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Recent changes in stratospheric aerosol budget from ground-based and satellite observations

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Stratospheric aerosol budget plays an important role in climate variability and ozone chemistry. Observations of stratospheric aerosol by ground-based lidars represent a particular value as they ensure the continuity and coherence of stratospheric aerosol record. Ground-based lidars remain indispensable for complementing and validating satellite instruments and for filling gaps between satellite missions. On the other hand, geophysical interpretation of local observations is complicated without the knowledge of global distribution of stratospheric aerosol, which calls for a combined analysis of ground-based and space-borne observations.

The present study aims at characterizing global and regional variability of stratospheric aerosol over the last 5 years using various sets of observations. We use the data provided by three lidars operated within NDACC (Network for Detection of Atmospheric Composition Change) at Haute-Provence, (44° N), Mauna Loa (21° N) and Maido (21° S) sites together with quasi-global-coverage aerosol measurements by CALIOP and OMPS satellite instruments. The local and space-borne measurements are shown to be in good agreement allowing for their synergetic use.

Since the late 2012 stratospheric aerosol remained at background levels throughout the globe. Eruptions of Kelud volcano at 4° S in February 2014 and Calbuco volcano at 41° S in April 2015 resulted in a remarkable enhancement of stratospheric AOD at a wide latitude range. We explore meridional dispersion and lifetime of volcanic plumes in consideration of global atmospheric circulation. A focus is made on the poleward transport of volcanic aerosol and its detection at the mid-latitude Haute-Provence observatory. We show that the moderate eruptions in the Southern hemisphere leave a measurable imprint on the Northern mid-latitude aerosol loading.

Having identified the volcanically-perturbed periods from local and global observations we examine the evolution of non-volcanic (background) aerosol by comparing the recent observations with historical data available from 23-yr observations at Haute-Provence and Mauna-Loa.