Geophysical Research Abstracts
Vol. 20, EGU2018-6918, 2018
EGU General Assembly 2018


# Spatiotemporal evolution of stratospheric smoke plume during late Summer 2017 from CALIPSO and Haute-Provence lidar observations

Sergey Khaykin, Sophie Godin-Beekmann, Alain Hauchecorne, Jacques Pelon, Francois Ravetta, and Philippe Keckhut

UVSQ, CNRS, LATMOS, Guyancourt, France (sergey.khaykin@latmos.ipsl.fr)

Extreme pyro-convection (PyroCb) events triggered by wildfires in northwest Canada and U.S. during Summer 2017 resulted in vast injection of combustion products into the stratosphere. The stratospheric smoke plume was observed by 532 nm and 355 nm lidars at Observatoire de Haute-Provence (OHP) in southern France during many weeks that followed PyroCb events as distinct aerosol layers at altitudes between 14 and 19.5 km. The aerosol backscatter and optical depth of the smoke layers were reaching unprecedentedly high values for a non-volcanic aerosol layer in the three-decade OHP lidar observation record.

We use space-borne CALIPSO lidar (CALIOP) and OMPS UV aerosol index (AI) observations together with trajectory analysis to track the spatiotemporal evolution of the smoke plume in the stratosphere during the first 3 weeks after the major PyroCb events around the lake Athabasca in northwest Canada. While the major stratospheric smoke plume was caused by Athabasca fires in mid-August, other clusters of forest fires in North America have also contributed to polluting the stratosphere. In particular, backward trajectories suggest that stratospheric smoke layer seen above OHP in early September likely originate from PyroCb clusters in northern California and Oregon that occurred in late August.

Vertically-resolved CALIOP observations put in evidence that in 19 days the stratospheric smoke plume has ascended from 340 K ($\sim$12 km) to a maximum of 560 K ($\sim$22 km), presumably due to radiative heating of highly-absorptive smoke particles. We note that the primary optically-thick patches of smoke have ascended diabatically with a rate of up to 30 K/day. With that, thinner plumes, mostly remaining at lower levels, have been subjected to fast zonal transport within the jet stream and circled the globe in about two weeks.

A remarkable agreement between OHP lidar and CALIOP sampling the same air mass on a particular date allowed us to extrapolate OHP observations to a regional scale, where CALIOP reported extreme AOD values as high as 0.21, which is comparable to the peak values recorded at OHP after the eruption of El Chichon and Pinatubo volcanoes. On a monthly time scale, local and global lidar observations indicate that boreal summer 2017 forest fires had a hemisphere-scale impact on stratospheric aerosol load, similar to that of moderate volcanic eruptions such as Sarychev and Nabro. This event, emphasizing the significance of biomass burning as a source of stratospheric aerosol, provides a perfect opportunity for re-evaluating the potential of wildfires to pollute the stratosphere.