Annales Geophysicae

ISSN: 0992-7689 (printed version)
ISSN: 1432-0576 (electronic version)

Abstract Volume 12 Issue 10/11 (1994) pp 944-955

Chemical composition and photochemical reactivity of exhaust from aircraft turbine engines

C. W. Spicer (1), M. W. Holdren (1), R. M. Riggin (2), T. F. Lyon (3)

(1) Battelle, 505 King Avenue, Columbus, Ohio 43201 USA
(2) Eli Lilly and Company, Lilly Research Center, Indianapolis, Indiana 46285 USA
(3) General Electric Company, Evendale, Ohio 45215 USA

Received: 4 October 1993/Revised: 18 April 1994/Accepted: 25 May 1994

Abstract. Assessment of the environmental impact of aircraft emissions is required by planners and policy makers. Seveal areas of concern are: 1. exposure of airport workers and urban residents to toxic chemicals emitted when the engines operate at low power (idle and taxi) on the ground; 2. contributions to urban photochemical air pollution of aircraft volatile organic and nitrogen oxides emissions from operations around airports; and 3. emissions of nitrogen oxides and particles during high-altitude operation. The environmental impact of chemicals emitted from jet aircraft turbine engines has not been firmly established due to lack of data regarding emission rates and identities of the compounds emitted. This paper describes an experimental study of two different aircraft turbine engines designed to determine detailed organic emissions, as well as emissions of inorganic gases. Emissions were measured at several engine power settings. Measurements were made of detailed organic composition from C_1 through C_{17}, CO, CO_2, NO, NO_x, and polycyclic aromatic hydrocarbons. Measurements were made using a multi-port sampling pro be positioned directly behind the engine in the exhaust exit plane. The emission measurements have been used to determine the organic distribution by carbon number and the distribution by compound class at each engine power level. The sum of the organic species was compared with an independent measurement of total organic carbon to assess the carbon mass balance. A portion of the exhaust was captured and irradiated in outdoor smog chambers to assess the photochemical reactivity of the emissions with respect to ozone formation. The reactivity of emissions from the two engines was apportioned by chemical compound class.