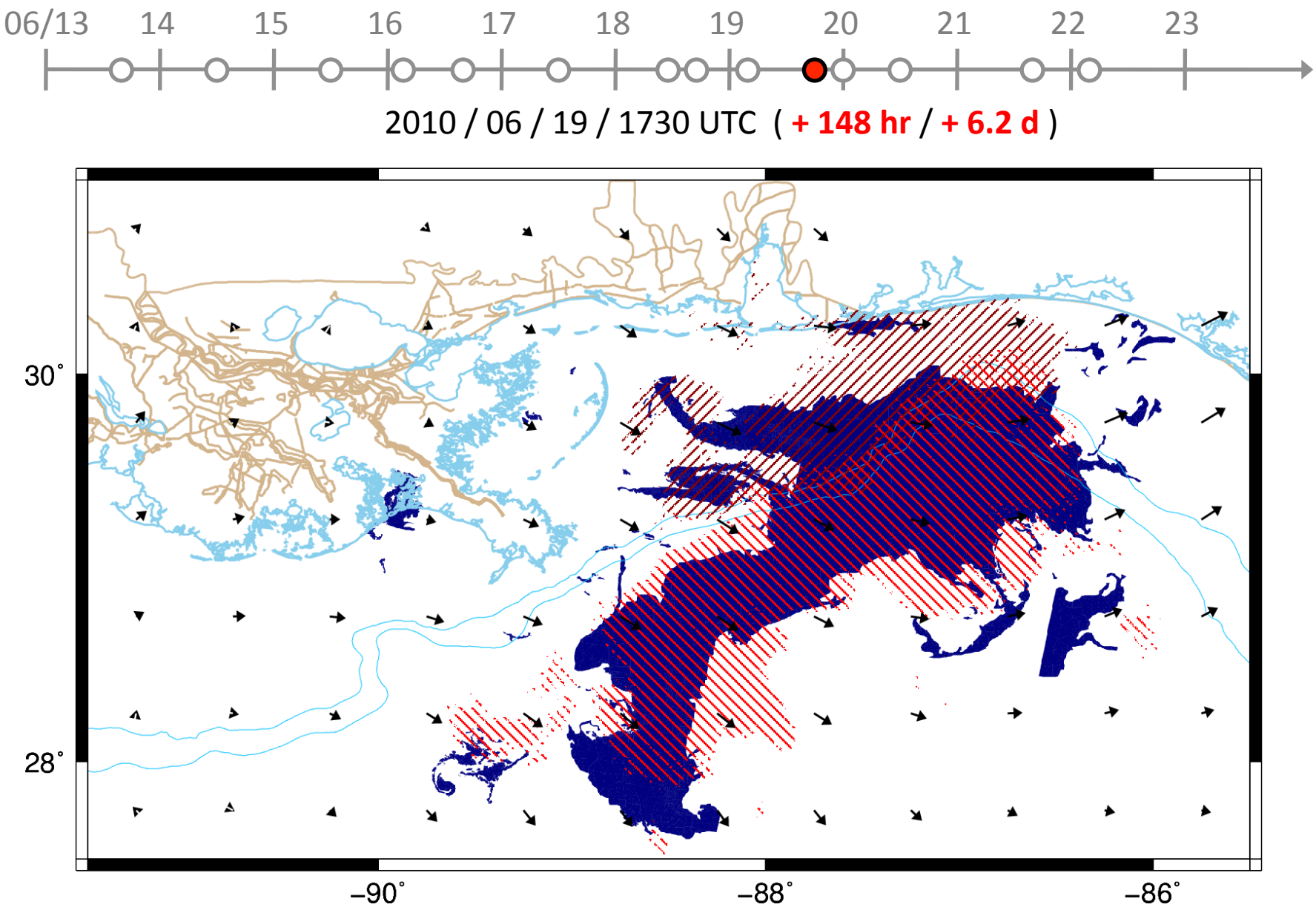
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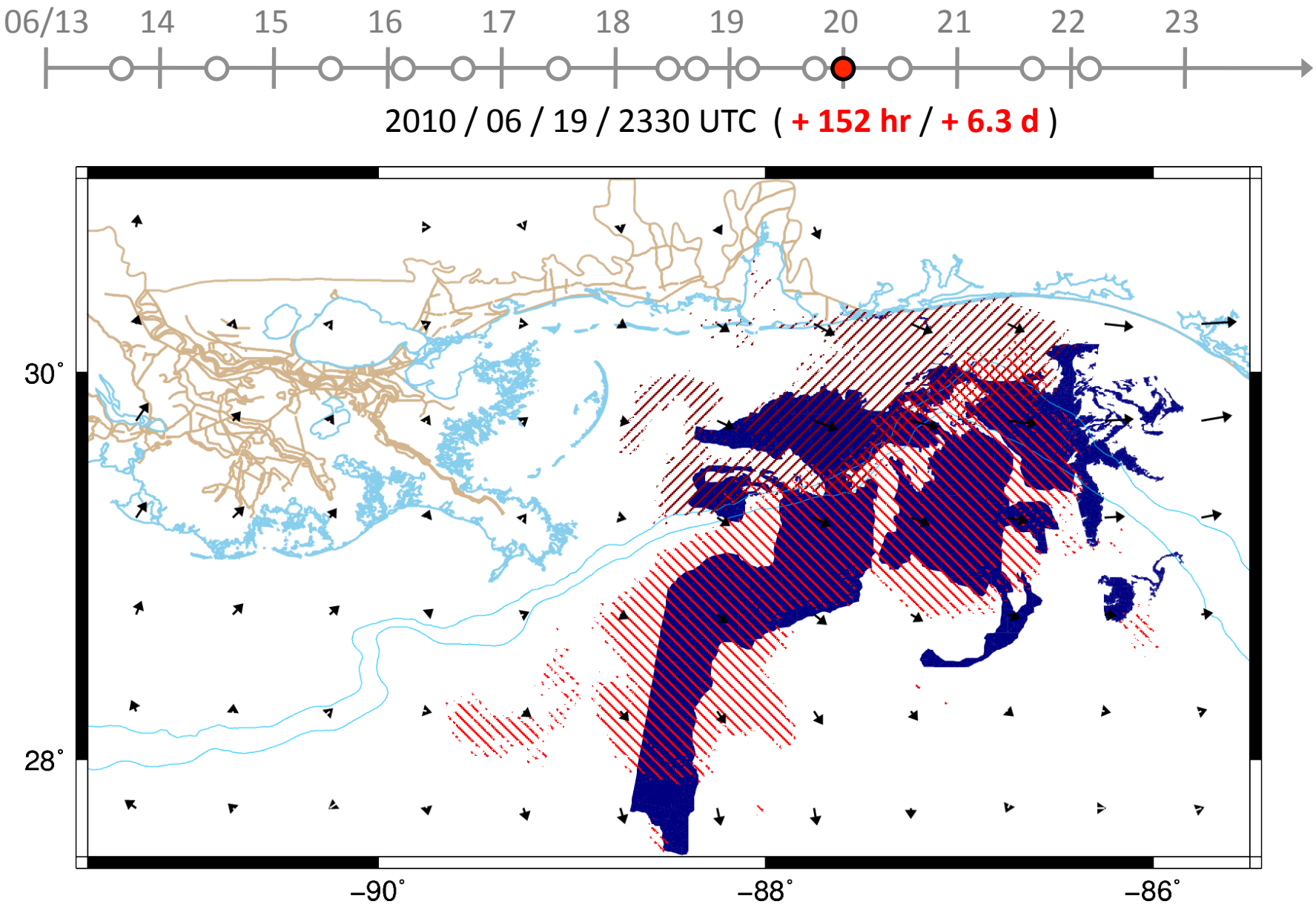
