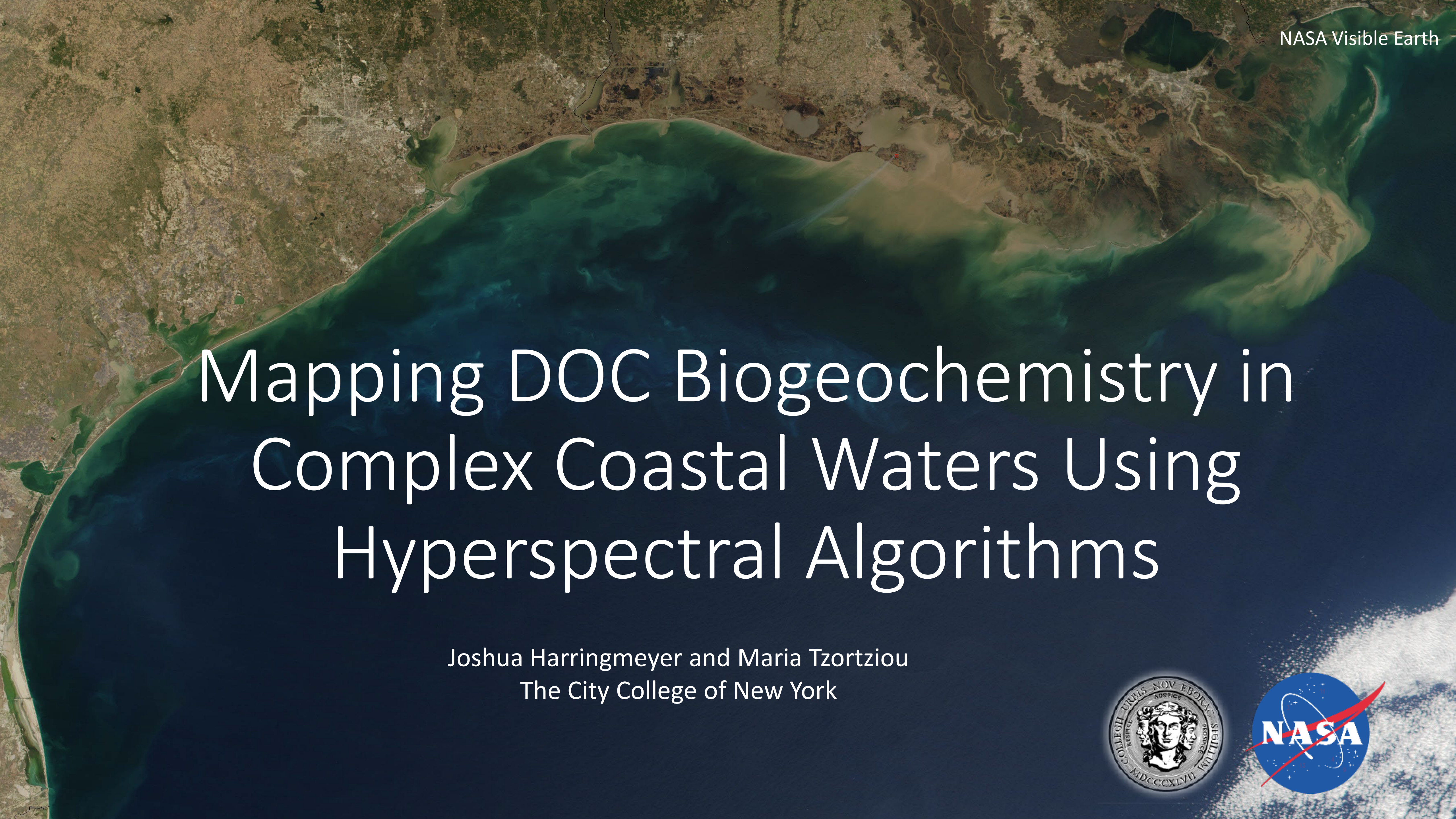


NASA Visible Earth

Mapping DOC Biogeochemistry in Complex Coastal Waters Using Hyperspectral Algorithms

Joshua Harringmeyer and Maria Tzortziou
The City College of New York

DOM along the land-river-ocean continuum varies as a function of sourcing and processing

Organic matter with different sources and compositions is processed in rivers and lakes during export

The fate of terrigenous DOM is further influenced by hydrology and conditions through estuary and coastal ocean processes

