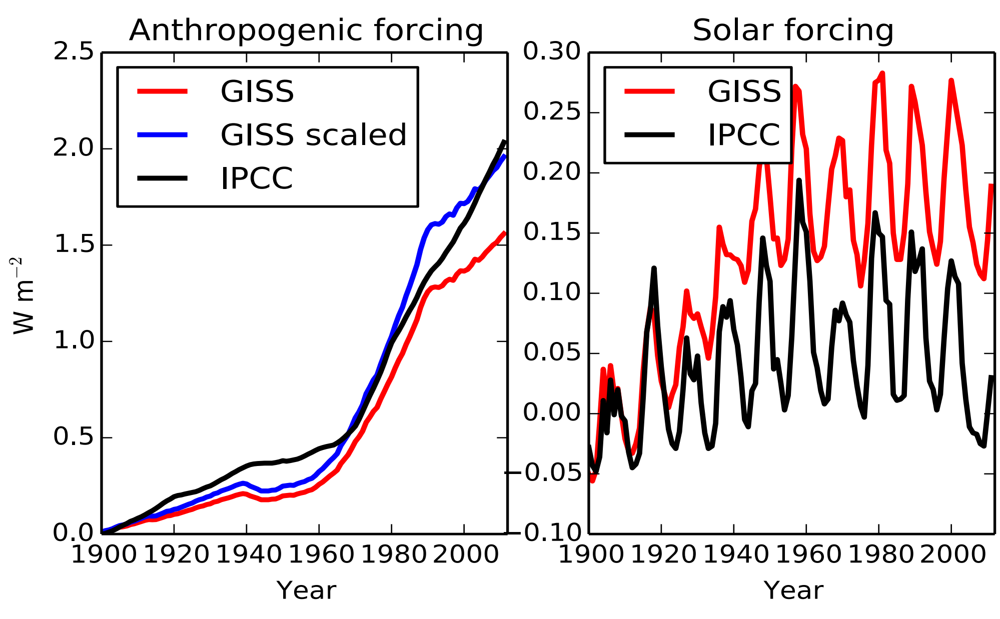
Overview

We would like to thank both reviewers for their constructive reviews. Before responding point by point we give an overview of the changes we made to the manuscript to address the concerns raised by the reviewers and several colleagues. The revised figures and new table are shown at the end of this document.

- We now base our analyses on the more recent IPCC AR5 forcings instead of using the GISS forcings as we did before. This led to higher TCR values (on average 1.6 instead of 1.3°C, see new Table 1) partly because of a different shape of the anthropogenic forcings (see Figure below, left panel) and partly because of differences in the solar forcing between the two datasets (right panel). Specifically, the more recent IPCC forcings indicate decreased solar forcing in the second part of our study period leaving more room for the temperature signal to be explained by anthropogenic factors.
- We expanded Figure 1 to better inform the reader about the datasets used in the MLR.
- Instead of only using the GISTEMP dataset we now also HadCRUT4 and Berkeley temperature datasets.
- We clarified several parts of our methods section and updated the figure captions so they are more precise.
- We expanded the TCR calculations with a Monte Carlo simulation to get a better handle on the uncertainties and to show the sensitivity to using different temperature datasets and AMO characterizations (see new Table 1).



Differences in datasets used in the discussion phase and final phase. Left panel the anthropogenic forcing from GISS, these values scaled linearly to match IPCC forcing in 2011 based on available information when we originally wrote the paper, and IPCC AR5 forcings (all scaled to be 0 in 1900). Right panel solar forcing from GISS and IPCC AR5, note the decrease in IPCC values not present in the GISS forcings.

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Response to Reviewer 1:

1. We appreciate the suggestion to use different temperature datasets in our analysis, and revised Figures 1, 3, as well as the new Table 1 is the result of that (all inserted at the end of this document). Somewhat surprising, the TCR values were more sensitive to the choice of temperature dataset than to the choice of AMO description.
2. When we applied running means to the data the results were as expected: a decreased role of factors with large interannual variability (mainly ENSO) while the other coefficients changed little. It did lower the coefficients of determination somewhat because of a smaller range of values.

