A SURVEY OF CRUISES, PROJECTS
AND FIELD OBSERVATIONS IN
PHYSICAL OCEANOGRAPHY
1966-2017

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Foreword

In 2015 I was contacted by the Norwegian Marine Data Centre (NMDC) at the Institute of Marine Research in Bergen, and informed that the NMDC was interested in marine data in a digitalized form. The representant at the University of Oslo has been Joël Durant. A master student, Ole Henrik Botvar, has digitalized data from master theses in physical oceanography from the period 1969-1993, and I have digitalized my own field observations in marine optics and hydrography. During this process I have found it useful to write a survey of the cruises in which I have participated, and in case the survey might be useful to others, it is published in the research archive of the University of Oslo, DUO: //www.duo.uio.no/ A section containing photos from some of the cruises has been added to the survey.

In addition to the transfer of data to NMDC, the data will also tentatively be stored at //archive.norstore.no/.
1. The big seas, coastal waters and Oslofjorden 1966-1973

1966
The Norwegian Sea July 3-28 on RV Helland Hansen
In 1966 participation in an oceanographic survey was obligatory for master students in physical oceanography at the University of Oslo. Such a cruise took place onboard the RV Helland-Hansen from the University of Bergen. The participants from Oslo were research assistant Tom McClimans and students Bente Baalsrud and Eyvind Aas. Cruise leader was Thor Kvinge, Birger Biskophavn was captain and Leif Herland chief. The purpose of the survey was to measure hydrography (temperature, salinity and currents). Moored current meters, later to be manufactured by the Aanderaa company, were applied. Photos (see the photo collection) reveal that plankton samples were also taken. The investigation was made in the areas around the Shetland and Faroe Islands. The collection of data is stored in the archives of the Department of Earth Science (formerly the Department of Geophysics) at the University of Bergen. This department has transferred a copy of the data to the NMDC.

In the fall of 1966 another event took place. Trygve Braarud, a professor in marine botany, was interested in the spectral irradiance in the sea as a part of the International Biological Program (IBP), and he persuaded my formal supervisor, professor Odd Henrik Sælen, to let one of his students specialize in the field of marine optics. As a result I was sent to professor Nils G. Jerlov at the University of Copenhagen, and I spent a few months there at his department, mainly with Bo Lundgren as the mentor.

1967
Oslofjorden March 1 - November 24 on RV Gunnar Knudsen
The irradiance recorded in Oslofjorden in 1967 was originally intended as a part of my master thesis (Aas, 1969a). On July 24, 1969 a preliminary report was sent to professor Trygve Braarud. The report contained a description of the stations and dates, as well as the spectrally integrated irradiance in the range 340-740 nm, at different locations and depths. The units were [W m\(^{-2}\)] and [number of quanta m\(^{-2}\) s\(^{-1}\)]. The instrument sensor was a photovoltaic selenium cell provided with filters of coloured glass from Schott. The method has been described elsewhere (Aas, 1969a,b; Aas, 1971). The captain on RV Gunnar Knudsen was Bjarne Søreng.

In the end of the work for the master thesis the data of integrated energy (\(E\)) and quanta (\(Q\)) irradiance from Oslofjorden were not included, but they are now transferred to the NMDC, where the calculated spectral irradiance at 4 wavelengths has been added. Temperature and salinity were provided by Bente Baalsrud (Baalsrud, 1975), whose hydrographic measurements were coordinated with the optical field work whenever possible. The difference in time between optical and hydrographical measurements varied in the range 0-6 days. The stations O1, O2, O3, O4 and O5 correspond to the NIVA stations Ap1, Bn1, Dk1, Fl1 and Im1, respectively. NIVA is the Norwegian Institute for Water Research.
A student report from a field course in Hallangspollen, May 1967 (Almnes et al., 1967), is of some interest here, since the Secchi disk depth may be obtained from the data. The report was provided by Fredrik Beyer at the Department of biology. Parts of the data from the report have now been sent to the NMDC.

Norwegian coastal waters Stad-Lofoten March 3-18 on RV Johan Hjort
In 1961 the International Council of Scientific Unions (ICSU) established a Planning Committee on the proposed International Biological Program (IBP). The committee later recommended that the IBP should "focus on the effect on biological communities of changes in the natural environment, ...". The IBP wanted to investigate if effects of UV radiation could be detected on eggs and larvae of herring. The irradiance was recorded, but unfortunately no eggs were found during this cruise. The cruise was reported by Bjørke et al. (1967). The captain was Anders Lunde, and the cruise leader was Olav Dragesund. Among the participants were Odd Nakken, Herman Bjørke and Sigmund Agdestein.

There were three locations with irradiance recordings, two of the stations have been presented elsewhere (Aas, 1969a,b), but for completeness, and because the old report may not be available any more, all three stations are now presented in the data collection sent to the NMDC. The observations have also been analyzed by Aas and Berge (1976) and Aas (1980).

