

REPORT ABOUT ENVISAT GOMOS NRT PRODUCTS (GOM_RR_2P) FOR MARCH 2008

Rossana Dragani

*ECMWF, Shinfield Park, Reading, RG2 9AX, United Kingdom,
Emails: Rossana.Dragani@ecmwf.int, Tel: 0044 118 9499259*

April 9, 2008

1. Key points for March 2008

- There were no data in the BUFR files at latitudes northern than 35N, and only a few observations were available at latitudes southern of 60S.
- The quality of the temperature in the GOMOS files was found stable and in good agreement with the ECMWF temperature. The monitoring statistics showed that, both in the global average and in the mean over latitudinal bands, the first guess and analysis departures were up to about -1% (-2 K) in all the Stratosphere. Larger first guess and analysis departures were found at mesospheric levels between 0.4 and 0.2hPa with differences within -2 and -3% (-4 and -6K) at all latitudes.
- The departures between GOMOS and ECMWF ozone profiles were within -5 and +15% in most of the stratosphere and lower mesosphere (between 40 and 0.2hPa) in the global mean. Larger departures were found elsewhere. The standard deviations of the departures were larger than 10% at all levels.
- When averaged over latitudinal bands, the GOMOS observations exhibited lower ozone values in the mid Stratosphere at all latitudinal bands (typically 5 to 10% lower), and larger elsewhere. The departures between the GOMOS ozone values and their model equivalent are typically within $\pm 10\%$ at midlatitudes in the NH, between $\pm 5\%$ in the tropics, and between -10 and +25% at most levels in the stratosphere and mesosphere at midlatitudes in the SH. The standard deviations of the analysis and first guess departures were about 10% in the stratosphere at midlatitudes in the NH, and within 10 and 30% at most levels in the tropics. At midlatitudes in the SH, the standard deviations of the analysis and first guess departures were larger than 10% at all levels, in particular they were larger than 50% in the lower Stratosphere ($p > 40\text{hPa}$), and in the Mesosphere.
- The quality of the water vapour retrievals was still quite poor despite the data used in the monitoring statistics were only those acquired in dark-limb conditions. The monitoring statistics showed that the GOMOS water vapour values were from one to four orders of magnitude larger than their model equivalent at all vertical levels and latitudes. The largest differences between GOMOS WV and ECMWF WV were still found in the Stratosphere. The geographical distribution of the GOMOS water vapour observations showed that, with the exception of a few scattered data, most of the WV measurements were sampled in a channel around the Equator. A slightly higher level of agreement between the GOMOS WV data and their model equivalent was found at midlatitudes in the SH, in particular in the upper stratosphere where the first-guess and analysis departures were typically about one order of magnitude.
- The monitoring statistics for March 2008 were produced with the operational ECMWF model, CY32R3.

2. Quality and amount of received data

Data coverage and amount of received data during March 2008 are shown in figures 1 and 2 in the temperature, ozone and water vapour reports. Overall, about 3180 (good) observations were available for temperature and just over 3000 (good) observations were available for ozone, with the largest number of observations available in the mesosphere and upper stratosphere, and only a fraction of them were available in the lower stratosphere (see figure 3 in the attached temperature and ozone reports). For what concerning the water vapour, up to 690 observations were available in the period under consideration, with the largest number in the stratosphere (see figure 3 in the attached water vapour report). There were no temperature and ozone data available at latitudes northern than 35N and only a few observations were available at latitudes southern than 60S for the period under consideration. With the exception of a few scattered data, most of the WV observations were sampled in the tropics.

3. GOMOS temperature data

The quality of the temperature data in the GOMOS BUFR files was stable and consistent with that reported in the last few months. The profile plots (temperature report: Figures 3-7) show that both in the global average and in the average over latitudinal bands, temperature in the GOMOS BUFR files was generally colder than the operational ECMWF temperature at all vertical levels. Both the global mean and the area mean first guess and analysis departures were up to about -1% (-2 K) in the Stratosphere. Larger first guess and analysis departures were found in the Mesosphere with the largest difference between -2 and -3% (-4 to -6K) at 0.2 hPa. The standard deviations of the departures were about 1% at all vertical levels and latitudes.

The scatter plots (temperature report: Figures 8-15) showed a similar level of agreement between the temperature in the GOMOS files and the operational ECMWF temperature, with a variability of the first-guess departures within $\pm 4\text{K}$ at most vertical levels in the Stratosphere. Slightly larger departures were found in the Mesosphere.

The Hovmoeller plots and the timeseries of the temperatures in the GOMOS files and their departures from the ECMWF temperature first-guess and analyses at several levels are shown in Figures 16, 17, 20-23 of the temperature report, respectively. Both the Hovmoeller plots and the timeseries confirmed the results discussed above.

4. GOMOS ozone data

The quality of the GOMOS ozone profiles was stable during March and consistent with that of the previous months. The profile plots (ozone report: Figures 3-7) showed that both the ozone first guess and analyses were within the observation one-standard deviation range at most levels and latitudinal bands, and that the GOMOS ozone generally exhibits larger values than their model equivalent. In the global average, the first-guess departures were within -5 and +15% in most of the stratosphere and lower mesosphere (between 40 and 0.2hPa). Larger departures were found elsewhere. The standard deviations of the departures were larger than 10% at all levels, and in particular larger than 50% in the mesosphere.

When averaged over latitudinal bands, the level of agreement between GOMOS ozone observations and the ECMWF ozone fields that was found in the global mean was generally confirmed. The GOMOS observations exhibited lower ozone values in the mid Stratosphere at all latitudinal bands (typically 5 to 10% lower), and larger elsewhere. At midlatitudes in the NH, the departures between the GOMOS ozone values and their model equivalent were typically within $\pm 10\%$ at most levels. Smaller departures (values typically within $\pm 5\%$) were found in the lower Stratosphere (for $p < 30\text{hPa}$) and lower Mesosphere (for $p > 0.3\text{hPa}$) in the tropical band. At midlatitudes in the NH, the departures between the GOMOS ozone values and their model

equivalent were between -10 and +25% at most levels in the stratosphere and mesosphere. The standard deviations of the analysis and first guess departures were about 10% at most levels at midlatitudes in the NH and within 10 and 30% at most levels in the tropics. At midlatitudes in the SH, the standard deviations of the analysis and first guess departures exhibited values larger than 10% at all levels, and in particular values larger than 50% in the lower Stratosphere ($p > 40\text{hPa}$), and in the Mesosphere.

The scatter plots (ozone report: Figures 8-15) are consistent with the results reported in February, and confirmed the above analysis. In particular, large scatter was still found in the GOMOS ozone observations at most vertical levels that led to a large scatter in the first-guess departures.

The timeseries of GOMOS ozone and departures at several levels and the Hovmoeller plots are shown in figures 16-19, and 20-21 of the ozone report, respectively. Both the timeseries and the Hovmoeller plots confirm the level of agreement between NRT GOMOS ozone retrievals and the ECMWF ozone analyses discussed above.

5. Water vapour data

As found in the previous months, also in March the level of agreement between the GOMOS water vapour and the ECMWF water vapour first guess and analyses was poor at all levels and latitudinal bands.

The profile plots (Water Vapour report: Figures 3-4) showed that the GOMOS water vapour values were from one to four orders of magnitude larger than those given by the model at all vertical levels and latitudinal bands. As discussed in the last months, the largest differences were still found in the Stratosphere, where not only did the GOMOS observations exhibit on average values of four orders of magnitude larger than their model equivalent, they also were larger than the mean GOMOS tropospheric observation. A slightly higher level of agreement was found at high latitudes in the SH. Here the GOMOS WV observations still exhibited higher values than their model equivalent, but the departures were considerably smaller than those seen elsewhere. In addition, the WV content especially in the upper stratosphere decreases with height as expected. Yet, the first-guess and analysis departures were more than one order of magnitude at all levels. However, it should be noted that the number of observations available at these latitudes is probably too small to make the results statistically significant.

The scatter plots (water vapour report: Figures 5-10) confirm the above analysis. They showed large scatter in the GOMOS water vapour data at all vertical levels and latitudes, and as a consequence of that they also showed large scatter in the first guess departures.

The Hovmoeller plots and the timeseries of GOMOS water vapour and departures at different levels are presented in figures 11, and 13 of the water vapour report, respectively. The Hovmoeller plots, and the monthly mean geographical distribution (figure 12) showed that with the exception of a few scattered data available at mid latitudes, most of the WV observations were sampled in the tropics. In addition, because of the very large difference between the ECMWF WV and the GOMOS WV, very little signal was detected in the time series at most levels.

6. Remarks

This monitoring report was produced with the operational ECMWF model (CY32R3). Ozone layers from SBUV/2 on NOAA-16, NOAA-17, NOAA-18 and SCIAMACHY total column ozone data produced by KNMI were actively assimilated.

The results presented in this reports made use of only the observations acquired in dark-limb conditions.

All ozone values are in Dobson Units (DU), temperatures are in K, and water vapour partial columns are in mg/m^2 .

REPORT ABOUT ENVISAT GOMOS NRT OZONE DATA (GOM_RR_2P) FOR MARCH 2008

Rossana Dragani

ECMWF, Shinfield Park, Reading, RG2 9AX, United Kingdom,
Emails: Rossana.Dragani@ecmwf.int, Tel: 0044 118 9499259

April 9, 2008

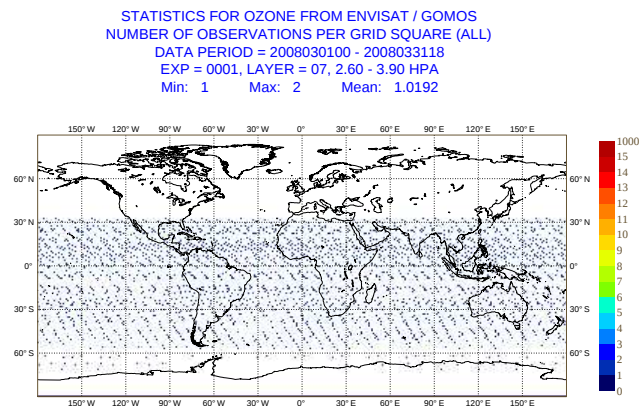


Fig. 1. Geographical distribution of mean number of ENVISAT GOMOS NRT ozone data for layer 7 (2.60-3.90 hPa) for March 2008.

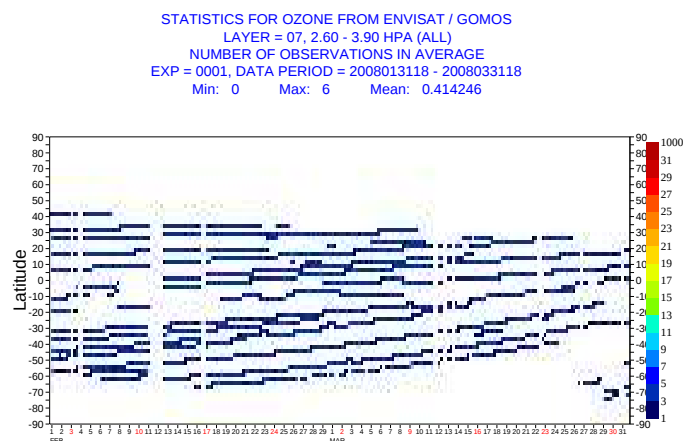


Fig. 2. Hovmoeller diagram of zonal mean number of data of ENVISAT GOMOS NRT ozone data per 6-hour cycle for layer 7 (2.60-3.90 hPa) for February-March 2008.

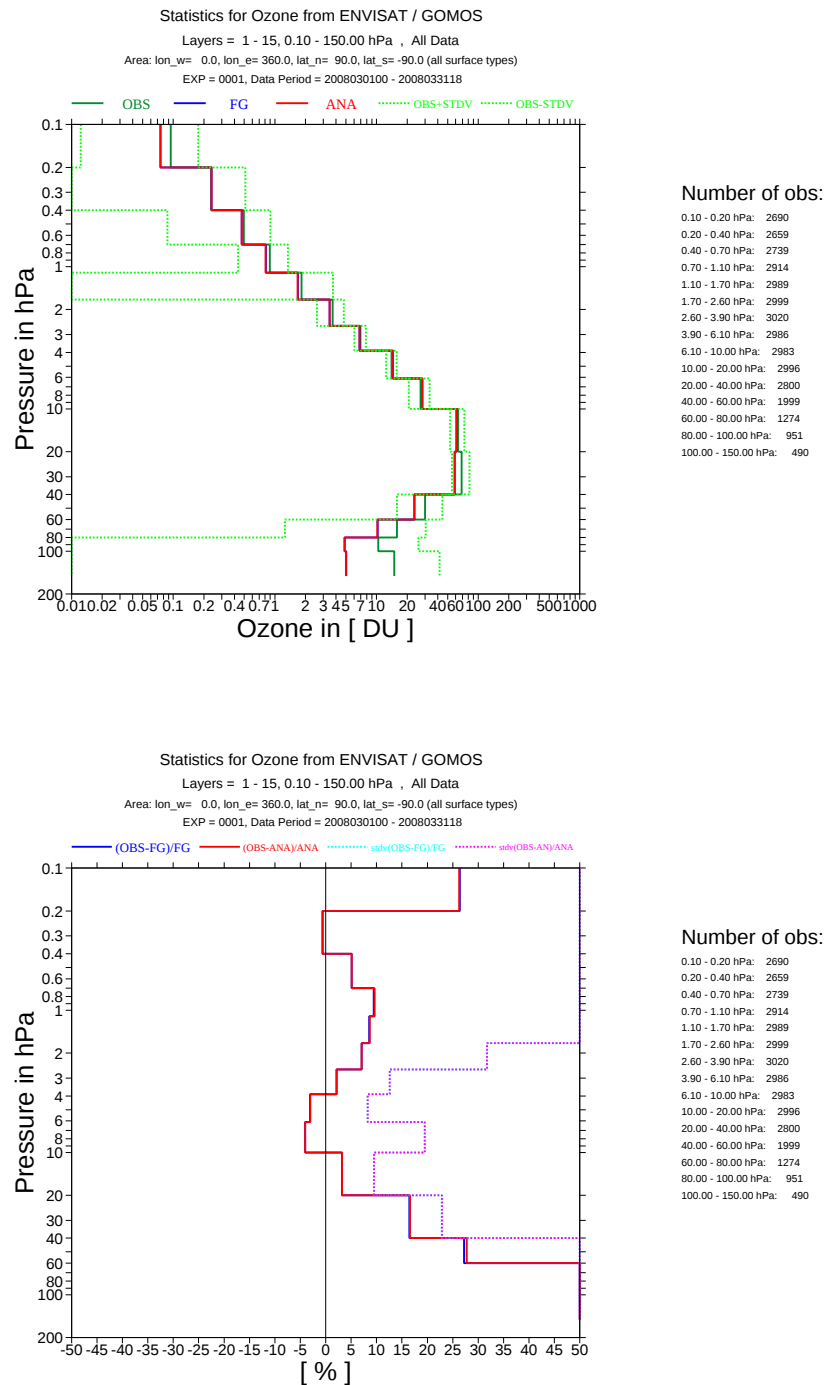


Fig. 3. Time mean vertical distribution of ENVISAT GOMOS NRT ozone data in DU for March 2008 (global mean). The top plot shows the mean analysis values (red), the mean first-guess (blue), the mean observation (red), and the mean observation (green) $\pm$ 1 standard deviation (green dotted lines). The bottom plot shows the departures and the standard deviation of the departures in %. Plotted are the partial columns for the 15 layers listed to the right of the diagrams.

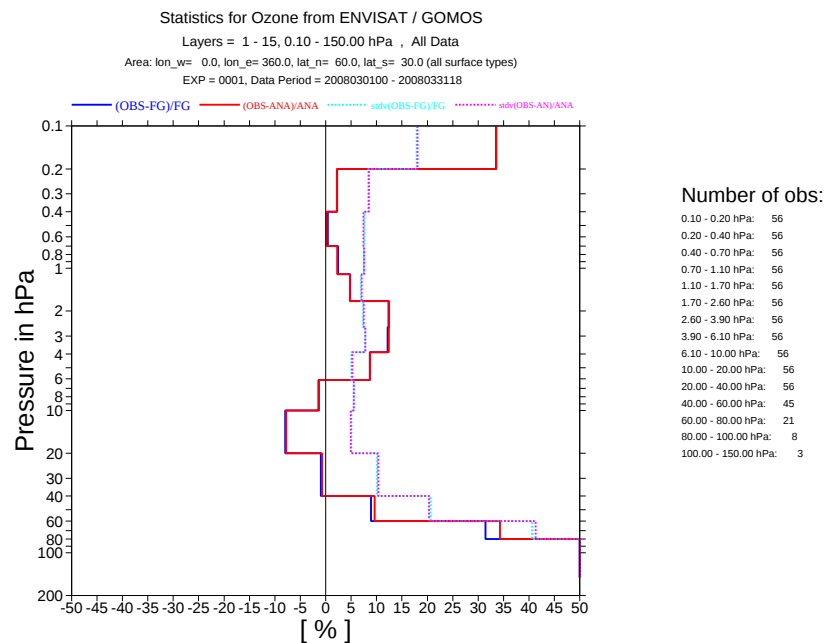
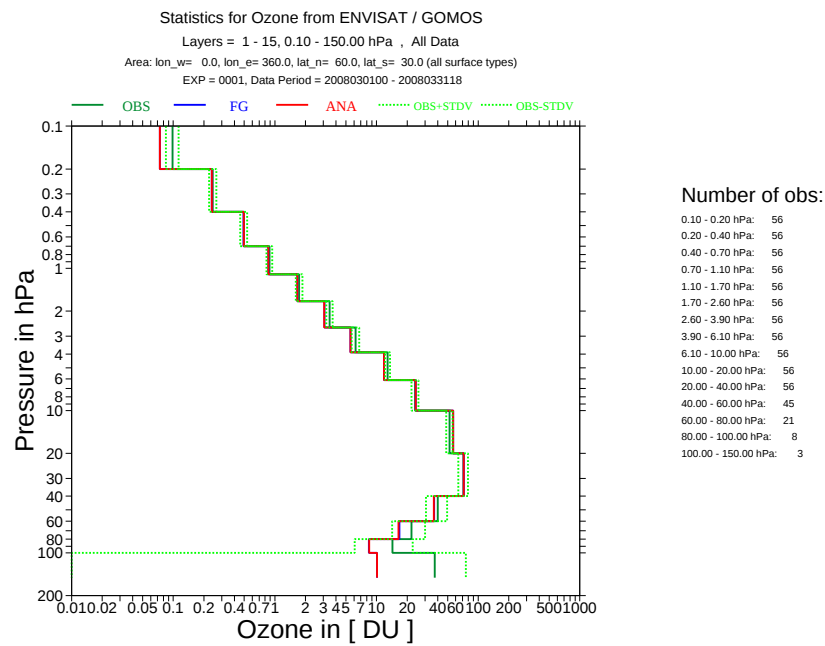


Fig. 4. As Fig. 3 but for 60-30N.

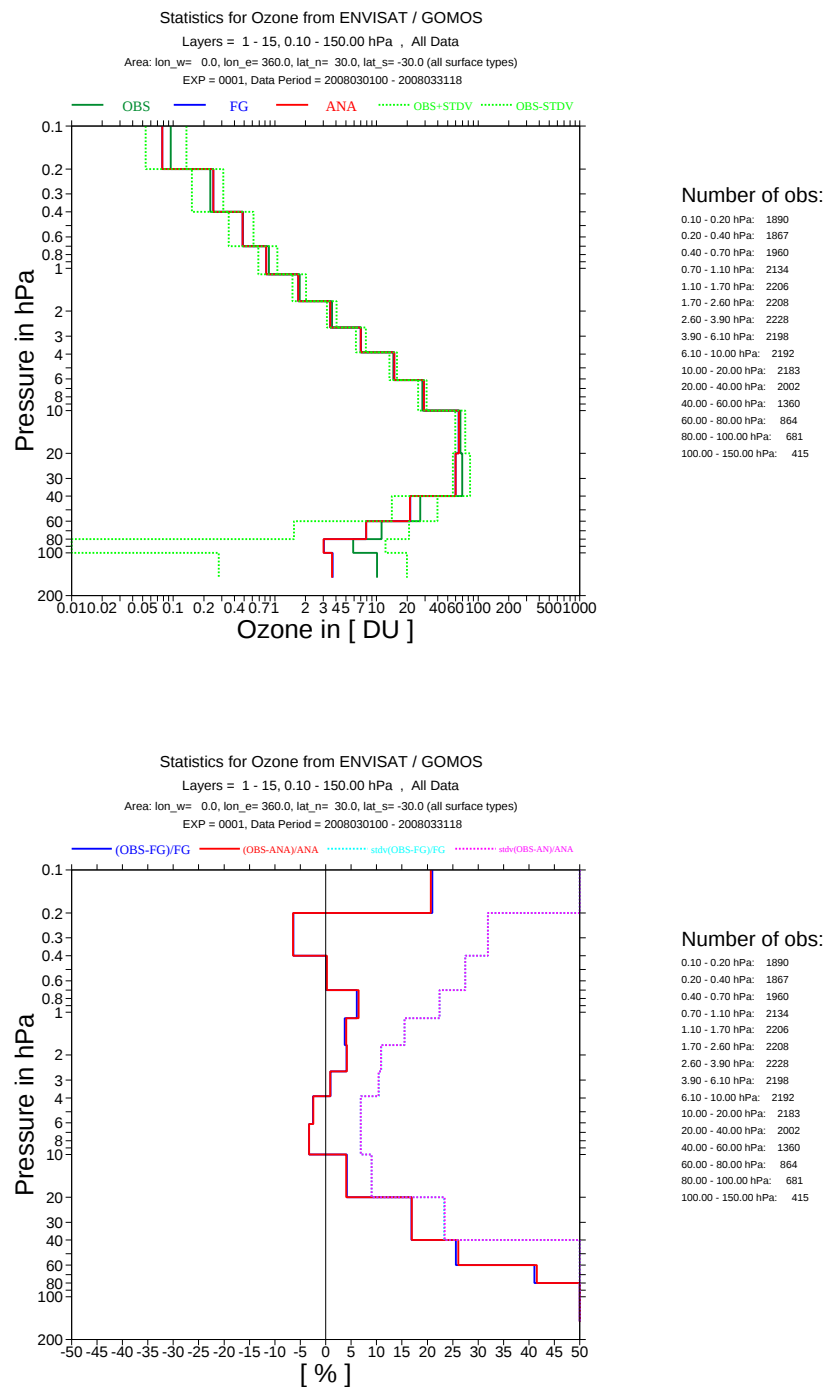


Fig. 5. As Fig. 3 but for 30N-30S.

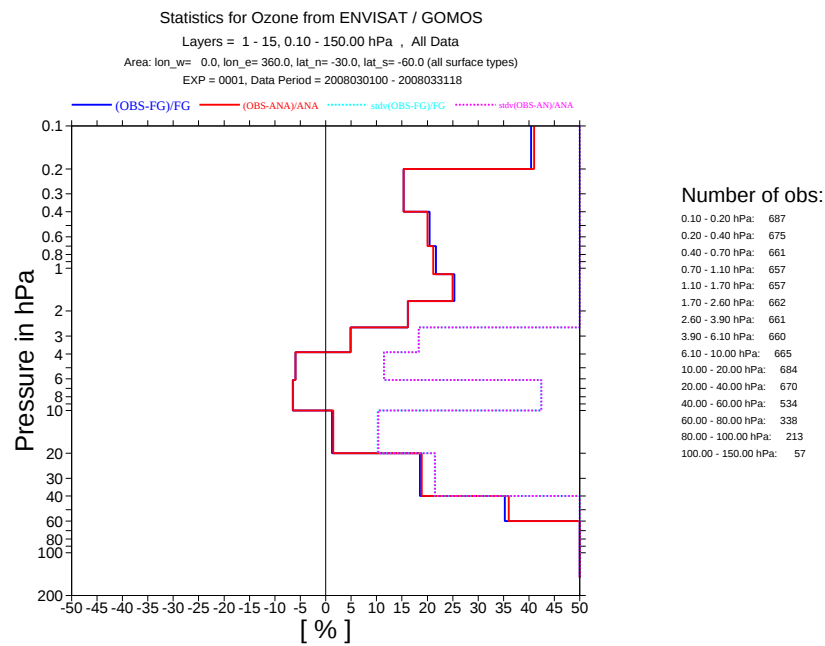
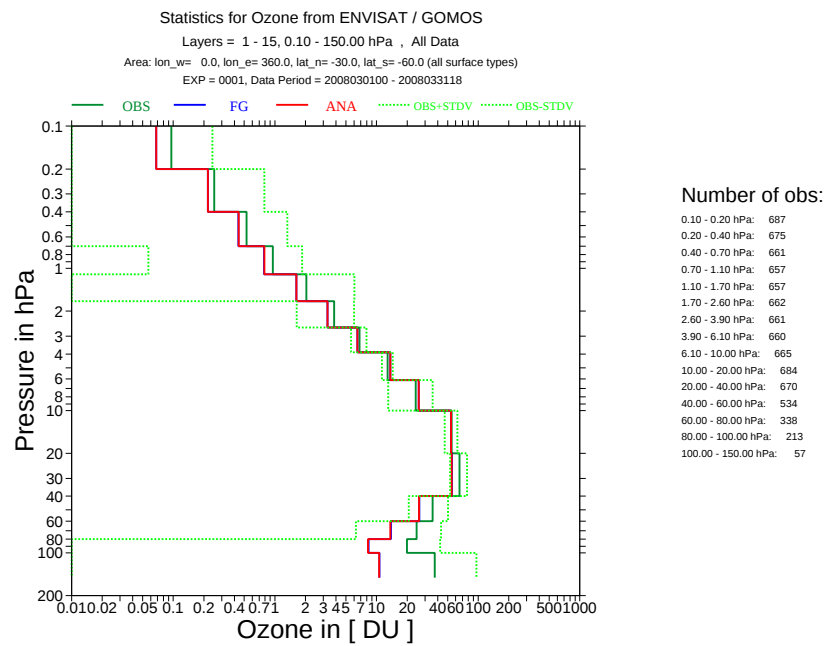


Fig. 6. As Fig. 3 but for 30S-60S.

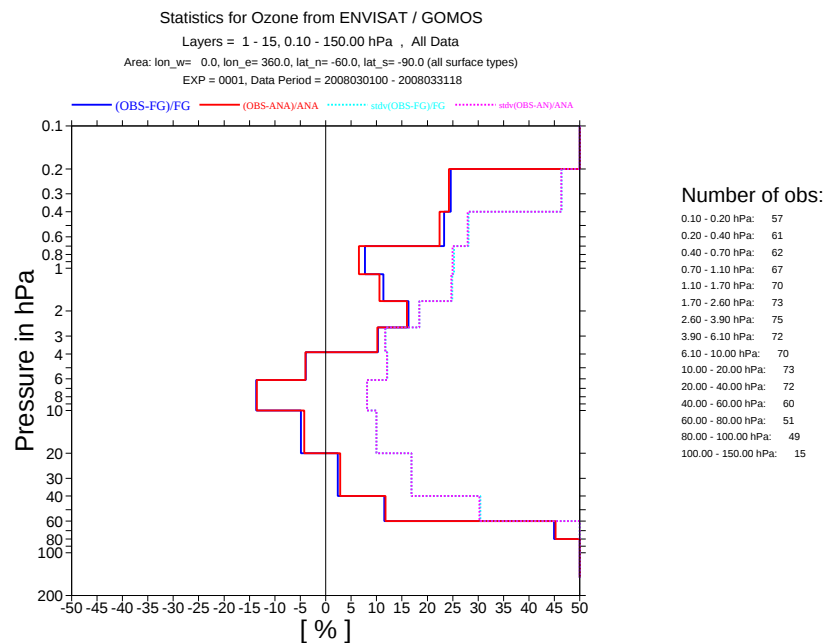
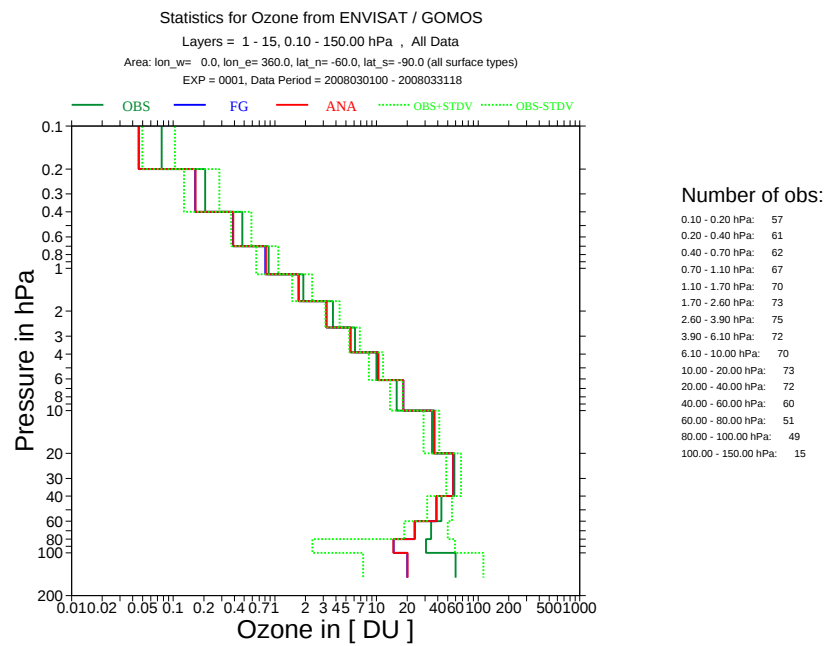


Fig. 7. As Fig. 3 but for 60-90S.

