

## ***Interactive comment on “Studying the Impact of Radioactive Charging on the Microphysical Evolution and Transport of Radioactive Aerosols with the TOMAS-RC v1 framework” by Petros Vasilakos et al.***

**Anonymous Referee #1**

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Vasilakos et al. introduces an extension to the TwO-Moment Aerosol Scheme (TOMAS) that includes the effects of radioactive charging. Using the extended model, TOMAS-RC, the authors demonstrate that radioactive charging plays a significant role in the lifetime and transport of particles within particular size ranges. The paper is interesting and relevant to the journal, the manuscript is well written, the methods are described with sufficient detail, and the results are presented clearly. I recommend publication if the authors address the following questions and comments:

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- A key finding of the paper is the importance of radioactive charging on particles in the coarse mode (on the order of  $5 \mu\text{m}$  in diameter), but it is unclear to me that one would expect such large charged particles in the atmosphere. I suggest the authors elaborate on the extent to which charging by such large particles would be expected in the atmosphere.
- In general, I would like to see more discussion on the expected size ranges of charged particles in the discussion of the results. The authors point out that this information is not well constrained, but they also provide the example of forest fires in the introduction; one would expect charged particles from forest fires to be much smaller. What mechanisms are expected to yield charged particles? It is difficult to understand the relevance of the results without understanding anything about the size ranges.
- A key factor seems to be the charge distribution as a function of particle diameter. The authors assume a gaussian charge distribution for particles within each size bin, along with a list of citations, but it is unclear whether they are following an assumption that was made by previous authors or if this charge distribution was determined experimentally. Please state explicitly how the functional form of the charge distribution was determined in these previous studies.
- I also think it would be helpful to show the charge distribution for an example aerosol population, perhaps as a 2D density distribution.
- Would the results differ under a more realistic simulation that also includes gas condensation? It seems this analysis should be reserved for a later study, but it would be helpful to understand why this mechanism is ignored. I suggest commenting on this early on in the paper.
- The authors describe the impact of particle charging on dry deposition due to enhanced or reduced coagulation rates. Would charging also impact the deposition

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flux in areas impacted by radioactivity? That is, could dry deposition for particles of a given size also be enhanced or reduced due to charging?

- Many of the equations are difficult to read. For example, in some cases, it is difficult to distinguish between multiplication, exponents, or superscripts. I assume this will be addressed during typesetting.

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