Volcanic Signatures in a Global Stratospheric Aerosol Climatology Produced from SAGE II and CLAES.

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A global climatology of the stratospheric aerosol has been produced using data from the Stratospheric Aerosol and Gas Experiment (SAGE II) and the Cryogenic Limb Array Etalon Spectrometer (CLAES) instruments. The climatology spans nearly 15 years, from December 1984 to August 1999, and encompasses the El Chich≤n recovery period, a period of several small volcanic eruptions, a two to three year low aerosol loading period beginning in 1989, the June 1991 eruption of Mt. Pinatubo, three to four years of post-Pinatubo aerosol dissipation, and approximately 3 years of record low aerosol mass loading from 1996 to 1999. The climatology includes values and uncertainties of measured extinction and optical depth at four SAGE II wavelengths (0.385, 0.453, 0.525 and 1.02 ¬m); and for the period January 1992 through May 1993, at the CLAES wavelength 12.82 ¬m. Also included are retrieved particle effective radius (Reff), distribution width (Sg), surface area (S) and volume (V). As a basis for aerosol retrievals, a multi-wavelength Look-Up-Table algorithm was developed that matches a combination of SAGE II and CLAES extinction ratios to pre-computed ratios that are based on a range of unimodal lognormal size distributions. The aerosol climatology reveals that there is no indication of an Reff peak above the tropical tropopause in the absence of volcanic aerosol. This suggests that particles comprising the stratospheric Junge layer decrease monotonically in size with altitude during periods not affected by volcanic eruptions. Aerosol retrievals show notable increases after most major volcanic eruptions, with increases in Reff lagging increases in other parameters. Post-volcanic increases in Sg, indicative of broader size distributions, are consistent with sudden increases in both small and large particle sizes. After Pinatubo, retrieved Reff and Sg took nearly 5 years to return to pre-eruption values, while slightly shorter recovery times are obtained for S and V. During low aerosol loading periods, e.g.,1998 and 1999, size distributions narrow in going from the tropical core to higher latitudes at altitudes between approximately 20 and 22 km. This is consistent with tropical aerosols being "younger" than high latitude aerosols. Seasonal variations in S and V are observed at high latitudes (with high values occurring in winter), but are less obvious in Reff. Latitudinal banding is often noted in retrievals in a layer just above the tropopause, with high values occurring in the tropics and at high latitudes. The overall uncertainty in retrievals is approximately ±20% for S and V, with slightly smaller values for Reff. Results were compared to several previously developed stratospheric aerosols climatologies, and with few exceptions, agree well with these climatologies. However, one noteworthy discrepancies is that the Thomason et al. values of S are less than LUT retrievals during

near-background periods (e.g., 1989 to mid-1991, and after 1996), and greater than LUT retrievals in the peak of the Pinatubo plume. In the peak of the plume near 20 km, Thomason's estimates are also two standard deviations above maximum S estimates by Lambert et al. based on CLAES/ISAMS data and by Optical Particle Counter estimates.