

Hurricane floodwater impact on optical-biogeochemical properties and carbon fluxes in a large estuary from ocean color

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LSU

Hurricane Harvey impact on Galveston Bay

Precipitation due to Hurricane Harvey

Hurricane Harvey (25-29 Aug, 2017) dumped record rainfall in the Houston and surrounding region (>52 inches) with potential to impact water quality and ecosystem of Galveston Bay

Need:

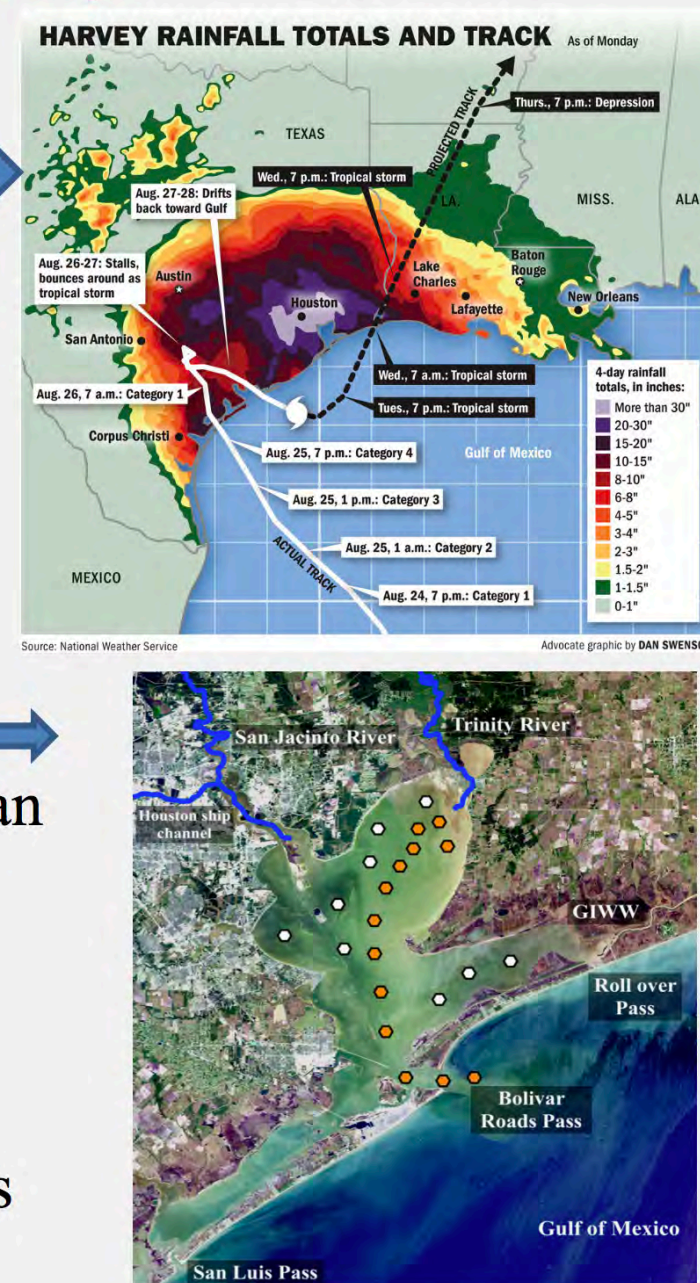
Critical to monitor short- and long-term response of water quality constituents such as SPM, CDOM/DOC, Phytoplankton biomass that impact ecosystem health

Challenges:

Estuarine waters are optically complex and standard ocean color algorithms (empirical and semi-analytical) have not been optimized for these waters.

