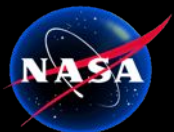




Understanding the relative contributions of sediment delivery and plants production
to resilience of the Mississippi River Delta to sea level rise

Marc Simard (PI) & Cathleen Jones (DPI)

<https://deltax.jpl.nasa.gov>



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Solving pressing Earth system Science issues:

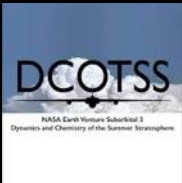
NASA's Earth Venture Suborbital – 3

(NASA's Science Mission Directorate/Earth Science Division)



- **ACTIVATE:**

Aerosol Cloud Meteorology Interactions over the Western Atlantic Experiment



- **DCOTSS:**

Dynamics and Chemistry of the Summer Stratosphere



- **Delta-X:**

Resilience of River Deltas



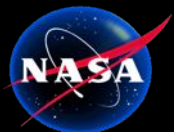
- **IMPACTS:**

Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms



- **S-MODE:**

Submesoscale Ocean Dynamics and Vertical Transport

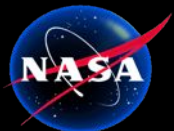


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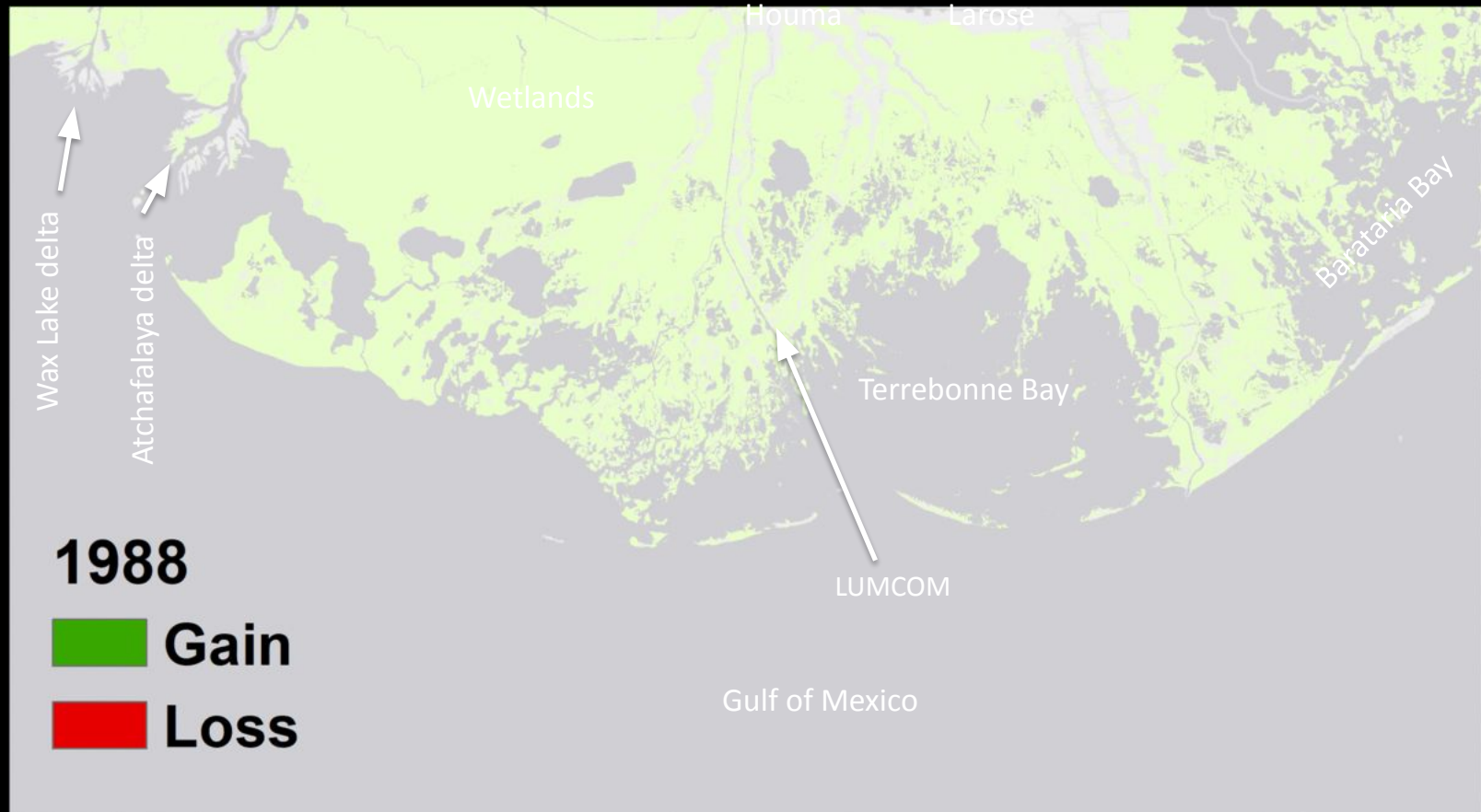
12 Co-Investigators from 8 different institutions from 6 coastal states

- **California:**
 - Jet Propulsion Laboratory, California Institute of Technology (M. Simard, C. Jones, E. Rodriguez, D. Thompson)
 - Caltech (M. Lamb)
- **Louisiana:** Louisiana State University, Baton Rouge (R. Twilley)
- **Texas:** University of Texas, Austin (P. Passalacqua)
- **Florida:** Florida International University (E. Castañeda)
- **North Carolina:** University of North Carolina (T. Pavelsky)
- **Massachusetts:**
 - Boston University (C. Fichot & S. Fagherazzi)
 - Woods Hole Oceanographic institution (L. Giosan)



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Land-Loss in Coastal Louisiana

