

## PACE Project Science monthly update for the PACE Science Team

May 2016

### **Executive summary**

The Project focused much of its energy on responding to Requests for Action and advisories from the Mar 8-10 Mission Concept Review (MCR) and preparing for its annual NASA Planning, Programming, Budget, and Execution (PPBE) exercise. Other than continuing their ongoing mission, spacecraft, and science studies, the Project conducted an intense technical, cost, and science evaluation of multiple OCI concepts with varied ground sample distances (GSDs) and SNRs and continued discussions with SRON (Netherlands) and Canadian Space Agency/NRL on the potential contributed polarimeter and dedicated coastal instrument. Details are presented below, with the purpose of providing new information since the past monthly update.

### **Details**

#### Project milestones

- Key Decision Point A (KDP-A), the gateway into Phase A (mission formulation), is scheduled for Jun 16. Unlike MCR, which was a 3-day internal GSFC review with a 10-member non-Project panel, KDP-A is a 3-hour review to brief, and be blessed by, NASA HQ. The Project is currently preparing presentation material for this event. The Project Scientist has a 30-min slot to present the science of the mission.
- The Acquisition Strategy Meeting (ASM) will be conducted approximately 30 days after KDP-A. This is the event where HQ will codify the method of procuring the PACE polarimeter and spacecraft (bus).
- The System Requirements Review (SRR) is tentatively scheduled for Fall-Winter 2016. This is a major review, required to be completed before entering Phase B, that evaluates whether the proposed mission and systems architecture is credible and responsive to mission requirements, constraints, and resources.
- We hope a decision on the dedicated coastal instrument can be made by Oct.

#### Instruments

- The Project had several additional conversations with CSA and NRL to discuss their proposal for a contributed dedicated coastal imager. While still outside the proposed mission concept for fiscal reasons, the Project is defining, evaluating, and costing the necessary accommodations to host a coastal imager on its spacecraft. The Project requested additional funding to support the inclusion of a coastal instrument. A Science Team subgroup for the coastal imager was been formed and held their first telecon. A second telecon will not be scheduled until we learn more about the instrument and budget. If you are interested, please contact Antonio Mannino ([antonio.mannino@nasa.gov](mailto:antonio.mannino@nasa.gov)).
- The OCI System Engineering team continued a study to evaluate SNR, technology, data rate, and cost impacts for multiple instrument concepts with ground sample distances

(GSDs) of 500, 750, 1000, and 1250 m. As a reminder, the threshold OCI concept is a hyperspectral scanner with 1000 m GSD. A full day debrief on their results is scheduled for May 12. See SNR vs. GSD Science analysis below.

- No news to share on the polarimeter. The Project preference continues to be SPEX after substantial reviews of both cost and scientific/technical capabilities.

## Science analyses

**All science data analysis packages will be shared with the Science Team. All input from the Science Team on any of the analyses, before or after completion, is most welcome.**

First, a proposal: We would like to begin sharing more specific details on the OCI concept (among other things) with the ST via webinars on the scale of every month or two, pending the availability of the Instrument Scientist and Systems Engineering. These will probably be short, targeted presentations on specific concepts or results. The Project will work with the ST leads to establish this activity.

