Jet Propulsion Laboratory
California Institute of Technology

Lessons Learned from a multi-aircraft airborne and In situ campaign in the Mississippi Delta: **10 recommendations**

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Christine Lyon, Tamlin Pavelsky

Global Distribution of Blue Carbon Ecosystems

Recommendation #1

Coastal regions, river deltas and estuaries should be considered in SWOT masks

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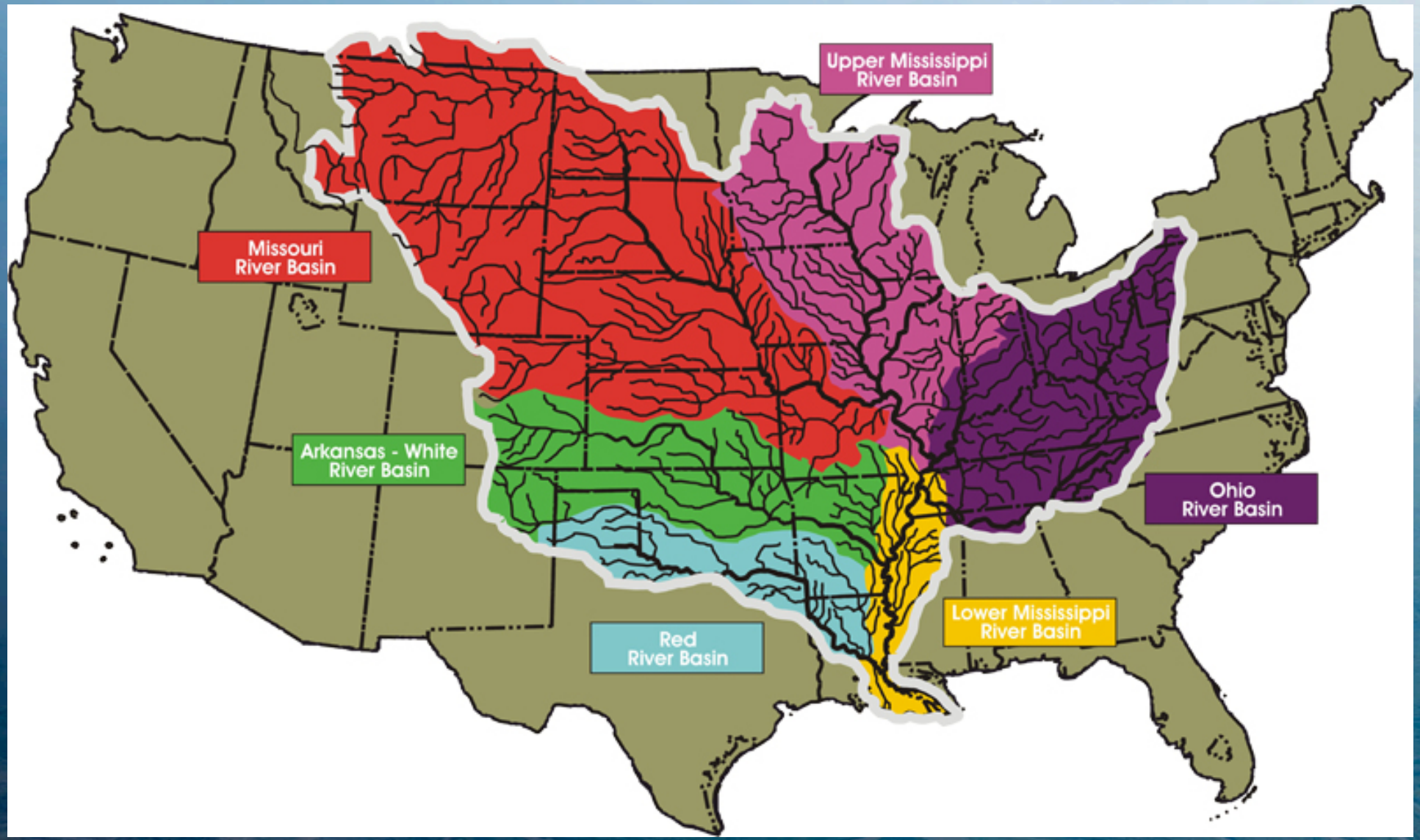

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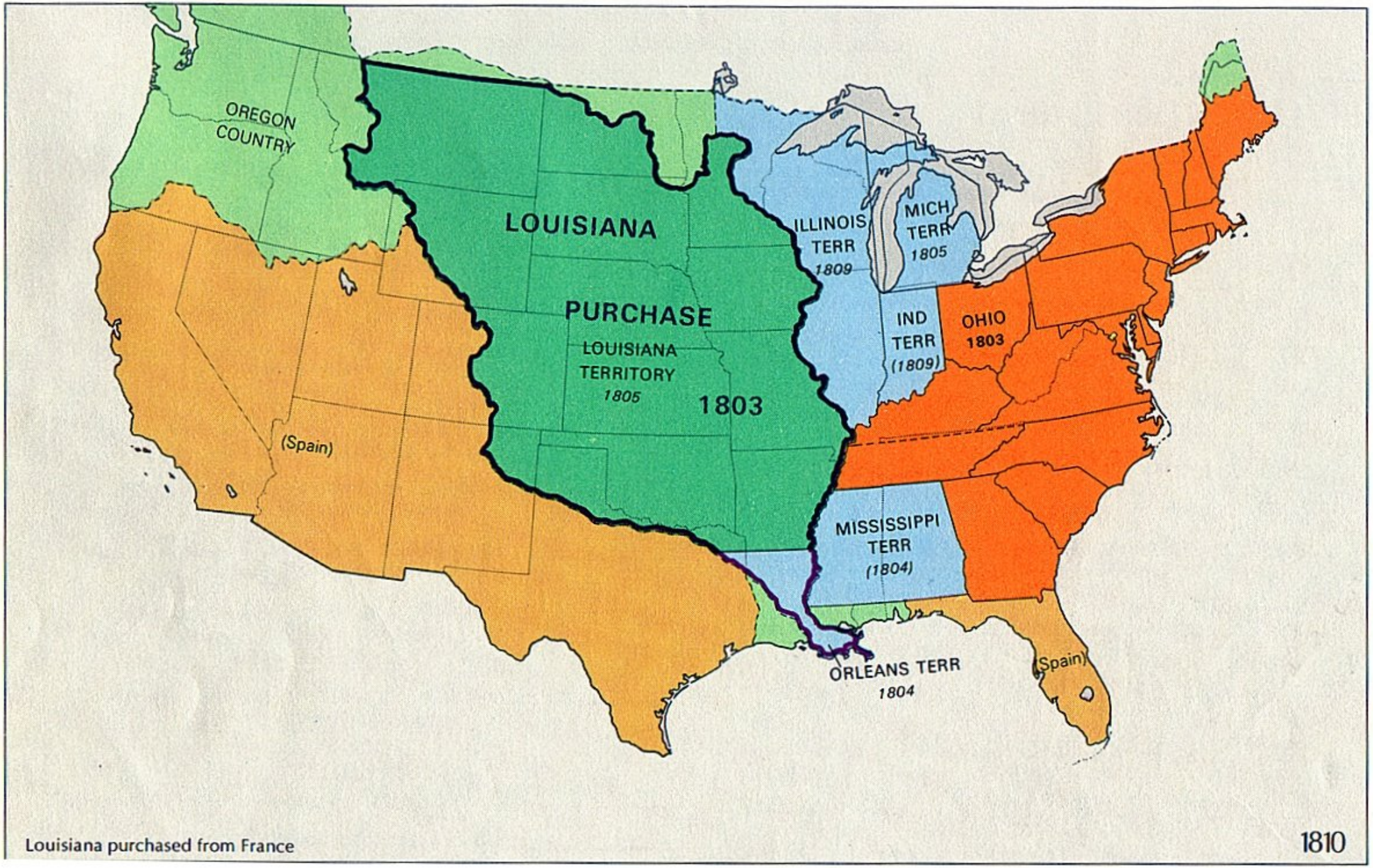
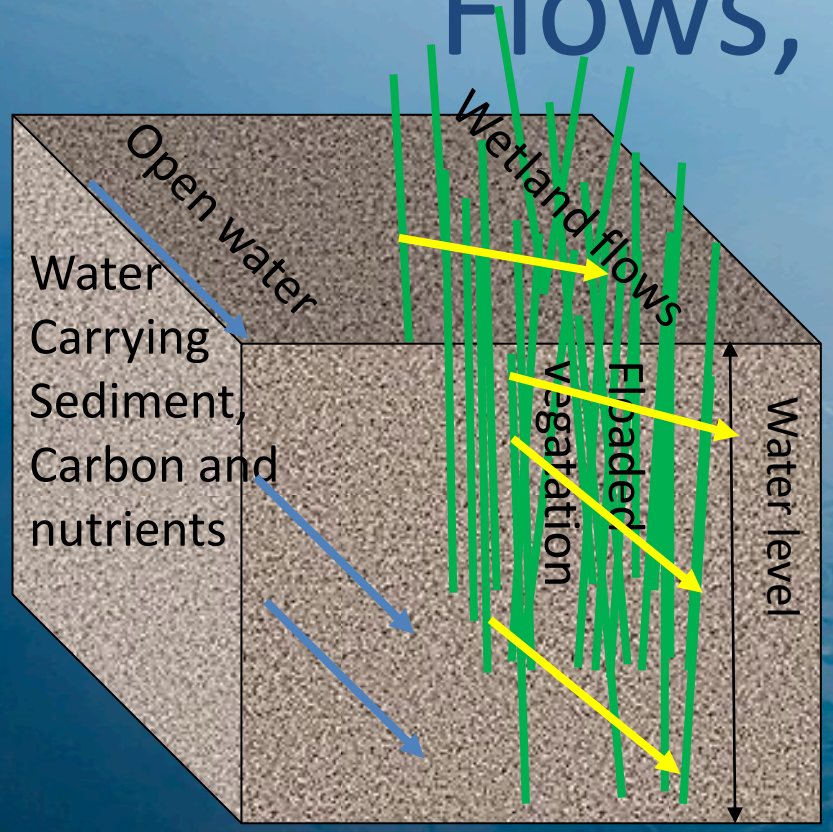
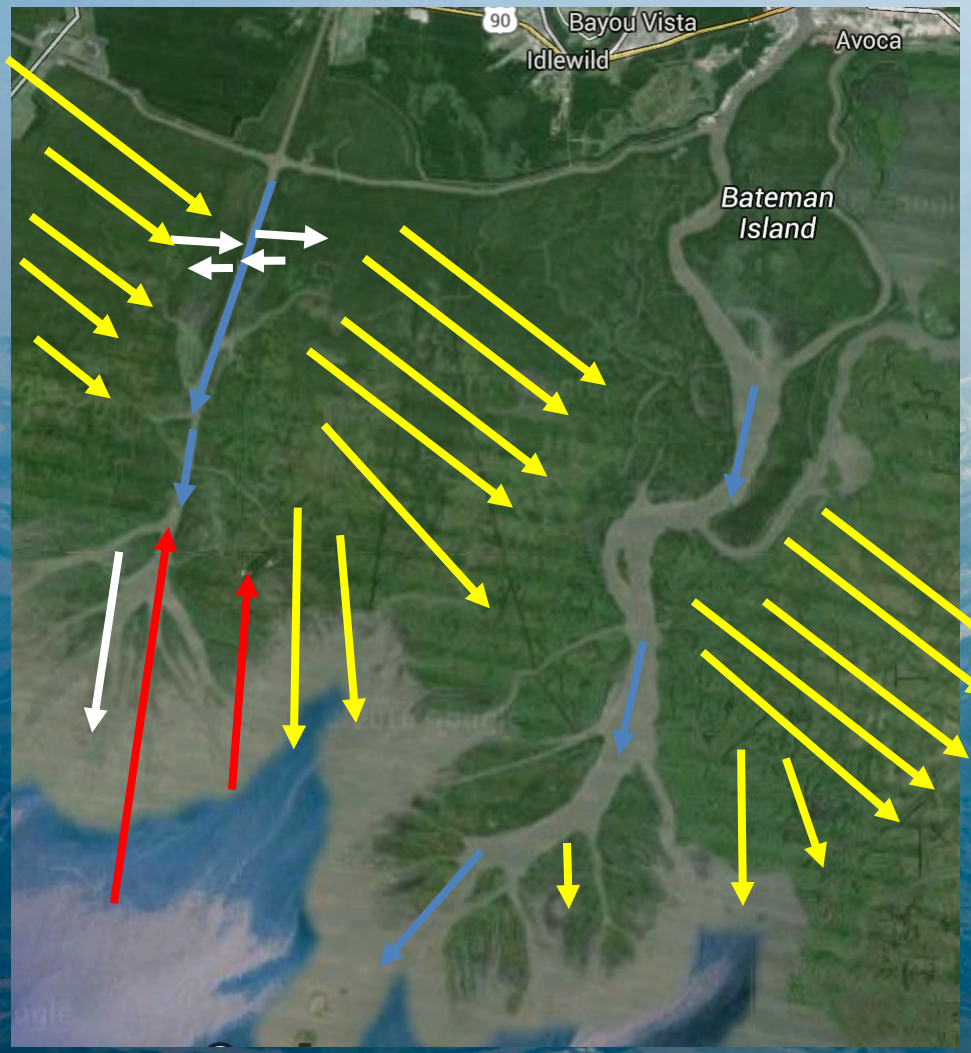

