Supplement to the paper "Merged SAGE II, Ozone_cci and OMPS ozone profiles dataset and evaluation of ozone trends in the stratosphere"

This supplement contains additional illustrations in support of the paper.

1 Intercomparison of deseasonalized anomalies from individual instruments

Figures 1- 7 show the deviations of the deseasonalized anomalies (in %) for individual instruments from the median deseasonalized anomalies of SAGE II, GOMOS, MIPAS, SCIAMACHY, OSIRIS, ACE-FTS and OMPS. In the beginning of SCIAMACHY and OMPS mission (Figures 3 and 6, these periods are indicated by black dashed lines), significant deviations from the median anomaly are observed. SCIAMACHY and OMPS observations from these periods are not included in the merged dataset.

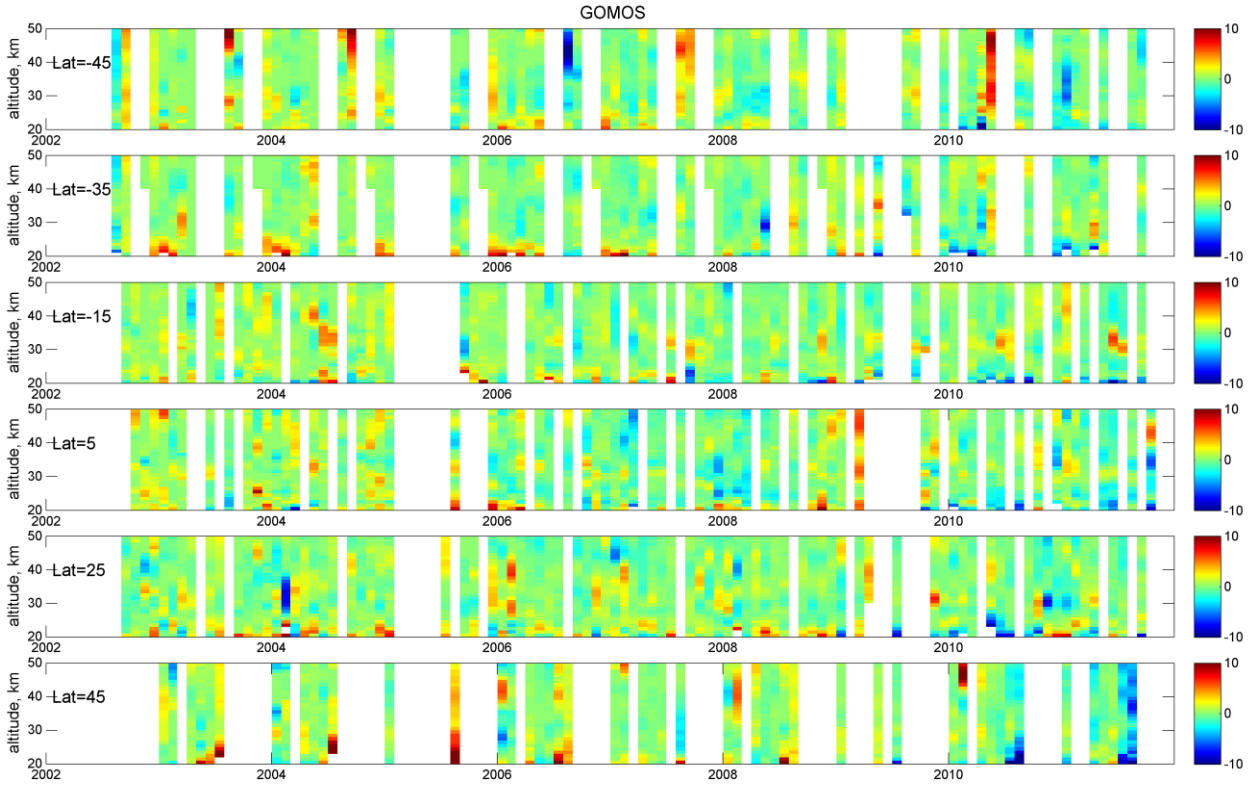

Figure 1. Deviations (in %, color) of GOMOS deseasonalized anomalies from the median deseasonalized anomalies of SAGE II, GOMOS, MIPAS, SCIAMACHY, OSIRIS, ACE-FTS and OMPS. 10°latitude bands are indicated by their centers in the panels.

