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Trans-Eurasian transport of ozone and its precursors: an East Asian perspective

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The chemical composition of the troposphere over central and eastern Asia is influenced by the emission of pollutants and ozone precursors over the heavily populated and industrialised regions of Europe and North America. Long-range transport of ozone and its precursors from European sources over continental regions differs substantially from that over the Pacific or Atlantic Oceans where the storm tracks which aid transport of North American and East Asian oxidants are much stronger than over Eurasia. Convective lifting processes over Europe are also weaker, and a greater proportion of polluted outflow from these sources occurs in the boundary layer, where lifetimes to chemical loss and to deposition are shorter. Lower insolation and colder temperatures at the more northerly latitude of European sources and outflow also influences the chemical processing of transported pollutants. Using the FRSGC/UCI global chemical transport model we examine the processes controlling export of oxidants from the European region, and quantify the impacts on O3 and CO over central and eastern Asia, comparing with available long-term observations from measurement sites in Siberia and Japan. We focus particularly on the effects in springtime, when strong westerlies, favourable transport pathways and chemical processing together lead to the largest impacts on oxidants. We compare and contrast the influence of European sources with that of North American sources, which are found to have a smaller effect on CO but a larger effect on O3. The combined influence of European and North American sources on surface ozone over Japan is modest, reaching a monthly-mean maximum of about 5 ppbv in springtime, but is sufficient to contribute to exceedence of the Japanese 1-hr O3 standard of 60 ppbv for extended periods during this season. Transport from European and North American sources plays very little role in urban ozone pollution episodes in summertime, when the prevailing monsoonal flow brings clean, marine air low in ozone. We emphasise the need for more

detailed long-term measurements over northern Asia to confirm these model results and to quantify the impacts more clearly.