GLIMR: A geostationary sensor for a dynamic coastal ocean

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Applied Science: What is unique in GLIMR

Hyper-Spectral

340-1040 nm;
<5 to <10 nm resolution across UV-VIS
< 5 nm sampling UV-VIS

High Temporal

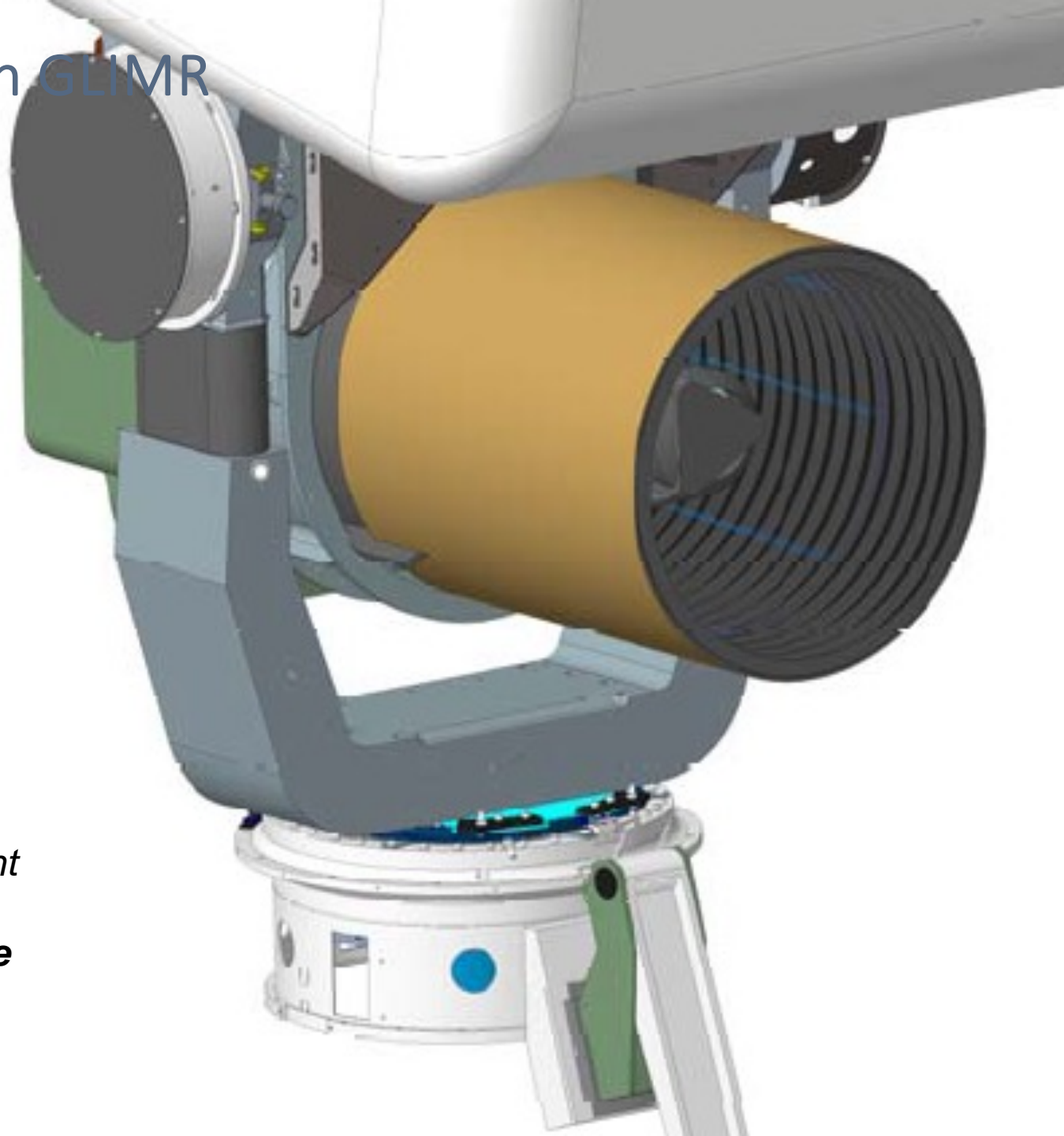
6x/day (~hourly) GoM
2x-3x/day elsewhere
3x/day HAB target sites

High Spatial

- 300 m nadir Ground Sample Distance, GSD
- 328 m Gulf of Mexico
- <500 m over coastal continental US

