

Kevin Turpie
University of Maryland,
Baltimore County

kturpie@umbc.edu

SBG Updates

NASA Earth System Observatory (ESO)

Surface Biology and Geology (SBG)

NASA OCRT Meeting
7 September 2022

K. Turpie

kturpie@umbc.edu

<https://sbg.jpl.nasa.gov>

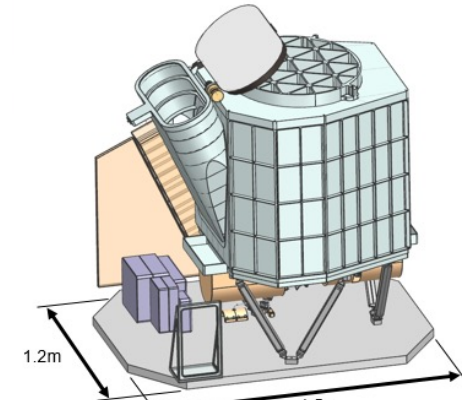
- 
- **Mission Development Update**
 - **Tilt Requirement for Sun Glint Mitigation**
 - **Coastal Marine Acquisition Mask**
 - **SHIFT Airborne Project**
 - **Joint Mission and Community Activities**

SBG MISSION CONCEPT



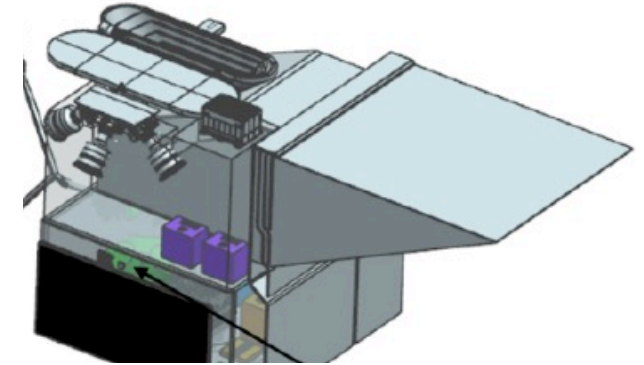
VSWIR Satellite

- Hyperspectral instrument (10 nm, 380-2500nm)
- SNR = 400:1 VNIR/250:1 SWIR (25% reflectance)
- Observation swath of 185 km
- Global coverage; Revisit ~16 days
- 6000 cross-track samples (~30 m GSD*)
- VSWIR 632 km Sun-Sync Orbit, 10:45 LTDN



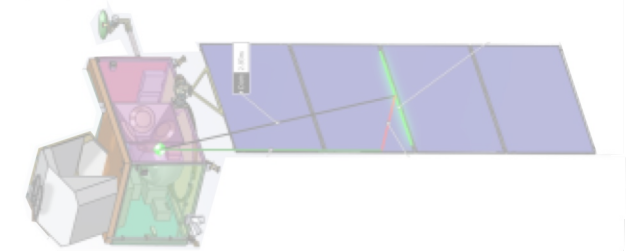
TIR Satellite

- Thermal instrument (multi or hyperspectral)
- Observation swath of 935 km (~60 m GSD*)
- Global coverage; Revisit ~3 days
- TIR 665 km Sun-Sync Orbit, 13:30 LTDN
- VNIR camera



VSWIR Smallsat Pathfinder

- Narrow swath constellation pathfinder
- Observation swath of < 20 km
- Fly leading or trailing VSWIR

