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Evaluation of ozone trends in the mesosphere/lower thermosphere using a new merged dataset of ozone profiles

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Section S1. Coverage of selected datasets

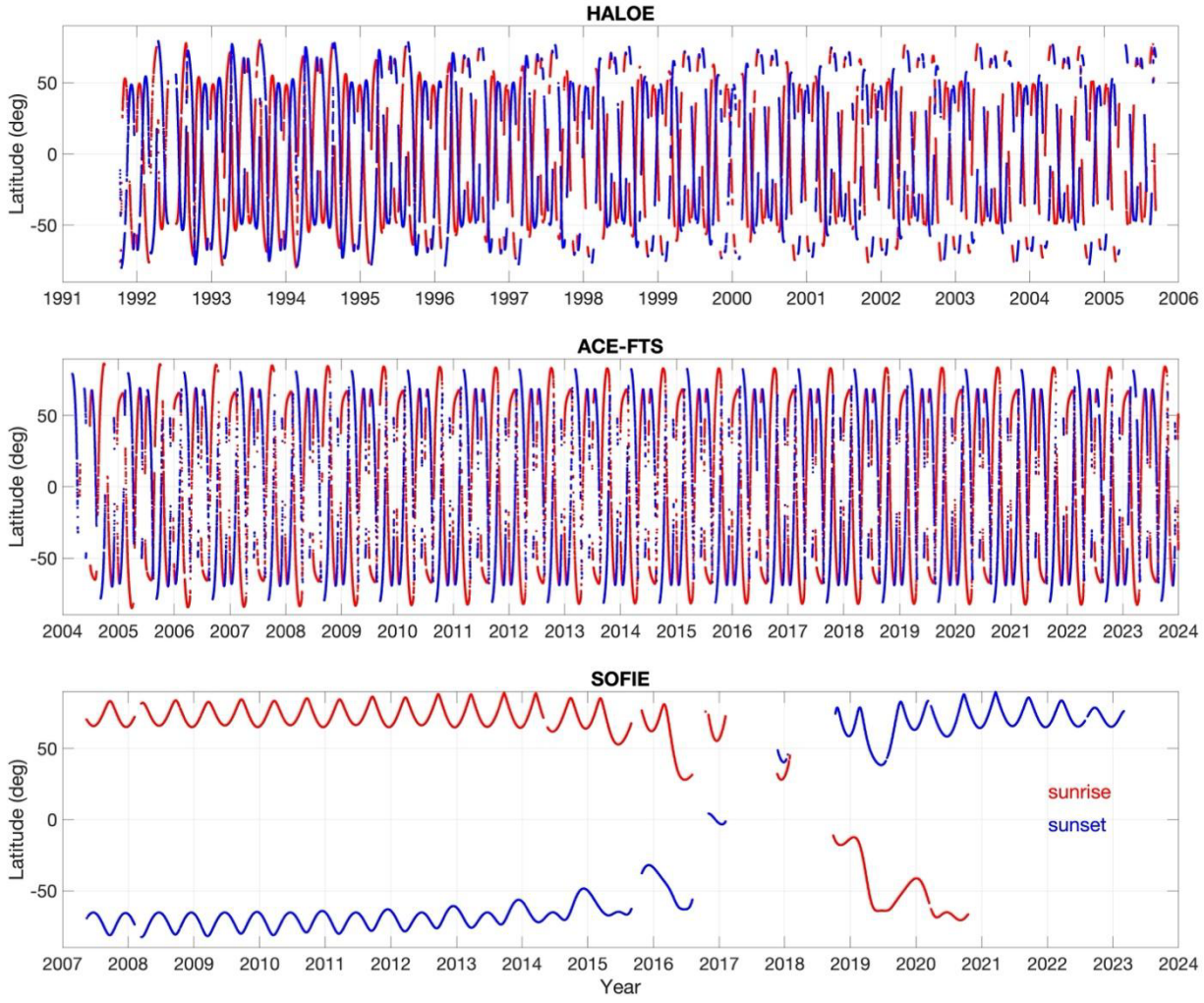

Figure S1: Latitude coverage by solar occultation measurements.