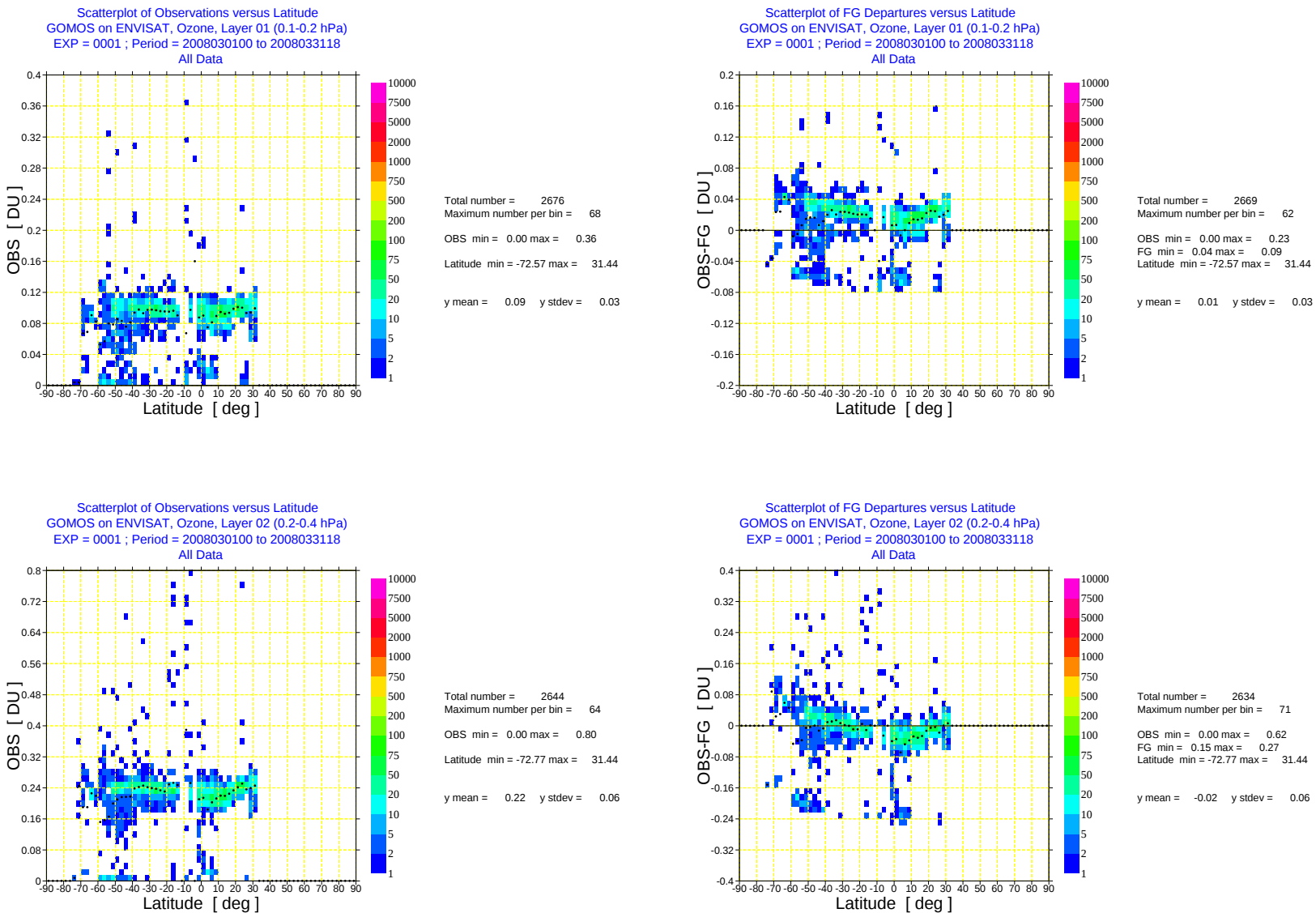


Fig. 8. Scatter plot of ENVISAT GOMOS NRT ozone data against latitude (left) and scatter plot of first-ness departures of ENVISAT GOMOS NRT ozone data against latitude (right) for March 2008 for layer 1 (0.1-0.2 hPa) and layer 2 (0.2-0.4 hPa). The colours show the number of data per bin, the black dots the mean value per bin.

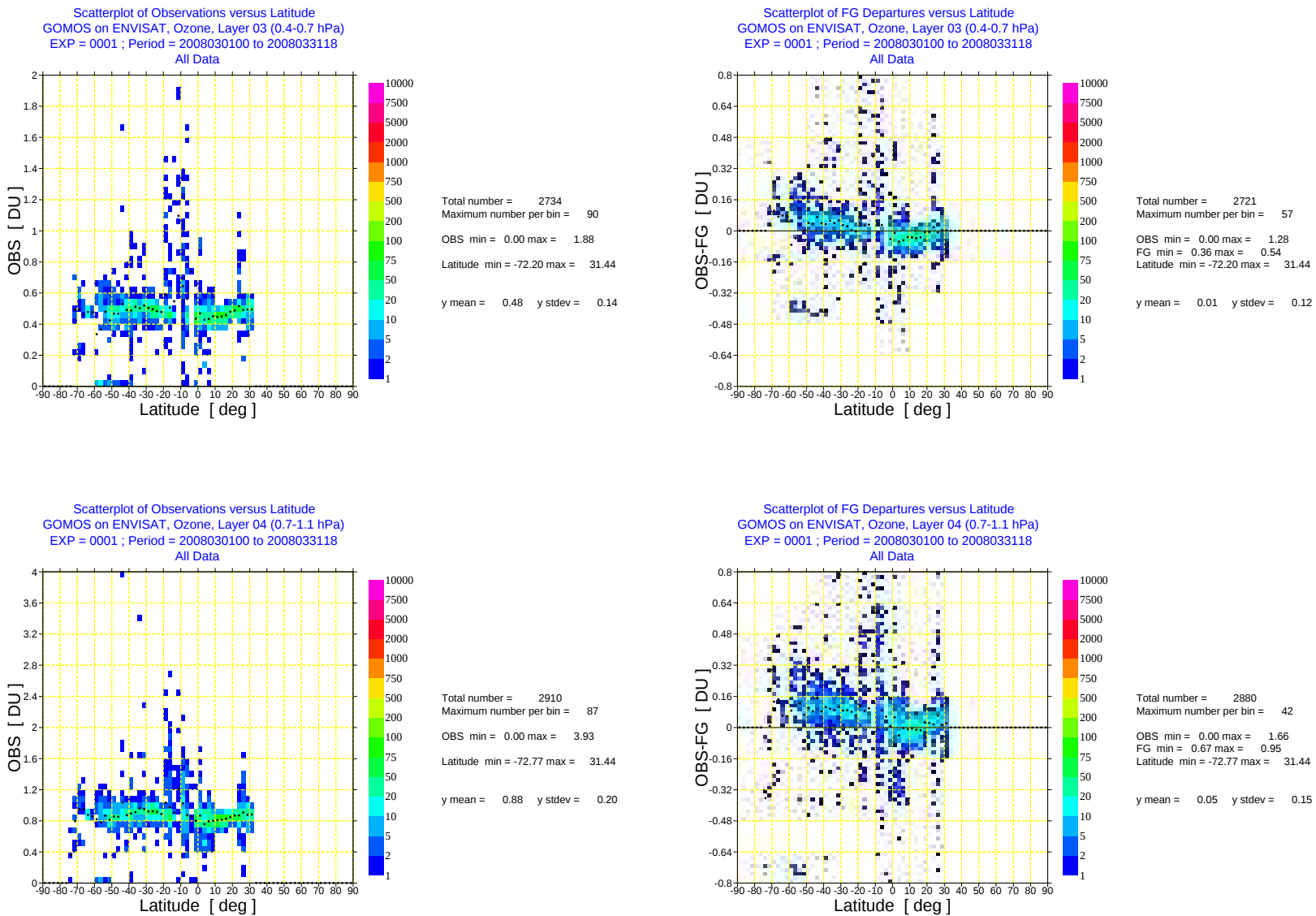


Fig. 9. As Fig. 7 but for layer 3 (0.4-0.7 hPa) and layer 4 (0.7-1.1 hPa).

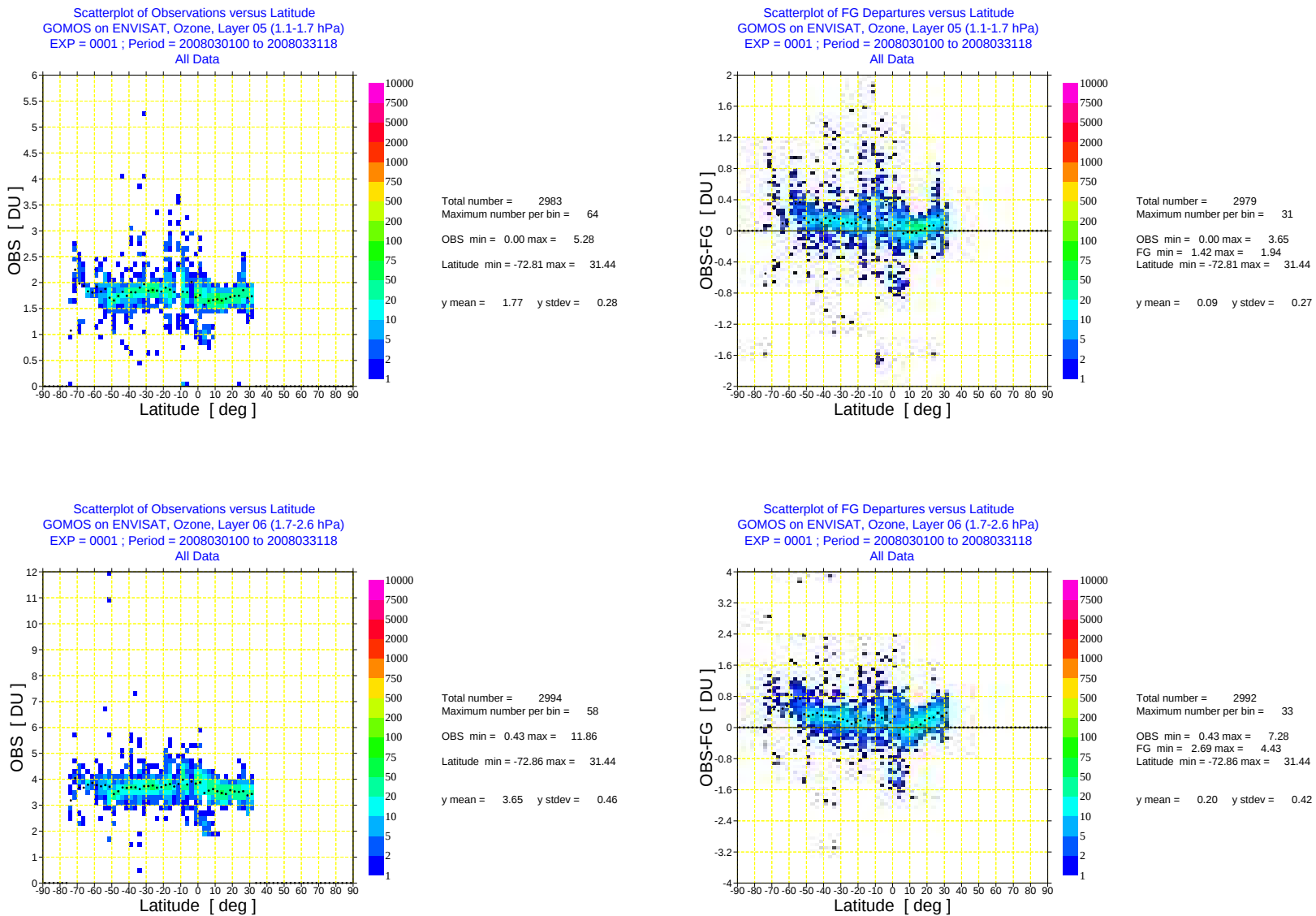


Fig. 10. As Fig. 7 but for layer 5 (1.1-1.7 hPa) and layer 6 (1.7-2.6 hPa).

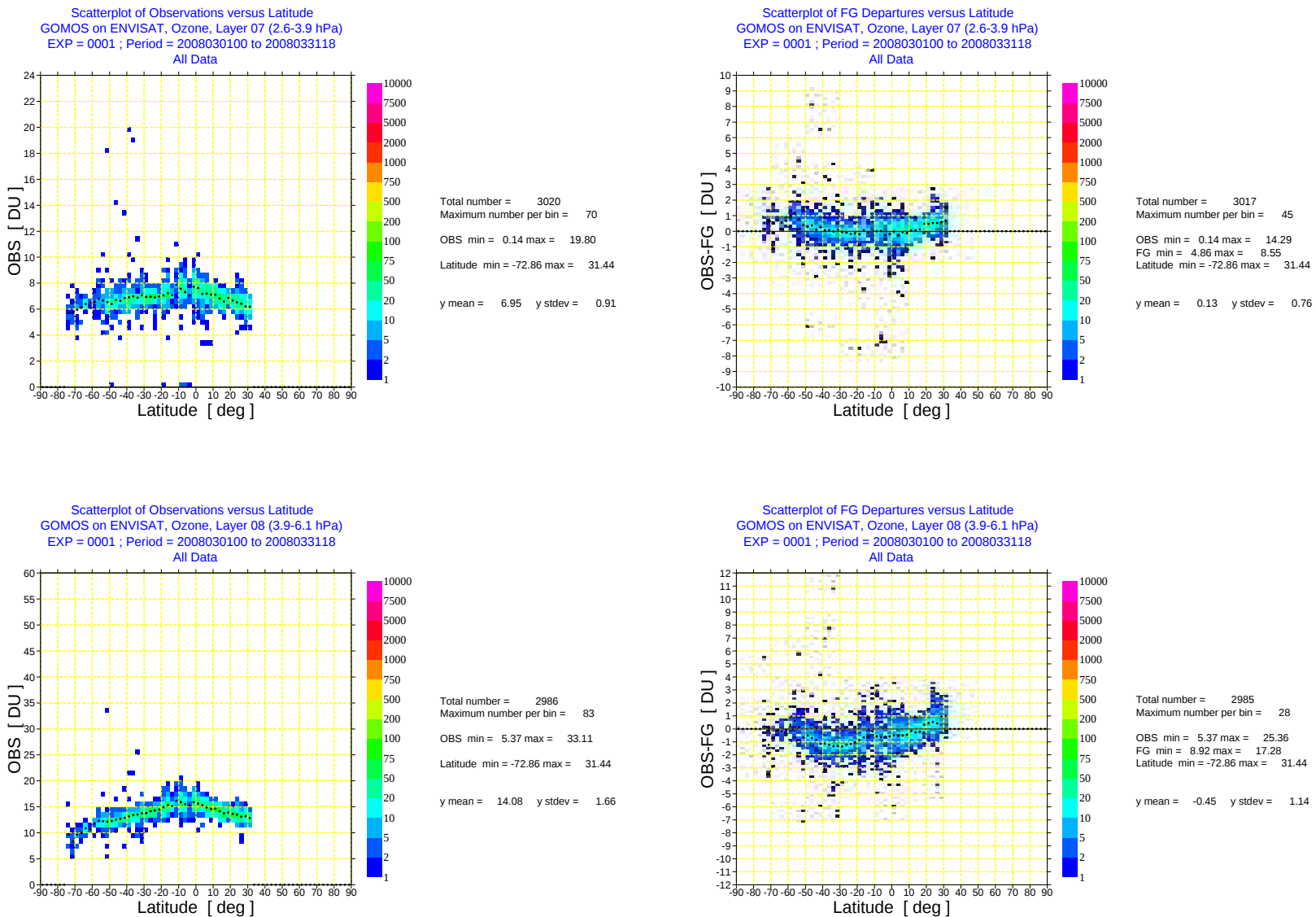


Fig. 11. As Fig. 7 but for layer 7 (2.6-3.9 hPa) and layer 8 (3.9-6.1 hPa).

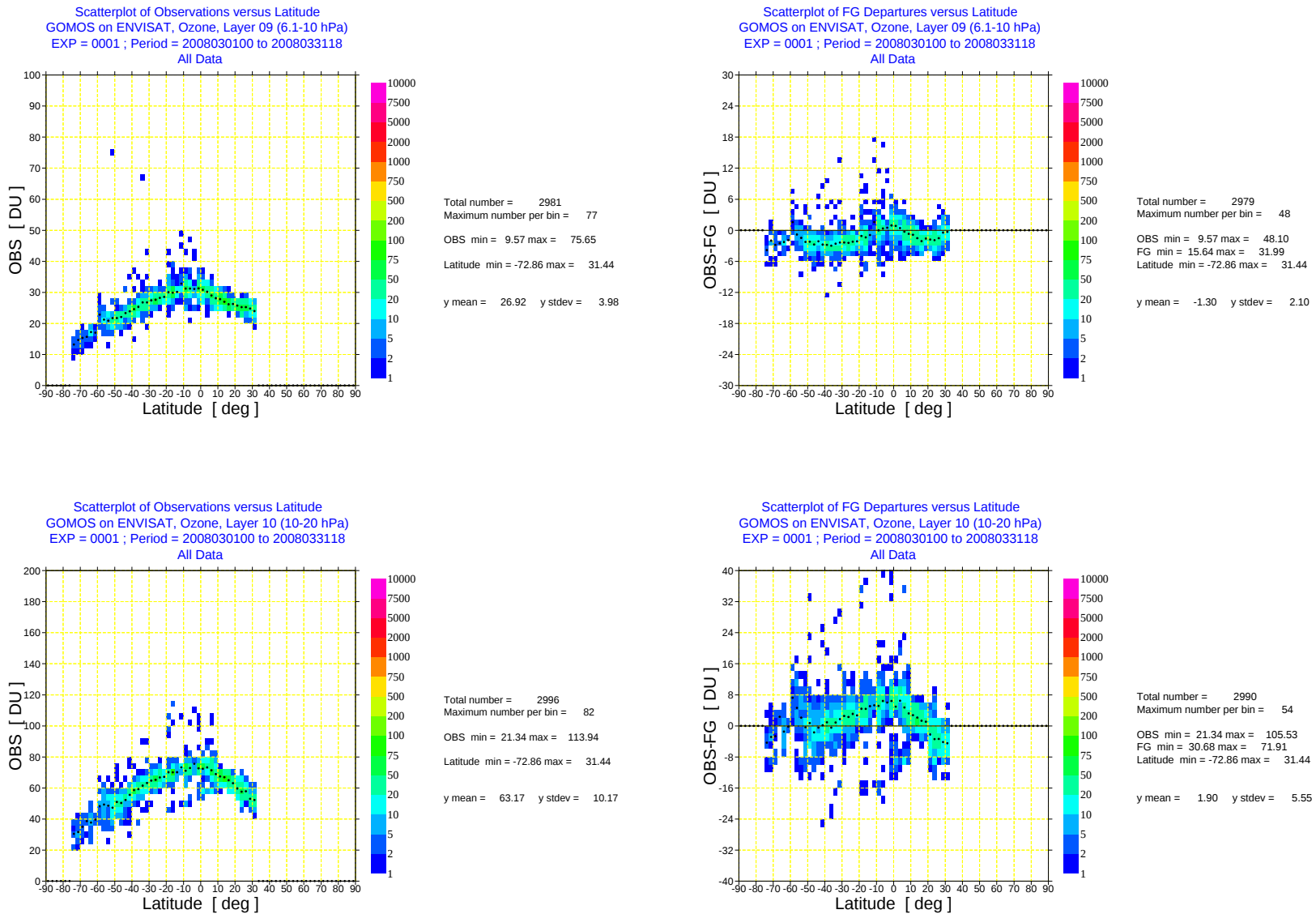


Fig. 12. As Fig. 7 but for layer 9 (6.1-10 hPa) and layer 10 (10-20 hPa).

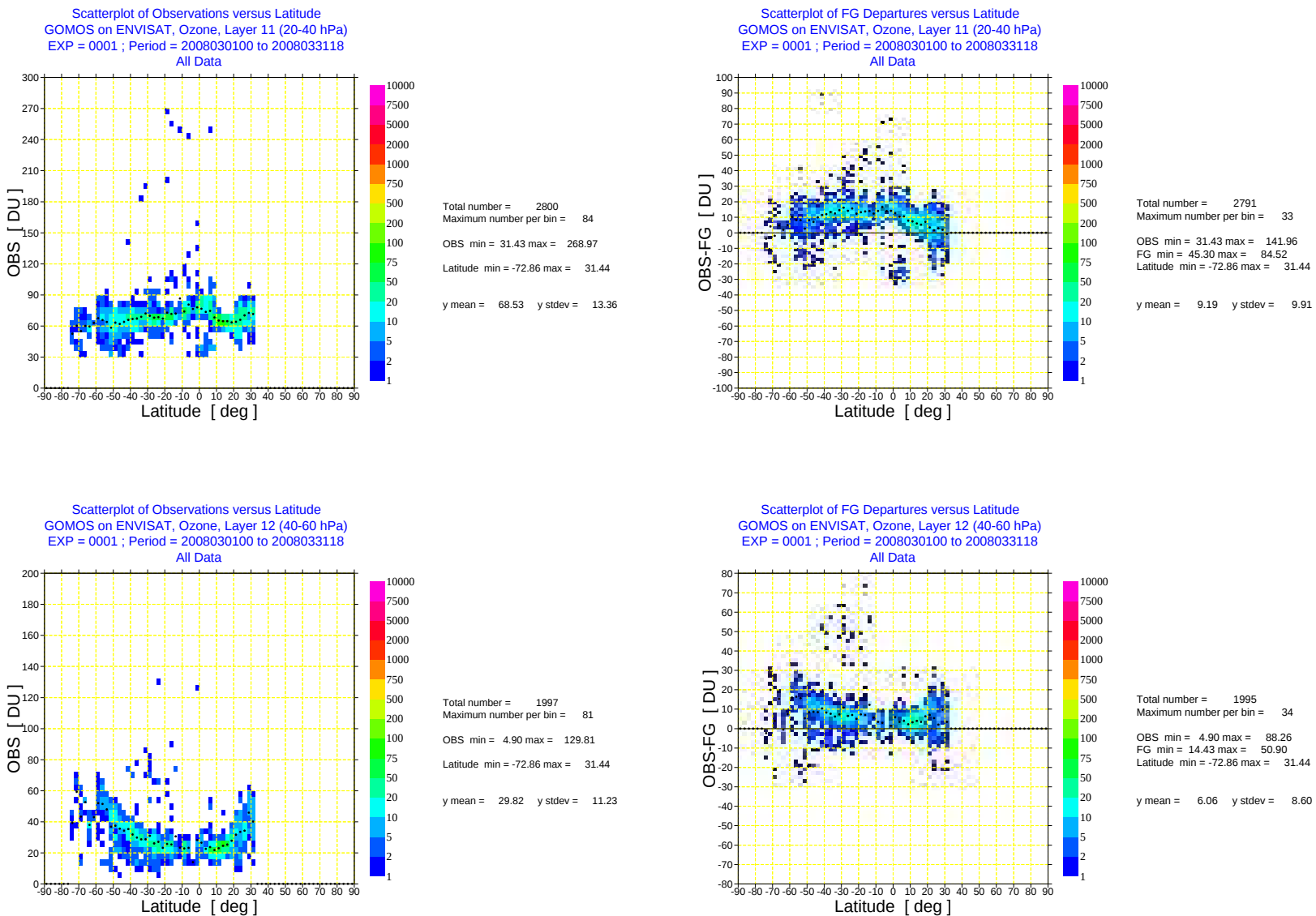


Fig. 13. As Fig. 7 but for layer 11 (20-40 hPa) and layer 12 (40-60 hPa).

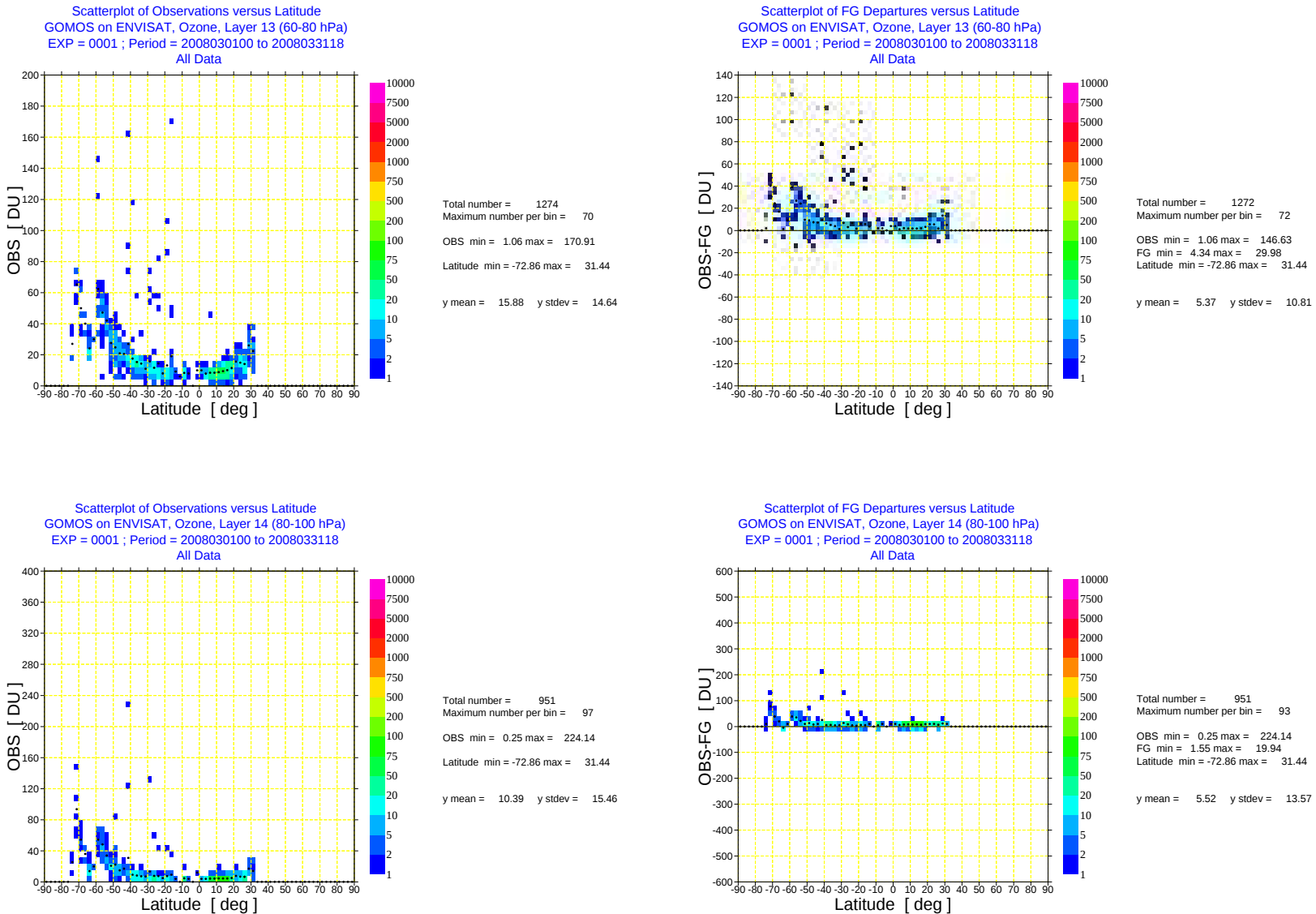


Fig. 14. As Fig. 7 but for layer 13 (60-80 hPa) and layer 14 (80-100 hPa).