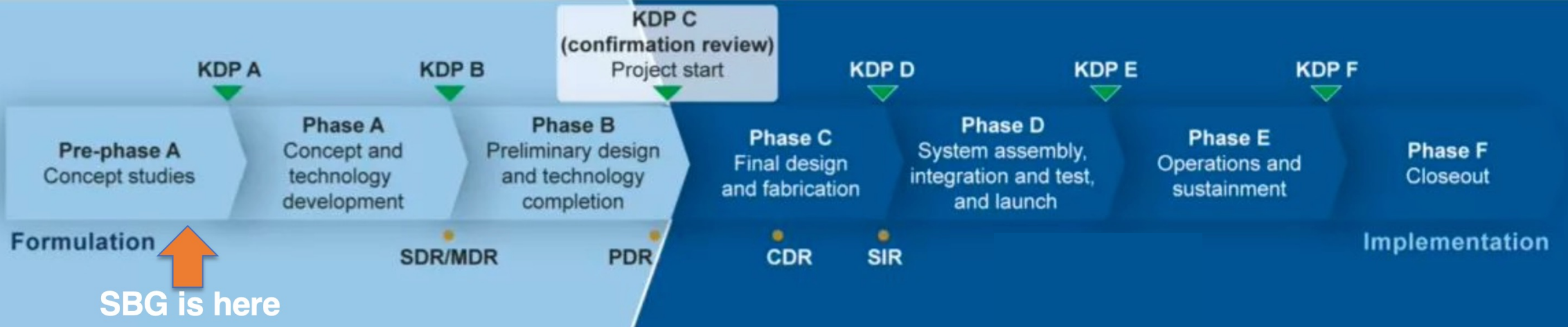


* - Tentatively, 1 km over open ocean

SBG Collaborating Missions



NASA PROJECT LIFECYCLE



SBG Nearby Milestones:

MCR – 24 Jun 2022
KDP-A – 12 Oct 2022

SBG Launch Dates:

TIR – NLT 10 Dec 2027
VSWIR – NLT 28 Apr 2028

SBG Sun Glint Mitigation

- **TILT** - SBG mission requirements now include a tilt for the VSWIR spectrometer to reduce specular effects of the sun.
- **RESULT** - Expected to significantly increase data coverage over water, especially for glint-sensitive data products.
- **ALGORITHMS** - Glint reduction algorithms are also to be studied to further reduce residual effects of sun (and sky) glint.

Draft SBG VSWIR Level-2 Requirement:

“The mission shall acquire data with a boresight observing angle of 3-5 degrees west of nadir to reduce the impact of sunglint (sic) on aquatic observations.”

The exact angle chosen is open for discussion / feedback, but the good news is that a tilt is a now a requirement.

Some decisions were based on 2022 Landsat Next study looking at proportions of Landsat 8 data with glint that exceeds SeaDAS threshold for glint correction. Nima Pahlevan (SSAI/NASA/GSFC) and Chris Crawford (USGS).

Coastal Marine Acquisition Mask

Objective: Define a coastal mask for SBG coastal marine data collection at native resolution (30m VSWIR/60m TIR).

Note: Open ocean collection at 1 km for both VSWIR and TIR is still on the table – decision to be made during KDP-A.

SIDE-BY-SIDE EFFORTS

Near-Term Planning Effort (JPL – Michelle Gierach)

Supports efforts central to developing initial mission design, conops and requirements.

Result: The **v4 best** is baseline for VSWIR and **v6 intermediate** baseline for TIR

Long-term Acquisition Strategy (ASG – America Alvarez, Kevin Turpie)

Continued development with deeper consideration of science and remote sensing objectives and with input and vetting from the community.

Result:

- Threshold requirement based on Sentinel 2 coastal mask plus regions of interest and special buffers.
- Baseline requirement based on Threshold plus prioritized regions from various GIS layers (Priority Heat Map).
- Adjustable / adaptable to changing needs or requirements.

