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A multi-model assessment of atmospheric composition in the UTLS with the IAGOS database, in the frame of the ACACIA EU project

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A wide variety of observation data sets are used to assess long-term simulations provided by chemistry-climate models (CCMs) and chemistry-transport models (CTMs). However, the upper troposphere – lower stratosphere (UTLS) is hardly assessed in the models because of uncertainties in remote measurements, a limited area for balloon-borne observations and a limited period for aircraft campaigns. Observations performed in the framework of the IAGOS program (In-service Aircraft for a Global Observing System) combine the advantages of *in situ* measurements in the UTLS with an almost global-scale area, a ~20-year monitoring period and a high sampling frequency. Few model assessments have been made using the IAGOS database, and none of them involved the whole cruise data set.

Cohen et al. (2021, GMD) proposed a method to project all the IAGOS data onto a model monthly grid, in order to make them ready for assessing global climatologies and seasonal cycles above several well-sampled regions in the North Hemisphere. This work has been extended to a daily resolution for an accurate separation between the upper troposphere and the lower stratosphere, and to other chemical species. In this study, we apply this method to a set of simulations generated by the following CTMs or CCMs: Oslo-CTM3, MOZART3, EMAC, UKESM, and LMDZ-OR-INCA, all involved into the ACACIA European Union program (Advancing the Science for Aviation and Climate) that focuses on the climate impact of the subsonic aviation emissions. The runs are generated following a common protocol, notably regarding the boundary conditions (e.g. emission inventories) and the chemical configurations, the latter including gaseous tropospheric and stratospheric chemistry, and heterogeneous chemistry. The multi-model assessment concerns the 1994 – 2017 period, and focuses on ozone, carbon monoxide, water vapour and reactive nitrogen (NO_y) fields.