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# Correction to: "Constraining climate forecasts: The role of prior assumptions"

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In the paper "Constraining climate forecasts: The role of prior assumptions" by Frame et al. (Geophysical Research Letters, 32, L09702, doi:10.1029/2004GL022241, 2005), the method used for the calculation of the likelihood functions has been found to be incorrect. The error is best illustrated with the computation of the likelihood function for climate system Effective Heat Capacity, or EHC. This is the ratio of two uncertain quantities: the amount of heat absorbed by the climate system over a given period and the surface warming over the same period. If both of these quantities are assumed to be Gaussian, we can generate a large sample and plot the likelihoods of the individual sample members as a function of their ratio, shown as the dots in the figure.

The appropriate likelihood profile is shown by the solid line, obtained by taking the maximum of the likelihoods as a function of EHC. In *Frame et al.* [2005], a sample histogram was taken instead, which gives the dashed line. This would coincide with the solid line if the distributions were Gaussian, but it is not. A similar error was made in the interpretation of the likelihood profile for attributable warming.

In addition, we also misinterpreted the reported warming over 1955–1998 in *Levitus et al.* [2005] as representing warming over the 39 year period between the centers of the first and last 5 year averaging periods. In fact, the figure pertains to warming over the full 44 year period. Correcting for this error approximately compensates for the other error in the EHC likelihood profile, yielding the dash-dotted line shown in the figure.

Correcting all these errors, the upper bound of the 5–95% range for climate sensitivity under a uniform prior increases from 11.6 to 14.5°C. Other reported upper bounds are affected by similar margins, with lower bounds unaffected. In the context of other assumptions in the study, the impact of the error is modest, but it illustrates the importance of care in distinguishing likelihoods and probabilities in a Bayesian analysis. Subsequent papers [e.g., *Allen et al.,* 2009] have used an explicit likelihood profiling approach for which this issue did not arise.

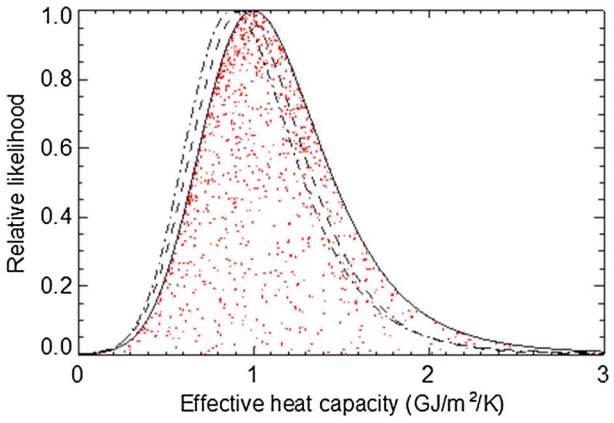


**Figure 1.** Likelihood profiles for climate system heat capacity as used in *Frame et al.* [2005]. Dots: likelihoods of a random sample of ocean heat uptake and surface warming rates, plotted as a function of their ratio. Dashed line: likelihood incorrectly calculated from a histogram of the dots, as in the original paper. Solid line: correctly calculated but still using the incorrect interpretation of dates in *Levitus et al.* [2005]. Dash-dotted line: correctly calculated and also with the correct interpretation of *Levitus et al.* [2005].

Other studies [e.g., *Domingues et al*., 2008; *Glecker et al*., 2012] have indicated much larger revisions in rates of ocean heat uptake than the differences shown in the figure, so we do not think it is necessary for papers making use of the results of *Frame et al.* [2005] [e.g., *Hegerl et al.,* 2006] to be reassessed. The central conclusion of the paper, highlighting the important role of prior assumptions in explaining the marked differences in upper bounds on climate sensitivity being reported at the time, still stands.

It is interesting that the "uniform sampling in observables" option as implemented by *Frame et al.* [2005] closely approximates the Jeffreys Prior [*Lewis*, 2013], but the arguments for and against the use of the Jeffreys Prior in climate parameter estimation should be made on their own merits, unaffected by mistakes made in the specification of a likelihood function a decade ago.

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