

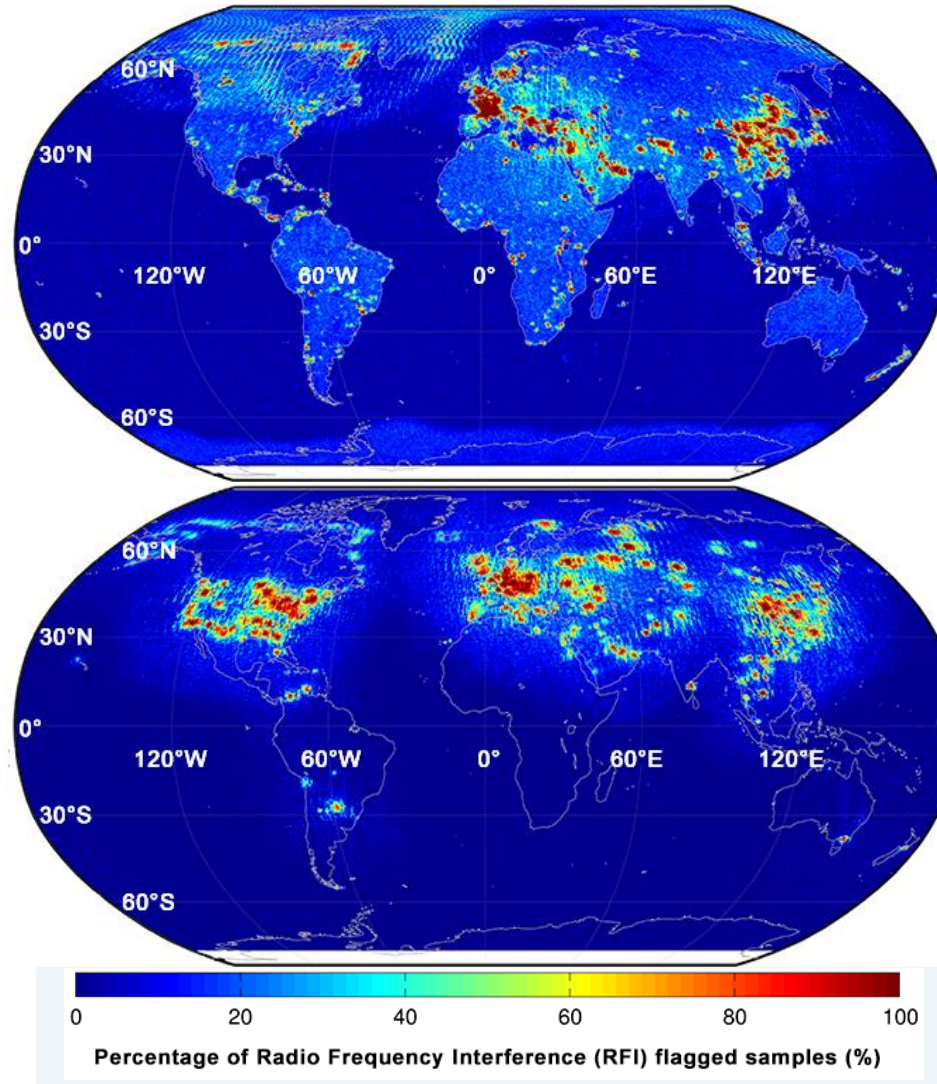


# Aquarius and SMOS Detect Effects of an Extreme Mississippi River Flooding Event in the Gulf of Mexico

Michelle M. Gierach, Jorge Vazquez-Cuervo, Tong Lee, Vardis M. Tsontos  
Jet Propulsion Laboratory, California Institute of Technology

Gierach, M. M., J. Vazquez, T. Lee, V. Tsontos, 2013: Aquarius and SMOS detect effects on an extreme Mississippi River flooding event in the Gulf of Mexico, *Geophys. Res. Lett.*, 40(19), 5188-5193, doi:10.1002/grl.50995.