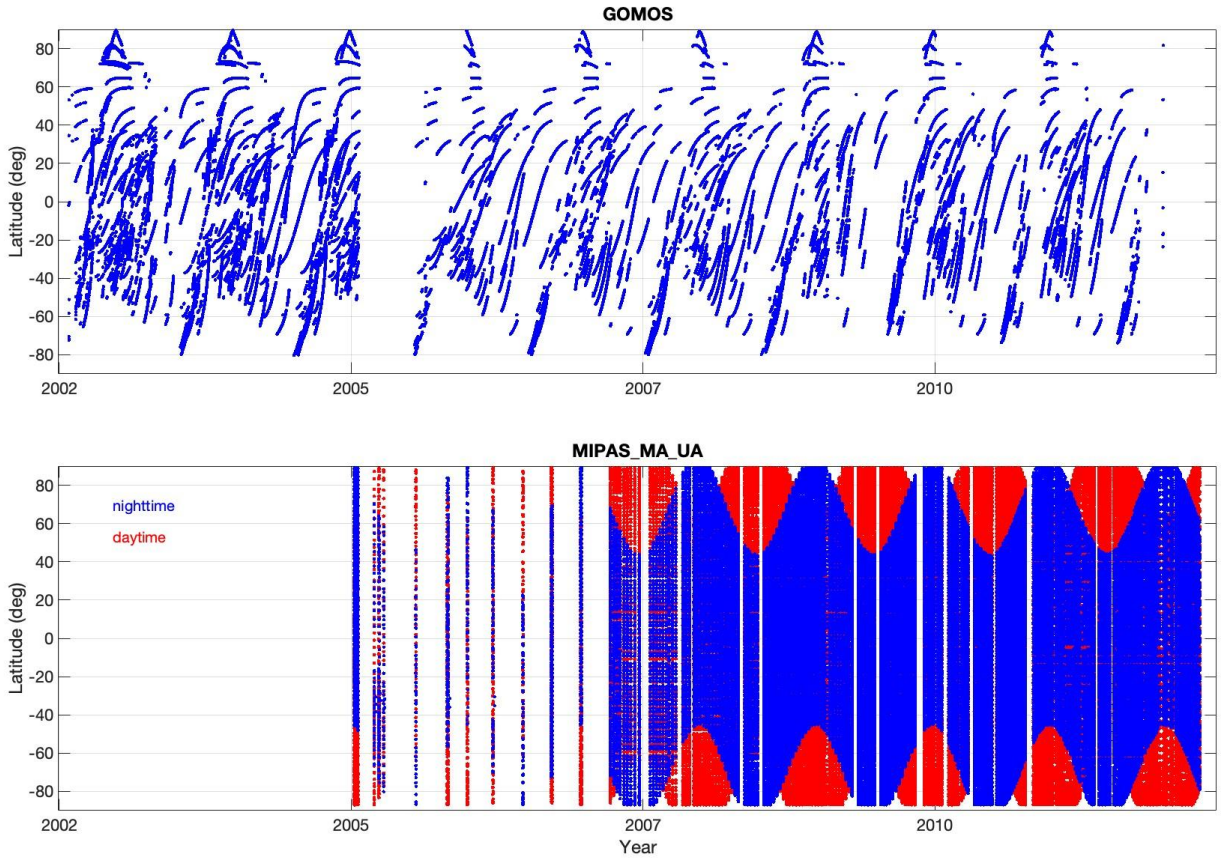

Figure S2: Latitude coverage by GOMOS and MIPAS_MA_UA mode.

Section S2. Conversion of GOMOS ozone profiles to pressure grid

GOMOS provides ozone number density profiles on an altitude grid. Since the temperature and pressure profiles in the GOMOS files are based on a combination of ECMWF analyses and the MSIS90 model and are therefore not very accurate, we applied the following approach. First, we computed ozone monthly zonal means on the GOMOS altitude grid. Then, we used the altitude-pressure relationship derived from MIPAS_MA_UA measurements to represent GOMOS profiles on a pressure grid. After 2007, when MIPAS_MA_UA provided dense coverage, altitude-pressure conversion profiles were used for each month and latitude zone. Before 2007, when MIPAS_MA_UA coverage was rather sparse, we used a climatology of altitude-pressure conversion derived from MIPAS data (i.e., conversion factors as a function of calendar month, latitude, and altitude). Figure S3 shows the differences in the altitude-pressure relationship when the original GOMOS pressure profiles are used (Figure S3, top) and after conversion using MIPAS_MA_UA data (Figure S3, bottom). When the original pressure data from the GOMOS files are used, the altitude differences can reach up to 1 km in the mesosphere and lower thermosphere. After conversion using MIPAS_MA_UA data, the altitude difference is exactly zero after 2007 by construction and does not exceed 0.5 km before 2007.