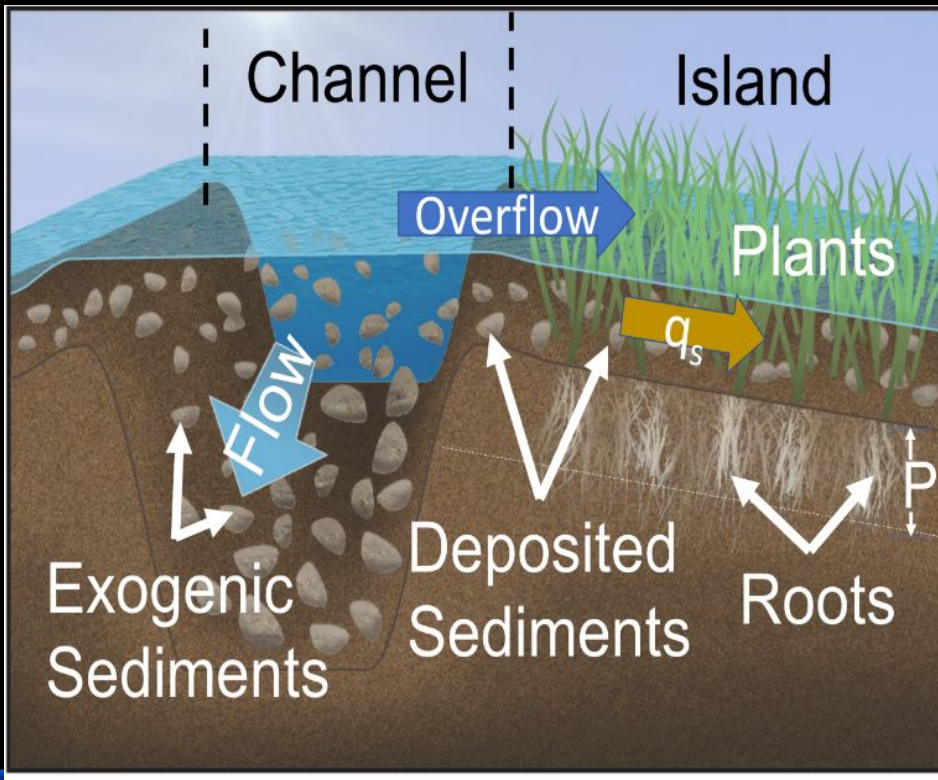


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Delta-X goal and objectives

Which parts of the Mississippi River Delta will survive and continue to grow, and which parts will be lost?



Science goal: to quantify the mesoscale patterns of soil accretion that control land loss and gain, and to predict the resilience of deltas under projected relative sea level rise (RSLR).

Objective 1: Evaluate the role of vegetation in determining soil accretion rates within deltaic wetlands.

Objective 2: Evaluate the role of distributary channel-network densities and associated sizes of deltaic islands on soil accretion rates.



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The Delta-X Framework Implementation

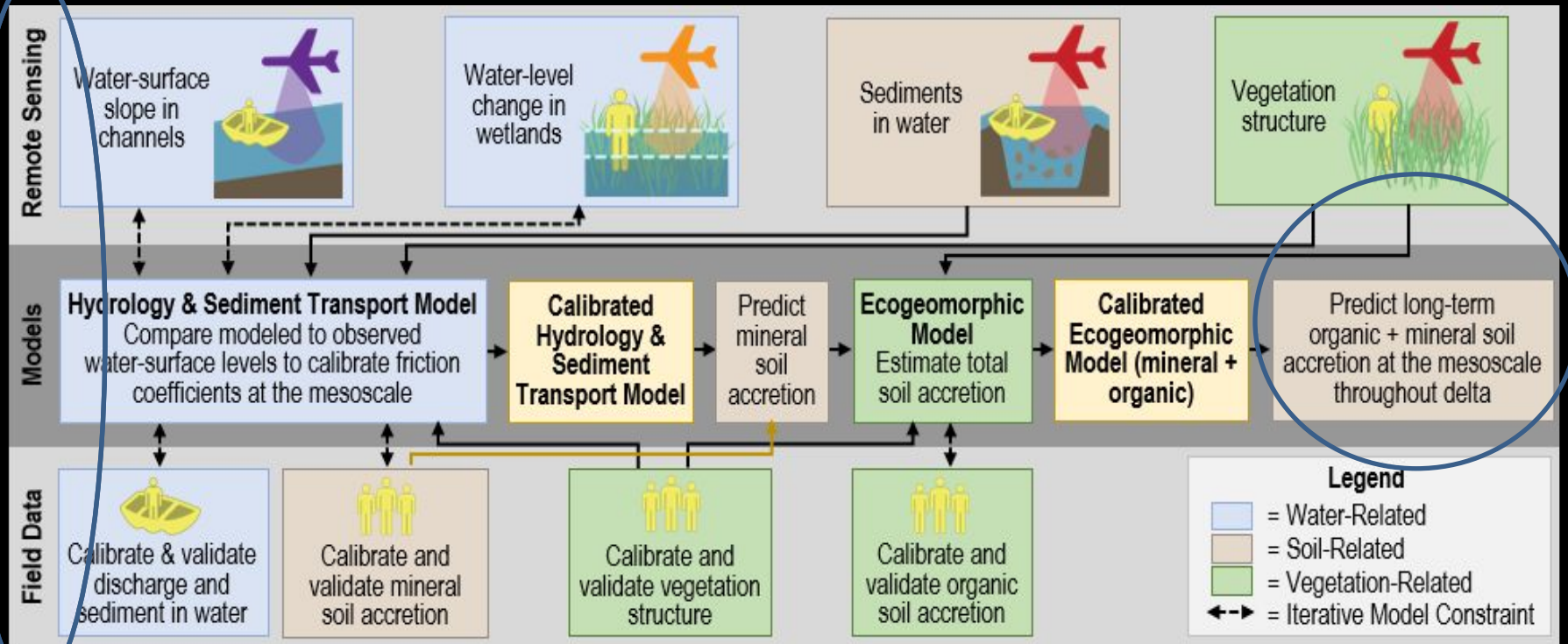
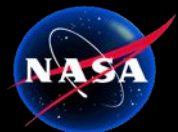
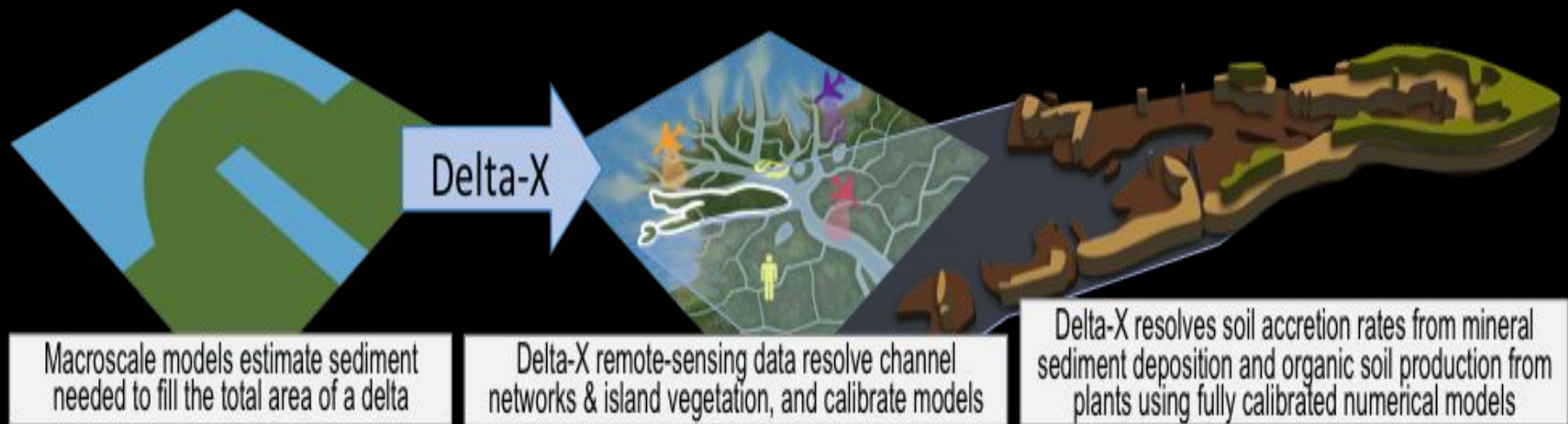


