5.068 Multi-model comparison of marine boundary layer O3 in HTAP2 simulations with cargo ship observations in Asia-Pacific.

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Abstract:

We evaluated surface ozone (O_3) simulated by global and hemispheric chemical transport models (CTM) participating in the Hemispheric Transport of Air Pollution (HTAP) Phase 2 by comparing with observations obtained on commercial cargo ships plying between Japan and Southeast Asian or Oceanian regions. Reproducibility of seasonal cycles of trace gases is the most common test for an evaluation of CTMs and an important requirement demonstrating model performance. The long-term observations from the cargo ships for about 10 years provide climatological seasonal variations and latitudinal gradients of O_3 in the marine boundary layer across a wide range of latitudes (40°S–35°N) on the western Pacific, East China, and South China Seas. At the northern midlatitudes, surface O_3 concentrations show a seasonal maximum during spring and minimum in summer, reflecting the seasonal cycle of the Asian monsoon. The CTMs generally reproduced the springtime peak of O_3 in April–May. However, the CTMs tended to overestimate the observed summer minimum in O_3 at 20–30°N on the Japan–Southeast Asia (mean bias of 12–14 ppbv in June–August) and the Japan–Oceania

routes. In addition, we found that the CTM results exhibited a similar positive bias of surface O_3 at the remote sites located in the same latitudinal regions (e.g., Okinawa and Ogasawara). The overestimates across wide areas of the Asian seas suggest that chemical loss and/or deposition processes of marine boundary layer O_3 are underestimated by the CTMs. The positive bias in this season may contribute to the overestimation of modeled surface O_3 around Japan, which was reported by the model intercomparison studies, because southerly winds prevail around the rim of the North Pacific High during summer. We have revealed the spatial structure of the summertime O_3 overestimation in the Asian region in many CTMs, which is useful to clarify the causes of this problem.