Geophysical Research Abstracts
Vol. 18, EGU2016-17611, 2016
EGU General Assembly 2016

Transport pathways from the Asian monsoon anticyclone to the stratosphere

Hella Garny (1) and William Randel (2)

(1) DLR, Institute for Atmospheric Physics, Oberpfaffenhofen-Wessling, Germany (hella.garny@dlr.de), (2) NCAR, Boulder, Colorado, USA

The upper tropospheric Asian monsoon anticyclone emerges in response to persistent deep convection over India and southeast Asia in northern summer. The monsoon circulation is associated with rapid transport from the surface to the upper troposphere within convective updrafts, leading to tracer anomalies within the anticyclone. Possibly air is transported further into the stratosphere, but the exact pathways of air from the upper tropospheric anticyclone to the stratosphere are currently under debate. While air is thought to be confined to the anticyclone by its surrounding wind jets, large variability in the anticyclone results in shedding of air from the anticyclone to its surrounding, and possibly air might reach the extratropical lower stratosphere by isentropic mixing. On the other hand, positive vertical velocities in the anticyclone region suggests upward transport of air into the tropical lower stratosphere.

In this study, we investigate transport pathways of air originating in the upper tropospheric Asian monsoon anticyclone based on isentropic and three-dimensional trajectories. Trajectories are driven by ERA-Interim reanalysis data, and three-dimensional results are based both on kinematic and diabatic transport calculations. Isentropic calculations show that air parcels are typically confined within the anticyclone for 10–20 days, and spread over the tropical belt within a month of their initialization. However, only few parcels (3 % at 360 K, 8 % at 380 K) reach the extratropical stratosphere by isentropic transport. When considering vertical transport we find that 31 % (48 %) of the trajectories reach the stratosphere within 60 days when using vertical velocities or diabatic heating rates to calculate vertical transport, respectively. In both cases, most parcels that reach the stratosphere are transported upward within the anticyclone and enter the stratosphere in the tropics, typically 10–20 days after their initialization at 360 K. This suggests that trace gases, including pollutants, that are transported into the stratosphere via the Asian monsoon system are in a position to enter the tropical pipe and thus be transported into the deep stratosphere.