

Fresh and coastal water product refinement and extension for PACE



MDN estimated Chlorophyll-a for
Lake Erie @ PACE resolution on 05-31-24



PI: Ryan O'Shea^{1,2} (ryan.e.o'shea@nasa.gov);

Co-Is: Pengwang Zhai³; Brandon Smith^{1,2};

Collaborators: Kimberly Hyde⁴; Ryan Vandermeulen⁵; Jennifer Wolny⁶; Robert Brewin⁷; Anthony Gidudu⁸;

Other Professional: Arun Saranathan^{1,2}; Akash Ashapure^{1,2}; Will Wainwright^{1,2};

¹Science Systems and Applications Inc., Lanham, MD, United States; ²NASA Goddard Space Flight Center, Greenbelt, MD, U.S.;

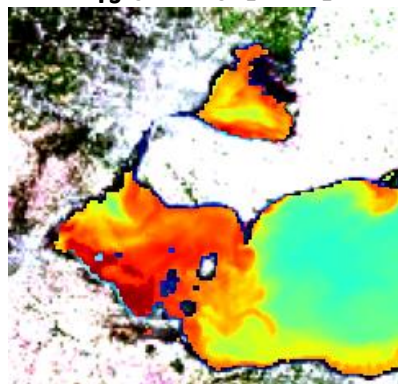
³University of Maryland Baltimore County (UMBC); ⁴NOAA, Northeast Fisheries Science Center; ⁵NOAA National Marine Fisheries Service; ⁶Food Drug and Administration (FDA); ⁷University of Exeter, United Kingdom; ⁸Makerere University, Uganda



PACE SAT III: Fresh and coastal water product refinement and extension for PACE

Module I: Atmospheric Correction

R_{rs} (560) [sr^{-1}]



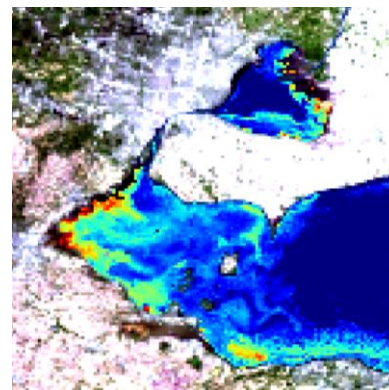
TOA \rightarrow R_{rs}



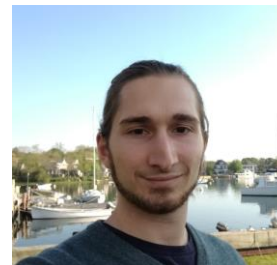
Dr. Akash Ashapure

Module II & III: Inverse Modeling

Chlorophyll [mg m^{-3}]



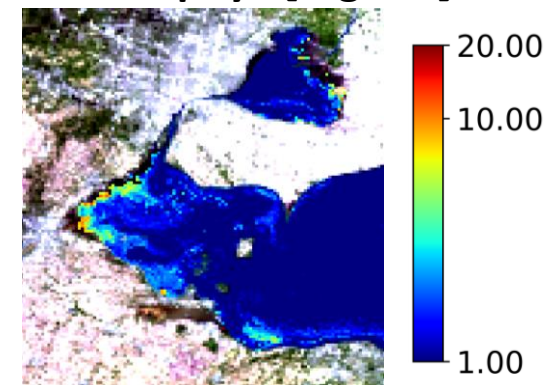
$R_{rs} \rightarrow$ IOPs & BPs \rightarrow PCC



Dr. Ryan O'Shea

Module IV: Uncertainty Products

Chlorophyll [mg m^{-3}]

