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Intercontinent transport of ozone to the Asian troposphere

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Tropospheric ozone is a major pollutant and a potent greenhouse gas. Intercontinent transport of ozone is one of the key factors controlling ozone concentrations and variability in the troposphere over different continents. Up to now, there are limited studies that focus on transport of tropospheric ozone to the Asian troposphere from the other continents. We use a Lagrangian model, HYSPLIT, and an Eulerian model, GEOS-Chem, to address this issue. The simulations from both models show that American and European ozone mainly influences the Asian region north of 30 N while the African influence appear mostly over south of 30 N in Asia. The southern hemispheric influence occurs mostly in summer and is generally small. The imported ozone from various continents to the Asian troposphere vary greatly with latitude, altitude and season, resulting from collective impacts of emissions of ozone precursors in the source regions, chemical and meteorological conditions in the source and receptor regions and along the transport pathways. The upward transport of ozone in the source regions is critical as uplifted ozone can be effectively transported over long distances. Such transport depends largely on the intensity of ITCZ (Intertropical Convergence Zone) over Africa and the intensity of the warm conveyor belts over the Atlantic Ocean. The downdrafts to the surface in summer behind the European trough effectively divert American and African ozone from reaching Asia. In Asia, the receptor region, imported ozone is transported to the surface mostly behind the Asian trough. The monsoon climate in Asia plays an important role in modulating the seasonal and interannual variations of imported ozone that is transported downward to the low troposphere and on the surface. This study shows that the HYSPLIT and GEOS-Chem simulations complement each other. HYSPLIT can visualize transport pathways effectively without considering chemical processes, while GEOS-Chem not only tracks transport of ozone but also considers chemical reactions during the transport, although the performance of GEOS-Chem depends largely on the accuracy of its emission inventories.