Geophysical Research Abstracts
Vol. 16, EGU2014-13182, 2014
EGU General Assembly 2014

Rapid increases of CO and H_2O in the tropical lower stratosphere during January 2010 stratospheric sudden warming event

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A potential transport mechanism of various tracers from the tropical troposphere to the lower stratosphere (LS) across the tropical tropopause layer (TTL) is the overshooting convective clouds which inject air with tropospheric characteristics (high CO, high H_2O, low O_3) into the LS over a period of a few days. Evidence of such convective intrusions extending up to the 90 hPa level are observed over the southern African continent at the end of January 2010 in MLS and CALIOP satellite measurements. Rapid increases of CO and water vapor concentrations over Africa are associated with increased convective activity over the region a few days prior to the onset of stratospheric sudden warming (SSW) event and contribute to enhancements in their zonal tropical mean concentrations during January and February 2010. The modulation of tropical upwelling by SSW appears to force stronger and deeper tropical convection, particularly in the Southern Hemisphere tropics. The January 2010 SSW event induced the lowest recorded LS temperature in MLS history (2004-13), allowing an unprecedented clear detection of stratosphere-troposphere exchange process by way of CO, H_2O and O_3 intrusions. The present study suggests that short duration, overshooting clouds can have a large impact on the zonally averaged fields of LS composition (zonally-averaged tracer fields in the tropical LS).
In this presentation, we present the simulated CO, water vapor and ozone mixing ratios during Jan 2010 SSW using GEOS-Chem model. We further investigate the transport pathways based on trajectory analysis of air parcels in convective regions of the tropics.