

Polarimetry with the NASA Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) Mission: status and next steps

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Since its launch in February 2024, the NASA Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission has been generating a variety of aquatic, atmospheric and terrestrial data products from its three sensors [1,2]. This talk will give an overview of the PACE mission status, then provide an assessment of data products from the pair of multi-angle polarimeters (MAP) onboard the PACE spacecraft. Both instruments were contributed to PACE and can be considered proof-of-concept for future missions. The Hyper-Angular Rainbow Polarimeter – 2 (HARP2) was constructed using engineering spare parts from the HARP CubeSat, while the Spectrometer for Planetary Exploration – one (SPEXone) is similarly cubesat sized. The measurement characteristics of HARP2 and SPEXone are different, yet complementary. HARP2 is a wide swath, four channel, MAP with up to 60 viewing angles in one channel. SPEXone has a narrow swath and five viewing angles but is a UV-VIS-NIR spectrometer. Several aerosol product algorithms have been implemented for these instruments, and validation shows that they successfully determine aerosol optical and microphysical properties at low aerosol optical depth. Byproducts of the aerosol algorithms characterize the surface bidirectional reflectance distribution function (BRDF) and bidirectional polarized distribution function (BPDF), both of which can be used to further understand aquatic or terrestrial properties. The MAPs can also determine cloud optical properties and 3D structure. Some of these products are currently available, others in the process of implementation and validation. We will summarize where the PACE mission stands with its polarimetric products, show how to access PACE data, documentation and validation information [3], and highlight some available tools that have been developed along the way [4].

References

- [1] Werdell, P. J., Cairns, B., Caplan, S. A., Cetinić, I., Foley, S. R., Franz, B. A., Gao, M., Fasnacht, Z. T., Huemmrich, K. F., Ibrahim, A., Knobelspiesse, K. D., Mannino, A., McKinna, L. I. W., Poulin, C., Rajapakshe, C., and Sayer, A. M.: Advancing Earth System Science With the NASA Plankton, Aerosol, Cloud, Ocean Ecosystem (PACE) Satellite Mission, *Global Change Biology*, 32(4), e70869, <https://doi.org/https://doi.org/10.1111/gcb.70869>, 2026.
- [2] https://youtu.be/VIVv40A-6_k?si=JBtetlUwaP1dH29a

- [3] https://pace.oceansciences.org/access_pace_data.htm
- [4] <https://nasa.github.io/oceandata-notebooks/>

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