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HALO aircraft measurements of East Asian anthropogenic SO_2 import into the lower stratosphere by a warm conveyor belt uplift

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We report on a case study of anthropogenic SO_2 pollution transport into the lower stratosphere from East Asian source regions. The pollution layer was observed over Central Europe by measurements from the new German research aircraft HALO. The layer contained enhanced SO_2, HNO_3 and water vapor and caused increased Lidar backscatter radiation. Meteorological analysis and air mass transport and dispersion model simulations reveal that the detected pollutants were released from ground-based sources in East-China, South-Korea, and Japan. The pollution plume was uplifted by a warm conveyor belt associated with a West-Pacific cyclone and finally injected into the lower stratosphere. Our HALO measurements were performed 5 days after the air mass uplift event, when significant parts of the Northern Hemisphere were already covered by the pollution plume. Accompanying trajectory chemistry and aerosol box model simulations indicate that H2SO4/H_2O aerosol droplets were generated in the SO_2-rich plume and grew to sizes large enough to explain the observed increased Lidar backscatter signal. Implications of the SO_2 transport pathway into the lower stratosphere presented in this study will be discussed.