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A numerical study of the impact of emissions from different modes of transport (land based, aircraft, ships) on tropospheric chemistry.

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The climate chemistry model, LMDz-INCA, is used to assess the impact of emissions from different modes of transport (land based, aircraft and ships) on concentrations of climatically important species, and estimate the associated uncertainty.

In this study, the INCA model considers a detailed tropospheric chemistry with a comprehensive representation of the photochemistry of non-methane hydrocarbons and volatile organic compounds from biogenic, anthropogenic, and biomass-burning sources. The chemical mechanism includes 89 chemical species and up to 340 reactions.

Several simulations are performed in the frame of this study: a reference one with all transport emissions, three others respectively without road transport emissions, ship emissions, and aircraft emissions, and the last one without all traffic emissions. Simulations are performed over two years (2002 and 2003) with the following resolution: 3.75˚x2.5˚ and 19 levels from ground to 3 hPa. The background emissions are based on EDGAR 3.2 Fast Track 2000 using effective emission heights for biomass burning. The road traffic and ship emissions are issued from new databases recently developed in the European QUANTIFY project. The emissions from AERO2K are used for aviation.

The results show that the impact of subsonic aviation on ozone is primarily at latitudes higher than 20˚N in the Northern Hemisphere upper troposphere. The aircraft-induced O_3 increase reaches maximum values around 2 - 2.3 ppbv (2.75 – 3.25 %) at subsonic

cruise levels, during the year 2003. This impact is finally relatively small, as at these subsonic cruise altitudes, the road traffic emissions have quantitatively a similar effect on O_3. These last emissions have a maximum impact in the Northern Hemisphere middle troposphere and in the tropical upper troposphere, with maximum relative values around 4 - 4.5 %. The ship emissions lead to maximum O_3 increases of 7 – 10 % mainly in the planetary boundary layer.