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8, S3308–S3311, 2008

Interactive Comment

## *Interactive comment on* "The role of atmospheric ions in aerosol nucleation – a review" *by* M. B. Enghoff and H. Svensmark

## M. B. Enghoff and H. Svensmark

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Thank you very much for taking the time to provide these helpfull comments on our paper. Please find our response below.

**Comment**: "The manuscript is very similar in subject, scope, and structure to "Tropospheric new particle formation and the role of ions" [Kazil et al. (2008)]."

**Response**: We did not know about this paper but look forward to reading it once it is published.

**Comment**: "Page 7479/line 13 ... Udelhofen and Cess (2001) found that cloud cover in the United States for the last 100 years correlated with solar activity.

While this is correct, [Udelhofen and Cess (2001)] also point out, referring to their analysis of the US cloud cover, that "The cloud cover variations are in phase with the



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solar cycle and not the GCR."

This is just the opposite of how a possible connection between GCR and clouds that proceeds by ions growing to aerosol particles and cloud droplets would be thought to present itself."

**Response**: This observation will be emphasized more clearly in the final paper.

**Comment**: "Page 7479/line 17 ... the amount of atmospheric ions is changing on timescales of hours to millennia ...

Is there a work addressing the variation of atmospheric ionization on the time scale of millennia?"

**Response**: Here we are referring to GCR proxies such as C-14 (found in tree-rings) and Be-10 (from ice-cores). While not a direct measure of ionization, a change in the GCR flux will result in changed ionization.

**Comment**: "Page 7496/line 5 ... sulphuric acid ...  $10^7 cm^{-3}$  which corresponds to atmospheric levels (Kazil et al. 2006).

I recommend using a more authoritative reference for atmospheric H2SO4 concentrations, such as [Weber et al. (2001)]."

Response: Thank you for the reference, we will add it to the list.

**Comment**: "Page 7497/line 18 Atmospheric observations indicate that binary homogeneous nucleation cannot explain some significant nucleation events, and ions may be the key.

Laboratory studies indicate that ammonia [Marti et al. (1997a), Kim et al. (1998), Ball et al. (1999)] and organic molecules [Zhang et al. (2004), Kulmala et al. (2006), Burkholder et al. (2007)], may be responsible for or contribute to neutral atmospheric nucleation events, in addition to sulfuric acid and water, and while there is a still a fair amount of uncertainty and controversy [Marti et al. (1997b), Janson et al. (2001), ACPD

8, S3308–S3311, 2008

Interactive Comment



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Anttila et al. (2005), Sellegri et al. (2005), Yu (2006), Kurtén et al. (2007)], mentioning these compounds in the summary would seem appropriate."

**Response**: The possibility of ammonia as a ternary nucleating compound is mentioned in the introduction (p. 7478) and that the cluster can be activated to growth by organics is mentioned on p. 7484. If the wording "ions may be the key" is too strong it could be changed into something like "ions is one possible explanation, while ammonia and organics are also considered".

**Comment**: "Page 7497/line 20 The fact that the exact mechanism for the nucleation is not known makes it difficult to obtain reliable observations ...

Shouldn't the observations help identifying the exact mechanisms for nucleation?"

**Response**: Certainly the observations are very usefull and there is no doubt that we will need many more. The point we are trying to make is that it can be difficult to draw definite conclusions from observations before the exact mechanism has been identified. One example is the interpretation of the charged fraction as described on p. 7493.

**Comment**: "Page 7497/line 21 ... since it is uncertain which parameters should be observed.

At least two observables can be named that can help identifying the nucleation mechanisms responsible for atmospheric new particle formation: Charging state [Kerminen et al. (2007)], and composition of the nucleating particles. While the latter cannot be yet analyzed for the smallest of particles, the corresponding methods [Voisin et al. (2003)] are being continuously improved."

Response: True. The cited line will be rephrased to elaborate a bit on the subject.

**Comment**: "References Please check the references to works authored/co-authored by R. G. Harrison, in some of them this author's name is misspelled."

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8, S3308–S3311, 2008

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Response: This will ofcourse be corrected, thank you for the notification.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 7477, 2008.

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8, S3308–S3311, 2008

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