- SNR vs. GSD: Project Science continued to compile the scientific benefits for the various GSDs and to evaluate the impact of the modeled SNRs (provided by Engineering) for the modified instrument concepts needed to achieve the various GSDs. The OBPG developed a Monte Carlo approach to evaluate the impact of noise on derived remote-sensing reflectances, the uncertainties from which will be used to infer if the OCI SNRs can meet mission threshold requirements on these reflectances (those of you at OCRT will note that Bryan Franz presented some of this material). Highlights:
  - o We believe the threshold uncertainty in the red (max of 0.001 reflectance or 5%) to be scientifically insufficient. We are looking into refinement of this to inform Systems Engineering of our needs to enable science related to phytoplankton fluorescence, gaseous transmission, etc. ST thoughts welcome.
  - o ST suggestions for atmospheric benefits of finer GSD are still welcome, but time is running out (by the end of this week please).
  - o The Project expects combined Science and Engineering results to be presented on May 12. Results will impact near-term decisions on long-lead procurements, such as instrument detectors.
- Hyperspectral SWIR: Project Science requested that Engineering evaluate the technical and cost impacts of replacing any/all of the SWIR diode arrays with a spectrograph(s). We believe hyperspectral SWIR will not be achievable for OCI given technological limitations of detector read rates (balanced with development costs), major increases in data rates, and other factors that increase instrument cost.
- Altitude reduction from 675 km to ~425 km: Per the request of HQ, the Project is exploring the technical and scientific impacts of lowering the PACE observatory altitude to ~425 km. Hypothetically, were a satellite constellation to be formed around PACE, this would benefit LIDAR and radar instruments used in oceanographic and atmospheric studies. We believe that 2-day global coverage (approximately 16 day repeatability) for OCI is achievable at roughly 425 km with sensor zenith angles to ~62-deg. Systems Engineering will further explore the impacts to both OCI and the spacecraft (e.g.,

additional fuel is required for orbit maintenance). In addition, ST input on an Equatorial crossing time of 13:30 (versus the threshold 11:00 to 13:00) is welcome.

- Spectral super-sampling: Project Science continued compiling and evaluating the utilities of collecting data of finer spectral resolution than 5 nm and spectral steps (e.g., 1.25 nm) of overlapping 5 nm bands (FWHM) for small spectral ranges (e.g., the chlorophyll fluorescence peak and NO<sub>2</sub> range as identified in the SDT). ST suggestions for additional (limited) spectral domains where such sampling would have significant benefits to the mission are welcome (near the O<sub>2</sub> peak?). Thank you to those of you who have commented on this.
- Others in the queue (advance input welcome from the ST): Science utility of extending the spectral range to 315 nm; SWIR SNR requirements; and, science impacts of spatial aggregation to smaller pixels at the end-of-scan (something the current OCI concept can do for UV-NIR, but not SWIR).

## Communications

The Ocean Ecology Lab and OBPG have been increasingly supporting the ocean color communications and outreach material coming out of GSFC. The list below represents the material related to PACE. Please let the Project know about related ocean color, clouds, and aerosols communications and outreach activities!

- We are involved in NASA-wide Earth Expeditions communications campaigns with relevance to PACE science themes (<http://nasa.gov/earthexpeditions>). The OBPG is collaborating with HQ, LaRC, JPL, and other centers on, for example:
  - o KORUS-OC – KORUS-AQ Apr 21 press release complete, May 20 dedicated press release planned, social media planned before and during cruise
  - o NAAMES – assisting with shareables, May 6 press release complete, May 10 NASA Social in Woods Hole planned, multi-media coverage planned from Woods Hole in port and onboard the C-130 flight during the campaign
  - o CORAL – social media planned, will assist with press releases
- Social media:
  - o Now on Facebook: NASA.Oceans and Instagram: nasa oceans
  - o Twitter: @NASAOceans has > 900 followers, 164K tweet impressions in April
  - o Earth 24Seven PACE-related action shots were broadcast over social media on Earth Day (Apr 22): <https://www.flickr.com/photos/earthrightnow/25943132954/in/album-72157665047762664/>
- Upcoming public engagement events:
  - o World Ocean Day – Jun 4 (ocean color table with phytoplankton cultures and microscopes and hands-on spectrophotometer activity)
  - o Science Day on Capitol Hill – Jun 15 (Hyperwall talk)

## Applied Sciences

The Project has requested additional budget support to develop an Applied Sciences program in accordance with an upcoming HQ/ESD directive. In the meantime, the HQ Applied Sciences

team and Project have held monthly telecons to coordinate preliminary activities on PACE research and applied sciences. The next priority will be the development of a formal PACE Mission Applied Sciences Plan – crafted acknowledging and in accordance with the approved budget – the deadline for which is KDP-B (entry into Phase B, roughly early Spring 2017).