

## **On the role of non-electrified clouds in the Global Electric Circuit**

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### **Summary**

This paper describes the use of a high resolution model to investigate the effect of non-thunderstorm clouds on the global resistance and vertical current flow in the global electric circuit. It demonstrates effectively that vertical current flow is significantly perturbed around clouds, and model calculations demonstrate that current flow is reduced beneath clouds, consistent with the few existing observations. The cloud parametrization described may ultimately prove very useful in understanding the contribution of cloud cover to global resistance. The paper is generally well written, presents worthwhile and useful results and I would recommend publication after the following minor revisions have taken place.

### **Specific comments**

#### **Section 1**

P. 9817, Line 19: rewrite “i.e. clouds that do not ...” as “hereby defined as clouds that do not ...”

P. 9817, Lines 19-30: This reads very much as a list of references, perhaps this could be re-worded ?

#### **Section 2**

P 9825, lines 1-10: although it is stated that details of the model are presented in B13, some basic information about the model must be included here e.g. horizontal and vertical resolution of grid boxes.

#### **Section 3**

P 9830, line 22: what is the “cloud chord length” – this should be defined, also define  $x$ .

#### **Section 4**

P9832, line 5: define what is being used as the baseline for global resistance (for which over and under estimates are compared to)

#### **Section 5**

P9836, lines 107: This is a particularly interesting observation given that large areas of the world's oceans are covered by broken cumulus/stratocumulus clouds, which are often very close together. It is worth mentioning this in the discussion.

Although clouds which are horizontally close together are considered in figure 8, can the authors say what happens in the situation in which multiple cloud layers exist (vertically separated). For

example it is very common to have a layer of stratocumulus beneath a layer of cirrus – is the current reduction beneath the cloud layers simply a superposition of the individual cloud layers or does coupling exist. This is something that should be included in the discussion section.

### **Acknowledgements**

Surely an acknowledgement to the ISCCP data set should be included here, as well as a link to where the data was obtained from.

### **Figures**

Figure 1. This is not very clear, the figure quality should be improved and the text made easier to read.

Figure 2. define green line in figure 2 (b) in the caption . Consider renaming axis to “horizontal extent (km)”.

Figure 8. It is unclear how the black contour lines indicate cloud cover fraction – is another key required here?