

Response to SC C6867: ‘Collaborative Comment on Hansen manuscript: on projections of sea-level rise and changing storm tracks’, Jason Williams, 15 Sep 2015

“The climate model used possesses large biases...” Indeed, we present evidence that our model and most models possess biases. Unfortunately the biases are such as to make the ocean too diffusive and less sensitive than the real world to freshwater forcing. They also pressure the model to have a too low climate sensitivity, as we discuss in the mini-paper that we wrote in response to SC C6361 (‘Predictions Implicit in “Ice Melt” Paper and Global Implications’ written by James Hansen and Makiko Sato), which is also available at [http://www.columbia.edu/~jeh1/mailings/2015/20151012\\_IceMeltPredictions.pdf](http://www.columbia.edu/~jeh1/mailings/2015/20151012_IceMeltPredictions.pdf).

Timing issues – see below

Eemian cannot be compared to the future. Did we do that? We used the Eemian to learn things about how the climate system operates; we did not say the future would look like the Eemian.

Extreme events are much more likely to occur after 2100 – therefore we recommend to avoid terminology such as “dangerous”. Hmm, yes, I guess that we should not be concerned about anything that happens 85 years from now – the dickens with those characters. The Dutch can migrate to Switzerland, after all.

Explanation of mid-Eemian sea level minimum is not sound? You admit that a late Eemian sea level rise due to rapid ice melt from Antarctica is plausible. Would not the sea level have been less right before the sudden rise due to Antarctic water? Late Eemian maximum was probably at a time ~118-119 ky BP based on U-series dating, e.g., see the several sentences below from our paper. However, why are you concerned about whether there was a sea level minimum before the late Eemian sea level rise? That is seeming to lose sight of the forest for the trees. The relevant point is that there was a late Eemian sea level rise of at least a few meters.

Regardless, here are the sentences:

W. Thompson et al. (2011) reexamined Eemian coral reef data from the Bahamas with a method that corrected uranium-thorium ages for diagenetic disturbances. They confirmed a mid-Eemian sea level minimum, putting sea level at +4 m at 123 ky b2k, at +6 m at 119 ky b2k, and at 0 m at some time in between, again noting that coral reefs only record minimum sea level.

Despite general consistency among these studies, considerable uncertainty remains about details of Eemian sea level change. Sources of uncertainty include post-depositional effects of GIA and local tectonics. Global models of GIA of Earth’s crust to loading and unloading of ice sheets are used increasingly to improve assessments of past sea level change. Although GIA models contain uncertain parameters, they provide a useful indication of possible displacement of geological sea level indicators. O’Leary et al. (2013) provide a new perspective on Eemian sea level change using over 100 well-dated U-series coral reefs at 28 sites along the 1400 km west coast of Australia and incorporating GIA corrections on regional sea level. In agreement with Hearty et al. (2007), their analyses suggest that sea level was relatively stable at 3-4 m in most of the Eemian, followed by a rapid (<1000 yr) late-Eemian sea level rise to about +9 m. U-series dating of the corals has the sea level rise begin at 119 ky b2k and peak sea level at  $118.1 \pm 1.4$  ky b2k.