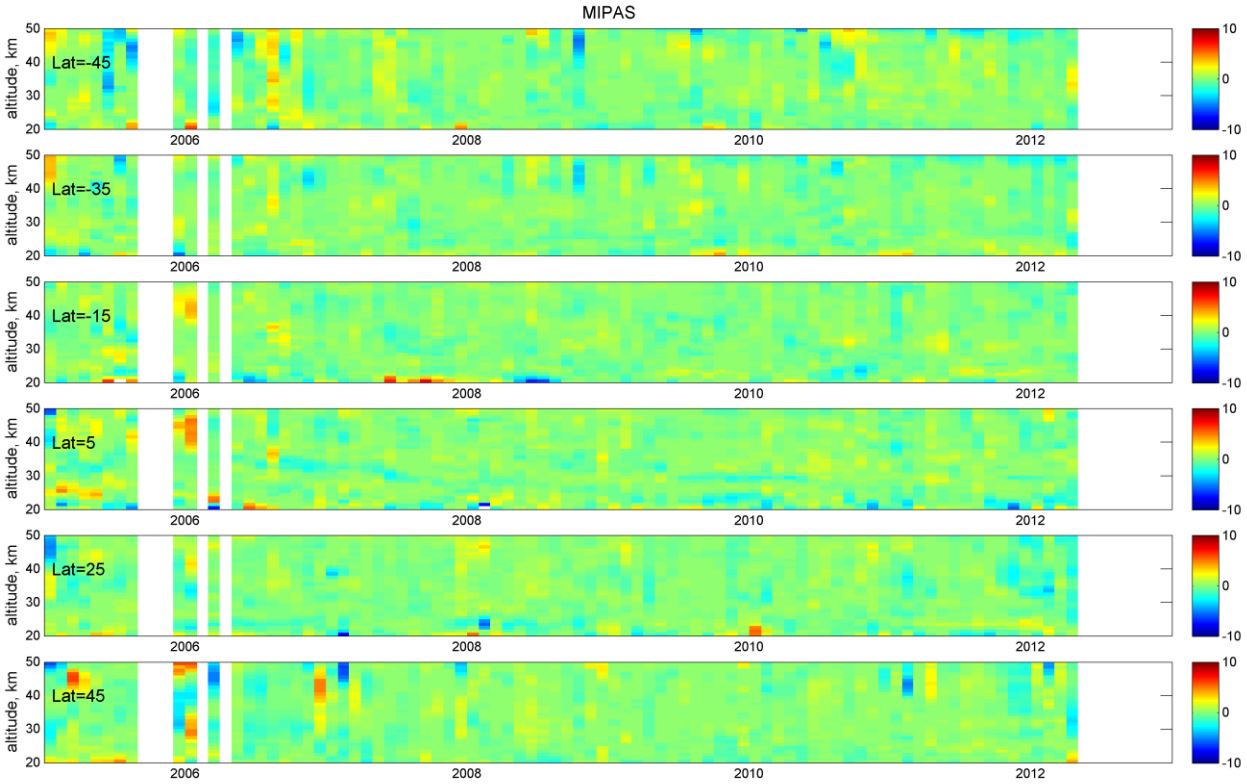

Figure 2. As Figure 1, but for the MIPAS deseasonalized anomalies

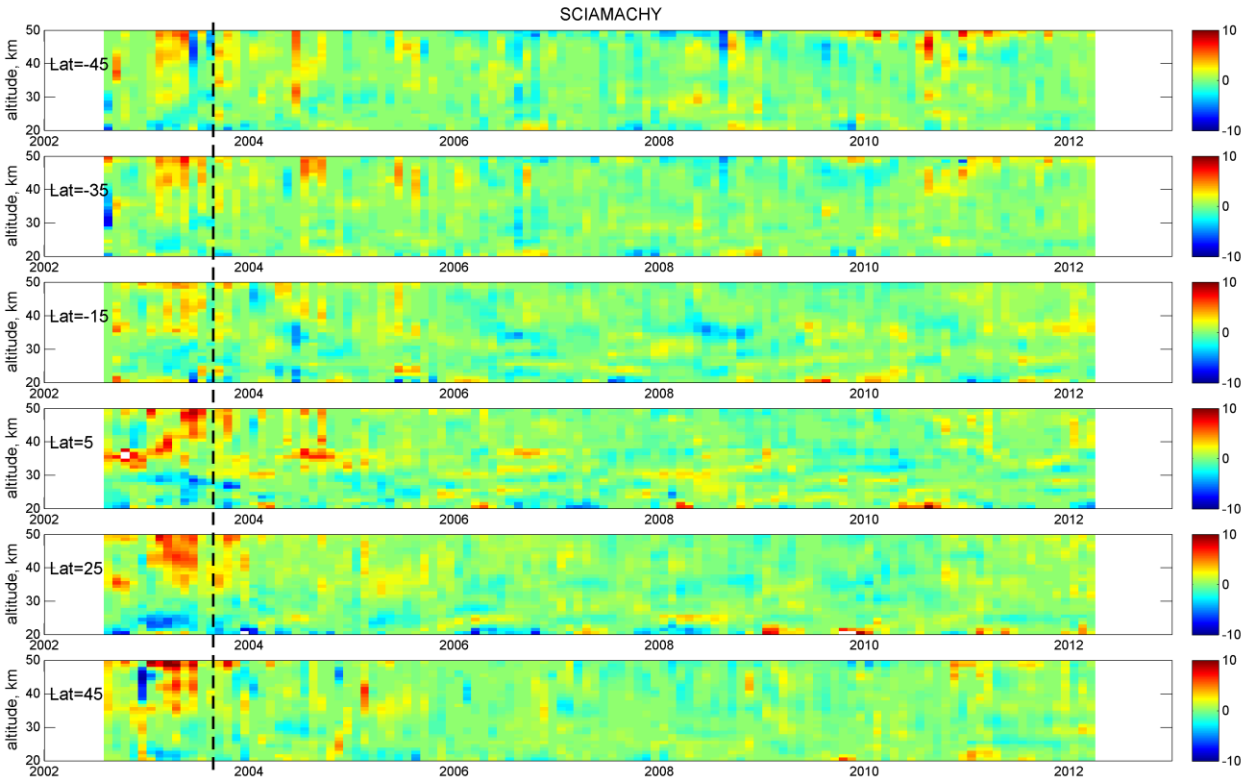

Figure 3. As Figure 2, but for the SCIAMACHY deseasonalized anomalies. The dashed line indicates the beginning of the mission when significant deviations from the median deseasonalized anomalies are observed. These data from the beginning of the mission are not used for the merged dataset.

