

Transport variability of very short-lived substances from the West Indian Ocean to the stratosphere

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Introduction

The supporting information contains the download web addresses for the climate indices used in the publication (Text S1). There is a presentation of the sensitivity test on using different stratospheric thresholds in FLEXPART and the convection scheme (Text S2, Figure S1). The supporting figures (S2-S7) include a latitudinal view of FLEXPART trajectories and the latitudinal density of VLSL tracers both mentioned in Section 3.1, stratospheric injection regions for DMS, CH₃I and CH₂Br₂ similar to Figure 4, and the detrended interannual time series of transport efficiency.

Text S1: Download addresses of the climate indices:

IMI: <http://apdrc.soest.hawaii.edu/projects/monsoon/seasonal-monidx.html>

AIRI: http://www.tropmet.res.in/static_page.php?page_id=53

DMI: <http://stateoftheocean.osmc.noaa.gov/sur/ind/dmi.php>

Text S2: Sensitivity test of stratospheric threshold boundary

We conducted a sensitivity test for the year 2014 to investigate the effect of 17 km as boundary to the stratosphere compared to the cold point tropopause (CPT) and 18 km (see also Section 4.4 “Uncertainties”). The annual mean transport efficiency from the sensitivity test is listed in Table 6 and the seasonal evolution of bromoform tracer transport efficiency for different stratospheric thresholds is displayed in Figure S1. Using the CPT as threshold leads to the highest transport efficiency; followed by 17 km and then 18 km with lowest transport efficiency. The CPT transport efficiency is about 30% higher and the 18 km transport efficiency 60% lower than the transport efficiency at 17 km we use in the manuscript. The annual cycle of transport efficiency for the bromoform tracer has a similar evolution for 17 km and as for the CPT and 18 km threshold with the before noted differences in magnitude.

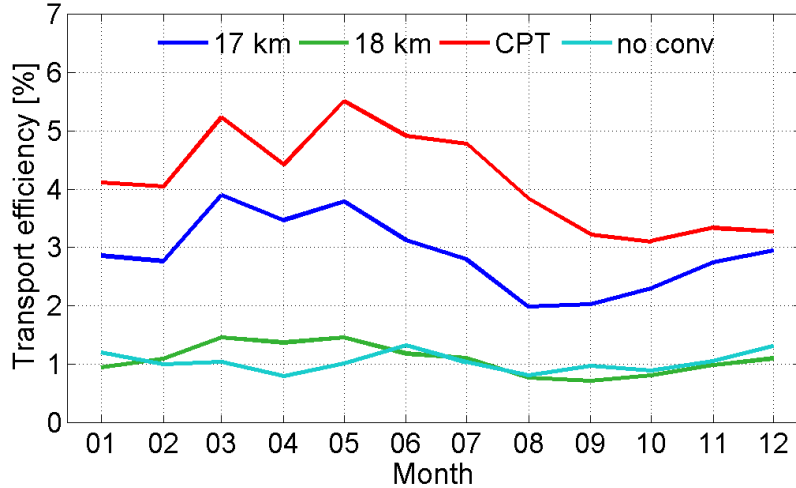


Figure S1: Seasonal evolution of transport efficiency of bromoform tracer for 2014 from the WIO to the tropical stratosphere (30°S-30°N) for different stratospheric thresholds and with the FLEXPART convection scheme switched off (no conv).

