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Interhemispheric transport into the southern hemisphere polar stratosphere from the Asian monsoon region

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The South-East Asian boundary layer has become one of the most polluted regions in recent years due to rapid
economic growth, which even affect the trace gas composition in the southern hemisphere by inter-hemispheric transport. We
study the transport from the boundary layer of the Asian summer monsoon (ASM) region [15° N, 45° N, 30° E, 120° E] into
the global upper troposphere and lower stratosphere (UTLS) using the Lagrangian chemistry transport model CLaMS driven
by the ERA5 reanalysis during 2010-2014. In particular, we quantify the inter-hemispheric transport contribution from the
ASM region to the southern hemisphere polar region (SP) [60° S, 90° S] and investigate the influence on pollution. Despite the
smaller size of ASM area compared to the southern hemisphere (SH) subtropics [15° S, 45° S] and tropics [15° S, 15° N], we
find that the air mass fractions (AMF) from the ASM to the SP are about 1.5 times larger than the corresponding contributions
from the SH subtropics and about two times smaller than those from the tropics. Transport from the ASM boundary layer to
the Southern polar vortex occurs largely above about 450 K and on timescales longer than 2 years, while transport timescales
to the Antarctic region below the vortex are shorter than about 2 years. The transport contribution from the ASM region to
the SP presents distinct inter-annual variability, which is strongly related to the strength of polar vortex. The relatively young
(less than two years) tracers originating from the ASM region show good correlations with CCl_4, F12, and CH_3Cl observations
from ACE-FTS in the antarctic UTLS. The reconstructed SF_6 indicates that about 20% of SF_6 in the SP stratosphere originates

from the ASM boundary layer, which is larger than the SF_6 fraction of SH subtropical origin, while 50% of SF_6 in the SP
stratosphere originates from the tropical boundary layer.