Cite abstract as Author(s) (2017), Title, European Aerosol Conference 2017, Zurich, Abstract T304N4b4

A miniature particle counter (LOAC) under meteorological balloons for the study of the temporal and spatial variability of stratospheric aerosols

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Keywords: Aerosol counter, Stratosphere, Balloon
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The study of the stratospheric aerosols is important for our understanding of the terrestrial radiative budget. Stratospheric aerosols play also an important role on the spatial and temporal distribution of the gas species in atmosphere through heterogeneous processes. In order to characterise the local variations of the stratospheric aerosol content, we have performed one hundred meteorological balloon profiles (Vignelles et al. 2016) carrying a new miniature aerosol counter called LOAC (Light Optical Aerosol Counter). This strategy has allowed us to produce a dataset of aerosol profiles up to 30 km over France with a frequency of 2 profiles per month over 3 years.

The LOAC particle counter has been designed for balloon-borne tropospheric studies (Renard et al. 2016). Its metrological performance in stratosphere has been characterised regarding the dependence on atmospheric pressure, inner temperature, cosmic rays and low concentration of particles. Tests in laboratories and on-board have shown that the principal limitation of the utilisation of LOAC in stratosphere is introduced by the temperature variations and by the influence of cosmic rays. A detection threshold has been determined in the laboratory to be of 1 particule.cm^{-3} in term of concentration which also limits the use of LOAC in the stratosphere where aerosol concentrations during volcanic quiescent periods may be lower than this limit.

Inter-comparisons between two LOAC under meteorological balloons and between a LOAC and another aerosol counter have revealed good performances and have allowed us to discuss the LOAC limitations in term of measurement reproducibility. Also these results have raised questions about the current hypothesis used by other teams concerning stratospheric aerosol properties.

At last, we have compared our LOAC dataset with three satellite records (OSIRIS, CALIOP and OMPS), a ground-based lidar (lidar OHP) and a model output (WACCM) over France. Comparative results have revealed good agreement between the various datasets up to 25 km (Figure 2 – Vignelles 2016). Above 25 km, data differ significantly.

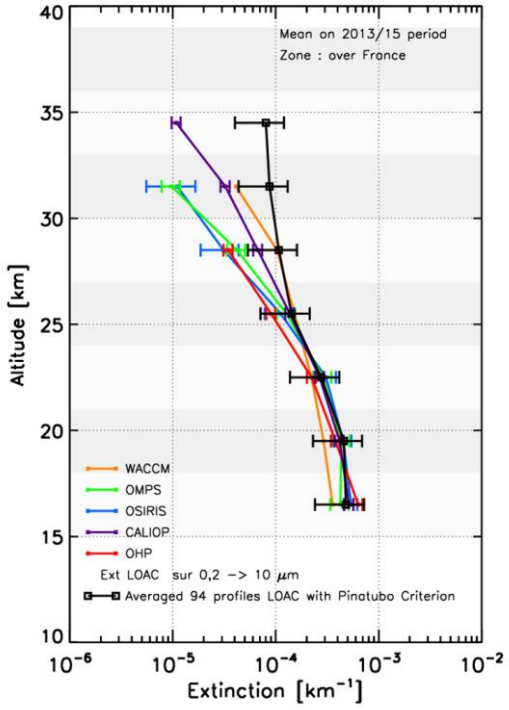

Figure 2. Comparative satellites, model, ground lidar and LOAC extinctions averaged over 3 km bands over France for the 2013-2016 period.

References:
Renard et al. (2016) *LOAC: a small aerosol optical sounter/sizer for ground-based and balloon measurements* AMT. 9, 1721-1742. doi:10.5194/amt-9-1724-2016
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