

# Organic bromine compounds—another threat to the ozone layer

November 3 2015, by Christopher Packham

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The ozone layer of the lower stratosphere is an extremely diffuse abundance of O<sub>3</sub> that absorbs up to 99 percent of incoming ultraviolet solar radiation, thereby creating the conditions that make known life possible. In the 1970s and 1980s, as scientists reported the dramatic thinning of stratospheric ozone, a regulatory push by governments around the world led to a reduction in the use of chlorofluorocarbons by industry. Nonetheless, other compounds released into the atmosphere have the effect of depleting ozone, though the dynamics are still the subject of study.

Until recently, scientists believed that only long-lived compounds like halons, chlorofluorocarbons or bromomethane contributed to global ozone depletion. Inconsistencies in stratospheric observations led researchers to look for another contributor, very short-lived brominated substances (VSL<sub>org</sub>). These are generated by ocean biogenic sources with cyclic variabilities that are not well understood. However, activity that increases the production of VSL<sub>org</sub> will also tend to accelerate the depletion of atmospheric ozone.

Now, a cross-disciplinary collaborative of chemists and atmospheric researchers has reported in the *Proceedings of the National Academy of Sciences* on their analysis of data collected by NASA's Airborne Tropical Tropopause Experiment (ATTREX) over the tropical Pacific region during 2013 and 2014. The experiment included measurements of organic bromine substances conducted with the Global Hawk Whole Air Sampler (GWAS). The researchers combined the aircraft observations

with a chemistry-climate model in an attempt to quantify the total bromine load in the atmosphere.

One surprising finding was the similarity of the amounts of bromine between the Eastern and Western Pacific Ocean, despite their different vertical transport mechanisms into the atmosphere. The study found ~6 parts per thousand to the stratospheric input at the tropical tropopause, the boundary between the troposphere and the stratosphere. The differences between the two regions were considered to be scientifically negligible.

The authors write, "Based on the CAM-chem simulation results, the overall contribution of VSL substances to total stratospheric bromine, quantified at ~17 km, show 5.81 ppt over the Western Pacific and 6.20 ppt over the Eastern Pacific. These results point out that although the production of Br<sub>y</sub> seems to be slightly different between the Eastern and Western Pacific, the overall contribution of very short-lived substances to stratospheric bromine is similar in both regions."

They note that uncertainties remain in the characterization of the overall contribution of VSL substances to total stratospheric bromine because all of the results described by the study are derived from model calculations. However, comparing the results of the NASA sampling activities in 2013 and 2014 to other studies conducted in 1996 and 2006 reveals a global decline in the level of atmospheric methyl bromide; over the same period, halons increased, reaching a maximum between 2004 and 2008, with an ensuing slow decline. The researchers do not believe that this is a long-term trend, though, because patterns of variability have not been established for such compounds in the atmosphere.

**More information:** Maria A. Navarro et al, Airborne measurements of organic bromine compounds in the Pacific tropical tropopause layer, *Proceedings of the National Academy of Sciences* (2015). [DOI:](#)

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