OREGON COUNTRY
LOUISIANA
PURCHASE
LOUISIANA TERRITORY
1805
1803
(Spain)
ILLINOIS TERR
1809
MICH TERR
1805
IND TERR
(1809)
OHIO
1803
MISSISSIPPI TERR
(1804)
ORLEANS TERR
1804
(Spain)
Louisiana purchased from France
1810

Flows, Everywhere





Discharge is the total amount of water from land to Ocean (includes rivers, channels and coastal flows)

Input from Ocean (tides, waves, currents)

Open water surface flows (rivers, lakes)

Water flows through wetlands

Rec #2:
Use simultaneous multiple sensors to capture connectivity of processes

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The Mississippi Delta Campaign 2015 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)

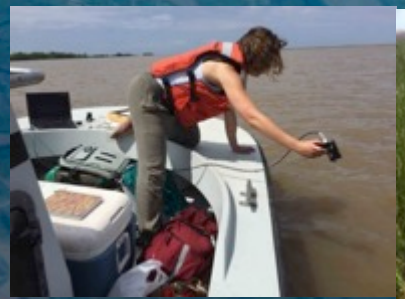
- Ka-band radar interferometer
- Centimeter-level open water surface elevation and surface slope

AVIRIS-NG (for HyspIRI and more)

- Imaging spectroscopy (432 bands)
- High spatial resolution (4m)
- Vegetation species and structure classification
- Water concentrations of CDOM & Sediments

In Situ

- Biomass, species, ADCP, water samples, reflectance and bathymetry



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The Mississippi Delta Campaign 2016 Instruments

UAVSAR (for NISAR)

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

ASO (for SWOT)

- Riegl lidar (full waveform) ~5pts/m^2
- Water Level and change
- Canopy height and AGB

AVIRIS-NG (for HyspIRI and more)

- Imaging spectroscopy (432 bands)
- High spatial resolution (4m)
- Vegetation species and structure classification
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In Situ

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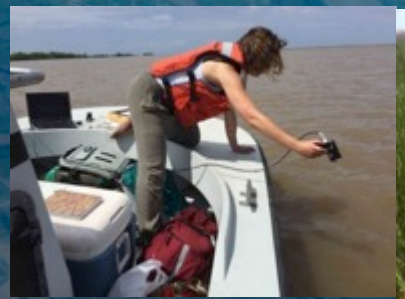

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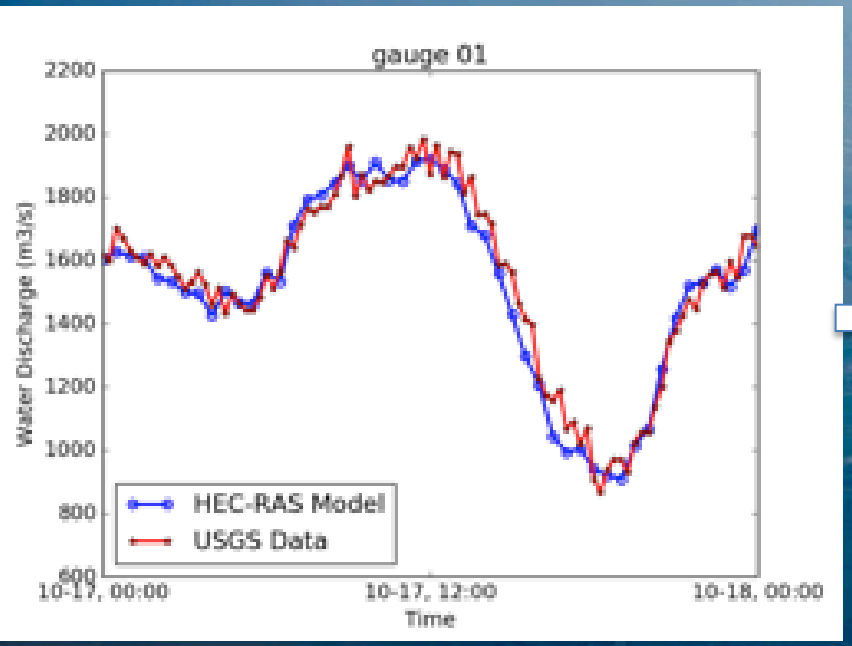
River Discharge + Sediment Concentrations = Export



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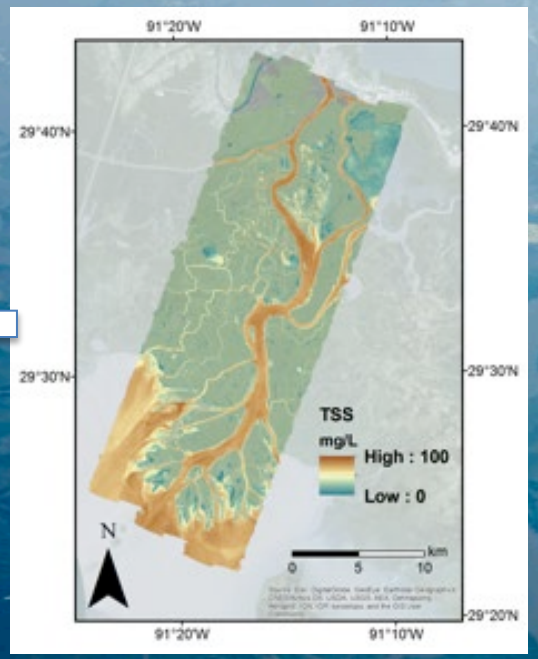

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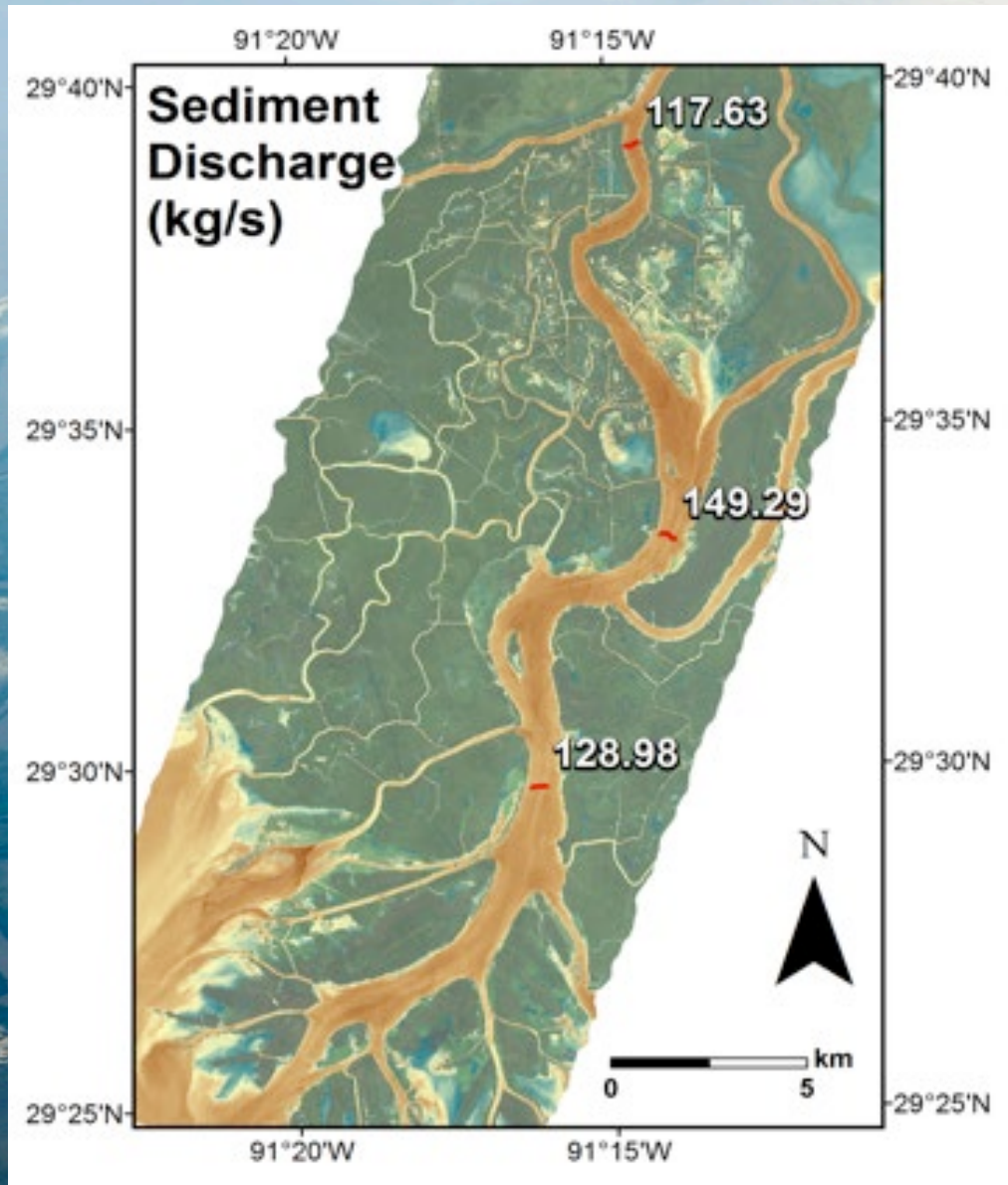

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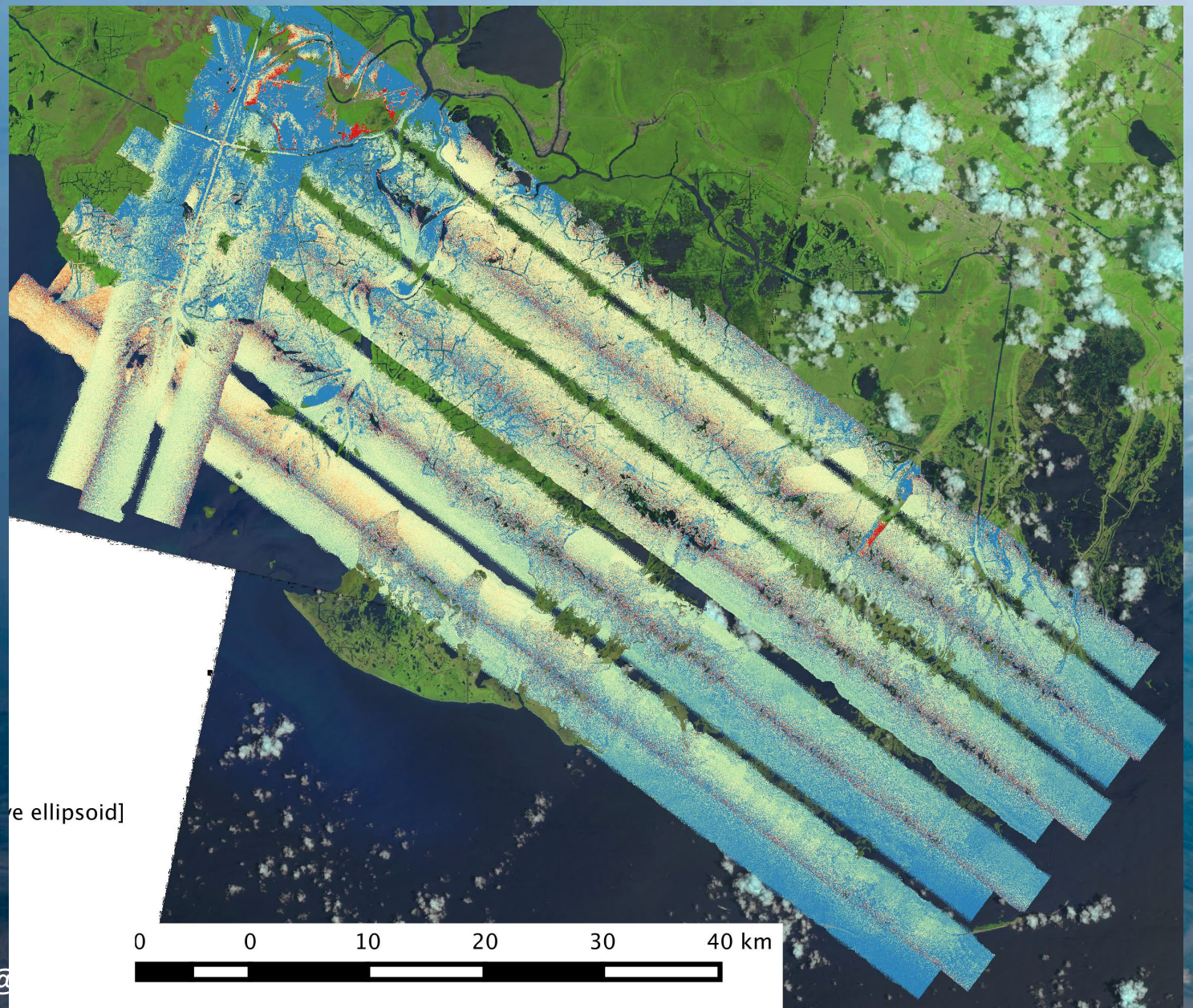
AirSWOT coverage May 2015

