Response to comments from Referee #3

Thank you for your comments. We will answer them below, point by point.

The effects predicted by the modeling may or may not be true but the good thing in the paper is that it gives a hypothesis that can be tested by measurements. It is true that the left panel of Figure 6 shows some qualitative agreement between observations and the model. However, the AERONET measurements that the model was compared against were made on land where all other sources of aerosol dominate and such AE variations, from 1.3 to 1.15, are not uncommon also in other times. The comparison made using MODIS data from over the oceans is not really supporting the model, like the authors also note. What the comparison with the MODIS data tells me is that the FD-related modification of AE is not a very significant process - which is not a bad result for the whole work and should be presented. This is also in agreement with a recent paper by Kulmala et al. (ACPD, 9, 21525–21560, 2009) that I suggest the authors cite in the revised version of the paper.

You are right that the AERONET comparison is not ideal. We also mention this on p. 22850 l. 25ff and we will expand on this explanation. Since no other data is available at these wavelengths we made the comparison anyways.
It is true that we do not see any signal in the MODIS data. However we do not agree that this necessarily means that the mechanism is not a very significant process. There seems to be a signal in the AERONET data for the low wavelength pair which disappears when using the high wavelengths and the model also shows that the signal is supposed to be stronger for the low wavelengths which are closer to the actual sizes of the aerosols.

We will add the Kulmala 2009 reference to the Introduction (p. 22836 l. 15).

Detailed comments:
22840, L2. The formula for AOD (Eq. 2) is wrong. AOD is unitless. The unit for extinction coefficient is 1/m and the integral as it is there, yields meters as units so they cancel out. Multiplied with Nsap the unit on the right side is 1/m^3. Correct the formula. I hope the calculations of AOD have been done with a correct one.

It is true that this appears to be wrong. However we used normalized extinction coefficients, which eliminates the problem. This will be clarified in the final version of the paper.

22842, L11-15. Reviewer #1 mentioned cloud processing that you have not taken into account. The other cloud-related process is below-cloud scavenging. You discuss the precipitation scavenging of particles and write "On smaller scales rain is a discrete and abrupt process that basically cleans out an area for particles." Below-cloud scavenging is a strongly size-dependent process and there is plenty of literature on this. Being sizedependent it will have a clear effect on the Angstrom exponent. Over the ocean this process alone may potentially lead to larger AE variations than the process predicted by the model here. So, I suggest you also add size-dependent below-cloud scavenging

into your model and discuss also its effects on AE in the revised work.

We agree that this is one of many additions we would like to make to our work. At this point it is not possible for us to do so it must something to add in future generations of the work.

22843, L13. Define the factor alpha in Eq. 6. And actually, use some other symbol if you are using alpha for angstrom exponent as presented earlier in Eq. 4. And also define the factor beta in line 20. And go through the whole text to give explanations to all symbols.

This alpha here is the recombination coefficient for ions. We will explain this and use a different symbol to avoid confusion. Also the beta will be explained.

I wish you presented the full general dynamic equation that you have used. For example it would make it easier to follow your "Figure" 3 - I suggest you rename it as a Table
   -   and all associated text.

The GDE will be added and figure 3 will be renamed to a table.

Add legends to figures so that the reader does not have to guess what line presents what.

We expand the figure captions to make them more understandable.