Goal of this study:

Assess bio-optical state and linkage to biogeochemical properties following Hurricane Harvey using field surveys and ocean color data



Methods and Data

As part of a NASA funded Rapid Response project, we conducted two field surveys in Galveston Bay on 29 Sept. and 29/30 Oct. 2017 (~1 and 2 months following Harvey)

Surface water samples were collected for absorption (CDOM, phytoplankton, non-algal particles), DOC, phytoplankton pigments, and suspended particulate matter (SPM) concentrations

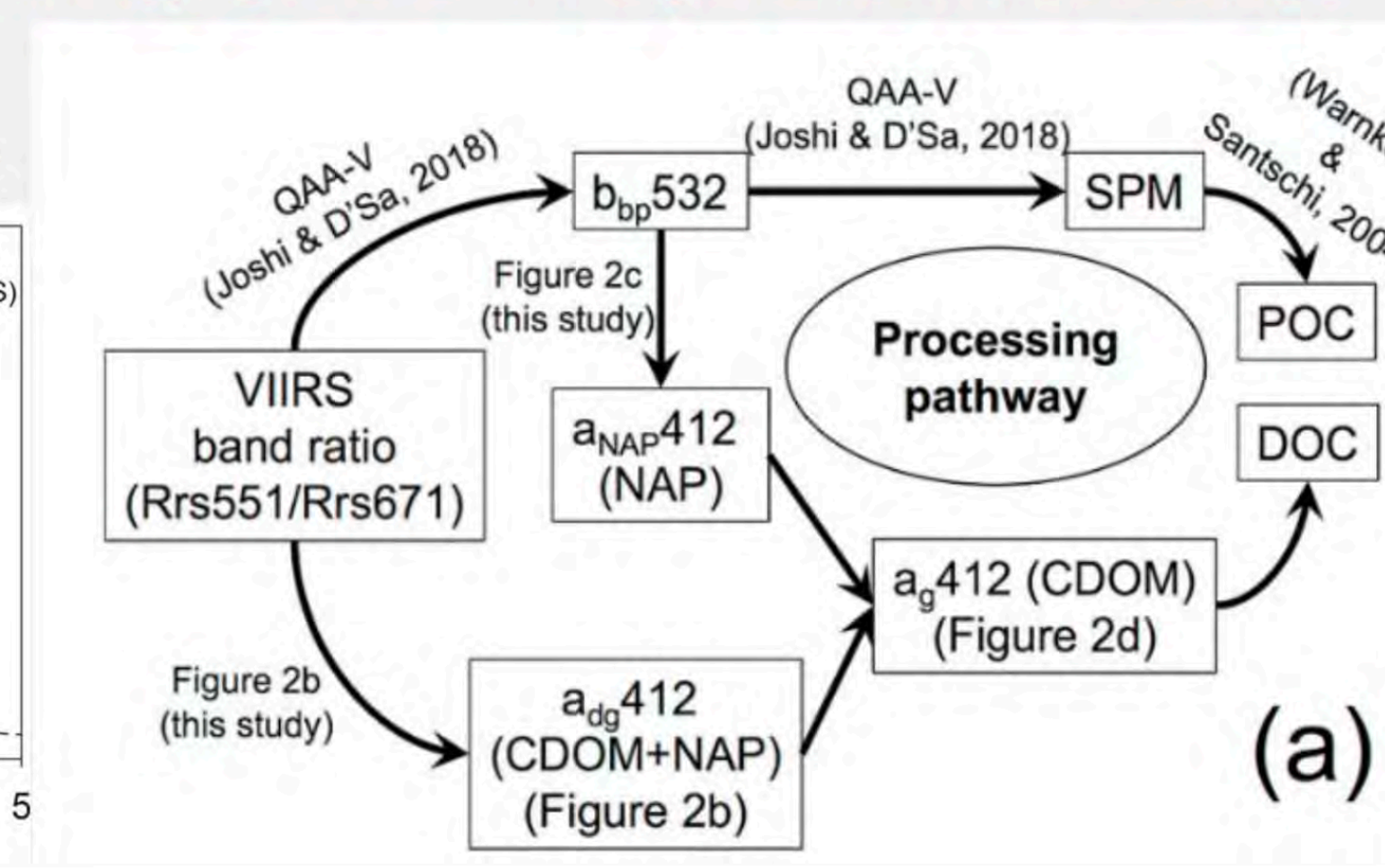
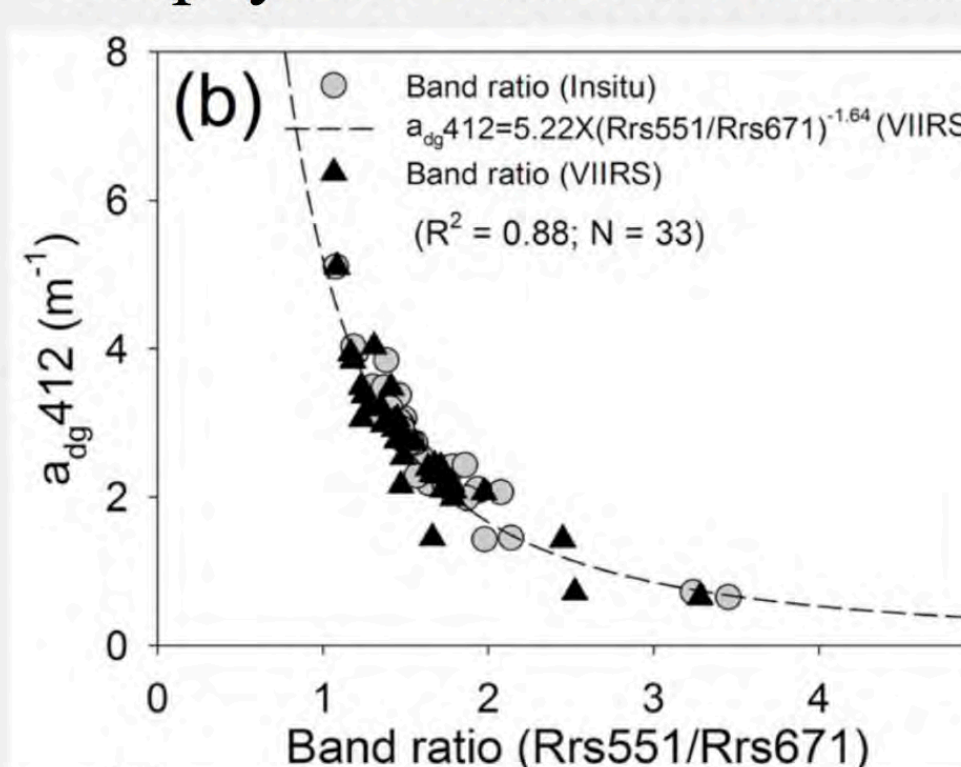
Bio-optical measurements using an optics package comprising a suite of instruments including: CTD, Wetlabs eco-triplet (chlorophyll, CDOM fluorescence, and backscattering at 532 nm) and ACS. Additionally, remote sensing reflectance (R_{rs}) were measured using a GER 1500 512IHR spectroradiometer.