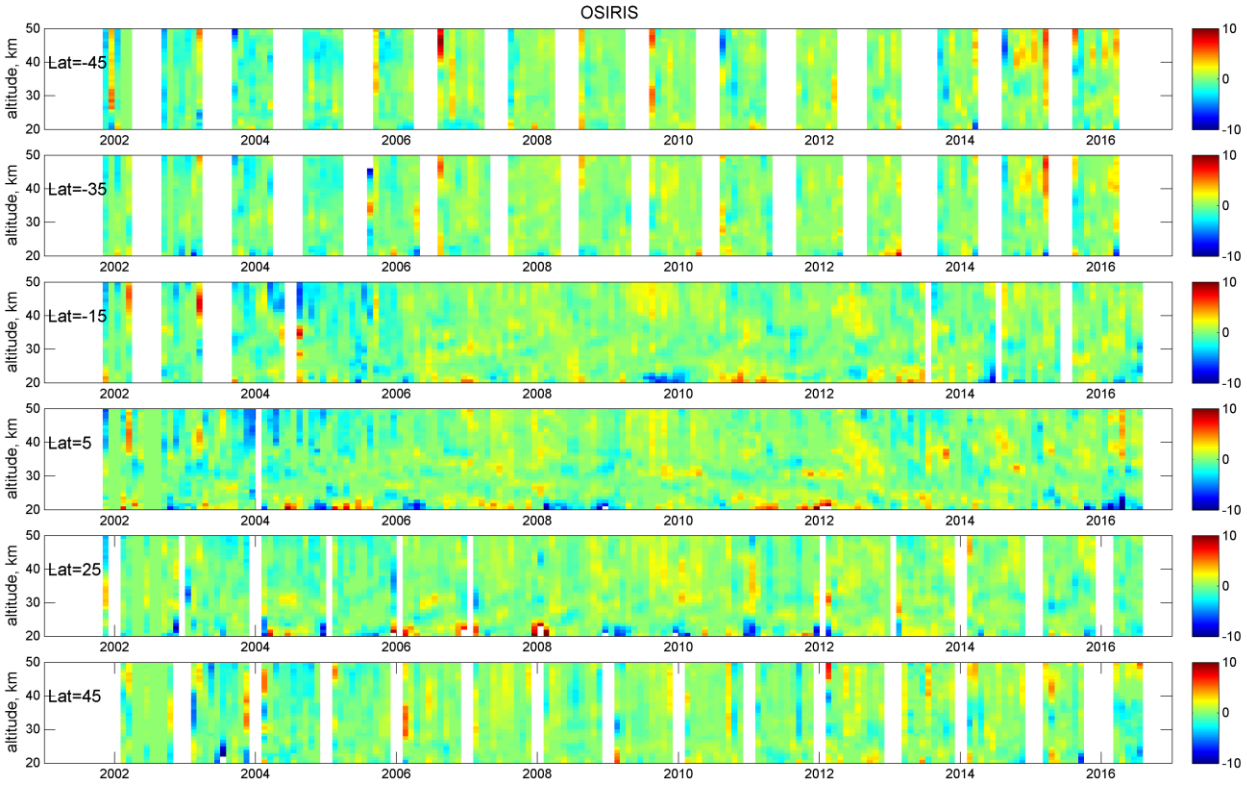

Figure 4. As Figure 1, but for the OSIRIS deseasonalized anomalies

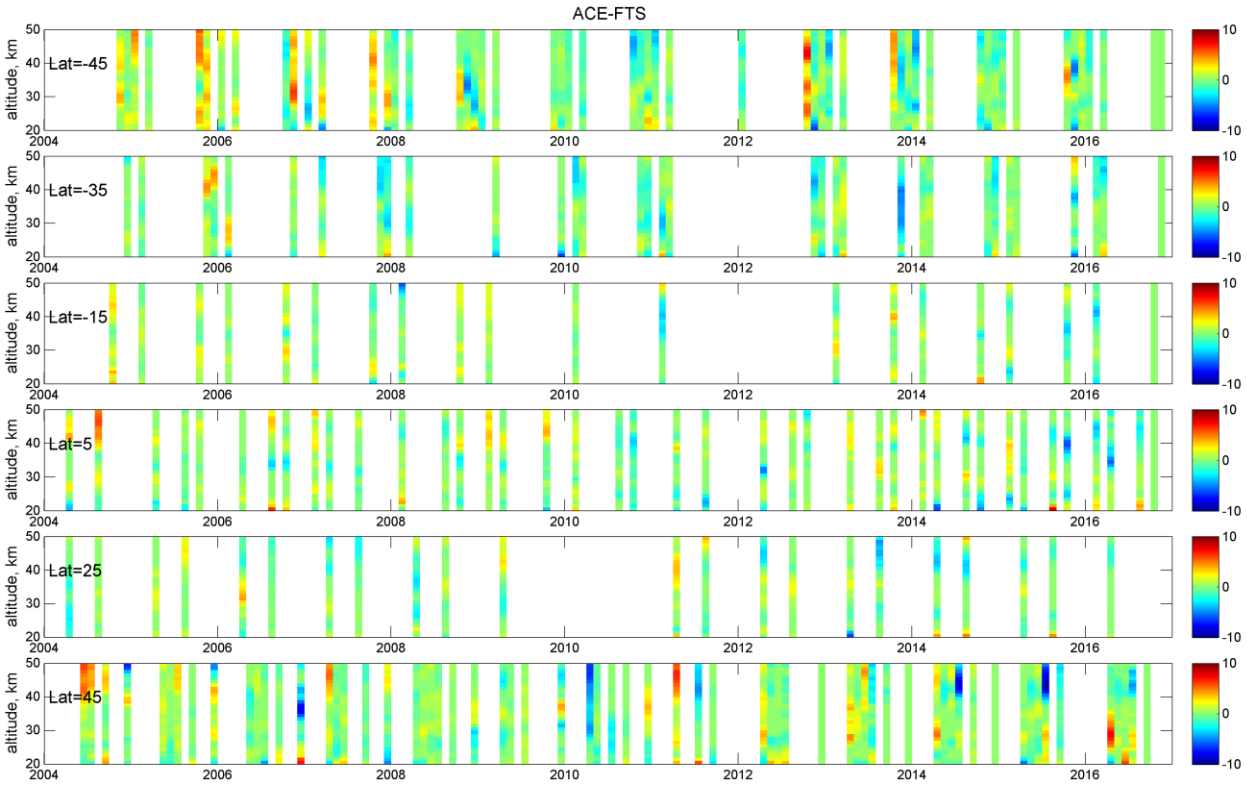

Figure 5. As Figure 1, but for the ACE-FTS deseasonalized anomalies

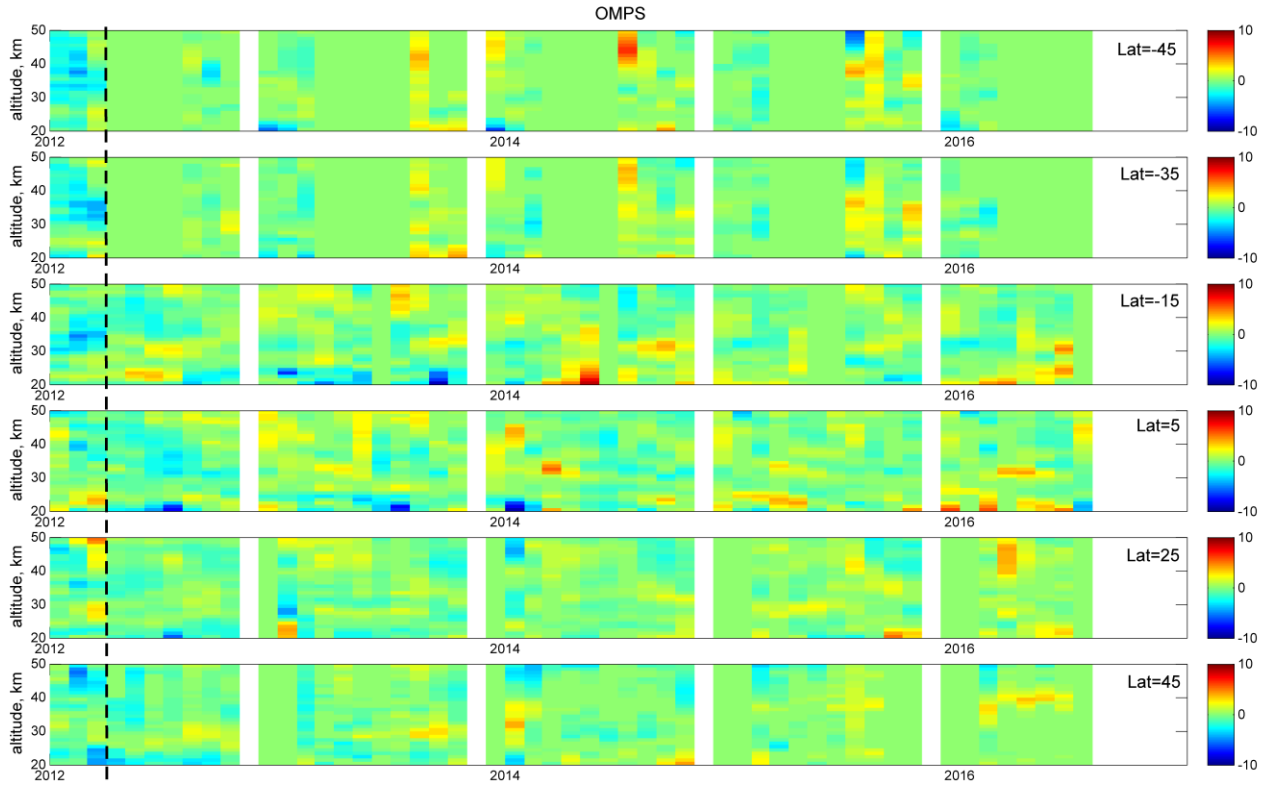

Figure 6. As Figure 3, but for the OMPS deseasonalized anomalies