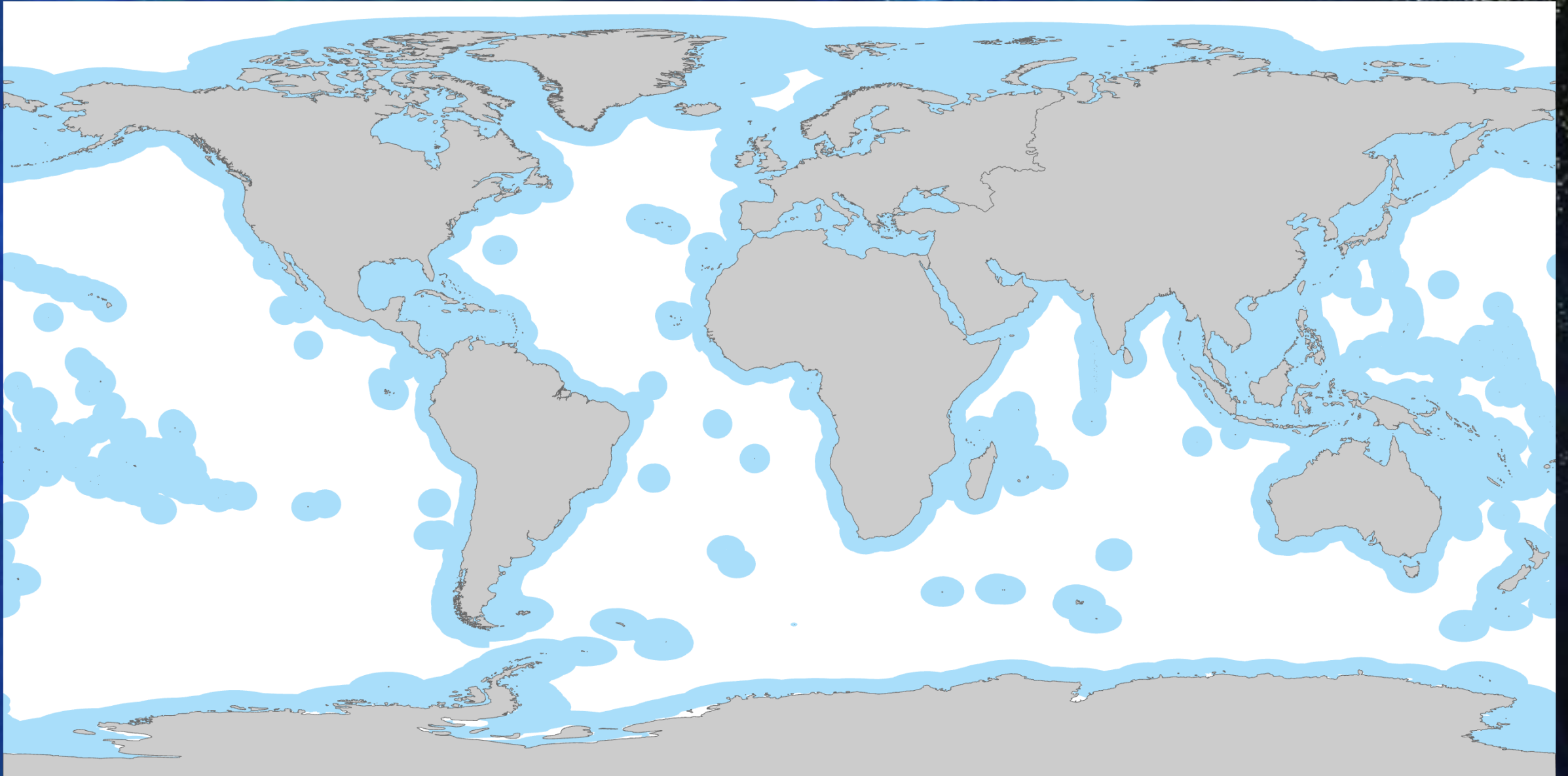
Coastal Marine Acquisition Mask

Source GIS Data Sets:

- Sentinel-2 coastal mask
- Internal waters*
- Contiguous waters*
- Territorial waters*
- Archipelagic waters*
- Marginal seas
- Coral reefs (warm water)
- **Special Regions of Interest**
- Calibration sites (e.g., MOBY, BOUSSOLE, MarONet)
- Sea ice extent
- Special islands (islands with corals or volcanoes)
- Exclusive economic zones (EEZ)
- Marine protected areas (MPA)
- Vulnerable marine ecosystems (VME)
- Marine heritage sites

