



An investigation on a peculiar episode of stratosphere-troposphere exchange in the lee of the Alps

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Stratosphere-troposphere exchanges (STE) are important for a better knowledge of the interaction between chemical, dynamical and radiative features of the atmosphere. The deep exchanges are characterized by a 2-4 day residence time of the particles (highly episodic) and involve significant mixing of chemical species. The description and analysis of a tropopause fold, is the purpose of this work. The chosen event, occurred on 14-15 December 2003, is a typical example of "cyclogenesis in the lee of the Alps" and is located in the Gulf of Genoa, where cyclogenesis is mostly frequent in winter. The episode of stratospheric intrusion is characterized by a significant interaction with alpine chain and by strong northern stream at upper level, related to intense low system. A Lagrangian approach was used to study the event through chemical and dynamical tracers. Vertical wind shear showed that the more turbulent air moves from level of 11 km to 5 km and confirmed the hypothesis of the stratospheric intrusion. Potential vorticity iso-surfaces showed that the maximum deformation of tropopause occurred during 15 December 2003. The evolution of the lower pressure level in which water vapour mixing ratio decreases until 0.02 g/kg (considered the typical value for stratospheric air) showed a significant slope. This event caused changes in total ozone content from latitude of 45°N to 50°N, with a maximum observed during the night between 14 and 15 December. Brewer total ozone measurements at Rome showed an increase of 33DU/4h. Forward trajectories showed the horizontal pathways penetrating southward and the stratospheric air descent from 10 km to tropospheric levels. A method derived from a previous technique developed by Wei in 1987 is then applied to compute air mass fluxes across the tropopause: the results showed an air mass flow descending from the stratosphere to the troposphere.