二、comment of amtd-2-C770-2009

1,

Missing information a) The relevance of the assumption that the NO2 concentration (or mixing ratio) is constant within the PBL and equal to that measured at the surface strongly depends on where and how the measurements are made. This assumption will be totally wrong if the active measurements were made next to a local source, e.g. at street level. However, there is no information at all on where and how these measurements are made: instruments? location in the city?, height above street level? etc.. b) The same for PBL height by meteorology, where? By which method?

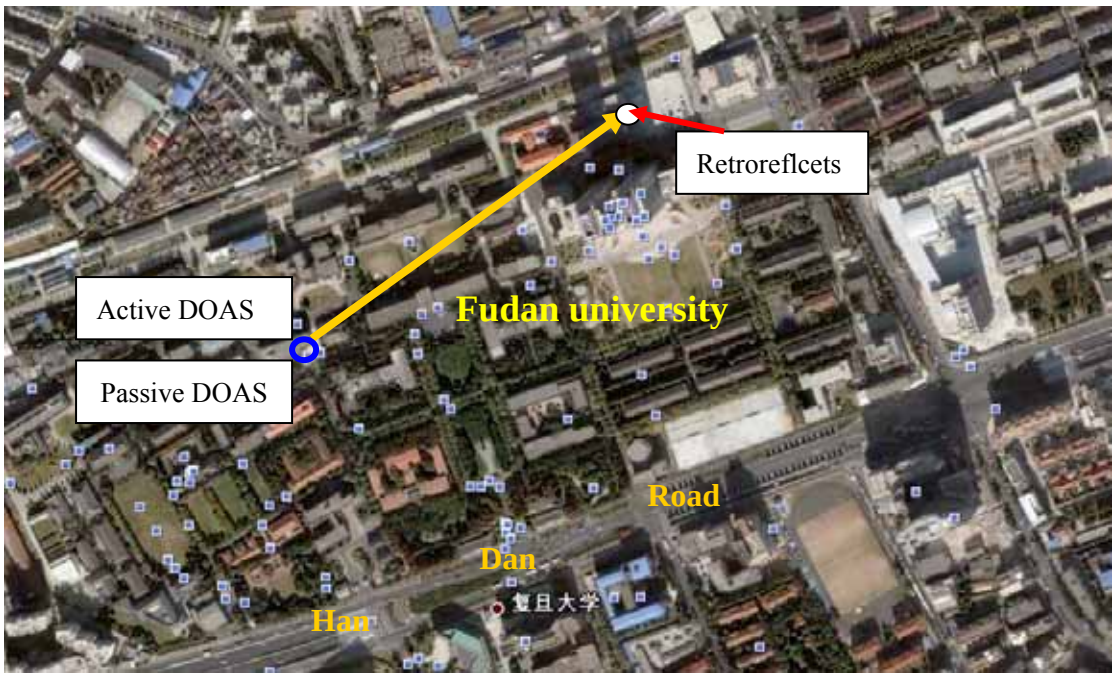


Fig. 2 Measurement site

Relay:

Figure 2 is the measurement site(we have added this in text), passive DOAS and transmit telescope of active DOAS are in the campus of Fudan University, which is located in the north-east of Shanghai, nearby the middle cycle. Both DOAS system were set on the roof of #4 teaching building which is nearly in the middle of the campus, light beam of active DOAS (yellow arrow in the figure 2) is totally within the campus without cross of any road, it's about 20m above ground and about 250m to middle cycle (Handan Road), average distance of light beam to Guoding Road is about 300m, which is to the east of the beam and nearly perpendicular to it, in the north, there is a Wuchuan Road, which is about 400m to light beam, there is not any road in the west of measurement site until about 2000m away.

Near the measurement site, there is not any point source of NO2, NO2 around this area mainly comes from vehicle emission. Because the roads are around the campus,

so in middle point of the light beam (about the middle of campus), NO2 mixed well relatively to roadside.