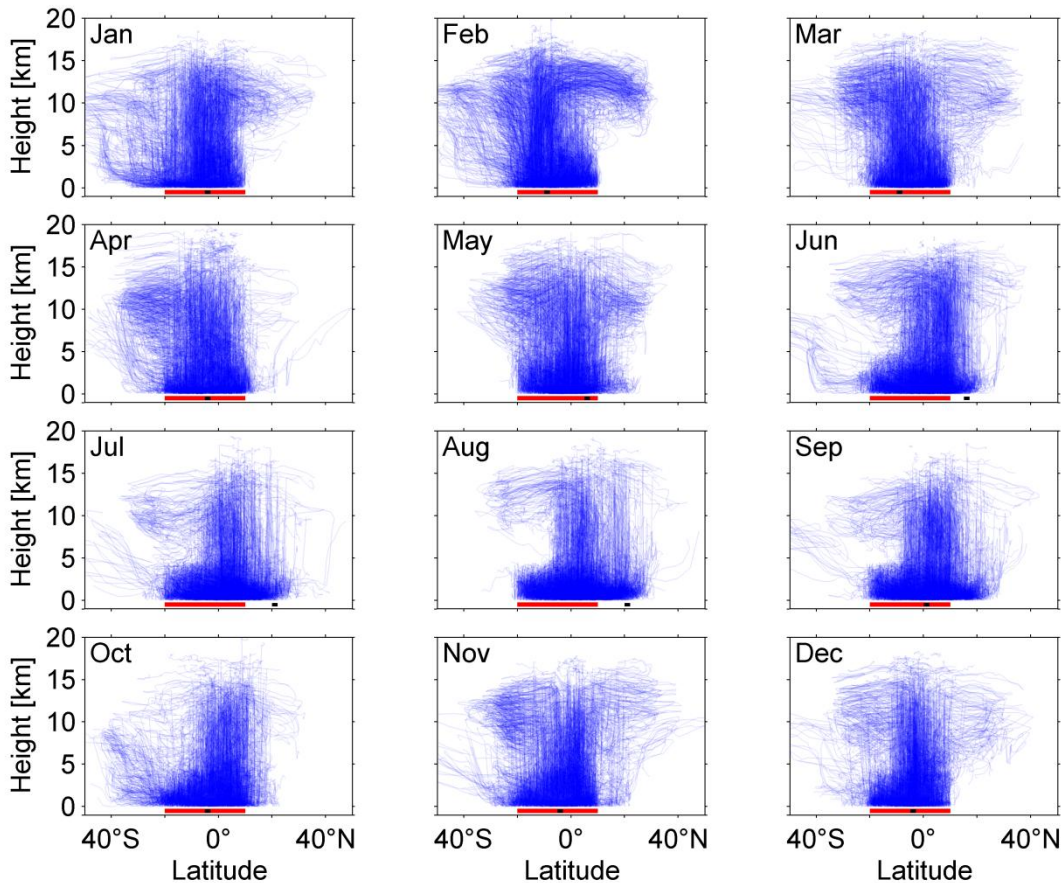


Figure S2: Latitude-height cross sections of ten day forward trajectories from the WIO release region (red) during 2014 and climatological position of ITCZ in the Indian monsoon region (black square) from 1998-2012 taken from Schneider et al. [2014]. The trajectories are plotted translucently, so that a more intense blue color displays a higher density of trajectories. Rapid vertical uplift (vertical lines) are mostly positioned around the ITCZ.

