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

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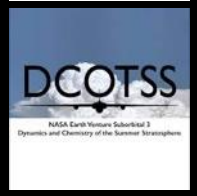
Solving pressing Earth system Science issues: NASA's Earth Venture Suborbital – 3

(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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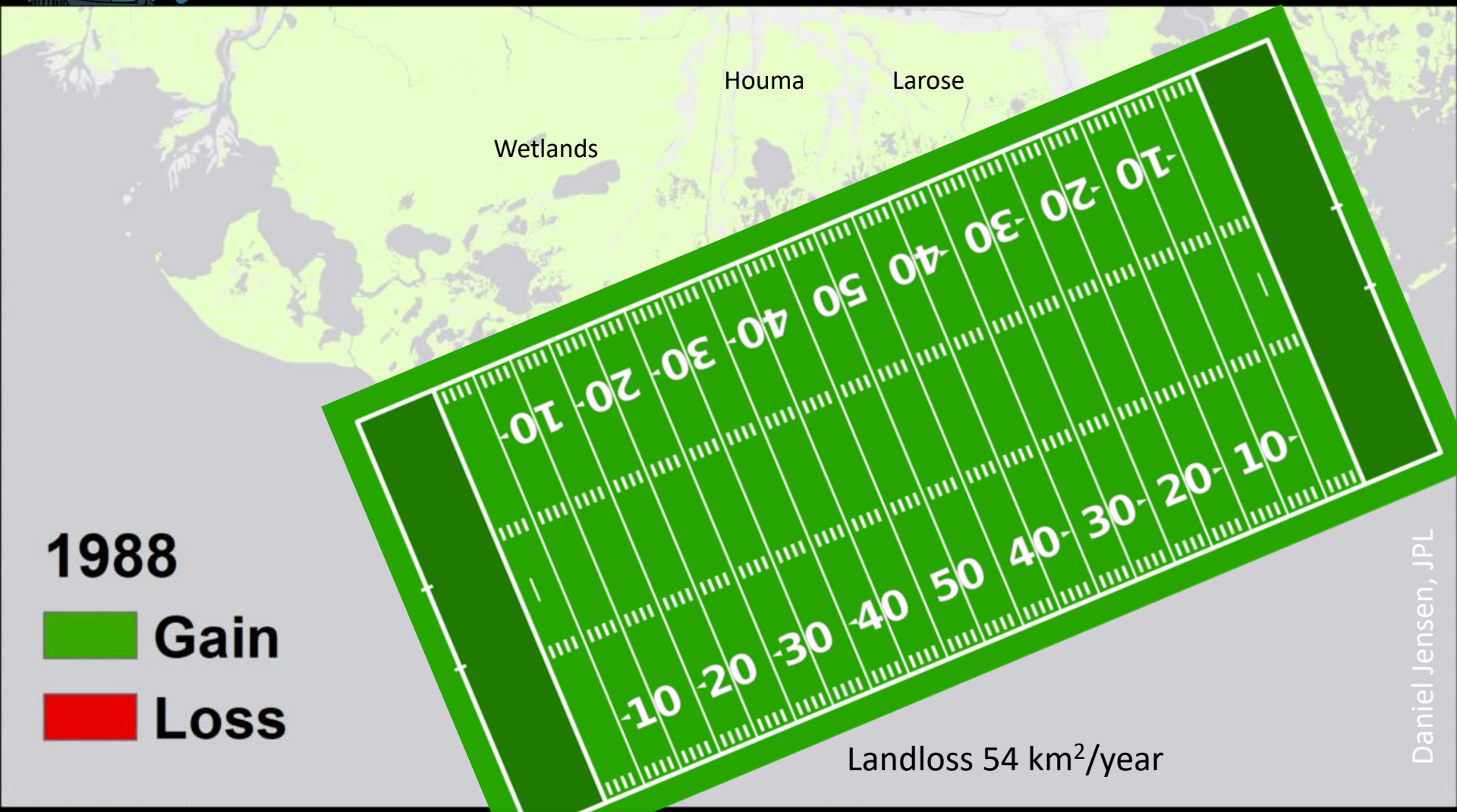

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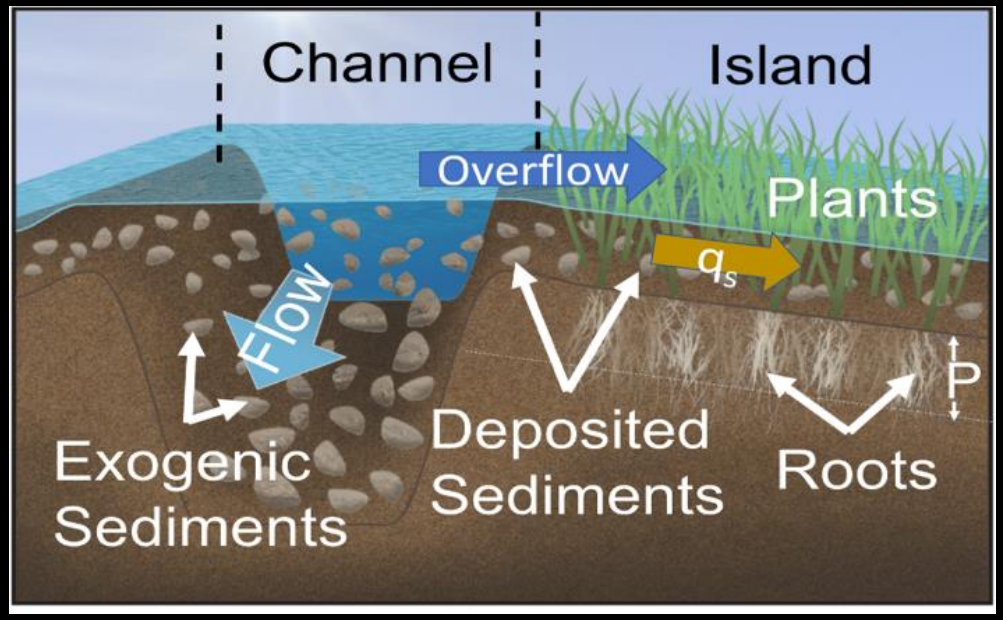
Delta-X goal:

To predict which parts of the Mississippi River Delta will keep up with sea level rise and which part will drown.

To achieve that goal, Delta-X develops a model that simulates the two processes that contribute to soil elevation:

1. **Sediment delivery to wetlands and;**
2. **Organic matter produced by vegetation.**



