Why do long-term environmental monitoring?

The world oceans play a major role in a large number of processes occurring at the surface of the earth. These processes influence the human environment and are in turn influenced by human pressure. The global climate seems to be in a process of change which could be caused by anthropogenic influence. Superimposed on this possible global changes are the large natural fluctuations.

In our waters there is a close relationship between the marine environmental variability and the fish stocks. Ocean climate fluctuations influence distribution, recruitment and growth of fish stocks. Long-term observation series (Fig. 9) combined with studies on the driving forces of the climate variability are necessary to predict the climate and thereby improve the management of the fisheries.

Significant amounts of contaminants have the ocean as their final destination. Monitoring the contaminant level is important both as an early warning of possible ecological damage and to observe the effect of introduced measures to reduce the pollution.

All nations have international obligation to monitor their marine waters and thereby contribute to the Global Ocean Observing System(GOOS). GOOS is conceived as a new, internationally organised system for gathering and distribution of marine data and derived products. It is envisioned to resemble the global meteorological observations and prediction network. The GOOS data and products will be applied for the benefit of mankind and for the safe use and preservation of the marine environment.

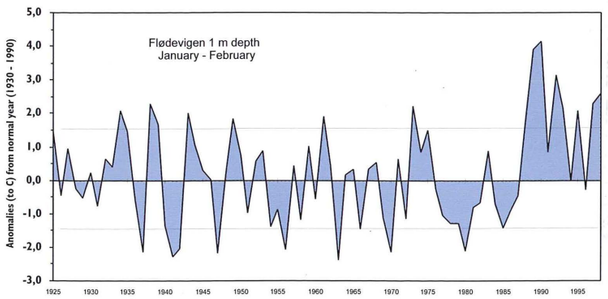

Fig. 9.Anomalies in the winter temperature of the surface layer close to the IMR's Research station Flødevigen

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The IMR's Environmental Observing System

ACTIVITY	OBSERVATIONS/YEAR	PARAMETERS	START YEAR
Fixed Stations			
Hydrographic stations, coastal	26 - 40	T, S	1935
Thermographic service	100 coast, 50 North Sea	T, S	1936
Flødevigen Research Station	350, *50	T, S, *Ppl (harmful algae)	1924
Fjords: Rogaland - Finnmark	1 (Nov-Des)	T, S, N, O_2	1975
Fjords: Skagerrak	1 (Oct), 12*	T, S, O_2* Oslofjord T,S,N,O_2	1920
Coastal monitoring, southern coast	12-24	T, S, N, O_2, Pm, Kl, Ppl, Zpl	1990
Station Mike - Norwegian Sea	60 (T/S)	T, S, N, Kl, Ppl, Zpl	1948
Fixed Sections			
Torungen - Hirtshals	11	T, S, O_2, N, Kl	1951
Hanstholm - Aberdeen	4 (Feb, April, June-July,*Nov)	T, S, *N, *Kl	1970
Oksø - Hanstholmen	4 (Feb, *April, June-July, *Nov)	T, S, *N, *Kl	1070
Utsira - Start Point	4 (Feb, April, June-July, *Nov)	T, S, *N, *Kl	1970
Feie - Shetland	4 (Feb, Apr, June-July, *Nov)	T, S, *N, *Kl	1970
Svinøy - NW	2 (Mar-Apr, July-Aug) *5-10 after 1995	T, S, *N, *Kl, *Ppl, *Zpl	1978
Gimsøy -NW	2 (Mar-Apr, July-Aug) *5-10 after 1995	T, S, *N, *Kl, *Ppl, *Zpl	1978
Fugløya - Bjørnøya	6 (Jan, Mar, Apr-May, June, Aug-Sept, Oct)	T, S, N, Kl, Zpl	1968
Bjørnøya -W	2 (March, Oct)	T, S	1958
Sørkapp -W	1 (Aug/Sept)	T, S	1978
Vardø -N	4 (Jan, Mar, June, Aug-Sept, Oct)	T, S, N, Kl, Zpl	1953
Sermøyene - N	2 (Jan-Feb, Aug-Sept)	T, S	1977
Regional coverages			
Barents Sea	4 (Jan-Feb, **June, *Aug - Sept)	T, S, *N, *Kl, *Zpl, **Flrv	1966
Barents Sea	Periodic observations	Contaminants, radioactivity, org. mat.	1991
Norwegian Sea (Central/Northern)	3 (May, July-Aug, Oct-Nov)	T, S, O_2, N, Kl, Zpl	1951
Norwegian Sea (Central/Northern)	Periodic observations	Contaminants and org. mat.	1994
Norwegian coast, North of 62 degr.	2 (*Apr, Oct)	T, S, *Flrv,Zpl,*N	1981
North Sea/Skagerrak	4 (Jan, July, Oct, *Nov-Des)	T, S, *N, *Kl	1967
North Sea/Skagerrak	Periodic observations	Contaminants, radioactivity, org.mat.	1991
Skagerrak - Jylland W	1 (April)	T, S, N,O_2, Kl, Ppl (harmful algae)	1988
Lofoten	1 (March - April)	T, S	1951
Ireland - Shetland - Faroe Is.	2 (March-April, May-June)	T, S	1971
Svalbard - W	1 (Aug-Sept)	T, S	1981