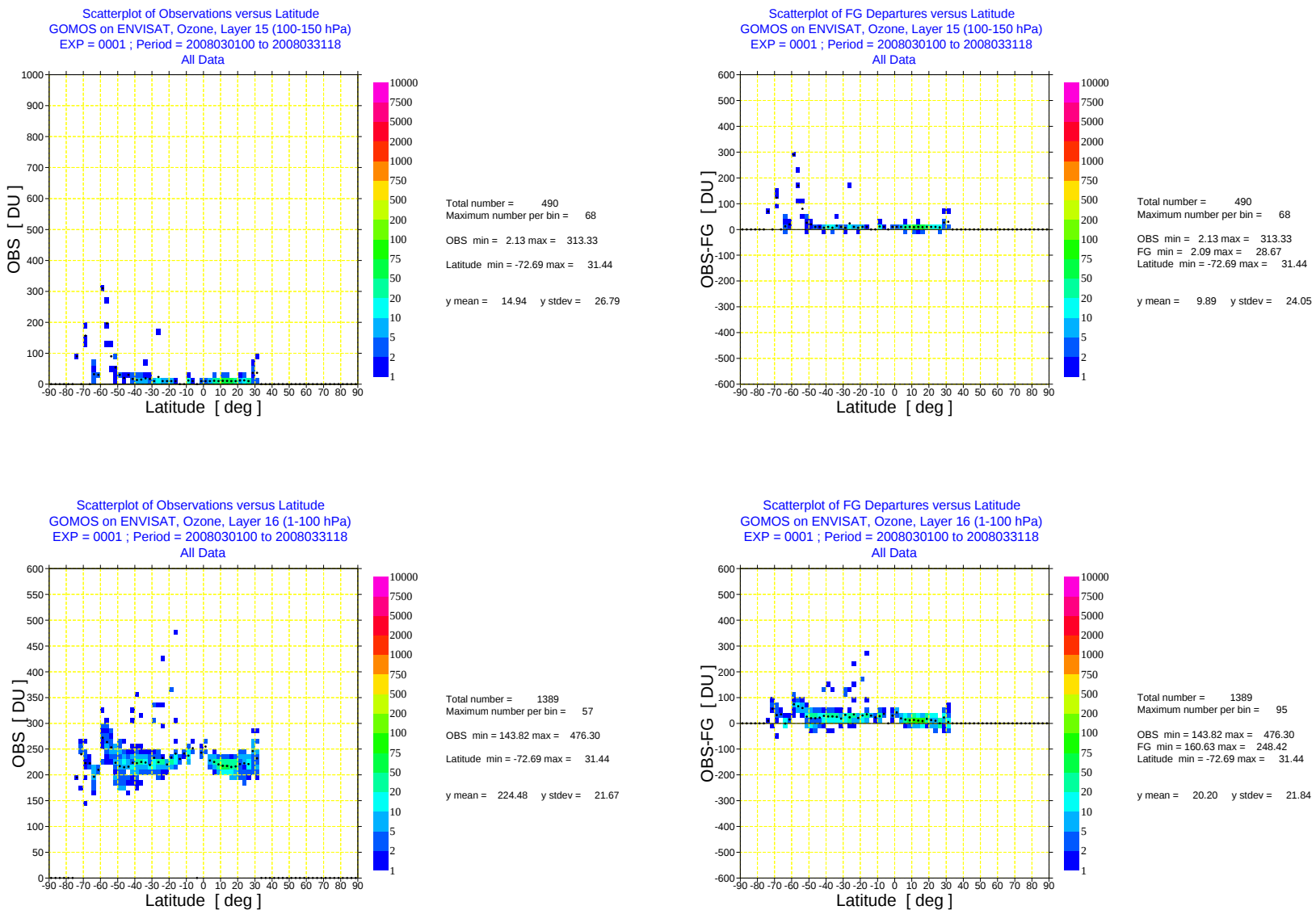


Fig. 15. As Fig. 7 but for layer 15 (100-150 hPa) and layer 16 (1-100 hPa).

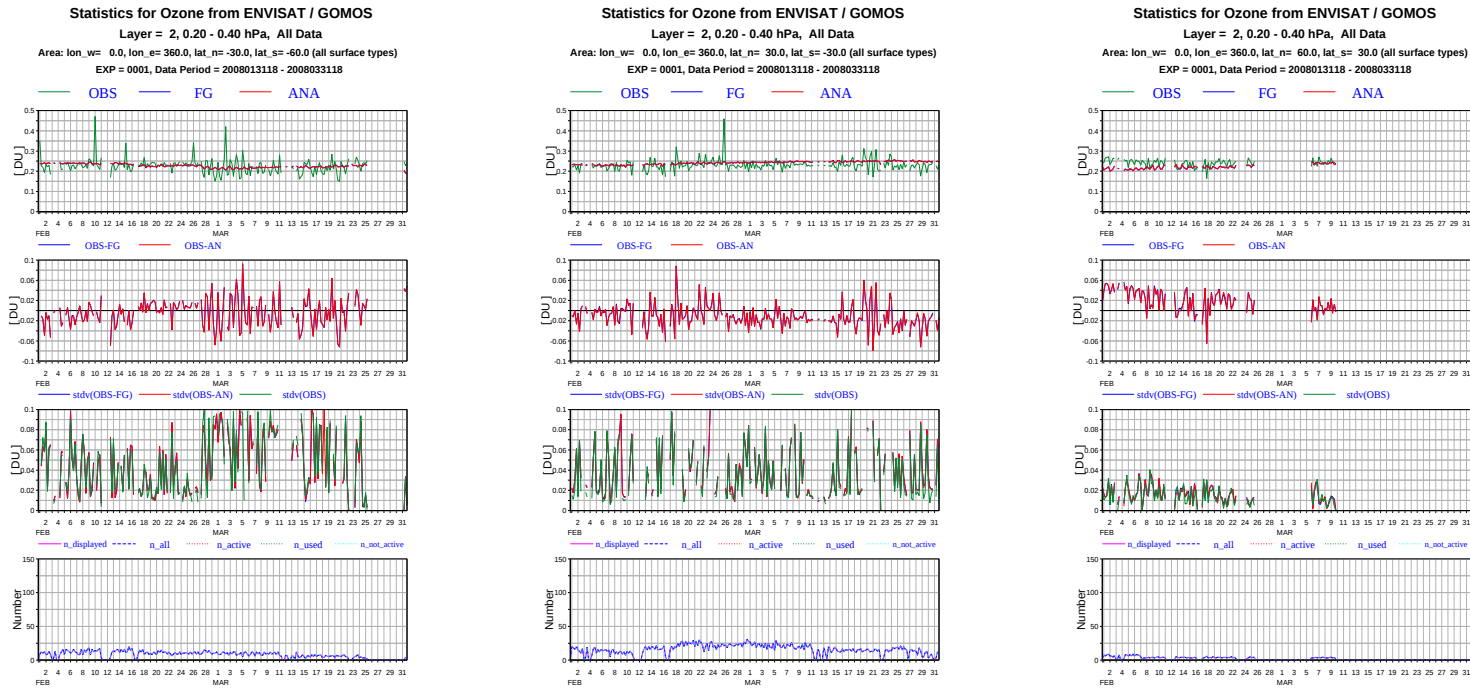


Fig. 16. Timeseries of mean ENVISAT GOMOS NRT ozone data, first guess and analysis values (top panels), first-guess and analysis departures (second panels), standard deviations (third panels) and number of data (bottom panels) per 6-hour cycle for layer 2 (0.2-0.4 hPa) 30-60N, 30N-30S, and 30-60S for the period February-March 2008.

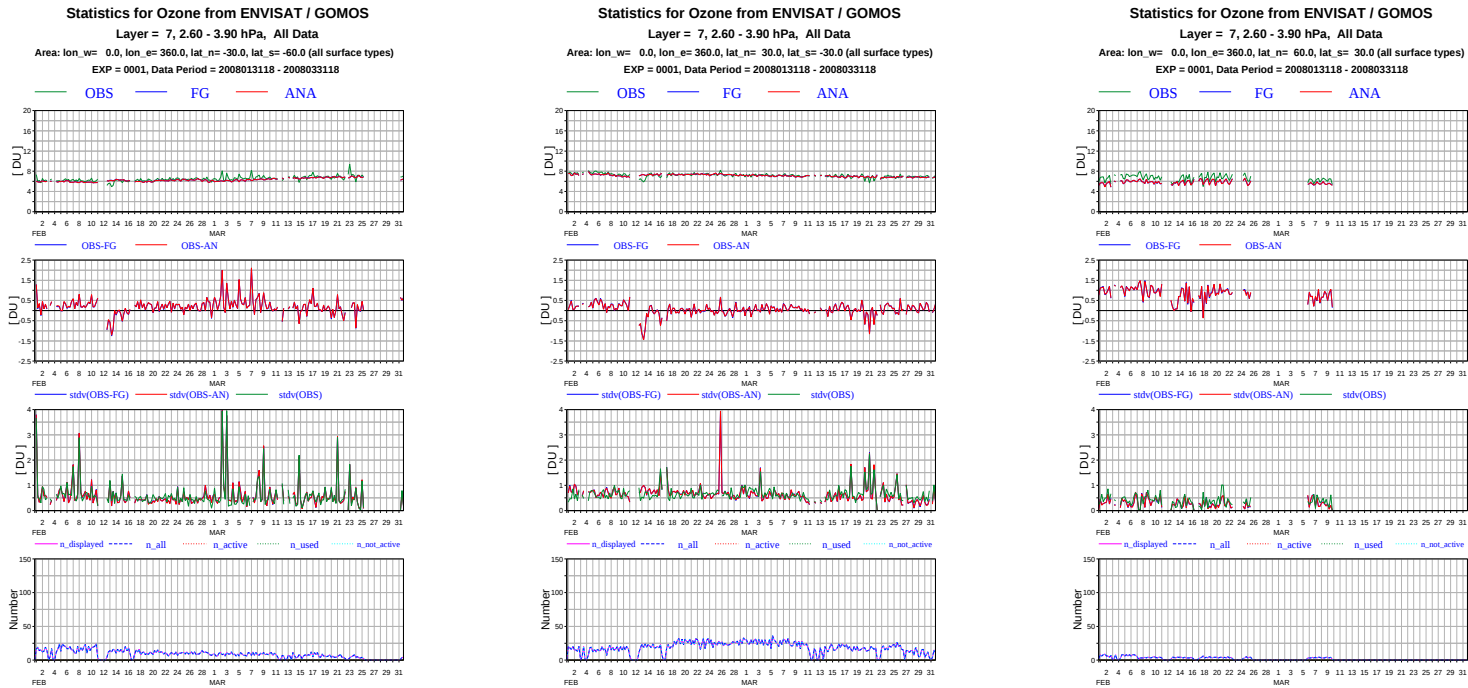


Fig. 17. As Figure 15, but for layer 7 (2.6-3.9 hPa).

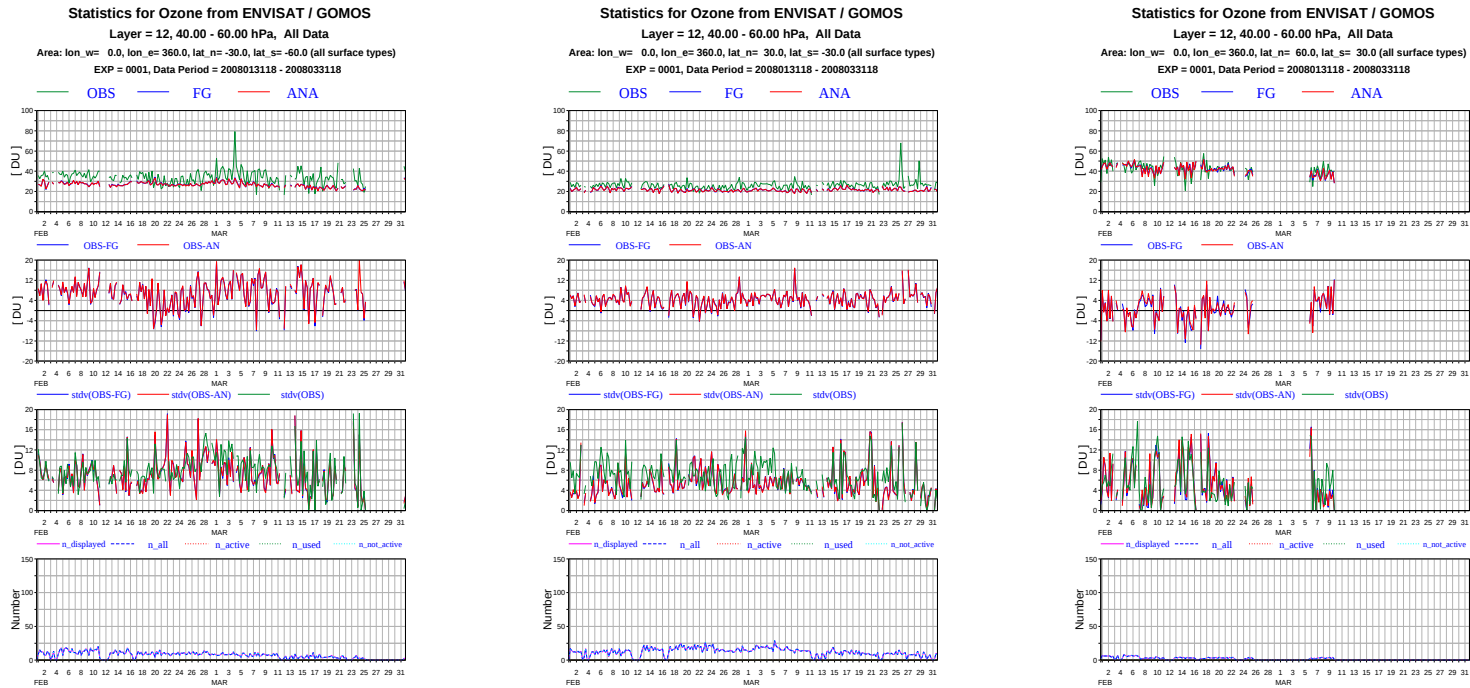


Fig. 18. As Figure 15, but for layer 12 (40-80 hPa).

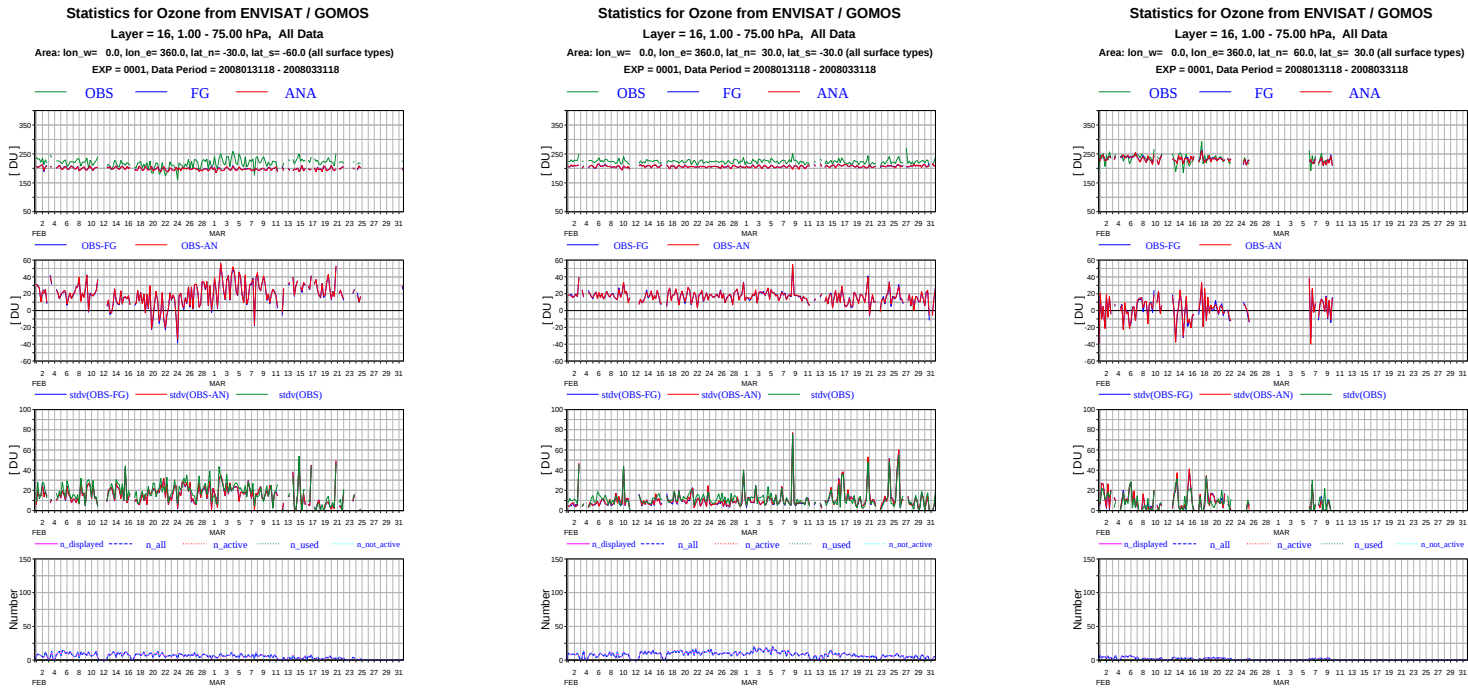


Fig. 19. As Figure 15, but for layer 16 (1-100 hPa).

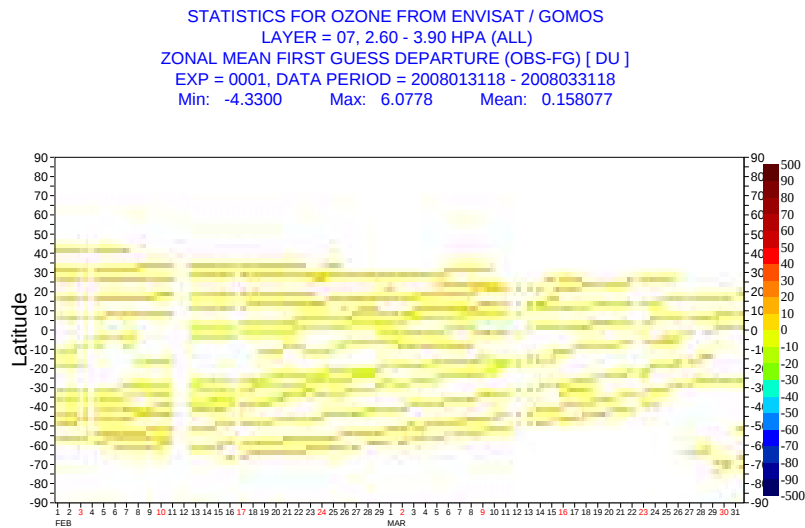
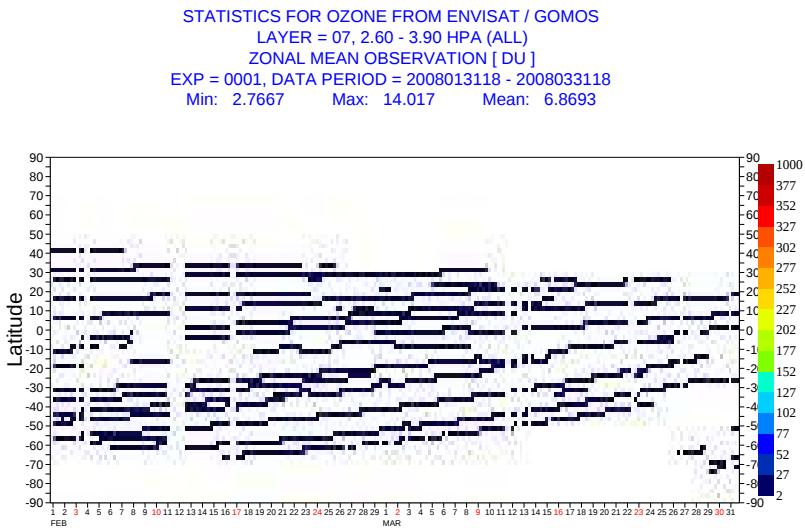
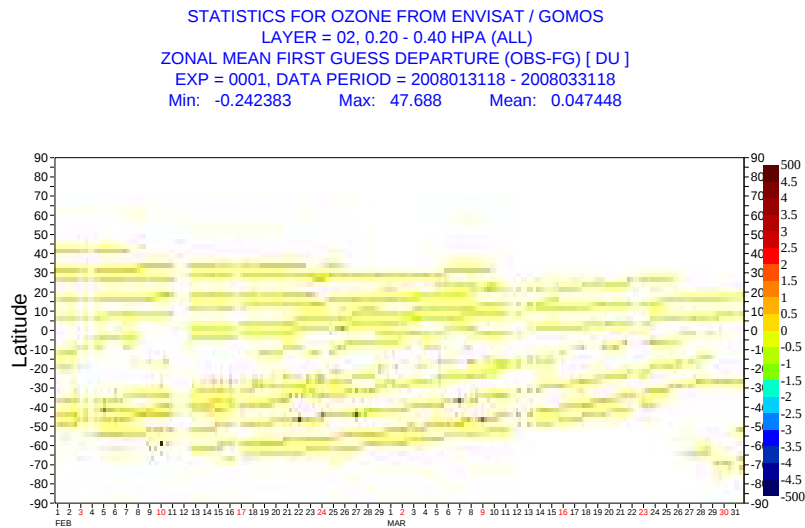
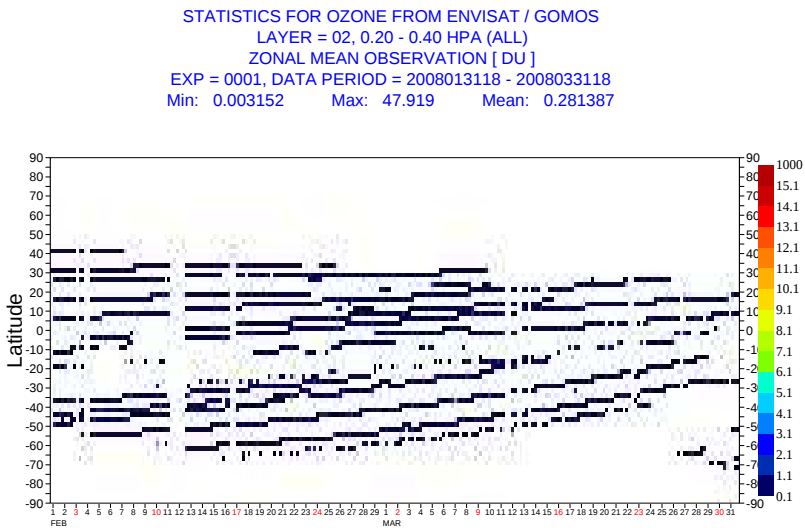


Fig. 20. Hovmöller diagram of zonal mean ENVISAT GOMOS NRT ozone data per 6-hour cycle for February-March 2008 and of the zonal mean first-guess departures for layer 2 (0.2-0.4 hPa) and layer 7 (2.6-3.9 hPa).

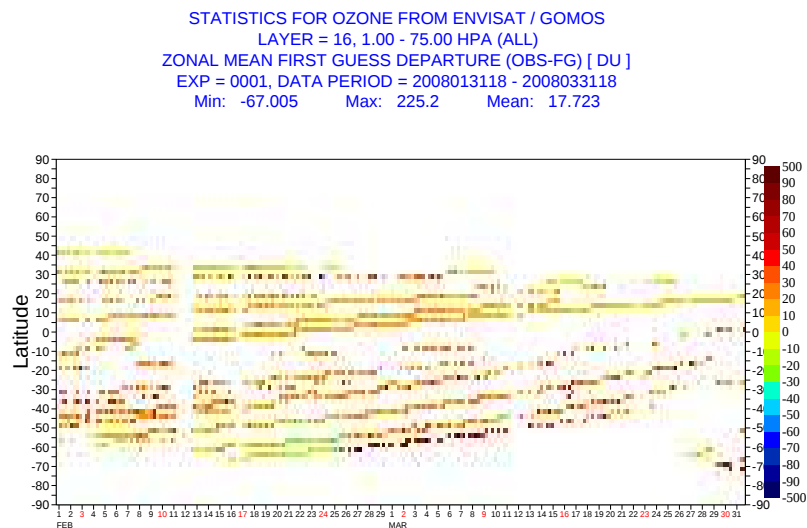
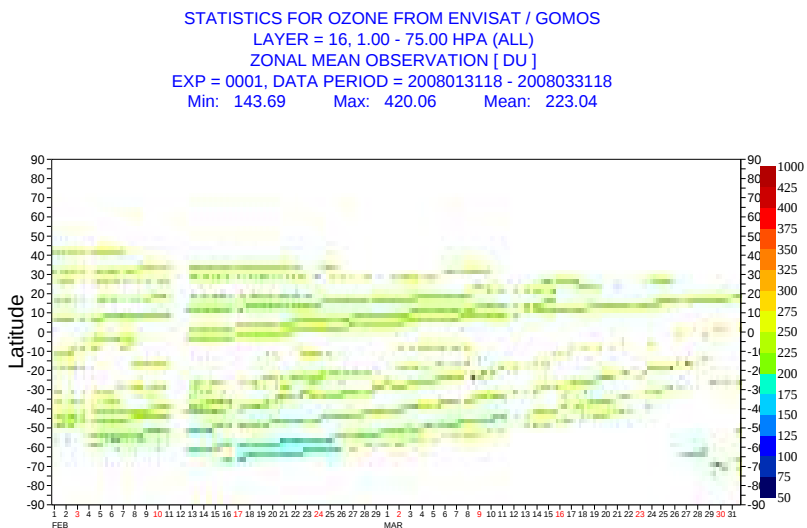
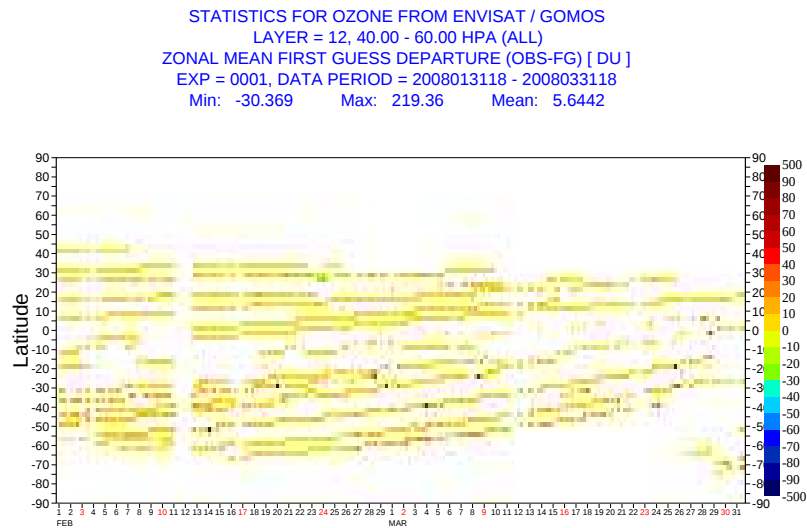
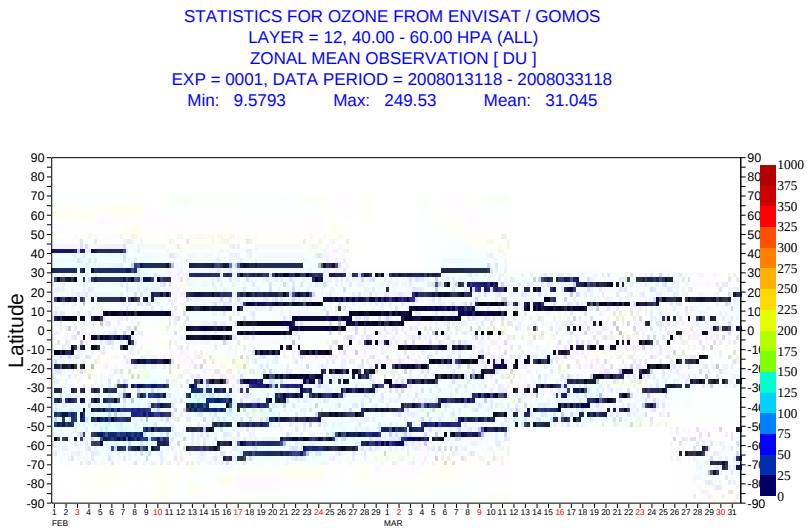
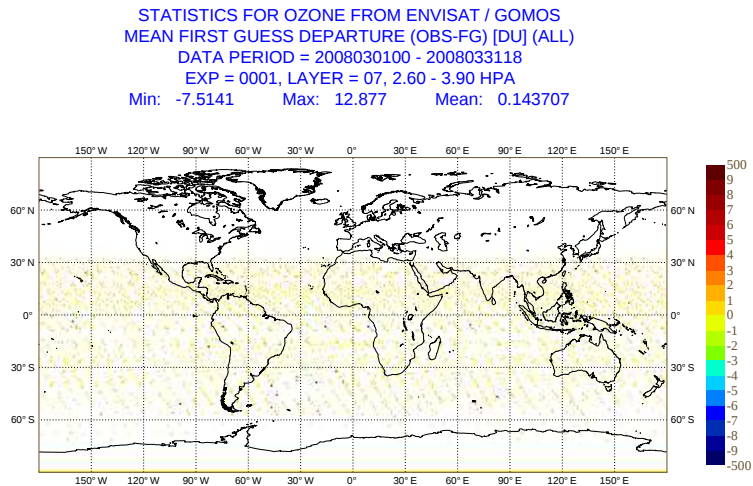
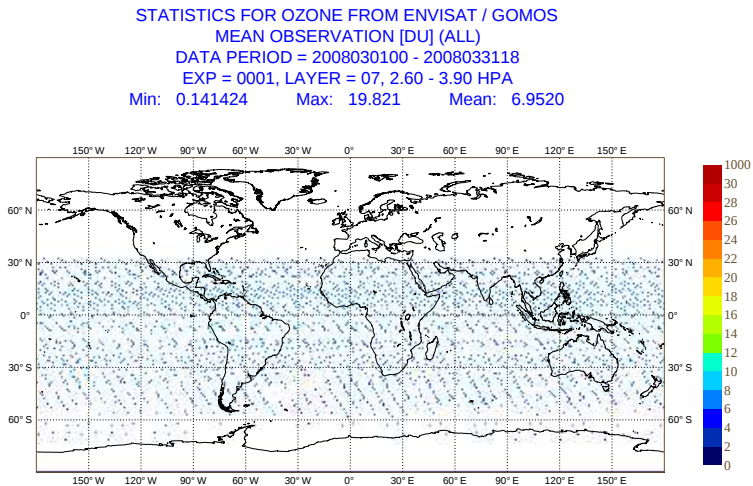
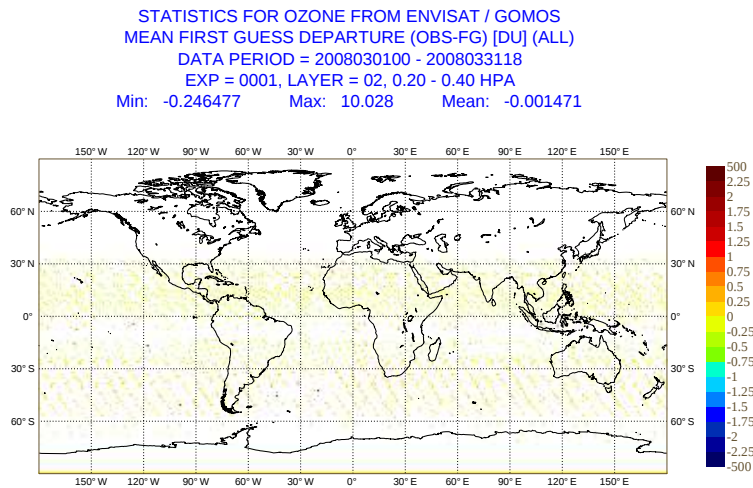
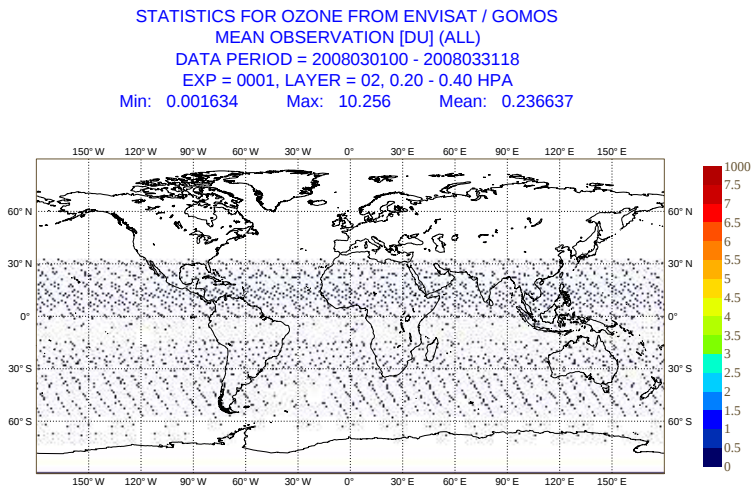


Fig. 21. As Fig. 19 but for layer 12 (40-60 hPa) and layer 16 (1-100 hPa).

