The interhemispheric transport pathways of methane as observed by GOSAT and simulated by ACTM

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Observations of long-lived tracers indicate that mixing tropospheric air between the Northern Hemisphere (NH) and Southern Hemisphere (SH) extratropics is about 1–1.5 yr. The importance of the seasonal migration of the zonally averaged Hadley circulation and intertropical convergence zone (ITCZ) oscillation on interhemispheric (IH) transport of tracers has been recognized. The mechanisms for transport through the tropics and the role of the monsoonal circulation, however, are not well understood. This study aiming to identify the transport pathways that connect NH and SH by analyzing CH_4 global distributions as measured by thermal infrared (TIR) band observations by the Thermal And Near-infrared Sensor for carbon Observation-Fourier Transform Spectrometer (TANSO-FTS) onboard the Greenhouse gases Observation SATellite (GOSAT) and simulated by MIROC4.0-based Atmospheric Chemistry Tracer Model (MIROC4-ACTM) for the period 2010-2013.

We found several longitudinal zones of active IH transport located in the Upper Troposphere and Lower Stratosphere (UTLS) zone (levels of 400– 200hPa). The IH exchange over Amazonia and tropical Africa is active both for winter and summer, while in the Asia region there is significant seasonal variability. Presented results confirm the role of the Asian Summer Monsoon Anticyclone (ASMA) zonally asymmetric heating on IH transport and highlight that the monsoon-induced eddy circulation plays an important role in the interhemispheric transport of long-lived chemical constituents. The dual role of ASMA has been revealed. On the one hand, its influence blocks IH in the tropical zone of the Indian Ocean and Southeast Asia, on the other, it enhances vertical ventilation in northern India, where significant methane fluxes are concentrated. Fast convective transport caused by ASMA accelerates the saturation of the middle and upper troposphere in NH with methane-rich surface air. These stratospheric levels are the origin of two west-directed jets (TEJ and AEJ) transported air mass to tropical Africa and further to SH.

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