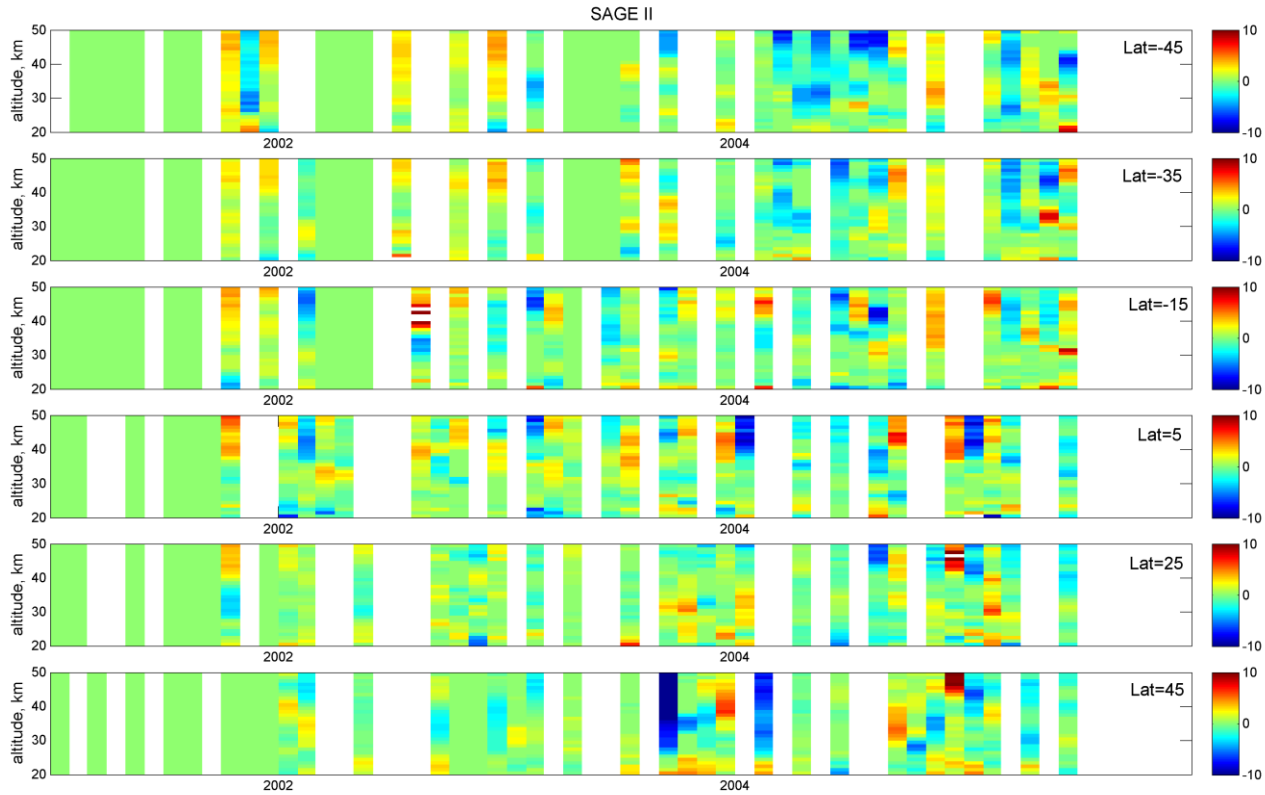

Figure 7. As Figure 1, but for the SAGE II deseasonalized anomalies

2 Representativeness of individual datasets in the merged dataset

The deseasonalized anomalies from individual dataset are usually very close to each other, so that several values can be typically found within the uncertainty interval of the merged anomaly $\Delta_{merged} \pm \sigma_{\Delta,merged}$. This is illustrated in Figure 8, where the instruments having data within $\Delta_{merged} \pm \sigma_{\Delta,merged}$ are indicated by colored markers.

