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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A foehn-induced haze front in Beijing: observations and implications" *by* Ju Li et al.

Anonymous Referee #1

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General comments:

The manuscript discusses a pollution event that produced a "haze front" over Beijing, China on 24 December 2015. The haze front is a sharp change in visibility on the boundary of warm dry clean air meeting cool moist polluted air over the city. The warm air mass was created by a foehn wind blowing down from the mountains to the north and west of Beijing. The interaction between the two air masses is analysed in detail using meteorological variables, and particular matter measurements from a number of sites across the city. The authors then conclude with statistics of how often this sort of event occurs. These events can have a large impact on air quality in Beijing and can potentially be applied to other cities with a similar geographical layout. I am not aware of a similar publication into haze fronts caused by foehn winds.

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Discussion paper

The manuscript reads well and the English is good, but there are some sections that need changing. Great use of many different measurement platforms. As there are a lot of sites, Table 1 and the map in Figure 1 really help for orientation. But some of the figures need some work (see below). The supplemental figures are helpful for providing a broader picture. I could not find a video (mentioned during the submission).

Specific comments:

Define the time zone LST (I assume it's local time)

PM2.5: sometimes the 2.5 is subscript or normal script

Mini-MPL: sometimes you refer to the Mini-MPL as Min-MPL

Table 1:

- observation heights missing

- AOT AWS is missing

Section 3.1 needs to discuss the meteorological conditions in a bit more detail.

- You show a number of weather charts, but don't really explain what the relevance is to the haze front case study. The upper level trough is not really relevant here.

- You don't reference the 850 mb charts in the main text. What height is the 850 mb surface? This is useful when comparing to the wind profiler data (Fig. 2d). But ultimately the surface wind is weak and doesn't really correlate with the upper level data in the morning. Figure 10 also shows very low wind speeds in the morning before the foehn arrives. Looking at Figure S1a there doesn't seem to be any evidence of a cold front or dominant wind direction.

- Figure 3: if possible add some dots to show measurement sites if they are not too close together. Maybe same as Figure 4 (IUM, IAP and GXT). As a minimum a dot showing the centre of Beijing. Also, in the caption it should be '850 mb'.

- Line 158 says the flow is weak south-westerly in Figure 2c, but looks weak north-easterly to me in Figure 3f. Which one is it?

- The radiosonde profile in Figure 2c also shows up the vertical extent of the haze front at GXT nicely.

- Figure 2a: Is it possible to add some sort of distribution of hourly PM2.5 values from the different sites (percentiles)? The event is highly variable. Also, what area does the average PM2.5 cover?

Section 3.2:

- Figure 4: it might help to add a narrow line to the images where you can pick out the haze front as it is quite difficult to see at first (similar to Figure 6)

- Figure 5b: The text says that the wind direction changes suddenly at t2 (ie. 16:21 LST) (line 177) but I can't see this in the figure. Are the wind directions in the plot correct?

- Figure 5 (caption, line 673): The scanning lidar is at IUM not IAP.

- Figure 7: can you add the haze front line to this plot? Also, personal preference: maybe flip the colour bar (red as dry and blue as moist)

- line 193: revise the word "surrounded"

Section 3.3:

- Figure 8 has values every hour and not three-hourly as mentioned in the caption. The use of tendency is a bit confusing. Using it for pressure works, to show the small differences between sites that produce the pressure gradient. Are the tendencies subtracted from the mean of the whole day? Unless the absolute values of temperature and humidity for the different sites are very different, I would find it easier if they were absolute (or at least include the mean values in the plot eg. Tmean[CP]=x.xdegC) as you reference absolute values in the main text.

- line 223: I think “gusty the foehn” should be “the gusty foehn”. Also, what do you mean by “enlarging the coverage”?

- line 225: do you mean “the pressure increased significantly compared to the other sites”?

- line 229: Reference that it is IAP Doppler lidar data in the text to make it clear. Otherwise I have to look at the figure to work that out.

- line 233: Please reword. I think you mean something like: “the temperature was higher and the turbulence was increased mainly between 12:00 LST and 19:00 LST”. The current wording implies that it started low at 12:00 LST and increased steadily to a maximum at 19:00 LST.

- line 236 and Figure 10: you might benefit from including potential temperature here, as this shows up stability better.

- line 237: Looks like the enhanced pollution wasn’t just below 100 metres. Figure 9 suggests the aerosol went all the way up to 400 metres.

- Figure 11: Are the tower plots correct? I’d expect DR to decrease as you get closer to the ground, but 47 m shows the highest DR. Also, it might be easier to read if you list the tower levels in one column in the legend.

- line 240 and Figure 11: do you mean AOT instead of ATZX?

- line 243: The lower PBL height is also to do with the PBL height being suppressed by the overrunning foehn wind, not just the reduced solar radiation at the ground.

Section 4:

- line 302: are mountain-plains winds and mountain breezes the same thing?

- line 319: add the types in brackets (eg. ‘(Type A)’) to the main text to make it more clear.

- Table 2: rewording for the types: eg. “Type A: polluted cases where PM2.5 concentrations for the CP, AOT and YZ sites had decreased 24 hours after the foehn’s occurrence.”

Data availability:

Couldn’t access http://www.ium.cn/dataCenter/ (Page not found)

Couldn’t access http://106.37.208.233:20035/ (Couldn’t install Silverlight on my system)

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