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Source attribution and interannual variability of Arctic pollution in spring constrained by aircraft (ARCTAS, ARCPAC) and satellite (AIRS) observations of carbon monoxide

J. A. Fisher[1], D. J. Jacob[1], M. T. Purdy[1,*], M. Kopacz[1,**], P. Le Sager[1], C. Carouge[1], C. D. Holmes[1], R. M. Yantosca[1], R. L. Batchelor[2], K. Strong[2], G. S. Diskin[3], H. E. Fuelberg[4], J. S. Holloway[5,6], E. J. Hyer[7], W. W. McMillan[8,9], J. Warner[9], D. G. Streets[10], Q. Zhang[10,11], Y. Wang[12], and S. Wu[13]

[1]Department of Earth and Planetary Sciences and School of Engineering and Applied Sciences, Harvard University, Cambridge, Massachusetts, USA
[2]Department of Physics, University of Toronto, Toronto, Ontario, Canada
[3]NASA Langley Research Center, Hampton, Virginia, USA
[4]Department of Meteorology, Florida State University, Tallahassee, Florida, USA
[5]Cooperative Institute for Research in Environmental Science, University of Colorado, Boulder, Colorado, USA
[6]Chemical Sciences Division, NOAA Earth System Research Laboratory, Boulder, Colorado, USA
[7]UCAR Visiting Scientist Program, Naval Research Laboratory, Monterey, California, USA
[8]Department of Physics, University of Maryland, Baltimore County, Baltimore, Maryland, USA
[9]Joint Center for Earth Systems Technology, University of Maryland, Baltimore, Maryland, USA
[10]Decision and Information Sciences Division, Argonne National Laboratory, Argonne, Illinois, USA
[11]Center for Earth System Science, Tsinghua University, Beijing, China
[12]Department of Environmental Science and Engineering, Tsinghua University, Beijing, China
[13]Department of Geological and Mining Engineering and Sciences and Department of Civil and Environmental Engineering, Michigan Technological University, Houghton, Michigan, USA
[*]now at: Risk Management Solutions, Hackensack, New Jersey, USA
[**]now at: Woodrow Wilson School of Public and International Affairs, Princeton University, Princeton, New Jersey, USA

Abstract. We use aircraft observations of carbon monoxide (CO) from the NASA ARCTAS and NOAA ARCPAC campaigns in April 2008 together with multiyear (2003–2008) CO satellite data from the AIRS instrument and a global chemical transport model (GEOS-Chem) to better understand the sources, transport, and interannual variability of pollution in the Arctic in spring. Model simulation of the aircraft data gives best estimates of CO emissions in April 2008 of 26 Tg month^{-1} for Asian anthropogenic, 9.4 for European anthropogenic, 4.1 for North American anthropogenic, 15 for Russian biomass burning (anomalously large that year), and 23 for Southeast Asian biomass burning. We find that Asian anthropogenic emissions are the dominant source of Arctic CO pollution everywhere except in surface air where European anthropogenic emissions are of similar importance. Russian biomass burning makes little contribution to

mean CO (reflecting the long CO lifetime) but makes a large contribution to CO variability in the form of combustion plumes. Analysis of two pollution events sampled by the aircraft demonstrates that AIRS can successfully observe pollution transport to the Arctic in the mid-troposphere. The 2003–2008 record of CO from AIRS shows that interannual variability averaged over the Arctic cap is very small. AIRS CO columns over Alaska are highly correlated with the Ocean Niño Index, suggesting a link between El Niño and Asian pollution transport to the Arctic. AIRS shows lower-than-average CO columns over Alaska during April 2008, despite the Russian fires, due to a weakened Aleutian Low hindering transport from Asia and associated with the moderate 2007–2008 La Niña. This suggests that Asian pollution influence over the Arctic may be particularly large under strong El Niño conditions.

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