

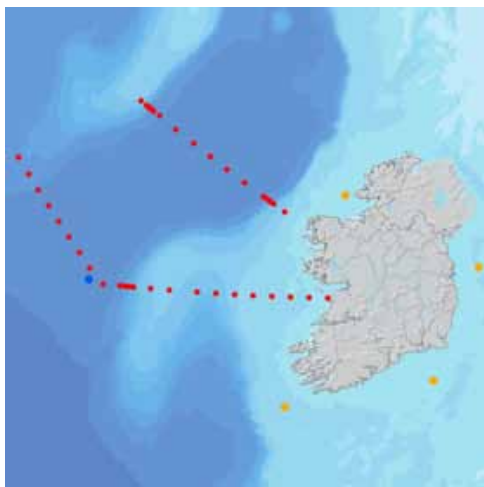
3.2 Ocean Surface and Sub-surface Salinity

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Salinity is defined as the total amount of dissolved salts in water. These constitute approximately 3.5% of the ocean's mass, the remaining percentage being pure water. Although decadal changes have been observed, no long-term trend in salinity levels of the northeast Atlantic has been detected. Monitoring of ocean salinity changes is an indirect method of detecting changes in precipitation, evaporation, river runoff and ice melt and therefore helps in understanding changes in the Earth's hydrological cycle.



Photo: © Didac Perales



Map 3.2. Location of moored stations and cruise tracks for surface and sub-surface salinity observations.

‘Surface and sub-surface salinity measurements around Ireland exhibit multi-annual variability but no distinct trend exists.’

Measurements

Since 2000, the Irish Marine Weather Buoy Network routinely collects sea surface and sub-surface salinity data from five offshore locations (orange and blue). Since 2008 salinity and temperature have been recorded hourly at five depths up to 1000 m on the M6 buoy mooring (blue). Salinity data have been collected by the ICES for many years but the dataset is

quite limited for the Irish region. Since 2004 standard oceanographic cruises (red) are also undertaken on an annual basis. The deep waters west of Ireland are monitored in winter, while the coastal shelf waters are monitored in May.

Sea-surface salinity can be monitored from space following the launch of the ESA *SMOS* (Soil Moisture Ocean Salinity) mission in 2010 and NASA's *AQUARIUS* mission in 2011. Both use sensors that detect microwave radiation emitted from the ocean surface from which salinity levels can be inferred. *In situ* measurements are required to validate these satellite-derived observations.

Time-series and Trends

Using the combined archive of salinity data from ICES, the Marine Institute and the World Ocean Database, [Fig. 3.4](#) shows that annual mean salinity anomalies on the Irish shelf exhibit a multi-annual variability. This variability has been linked to variation in the North Atlantic Oscillation (NAO).¹³ Salinity anomalies are calculated relative to the 1975–2007 climatology,

and have been averaged over the region 48°–58°N, 3°–15°W. Surface salinity anomalies on the Irish shelf also show variability from year to year, with evidence of some freshening in coastal waters associated with increased winter rainfall.

Sub-surface Salinity

[Figure 3.5](#) shows the key water masses and their salinity levels (psu) in the deep waters west of Ireland. Degrees longitude west of Greenwich are shown on the x-axis. Different situations pertain in the near-surface, intermediate and deep layers. In general, the deeper waters are less saline and the surface waters more saline.

Deep-water masses have been monitored since 2004 on standard oceanographic cruise sections. One highlight of this short time-series is the progressive freshening of the Labrador Sea Water (LSW) between 2006 and 2009 – representing the arrival in the Rockall Trough of waters that had formed in the Labrador Sea around 2000. The LSW has become more saline in 2010 and 2011. Near-surface and