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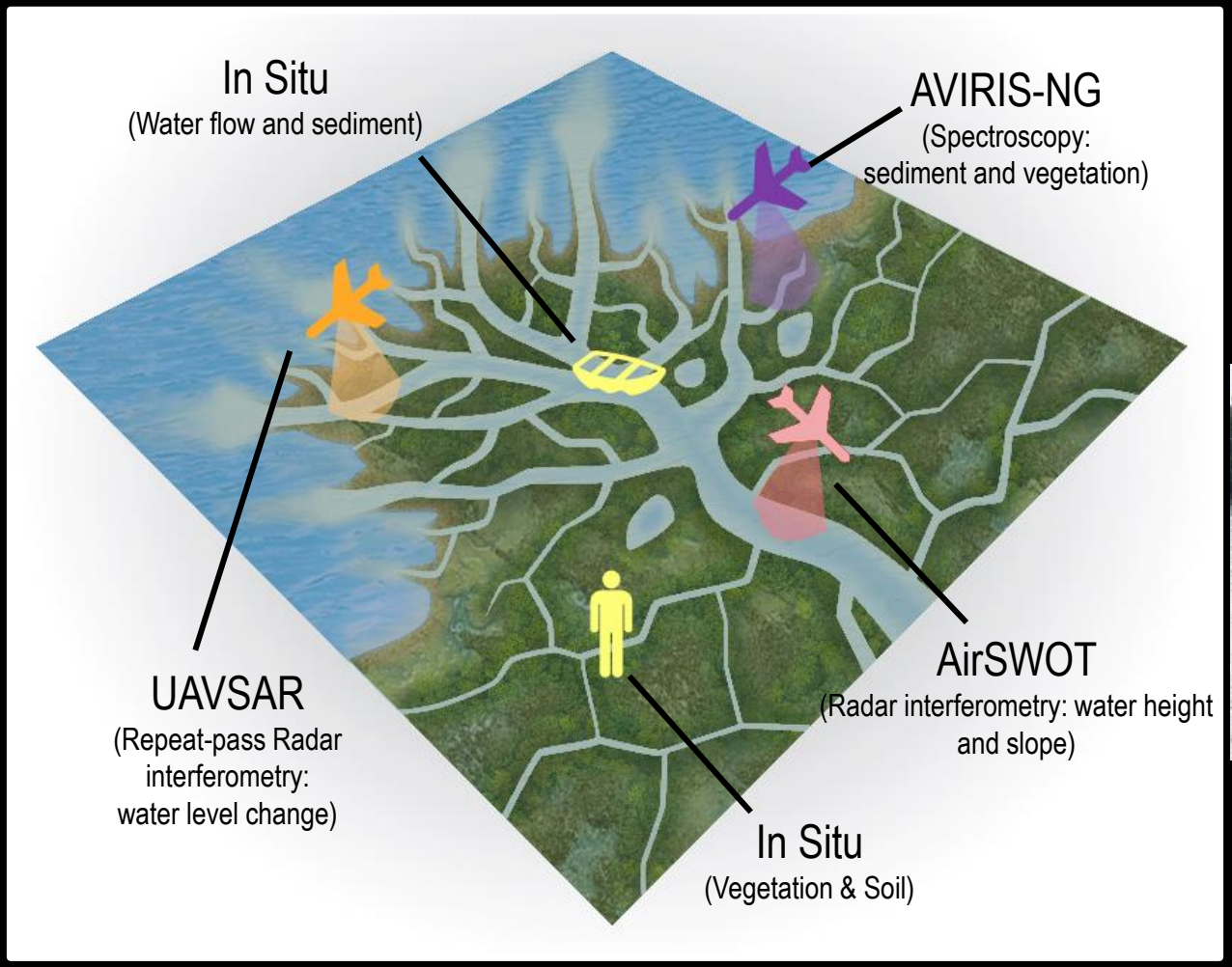
12 Co-Investigators from 8 different institutions from 6 coastal states

- **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)
- **Massachusets**:
  - Boston University (C. Fichot & S. Fagherazzi)
  - Woodshole Oceanographic institution (L. Giosan)

Earth Venture Suborbital 3 Delta-X



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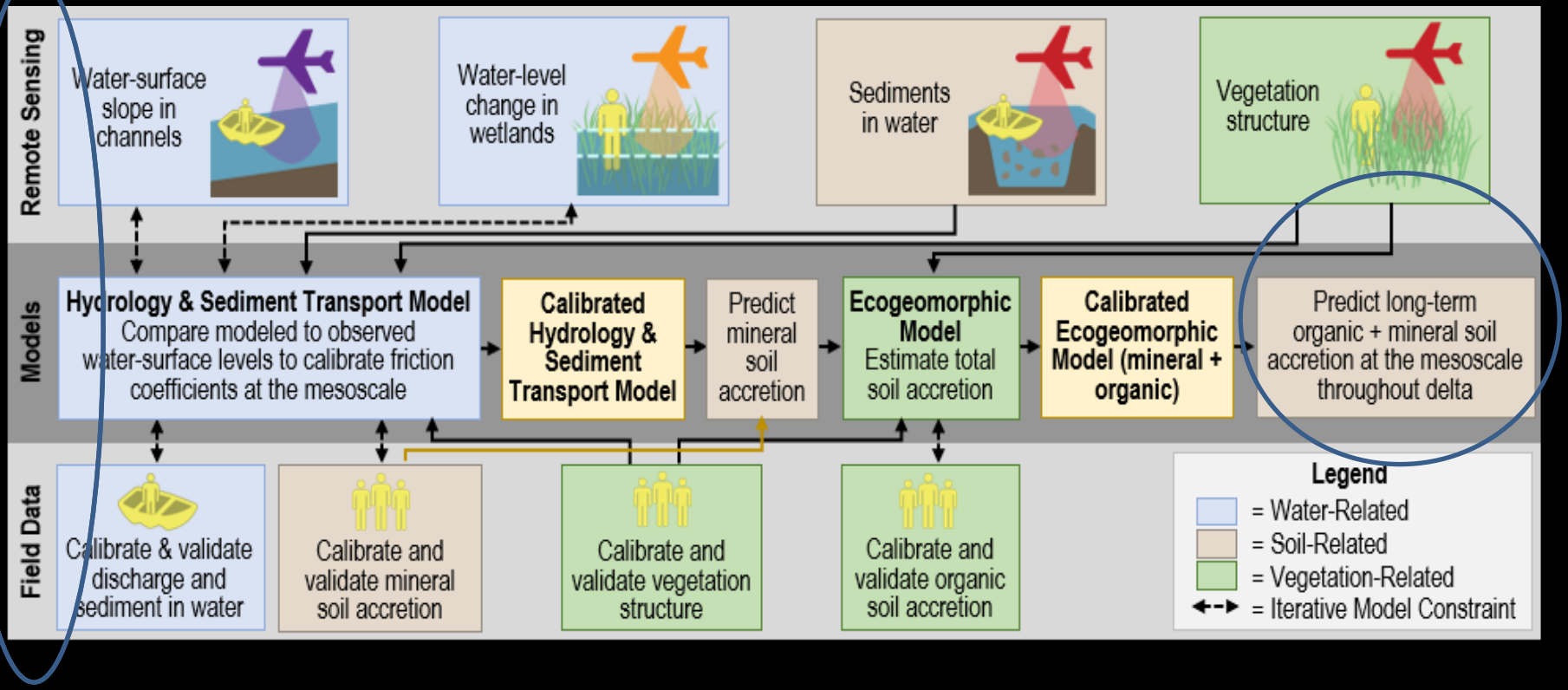
The Delta-X Framework Implementation



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Airborne Remote Sensing Instruments

UAVSAR (for NISAR)

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

AirSWOT (for SWOT)

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

AVIRIS-NG (for SBG and more)

