In the reply, the referee's comments are in *italics*, our response is in normal text, and quotes from the manuscript are in blue.

Anonymous Referee #2

In this numerical work, a statistical approach is described for analysing the effects of sulphate geoengineering on the genesis of tropical storms. The procedure is well designed on the general methodology of the GeoMIP project, with use of data that independent global models have provided in a common database with their G4 simulations. The manuscript is scientifically robust and deserves publication on ACP.

Some of the conclusions are important, mainly the fact that the thermodynamic role of SST changes induced by geoengineering aerosols dominates over the lower stratospheric aerosol heating. However, sometimes the authors compare the SST effects with changes in static stability, as if they were two independent things (see for example in the conclusions, lines 547-549). Actually, SST changes may affect the atmospheric static stability by themselves, even in the absence of a stratospheric warming. I would suggest rephrasing. The authors themselves clearly explain how static stability changes are controlled by both surface and upper tropospheric temperatures (page 18, lines 358-360). This is the main specific point I suggest to better clarify all along the manuscript, before final publication on ACP.

Reply: Yes, this is good point. We fully appreciate the point that static stability is not the same as SST. Apparently our original sentences were not clear enough on this and we have rewritten the entire section discussing impacts on static stability due to SAI, with the helpful suggestions from the referee.

In addition, it is true that the aerosol heating is mostly located in the 16-25 km layer (see page 27, lines 540-542); however, due to the large size of the geoengineering aerosol particles (effective radius of the order of 0.6 μm or more), a significant fraction of the stratospheric particles would settle down below the tropical tropopause (Niemeier et al., 2010; English et al., 2012; Cirisan et al, 2013), thus producing some diabatic heating superimposed to the convectively-driven upper tropospheric cooling. This means that the surface cooling (with associated upper tropospheric tropical cooling, due to lesser efficient convective motions) may be expected as the dominant process controlling the geoengineering induced changes of atmospheric static stability. At the same time, the aerosol heating in a few kilometres layer immediately below the tropical tropopause (due to gravitational sedimentation of large geoengineering sulfate aerosols) should also be considered as a contributing smaller effect.

Reply: Thank you for this insight. We modify the text to take these points into account: In contrast with the solar dimming G1 experiments analyzed by Davis et al., (2016), here we analyze G4 which is an aerosol injection protocol. The aerosol is prescribed in the GeoMIP G4 protocol (Kravitz et al., 2011a) as injected into the equatorial stratosphere at 16-25 km altitude, where most of the direct radiative heating takes place (Pitari et al., 2014). However, due to the large size of the geoengineering aerosol particles (effective radius of the order of 0.6 μm or more), a significant fraction of the stratospheric particles settle below the tropical tropopause (Niemeier et al., 2010; English et al., 2012; Cirisan et al, 2013), thus producing some diabatic heating a few kilometres immediately below the tropical tropopause. This is superimposed on the convectively-driven upper tropospheric cooling caused by surface cooling due to the SAI and reduced convection and weakened hydrological cycle (Bala et al., 2008). This may be expected to be the dominant process controlling the SAI-induced changes in atmospheric static stability

It would be worth to note that another indirect effect of sulfate geoengineering, related to the surface cooling and static stability changes, is discussed in Visioni et al. (2018). Here the sensitivity of upper tropospheric ice formation is studied with inclusion of the aerosol-induced surface cooling, with respect to a reference condition documented in Kuebbeler et al. (2016), where only the stratospheric warming due to the aerosols was taken into account. The conclusions presented in the manuscript of Wang et al. (2018) go in the same direction of what discussed in this other study.

Reply: Yes, thank you we not this now: Furthermore, recent work (Visioni et al., 2018 ACP in discussion) explores the secondary of surface cooling on the upper troposphere with the impact on cirrus clouds, and the concomitant impact on static stability. Surface cooling and lower stratospheric warming, together, tend to stabilize the atmosphere, thus decreasing turbulence and water vapor updraft velocities. The net effect is an induced cirrus thinning, which serves to increase net global cooling due to the SAI.

Minor points

P. 3, line 66: the Kravitz reference has a wrong comma between the name and et al.

Reply: Done

P. 3, line 72: some more recent articles can be cited here, for example Visioni et al. (2017).

Reply: yes we added Visioni (2017); Kashimura, H., M. Abe, S. Watanabe, T. Sekiya, D. Ji, J. C. Moore, J.N.S. Cole and B. Kravitz 2017 Shortwave radiative forcing, rapid adjustment, and feedback to the surface by sulfate geoengineering: analysis of the Geoengineering Model Intercomparison Project G4 scenario, *Atmospheric Chemistry and Physics* 17, 3339-3356, doi:10.5194/acp-17-3339-2017, 2017; and Russotto, R. D. and Ackerman, T. P.: Energy transport, polar amplification, and ITCZ shifts in the GeoMIP G1 ensemble, Atmospheric Chemistry and Physics, 18, 2287–2305, doi:10.5194/acp-18-2287-2018, 2018)

P. 4, line 83: are used instead of have used.

Reply: Done

P. 6, line 126-130: I would suggest rephrasing this concept, maybe splitting the long sentence in two. In its present form it is hard to follow.

Reply: Rewritten: Jones et al. (2017) showed SAI in the northern hemisphere reduced the numbers of TC in the North Atlantic while SAI in the southern hemisphere increased numbers in the basin.

P. 7, line 149: explain better the altitude at which the injection is simulated, since it has been shown how different injection heights may affect differently the climate response (Tilmes et al., 2017; Kleinschmitt et al., 2018).