Vertical distribution of NO2 within mixing layer is the key point of measurement method, there are many factors that can impact NO2 mixing, especially the source of NO2, if the measurement site is far away from source, it can be accepted that NO2 mixes well in mixing layer. Jochen Stutz,(Jochen Stutz,2004) study the distribution of NO2 near the ground at the La Porte Municipal Airport 30km ENE of the city center of Huston, TX, and nearby heavy industrialized ship channel area, with multi-beam DOAS, in-suit measurement shows no special profile of NO2 below 120m was found during day time. Although our experiment setup is more closer to the center of city than Jochen Stutz experiment, but vehicle emission is the mainly NO2 source of both shanghai and Huston, and both experiments are close to line source of NO2(road and industrialized ship channel area) so Jochen Stutz's study can be used to support our assumption.

The data of PBL height by meteorology comes from reference (Yang 2004), there is not statement on where the data comes from, the method used to retrieve PBL are presented in text.

Specific comments:

1,

Experimental. Description of measurements totally missing. Fig 1 and 2 very little informative. Could be easily removed.

Reply:

Ok, we will remove fig.1 and fig.2

2,

Calculation of effective trace gas missing height Fig.3. On which day / season these measurements have been made? How can you say from these that the analysis confirms your basic assumptions? 0.3-0.8 km seems to be very small for a mixing layer. In the text you are saying 1-2 km and in the conclusion 01 to 2.8 km. Discussion of error: this is just an affirmation. There is nothing to support this.

Reply:

The day is 9,June,2007, this day is not particular day, it is picked up by random, just a example to illustrate our method, It's not to confirm our basic assumption, it's just to show how to retrieve ETMH according to our assumption. 0.3-0.8km of ETMH in this day no specific meaning, as it says in conclusion, more than 90% of the measurements yield an ETMH between 0.2 km and 2.0 km., 0.3-0.8km of ETMH is in the range of this. It's not good that said "boundary layer is usually confined to the lowest 1–2 km", we have replaced this by "boundary layer is usually below 2 km".

In error discussion, we present some factors that can cause measurement error in this method, such as realistic profile of NO2 in mixing layer and the existent NO2 in free troposphere. It very difficult to compare our measurement to other accepted method, such as Lidar, in our experiment period because of lack of those data in Shanghai, frankly said this is one of weak point of our paper, so it's also hard to say how much is the error caused by the difference between our assumption profile and the realistic profile.

But according to Stutz's result, no special profile of NO2 in mixing layer, so there is little system error caused by the assumption profile, the error mostly caused by NO2 plume in atmosphere. Because of our experiment setup is about 200-300m away from main road and about 20m above ground, so the vehicle emission has little direct effect to our assumption.

The effect of NO2 in free troposphere has been analyzed in text. Please seeing Sect. 5.

3,

Results The data are said selected for cloud cover using O4. I have no access to the paper of Chen et al. What is the meaning of "mainly" cloud free? It could be good to show some statistics on cloud information for selected days. Description of Figures missing in the text. Fig 4. Comparison of DOAS and met derived mixing layer height. Since DOAS measurements can be performed during daytime only why not using Met height at 8:00 and 14 h only? Would be useful to show also the monthly mean NO2 passive column and surface concentration to see how much the ETMH could be sensitive to pollution. Fig 5. What is the time ? Solar? Standard? How is the NO2 diurnal photochemical cycle taken into account? It might be different at surface level (close to emissions) than higher in the PBL. The photochemistry should be far less active in January. The only data you have in the summer are the 7 days of September. The height decrease after 14h seems surprising compared to other month. Is there a reason for that? How it compares with met information, including cloud cover. Would it be possible to show the MH height diurnal variation in the winter in a similar format?