Bauer et al. 2013

Liu et al. 2023

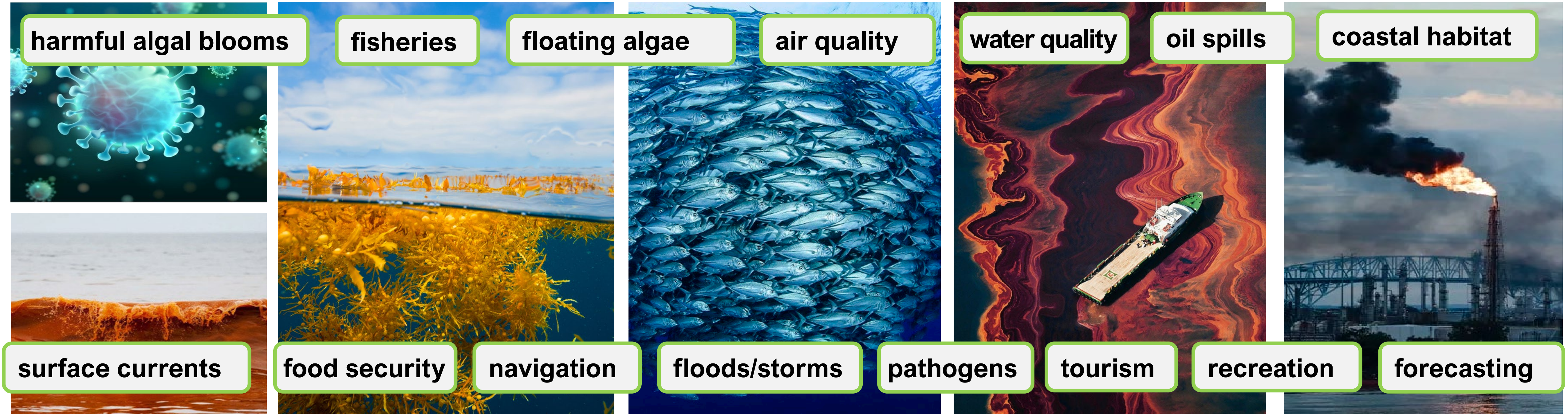
NASA's first Geostationary and Hyperspectral Ocean Color Sensor

GLIMR

Targeting the **formation, magnitude, and trajectory** of dynamic processes and transient events, for improved **management & mitigation, early warning systems, and timely response to disasters**

- **hyperspectral** resolution (340-1040nm, 2-7 nm across the UV-Vis-NIR)
- **high-spatial** resolution (300 m nadir Ground Sample Distance)
- **high temporal** resolution (e.g., hourly scans)
- **high radiometric quality**

This unique **combination of these capabilities** make GLIMR particularly well suited for addressing a wide range of applications…



GLIMR Program Applications Lead: Woody Turner, woody.turner@nasa.gov | GLIMR Mission Applications Lead: Maria Tzortziou, maria.a.tzortziou@nasa.gov