Baltic Sea June 1-24 on offshore patrol frigate HDMS Fylla
The Department of Physical Oceanography at the University of Copenhagen participated in the international project "Military Oceanographic Month, Baltic Sea, 1967" (MILOC BALTIC 67) onboard the patrol frigate "Fylla" from the Danish navy, with Gunnar Kullenberg, Kim Larsen, Bo Lundgren, Kjell Nygård and Milan Thamsborg. Other guests were Willi Brogmus from Institut für Meereskunde in Kiel, and myself from the University of Oslo. I did not do any recordings on my own, but being a master student I assisted in order to observe and learn.

The ships from Denmark were Cutter, Fylla and Nymfen, from the Netherlands Snellius, from West Germany Fehmarn, Helgoland, Sauerland and Trave, from the USA Atlantis II, and from the SACLANT Maria Paolina G. Scatterance observations at small angles from the Danish part of the cruise were later published by Kullenberg (1969).

Hardangerfjorden July 3-23 on RV Gunnar Knudsen
The aim of the cruise was to examine the environmental conditions for phytoplankton growth in Hardangerfjorden (Braarud, 1961), and thus provide data for the master thesis of Ulf Aabel Lillemoen. The captain was Bjarne Søreng, and the students were Bente Baalsrud, Lars Føyn, Ulf Lillemoen and Eyvind Aas. Visitors during the cruise were scientific assistant Roald Sætre (University of Bergen), professor Ernst Føyn and associate professor Sven Rolf Lange (both from the University of Oslo).

Figures for temperature, salinity, density, oxygen content and irradiance, as well as a figure with location of the stations, have been presented by Aas (1971). Other results were also presented by Aas (1971, 1976). Irradiance at these stations was presented in tabulated form. Tables of the hydrographic parameters were prepared by Baalsrud and sent to professor Trygve Braarud, but they seem to have been lost, and consequently new copies have been made. The Ekman current meter was also applied during the cruise, but the fate of the recordings is not known. Phytoplankton counts and hydrography were presented by Lillemoen (1971).
1968
In 1968 I had planned to finish my master thesis by the end of the year, and consequently the cruises were restricted to the IBP project in Norwegian coastal waters.

**Norwegian coastal waters Stad-Lofoten April 16-30 on RV G. O. Sars**
The IBP cruises continued in 1968. The captain was Dagfinn Sætre and the chief Hans Hufthamar. Cruise leaders were Grim Berge and Herman Bjørke. There were three locations with irradiance recordings, two of which have been presented elsewhere (Aas, 1969a,b). All three stations are now collected in the data collection sent to the NMDC. The observations have also been analyzed by Aas and Berge (1976) and Aas (1980).

1969
**Norwegian coastal waters Stad-Lofoten May 2-7 on RV Johan Hjort**
In January 1969 I passed my exam in physical oceanography, and I was engaged by Trygve Braarud as a research assistant in the International Biological Program. The cruises of the IBP in the Lofoten area continued, and the cruise leaders in 1969 were Grim Berge, Arvid Hylen, Odd Nakken and Herman Bjørke. This was the last IBP cruise where I participated.

Eight stations with irradiance recordings were obtained, but at three of them only blue irradiance at 470 nm was measured (Aas and Berge, 1976; Aas, 1980). The data have been transferred to the NMDC.

1970
**Hardangerfjorden January 27 - February 1 on RV Helland-Hansen**
A cruise in January was led by Gunvald Bøyum from the University of Bergen. Kjell Nygård from the University of Copenhagen was participating, testing out a 2 meter long transmittance meter (c-meter). Irradiance was recorded at station H1 where the surrounding mountains prevented the sun rays from reaching the sea surface, and at Bleie in Sørfjorden where the sun rays could enter from the south. Irradiance data for H1 have been published earlier (Aas, 1971), and irradiance at Bleie is now presented in the data collection sent to the NMDC. Temperature and salinity at both locations are also presented.

**Barents Sea July 1-15 on RV G. O. Sars**
In 1970 the new RV G. O. Sars replaced the older vessel of the same name (later renamed Harengus). The cruise in July was aimed at searching for capelin in the Barents Sea. Recordings of light scatterance and fluorescence of water samples were made with a Tyndall meter, manufactured by Kjell Nygård at the Department of Physical Oceanography at the University of Copenhagen. The volume scattering function $\beta$ was observed at a scattering angle of 45° and a wavelength of 406 nm. The results were presented in department reports (Aas, 1979a, 1984b), including temperature and salinity. The data are now transferred to the NMDC.

**Hardangerfjorden November 16-21 on RV Helland-Hansen**
Participants from the Department of Geophysics, University of Bergen, were Bøyum, Kvinge, Revheim and Devold, and the crew consisted of Hauge, Wiksøe, Herland, Næss, Lorentzen, Monsen, Haugland and Vågen. The cruise started with a vertical section across the Norwegian Coastal Current, but due to the wind conditions, the number of stations was reduced. The cruise continued in Hardangerfjorden, where the wind again made the work difficult. Scatterance and fluorescence were measured with the Tyndall meter. A vertical section with
scatterance observations has been shown by Aas (1976). (In that paper there is an error in the figure legend: The wavelength of the scatterance is 406 nm, not 366 nm.) The volume scattering function $\beta$ was observed at 406, 546 and 578 nm. The fluorescence function $\phi$ of yellow substance (CDOM) was similarly observed with the Hg line at 366 nm as excitation wavelength and 525 nm as emission wavelength. The complete recordings are presented in the data collection (NMDC).