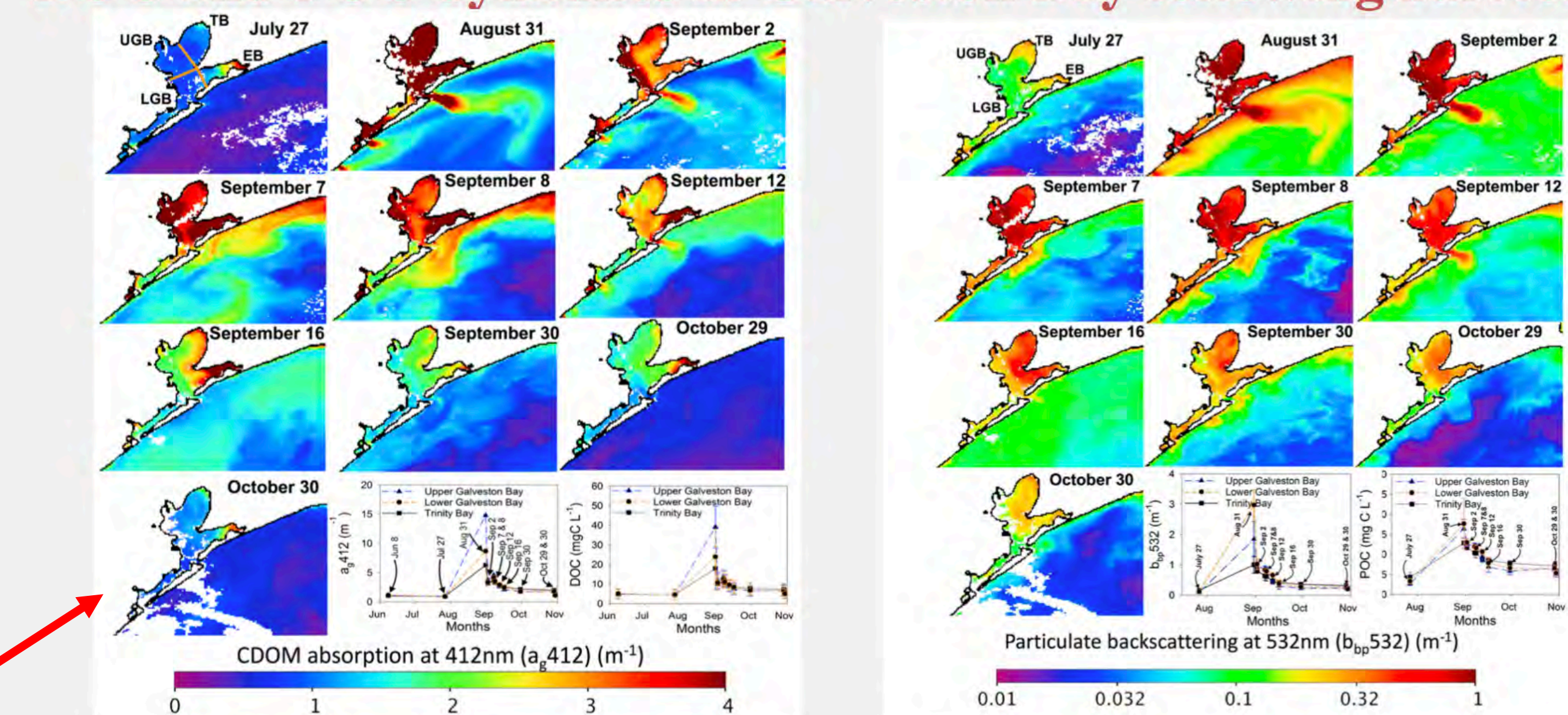
Bio-optical Profile

DOC/POC from VIIRS using QAA-V + empirical relationships

D'Sa, Joshi and Liu 2018
Geophysical Research Letters



DOC and POC dynamics in Galveston Bay following hurricane



DOC and POC fluxes to coastal ocean

Over 10 days during/following hurricane, ~25x10⁶ kg C (TOC) and ~314x10⁶ kg of SPM were rapidly exported from Galveston Bay to shelf waters

QAA-V semi-analytic/empirical approach

VIIRS Remote Sensing Reflectance R_{rs} (downloaded from NASA OC site)