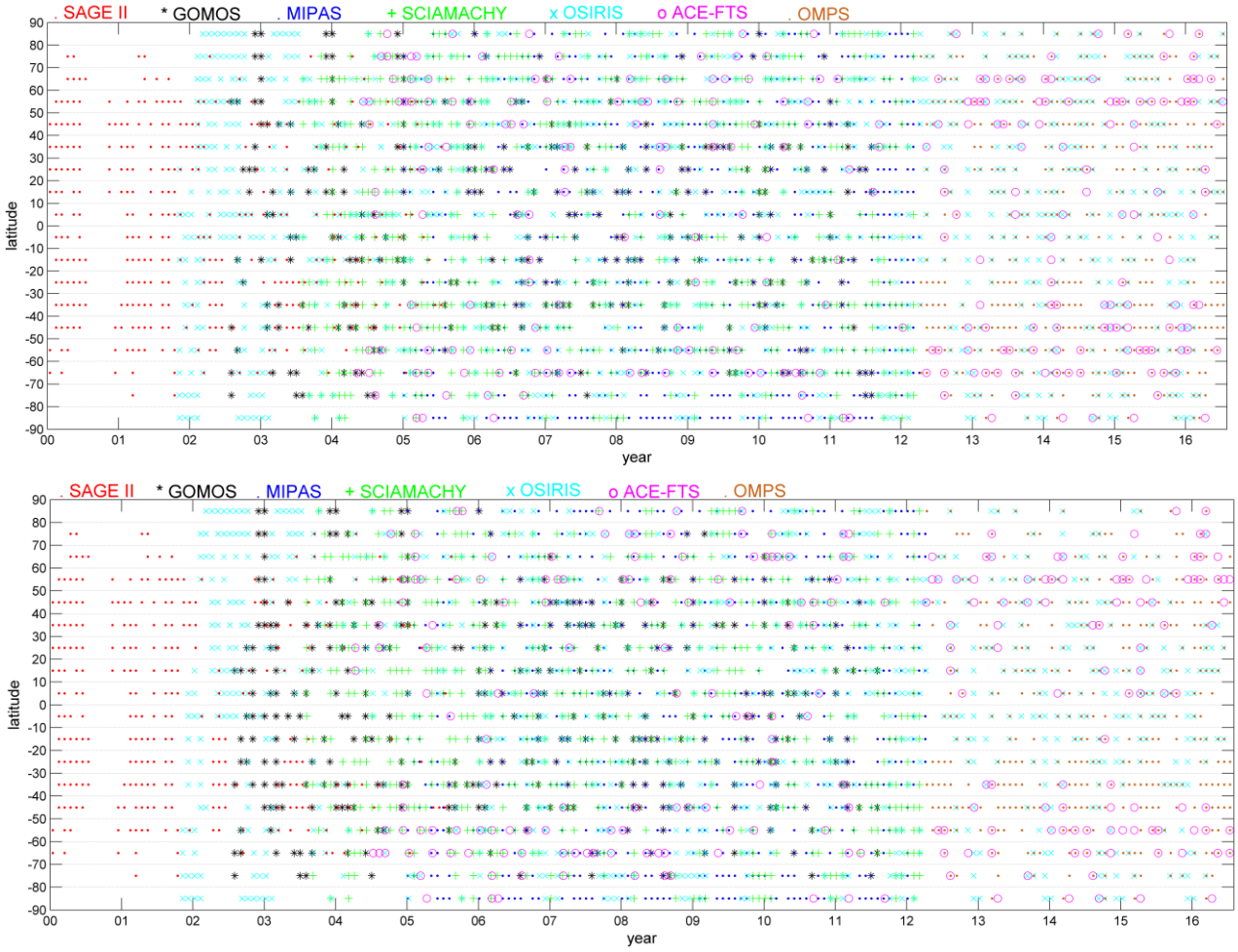

Figure 8. Colored markers indicate the instruments, which have anomalies within 1-σ errorbar from the median value (merged anomaly), for 25 km (top) and 45 km (bottom).

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3 Analyses of sensitivity of ozone trends

In this section, we present sensitivity analysis of ozone trends to:

1) Filtering of suspicions data

2) Using only instruments, which retrieve ozone number density profiles on a geometric altitude grid.

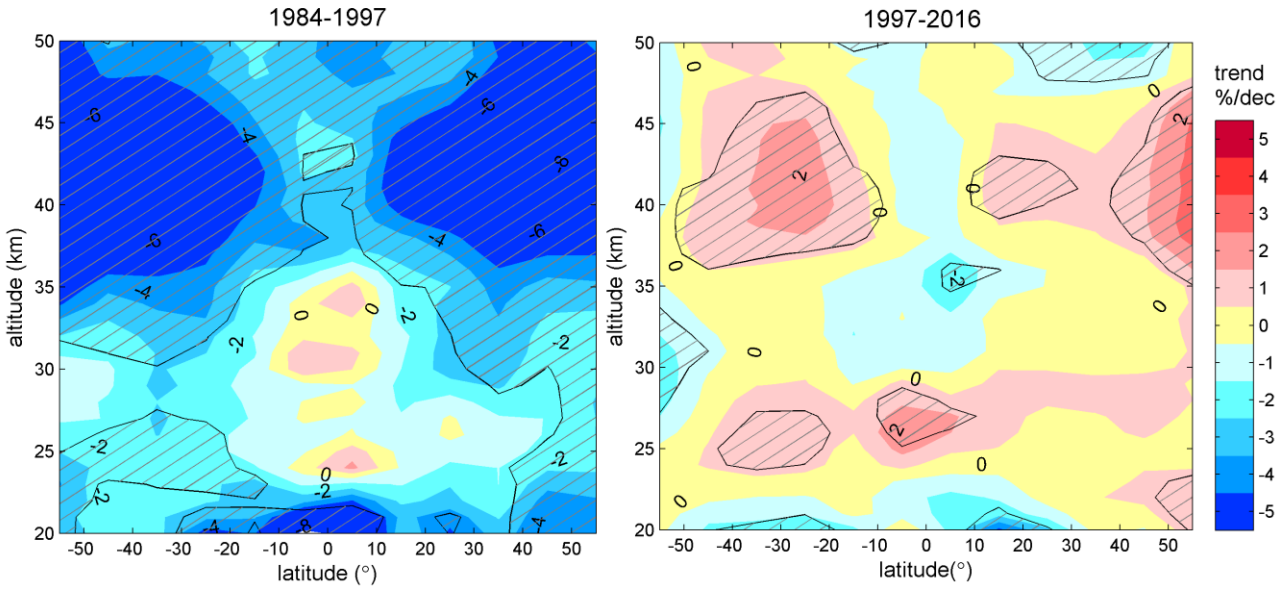

Figure 9. The ozone trend in % per decade for different latitudes for 1984–1997 (left) and 1997-2016 (right). Shaded areas show regions where trends are statistically different from zero at the 95% level. In the merged dataset, the early period of SCIAMACHY and OMPS are not filtered.

