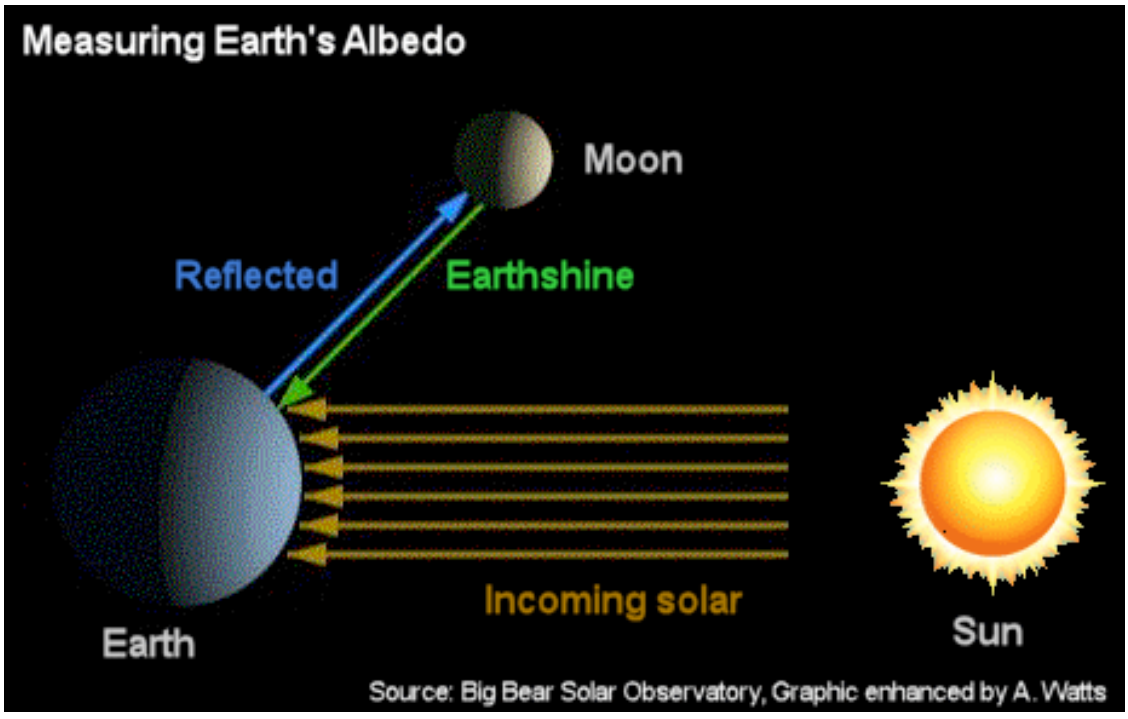
From: Albert Jacobs <afjacobs@telusplanet.net>
Subject: **Fwd: The Hockey stick and the meaning of global temperature**
Date: October 20, 2007 10:01:23 AM MDT (CA)
To: Albert Jacobs <afjacobs@telusplanet.net>

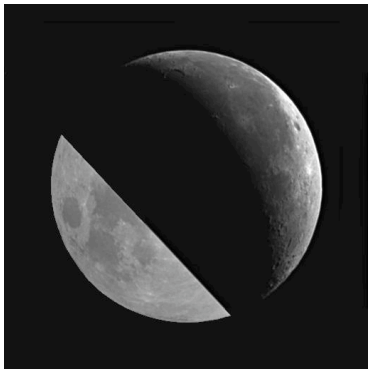
Earth's Albedo Tells an Interesting Story

17 10 2007

Thanks to one of our commenters (thanks Henry), this unique project called "Earthshine" being done at the Big Bear Solar Observatory has been brought to my attention. The project is simple in concept:

> The Earth's climate depends on the net sunlight deposited on the globe, which is critically sensitive to the Earth's albedo. A global and absolutely calibrated albedo can be determined by measuring the amount of sunlight reflected from the Earth and, in turn, back to the Earth from the dark portion of the face of the Moon (the `earthshine' or `ashen light').

