Exploring the effects of extreme wildfires using satellite and ground-based lidars

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Résumé : Wildfire-driven pyro-convection (PyroCb) is capable of lofting combustion products into the stratosphere, polluting it with smoke aerosols at hemispheric and yearly scales. This realization has emerged after the record-breaking British Columbia PyroCb event in August 2017 that approached moderate volcanic eruptions in terms of stratospheric aerosol load perturbation. The Australian “Black Summer” bushfires in 2019/20 have surpassed the previous record by a factor of 3 and rivaled the strongest volcanic eruptions in the XXI century. Here we exploit a synergy of satellite and ground-based lidar observations, ECMWF meteorological analysis and radiative transfer modeling to quantify the perturbation of stratospheric particulate and gaseous composition, dynamical circulation and radiative balance caused by the Australian New Year’s PyroCb outbreak. One of the most striking repercussions of this event was the generation of several persistent anticyclonic vortices that provided confinement to the PyroCb plumes and preserved them from rapid dilution in the environment, whilst lofting the smoke to 35 km altitude. The startling consequences of the Australian event provide new insights into climate-altering potential of the wildfires, that have increased in frequency and strength over the recent years.