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Response to Reviewer 2:

Regarding the confusion on how the anthropogenic temperature trends were calculated: we have clarified this in the Methods section. Our methodology was indeed as the reviewer thought it was. Because the MLR coefficients were derived from the 1900-2011 period while the anthropogenic trends were calculated on shorter periods (to show where the differences in previous studies originated) we understand the confusion and have now re-written the end of the results section: *"…However, the key result here is that also intermediate values are possible; the characterization of the AMO as well as the temperature dataset used played an important role (Fig. 3). According to our results, anthropogenic temperature trends for the past 30 years were between about 0.11 and 0.17°C per decade (Fig. 2i, range of values based on using radiative forcing as anthropogenic influence and including AMO). ….*

To some degree, the way the AMO characterization influences the 30-year anthropogenic warming rate is also seen in the TCR values we derived from multiplying the coefficients given to the anthropogenic factor with the radiative forcing of a CO_2 doubling (Table 1). Including AMO in general lowers the TCR, but to a much smaller degree than for the 30-year anthropogenic warming rate discussed above because of the longer time period considered (1900-2011) and thus smaller relative impact of multidecadal oscillations….. "

We have now also calculated what the anthropogenic temperature trend would be derived from multiplying the anthropogenic coefficient with the change in forcing as suggested by the reviewer: *"…The anthropogenic trends calculated this way show a similar pattern as and agree within their uncertainties with the trends we had expected from multiplying the coefficients found for the anthropogenic forcing (Fig. 2a) with the change in forcing over the 1982-2011 period (1.01 W m^{-2}), shown in Fig. 2i. However, the difference is larger than expected for the NA SST and Enfield AMO descriptions, potentially reflecting non-linearities or temporal variability in the role of the natural forcings and highlight uncertainties in these approaches. "*, see also the revised Figure 2 at the end of this document.

We have inserted a reference to Stott et al. (2006) in the discussion section, not in the introduction because the TCR calculation is very much a derived parameter and not discussed in the introduction: *"…. This translated to relatively stable TCR values that differed more from changing temperature dataset than due to differences in AMO characterization (Table 3). Our values were somewhat higher but well within the uncertainty range of recent studies based on energy budget constraints, e.g., Otto et al. (2013), but lower than more sophisticated attribution studies also accounting for the spatial variability (e.g., Stott et al., 2006). ……"*

Data and methods are now more clearly described and all code and results are posted on http://www.falw.vu/~gwerf/code/ESD_AMO/ in case more detailed information on the calculations are needed.

We now clearly mention that our study period is 1900-2011 and that the MLR results are derived from that but that the anthropogenic warming rates are calculated differently, both in the Methods section and in the captions of Figure 2.

We have corrected the units for the regression coefficients

532:L25: We meant the difference between Zhou and Tung (2013) and Chylek et al. (2013). This is now stated as: *"… Another key difference compared to Chylek et al. (2013) is that Zhou and Tung (2013) did not use the anthropogenic forcings but a linear trend, just as Foster and Rahmstorf (2011) did …"*

533:L14: We have deleted this section to avoid further confusion: we have tested for co-variations between the explanatory variables (which was not the case).

535:L14: We have changed this section to: *"….Since 1) the shape of the anthropogenic forcing is known to be not linear (while large uncertainties exist in the aerosol forcing the dominant greenhouse gas forcing is well known and increased exponentially) … "*

536:L15: That is right, by including a reference to Zhang et al. (2012) who debunked the study claiming the AMO was anthropogenic and we now assume the AMO is natural: "*These two lines of thought (natural versus anthropogenic) are difficult to reconcile but given the multiple lines of evidence showing a natural component and doubts on whether aerosols are indeed driving the AMO (Zhang et al., 2012) we assume here that the AMO represents a natural oscillation*."

537:L23: Agreed, has been removed

Figures: we have changed Figures 1 and 2 as suggested, please see below.

New Table and revised figures

Table 1. Transient climate response (TCR) including 5th and 95th percentiles based on Monte Carlo simulations taking into account uncertainties in radiative forcing, temperature data, and the radiative forcing regression coefficient.

AMO description	Temperature dataset			
	GISTEMP	HadCRUT4	Berkeley	All
No AMO	1.76 (1.16-3.55)	1.57 (1.03-3.18)	1.67 (1.10-3.38)	1.67 (1.09-3.37)
NA SST	1.66 (1.09-3.34)	1.46 (0.96-2.95)	1.55 (1.02-3.13)	1.56 (1.01-3.16)
Enfield	1.64 (1.08-3.32)	1.43 (0.94-2.89)	1.52 (1.00-3.08)	1.53 (0.99-3.11)
Van Oldenborgh	1.75 (1.16-3.55)	1.57 (1.03-3.17)	1.67 (1.10-3.37)	1.66 (1.09-3.36)
Trenberth	1.76 (1.16-3.56)	1.58 (1.04-3.20)	1.68 (1.11-3.38)	1.67 (1.09-3.39)
All[1]	1.70 (1.12-3.44)	1.51 (0.98-3.06)	1.61 (1.05-3.26)	1.61 (1.04-3.26)