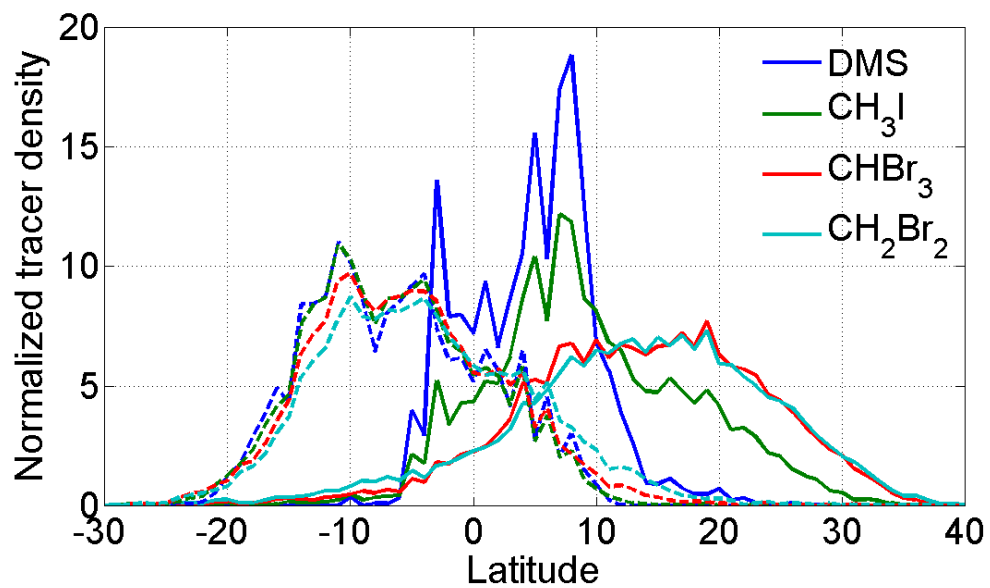


Figure S3: Tracer density along latitude in 2014 at 15 km height for the southernmost position of the maximum in February (dashed) and the northernmost location in July (solid) normalized for all VLSL tracer.

