Today's Agenda

- **Points of Information (Bontempi and Werdell)**
  - Paula Bontempi, PACE Program Scientist
  - Jeremy Werdell, PACE Project Scientist
- **New Business (Dierssen and Remer)**
  - Science Team Goals
  - Overview of Science Team Topics
  - PACE Science Product Validation Plan
  - First meeting logistics
  - Science Team Recorded Presentations
  - Science Communication
  - Subgroup topics
- **Presentation 1: Early Adopters (15-20 min)**
  - Erin Urquhart and Joel Scott: erin.urquhart.jephson@nasa.gov; joel.scott@nasa.gov;
- **Presentation 2: Level 1C merged OCI Radiometry with Polarimeter data**
  - Kirk Knobelspiesse: kirk.d.knobelspiesse@nasa.gov
- **Next Telecon: 1 May 2020**

PACE Science Team Goals

Scientifically, the Project expects the SAT to add to and improve upon the dynamic range of science data products and their basic research and applied sciences uses. This includes the development of PACE science data algorithms and also ideally encompasses:

- The identification and demonstration of end-user research and applied sciences applications.
- Explicit strategy development for pre- and post-launch science data product validation.
- Identification of gaps and prioritization of science data product development/implementation.
- Derivation and propagation of system-level uncertainties.

Socially, the Project hopes the SAT will spread news and updates on the mission and communicate results with the community and general public, as possible.

Science and Applications Team by Project

1	**Stramski**	**Dariusz**	**PI**
1	Reynolds	Rick	Co-I
2	**Gaube**	**Peter**	**PI**
2	Chase	Alison	Co-I
3	**Zhai**	**Pengwang**	**PI**
3	Hu	Yongxiang	Co-I
4	**Boss**	**Emmanuel**	**PI**
4	Frouin	Robert	Co-I
5	**Rousseaux**	**Cecile**	**PI**
5	Mahajan	Rahul	Co-I
5	Gregg	Watson	Co-I
6	**Remer**	**Lorraine**	**PI**
6	Hsu	Christina	Co-I
6	Torres	Omar	Co-I
6	Levy	Robert	Co-I
6	Lyapustin	Alexei	Clb
6	Davis	Anthony	Clb
7	**Pahlevan**	**Nima**	**PI**
7	Smith	Brandon	PD
7	Binding	Carol	Co-I
7	Boss	Emmanuel	Co-I
7	Kudela	Raphael	Co-I
7	Stump	Rick	Co-I
7	Schollaert Uz	Stephanie	Co-I
7	Raymond	Heather	Clb
7	Wolny	Jennifer	Clb
8	**Odermatt**	**Daniel**	**PI**
8	Damm	Alexander	Co-I
8	Minaudo	Camille	Co-I
9	**Hu**	**Chuanmin**	**PI**
9	Wang	Mengqiu	PD

9	Murch	Brockwell	OP
9	Cannizzaro	Jennifer	OP
9	Triananes	Joaquin	OP
9	Brewton	Rachel	OP
9	Lapointe	Brian	Co-I
9	Goni	Gustavo	Co-I
10	**Barnes**	**Brian**	**PI**
10	Hu	Chaunmin	Co-I
10	Garcia	Rodrigo	Clb
11	**Twardowski**	**Michael**	**PI**
11	Moore	Tim	Co-I
12	**Westberry**	**Toby**	**PI**
12	Graff	Jason	Co-I
12	Behrenfeld	Michael	Co-I
13	**van Diedenhove**	**Bastiaan**	**PI**
13	Geogdzhayev	Igor	Co-I
13	Alexandrov	Mikhail	Co-I
13	Zhang	Zhibo	Co-I
13	Miller	Daniel	Clb
13	Martins	J. Vanderlei	Clb
13	Meyer	Kerry	Clb
13	Hasekamp	Otto	Clb
13	Platnick	Steven	Clb
14	**Zhang**	**Xiaodong**	**PI**
14	Gray	Deric	Co-I
15	**Shuchman**	**Robert**	**PI**
15	Fahnenstiel	Gary	Co-I
15	Gahnenstiel	Gary	Co-I
15	Sayers	Mike	Co-I
15	Moore	Tim	Co-I
15	VanderWoude	Andrea	Clb

15	Binding	Caren	Clb
15	Lekki	John	Clb
15	Ruberg	Steve	Clb
16	**Chowdhary**	**Jacek**	**PI**
16	van Diedenhoven	Bastiaan	Co-I
16	Tsigaridis	Konstantinos	Co-I
16	Liu	Li	Co-I
16	Ottaviani	Matteo	Co-I
16	Stamnes	Snorre	Co-I
16	Schuster	Gregory	Clb
16	Moosmuller	Hans	Clb
16	Kowalewski	Matthew	Clb
16	Mishchenko	Michael	Clb
16	Hasekamp	Otto	Clb
16	Bauer	Susanne	Clb
17	**Dierssen**	**Heidi**	**PI**
18	**Meyer**	**Kerry**	**PI**
18	Coddington	Odele	Co-I
18	Holz	Robert	Co-I
18	Ackerman	Steven	Co-I
18	Platnick	Steven	Co-I
18	Heidinger	Andrew	Clb
18	van Diedenhoven	Bastiaan	Clb
18	Joiner	Joanna	Clb
18	Zhang	Zhibo	Clb
19	**Lyapustin**	**Alexei**	**PI**
19	Korkin	Sergey	Co-I
19	Wang	Yujie	Co-I
19	Huemmrich	Karl	Clb
19	Remer	Lorraine	Clb
19	Torres	Omar	Clb

20	**Siegel**	**David**	**PI**
20	Maritorena	Stephane	Co-I
21	**Krotkov**	**Nickolay**	**PI**
21	Vasilkov	Alexander	Co-I
21	Joiner	Joanna	Co-I
21	Mok	Jungbin	Co-I
21	Torres	Omar	Co-I
21	Castellanos	Patricia	Co-I
21	Fasnacht	Zachary	Co-I
21	Haffner	David	Clb
21	Kim	Jhoon	Clb
21	Bhartia	Pawan	Clb
21	Spurr	Robert	Clb
21	Qin	Wenhan	Clb
22	**Stamnes**	**Snorre**	**PI**
22	van Diedenhoven	Bastiaan	Co-I
22	Chowdhary	Jacek	Co-I
22	Allen	James	Co-I
22	Burton	Sharon	Co-I
22	Liu	Xu	Co-I
22	Hostetler	Chris	Clb
22	Hair	John	Clb
22	Hasekamp	Otto	Clb
22	Ferrare	Richard	Clb
22	Hu	Yongxiang	Clb
23	**Ottaviani**	**Matteo**	**PI**
23	Chowdhary	Jacek	Co-I
23	Hasekamp	Otto	Co-I
23	Wasilewski	Andrzej	Clb
23	Martins	J. Vanderlei	Clb