[1]. Running with no AMO excluded

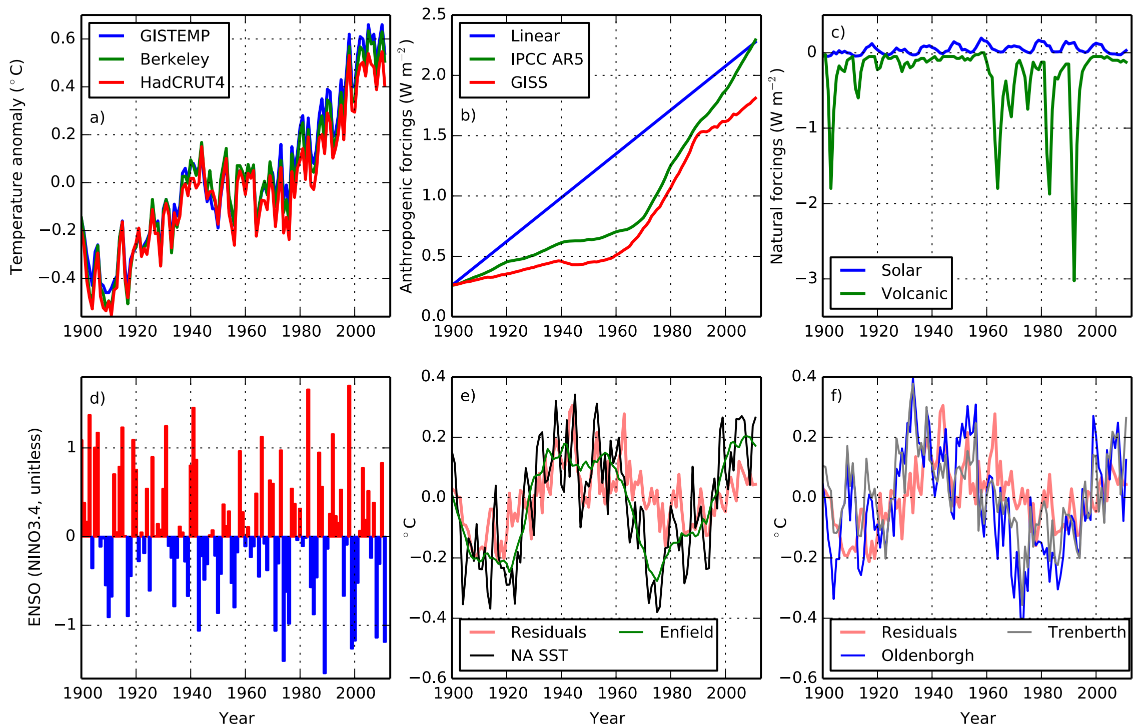

Figure 1. Input datasets used in this study, a) three different temperature datasets, b) anthropogenic forcing, c) natural forcings, d) ENSO, e) AMO characterizations based only on NA SST, and f) AMO characterizations aiming to isolate the intrinsic AMO signal. Also shown in e) and f) are MLR residuals when explaining GISTEMP temperature with GISS anthropogenic radiative forcing as well as with solar, volcanoes, and ENSO as explanatory variables.

