

Synergistic Retrieval of aerosol and surface properties from PACE polarimetric and spectrometric observations using GRASP algorithm

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NASA's PACE mission was successfully launched on February 8, 2024. PACE provided coordinated complementary observations from three key instruments: HARP2, SPEXone and OCI. Both HARP2 and SPEXone are advanced multi-angular polarimeters that measure both the intensity and polarization of reflected solar light, providing high sensitivity to aerosol characteristics such as particle size, type, and absorption etc. OCI, on the other hand, is a hyperspectral radiometer designed to measure ocean color and atmospheric properties across the UV to SWIR, providing high resolution data for ocean and atmospheric applications.

This study exploits the complementarity of all three PACE instruments to develop advanced aerosol and surface synergy products using the GRASP algorithm. As a first step, we demonstrated the correctness and robustness of GRASP for each instrument individually by designing and implementing technical and methodological developments, including harmonization of data format, accuracy specifications of each instrument, selection of channels for spectrometric observations, corrections for gaseous absorption, etc. Validation of aerosol and surface properties retrievals from each sensor have shown encouraging performance, highlighting the strong potential of PACE/GRASP products for accurate aerosol and surface characterization.

Building on these results, we implemented a synergistic retrieval combining all 3 sensors to maximize information content and improve the retrieval coverage and accuracy. HARP2 provides up to 60 viewing angles at 4 wavelengths with two-day global coverage, its high information content is crucial for determining aerosol particle size and shape; SPEXone provides continuous spectral measurements from 385 to 770 nm, which are particularly valuable for constraining aerosol absorption; OCI provides wide global coverage and broad spectral coverage from 340 to 890 nm continuously with discrete bands in the near-infrared. Synergy strategies were developed accounting for differences in information content and calibration accuracy among the instruments and weighting the measurements accordingly. Overall, the results demonstrate that combining measurements from all three PACE instruments significantly improves the retrieval of aerosol properties and surface BRDF compared to single-instrument approach.

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