Reply:

"mainly cloud free" means in those days, the daily variation of O4 SCD(Slant Column Density) is U-shape, the detail of this could be found in Chen's article in ACP, following is citation of this section:

"Because the O4 concentration in the atmosphere mainly depends on the square of the O2 concentration, and the atmospheric O2 column varies only slightly (depending on pressure) (Perner and Platt, 1980; Greenblatt et al., 1990;Wagner et al., 2002;Wittrock et al., 2004), the O4 absorption can be used as a criterion to identify the existence of clouds and aerosols. For a trace gas with constant amount in the atmosphere, the observed diurnal SCD variation shows a smooth increase with the increasing SZAs in clear sky condition (Meena et al., 2004). Therefore, here the U-shape diurnal variation of the retrieved O4 DSCDs is taken as an indicator for a clear day. As shown in Fig. 7 in Chen's paper, using this criterion, it can be well distinguished between a clear day (30 May 2007) and a cloudy day (31 May 2007). "

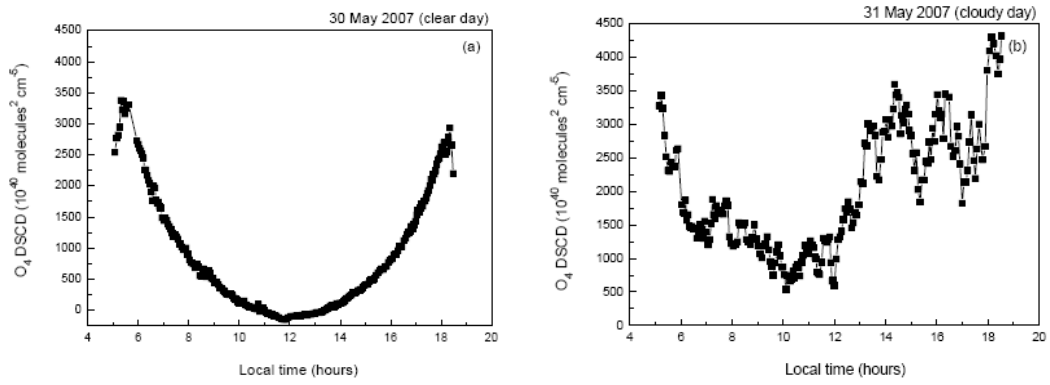


Fig. 7. Diurnal variations of the O_4 DSCDs on a clear (30 May 2007, **a**) and a cloudy day (31 May 2007, **b**), respectively.

Sentence “those days when observed daily variation of O4 slant column density are U-shape were selected” is added to P1668 Line 12

Sentence “the red line B in Fig.4(in new version, it’s Fig.3) is Yang’s (Yang, 2006) observation in shanghai, for detail of this, please seeing section 4.4.” is added to

The data of yang,2006 in Fig. 4(in new version, it’s Fig.3) has been change to 8 and 14:00 local time.

In figure 5, the time is local time;

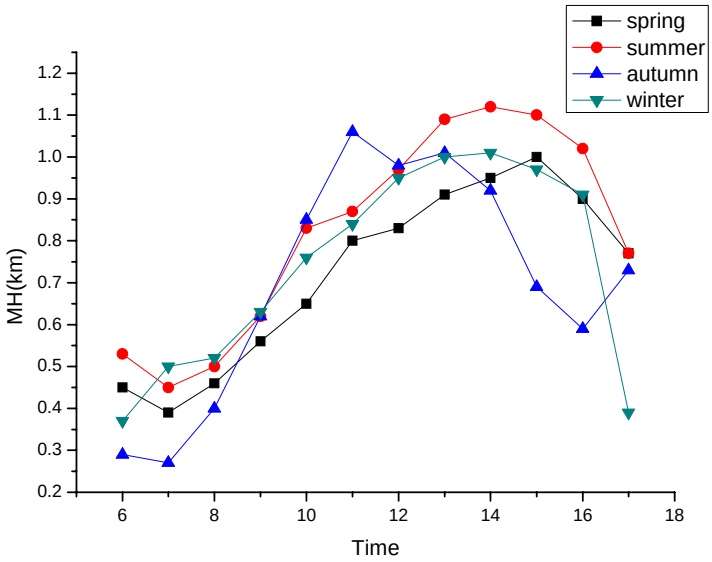
Here the NO2 diurnal photochemical cycle is not taken into account, because our measurement lever is about 20m above ground, and in Jochen Stutz’s research experiment, it said, no obvious gradient can be found in daytime. Jochen Stutz’s research result in Phoenix’s urban area also shows the gradients of NO2 distribution gradually disappeared after the onset of convective mixing.