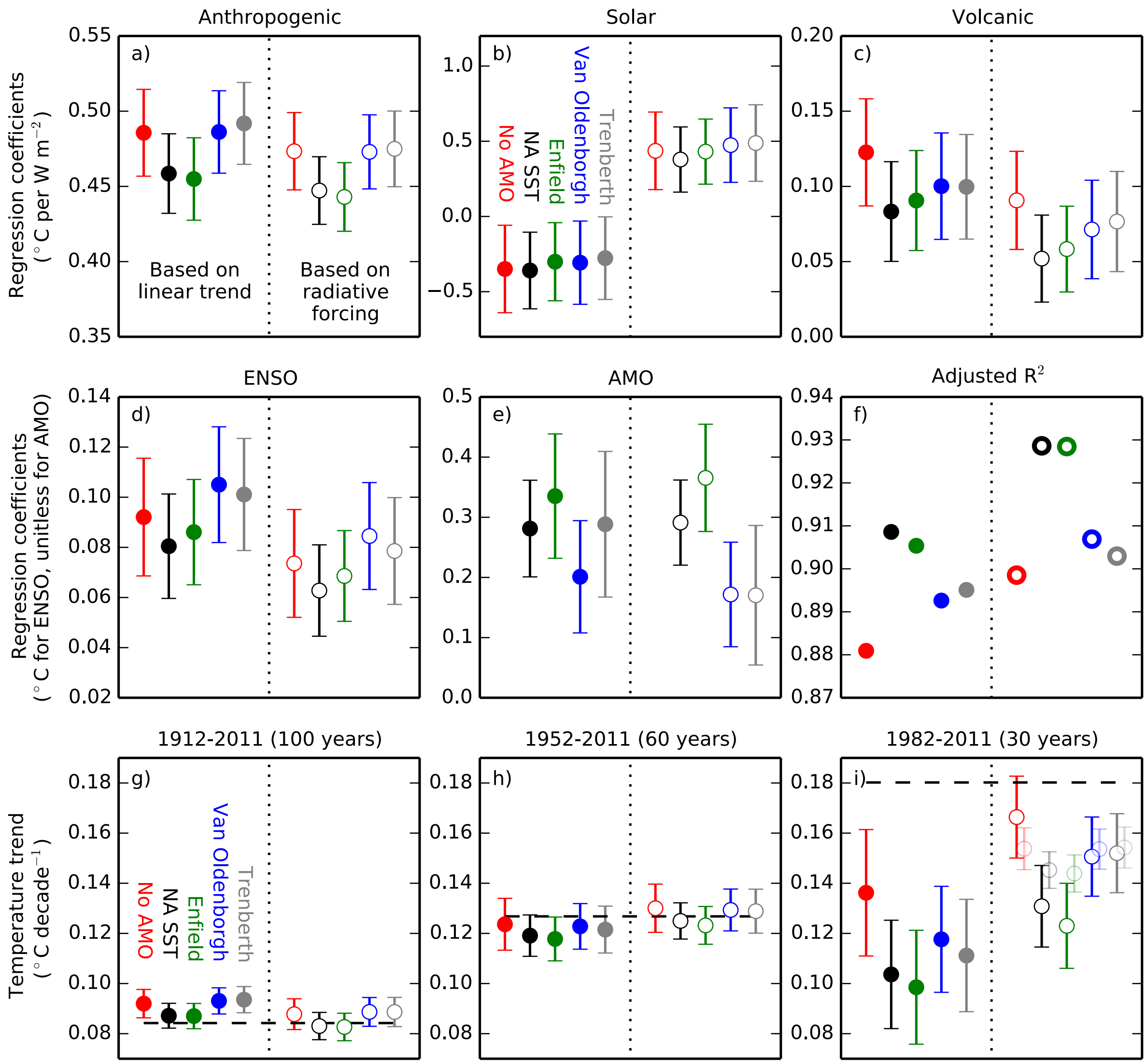

Figure 2. Regression coefficients (a-e) and adjusted coefficient of determination (f) for MLR exercises over the 1900-2011 period using GISTEMP temperature data as well as calculated anthropogenic trends and observed temperature trends (dotted black lines) for three different time windows (g-i). Light colored bars in i) are calculated anthropogenic temperate trends based on the regression coefficients shown in panel a) and the change in forcing. Results are shown for 10 different MLR exercises with the first five (closed circles) based on a linear trend for the anthropogenic influence and the second five (open circles) using IPCC AR5 anthropogenic radiative forcing instead. Within these two sets 5 MLRs were done without AMO and with 4 different AMO descriptions as indicated in b) and g). Errorbars indicate 5th and 95th percentiles without taking uncertainties in input datasets into account.

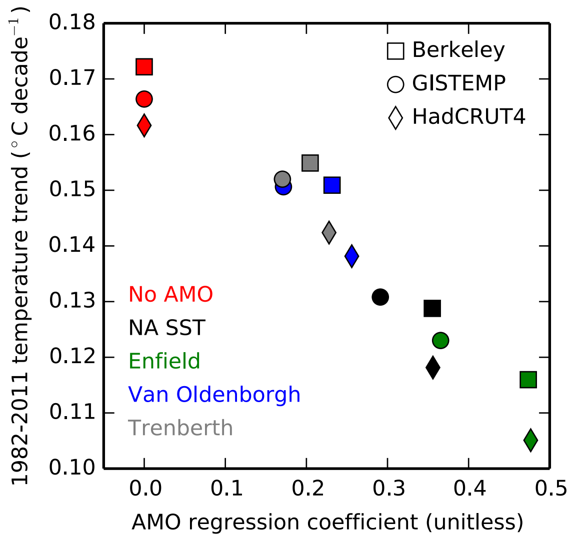

Figure 3. Relation between the weight given to the AMO in the MLR and the derived anthropogenic temperature trend over 1982-2011 for 3 different temperature datasets and 5 different AMO characterizations.