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Interactive comment on “Asian dust storm observed at a rural mountain site in Southern China: chemical evolution and heterogeneous photochemistry” by W. Nie et al.

Anonymous Referee #1

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This paper reports on the chemical processing of mineral dust as observed during an Asian dust storm at a rural mountain site in southern China. It specifically focuses on the heterogeneous processes modifying the dust particle composition with a potential link with changes in hygroscopicity.

It is shown, among other, that dust particles arriving at the observation site were strongly influenced by chemistry, and potentially by photochemistry, with a large enrichment in secondary species (or ions).

This manuscript is well written and documented. The topic fits perfectly in the scope of ACP. I therefore recommend this manuscript for publication once the authors have com-

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mented following points. Some aspects of the manuscript are totally new potentially highlighting processes so far only observed at the laboratory scale i.e., photochemistry of dust. In addition maybe the figures could be made more explicit.

The experimental section would gain in strength with more details about the used instrumentation and their associated uncertainties. In fact, some observed changes are small. Before discussing these changes in terms of chemical processing, a discussion on error and uncertainties would strengthen the overall paper and content. For example, the sulphate increase during ageing was from 1.7% to 2.4%. Is this change real when taking into account experimental uncertainties?

One of the key points of this study is to associate the dust processing with the photochemical age of the sampled air masses. I did find the discussion on that topic not strong enough and would encourage the authors to elaborate a bit more their ideas to get the message more convincing. For instance, why not merging figures 5 and 6 to illustrate the coupling between ion production and photochemical age?

The ammonium enrichment on dust and the corresponding ageing of carbonate-rich Asian dust is interesting. The authors conclude that their observations fit a conceptual model involving four stages (as shown in Figure 7). However, I'm not able from Figure 6 (which corresponds to the data supporting this conclusion) to identify these four stages. I would here recommend more information to make sure that the reader can analyze how strongly this four-stage process is supported by the data.

The photo-enhanced nitrite formation during ageing is very interesting and warrants publication by itself. The TiO₂ content calculations were calculated from a formula given on page 11. However, is this supported by any publication? TiO₂ may be enriched in smaller particles enhancing the photochemical processing.

The production of gaseous HONO is important as this gas acts as an atmospheric OH source. However its formation from nitrite depends on pH. The authors elaborated a complex four stage processes to highlight the pH change upon ageing. I'm surprised

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that they did not apply it to HONO formation and this kind of conceptual approach may be important. In fact, HONO release from dust is definitively associated with acidity and may not take place all the time as specific conditions are required. Maybe the authors elaborated a bit on this and use their four-stage model to highlight when and where HONO is produced? In fact the HONO levels provided in this manuscript are certainly upper limits and real release of HONO being limited by dust particle acidity.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 19135, 2012.

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