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Interactive comment on "Effects of cosmic ray decreases on cloud microphysics" *by* J. Svensmark et al.

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Review of "Effects of cosmic ray decreases on cloud microphysics" by Svensmark et al.

This paper looks at the change in MODIS-derived globally averaged cloud properties as a function of time in the periods before, during and after major Forbush decreases. It shows statistical analyses to determine the significance of changes in the cloud properties and concludes that the major cloud properties are affected by the Forbush decrease. This is an extension of analyses presented in an earlier paper by this group (Svensmark, Bondo and Svensmark, GRL, 2009).

The paper is of interest to the ACP readership and deserves to be published ones a

few minor comments have been address.

I reviewed an earlier version of this article for a different journal and nearly all of my concerns have already been addressed.

General comments

- Forbush decreases often occur within several days of solar energetic particle (SEP) events. These events can bring dramatic changes in ionization to the stratosphere leading to chemical changes (e.g. Funke et al., 2011). Its not clear if this could feed back dynamically on the troposphere (e.g. Atmospheric tides) and effect clouds, but perhaps this should be mentioned. I believe that Calogovic et al. (2010) tried to filter out Forbush Decreases that had accompanying SEP events, and this could be one possibility for the differences between that paper and SBS 2009.

Funke, B., Baumgaertner, A., Calisto, M., Egorova, T., Jackman, C. H., Kieser, J., Krivolutsky, A., López-Puertas, M., Marsh, D. R., Reddmann, T., Rozanov, E., Salmi, S.-M., Sinnhuber, M., Stiller, G. P., Verronen, P. T., Versick, S., von Clarmann, T., Vyushkova, T. Y., Wieters, N., and Wissing, J. M.: Composition changes after the "Halloween" solar proton event: the High Energy Particle Precipitation in the Atmosphere (HEPPA) model versus MIPAS data intercomparison study, Atmos. Chem. Phys., 11, 9089-9139, doi:10.5194/acp-11-9089-2011, 2011.

- In Section 4.1, the theory shows that the changes in optical depth (tau) are driven more by the changes in LWP than by droplet number concentration (CCN) (eqn. 3) or effective radius (eqn. 2). This shows that the first aerosol indirect effect (brightness effect) is likely not the main player in the cloud changes. It could possibly the second aerosol indirect effect (lifetime effect) if the clouds have a very strong LWP response to smaller change in droplet number. However, I would interpret the small changes in cloud-drop number concentrations as evidence that aerosols are not driving the changes in clouds. Obviously there is nothing conclusive regarding the mechanisms in the data, however, I believe that a brief discussion of how the relative changes in

optical depth, LWP, cloud droplet number and effective radius give evidence for certain mechanisms would help the paper.

- Section 4.3, what fraction of each factor is described in the first principle component? I'm curious to see if certain factors are NOT part of this principal component. This may give some insight into the physical mechanisms, which could aid in the discussion above. For example, are CCN and/or effective radius strongly part of this principal component?

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 3595, 2012.