ESONET NoE - Nordic Seas Observatory – Atlantic Ocean

The MOEN (Meridional Overturning Exchange with the Nordic Seas) station uses the Faroes branch of the CANTAT-3 cable for measuring water column induced voltage. The recorded voltage is strongly influenced by the inflow of the North Atlantic Current. Long term monitoring of this current is of paramount importance in the understanding oceanic fluxes of heat, salt and freshwater at high northern latitudes and their effect on global ocean circulation and climate change in the arctic region.

Scientific context and relevance

The relative pleasant climate of the Nordic Countries is to a large extent the result of the warm saline water that enters the Nordic Seas. This flow has not only scientific but also social economic impacts. Even a small disturbance, anthropogenic or naturally, will most probably induce strength on the European community. The reason for the present climate is the large amount of warm water that flows northwards eventually passing the Faroe Islands. The current system responsible for the heat transport has its origin in the Gulf Stream. At higher latitudes a northern branch develops flowing northwards. This water is characterised as warm, saline and buoyant. At northern latitudes about 8 million cubic meters per second enters the Nordic Seas by passing over the submarine ridge that lays between Greenland and Scotland. Here the currents release their heat to the atmosphere and as a result become cold and saline. This transformation makes the buoyant water dense and as a consequence sinks. The submarine ridge acts as wall arresting the descending water north of the ridge. This process has been on going for a long time and a steady state has developed where the sinking water eventually escapes through the deepest channel in the ridge, which is located south of the Faroes. The surface inflow, the sinking followed by the escape acts as a thermal pump; the process has therefore been named the thermohaline circulation (THC).

From the simplified picture, outlined above, it becomes evident that the climate is dependent on the strength of the thermohaline pump. It is thought that a slight raise in average temperature will increase the melting of the Greenland ice sheets. The added fresh water will slowly dilute the saline surface waters in the Nordic Seas and eventually, create a lid of buoyant water that will become strong enough to resist the force of the north flowing water, as a consequence the warm water will be hindered from reaching the higher latitudes. This picture is however painted with a course brush and there could be compensating effects that will keep the lid at bay. Recently there was a report on an observed freshening of the Nordic Seas. The forecast, suggested that the inflow could cease in about 100 years timescale (Curry and Mauritzen Nature 2005). Shortly afterwards a new report was released presenting results that show that the freshening could to some degree be balanced by an increasing salinity of the inflow induced by lateral displacements of the subpolar gyre (Hátún et al. Nature 2005).

More and more studies suggest that the THC cannot be regarded as a simple heat pump. Small-scale phenomena are strongly linked to the dynamics of the THC. Unfortunately there is a lack of long-term observations covering the North Atlantic. The reason for this is that monitoring with traditional instruments is costly. Higher instrumental density and introduction of alternative measuring techniques are to large extent excluded by the pertinent financial situation. The social-economical importance related to the inflow strongly suggests that this region by necessity is developed into a Nordic Node as a part of a European observatory strategy. The Atlantic water inflow is the key parameter for the wealth and stability of the European Community.

Nordic Seas – Atlantic Ocean

Scientific objectives

First-hand objective is to establish a continuous monitoring of the inflow of the Faroe Branch (north of the Faroese) and the Shetland branch (southeast of the Farose) and the overflow of dense water (south of the Farose). The ultimate goal is to use the Nordic Node for now-casting and fore-casting of the thermohaline circulation, herby making it the "warning bell" of a changing climate. The observatory approach will allow the measurement to become more versatile then what the case is today, thus a backbone of sensors will easily be complimented by other instrumentations tailored for special studies, e.g. oceanographic, chemical and biological investigations. An extraordinary benefit is that data from several sensor systems become synchronized and stored coherently. The scientific objectives are to continuously observe the flows in and out of the Nordic Seas at the Faroese region and to relate these to the dynamics of the North Atlantic and the Nordic Seas. Studies of the inflow related to temperature changes of the arctic are of interest as well as influence of salinity dilution of the circulation. The meteorological influence on the circulation is also of interest, especially the redistribution of water due to wind forcing. Combination of flow with meteorological observations will improve the understanding of the wind driven dynamics. Finally to develop a forecasting system based on data from the node is a challenge that will include the merging of frontier research in meteorology, climatology, oceanography and technology.

Existing national and international programmes on the site

Since 1994 there has been an observational program in the region based on bottom mounted ADCPs combined with standard hydrographical sections. This has been to a large degree dependent on financing from the European Community, e.g. Veins and MOEN projects. During, temporarily lack of EC support, the program has been kept alive by local initiatives. The latter has to a large degree excluded joint use of data and sometimes resulted in reduction of sensors. By tradition the flows have been monitored by the scientists from Faroese, Norway, Scotland, Germany, Iceland and Sweden. Stockholm University has been working on the inflows and overflow for several years both theoretically and experimentally. In the EC financed project MOEN, a cable-based measurement was developed as fore runner for a future observatory. This instrument makes use of a 100 km sub-sea cable and produces near-real-time data of the integrated flow north of the Faroese.

Preliminary plan for the Nordic Node:

1) The forming of both a central consortium and a peripheral interest group (the former connected to ESONET and the latter constituting the scientific user group)
2) Investigation of techniques, liability and costs to serve as basis for proposals
3) Pan-European proposal for the Nordic Node
4) Establishment of regional ESONET-committee
5) Deployment of first leg of Node
6) Evaluation of the Node-success (lessons learned, improvements)
7) Extension of the second leg of the cabled node
8) Extension to the third leg

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Sweden: Stockholm University, Johan Nilsson
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