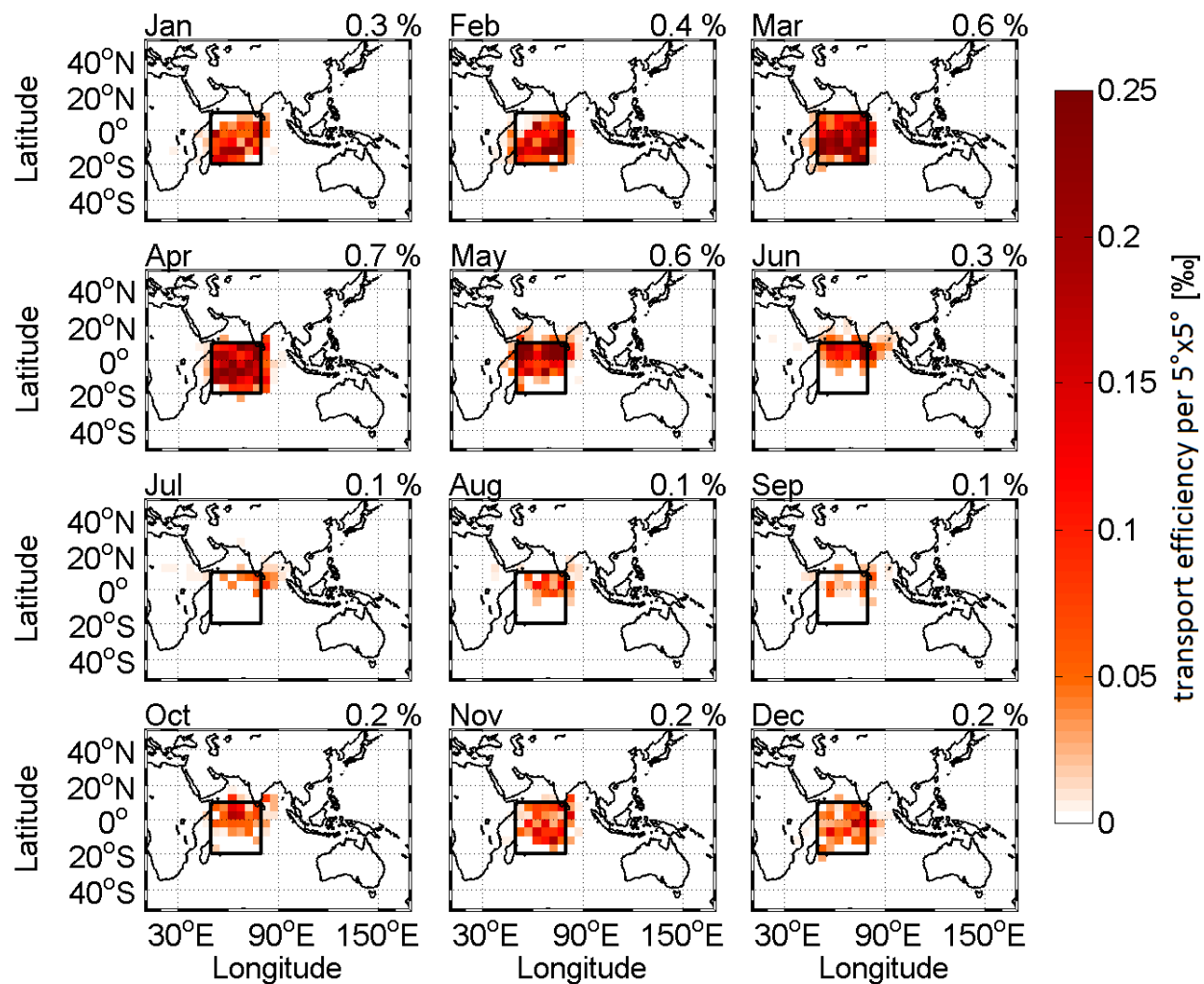


Figure S4: Stratospheric injection regions for DMS tracer released in 2014 shown as transport efficiency (in %) per 5°x5° grid box. The black box shows the WIO release area. The total transport efficiency (in %) for each month is noted on the upper right hand side.