Fig. 22. Geographical distribution of mean ENVISAT GOMOS NRT ozone data and mean first-guess departures for March 2008 for layer 2 (0.2-0.4 hPa) and layer 7 (2.6-3.9 hPa).



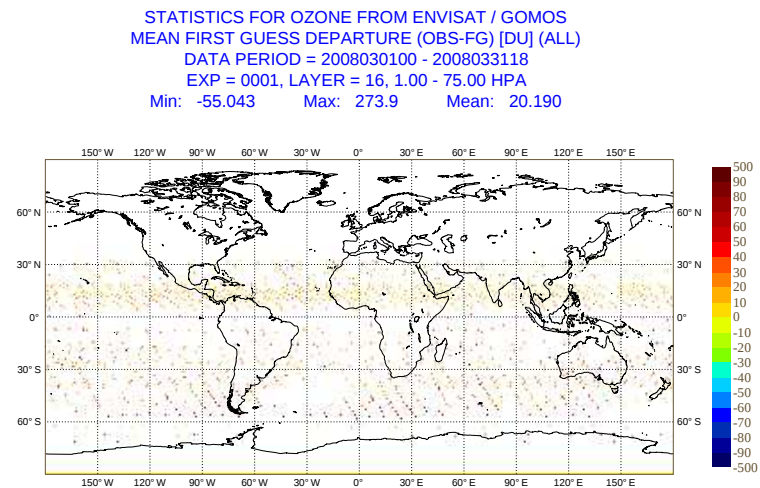
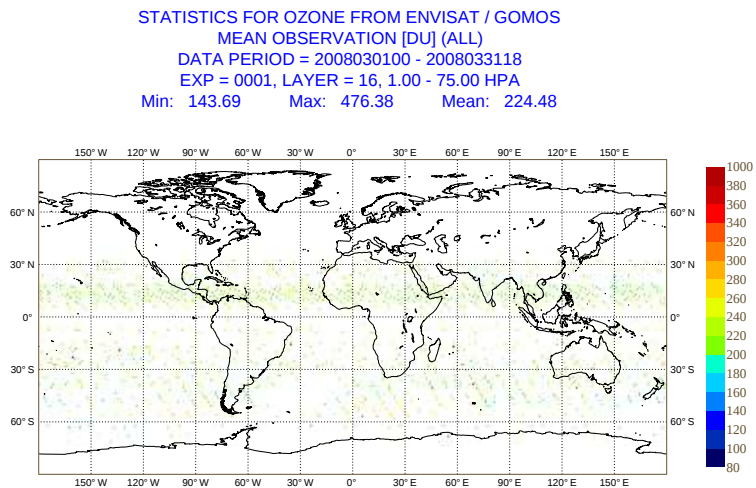
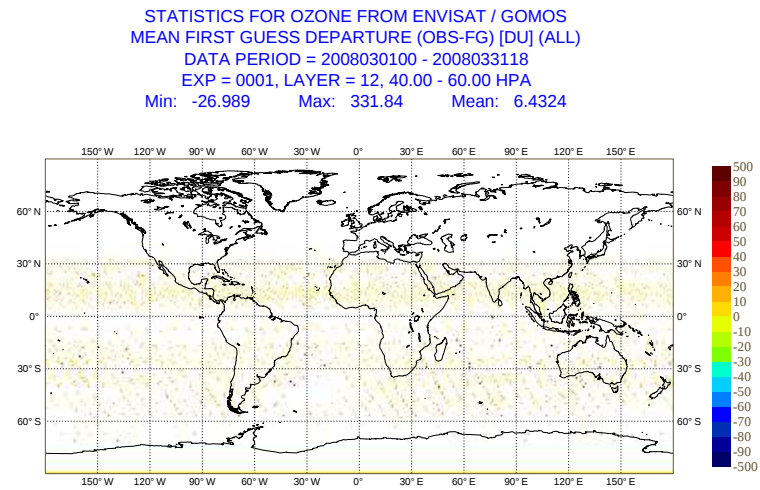
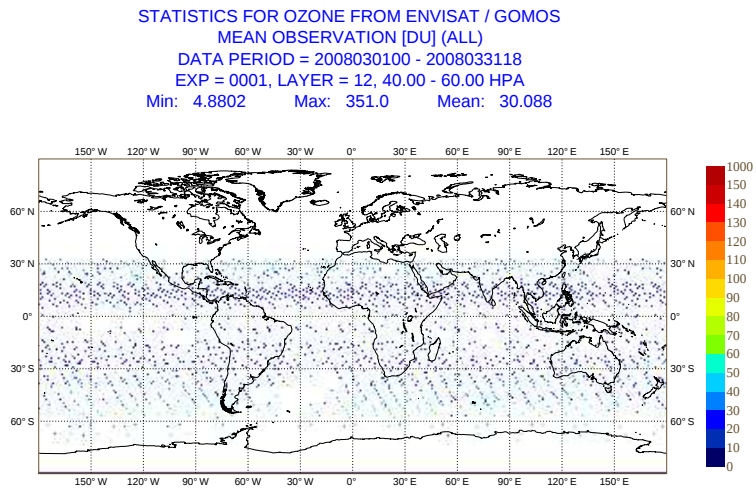


Fig. 23. As Fig. 21 but for layer 12 (40-60 hPa) and layer 16 (1-100 hPa).

REPORT ABOUT ENVISAT GOMOS NRT TEMPERATURE DATA (GOM_RR_2P) FOR MARCH 2008

Rossana Dragani

*ECMWF, Shinfield Park, Reading, RG2 9AX, United Kingdom,
Emails: Rossana.Dragani@ecmwf.int, Tel: 0044 118 9499259*

April 9, 2008

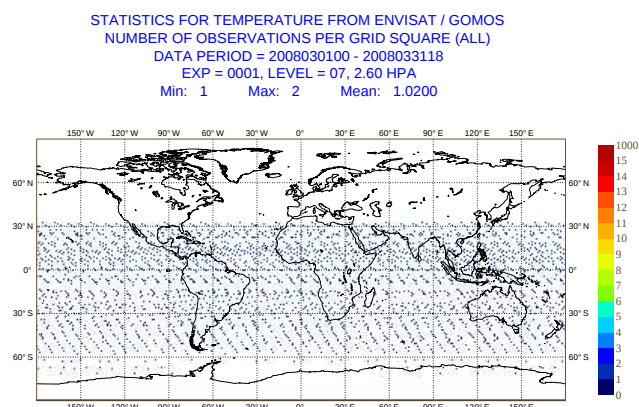


Fig. 1. Geographical distribution of mean number of ENVISAT GOMOS NRT temperature data for level 7 (2.6 hPa) for March 2008.

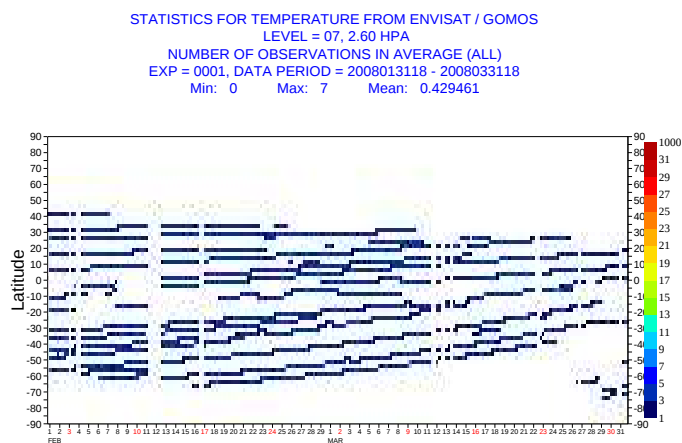


Fig. 2. Hovmoeller diagram of zonal mean number of data of ENVISAT GOMOS NRT temperature data per 6-hour cycle for level 7 (2.6 hPa) for February-March 2008.

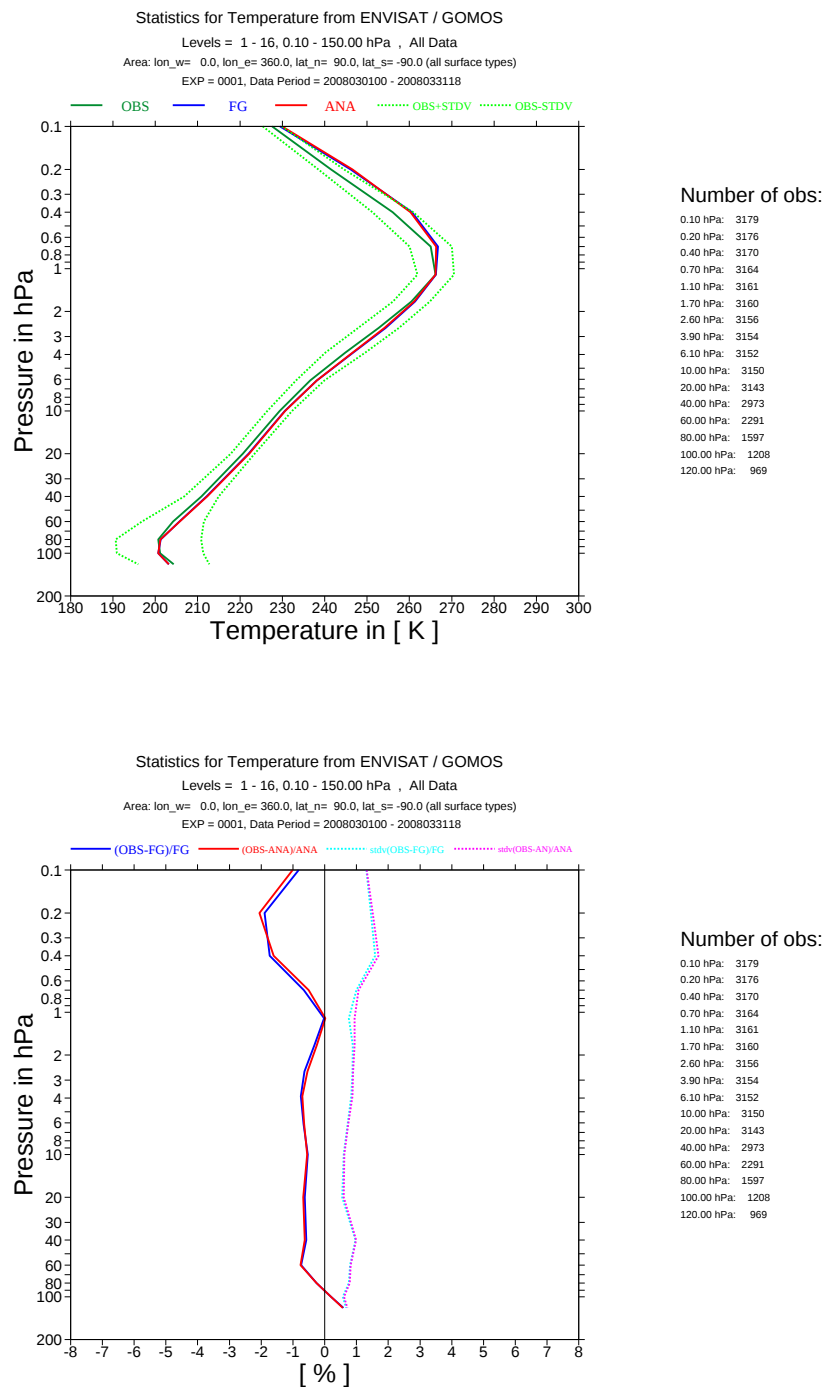


Fig. 3. Time mean vertical distribution of ENVISAT GOMOS NRT temperature data in K for March 2008 (global mean). The top plot shows the mean analysis values (red), the mean first-guess (blue), the mean observation (green), and the mean observation ± 1 standard deviation (green dotted lines). The bottom plot shows the departures and the standard deviation of the departures in %. Plotted are the values for the 16 levels listed to the right of the diagrams.

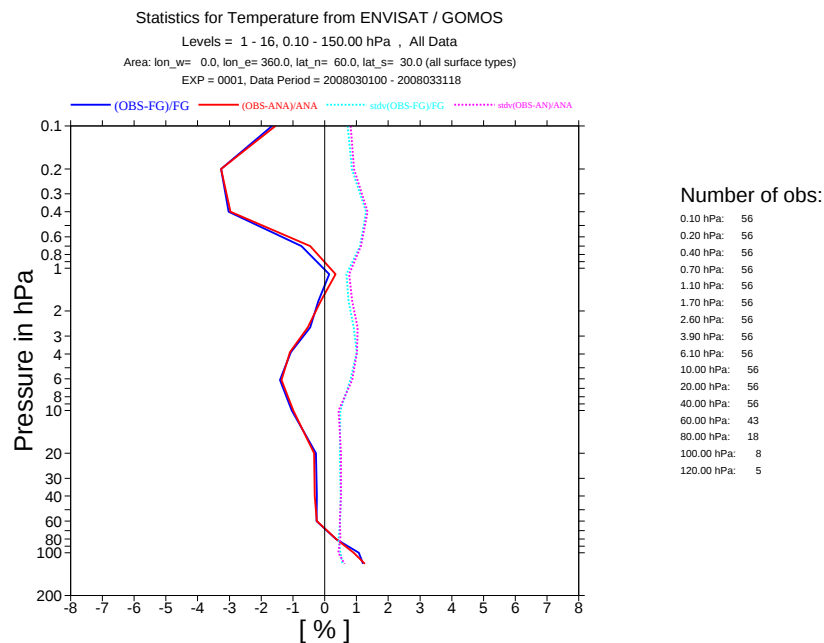
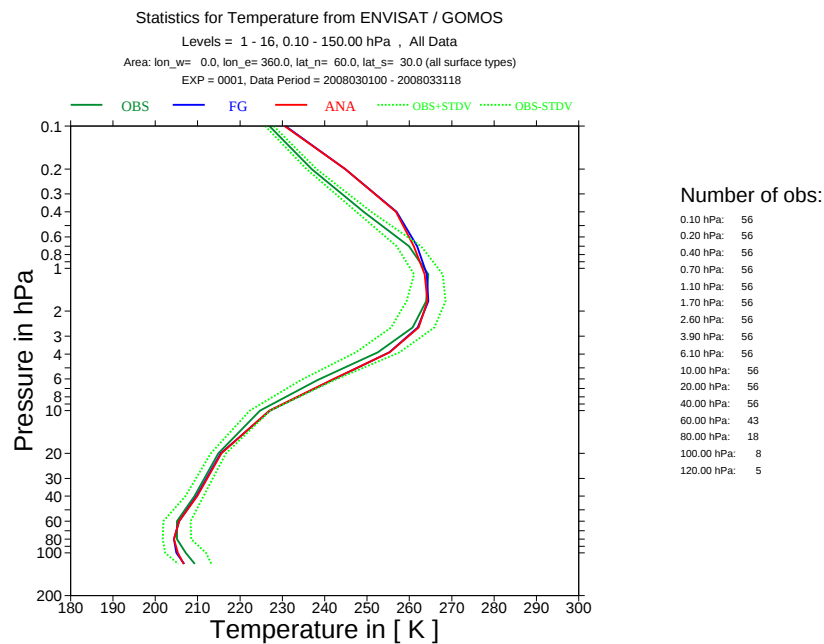


Fig. 4. As Fig. 3 but for 60-30N.

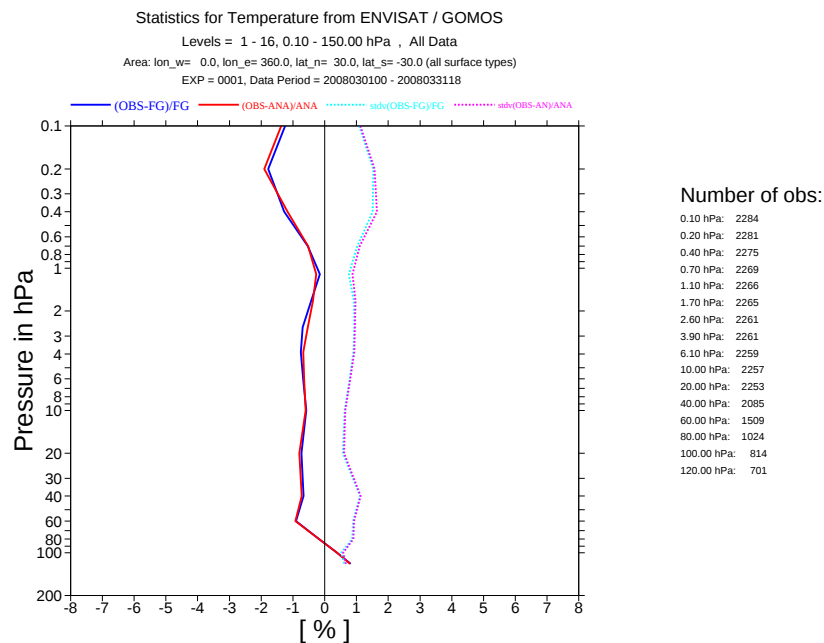
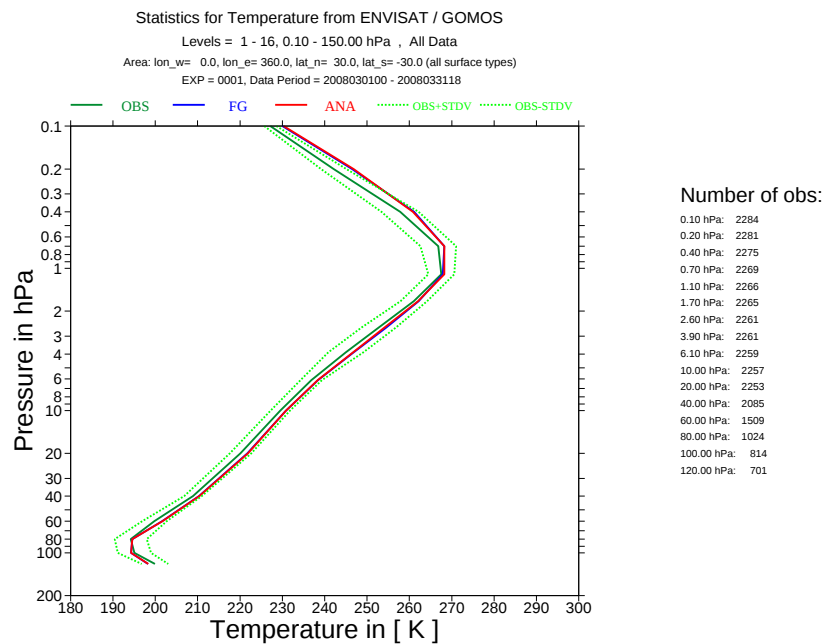


Fig. 5. As Fig. 3 but for 30N-30S.

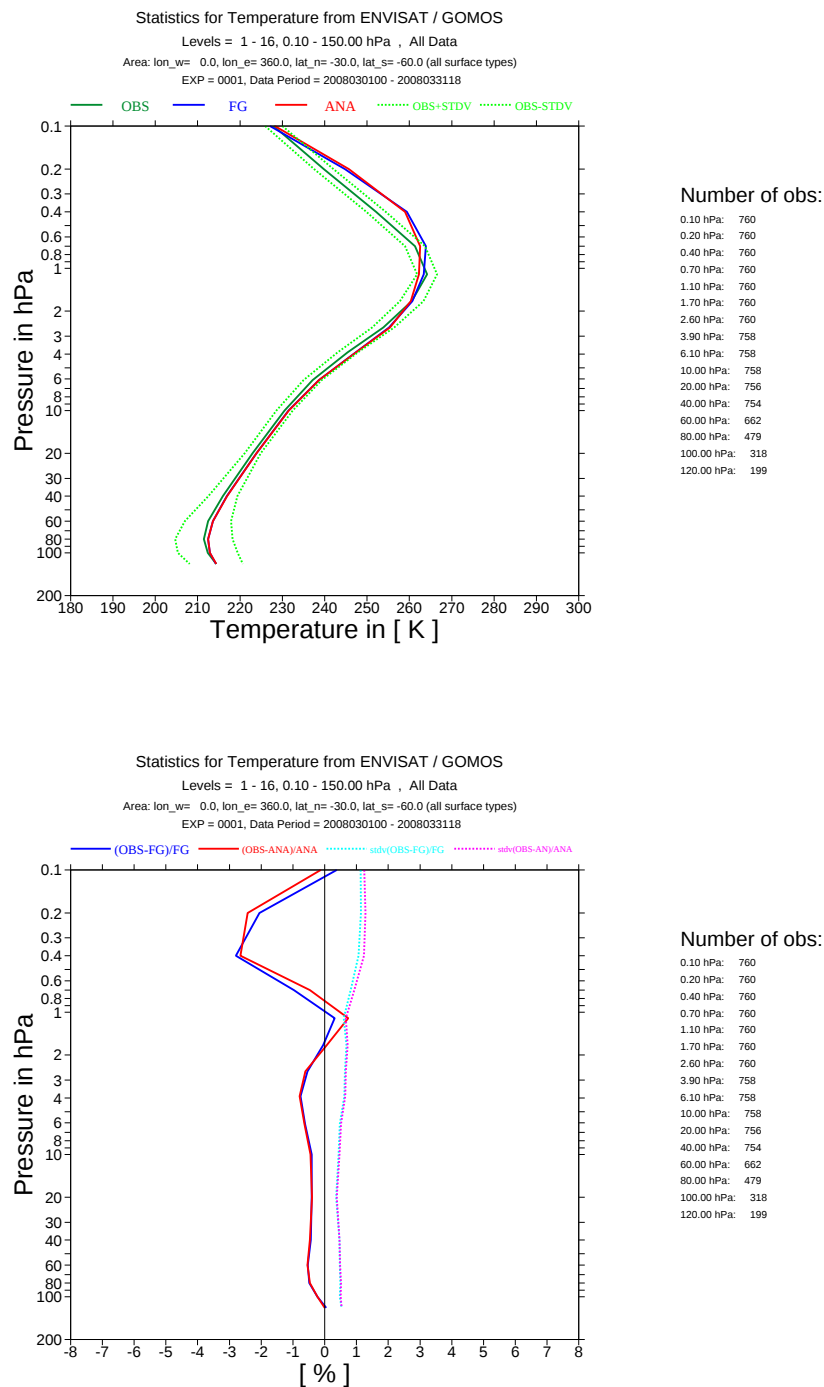


Fig. 6. As Fig. 3 but for 30-60S.

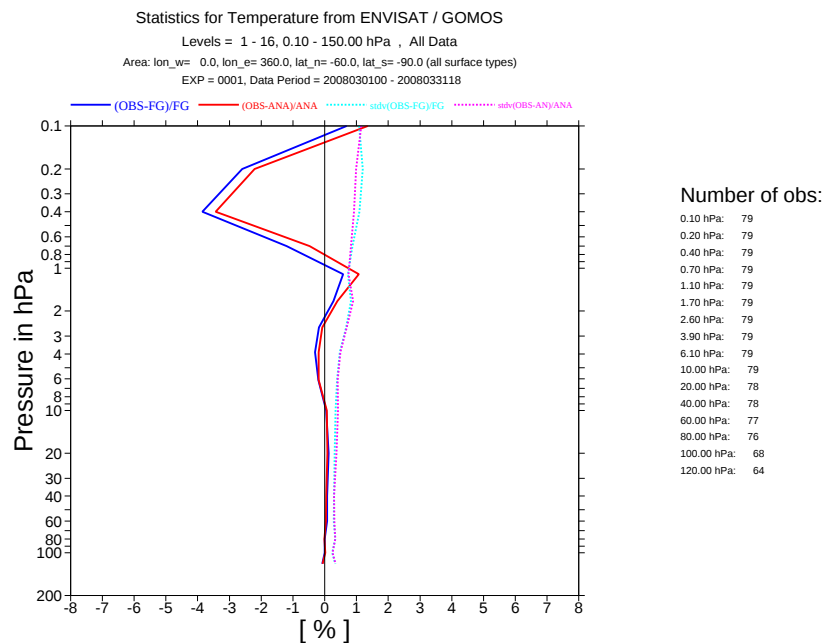
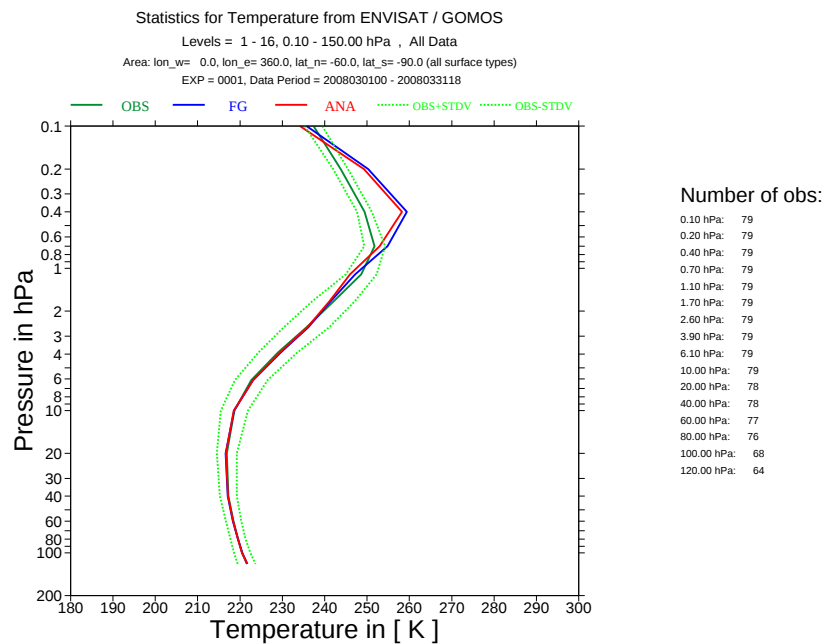


Fig. 7. As Fig. 3 but for 60-90S.

