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A combined Eulerian-Lagrangian model study of QBO effects on stratospheric transport

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The quasi-biennial oscillation affects transport and mixing in the tropical stratosphere in multiple ways. We present a novel approach feeding chemistry-climate model (CCM) results into a Lagrangian transport model to investigate these effects. The CCM MAECHAM4-CHEM gives distinctly different results for a free run and one with nudged QBO in terms of potential vorticity, suggesting a QBO effect on the tropical-subtropical transport barrier. Backward trajectories computed with the Chemical Lagrangian Model of the Stratosphere (CLaMS) confirm the existence of separate horizontal transport patterns in the tropical, subtropical and extratropical latitude regions. Longer term trajectories over 90 days illustrate the different origins of tropical air at a given level in dependence of QBO phase and season. E.g., the ascent rate differs by up to 100 % between easterly and westerly shear phases of the QBO. In northern winter, the fraction of air from the extratropical summer hemisphere also depends on the state of the QBO. When averaged over several annual and QBO cycles, the regions of origin still differ clearly among the model experiments with and without representation of the QBO.