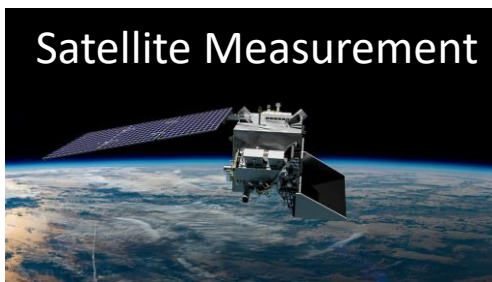


R_{rs} , BPs, IOPs \rightarrow Uncertainty



Dr. Arun Saranathan

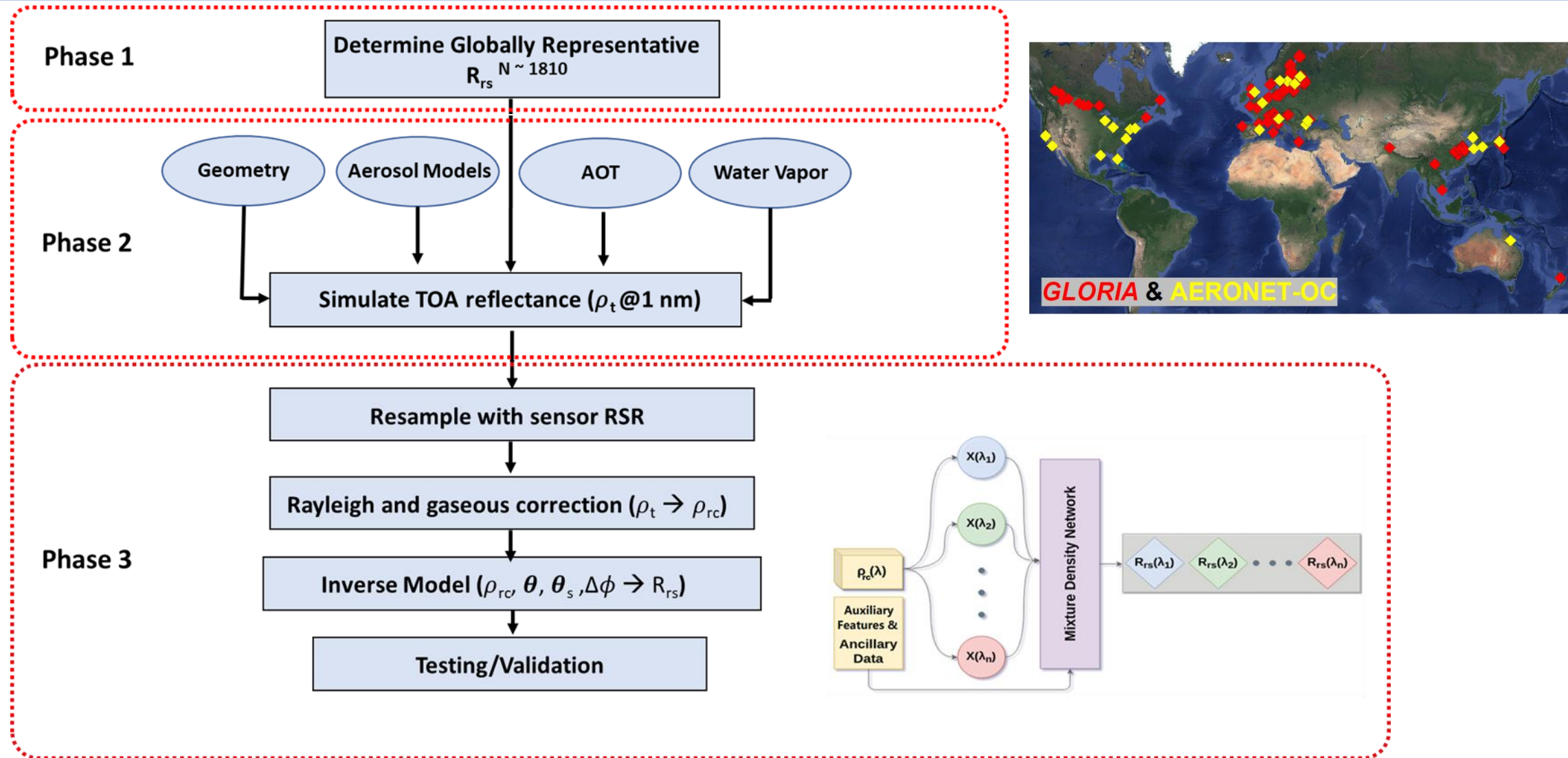
TOA reflectance
Satellite Measurement



Objectives:

- I. Improve the quality and utility of OCI-derived R_{rs} spectra in optically complex inland and coastal waters
- II. Utilize a novel physics-informed MDN model to enhance the quality of global WQ products for inland and coastal waters.
- III. Develop high-quality global phytoplankton community composition maps comprised of phytoplankton size classes and types.
- IV. Produce, calibrate, and validate MDN-generated pixel-level uncertainties for our products obtained in **Modules I and II**.