# Why is This Important?

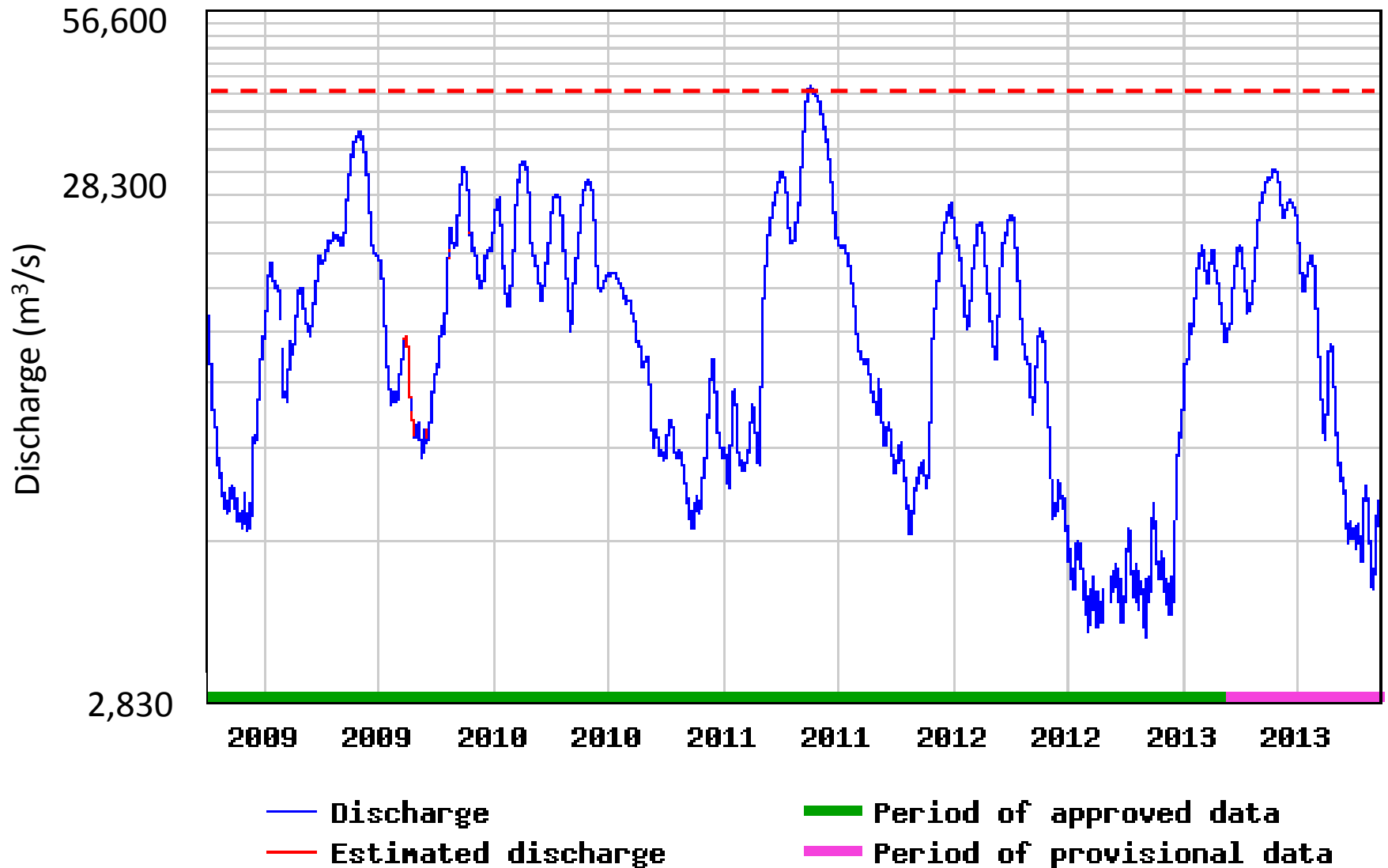


- It remains unclear as to what extent Aquarius and SMOS data can be used to study salinity variation in marginal seas due to smaller spatial scales of salinity features and the potential contamination of the SSS signal near land