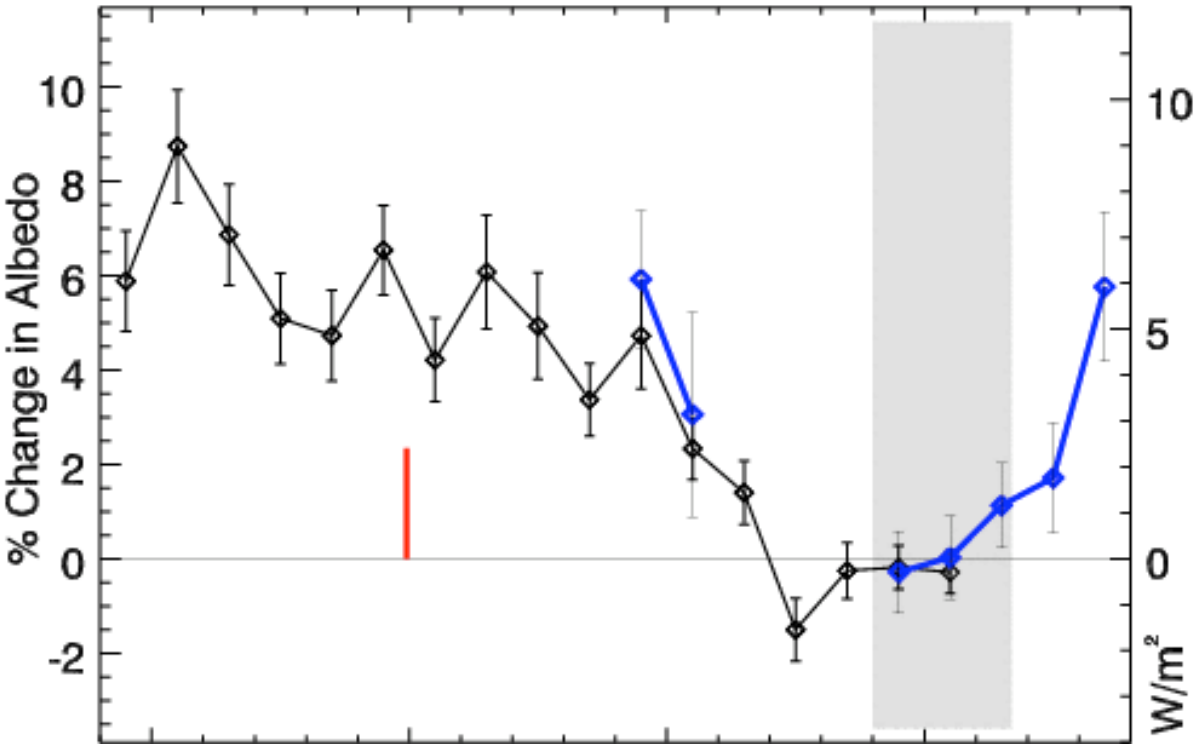


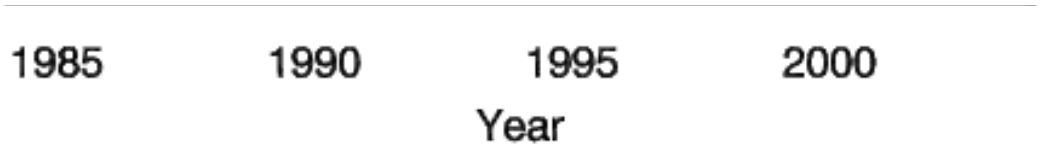


What earthshine looks like on the moon, using photo enhancement on the lower left. BBSO uses a blocking filter to dim the moonshine crescent, typically about 10,000 times brighter than the earthshine.

In simple terms, the lower the albedo of the Earth, the greater amount of solar radiation it will absorb. The greater the albedo, the more solar radiation is reflected. This of course affects earthly temperatures.

The Earthsine project is producing some very interesting results. Notably, that the Earth's Albedo has risen in the past few years, and by doing reconstructions of the past albedo, it appears that there was a significant reduction in Earth's albedo leading up to a lull in 1997. 1998 has been touted as one of the warmest years on record, and the time lag may have had to do with the thermal inertia of the oceans. Then the albedo increased, making the earth more reflective. Clouds have the greatest potential for changing albedo on a short time scale.





Reconstructed annual reflectance anomalies, Δp^* (black) with respect to the mean anomaly for the regression calibration period, 1999-2001 (gray band). The large error bars result from the seasonal variability of the Earth's albedo, which can be 15-20%. Also plotted (blue) are the ES-observed annual anomalies for 1999-2003 and 1994-1995. The right-hand vertical scale shows the deficit in global SW forcing relative to 1999-2001. The red solid bar represents the accumulated forcing (in W / m^2) attributed to the greenhouse gases concentration increase over the last 100 years, from the International Panel for Climate Change (2001).
Image credit: Earthshine Project, BBSO.

The most interesting thing here is that the albedo forcings, in watts/sq meter seem to be fairly large. Larger than that of all manmade greenhouse gases combined:

- Carbon dioxide: 1.5 Watts per square meter.
- Methane: 0.5 Watts per square meter.
- Nitrous oxide: 0.2 Watts per square meter.
- Halocarbons: 0.2 Watts per square meter.
- Total from all greenhouse gases: 2.4 Watts per square meter.

This rapidly changing albedo lends some credence to Svensmark's theory of Earth's cloud cover being modulated by Galactic Cosmic Rays, but it could also be caused by other factors such as aerosols.

Whatever the cause for the rapid change in albedo, it seems to have quite an effect of earth's radiation budget. The California Instttute of Technology made a press release in 2004 that summed up the project fairly well:

By using a combination of earthshine observations and satellite data on cloud cover, the earthshine team has determined the following:

= Earth's average albedo is not constant from one year to the next; it also changes over decadal timescales. The computer models currently used to study the climate system do not show such large decadal-scale variability of the albedo.

= The annual average albedo declined very gradually from 1985 to 1995, and then declined sharply in 1995 and 1996. These observed declines are broadly consistent with previously known satellite measures of cloud amount.

= The low albedo during 1997-2001 increased solar heating of the globe at a rate more than twice that expected from a doubling of atmospheric carbon dioxide. This "dimming" of Earth, as it would be seen from space, is perhaps connected with the recent accelerated increase in mean global surface temperatures.

= 2001-2003 saw a reversal of the albedo to pre-1995 values; this "brightening" of the

Earth is most likely attributable to the effect of increased cloud cover and thickness.

These large variations, which are comparable to those in the earth’s infrared (heat) radiation observed in the tropics by satellites, comprise a large influence on Earth’s radiation budget.