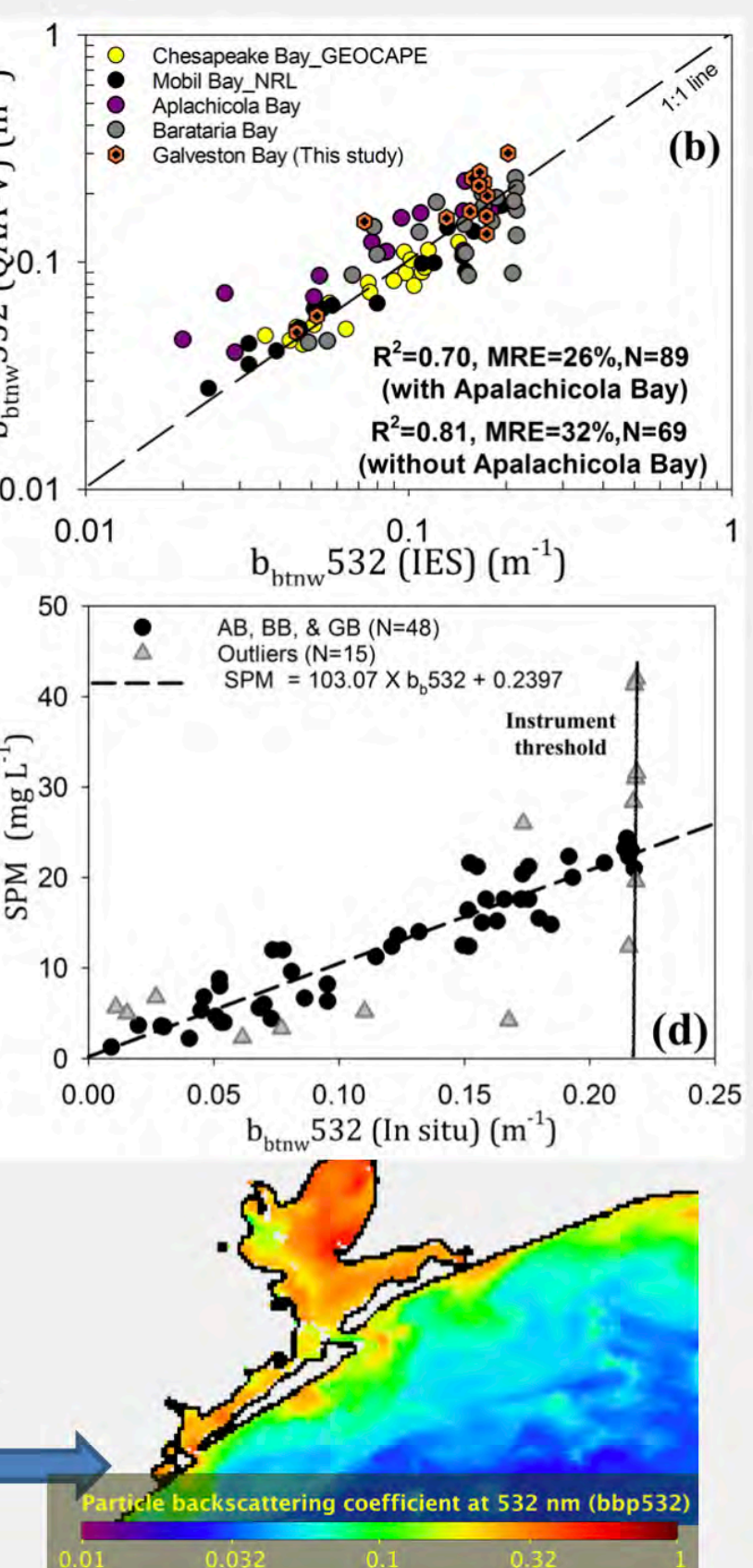
VIIRS R_{rs} (atmospheric correction)

QAA-V Processing Steps for turbid waters
Joshi and D'Sa-2018, Biogeosciences

Outputs (validation)
absorption coefficients
scattering coefficients

Relationship between b_{532} vs
SPM (mg/L) for Galveston Bay
(29 Sep, 29 & 30 Oct 2017)