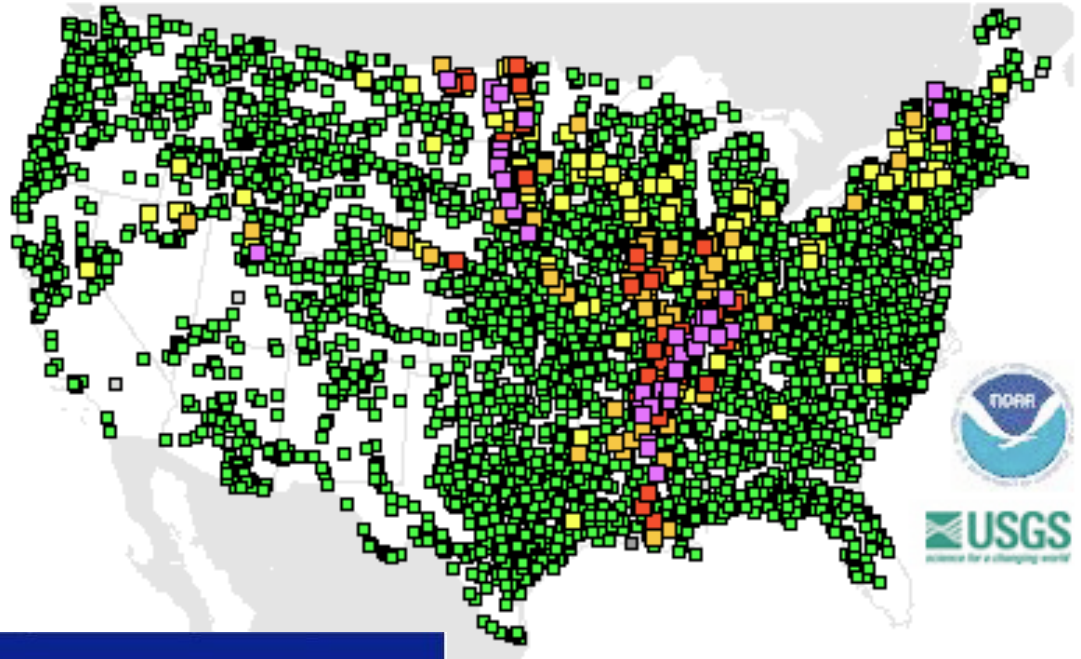


# The Mississippi River

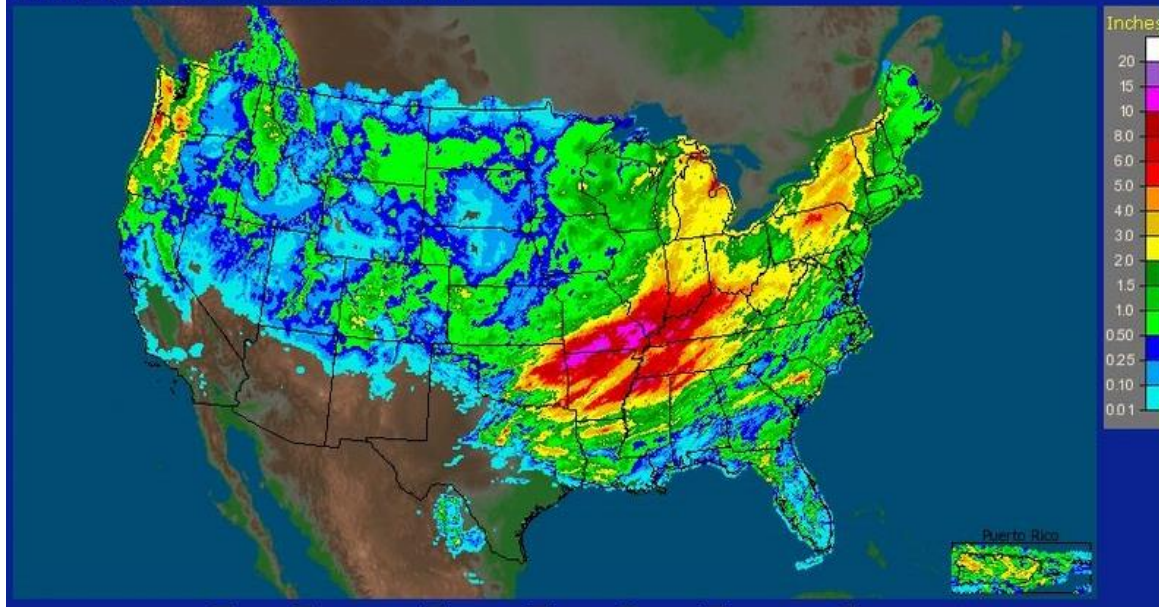
USGS 07374000 Mississippi River at Baton Rouge, LA