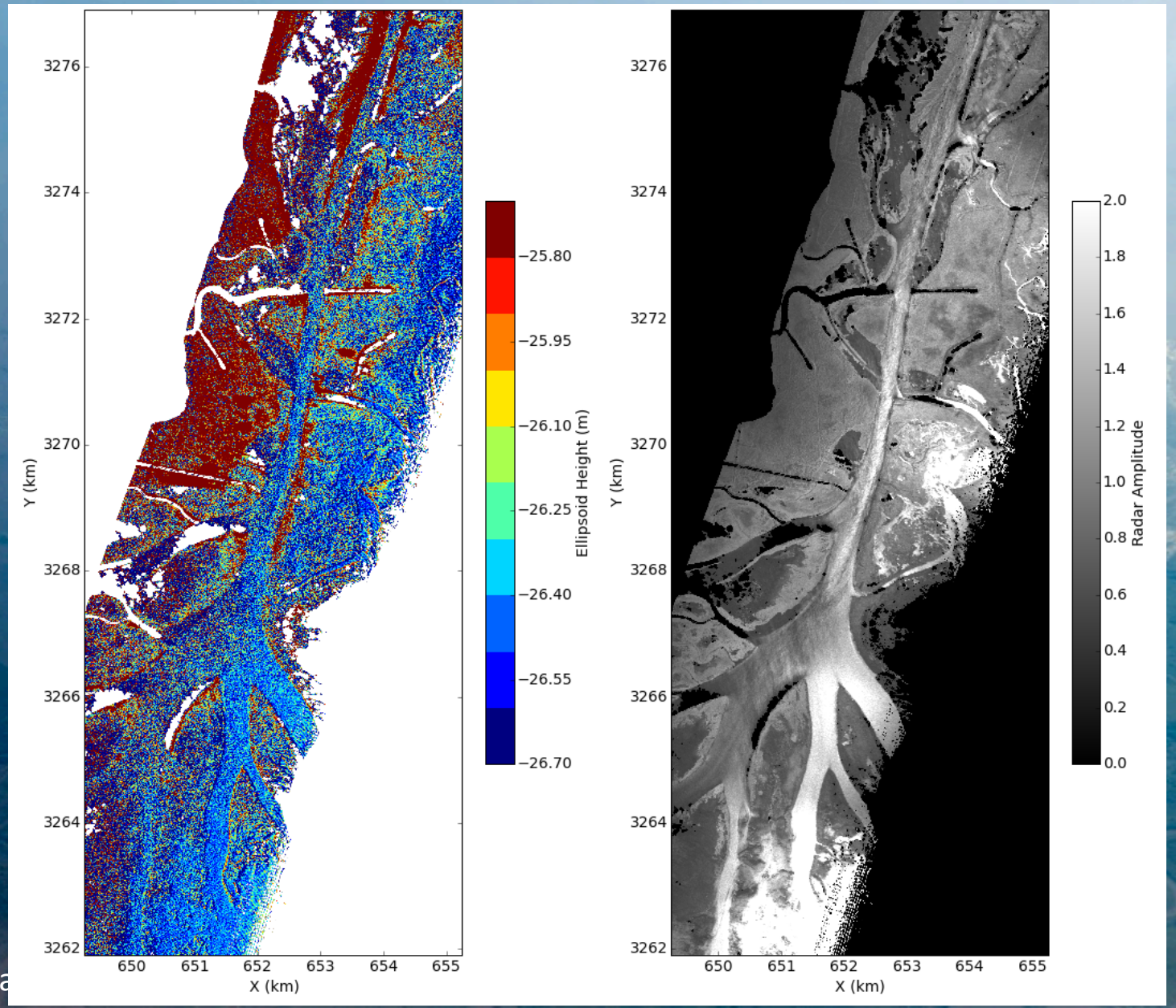


Rec #3:
AirSWOT requires ~30-50% swath overlap and cross validation passes to estimate time-varying phase delay

AirSWOT surface elevation data (2015/05/09) & location of the Wax Lake Delta

Contact: Marc.simard@

AirSWOT DEM/Image Wax Lake Delta



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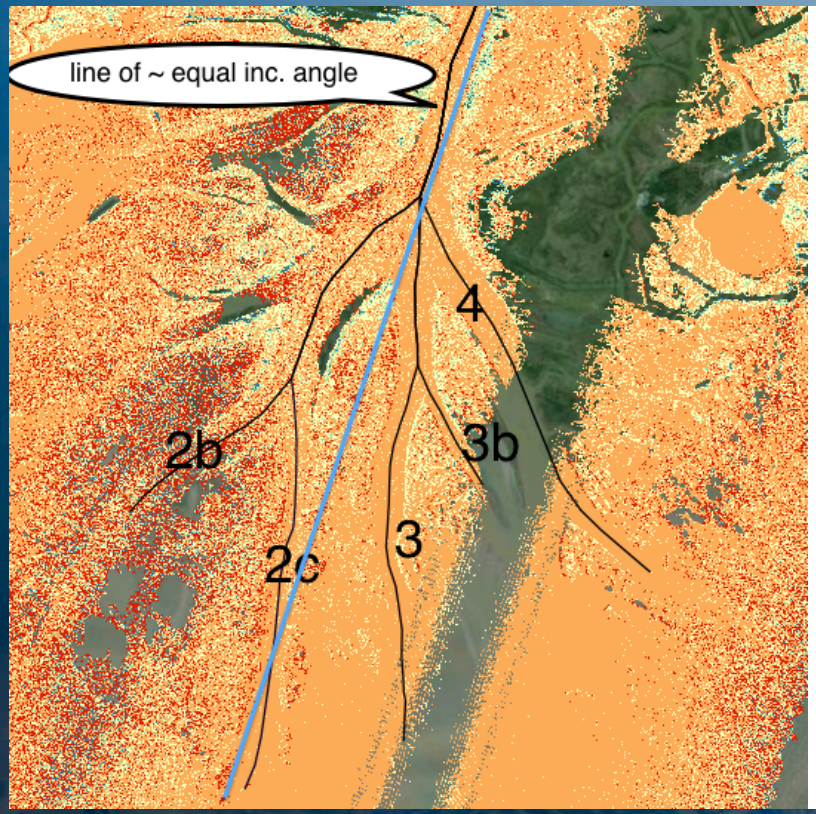
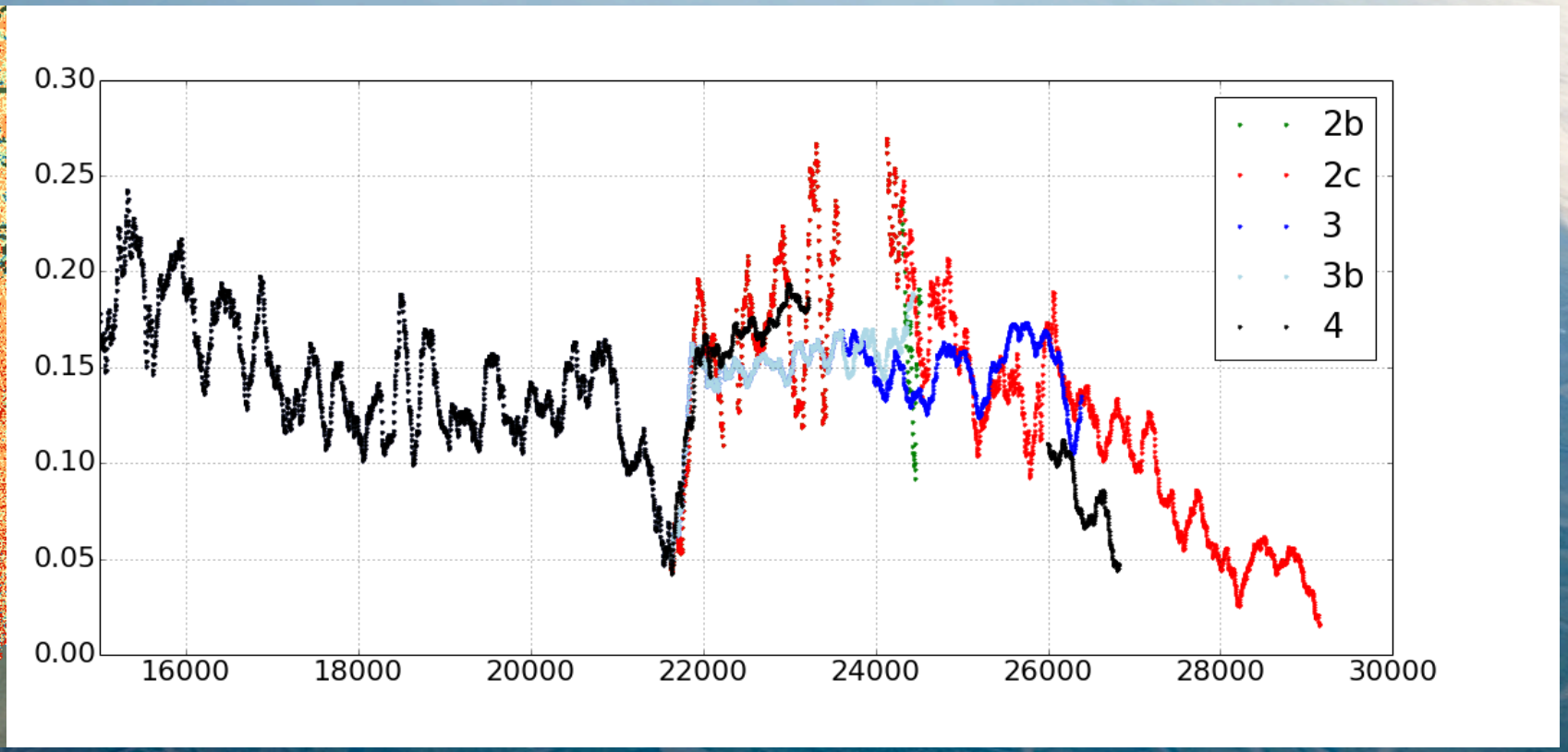
AirSWOT time varying phase delay





