NASA's first ocean color instrument in geostationary orbit (GLIMR) will resolve rapidly evolving features in the coastal ocean

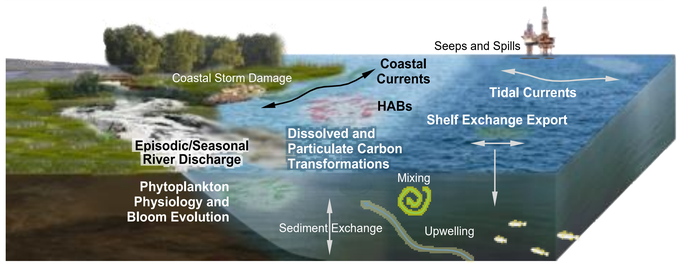
Joseph Salisbury, Antonio Mannino[2], Dirk Aurin[3], Mark Schless[4], and the GLIMR Team

[1] University of New Hampshire, [2] NASA Goddard Space Flight Center, [3] NASA GSFC/Morgan State Univ., [4]Raytheon Corp, Segundo, CA

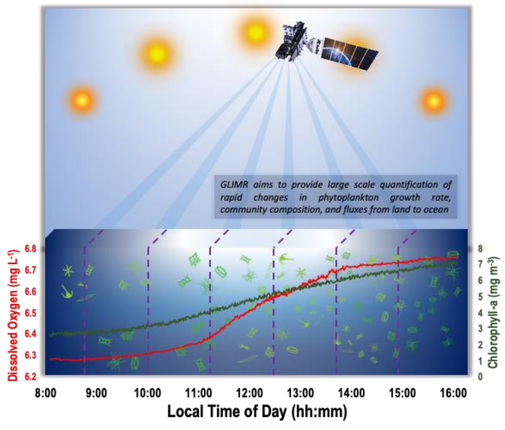
"The Earth's main energy pumps are the annual and diurnal cycles, each with comparable driving power." (Chesters, 1998)

The Geostationary Littoral Imaging and Monitoring Radiometer (GLIMR) is a NASA Earth Venture Instrument (EVI-5) launching in mid-2028 to geostationary orbit over the eastern Pacific to observe U.S. coastal waters and other regions multiple times per day. **GLIMR** will be the first sensor specifically designed to study rapidly evolving features in the surface ocean.

While such features in the atmosphere are well known and affect our everyday lives, less is known about important processes occurring in the surface ocean that evolve over timescales of minutes to days. Such processes include *physiological changes in phytoplankton communities, vertical migration of phytoplankton and zooplankton, horizontal and vertical fluxes of land and ocean materials, and a host of other processes occurring at tidal frequencies. (see below)*



GLIMR Science and Applications Objectives: GLIMR will enable a large-scale quantification of rapid changes in phytoplankton growth rate, community composition, and material fluxes from land to ocean while providing vital information on coastal hazards including harmful algal blooms and oils spills for improved response both at sea and along the coast with multiple diurnal observations.



Science Questions & Hypotheses

Q1. How do physical processes that vary at timescales from hours to days impact the rates and fluxes of materials within and between aquatic coastal ecosystems?

H1. Diurnal variability in light and nutrient availability influences phytoplankton physiology in a manner that determines their growth rate and thus community composition and overall ecosystem production.

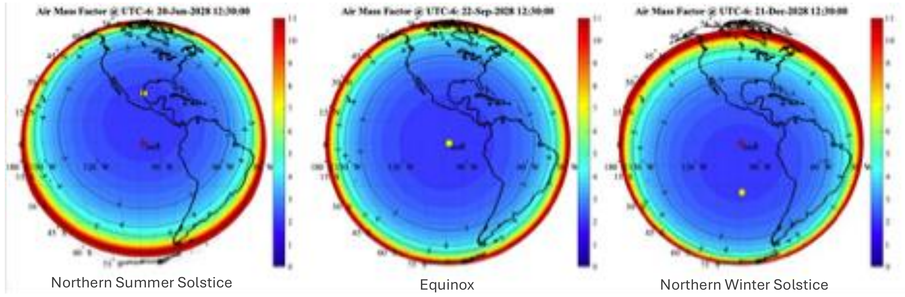
H2. Episodic fluxes and sub-diurnal pulses of sediments, organic matter, nutrients, and other optically active materials between and within aquatic coastal ecosystems (river-estuary-coastal ocean-open ocean) have a disproportionate impact on the productivity and health of coastal ecosystems relative to the longer-term mean and annual total.