Science and Applications Team Alphabetical

18	Ackerman	Steven	Co-I
13	Alexandrov	Mikhail	Co-I
22	Allen	James	Co-I
10	**Barnes**	**Brian**	**PI**
16	Bauer	Susanne	Clb
12	Behrenfeld	Michael	Co-I
21	Bhartia	Pawan	Clb
7	Binding	Carol	Co-I
15	Binding	Caren	Clb
4	**Boss**	**Emmanuel**	**PI**
7	Boss	Emmanuel	Co-I
9	Brewton	Rachel	OP
22	Burton	Sharon	Co-I
9	Cannizzaro	Jennifer	OP
21	Castellanos	Patricia	Co-I
2	Chase	Alison	Co-I
16	**Chowdhary**	**Jacek**	**PI**
22	Chowdhary	Jacek	Co-I
23	Chowdhary	Jacek	Co-I
18	Coddington	Odele	Co-I
8	Damm	Alexander	Co-I
6	Davis	Anthony	Clb
17	**Dierssen**	**Heidi**	**PI**
15	Fahnenstiel	Gary	Co-I
21	Fasnacht	Zachary	Co-I
22	Ferrare	Richard	Clb
4	Frouin	Robert	Co-I
15	Gahnenstiel	Gary	Co-I
10	Garcia	Rodrigo	Clb
2	**Gaube**	**Peter**	**PI**
13	Geogdzhayev	Igor	Co-I

9	Goni	Gustavo	Co-I
12	Graff	Jason	Co-I
14	Gray	Deric	Co-I
5	Gregg	Watson	Co-I
21	Haffner	David	Clb
22	Hair	John	Clb
23	Hasekamp	Otto	Co-I
13	Hasekamp	Otto	Clb
16	Hasekamp	Otto	Clb
22	Hasekamp	Otto	Clb
18	Heidinger	Andrew	Clb
18	Holz	Robert	Co-I
22	Hostetler	Chris	Clb
6	Hsu	Christina	Co-I
9	**Hu**	**Chuanmin**	**PI**
10	Hu	Chaunmin	Co-I
3	Hu	Yongxiang	Co-I
22	Hu	Yongxiang	Clb
19	Huemmrich	Karl	Clb
21	Joiner	Joanna	Co-I
18	Joiner	Joanna	Clb
21	Kim	Jhoon	Clb
19	Korkin	Sergey	Co-I
16	Kowalewski	Matthew	Clb
21	**Krotkov**	**Nickolay**	**PI**
7	Kudela	Raphael	Co-I
9	Lapointe	Brian	Co-I
15	Lekki	John	Clb
6	Levy	Robert	Co-I
16	Liu	Li	Co-I
22	Liu	Xu	Co-I

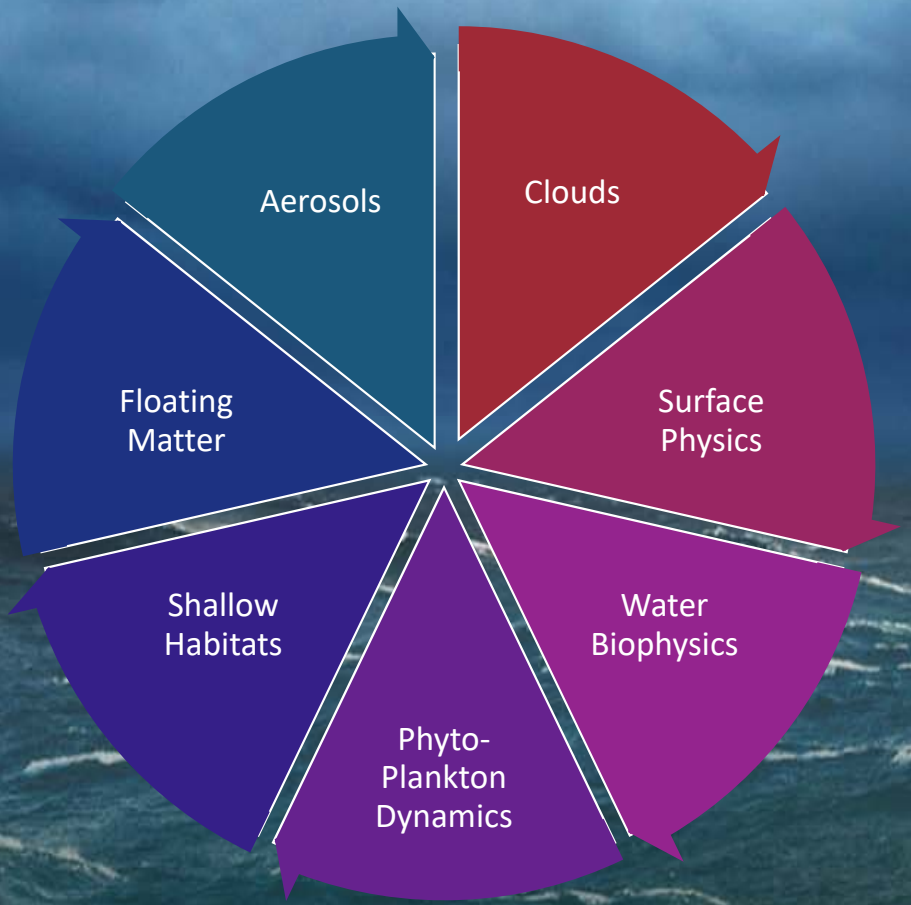
19	**Lyapustin**	**Alexei**	**PI**
6	Lyapustin	Alexei	Clb
5	Mahajan	Rahul	Co-I
20	Maritorena	Stephane	Co-I
13	Martins	J. Vanderlei	Clb
23	Martins	J. Vanderlei	Clb
18	**Meyer**	**Kerry**	**PI**
13	Meyer	Kerry	Clb
13	Miller	Daniel	Clb
8	Minaudo	Camille	Co-I
16	Mishchenko	Michael	Clb
21	Mok	Jungbin	Co-I
11	Moore	Tim	Co-I
15	Moore	Tim	Co-I
16	Moosmuller	Hans	Clb
9	Murch	Brockwell	OP
8	**Odermatt**	**Daniel**	**PI**
23	**Ottaviani**	**Matteo**	**PI**
16	Ottaviani	Matteo	Co-I
7	**Pahlevan**	**Nima**	**PI**
18	Platnick	Steven	Co-I
13	Platnick	Steven	Clb
21	Qin	Wenhan	Clb
7	Raymond	Heather	Clb
6	**Remer**	**Lorraine**	**PI**
19	Remer	Lorraine	Clb
1	Reynolds	Rick	Co-I
5	**Rousseaux**	**Cecile**	**PI**
15	Ruberg	Steve	Clb
15	Sayers	Mike	Co-I
7	Schollaert Uz	Stephanie	Co-I

