

Sunshine duration measurement

Sunshine duration is defined by World Meteorological Organization (WMO) as the time during which the direct solar radiation exceeds the level of 120 W/m^2 , and is normally measured in hours.



UV Measurement

Sunlight in space at the top of Earth's atmosphere is composed of about 50% infrared light, 40% visible light and 10% ultraviolet light, for a total intensity of about 1400 W/m^2 in vacuum



Radiation Measurement in India

India Meteorological Department has been measuring radiation parameters at different stations in India since 1957.

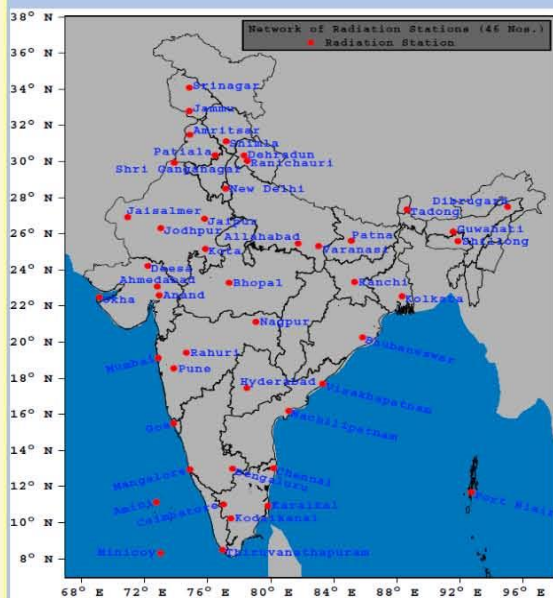
Regional Radiation Centre

The World Meteorological Organization (WMO) has designated the Central Radiation Laboratory at IMD, Pune as Regional Radiation Centre for Asia (RA-II region)

Books and Research Papers

1. Solar Radiant Energy Data over India, 2009, IMD, Ministry of Earth Sciences.
2. Handbook of Solar Radiation Data, A. Mani, 1980, IMD.

The Network of Radiation Stations



The Network consists of 46 stations across the country where seven basic radiation parameters viz. Global solar radiation, Diffuse solar radiation, Direct solar radiation, Terrestrial radiation, Duration of bright sunshine, UV – A and UV – B

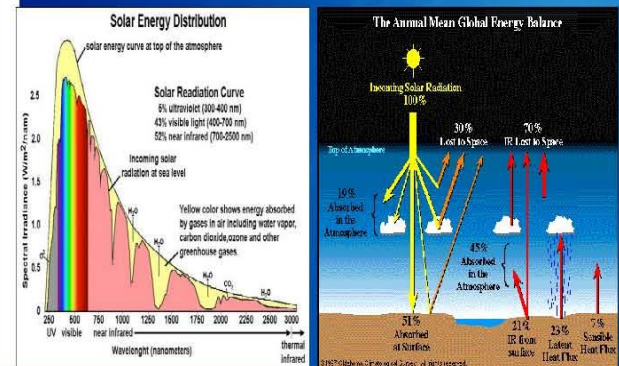
RECENT ACHIEVEMENTS

- ❖ Primary standard of Solar Radiation instruments (Cavity Radiometer) has been upgraded with new system.
- ❖ Datalogger have been Installed at WRDC stations to have real time data available to Radiation Lab.
- ❖ Calibration facility of Pyranometer have upgraded for departmental and departmental

FUTURE PLAN

- ❖ All solar radiation station will be upgraded with New datalogger with GPRS modem to have data availability in real time
- ❖ The Solar radiation network will be enhanced by including new Radiation station in the Network.
- ❖ The indoor calibration facility of solar radiation sensors will be made available in Central Radiation

Solar Radiation Instruments Networks



Background of Radiation measurement in India

Actinometric measurements began in India since 1879. Measurement at Pune started in 1930 using Angstrom Pyrgometer for measuring net terrestrial radiant energy. IMD started a network of four Radiation at Pune, New Delhi, Chennai and Kolkata in 1957. The network was expanded to 14 stations by the year 1969. IMD started manufacturing of radiation instruments of the specified accuracy at IMD Workshop. The network was upgraded in the year 2005-06 and presently the network consists of 46 stations.

Radiation measurement

- ❖ The network is equipped with sensors for measurement of solar radiation (short wave radiation in the frequency band of 0.2 to 4.0μ) emitted by the sun and terrestrial radiation (long wave radiation in the frequency band of 4.0 to 120μ emitted by the earth and atmosphere.
- ❖ Pyranometer, Pyrliometer with solar tracker, Pyrgometer, Net radiometer, UV A and UV B radiometer of radiation parameter.
- ❖ 13 stations from the network have been identified by WMO to share data to World Radiation Data Centre (WRDC) at St. Petersburg, Russia

Radiation Measuring Instrument

Pyranometer is used to measure total hemispheric solar irradiance from 280 nm to 2,800 nm as part of the IMD Baseline Measurement System. It is also called Global irradiance. Its sensor has a horizontal radiation-sensing surface that absorbs solar radiation energy from the whole sky (i.e. a solid angle of 2π sr) and transforms this energy into heat. Global solar radiation can be ascertained by ensuring this heat energy.



Pyranometer is mounted under an adjustable shading band to measure diffuse horizontal solar irradiance.

Shading band is adjusted daily for the changing solar declination angle to match the path of the sun across the sky.

A shadow band correction factor must be applied to pyranometer measurements to account for the portion of the sky blocked by the band.

Net Pyrriadiometer comprises of two thermopiles in combination, one is facing to the ground and another to the sky ensures to measure the balance between total downward and total upward radiant energy or the net radiant energy, is measured by net pyrriadiometers. The radiant field is 4π steradian.



Test and Calibration Facilities

A series of radiation standards are being maintained. The Central Radiation Laboratory has array of standard equipment-primary, secondary, transfer, working and touring standards.

Central Radiation Laboratory, Pune maintains the three primary standards of the laboratory and the calibration factors are always with reference to this WRR. To ensure the stability of the primary standards, one instruments regularly participates in the International Pyrheliometer Comparison held once in five years at the World Radiation Centre (WRC) at Davos, Switzerland. The laboratory also provides its facilities for calibration of radiation instruments of the member countries (of WMO) whenever the demand is made. India also participates in the Asian Regional Pyrheliometer Comparison whenever these are arranged.



Purpose of calibration of the radiation sensor is to compute sensitivity factor or the multiplicative calibration constant (inverse of sensitivity factor) of the sensor.



HF Cavity radiometer and PMO6 facility (a reference instrument to measure direct solar irradiance.

A **pyrheliometer** is an instrument for measurement of direct beam shortwave solar irradiance by pointing directly at the sun. Sunlight enters the instrument through a window and is directed onto a thermopile which converts heat to an electrical signal that can be recorded. The signal voltage is converted via a formula to measure watts per square meter. It is used with a solar tracking system to keep the instrument aimed at the sun.

Sun Tracker is an instrument used to track the sun along its path to make pyrheliometer parallel to sun rays and allow perpendicular radiations fall on the thermopile. As sun path changes daily due to its declination towards 23.5° north and south, an inbuilt microprocessor and GPS system calculate daily sun path for the solar tracker.



A **Pyrgeometer** comprises of a wire wound-plated thermopile detector encased in a chrome brass desiccate housing. Pyrgeometers are used to measure long wave radiation, using a diffused silicon coating window with a "solar blind" filter, which only transmits the radiation with wavelengths from $4.5 \mu\text{m}$ up to $42 \mu\text{m}$.