High SNR

> 420 in UV
>1000, 400-580 nm
>750, 580-650 nm
>580, 650-712 nm
>500, 713-890 nm



Quote from NASA Panel Review: *"GLIMR fills significant gaps in the current suite of ocean color sensors. Current NASA ocean color missions do not provide* ***the temporal and spatial resolution necessary*** *to describe processes in the dynamic coastal zone."*

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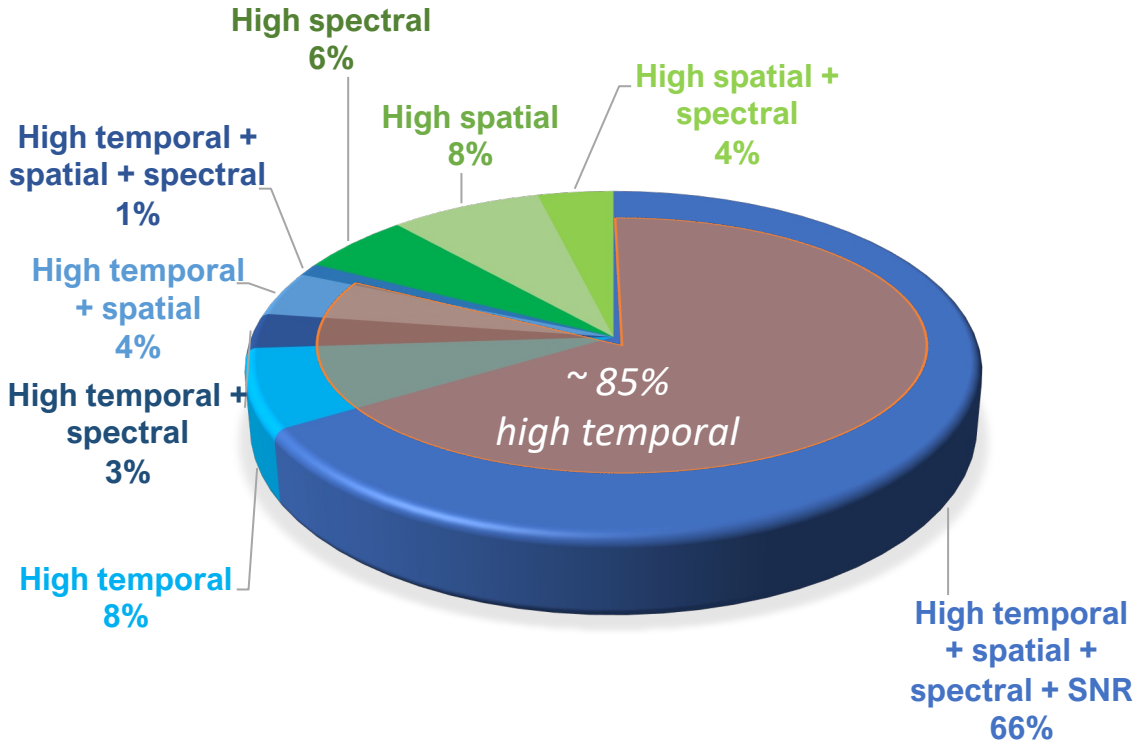
Special Request Priorities

1. **Disaster and Emergency Acquisitions**
   - **Federally Declared Disasters**
   - **Threshold Violations (HABs, oil, etc.)**
2. Field Campaigns
3. Engineering and Calibrations
4. US researcher requests
5. International researcher requests

~350 participants
GLIMR 1st Applications Workshop

*What GLIMR capability would be **more useful** for your work?*

GLIMR Apps Workshop



GLIMR: Data Products

"Typical" Ocean Color Products
Remote sensing reflectance (360 to 720nm every 15 or 10 nm @ 5 nm steps)
Spectral diffuse attenuation coefficients
Apparent visible wavelength
Spectral absorption coefficients (a_t, a_p, a_{ph}, a_{cdm}, a_g) and backscatter coefficients (380 to 680 nm)
CDOM Spectral slope coefficients
Chlorophyll-*a*
Phytoplankton pigments
Phytoplankton community composition
Daily and instantaneous PAR
Fluorescence line height
Euphotic depth
Particulate organic carbon
Dissolved organic carbon
Suspended particulate matter
Particle size distribution

Rates and Flux Products
Net primary production (NPP)
Net community production of POC
Fluxes of SPM, POC and DOC
Surface Ocean Currents

