

## ***Interactive comment on “NO<sub>2</sub> seasonal evolution in the North Subtropical free troposphere” by M. Gil-Ojeda et al.***

### **Anonymous Referee #1**

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This paper presents a three-year data set of NO<sub>2</sub> volume mixing ratios (vmr) derived by applying the Modified Geometrical Approximation (MGA) to MAX-DOAS observations at the high mountain observatory of Izana (Tenerife Island). The NO<sub>2</sub> vmr at the level of the station (2370m asl) is obtained by dividing the NO<sub>2</sub> differential slant column density (DSCD) measured in the horizontal viewing geometry - using the zenith elevation angle as reference - by the horizontal optical path estimated from the corresponding oxygen collision complex O<sub>4</sub> DSCD. These NO<sub>2</sub> vmr observations are compared to parallel in-situ measurements. The level of agreement between both techniques is seen to strongly depend on the three main wind regimes observed at the station (South wind/Upslope breeze/weak or no breeze). Back-trajectory calculations and a chemistry-climate model are used to interpret these features.

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#### General comments:

The Gil et al.'s paper presents interesting results and is reasonably well written. The scientific quality of the paper has been improved by adding a Section on the Optimal Estimation Method. However, a lot of questions remain unanswered regarding this method: On which criteria did you decide not to include aerosols in the OEM retrieval? Did you perform sensitivity tests on this? What is the impact of the apriori profile on your retrieved profiles, especially on the vertical extension of the NO<sub>2</sub> layer? A brief description on the main sources of uncertainty of the OEM is still missing. All these points should be discussed in the revised manuscript.

#### Specific comments:

Page 14479, lines 15-29: The Thalman and Volkamer (2013) O<sub>4</sub> cross-sections are used in the test on the impact of the temperature dependence of the O<sub>4</sub> cross-sections. Since this cross-sections data set is now considered by the DOAS community as the reference O<sub>4</sub> cross-sections, what would be the impact of using them on the MGA approach results instead of Hermans et al. (1999)?

Page 14482, line 9: a reference should be added for the Gaussian correlation functions. Why did you choose a correlation length of 300m? What is the impact of this correlation length on the vertical extension of the NO<sub>2</sub> profiles presented in Fig. 3?

#### Technical corrections:

Page 14478, line 5: 'specie' -> 'species'

Page 14500, Fig. 4: The y-axis legends in the three plots should be identical, e.g. 'NO<sub>2</sub> concentration (pptv)'.

Page 14485, line 1: You should refer to Sect. 4 instead of Rodgers et al. (2000).