ON THE ORIGIN OF THE OZONE SUMMER MAXIMUM IN THE UPPER TROPOSPHERE OVER THE NORTH ATLANTIC

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The budget of ozone in the upper troposphere (UT) is uncertain. Ozone in this region can be produced by photochemical processes, involving carbon monoxide, methane, long-lived organic compounds and oxides of nitrogen. Also downward transport from the stratosphere and upward transport through convection of ozone or its photochemical precursors from the lower troposphere, ultimately from the planetary boundary layer, contribute to the budget of ozone in the UT.

Since August 1994, MOZAIC (Measurement of Ozone and Water Vapor by Airbus In Service Aircraft) provides a comprehensive set of daily measurements of the large-scale distributions of ozone at the cruise altitude of commercial jet aircraft between 9 and 12 km. A more than 8 year record of UT ozone observations over North America, Atlantic ocean and Europe between 30°N and 60°N, obtained from more than 8000 individual intercontinental MOZAIC-flights, reveals a very pronounced seasonal cycle with winter minimum and summer maximum. This seasonal cycle is in phase with the cycle observed in the lower troposphere. No significant latitudinal or longitudinal gradients of ozone have been observed.

Employing a simple heuristic Lagrangian model we will discuss the UT ozone budget in the northern mid-latitude belt. From our data analysis we conclude that the summer maximum of UT ozone concentration is not of stratospheric origin but most likely caused by photochemical production. We will focus the discussion on the question in how far the origin of the UT ozone summer maximum is located in the upper troposphere or in the lower troposphere over the continents in conjunction with rapid convective transport to the UT, followed by large scale horizontal transport in the...
prevailing westerly wind direction.