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A review of the Match technique as applied to AASE-2/EASOE and SOLVE/THESEO 2000

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Abstract. We apply the NASA Goddard Trajectory Model to data from a series of ozonesondes to derive ozone loss rates in the lower stratosphere for the AASE-2/EASOE mission (January-March 1992) and for the SOLVE/THESEO 2000 mission (January-March 2000) in an approach similar to Match. Ozone loss rates are computed by comparing the ozone concentrations provided by ozonesondes launched at the beginning and end of the trajectories connecting the launches. We investigate the sensitivity of the Match results to the various parameters used to reject potential matches in the original Match technique. While these filters effectively eliminate from consideration 80% of the matched sonde pairs and >99% of matched observations in our study, we conclude that only a filter based on potential vorticity changes along the calculated back trajectories seems warranted. Our study also demonstrates that the ozone loss rates estimated in Match can vary by up to a factor of two depending upon the precise trajectory paths calculated for each trajectory. As a result, the statistical uncertainties published with previous Match results might need to be augmented by an additional systematic error. The sensitivity to the trajectory path is particularly pronounced in the month of January, for which the largest ozone loss rate discrepancies between photochemical models and Match are found. For most of the two study periods, our ozone loss rates agree with those previously published. Notable exceptions are found for January 1992 at 475K and late February/early March 2000 at 450K, both periods during which we generally find smaller loss rates than the previous Match studies. Integrated ozone loss rates estimated by Match in both of those years compare well with those found in numerous other studies and in a potential vorticity/potential temperature approach shown previously and in this paper. Finally, we suggest an alternate approach to Match using trajectory mapping. This approach uses information from all matched observations without filtering and uses a two-parameter fit to the data to produce robust ozone loss rate estimates. As compared to loss rates from our version of Match, the trajectory mapping approach produces generally smaller loss rates, frequently not statistically significantly different from zero, calling into question the efficacy of the Match approach.

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