Response to interactive comments by anonymous Referee # 2:

The comments of the Referee are printed in usual black font and our answers are printed in **bold font**. New passages of the revised manuscript are printed in ***italic.***

Comment 1

Referee # 2: Page 27482, line 18: What is the principle of the DOASIS software for calculating the Ring cross-section? How does that software calculate the Ring spectrum? It doesn't appear in the associated reference.
Authors: The calculation of the Ring spectrum in the software DOASIS is based on Bussemer (1993) and a description how it is implemeted can be found in:
https://doasis.iup.uni-heidelberg.de/bugtracker/projects/doasis/.
As already explained on page 27483, line 11, the Ring spectrum is calculated according to Chance and Spurr (1997) by dividing a calculated Raman smoothed skylight spectrum with the original skylight spectrum, both being wavelength normalised. Accordingly, the following sentence has been included in the revised manuscript on page 27482, line 19:
The Ring spectrum in DOASIS was calculated according to Bussemer (1993) by dividing a Raman smoothed skylight spectrum with the original skylight spectrum (i.e. the Fraunhofer reference spectrum), both being wavelength normalised.

Comment 2

Referee # 2: Page 7262: Detail the cloud filter used.
Authors: Previous measurements under extreme conditions with very low visibility have shown that our retrieval algorithm produces reliable results even under adverse conditions (fog, blowing snow, etc.), see Friess et al. (2011). Therefore, for the analysis of the IO data no cloud filter e.g. according to Sinreich et al. (2010) was used. Only data points with reasonably small error bars, i.e. with a residual root mean square (RMS) smaller than $4{\cdot}10^{-4}$ were taken into account. The following sentence has been added to the revised manuscript on page 27484, line 25:
For the further analysis, only data points with an RMS smaller than $4{\cdot}10^{-4}$ were used.

Comment 3

Referee # 2: Page 27491: How much can the measurements under rainy conditions be trusted?, please provide details to make the comparison with clear sky days meaningful.
Authors: During the rainy periods the visibility was very low. As already described in the reply to the previous comment, reliable profile

information can be retrieved even under such conditions. It could be the case, that some water droplets covered the entrance of the telescope, causing optical distortions.

Comment 4

Referee # 2: Page 27492: When comparing IUP Bremen versus Heildeberg, Did the two instruments have the same line-of-sight onboard the ship?. Did IUP Heidelberg try a single daily zenith Fraunhofer spectrum for comparison?
Authors: Yes, the Bremen and the Heidelberg instrument had the same line-of-sight. Both instruments were operated next to each other on the portside of the RV Sonne with a viewing direction orthogonal to the heading of the ship. The sentence on page 27480, line 3 has been changed in the revised manuscript in the following way:
Two MAX-DOAS instruments were operated next to each other aboard the RV Sonne *with the same line-of-sight.* The IUP Bremen group focussed on the measurements of NO_2 and HCHO and their validation with satellite measurements (Peters et al., 2012) and the IUP Heidelberg group focussed on the retrieval of IO mixing ratios and profiles in the MBL along the cruise track (this study).

Comment 5

Referee # 2: Page 27492: Did IUP Heidelberg try a single daily zenith Fraunhofer spectrum for comparison?
Authors: We have noted that, by mistake, a retrieval with single noon reference from the Bremen has been compared with a retrieval with current reference in Fig. 6. Fig. 6 has been replaced in the revised manuscript, now also showing the Heidelberg data analysed using a single noon reference. The text in the revised manuscript on page 27492, line 2 was changed in the following way:
In order to avoid direct sunlight and detector saturation effects, the spectra from the IUP Bremen instrument were analysed against a single daily zenith Fraunhofer reference spectrum taken at an SZA of 45°, whereas for the IUP Heidelberg retrieval the 20° spectrum taken during each elevation sequence was used as a Fraunhofer reference spectrum. For this comparison however, the IO dSCDs from Heidelberg were also analysed against a single daily zenith Fraunhofer reference spectrum taken at an SZA of 45°. Overall, both data sets were in good agreement and the diurnal variations were similar for all days of the cruise. The Heidelberg IO dSCDs were found to be slightly higher than those inferred from the Bremen instrument. The difference was likely due to the different choice of reference spectra selected by both groups.

Comment 6

Referee # 2: Figures: Please increase the size of axis ticks in Figure 9.
Authors: Thank you for the helpful comment. The size of the ticker marks of both axes in Figure 9 has been increased.

Bibliography

Bussemer, M.: Der Ring- Effekt: Ursachen und Einfluß auf die spektroskopische Messung stratosphärischer Spurenstoffe, Diploma thesis, University of Heidelberg, Heidelberg, Germany, 1993.

Peters, E., Wittrock, F., Großmann, K., Frieß, U., Richter, A., and Burrows, J. P.: Formaldehyde and nitrogen dioxide over the remote western Pacific Ocean: SCIAMACHY and GOME-2 validation using ship-based MAX-DOAS observations, Atmospheric Chemistry and Physics, 12, 11 179–11 197, doi: 10.5194/acp-12-11179-2012, 2012.

Sinreich, R., Coburn, S., Dix, B., and Volkamer, R.: Ship-based detection of glyoxal over the remote tropical Pacific Ocean, Atmospheric Chemistry and Physics Discussions, 10, 15 075–15 107, doi:10.5194/acpd-10-15075-2010, 2010.