

Trajectory dispersion due to uncertainties in analysis wind fields and the inherent limitations of transport calculations in the upper tropical troposphere

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Lagrangian trajectory calculations, in which air-parcel paths are determined from wind fields from operational analysis and reanalysis data, are standard tools for diagnosing dynamical interactions and chemical concentrations in the upper troposphere and lower stratosphere. However, due to poor observational sampling, these calculations suffer from uncertainties that are difficult to account for. We examine trajectory dispersion from two sources. The first arises from the uncertainty of resolved fluctuations in the analysis wind fields. This uncertainty is investigated via ensembles of trajectories calculated using wind fields from different analysis data sets. The second is the uncertainty that arises from small-scale wind fluctuations that are unresolved by analyzed fields. This uncertainty is investigated by simulating, with random perturbations, small-scale wind fluctuations. This work is aided by the fact that, while actual wind fluctuations are not known, their statistical properties are constrained by high-resolution observations from aircraft. These two methods agree that the uncertainty of air-parcel location in the upper tropical troposphere grows at a rate of 1 degree per day in the horizontal and 5 mb per day in the vertical.