H3. The long-term fluxes of sediments and organic matter over annual time scales are underestimated based on data records from LEO satellite observations.

Q2. How do the fluxes and rates within and between aquatic coastal ecosystems promote the formation, magnitude and trajectory of HABs and impact ecosystem health and human health?

A glimpse into GLIMR's Capabilities

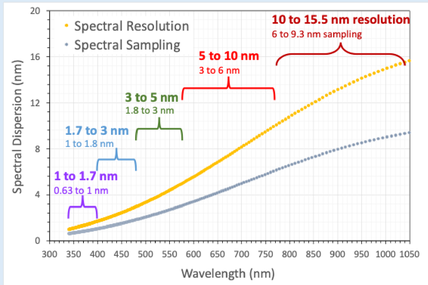
GLIMR can retrieve science observations anywhere where/when Air Mass Factor <=5



GLIMR location modeled at equator, 98 °W

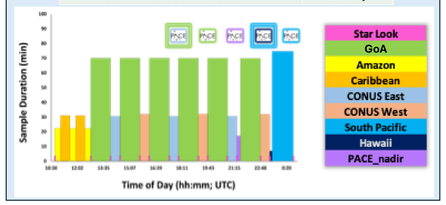
High Spectral

- Hyperspectral: 340-1040 nm (252 bands)
- Fine spectral sampling and resolution



High Temporal

Baseline Regions	Frequency
Gulf of America	6x / day
East & West CONUS coastal waters	3x / day
Amazon River Plume	3x / day
Caribbean Sea region	2x / day
Hawaii region	2x / day
Other HAB target sites	3x / day
Calibration w/ PACE OCI or other sensors	5-7x / day
Invariant South Pacific clear waters	2x / day



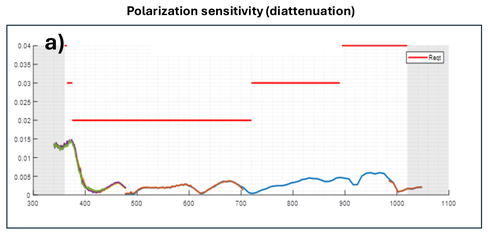
Moderate Spatial Resolution

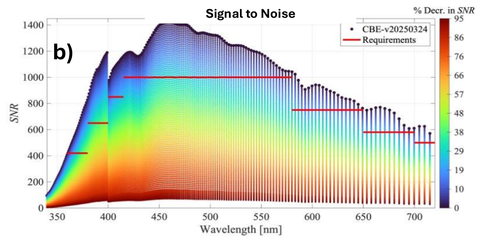
- 300 m ground sample distance (nadir)
- ~500 m spatial resolution performance (TBD)
  - ***>4 to >12 GLIMR pixels per PACE OCI pixel***

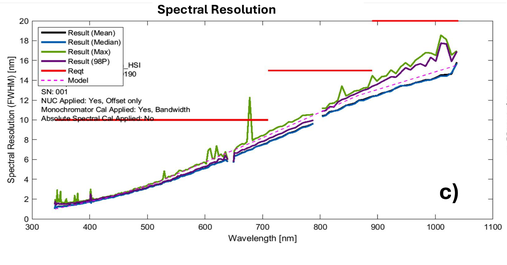
Adaptive Scheduling & Targeting

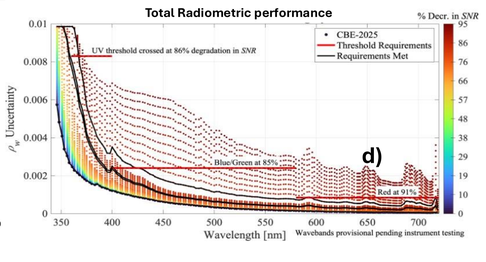
- Flexibility to target episodic events & hazards at high frequency (<1/hour possible).
- e.g. Oil spills, HABS, Sargassum, Storm recovery

GLIMR performance results (below): The GLIMR sensor is currently being evaluated and has shown to be an ideal instrument for our science and applications objectives. Results shown are for **a)** Polarization sensitivity, **b)** Signal to noise**, c)** Spectral resolution **d)** Total performance

