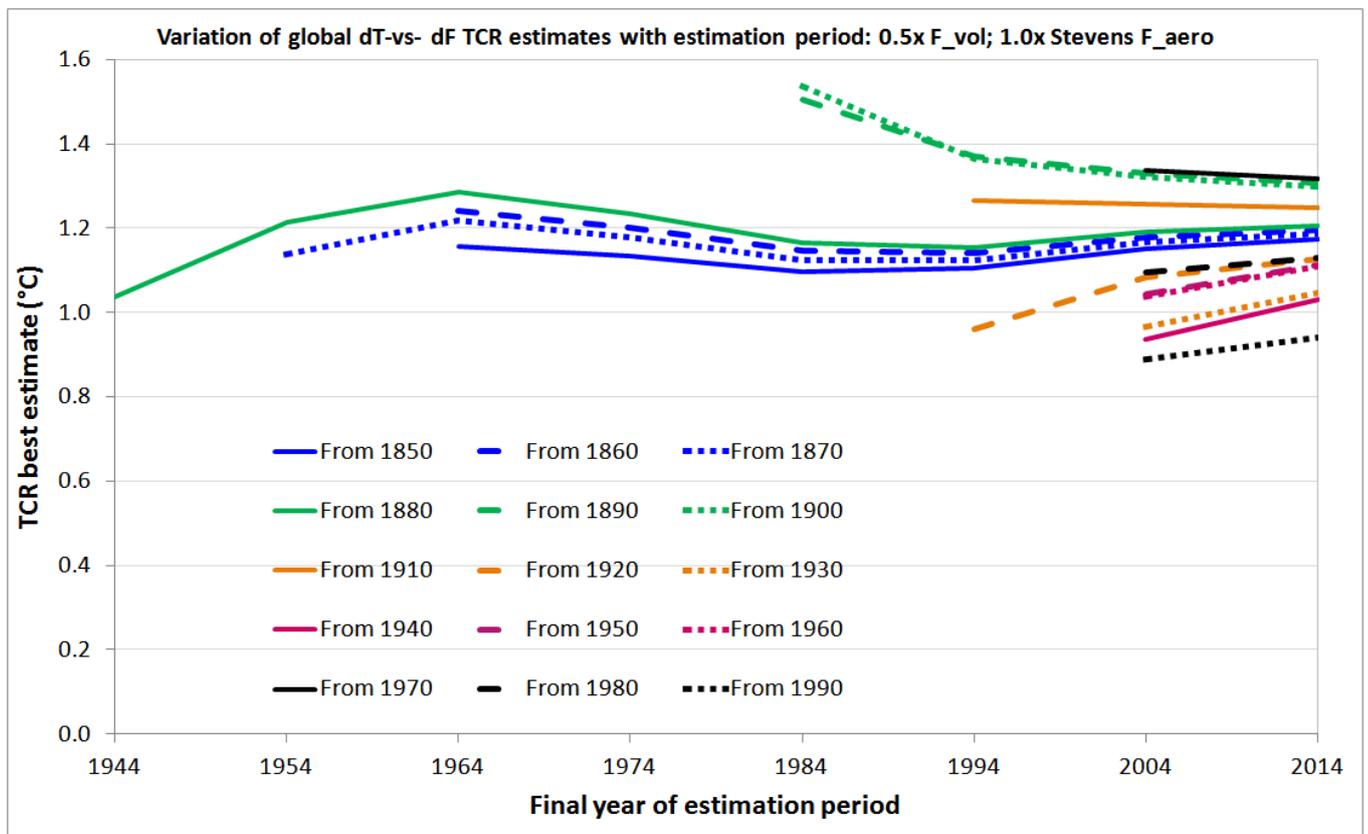


Sensitivity of simple model TCR estimates to internal variability

The below figure shows how simple model TCR estimates vary with the analysis period start and end dates. The estimates are affected both by internal climate system variability, especially multidecadal variability, and by errors in the best estimate time series of global surface temperature (GMST) and effective radiative forcing (ERF) used. As can be seen, the TCR estimates are remarkably stable, and converge on around 1.2°C when data to 2014 is used. Including the hiatus decade 2005-2014 slightly *increases* most TCR estimates compared with those using data ending in 2004.

TCR estimates are not shown for analysis periods in which the linear trend changes in GMST (dT) or in ERF (dF) were under 0.3°C or 0.9 W/m² respectively (a ratio consistent with the mean of all the TCR estimates), as estimation is unreliable with such small changes. Nor are TCR estimates shown when the correlation between annual changes in GMST and ERF is under 0.5, which is taken to indicate excessive influence either of errors in time series estimates thereof or of internal variability.



Methods details

GMST is per HadCRUT4v4. ERF is per IPCC AR5, modified by scaling volcanic forcing by a factor of 0.5 and for aerosol forcing substituting the time series implicit in Stevens (2015) for that in AR5. Final, 2011, ERF values in AR5 have been extrapolated to 2014; forcings other than greenhouse gas and solar have been assumed unchanged. An efficacy factor of 3x has been applied to black carbon on snow forcing, in line with AR5. It is well known that volcanic forcing needs to be scaled down substantially in order for it not to distort estimation in global energy balance models (see, e.g., discussion in Lewis and Curry 2014, Climate Dynamics). Doing so increases the TCR estimate for some periods analysed and reduces it for others.

The TCR best estimate shown is 3.71 W/m² (the ERF for a doubling of atmospheric CO₂) times the average of the ratio of dT to dF, and the slope of the regression of GMST on ERF, both over the relevant estimation period. The two bases of TCR estimation are affected differently by internal variability and non-linearities in the relationship between estimates of GMST and ERF; taking their mean produces more stable TCR estimates.