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Resolution Dependency of Numerically Simulated Stratosphere-to-Troposphere Transport Associated with Mid-Latitude Closed Cyclones in Early Spring around Japan

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The resolution dependency of simulated stratosphere-to-troposphere transport (STT), associated with mid-latitude closed cyclones at mid- and upper-troposphere in early spring around Japan, was investigated using the Nonhydrostatic Icosahedral Atmospheric Model (NICAM), with three horizontal resolutions (∼220, 56, and 14 km). We defined "STT-producing cyclone" as the developed mid-latitude cyclones that have isolated low pressure systems with closed contours at mid- and upper-troposphere, generated by the deepening of a trough. The STT-producing cyclone itself, with a large spatial scale, is well-simulated from three horizontal resolution experiments. As the horizontal resolution increased, the baroclinic zone on the rear side of the surface cold front became sharper along the southern areas of the upper low, bringing stratospheric dry air down to the troposphere. This comprises a sharp and deep intrusion of dry air into the troposphere, with increased dry air along the jet-axis. While the sufficient resolution for accurate estimation remains unclear, these results suggest that the minimum horizontal resolution for reproducing the sharp and deep intrusion from the stratosphere to the troposphere during the STT-producing cyclone events is approximately
14–56 km.