T=temperature, S=salinity, O_2=oxygen, N=nutrients, Pm=particulate matter, Kl=chlorophyll a, Ph=phytoplankton, Zpl=zooplankton, Flrv=fish larvae

Institute of Marine Research (IMR) Norway

IMR`s Environmental Observing System

IMR is a national centre placed under the Ministry of Fisheries for research on the marine living resources and the marine environment. The institute has about 500 employees of which 150 are scientists. In addition to the main facilities in Bergen, IMR has three research stations and five research vessels. The overall objectives of the institute are to provide the scientific basis for;

- Future-oriented and sustainable management of the marine environment.
- Diverse and economic viable fisheries by ecologically responsible utilisation of the marine living resources.
- Diverse and viable aquaculture on a genetic and environmental safe base.

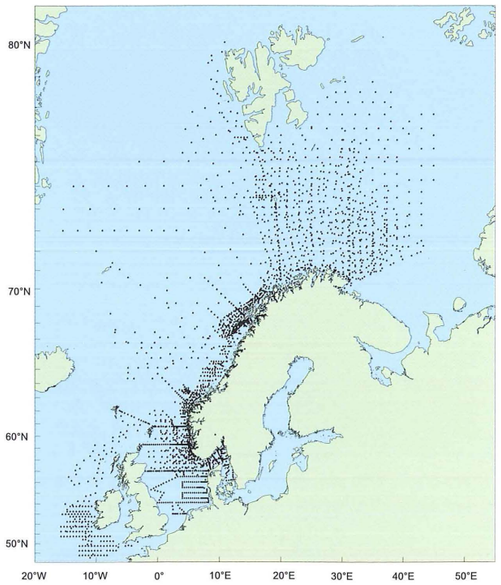

Fig. 1. Distribution of oceanographic stations in 1998 (4050 stations)

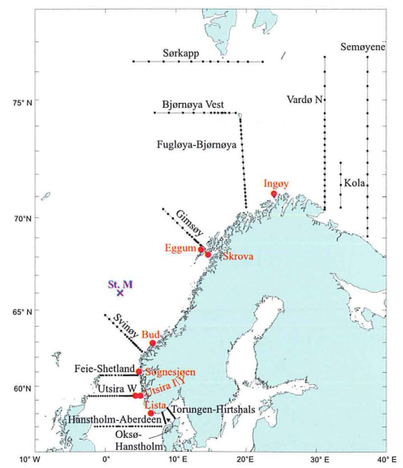

Fig. 2. Fixed oceanographic stations and sections

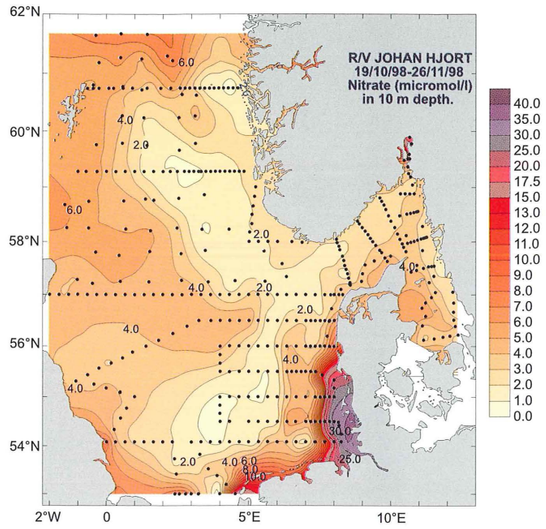

Fig. 3. Typical coverage of theNorth Sea during autumn showing grid of stations and nitrate in 10 m depth.

