**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Chemical characteristics of inorganic ammonium salts in PM$_{2.5}$ in the atmosphere of Beijing (China)" *by* A. Ianniello et al.

Anonymous Referee #2

Summary: This manuscript uses annular denuder and filter pack measurements to examine the gas-pahse precursors, NH3, HNO3, SO2, HCL, and the inorganic components, NH4+, SO4–, NO3-, and Cl-, to PM2.5 observed in Beijing, China. The observations are used with meteorological data to compare theoretical equilibrium dissociation constants of ammonium nitrate and ammonium chloride with the observed partial pressure concentration products. The analysis follows the chapter on aerosol thermodynamics in Seinfeld and Pandis (1998). The manuscript applies known thermodynamic equilibrium concepts to a new data set. The paper is suitable for publication with minor corrections.

General Comments: The analysis essentially applies the calculations found in the chapter on aerosol thermodynamics from Seinfeld and Pandis (1998) to the dataset from Beijing, China. The result of this analysis (p17144-17145) is that the ammonium nitrate aerosol cannot be treated as a pure solid. The analysis and discussion hints at the concepts of deliquescence and crystallization but only dances around the edges. Though not necessary, I think the authors could do a better job of synthesizing these concepts with their observations. Ammonium sulfate, for example, at room temperature deliquesces around 79% RH but once it deliquesces it remains in the aqueous phase until it reaches its crystallization relative humidity, around 33%, due to hysteresis (i.e., Czizo et al, JGR 1997). Ammonium nitrate, on the other hand, once reaching the deliquescence RH (DRH), does not seem to have a crystallization RH (Pauline et al., J. Aero. Sci., 1998). So, it is not just the measured RH that is important but the RH and temperature history of the air parcel along with the aerosol composition. Under these conditions a thermodynamic models such as AIM or ISORROPIA might be more appropriate than unconnected discrete equations. Furthermore, these models are used in regional air quality models and comparing these observations with those model results would be of value to in evaluating regional air quality models, in general, and of Beijing, in specific. I hope the authors with consider this in the future.

There is a tendency in this paper to overuse undefined qualifiers. For example, how are the authors differentiating a good correlation from a strong correlation (i.e., p17145, line 15)? Is an r^2 of 0.40 universally considered 'good' correlation? Also, p17145, line 15, is 40% high relative humidity? In the context of the deliquescence and crystallization of ammonium sulfate or ammonium nitrate aerosol it could be.

Specific comments:

The writing is very spotty with numerous examples of misusage and over usage of words such as, indeed, besides, thus, however, instead.

p17129, line 16 - add an "s" on the end of "source"

p17129, line 18 - "in the gas phase"

p17129, line 23 - typically not "tipically"

p17130, line 6 - "gases, such as..."

p17130, line 23 - reference to HNO3 formation

p17130, line 24 - remove "may"

p17131, line 5 - reference to HCl sources/budget

p17131, line 8 - "volcanoes" not vulcanoes

Table and Figure labels should specify whether the 2hr or 24hr data is being shown.

Figures 5,6, and 7 – Range (error) bars should be added to the measured concentration products.