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NASA Studies High Springtime Ozone Levels Over Canada and the Arctic

The high springtime ozone levels in the lower atmosphere at high northern latitudes, such as over Canada and the Arctic, are caused by the long-range transport of air pollution and not by natural processes in the atmosphere.

A NASA Langley Research Center scientist and his co-investigators from NASA Langley, the National Center for Atmospheric Research (NCAR), and several universities will present this result at the American Geophysical Union (AGU) spring meeting in Boston, May 29 to June 2. The finding stems from a NASA Langley-led investigation that was one of many studies in the Tropospheric Ozone Production about the Spring Equinox (TOPSE) field experiment funded by the National Science Foundation and led by NCAR. Results will be presented for the first time from TOPSE at the AGU Spring meeting.

Background levels of ozone exist in the lower atmosphere at all times, but a peak occurs during the springtime at high northern latitudes. The timing of the peak is unusual because other areas, such as over most of the United States, experience their highest seasonal ozone levels during the summer.

“Springtime ozone levels in the high northern latitudes have been increasing with time, and we wanted to understand if this was a natural process or not,” said Edward Browell, head of the Lidar Applications Group at NASA Langley and lead-author of this investigation. Scientists have known for many years from ground-based and balloon measurements that ozone amounts were higher in the high latitudes of the Northern Hemisphere during the spring than in other seasons.

Scientists determined that these higher springtime ozone amounts could not be explained by an increase in the natural transport process called stratosphere-troposphere exchange. This process mixes ozone-rich air into the troposphere (the atmosphere from the surface to 8-10 kilometers at high latitudes) from the stratosphere (the atmospheric layer above the troposphere).

From field experiments, researchers found that long-range transport moved air pollution into remote Arctic areas during the winter and into the spring. In the springtime, processes convert some of the

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air pollution into ozone in the troposphere. Ozone is produced by photochemical processes that begin when sunlight comes into contact with chemically active molecules like those found in the air pollution. Scientists concluded the transported pollution was responsible for causing the production of the highest seasonal ozone levels over Canada and the Arctic.

“It’s important to study these remote regions to better assess the relative impact of human activities versus natural processes. If we separate those processes, we see the effects of human activities all over these areas,” Browell added.

From February to May 2000, researchers made seven flights to high latitudes from Broomfield, Colorado with bases in Churchill, Canada and Thule, Greenland. They took remote lidar measurements of ozone and aerosols above and below the aircraft and integrated them with meteorological analyses, chemical model results, and in situ measurements to arrive at their conclusions.

Browell will present the results of this TOPSE investigation on Tuesday, May 29, in the Convention Center, Room 311, Session A22B at 2:30 p.m.

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