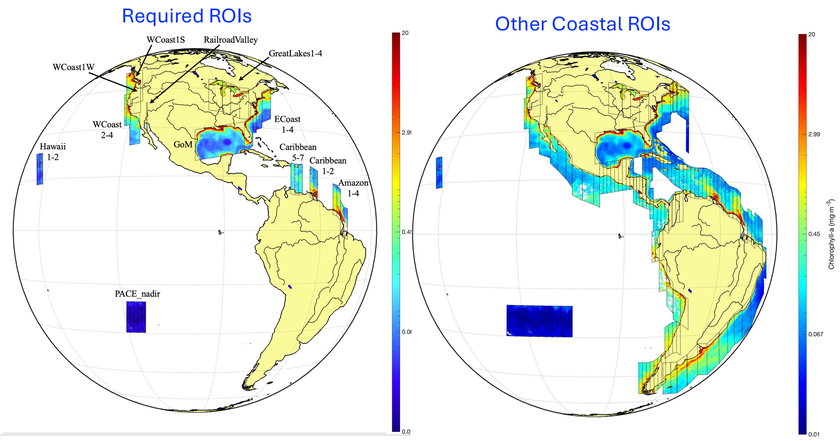






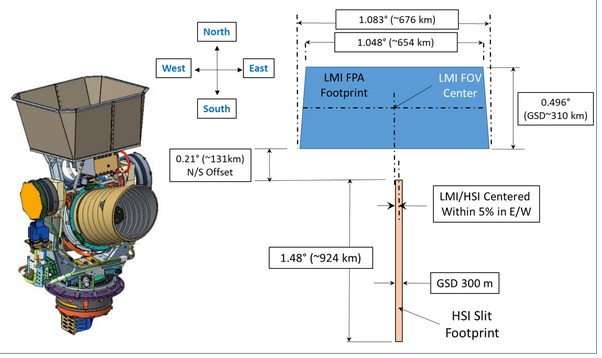


GLIMR's Scan Regions of Interest (ROIs)



GLIMR Instrument Design and Operations

A telescope mounted on a 2-axis gimbal that actively scans an imaging spectrometer across a region of interest. The landmark imager (LMI), a 2D single band camera (865 ±20 nm), observes landmarks (~146 m GSD nadir) at high frequency than hyperspectral spectrometer imager (HSI) as well as stars for image navigation and registration of the HSI data.



Data Products

Heritage/PACE-like Ocean Color Data Products	
Product	**Description of Data Products**
L_t	Top-of-Atmosphere radiance in range of 350-1020 nm
Rrs ***	Remote sensing reflectance in range of 350 to 720 nm
K_d ***	Spectral diffuse attenuation coefficients
K_{PAR} ***	PAR diffuse attenuation coefficient
AVW	Apparent visible wavelength
Absorption ***	Spectral a_t ***, a_{ph} ***, a_{cdm} ***, a_{pr}, a_g (400 to 600 nm)
Backscatter ***	Spectral b_{bp} *** (400 to 600 nm)
S_{CDOM}	CDOM Spectral slope coefficients
Chl-*a* ***	Chlorophyll-*a*
Pigments	Phytoplankton pigments
PCC	Phytoplankton community composition
PAR, iPAR ***	Daily and instantaneous PAR
FLH ***	Fluorescence line height
Z_{eu}	Euphotic depth
POC	Particulate organic carbon
DOC	Dissolved organic carbon
SPM	Suspended particulate matter
PSD	Particle size distribution
NPP	Net Primary Production - modeled
AOT	Aerosol optical thickness

*** NASA required data products

Unique GLIMR Data Products	
	Rates and Fluxes Products
NPP_{Geo}	Net primary production (GEO-optimized)
NCP	Net community production of POC
Flux SPM, POC, DOC	Fluxes of SPM, POC and DOC
SC	Surface Ocean Currents
	GLIMR Applications Products
HAB	HAB detection index
Kbrev	Karenia brevis cell count index
Myc	Mycrocystis cell count index
FAB	Floating algae biomass
WTC	Water type classification
PD, PT	Petroleum detection and thickness
OD	Oil density
AAI	Absorbing aerosol index

New products: No existing heritage/mature algorithms

Current GLIMR Status

- GLIMR instrument continues integration and testing at Raytheon.
  - Radiometric characterization and calibration is underway.
  - Radiometric performance test results (e.g., polarization sensitivity) show compliance with requirements and consistency with Raytheon's modeled predictions.
  - Instrument pre ship review (PSR) to occur in January 2027
- **Access to Space (ATS)**
  - On April 15, NASA released an RFI for GLIMR's ATS with a final RFP due out in July 2026 with selections in January 2027.
  - The RFI lists an 18-month planning and integration period, 6 months of on-orbit commissioning, 1 yr of operations, and two 1-yr options for extended operations.
  - **Launch date in mid-2028** based on the present timeline.
- **Science Phase**
  - Product and applications development
  - Address science and applications questions