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A new way to Estimate the Earth's Radiation Budget at the top-of-atmosphere

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The Earth's Radiation Budget at the top-of-atmosphere (TOA) is investigated by combining remote sensing data from different Earth observing satellites and the solar radiation monitoring from dedicated missions. Despite the relatively high precision of each individual instruments, the uncertainties in the current net radiation derived at the TOA is still too large to track small energy imbalance associated with forced climate change. A new method to estimate the net energy balance at the TOA is introduced based on nearly three years space experiments from the Bolometric Oscillation Sensor (BOS) onboard PICARD satellite.

PICARD satellite is circling the Earth on a heliocentric orbit, the descending and the ascending nodes of the PICARD are around 6 a.m. and 6 p.m. local time, respectively. The BOS sensor onboard PICARD satellite is sensitive to the radiation coming from both the sun and the Earth. Besides solar shortwave electromagnetic radiation, the black-coated BOS sensor measures also the reflected (visible) and reemitted (infrared) terrestrial radiation.

The net radiation of the Earth is described as:

$$f_{net} = f_{in} - (f_{vis} + f_{ir}) \tag{1}$$

Where f_{net}, the net radiation of the Earth at the TOA, f_{in}, the incoming solar irradiance, f_{vis}, the reflected solar radiation at the TOA, f_{ir} infrared radiation of the Earth.

The energy absorbed by the main detector of the BOS can be approximately written as:

$$f_{bos} = f_{sun} + (f_{vis} + f_{ir}) \tag{2}$$

Where f_{bos}, the measurements of the BOS instruments, f_{vis}, the reflected solar radiation at the TOA, f_{ir} infrared radiation of the Earth. Frome equation (1) and (2), we can found a new method to estimate the net radiation:

$$f_{net} = f_{sun} + f_{in} - f_{bos} \tag{3}$$

BOS/PICARD experiment allows us to employ this new approach to study the Earth's Radiation Budget from a single remote sensing instrument. Here we discuss the BOS data between July 2010 and October 2013 and their implication on Earth's Radiation Budget estimate.