

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

**Anonymous Referee #2**

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This paper proposes that increased man-made aerosol may have increased upper tropospheric humidity. The proposed mechanism is through an increase in the amount of moisture being transported into the upper troposphere through deep convection and literature (mostly modelling studies) are cited in support of this.

The idea is certainly plausible and the evidence for the effect of an increased cloud height and anvil ice water content with an increase in aerosol is reasonably strong. I agree with the authors that the influences of aerosol may well have been underestimated in recent modelling studies of climate change, however, the case needs to be made more strongly and with a wider consideration of competing processes regulating upper tropospheric humidity. The argument in the paper could be made stronger by a much more detailed consideration of other explanations of recent water vapour content

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changes, a wider range of aerosol type (In addition to sulfate) and quantification of the argument including the proposed cloud effect.

The main weaknesses in the paper is that the selection of literature cited is such as to offer support for the hypothesis presented with other papers not discussed. For example Connolly et al 2006 find that there is an optimum number of aerosols for maximum water content in the anvil rather than an ever increasing amount of water with ever increasing aerosol. Further literature offering other explanations for changes in troposphere humidity are not discussed

Specific points

1. Kulmala is a world leading expert on atmospheric particulate and I am sure the authors are aware that non sulfate aerosol play a very important part as Cloud Condensation Nuclei in the atmosphere.
2. The relative importance of other processes that are often assumed to control changes in upper atmospheric humidity need to be discussed alongside the role of the aerosol.
3. This particular section in the conclusions ‘The changes in UTRH during 18 years (1979–1997) have been about 1–2% in the midlatitudes. If the observed decrease of UTRH in midlatitudes is indeed associated with the decrease of sulfur emissions in 1979–1997, then larger absolute changes in UTRH may have occurred in the 20th century when the sulfur emissions increased from about 10 TgS to about 70 TgS (Stern, 2006).’ Needs attention. I know the authors are only saying ‘if’ but the sentence leaves the reader with the suggestion that sulfate aerosols are the only or at least the dominant factor controlling upper tropospheric relative humidity. This case is most certainly not made in the current paper.

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