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Referee Comment on acp-2022-370

Anonymous Referee #2

Referee comment on "Future dust concentration over the Middle East and North Africa region under global warming and stratospheric aerosol intervention scenarios" by Seyed Vahid Mousavi et al., Atmos. Chem. Phys. Discuss.,
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This paper is a straight forward comparison of predictions of model ensembles using one model with two scenarios, global warming (RCP8.5) and stratospheric aerosol injection (SAI), over 80 years compared with a control run of 20 years. The variable of interest is dust and its correlation with surface temperature, leaf area index, precipitation, soil moisture and wind speed. The region of interest is north Africa and the middle east with various dust hot spots identified. The bulk of the paper rests on describing Figs 3-9 which show the spatial and temporal variation of each of these parameters under the two scenarios for monthly and annual means. The spatial differences are shown variously as absolute value or percentage depending on the variable. It is not clear why they are not all shown as percentages.

The authors then make some conclusions about the differences between the RCP8.5 and SAI scenarios, a number of which are difficult to believe if the error bars are included in the discussion of the annual differences or trends in for example soil moisture, wind speed.

Error bars should be included on all the figures showing mean values: monthly, annually, or spatially. Currently error bars are included only on the annual means. The same should be applied to Fig. 10. Then the authors discussion of notable differences can be placed in the context of how well any one variable is known.

One of the results which is rather striking, but which the authors largely ignore, is how little difference there is between the various variables, except for surface temperature and leaf area index, for the two scenarios, see e.g. Fig. 10. Similarly for most variables there is primarily little difference between the two scenarios and the control. Isn't this surprising given one scenario is global warming as usual, whereas the other is to deal with global warming. Are we to conclude that only primarily temperature will be affected?

The paper would be improved if some discussion along these lines was added and if the authors treated the supposed differences and trends more carefully to put them in the context of the uncertainty in the knowledge of variable in question. If differences or trends are small fractions of the uncertainty, there cannot be much confidence in such predications.

More detail on these and other points follow in paper order, including a couple of minor points.

44 From remote "regions?"

80 dioxide

166 Isn't it the cumulative LWTC averaged over time? Or is there a new variable WTC?

Fig. 2 Some general comments should be made to explain the similarities of all the figures no matter the variable being correlated, particularly for readers not accustomed to such plots. For example, why is there always a strong annual cycle? Is this just the strong annual seasonal cycle? Why is there a definite semicircle traced out delineating the bright and dim colors in all plots? Is this an issue with the period versus the year, i.e. there can't be an eight year correlation for times less than 16 years beyond the start date? Presumably this is the cone of influence. But if that is the case why are there any correlations outside this cone shown on the figure?

Fig. 2 caption is unclear. 1) Isn't the cone of influence denoted by the more intense colors? If that isn't the case then it suggests the cone of influence is only from 2-20 years before 2050 and after 2070 with no influence in the center of the figure? 2) What is meant by the whole MENA region. Is that different than the MENA region? Also in the text line 199, and similarly confusing whole middle east. These regions were defined clearly earlier, now there seems to be a confusion about what they mean.

218 Again the whole MENA compared with the Middle East. Is this now not the whole Middle East?

Fig 3 c-q. Consider using percentages. The average reader may not know if 45 ug/m³ is a lot or a little. But checking Figs 3a,b indicates that 45 ug/m³ is 50-100% above or below the mean value, so it is a lot.

Figs 6-9 q) which depict the annual mean value. Don't all of these figures, except fig. 6q) show that considering the error bars there is no difference between RCP8.5 and SAI. The difference in the means is a small fraction of the range of differences mapped out by the error bars. The differences shown in the monthly mean value figs p) appear at first more significant, but where are the error bars on this figure? If they were included the picture might be just as difficult in concluding a difference between RCP8.5 and SAI. Of these figures the only two that show a distinct difference outside the error bar range are surface temperature and TLAI.

Thus the authors conclusions such as at lines 311-, "Figure 7q further shows ... and under SAI, the wind speed reduction is gradually stronger than RCP8.5 starting from 2050.", or 324, "Fig 8q shows that a moderate positive trend of the annual mean value exists in the soil moisture under the SAI scenario." are deeply flawed. There is no trend that would stand under any statistical test given the size of the error bars on the data. The authors must be much more careful about what can be concluded from these monthly and annual mean values.

Similar comment can be made about Fig. 9r), a slight difference appears in the mean values east of 50 degrees, but would this appear significant if the error bars were included on this figure? The error bar range is on the order of plus/minus 100 mm/year.

Fig. 10. Error bars should be included on this figure, just as they have on all the annual means shown. This is needed to put the differences noted in the context of the overall uncertainty in the predictions.