Figure 4: Delta-X calibrates a hydrology and ecogeomorphic model with remote-sensing and in situ data. Two airborne radar instruments observe the water surface elevation changes, and an imaging spectrometer measures vegetation type and structure and sediment concentrations in water. Modeled water-surface elevation and slopes are compared to remotely sensed observations to invert the friction coefficient. The hydrology model's mineral sedimentation rate outputs are used as inputs in the ecogeomorphic model. Once the numerical ecogeomorphic model is calibrated, it is run independently of observations to predict long-term soil accretion under projected RSRL, river discharge, and sediment supply

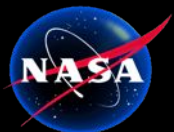


From Bathtub to ecogeomorphic scales

The mesoscale concept



Delta-X makes breakthrough advances in the study of deltaic evolution, moving beyond coarse areal averaging of delta mass balance, to resolve mesoscale features using remote-sensing and in situ measurements. This cross-disciplinary study, encompassing hydrology, ecology, and geomorphology, calibrates numerical models of sediment transport, ecological production, and soil accretion.

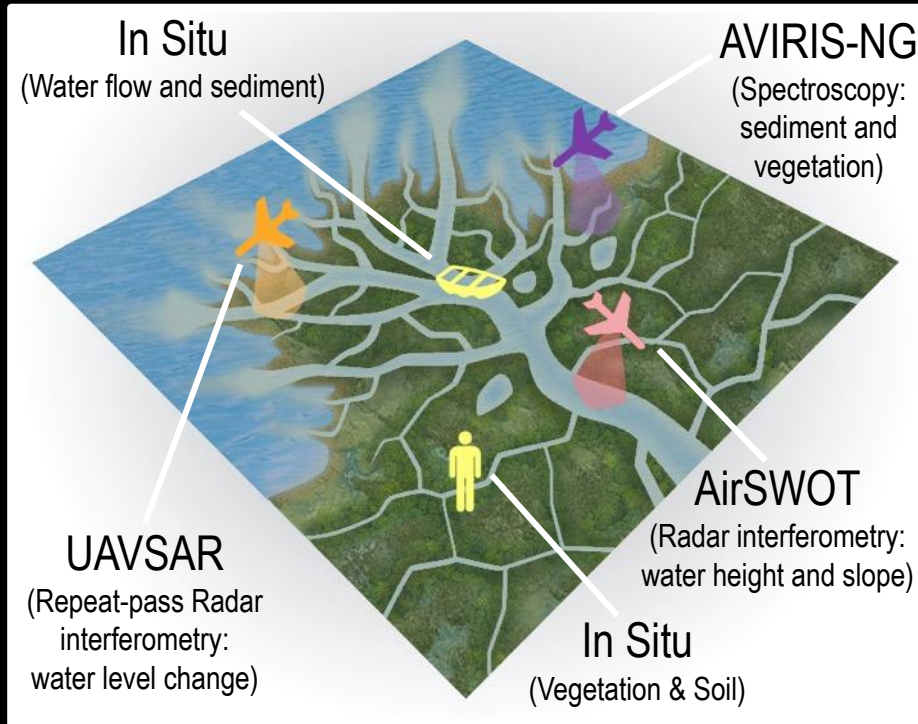


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Earth Venture Suborbital 3 Delta-X

Delta-X Science Question: Will river deltas completely drown, or some parts of these deltas accumulate sufficient sediments and produce enough plants to keep pace with RSLR ?



- ✓ Delta-X uses airborne radar to measure the flow of water and hyperspectral remote sensing to estimate sediment concentrations in water. These observations are used to calibrate hydrodynamic and ecosystem productivity models.
- ✓ Only airborne remote sensing can capture the rapid hydrodynamic processes occurring through the coastal continuum (i.e. river discharge and ocean tides).
- ✓ Delta-X delivers fully calibrated hydrology and ecosystem productivity models to predict which parts of the delta will survive SLR.



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Delta-X Instruments

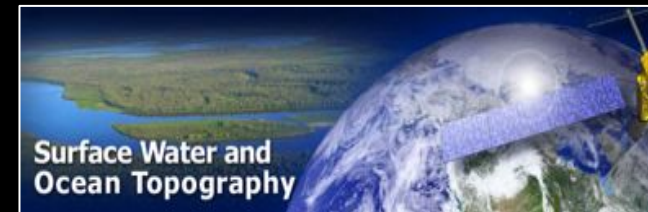
UAVSAR (for NISAR)

- 4 L- band radar, full-pol, 6m
- 4 Shallow bathymetry,
- 4 Above Ground Biomass AGB
- 4 Water level changes within marshes
- 4 Water surface velocity



AirSWOT (for SWOT)

- 4 Ka-band radar interferometer
- 4 Centimeter-level open water surface elevation and surface slope



AVIRIS-NG (for SBG and more)

- 4 Imaging spectroscopy (425 bands)
 - 4 380-2510nm, 5nm
- 4 High spatial resolution (~4m)
- 4 Vegetation species and structure
- 4 Water quality