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

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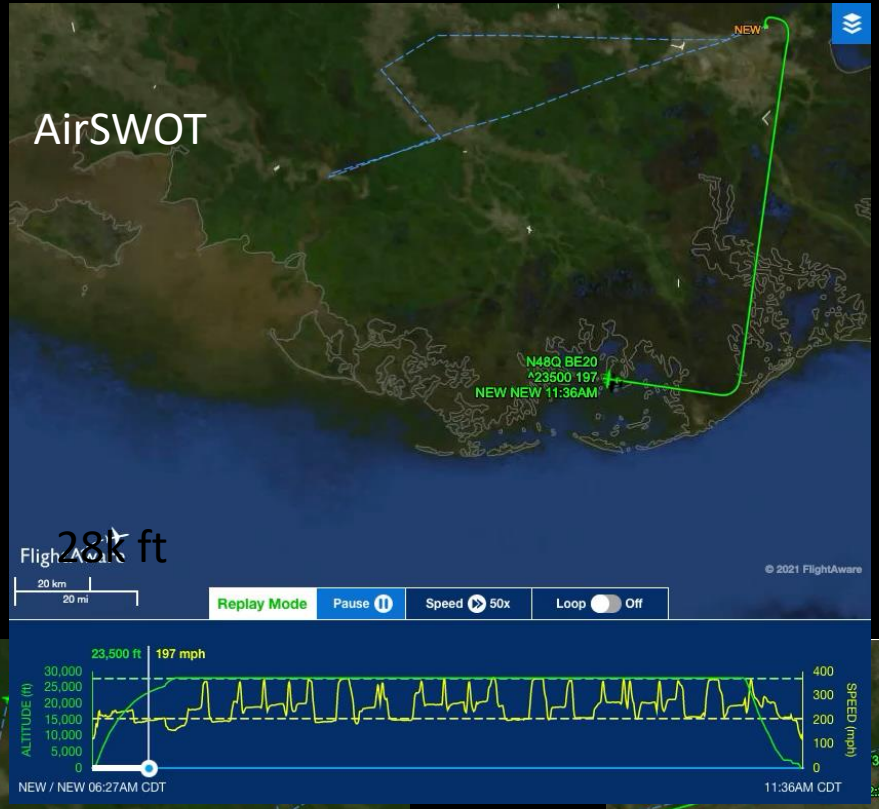
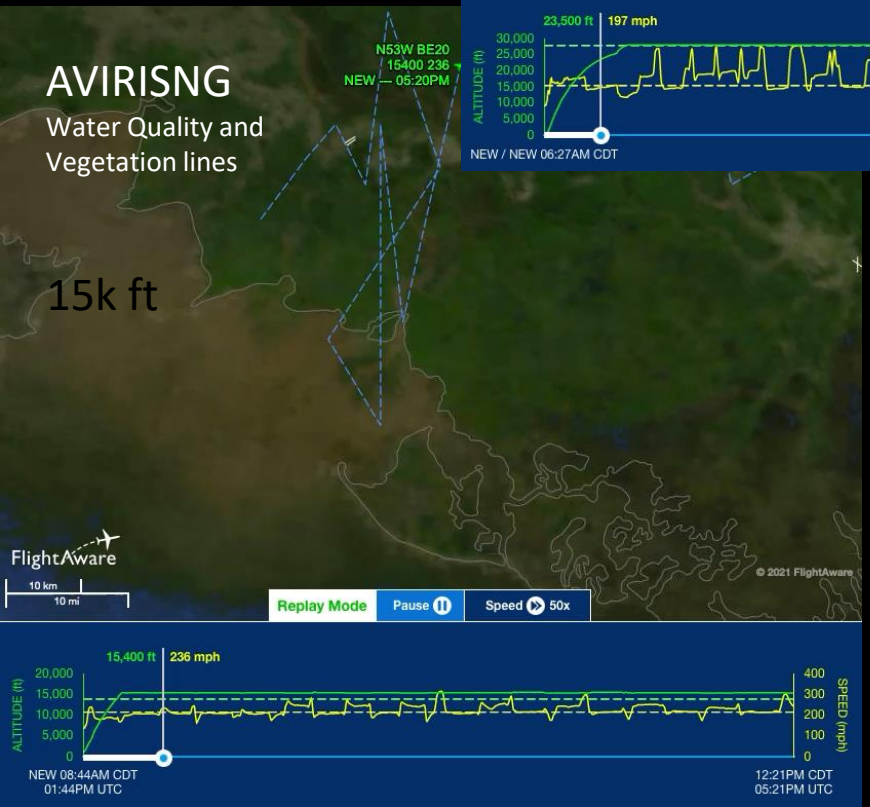
Delta-X Airborne Campaign

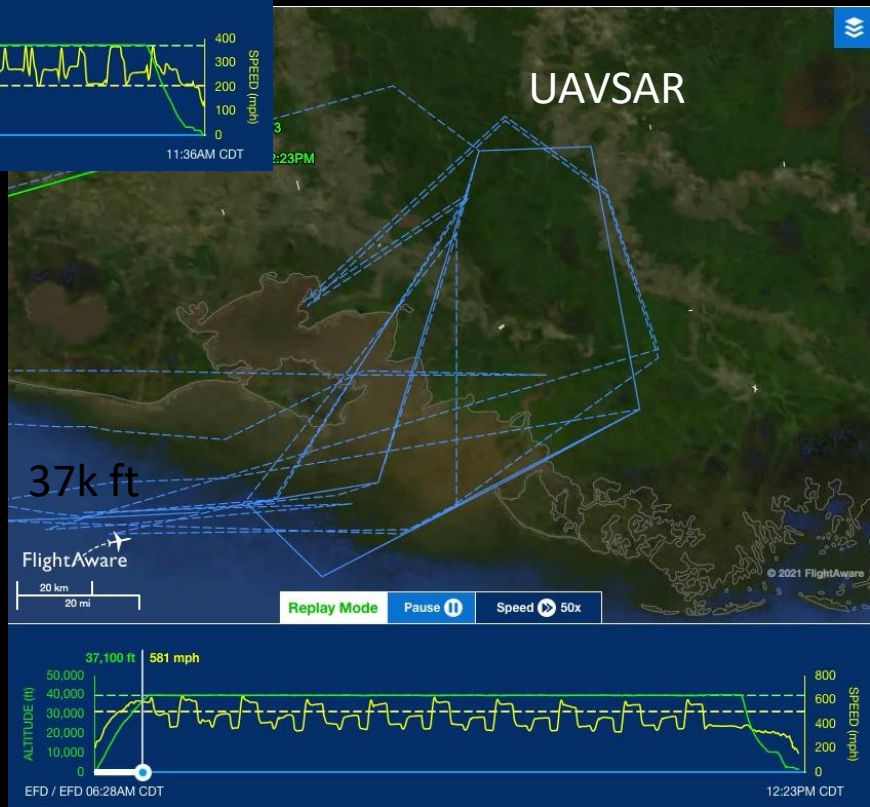
- Spring campaign 2021: March 21st - April 22nd (including in situ)
  - 3/27/21 - 4/6/21 AVIRIS-NG flights
  - 3/26 - 4/18 AirSWOT flights
  - 3/27 – 4/18 UAVSAR flights.
- Fall campaign 2021: August 16th - September 26th (including in situ)
  - 8/21/21-9/12/21 AirSWOT flights
  - 9/1/21-9/12/21 UAVSAR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