# 2011 Mississippi River Flood



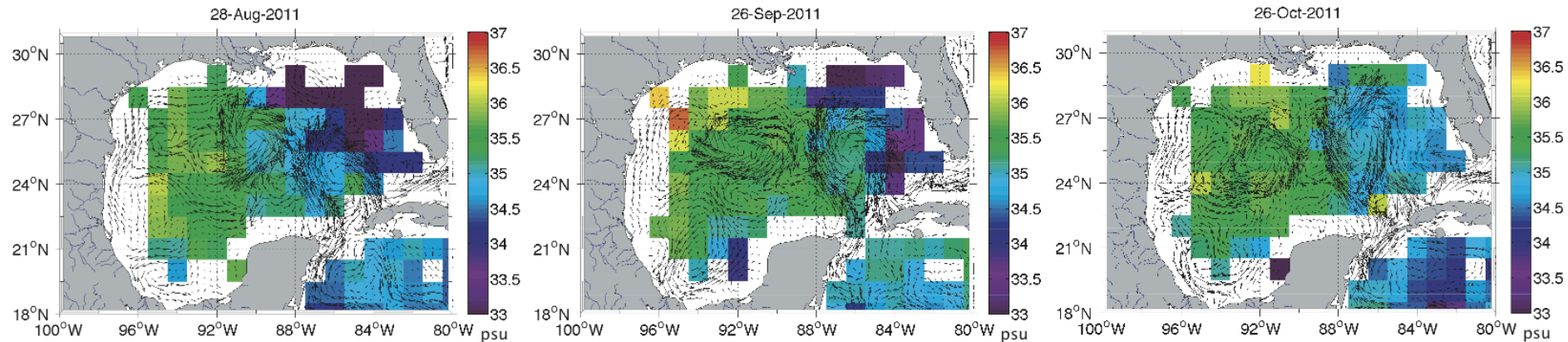
CONUS + Puerto Rico: Yesterday's 7-Day Observed Precipitation  
Valid at 4/29/2011 1200 UTC - Created 4/29/11 23:38 UTC



24 hours

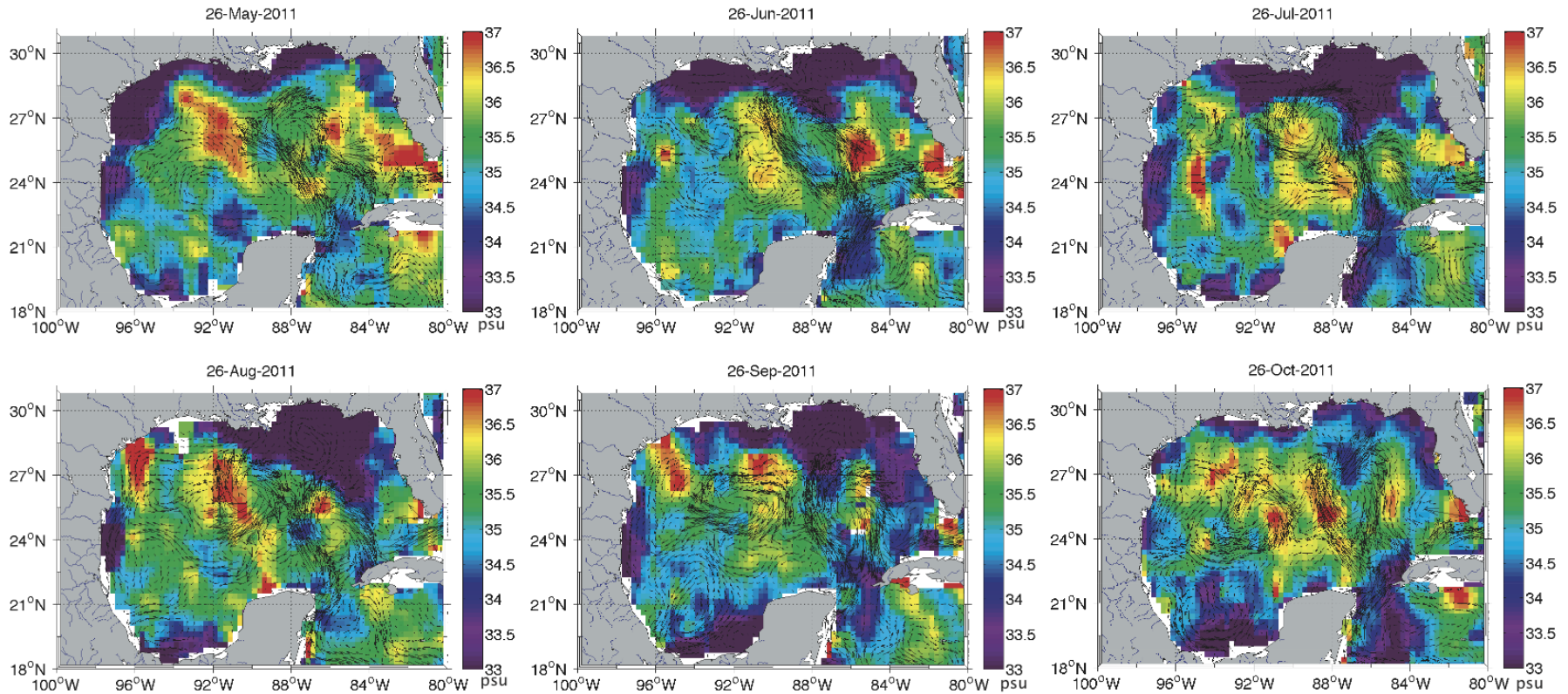
- 48 Gauges: Major Flooding
- 52 Gauges: Moderate Flooding
- 93 Gauges: Minor Flooding
- 118 Gauges: Near Flood Stage
- 4231 Gauges: No Flooding