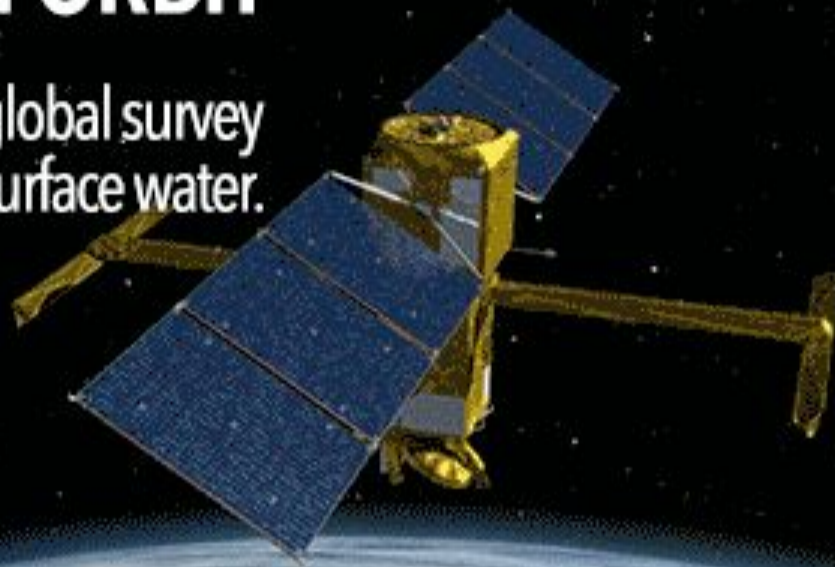
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JPL is leading the way in monitoring our water from air and space

SWOT IN ORBIT

Will provide NASA's first global survey
of Earth's surface water.



Upcoming satellites



The Opportunity of Measurements from Above

Simultaneous measurement over large areas



JSC Gulfstream III

UAVSAR

- 4 Measure water flow under vegetation



AirSWOT

- 4 Measure river and lake discharge



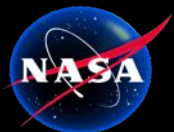
King Air B200

AVIRIS-NG

- 4 Vegetation species and structure classification
- 4 Sediment concentrations in water