Predicted Particle Locations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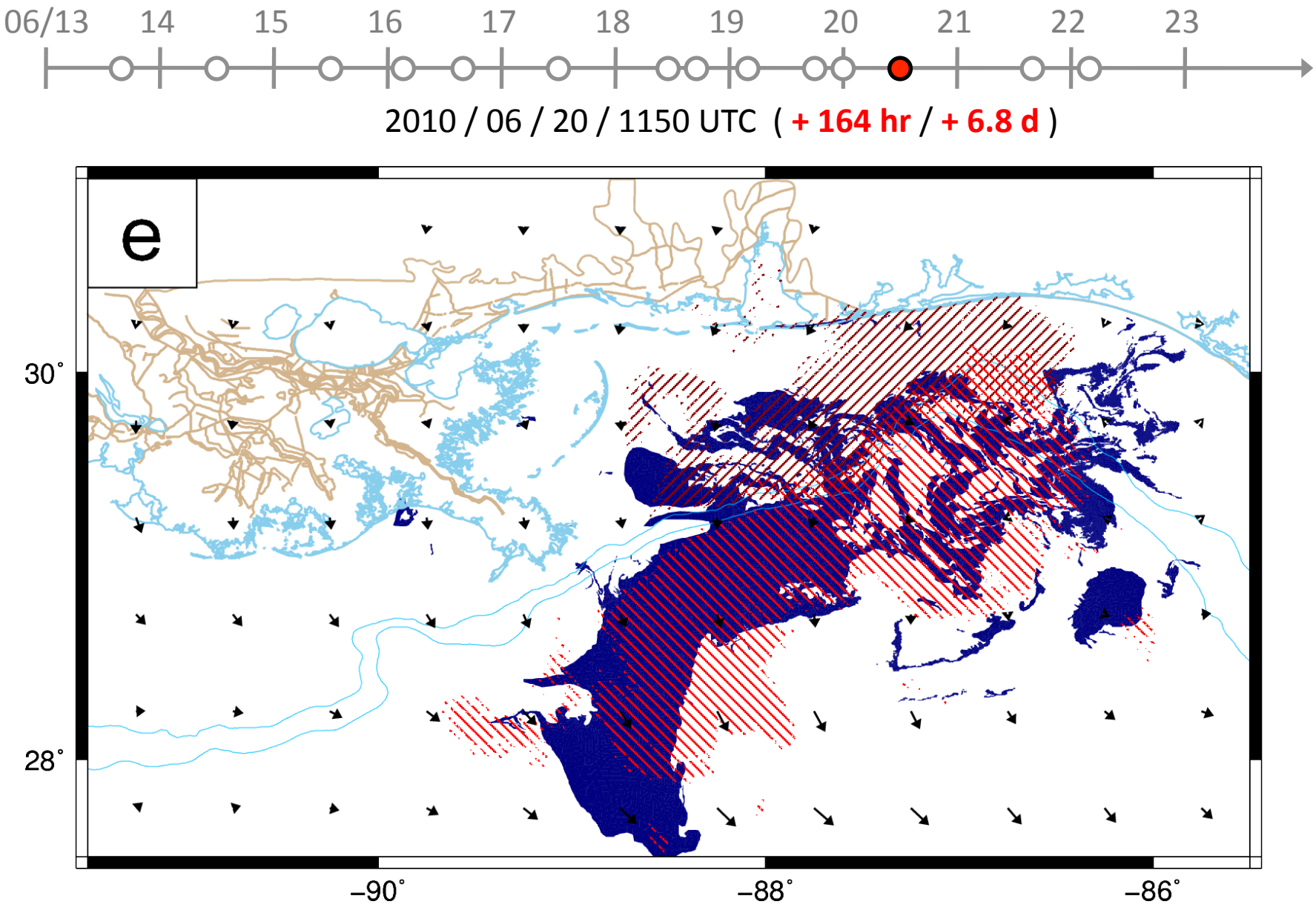
