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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Spatial features of rain frequency change induced by pollution and associated aerosols" *by* Yanfen Lin et al.

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The paper describes analysis of rain frequency changes due to air pollution. The work relies on satellite observed distribution of rain frequency, NO2 and aerosol concentrations. The results and conclusions are based on data from 1998 to 2009 over Shanghai.

General Comments:

The authors claim that the pollution enhancement occurring over the research period is responsible for the changes in frequency of precipitation events. They stress that this work only relates to the frequency of storms rather than to rainfall amounts. Although the authors mention that both direct and indirect effects could be responsible for the observed changes, they devote most of the paper to the potential impact of the indirect effect, namely the role of CCN increases in modifying the precipitation frequency. It is not clear to me what the relative effect of each of the above processes is. One could

easily argue that the effects of the pollution on changing the atmospheric stability are more important than their microphysical impact on the clouds.

Furthermore, in the whole paper there is no mention of other very important factors such as the urban effects (e.g. urban heat island, changes in wind speed due to the urbanization, changes in soil moisture and more). These factors could be much more important in changing the rainfall frequency than any of the other factors mentioned in the paper.

One important problem that I find with the paper is the fact that they draw conclusions based on only twelve years of data. This is especially true since the data is so noisy and varies a great deal from year to year (see fig. 1). Extending the period of observation by only a few years may reveal a completely different picture.

The paper does not cover the literature in detail. For example, in the introduction, papers such as Alpert et al, J. App. Meteor., 2008; van den Heever and Cotton, J. App. Meteor., 2007; Changnon et al, Bull. Amer. Soc., 1981 and others have not been mentioned, although they deal with a similar topic.

Specific Comments:

On page 14497- line 8 the references to Levin et al, JGR, 1996, Wurzler, et al JAS, 1997 JAS; Wurzler, et al, JGR, 2000 are just examples of what should be mentioned.

On page 14498 line 9 – only the role of aerosol pollution as CCN is mentioned. Here is another place where the direct effect of pollution on the stability of the atmosphere and the resulting effects on precipitation development should be discussed.

Page 14499 lines 5-14- here the authors argue that the increase in NO2 concentration is correlated with increases in AOD, primarily in the fine fraction aerosols. They also mention the frequent dust storms that occur during the spring period. It is not clear how they separate the effects on precipitation of the GCCN from dust from those of the fine fraction aerosols. In fact, in Fig 1a the variations in AOD ratio are so large, that

one can assume that extending the period of observation by only a few years would reveal a completely different trend. Similarly, the figure shows no correlation between AOD and NO2 concentrations over the years.

Page 14499 from line 21 – the authors use TRMM data with 100 km box and correlate it with a single rain gauge in the middle of the urban area. This seems to be a very poor comparison. Changes in spatial and temporal distributions of rainfall could be expected to occur due to the urban development as has been shown by many papers (e.g. van den Heever and Cotton, J. Appl. Meteor. Climat., 2007; Alpert et al, 2008: J. Appl. Meteor., 47, 933–943, 2008; Halfon et al, Environ. Res. Lett. 4, 2009). Therefore, correlation with a single station is not sufficient.

Page 14500 near the top – the author state: “Clearly, the decrease trend of 4.04% per year in rain frequency (0.21% per year in absolute rain frequency) is slightly greater than the decrease trend of 2.49% per year in rain amount (5.75mm per year in absolute rain amount). It suggests that reduction in precipitation is mainly due to the suppression of rain occurrence with a slight enhancement of rain intensity”. This needs to be better explained especially since the variations in rainfall frequency (Fig 1b) vary so much and cover only 12 years of data.

Page 14502 paragraph starting in line 15 – the references used here deal with orographic rainfall. The authors should refer to papers that deal with rainfall in urban areas (e.g. see references mentioned above).

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 14495, 2010.