16	Schuster	Gregory	Clb
15	**Shuchman**	**Robert**	**PI**
20	**Siegel**	**David**	**PI**
7	Smith	Brandon	PD
21	Spurr	Robert	Clb
22	**Stamnes**	**Snorre**	**PI**
16	Stamnes	Snorre	Co-I
1	**Stramski**	**Dariusz**	**PI**
7	Stump	Rick	Co-I
6	Torres	Omar	Co-I
21	Torres	Omar	Co-I
19	Torres	Omar	Clb
9	Triananes	Joaquin	OP
16	Tsigaridis	Konstantinos	Co-I
11	**Twardowski**	**Michael**	**PI**
13	**van Diedenhovel**	**Bastiaan**	**PI**
16	van Diedenhoven	Bastiaan	Co-I
22	van Diedenhoven	Bastiaan	Co-I
18	van Diedenhoven	Bastiaan	Clb
15	VanderWoude	Andrea	Clb
21	Vasilkov	Alexander	Co-I
9	Wang	Mengqiu	PD
19	Wang	Yujie	Co-I
23	Wasilewski	Andrzej	Clb
12	**Westberry**	**Toby**	**PI**
7	Wolny	Jennifer	Clb
3	**Zhai**	**Pengwang**	**PI**
14	**Zhang**	**Xiaodong**	**PI**
13	Zhang	Zhibo	Co-I
18	Zhang	Zhibo	Clb

1 - PI
2 - Co-I
1 – Collaborator
==========
4 Proposals!!!

