Comment on "Earth's Energy Imbalance: Confirmation and Implications" by Hansen et al. 2005 Science Express. June 14, 2005

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The article by Hansen et al. (2005) correctly recognizes that ocean heat storage changes can be used to accurately assess the Earth's radiative imbalance. This usage was discussed in Pielke (2003).

There are substantive overlooked science issues, however, and an arbitrary selection of the largest value of the heat flux to highlight their conclusions. Their report of a global 0.85 +/- 0.15 Watts per meter radiative imbalance is substantially larger than the interpretation presented in Willis et al. (2004). Willis et al. list a value of about 0.93×10^{23} Joules of accumulated ocean heat over a period of 10 years. This corresponds to a global radiative imbalance of 0.62 Watts per meter squared, which is essentially what Hansen et al also obtained for the period between 1993 and mid 2003.

Hansen et al. restricted the analysis to a comparison of the model imbalance vs. the ocean uptake accumulated over the most recent decade, which seemed to show agreement (their Fig. 2). We have calculated the same quantities for all 10-year periods (1970-79 through 1994-2003, 25 cases). In all cases, the model average indicated 10-year positive accumulated forcing, ranging from about +1 to +6 W-yr/m^2, while the observations indicated a loss in ocean heat content 8 times (-1.5 to –4.2 W-yr/m^2) and 4 more with near zero change in heat content. Thus, a more thorough comparison between 10-year segments of the accumulated model imbalance and the ocean heat content changes suggest model deficiencies in forcing.

An examination of first order climate forcings, as reported in NRC (2005) shows that important ones are neglected in the Hansen et al. study (e.g., the biogeochemical effect of increased CO_2 ; the thermodynamic indirect aerosol effect). To use a value of -0.77 Watts per meter squared for the selected climate forcing for the indirect aerosol effect in the Hansen et al. paper is not justified at this precision and seems to be used to fit the model to the observations. By fitting the models in this manner, the role of other first order climate forcings could be incorrectly missed.

There is, in addition, a significant disconnect in the Hansen et al. contribution with respect to the Willis et al. report (even though Willis is a co-author of the Hansen et al paper). Willis et al. state that

"Maps of yearly heat content anomaly show patterns of warming commensurate with ENSO variability in the tropics, but also show that a large part of the trend in global, oceanic heat content is caused by regional warming at midlatitudes in the Southern Hemisphere."

This heating is

"...centered on 40°S is spread more uniformly over the water column and warms steadily throughout the entire time series..."

They further find that, with respect to the current rate of warming

"....the warming rate in the early 1970s is comparable to the present rate.....With the present time series, it is therefore not possible to identify whether the recent increase in ocean warming is due to an acceleration of heat uptake by the ocean or is simply decadal variability."

These caveats with respect to the Hansen et al. study are overlooked. Indeed, in contrast to the Willis et al. conclusions, Hansen et al. states that

"Yet the model runs contain essential features of observations, with deep penetration of heat anomalies at middle to high latitudes and shallower anomalies in the tropics."

This statement is in clear contradiction to the Willis et al. (2004) paper of where the ocean heat changes occurred.

Therefore, while we agree on the value of using ocean heat storage changes to assess the Earth's radiative imbalance, the Hansen et al. study omits addressing important scientific issues which are essential in order to permit more confidence in the accuracy of the model simulations of the Earth's climate system.

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