

## ***Interactive comment on “Anthropogenic aerosols may have increased upper tropospheric humidity in the 20th century” by M. Bister and M. Kulmala***

**M. Bister and M. Kulmala**

marja.bister@helsinki.fi

Received and published: 22 February 2011

We are grateful for the comments and suggestions made by referee 2. We first address the general comments and questions raised by this referee.

The referee suggests that we would consider other explanations for recent water vapor content changes in more detail. There are basically two explanations, first, that water vapor is determined by large scale winds only and second, that it is also affected by microphysics. As the former is suggested in so many recent studies, we feel that it would not be useful to go over those studies in more detail than we do now. We have, however, added a reference to Sherwood et al (2010) for a reader who is interested in the large scale control theory of relative humidity.

C14009

We here reproduce our reply to referee 1 concerning the role of other aerosols than sulfate aerosols. We do not imply that other aerosols would be insignificant (note that we do discuss aerosols from biomass burning and desert dust to explain the trends in the data analysis). However, we use sulfate aerosols as a proxy for anthropogenic aerosols and during the time period considered, sulfate is a key component. We have added a few sentences on this to the beginning of section 3.

When it comes to quantification of the suggested effect, that must await for many more studies, first observational and then modelling studies. In the end, GCMs with aerosol effects on convective clouds would be needed. But first, we need to analyze data to see whether this effect is currently operating in the atmosphere.

As we said above, as most if not all recent studies conclude that microphysics is not important for relative humidity, we think it would not be very fruitful to repeat the findings of those studies in detail. The purpose of our study is to show evidence for the fact that we may have overlooked an important process. We did not mean to imply that our manuscript is a proof for the mechanism. It is more of a warning sign showing that this issue is not solved yet.

When it comes to Connolly et al 2006, the observed logarithmic sensitivity of clouds to aerosols is mentioned in the manuscript. Thank you for an interesting reference.

Specific points

1. Discussed above
2. See above for discussion on the large scale control theory. The effects of several meteorological phenomena (North Atlantic Oscillation, Rossby waves, widening of Hadley cell, and ENSO) on relative humidity and whether they could explain the observations of McCarthy and Toumi are discussed in section 3.
3. We agree, and have added the following sentence just after the "if" sentence "However, careful analysis of data is needed to see whether this is indeed the case".

C14010

C14011