# Aquarius Detects River Discharge



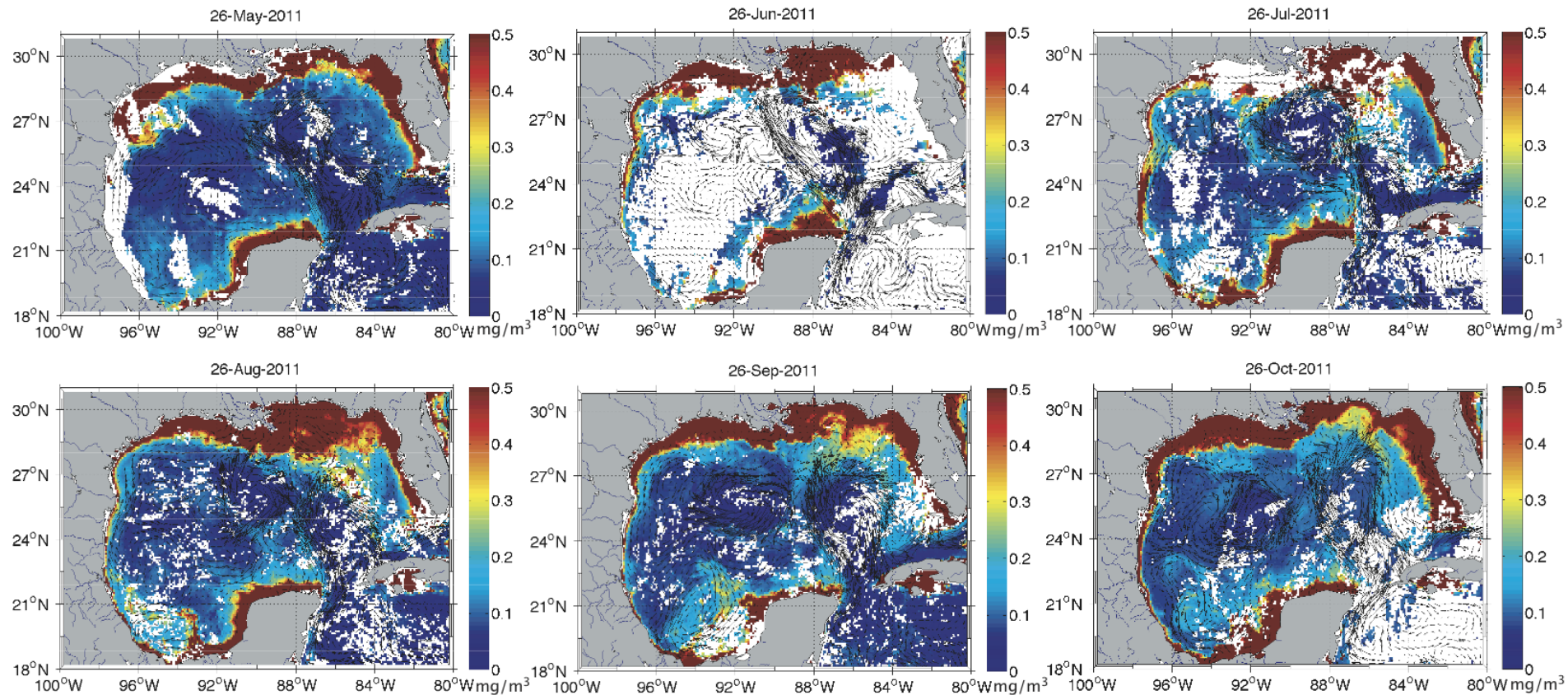
- Aquarius data began in late August 2011 and captured part of this discharge event in the Gulf of Mexico
- Aquarius observed low SSS values ( $< 34$  psu) in the northeastern Gulf of Mexico from August-September 2011 (3– 4 months after peak discharge) that were no longer visible by October 2011 (5 months after peak discharge)
- Seasonal winds and general circulation variability in the Gulf of Mexico impacted the observed salinity response to the record 2011 Mississippi River flooding event

