Mainstream science suggests only 0.5±0.1 K new manmade warming to 2100

Abstract: The Copenhagen Accord (UNFCCC 2009, p.5, §1) said 2 K global warming since 1750, 1.1 K above today, would cause harm. Fortunately, mainstream methods and data from IPCC's five *Assessment Reports* (AR1-5) suggest just 0.5 K anthropogenic warming by 2100, even with little mitigation, because –

a) The RCP 8.5 CO_2-growth scenario unrealistically assumes a population explosion and a switch from gas to coal;
b) AR5/CMIP5 models' estimates of the temperature-feedback sum f are well below the AR4/CMIP3 estimates;
c) Only two-thirds of equilibrium warming ΔT_∞ in response to a pulse ΔF of forcing occurs within 85 years; and
d) Anthropogenic forcing arises slowly over time, amounting to about half the forcing from a single pulse in year 1.

Introduction: (1) gives climate sensitivity ΔT to a forcing ΔF, where the Planck parameter λ_0 is 0.31 K W^{-1} m^2 and f is the temperature-feedback sum (TAR ch. 6.1; Bony+ 2006; AR4 p. 631 fn.; Roe 2009; Monckton of Brenchley+ 2015):

$$\Delta T = \Delta F \lambda_0 (1 - \lambda_0 f)^{-1}. \quad | \quad \text{Fundamental equation of climate sensitivity} \quad (1)$$

a) **The extreme RCP 8.5 scenario** unrealistically assumes population explosion to 12 bn, high energy and emissions intensities, a switch from gas to coal and an anthropogenic forcing ΔF_{85} = 5.67 W m^{-2} from 2015-2100 that is more than double the 2.75 W m^{-2} projected under the "business-almost-as-usual" RCP 6.0 scenario used here.

b) **AR5 cuts f:** Uncertainty in constraining equilibrium sensitivity $\Delta T_{2x,\infty}$ to a forcing ΔF_{2x} = 5.35 ln(2) = 3.71 W m^{-2} (Myhre+ 1998) at 2 x CO_2 arises chiefly from f, whose CMIP3/AR4 interval **1.93** [1.53, 2.35] W m^{-2} K^{-1} (Fig. 1) validates (1) by giving $\Delta T_{2x,\infty}$ on [2.2, 4.4] K: *cf.* the published [2.1, 4.4] K CMIP3 interval (AR5 p. 820, §9.7.3).

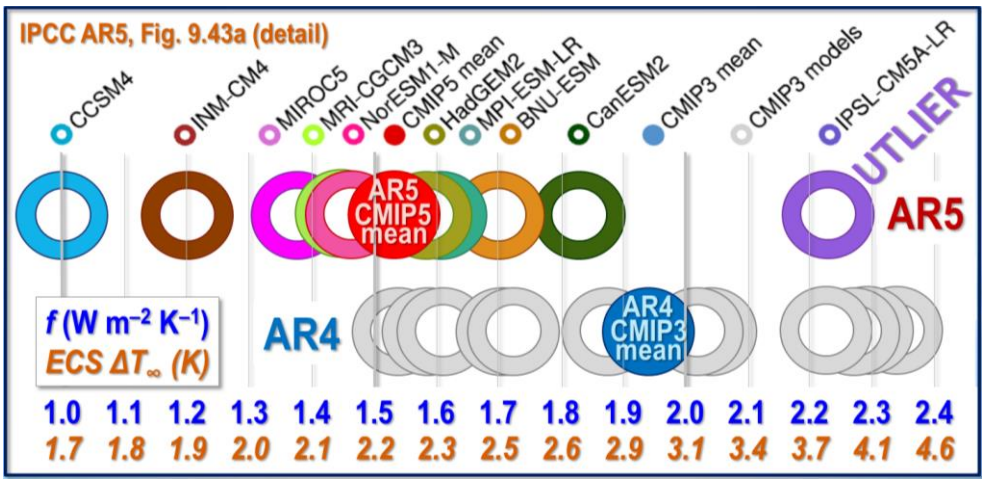
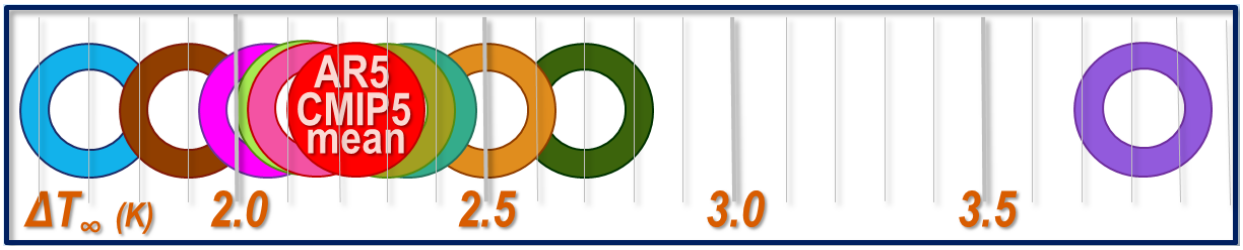


