

SOURCE CHARACTERIZATION OF CARBON MONOXIDE AND OZONE OVER THE NORTHWESTERN PACIFIC IN SUMMER 2012

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ABSTRACT

Carbon monoxide (CO) and ozone (O₃) were continuously measured in the marine boundary layer of the East Sea, the Northwestern Pacific, and the Bering Sea onboard R/V Araon in the second halves of July and September of 2012, as a part of the SHIPborne Pole-to-Pole Observations (SHIPPO) program. Depending on the characteristics of each section of the cruise track, up to 66 ppbv and 17 ppbv of CO and O₃ variability were observed, respectively. The O₃/CO ratio suggests that O₃ was dominantly produced by photochemical reactions in the troposphere, although in the northern sections of the cruise track, the ratio likely suggests vertical transport from the free troposphere or the lowermost stratosphere. To analyze the source characteristics and the transport of both trace gases, a tagging technique in a 3-D global chemical transport model (Model for OZone And Related chemical Tracers-4; MOZART-4) was applied. The model reproduced the observations fairly well, and the technique enabled us to characterize the source regions and composition of the observed CO. Anthropogenic emissions from Northeastern Asian countries appeared to be substantial sources of the CO in the southern sections, and biomass burning in Siberia was an important source of the CO observed in the northern sections of the cruise track. Long-range transport of anthropogenic CO emissions was distinct over the Bering Sea, where the comparable contributions from North America, Northeast Asia, and Europe were identified. Low CO events driven by southern hemispheric invasion were encountered at the southern coast of the Korean peninsula and in the North Pacific at ~50N latitude.

The model pointed to a noticeable contribution from the open ocean in the Southern Hemisphere for these events.