Example flight patterns: April 1st

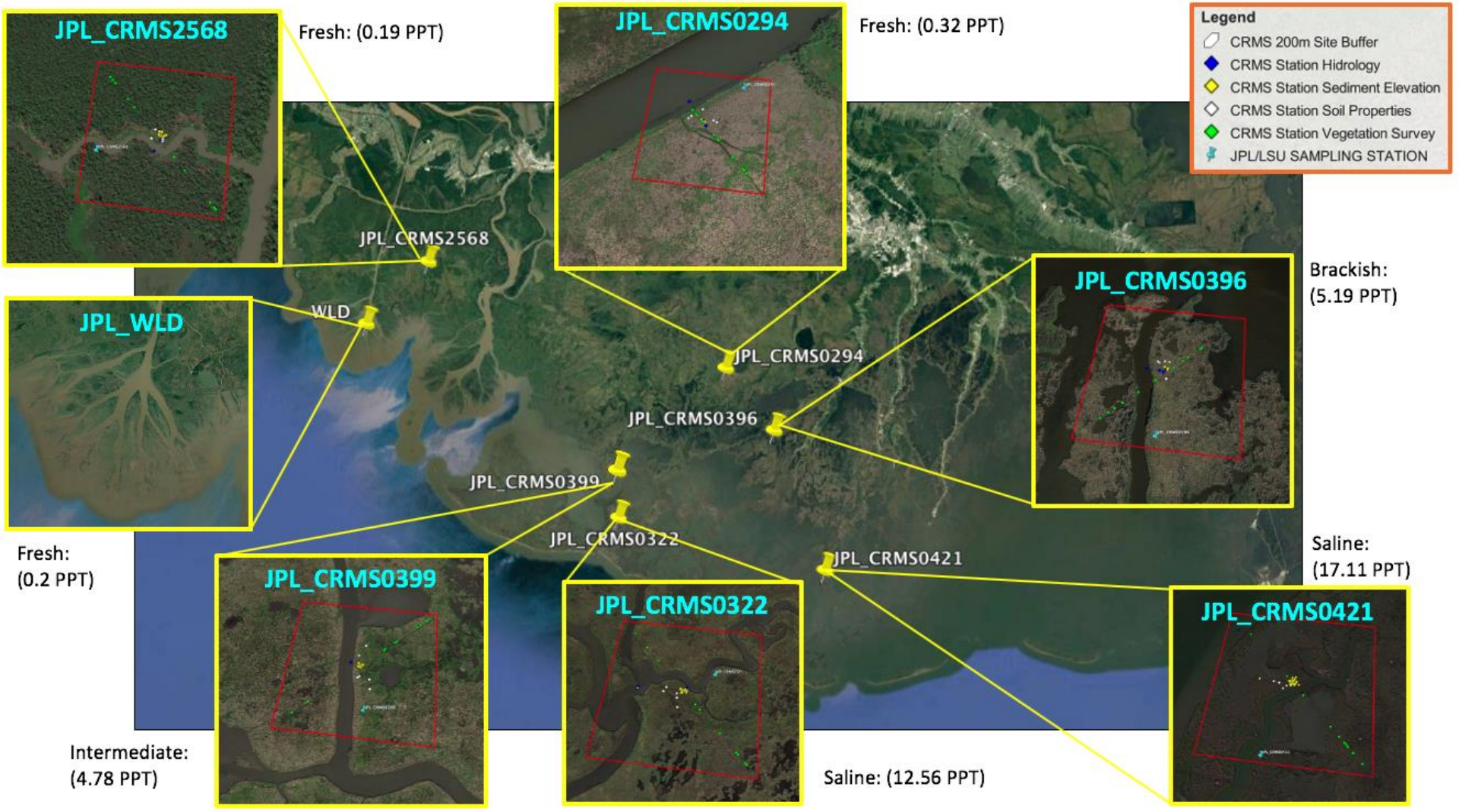


These patterns were repeated 3 times to capture around high, low and receding tides. (nb: pattern differs in each of the 3 regions)





Location of the 7 Delta-X Intensive Study Sites



Diversity of Vegetation Types

Hydrogeomorphic zones are defined from ground elevation with respect to mean water level. These zones control hydrology and vegetation type.

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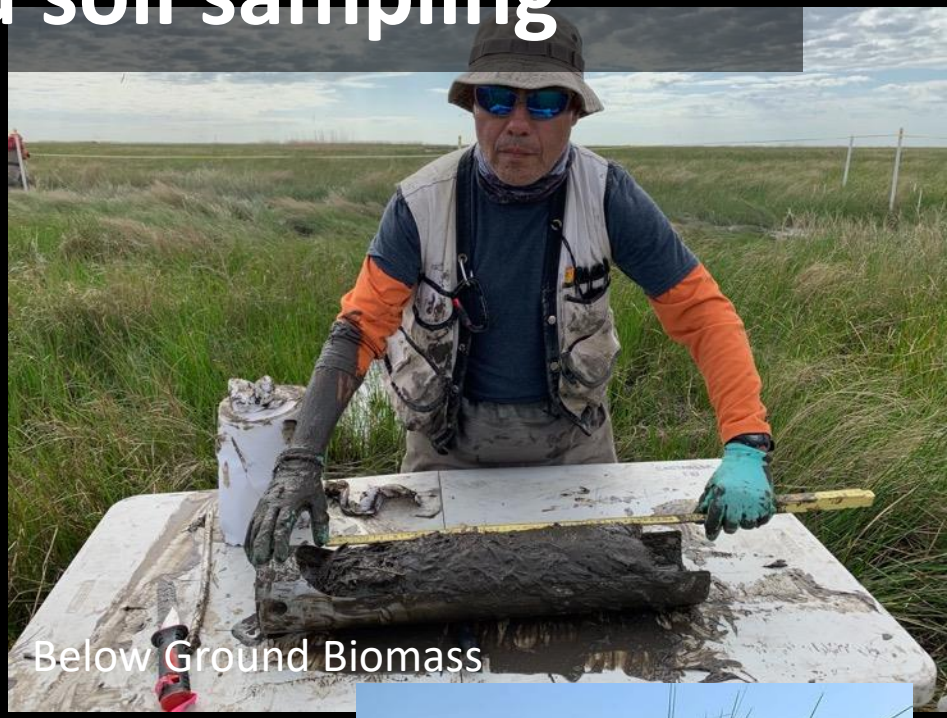
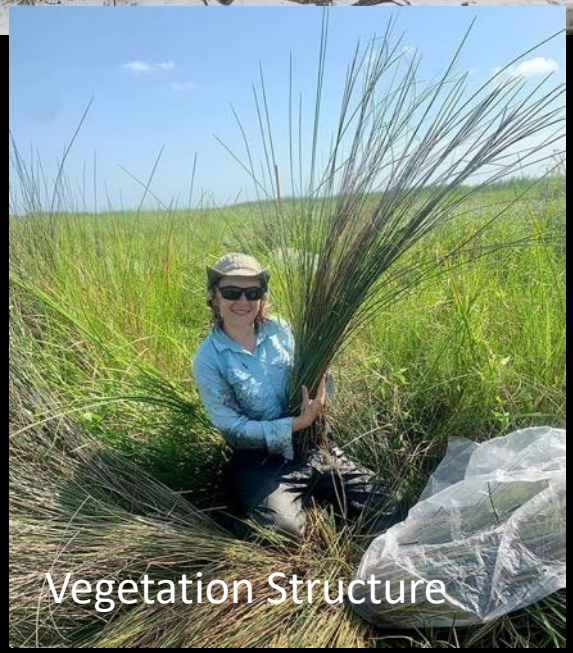
Vegetation and soil sampling



