The Earthshine Network: an update 1998–2013

Earthshine Project
A research group on climate change and astrophysics

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Abstract

Earth's global albedo, or reflectance, is a critical component of the climate. This parameter, together with the solar constant, determines the amount of incoming radiation reaching Earth. Probably because of the lack of reliable data (there is not a long-term global albedo database), the Earth's albedo has been traditionally considered to be roughly constant, or studied just theoretically. Recently, however, several studies have shown a large decadal variability in the Earth's reflectance. Variations in the terrestrial reflectance have been found to derive primarily from changes in the amount of cloud cover, and thickness and distribution of clouds, all of which seem to have changed over decade time scales.

The main goal of the Earthshine Project is to provide a global albedo measurement, which can be calculated by determining the amount of sunlight reflected from Earth and retroflected back to Earth from the dark side Moon (the "earthshine" or "ashen light").

The Earthshine Network

We have been measuring the Earth's large-scale reflectance from Big Bear Solar Observatory (BBSO) for over fifteen years. The precision of the Earth's albedo determination by means of the earthshine strongly depends on the number of nights for which we have data. In this sense, increasing the number of earthshine stations strategically distributed in longitude significantly increases the precision of the mesurement. Therefore, to get better time and spatial coverage of the Earth, we have built the world's first global earthshine network. At present time, the amount of sunlight incident on Earth and retroflected by it is measured photometrically every night from three Earthshine Telescopes (EST), at BBSO, Crimean Astrophysical Observatory and Teide Onservatory.

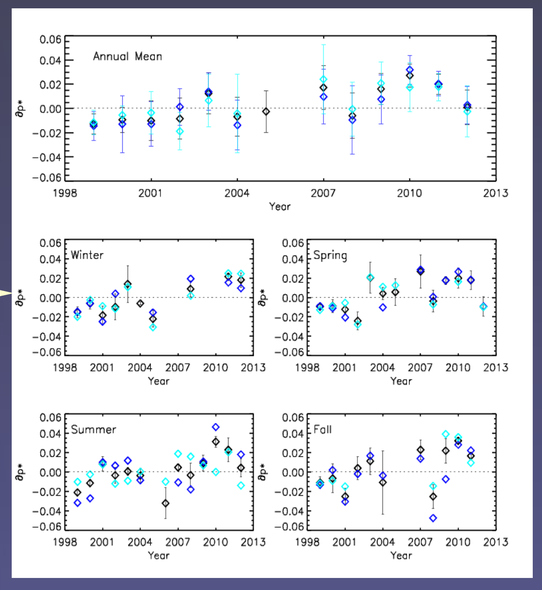
Global distribution of the earthshine network:

Big Bear Solar Observatory (USA) 1998-present: the first station of the project.

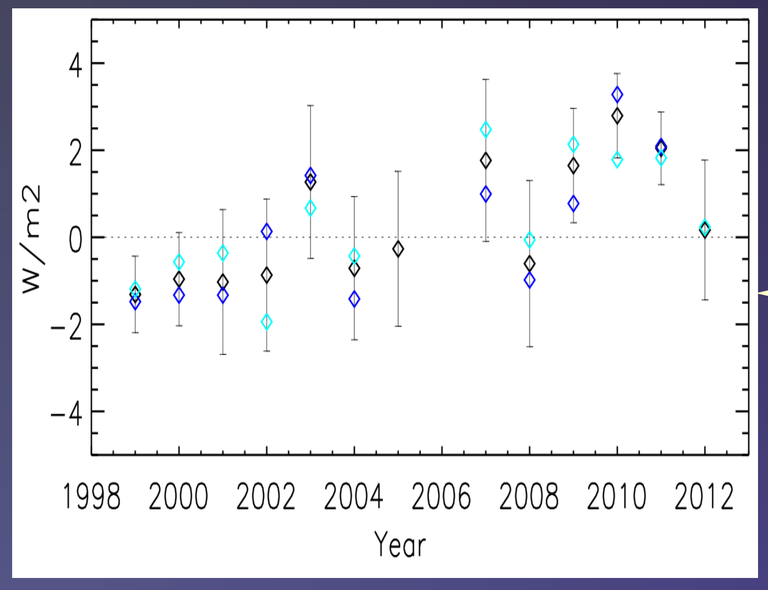
Crimean Astrophysical Observatory (Ukraine) 2003-present: a calibrated telescope that requires an observe. The CrAO provides us an intermittent ongoing esrthshine data.

Teide Observatory (Tenerife, Spain) 2010-present: a carefully calibrated replica of the BBSO unit, which operates on remote mode.

The Earth's Albedo

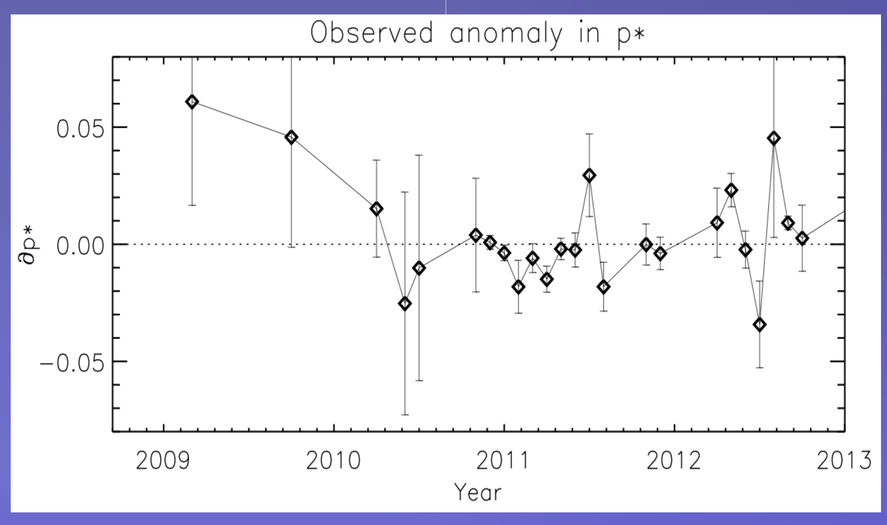


Mean annual and seasonal albedo trends 1998-2013 recorded with our earthshine telescope at Big Bear Solar Observatory (California). Black points represent the average of all data, while dark blue and cyan points represent the data taking only positive or negative lunar phase observations, respectively. Positive an Negative lunar phases sample two independent portions of the globe. All the data subsets point toward an increase in the Earth's albedo over this period.



Radiative forcing at the top of the atmosphere derived from our earthshine observations. Over the period 1998-2013 a global radiative forcing decrease of about 3 W/m^2 is detected.

Earth's albedo measurements from Izaña station, Tenerife, 2010-2013. Note that during 2010 our measurements are few and with large error bars due to bad performance of the instrumentation. From 2011 onward data are being collected on regular bases, although the serie is still too short to study any long-term tendencies.



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http://www.iac.es/proyecto/earthshine