Pycroft, J., L. Vergano, C. Hope, D. Paci, J. C. Ciscar, "A Tale of Tails: Uncertainty and the social cost of carbon dioxide"

RESPONSE TO REFEREE 2

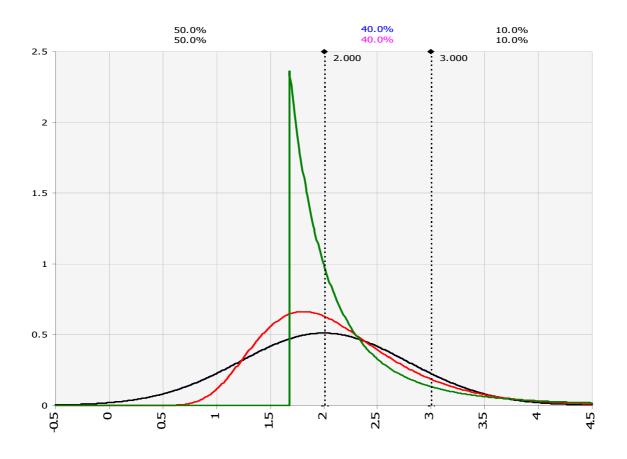
We would firstly like to thank this reviewer for his/her useful comments. We address some of the points specifically here.

Regarding the comments about the choice of probability distribution function, the following discussion should be helpful.

Taking the argument for the damage function exponent,¹ the key idea is to have 10% probability that the value is greater than 3° C,² with different tail shapes. What should be the shape of the remaining 90%?

(i) One option would be to use the PAGE09 standard, which is triangle (1.5, 2, 3). The difficulty with this option is that the probability density falls to zero at 3, then "jumps" to something positive, for the tails to then slope downwards. This seemed pretty awkward to us.

(ii) A second option would be to use the full normal / lognormal / Pareto for the entire probability distribution, sticking with the 50^{th} percentile being 2, and the 90^{th} being 3. This gives the following three distributions:

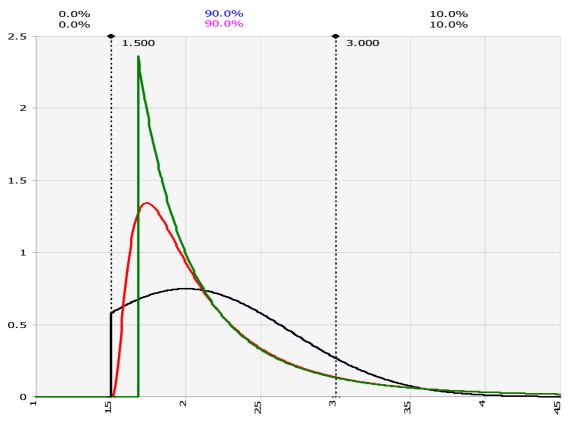


¹ The reasoning is essentially the same for the climate sensitivity parameter.

 $^{^{2}}$ As explained in the paper, we followed the Weitzman approach, by referring to the values taken into account in the cited IPCC report (2007).

As can be seen, using the same distributions for the lower 50 percentiles would lead to large variations in this part of the distribution. This is especially the case for the normal and Pareto distributions. The normal distribution is symmetrical, and so would include small and negative³ values. The Pareto has a minimum of 1.68 and has the odd shape where the lowest value is the mode.

Obviously, the distributions could be adjusted somewhat to make more sense. For example, the following:



Here the normal distribution has been truncated at the minimum value from the PAGE09 standard of 1.5.⁴ The minimum value (or location) of the lognormal has been adjusted to equal the PAGE09 minimum of 1.5. These distributions are an improvement on those in the first figure. Nevertheless, in whatever way the distributions are adjusted or truncated, there will still be wide variations for the lower half of the distribution.

We were uncomfortable with such changes for the lower half of the distribution, because our theoretical argument does not address this part of the distribution. (In fact, we expect that this part of the distribution is the best specified of all).

This led us to decide to use some of the standard PAGE09 distribution so as to keep at least the lower end of the distribution equal for each of the three runs, as well as equal to the standard model. The question then becomes how much of the standard PAGE09 distribution to use. Nothing is too little, because of the problems with (ii). The full distribution up to 3 is too much, because of the problems with (i).

³ If used, negative values would imply that the higher the temperature above the calibration value, the *lower* the damage.

⁴ Consequent adjustments are made to retain the 85th percentile at 3.

We wanted to use the proposed distributions in Weitzman (2010), which specify a common 50^{th} percentile (of 2). This is, therefore, a point where we can consistently match the three distributions. We judged this to be the best option.

In light of these considerations, we suggest explaining more clearly in the text our choices, especially focusing on why we chose not to use the normal / lognormal / Pareto for the whole pdfs. Moreover, as suggested by the reviewer, we are happy to include some further runs using the full normal / lognormal / Pareto for the whole pdfs as a robustness check.

Regarding the discount rate, we will describe the assumptions on the rate of pure time preference and the marginal utility elasticity. The question of the effect of the PTP rate on the social cost of CO2 is an interesting one, which itself merits deeper investigation. We would prefer to dedicate this paper to the analysis of distributions relating to climate sensitivity and to the damage functions.

Otherwise, we are happy to address the minor points raised in the report, and will adjust the final submission accordingly.