Geophysical Research Abstracts
Vol. 21, EGU2019-18791-1, 2019
EGU General Assembly 2019

Strong impact of wildfires on the abundance and aging of black carbon in the lowermost stratosphere

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Wildfires inject large amounts of black carbon (BC) particles into the atmosphere, which can reach the lowermost stratosphere (LMS) and cause strong radiative forcing. During a 14-month period of observations on board a passenger aircraft flying between Europe and North America, we found frequent and widespread biomass burning (BB) plumes, influencing 16 of 160 flight hours in the LMS. The average BC mass concentrations in these plumes ($\sim$140 ng·m−3, standard temperature and pressure) were over 20 times higher than the background concentration ($\sim$6 ng·m−3) with more than 100-fold enhanced peak values (up to $\sim$720 ng·m−3). In the LMS, nearly all BC particles were covered with a thick coating. The average mass equivalent diameter of the BC particle cores was $\sim$120 nm with a mean coating thickness of $\sim$150 nm in the BB plume and $\sim$90 nm with a coating of $\sim$125 nm in the background. In a BB plume that was encountered twice, we also found a high diameter growth rate of $\sim$1 nm·h^{-1} due to the BC particle coatings. The observed high concentrations and thick coatings of BC particles demonstrate that wildfires can induce strong local heating in the LMS and may have a significant influence on the regional radiative forcing of climate.

Reference:
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