PACE SAT Meeting

1:00 -1:40 Project Update and Points of Information

1:40-2:00 Gaps Analysis Breakout Groups

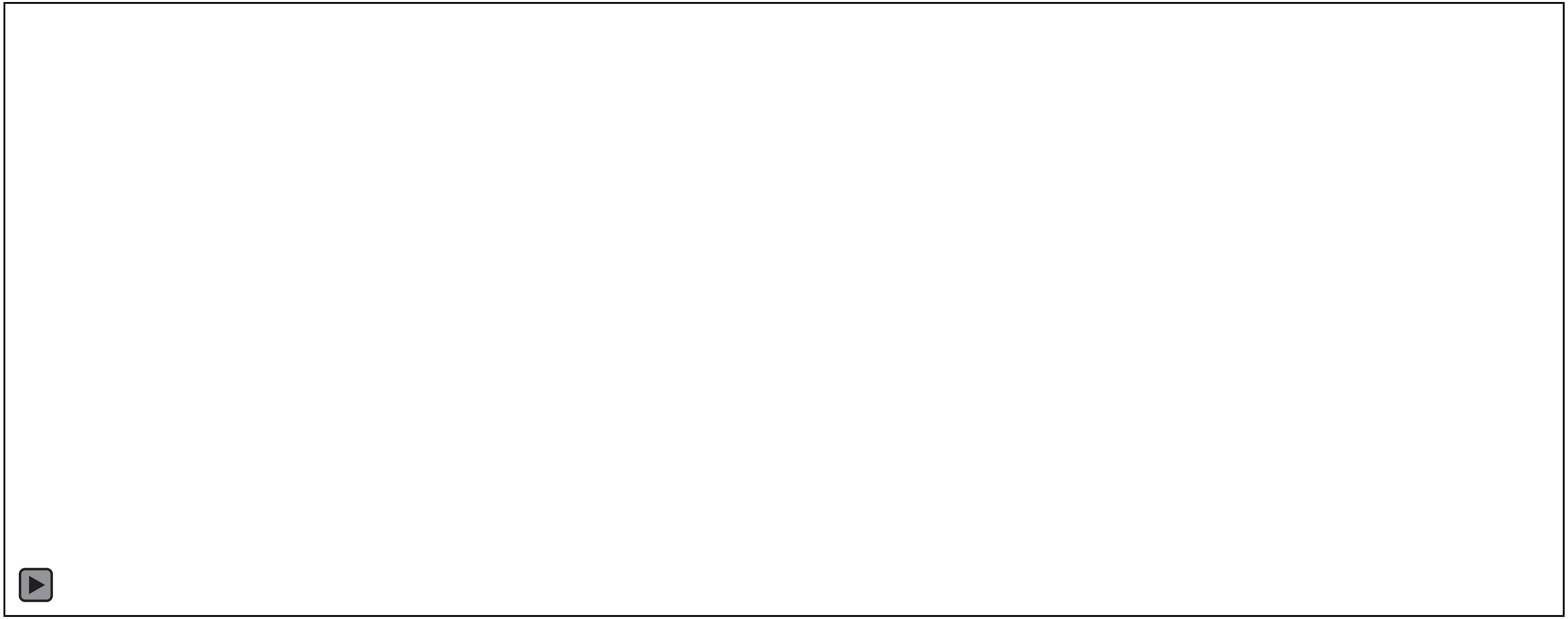
2:00-2:20 General Discussion

Points of Information

- Jeremy Werdell – Mission update
- Vanderlei and Lorraine -- HARP2 update
- Erin Urquhart Jephson – Applications
- Heidi Dierssen – SAT Team Meeting

1. Second Meeting Logistics

- Mystic CT and University of Connecticut
- HYBRID/IN PERSON & ONLINE
- **6-8 October 2021. Wed., Thurs., Fri. (half day)**



Invited

- Anyone from your team working on PACE is invited to attend
    - Postdocs, grad students, collaborators
- Each SAT Team and anyone from NASA PACE Team
    - Upload 15-20 min. prerecorded talks 2 weeks ahead of time
        - 22 September
        - https://pacesat.marinesciences.uconn.edu/presentations/
        - You can include your Haiku!

    - Each team will present a 1-slide/5 min. overview during meeting

More emails regarding logistics and registration coming up in next week!

