Asian air emissions increases ozone over western North America

Increases in tropospheric ozone levels above western North America during springtime are due to eastward air flows across the Pacific Ocean, with the largest increases associated with air that comes from south and east Asia, according to a recent study.

In the troposphere, the lowest layer of the atmosphere, high levels of ozone are considered to negatively affect human health and crop production. Ozone at this level in the atmosphere is produced mainly by reaction of nitrogen oxides ($\text{NO}_x$) and volatile organic compounds in the presence of sunlight. These ozone precursors primarily come from manmade sources, such as from the combustion of fossil fuels.

Satellite measurements suggest $\text{NO}_x$ emissions have increased in China and in other parts of Asia during 1996-2005, whereas emissions have decreased in Europe and North America. Atmospheric pollutants can affect regions far from where they were produced through long-range transport in the atmosphere: much of springtime pollution from east Asia travels eastwards across the Pacific Ocean towards western North America.

An international team of researchers analysed data on ozone measurements collected in previous studies, including the MOZAIC project\(^1\), funded by the EU. They focused on springtime ozone levels over western North America because winds transporting pollutants from Asia across the Pacific Ocean are strongest at that time of the year, making it easier to detect any trends in ozone levels.

Using ozone observations from research balloons and instruments on aircraft the study primarily focused on the mid-troposphere, the layer of atmosphere 3 to 8 kilometres above the earth’s surface. For each measurement, a model was used to trace the emission pathway back in time to the region from which it originated.

Springtime ozone values above western North America were found to have increased by 14 per cent during 1995-2008, and evidence suggests a similar rate of increase has occurred since 1984. Due to the general east-west flow of the atmosphere the ozone values above this region are associated with the transport of air from regions to the west of North America. The study determined that, as average ozone values increased, the origin of the transported air moved even further to the west with the largest increases in ozone values associated with dominant airflows from south and east Asia. This study could not measure the relative contributions to ozone increases from China, India and south-east Asia because air flows from India and southeast Asia cross China en route to North America.

Although North American emissions contribute to global ozone levels that circulate in the atmosphere, the researchers did not find any evidence that local emissions were responsible for the increase in ozone levels.

Previous work suggests that polluted air in the mid-troposphere, arriving in western North America can descend and affect surface ozone formation. Therefore, despite decreasing levels of domestic ozone precursor emissions since 1985, ozone transported from Asia could make it more difficult for the United States to meet the ozone air quality standard mandated by the Clean Air Act\(^2\).

1. The MOZAIC project was supported by the European Commission, initially under the Third Framework Programme (FP3) and continued under FP4, FP5 and FP6. See: http://mozaic.aero.obs-mip.fr/web/
2. See: http://www.epa.gov/air/caa/


Contact: owen.r.cooper@noaa.gov

Theme(s): Air pollution