Fig. 1. Feedback sums f (Vial+ 2013 for AR5; Soden & Held 2006 for AR4). In the CMIP5 models for AR5, feedbacks are derived from 4 x CO_2 simulations.

Detail from AR5, p. 819, Fig. 9.43(a).

From values for f (in **Roman**), equilibrium sensitivities ΔT_∞ (*italic*) to 2 x CO_2 are determined using (1).

CMIP5/AR5 cut f to **1.53** [1.00, 2.23] W m^{-2} K^{-1}, implying ΔT_∞ at 2 x CO_2 on **2.2** [1.7, 3.8] K from (1). CMIP5 & AR5 intervals were **3.2** [2.1, 4.7] K (AR5 pp. 75 & 83) and [1.5, 4.5] K (AR5 p. 16) respectively. The French IPSL-CM5A-LR model is a notable outlier, as rescaling Fig. 1 for sensitivity (panel below) shows. It is reasonable to exclude it: then the high-end estimate of f is 1.83 and the mean is **1.47** W m^{-2} K^{-1}, with ΔT_∞ on **2.1** [1.7, 2.7] K.



On RCP 6.0 (Fujino+ 2006; Hijioka+ 2008), IPCC expects anthropogenic forcings ΔF_{250} = 5.15 W m^{-2} from 1750-2100, of which 2.3 W m^{-2} had arisen by 2012 and another 0.1 W m^{-2} by 2015, leaving ΔF_{85} = 2.75 W m^{-2} to come by 2100 (AR5 table AII.6.8 & fig. SPM.5), implying that, for f on **1.47** [1.00, 1.83] W m^{-2} K^{-1}, $\Delta T_{85,\infty}$ will fall on **1.6** [1.3, 2.0] K, with bounds below the RCP 6.0 21st-century warming [1.4, 3.1] K predicted at p. 20 of AR5.

c) **85-year fraction of equilibrium warming:** For f on **1.47** [1.00, 1.83] W m^{-2} K^{-1}, **64** [73, 60] % of equilibrium warming will arise by 85 years after a forcing (based on Roe 2009: Fig. 2 below), reducing ΔT_{85} to **1.0** [0.9, 1.2] K.

d) **Anthropogenic forcing arises progressively over the century,** not all in year 1, halving ΔT_{85} to **0.5** [0.4, 0.6] K.

Additional "committed" warming now seems unlikely: the central medium-term rate of warming predicted in FAR, at ~0.3 K decade^{-1} since 1990, was a near-threefold exaggeration, and, though one-third of all anthropogenic forcings have arisen since 1997, RSS and UAH satellite data show no global warming at all for approximately 18½ years (Fig. 3).

Conclusion: Mainstream climate science suggests anthropogenic warming ΔT_{85} to 2100 will be only **0.5** ± 0.1 K, Further warming may occur to 2300, but by then fossil fuels will approach exhaustion. Residual warming to equilibrium will be spread over thousands of years (Solomon+ 2009; Roe 2009), allowing plenty of time for adaptation.