- **Online Registration and Registration Fee will be charged ($250-$300)**
  - Cover all Lunches and Dinners, Coffee breaks
  - Meeting space, audiovisual, vans, etc…
- Lodging will be your own responsibility
  - We are negotiating group rate at a few select hotels.
  - Reserve early if possible.
  - Please get hotel in MYSTIC and not ~~GROTON~~ or ~~NEW LONDON~~
- We hope to setup transportation vans to/from Mystic to campus
  - Parking permits for those who want to drive together
- We will setup a carpool link for you to connect together

DRAFT Agenda for PACE Meeting

Day 1

<u>Morning Session</u>

9:00-9:30 am Welcome and Introductions and Logistics

9:30-10:30 am Science SAT intro 5 min talks each (9)

10:30-10:50 am Coffee Break

10:50-12:30 am Science SAT intro 5 min talks each (13)

12:30-1:45 pm LUNCH Branford House

<u>Afternoon Session</u>

1:45-2:15 pm Mission science & science team updates (Laura, Jeremy)

2:15-2:45 pm Mission progress & next steps updates (Andre' Dress, Gary Davis; 15 min each))

2:45-3:00 pm OCI update (Eric Gorman)

3:00-3:15 pm Coffee Break

3:15-3:45 pm Polarimeter updates (Vanderlei Martins, Otto Hasekamp; 15 min each)

3:45-4:30 pm <u>Cal/Val Talks</u>: MarONet (Ken Voss), HyperNAV (Andrew Barnard) (~20 min each)

5:15-8:00 pm Dinner at Latitude 41

Day 2

Morning Session

9:00-9:45 am Applications Overview: Erin Urquhart Jephson
3 Case Studies to inspire from each discipline (recorded or in person)

9:45-10:30 am SEABASS Overview, SeaDAS Overview, etc…

10:30-10:45 am Coffee Break

10:45-11:30 am Subgroup Summaries -- 1: Uncertainties (Ibrahim & Sayer), 2: Polarimetry (Knobelspiesse)

11:30-12:30 am Breakout Group 1: Validation Disciplinary Working Groups. Campaigns, Data Archiving, Needs, Concerns, Instrumentation, etc..

12:30-1:45 pm LUNCH Branford House

Afternoon Session

1:45-3:00 pm Subgroup Summaries -- 3: Cloud (Cairnes), 4: Ultraviolet (Remer), 5: IOP Data (Stramski)

3:00-3:15 pm Coffee Break

3:15-4:30 pm Breakout Group 2: Gap Analysis. Overview previously identified gap analysis, progress made, and new gaps

4:30-5:00 pm Discussion of Breakout Groups and Summaries.

6:30-9:30 pm *Catered Dinner in Mystic*

Day 3

Morning Session

9:00-10:30 am PACE SDS activities/facilities (Franz recorded), Level 1C Merged (Knobelspiesse), Aeronet (?), Other?

10:30-10:50 am Coffee Break

10:50-11:30 am Breakout Group 3: Public Relations (Brainstorm Ideas on How to get the word out about mission science, applications, and communication outside our science world)

11:30-12:30 am General Discussion and Summaries of Where we are? and Where we are going?

12:30 pm Meeting Adjourns – Gourmet Box Lunch Provided on Lawn or To Go.

2021 NASA Virtual Ocean Color Research Team Meeting

27 and 28 October 2021

On behalf of the NASA Ocean Biology and Biogeochemistry program, you are invited to attend the 2021 NASA Ocean Color Research Team (OCRT) virtual meeting, which will be held from 1-5p ET on 27 Oct 2021 and 1-4p ET on 28 Oct 2021. Connection details and agenda follow and are also attached as a PDF. Please forward to co-Is, postdocs, students, and collaborators, as relevant.

There are still four remaining slots for student/early career lightning (5-min) talks. This is a great opportunity for folks early in their career to have exposure among our community, which can be tough during virtual meetings. Please encourage your students to email joel.scott@nasa.gov to claim a spot before they are gone.

