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Impact of uncertainties in transport representation on UTLS composition modeling and radiative forcing

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The upper troposphere / lower stratosphere (UTLS) region plays an important role in the climate system. Changes in the structure and chemical composition of this region result in particulary large changes in the radiative forcing (RF) of the atmosphere. Quantifying the processes that control UTLS composition therefore represents an important task. We assess the influence of uncertainties in modelling vertical transport (advection) and mixing (the irreversible part of transport) on global UTLS distributions of greenhouse gases (water vapor, ozone, methane, nitrous oxide) and the associated radiative forcing. Our assessment is based on multi-annual simulations with the Lagrangian CLaMS model driven by ERA-Interim meteorological data. The irreversible part of transport, i.e. mixing, is controlled by the local horizontal strain and vertical shear rates with mixing parameters (e. g. critical Lyapunov exponent) deduced from observations. In order to assess the sensitivity of our simulation results on mixing uncertainties, the critical Lyapunov coefficient is varied within current uncertainty limits. The sensitivity to uncertainties in the advective part of vertical transport is investigated by comparing results obtained from a diabatic and from a kinematic transport representations. In this presentation, we show that both (1) uncertainties in vertical advection and (2) uncertainties in the mixing strength have a significant impact on the radiative forcing of the atmosphere. Furthermore, we illustrate the potential of PREMIER (PRocess Exploration through Measurements of Infrared and millimetre-wave Emitted Radiation), one of three candidates for ESA's 7th Earth Explorer Core Mission, to considerably narrow down theses uncertainties.