Remote sensing of cloud properties using PACE SPEXone and HARP-2

PACE SCIENCE TEAM BY TOPIC

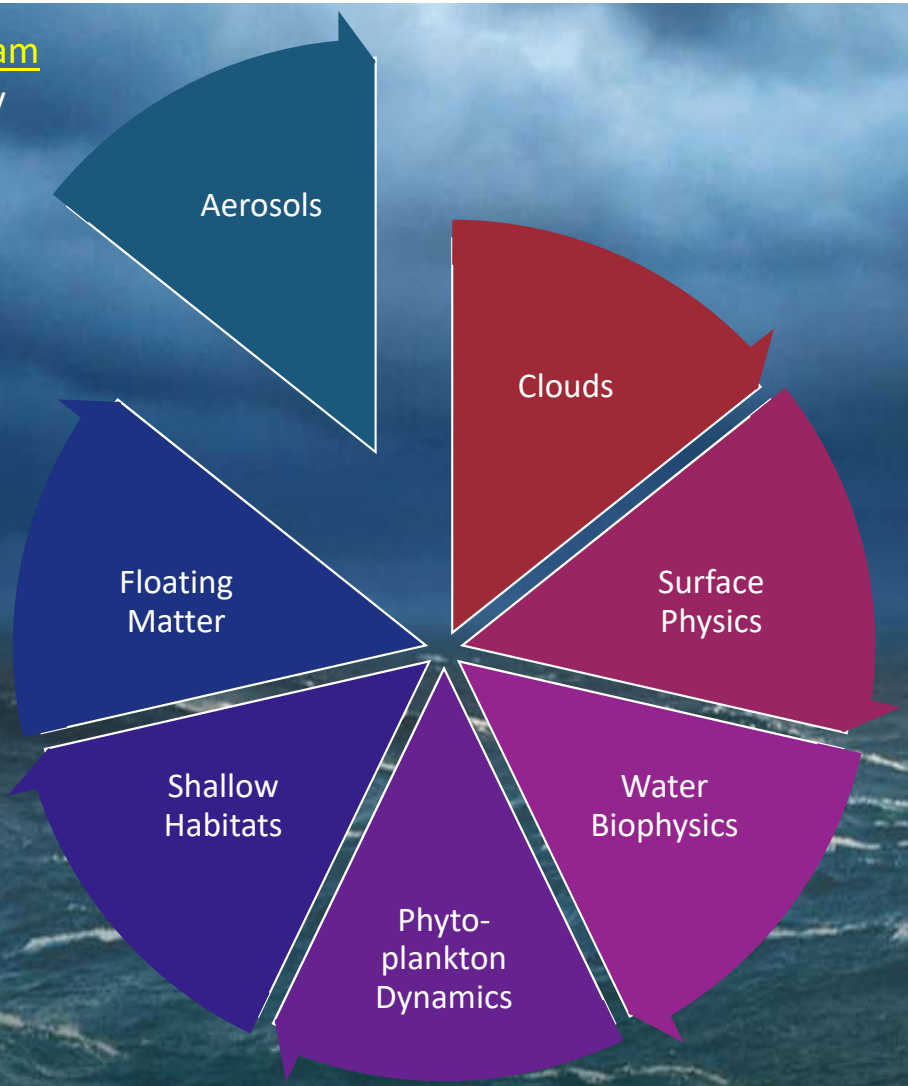


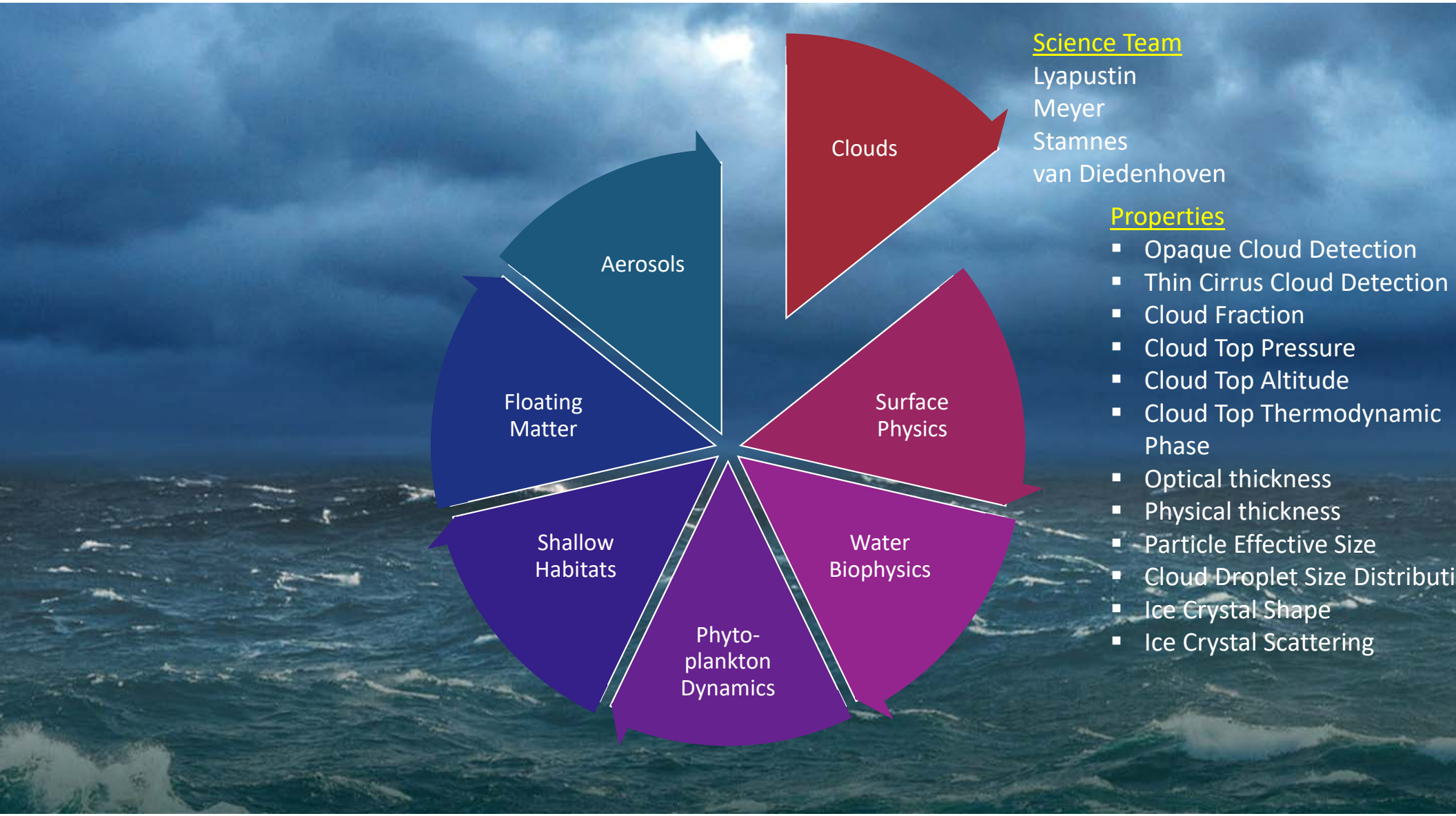
Science Team

Chowdhary
Lyapustin
Ottaviani
Remer
Stamnes
Zhai

Properties

- Spectral Optical Depth (water and land)
  - Fine mode
  - Sea Salt
  - Dust
- Spectral Absorption
- Black Carbon Concentration
- Brown Carbon Concentration
- Aerosol Height
- Aerosol Size Parameter
- Aerosol Effective Radius
- Column Water Vapor (land)



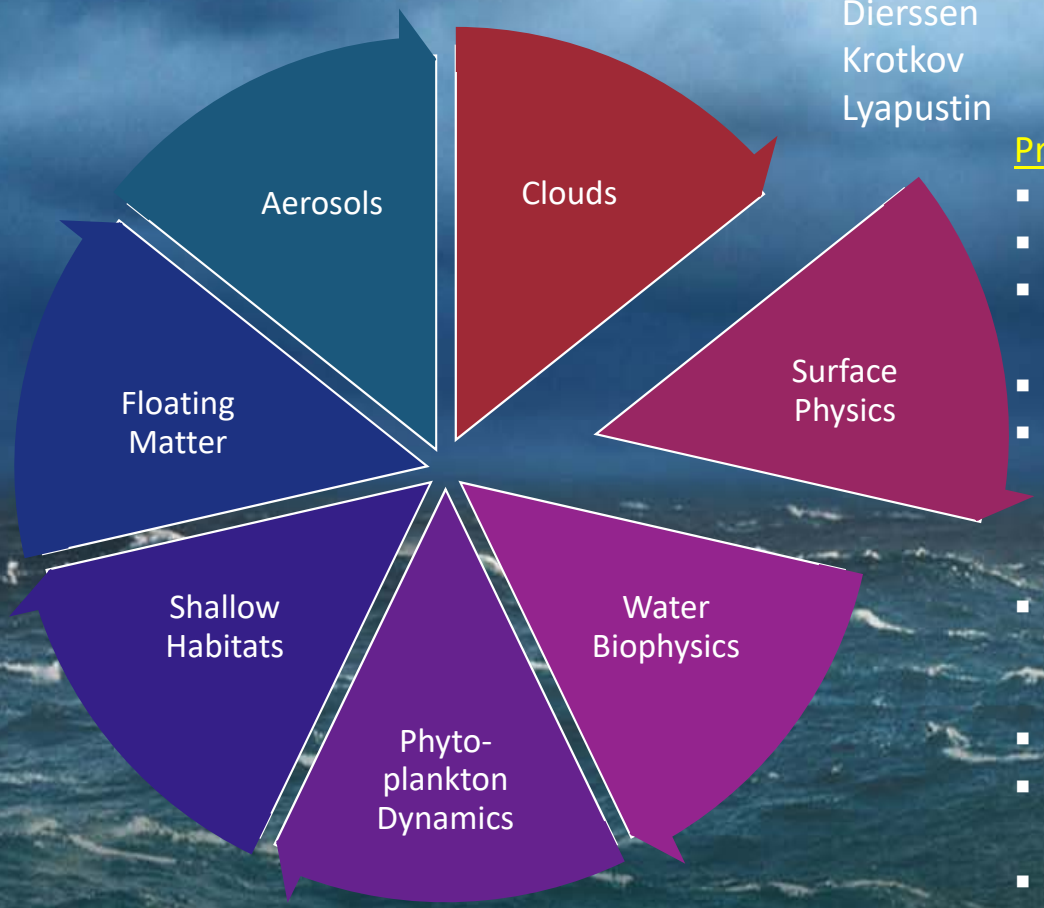


Science Team

Lyapustin
Meyer
Stamnes
van Diedenhoven

Properties

- Opaque Cloud Detection
- Thin Cirrus Cloud Detection
- Cloud Fraction
- Cloud Top Pressure
- Cloud Top Altitude
- Cloud Top Thermodynamic Phase
- Optical thickness
- Physical thickness
- Particle Effective Size
- Cloud Droplet Size Distributi
- Ice Crystal Shape
- Ice Crystal Scattering