We look forward to seeing you virtually in October!
Laura & Joel

2022 Ocean Sciences Meeting Sessions on Global Ocean Ecology

Dear colleagues,

Please consider submitting your abstract to one of the three amazing sessions, to be held in hybrid format during the 2022 Ocean Sciences Meeting (**https://www.aslo.org/osm2022/**) in Honolulu, HI:

1) **OT02 Ushering in a new era of hyperspectral and polarimetric radiometry for remote sensing of global ocean ecosystems.**
Organizers: Jeremy Werdell, **jeremy.werdell@nasa.gov**; Ivona Cetinic, **ivona.cetinic@nasa.gov**; Lachlan McKinna, **lachlan.mckinna@go2q.com.au**; Heidi Dierssen, **heidi.dierssen@uconn.edu**

2) **CT07 Multidisciplinary insights into pathways of carbon export.**
Organizers: David Siegel, **david.siegel@ucsb.edu**; Ivona Cetinic, **ivona.cetinic@nasa.gov**; Amy Maas, **amy.maas@bios.edu**; David Nicholson, **dnicholson@whoi.edu**; Melissa Omand, **momand@uri.edu**

3) **OB27 Expanding Frontiers In Productivity and Flux from Ocean Optics.**
Organizers: Norman Nelson, **norm@eri.ucsb.edu**; Jason Graff, **jason.graff@oregonstate.edu**; Collin Roesler, **croesler@bowdoin.edu**; Sasha Kramer, **sasha.kramer@lifesci.ucsb.edu**; Zachary Erickson, **zachary.k.erickson@nasa.gov**

Your abstracts can be submitted till Wednesday, **September 29th at 11:59 EDT.**
Thank you for your consideration.

All the best,

Ivona Cetinić on behalf of the PACE and EXPORTS Projects

Abstracts are due by Wednesday, September 29th at 11:59 EDT (although the submission system has yet to open, as of this morning).

- CB04 PACE, GLIMR and SBG: Synergy across Future NASA Missions for Hyperspectral Remote Sensing of Coastal and Inland Waters
- CB05 Advancing Water Quality Monitoring and Forecasting in Coastal and Inland Waters
- CB09 Trans- and interdisciplinary connections in tropical coastal and estuarine processes
- CB13 Acidification in the Gulf of Mexico – chemical changes, biological and ecological responses
- CB15 Application of Remote Sensing to Societally Important Regions: Coastal, Estuarine, Tropical and Polar Waters"
- CB16 Advancing our understanding of biogeochemical coupling with models and observations in estuaries and coastal waters
- CT07 Multidisciplinary insights into pathways of carbon export
- ED05 Safety in Ocean Field Science: Prevention and Improved Response for Sexual and Gender Harassment
- ED08 Addressing Barriers to Minoritized Scholars Entering Internship, Fellowship, and Graduate Programs in the Ocean Sciences
- ED11 Global capacity development in ocean science for sustainable development
- HL06 Advances in understanding the circulation and carbon cycle of the Southern Ocean
- HL18 Ocean Science for Ocean Worlds
- IN03 Indigenous Partnerships for a Sustainable Ocean
- IN11 Historical Resonance in the Atlantic: Implications for Black Marine Scientists
- OB07 Research Opportunities from a Global Biogeochemical Argo Fleet
- OB27 Expanding Frontiers In Productivity and Flux from Ocean Optics
- OP10 Informing Adaptive Management: Regional Vulnerability Assessments for Ocean Acidification
- OS06 E is for equity: centering ocEan science beyond the Ocean Decade
- OS10 Marine Litter and Microplastic Monitoring and Understanding
- OS11 Observing and Predicting the Global Coastal Ocean
- OT02 Ushering in a new era of hyperspectral and polarimetric radiometry for remote sensing of global ocean ecosystems
- OT08 Emerging Technologies and Techniques for Remote Sensing of Coastal and Inland Waters
- OT09 From Origins to Oceans: Detecting and Monitoring Plastic Pollution using Emerging Technologies, Sensors, and Instrument Applications
- OT10 Advances in Ocean Remote Sensing and Data Science: from Instrument to Solutions Showcase
- OT11 Lidar Technology for the Estimation of the Surface and Vertical Ocean Physical, Optical, and Biogeochemical Properties
- OT14 Innovative Applications and Emerging Ocean Satellite Observations

