The PolCube CubeSat polarimeter for Earth Science

Snorre Stamnes[a,*], Yongxiang Hu[a], Bongkon Moon[b], Young-Jun Choi[b], Vianni Ricano Cadenas[a], Marilee Roell[a], Charles Hill[a], Michael Jones[a], Eduard Chemyakin[a,c], Adam Bell[a,c], Jacek Chowdhary[d,e], Brian Cairns[d]

[a]*NASA Langley Research Center, Hampton, VA, USA*
[b]*Korea Astronomy and Space Science Institute (KASI), Daejeon, South Korea*
[c]*Coherent Applications, Inc., Hampton, Virginia 23666, USA*
[d]*NASA Goddard Institute for Space Studies, New York, NY, USA*
[e]*Department of Applied Physics and Applied Mathematics, Columbia University,
2880 Broadway, New York, NY, USA*

[*]*Presenting author (snorre.a.stamnes@nasa.gov)*

PolCube is a 12U CubeSat + polarimeter instrument designed by NASA Langley and the Korea Astronomy and Space Science Institute (KASI) for Earth Science [1]. PolCube is based on the PolCam polarimeter onboard the Korean Pathfinder Lunar Observatory (KPLO) that launched in August 2022 [2]. The objective of the PolCube instrument is to retrieve detailed fine-mode (pollution and smoke) and coarse-mode (sea-salt and dust) aerosol properties over the ocean for a range of light to heavy aerosol loadings using its polarimetric-imaging capability at multiple angles and wavelengths from 410-865 nm. An additional objective is to discriminate aerosols from thin clouds. We quantify the performance of aerosol and ocean remote sensing products from the PolCube polarimeter instrument using the Microphysical Aerosol Properties from Polarimetry (MAPP) remote sensing retrieval algorithm [3,4]. PolCube's accurate and high-resolution aerosol-retrieval products will provide unique spatial and temporal coverage of the Earth that can be used synergistically with other instruments, such as the PACE (Plankton, Aerosols, Clouds and Ecosystems) and GEMS (Geostationary Environmental Monitoring Spectrometer) mission to improve air-quality forecasting. We present the PolCube-MAPP retrieval algorithm, which uses coupled atmosphere-ocean vector radiative transfer, optimal estimation, artificial intelligence, and powerful inherent optical property look-up-tables for the Earth's aerosol, cloud, and hydrosol particles. We estimate that PolCube can retrieve total aerosol optical depth at 555 nm (AOD555) within ±0.068, fine-mode AOD555 within ±0.078, and fine-

mode single-scattering albedo within ±0.036, where all uncertainties are expressed as one standard deviation (1σ).

References

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