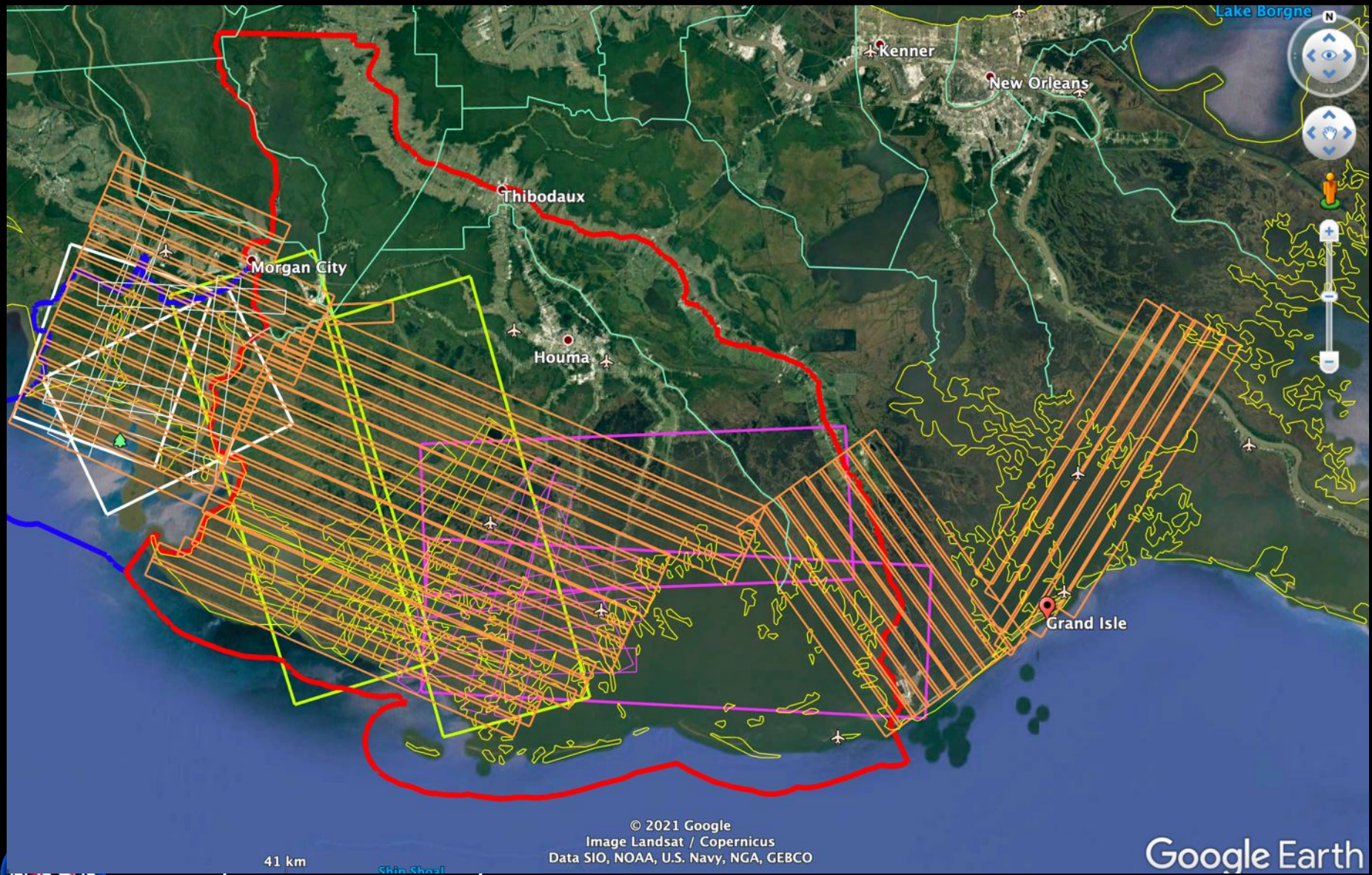
Mississippi River Delta Floodplain



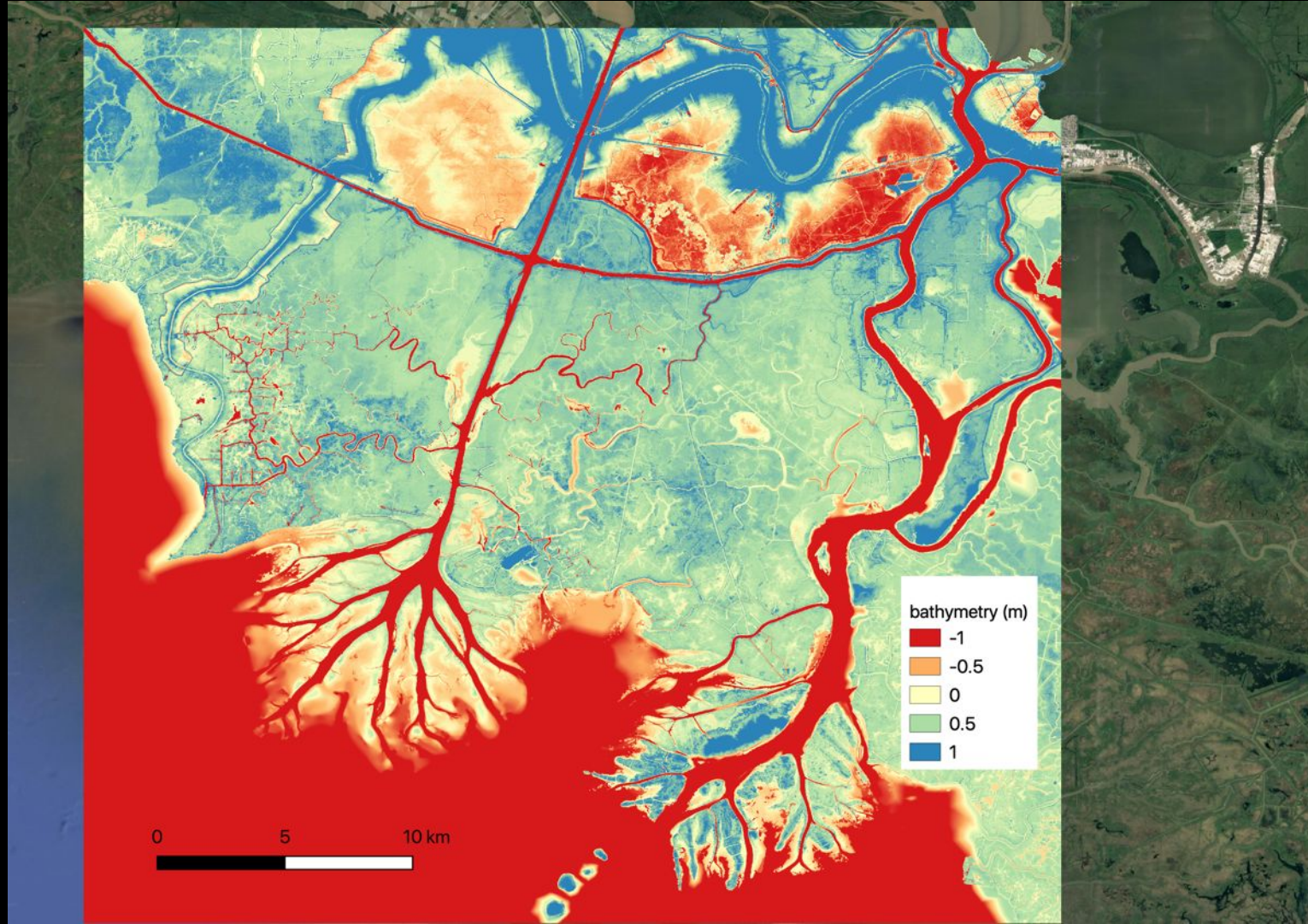
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Airborne remote sensing data coverage



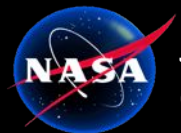
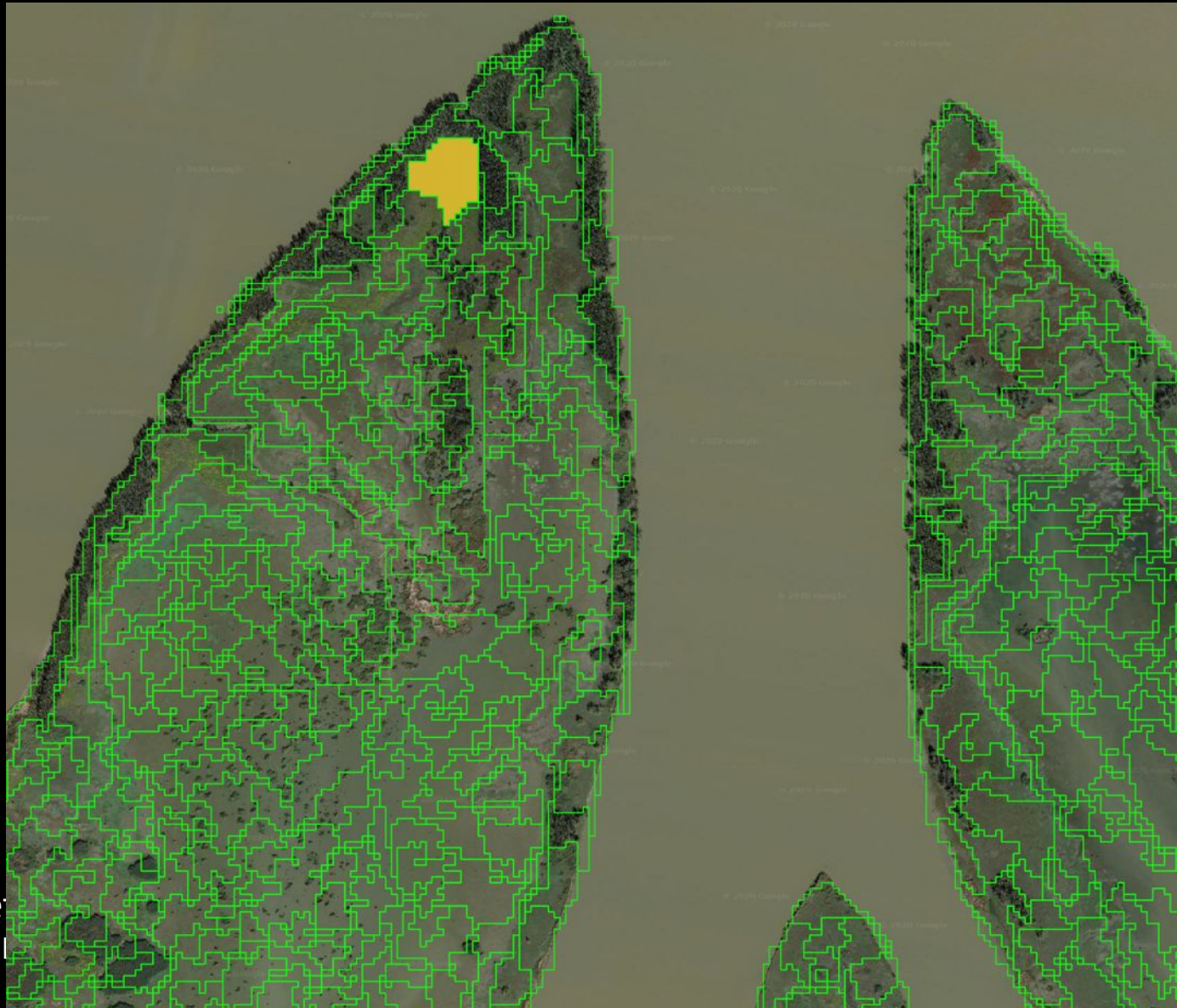
Recreating a new DTM for the Atchafalaya and Terrebonne Basins based On new Lidar (7 sites) and Sonar transects.