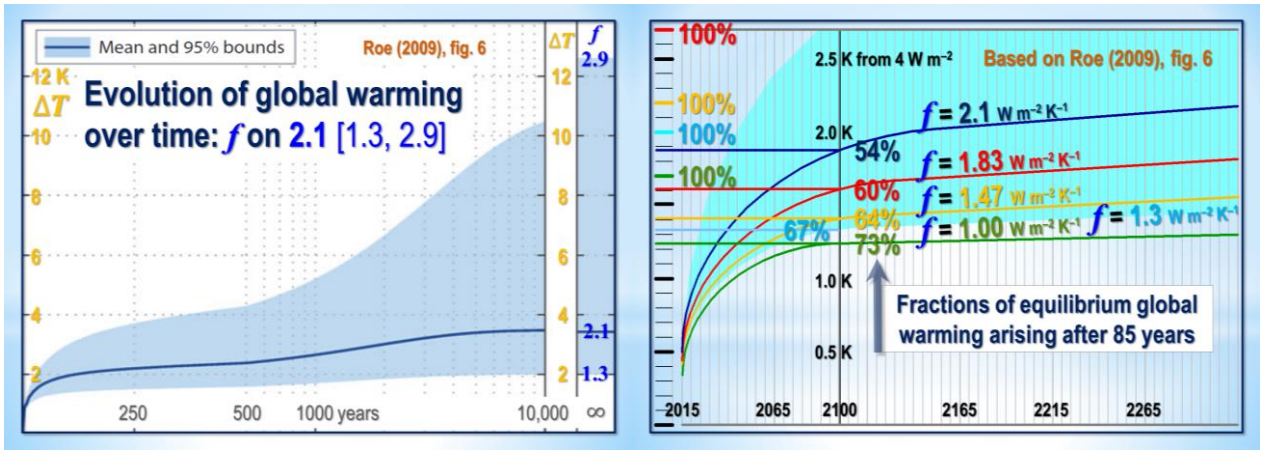


Fig. 2. Evolution of global warming over time, and fractions of equilibrium warming arising after 85 years.

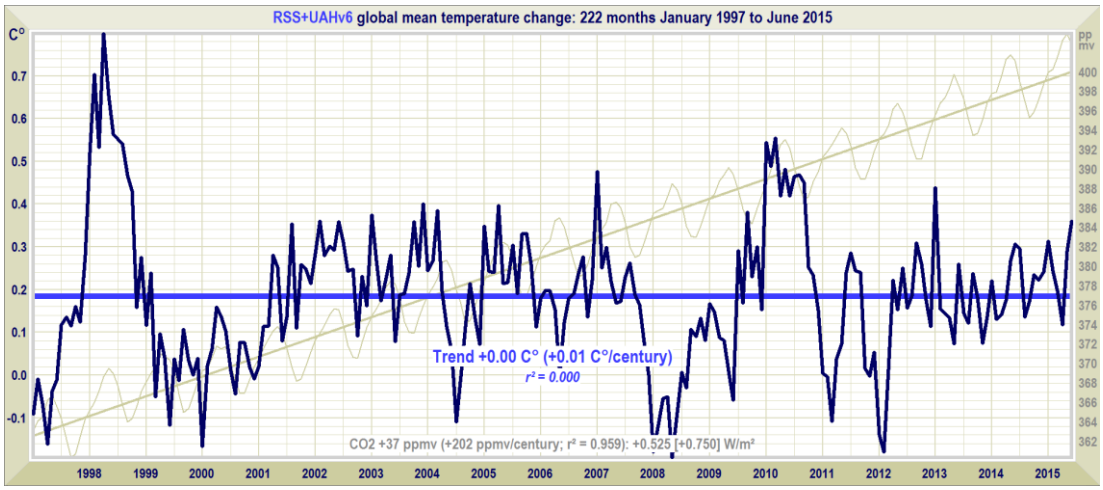


Fig. 3. NOAA CO_2 and Mean of 2 satellite lower-troposphere temperature anomalies, Jan 1997-Jun 2015.

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