Applied Science Products
Turbidity, Water clarity
HAB detection index
***Karenia brevis* cell count index**
***Mycrocystis* cell count index**
Floating algae biomass
Water type classification
Water Quality Indicators (e.g., CDOM quality)
Petroleum detection and thickness
Oil density

GLIMR Applications Team

- **EPA** – water quality & lakes
- **NOAA NOS** – harmful algal blooms and water quality
- **NOAA NMFS** – fisheries
- **US Navy** – water quality
- **NASA** – food security
- **USF** – oil spills and nuisance floating algae
- **CCNY** – water quality
- **LDEO** – harmful algal blooms

GLIMR: Synergies with other missions

Hyperspectral PACE & SBG Missions

ACME – Aquatic Cross Mission Exchange Working Group

What are the Opportunities for synergies across Missions Pre-launch (2022-2024)?

- Collection of **new hyperspectral datasets** shared across missions
- Development of **common algorithms and data products** across three science teams
- Shared working groups to better characterize aquatic biodiversity in terms of **phytoplankton community composition**
- Shared methods for calculating and distributing **Uncertainties** for products
- Joint efforts to conduct **Vicarious Calibration and Product Validation**
- Established methods **to distribute and use "big data"**

GLIMR/PACE/SBG Synergies paper

JGR Biogeosciences

RESEARCH ARTICLE
10.1029/2023JG007574

Special Section:
The Earth in living color: spectroscopic and thermal imaging of the Earth: NASA's Decadal Survey Surface Biology and Geology Designated Observable

Synergies Between NASA's Hyperspectral Aquatic Missions PACE, GLIMR, and SBG: Opportunities for New Science and Applications

H. M. Dierssen[1], M. Gierach[2], L. S. Guild[3], A. Mannino[4], J. Salisbury[5], S. Schollaert Uz[6], J. Scott[7], P. A. Townsend[8], K. Turpie[9], M. Tzortziou[10,11], E. Urquhart[4], R. Vandermeulen[12], and P. J. Werdell[4]

GLIMR: Synergies with other missions

Hyperspectral PACE & SBG Missions

ACME – Aquatic Cross Mission Exchange Group

What are the Opportunities for synergies across Missions with a constellation Post-launch (> 2028)

- **Assessment of algorithm performance (and applications tools)** across a wider range of conditions.
- Measurements of atmospheric parameters from PACE with polarimetry could inform **atmospheric correction** of other missions.
- Measurements of diurnal variability from GLIMR will be valuable to quantify **uncertainties in match-ups** with field datasets across all missions.
- Improved spatial resolution (SBG and GLIMR) can be used to evaluate **within satellite pixel variability** (for GLIMR and PACE)
- Study processes **across the continuum** of inland-coastal-marine environments
- Potential monitoring of **events at different phases of development** and environmental forcing (in coastal waters and open ocean).
- Monitoring of hazards and events that require **high spatial/temporal/spectral** resolutions, a **combination of different datasets, products** .

