

http://www.eohandbook.com/eohb2012/sat_earth_obs_earth_rad_budget.html

Earth Radiation Budget Radiometers

Description

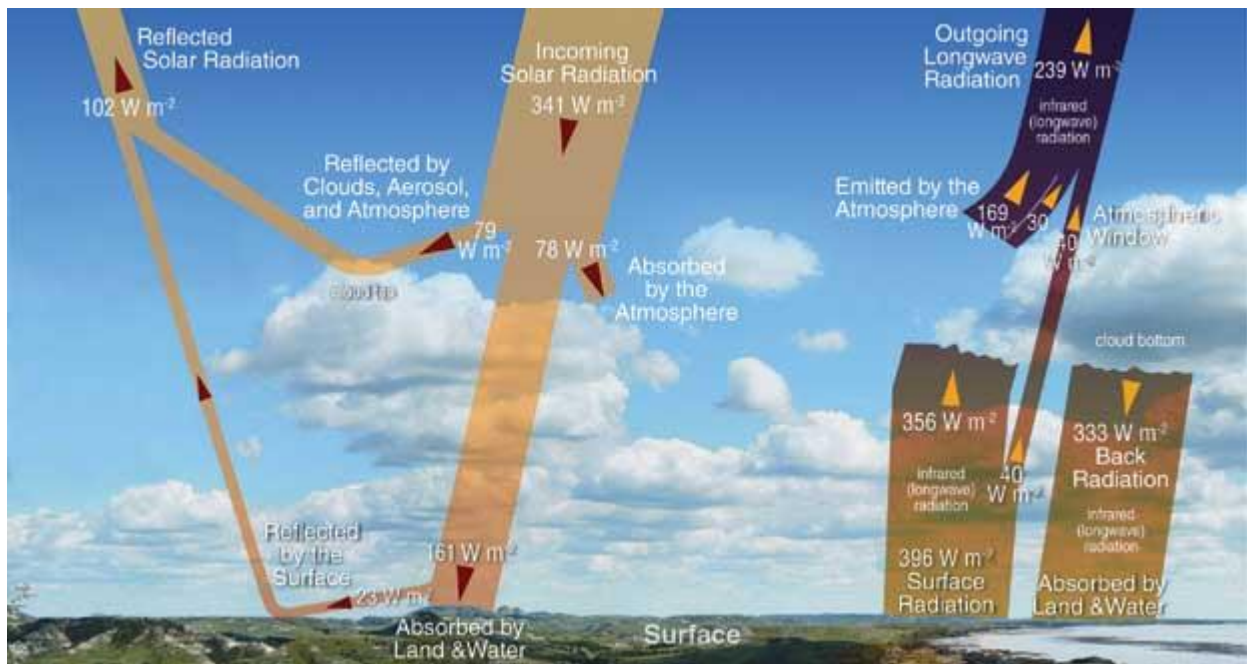
The Earth's radiation budget is the balance between the incoming radiation from the Sun and the outgoing reflected and scattered solar radiation plus the thermal infrared emission to space. A number of instruments contribute to measurements of these parameters. The discussion here focuses on those instruments specifically designed to study radiation budget as their sole or primary mission.

In general, different instruments are used to measure the different components of the radiation budget:

- to cover the full range of incoming solar radiation (0.2 – 4.0 μm);
- to monitor the long-wave emitted Earth radiation (3 – 100 μm);
- to measure the reflected short-wave radiation from the Earth.

The instruments offer high radiometric accuracy to provide accurate absolute measurements ($\sim 1 \text{ W/m}^2$ is needed). Most radiometers have a narrow field of view and are used to measure the radiance in a particular direction. Using this, together with information on the angular properties of the radiation, the flux may be obtained. Advanced instruments have a directional capability and channels which allow study of the anisotropy and polarisation characteristics of the radiation fluxes.

To provide the much needed improvement of temporal sampling of the Earth radiation budget (ERB), observations by the Geostationary Earth Radiation Budget (GERB) instrument on EUMETSAT's Meteosat 8 and 9 are being used. This instrument provides measurements of the ERB every 15 minutes, providing a unique view of the diurnal cycle.



The Earth's energy budget. The numbers indicate the average energy fluxes over one year, at a global scale. (Credit: NASA/ Sally Benson)

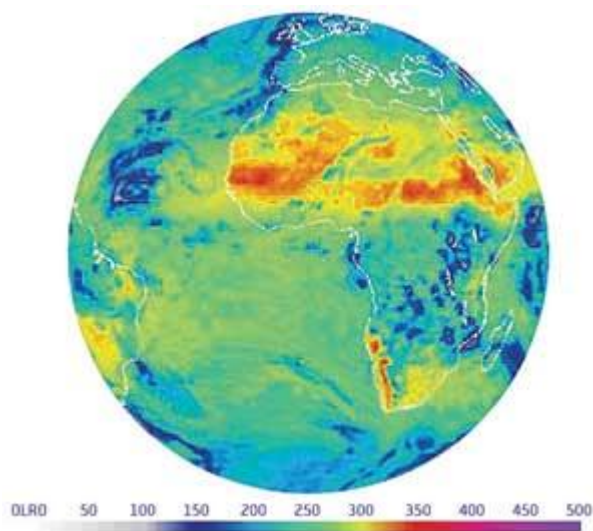
Applications

Solar radiant energy is a major driver of the Earth's climate. The reflection, absorption and re-emission of that energy occur through a complex system of clouds, aerosols, atmospheric constituents, oceans, ice and land surfaces. Variations in this complex system are the source of changes in the Earth's radiation balance. The input of energy from the Sun is not constant and its small variations with sunspots and other factors cause some small, but significant, modification of the Earth's climate. Seemingly small (0.5%) changes in the total solar irradiance (TSI) over a century or more may cause significant climatological changes, and models suggest that as much as 25% of the recent global warming of the Earth may be solar in origin. Measurements of radiation leaving the Earth suggest some changes in the components of this radiation in recent decades, so sustained measurements are critical to allowing future improved knowledge and understanding.

Current & planned instruments

ACRIM III	ScaRaB
BBR (EarthCARE)	SIM
CERES	SIM
ERBS	SIM-2
ERM	SODISM
ERM-2	SOLSTICE
GERB	SOVAP
NISTAR	TIM
PREMOS	TSIS

Especially when coupled with other information on clouds, aerosol and land cover, radiometers offer a unique contribution to understanding of the Earth's radiation budget, together with its relationship to global warming – such as that resulting from the greenhouse effect. Cloud and aerosol feedbacks related to global warming caused by greenhouse gases have long remained the most uncertain aspect of understanding and predicting future climate change, and improved climate projections depend on gaining the information to detail these feedbacks. Planned measurements will have unprecedented accuracy (0.1%) and precision (relative changes of 0.03%). This is necessary for detecting the small changes in Earth's radiances that correspond to the incremental changes in our climate system and which could be of major importance for humankind far into the future.



Outgoing Longwave Radiation (OLR) as measured by GERB.

Further Information

ACRIMSAT: acrim.jpl.nasa.gov

Earth radiation budget: www.atmosphere.mpg.de/enid/252.html

CERES: ceres.larc.nasa.gov/

PICARD: smc.cnes.fr/PICARD

TIM/SIM/SOLTICE: lasp.colorado.edu/sorce/index.htm

GERB: gerb.oma.be/doku.php

ScaRaB: smc.cnes.fr/SCARAB/Fr/