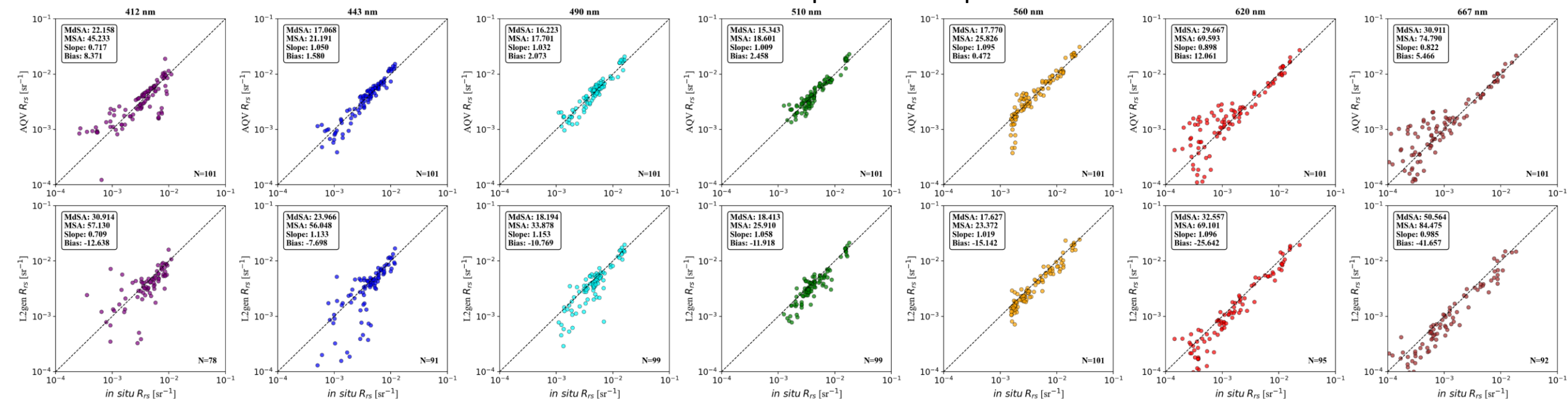
PACE SAT III, Module I: Atmospheric correction for inland and coastal waters



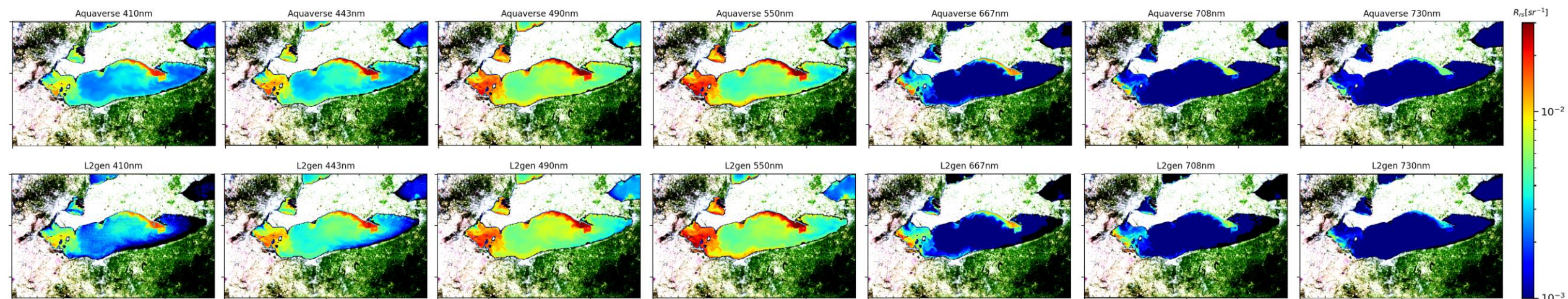
Objective: Improve the quality and utility of OCI-derived R_{rs} spectra in optically complex waters and atmospheres via a dedicated MDN model to compensate for the confounding impacts of aerosol contribution.