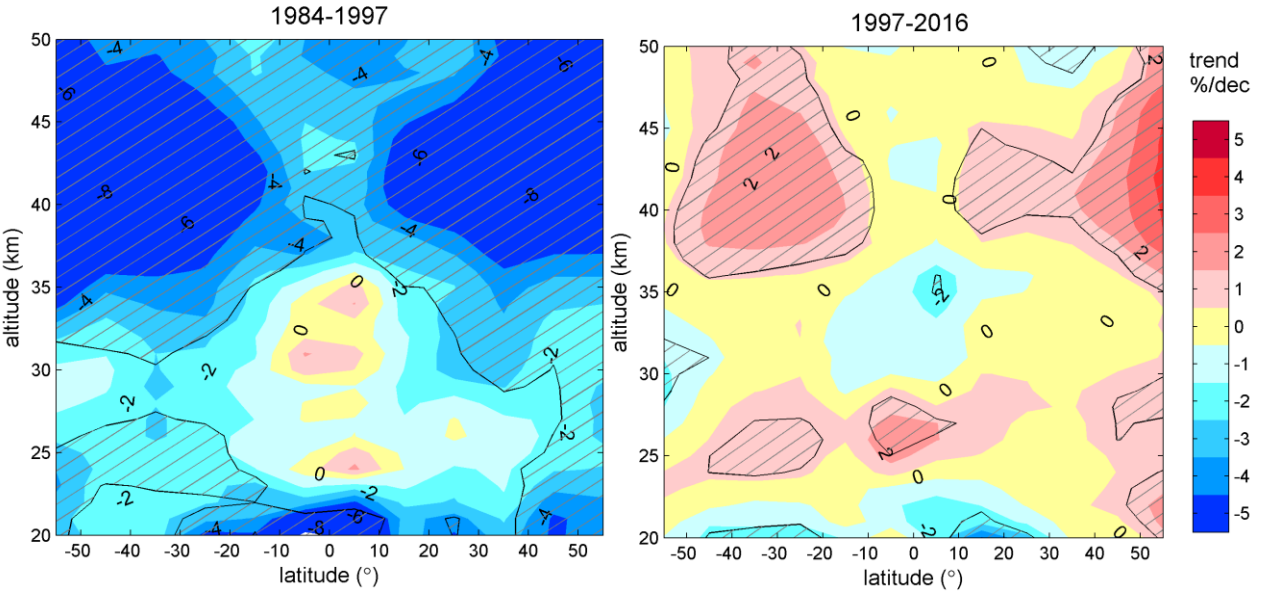

Figure 10. As Figure 9, but MIPAS and ACE-FTS data are not used for the merged dataset.

For the first test, we created a version of the merged dataset in the same way but keeping the early periods of SCIAMACHY and OMPS operations and performed the same analysis. Keeping all data results in only very minor changes after 1997 are observed in ozone trends (mostly less than 0.3 %/dec), as illustrated by Figure 9 (to be compared with Figure 10 in the main paper).

For the second test, we created a version of the merged dataset without MIPAS and ACE-FTS data. This merged dataset contains only data that were retrieved in number density on geometric altitude grid. As expected, only minor changes in ozone trends after 1997 are observed (Figure 10): they are less than 0.3 % /dec below 40° latitude and are up to 1 %/dec at latitudes 40°-60°, in both hemispheres.

4 From merged deseasonalized anomalies to merged ozone profiles

Computation of number density profiles from the merged deseasonalized anomalies is performed according to Eq.(4) in the paper: the seasonal cycle is restored. The best estimate of the amplitude of seasonal cycle is given by MIPAS measurements, because they provide all season pole-to-pole measurements with dense sampling. We take the absolute values of the seasonal cycle from SAGE II and OSIRIS in the overlapping period (which are very close to each other and also to GOMOS measurements), thus preserving the consistency in the dataset through the whole observation period. Technically, the seasonal cycle corresponding to the merged dataset is the MIPAS seasonal cycle, which is offset to the mean SAGE II and OSIRIS values. The illustrations of MIPAS, OSIRIS and SAGE II, and "merged" seasonal cycles are shown in Figure 11.