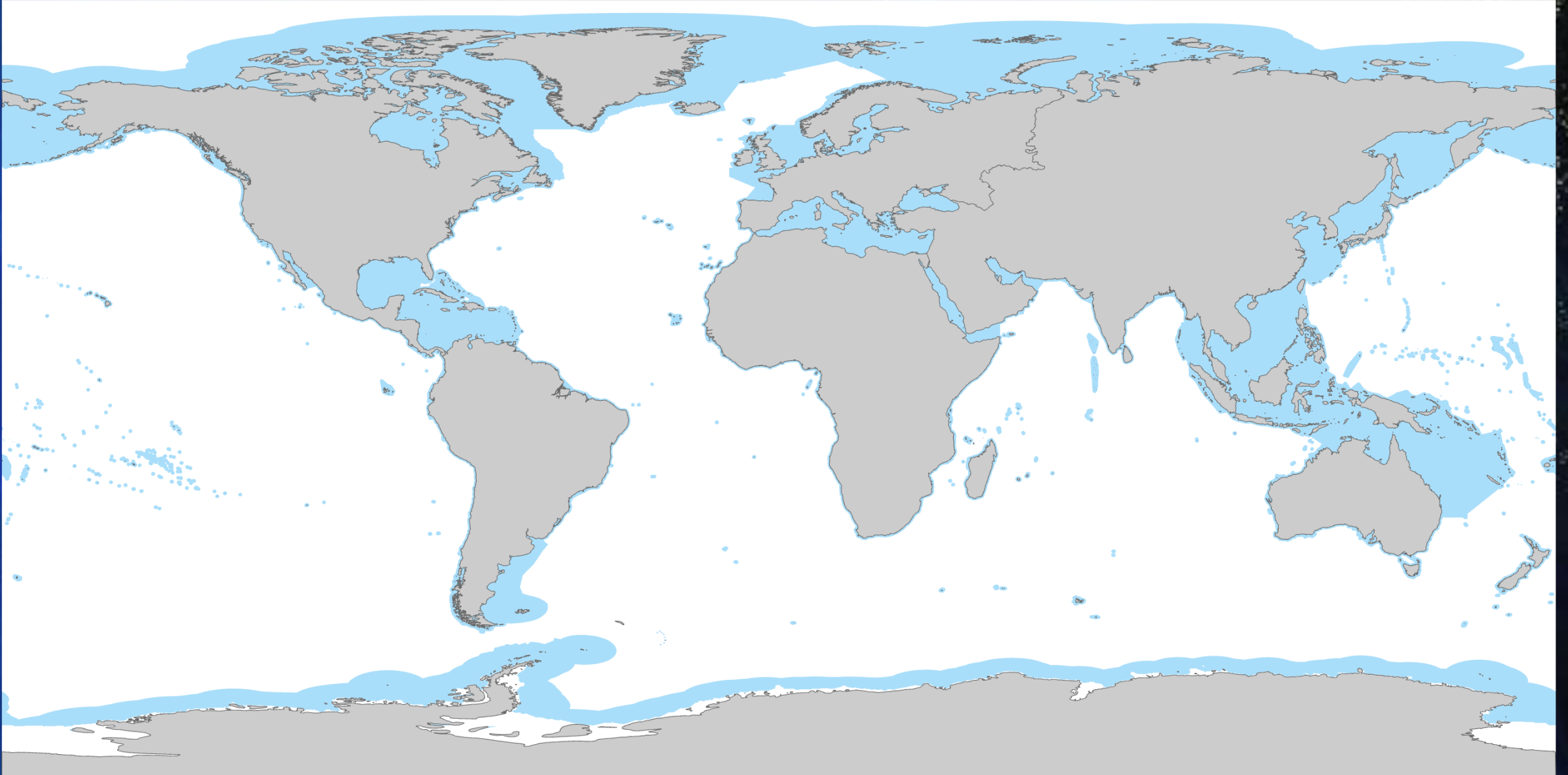
*Maritime boundaries

SBG VSWIR Mission Planning Mask (v4 Best)



