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Impact of the Asian Summer Monsoon on the Lower Stratosphere: Results from TACTS/ESMVal 2012

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We present results from the German research aircraft HALO during the TACTS/ESMVal project (Transport and Composition in the UTLS and Earth System Model Validation). We focus on the distribution of CO, N2O and ozone as well as water vapour. The measurements took place in the extratropical UTLS (upper troposphere/lower stratosphere) region over Europe from August to September 2012. Here, we focus on the northern hemispheric trace gas composition above potential temperatures of 370 K.
In this region we could for the first time identify mixing lines, which indicate mixing between stratospheric air masses of different origin. Introducing a new pair of correlation species (N2O-CO) we could identify air masses, which do not involve mixing directly at the tropopause. Based on a case study we show, that the atmospheric region between the extratropical tropopause and potential temperatures up to Θ = 405 K is affected by mixing of 'young' stratospheric air from the monsoon region with aged stratospheric air.
Based on the distribution of CO and N2O we show that the lower stratosphere over Europe becomes more tropospheric from August to September with enhanced CO, N2O and water vapour as well as decreasing ozone. Using comprehensive trajectory calculations our results particularly indicate that the Asian summer monoon is the main contributor to this composition change and that mixing from the tropical tropopause layer becomes weaker over time.
Therefore we conclude that the monsoon significantly contributes to the flushing of the extratropical UTLS during summer and autumn.