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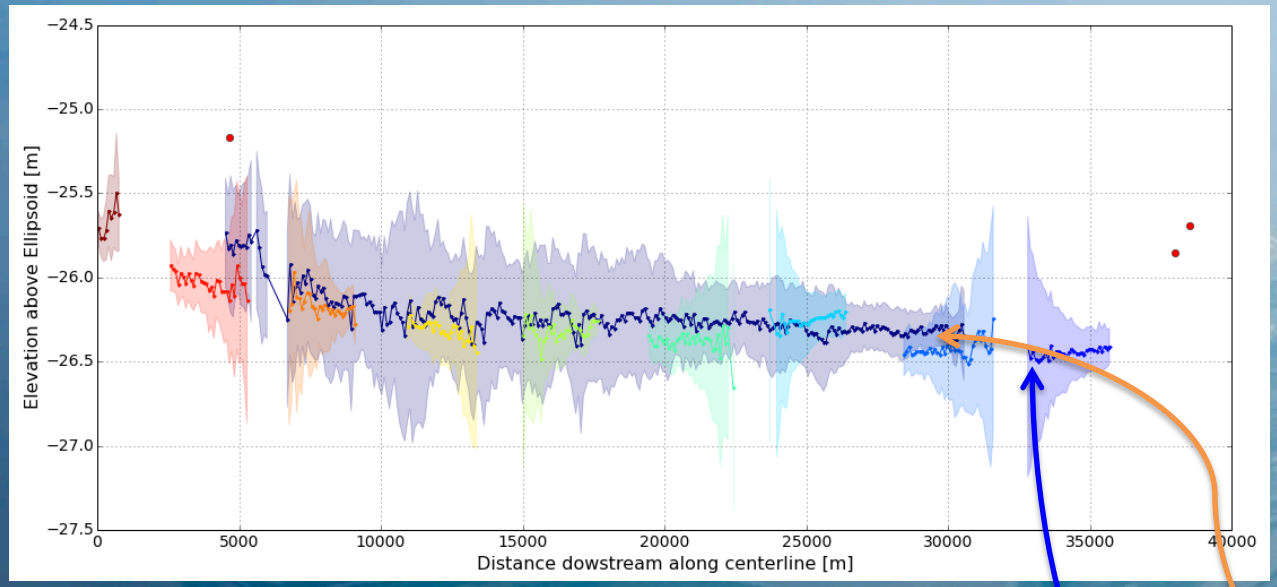

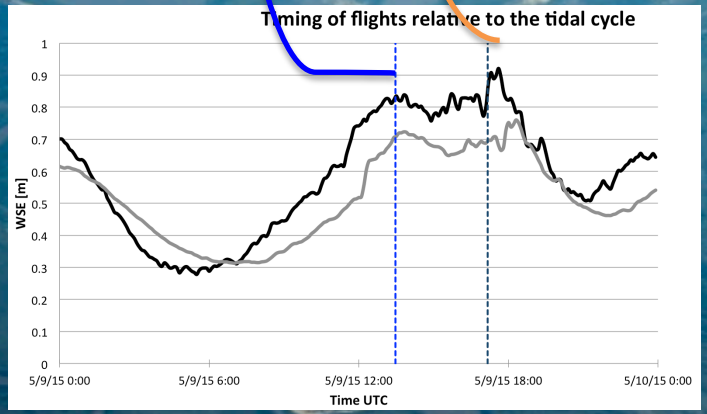

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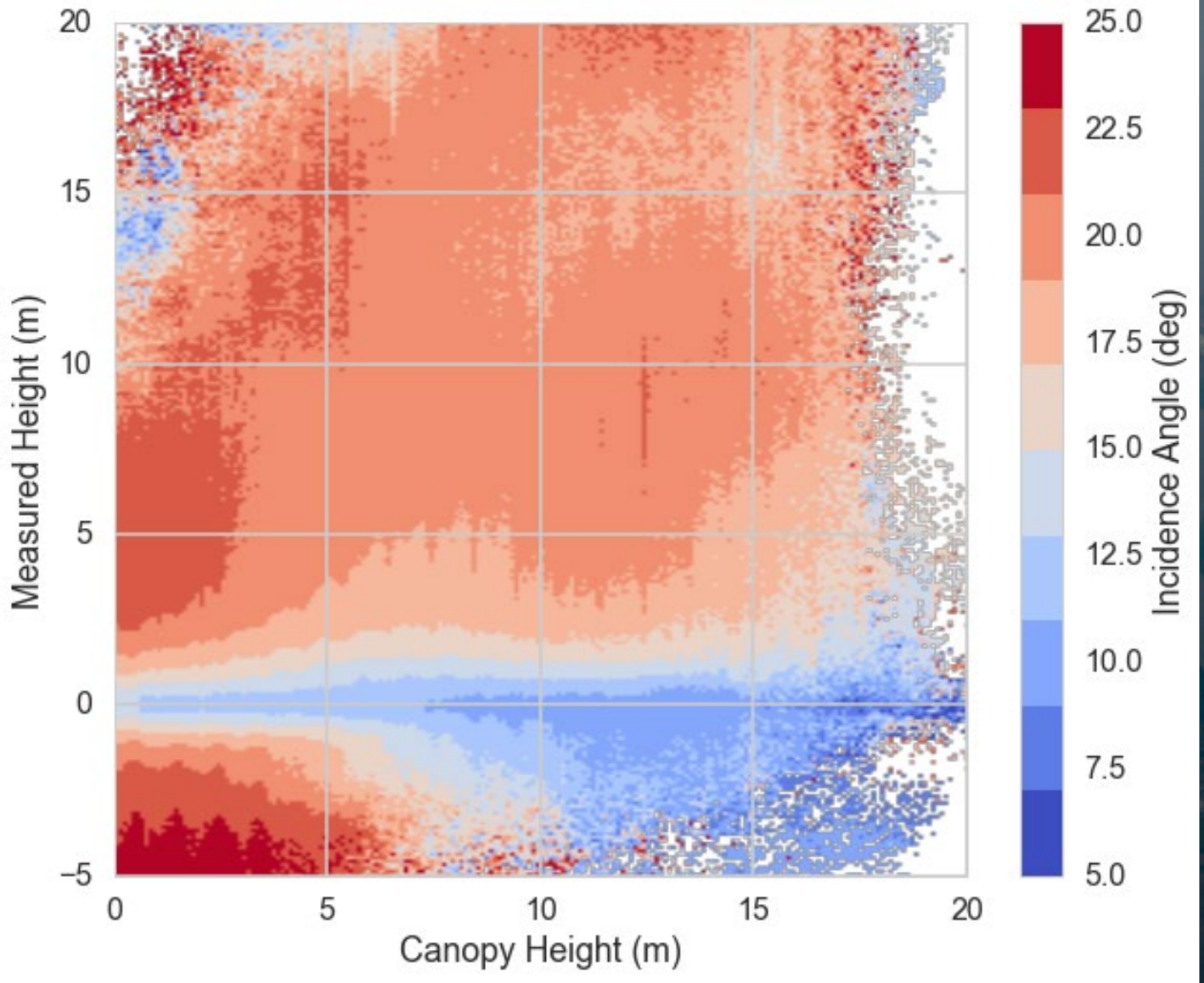
How much vegetation penetration will SWOT have?



- Flooded vegetation ranges from dense cypress to open shrub to grasses.
- Tree height from SRTM and lidar
- For small incidence angles (<10 deg), there is significant penetration into the canopy and the reported height is near the water surface.
  - At larger incidence angles, vegetation starts to approach true vegetation height (but is always below).
  - Degree of penetration is dependent on canopy gap density.

Rec #4:

Measure water levels below vegetation canopies

October 2016: The Simultaneous Acquisition of UAVSAR, ASO, AVIRISNG and In Situ Field Data

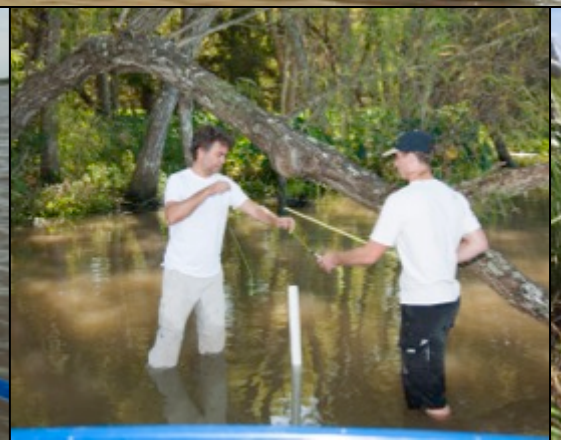
- Collected simultaneous airborne and in situ data at low and high tide

1. AVIRISNG (spectroscopy) for water color.
2. UAVSAR (repeat-pass inSAR) for water level change within marshes.
3. ASO (lidar) elevation, slope and change of water surface in river channels.
4. Two boats for field cal/val
   - ADCP (water current)
   - bathymetry
   - Water surface level + slope
   - Handheld spectometer data
   - Carbon+sediment+nutrient concentration

Rec #5:

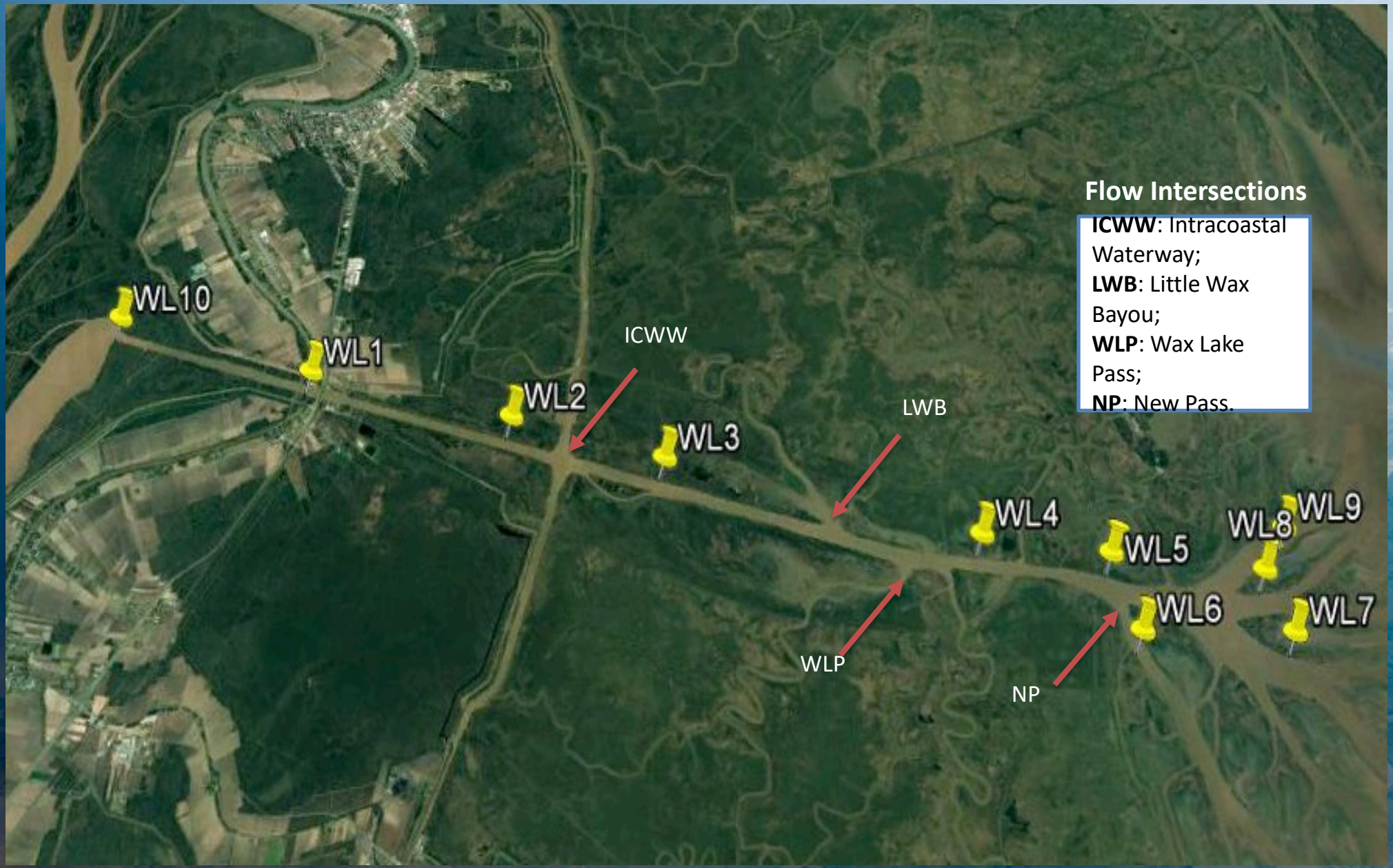
When using Lidar, prepare two flight plans with nadir-only lines for high AND low altitude lidar flights to secure reflections and mitigate clouds.