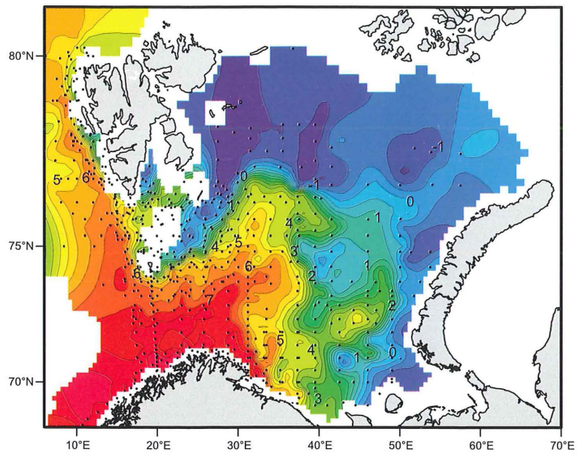

Fig. 4. Coverage of the Barents Sea during August-September 1994 showing grid of stations and temperature in 50 m depth.

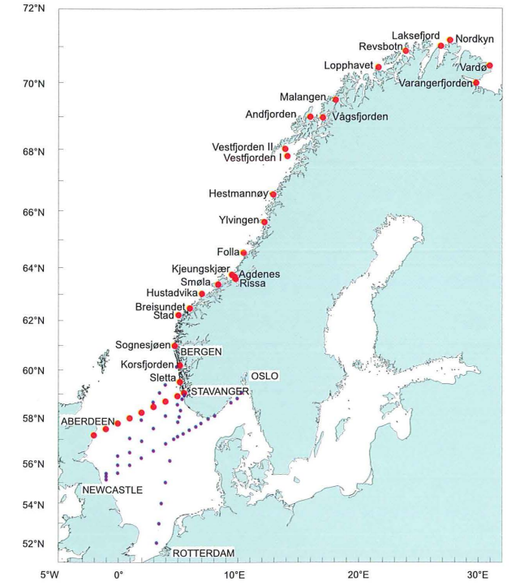

Fig. 5. The thermograph service. Red dots indicate ongoing activity. Blue dots indicate historical time series.

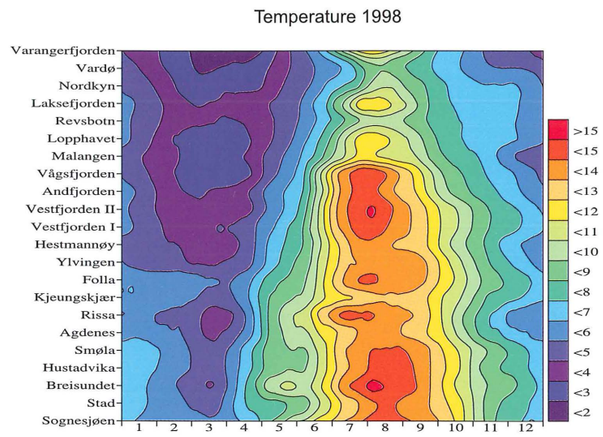

Fig. 6. Surface temperature along the Norwegian coast in 1998 as observed by the termograph service(Fig. 5)

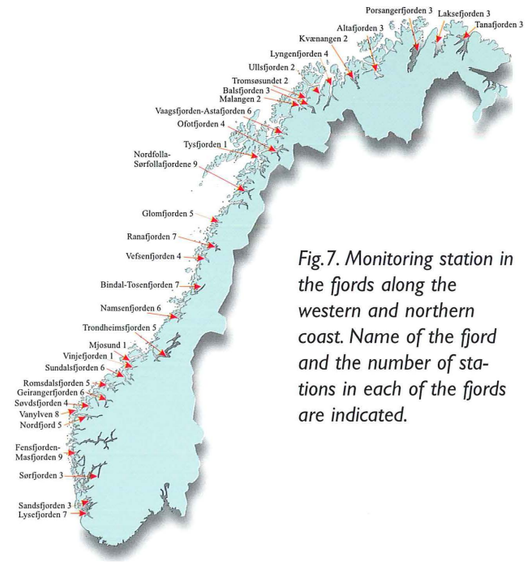

Fig. 7. Monitoring station in the fjords along the western and northern coast. Name of the fjord and the number of stations in each of the fjords are indicated.

