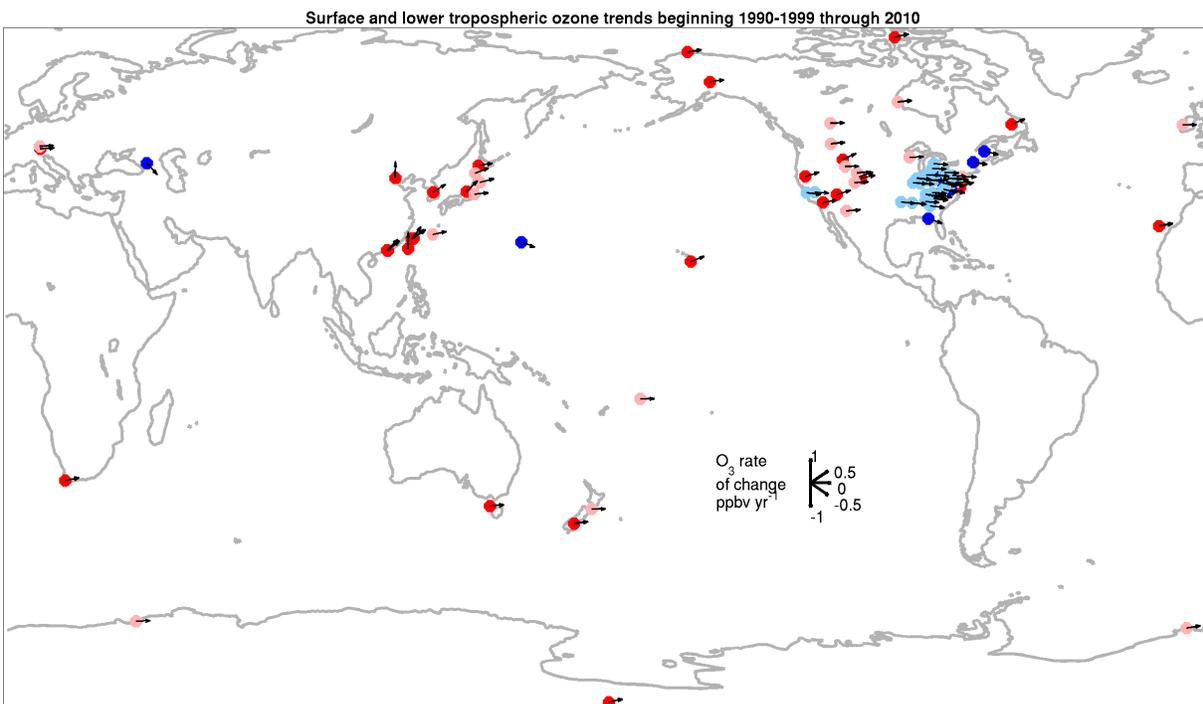


## Global Surface Ozone Trends, a Synthesis of Recently Published Findings

O.R. Cooper

Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309; 303-497-3599, E-mail: owen.r.cooper@noaa.gov

A comprehensive understanding of global surface ozone trends has eluded the scientific community due to limited long-term observations and relatively few ozone monitors in regionally representative rural or oceanic regions. Furthermore, satellite records of lower tropospheric ozone mixing ratios are presently too short to yield robust results. However, in recent years several studies have provided updates to ozone trends at long-established sites, or reported trends at many newer sites that now have lengthy records sufficient for trend analysis. This presentation provides a review of all the current ozone trend analyses in the peer-reviewed literature, focusing on rural rather than urban monitoring sites to facilitate understanding of ozone changes across broad regions. Trends at rural sites are also more easily compared to global chemistry-climate models. The earliest reliable ozone records began in the 1950s and 1970s with more and more sites becoming available in the 1980s and 1990s. The ozone rate of change has varied in magnitude and even sign over the decades with the strongest changes occurring in East Asia, eastern North America and western Europe where changes in domestic ozone precursor emissions have been greatest. I found that the best way to comprehend the confusing state of these temporally and spatially varying trends is to plot them with a vector-based method as shown in Figure 1. Ozone trend vector plots will be shown for ozone records covering the past 40, 30 and 20 years. The most recent ozone trends will be compared to global images of satellite-detected tropospheric column  $\text{NO}_2$  to identify regions where ozone trends are consistent, or inconsistent with observed ozone precursor changes and our general understanding of tropospheric chemistry.



**Figure 1.** Ozone trends at the surface or within the lower troposphere between 1990 and 2010, based on yearly average values. Vectors indicate the ozone rate of change at each site, ppbv yr<sup>-1</sup>, as shown in the legend. Most of the sites are in rural locations so that they are representative of regional air quality, however many of the Asian sites are urban. Red dots indicate sites with a statistically significant positive ozone rate of increase, while pink, light blue and dark blue dots indicate trends that are insignificant positive, insignificant negative and significant negative, respectively.