Yes, the data in September are only 7days, and the height decrease rapidly after 14h compared to other month, we can not find special reason for this, but by analysis the temperature variation of those days in Sep. we could find the temperature decrease also rapidly in Fig1. Maybe this is the reason.

Following figure is the diurnal variation of MH in different season,

Winter:11/12/1, Sprint:2/3/4, Summer: 5//6/7/, Fall:8/9/10

but we are not sure it is necessary to add it to text.



Figure, The diurnal variation of MH in different season

Discussion:

1,

Correlation with surface temperature Fig 6. Date missing in the caption. This is a case of very large amplitude of temperature diurnal cycle. Would be interesting to see the same for the smallest T amplitude during the same month (may be cloudy) and during a colder period in December. Fig 7: meaning of various symbols and colours? The mean R in May is about 0.60, meaning that the 0.922 of Fig 6 is an extremely good example. It is said that there are too little data in March (4), June (3) and October (8) for making statistics. In that case what about the 7 days of September?

Reply:

We will add date in Figure 6. it's 11 May 2007. The temperature diurnal cycle ΔT (ΔT=Tmax-Tmin) in Fig.6 is largeer comparison with other days in the year, the average ΔT in the year is 11.28 ℃, the maximum monthly average of ΔT is 14 ℃ (March), and the minimum monthly average of ΔT is 7.4 ℃, the ΔT in Fig.6 is 14 ℃.Yes the correlation with surface T in Fig.6 is an extremely good example to show the correlation between ETMH and T, but we have said in text that the mean R is 0.6, here we don't want to mislead the readers to think the correlation between ETMH and T is always good.

In figure 7, the color no special mean, different color corresponding to different month (we have added this in the caption of Fig.6 and 7), there are the means introduction of symbol in text.

Actually, there are just two days met data in October, so when calculating correlation between ETMH and T, there are just two days data can be used. We have added this

information in text as following.

P 1670 Line 4, sentence “because there are too little data in March, June and October, no median is calculated in 5 those months.” has been replaced by “because there are too little data in March, June and October(just 2 days met data can be used), no median is could been found in Figure of those months”

2,

Correlation with wind speed Fig 7: same comments as for Fig.6 What is the meaning of anti-correlation? Large height in the absence of wind? small height in strong wind maritime air? Other? Last paragraph: discussion. Cloud cover has a strong impact on convection as well as on NOx photochemistry. You said that you are using O4 for deriving it. But which threshold is used? Are all the data used here really cloud free? It would be helpful to see the plots of the periods quoted in text, together with met info: temperature, wind speed and cloud cover, + passive and active DOAS measurements.

Reply:

Sorry, we could not find “anti-correlation” in text!

As we have added in text, U-shape of SCD of O4 daily variation is used to identify clear day (mainly cloud free), so all the data used here are mainly cloud free,

In generally, I agree this propose, but if we put all the data on one plot, include T, WS, active and passive DOAS data, we are afraid of confusing the readers.

3,

Influence of atmospheric lifetime. What are the polluted regions? Beijing-Nanjing? Reference? Not only long distance but also local pollution could play a significant role in the MH derivation. Is there an indication of strong local pollution? Fig 9. It would be very informative to plot also the passive and active DOAS NO2 measurements.

Reply:

From satellite map of pollutants over the world, we can see the region to north-west shanghai suffers heavy NO2 pollution, so if the wind (in free troposphere) comes from north-west, it can carry a little bit more NO2 to Shanghai, there are some local source of NO2, include vehicle emission and power factory emission, but we think, local source contributes mainly to boundary layer NO2, less to free troposphere, comparing with this, long distance source contributes more to free troposphere. We have added active and passive DOAS data into Fig 9,

4,

Comparison with Met MH The comparison between the 15 yr mean MH diurnal variation and those derived from a few days each month in 2007 (excluding summer) is not very convincing. Better show this for the same days, or at least the same months in Fig 5.

