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Evaluation of MIPAS ozone fields assimilated using a new algorithm constrained by isentropic tracer advection

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Abstract. A new data assimilation algorithm, using the isentropic advection equation, is applied to MIPAS and SBUV measurements of stratospheric ozone. The system is solved separately on each isentropic level, with neither vertical advection nor chemical reactions represented. The results are validated against HALOE, POAM III, SAGE II & III, OSIRIS and ozone sonde data. The new assimilation algorithm has the accuracy of the Kalman smoother but is, for the systems studied here with up to 200 000 variables per time step and 61 million control variables in total, many orders of magnitude less computationally expensive. The analysis produced minimises a single penalty function evaluated over an analysis window of over one month. The cost of the analysis is found to increase nearly linearly with the number of control variables. Compared with over 800 profiles from Electrochemical Concentration Cell sondes at 29 sites the analysis is found to be merely 0.1% high at 420 K, rising to 0.4% at 650 K. Comparison against the other satellites imply that the bias remains small up to 1250 K (38 km) and then increases to around −10% at 1650 K (44 km). Between 20 and 35 km the root-mean-square difference relative to HALOE, SAGE II & III, and POAM is in the 5 to 10% range, with larger discrepancies relative to other instruments. Outside this height range rms differences are generally larger, though agreement with HALOE remains good up to 50 km. The assimilation has closer agreement to independent observations than found in direct near-neighbour comparisons between profiles, demonstrating that the assimilation can add value to the observations.

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