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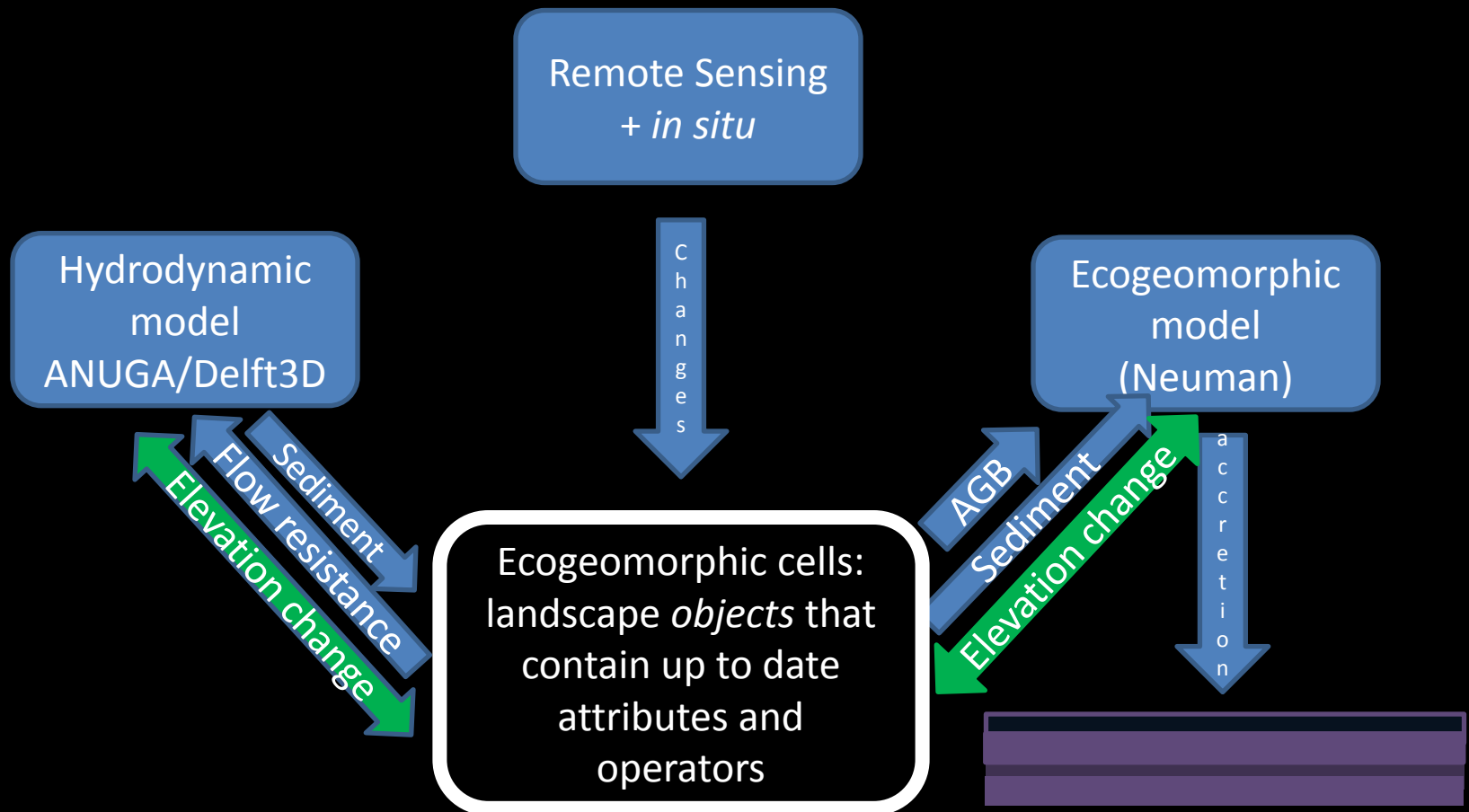
We use the concept of “ecogeomorphic cells”, representing small homogeneous areas ($\sim 1\text{ha}$), and predict their trajectory in time.



Je
Cal

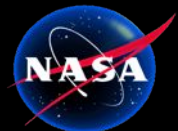
@jpl.nasa.gov

Using ecogeomorphic cells as the 'connector'

