General comments.

The manuscript presents measurements and analysis of relative humidity (RH) dependence of aerosol light scattering in a major aerosol source region within NW PRC. The parameterization of the results are of use to the general atmospheric chemistry community and the authors' goal of regionally specific input to global climate models.

Given that the overall HaChi experiment operated from October through January and that this particular subset of the data set is only for 20 days in January, it would be good to put the data subset in context if other data is available. For example, if you have longer term dry nephelometer light scattering, how do the means and standard deviations compare? The point here is to be able to say with some confidence that the hygroscopic and cloud drop nucleating properties that you present are representative of a longer time period or rather are only relevant to the shorter time period – basically a case study. For application to models of radiative forcing, an estimate of representativeness is needed.

There were two distinctly different synoptic situations during the study in January. I suggest that these be presented as two contrasting case studies. Further, more detail of the meteorology including short term, 3 to 4 day, air mass backtrajectories within the boundary layer would be valuable. This would help to define the two events and provide input for eventual input to models.

Several terms are used for the parameter of measure and interest. Stay with one term for readability or maybe two - to not seem monotonous. The general term "Aerosol hygroscopicity parameter" is good and short, for the title. In the abstract "relative humidity (RH) dependence of aerosol light scattering" is a good, properly phrased term, but too long for general use; it can be shortened to "RH dependence of light scattering" for subsequent use. "aerosol light scattering enhancement factor" or later, "scattering enhancement factor" are fine, too.

The English usage needs to be improved throughout the manuscript. While the science, experiment, results and conclusions are clear to a reader who is familiar with the topic and the literature, it is not easily readable or understandable by the less initiated. Scientific translation is a difficult task, I know, but needs to be done by a co-author or colleague or linguistics professional who is highly fluent in English. I have given some suggestions below but have not worked through the entire manuscript.

Specific comments.

In the following I have suggested deletions, and additions or changes to text and sentence structure in ~~strikethrough~~ or **bold,** respectively. Or I have simply rewritten the sentence.

For my questions or other useful changes I have specified my suggestion or explanations in *italics*.

Abstract
On account of the insufficient information of aerosol hygroscopicity in climate models, more details of the parameterized hygroscopic growth factors are urgently required.
Because of ~~the~~ insufficient information ~~of~~ **about** aerosol hygroscopicity in climate models, ~~more details of the~~ **a more detailed parameterization** of hygroscopic growth factors and **resulting optical properties with respect to location, time, sources, aerosol chemistry and meteorology** are urgently required.

Measurements show that *f* (RH) sharply increases with the ascending RH, and the variation range of *f* (RH) is much wider at higher RH.
Measurements show that *f* (RH) increases **sharply** with ~~the ascending~~ increasing RH, and **that** the ~~variation range~~ **time variance** of *f* (RH) is much ~~wider~~ **greater** at higher RH.
This is a more scientific, mathematical wording.

A sensitivity **analysis** reveals …

Page 3460
Atmospheric aerosols ~~have exhibited great contribution~~ contribute significantly to ….

~~The~~ Aerosol optical properties are crucial input parameters ...

Page 3461, line 16
It should be noted that, differ from the size-resolved aerosol diameter growth factor (*g*(RH)), the aerosol light scattering enhancement factor stands for the overall hygroscopicity of the aerosol population, and jointly determined by the particle number size distribution (PNSD), hygroscopicity, and aerosol optical properties.

It should be noted that, differ**ent** from the size-resolved aerosol diameter growth factor (*g*(RH)), *f*(RH)~~the aerosol light scattering enhancement factor stands for~~ **represents** the overall **aerosol light scattering enhancement factor** of the aerosol population, and **is** jointly determined by the particle number size distribution (PNSD), ~~hygroscopicity~~ **chemical composition, density and refractive index** ~~and aerosol optical properties~~.