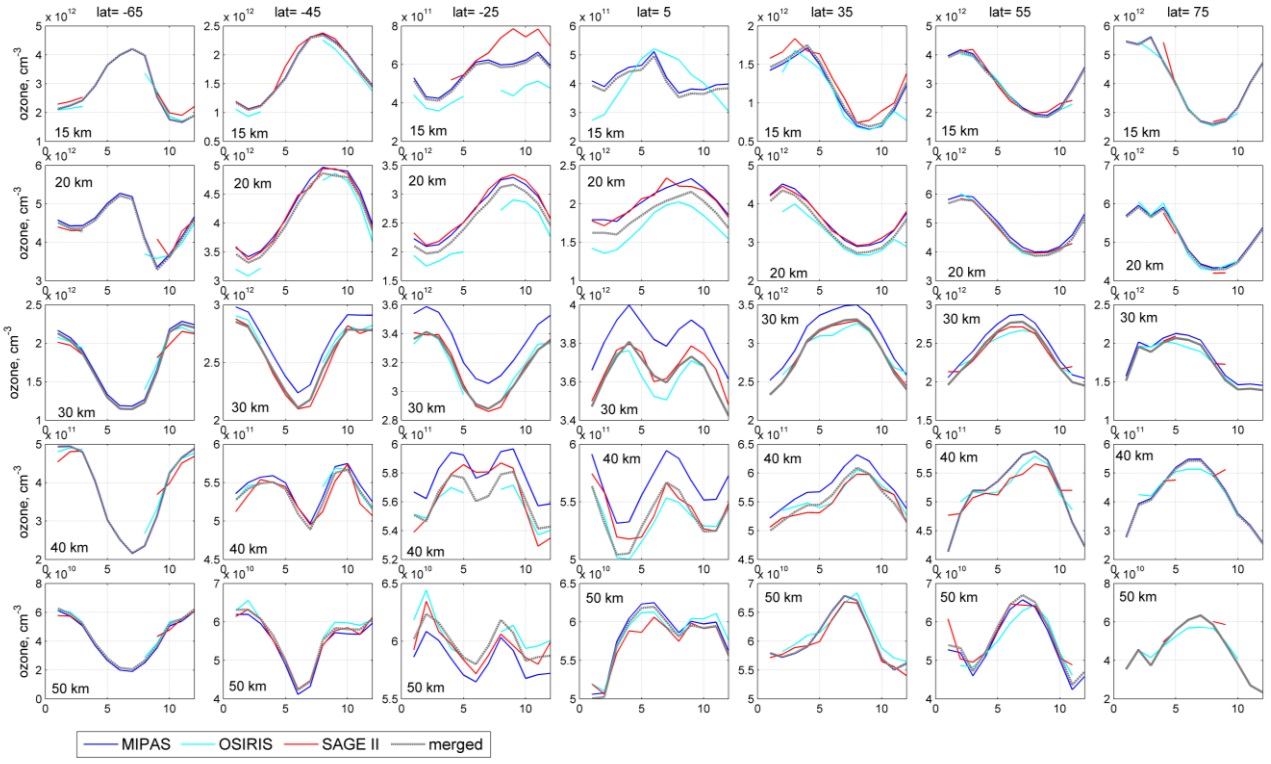

Figure 11. Illustration of computing the seasonal cycle corresponding to the merged dataset (dashed grey lines). Colored lines: seasonal cycle estimates for MIPAS (blue), OSIRIS (cyan) and SAGE II (red).

The examples of ozone number density time series from individual instruments and the merged SAGE-CCI-OMPS dataset are shown in Figure 12, for the latitude band 50°-60° N.

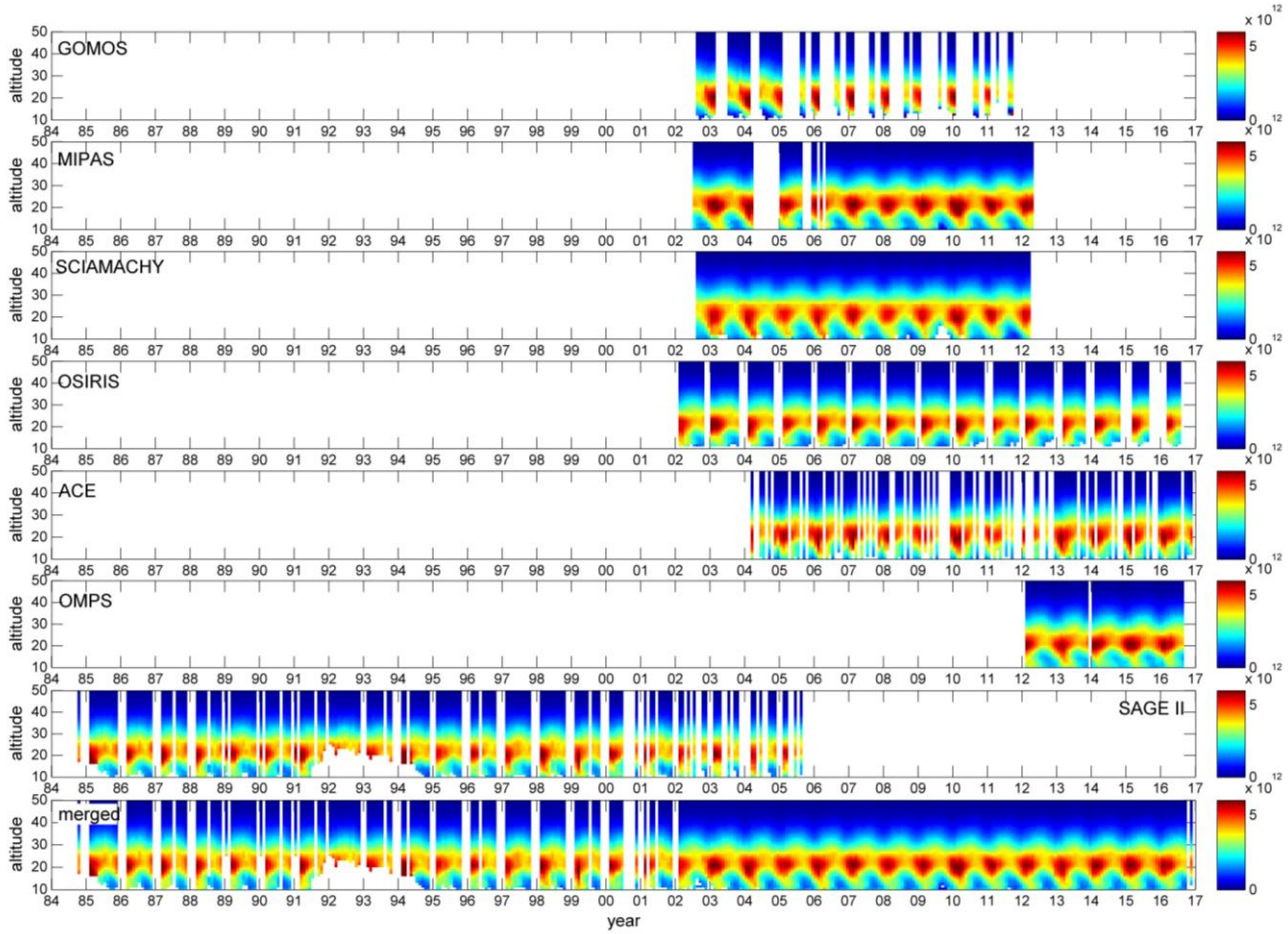

Figure 12. Ozone number density (color: cm^{-3}), for individual datasets and the merged SAGE-CCI-OMPS dataset, for the latitude band 50°-60° N.