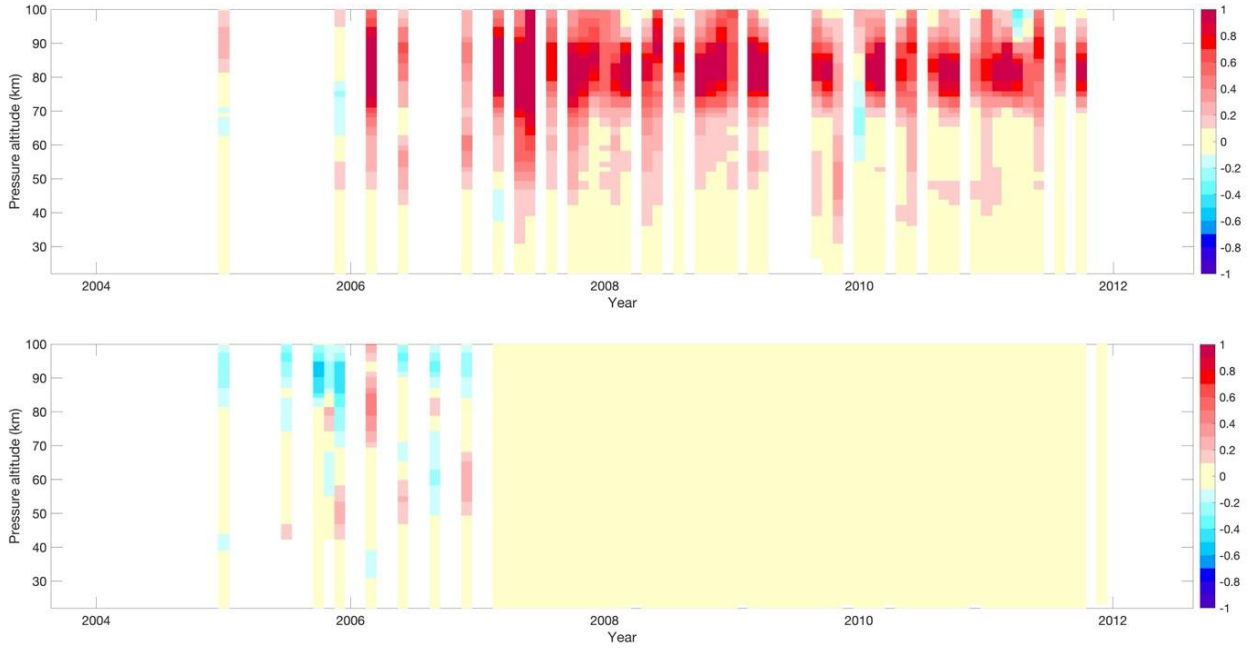

Figure S3: The time series of differences between GOMOS and MIPAS_MA_UA altitude (km) as a function of pressure altitude (pressure altitude $z = 16log_{10}(1013/P)$, where P is pressure in hPa) when the original GOMOS pressure-altitude relation is used (top) and when the MIPAS_MA_UA altitude-pressure relation is used (bottom).