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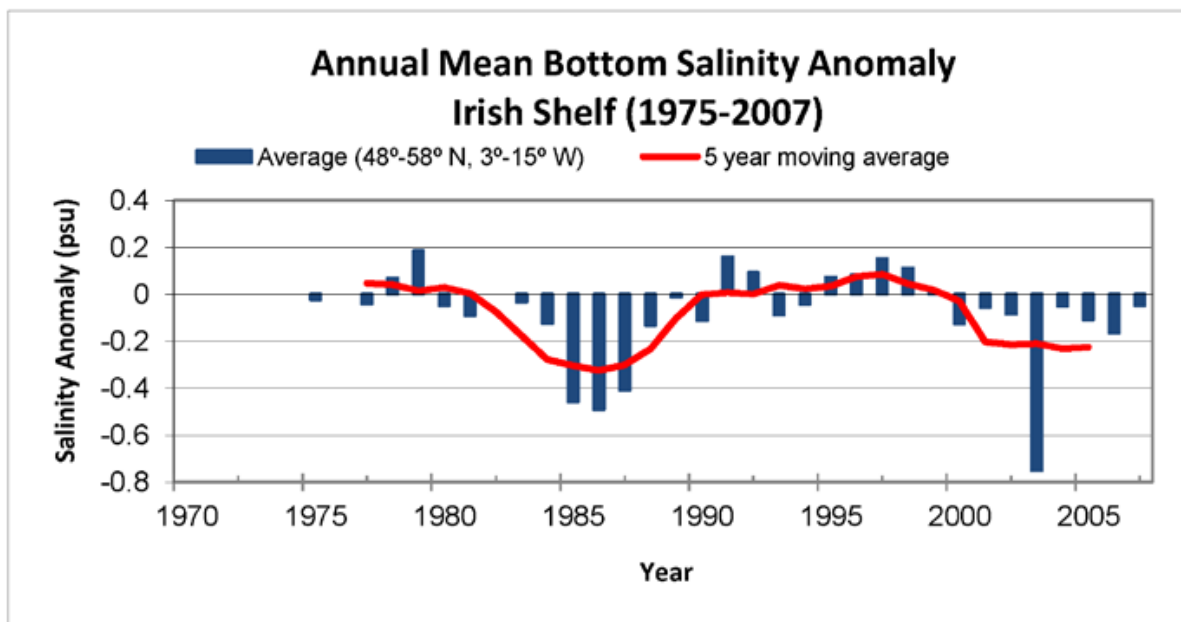
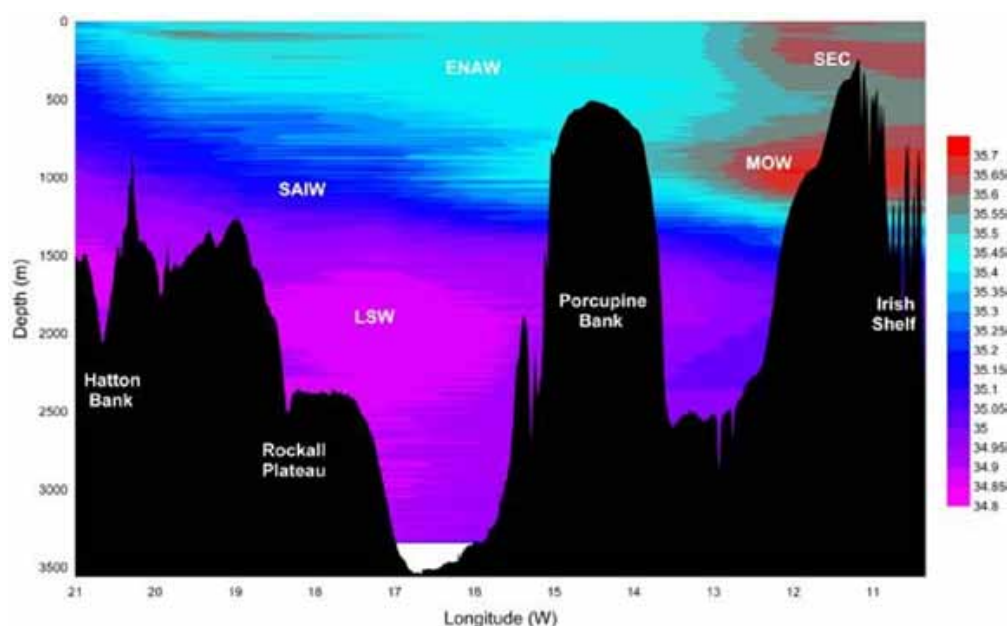


Figure 3.4. Annual mean salinity anomalies on Irish shelf (1975–2007).

¹³ The NAO describes a north south variation of atmospheric pressure centres between the Arctic low and subtropical Atlantic high mean sea-level pressure over the North Atlantic.



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Figure 3.5. Key water masses and their salinity levels (psu) in the deep waters west of Ireland: SEC=Shelf Edge Current, MOW=Mediterranean Outflow Water, ENAW=Eastern North Atlantic Water, SAIW=Sub-Arctic Intermediate Water, LSW=Labrador Sea Water.

intermediate water masses are highly variable, with no obvious trend since these observations began.

‘Annual measurements of deep-sea salinity need to be maintained to build on the existing time-series which is already revealing the complexity of sub-surface salinity.’

Maintaining the Observations

The National Weather Buoy Network is funded under a Memorandum of Understanding with the Department of Transport. Funding for this network is negotiated on an annual basis. Deep sea sub-surface salinity observations are made annually and are funded under the National Development Plan Ship Time fund and through internal Marine Institute funding.

Further Information and Data Sources

Cannaby, H. and Nolan, G. (2009) Physical oceanography. *Irish Ocean Climate and Ecosystem Status Report 2009*. Nolan, G., Gillooly, M. and Whelan, K. (eds.) Marine Institute, 100 pp.

Fennell, S. (2007) A study of the behaviour and interannual variability of surface salinity and temperature at the M3 weather buoy off the southwest coast of Ireland. MSc, Marine Institute, Co. Galway, Ireland.

Information and observations from the Irish Marine Weather Buoy Network:
http://www.met.ie/marine/marine_observations.asp

Oceanographic data from cruises are archived by the Marine Institute and may be accessed on request:
<http://www.marine.ie/home/publicationsdata/>

Oceanographic data from cruises are archived by ICES on an annual basis: (www.ices.dk)

Information on the SMOS mission:
<http://www.esa.int/SPECIALS/smos/>

Information on the AQUARIUS mission:
<http://aquarius.nasa.gov/index.html>