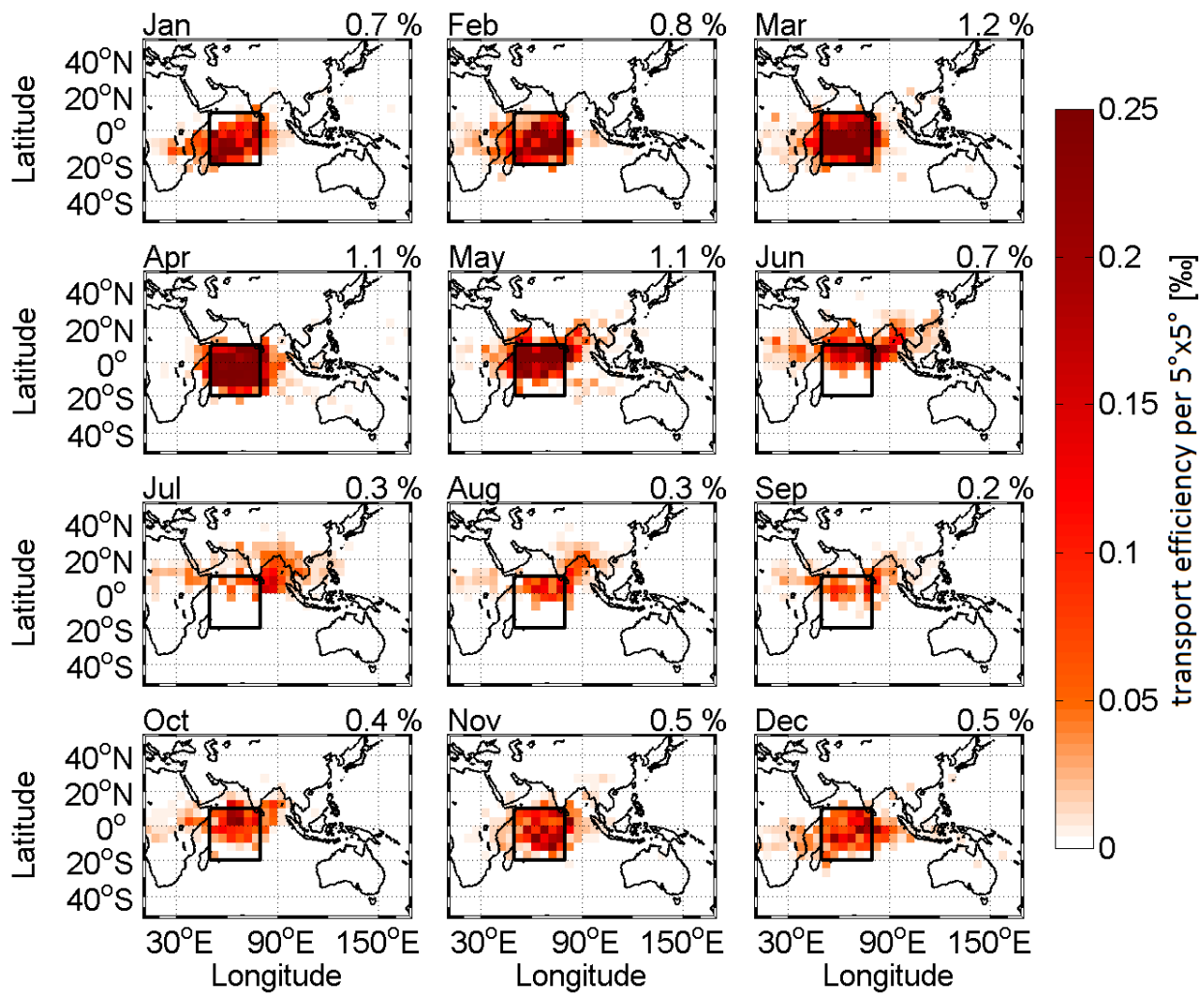


Figure S5: As Figure S4 for the CH_3I tracer.

