Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 9, 1303-1323, 2009
www.atmos-chem-phys.net/9/1303/2009/

Increasing ozone in marine boundary layer inflow at the west coasts of North America and Europe

D. D. Parrish[1], D. B. Millet[2], and A. H. Goldstein[3]
[1]NOAA Earth System Research Laboratory, Chemical Sciences Division, 325 Broadway R/CSD7, Boulder, CO 80305, USA
[2]Department of Soil, Water & Climate, University of Minnesota, St. Paul, MN, USA
[3]Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA, USA

Abstract. An effective method is presented for determining the ozone (O_3) mixing ratio in the onshore flow of marine air at the North American west coast. By combining the data available from all marine boundary layer (MBL) sites with simultaneous wind data, decadal temporal trends of MBL O_3 in all seasons are established with high precision. The average springtime temporal trend over the past two decades is 0.46 ppbv/yr with a 95% confidence limit of 0.13 ppbv/yr, and statistically significant trends are found for all seasons except autumn, which does have a significantly smaller trend than other seasons. The average trend in mean annual ozone is 0.34±0.09 ppbv/yr. These decadal trends at the North American west coast present a striking comparison and contrast with the trends reported for the European west coast at Mace Head, Ireland. The trends in the winter, spring and summer seasons compare well at the two locations, while the Mace Head trend is significantly greater in autumn. Even though the trends are similar, the absolute O_3 mixing ratios differ markedly, with the marine air arriving at Europe in all seasons containing 7±2 ppbv higher ozone than marine air arriving at North America. Further, the ozone mixing ratios at the North American west coast show no indication of stabilizing as has been reported for Mace Head. In a larger historical context the background boundary layer O_3 mixing ratios over the 130 years covered by available data have increased substantially (by a factor of two to three), and this increase continues at present, at least in the MBL of the Pacific coast region of North America. The reproduction of the increasing trends in MBL O_3 over the past two decades, as well as the difference in the O_3 mixing ratios between the two coastal regions will present a significant challenge for global chemical transport models. Further, the ability of the models to at least semi-quantitatively reproduce the longer-term, historical trends may an even greater challenge.

Final Revised Paper (PDF, 3188 KB) Discussion Paper (ACPD)

Citation: Parrish, D. D., Millet, D. B., and Goldstein, A. H.: Increasing ozone in marine boundary layer inflow at the west coasts of North America and Europe, Atmos. Chem. Phys., 9, 1303-1323, 2009. Bibtex EndNote Reference Manager