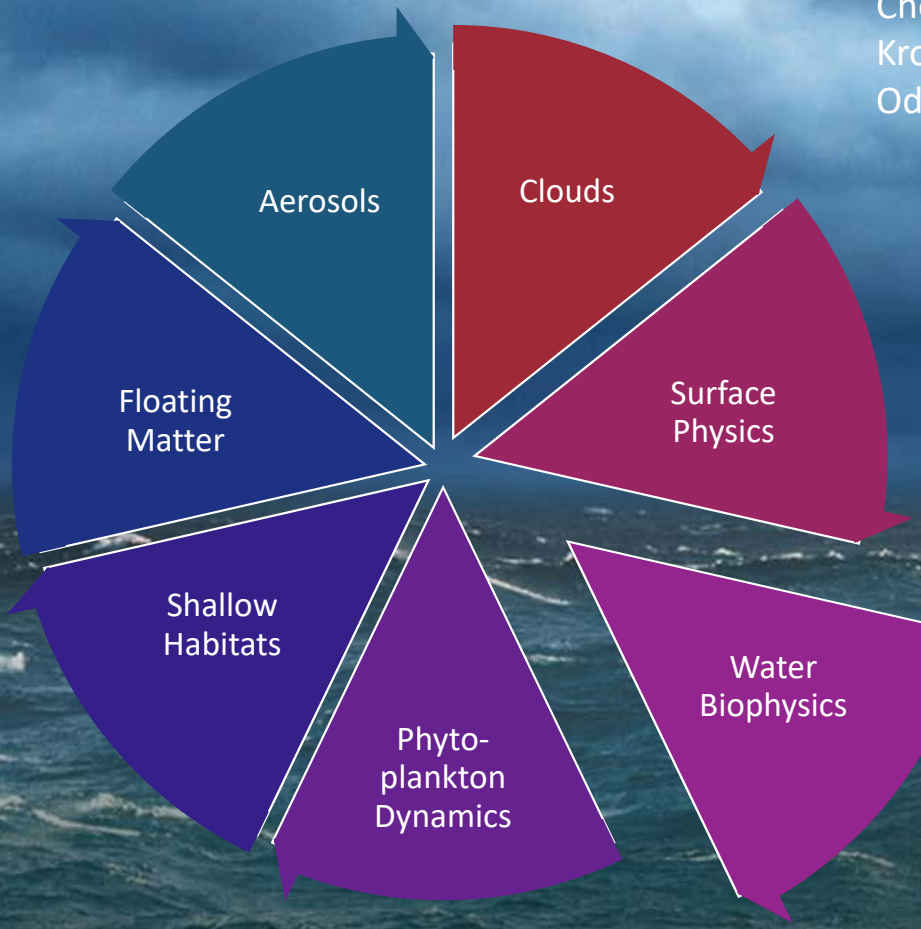


Science Team

Boss
Chowdhary
Dierssen
Krotkov
Lyapustin
Ottaviani
Twardowski
Zhai
Zhang

Properties

- Ocean Albedo $R(\lambda)$
- Land Albedo $R(\lambda)$
- Spectral Water-leaving Reflectance $R_w(\lambda)$
- Polarization Parameters
- Irradiance at Interface
  - Photosynthetically Available Radiation $E_d(0^+, PAR)$
  - Downwelling Irradiance $E_d(0^+, \lambda)$
- Irradiance Below Water Surface
  - Downwelling Irradiance $E_d(0^-, \lambda)$
  - Scalar Irradiance $E_o(0^-, \lambda)$
- Surface Index of Refraction
- Bidirectional Reflectance Function (BRDF)
- Whitecap Fraction/Factor