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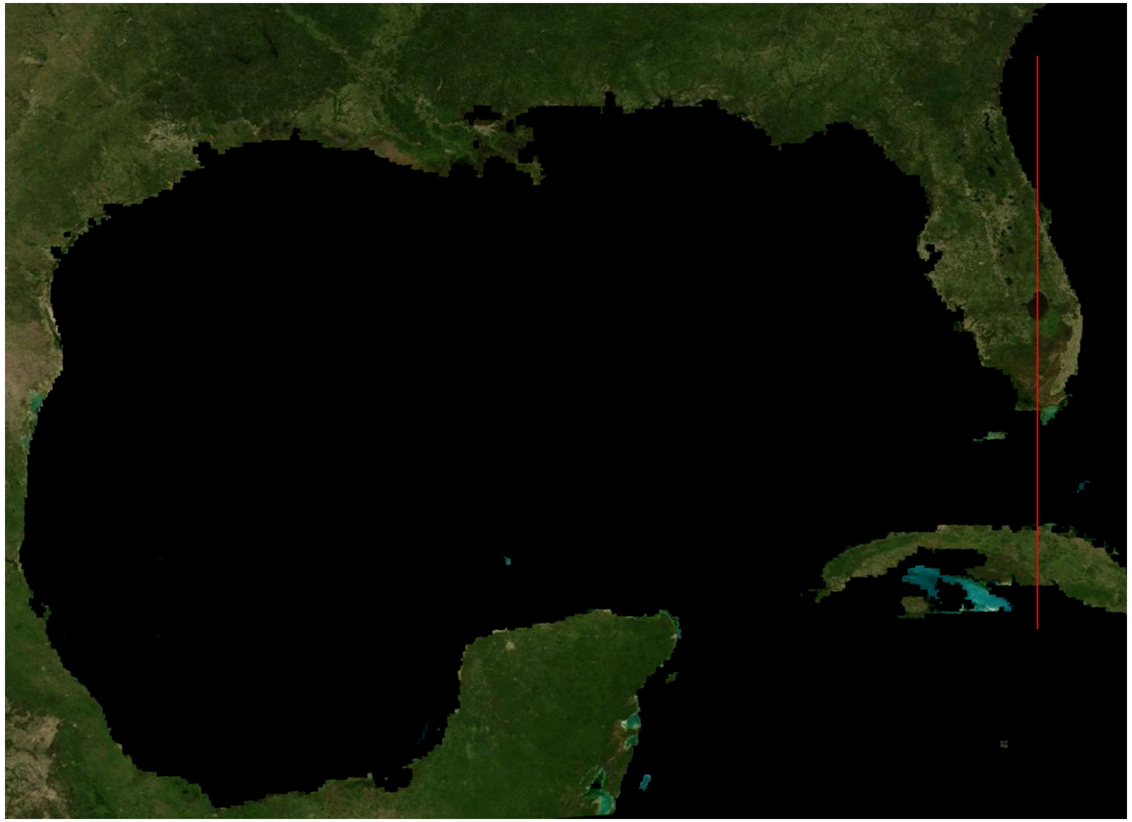
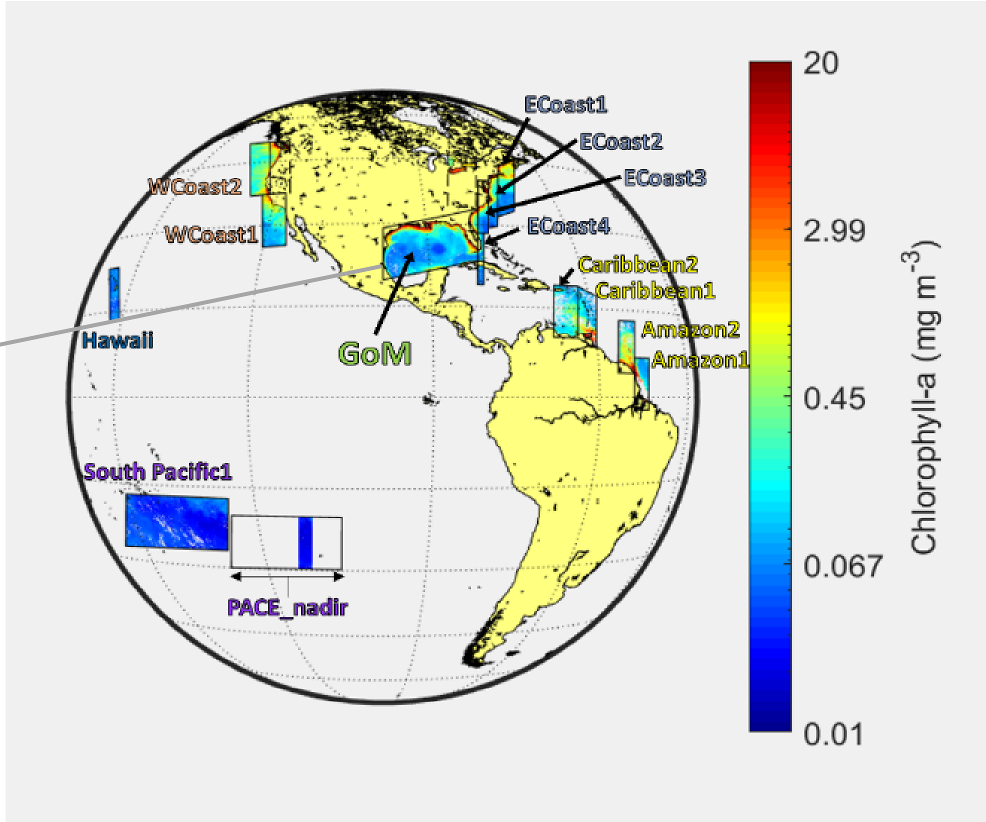