PACE SAT III Module I: Preliminary atmospheric correction results

AERONET Resampled Matchups

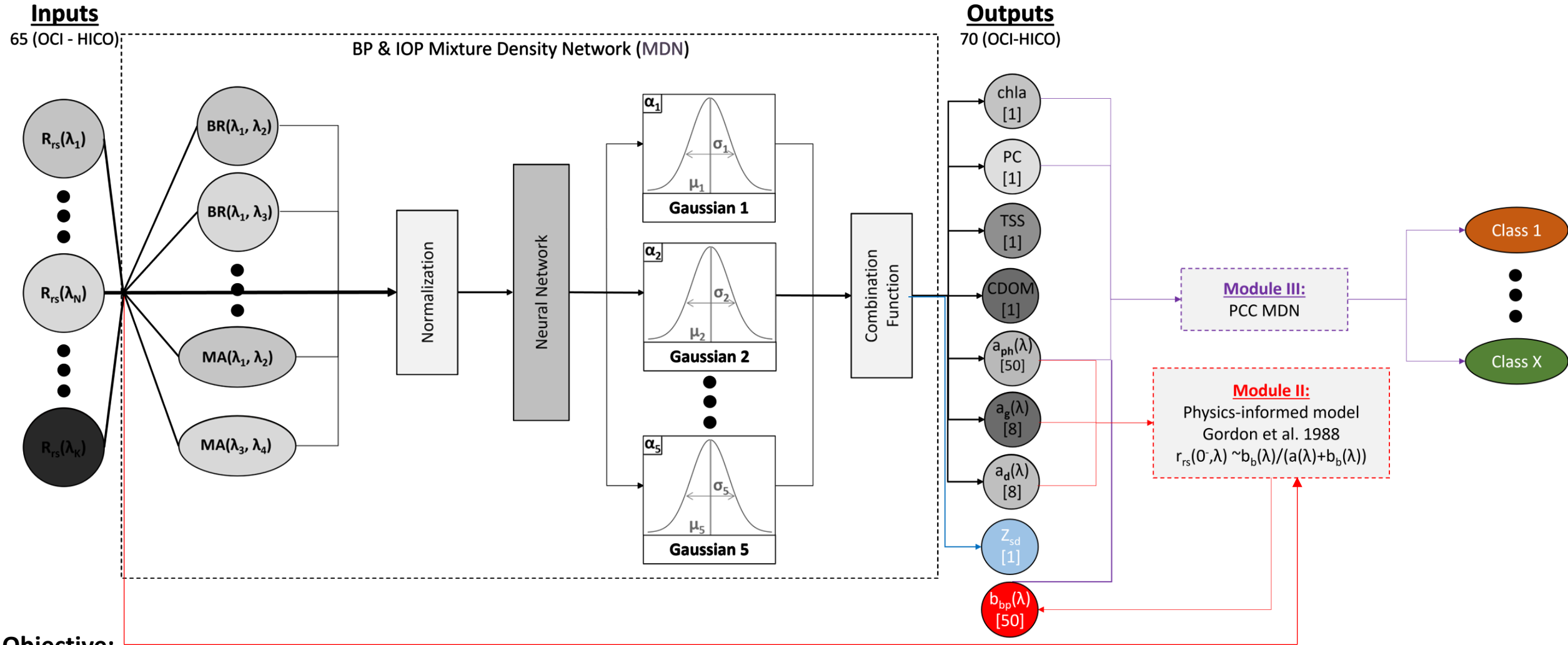


PACE Image of Lake Erie (5/31/2024)



PACE SAT III, Modules II & III: Physics-informed BP, IOP, and PCC inversion for inland and coastal waters

PACE SAT II (O'Shea et al. 2023)



Objective:

- Utilize a novel physics-informed MDN model to enhance the full suite of global WQ products (e.g., Chla, Z_{sd}) and hyperspectral IOPs products (**Module II**).
- Develop high-quality global phytoplankton community composition maps (**Module IV**) comprised of phytoplankton size classes and types to expand the applicability of our OCI products for fisheries operations and HAB monitoring.