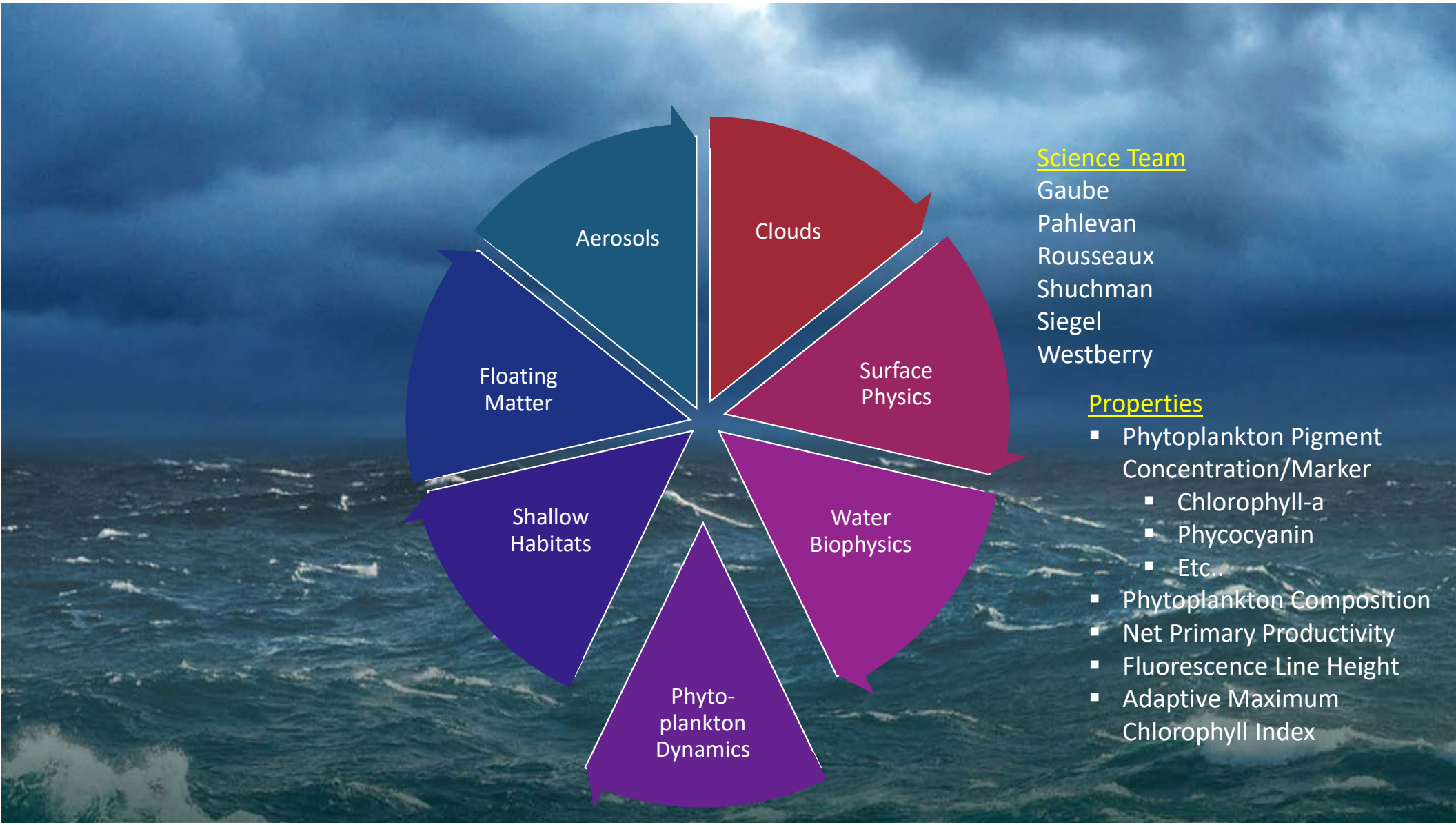


Science Team

Barnes
Boss
Chowdhary
Krotkov
Odermatt
Pahlevan
Shuchman
Stamnes
Stramski
Twardowski
Zhai

Properties

- Spectral Light Penetration
  - Downwelling Attenuation Kd(λ), Kd(PAR)
  - Scalar Attenuation Ko(λ)
- Turbidity
  - Suspended Particulate Matter (SPM)
  - Nephelometric Turbidity Unit (NTU)
- Vertical Stratification Properties
- Spectral Inherent Optical Properties (Deep and Shallow)
  - Absorption by Gelbstoff
  - Absorption by Phytoplankton
  - Absorption by Non-pigmented Particles
  - Volume Scattering Function
  - Backscattering
  - Particulate and Bubble Backscattering
  - Backscattering Ratio
- Shallow Bathymetry

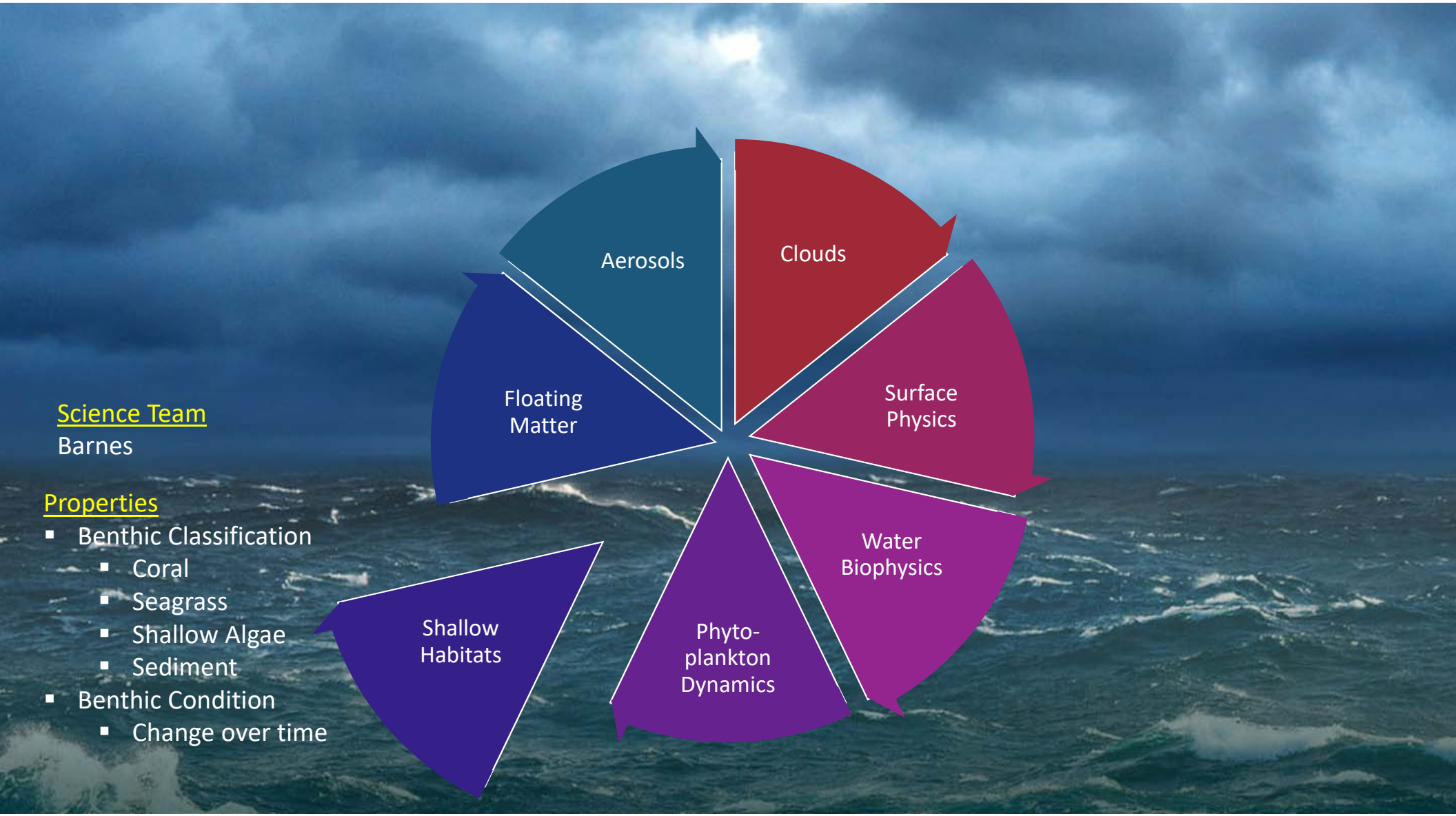


Science Team

Gaube
Pahlevan
Rousseaux
Shuchman
Siegel
Westberry

Properties

- Phytoplankton Pigment Concentration/Marker
  - Chlorophyll-a
  - Phycocyanin
  - Etc..
- Phytoplankton Composition
- Net Primary Productivity
- Fluorescence Line Height
- Adaptive Maximum Chlorophyll Index

