2.5 Water Vapour

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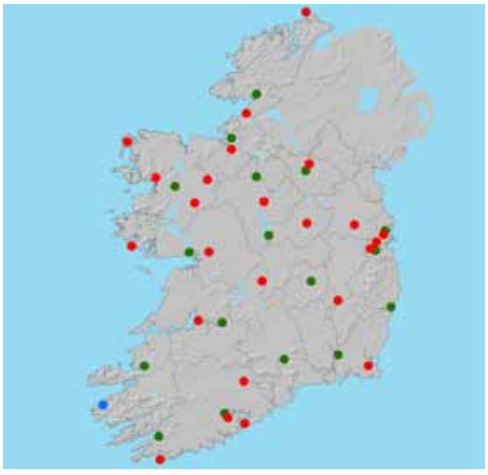
Water vapour exists at all levels in the atmosphere. Near the surface it affects cloud formation and development and hence is a key driver of precipitation. It is the dominant greenhouse gas accounting for almost 60% of the natural greenhouse effect. Globally, higher air temperatures and warmer oceans have led to an increase in atmospheric water vapour which may be linked with more intense precipitation events and enhanced warming. The amount of water vapour in the atmosphere is highly variable in space and time. Knowledge of this variability in the upper atmosphere is still quite limited.

Photo: © Valerie Robus



Map 2.5. Location of humidity and water vapour observation stations.

'Water vapour is the dominant greenhouse gas, accounting for almost 60% of the natural greenhouse effect. Globally, higher air temperatures and warmer oceans have led to an increase in atmospheric water vapour.'

Measurements

Surface level water vapour and water vapour pressure are derived from humidity measurements taken at the 25 synoptic weather stations (red and blue) operated by Met Éireann. Since 1943, profiles of upper air humidity have been measured at Valentia Observatory in Co.

Kerry (blue) using radiosondes, which are released twice a day. Since 2009 column-integrated water vapour quantities are retrieved from a network of Global Positioning System (GPS) receivers (green) on an hourly basis.

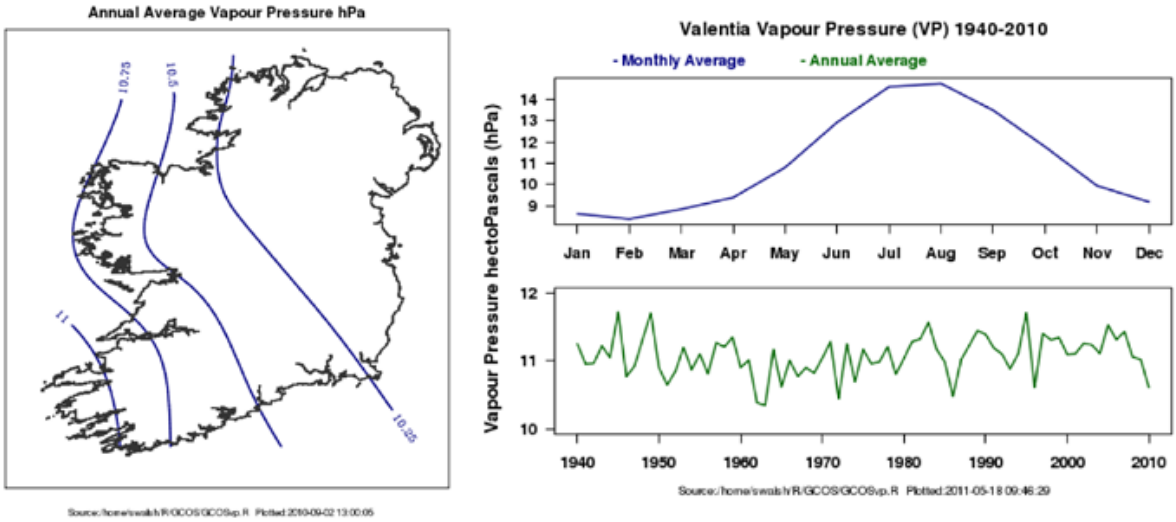
A number of sensors on different satellites measure water vapour. These include the SEVIRI instrument on the European Meteosat system.

> 'Insufficient analysis has been carried out to identify any trend in water vapour measurements over Ireland.'

Time-series and Trends

The water vapour pressure is related directly to the number of water vapour molecules in the air. The capacity of the atmosphere to hold water vapour increases with increasing temperature. Figure 2.9 (a) shows the annual average vapour pressure across the country derived from long-term synoptic weather station measurements, and Fig. 2.9 (b) how the monthly average vapour pressure at Valentia Observatory reaches a maximum in summer whilst the annual average vapour pressure can vary substantially from year to year. Due to the very limited analysis of these data to date, it is not possible to identify any trend in water vapour measurements over Ireland.