~~In the late 1970s,~~ Pilat and Charlson (1966) attempted to measure …

~~Up to now, the instruments based on the principle of humidified nephelometer measurement have~~ **More recently, the principle of humidified nephelometery has** been improved (Fierz-Schmidhauser et al., 2010a–c). To be specific, ~~with adding a set of PID~~
~~(Proportional-Integral-Derivative) controller to the humidified nephelometer system,~~
by adding a fast temperature and RH feedback controller to the humidified nephelometer and maintaining a stable reference RH, a quick, automated response

of the scanned RH, and *f*(RH) can be achieved.

Page 3462, line 4
… relatively low RH.
Specify the range Malm used.

a comparison results reveal**s** that …

It~~'s~~ **is** known that, at a given supersaturation, the aerosol activation ability is ~~primarily~~ determined **primarily** by the particle size **and secondarily** by aerosol hygroscopicity (Seinfeld and Pandis,1998)

The online**,** continuous observations of ~~aerosol size~~ **PNSD** can be easily achieved ~~with some~~ **using** commercial instruments. However, ~~the~~ direct measurements of aerosol hygroscopicity are ~~relatively tougher a lot.~~ **relatively much more difficult and demand custom instrumental systems.**

In ~~the proposed~~ **our** approach, **we have made** the assumption that the aerosol consisted of simply a soluble fraction of ammonium sulfate and an **unspecified** insoluble component
~~was applied~~.

Page 3463, line 3
I'm not sure what is meant here. Try this.
We show ~~It should be convinced~~ that our retrieval algorithm for *k* ~~with the~~ **based on** *f* (RH) measurements is of significant utility and applicability.

Recently, with the rapid economic growth, along with the sharp ~~aggravation~~ **expansion** of industrialization and urbanization ~~processes~~, most megacities in the north China plain (NCP) have inevitably experienced severe aerosol pollution. ~~Accompanied~~ **Resulting** aerosol pollution episodes, as well as the aerosol-related environmental and health effects, have aroused great public concern. Considering the unique physical and chemical characteristics of aerosol particles in this region, research~~es~~ on aerosol hygroscopicity **is** ~~are thus~~
of special necessity. Previous studies indicated that aerosols in the highly polluted NCP are ~~of strong hygroscopicity~~**highly hygroscopic** (Liu et al., 2011). Consequently, ~~it would result in~~ **hygroscopic growth of the aerosol will have an** immense impact on aerosol optical **properties** and **cloud droplet** activation ~~properties~~ (Deng et al., 2011; Chen et al., 2012). Nevertheless, due to the limitation**s** of measurement technologies, it~~'s~~ **is** relatively difficult to directly measure ~~the~~ aerosol hygroscopicity, and hence the ~~corresponding~~ **existing** research results are insufficient ~~in this area~~ (Massling et al., 2009; Meier et al., 2009). ~~On account of the observation of~~ **Because measurement** of aerosol light scattering enhancement **with integrating nephelometers** is more feasible ~~in~~ **and** practical ~~application~~, many measurements of *f* (RH) have been carried out in the NCP; while relevant studies on *f* (RH) in the northern **part of the** NCP are relatively

scarce (Pan et al., 2009; Yan et al., 2009). For better estimation of the radiative forcing by aerosols in the NCP, a comprehensive description of aerosol hygroscopicity and parameterized hygroscopic growth factors are urgently needed in climate models.

Table 2.
Include equation (1) in the caption to make the regression constants more direct and clear to the reader.

Figure 1.
Since the relationship is so clear I suggest eliminating the figure and presenting the regression equation, slope and offset in the text. Follow this with your discussion of the regression slope greater than 1.

The TSI nephelometer has minimal electronic or multiple scattering errors at scattering below 2000Mm^-1. Thus, your second explanation is unlikely the cause of the slope >1. More likely it is due to a difference in RH or in the RH history of the aerosol sample in the nephelometer system along with hysteresis effects.

Figure 2.
The time series is difficult to interpret qualitatively or quantitatively. I suggest including it as a supplement to the ACP manuscript.