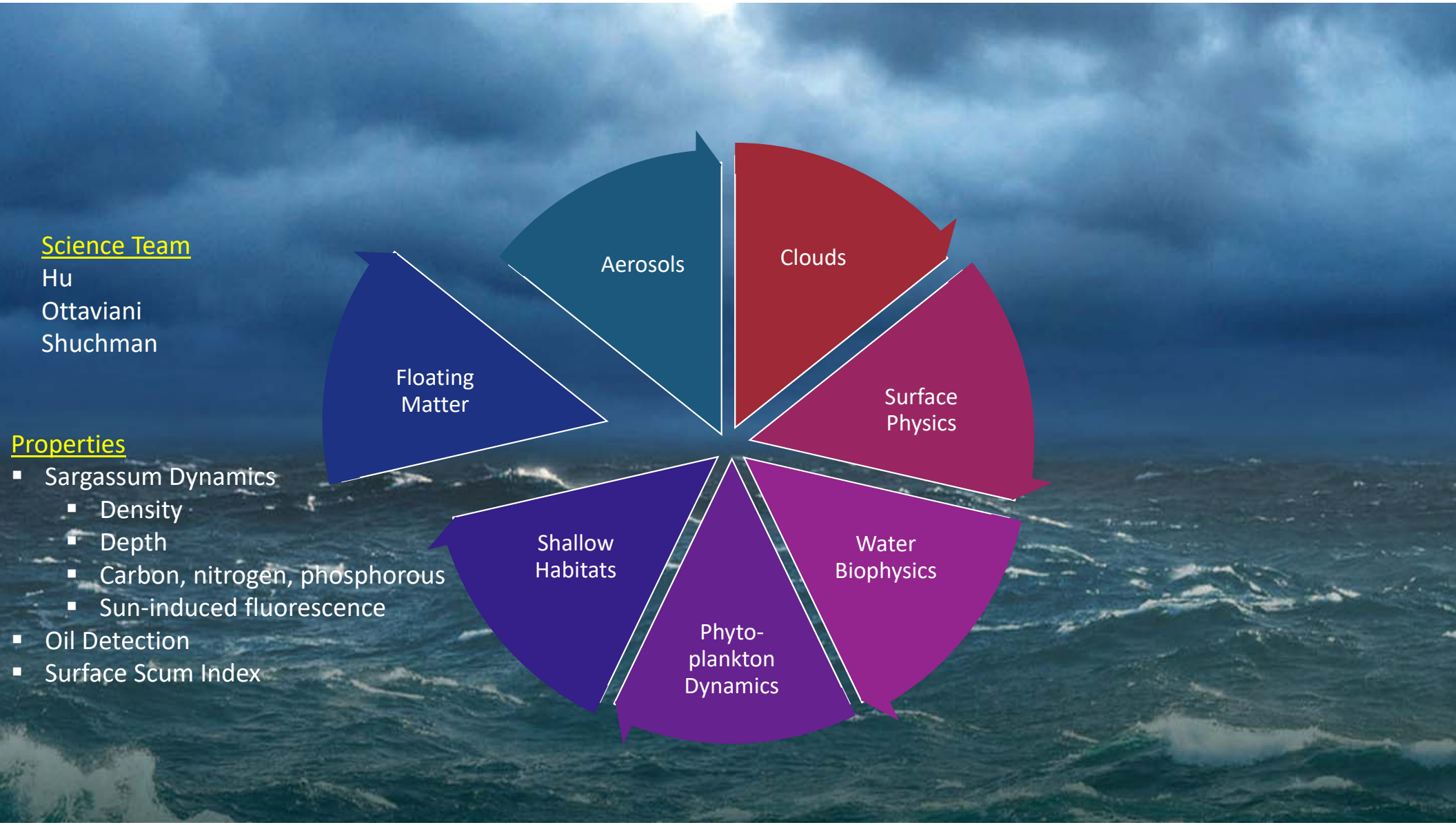


Science Team

Barnes

Properties

- Benthic Classification
  - Coral
  - Seagrass
  - Shallow Algae
  - Sediment
- Benthic Condition
  - Change over time



Science Team

Hu

Ottaviani

Shuchman

Properties

- Sargassum Dynamics
  - Density
  - Depth
  - Carbon, nitrogen, phosphorous
  - Sun-induced fluorescence
- Oil Detection
- Surface Scum Index

Lone Wolf Award

Biography – Brian Barnes

Research Interests:

My overarching interest is in research and monitoring of reef systems & ecology with an emphasis on preservation and restoration. Current work is to improve understanding of coral health and ecology in the Florida Keys reef tract through combination of multiple remote sensing techniques. Past projects include larval-adult interactions on oyster reefs, comparative ecology of native and non-native oyster reefs, physical and biological changes associated with barrier-island inlet morphology, spiny lobster disease dynamics, coral reef ecology and monitoring, and installation and maintenance of NDBC & SeaKeys stations.

PACE Science Data Product Validation Plan

- Antonio Manino wants to share that the plan is now LIVE on the PACE website
- https://pace.oceansciences.org/documents.htm?id=memo

- There will be a PACE Validation Science Team (PVST) solicited
  - The overarching goal of the PACE Science Data Product Validation program is to verify that the required and advanced science data products from OCI, HARP2, and SPEXone meet the specified mission requirements and goals and to provide an evaluation of uncertainty for each data product.

Required OCI data products

Table 1. Required OCI ocean color data products.

Data Product	Baseline Uncertainty
Water-leaving reflectances centered on (±2.5 nm) 350, 360, and 385 nm (15 nm bandwidth)	0.0057 or 20%
Water-leaving reflectances centered on (±2.5 nm) 412, 425, 443, 460, 475, 490, 510, 532, 555, and 583 (15 nm bandwidth)	0.0020 or 5%
Water-leaving reflectances centered on (±2.5 nm) 617, 640, 655, 665 678, and 710 (15 nm bandwidth, except for 10 nm bandwidth for 665 and 678 nm)	0.0007 or 10%
Ocean Color Data Products to be Derived from Water-leaving Reflectances	
Concentration of chlorophyll-a	
Diffuse attenuation coefficients 400-600 nm	
Phytoplankton absorption 400-600 nm	
Non-algal particle plus dissolved organic matter absorption 400-600 nm	
Particulate backscattering coefficient 400-600 nm	
Fluorescence line height	

The requirements for ocean color products stated in Table 1 are defined for 50% or more of the observable deep ocean (depth>1000 m).