Analysis of the thermal infrared information collected by the *Meteosat-8* satellite is used to generate daily estimates of total water vapour content in the atmospheric column. In Fig. 2.10, which is an example product from 10 July 2005, the scale is in millimetres and represents how much rain would fall over each small area if the water vapour condensed into liquid.



(a) **(b)**

Figure 2.9. Annual average water vapour pressure across Ireland (a) and monthly and annual average water vapour pressure at Valentia Observatory (b) (1940–2010).

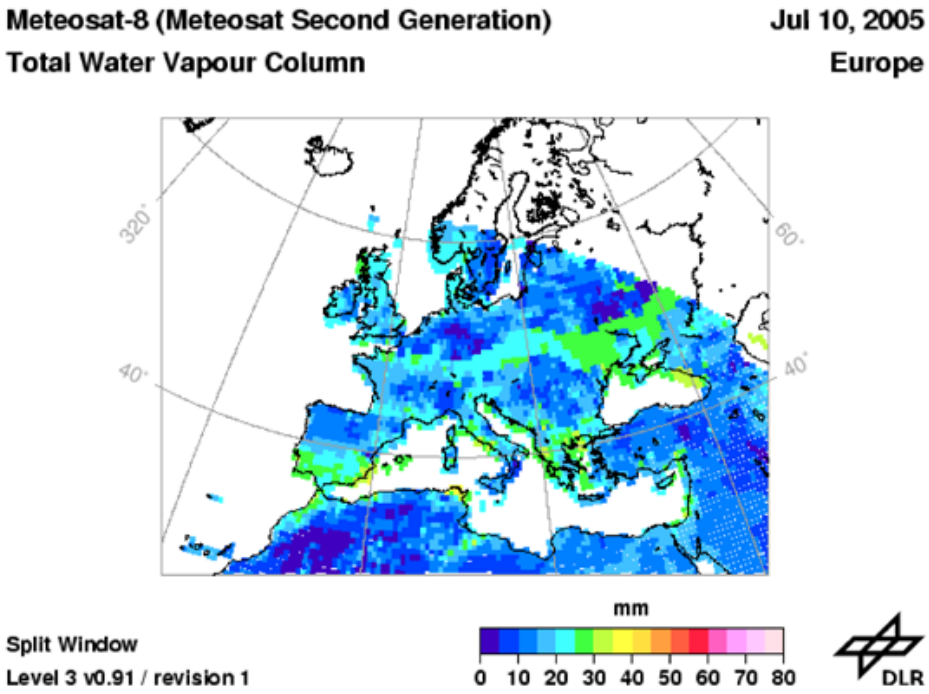


Figure 2.10. Example of total water vapour column content over Europe derived from *Meteosat*-8 satellite observations, 10 July 2005.

Maintaining the Observations

Ground and radiosonde measurements are carried out on an operational basis by Met Éireann. GPS receivers at Mace Head and Valentia Observatory have been operated as part of an EPA-funded research project; the remaining GPS receivers are operated and maintained by Ordnance Survey Ireland. Resources are required to digitise paper records and carry out systematic analysis of the long-term historical ground and upper air water vapour records.

Further Information and Data Sources

Schroedter-Homscheidt, M., Drews, A. and Heise, S. (2008) Total water vapor column retrieval from MSG-SEVIRI split window measurements exploiting the daily cycle of land surface temperatures, *Remote Sensing of Environment,* Vol. 112, pp. 249–58, doi: 10.1016/j.rse.2007.05.006

Hanafin, J.A., Jennings, S.G., O'Dowd, C.D. and McGrath, R. (in press) *Retrieval and analysis of atmospheric water vapour from GPS receivers*, EPA.

Information on radiosonde measurements at Valentia Observatory: http://www.met.ie/about/valentiaobservatory/radiosonde.asp

Information on data availability: http://www.met.ie/climate/climate-data-information.asp

Surface data from some Irish synoptic stations may be accessed at the US National Climate Data Centre: http://www7.ncdc.noaa.gov/CDO/cdo Note that humidity related measurements from Ireland have not been quality controlled.

European programme providing water vapour measurements derived from GPS: http://egvap.dmi.dk/

Water vapour column retrieval from the SEVERI instrument: http://wdc.dlr.de/data_products/TRACEGASES/seviri_twc/daily_twc_seviri.php

The atmospheric infrared sounder used for water vapour retrieval: http://airs.jpl.nasa.gov/