

Has lower atmosphere ozone stopped increasing?

A recently published paper, “Recent Tropospheric Ozone Changes – A Pattern Dominated by Slow or No Growth”, published in *Atmospheric Environment* (Oltmans et al. 2012) indicates that after a long period of increasing ozone in the lower atmosphere (surface to 10 kilometers – surface to 30,000 feet) background ozone has stabilized, or in some cases begun to decrease. In the region of the atmosphere that includes the layer near Earth’s surface, there has been a doubling of ozone concentrations since the beginning of the industrial revolution in the mid latitudes of the Northern Hemisphere (N.H.) associated with human emitted chemicals that react to produce ozone. A relatively comprehensive global set of measurements that includes both measurements at the surface, as well as profiles through the lower atmosphere, shows that in regions where ozone has increased for several decades, these increases have stopped. This change has been most noticeable over Western Europe and North America, where pollution controls of stationary (power plants) and mobile (automobiles) sources of ozone producing chemicals (ozone precursors) have been in place for approximately three decades. In some locations, the most recent 10-15 year period has shown small but significant declines. Because ozone in the lower atmosphere has a lifetime of only days to weeks, there is a large variation in the distribution and changes in ozone related to the proximity to ozone precursor sources and pathways that transport ozone or its precursors from one location to another. This work focuses on measurements that are generally representative of broader geographical regions to obtain a picture that provides an assessment of changes on regional and hemispheric scales. While a reasonable set of longer term measurements exist in the mid latitudes of North America and Europe, measurements are much sparser in the rapidly developing regions of Asia. An important constraint in determining the trajectory of changes in the N.H. is the limited data from the rapidly expanding economies of East Asia. While a few longer term measurements are available from locations in Japan that are often downwind of China, it is not clear to what extent these observations might be representative of the contribution from China to ozone over a broad region such as the North Pacific basin. The Japanese observations indicate a flattening of the trend, which is similar to the trends observed at other N.H. locations. Although emissions of ozone precursors in China, and probably ozone as well, have increased in the recent decade, there is also some indication that nitrogen oxide emissions (one of the important ozone precursors) may be leveling off. Whether this is due to an economic recession or a result of a stated goal to reduce these emissions is unclear at this point. These results, coupled with those reported earlier by Oltmans et al. (1998, 2006) and recently by Logan et al. (2012) suggest that on a hemispheric scale it is currently difficult to observe the projected increases in tropospheric ozone that models indicate may occur from growing Asian emissions.

In the Southern Hemisphere (S.H.), where there are many fewer observations than in the N.H., an approximately two-decade increase in lower atmosphere ozone in the mid latitudes also appears to have leveled off. In the S.H. the largest source of ozone precursors is likely associated with biomass burning rather than fossil fuel related emissions, which dominate in the N.H.

Although there is some suggestion that a shift in transport patterns that could redistribute ozone from one region to another has brought about the S.H. changes, it is unclear what the source of the increase or the current flattening of ozone levels is in the S.H.

Oltmans, S.J., A. S. Lefohn, D. Shadwick, J. M. Harris, H.E. Scheel, I. Galbally, D. W. Tarasick, B. J. Johnson, E.- G. Brunke, H. Claude, G. Zeng, S. Nichol, F. Schmidlin, J. Davies, E. Cuevas, A. Redondas, H. Naoe, T. Nakano, T. Kawasato (2012), Recent tropospheric ozone changes – a pattern dominated by slow or no growth, *Atmos. Environ.*, in press.