Section S3. Example time series of ozone

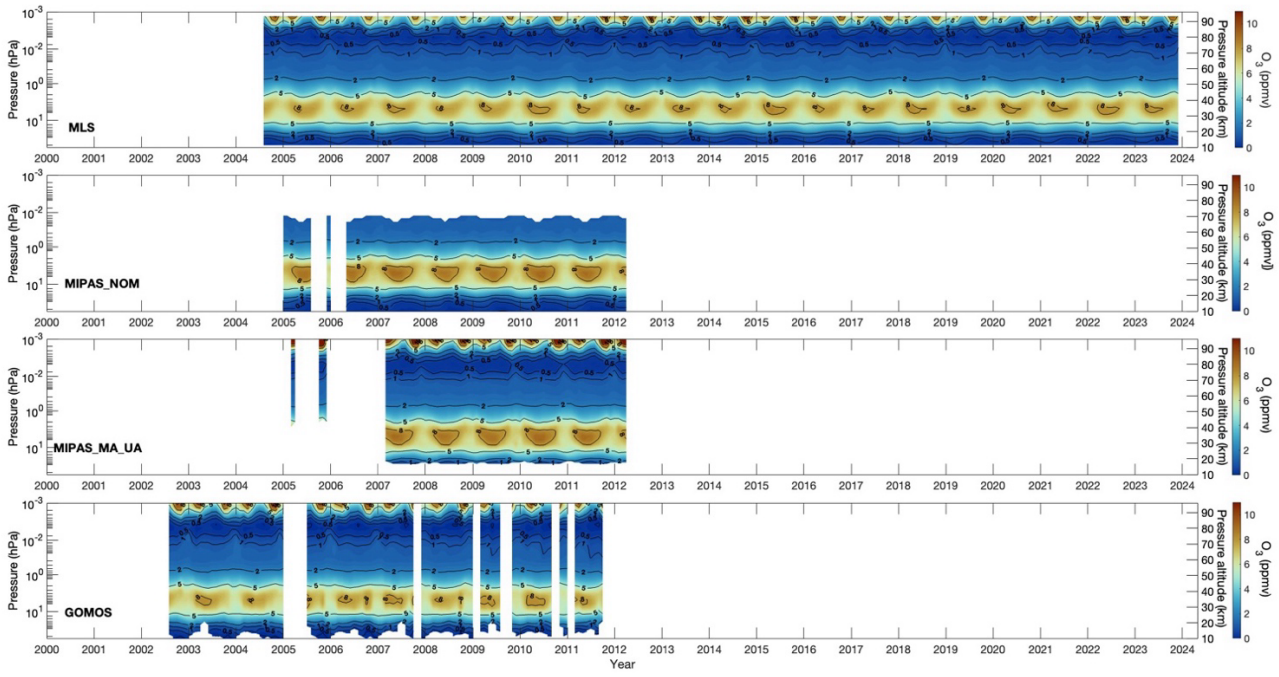

Figure S4: Time series of nighttime ozone at mid-latitudes (30°N–60°N) from MLS, MIPAS_NOM, MIPAS_MA_UA, and GOMOS (from top to bottom).