# SMOS Detects River Discharge



- SMOS data began in 2010 and captured the entire discharge event
- Low SSS values (< 34 psu) from SMOS were confined along the Mississippi-Alabama-Florida coasts in May 2011 and began to spread into the Gulf of Mexico from June-July 2011 (1–2 months after peak discharge)
- A similar SSS response was shown from August-October 2011 consistent with Aquarius

# Chlorophyll-a Validates Aquarius and SMOS Observed River Discharge



- The observed salinity responses from SMOS and Aquarius to the discharge event were consistent with MODIS chlorophyll-a concentrations from May-October 2011



# Using ECCO to Further Investigate River Discharge during the 2011 Mississippi River Flooding Event

- A passive tracer tool based on ECCO state estimation was used to assess the pathway and transit time of the low SSS signal in the Gulf of Mexico (Fukumori et al., 2004)
  - A uniform tracer was initialized in May 2011 in the top 40 m at the mouth of the Mississippi River ( $28^{\circ}\text{N}$ – $29^{\circ}\text{N}$ ,  $89^{\circ}\text{W}$ – $90^{\circ}\text{W}$ ) and ran forwards in time for 6 months (June – November 2011)

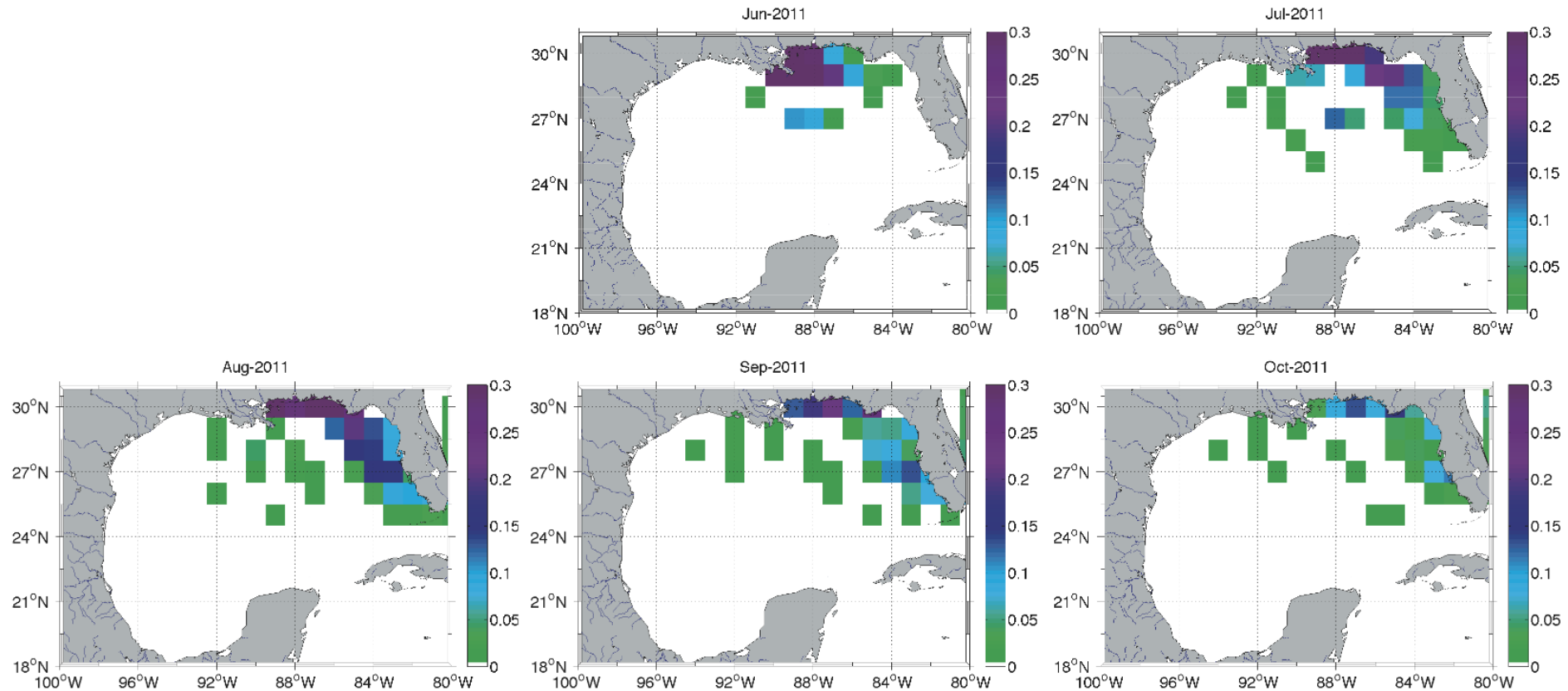
