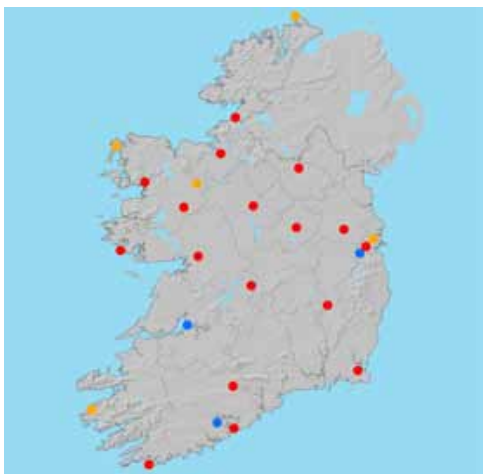


2.6 Surface Radiation Budget

Ned Dwyer, Kevin Black and Séamus Walsh

Energy reaches the Earth's surface directly from the sun and diffusely, from scattering caused by clouds, aerosols and various gases in the atmosphere. Some of this incident energy is reflected and emitted back to space. 'Net incoming radiation' is the quantity of radiation remaining at the Earth's surface. This includes visible light as well as infrared and ultraviolet radiation. Long-term changes in the amount of solar radiation reaching the Earth's surface can have a significant influence on climate, hydrological cycles and crop productivity.

Photo: © Ned Dwyer



Map 2.6. Location of sunshine duration and solar radiation observation stations.

Measurements

Historically, sunshine duration was the observed solar variable; more recently, there has been a shift to solar radiation (incoming radiation), also known as global radiation, which represents a more comprehensive measurement of solar energy. Both solar radiation and sunshine duration are observed at five Met Éireann synoptic stations (orange). Solar radiation is measured at an additional 17 automatic weather stations (red). Sunshine duration only is measured at three other staffed synoptic stations (blue). Further upgrades to the sunshine and radiation observation network are in progress.

'Annual average solar radiation declined approximately 19% over the period 1955 to 1984, with stabilisation and some evidence of an increase over subsequent years.'

Time-series and Trends

The most recent analysis of solar radiation data from seven synoptic stations has shown an approximately 19% drop in the annual average value over the period 1955 to 1984 after which it levelled off, with some evidence of an increase in more recent years. This is illustrated for Valentia Observatory in [Fig. 2.11](#). The measurements from Valentia suggest that there was

a greater decline over the summer months compared to winter; however, this is not consistent across all the stations. The stabilisation in and increase of solar radiation may, in part, be due to alterations in atmospheric optical properties. It may also be due to cleaner air caused by reductions in atmospheric pollutants, such as black particles, sulphate particles and/or sulphate cloud-forming nuclei, the presence of which lead to the sun's energy being reflected back into space before reaching the Earth's surface.

'Regular analysis of national trends in the net surface radiation balance needs to be carried out given its role in plant growth, the hydrological cycle and the larger climate system.'

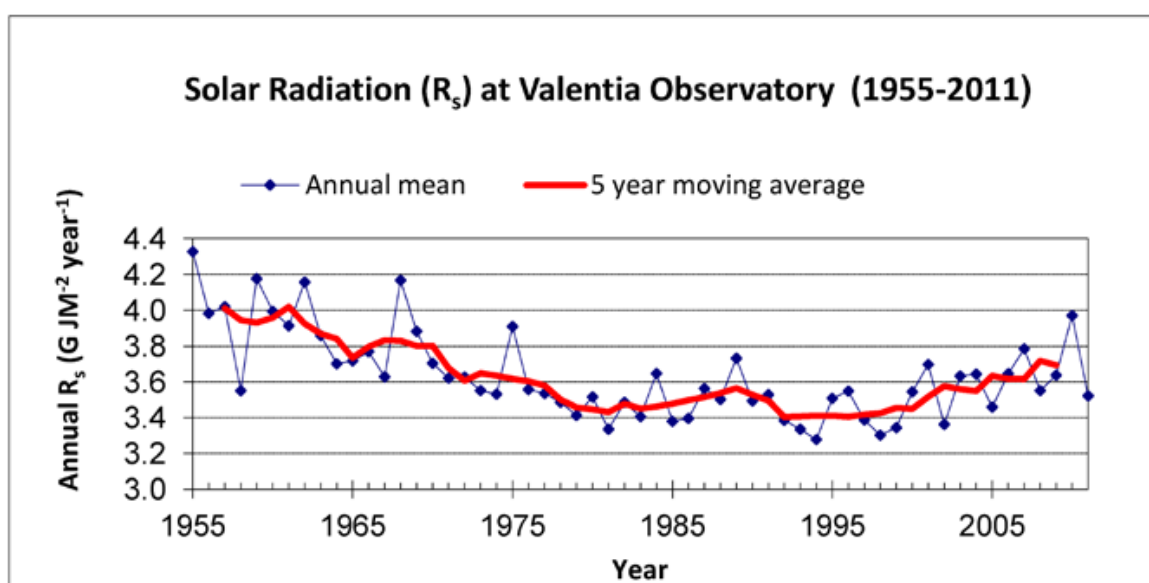


Figure 2.11. Annual solar radiation at Valentia Observatory (1955–2011). Units are in per metre squared GigaJoules (G JM^{-2}) per year.

Maintaining the Observations

A comprehensive suite of solar and terrestrial radiation measurement instrumentation is maintained by Met Éireann at Valentia Observatory. Solar radiation measurement instrumentation has been installed at all of the automatic TUCSON (The Unified Climate and Synoptic Observation Network) locations: therefore, the ongoing collection of data is ensured. Regular analysis of national trends in the net surface radiation balance needs to be carried out given its role in plant growth, the hydrological cycle and the larger climate system. The National University of Ireland Galway is carrying out a research project at the Mace Head Atmospheric Research Station, Carna, Co. Galway investigating the relationship between atmospheric constituents and solar radiation.

Further Information and Data Sources

Black, K., Davis, P., Lynch, P., Jones, M., McGettigan, M. and Osborne, B. (2006) Long-term trends in solar irradiance in Ireland and their potential effects on gross primary productivity, *Agricultural and Forest Meteorology*, Vol. 141, pp. 118–32.

Stanhill, G. (1998) Long-term trends in, and spatial variation of, solar irradiances in Ireland, *International Journal of Climatology*, Vol. 18, pp. 1030–50.

Information on sunshine and solar radiation from Met Éireann:

<http://www.met.ie/climate-ireland/sunshine.asp>

Information on solar and terrestrial radiation observations at Valentia Observatory:

<http://www.met.ie/about/valentiaobservatory/solarradiation.asp>

World Radiation Data Centre: <http://wrdc.mgo.rssi.ru/>

Baseline Surface Radiation Network:

<http://www.gewex.org/bsrn.html>