2016: Extensive In Situ Field Data



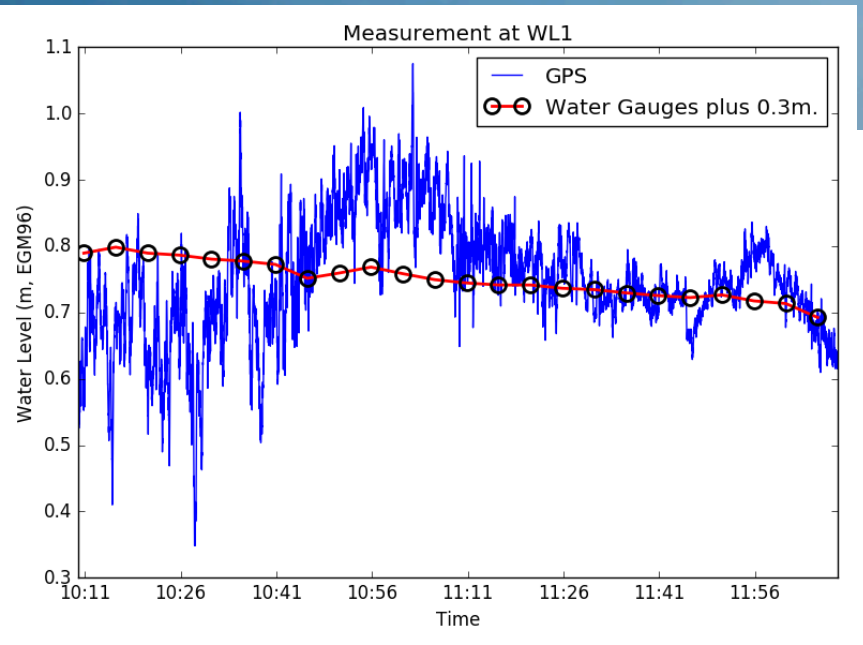
Rec #6
Duplicate *in situ* measurements as much as possible and collect multi-disciplinary measurements simultaneously

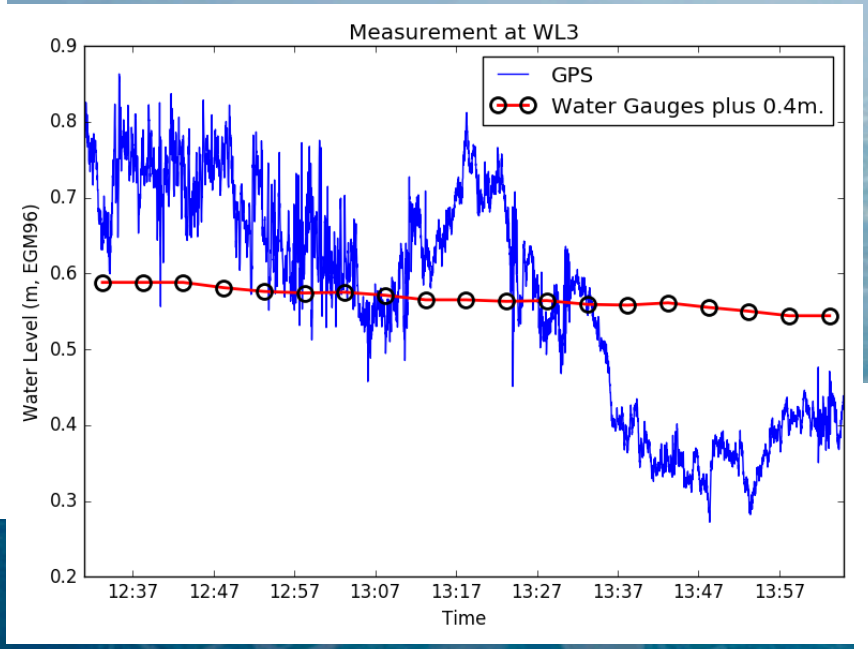
Tidal Phases

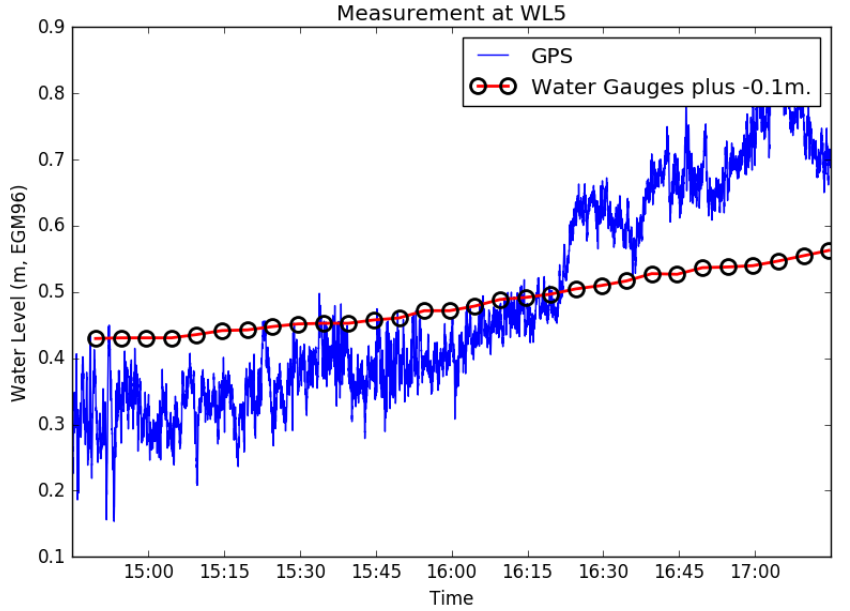


Rec #7:
To learn the dance, follow its steps. Plan for multiple Water level gauges and intersection with tributaries to capture tidal wave propagation and overflow delays.

Absolute Calibration of water level gauges







Rec # 8

To obtain absolute elevation, stay away from trees and integrate for more than 2 hours

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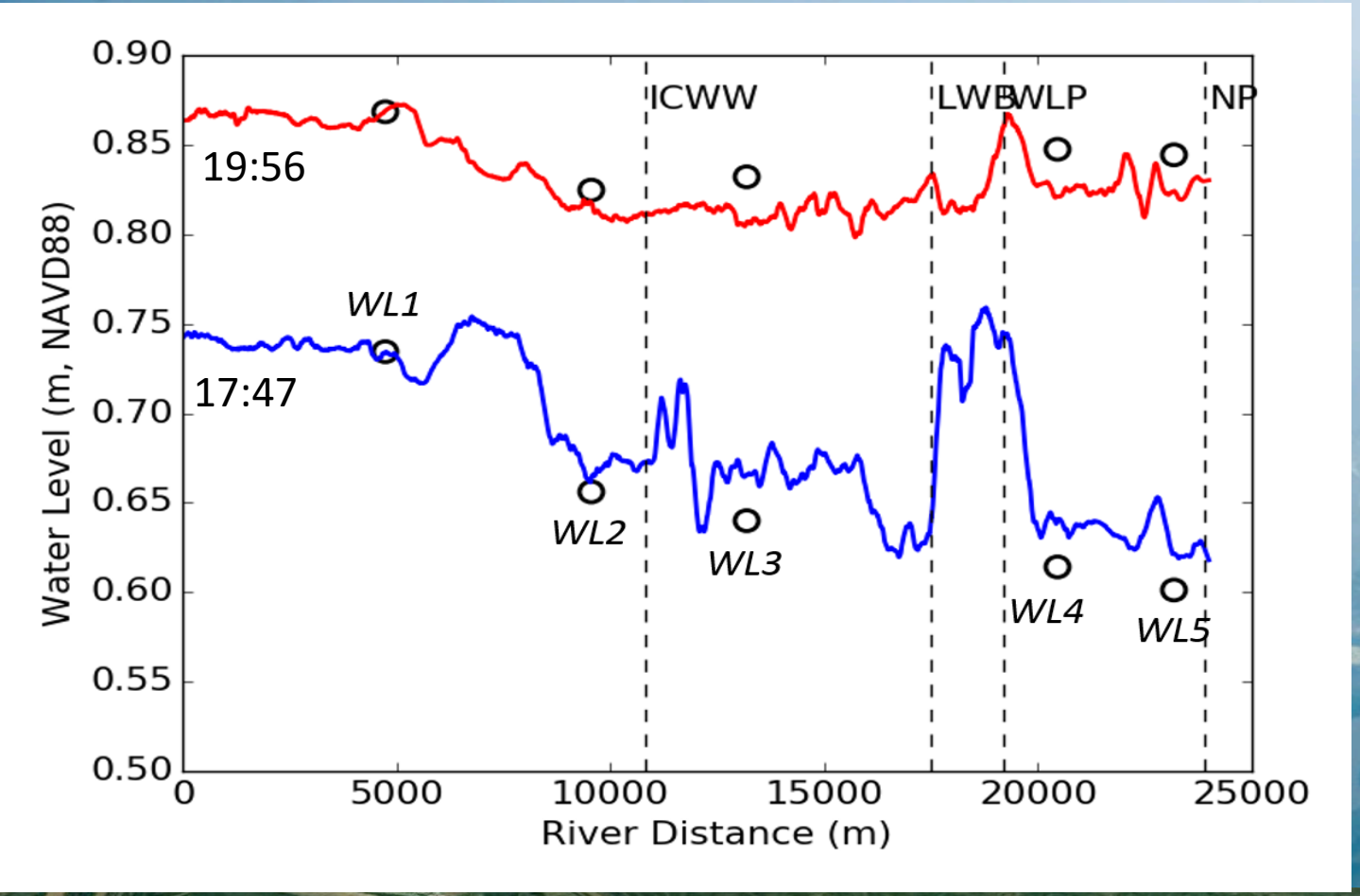
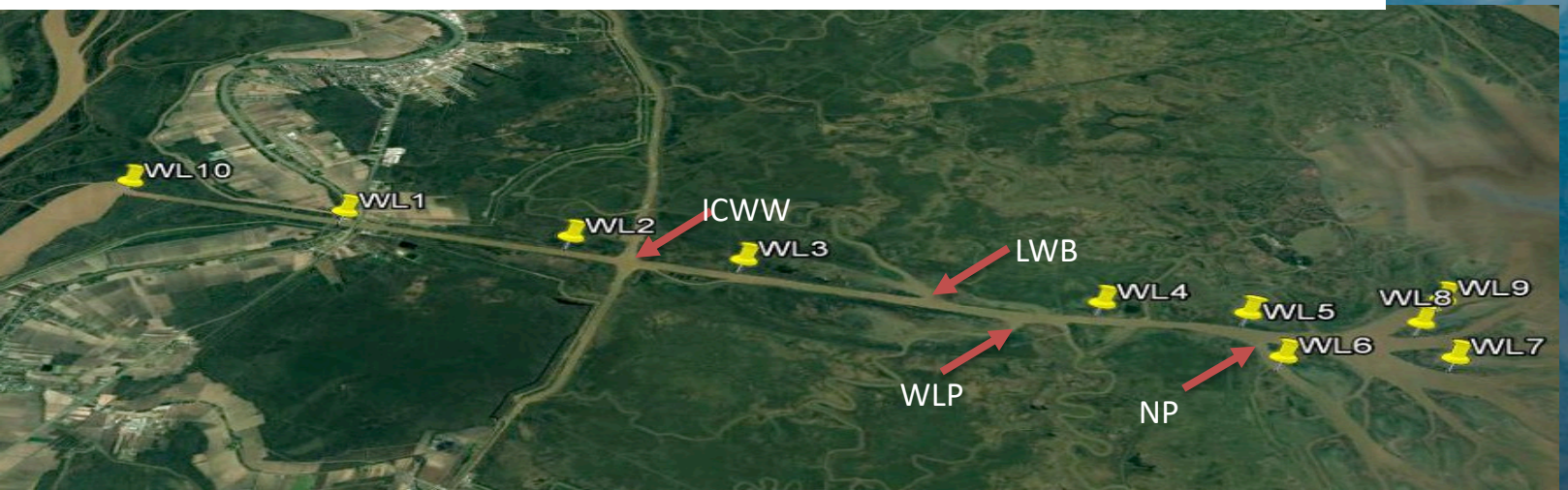
Lidar transects