Section S4. Example of deseasonalised anomalies for MIPAS

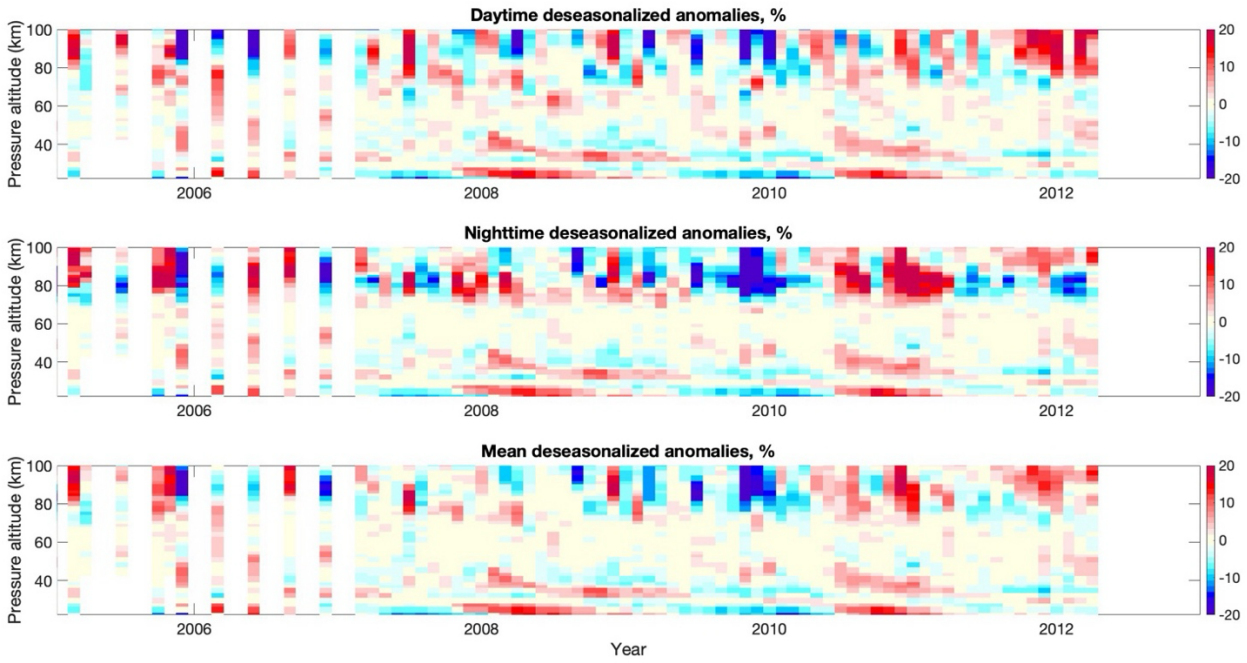

Figure S5: MIPAS_MA_UA deseasonalized anomalies at 0-10°N. Top: daytime anomalies, center: nighttime anomalies, bottom: the weighted mean of daytime and nighttime anomalies.

Section S5. Ozone trends from LOTUS model

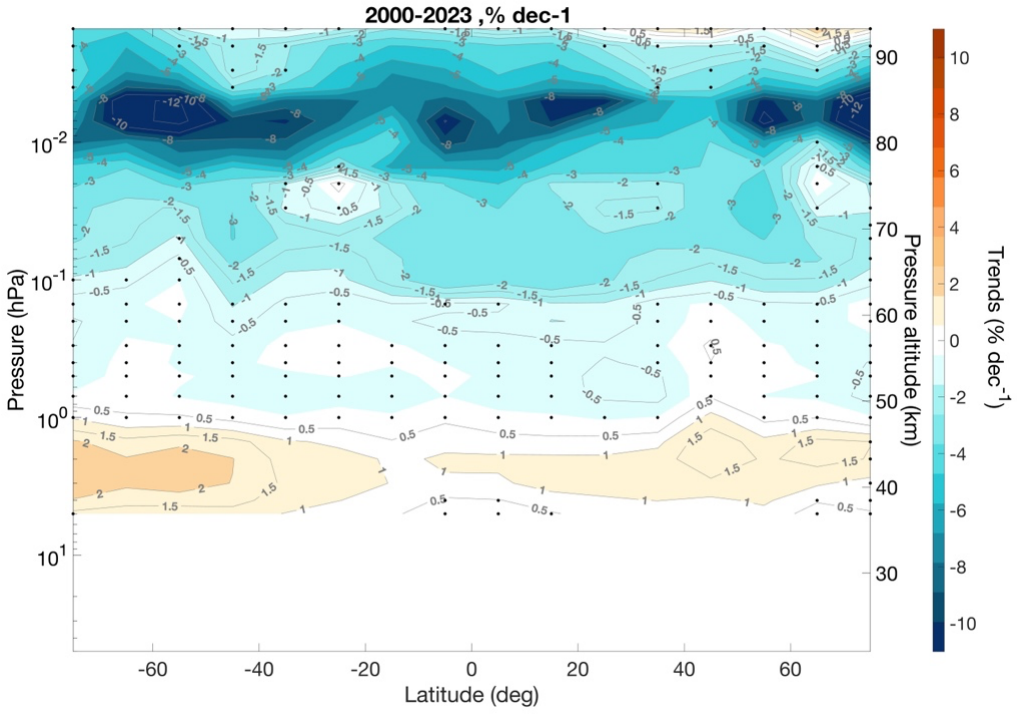

Figure S6: Latitude-altitude variation of ozone trends derived from the METEOR-O_3 dataset using LOTUS model. Trends are calculated over 2000-2023. The black dots denote trends that are not statistically significant at the 95% confidence level. Trends are given in % per decade.