Continuous spectral information can help separate overlapping constituent IOPs

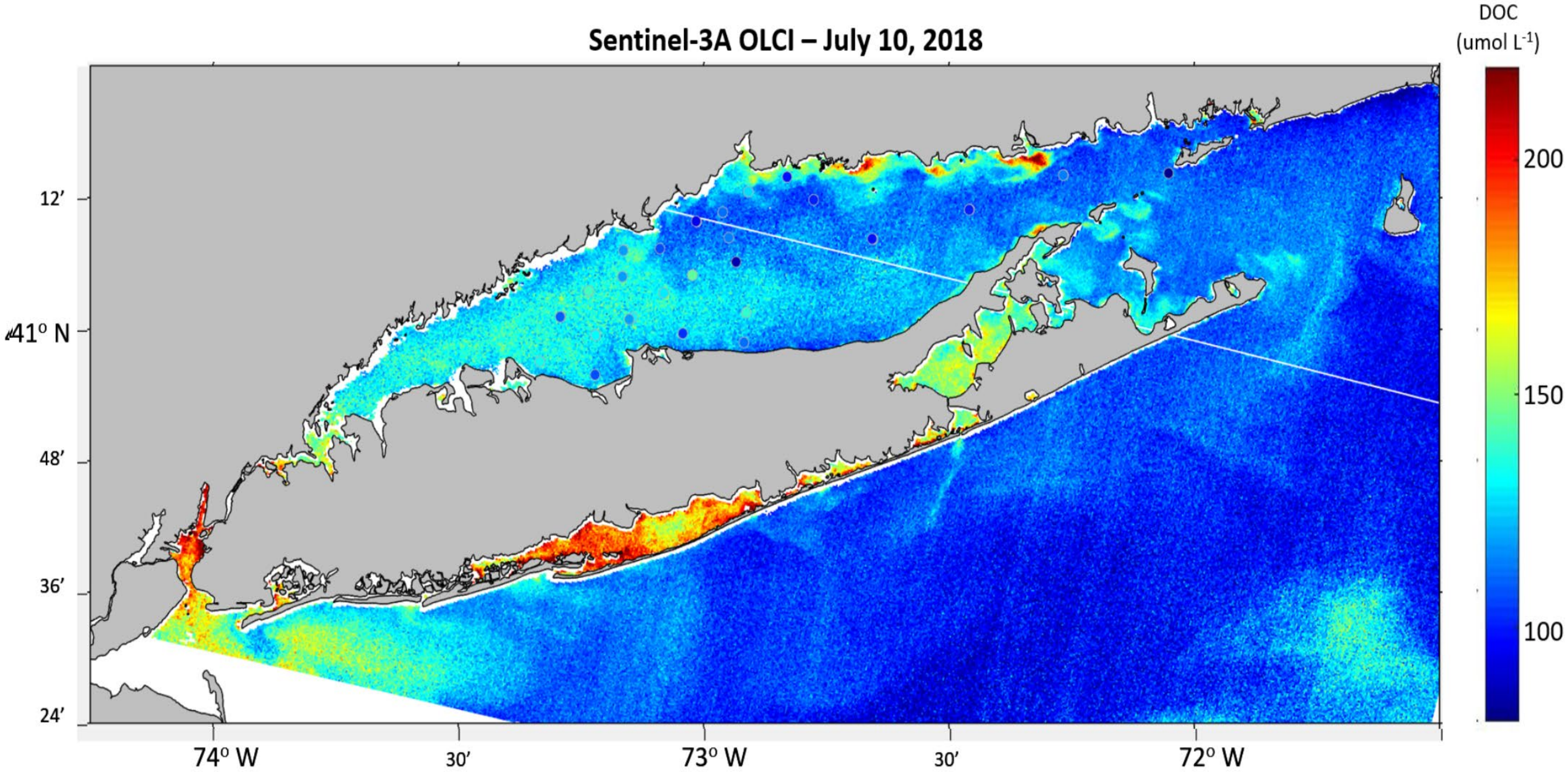
Spectral overlap in constituent inherent optical properties (IOPs) can result in non-unique multispectral R_{rs} *spectra*

a_{CDOM}

Particularly challenging in complex coastal waters using limited band information (VIIRS Bands for Comparison)

New algorithms are needed to fully utilize GLIMR imagery

Multispectral CDOM, spectral slope and DOC



Cao and Tzortziou 2024

Optimized for multispectral satellites with limited bands

PRISM Hyperspectral CDOM

Santa Monica,
CA

Harringmeyer et al. 2021

Limited to a small region

GLIMR in-situ dataset, US coastal waters

Each station has: hyperspectral, UV-Visible CDOM ($\lambda_{min} \geq 275$ nm) and R_{rs}(400-700)

