Using the Oceans to Quantify Solar Forcing

By: Ken Gregory, March 2009

An important paper by Nir J. Shaviv, of the Racah Institute of Physics, Hebrew University of Jerusalem, Israel, shows that the solar forcing associated with the eleven year solar cycle is about seven times larger than that caused by the total solar irradiance (TSI) variations. TSI refers to the total amount of radiation energy received from the Sun.

Small changes in the TSI are not enough to significantly affect Earth's climate and the IPCC has repeatedly dismissed solar forcing for these reasons. However, hundreds of studies show strong correlations between the solar changes and global temperatures.

The solar constant of 1366 W/m^2 varies by about 1 W/m^2, which results in a solar forcing of about 0.17 W/m^2 over the Earth's surface net of the reflected component.

The paper uses three independent records to estimate the heat flux into the oceans:

1. Ocean heat content (OHC)
2. Sea level rise changes from tide gauges (SLR)
3. Sea surface temperature (SST)

These three records vary with the solar cycle and show that there *must* be an amplification mechanism of the solar irradiance to explain the large heat flux associated with the oceans.

The heat flux into and out of the oceans as determined by the three records expressed as a ratio of the TSI change (of about 1 W/m^2) is:

1. Heat flux per TSI from OHC = 1.2 +/- 0.3 (21)
2. Heat flux per TSI from SLR = 1.68 +/- 0.6 (18)
3. Heat flux per TSI from SST = 1.15 +/- 0.35 (19)

The numbers in brackets correspond to the equation numbers in the paper. The author considers the heat flux calculated from the ocean heat content data to be the most accurate. The heat flux going into and out of the oceans over the solar cycles is about seven times that expected from the TSI forcing alone, therefore there must be a seven fold amplification of the TSI. The Sun affects climate through a mechanism other than just TSI variations.

Niv Shaviv favors the solar-wind cosmic ray theory promoted by Svenmark. In this theory, changes of solar wind change the galactic cosmic ray flux entering the atmosphere. Cosmic rays act to seed clouds which reflect solar radiation.

Cloud plus TSI forcing per change TSI = 1.3 +/- 0.4 (23)
Where the TSI forcing is 0.17 W/m^2

The heat flux going into the oceans is consistent with the low-altitude cloud variations. The Sun-cosmic ray-climate link predicts the correct radiation imbalance observed in the ocean heat flux variations.

There was no time lag between the solar cycle and the measured heat flux. Any atmosphere feedback into the oceans would result in a time lag, which is not observed.

Nir Shaviv concludes, “The sheer size of the heat flux, and the lack of any phase lag between the flux and the driving force further implies that it cannot be part of an atmospheric feedback and very unlikely to be part of a coupled atmosphere-ocean oscillation mode. It must therefore be the manifestation of real variations in the global radiative forcing.”

The climate sensitivity of increasing CO_2 concentrations used in climate models are scaled to explain the 20th century warming, assuming that the Sun has an insignificant effect on climate. This procedure results in very high sensitivity to CO_2. This paper shows that most of the warming is due to the Sun. The effect of CO_2 on climate is therefore much less than that used in climate models.

The technical paper titled “Using the oceans as a calorimeter to quantify the solar radiative forcing” was published by the Journal of Geophysical Research, Volume 113, November 4, 2008, and is **here**.

Appendix

The equations presented in the paper without error estimates are summarized below:

Net Heat flux per change TSI from OHC = 1.05 (17)

Total Heat flux per change TSI for OHC = 1.2 (21)

Net Heat flux per SLR = 0.29 W/m2/(mm/yr) (16)

Linear regression of SLR and TSI gives 5.8 mm/yr/(W/m2)

Combining with (16) gives

Net Heat flux per change TSI from SLR = 1.68 (18) [Equ. mislabeled SST in the paper]

Total Heat flux per SST = 13 W/m2/C (13)

Linear regression of SST and TSI gives 0.09 C/(W/m2)

Combining with (13) gives

Total Heat flux per change TSI from SST = 1.15 (19) [Equ. mislabeled SLR in the paper]