Predicted Particle Locations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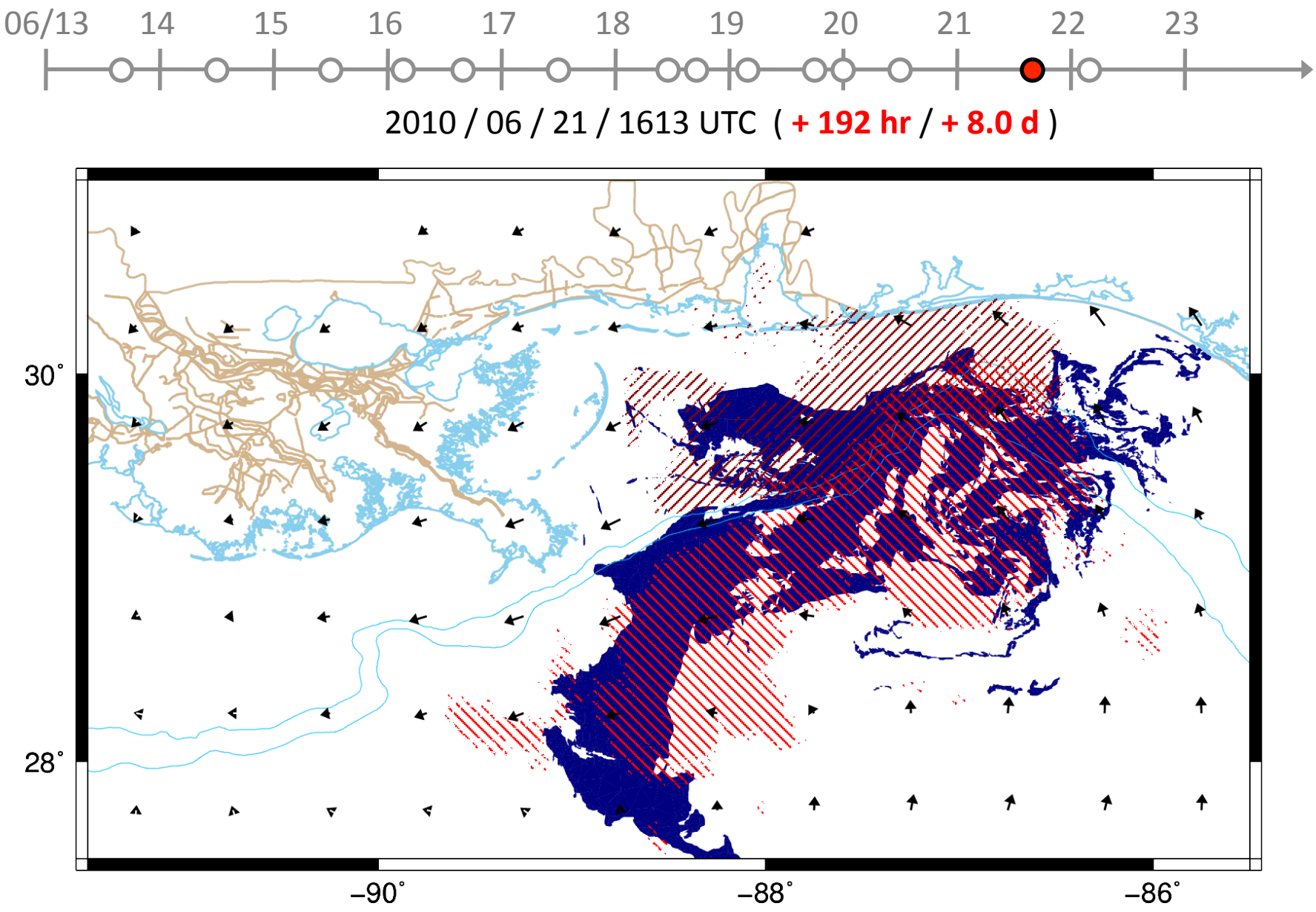