Gap Analysis

PACE Inherent Optical Properties – Gaps Matrix

IOPs	State of the art	What is felt is needed for PACE
CDOM	Lab measurements spanning the full PACE spectrum. In situ limited to 410-750nm	In-situ spanning UV<->NIR instrumentation
ap	Lab measurements spanning the full PACE spectrum. Issues with sample stability in the UV. In-situ limited to 410-750nm. Significant uncertainty due to scattering correction, particularly where inorganic particles abound.	In-situ UV<->NIR instrumentation with reduced uncertainties compared to existing technology. Laboratory studies focused on a_phi in UV.
cp, bp	In situ sensors limited to 410-750nm (can also be used in the lab).	In-situ spanning UV<->NIR instrumentation at <5nm resolution Understanding of uncertainties arising from pumping water through instruments in different environments.
VSF, back-scattering	Commercial: near forward VSF at one wavelength (LISST). One or three angles in the back direction at a few wide bands (ECO-VSF, Eco-bb, Hydroscat). Prototypes: High angular resolution from 10-170degrees at one or a few wavelengths. New commercial sensor exists (LISST-VSF) but has not been vetted.	Need in-situ instrumentation from spanning UV<->NIR, with high angular resolution (<=10degrees).

Gaps cont…

Polarized IOPs	New commercial sensors for S11, S12 and S22 at a single wavelength exist (LISST-VSF, LISST-STOKES) but has not been vetted.	Need in-situ instrumentation spanning from UV<->NIR, with high angular resolution (<=10degrees).
Water optical properties	Papers by Pope and Fry, 1997, Lee et al., 2015, Mason et al, 2016.	Raman emission as function of T & S, depolarization ratio, Absorption values in the UV (current uncertainties ~0.002m^-1) including the influence of various inorganic compounds.

Scalar irradiance	PAR only	Hyper-spectral (UV-VIS-NIR) scalar radiometer.
Lu(0-)	Most often extrapolated from sub-surface measurement resulting in large uncertainties in red and NIR that are too large for validation studies.	Improved methods/measurement platform for Lu(0-) in red and NIR.

Other gaps:

Radiative transfer codes	Hydrolight – unpolarized, ocean only. Fully spectral and vector RT of ocean+atmosphere exist with Zhai, Chowdhary, Kattawar, Chami.	Commercial or open-source polarized ocean only RT code to increase understanding of the effects of polarization on scalar radiance fields, facilitate closure studies and inversion developments.
Codes for single particle models	Available codes for: Mie, coated spheres, spheroids and coated spheroids, simplified models of aggregates based on the above. Some groups have data for more complicated shapes but codes are not widely available.	More realistic models of oceanic particles to improve our understanding on how their microphysical properties affect the IOPs we measure.
Characterization of particle microphysical properties	Measurements for bulk properties (PSD, organic fraction, pigments). Early phase of single-particle imaging (size, scattering, fluorescence). Flow-cytometry.	High throughput single particle property analysis to better understand how IOPs relate to suspended particles covering particles from sub-micron to mm.
Measurement protocols	SeaWiFS era Protocols. Some (e.g. absorption) have been updated. Some are in review.	A full suite of community agreed protocols for ALL relevant in-situ measurements.

- Clouds?
- Aerosols?
- Land?

To improve inversion algorithms:

- Infrastructure for computationally demanding inverse algorithms.
- Comprehensive in-situ datasets with UV-NIR hyperspectral reflectance, IOPs and biogeochemical variables, and other environmental properties (e.g., temperature, salinity, MLD, depth, lat, lon, etc.).
- Research on how polarimetry could help improve inversions.
- Research on how PACE capabilities could be used to improve inversion of biogeochemical variables.
- Studies of other variables (e.g. lon, lat, temperature, MLD, distance from shore, depth) that could inform inversion algorithms.

Quantify system uncertainty:
Increased assessment and quantification of uncertainty budgets, including those associated with the satellite instrument, sub-pixel variability, atmospheric correction algorithms, bi-directional reflectance characterizations and simplified AOP-IOP relationships, in-water algorithms, and in-situ and laboratory measurements, so that efforts can target reduction of the largest sources of uncertainty.

For PACE validation:
A community definition of a “minimal” list of in situ observations for the purpose of PACE validation program.

To maximize PACE science:
There is a strong need for a national program supporting basic research in ocean optics in the US.