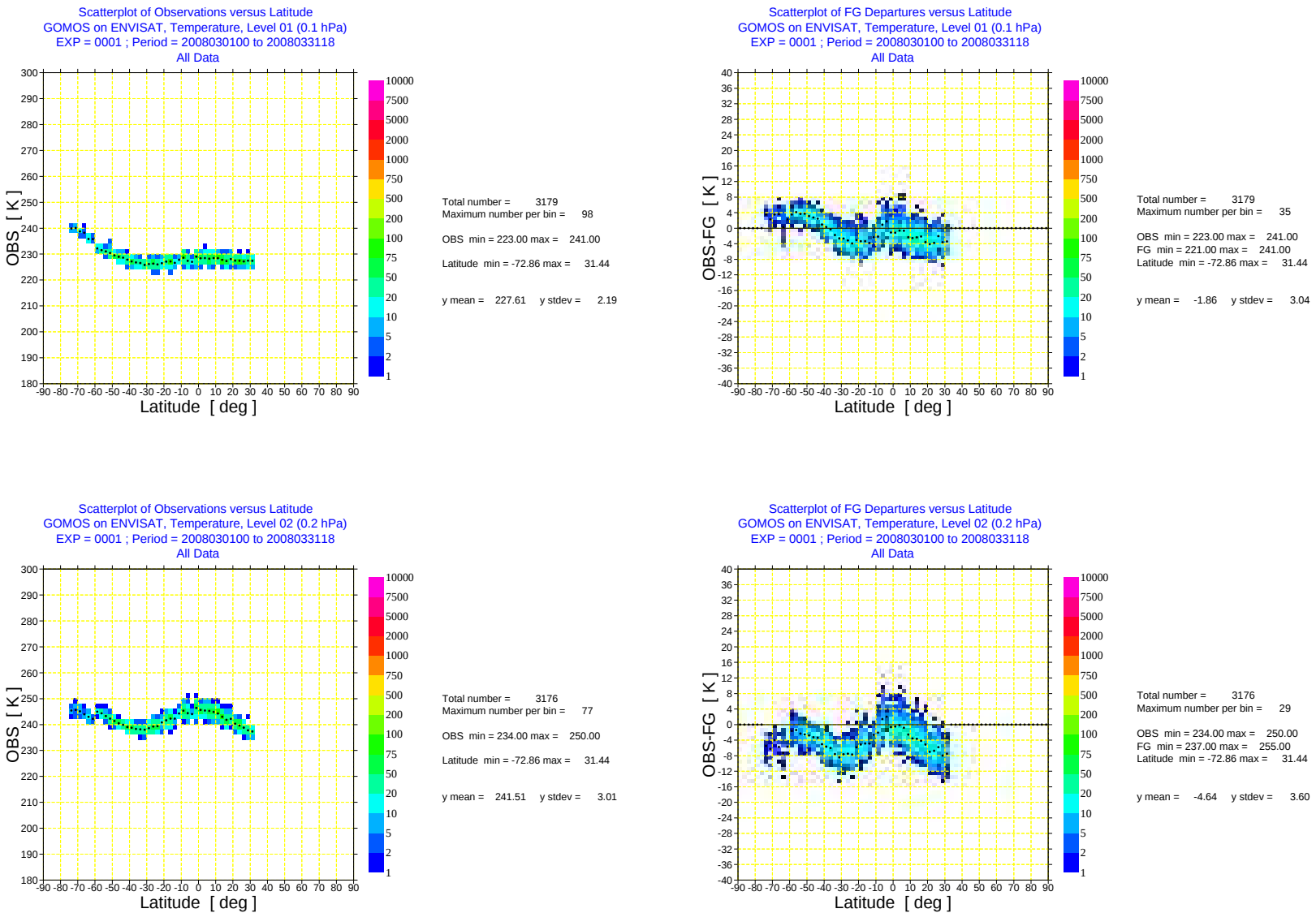


Fig. 8. Scatter plot of ENVISAT GOMOS NRT temperature data against latitude (left) and scatter plot of first-guess departures of ENVISAT GOMOS NRT temperature data against latitude (right) for March 2008 for level 1 (0.1 hPa) and level 2 (0.2 hPa). The colours show the number of data per bin, and the black dots the mean value per bin.

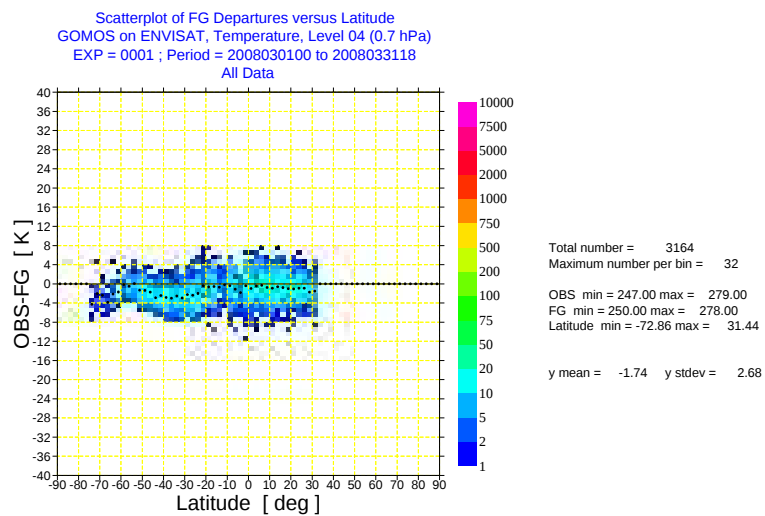
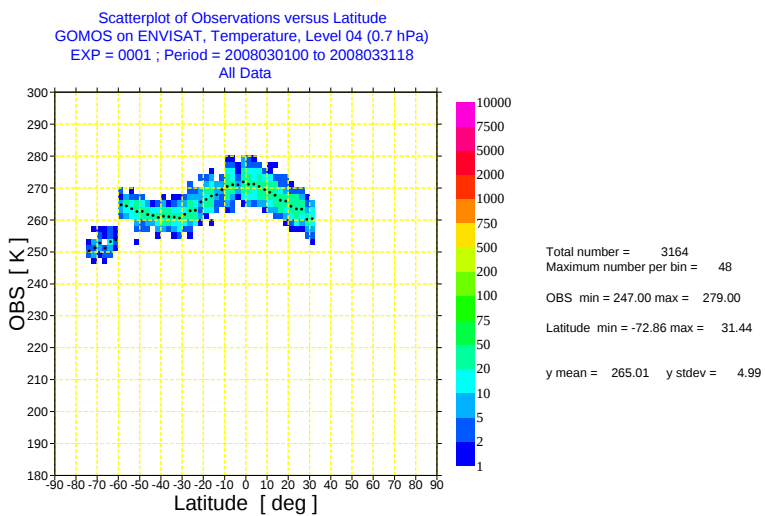
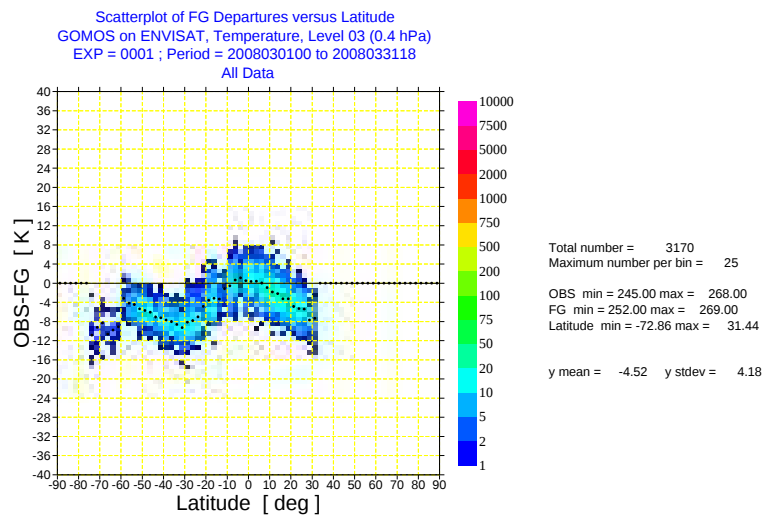
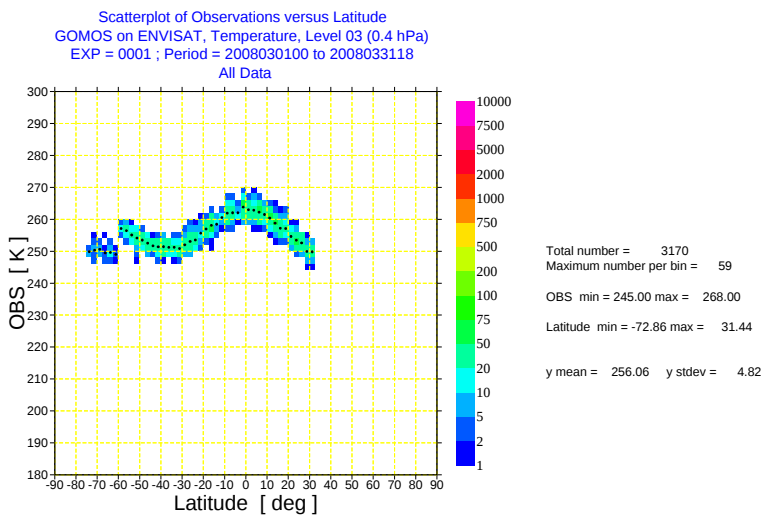


Fig. 9. As Fig. 7 but for level 3 (0.4 hPa) and level 4 (0.7 hPa).

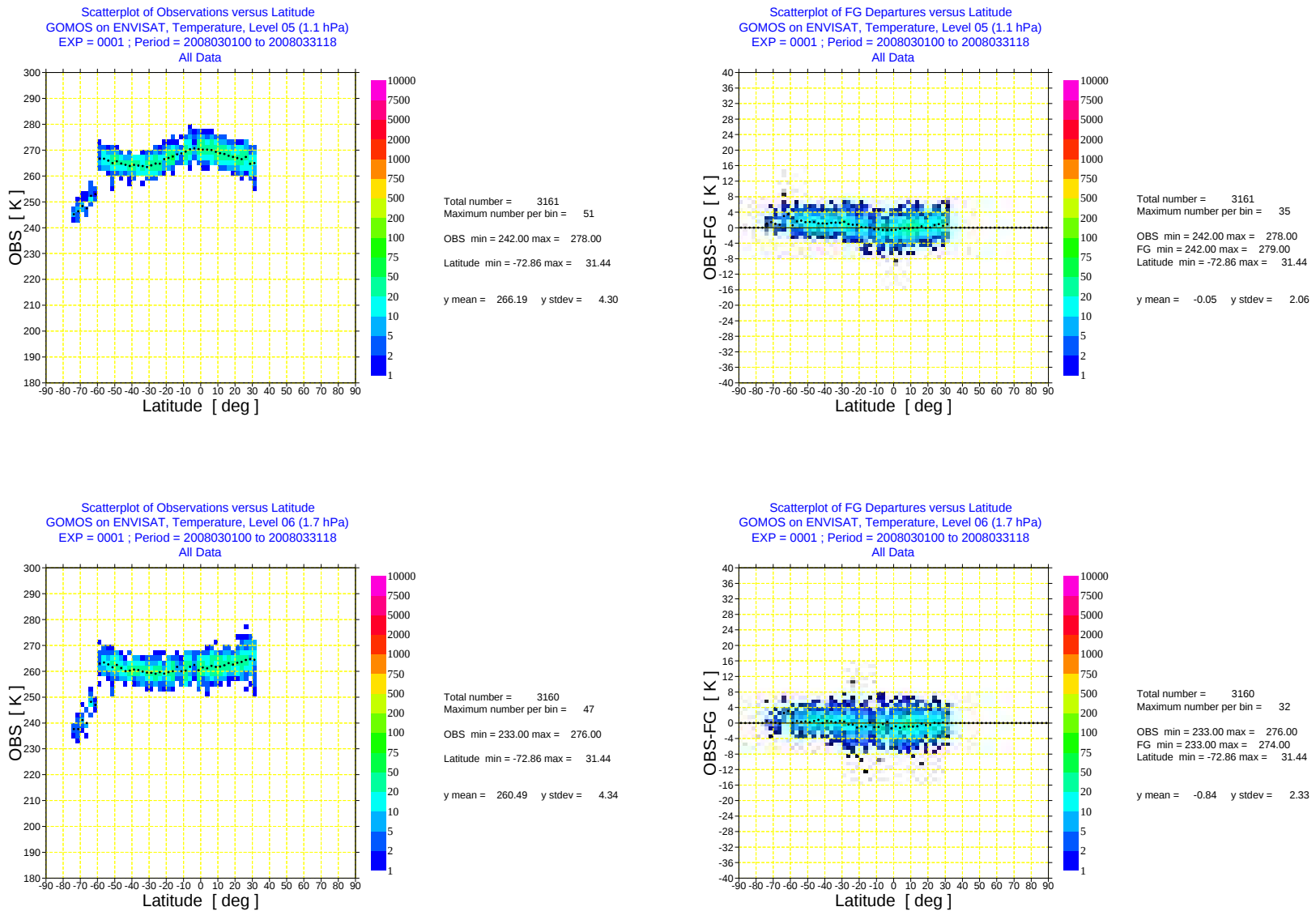


Fig. 10. As Fig. 7 but for level 5 (1.1 hPa) and level 6 (1.7 hPa).

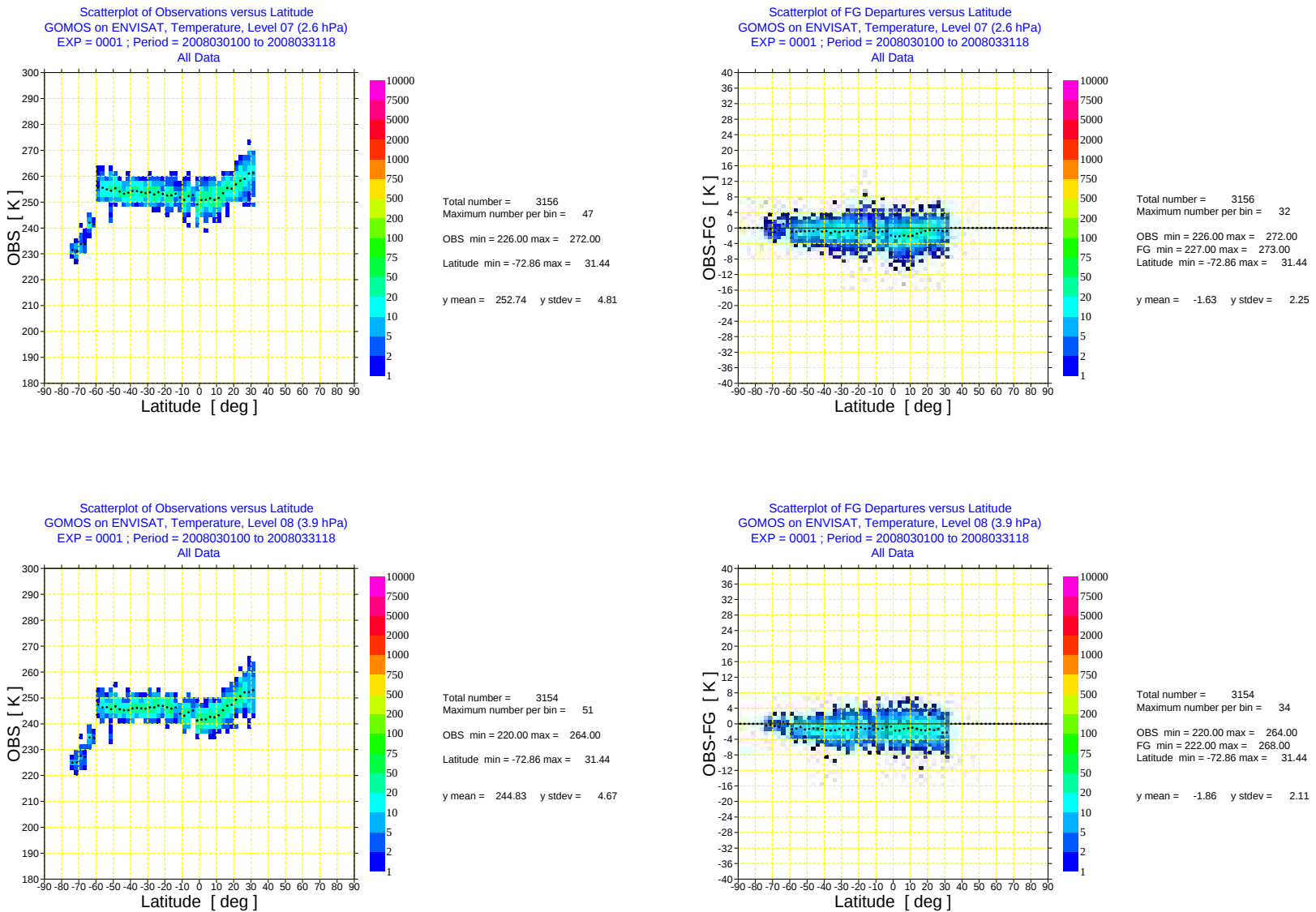


Fig. 11. As Fig. 7 but for level 7 (2.6 hPa) and level 8 (3.9 hPa).

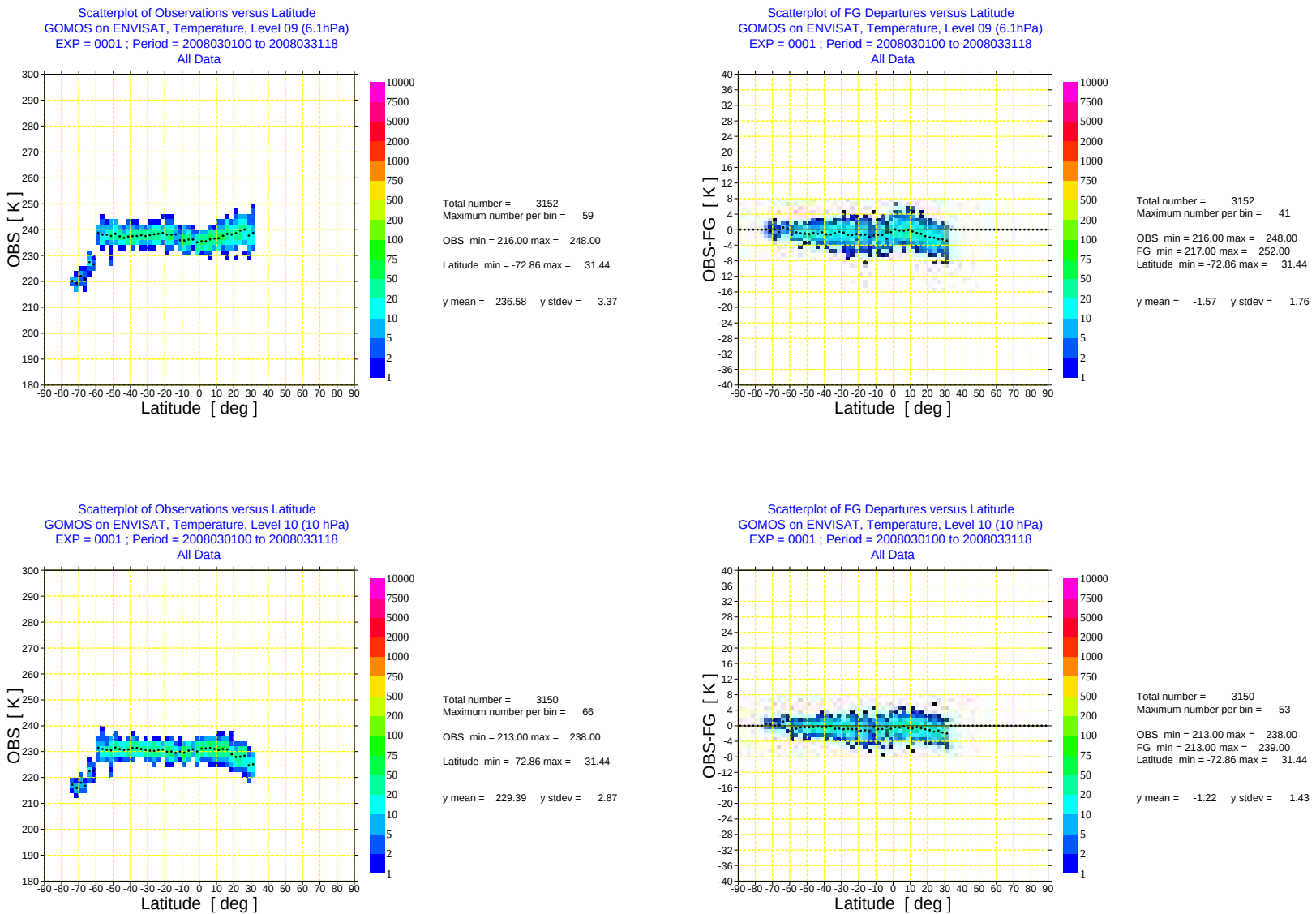


Fig. 12. As Fig. 7 but for level 9 (6.1 hPa) and level 10 (10 hPa).

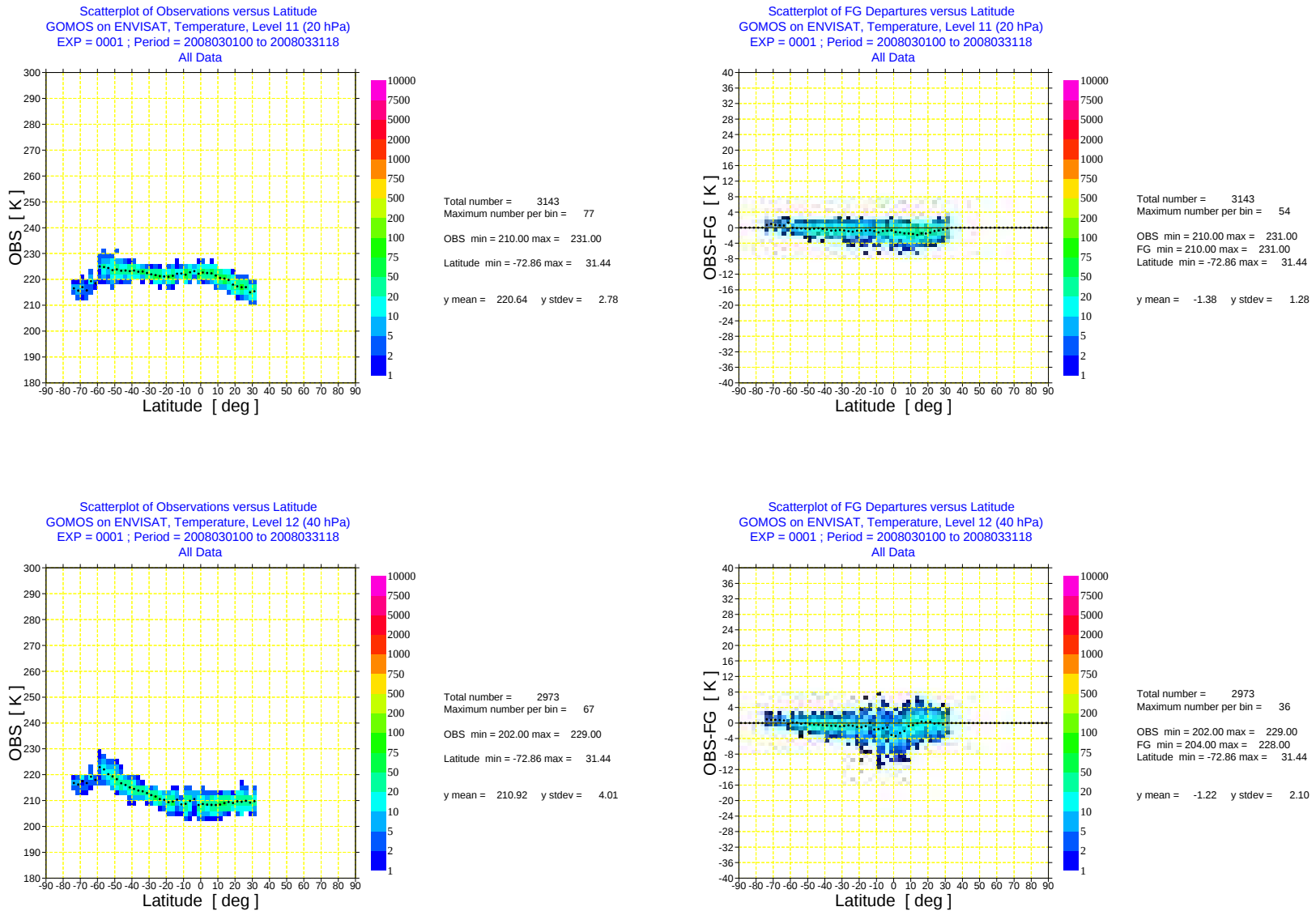


Fig. 13. As Fig. 7 but for level 11 (20 hPa) and level 12 (40 hPa).

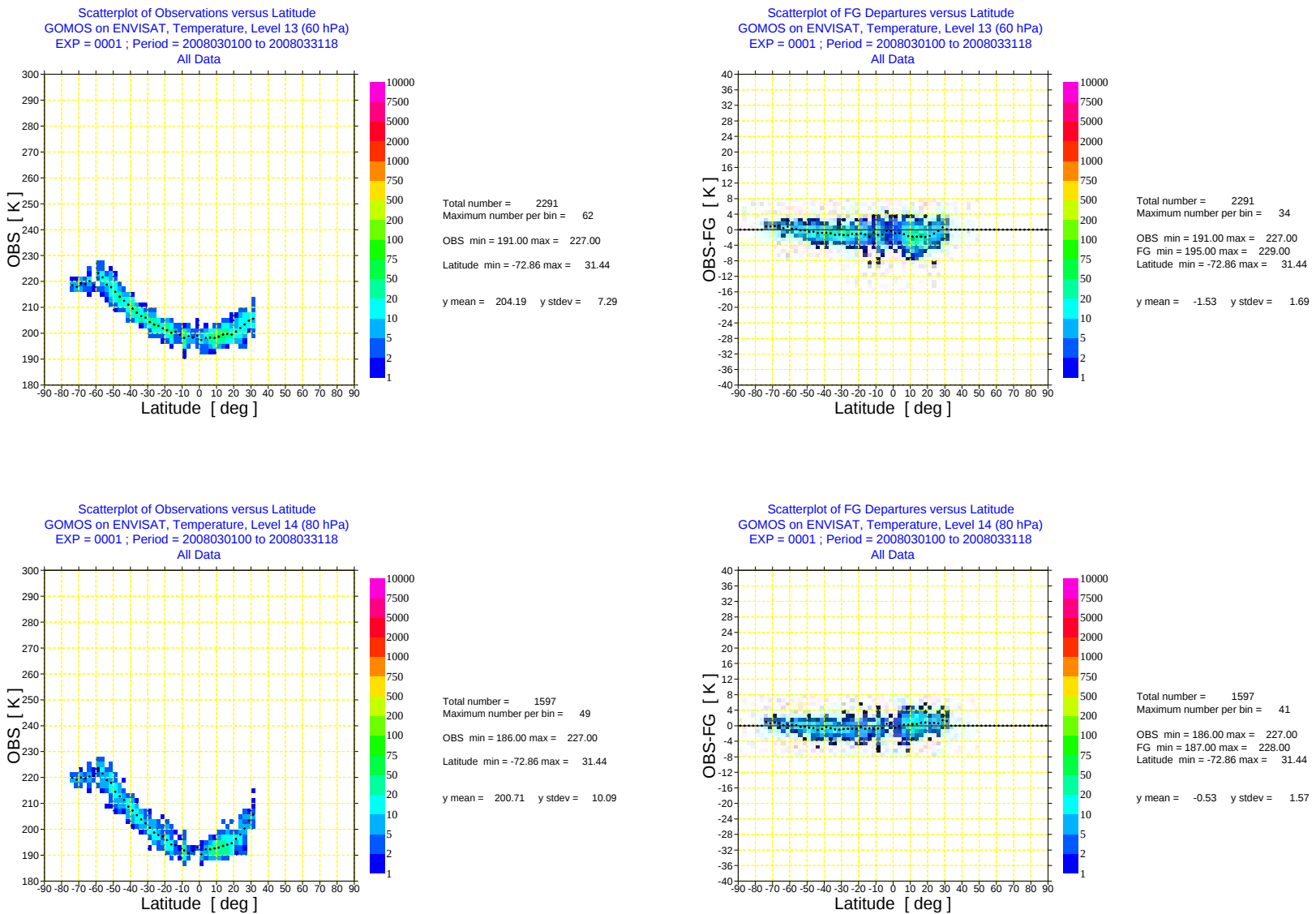


Fig. 14. As Fig. 7 but for level 13 (60 hPa) and level 14 (80 hPa).