Satellite Imagery
Predicted Particle Locations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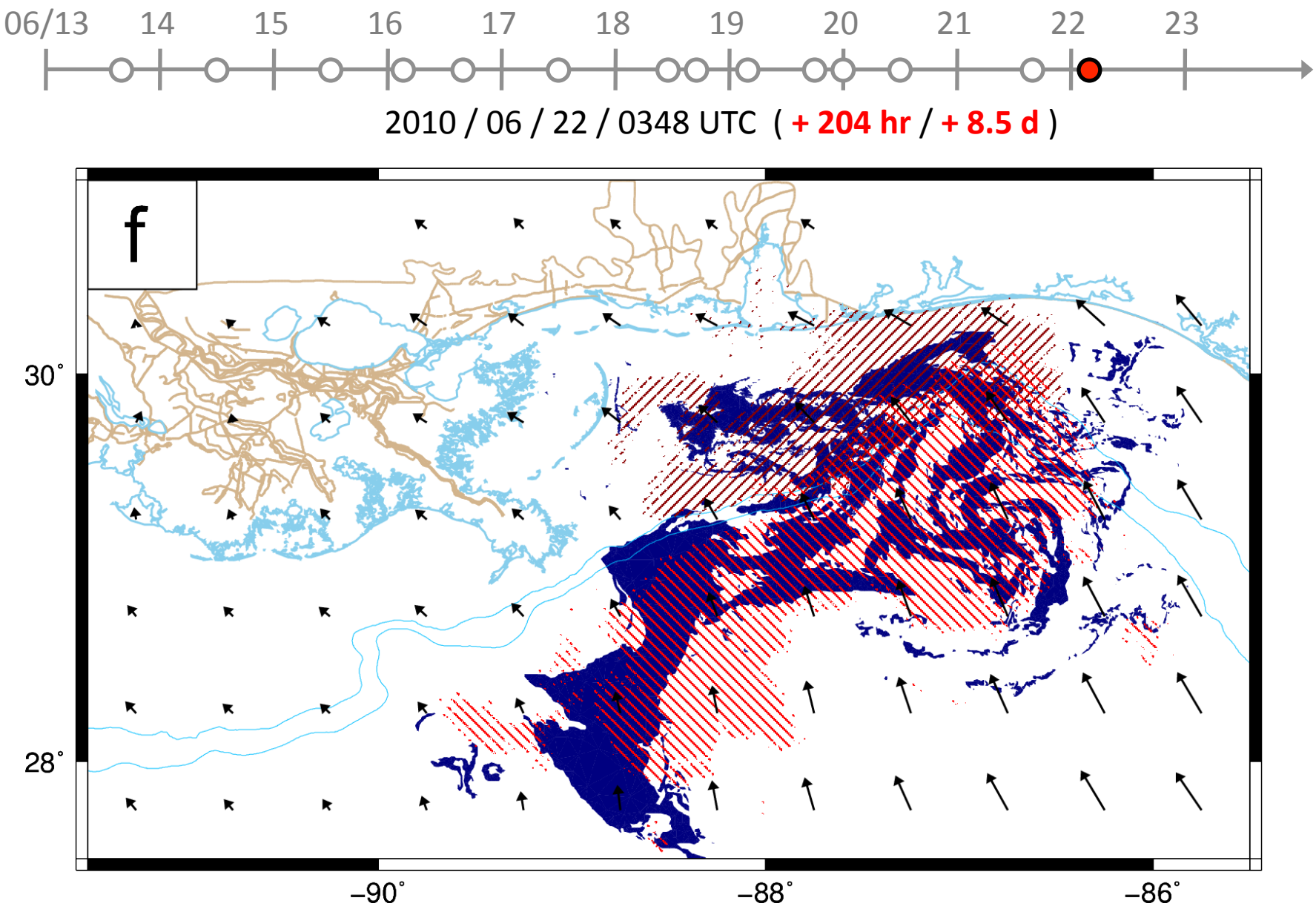
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# Conclusions

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