Below Ground Biomass

Feldspar

Soil Accretion



Vegetation Structure

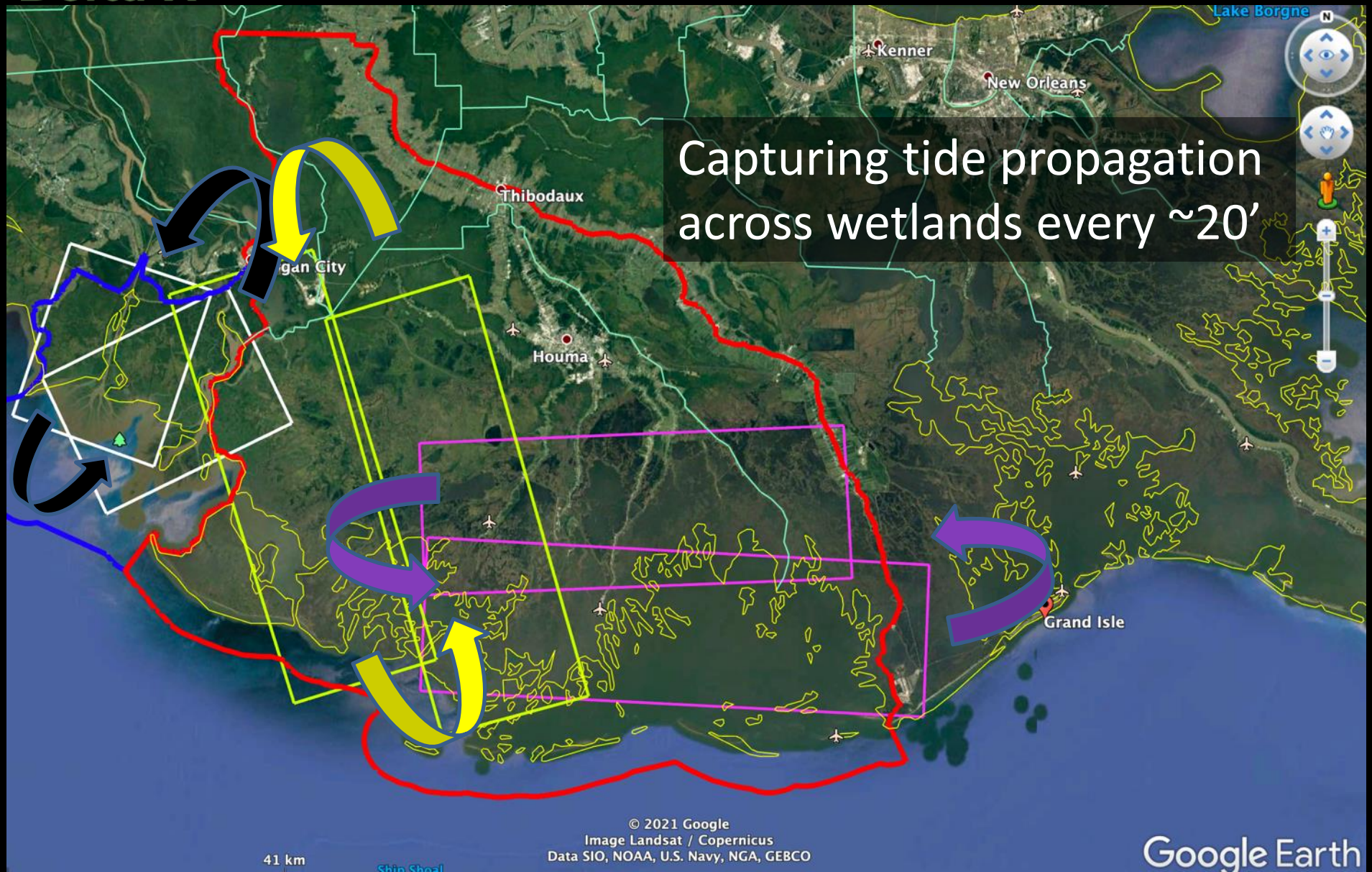
Water Quality And Dynamics


Water Quality

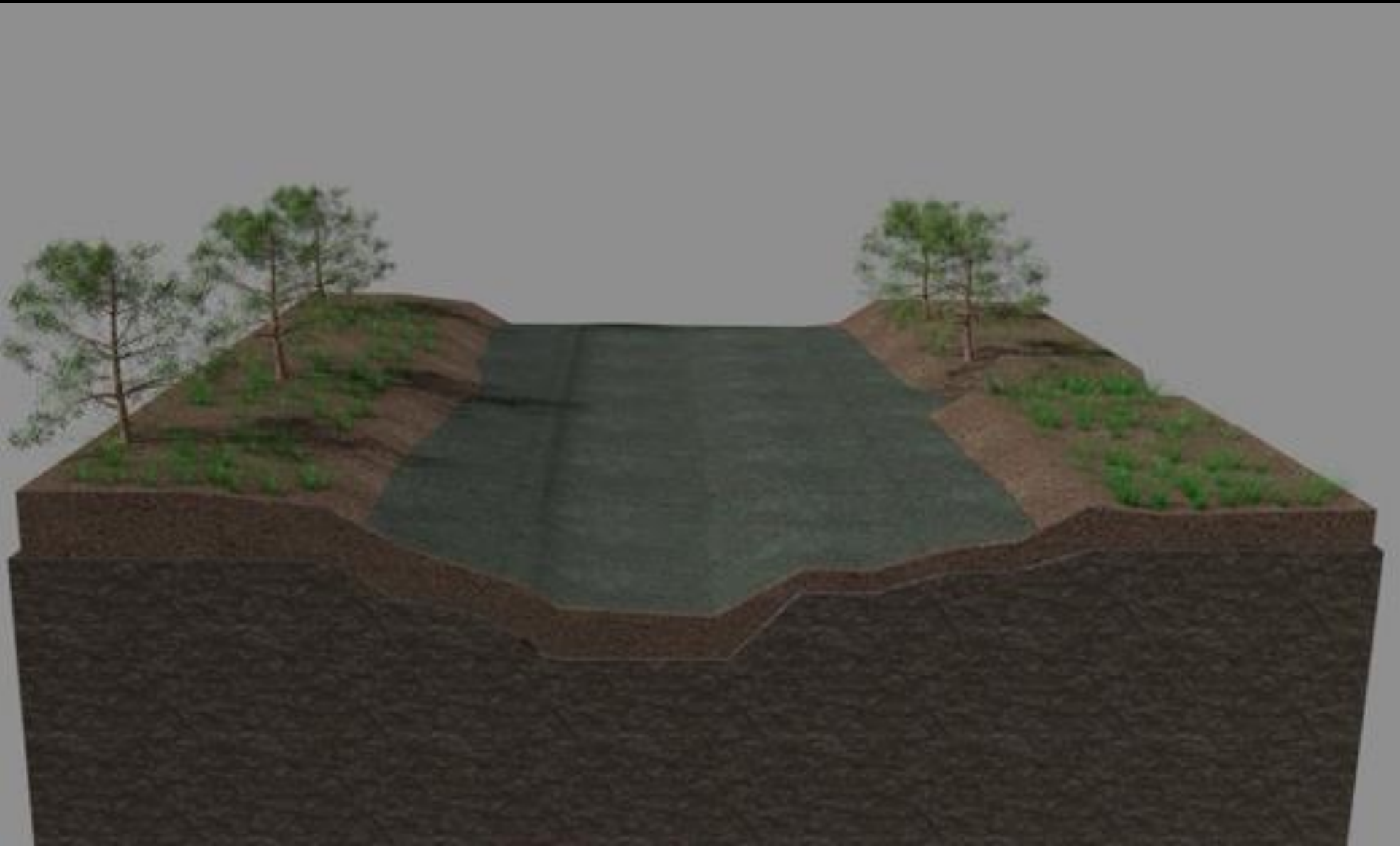

Water Flow (ADCP)

