

Evolution of physical oceanography observations in Finland

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Systematic physical oceanography measurements in Finland date back to 1887 when a permanent sea level station was founded in Hanko. Regular research cruises were started in 1898. Also the sea ice observation network was established at the end of 1800's.

The Finnish sea level station network got its second station, Helsinki in 1904. Ten more stations were built in 1920's, then one in 1933 and the newest in 2014. The old stations recorded sea level continuously on paper rolls. That data is digitized in four hours intervals till 1970 and with one-hour interval since then. Nowadays the stations record data in digital form with one-minute intervals. The remarkable thing is that it is possible to go back to the original recordings and digitize them again. That has been done in recent studies of meteotsunamis. Those have been identified between the digitized time steps of data.

The coasts of Finland are in many places full of islands and bank and therefore in addition to lighthouses also light ships were in use the first half of 1900's during ice-free seasons. The ships were anchored in fixed positions. Regular daily observations of weather parameters and sea temperature and currents were part of the life of those vessels. Salinity was also observed by taking water samples. In addition to the light ships, oceanography observations were made on fixed oceanographic stations, too. Those stations were located to as deep as possible places near the coast near to pilot stations or other places in archipelagos where people lived. The number of such fixed stations varied from year to year considerably. After 1950's the light ships were no more needed and the number of people living at the outer edges of the archipelago diminished, which led eventually to drastic decrease of the number of fixes stations. At present there are only five such left and instead of water samples the CTD is used to get the salinity and temperature profile.

The Finnish research cruises were done first with steam ship Suomi, then with Nautilus from 1903 end of 1930's. In 1938 a new ship was build for marine research and it was named Aranda. Because of the Second World War it did only 1 research cruises. After the war it was delivered to Soviet Union as part of the war reparations. In 1953 a combined research and passenger ship Aranda was taking into used. It served first research in the summers and passengers in the archipelago in late autumns and in spring when there was still ice on the sea. In 1970's the ship was entirely used for research and the cruises extended to cover wintertime, too. The old Aranda was replaced in 1989 with a new Aranda, which is still in use. It was built to be usable in all oceans and it cruised to Weddell Sea in 1989 when Finland joined the Antarctic Treaty. The present Aranda was planned with scientists and built entirely for research purposes.

The building of Aranda 1989 was a milestone in Finnish oceanography because then the oceanographic data systems were renewed, too. The ship included multi scientific database system, laboratory information management system, cruise planning system and internal and external information's systems. Those included the delivery of data to land during the cruises and once a day updates of the position map and weather conditions on Aranda in the Aranda Internet pages. The database system included automatic compression of data to files that the crew sent to the institute via e-mail. On land the files were decompressed and data put to the database. Thus the "rolling deck to repository" was reality in early 2000's.

Automatic real-time observation began in 1980's when the use of wave buoys at fixed position(s) was begun after several years of measuring the wave conditions in different sea areas for research and statistical purposes. At present semi permanent wave buoy stations are in the northern Baltic Sea proper, Gulf of Finland, Bothnian Sea and Bothnian Bay. These buoys are larger Wave Rider buoys. Smaller wave buoys are in use on research projects.



Figure 1: Taking samples from Nautilus, FMI's Argo-buoy, Aranda and glider. (Photos from FMI's archives)

The drifting buoys have been used in 2010's for surface drift research, for ice research and nowadays they are used as semi permanent temperature buoys in anchored mode, too.

FMI took as the first institute, the Argo buoys into use in the Baltic Sea. As a member of Euro-Argo, Finland, has been using Argo buoys in the Bothnian Sea since 2012 and in the Baltic Sea Proper since 2013. These buoys have two-way satellite communication system and they transmit data once a week. The buoys are replaced once a year. Thus the Baltic Sea Argo buoys can be used again and again.

The newest step in physical oceanography observations in the taking into use of underwater glider. FMI was a participant in European glider project GROOM and tested with Spanish colleagues a glider in the Bothnian Sea and Archipelago Sea. After these successful tests, FMI has got into its repertoire a Slocum shallow sea glider as part of the Finnish marine research infrastructure FINMARI.

A permanent ICOS station has been established at the Utö Island in the outer edge of the Archipelago Sea towards the Baltic Sea proper. That station has many oceanographic measuring systems included, too. The next step will be a bottom-mounted cabled underwater profiling system. It can operate all year round, a great advantage in areas with ice-cover in winter.

As a conclusion we can state that there has been success stories and obstacles to overcome in Finnish physical oceanography observations. Active participation in international observation campaigns and systems, and in organizations like ICES, IOC and HELCOM, and in international oceanographic data system development projects like SeaDataNet and EMODnets, have been vital for Finnish oceanography, too.