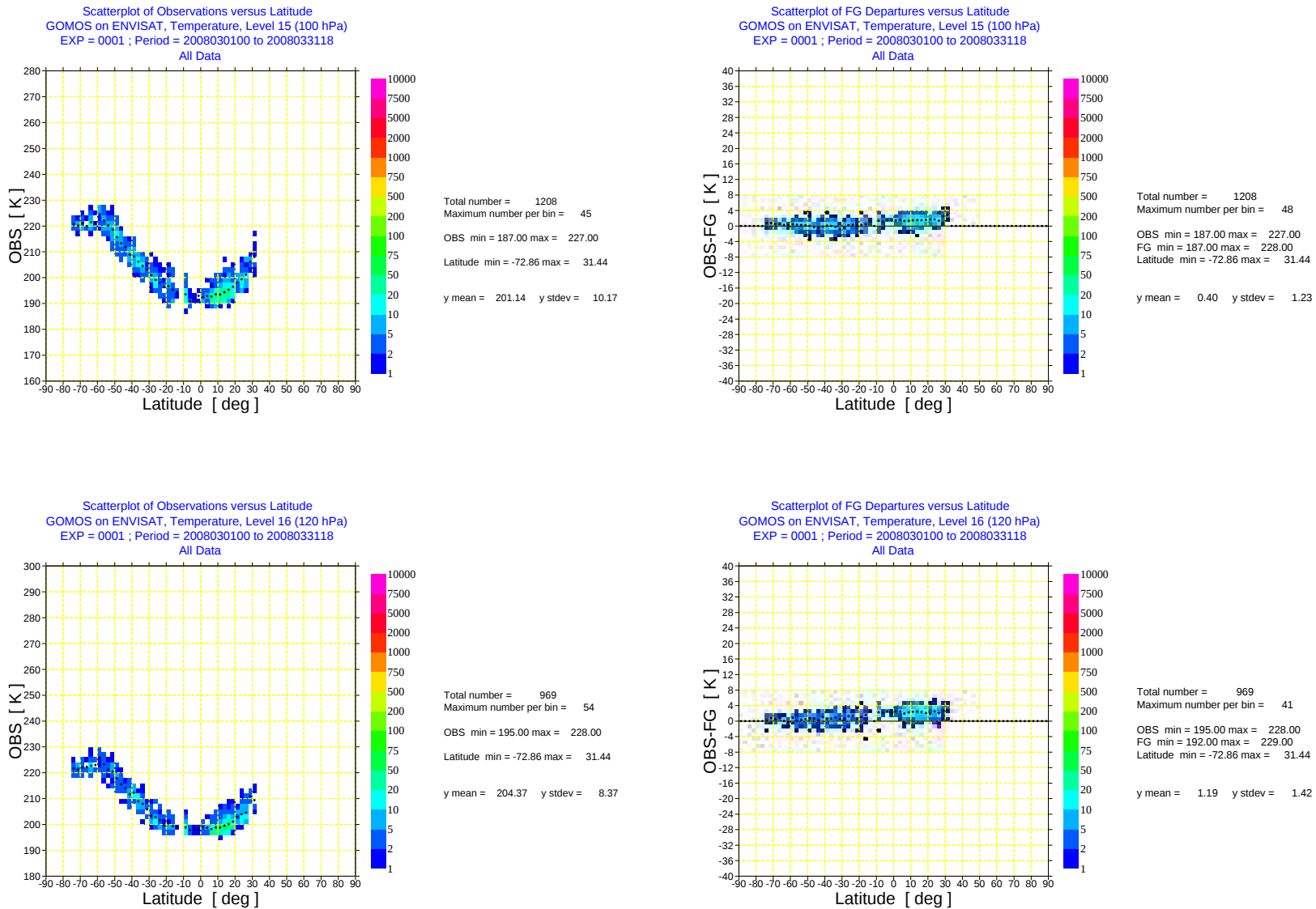


Fig. 15. As Fig. 7 but for level 15 (100 hPa) and level 16 (120 hPa).

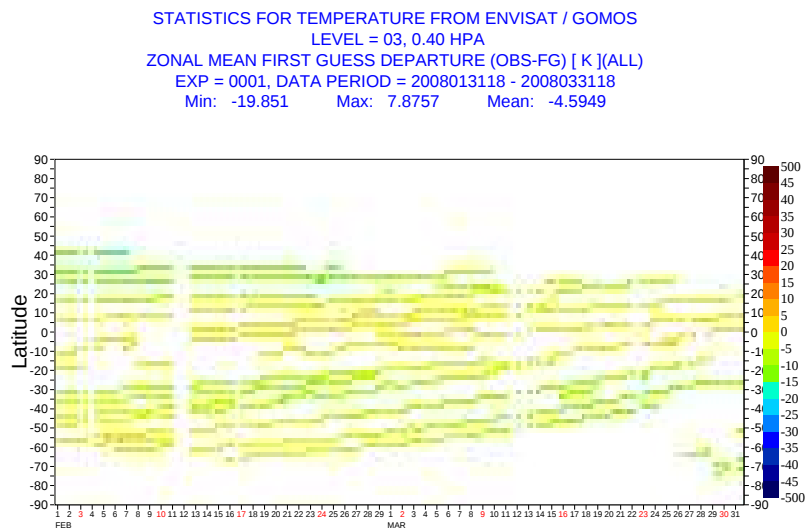
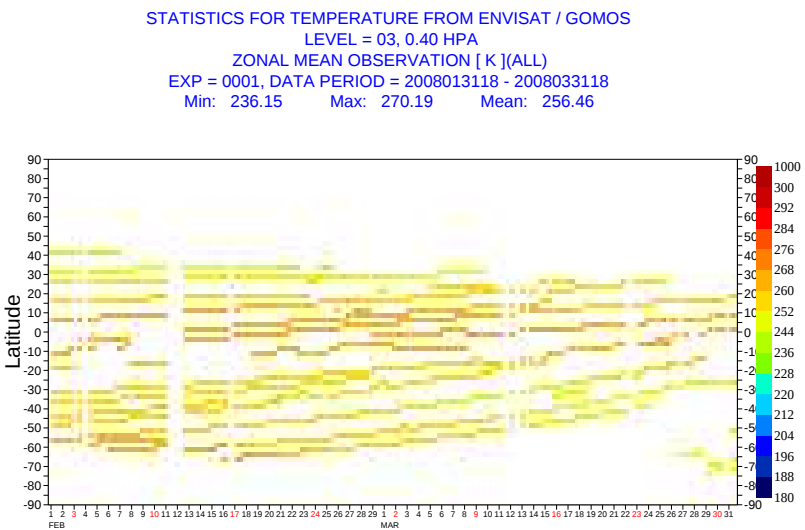
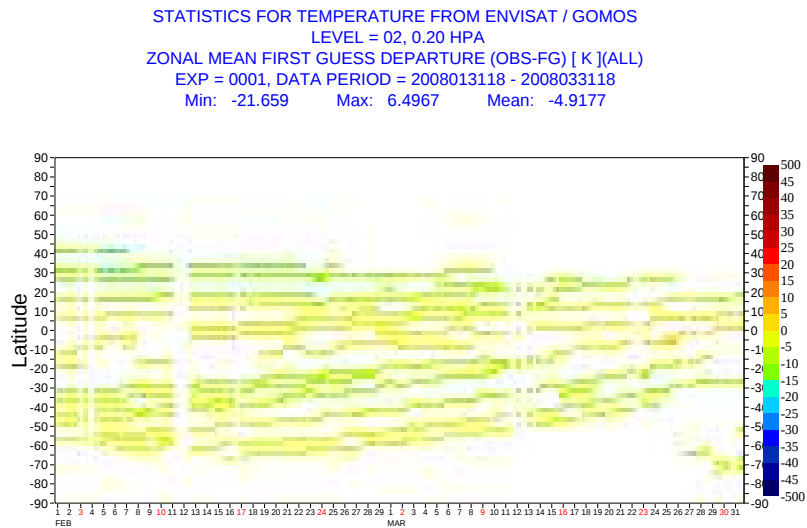
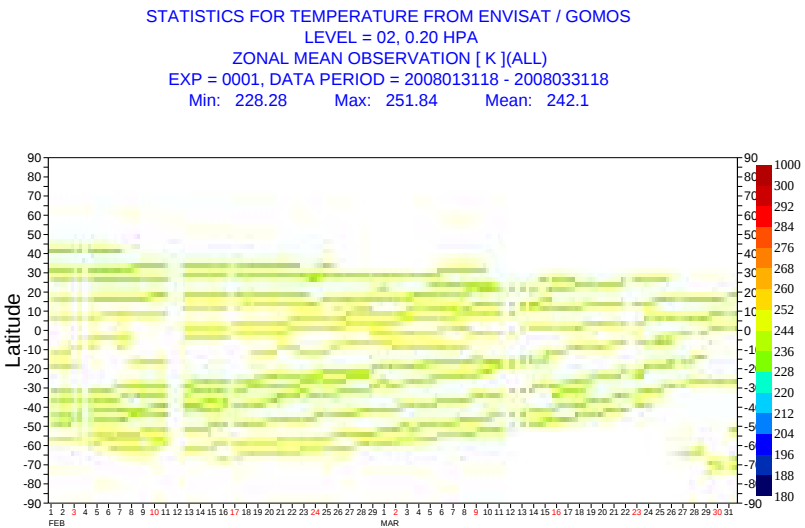


Fig. 16. Hovmöller diagram of zonal mean ENVISAT GOMOS NRT temperature data per 6-hour cycle and of the zonal mean first-guess departures for level 2 (0.2 hPa) and level 3 (0.4 hPa) for February-March 2008.

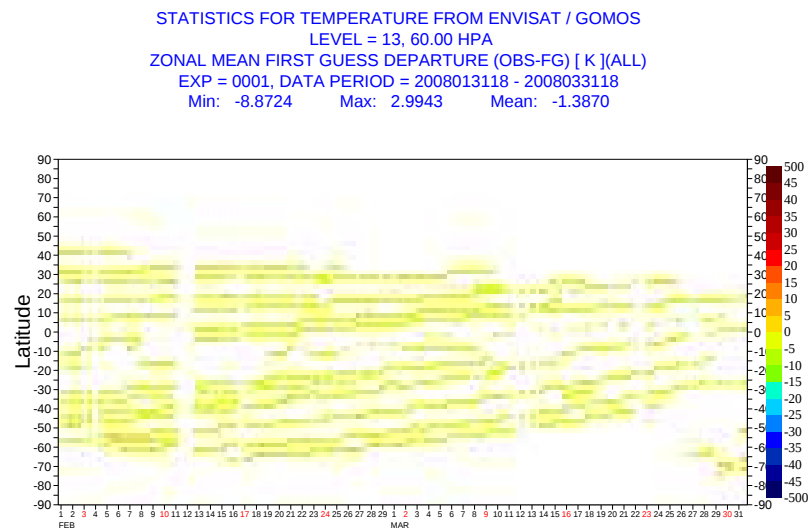
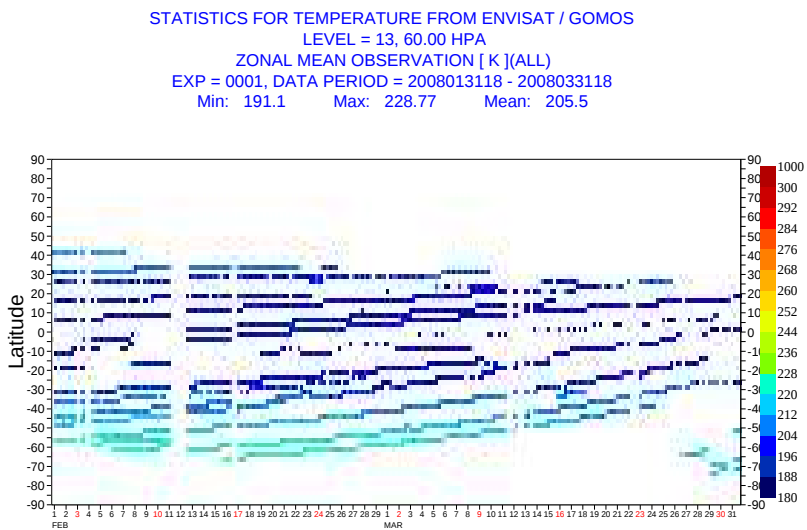
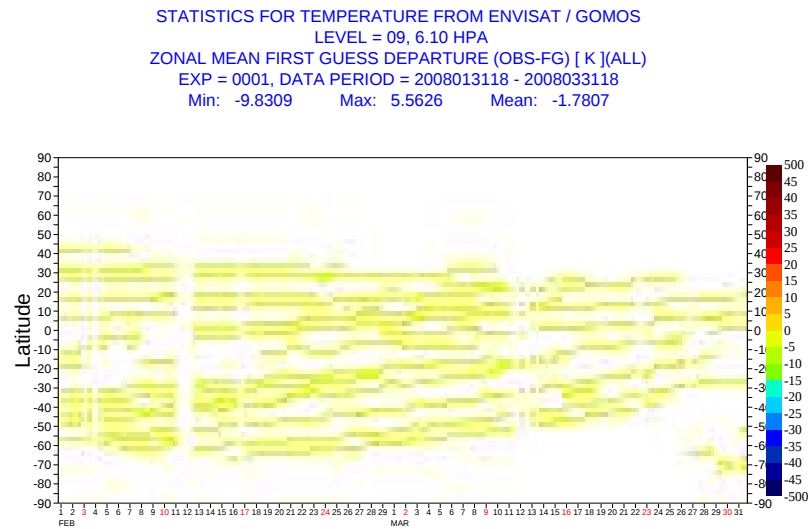
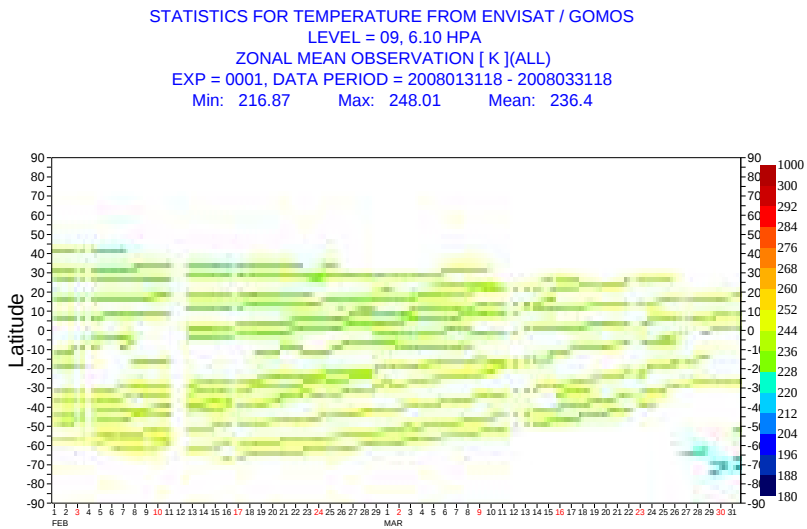


Fig. 17. As Fig. 15 but for level 9 (6.1 hPa) and level 13 (60 hPa).

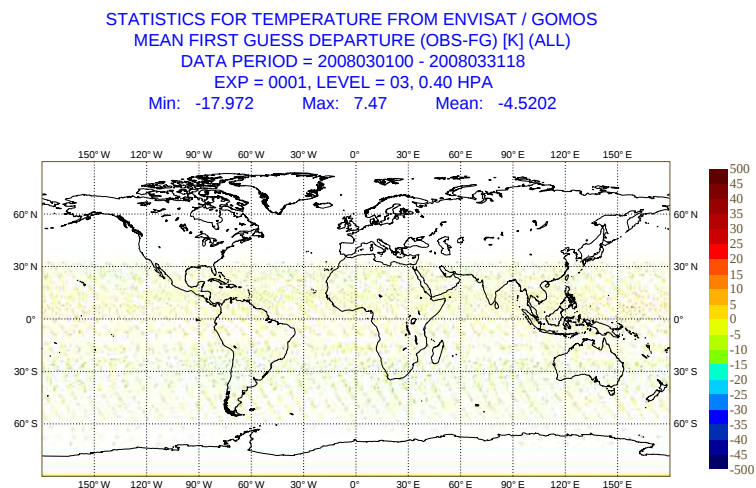
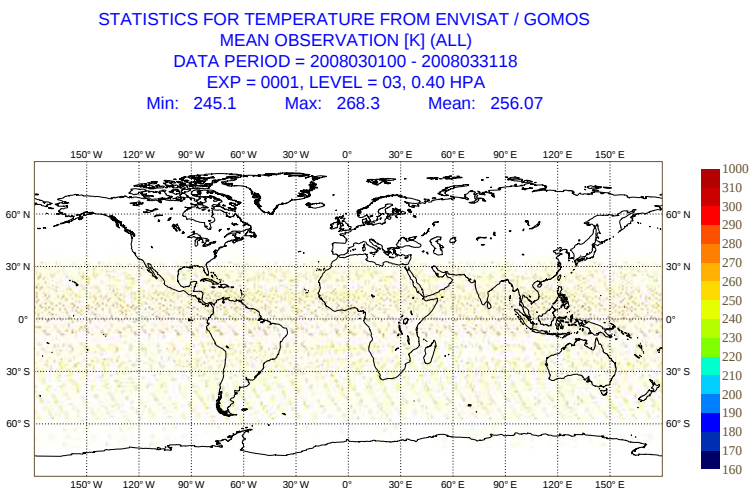
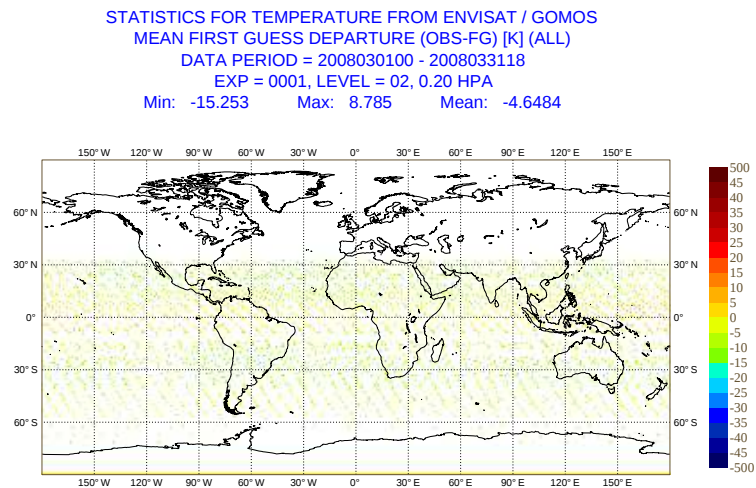
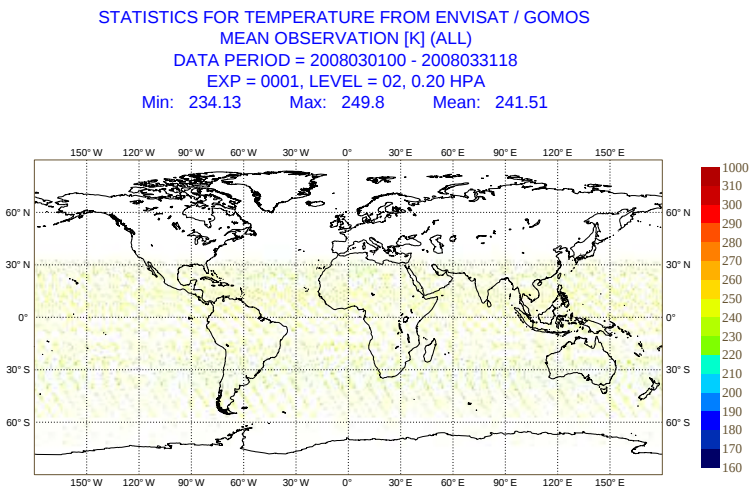


Fig. 18. Geographical distribution of mean ENVISAT GOMOS NRT temperature data and mean first-guess departures for level 2 (0.2 hPa) and level 3 (0.4 hPa) for March 2008.

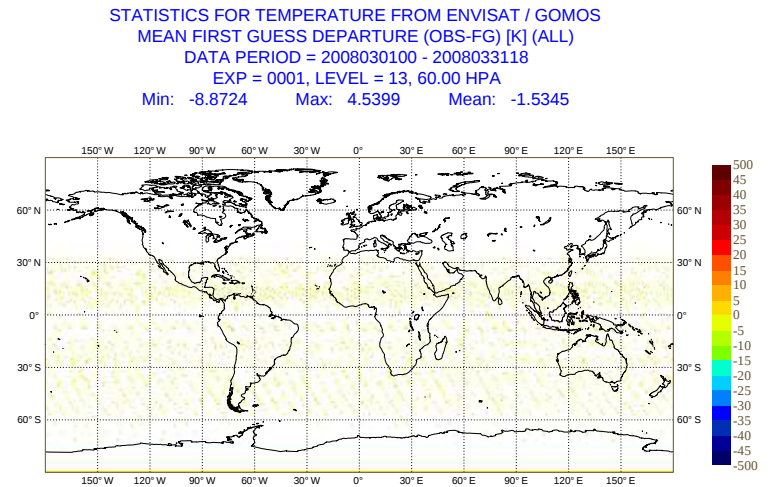
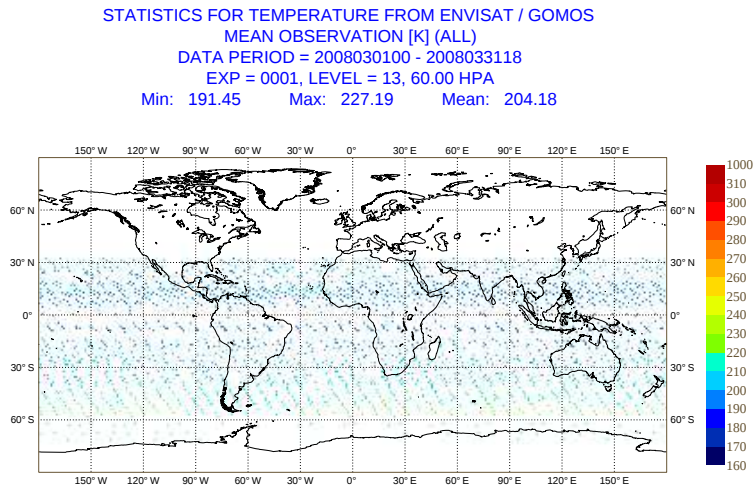
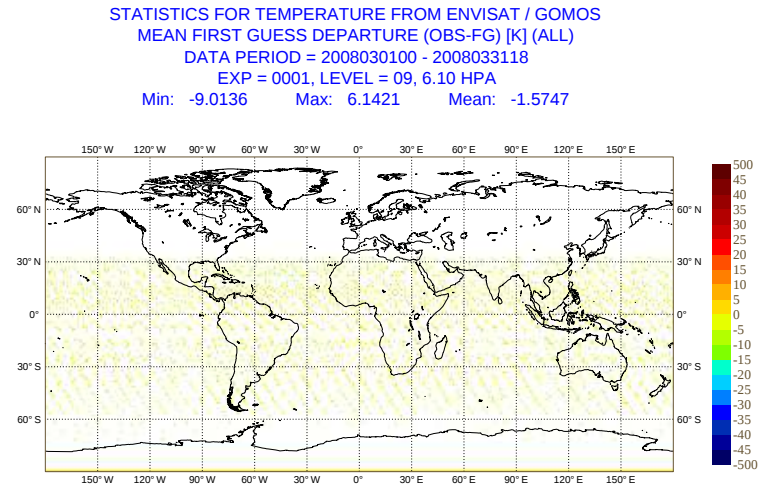
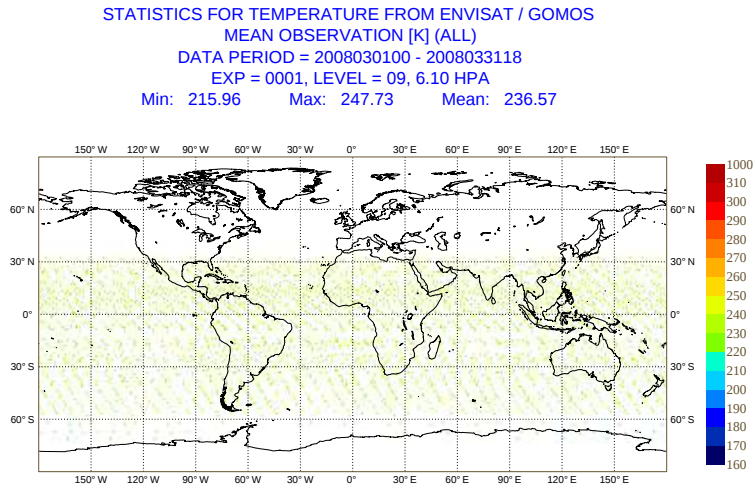


Fig. 19. As Fig. 18 but for level 9 (6.1 hPa) and level 13 (60 hPa).

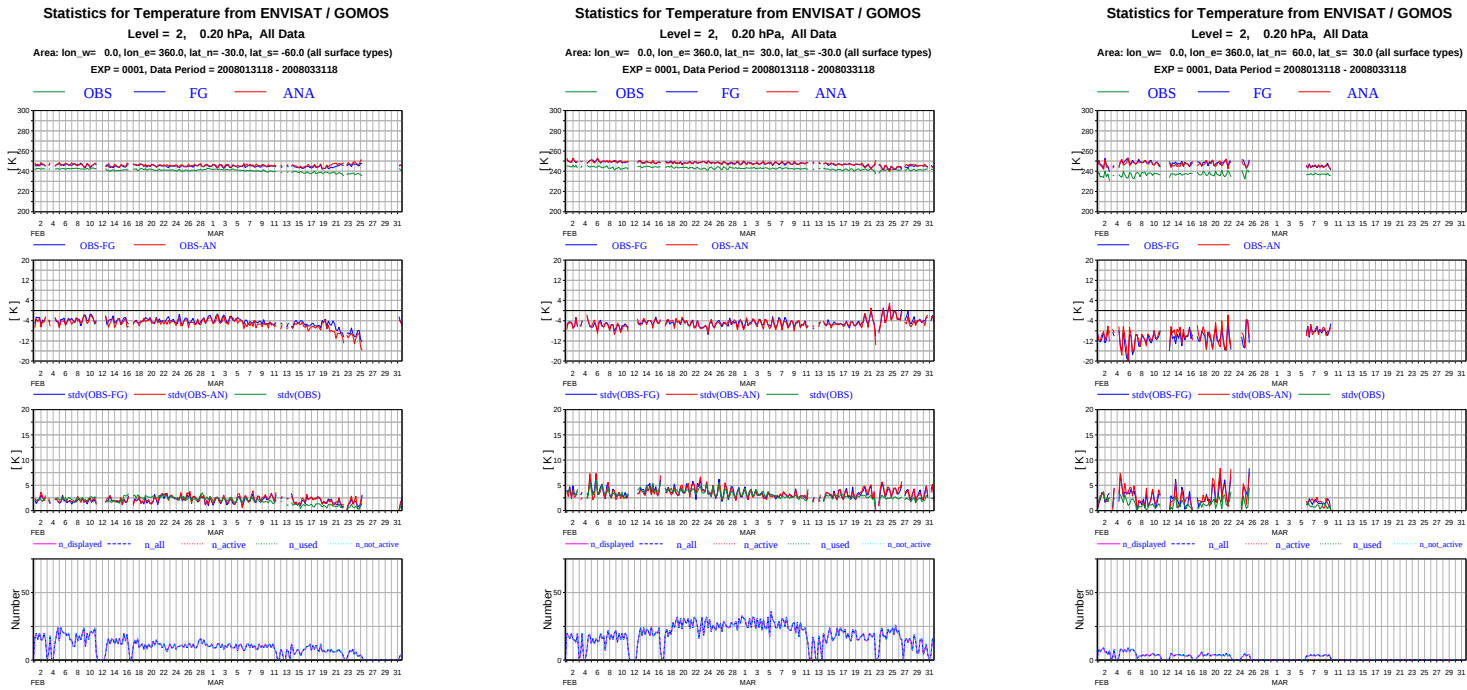


Fig. 20. Timeseries of mean ENVISAT GOMOS NRT temperature data, first guess and analysis values (top panels), first-guess and analysis departures (second panels), standard deviations (third panels) and number of data (bottom panels) per 6-hour cycle for level 2 (0.2 hPa) 30-60N, 30N-30S, 30-60S for the period February-March 2008.

