4.7 Soil Moisture

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Soil moisture comprises only a tiny percentage of the total global water budget, but it has a key role in influencing the hydrological cycle and is a major driving force in regard to the soil's ability to act as a carbon sink or source. Soil moisture content refers to the amount of water held in the soil and is affected by the soil texture, topography, land cover and weather conditions. It is an important measure for agriculture as it affects the length of the grazing season, grass and crop growth rates and nutrient uptake and loss.

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Map 4.1. Location of synoptic stations at which soil moisture deficits are calculated.

Measurements

Soil moisture can be determined using various *in situ* approaches. However, they are all labour intensive and only representative of local conditions. Met Éireann has estimated daily soil moisture deficits (SMD) at its synoptic stations since 1980. These are modelled values based on the difference between rainfall amount and actual evapotranspiration and are estimated separately for poorly, moderately and well drained soils.

A number of satellite sensors make broad-scale measurements of soil moisture. Research continues on retrieval methods using data from high-resolution satellite radar sensors. Such satellite-derived values need to be carefully calibrated and validated with *in situ* measurements.

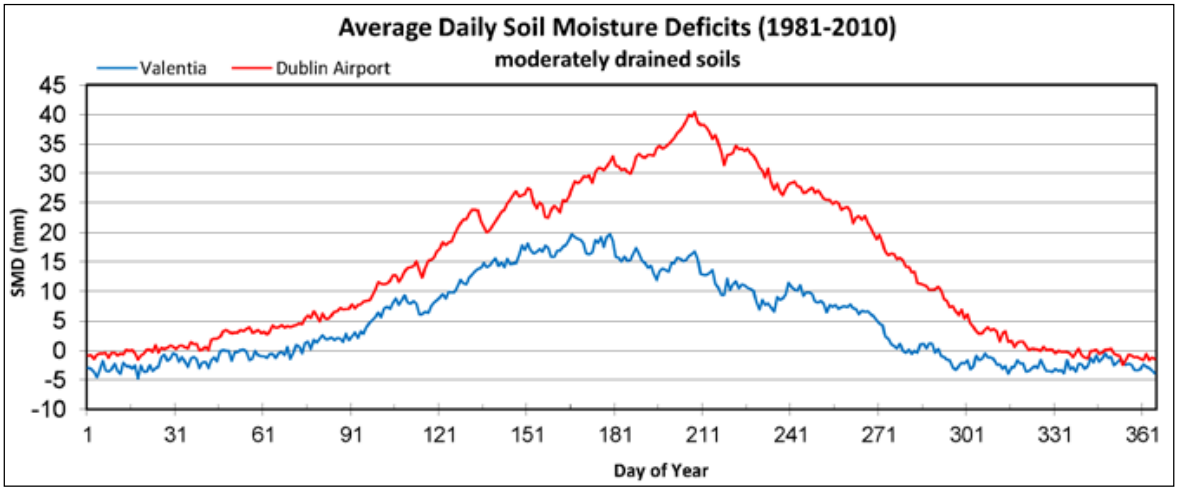

Figure 4.12. Average daily soil moisture deficits calculated at Valentia Observatory and Dublin airport (1981–2010).

'Met Éireann has estimated daily soil moisture deficits at its synoptic stations since 1980 but detailed analysis of trends needs to be carried out.'

4

Time-series and Trends

Figure 4.12 shows the average daily SMD for moderately drained soils based on data collected at Valentia Observatory and Dublin Airport synoptic stations from 1981 to 2010. SMD is the rainfall in millimetres required to saturate or fill all the pores in the soil. Saturated soils (negative SMD) generally occur on wet winter days but such moderately drained soils return quickly to non-saturated conditions. Greatest soil moisture deficits, which usually occur in the summer and when sustained can be indicative of droughts, generally occur in the east and southeast of the country.

Figure 4.13 shows the mean monthly surface soil moisture over Europe for August 2010 as determined from a combination of satellite microwave scatterometry and passive microwave radiometer data at a spatial resolution of 25 km.[22] Orange colours represent dry soils, whereas blues represents saturated soil.

22 Image courtesy of the Technical University of Vienna 's ESA funded WACMOS and Soil Moisture Climate Change Initiative projects

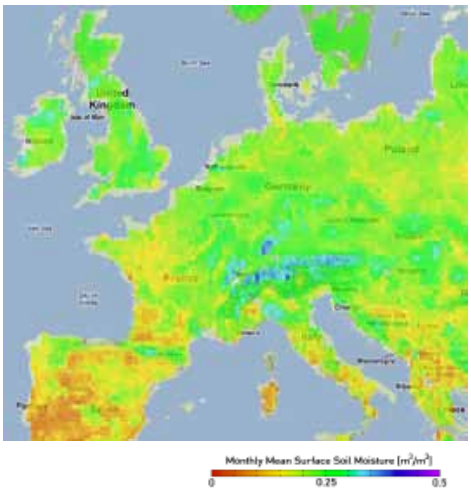

Figure 4.13. Mean monthly surface soil moisture over Europe for August 2010.

'A comprehensive needs analysis is required to secure and potentially enhance Ireland's limited evapotranspiration measurement network.'

Maintaining the Observations

The network of synoptic stations need to be maintained and further developed to ensure the future of long-term measurements. Evapotranspiration measurements are currently carried out at Valentia Observatory and Johnstown Castle. However, a comprehensive needs analysis is necessary to secure and potentially enhance this limited network. Further resources are required to conduct analysis of the historic record of SMD and perform research on alternative measurement techniques. The CMRC at University College Cork is a partner in an ESA-funded Climate Change Initiative project (2012–2014) to develop comprehensive and robust global soil moisture products using satellite data.

Further Information and Data Sources

Barrett, B.W., Dwyer, E. and Whelan, P. (2009) Soil moisture retrieval from active spaceborne microwave observations: an evaluation of current techniques, *Remote Sensing,* Vol. 1, pp. 210–42: http://www.mdpi.com/2072-4292/1/3/210/

Schulte, R.P.O., Diamond, J., Finkele, K., Holden, N.M. and Brereton, A.J. (2005) Predicting the soil moisture conditions of Irish grasslands, *Irish Journal of Agricultural and Food Research,* Vol. 44, pp. 95–110.

Schulte, R.P.O., Richards, K., Daly, K., Kurz, I., McDonald E.J. and Holden, N.M. (2006) Agriculture, meteorology and water quality in Ireland: a regional evaluation of pressures and pathways of nutrient loss to water, *Biology and Environment: Proceedings of the Royal Irish Academy,* Vol. 106B, No. 2, pp. 117–33.

Information on the SMOS mission: http://www.cesbio.ups-tlse.fr/us/indexsmos.html

ESA's Climate Change Initiative: Information and global time-series of soil moisture from satellites sensors: http://www.esa-soilmoisture-cci.org/

Soil moisture deficit maps from Met Éireann: http://www.met.ie/agmet/default.asp

Soil moisture deficit calculations: http://www.met.ie/climate/agri-meteo-data.asp