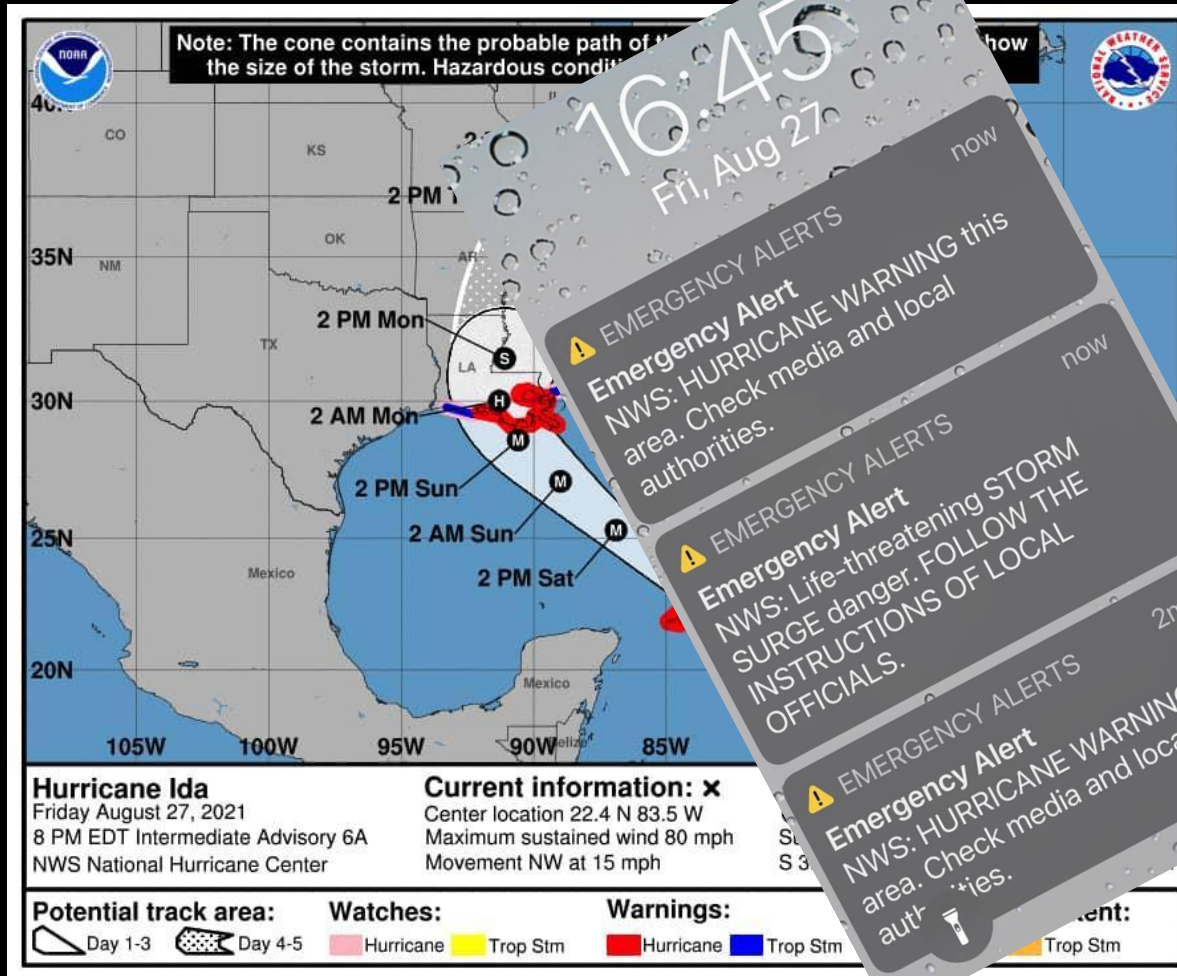


Delta-X Airborne Campaign

- Spring campaign 2021: March 21st - April 22nd (including in situ)
 - 3/27/21 - 4/6/21 AVIRIS-NG flights
 - 3/26 - 4/18 AirSWOT flights
 - 3/27 - 4/18 UAVSAR flights
- Fall campaign 2021: August 16th - September 25th (including in situ)
 - 8/18/21 - 8/25/21 AVIRISNG flights
 - 8/21/21 - 9/12/21 AirSWOT flights
 - 9/1/21 - 9/12/21 UAVSAR flights
- Pre-Delta-X campaigns
 - May 2015 (Spring)
 - October 2016 (Fall)



The Ida Interruption



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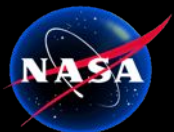
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May 4th Agenda

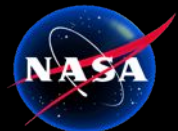
Time (CT)	Topic	Presenter
8:00 – 8:30	Introduction	
8:30 – 9:00	Delta-X Overview	Marc Simard
	Data Management Plan and Data Archive	Cathleen Jones
9:00 – 10:00	Field Data Overview and Access	Alex Christensen
	<i>Break 15'</i>	
10:15 – 11:15	Field Data Analysis	Alex Christensen
11:15 – 12:00	AVIRIS-NG Data Overview and Access	Daniel Jensen
	<i>Lunch 90'</i>	
13:30 – 15:45	AVIRIS-NG Application	Daniel Jensen
	<i>Break 15'</i>	
16:00 – 18:00	AirSWOT Data Overview, Access and Application	Michael Denbina

May 5th Agenda

Time (CT)	Topic	Presenter
8:00 – 9:30	AirSWOT Application Continued	Michael Denbina
9:30 – 10:00	UAVSAR Data Overview and Access	Talib Oliver Cabrera
	<i>Break 15'</i>	
10:15 – 12:00	UAVSAR Application	Talib Oliver Cabrera
	<i>Lunch 90'</i>	
13:30 – 15:30	ANUGA Model	Kyle Wright
	<i>Break 15'</i>	
15:45 – 17:45	Delft3D Model	Luca Cortese
17:45 – 18:00	Closeout	



End



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Fall Campaign Summary

- AirSWOT successfully completed
 - 11 science flights
 - 88.63 flight hours (63 science hours)
 - 226 data lines
- UAVSAR successfully completed
 - 7 science flights
 - 45.2 flight hours
 - 92 data lines
- AVIRIS-NG successfully acquired all high priority (required) lines
 - 6 science flights
 - 29 flight hours
 - 125 data lines
- Islands and Vegetation teams collected all required measurements and returned home on August 27, 2021
- Water Quality team returned to field post Ida on September 12-24, 2021
- JPL & UNC ADCP teams returned to field post Ida on September 20-25, 2021 to retrieve water level gauges and do a few remaining ADCP transects
- Last day of fall campaign: September 25, 2021!

Final Schedule

Date	Day	Target Area & Condition	On Station Times (CT)	AVIRIS-NG
8/17/2021	Tue			
8/18/2021	Wed			
8/19/2021	Thu			
8/20/2021	Fri			
8/21/2021	Sat	Atchafalaya high tide (AirSWOT only)	6:00 AM	
8/22/2021	Sun	MOVE/Atchafalaya receding tide (AirSWOT only)	3:00 PM	
8/23/2021	Mon	Terrebonne East high tide (AirSWOT only)	10:00 AM	
8/24/2021	Tue	Terrebonne West high tide (AirSWOT only)	11:30 AM	
8/25/2021	Wed			
8/26/2021	Thu			
8/27/2021	Fri			
8/28/2021	Sat			
8/29/2021	Sun	Hurricane Ida Landfall		
8/30/2021	Mon			
8/31/2021	Tue			
9/1/2021	Wed	Terrebonne East rec tide (UAVSAR & AirSWOT)	9:30 AM	
9/2/2021	Thu	DOWN DAY due to weather and aircraft maintenance		
9/3/2021	Fri	Terrebonne West rec tide (UAVSAR & AirSWOT)	10:00 AM	
9/4/2021	Sat	Terrebonne East rec tide (UAVSAR & AirSWOT)	11:00 AM	
9/5/2021	Sun	Atchafalaya receding tide (UAVSAR & AirSWOT)	3:00 PM	
9/6/2021	Mon	HARD DOWN		
9/7/2021	Tue	Terrebonne East high tide (UAVSAR & AirSWOT)	9:30 AM	
9/8/2021	Wed	BAD TIDES - DOWN		
9/9/2021	Thu	BAD TIDES - DOWN		
9/10/2021	Fri	BAD TIDES - DOWN		
9/11/2021	Sat	Terrebonne West high tide (UAVSAR & AirSWOT)	11:00 PM	
9/12/2021	Sun	Atchafalaya high tide (UAVSAR & AirSWOT)	9:30 PM	
9/13/2021	Mon			