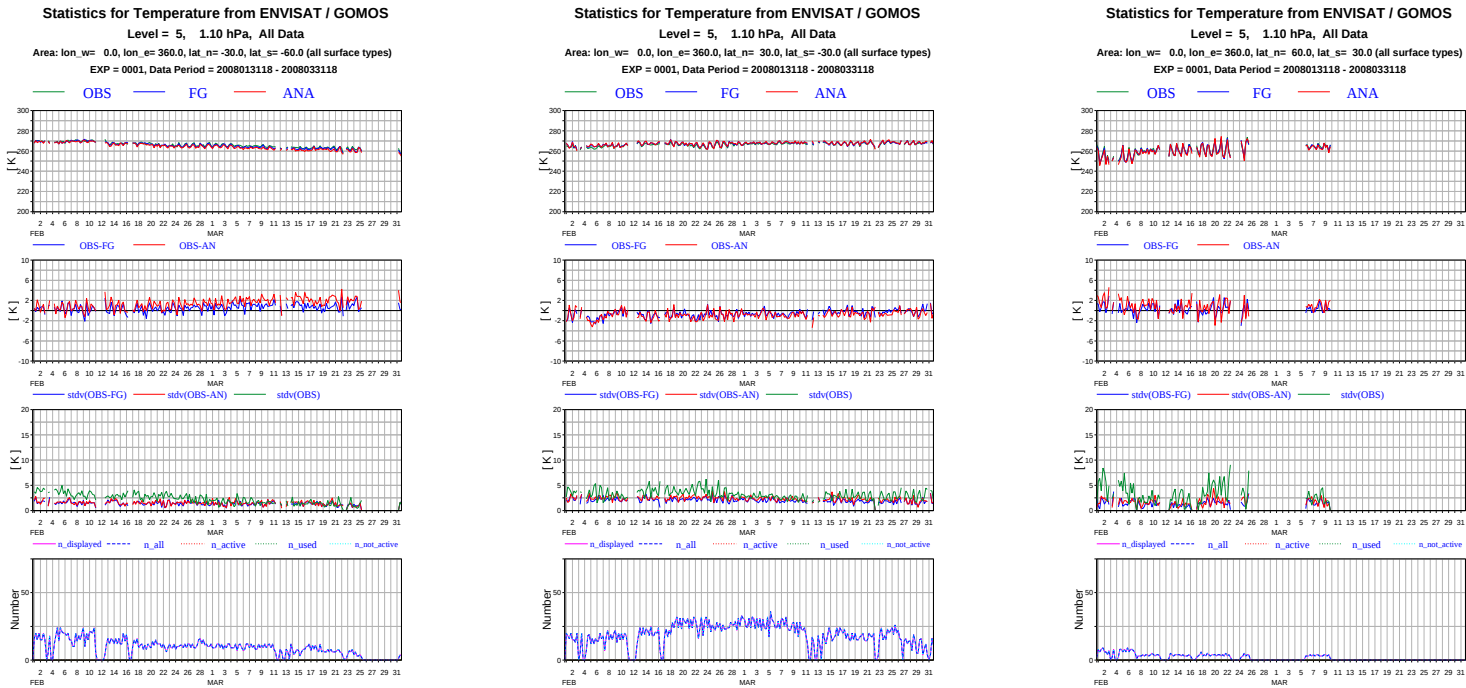


Fig. 21. As Figure 19, but for level 5 (1.1 hPa).

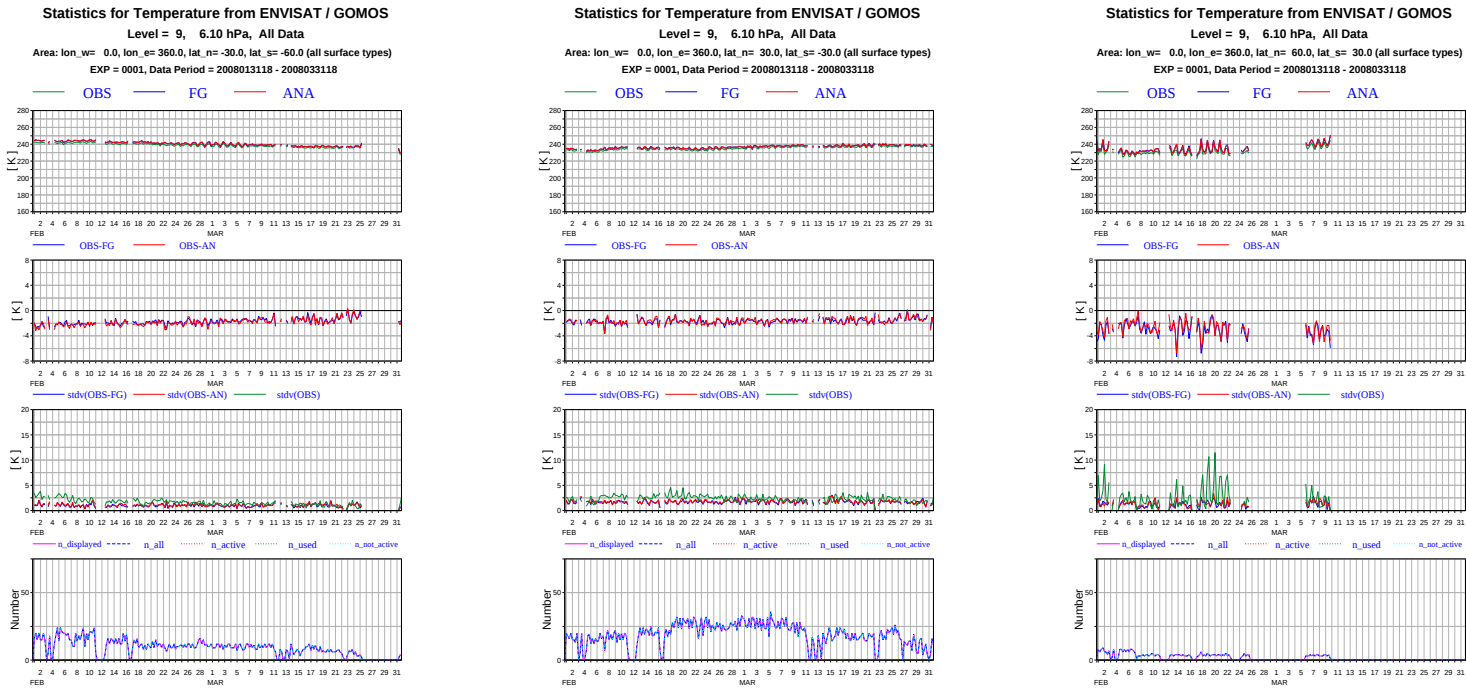


Fig. 22. As Figure 19, but for level 9 (6.1 hPa).

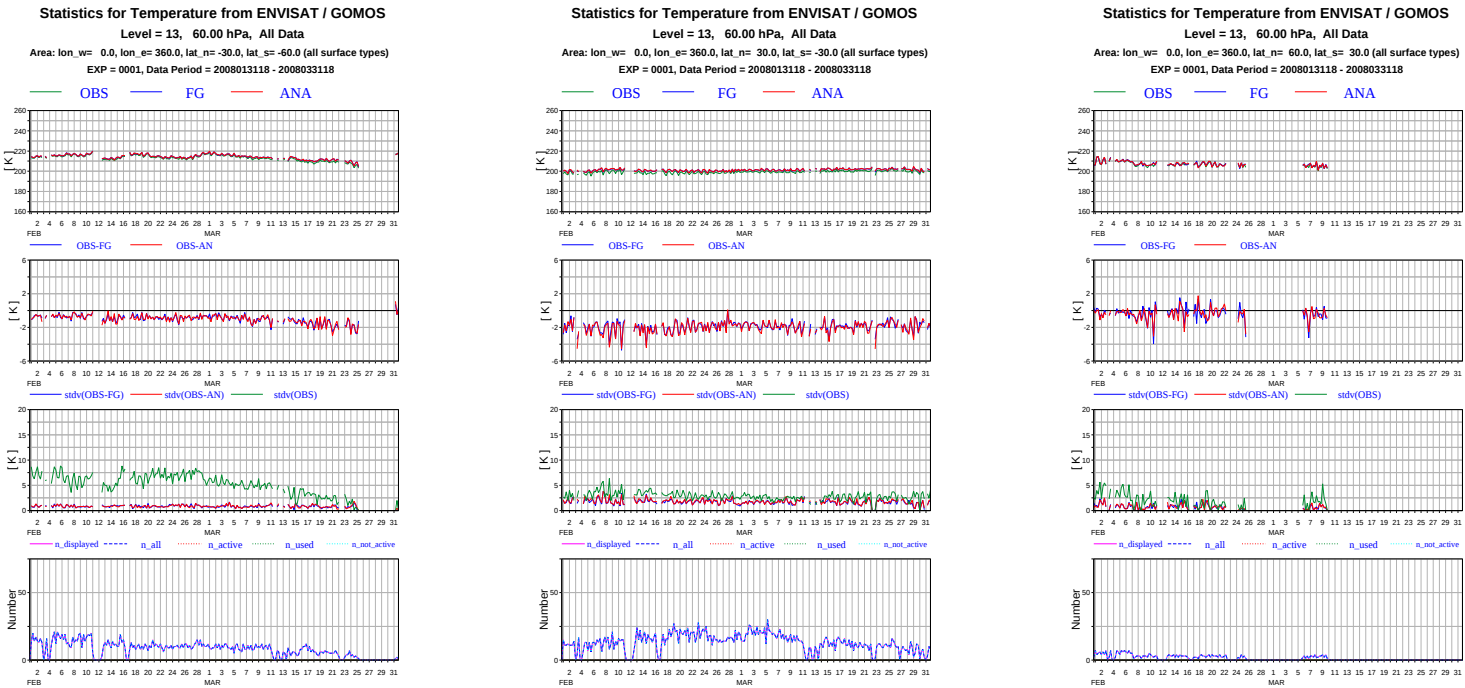


Fig. 23. As Figure 19, but for level 13 (60 hPa).

REPORT ABOUT ENVISAT GOMOS NRT WATER VAPOUR DATA (GOM_RR_2P) FOR MARCH 2008

Rossana Dragani

*ECMWF, Shinfield Park, Reading, RG2 9AX, United Kingdom,
Emails: Rossana.Dragani@ecmwf.int, Tel: 0044 118 9499259*

April 9, 2008

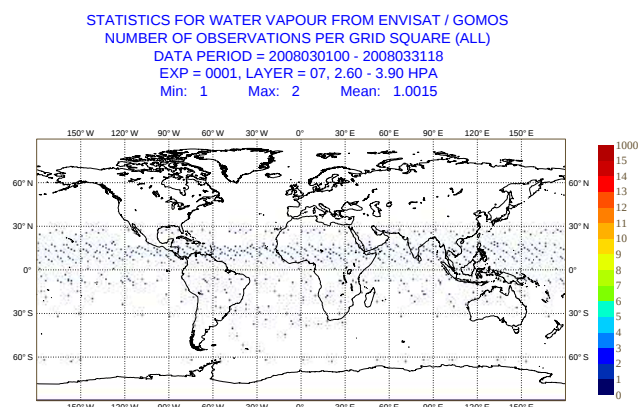


Fig. 1. Geographical distribution of mean number of ENVISAT GOMOS NRT water vapour data for level 7 (2.6-3.9 hPa) for March 2008.

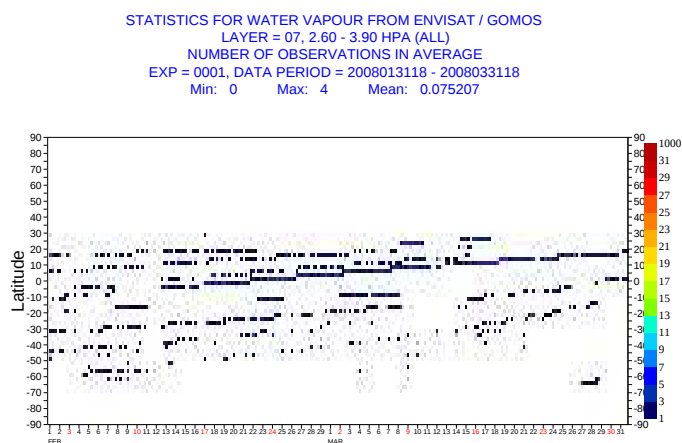


Fig. 2. Hovmoeller diagram of zonal mean number of data of ENVISAT GOMOS NRT water vapour data per 6-hour cycle for level 7 (2.6-3.9 hPa) for February-March 2008.

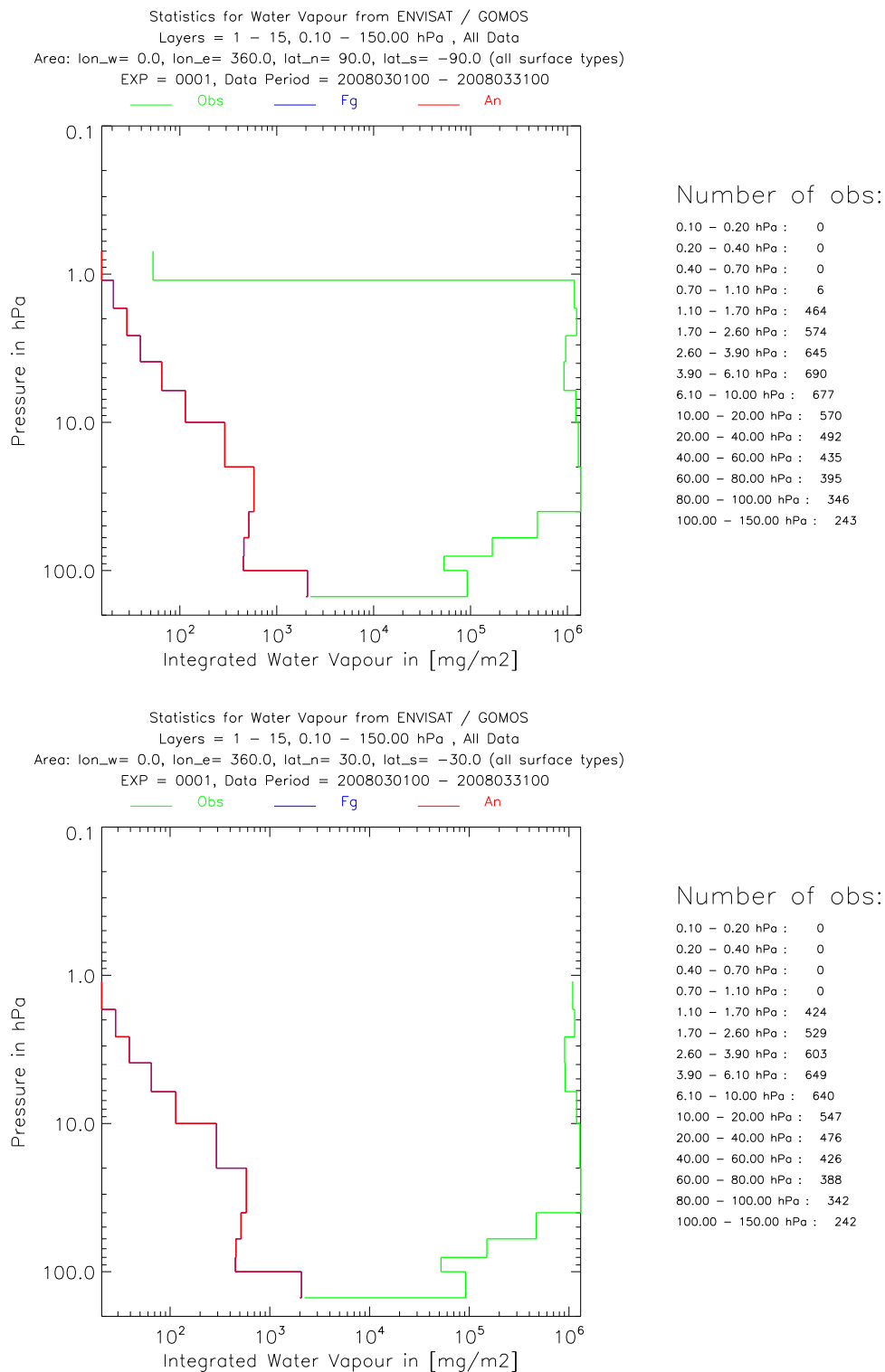


Fig. 3. Time mean vertical distribution of ENVISAT GOMOS NRT water vapour data in mg/m^2 for March 2008. The top plot shows the mean analysis values (red), the mean first-guess (blue), the mean observation (green) globally averaged. The bottom plot shows a similar plot for the tropical band (30N-30S) Plotted are the partial columns for the 16 levels listed to the right of the diagrams.

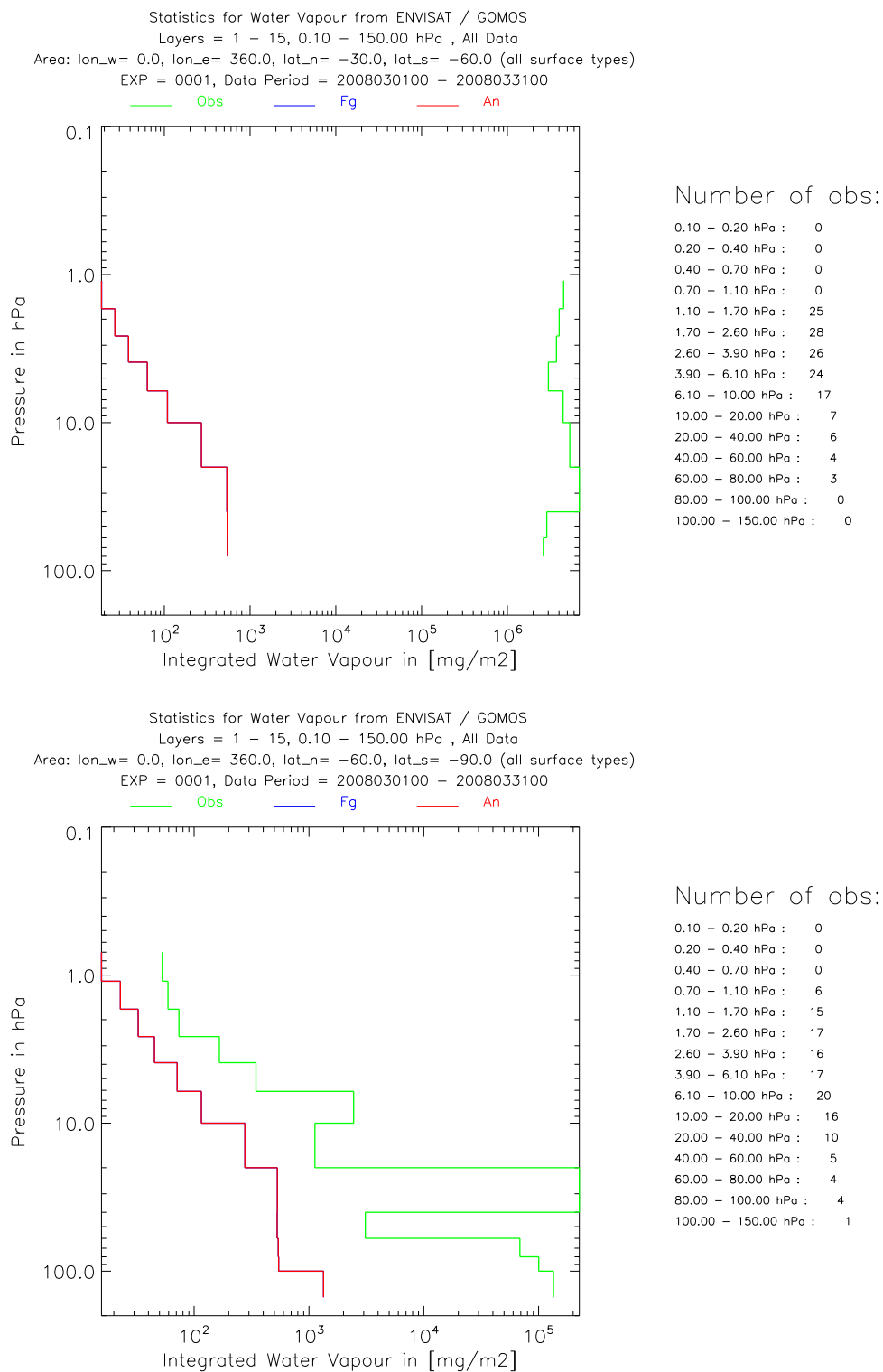


Fig. 4. As Fig. 3 but for 30-60S (top panel) and 60-90S (bottom panel).

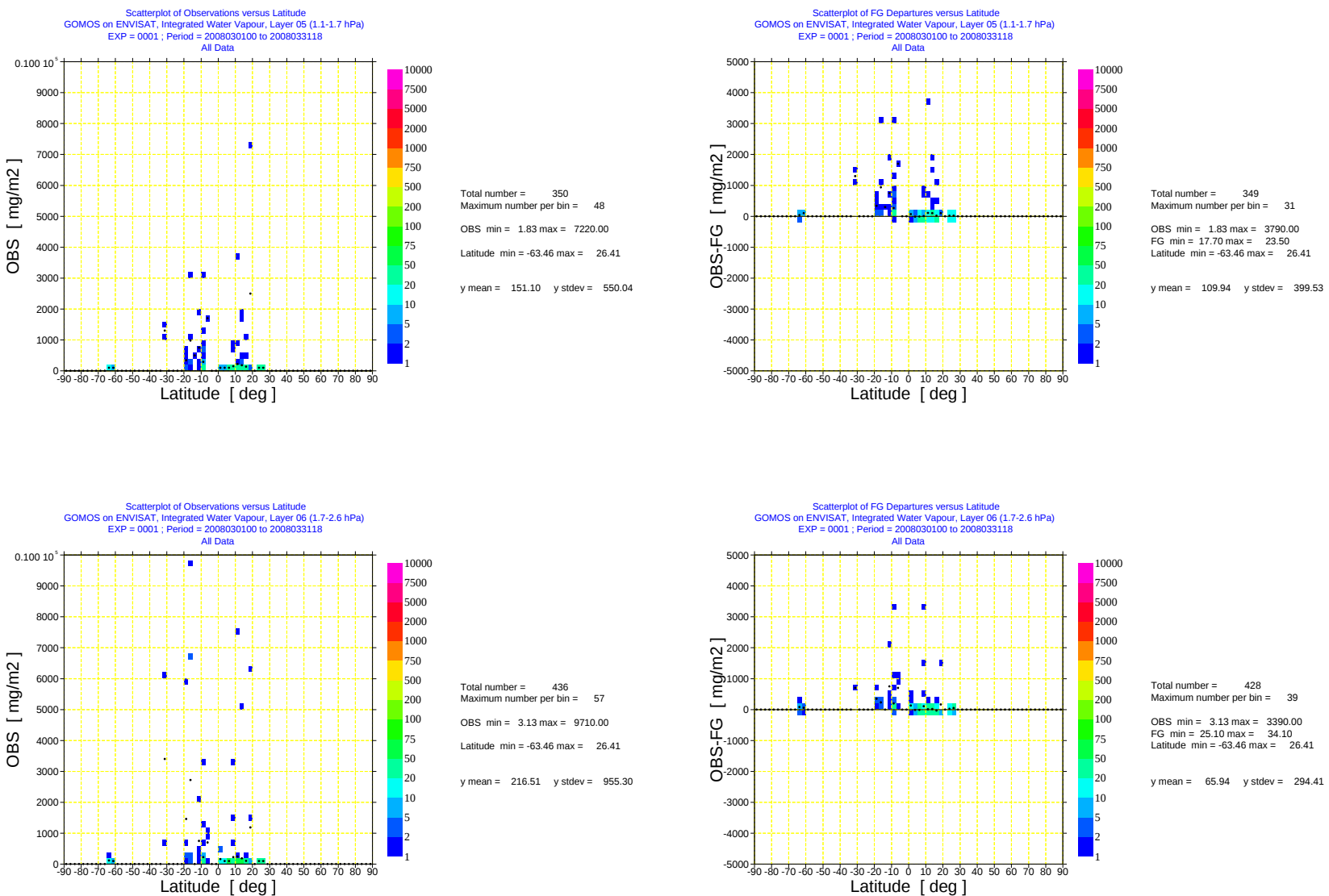


Fig. 5. Scatter plot of ENVISAT GOMOS NRT water vapour data against latitude (left) and scatter plot of first-guess departures of ENVISAT GOMOS NRT water vapour data against latitude (right) for March 2008 for level 5 (1.1 hPa) and level 6 (1.7 hPa). The colours show the number of data per bin, and the black dots the mean value per bin.

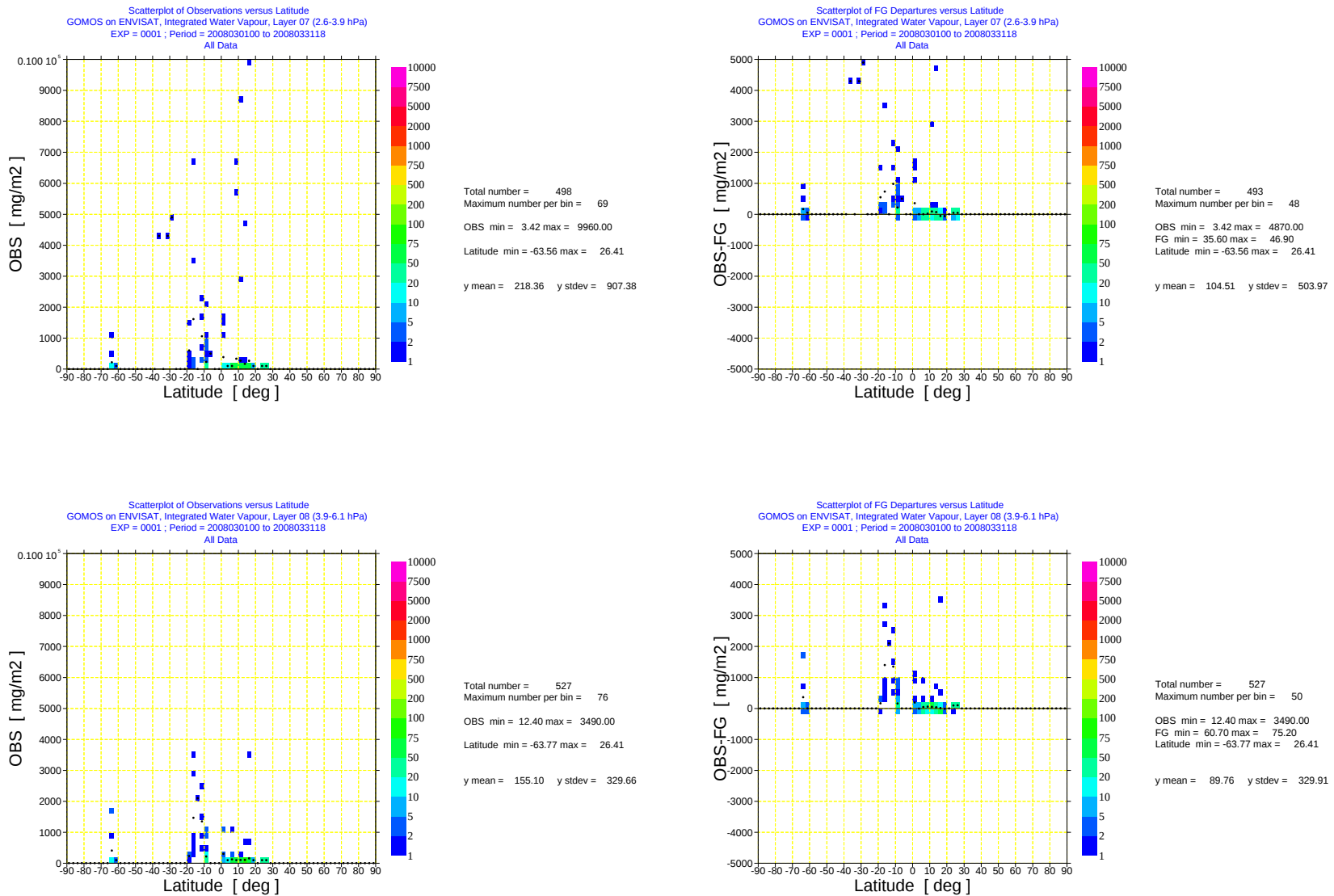


Fig. 6. As Fig. 5 but for level 7 (2.6 hPa) and level 8 (3.9 hPa).