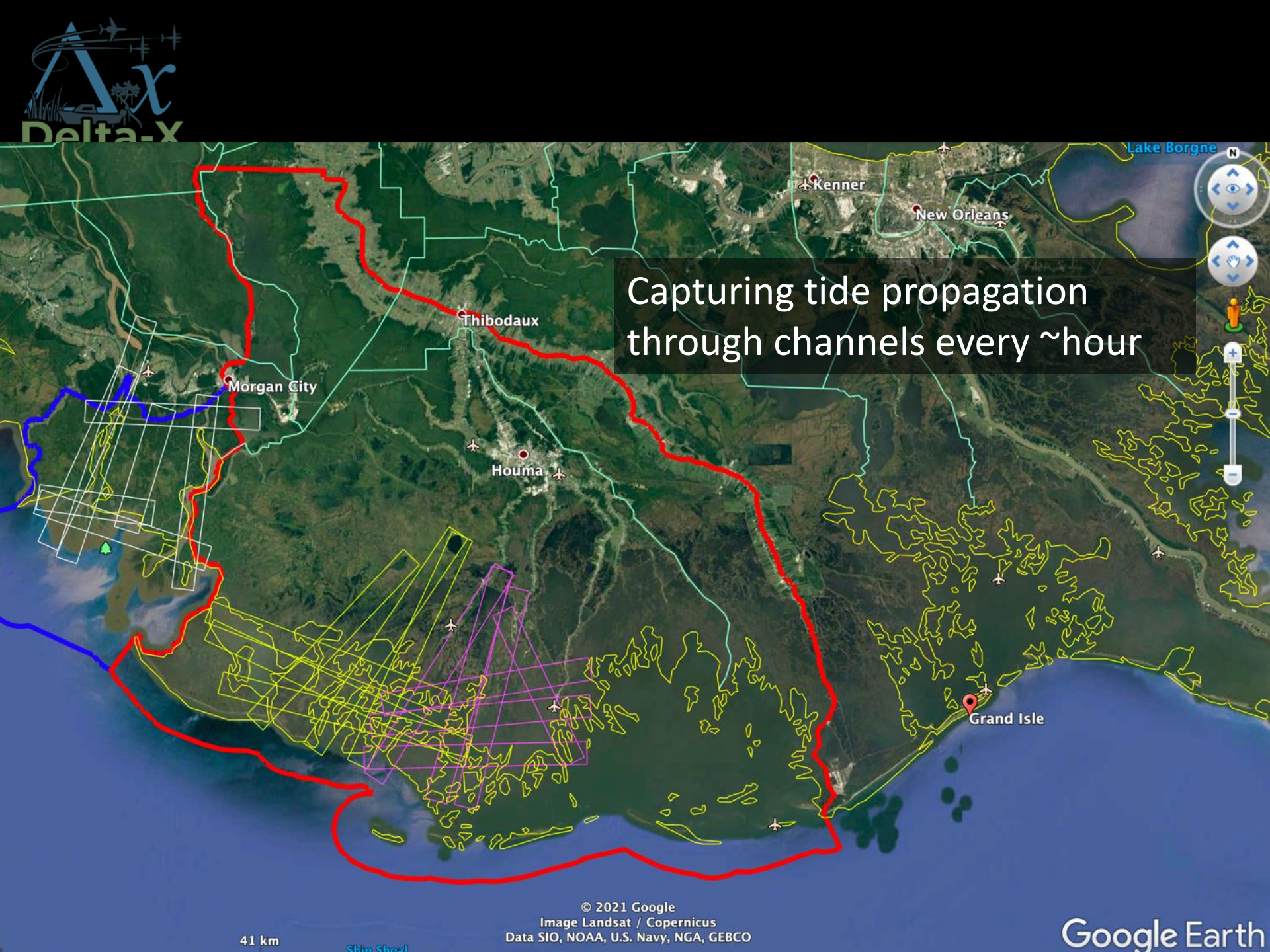

Water Level


Water Flow, turbity, grain size distribution


Delta-X
Capturing tide propagation across wetlands every ~20’
Lake Borgne
Kenner
New Orleans
Thibodaux
Houma
Grand Isle
© 2021 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
41 km
Google Earth

Repeat Radar Measurements as tides come in-and-out of the wetlands




Capturing tide propagation through channels every ~hour
Kenner
New Orleans
Lake Borgne
Thibodaux
Morgan City
Houma
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Delta-X
Lake Borgne
Kenner
New Orleans
Thibodaux
Morgan City
Houma
Grand Isle
Captured tide propagation around high, low and receding stages simultaneously in channels & wetlands
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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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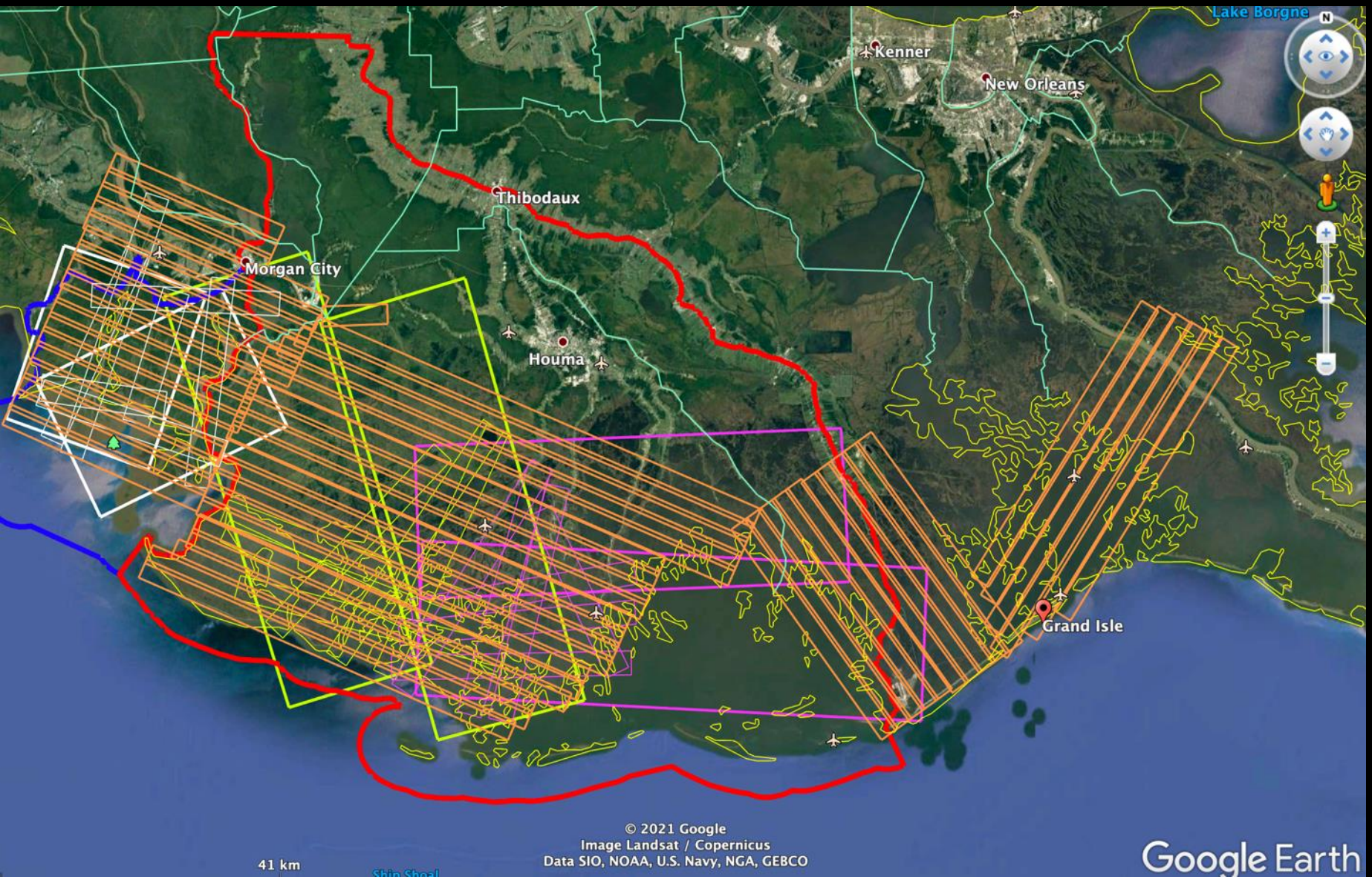
Delta-X