Table 2. Required OCI aerosol and cloud data products.

Data Product	Range	Baseline Uncertainty
Total aerosol optical depth at 380 nm	0.0 to 5	0.06 or 40%
Total aerosol optical depth at 440, 500, 550 and 675 nm over land	0.0 to 5	0.06 or 20%
Total aerosol optical depth at 440, 500, 550 and 675 nm over oceans	0.0 to 5	0.04 or 15%
Fraction of visible aerosol optical depth from fine mode aerosols over oceans at 550 nm	0.0 to 1	±25%
Cloud layer detection for optical depth > 0.3	NA	40%
Cloud top pressure of opaque (optical depth > 3) clouds	100 to 1000 hPa	60 hPa
Optical thickness of liquid clouds	5 to 100	25%
Optical thickness of ice clouds	5 to 100	35%
Effective radius of liquid clouds	5 to 50 μm	25%
Effective radius of ice clouds	5 to 50 μm	35%
Atmospheric data products to be derived from the above		
Water path of liquid clouds		
Water path of ice clouds		

The timeline for validation program activities is as follows:

- January-December 2020: SDS in coordination with Project Science begins to ingest *in situ* data from various sources that can be applied to validate PACE required and advanced science data products (see Table 6) for the purpose of preparing for PACE launch and implementation of formal validation activities.
- January 2021: Citations or URL links to field measurement protocols for required and advanced data products (as appropriate) are posted on the PACE website.
  - SDS develops and updates ocean field measurement protocols through post-launch. The most recent versions of the IOCCG Ocean Optics and Biogeochemistry Protocols for Satellite Ocean Colour Sensor Validation available at https://ioccg.org/what-we-do/ioccg-publications/ocean-optics-protocols-satellite-ocean-colour-sensor-validation/ are the official protocols for the PACE mission.
  - Appropriate references for *in situ* and airborne measurement protocols of aerosol and cloud properties are posted on the PACE website.
- February 2021: Release of ROSES 2021 (TBC) containing solicitation for the PVST. Response due date TBD.
- [TBD]: Responses to ROSES 2021 (TBC) PVST solicitation are due.
- NLT December 2022: Selected PVST Teams begin work.

Science Team meeting is likely postponed

- June will likely not be a good time for travel.
  - Pray for miracles
- But we are maintaining optimism and have not cancelled yet
  - there are no fees associated with late cancellation
- If so, we will postpone the in-person meeting maybe until Fall/Winter
  - I like the week before Thanksgiving. Easy to get flights, hotels, etc…

15-20 min Virtual Presentation on Research

- **Due by May 19 (two weeks before proposed meeting)**
- Recorded presentation
- Introduction of team (pictures good)
- Project objectives
- Deliverables
- Methods and fieldwork
  - Required ancillary measurements
- Uncertainty assessment
- Validation plan
  - Needs that can and cannot be met presently
- **Anything you want to share in terms of collaborations, assistance, field requests, etc…**

- Instructions: https://www.dummies.com/software/microsoft-office/powerpoint/how-to-record-narration-for-a-powerpoint-presentation/

Proposing a Virtual Meeting in June 2020

- 2 June:
  - *11:00 am- 12:15 pm: PACE mission presentations (NASA GSFC)*
  - *3:00 pm -4:15 pm: Science Team 1: 5 min. introductory slides from each Team*
- 3 June:
  - *11:00 pm -12:15 pm: Science Team 2: 5 min. introductory slides from each Team*
  - *3:00 pm -4:15 pm: Science Team 3: 5 min. introductory slides from each Team*

Working Groups from last Science Team

1. Inherent Optical Properties IOP
2. Atmospheric Correction

Subgroups:

- Hyperspectral IOP Database (Rousseaux)
- Radiative transfer models (Chowdhary)
- Gap Analysis (Boss)

Working Groups

Dividing by Topics for Collaboration

Or for Consensus Building

1. Whole Group Input
   - Uncertainties/Metrics
   - Validation Needs and Approaches
   - Nomenclature

2. Possible Subgroups
   - Polarimetry to do Atmosphere-Ocean Retrievals
   - Ultraviolet working group
   - Algorithms for Phytoplankton Characterization
   - Differentiating and Atmospheric correction for Bright Targets (Cirrus Clouds, Sea ice, Shallow water, Sargassum, Scum, High Chl, Turbidity, Whitecaps)
   - Absorption partitioning: ap, adg, ag, anap, aphy, etc.. Methods and uncertainties.

Uncertainties Working Group (Leads Wanted)

- Derivation and propagation of system-level uncertainties
- This is can include consist metrics for evaluating algorithms (e.g., Mean bias, Root mean square deviation

- We are looking for leads for this effort who will produce a STRAWMAN report for the Science Team to discuss and provide input
- Please email me and Lorraine if you are interested

Validation Approaches

- Validation data needs and approaches
  - New data needs for PACE
    - Hyperspectral optical data
    - Polarized reflectance
    - Phytoplankton diversity
    - Sargassum characteristics
    - Aerosol parameters: absorption, size, height etc..
    - Cloud parameters: thickness, size, composition, etc…
  - Approaches:
    - Proposed airborne and ship cruise on a post-launch cruise
    - Perhaps assets focused on time series may be preferred
      - Amplified AERONET-type moorings with upward facing optics/lidars, hyperspectral and polarized, and in-water suites of instruments, additional monthly water sampling, etc..
      - Profiling floats, ferries, etc..

How important is one campaign versus investing in monitoring assets?

Science Communication

- PACE website is a great resource
- We will also need to individually work on science communication
  - use social media to get public attention
- Please let me know if you are doing any cool fieldwork or have interesting science results that we can work together to promote for PACE.

To Do

- Begin constructing your Research Presentation
  - Due 19 May 2020
  - May eventually become public but you can modify
- Provide feedback on topics, parameters, and groupings presented above
- Looking for Leads to spearhead whole group efforts:
  - Uncertainties Report (You?)
  - Nomenclature Report (You?)
  - Validation Report (Dierssen will lead)
- Feedback on Working Groups you would like to lead or join
  - Polarimetry
  - Ultraviolet
  - Phytoplankton algorithms
  - Differentiating IOPs
  - Bright targets
- Feedback on Early Adopter Program :
  - erin.urquhart.jephson@nasa.gov; joel.scott@nasa.gov;
- Feedback on proposed Level 1C merged product:
  - kirk.d.knobelspiesse@nasa.gov