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GCM-free, scaling quantification of natural and anthropogenic climate change: probabilities and return times for the industrial warming, postwar cooling and the "pause"

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In 1896 Arrhenius estimated that a doubling of atmospheric CO_2 concentrations would lead to a 5 - 6 K temperature increase of the global temperature. The development of Global Circulation Models (GCM's) in the 1970's has barely improved the situation, for example:
i) The 1979 NAS estimate for CO_2 doubling was a 1.5 - 4.5 K temperature increase, identical to last year's IPCC5 range.
ii) Global warming is only evaluated indirectly using models (e.g. "fingerprinting"): the data is not fully exploited.
iii) The exclusive reliance on GCM's for assessing anthropogenic warming gives ammunition to climate skeptics: one has to believe the models.
iv) The statistical hypothesis that the warming is due only to natural variability must be statistically tested. The failure to reject this hypothesis gives ammunition to climate skeptics.
GCM-free approaches are thus urgently needed; in this presentation we show how scaling notions and new data analysis techniques can be used to:
i) Quantitatively define the climate (the climate is not "what you expect": expect "macroweather"!).
ii) Quantify the natural space-time atmospheric variability over huge ranges of scale.
iii) Quantify and distinguish natural and anthropogenic variability.
Two new ideas are needed to distinguish natural and anthropogenic variability: a) use the industrial epoch CO_2 forcing as a linear surrogate for all anthropogenic forcings (they are historically highly correlated due to economic activity), b) consider all the anthropogenic forcings as deterministic and all the natural (not - as is usually done - just internal) variability as stochastic. When this is done, we estimate the total anthropogenic warming (1880-2004) and the (effective) climate sensitivity: ΔTanth = 0.87$\pm$0.11 K, λ2x,CO_2,eff = 3.08 $\pm$0.85 K. These are close the IPPC values ΔTanth = 0.74$\pm$0.18 K (1900-2005) and λ2x,CO_2 = 3$\pm$1.5 K (equilibrium climate sensitivity) and is independent of GCM models, radiative transfer calculations and emission histories. Using centennial scale probabilities of natural fluctuations estimated using scaling, fluctuation analysis on multiproxy data, we estimate that the probability of the warming being due to natural variability is $<\approx$ 0.1% (this takes into account both the long range statistical dependencies and the extreme non Gaussian "fat" probability tails). We can also estimate the return period for the post war cooling (1944-1976) of as $\approx$125 years (i.e. equal to the length of the record - it is expected!), and of the recent "pause" (1998-2012) as 20 - 40 years.