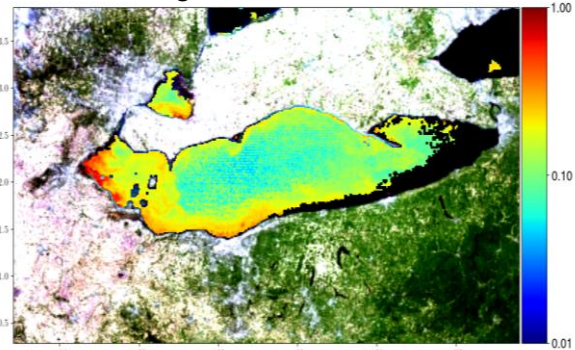
Module II Current Status: Aquaverse(AQV) Inversion & uncertainty products from PACE SAT II

PACE Image of Lake Erie (5/31/2024)

Chlorophyll [mg m^{-3}]



$a_g(440)$ [m^{-1}]



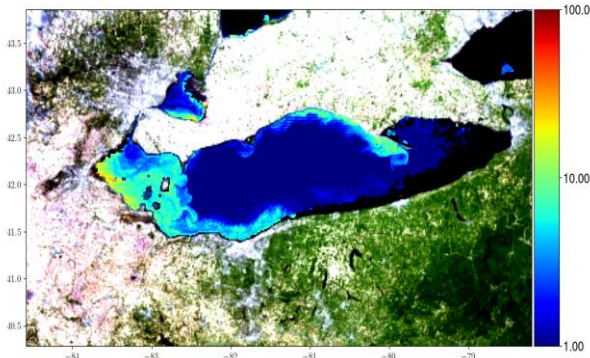
PC [mg m^{-3}]



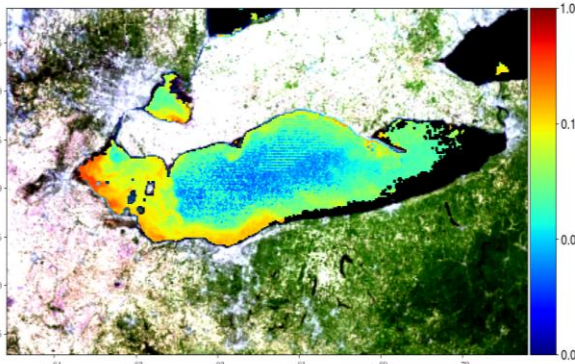
$a_{ph}(620)$ [m^{-1}]



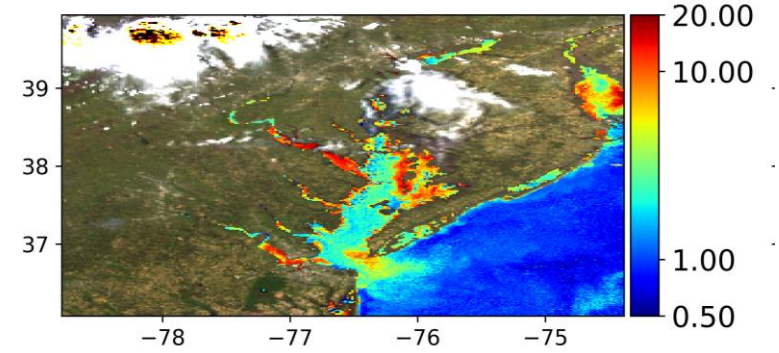
TSS [g m^{-3}]



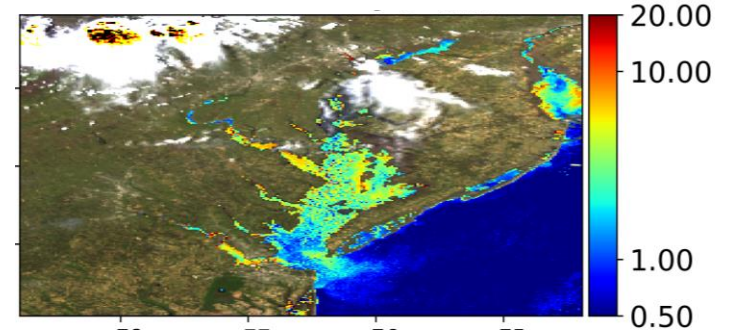
$a_d(440)$ [m^{-1}]