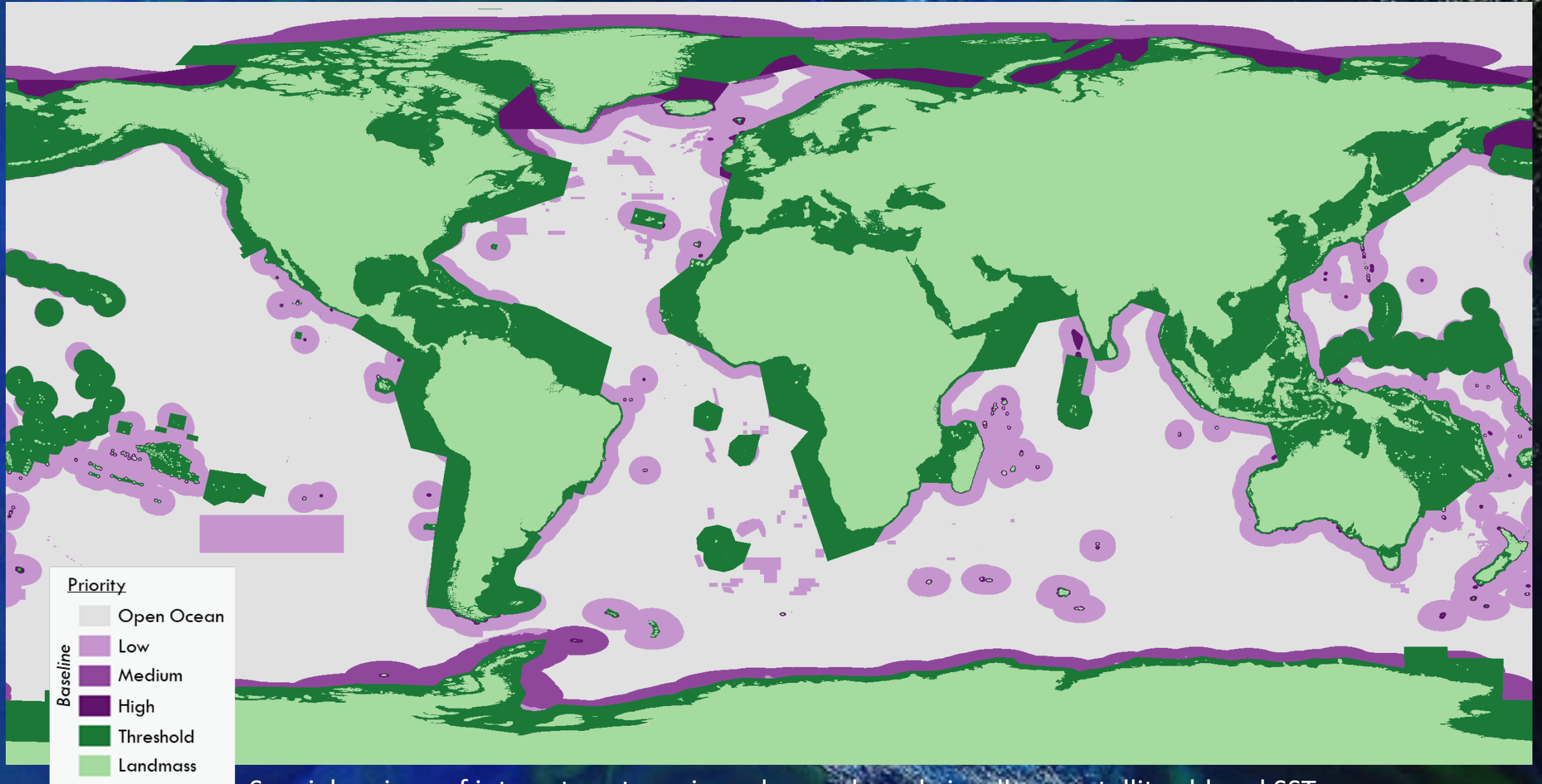
EEZ, maritime boundaries, marginal seas, and global islands

SBG TIR Mission Planning Mask (v6 Intermediate)



maritime boundaries, marginal seas, global islands, warm water corals, sea ice extent, and NISAR volcano locations

SBG Coastal Marine Acquisition – Priority Heat Map



Special regions of interest capture river plumes; based visually on satellite chl and SST.

SBG High-Frequency Time-series (SHIFT)

Objective: To collect the first openly-available airborne VSWIR spectral imagery (AVIRIS) dense time series at an approximately weekly cadence over a period of significant phenological change (Mar-May 2022, then extended late Summer).

Self-funded aquatic investigations in support of SHIFT:

- **Erin Hestir** (UC Merced)
- **Kristin Byrd** (USGS) – wetland vegetation
- **Kyle Cavanaugh** (UCLA), **Tom Bell** (WHOI), **Kate Cavanaugh** (PhD) – Kate is looking at seasonal kelp ecological dynamics with airborne imaging spectroscopy
- **Nick Nidzieko** (UCSB), **Luke Carberry** (PhD) – Luke is looking at comparison of in situ hand remote ocean color spatial variability
- **Nick Nidzieko** (UCSB), **Jordan Snyder** (PhD) – Nearshore-to-offshore aquatic gradients in environmental variables and relation to coastal kelp ecosystems
- **Kelly Luis** (JPL) – Aquatic intrinsic / residual dimensionality for absorption of phytoplankton

