Rapid Transport of CO from Troposphere to Stratosphere via Tropical Convection During Stratospheric Sudden Warming 2010

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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 carbon monoxide (CO), high water vapor (H_2O), low ozone (O_3) into the LS over a period of a few days. Evidence of such convective intrusions is observed at the end of January and beginning of February in 2010 associated with increased convective activity over the southern African continent following the onset of stratospheric sudden warming (SSW) event. The modulation of tropical upwelling by SSW appears to force stronger and deeper tropical convection, particularly in the Southern Hemisphere (SH) tropics. The simulation analysis also found by using the vertical fine resolution that the deep convection especially in the SH became stronger during the SSW event, because the upwelling associated with SSW make the TTL unstable [Eguchi et al., ACP, 2015].

The January 2010 SSW event induced the lowest recorded LS temperature in MLS history (2004-13), which destabilized the TTL 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.

Key words: Stratosphere-Troposphere Exchange (STE), Stratospheric Sudden Warming (SSW), Tropical Tropopause Layer (TTL), Convective clouds

References (if needed)

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