Expanded field dataset, US coastal waters

Field data relationships

By combining CDOM ($a_g(300)$) with UV spectral slope ($S_{275\text{-}295}$) we have strong optical proxies for DOC

$a_g(300)$ Algorithms

OLCI-bands MLR

Partial Least Squares Regression R_{rs}(400:5:700)

Random Forest Regression R_{rs}(400:5:700)

Support Vector Regression R_{rs}(400:5:700)

$S_{275\text{-}295}$ Algorithms

OLCI-bands MLR

Partial Least Squares Regression R_{rs}(400:5:700)

Random Forest Regression R_{rs}(400:5:700)

Support Vector Regression R_{rs}(400:5:700)

Computing DOC from RF-retrieved CDOM

$$DOC = a_g(300) * \frac{DOC}{a_g(300)}$$

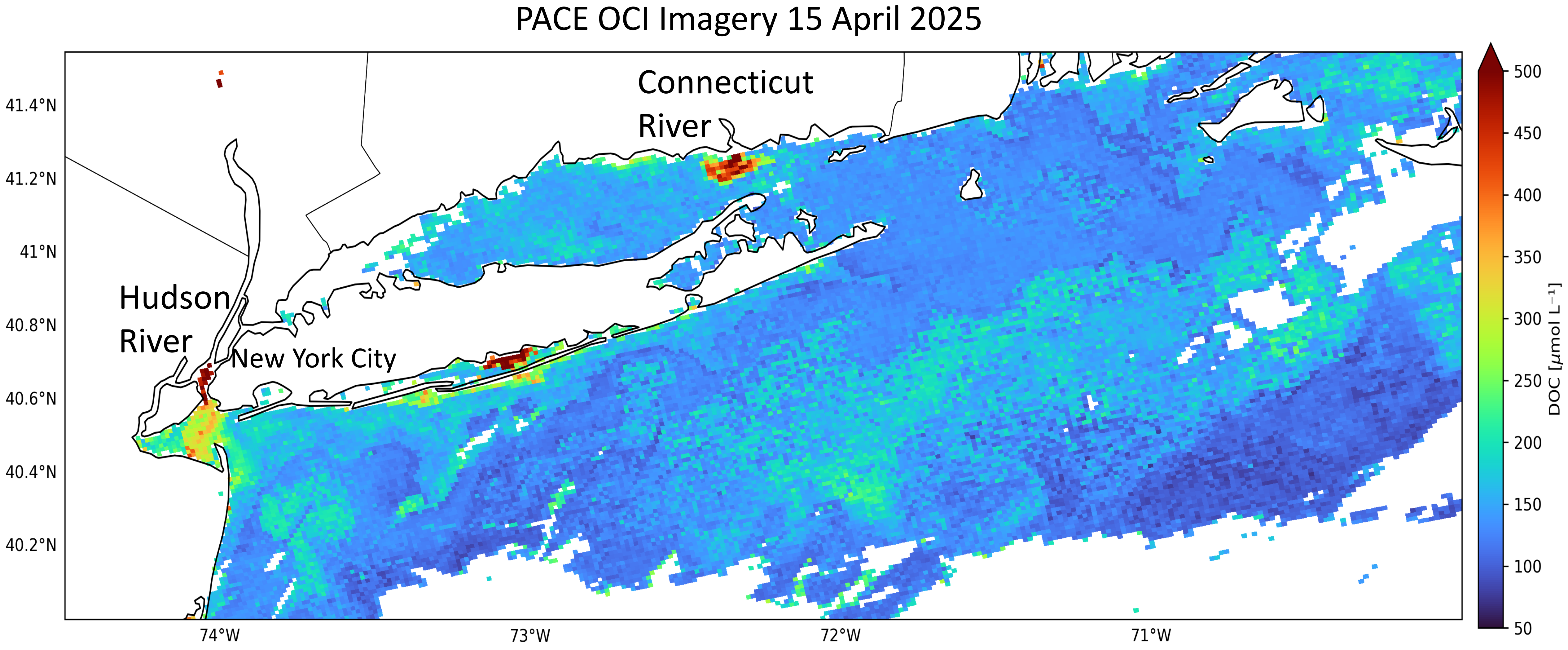
$$DOC = a_g(300) * (e^{-2.87-80.47*S_{275-295}} + e^{-0.93-174.7*S_{275-295}})^{-1}$$