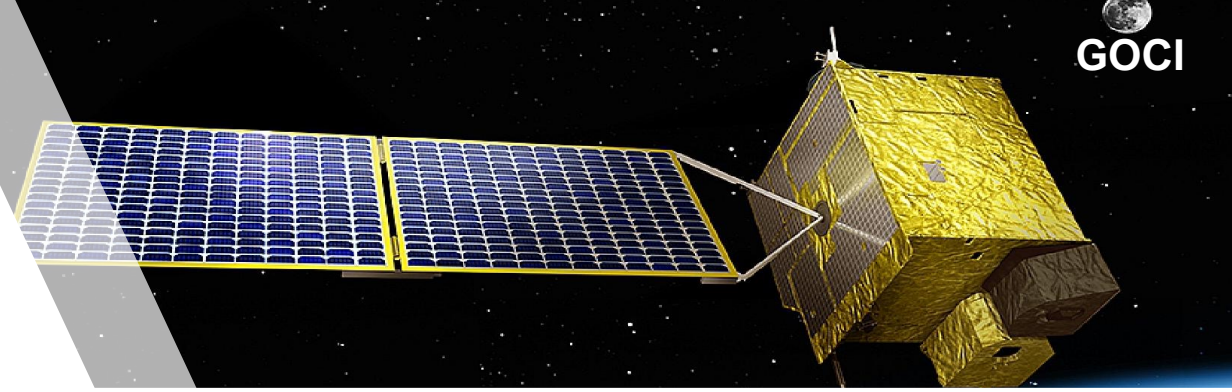
GLIMR/PACE/SBG Synergies paper

GLIMR: Synergies with other missions

Global Constellation of Geo-stationary Sensors

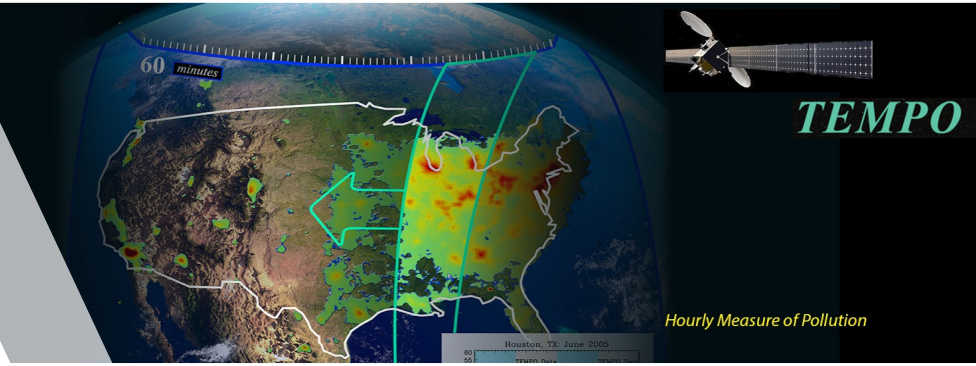
KIOST GOCI / GOCI-II Satellite Series – Launch 2020

Products: Ocean color (multi-spectral remote sensing reflectance, water inherent optical properties, biogeochemical variables) and atmospheric products



EUMETSAT Meteosat Satellite Series / SEVIRI and FCI

Products: Ocean color (suspended sediments, light attenuation, chlorophyll-a, water quality parameters) and atmospheric products



NOAA GOES-R – 2017 and GeoXO – Launch 2032
Geostationary Extended Observations

Products: Agriculture, fire, health, oceans, weather

NASA TEMPO (EVI-1) – Launch 2022
Tropospheric Emissions: Monitoring of Pollution

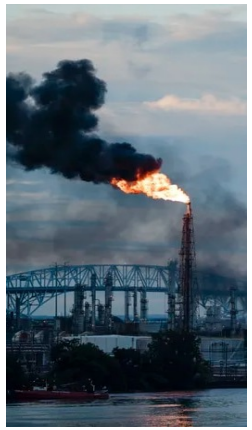
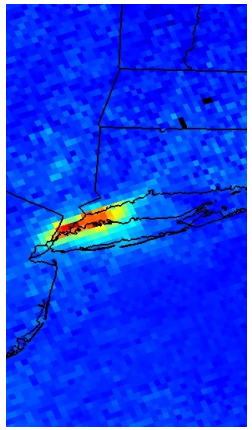
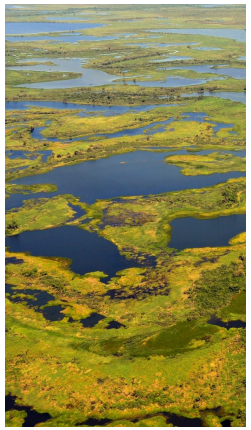
Products: Aerosol products (e.g., AOD, AAOD, AI), cloud products, atmospheric trace gases (e.g., O_3, NO_2, SO_2, H_2CO, $C_2H_2O_2$).

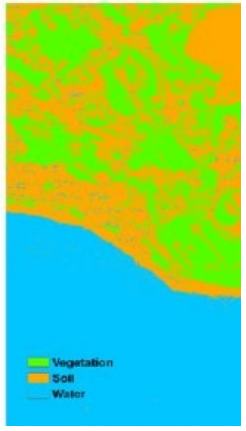
Opportunities for Synergies discussed in May 2023 at the 2023 Joint Science Meeting for TEMPO, GeoXO ACX, & TOLNet

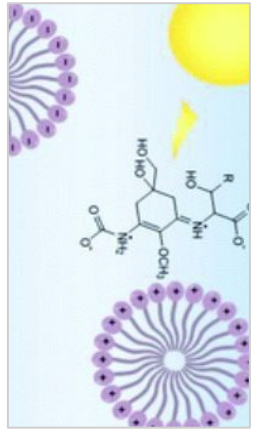
GLIMR: Other multidisciplinary applications & products