Lake Borgne
Kenner
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Thibodaux
Morgan City
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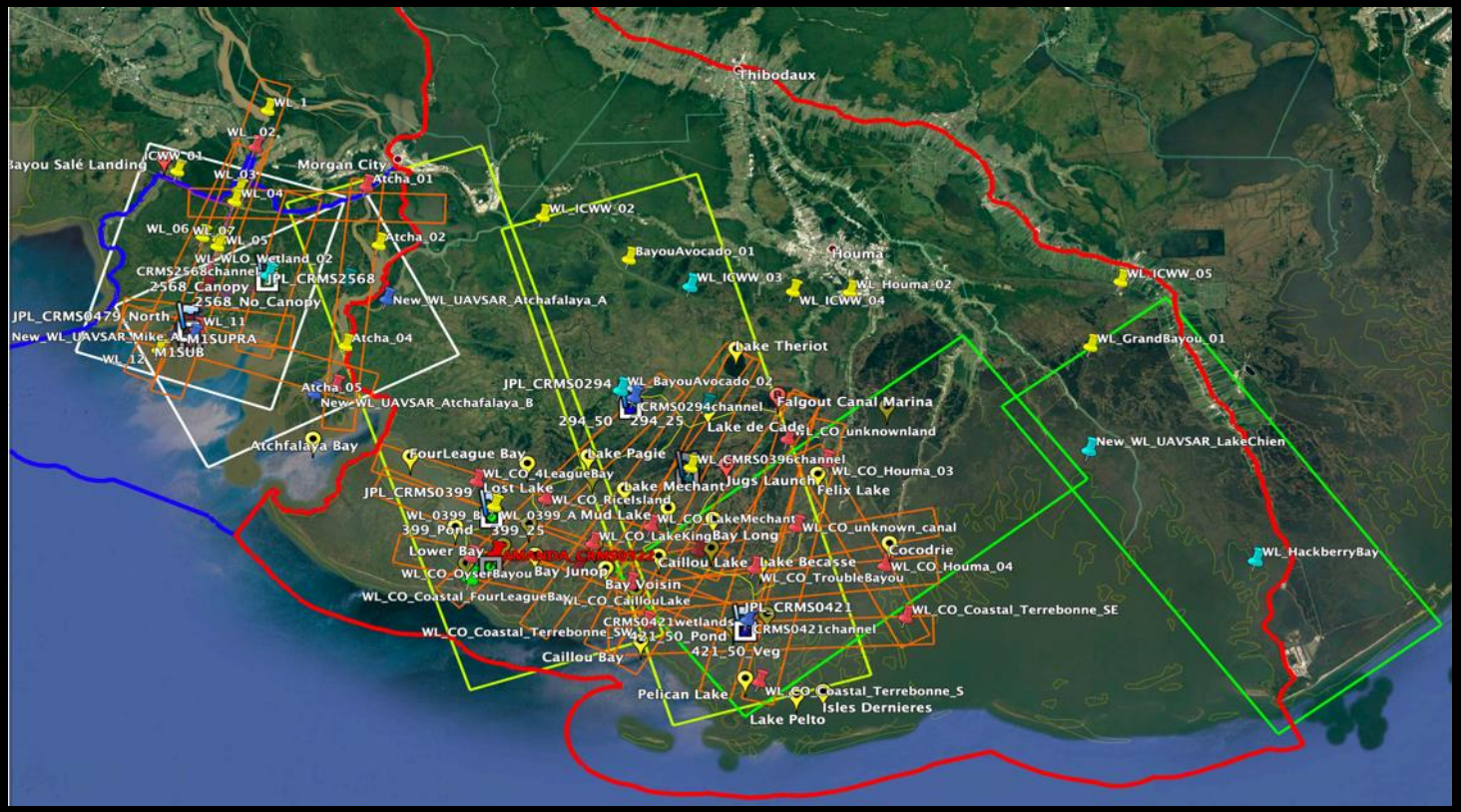
Google Earth

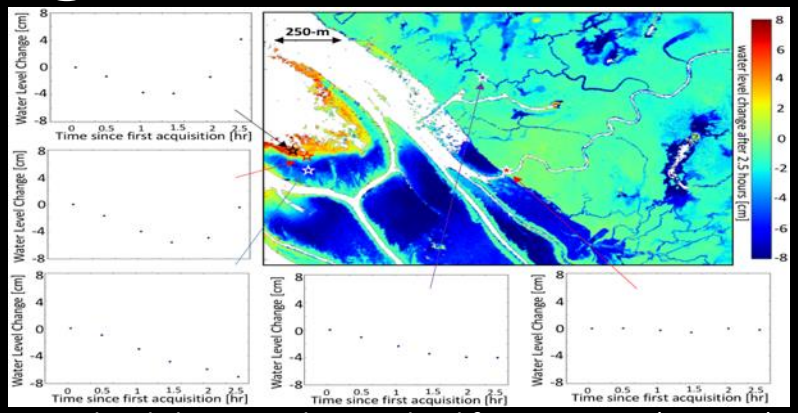
Flight Plans: AVIRIS-NG, AirSWOT, UAVSAR



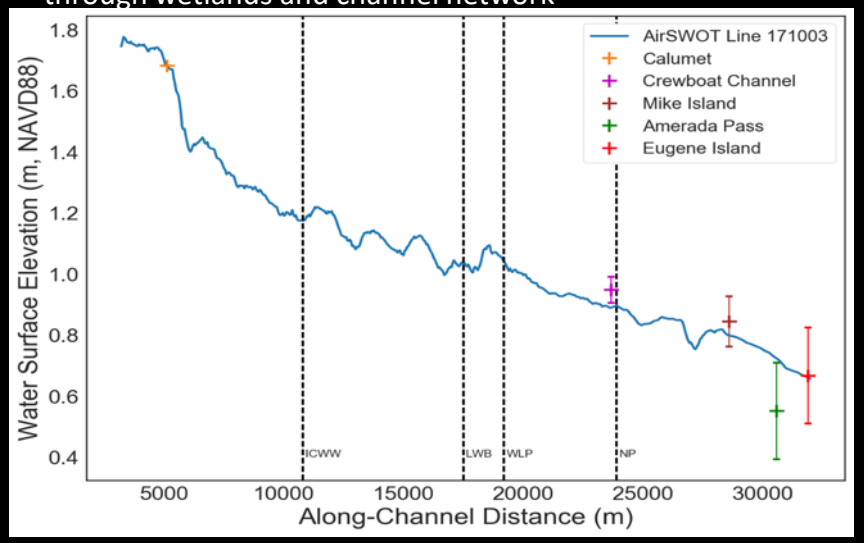
UAVSAR (white,yellow,green boxes) and AirSWOT (orange boxes) flight plans. Each UAVSAR box represents the area this is imaged 5-8 times during each flight. AirSWOT and UAVSAR fly at the same time in 9 (6) flights during the Fall campaign. Yellow and red markers are Delta-X water level gauges for hydrodynamic modeling and AirSWOT and UAVSAR cal/val. Small lozenges are CRMS stations (water level, weather, plant data) Not all field instrumentation / sites are shown.

Summary:
Remote Sensing Measurements

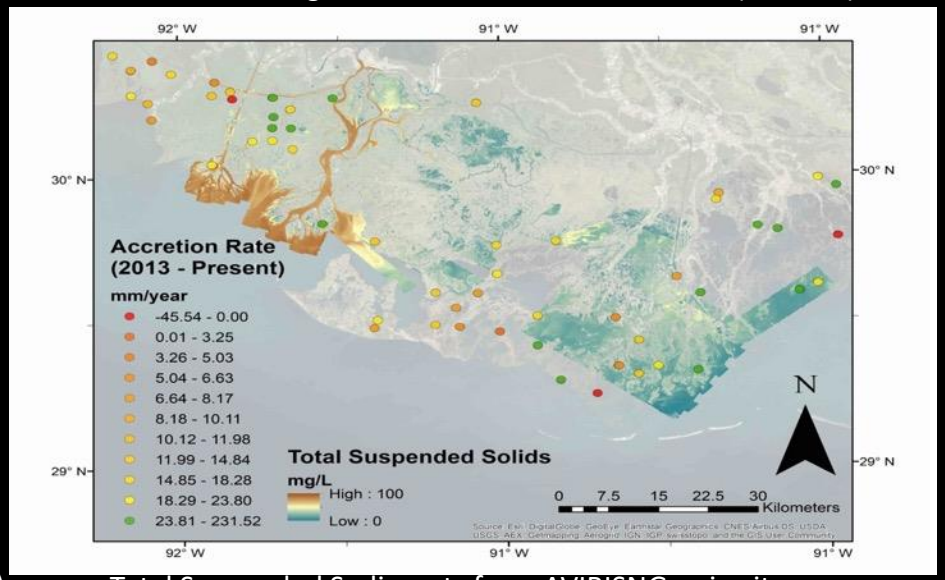
Flight during rising and falling tide to capture water seeping through wetlands and channel network



Water level change within wetland from UAVSAR (to 5mm)



Water surface slope measurement from AirSWOT (1cm/km)