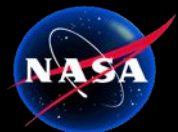
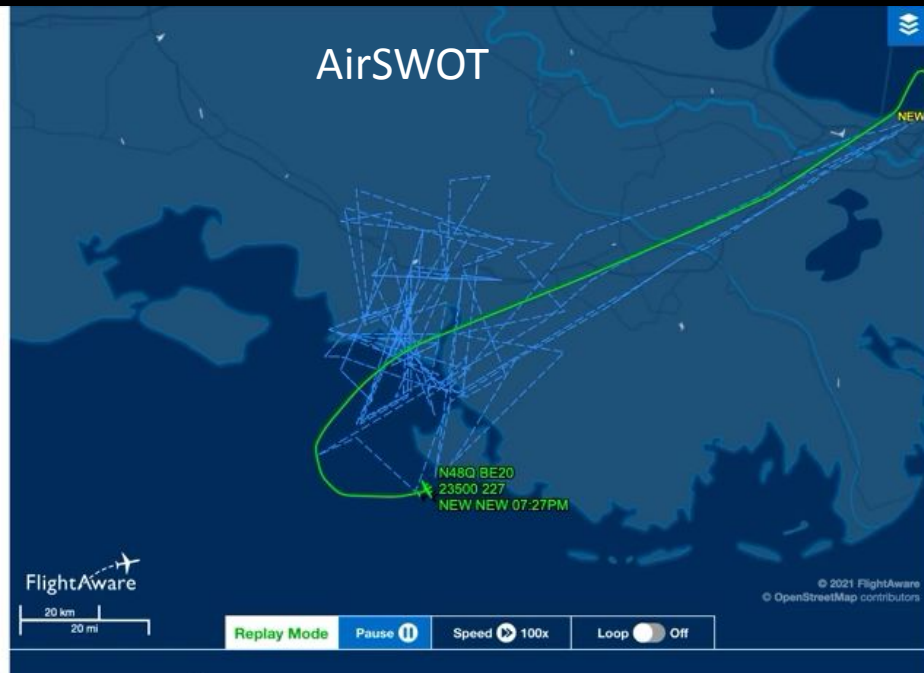


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Legend	
	UAVSAR/AirSWOT Atchafalaya flight day
	UAVSAR/AirSWOT Terrebonne flight day
	AVIRIS-NG flight day

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Pirouettes in the sky



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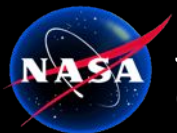
Two Dynamic Aviation Aircraft



AVIRIS-NG: view of the Atchafalaya River

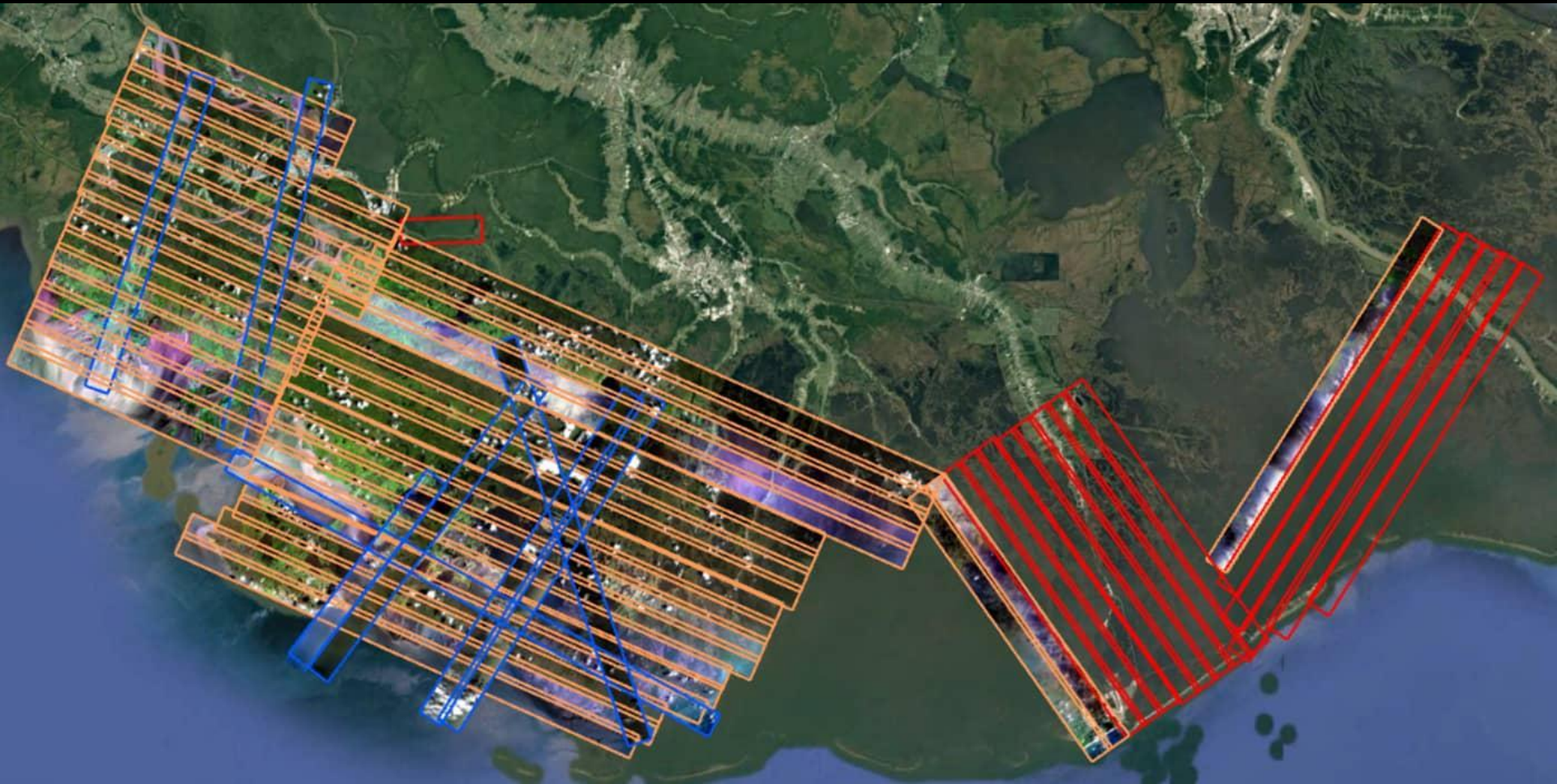


AirSWOT: view of the Terrebonne basin



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Delta-X's AVRISNG Coverage



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