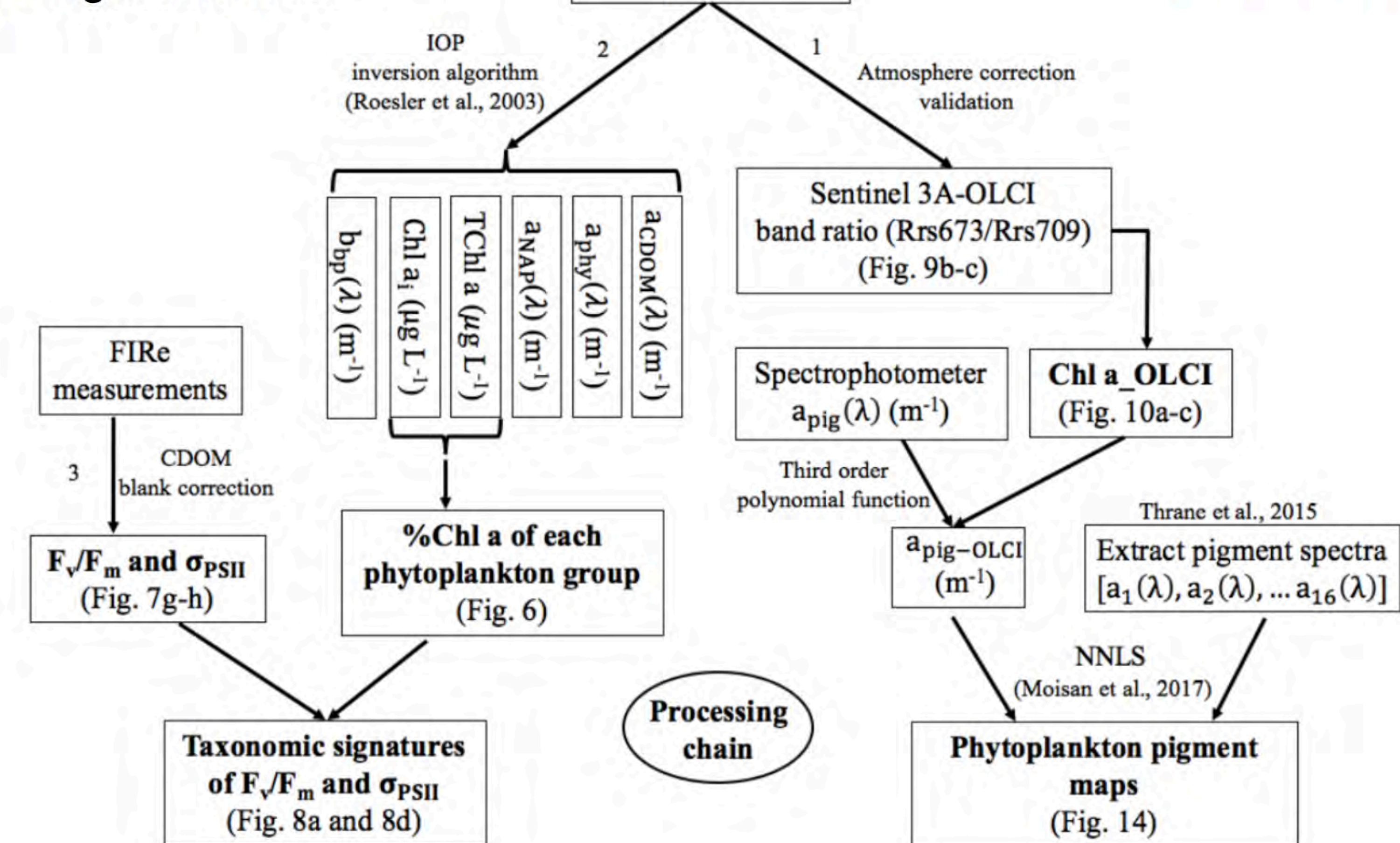
Joshi and D'Sa 2018, Biogeosciences



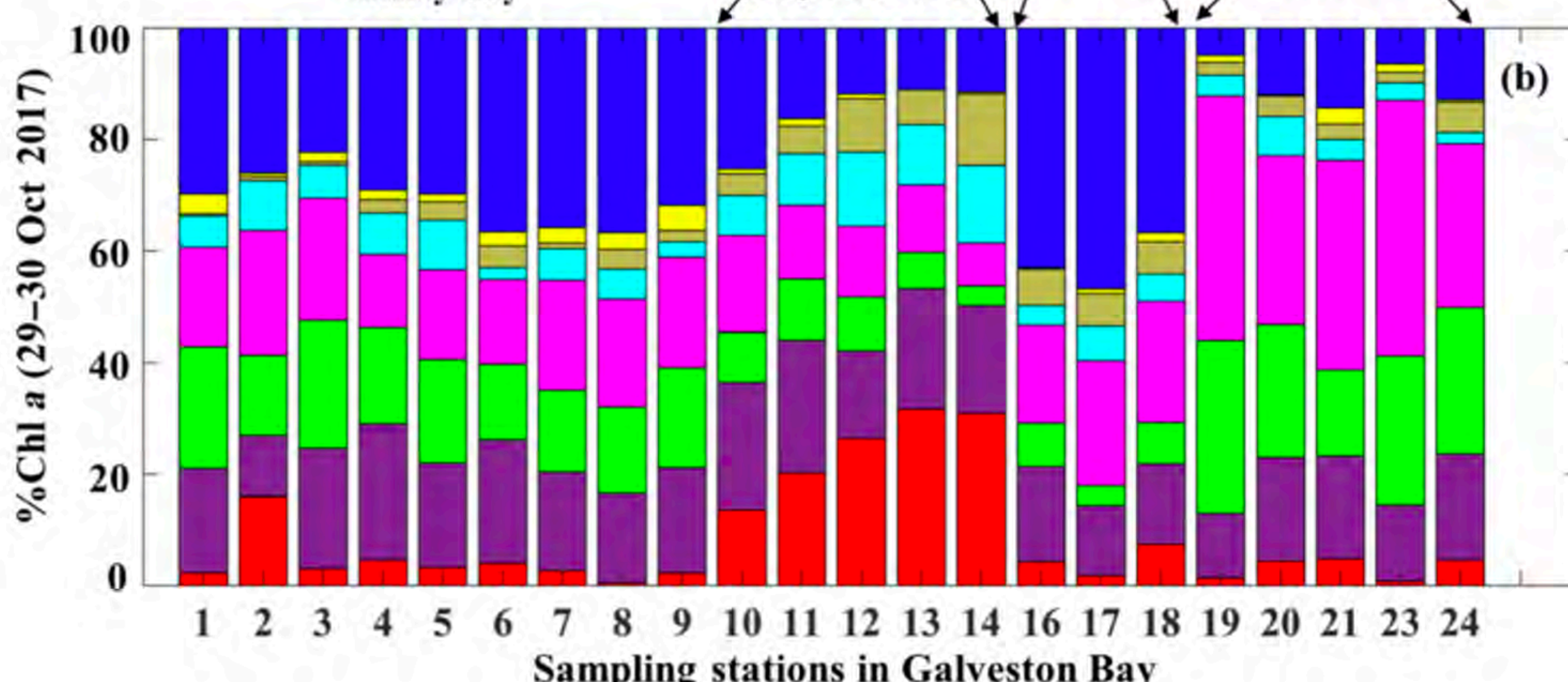
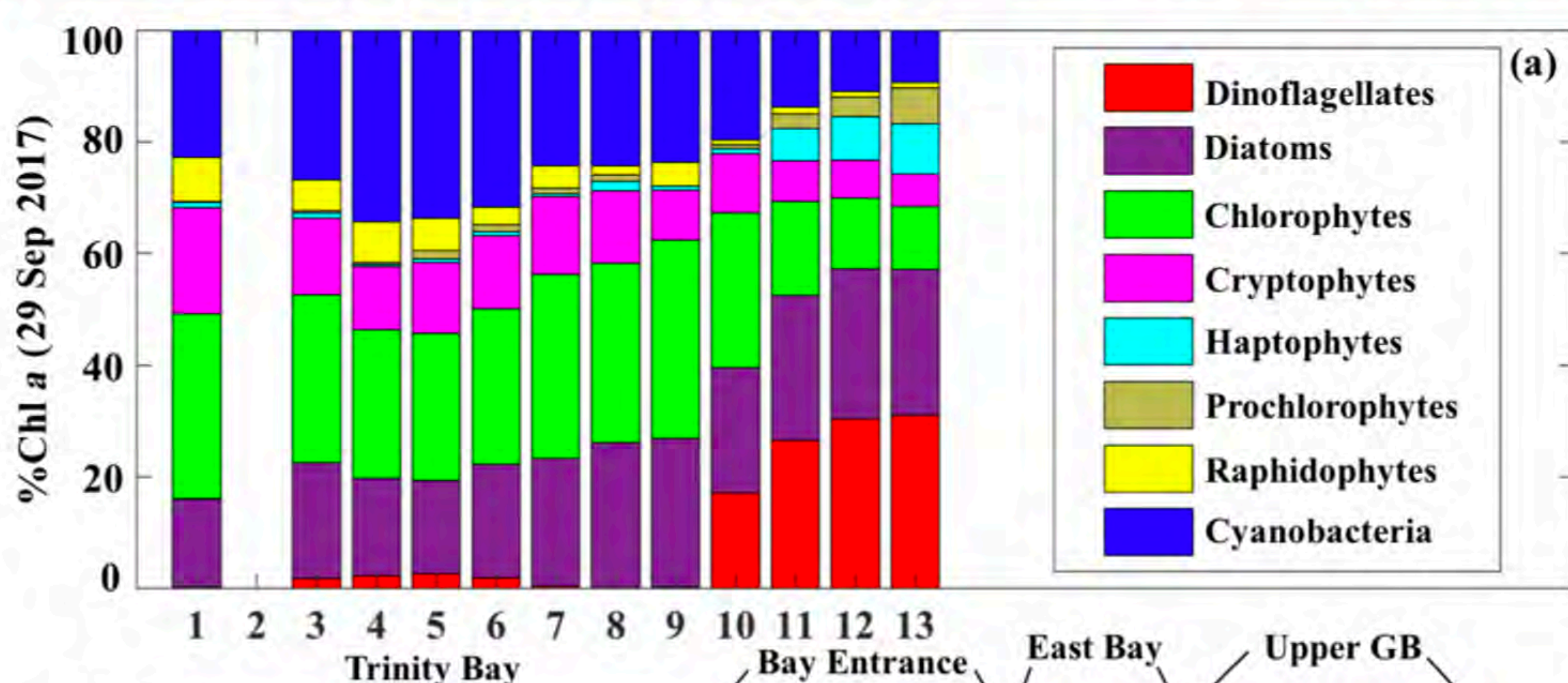
Phytoplankton taxonomy & OLCI derived pigments

Liu, D'Sa and Joshi 2019
Biogeosciences.

Flowchart



Phytoplankton taxonomy: 1&2 months following hurricane



Summary

- Field and ocean color data combined with semi-analytical and inversion algorithms provided new insights on the biogeochemical response of a turbid estuary to an extreme flood perturbation.
- Environmental drivers, especially floodwater discharge and winds strongly influenced the spatiotemporal distribution of DOC, POC and phytoplankton in the bay and shelf waters following the hurricane passage.

Acknowledgements

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References

- D'Sa, E. J., I. Joshi and B. Liu. 2018. Geophysical Research Letters
- Joshi, I. and E. J. D'Sa, 2018. Biogeosciences
- Lee, Z., K. L. Carder and R. A. Arnone, 2002. Applied Optics
- Liu, B., E. J. D'Sa and I. Joshi. 2019. Biogeosciences
- Moisan, T., et al. 2017. Frontiers in Marine Science
- Roesler, C. S., M. J. Perry. 1995, J. Geophysical Research-Oceans
- Thrane, J., et al. 2015. PloS One