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Interactive comment on "Nitrogen dioxide stratospheric column at the subtropical NDACC station of Izaña from DOAS, FTIR and satellite instrumentation" *by* Cristina Robles-Gonzalez et al.

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Trend analysis. A first point is that there were instrument changes during the 2000-2012 period for both FTIR and zenith-sky DOAS. Did you investigate the possibility to have a bias in the corresponding NO2 vertical column time-series due to these instrument changes ? If not, this should be done and if there is a bias for one or both techniques, then its impact on the trend analysis should be assessed.

DOAS NDACC dataset has been carefully homogenized in last years through a number of EU framework program projects (i.e. GEOMON, NORS). Data were repro-

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Discussion paper

cessed following the NDACC recommendations by using same analysis, same cross-sections and same AMF code. Most important change was the switching from PMT scanning spectrometer to PDA-detector spectrometer in late 1998. However, differences between both instruments during 3-years overlapping period were negligible (slope=0.997, r2=0.96 standard deviation=1.4E14 molec.cm-2) and therefore no correction factors were needed (Gil et al., 2008). The overlapping period is already mentioned in line 118, but will make it more clear in the text, by changing a few things in paragraph starting in line 115 and adding in line 128 the next paragraph: “A 3-year overlapping period was used to ensure the serie continuity. However no corrections to the data were needed since the agreement between instruments was excellent (see Gil et al. 2008). A more detailed description of the instrument can be found in Gil et al., 2008.“.

A second point is that applying a linear regression for the trend analysis is maybe too simplistic for a time-period of 13 years. I think it would be useful to include the solar cycle and QBO in the calculation. This would also help to compare the derived values with other published studies since the latter take usually these effects into account.

We agree with the reviewer that the analysis trend is very simplistic. A detailed trend analysis based on multiple regression from a number of stations is on the way for a future publication. We find, however, interesting to compare all satellite and GB datasets available even with such a simple approach since at this particular station the evolution is dominated by the seasonal waves. We have included a sentence to reflect this more clear in the manuscript, in line 396: “. The fact not to take these two effects into account would imply a possible inaccuracy over some stations but over our study station the evolution of the NO2 is dominated by the seasonal waves, therefore, the omission of the QBO and the stratospheric temperature has a minor effect due to the fact that we are considering the most relevant one. Anyway a more detailed study on NO2 trends is ongoing in order to improve the preliminary trends presented here and to better understand the results.”

Comparison DOAS/FTIR: it is found that AM values compare better than PM ones. A possible reason for that would be the contamination of afternoon FTIR measurements by the upwelling of high NO2 boundary layer airmasses. Maybe this effect could be quantiïňĄed for some selected days.

We suggest in the text two possibilities including the pollution upwelling. In recent work (Gil-Ojeda et al ACP, 2015) it was shown that significant upwelling due to slope heating increase the NO2 concentration at the level of the station during the day. The relative importance of this effect on direct sun spectroscopic measurements is dependent on the thickness of the polluted layer above the station but also on the sensitivity of the instrument to lower layers. FTIR sensitivity to lower troposphere is very poor and consequently we will remove the possibility of contamination on FTIR data. Even though some efforts have been done to clarify the reason of the PM discrepancy, at present we have no explanation to provide.

The maximum of NO2 vertical column is observed in June for satellite and in July for ground-based instruments. Did you investigate the impact of the temperature dependence of the NO2 cross sections on these results?.

This is one of the surprising findings of the work. Ground based instruments use NO2 cross section at 220K temperature (Vandaele et al) all year round. This might introduce a bias in high latitudes data. However, temperature seasonal excursions are low in the tropical lower stratosphere. The June to July difference at 10 hPa is of 1K and even smaller at lower heights. The temperature dependence in cross sections is of 2-3%/10K temperature change and therefore it cannot explain the observed discrepancy.

Do you obtain similar results without applying any photochemical correction on the different data sets?

The same seasonal behavior is observed if data are not corrected photochemically. There is a chance that it could be related to the climatology used in the AMF calculations for the location, which uses monthly values, therefore it is different for June and

July. We will explore that possibility. However, FTIR-direct Sun does not use the same climatology, the FTIR uses daily pressure and temperature profiles

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