Reply:

Yes, the comparing is not very convincing, but we could not find more information of the MH data in Shanghai, this reference is the only one we could find. Our method is completely different to the method in yang's reference, but our result is very close to Yang's result of the average of 8:00 and 14:00, please see fig 4, we also can not find the daily value of MH in Yang's article, so it's impossible to show the same days comparison, but the same month's comparison has been illustrated in Fig 4.

Fortunately, we could calculate the MH by NCEP's GDAS (Global Data Assimilation System) model (ARL, http://ready.arl.noaa.gov/READYamet.php) for the same days, we have added the comparison in text, please seeing Sect. 4.4.

5,

Conclusions Since the ETMH is said to vary between 0.1 and 2.8 km, it could be good to show an example of measurements (including passive and active DOAS NO2 column and concentration) presumably in the summer, to see how the DOAS derived ETMH compares with meterological information. A yearly average is not very demonstrative. Since the winter season is shown to be uncertain because of the little actinic activity and the long distance transport of pollution from other areas, why not late spring/summer/ early fall observations only. A correlation of 0.37 with wind speed has very little meaning. Before speaking about other species, I could recommend to demonstrate better how the idea applies to NO2.

The ETMH vary between 0.1 and 2.8km is just a general statistic of the whole year data, the variation and the value of ETMH in each month have been showed in text (Fig 3 and Fig.4).,we can add the monthly variation of active and passive DOAS result in text, please see Fig.5

The correlation of 0.37 with wind speed is the yearly average, we also show the seasonal average in table 3

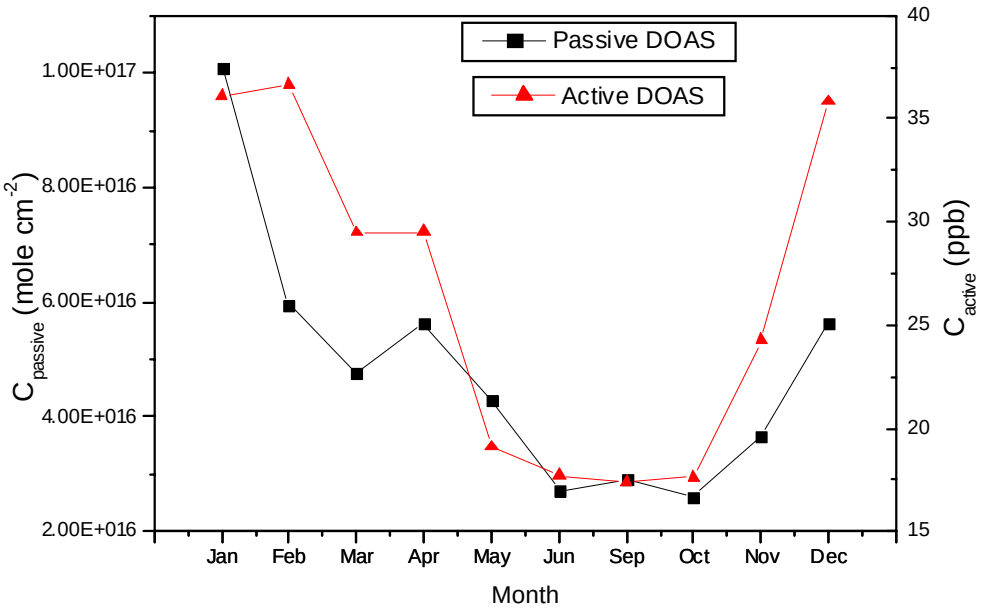


Fig.5 Monthly average of passive DOAS and active DOAS in 2007, it could be seen both measurements have high concentration in winter and low concentration in summer, because of the lifetime of NO2 in atmosphere.

If we just put the result in some season instead of whole year data, this maybe mislead some readers to think we just select good result to support our method, so we show whole year result in paper, even if the data in January is not good enough to support our method. We think we can not slide over this problem, we have analyzed the potential reason for this.

We will think about it carefully to speak other species.