Showing water surface elevation changes and anomalies near tributaries



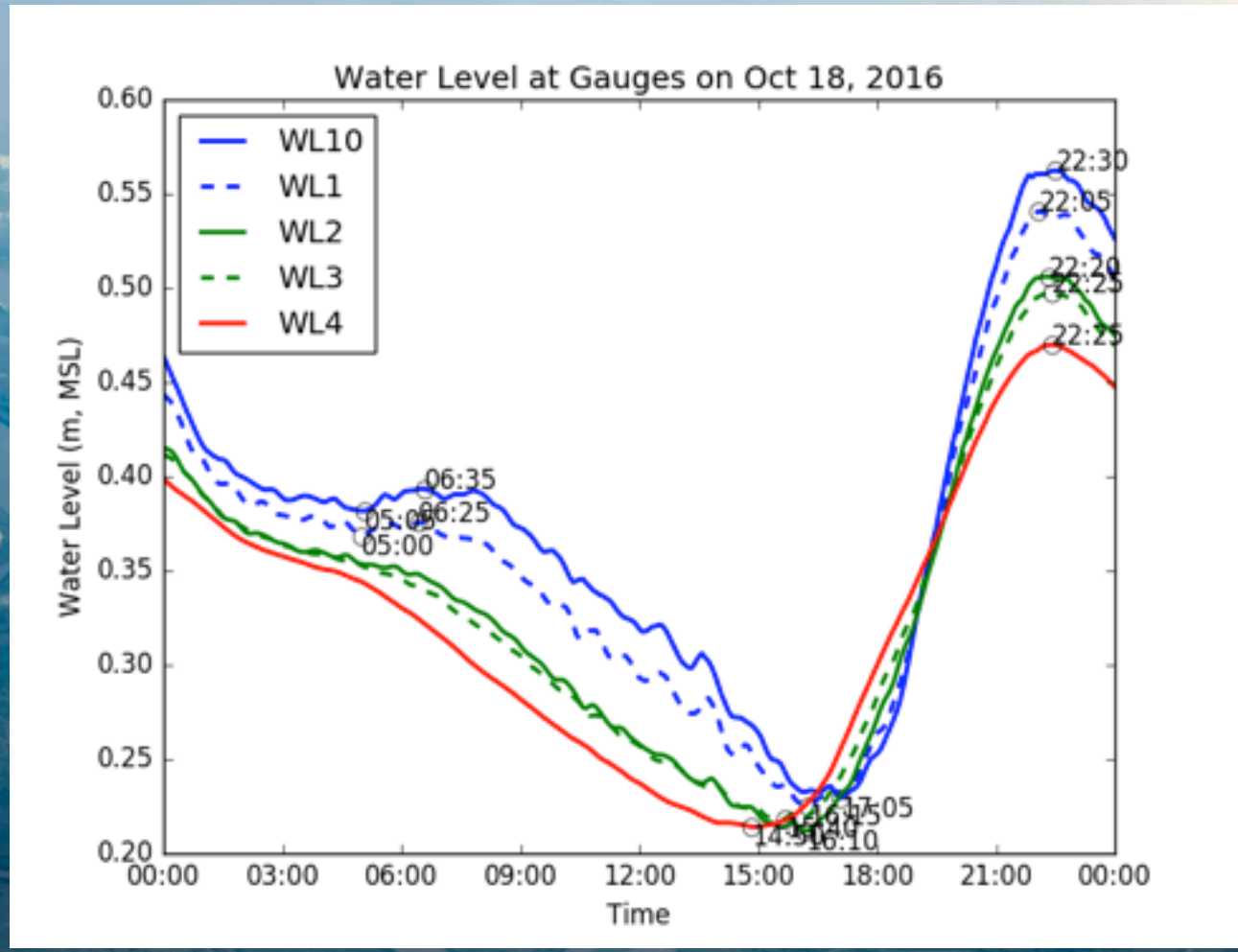


Rec #9

If you have enough gauges, sample expected anomalies (i.e. confluence), otherwise just be aware of them.

Modelling Hydrology
DELFT3D implementation
Tidal Phase: in the Channel

	Simulation	Measurements
High Tides	25 min (WL10 and WL1)	1 hr 20 min (WL10 and WL4)
Low Tides	2 hr 15 min (WL10 and WL4)	1 hr 10 min (WL10 and WL4)



Rec #10

Keep hydrology model simple and real

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10 recommendations

1. Coastal regions, river deltas and estuaries should be considered in SWOT masks
2. Use simultaneous multiple sensors to capture connectivity of processes
3. AirSWOT requires ~30-50% swath overlap and cross validation passes to estimate time-varying phase delay
4. Measure water levels below vegetation canopies
5. When using Lidar, prepare two flight plans with nadir-only lines for high AND low altitude lidar flights to secure reflections and mitigate clouds.
6. Duplicate *in situ* measurements as much as possible and collect multi-disciplinary measurements simultaneously
7. To learn the dance, follow its steps. Plan for multiple Water level gauges and intersection with tributaries to capture tidal wave propagation and overflow delays.
8. To obtain absolute elevation, stay away from trees and integrate for more than 2 hours
9. Sample expected anomalies (i.e. confluence), otherwise just be aware of them.
10. Keep hydrology model simple and real to connect in situ and airborne data in space and time

AVIRIS-NG Calibration

Reflectance Before BRDF

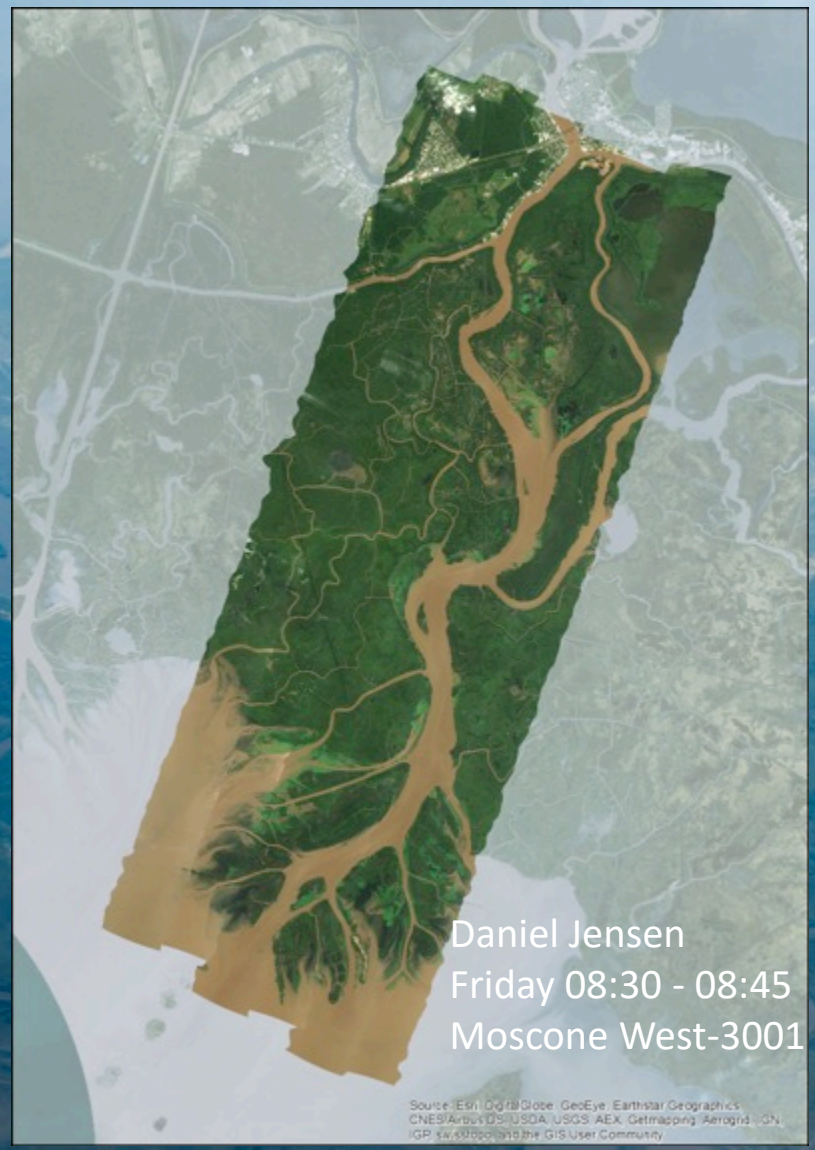
After BRDF correction

Rec#5

For optical sensors, plan for the longer campaigns. Coasts are often cloudy or hazy.

Seamless mosaics of AVIRISNG images

- Reflectance
- Bidirectional reflectance correction
- Extract species spectra
- Map species and biomass



Daniel Jensen
Friday 08:30 - 08:45
Moscone West-3001

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AVIRISNG to Estimate Sediment Concentrations

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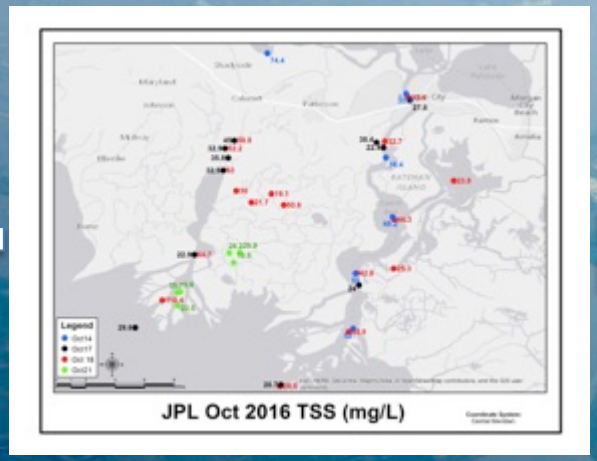

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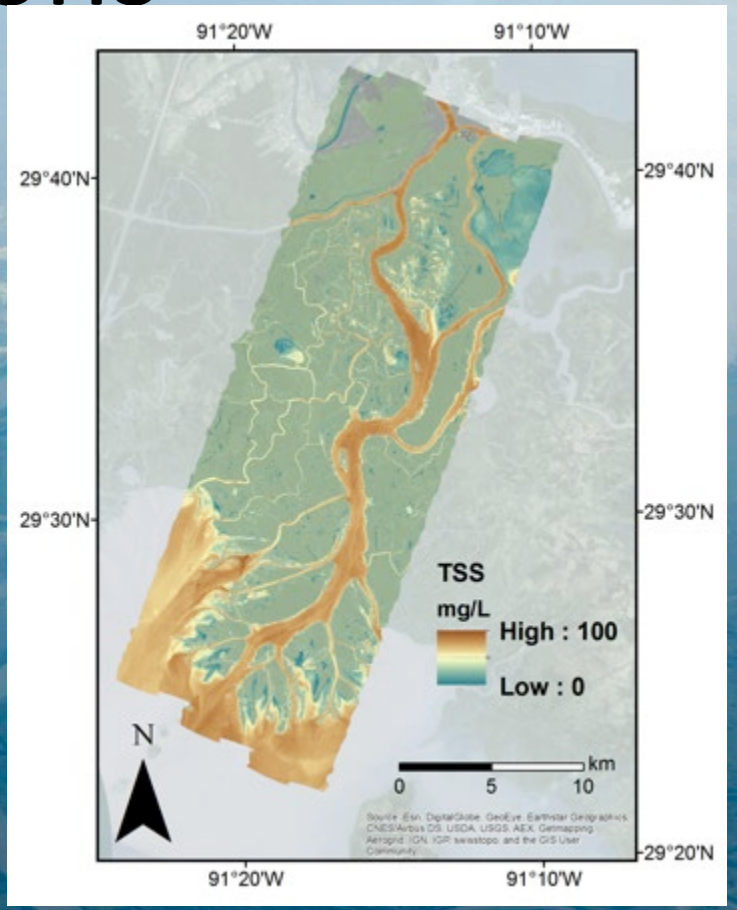