R^2=0.92
MAPD=16.2%
Med Bias = -14

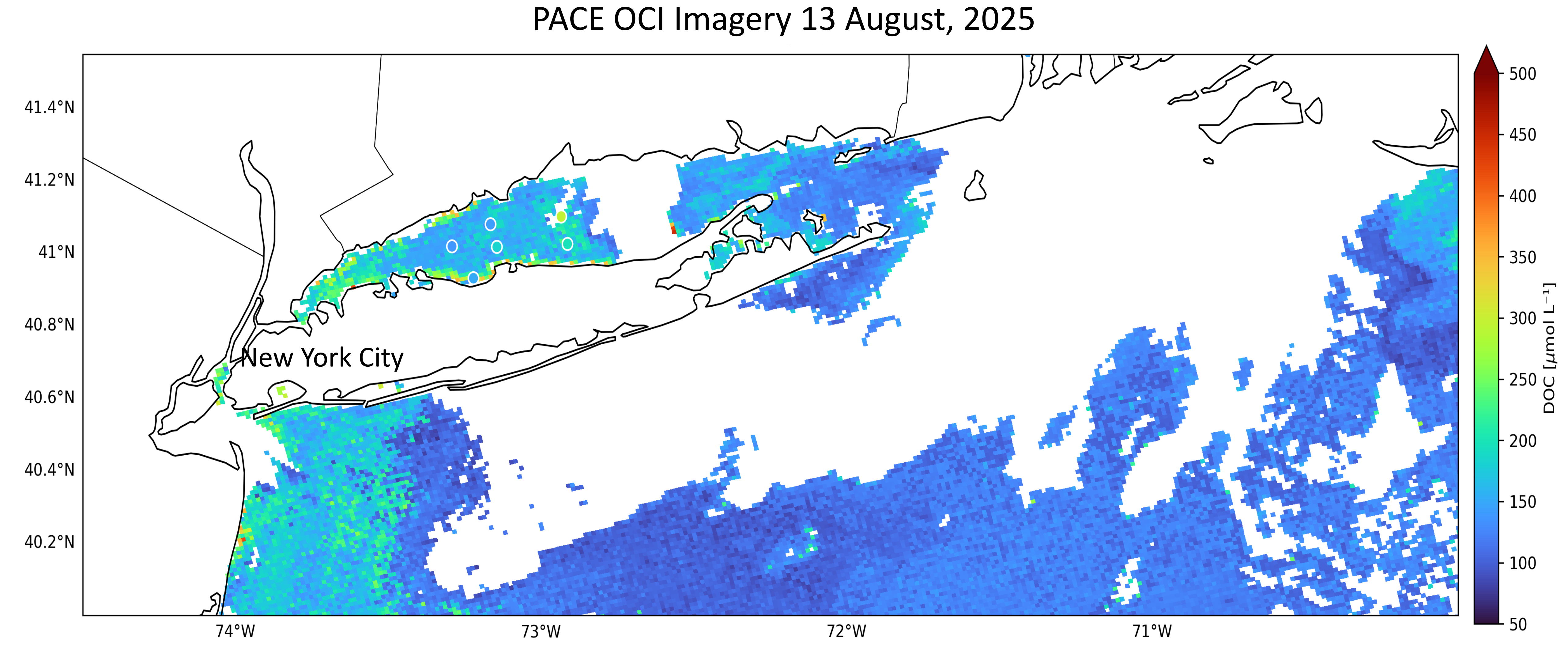
R^2=0.91
MAPD=19.3%
Med Bias = -25.7

Next steps: retrieving DOC from existing hyperspectral satellites (NASA PACE and EMIT, DLR DESIS)

PACE OCI-derived DOC – Long Island Sound



PACE OCI-derived DOC – Long Island Sound



Results:

Wide-ranging in-situ CDOM, DOC, and hyperspectral R_{rs} across U.S. coastal regions allows for improved retrieval of existing CDOM and DOC parameters using machine learning

Priorities for Future Work:

1-Year: Development of new remotely retrievable **DOM compositional proxies** using CDOM spectral information

5-Year: Improved **coastal atmospheric correction** and **validation of hyperspectral satellite imagers**

10-Year: Refinement of DOC composition retrievals combined with frequent imaging allow for **direct tracking of land-ocean fluxes and fate of DOC** in the coastal ocean

Acknowledgments:

- Thank you to NASA EVI GLIMR Mission and GLIMR Science Team
- Thank you to Bingqing Liu, Michael Ondrusek, Jennifer Cannizzaro, and the NOAA VIIRS Cal/Val cruise teams for making field datasets available

PACE/OCI view of the NE U.S. Coast in October 2025 (from Joseph Knuble, NASA Goddard Space Flight Center)