Zonally-Averaged Global Atmospheric Transport Model for Long-lived Trace Gases

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Abstract

We present a two-dimensional, zonally averaged global model of atmospheric transport named MALTA: Model of Averaged in Longitude Transport in the Atmosphere. It aims to be accessible to a broad community of users, with the primary function of quantifying emissions of greenhouse gases and ozone depleting substances with improved representation over widely used box models. The model transport is derived from meteorological reanalysis data and flux-gradient experiments using a three-dimensional transport model. Atmospheric sinks are prescribed loss frequency fields. The zonally averaged model simulates important large-scale transport features such as the influence on trace gas concentrations of the quasi-biennial oscillation and variations in inter-hemispheric transport rates. Stratosphere-troposphere exchange is comparable to a three-dimensional model and inter-hemispheric transport is slightly faster than both the three-dimensional model from which transport rates are derived and that estimated from measurements. Validation of the model shows that it outperforms a commonly used box model of atmospheric transport when used to derive emissions. The model is open source and is expected to be applicable to a wide range of studies requiring a fast, simple model of atmospheric transport and chemical processes for estimating associated emissions or mole fractions.