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

This summary includes two types of gaps, those which are opportunities for the PACE mission to address and those that are needed for the PACE mission to succeed. The later are denoted as 'Gap-risk' below.

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, absorption by pure seawater in the 320-400nm range.

Outcome:
- Ocean and atmosphere products with lower uncertainties.

GAP: Need to predict IOP evolution.
- Mass specific IOPs.
- CDOM production and photobleaching.
- IOP of phytoplankton functional types and their variability.

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. Need to resolve near surface IOPs and constrain effects of observed likely vertical structure in IOPs on upwelling light.

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: Continuantion of existing validation assets: AERONET for both ocean reflectance and aerosol. Lidar in space for cloud property validation (CALIOP 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