Total Suspended Sediments from AVIRISNG vs in situ accretion rates within 20mg/L

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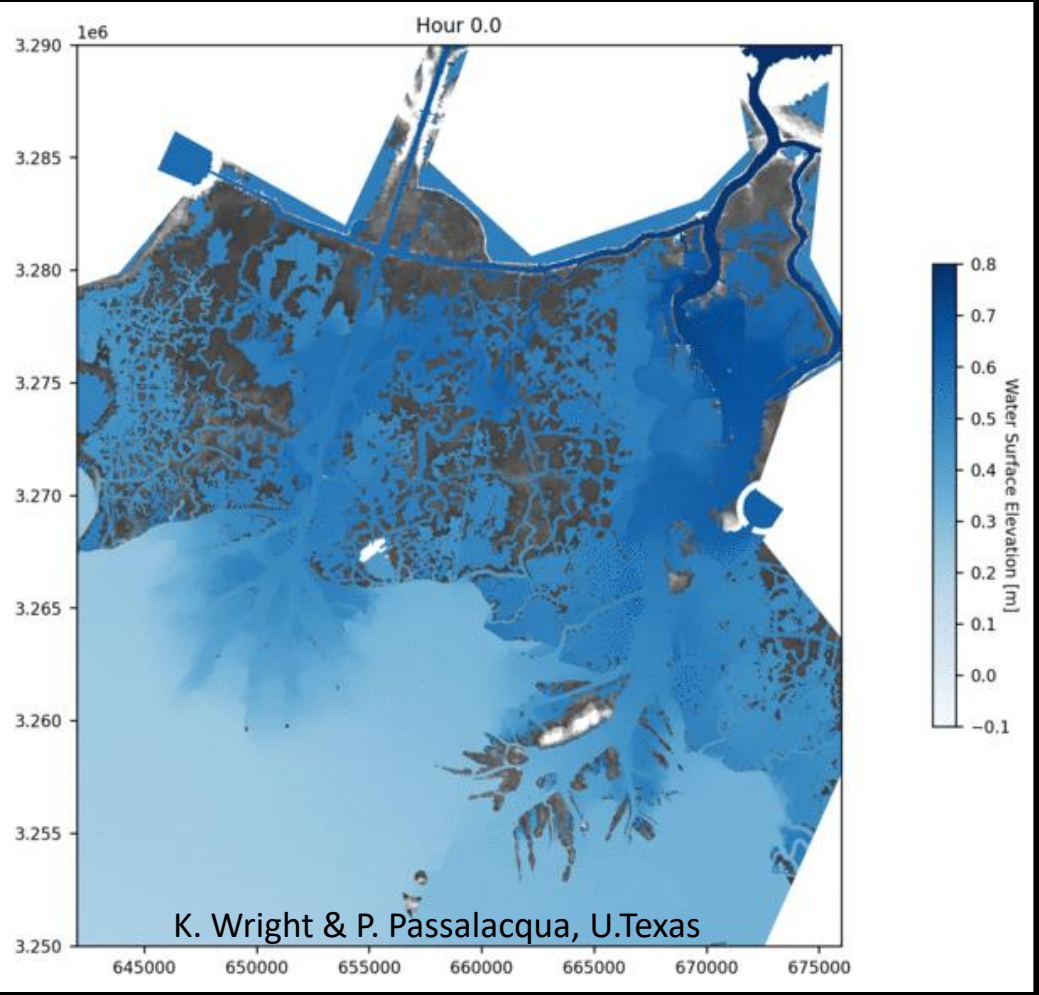
Hydrodynamic Models

(Atchafalaya Basin)



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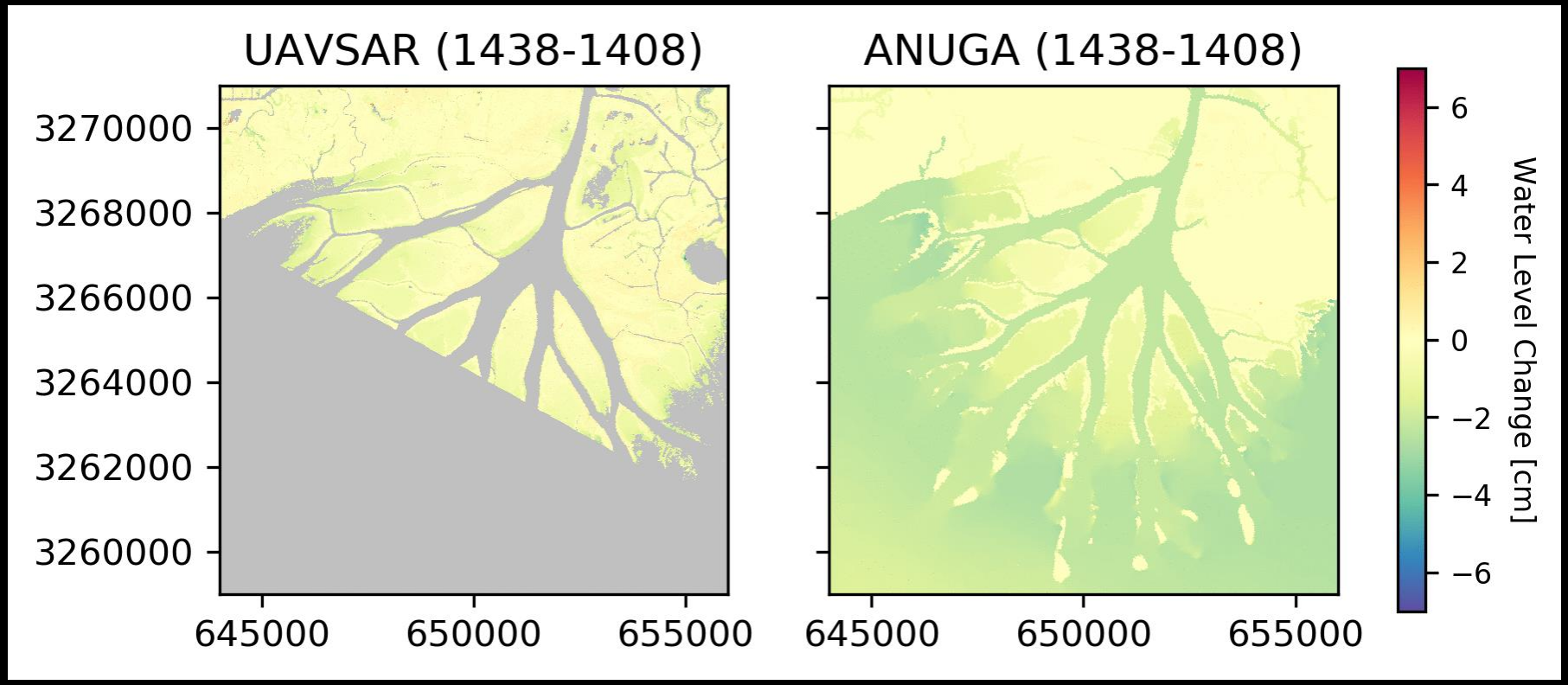
Model calibration and validation



Observed (UAVSAR and AirSWOT) and modeled (U. Boston and U. Texas) water level changes.

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Public Access to All Data and Models

- Last in situ field campaign in Fall 2023 to validate model.
- Delivery of L4 calibrated hydrodynamic models (September 25th, 2023)
- End of project April 2025

Agenda: Open Data Workshop

10:00 – 10:15 am Introduction Marc Simard
10:15 – 10:50 am Data Access Matt Donovan, Yaxing Wei
10:50 – 11:00 am Aboveground Biomass Daniel Jensen
11:00 – 11:10 am Water Level Change Talib Oliver Cabrera
11:10 – 11:20 am Water Level Michael Denbina
11:20 – 11:30 am Sediment Accretion Robert Twilley, Andre Rovai
11:30 – 11:40 am Vegetation Data Edward Castaneda, Elena Solohin
11:40 – 11:50 am DEM Alexandra Christensen
11:50 – 12:00 pm Modeling Hydrodynamics Using ANUGA Paola Passalacqua, Antoine Soloy
12:00 – 12:20 pm Discussions & Question