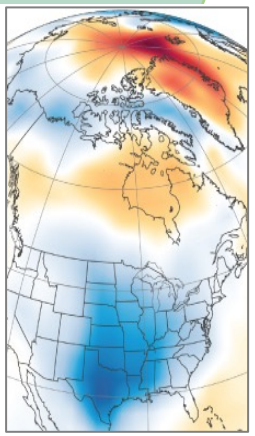
- **Land applications/land surface reflectance**
- **NDVI** (normalized difference vegetation index)
- **Wetland** extent/vegetation properties
- **Coastal inundation**
- **Land-ocean biogeochemical exchanges**

- **Synergies/Improve utilization of other sensors**
- Provide **additional model inputs**
- Validate regional **weather/climate models**
- Improve storm surge modeling



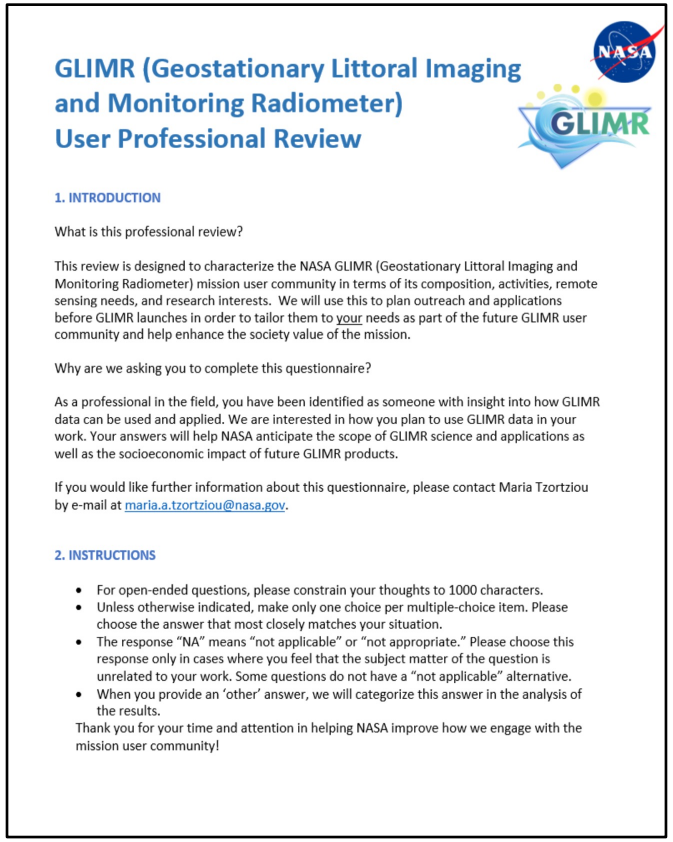


- **Nitrogen Dioxide (NO2)**
- **Absorbing aerosols**
- **Air Quality Index** and other atm. applications
- **Air-Sea exchanges**

- **MAAs** (Mycosporine-like Amino Acids)
- **Pathogens** in urban waters

GLIMR Applied Science: Activities

Phase A-B: Community Assessment to identify and engage user Communities of Practice and Potential, receive initial feedback on data products and their delivery.



GLIMR (Geostationary Littoral Imaging and Monitoring Radiometer)
User Professional Review

1. INTRODUCTION

What is this professional review?

This review is designed to characterize the NASA GLIMR (Geostationary Littoral Imaging and Monitoring Radiometer) mission user community in terms of its composition, activities, remote sensing needs, and research interests. We will use this to plan outreach and applications before GLIMR launches in order to tailor them to your needs as part of the future GLIMR user community and help enhance the society value of the mission.

Why are we asking you to complete this questionnaire?