What are the opportunities to increase success of the PACE mission in terms of **gaps?**

Emerging research areas (broader success to the mission):
Coupled ocean-atmosphere RT modeling:
We have made progress in this area in the past two years. The tools are there. The benchmark documentation will be published.

GAP: Resources and support for a community RT model that includes all the pieces, but is modular so that users can choose a configuration for their own purposes. Documented. User support and training.

GAP: Need better representation of particle properties for RT modeling.
(a) hydrosols properties.
(b) aerosols properties.
Outcome:
- Ocean and atmosphere products with lower uncertainties.
- Novel science (exploration).

GAP: Need better representation of H_2O properties: depolarisation ratio, temperature dependence of Raman emission.
Outcome:
- Ocean and atmosphere products with lower uncertainties.

Space satellite capability:
GAP: Data compression techniques. How do we handle this increased data flood?
Higher spectral resolution will provide ability to improve resolution of none-aggregated bands:
Gas bands inclusion and avoidance (NO_2, O_2, H_2O).
Better phytoplankton functional type and HAB science and carbon science.

Data sets for algorithm development and validation:
Incomplete data sets exist, but there are gaps:

GAP-RISK: New technology for characterizing IOP (including polarization) and hydrosol properties (e.g. PSD). Specifically, there is a need to measure absorption and backscattering spanning from UV to NIR and instrumentation to measure polarized scattering from hydrosols. There is a need for instruments to size submicron oceanic particles.

Advantages seen for development of a simple comprehensive validation package. User support, training and common data processing infrastructure.

GAP-RISK: Vicarious calibration. Can we continue to use MOBY in the same way for the expanded wavelength range? Need technology for vicarious calibration in the UV, red and NIR.

GAP-**RISK**: Continuance of existing validation assets: AERONET for both ocean reflectance and aerosol. Lidar in space for cloud property validation (CALIOPE may not be available in PACE era). Continuance is not assured. Expand technology to UV. Need validation technology for cloud and aerosol to separate their signal from the surface ocean.

GAP-**RISK**: Comprehensive field-measured data sets of measurements from TOA through atmosphere, ocean surface and ocean IOPs and constituent properties. Need across the range of representative conditions. Need full spectral range. Need spatial scale studies.

GAP-**RISK**: Atmospheric correction in UV is not established when dealing with dust and absorbing aerosols. We need datasets to fully test methods using polarimeters. In addition Current airborn sensors are not well calirated in the blue/UV making such data of limited usefulness.

Basic algorithms for products and their uncertainties.

GAP: Advanced algorithm methods. Needs investment beyond a historical approach to further decrease uncertainties in operational environment and explore new products.

(a) Machine learning
(b) Multi-pixel
(c) Optimal estimation (Bayesian)
(d) Information content analysis for ocean retrievals.
(e) Integrating OCI and Polarimeter information in an operational environment.
(f) Increase use of data from other sources.
(g) Improved uncertainty estimate.
(h) Mechanistic algorithms.
(i) Accuracy of trace gases with PACE

Haiku 1

Polarimetry
Gives information on clouds
For climate research

偏光測定
雲に関する情報を提供します
気候研究用

Henkōsokutei
kumo ni kansuru jōhō o teikyō shimasu
kikō kenkyū-yō

Haiku 2

On Chesapeake Bay:
yesterday new AERONET
-OC node installed!

Stephanie Uz

Haiku

Looking towards PACE
To do science. But for now…
Meetings, more meetings

What’s wrong with Haikus?
Because once I get started
I can’t stop doing

Robert Levy

More Haikus

Antarctic plankton
Cryptophyte or diatom?
We will see from space

Water, air, and clouds
Solving everything at once
LUTs are key!

Fearsome PACE leader
Full of history and facts
Herder of cats

Sun and algae mix
brighten oceans and our lives
feeding us oysters

HARP2 manager
OCI algorithm
Running a brisk PACE

Bureaucrat I am
Headquarters my home, oh my
Do paperwork, yikes!

Breakout Groups

- Introduce yourself with Haiku (if you have otherwise wing it!)

- Have a person record and start a discussion of previously identified gap analysis, progress made, and new gaps

- 20 minutes
- Return to group to collate ideas

NEXT PACE SAT Meeting In person/Hybrid
6-8 October.