CORRESPONDENCE:

Open science is necessary

To the Editor — The disclosure of climate data from the Climatic Research Unit at the University of East Anglia led to an intensive examination of the scientific practices of climate change researchers. The House of Commons' report[1] strongly suggested that the scientific community change practices "to ensure greater transparency," and ended with a declaration that "the science must be irreproachable".

Unfortunately, the US government does not endorse such high standards. Much of the US government-financed research related to climate change policy is not available for public scrutiny. For example, consulting firms doing such research are not obligated to reveal the formulas they use to arrive at their policy evaluations and recommendations. This makes the kind of examination that is the norm for scientific communications impossible.

An excellent example of the value of open science arises when one examines the Interagency Working Group on Social Cost of Carbon[2]. This was a major attempt at determining the social cost of carbon, the dollar value on damages from one ton of carbon emissions, and the optimal carbon tax. DICE2007 (ref. 3) was one of three integrated assessment models used by the Working Group. Professor Nordhaus, the author of DICE, has always made public the details of his calculations. We have recently found[4] serious problems in DICE2007 (refs 5,6).

DICE2007, like most analyses involving climate change, takes the differential equations that represent the climate system and solves them with a finite difference method. However, unlike climate models where time resolution is measured in days or hours, DICE2007 uses a ten-year time step, but recognizes that such a long time step implies undesirable lags in the climate response to carbon dioxide emissions. Therefore, DICE2007 (ref. 6) uses approximations that reduce problems with lags, but introduces non-causal interactions. For example, global warming between 2025 and 2035 is increased by carbon dioxide emissions between 2035 and 2045.

Instead, we begin with the continuous-time model implied by the diffusivity parameters in DICE2007, and solve it with standard finite-difference methods consistent with physical causality[4]. In Fig. 1, the dashed line shows the DICE2007 carbon tax numbers[3,5], and the solid line represents the results from using standard numerical methods[4] with either a one-year, six-month or three-month time step. Fig. 1 shows that the DICE2007 carbon tax numbers exceed our solutions by roughly 50%.

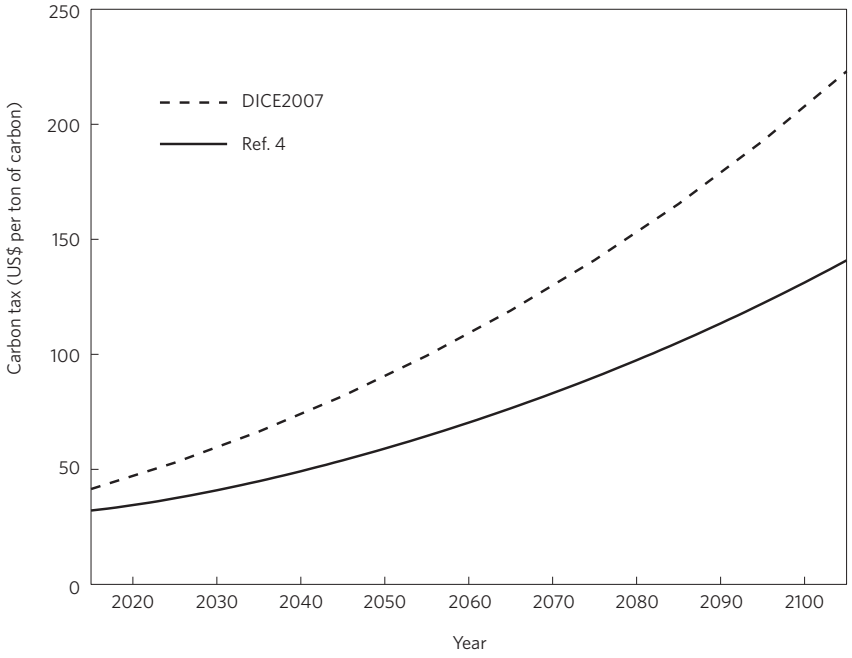

Figure 1 | Comparison of carbon tax results for different computational methods. The dashed line shows the path of optimal carbon taxes (in US$ per ton of carbon) computed in DICE2007 (ref. 6) for the DICE model with ten-year time steps. The solid line shows the path computed for the continuous-time version of DICE using finite difference methods for differential equations[4].

Without access to the details of DICE2007, the critique above would have been impossible and there could be no discussion of these issues. Professor Nordhaus is to be commended for following the principles of open science. The scientific and policy communities should insist that all follow his practices, allowing others to scrutinize the analyses. Only open and transparent research using the best mathematical and computational methods can provide the intellectual foundation for significant policies that address climate change. ❐

References
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