Abstract

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The water mass structure and anthropogenic carbon content of the Nordic Seas have been studied with the main focus on the East Greenland Current. This current transports waters from the Arctic Ocean and the Nordic Seas to the North Atlantic Ocean. The studies presented in this thesis have utilised halogenated tracers for identifying water masses, in addition to other hydro-chemical parameters, and also for assessing ages of water masses. The used tracers are sulphur hexafluoride (SF_6) and the chlorofluorocarbons CFC-12 and CFC-11, which all have a well known atmospheric history. Furthermore, SF_6 has been utilised as a deliberately released tracer from an experiment in the Greenland Sea in 1996 and the spreading of the tracer, and hence the intermediate water from the Greenland Sea, is discussed. The studies on the East Greenland Current applied optimum multiparameter analysis which was used to quantify the contribution of different water masses to the current and the overflow through Denmark Strait.

The Nordic Seas and the Arctic Ocean are areas where some of the densest waters of the world's oceans are formed through different processes. Some of these dense waters are transported to the North Atlantic Ocean as "overflows" across the Greenland-Scotland Ridge from where they contribute to the deep bottom current important for the global ocean circulation. With the objective to evaluate the sensitivity of the dense overflows to climate changes the sources to the overflows are studied. The results show that the East Greenland Current was the main supplier to the overflow through the Denmark Strait, at least in the years of the surveys, and the most important sources were from the West Spitsbergen Current, Atlantic and intermediate water from the Arctic Ocean and intermediate water from the Greenland Sea. The SF_6–tagged water was observed in most parts of the Nordic Seas and special attention was given to the distribution in the East Greenland Current, in the Denmark Strait and the Faroe Bank Channel. The studies showed that this water can supply both main parts of the Greenland-Scotland overflow with a transit time of less than three years from the Greenland Sea.

Two new methods of estimating the amount of anthropogenic carbon are also presented in the thesis, one of which is used to calculate the anthropogenic carbon transported with the East Greenland Current and the other to determine the anthropogenic carbon content in the basins of the Nordic Sea. The inventory of anthropogenic carbon in the whole Nordic Seas in 2002, below 250 m, was ~1.2 Gt C, which is about 1% of the total inventory of the Atlantic, the Pacific and the Indian Oceans. The amount of anthropogenic carbon transported with the Greenland-Scotland overflows was estimated to almost 0.1 Gt C per year, which corresponds to about 5% of the annual oceanic uptake of anthropogenic carbon.

KEY WORDS: tracers, CFCs, sulphur hexafluoride, water masses, OMP analysis, anthropogenic carbon, East Greenland Current, Greenland-Scotland overflow, Nordic Seas, Greenland Sea, Denmark Strait, Faroe Bank Channel

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