The screenshot shows the JPL ECCO Ocean Data Assimilation website. The main heading is "JPL ECCO Ocean Data Assimilation" with a sub-heading "A Member of ECCO Consortium (JPL | MIT | SIO)". Below this is a map titled "ECCO Near Real-Time Ocean Estimate for February 29, 2012". The map displays sea level anomalies (cm) relative to the average seasonal cycle, with a color scale from -20 to 20. The map shows a large positive anomaly (red/orange) in the Gulf of Mexico and a large negative anomaly (blue) in the Atlantic Ocean. To the right of the map are controls for date (2012/02/29), variable (sea level), and depth (0 m). Below the map are links for "Project Description" and "Access to Products".

<http://ecco.jpl.nasa.gov/external/>

The screenshot shows the "Submit Request for Passive Tracer Integration" form on the JPL Ocean Data Assimilation website. The form includes fields for "Your Name:", "Email:", "Longitude: (deg E)", "Latitude: (deg N)", "Depth: (in meter)", and "Time: (yyyy-mm-dd)". The form is pre-filled with values: Longitude (210, 270), Latitude (-5, 5), Depth (0, 50), and Time (1997-12-31, 1997-01-01). A "submit" button is located below the form. To the right of the form is a text box explaining the tool's purpose: "This is an experimental web-based tool allowing users to conduct passive tracer simulations to study pathways of ocean circulation using ECCO's time-variable circulation estimates." Below the form is a "Please provide your name and email address." instruction. The footer includes the "FIRSTGOV" logo, the date "Last updated: July 20, 2004", and the "Feedback" link.