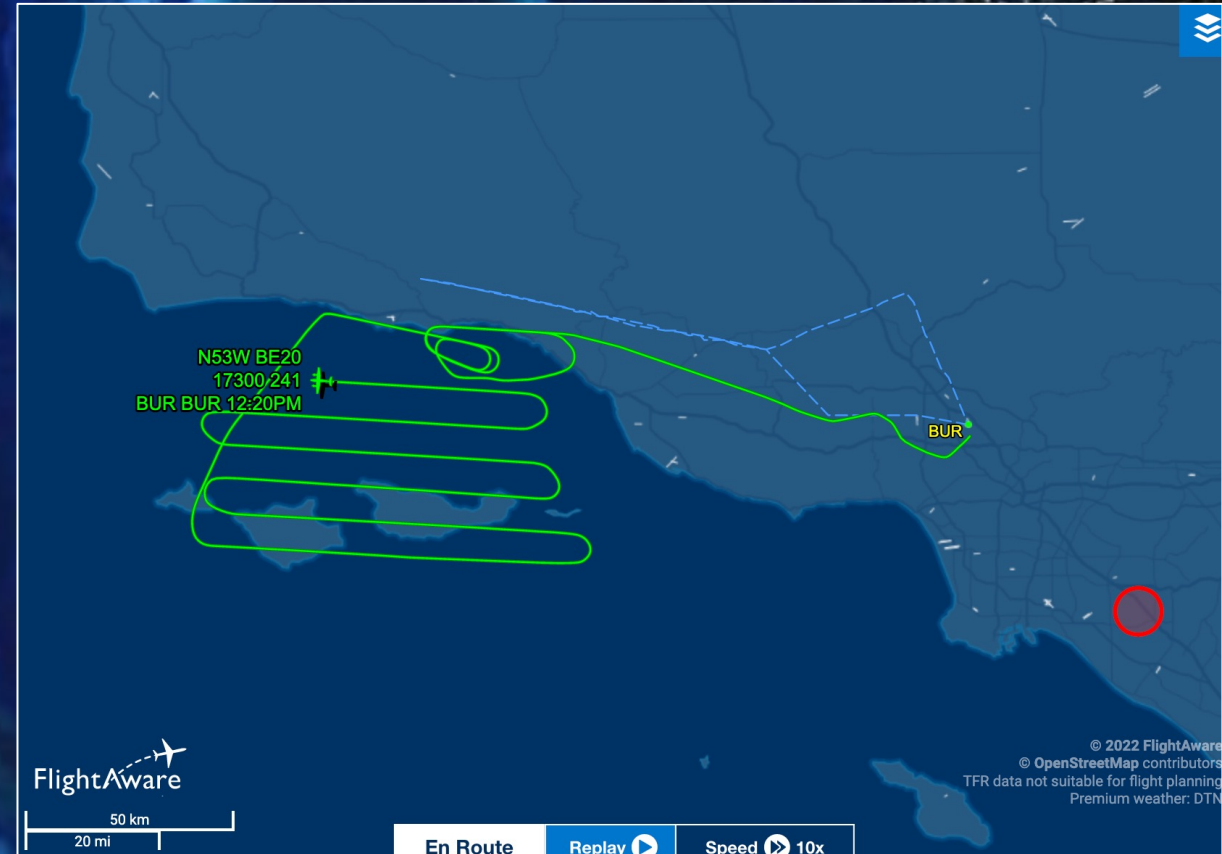


SBG High-Frequency Time-series (SHIFT)

Objective: To collect the first openly-available airborne VSWIR spectral imagery (AVIRIS) dense time series at an approximately weekly cadence over a period of significant phenological change (Mar-May 2022, then extended late Summer).