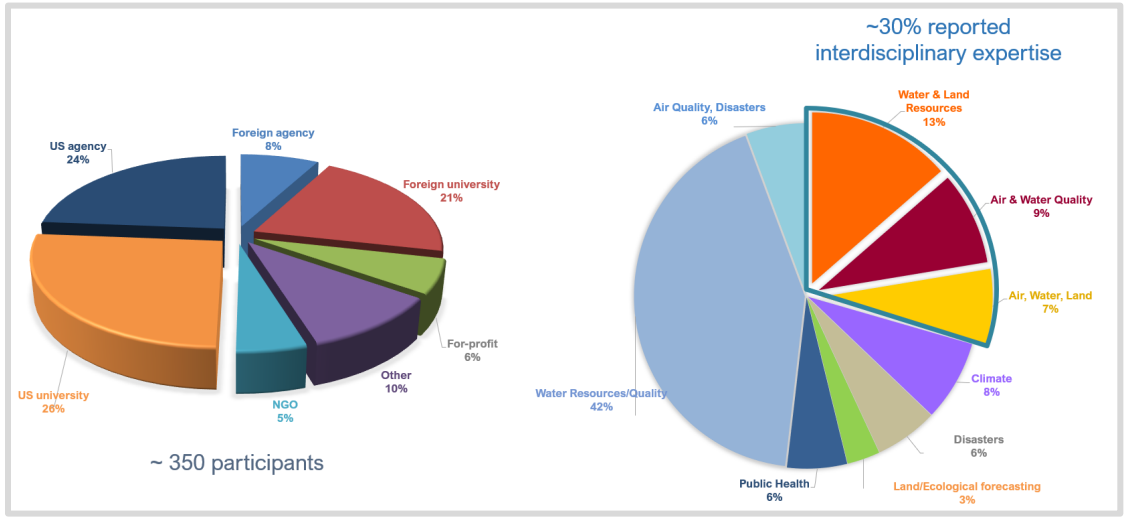
As a professional in the field, you have been identified as someone with insight into how GLIMR data can be used and applied. We are interested in how you plan to use GLIMR data in your work. Your answers will help NASA anticipate the scope of GLIMR science and applications as well as the socioeconomic impact of future GLIMR products.

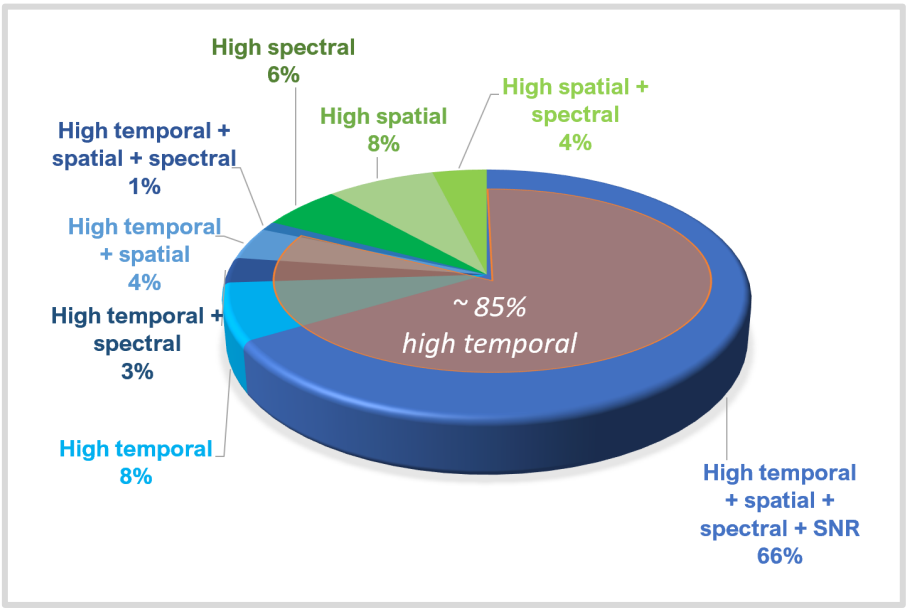
If you would like further information about this questionnaire, please contact Maria Tzortziou by e-mail at maria.a.tzortziou@nasa.gov.

2. INSTRUCTIONS

- For open-ended questions, please constrain your thoughts to 1000 characters.
- Unless otherwise indicated, make only one choice per multiple-choice item. Please choose the answer that most closely matches your situation.
- The response "NA" means "not applicable" or "not appropriate." Please choose this response only in cases where you feel that the subject matter of the question is unrelated to your work. Some questions do not have a "not applicable" alternative.
- When you provide an 'other' answer, we will categorize this answer in the analysis of the results.

Thank you for your time and attention in helping NASA improve how we engage with the mission user community!





GLIMR Applied Science: Activities

Phase A-B: Community Assessment to identify and engage user Communities of Practice and Potential, receive initial feedback on data products and their delivery.