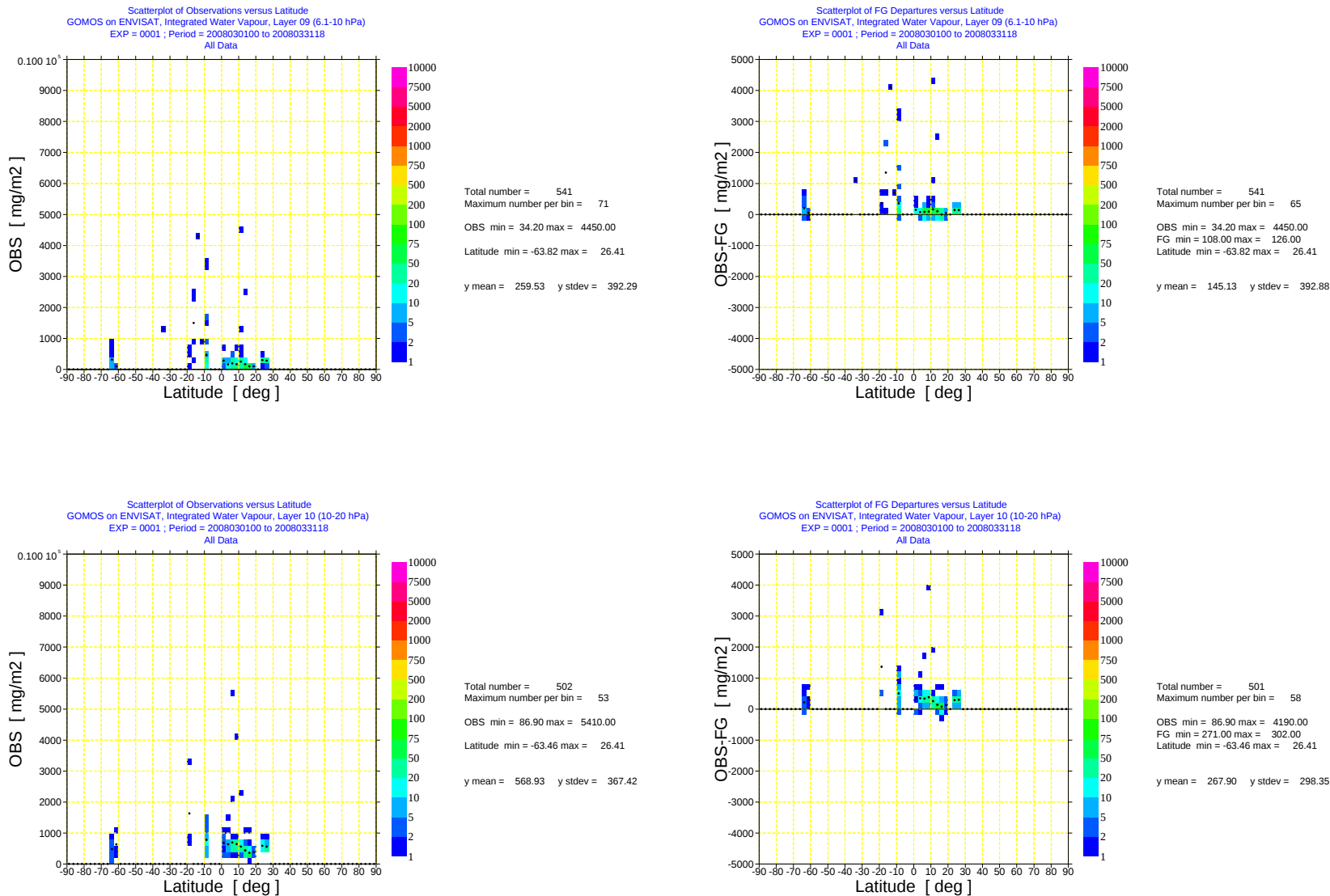


Fig. 7. As Fig. 5 but for level 9 (6.1 hPa) and level 10 (10 hPa).

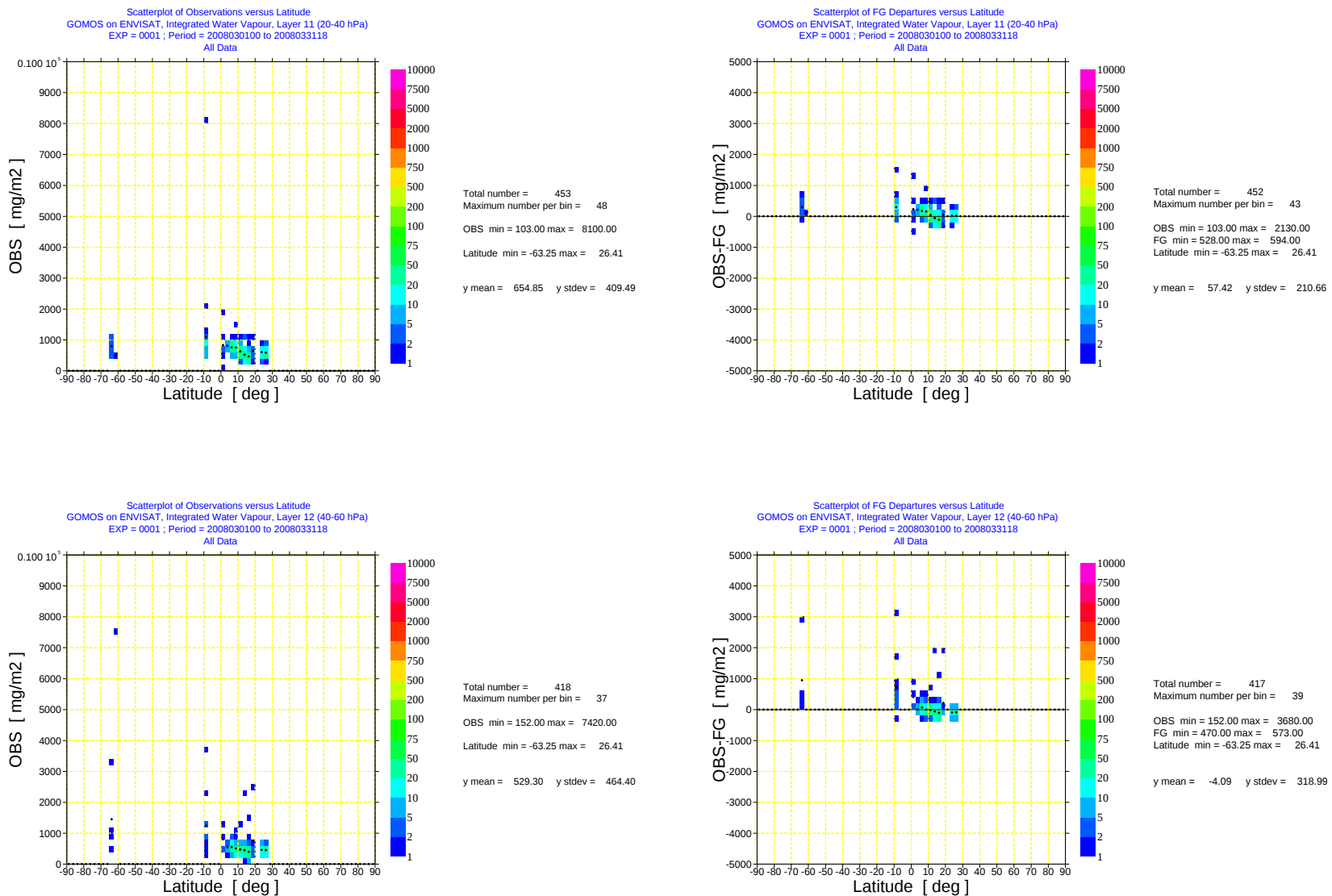


Fig. 8. As Fig. 5 but for level 11 (20-40 hPa) and level 12 (40-60 hPa).

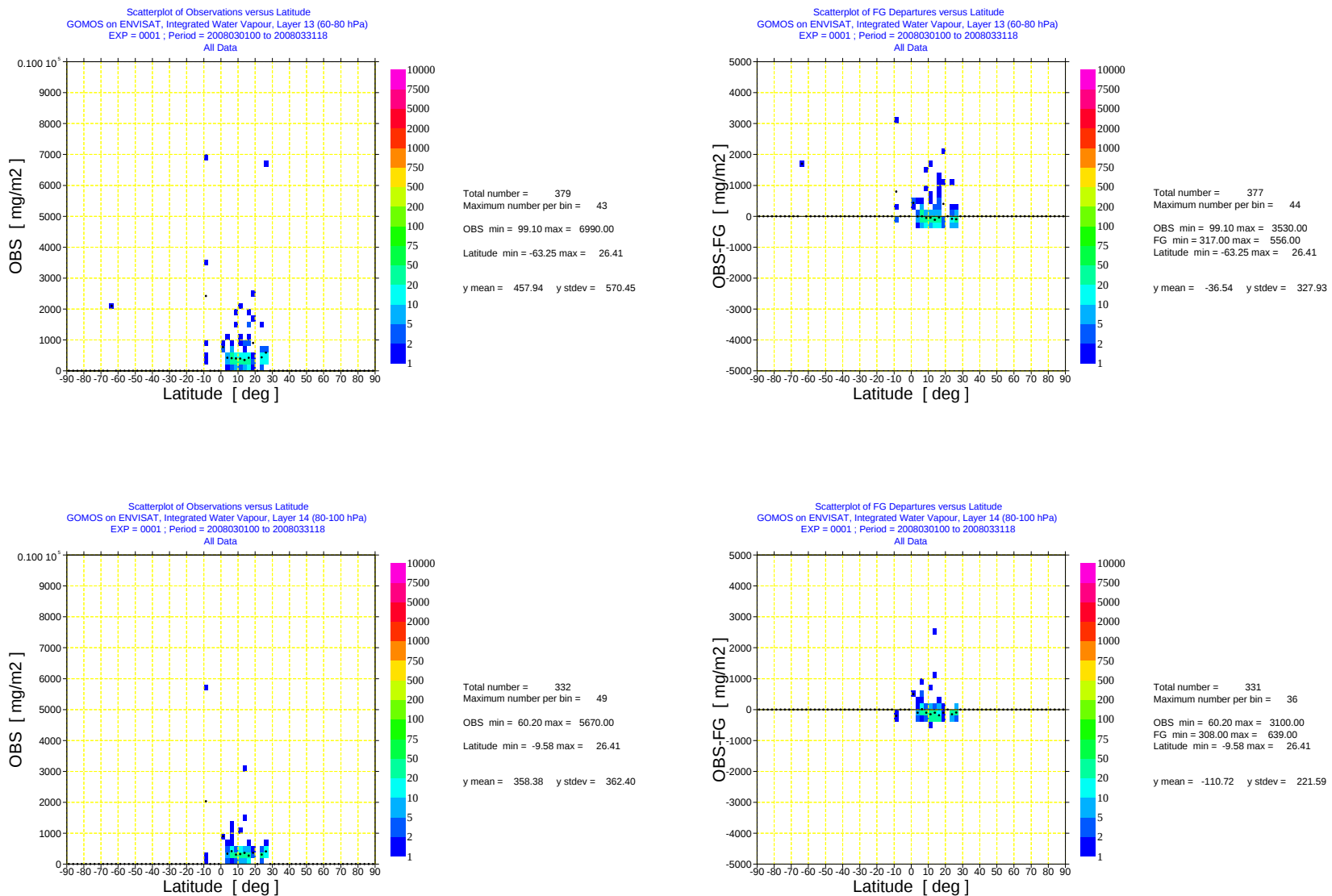


Fig. 9. As Fig. 5 but for level 13 (60-80 hPa) and level 14 (80-100 hPa).

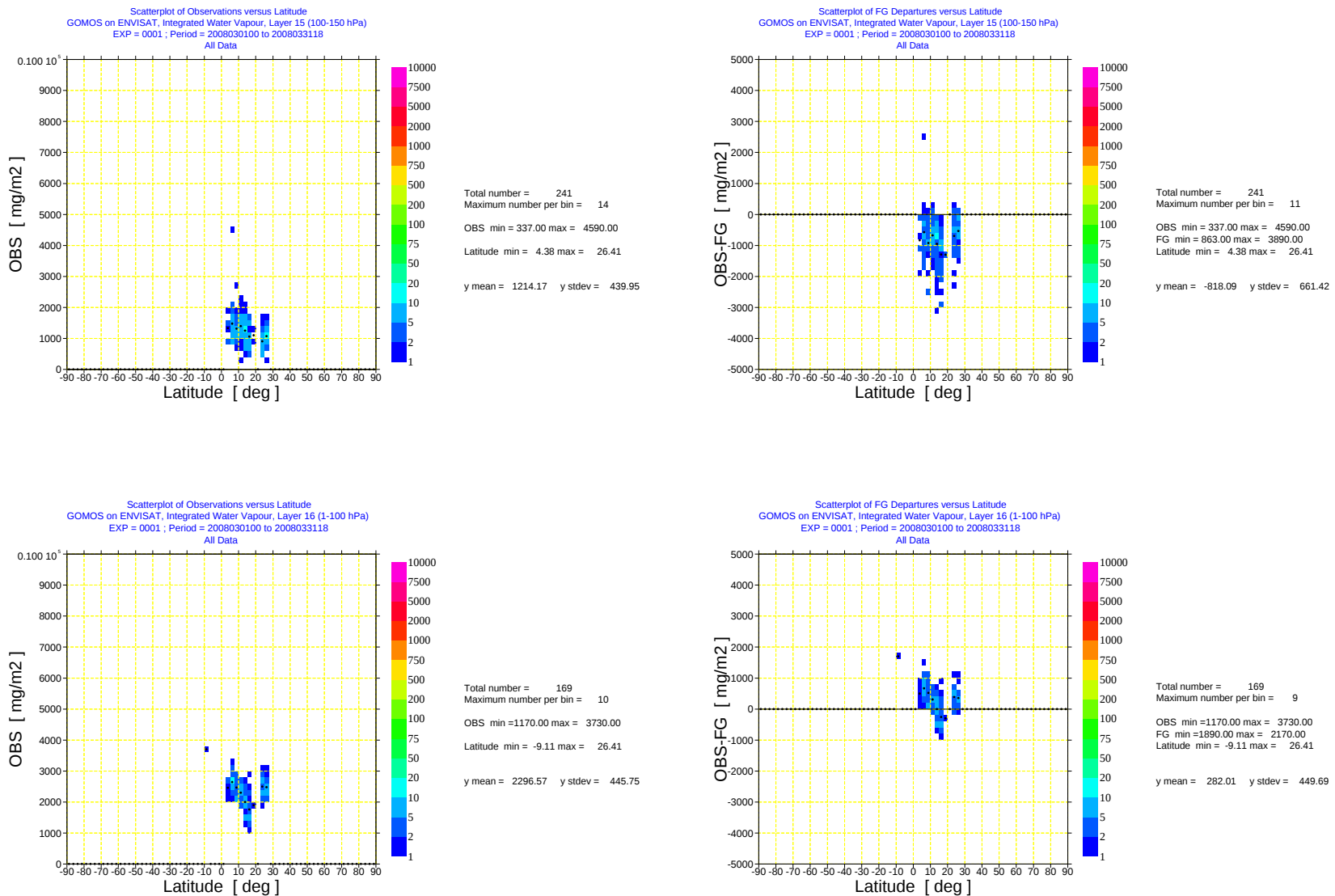


Fig. 10. As Fig. 5 but for level 15 (100-150 hPa) and level 16 (1-100 hPa).

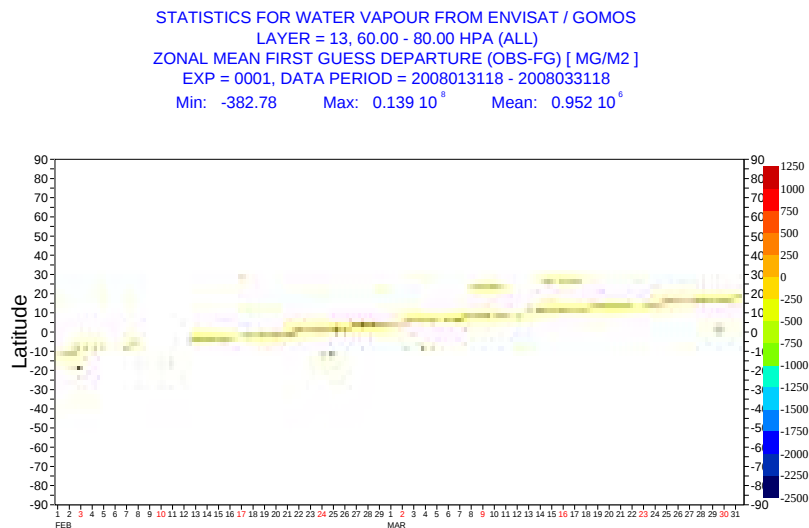
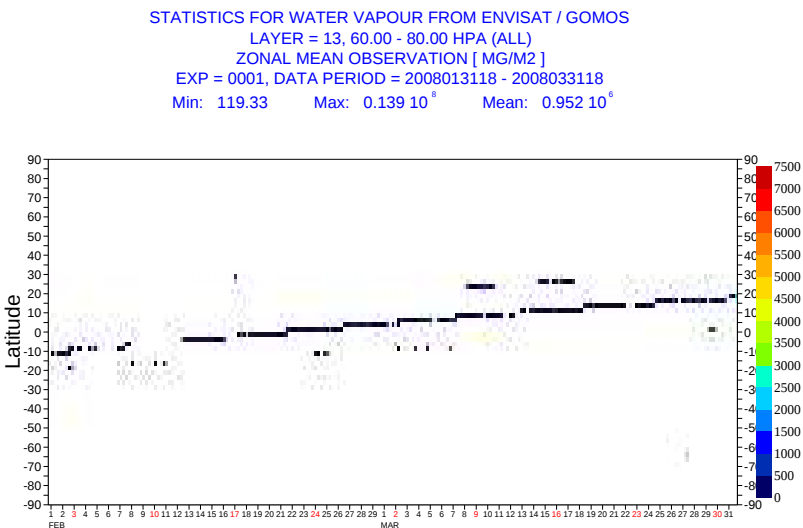
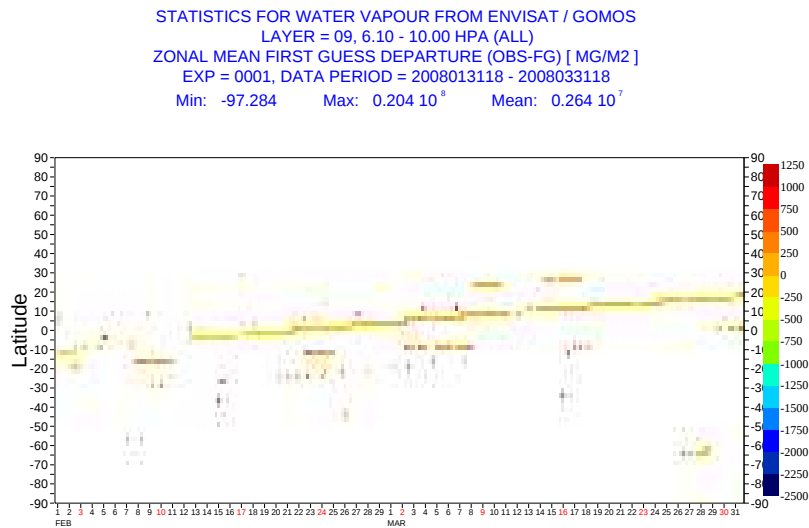
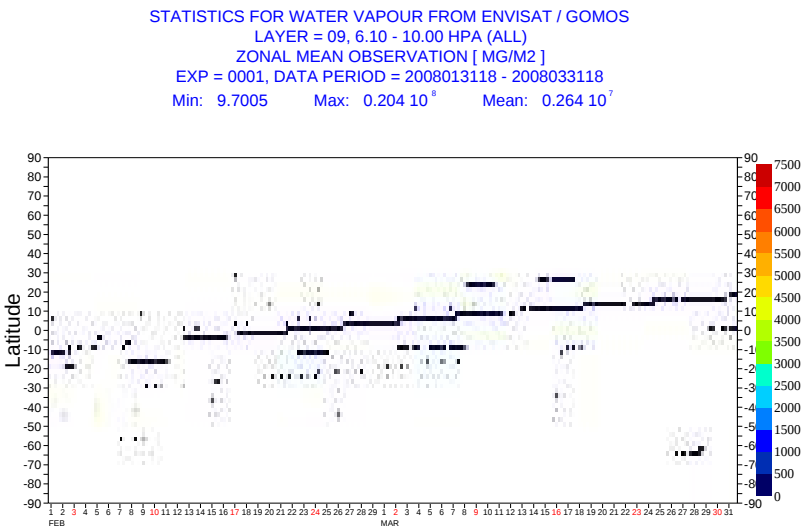
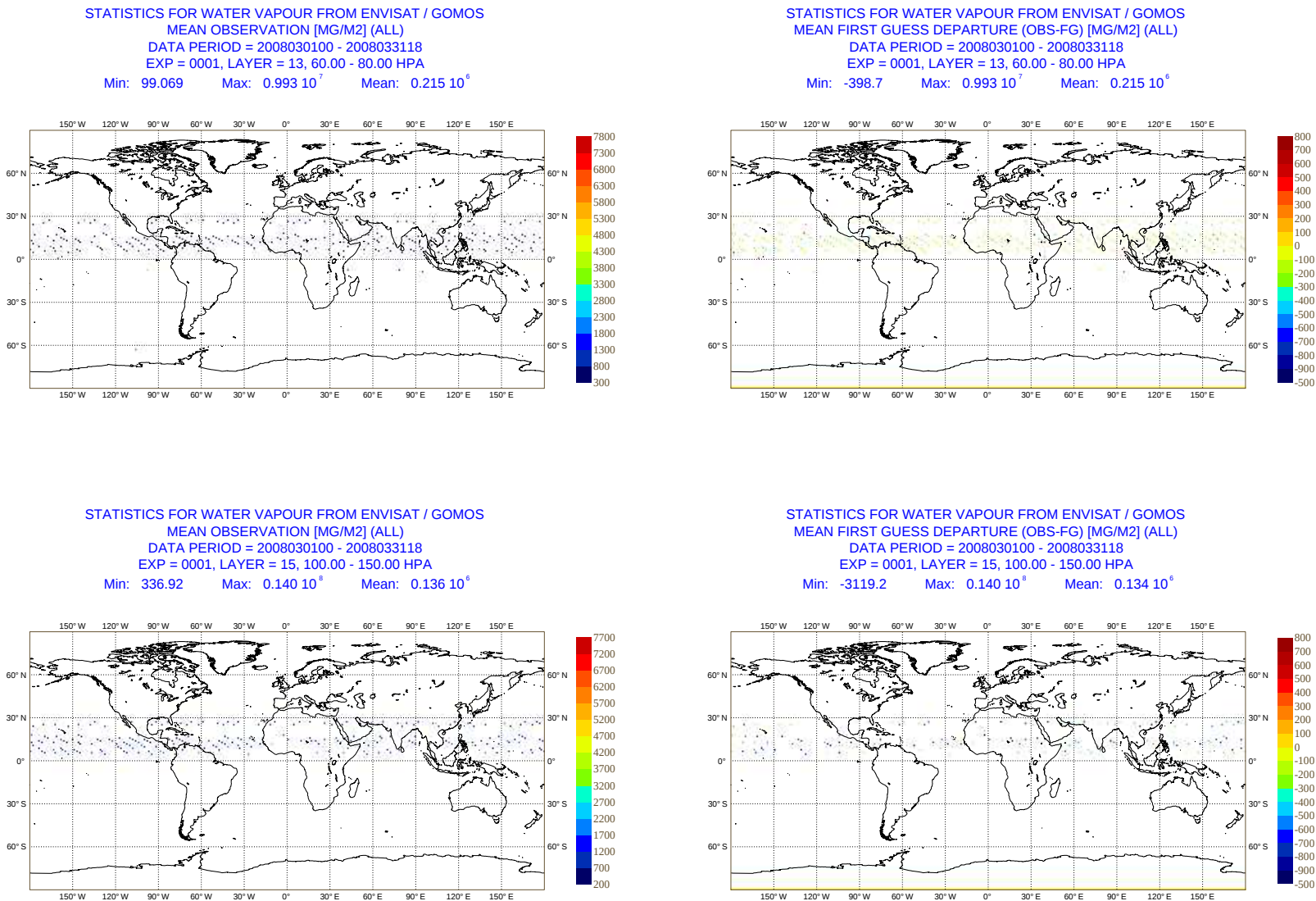


Fig. 11. Hovmöller diagram of zonal mean ENVISAT GOMOS NRT water vapour data per 6-hour cycle and of the zonal mean first-guess departures for level 13 (60-80 hPa) and level 15 (100-150 hPa) for February-March 2008.

Fig. 12. Geographical distribution of mean ENVISAT GOMOS NRT water vapour data and mean first-guess departures for level 13 (60-80 hPa) and level 15 (100-150 hPa) for March 2008.



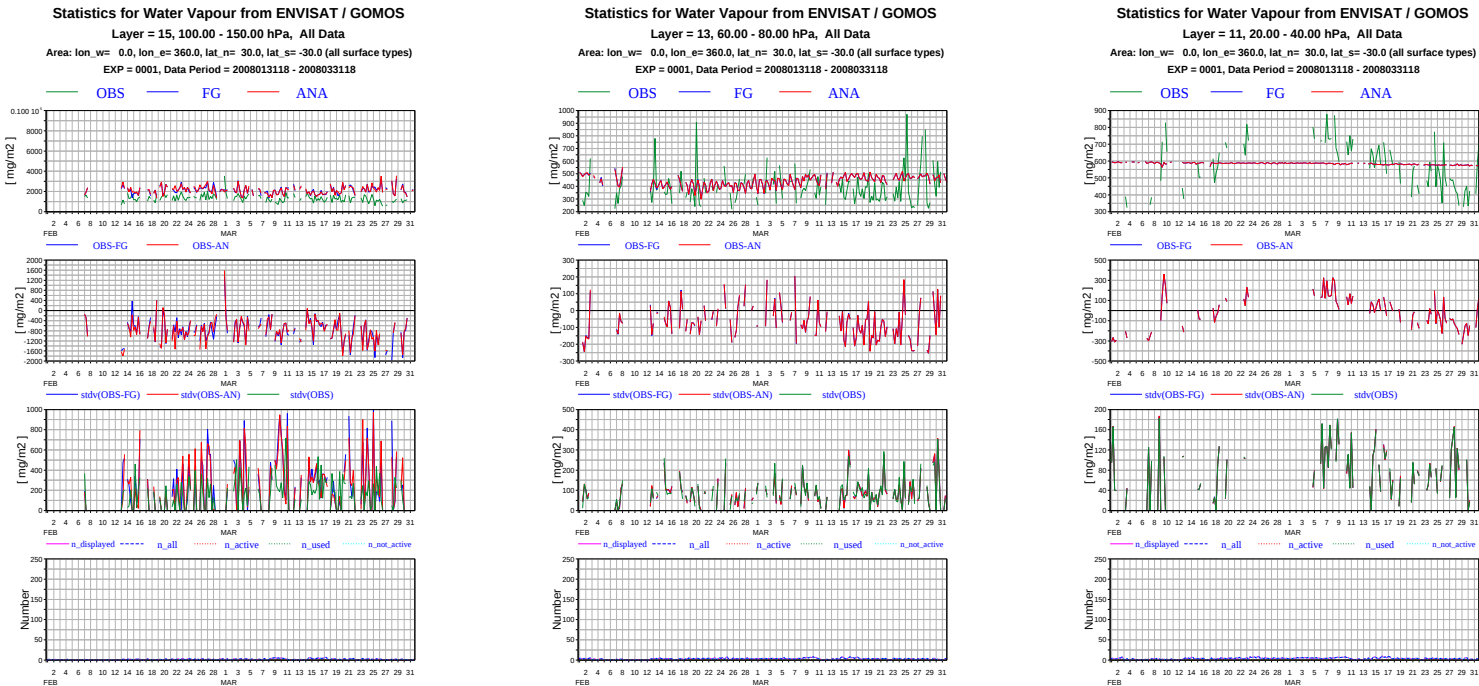


Fig. 13. Timeseries of mean ENVISAT GOMOS NRT water vapour data, first guess and analysis values (top panels), first-guess and analysis departures (second panels), standard deviations (third panels) and number of data (bottom panels) per 6-hour cycle for layer 11 (20-40 hPa), level 13 (60-80 hPa), and level 15 (100-150 hPa) in the latitudinal band 30N-30S for the period February-March 2008.