Chlorophyll-a Retrievals



Chlorophyll-a Uncertainty

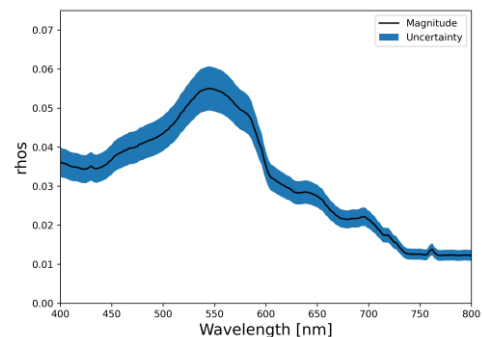


MDN tutorials

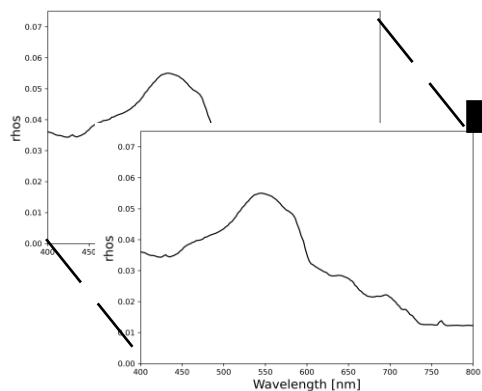


PACE SAT III, Module IV: Total uncertainty production via Monte Carlo Simulation

Input Distribution

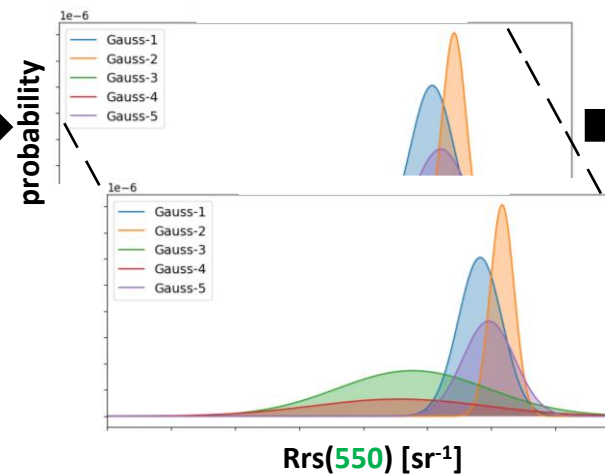


Sample Generation

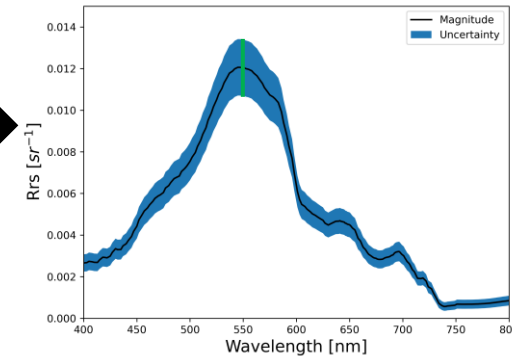


Rrs MDN
(Module I)

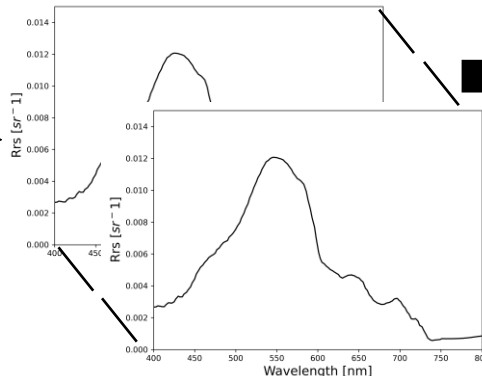
Output Distribution



Extract Model Estimate & Uncertainty (R_{rs})

