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THE HYPERANGULAR RAINBOW POLARIMETER (HARP) CUBESAT DEMONSTRATION OVERVIEW: DATA ACCURACY, AVAILABILITY, AND LESSONS LEARNED FOR SMALL PAYLOAD REMOTE SENSING CAMERAS AND PACE/HARP2

Abstract

The HyperAngular Rainbow Polarimeter CubeSat is a polarized remote sensing camera launched in late 2019, where it entered orbit from the ISS in early 2020 and has continued to operate through to early 2022. HARP as a technical demonstration has double its expected lifetime and produced valuable bonus scientific data in the form of wide-swath images of the Earth's surface in up to 60 viewing angles (113 degrees along-track, 94 degrees cross-track), four wavelengths (440, 550, 670, and 870 nm with 10 nm bandwidth), and the first three Stokes parameters (I, Q, U, and degree of linear polarization). From this information HARP can provide useful climatological information such as the size, shape and distribution of aerosol and cloud particles around the globe; aerosols being one of the major uncertainties in climate change, as are their interactions with cloud droplets. HARP precedes the HARP2 instrument planned for the NASA PACE mission, which will be one of the first polarimeters to get full, global, polarimetric coverage of the Earth in over a decade. HARP's initial calibration was that of a technical demonstration, but rigorous analysis of data post-launch has now been completed which will allow that data to be used in atmospheric science. Here I report on the state of that data, the polarimetric and spectral accuracy, the georeferencing uncertainty, and the availability of data. Throughout its lifetime, HARP has produced over fifty fine-pointing ground captures which scientists can use to retrieval aerosol, cloud, and surface properties. Here we show several case studies from that dataset to demonstrate the available information within the HARP products, as well as explain how eager scientists can access HARP data to use themselves. This paper will also serve as a post-mortem on the HARP demonstration, identifying key difficulties which could have improved the amount of data collection and/or the accuracy of that data. The information taken from HARP will be especially relevant for future distributed systems of small remote sensing platforms, and small payload cameras that are necessary in the future NASA mission plans. The HARP data products are supported now by the NASA FINESST fellowship award.