

## ***Interactive comment on “DOAS measurements of NO<sub>2</sub> from an ultralight aircraft during the Earth Challenge expedition” by A. Merlaud et al.***

### **Anonymous Referee #2**

Received and published: 23 April 2012

The paper presents a new airborne DOAS instrument developed with the goal of deploying on an ultralight aircraft without an operator on board. The instrument was deployed during the earth challenge project and presents NO<sub>2</sub> comparison with the satellite observations in areas where very few previous measurements have been reported. It also reports confirmation of soil signature above the deserts. I believe the authors have adequately described the instrument and presented relevant results to convince that the new instrument could be a low cost alternative to more sophisticated airborne DOAS instruments and used for tropospheric NO<sub>2</sub> validation of satellite measurements and flux measurements from point sources. The manuscript is concise, and has potential to advance airborne atmospheric observations of trace gases and merits publication in AMT but needs to be edited by a native English speaker before publication.

## General comments:

There have been many papers comparing satellite NO<sub>2</sub> observations with ground based DOAS measurements. Authors should consider including some of them as reference. For example Herman et al. (JGR, 2009), Shaiganfar et al. (ACP, 2011), Kramer et al. (JGR-Atmos., 2008) to name the few of the recent ones.

Solar zenith angle (SZA) is considered as a constant for AMF calculations. It would have been fairly easy to change SZA in AMF calculations and I am surprised that the authors decided to treat it as a constant. AMF is dependent on SZA especially at high SZA and could result in higher error than due to NO<sub>2</sub> effect, surface albedo and pitch. It is very much possible that most of the flights were at lower SZA and is not a big source of error but an explanation on why it was treated as a constant would be helpful.

With regards to soil structure, it would be interesting to see how a reference spectrum from over water (e.g. Gulf of Oman) changes the soil signal over land covered by vegetation (Italy) and sand (Saudi Arabia). Authors mentioned that they did not observe soil signal over Italy but it could be due to the fact that the reference spectrum comes from Italy. It would also be interesting to look into soil signature over Rajasthan. From Fig. 3 it seems that the plane crossed the Thar Desert. The contrast in soil signature over different land forms could be a strong indication for a need to include soil signature for DOAS retrieval over barren lands. The authors could also add a comment on effect of a higher order polynomial on the soil signature and retrieval.

## Specific comments:

Page 1949, line 21: replace “yet” with “so far”

Page 1949, line 26: mention what ULM-DOAS stand for.

Page 1951, line 16: change “time” to “season”

Page 1951, line 18: change “sea rising” to “sea level rising”

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Page 1951, line 25: “Gulf of Oman” is the proper name.

Page 1952, line 2: typo “where”

Page 1952, line4: “expected” in place of “expectable”

Page 1953, line 17: it should be “four panels” not “three panels”

Page 1953, line 21: “expected” in place of “expectable”

Page 1955, line 17: It is not clear why each SCD is the weighted mean of 13 SCDs. Is it because the radiative transfer program does not consider large field of view of the telescope for AMF calculation?

Page 1959, line 6: “negligible” in place of “neglectable”

Page 1959, line 16: It might be helpful for the readers to include the NO<sub>2</sub> value from GOME-2 for Po Valley in the text.

Page 1960, line 3. Replace “in desertic areas” with “over deserts”

Page 1961, line 8. It might be better to say “one of the largest city” rather than just saying “largest city” as one can find conflicting results regarding the largest city in terms of population.

Page 1962, line 25. Typo “attitude” stabilization? Do you mean altitude or elevation angle stabilization? Also in line 9, Page 1948.

Table 3. The number in table 3 for Rajasthan does not agree with the values in Figure 8. The table reads the max NO<sub>2</sub> vcd as  $3.4 \pm 1 \times 10^{15}$  but values in figure are less than  $3 \times 10^{15}$ . It is probably better to leave a blank space than ? for the unavailable data for Chittagong in the table.

Figure 5, 6 and 7. Could you include conditions for the AMF calculations.

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Interactive comment on Atmos. Meas. Tech. Discuss., 5, 1947, 2012.