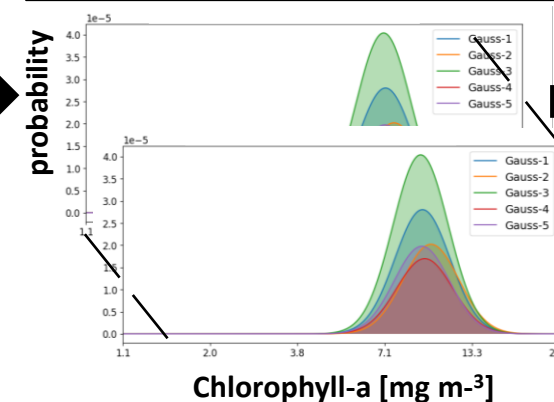


Sample Generation

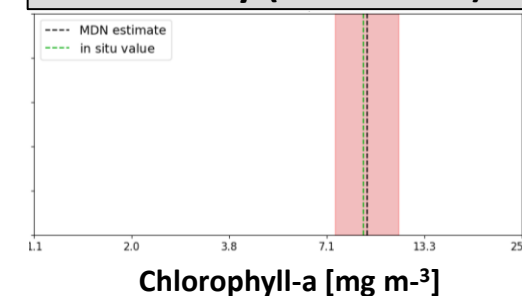


BP & IOP
MDN
(Module II)

Output Distribution



Extract Model Estimate & Uncertainty (BPs & IOPs)

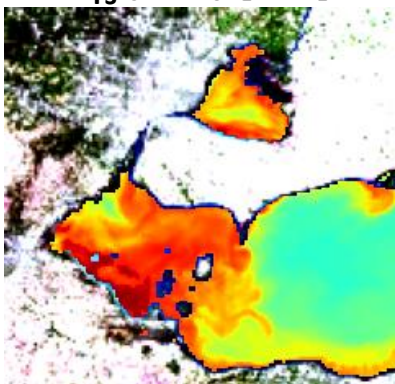


Objective: Produce, calibrate, and validate MDN-generated pixel-level uncertainties for our products obtained in **Modules I** and **II**.

PACE SAT III: Fresh and coastal water product refinement & extension for PACE

Module I: Atmospheric Correction

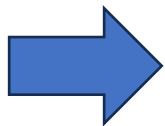
R_{rs} (560) [sr^{-1}]



TOA \rightarrow R_{rs}

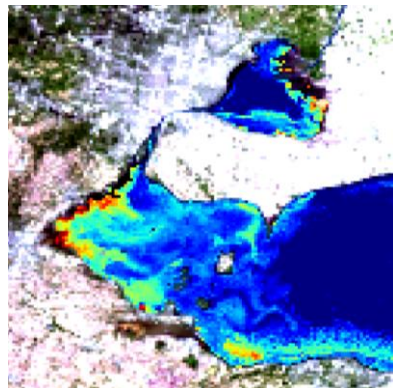


Dr. Akash Ashapure



Module II & IV: Inverse Modeling

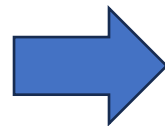
Chlorophyll [$mg\ m^{-3}$]



R_{rs} \rightarrow IOPs & BPs \rightarrow PCC

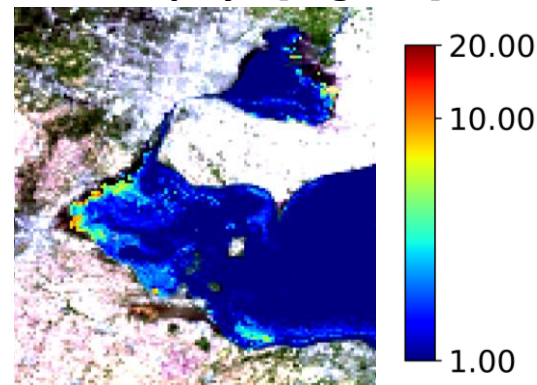


Dr. Ryan O'Shea
ryan.oshea@ssaihq.com



Module III: Uncertainty Products

Chlorophyll [$mg\ m^{-3}$]



R_{rs} , BPs, IOPs \rightarrow Uncertainty



Dr. Arun Saranathan

MDN tutorials



STREAM