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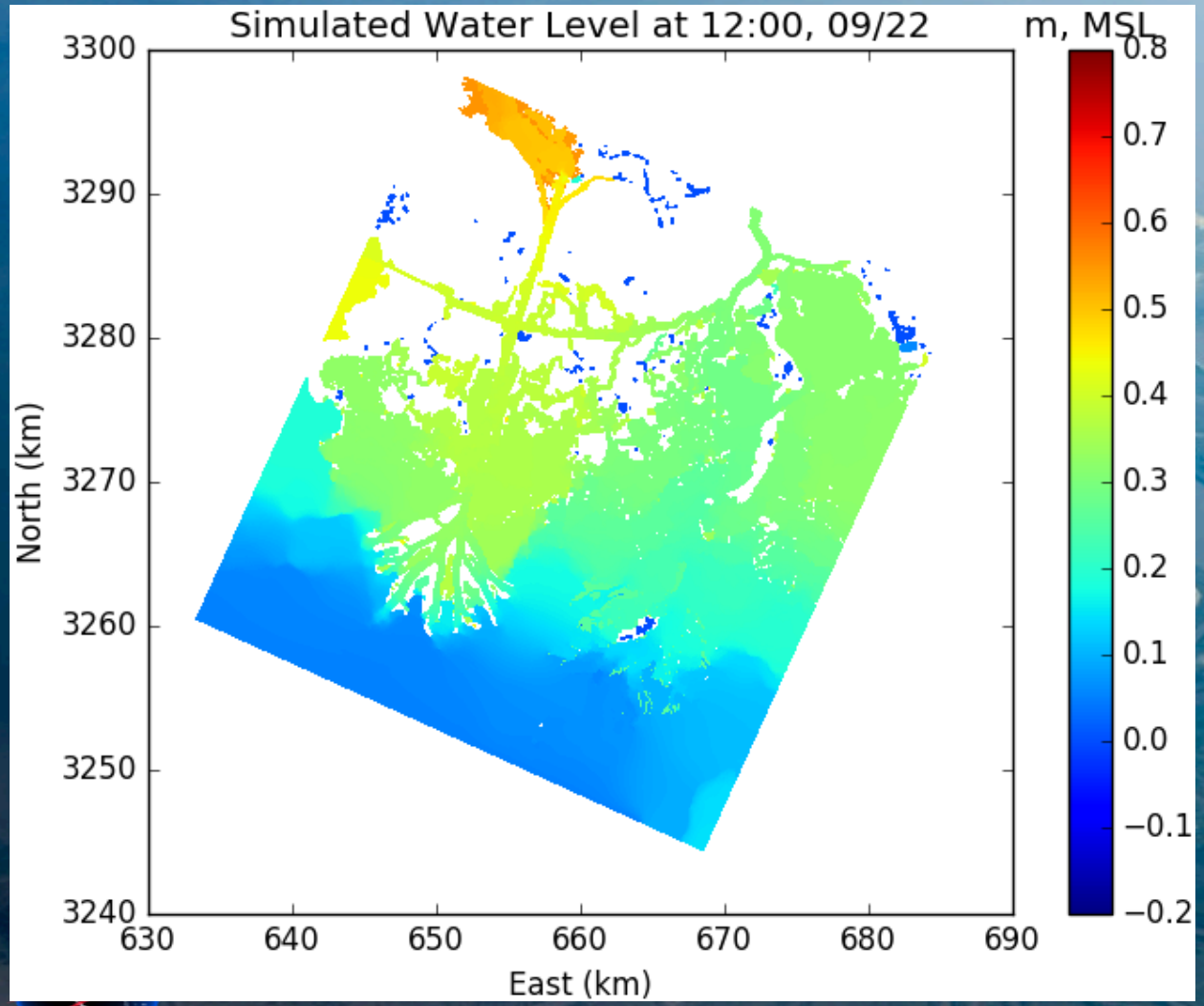
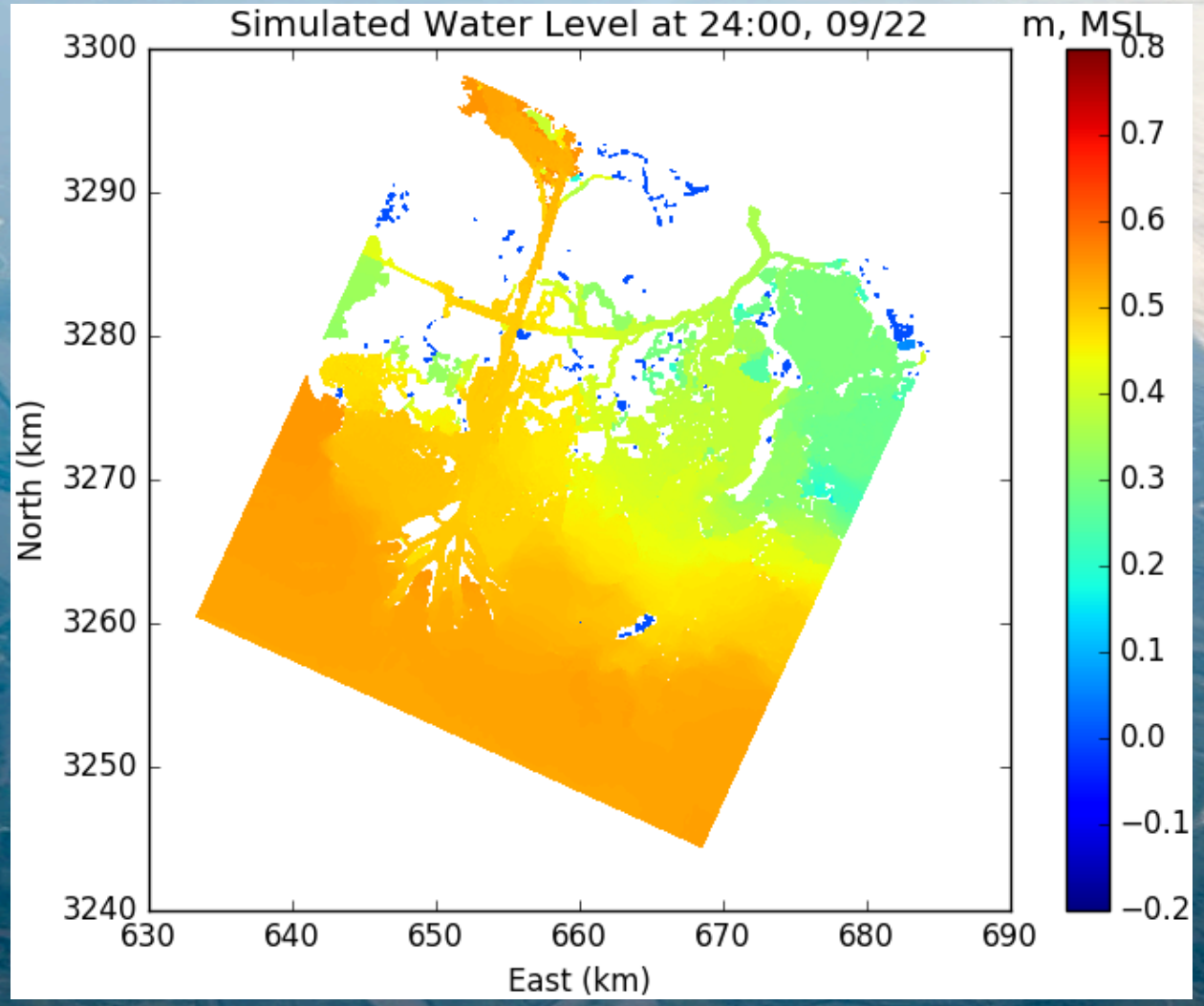
Landscape scale hydrology at the coastal interface.

60 Hours:



72 Hours:



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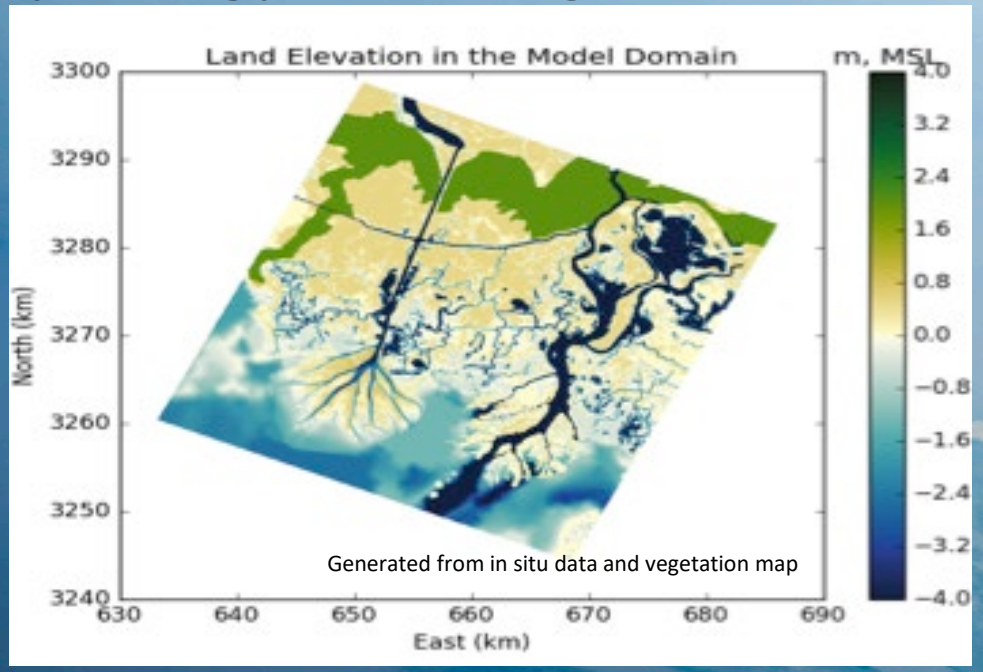
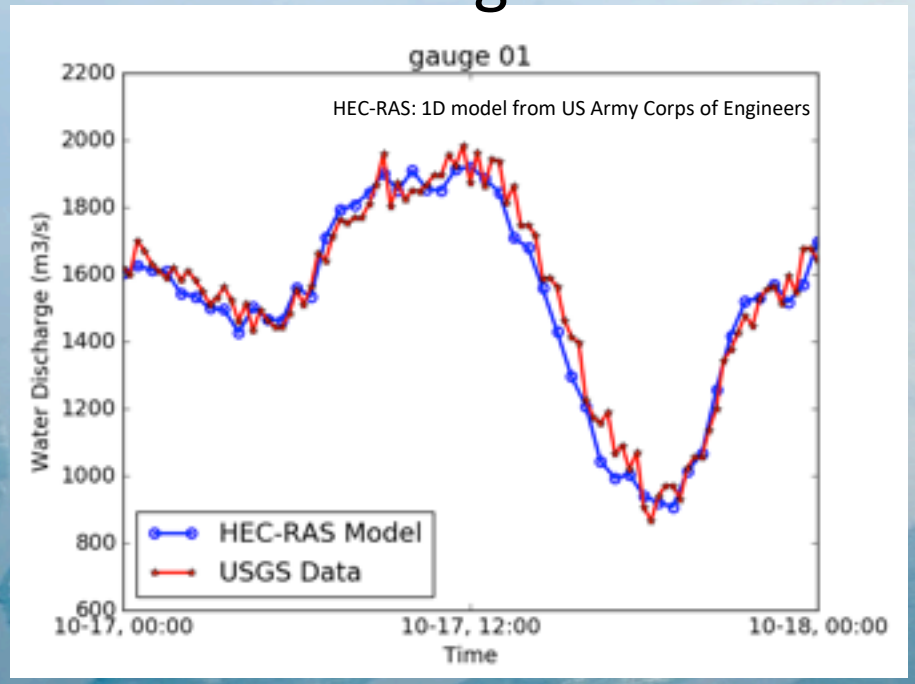
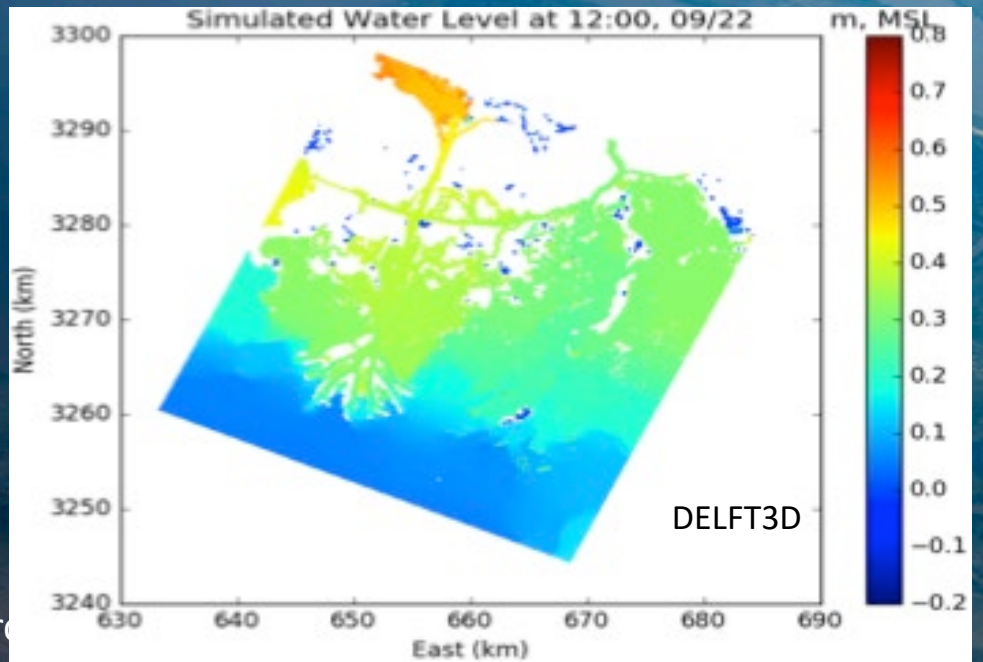
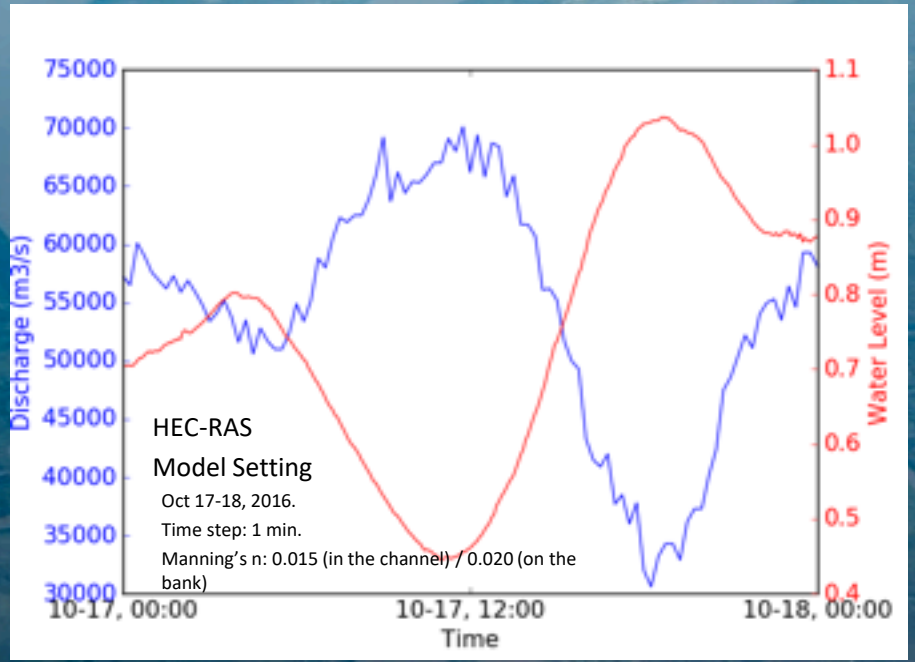
Hydrology Modeling: Water Surface Level and Discharge from models

