

Interactive comment on “The radiative forcing potential of different climate geoengineering options” by T. M. Lenton and N. E. Vaughan

Anonymous Referee #2

Received and published: 18 March 2009

This is a thought-provoking and generally well-written paper in an area of much topical interest.

From a scientific point of view, though, I find it a paper of two-halves. The discussion of longwave geoengineering options appears robust, though simplified (although I am not a carbon cycle expert). By contrast, the discussion of shortwave geoengineering options is much weaker, and I believe the paper should not be accepted without a significant improvement (by which I mean major amendments) to the methodology described in Section 2.1

Major comment

Section 2.1 presents the methodology for calculating the shortwave forcing for geoen-

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neering options. It adopts an entirely home-grown method developed by the authors and is not bedded in the decades of work developing both complex and simplified solar radiation methods and hence it is impossible to judge its quality. The statement made twice (2567, line 27 and 2568 line 11) that "this is a reasonable approximation" is entirely meaningless; all the authors are saying is that it is plausible that the approximation is correct but no attempt has been made to verify whether it is so. What makes me even more concerned is that there is no acknowledgement by the authors that they are making a number of sweeping assumptions.

I see lots of potentially difficulties in their approach. One is that the absorption in the troposphere is mostly by water vapour in the solar near-infrared, and yet most of the reflection by clouds and aerosols is in the visible part of the spectrum and hence the two mechanisms are anticorrelated. The authors' approach does not take this into account. By contrast, for vegetation changes, the high albedo lies at wavelengths where the absorption is greatest. The global-mean approach takes no heed of the fact that the forcing mechanisms have a distinct geographical variation and hence it is questionable that the global-mean insolation is appropriate. And to add to the strangeness, the arithmetic on 2566 line 26 appears incorrect and the total absorption (342-107) is 235 W/sq m and not 265 as stated. As this number is repeated on page 2567, I do not think this to be a typo. On page 2577 when the approach is applied to marine stratocumulus and yet uses, as far as I can tell, a global-mean surface albedo that is inappropriate to the oceans.

What is particularly concerning to me is that this highly simplified model appears to be the basis of the statement in the abstract (2560, line 10) that the work reveals "significant errors" in prior research (on 2589 line 15 "significant" grows into "grossly"!). I frankly do not think that such a simplified radiative transfer code can be used as the basis of such a damning assessment of other work.

I wonder why the authors have adopted such a simplified unvalidated scheme in the year 2009 – better simple schemes are used in many energy balance models,

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and even old codes, such as Lacis and Hansen (1974) do not take that much coding up and would be more reliable; and more modern codes are readily available to, at the very least, test the assumptions presented in this paper.

Minor comments

1. (2564, 6): No, radiative forcing measures the perturbation due to human and natural "interventions".
2. (2564, 13) Another "reasonably well" that could easily be quantified by reference to AR4 Chapter 2.
3. (2579, 4) "static 2-D radiative transfer model" I havent got a clue what this means; which 2 dimensions?
4. (2582, 21) "whopping" rather tabloid language
5. (2594, 7 and elsewhere) I found the discussion on the marine stratiform clouds to be rather uncritical as it assumes that only the first indirect effect operates and this doesnt mean that it is an underestimate. If cloud top entrainment is altered by, for example, changes in the cloud top cooling, then it is hard to predict the net impact on the cloud water path.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 2559, 2009.

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