Atmos. Chem. Phys. Discuss., 15, C5469–C5472, 2015
www.atmos-chem-phys-discuss.net/15/C5469/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modeling, and modern observations that 2 °C global warming is highly dangerous" *by* J. Hansen et al.

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Received and published: 30 July 2015

There is so much that we do not about the earth and this paper selects a period of time where surface temperature was greater than today. In principle finding similarities between climates of the period of time in consideration and future climates merit consideration. The model used makes a large number of assumptions and can be improved. The major two unrealistic assumptions follow:

1) Line 15, page 20062: "We suggest that this viewpoint fails to appreciate the nature

of the threat posed by ice sheet instability and sea level rise. If the ocean continues to accumulate heat and increase melting of marine-terminating ice shelves of Antarctica and Greenland, a point will be reached at which it is impossible to avoid large scale ice sheet disintegration with sea level rise of at least several meters."

Clearly the model assumes that heat transfer between ocean and ice is the cause of ice melting. This is incorrect and it is a major flaw in the model. Surface temperature rise is of the order of 0.000001 °K per hour. Any heat transfer handbook will reveal that the heat transfer coefficient between ocean and ice for this infinitesimal temperature rise is about zero J hr-1 m-2 °K-1. The only way the observed ice melting and the resulting sea level rise can be explained is by heat transfer coefficient of the order of 2.0 x 10 E+6 J hr-1 m-2 °K-1. Only water vapor condensation can provide such a high heat transfer coefficient. Therefore, glaciers melting due to direct contact with sea water cannot be a major factor, and the model requires improvement for credibility and alignment with heat transfer processes.

2) Lines 23, page 20081 through line 6 page 20082: "GHGs alone (scenario A1B) slow AMOC by the early 21st century (Fig. 12), but variability among individual runs (Fig. S9) would make definitive detection difficult at 25 present. Freshwater injected onto the North Atlantic or in both hemispheres shuts down the AMOC (Fig. 12, right side). GHG amounts are fixed after 2100 and ice melt is zero, but after two centuries of stable climate forcing the AMOC has not recovered to its earlier state. This slow recovery was found in the earliest simulations by Manabe and Stouffer (1994) and Rahmstorf (1995, 1996). Freshwater injection already has a large impact when ice melt is a fraction of 1 m of sea level. By the time sea level rise reaches 59 cm (2065 in the present scenarios), 5 when fresh water flux is 0.48 Sv, the impact on AMOC is already large, consistent with the substantial surface cooling in the North Atlantic (Fig. 9)."

The model assumes that the thermohaline circulation is driven at surface and its flow rate is sensitive to fresh water injection in the hemispheres. It further assumes that water injection would lead to circulation shutdown.

This thermohaline circulation model is prematurely proposed for the real driver of the thermohaline circulation is not known yet; it is an active research subject. The Authors thus makes a highly speculative assumption that the thermohaline circulation is driven at surface and water injection would shut down the circulation. How do surface events of fresh water injection at surface increase or decrease the rate of the thermohaline circulation that is over three kilometers below the surface? What is the physical explanation and how is the driving force of the circulation altered by water injection rate? What is the nature of energy variation resulting from water injection that changes the flow of the thermohaline circulation? Unless the Authors address these issues, the model would be creating/destroying energy in violation of the laws of thermodynamics. This will certainly diminish the value of the publication and potentially make it obsolete.

Other comment, Line 26, page 20062: "Accurately known changes of Earth's astronomical configuration altered the seasonal and geographical distribution of incoming radiation during the Eemian. Resulting global warming was due to feedbacks that amplified the orbital forcing. While the Eemian is not an analog of future warming, it is useful for investigating climate feedbacks, the response of polar ice sheets to polar warming, and the interplay between ocean circulation and ice sheet melt."

The relationship between feedback and orbital forcing is clearly an important equation for the submitted work, yet it is not explained. This relationship should be presented in the manuscript for reader's examination to add credibility to the paper. The climate model used is an improved version in that it simulates the atmosphere through the mesopause. Finding a correlation between mesopause temperature and orbital eccentricity should not be a difficult task. Once this relationship is determined, orbital forcing at surface can be reasonably obtained. As a guideline, please see Anthropogenic and Natural Forcings as Functions of Emission time, Development in Earth Science (DES) Volume3, 2015, www.seipub.org/des, doi: 10.14355/des.2015.03.001

Uncertainty is inherent to climate models, IPCC, Section 9.2.3 of Chapter 9 of the IPCC Fifth Assessment Report (AR5). There is a concern of how the climate exper-

iment would be representative given the large amount of time between the period in consideration, about 130,000 years before present, and today. What is the magnitude of the calculated forcing and its error at surface?

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 20059, 2015.