

Project Details

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Project Title:

Earthshine: Measurements and Simulations of the Earth's Reflectance

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Project Member(s):

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Summary:

It is important to know the Sun's role in the apparent on-going global change in the Earth's climate. In this effort, one needs precise, globally integrated measures of relevant quantities extending over many years. To that end, we propose to continue observations, both photometrically and spectrally, and interpretation of the earthshine, which is sunlight reflected from the Earth and then retro-reflected from the Moon back to the earth. Proposed Scientific Objectives in the Earthshine Project: 1) We propose to continue our photometric observations of the earthshine from Big Bear Solar Observatory (BBSO), while expanding these observations to a global network. These data are critical in our efforts to determine the relationship between a varying terrestrial albedo and a variable Sun. For this, we need a precise determination of the reflection of the Earth in all directions, the Bond albedo. From a single site, we can reliably determine the Bond albedo as an annual average. The global network is essential here because our modeling has convinced us that we can determine precise monthly averages with it. Monthly averages enable us to make more precise comparisons with climate parameters and various measures of solar activity from sunspot number to galactic cosmic ray flux at the Earth. 2) We propose to improve our simulations to include more sophisticated models of the terrestrial scenes, while including more parameters for the cloud cover by using data from the International Satellite Cloud Climatology Project (ISCCP). An improved treatment of the clouds is required to improve our simulations. 3) We propose to sharpen and exploit the connection of the earthshine observations to cloud cover data from ISCCP, which will significantly improve our understanding of cloud cover data and aid our efforts to determine the connection between the solar output and the net sunlight reaching us on Earth (solar irradiance plus any indirect effects of irradiance and/or solar magnetism on the Earth's reflectance). The ultimate goal is to learn the origin of the terrestrial signature of the solar cycle, and the usefulness of the sunspot number as a proxy for the net sunlight reaching Earth. 4) Finally, we propose to perform and interpret spectral observations of the earthshine in the visible and near infrared to study the variation of the atmosphere's greenhouse gas (water, carbon dioxide, methane, ?) content to understand the physical origin of the Earth's radiation budget variability. Here we also will probe the wavelength dependence of the Earth's albedo. In the near infrared where some greenhouse gasses have a strong signature, we propose to compare our observations with modelled spectra to reveal essential information about the abundance of greenhouse species in the atmosphere, providing temperatures, optical path lengths and column densities for each of them. These parameters are otherwise difficult to determine as a global average, in particular for water vapor, which is not a well-mixed gas. Further, we propose to monitor changes in the abundances of those species and the radiative properties of the atmosphere. These Earth-as-a-star observations can also provide complementary information to future NASA missions searching for extra-solar planets. In "Astrophysics in 2001" by Trimble and Aschwanden (2002), the authors remarked about our earthshine observations saying that this "type of lunar-geo-solar observations is one of the rare interdisciplinary examples that naturally fulfills all requirements for NASA funding, for originality of astronomical research to direct benefits for humankind".

Publication References:

Summary: "

Reference: Philip Goode / New Jersey Institute of Technology - Earthshine: Measurements and Simulations of the Earth's Reflectance

Summary: no summary

Reference:

Pallé, E.; Montañés Rodríguez, P.; Goode, P. R.; Qiu, J.; Yurchyshyn, V.; Hickey, J.; Chu, M.-C.; Kolbe, E.; Brown, C. T.; Koonin, S. E.; (2004), The Earthshine Project: update on photometric and spectroscopic measurements, *Advances in Space Research*, Volume 34, Issue 2, p. 288-292, doi: 10.1016/j.asr.2003.01.027

Summary: no summary

Reference: Pallé, E.; Goode, P. R.; Montañés-Rodríguez, P.; Koonin, S. E.; Rumyantsev, V.; (2005), Toward a global earthshine network: First results from two stations, *Geophysical Research Letters*, Volume 32, Issue 11, CiteID L11803, doi: 10.1029/2005GL022575