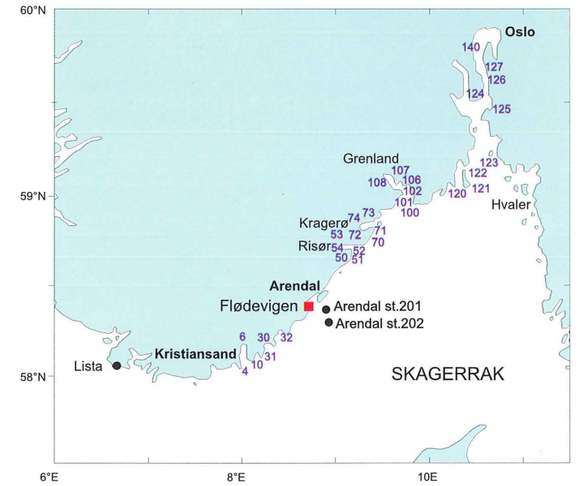

Fig 8. The IMR's Research Station Flødevigen and the coastal and fjord stations of the Skagerrak coast

Fixed oceanographic stations and sections

During the period 1935-1947 the Institute of Marine Research established a number of fixed oceanographic stations along the Norwegian coast between the Skagerrak and the Barents Sea (Table 1 and Fig. 2). The main objective was to monitor the ocean climate variability in relation to fisheries. Temperature and salinity measurements were regularly taken on these fixed stations since the start with yearly observation frequency of 26 - 40. The work is carried out by local observers who today are equipped with modern instrumentation. Ocean Weather Station Mike in the Norwegian Sea (Fig.2) has been operated by the University of Bergen since 1948.
Since 1990 the IMR has carried out weekly measurements of nutrients, chlorophyll and phytoplankton.

The system of fixed oceanographic sections have been operated for about 20 years in the Norwegian and the Barents Seas and for about 30 years in the North Sea. Some of the sections have sporadically been observed since the turn of this century. Chemical parameters, such as nutrients and oxygen, as well as plankton have been observed on selected stations and sections during the last 10-20 years.

Regional coverages

In addition to the system of fixed oceanographic stations and sections IMR has regular regional monitoring of the conditions in the North Sea/Skagerrak, the Norwegian Sea, the Barents Sea and in the Norwegian coastal area.This activity is related to variability in ocean climate, plankton production, recruitment to fish stocks and anthropogenic impacts, such as input of nutrients and harmfull algae blooms, organic contaminants and radioactivity. Examples of such regional coverages are given in Figs. 3 and 4.

Thermograph service

In 1936 the IMR established a system for recording temperature and salinity in the surface layer along the Norwegian coast by using commercial vessels. The route between Stavanger and the northernmost coast of Norway is surveyed twice a week. In the mid-fifties the program was extended to some shipping routes across the North Sea (Fig 5).
These routes were stopped in the early 1980s and today only the North Sea route beween Stavanger and Aberdeen is covered once a week. Fig. 6 demonstrate the annual results from the termograph service.

Monitoring the fjords

In November - December each year the environmental conditions in the fjords along the western and northern coast of Norway are observed (Fig. 7). Temperature, salinity, oxygen and nutrients are measured. These observations give information on long-term variations in the ocean climate and a possible negative development in the content of nutrients and oxygen as a consequence of eutrophication.

The Skagerrak coastal conditions

At Flødevigen Research Station temperature and salinity are observed daily at several depths. These time series dates back to 1924. Since 1985 there has been a regular monitoring for harmfull algae and the results are reported weekly during the algae season. Since 1990 hydrographic, hydrochemical and biological parameters have been observed monthly at two locations off Arendal (Fig. 8). In October each year the fjords of the Norwegian Skagerrak coast are monitored with respect to hydrographic and hydrochemical parameters as well as beach seine sampling for juvenile fish.
These investigations started in 1920