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The efficiency of transport into the stratosphere via the Asian and North American summer monsoon circulations as derived from the Chemical Lagrangian Model of the Stratosphere (CLaMS)

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Inaccurate representation of mixing in chemistry transport models, mainly suffering from an excessive numerical diffusion, strongly influences the quantitative estimates of the stratosphere-troposphere exchange (STE). The Lagrangian view of transport as implemented in the Chemical Lagrangian Model of the Stratosphere (CLaMS) offers an alternative to exploit the numerical diffusion to parametrize physical mixing. The novel concepts of CLaMS will be presented which are mainly based on a consequent use of potential temperature-based coordinates and on implementation of mixing.

Transport of pollutants into the stratosphere via the Asian summer monsoon (ASM) or North American summer monsoon (NASM) may affect the atmospheric composition and climate both locally and globally. Using CLaMS driven by the ERA-Interim and MERRA-2 reanalyses, we identify and study the robust characteristics of transport from the ASM and NASM regions to the stratosphere. We release artificial tracers in several vertical layers from the middle troposphere to the lower stratosphere in both ASM and NASM source regions during July and August 2010-2013 and track their evolution until the following summer. We find that more air mass is transported from the ASM and NASM regions to the tropical stratosphere, and even to the Southern Hemispheric stratosphere, when the tracers are released clearly below the tropopause (350-360K) than when they are released close to the tropopause (370-380K). For tracers released close to the tropopause (370-380K), transport is primarily into the Northern Hemispheric lower stratosphere. Results for different vertical layers of air origin reveal two transport pathways from the upper troposphere over the ASM and NASM regions to the tropical pipe: (i) quasi-horizontal transport to the tropics below the tropopause followed by ascent to the stratosphere via tropical upwelling, and (ii) ascent into the stratosphere inside the ASM/NASM followed by quasi-horizontal transport to the tropical lower stratosphere.

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Refreshments 3:15 p.m
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