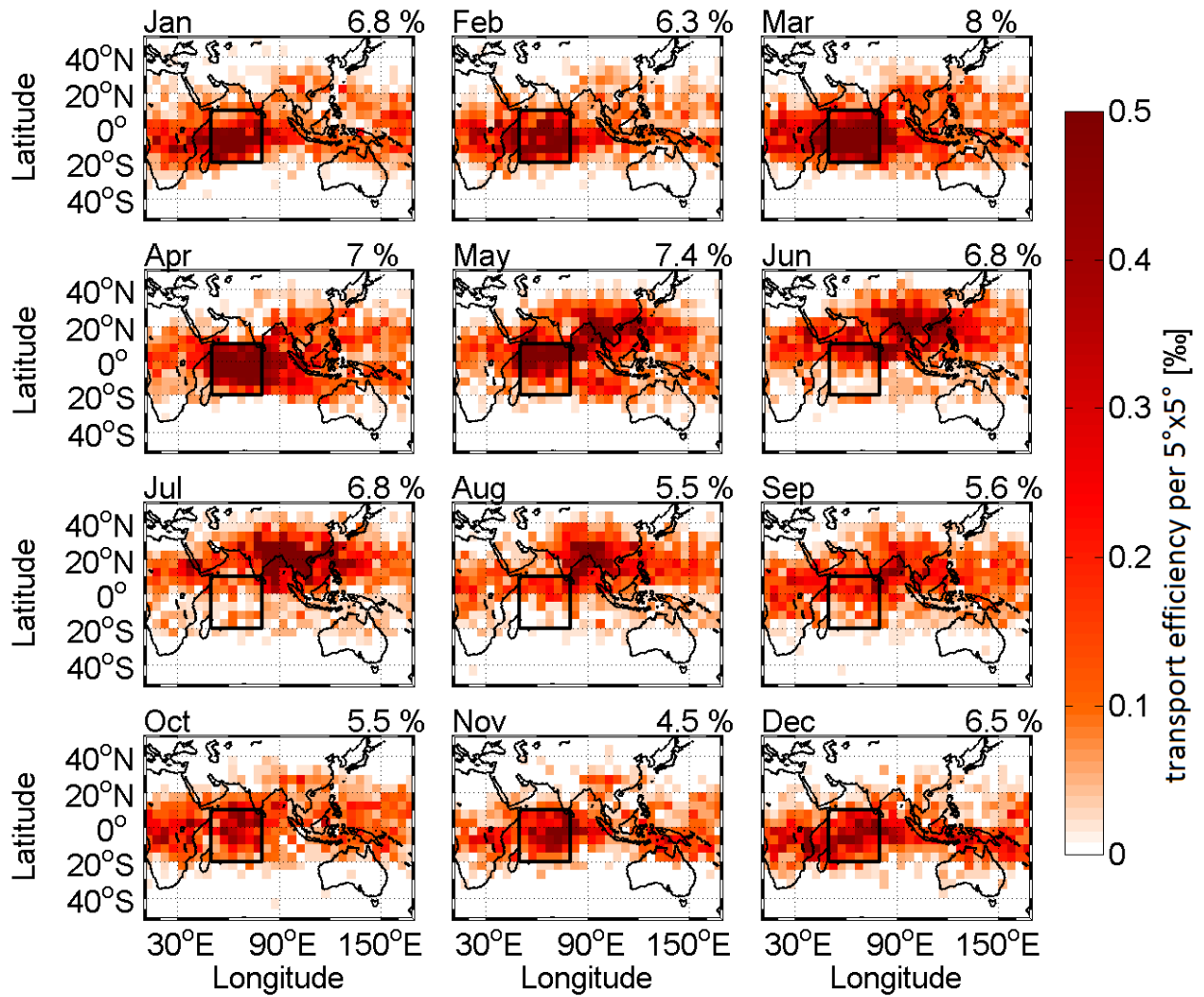


Figure S6: As Figure S4 for the CH₂Br₂ tracer.

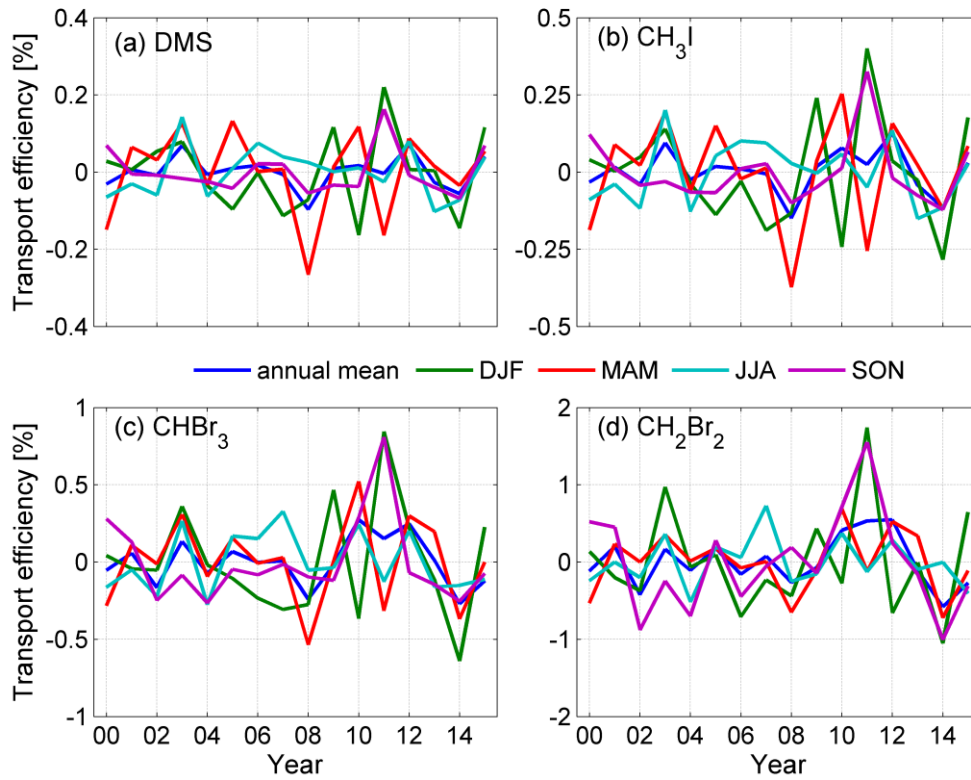


Figure S7: Detrended interannual time series of the annual and seasonal mean anomalies of transport efficiency of VSL tracers from the West Indian Ocean to the stratosphere.

References

Schneider, T., T. Bischoff, and G. H. Haug (2014), Migrations and dynamics of the intertropical convergence zone, *Nature*, 513(7516), 45-53.