Geophysical Research Abstracts, Vol. 7, 06970, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06970

How homogeneous and isotropic is stratospheric mixing ?: Comparison of CRISTA-1 observations with transport studies (CLaMS)

P. Konopka (1), R. Spang (2), G. Guenther (3), R. Mueller (4), D.S. McKenna (5), D. Offermann (6), M. Riese (7)

(1,2,3,4, 7) Forschungszentrum Juelich, ICG-I, 52425 Juelich, Germany, (5) NCAR, Boulder, CO, USA, (6) University of Wuppertal, Wuppertal, Germany

The Chemical Lagrangian Model of the Stratosphere (CLaMS) is used for the interpretation of N2O observed during the CRISTA-1 experiment in early November 1994. By comparing CRISTA data with CLaMS simulations, the impact of the large-scale horizontal deformations on mixing is studied. Using the probability density function technique (PDF) quantifying the statistics of N2O variability, the critical deformation γ_c was inferred that triggers the mixing algorithm in CLaMS. The critical deformation γ_c measures the ratio between the major and minor axes of the ellipse resulting from the stretching of a circle surrounding a given Lagrangian air parcel, i.e. only deformations stronger than γ_c are relevant for mixing in CLaMS. The PDF derived from CRISTA observations at 700 K and on the horizontal scales of the order of 200 km is characterized by a Gaussian core and non-Gaussian tails indicating filamentary structures typical for 2D turbulence. The PDFs obtained from CLaMS simulations strongly depend on γ_c but only weakly on the horizontal resolution r_0 that was varied between 45 and 200 km. The choice $\gamma_c = 0.8$ in the model best reproduces the observed PDF. This implies that the large-scale isentropic transport leads to scale collapse and subsequent mixing in those parts of the flow where on a time scale ≈12 hours and a spatial scale ≈200 km the flow stretches a circle to an ellipse with the ratio between the major and minor axes exceeding 5. Owing to the spatial resolution of the CRISTA instrument that smoothes out the non-Gaussian tails, the elongation rate ≈ 5 estimates only the lower bound of the critical deformation. Furthermore, our simulations show that air masses of low amounts observed by CRISTA are fragments of the polar vortex which were formed about two weeks earlier.