Technical Help
Light Sensors

How to Make Reflectance Calculations

Skye Instruments have been designing light and radiation sensors for measuring Incident Light (Irradiance) and Reflected Light (Radiance) since 1983.

Irradiance sensors have a Cosine Corrected Light Response, meaning they accept light and radiation from a hemisphere above the top surface, according to Lambert's Cosine Law. This is the scientifically accepted method of measuring Irradiance. Irradiance sensors are usually calibrated in units of watt m^{-2} or μmol $m^{-2} s^{-1}$

Radiance sensors have a limited Field of View (FOV), so that they can be positioned to measure light and radiation coming from a defined area of ground. The FOV is defined as an angular cone, e.g. 25 degrees (12.5 degrees off perpendicular). The area of ground to be measured can be adjusted simply by changing the height of the sensor above the ground. Increasing the height of the sensor increases the radius of the FOV and also the area of measurement (similar to a zoom function on a camera). Radiance sensors are usually calibrated in units of watt $m^{-2} sr^{-1}$ or μmol $m^{-2} s^{-1} sr^{-1}$

Skye sensors can have an analogue output of μA, mA, mV or V, depending on the model purchased. Each sensor and each channel of Multichannel Radiometers are individually calibrated, and supplied with a Calibration Factor for every sensor or channel.

The format of the Calibration Factor is given as Calibration Unit per analogue output.
For example watt m^{-2} per μA or μmol $m^{-2} s^{-1} sr^{-1}$ per mV

To calculate Irradiance and Radiance values from each sensor or channel, simply multiply the analogue output measured by the Calibration Factor for that sensor / channel.
For example, multiply mV readings by the Calibration Factor μmol $m^{-2} s^{-1} sr^{-1}$ per mV and the result is μmol $m^{-2} s^{-1} sr^{-1}$

To calculate Reflectance from a pair of matched Irradiance and Radiance sensors or channels, first convert the analogue output readings into Calibration Units as shown above.
For example calculate Irradiance in μmol $m^{-2} s^{-1}$ and Radiance in μmol $m^{-2} s^{-1} sr^{-1}$

Reflectance = Irradiance / Radiance

It is scientific convention to calculate Reflectance in this way, even though the units of Irradiance and Radiance are not identical. The Steradian is a dimensionless unit and so it can be ignored in this calculation.

The definition of a Steradian is described on Wikipedia here: http://en.wikipedia.org/wiki/Steradian

A Steradian describes a solid angle exactly like the cone shaped FOV of a Skye radiance sensor.
It is dimensionless as 1 sr = $Length^2$ / $Length^2$ (e.g. m^2 / m^2)

Skye Instruments Ltd
21, Ddole Enterprise Park, Llandrindod Wells
Powys LD1 6DF, United Kingdom

TEL +44 (0)1597 824811

EMAIL skyemail@skyeinstruments.com
WEB http://www.skyeinstruments.com