Response to Anonymous Referee #2

We thank the reviewer for positive comments on the manuscript. Below we include a point-by-point response (in bold blue) to the reviewer, responding to *their comments (in italic)* and explaining the changes made to the manuscript.

This paper uses modeling in conjunction with observations to assess the causes of surface ozone trends in the United States, and applies some novel approaches to this important problem. The analysis is robust and the paper is generally well-written. I have listed some specific comments below to improve the clarity of some parts of the text.

Page 1 Line 32: Clarify that this is future springtime O3

RE: From the sentence below, it is clear that we are talking about future springtime ozone.

"Rising Asian emissions and global methane under the RCP8.5 scenario increase mean springtime O3 above the WUS by ~10 ppb from 2010 to 2030."

Page 1 Lines 34-35: Do you mean that the onset of isoprene emissions is earlier in the Southeast than other regions, or that it became earlier over time?

RE: We now say "Historical EUS O_3 decreases, driven by regional emission controls, were most pronounced in the Southeast with an earlier seasonal onset of biogenic isoprene emissions and NO_x-sensitive O_3 production."

Section 2.1: What time period is the model run for?
RE: please see Table 1.

P6 Line 18: Why not adjust for sample autocorrelation?
RE: We do not adjust the confidence limit for sample autocorrelation to enable a directly comparison with the trends reported in the published literature (e.g., Cooper et al., 2012; Parrish et al., 2014).

P6 Line 35: Is it only 1990 that has anomalously low values at some sites, or several of the early years? See, for example, the discussion in Strode et al. [2015].
RE: Here we are talking about the cross-site consistency on the anomalies. The other years, such as 1992-1993, also have low-anomalies, but they are consistent across the sites, reflecting the influence from the Mount Pinatubo eruption as discussed in Lin et al. (Nature Communications, 2015).

P7 Line 27: What is the justification for picking 700 hPa?
RE: The level is representative of free tropospheric air since we want to limit the excessive influence from surface pollution in the model.

P7 Line 35: Is BASE the same as AM3_BASE? If so, please use one or the other consistently.

RE: Yes, they are the same. We have avoided using AM3_BASE in the revised manuscript.

P11 Line 31: Since a number of studies have examined trends for slightly different time periods (for example, Cooper et al [2012]), it would be helpful to summarize here how your results for trends through 2014 compare with those trends, and what effect the inclusion of recent years has on the trends.

RE: Good suggestion!! We now include additional discussions in Section 4.1 regarding the difference in the trends reported in this work compared to prior studies. Copied below:

"The north-to-south gradient in springtime O_3 trends over the EUS reflects the earlier seasonal transition from NO_x-saturated to NO_x-sensitive O_3 production regimes in the Southeast, where plentiful radiation in spring enhances HO_x supply and biogenic isoprene emissions are turned on earlier than the Northeast. The different response of springtime O_3 to NO_x controls in the Southeast vs. Northeast noticed in this work is not present in prior analyses for shorter time periods (1990-2010 in *Cooper et al*. 2012 and 1998-2013 in *Simon et al*. 2015). We find 72% of the Southeast sites experiencing significant median O_3 decreases in spring over 1988-2014, while *Cooper et al*. found only 8%. Sites with significant 95^{th} percentile springtime O_3 decreases in the EUS are also more common in our study (85% versus 43% in *Cooper et al*.). For the 5^{th} percentile, 45% of the Northeast sites in our analysis have significant spring O_3 increases, whereas only 15% in *Cooper et al*.

"Compared to the 1990-2010 trends reported in *Cooper et al*., the EUS summer O_3 decreases reported here with additional data to 2014 are 33% stronger."

P13 Line 23: How does the GHCNDEX relate to the meteorology used to drive the model? Why not calculate the change in max temperature etc. using the same met fields that drive the model?

RE: Note that the model is nudged to NCEP U and V but not temperature (as described in Section 2.1). The simulated change in Tmax is shown in Fig.12b. GHCNDEX represents observations, with input data from the Global Historical Climatology Network (GHCN) Daily station data.

P20 Line 16: This is a significant bias, and should be discussed earlier in the paper.

RE: We have mentioned the mean model biases in Section 4.2 when referring to Figs. S4 and S5. The high model biases in EUS surface ozone is well known and common across the models. The discussion fits better in Section 6, which focuses on the EUS.

Fig. 8 caption: What does "colorbar saturates at -0.8" mean?

RE: Changed to "The color scale saturates at $\pm$ 0.8". It means that there are values outside of the -0.8 to +0.8 range.