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The impact of subsonic aircraft emission on upper troposphere/lower stratosphere composition and radiative forcing: An update

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Emissions from subsonic aircraft can have potential impact on radiatively-important gas phase and particulate components and their precursors in the upper troposphere/lower stratosphere. These include CO2,O3, CH4, water, sulfate and soot aerosols, contrails and cirrus clouds. In particular, emissions of NOx induce production of O3 (positive radiative forcing), and increases in OH which lead to decreases in CH4 (negative radiative forcing). A thorough assessment of these and other effects was carried out by IPCC in 1999, and other subsequent efforts (e.g., QUANTIFY). Several participating models have not included a complete treatment of both tropospheric and stratospheric chemistry and dynamics. We present calculations carried out by the Global Modeling Initiative Chemical Transport model, which includes complete chemistry and dynamics from the ground up to about 70 km. We adopt the same 1992 aircraft and boundary conditions as in IPCC (1999), in order to determine the impact of improved models on the early results. To estimate the effect of dynamic variability, we force the CTM with meteorological fields obtained from the Goddard/Geos Coupled Chemistry-Climate Model, for extreme El Niño and La Niña conditions. In addition, we present results for 2006 aircraft emission conditions and estimated emissions in 2050, provided by FAA and DOT/Volpe Center. Results for the impact on UT/LS ozone and methane, as well as radiative forcing for these species, are also discussed.