<http://ecco.jpl.nasa.gov/tracer/>

# Tracer Concentrations Validate the Pathway and Transit Time of River Discharge

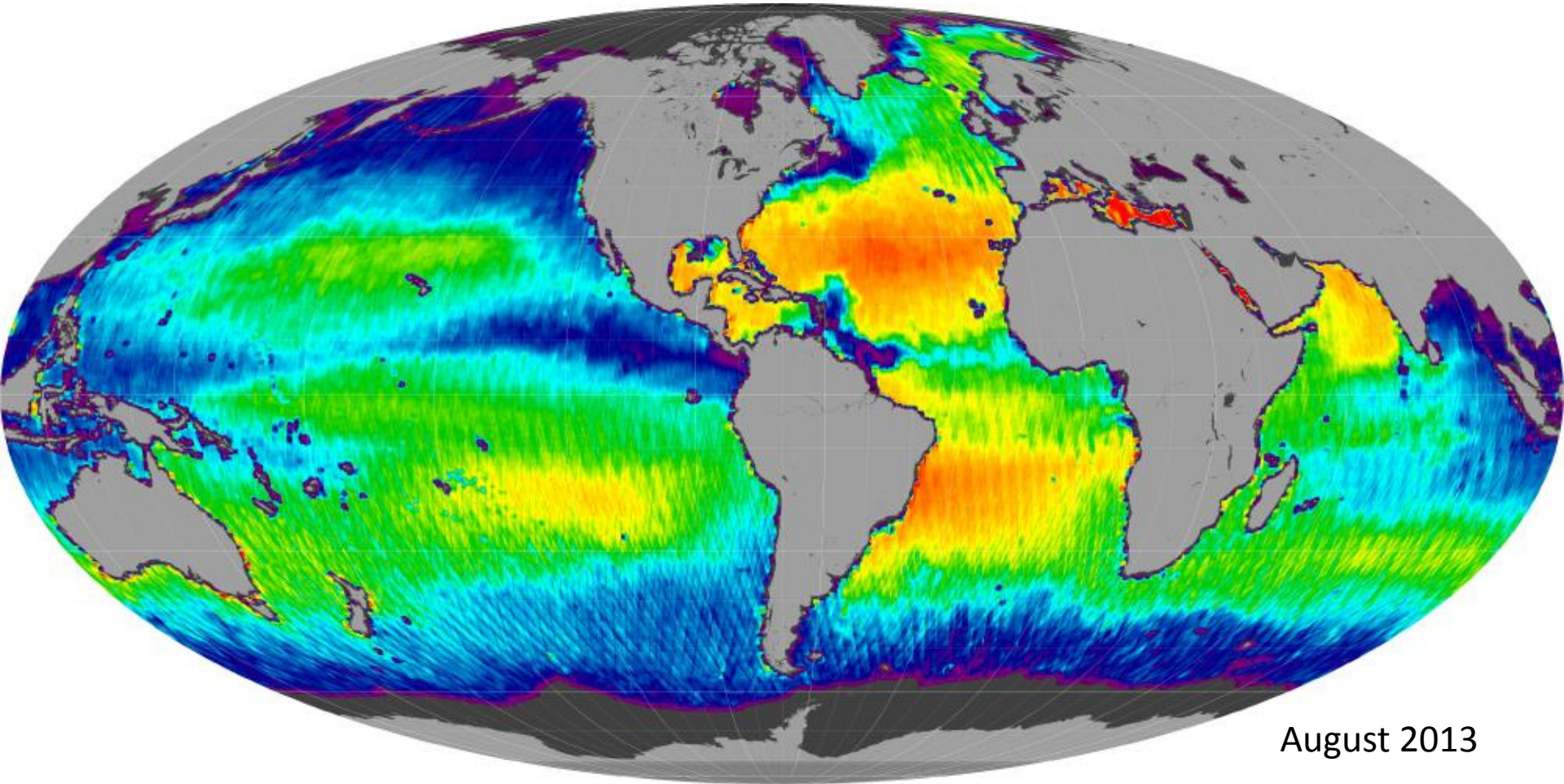


- Results are consistent with the transit time of freshwater spreading from Aquarius and SMOS

# Summary

- First successful application of satellite SSS to study salinity variation in marginal seas
- Aquarius observed salinity freshening associated with the record 2011 Mississippi River flooding event in the Gulf of Mexico
- The salinity response from Aquarius was consistent with SMOS and chlorophyll-a concentrations
- Seasonal winds and the general ocean circulation impacted the observed salinity response
- Freshwater plumes and salinity variability in marginal seas have implications on large-scale ocean circulations and climate

# Questions...



August 2013