Phase C: Development of an **updated Applications Traceability Matrix (ATM) for GLIMR**

Phases C-E: Engage and inform user communities about GLIMR capabilities, products, and applications foci areas during GLIMR-relevant workshops, meeting sessions, webinars

Phases C-E: Engage Early Adopters (e.g., EPA, NOAA, NRL) to provide specific input on GLIMR data products and integration into application tools, develop white papers and link to other relevant satellite missions (e.g., resource management, decision making)

Applications SAT Matrix

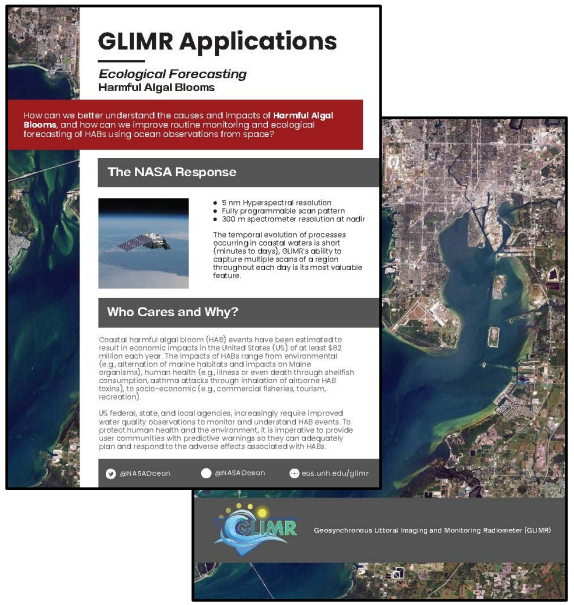
developed with input from the user community

GLIMR Applications Traceability Matrix (ATM)

Agency	Applications	Satellite products	Spatial requirements	Temporal requirements
NOAA	Habitat assessment, fisheries management, water quality, **HABs,** ecological forecasting, pollution monitoring, coral health, acidification	Chlorophyll, Rrs(λ), abs(λ), HABs, K_{490}, K_{PAR}	100m – 4km	3hrs - daily
EPA	Sustainable coastal resources; air, climate and energy research; **healthy and sustainable coastal communities**	Chlorophyll, Rrs(λ), abs(λ), abs(cdom, phy, det), HABs, SPM, K_{490}, K_{PAR} and more	<250m to 500m	0.5 – 3hrs
EPA	Pathogen detection, indicators, modeling	Turbidity, salinity proxies, etc	<250m to 500m	1 – 3hrs
EPA	**Oil Spill monitoring** in rivers, lakes, estuaries and coastal waters	Visible/true color imagery	<250m to 500m	0.5-1 hr
US Navy	Surface currents, instrument assessments, bathymetry, visibility, coastal oceanography, navigation	Chlorophyll, Rrs(λ), abs(λ), abs(cdom, phy, det), bbp(λ), HABs, SPM, K_{490}, K_{PAR} currents	250m – 1km	1hr - daily
Gulf of Mexico Fishery Mgmt Council	Habitat quality, **fisheries conservation**, coral conservation	Chlorophyll, NPP, currents	Not specified	Not specified
BOEM	Ecological models, sediment transport, current trajectory, **oil detection and thickness**	Chlorophyll, NPP, currents, cdom, SPM	Not specified	Not specified
U.S. Army Corps of Engineers	Coastal & Inland Water Quality Monitoring and Forecasting (including **HAB detection and monitoring**), Nearshore Benthic Habitat Mapping to Support Coastal Operations and Planning	Chl-a, phycocyanin, CDOM, turbidity, CDOM, green laser reflectance, hyperspectral Rrs, bottom type characterization, habitat change detection	5 to 50 m	daily (WQ), monthly-seasonal (mapping)

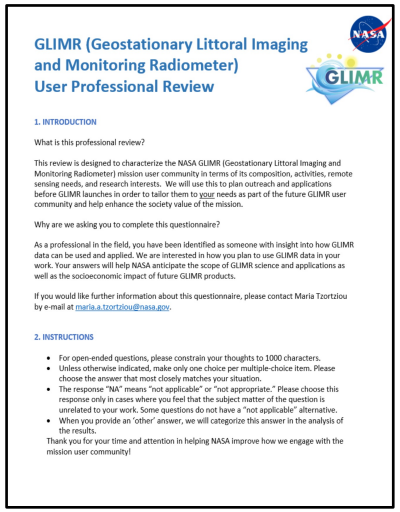
White Papers

One-page fact sheets highlighting specific applications concepts



Community Survey

to characterize user communities, and use user feedback to plan outreach and applications



Thank you

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