Aquatic Efforts

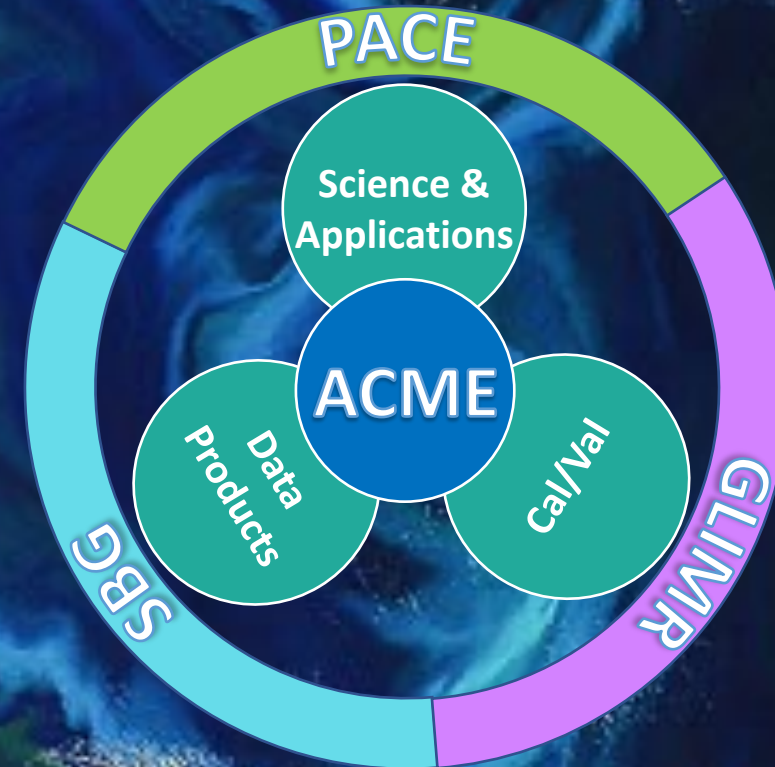
- SHIFT aquatic efforts were largely focused on coastal ecosystems.
- Data was collected over the May 12 Plumes and Blooms cruise (see image)
- Erin Hestir had a Trios Ramses deployed the entire time off of Stearns Wharf.
- The last SHIFT flight is the week of September 12, and will hopefully collect during the Sept 14 Plumes and Blooms cruise
- Data is available!



Aquatic Cross-Mission Exchange (ACME)

Purpose: To identify shareable resources, mutually beneficial opportunities, overlapping activities and find ways to synergize efforts across aquatic missions in order to reduce risk, save cost and better our support of the research and applications needs of the aquatic remote sensing communities.

- **Ocean Science Meeting 2022 Feb 27 – Mar 4**
 - Joint Town Hall
 - Joint Science Sessions (2 Oral, 2 Poster)
- **Combined Observations for Coastal and Inland Aquatic Science and Applications**
- **Data Products – Algorithm Development and Evaluation; Data Harmonization**
- **Cal/Val Infrastructure and Resources; Inter-Calibration; Instrumented Stations; Field Work**
- **Community Outreach (ASG, GLEON)**



MEMBER MISSIONS



Phytoplankton, Aerosols,
Clouds and ocean Ecology



Surface
Biology and Geology



GLIMR
Geostationary Littoral
Imaging and Monitoring
Radiometer

COMMUNITY ENGAGEMENT

WORKING GROUPS OF THE SBG RESEARCH AND APPLICATIONS TEAM

ALGORITHMS

Kerry Cawse-Nicholson

Kerry-Anne.Cawse-Nicholson@jpl.nasa.gov

- State-of-Research Algorithms
- Representative Data Products

APPLICATIONS

Stephanie Schollaert Uz

stephanie.uz@nasa.gov

- Representative applications
- Applications supportability

CAL/VAL

Kevin Turpie

kturpie@umbc.edu

- Cal/Val Infrastructure
- Calibration Technology

MODELING

Ben Poulter

benjamin.poulter@nasa.gov

- Observation System Simulation Experiments (OSSE)
- Uncertainty Quantification

COMMUNITY ENGAGEMENT

WORKING GROUPS OF THE SBG RESEARCH AND APPLICATIONS TEAM

- **SBG Community Workshop**
 - In-person/hybrid
 - Oct 12-14 2022, Washington, D.C.
- **Internship programs at JPL and other NASA centers:**
 - Dave Schimel (dschimel@jpl.nasa.gov)
 - Ben Poulter (Benjamin.poulter@nasa.gov)
- **SHIFT**
 - Dana Chadwick (katherine.d.chadwick@jpl.nasa.gov)
- Email us (seriously we want to hear from you): sbg@jpl.nasa.gov

Summary

- SBG completed MCR 24 June 2022; KDP-A is 12 Oct 2022, after which development phase A begins.
- SBG has established a tilt requirement for the VSWIR spectrometer.
- A priority heat map is being developed to create a coastal marine acquisition mask. Two versions of the mask were created for the VSWIR and TIR instruments to meeting concept planning requirements.
- The aquatic coastal and inland science and application communities are interested and involved.
 - ACME facilitating joint activities for SBG, PACE and GLIMR.
 - ASG will meet regarding coastal mask and glint algorithms.
 - SBG Algorithms, Applications, Modeling and Cal/Val working groups meetings and webinars.
 - SBG Community Workshop: 13-15 October 2022 in Washington, D.C. with hybrid options.



Thank You