

Interactive comment on “NO₂ seasonal evolution in the North Subtropical free troposphere” by M. Gil-Ojeda et al.

Anonymous Referee #2

Received and published: 19 June 2015

This manuscript provides a nice analysis of the seasonal variability of NO₂ in the free troposphere at Izana Observatory. There are limited long term free tropospheric NO₂ measurements, due to the challenges in operating instruments in remote mountain top sites and the impact from upslope effects. To overcome this, the authors have applied a recently developed method to determine vmr of NO₂ in the free-troposphere from horizontal MAX-DOAS measurements, using O₄ to infer horizontal path lengths. The measurements benefit from a reduced impact from upslope, which is often observed in the in situ measurements, at the same site. Additionally this method allows for measurements of NO₂ vmr, down to a few pptv.

A comparison study with in situ measurements was performed and the data were analyzed under different meteorological conditions along with back trajectories and model

C3813

results. An Optimal Estimation Method was applied to data, during a period when an air mass with high NO₂ arrived at the station, as a case study to determine the profile of NO₂ in the FT.

General comments:

Overall this manuscript includes some very interesting results and should be published after revision. I agree with the comments from reviewer 1 regarding the OEM technique. If sensitivity tests on the impact of aerosols on the OEM have not been performed, then the authors may want to consider doing this for the revised manuscript.

Figure 4a shows individual NO₂ measurements from MAX-DOAS for 2011, 2012 and 2013 as a seasonal time series. This figure demonstrates the seasonal variability of the NO₂ in the FT, however, it may also be interesting to see how the NO₂ differs between years, in particular over the spring/summer period when biomass burning may impact the site. Do you observe higher NO₂ levels in the FT during a high fire year?

Specific Comments:

Pg 14476, l5-6: Kleissel et al. (2007) also discusses the impact of upslope on trace gases at Pico.

Pg 14477, l19-20: What is meant here when discussing the slant paths of 0 and 90 degree views cancelling out. Are you referring to the absorption of gas species (except NO₂) and scattering from aerosols between the different views cancelling out? This should be clarified.

Pg 14778, l12: How are the AMFs at different SZA calculated here, to determine g and g' ?

Pg 14481, l10: Please expand on the negative values and why these were observed. What percentage of the final dataset were negative?

Pg 14481, l14: Here, do you mean that the OEM was applied to the final year of data

C3814

(i.e. 2013)? Please clarify.

Pg 14486, l22: Can you link the sporadic peaks over 100 pptv to the transport of polluted plumes from North America, either from biomass burning or anthropogenic emissions?

Technical corrections:

Pg 14475, l28: clouds → cloud

Pg 14477, l1: On year 2010 → In year 2010

Pg 14477, l22: de → the

Pg 14478, l7: The later → The latter

Pg 14484, l24: not negligible → non-negligible

References:

Kleissl, J.K., R. E. Honrath, M. P. Dziobak, D. Tanner, M. Val Martín, R. C. Owen, and D. Helmig (2007), Occurrence of upslope flows at the Pico mountaintop observatory: A case study of orographic flows on a small, volcanic island, *J. Geophys. Res.*, 112, D10S35, doi:10.1029/2006JD007565.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 15, 14473, 2015.