PACE Project Science monthly update for the PACE Science Team

June 2016

Executive summary

The Project focused much of its energy on preparing for the Key Decision Point A (KDP-A) event on 16 Jun 2016. This is the milestone to advance from Pre-Phase A (pre-formulation) to Phase A (formulation). Once in Phase A, the financial clock starts ticking. Beyond KDP-A preparations, the Project continued their intense technical, cost, and science evaluation of the OCI concept as it impacts SNRs, started exploring alternative options to acquire a PACE polarimeter, and continued their dialog with the Canadian Space Agency/NRL regarding the potential contributed 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 has prepared material for this event and reviewed it in nauseating detail with GSFC and HQ. The Project Scientist has a 30-min slot to present PACE science.
- 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.
- If a procured polarimeter is pursued (via a formal Request for Proposals this Fall), we hope an award can be made by Apr 2017.
- We hope a decision on the dedicated coastal instrument can be made by Oct 2016.

Instruments

- The Project hosted a 2-day workshop with CSA and NRL to discuss their proposal for a contributed dedicated coastal imager. Several research community members, plus the EPA and PACE Applied Sciences were also in attendance. While still outside the proposed mission concept for fiscal reasons, the Project is defining, evaluating, and costing the necessary accommodations to host this coastal imager on its spacecraft. The Project requested additional funding to support the inclusion of a coastal instrument, but has yet to hear back on this from NASA HQ. A Science Team subgroup for the coastal

imager was been formed. If you are interested in participating, please contact Antonio Mannino (antonio.mannino@nasa.gov).

- The OCI System Engineering team completed its study of 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 Project debrief on their results was conducted – a similar review will be conducted with HQ this month. The OCI team is now focusing on requirements for OCI CCDs, which need to be acquired soon to enable robust testing and inclusion in engineering test units. The Instrument Scientist will host a webinar in late June to present the current OCI concept to the science team (details to follow separately). See Science Analysis below.
- Unfortunately, the Dutch polarimeter SPEX is no longer a viable option for PACE because of funding limitations of their government. The Project expects to release a Request for Information to explore procurement of an alternate polarimeter in early Jun, followed by a formal Request for Proposals in the Fall.

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.

Following up from a proposal from last month: From the May update … "*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*." The Instrument Scientist (Gerhard Meister) will host a WebEx presentation to present an overview of the current OCI concept in late Jun, tentatively Tue, Jun 28 at US east coast lunchtime. A detailed message will follow in the coming week(s). If successful and of interest, we will follow this event with additional webinars on more targeted topics.

- SNRs: Project Science evaluated 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. Current status: the SNR model for the current OCI concept (note: it is just a model and perhaps imperfect) suggests that MODIS-level SNRs can be achieved at the key aggregate bands listed in Table 3.1 of the SDT report – hyperspectrally, without image striping. Highlights:
    - We believe the threshold uncertainty in the red (max of 0.002 reflectance or 10%) 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.
    - Per an email to the ST in late May, we plan to reduce the Lmax from roughly ~650 to ~710 nm (TBD) from ~500 W/m2/nm to ~200 W/m2/nm. Note, this will not impart CCD saturation, only digital saturation. Some impacts to science were

noted (thank you all for your comments), but we believe the benefit of increasing red SNRs (+50%) in this spectral region to be substantial.
    - On the minds of the OCI Systems Engineering team: CCD read rates, analog-to-digital convertors, their effective numbers of bits, and their space readiness, numbers of CCD read taps, Lmax values assigned to each tap, transitions zones between the blue and red spectrographs, and CCD electron well capacities. All of which impact performance, cost, and SNRs. These could all be potential topics for additional webinars if there is interest from the ST.
- Altitude reduction from 675 km to ~425 km: Per the request of HQ, the Project explored the technical and scientific impacts of lowering the PACE observatory altitude to ~420 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 do not believe there to be substantial impacts to core PACE science with this altitude reduction. Systems Engineering is further exploring the impacts to both OCI and the spacecraft (e.g., additional fuel is required for orbit maintenance). A discussion with HQ will be conducted in mid-July to determine if this is worth exploring further in detail. Systems Engineering predicts roughly 4 weeks of dedicated analyses to fully define the impacts to the OCI optical prescription and the spacecraft.
- Project Science has requested that the OCI team evaluate extension of the UV spectral range to ~315 nm. One major benefit of this could be characterization of ozone to support ocean color atmospheric correction with relying on ancillary data sources
- 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_2 range as identified in the SDT). ST suggestions for additional (limited) spectral domains where such sampling would have significant benefits are welcome. Thank you to those of you who have commented on this.
- Others in the queue (advance input welcome from the ST): 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 released a revised PACE Web site (http://pace.gsfc.nasa.gov) that now includes Level-2 pages under the general categories of "Mission," "Science," "Applications," "Campaigns," and "Gallery." Its database currently includes ~450 resources (images, videos, PDF files, etc.) that are being used to populate 23 profile pages for members of the PACE Science Team (check them out!) and overviews of 6 PACE-related science meetings.

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 begun 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). The Applied Sciences team participated in the CSA-NRL workshop described above and now has the action to produce several one-page white papers that highlight the applications value of a high spatial resolution instrument. Finally, we encourage you to visit the Applications section of the PACE Web site, the content for which has been substantially enhanced.