Role of clouds, aerosols, and aerosol-cloud interaction in 20th century simulations with GISS ModelE2

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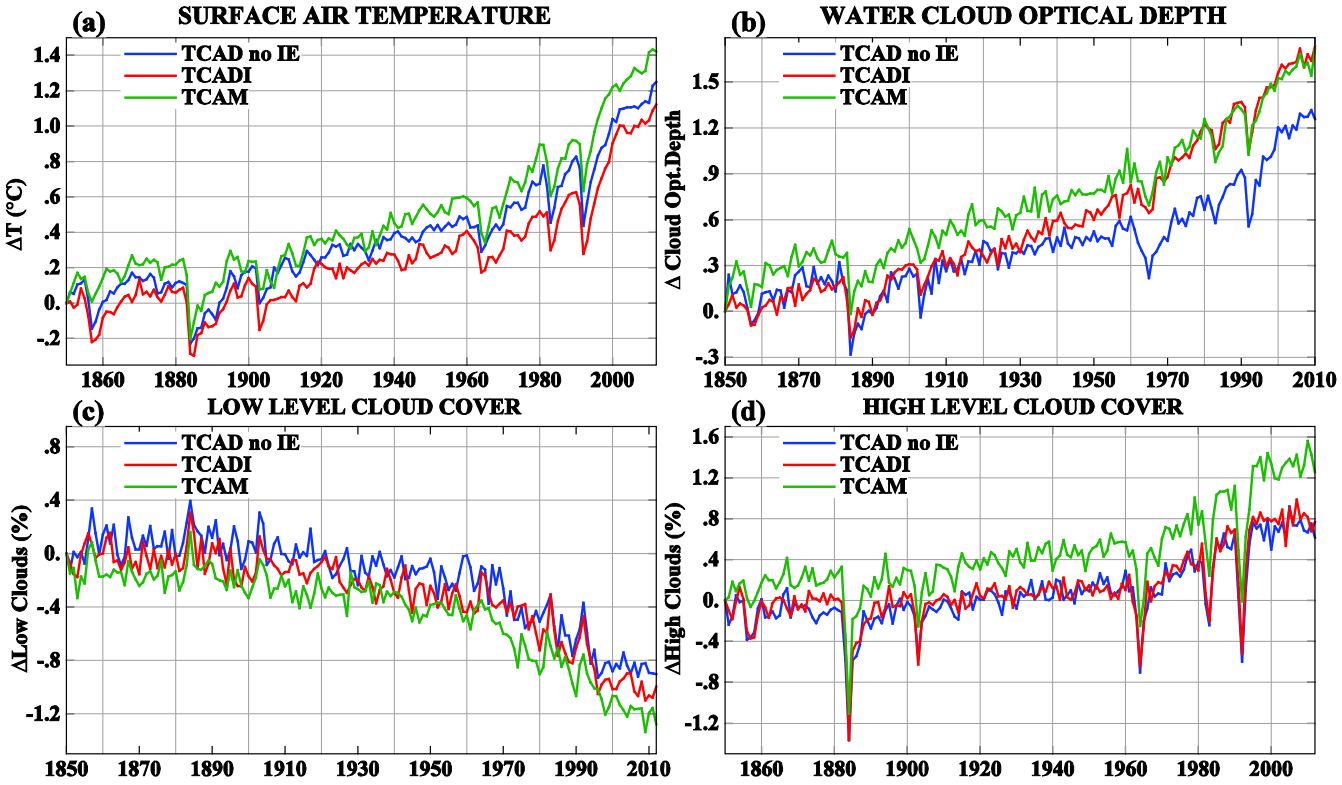
We use the new version of NASA Goddard Institute for Space Studies (GISS) climate model, modelE2 with 2º by 2.5º horizontal resolution and 40 vertical layers, with the model top at 0.1 hPa [*Schmidt et al.,* 2014].

We use two different treatments of the atmospheric composition and aerosol indirect effect: (1) TCAD(I) version has fully interactive Tracers of Aerosols and Chemistry in both the troposphere and stratosphere. This model predicts total aerosol number and mass concentrations [*Shindell et al*., 2013]; (2) TCAM is the aerosol microphysics and chemistry model based on the quadrature methods of moments [*Bauer et al.*, 2008]. Both TCADI and TCAM models include the first indirect effect of aerosols on clouds [*Menon et al*., 2010]; the TCAD model includes only the direct aerosol effect.

We consider the results of the TCAD, TCADI and TCAM models coupled to "Russell ocean model" [*Russell et al.*, 1995], E2-R.

We examine the climate response for the "historical period" that include the natural and anthropogenic forcings for 1850 to 2012. The effect of clouds, their feedbacks, as well as the aerosol-cloud interactions are assessed for the transient climate change.



Anomalies relative to 1850: (a) global annual mean surface air temperature; (b) water cloud optical depth; (c) low level cloud cover; (d) high level cloud cover .