

Interactive comment on “Dynamics of the chemical composition of rainwater throughout Hurricane Irene” by K. M. Mullaugh et al.

Anonymous Referee #1

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General Comments:

This manuscript presents a rare comprehensive investigation of the chemical properties in precipitation during a subtropical storm (Hurricane Irene) at the coast of North Carolina in 2011. It clearly documents that during the large amount of precipitation, the chemistry of the rain is dynamic and well resolved according to the rotation of the local winds under high stress. At the beginning the chemistry reflects that of marine origin (high sea salt, low DOC), and then toward the end that chemistry of terrestrial origin (low sea salt, high DOC/ammonium). The quality of the analytical chemistry is excellent to allow such good resolution, as has been the hallmark of this laboratory long recognized for its advances in precipitation chemistry. It should be accepted for publication in ACPD pending consideration of the following minor points.

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Specific Comments:

2. Methods. Were any trace elements sampled and analyzed in parallel, as this laboratory is well known for them and their species? Were any components of the carbonic acid cycle analyzed, as with pH well defined anions and insight as to the origin of the Ca excess?

Page 5, line 6. What is a ration? The constant ion ratio of sea salt chloride to sulfate should be the inverse of 0.0517. In fact, Fig. 2A suggests there is a small yet resolved excess of Cl relative to Na, as expected during photo oxidation of aerosol chloride. The authors should consult the paper by Keene, et al. on how to best correct for non-sea salt sulfate.

2.3 What was the basis for selecting 500 meters for the air mass trajectories; the assumed altitude of rain during such storms?

3. Results

The annual proportion of the 200 mm (16%) should be reiterated here. In fact the proportion of Cl to Na is not very close to that in sea water, indicating as noted above a small but well resolved excess of Cl for the reasons given.

Page 7. Are the CaCO₃ soils local or long range? Again the source might be resolved from solving the carbonic acid system, if the alkalinity were known or assumed conservative in the sea salts.

Section 3.3. Table 2 should be cited again. The correlation of the acid components should be made with a figure or at least the statistics.

Section 3.4. In fact, the hydrogen peroxide shows the same minor peak (Fig. 5) early in the storm as do the acid components. How is this related to the same photo peak or wrap around effect of the storm?

4. Discussion

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Section 4.1 The vertical movement as shown in Figure 7 is not high, low and then high as described; just a rapid vertical elevation at the end. Cite non-hurricane sample concentrations for comparison to that of hurricanes, including this and early ones reported by the same group. Is the removal of water soluble aerosols from the troposphere of remote marine origin during the storm transit?

Section 4.2, line 3. Is it washout or simple dilution of the sea salt?

Section 4.4, line 29-30. Are the additional inputs of natural and anthropogenic organic material derived as a result of the storm (e.g. high wind stress, resuspension, sea salt photo chemistry?).

Page 11, lines 11-12. Reword, as the acid components at the end of the storm did exceed that experienced in Phase 1, as did DOC and ammonia. In this case, are these later components redeposited from suspension, or outgassed production in the areas of intensive swine production?

5. Implications

Line 1. Did the high volume of rain in this or other subtropical storms result in an increase in total deposition of all or just the ionic (e.g. sea salt) components?

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 26995, 2012.