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A deep stratospheric intrusion associated with an intense cut-off low event over the Eastern Asia

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European Centre for Medium-Range Weather Forecasts Re-Analysis Interim (ERA-Interim) reanalysis data and satellite data, and trajectory model were applied to analyze the dynamical, thermo-dynamical and chemical structure in the upper troposphere and lower stratosphere of an intense cut-off low (COL) event occurring over the Eastern Asia during June 19-23, 2010, and to characterize the process and transport pathway of deep stratospheric intrusion. The Atmospheric Infrared Sounder (AIRS) ozone data and ozonesonde data showed that the air mass originating from the polar formed a region with relatively high values of potential vorticity (PV) and ozone in the center of COL, and a secondary ozone peaks appeared in the upper troposphere during mature stage of the COL. Forward trajectory simulation suggested that during the first stage of COL, deep stratospheric intrusion associated with strong northerly wind jet on the west side of the upper-level trough transported ozone-rich air from the polar lower stratosphere into the middle and lower troposphere in the mid-latitude, and increased the ozone concentration there. During the mature stage of the COL, stratospheric air was transported counterclockwise into the troposphere. Finally, backward trajectory model was used to find the source regions of air mass within the COL during its mature stage. Back-trajectory simulations showed that air masses with high ozone concentration in the center of the COL had two source regions: one is the polar vortex, where ozone-rich air played a major role in increasing the ozone concentrations, and the other is the strong shear region in the cyclonic side of the extratropical jet axis. The air masses with low ozone concentration around the COL also had two source regions: one is the anticyclonic side of the extratropical jet axis, where the air mass with the relatively low ozone concentration at the bottom of the COL was mainly controlled by horizontal movement, and the other is the local area, where the air mass on the east side of the COL was mainly dominated by local upward motion.