Reply: Rewritten . G4 is based on the GHG emissions from the RCP4.5 scenario but short wave radiative forcing is reduced by injection of SO_2 into the equatorial lower stratosphere at altitudes of 16–25 km, at a rate of 5 Tg per year from the year 2020 to 2069.

P. 8, line 162-165: for a recent study analysing the connection between the stratospheric warming due to the sulfur injection and the tropospheric response in term of vertical motions, see Visioni et al. (2018) (now under review in ACPD).

Reply: Rewritten, reference added

P. 14-15: I suggest to the authors to move some of the longer equations derivations to the supplementary material for better readability of the manuscript.

Reply: Several equations are removed and so improve readability.

P. 22, line 433: no comma between models and are.

Reply: This section has been deleted in response to Ref#1.

P. 25, line 510: I would suggest using "variability" instead of "variations".

Reply: Done

P. 27, line 539: analyze instead of analysis. Better rephrase "aerosol injection scheme" into a more appropriate description, such as "protocol".

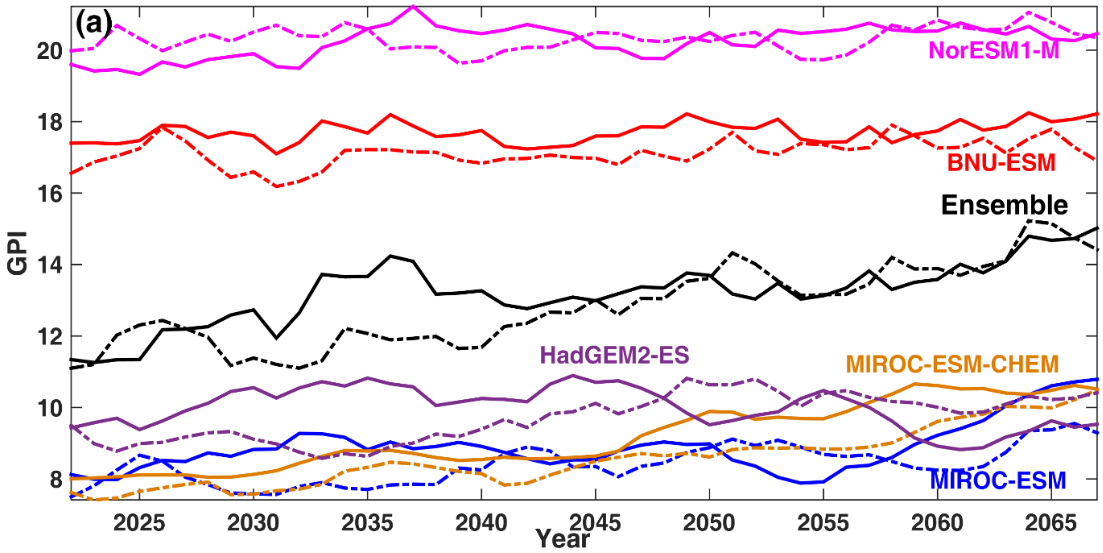
Reply: Done.

P. 27, line 552: "in the response strength across the ocean basins" sounds probably better than "in strength of response across the ocean basins".

Reply: Done.

P.38, Fig. 1: adding a legend outside the figure, instead of having the names of the models close to the related lines, would make it easier to read.

Reply: We have revised Fig. 1 to separate the lines better which we hope solves this problem.



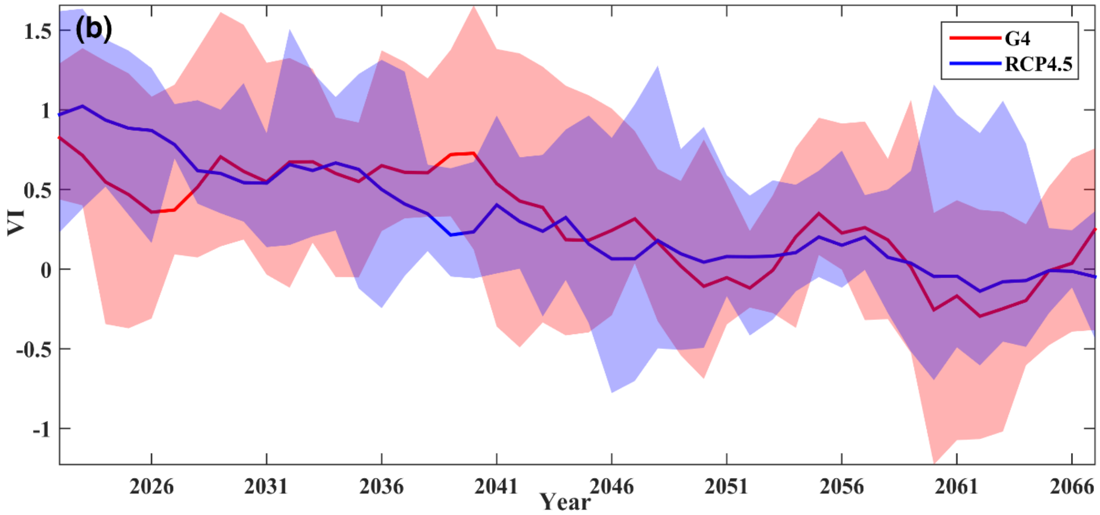


Figure 1. Five yearly moving annual averages across the 6 TC basins and TC season, of (a) GPI, solid lines denote forcing under RCP4.5 and dotted lines values under G4. Ensemble mean series were calculate using normalized time series, shifted by the ensemble mean. (b) VI with solid lines denoting model ensemble means and shading indicating the range across the five models.