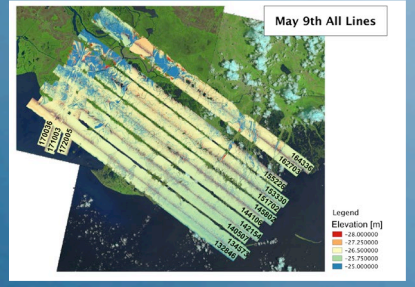




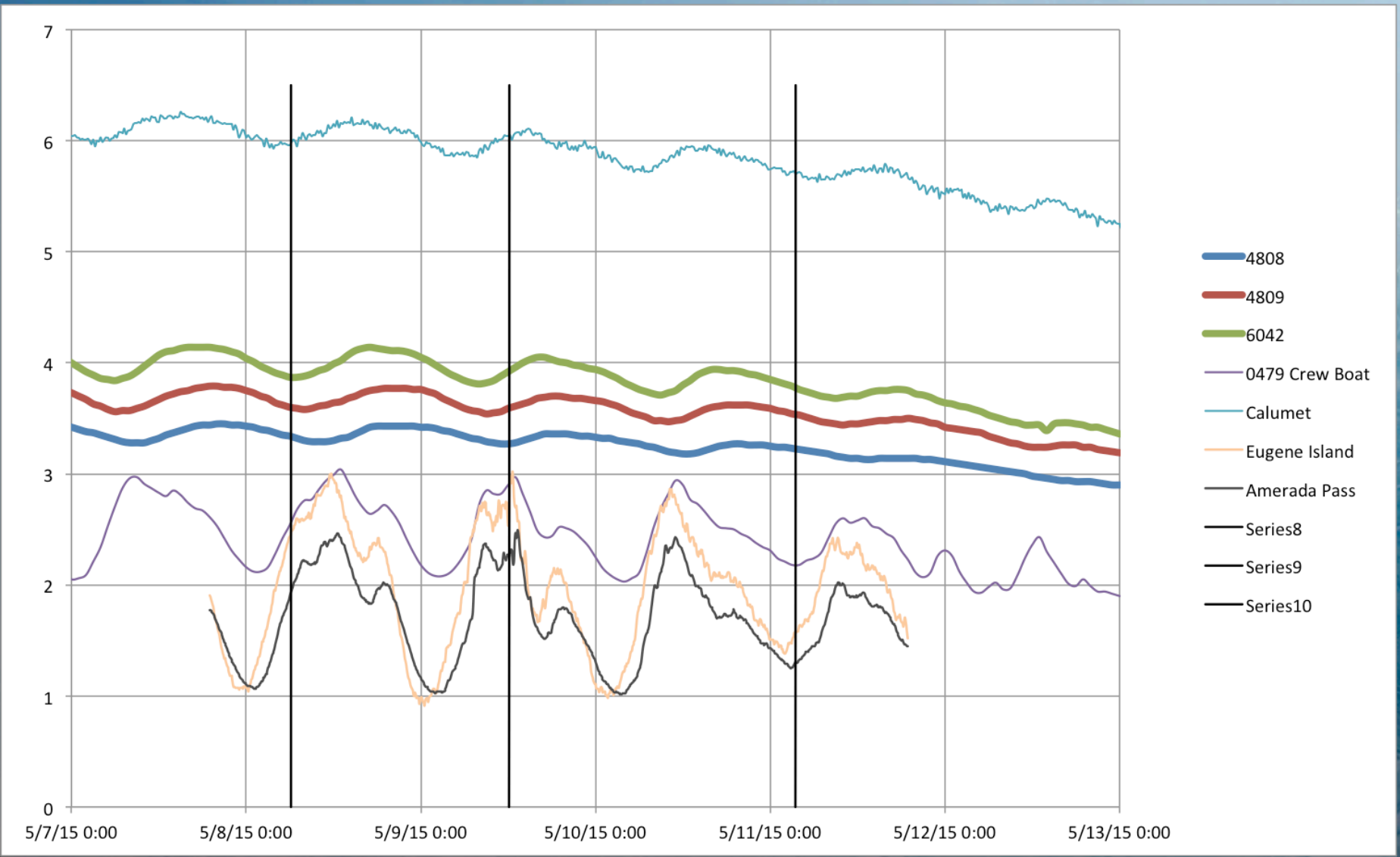




Contact: Mar

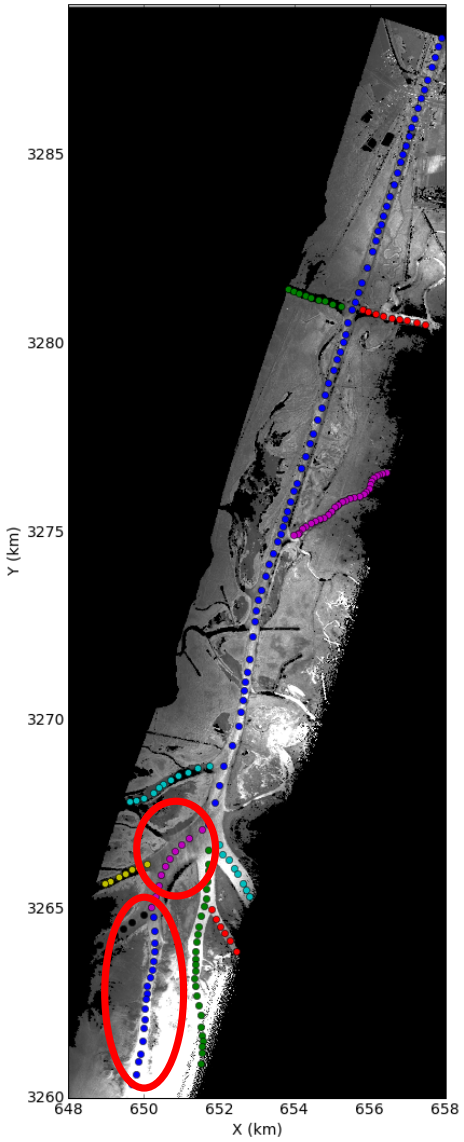


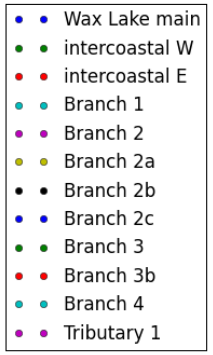
The Mississippi Delta Campaign 2015
Data Collection Strategy

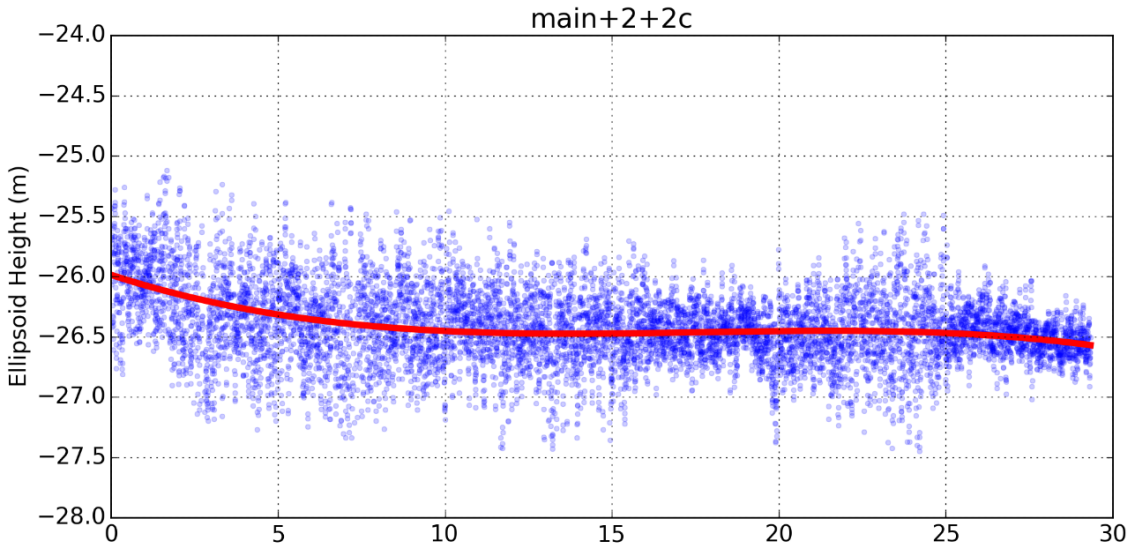


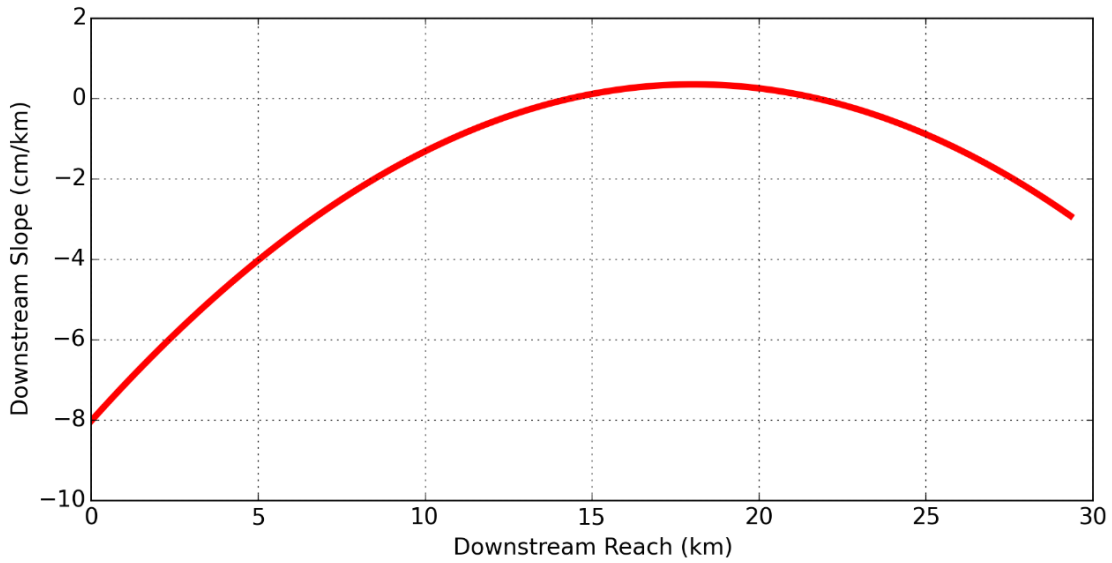
To capture tidal processes and to complement SOWT

Wax Lake Main Channel + Branch 2/2c Height/Slope









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