

## ***Interactive comment on “Projection of North Atlantic Oscillation and its effect on tracer transport” by Sara Bacer et al.***

### **Anonymous Referee #2**

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This paper analyzes recent and future trends of the effect of the North Atlantic Oscillation on tracer transport using idealized CO-type tracers in a general circulation model.

While this sounds ideally like an interesting topic, in fact there may not be much here. Long-term trends in the NAO are rather small. While there appears to be a positional change in the NAO, the overall pattern of correlations between the NAO and the tracer appear similar between 1980-2010 and 2070-2100. At this point I'm not at all convinced the future changes in transport due the NAO are important enough to publish (see point 1 below). At the minimum the paper needs major revisions in order to be acceptable for publication.

1. The correlation pattern between PC1 and CO25 look rather similar between the present-day and future periods, although they differ in detail. The correlation maps

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however, really do not indicate the magnitude of the differences. It would be better to regress the NAO against the CO<sub>25</sub> concentration during the two periods and determine differences between CO<sub>25</sub> concentrations. Are these really large? In my opinion this extension and its significance is necessary for publication.

2. Differences in tracer concentration due to the NAO could be due to both trends in NAO or in changes in the EOF pattern. I believe the changes in Figure 4 are due to changes in the pattern. However, the authors should also examine changes in the tracer concentration due to changes in the NAO trend (or are these not important?). The authors concentrated on changes in the NAO trend in the first part of the manuscript so the importance of temporal changes should be addressed.

3. When computing changes in the NAO trend I assume the authors are allowing for variations in the pattern of the 1st EOF depending on the time period. This should be made very clear (in section 3.2). My feeling is it would be better to look at trends in an invariant NAO pattern.

4. I am puzzled between the similarity in pattern between the slopes of the model generated PC1 and the observational generated pattern over the historical period. Has this been seen in other general circulation models considering a substantial portion of the NAO is forced by atmospheric variability? The authors suggest that similarities in patterns and slope are in good agreement validating the ability of the model to correctly simulate the NAO. However, why does one expect agreement?

5. Finally, I'm somewhat concerned about the shift in position of the NAO between future and present climates (Figure 1). Could this shift and the corresponding changes in tracer correlation (Figure 4) simply be due to interdecadal variability? This distinction seems somewhat important as the significance of the change in pollution with future changes in the NAO depends on the fact that the shift in the NAO is climate induced. I feel the authors should try to demonstrate that this shift is not simply due to interdecadal variability.

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