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Linking CALIOP and Historical Solar Occultation Data Records to Investigate Long-Term PSC Variability

Michael Pitts (1), Ryan Gonzalez (), and Lamont Poole ()

(1) NASA Langley Research Center, Science Directorate, Hampton, United States (michael.c.pitts@nasa.gov), (2) Universities Space Research Association, NASA Interns Scholars and Fellowships, Hampton, VA USA, (3) Science Systems and Applications, Incorporated, Hampton, VA, USA

Data from spaceborne solar occultation instruments such as Stratospheric Aerosol Measurement (SAM) II (1978-1993) and Polar Ozone and Aerosol Measurement (POAM) II/III (1996-2006) provided important baseline information on polar stratospheric clouds (PSCs) such as their link to very cold stratospheric temperatures and their spatial distribution and seasonal variability in both polar regions. More recently, the PSC observational database has been greatly expanded by the more than 11-year record of measurements by the CALIOP (Cloud-Aerosol Lidar with Orthogonal Polarization) instrument on the CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) satellite. In this study, we investigate the long-term (multi-decadal) variability of PSC occurrence by linking the CALIOP record with the solar occultation PSC record from SAM II (spanning the years 1978-1989; Poole and Pitts, 1994) and the unified database from Fromm et al. (2003), which extended the SAM II record using solar occultation data from the SAGE II (Stratospheric Aerosol and Gas Experiment II) and POAM II/III instruments. To facilitate these comparisons, we have (1) subsampled the CALIOP data to match the solar occultation sampling pattern where measurement latitude varies slowly over the season; (2) degraded the resolution of the CALIOP PSC products to mimic that of solar occultation data, typically 0.5-1.0 km in the vertical and several hundred kilometers in the horizontal; and (3) developed techniques for using the CALIOP backscatter signals at 532-nm wavelength to calculate equivalent extinction coefficients at/near 1-μm wavelength that would be measured by the solar occultation devices. We then examine this combined record to quantify multi-decadal variability/trends in PSC occurrence.