1971

In 1971 I ended my employment with the IBP program, and started as a research assistant at the Department of Geophysics at the University of Oslo.

Oslofjorden January 6-7 on RV H. H. Gran

The cruise consisted of stations close to Elle, Bastøy and Torbjørnskjær in the Outer Oslofjord. The names for the stations by the Norwegian Institute for Water Research (NIVA) are Jm2, Vn1 and Æq1, respectively. Scatterance and fluorescence were recorded with the Tyndall meter, and hydrography by water samplers and a measuring bridge from Electronic Switchgear Ltd. The captain was Einar I. Andersen, and Finn-Erik Dahl was cruise leader. The data have been transferred to the NMDC.

Ranafjorden April 20-24 on RV G. O. Sars

Before RV G. O. Sars started on its cruise to the areas around the Faroe Islands, it made a brief trip to Ranafjorden for some chemical investigations. According to my cruise journal Grim Berge, Torkild Carstens, Lars Føyn, Karsten Palmork, Kjell Seglem and Roald Sætre participated in this part of the cruise. I used the opportunity to measure scatterance of the particle content and fluorescence of yellow substance (CDOM) by means of the Tyndall meter. Part of the results was presented by Aas in 1974 during a symposium on the influence of fresh water on the sea (Aas, 1976). There is an error in the published figure legend, since the investigation in Ranafjorden took part in April and not in March, and the wavelength of the published scatterance was 406 nm and not 366 nm. The results were also presented at a symposium in 1980 (Aas, 1981a). The recordings, converted to absolute units (Aas, 1979b), have been transferred to the NMDC.

Norwegian Sea April 24- May 7 on RV G. O. Sars

The main purpose of the cruise was to investigate the distributions of blue whiting and cuttlefish in the Norwegian Sea around the Faroe Islands. Among those participating in the cruise I have noted Bertone, Bostrøm, Brattberg, Bøhle, Hansen, Klæt, Lygren, Nygård, Sangoldt, Storler and Tveite. Odd Nakken and Stein Hjalti Jakupsstovu were cruise leaders. Some results of the irradiance recordings have been published by Aas and Berge (1976) and Aas (1980), while the remaining data are transferred to the NMDC.

Mediterranean Sea June 24-July 13 on RV Helland-Hansen

The Nordic Mediterranean Cruise in 1971 was a result of collaboration within the Nordic Collegium for Physical Oceanography. The main subjects to be studied were bottom currents in the Straits of Gibraltar, mixing processes in the surface layer and optical conditions in the Western Mediterranean. The crew was Magnus Hauge (captain), Birger Biskopshavn (mate), Leif Herland (chief), Asbjørn Næss (engineer), Åsvald Haugland (deck hand), "Store-Knut" Angeltveit (deck hand) and Arthur Peder Småge (steward). The surname of the messboy was Kausland.
The optical cruise lasted from May 29 to July 13 and had two parts. The second part was from June 24 to July 13, and the researchers were Niels Berg Olsen, Jørn Holck, Bo Lundgren and Arne Nielsen from Denmark, Raymond C. Smith from the USA, and Eyvind Aas from Norway. The radiances observed by Smith were presented in Copenhagen the next year (Smith, 1974), and a figure with some of Lundgren's radiance observations was presented by Jerlov (1976, Fig. 56). Twenty-six years later more of Lundgren's observations were published by Højerslev and Aas (1997) and Aas et al. (1997), while Adams et al. (2002) compared modelled and observed polarizations and radiances.

1972
A proposal for research funding of a project entitled "Sjøvannets optiske egenskaper" (Optical properties of seawater) for the years 1972-74 had been sent to the Norwegian Reasearch Council (NAVF). The field work was planned to take place in the Norwegian Sea and adjacent areas, including the Oslofjord-Skagerrak area. The proposal was granted. The expenses became smaller than expected, and thus the project could be prolonged to 1976.

Barents Sea August 1-23 on RV Johan Hjort
The cruise started from Bergen on August 1 and ended in Kirkenes on August 23. Recordings with the Tyndall meter were made at 31 stations. The last station was taken west of Novaya Zemlya on August 21. In the morning sun the sea was for once almost flat, and I obtained a personal Secchi depth record of 36 m. The disk was small, with a diameter of 23 cm, and with a greater disk the depth probably would also have been greater.

Parts of the recordings have been published earlier (Aas, 1979a), but then the scatterance and fluorescence were presented in relative units. In a later investigation of the wavelength selectivity of scatterance in the Barents Sea (Aas, 1984b) absolute units were applied. Data in absolute units from the 31 stations have now been transferred to NMDC.

1973
The project "Optical Properties of Seawater" was supported by the Norwegian Research Council for Science and the Humanities (NAVF) with NOK 7000 for 1973. The project was later extended to 1974. Recordings of irradiance, particle scattering of light and fluorescence from yellow substance (CDOM) were made in Oslofjorden in 1973-74, and scatterance and fluorescence were observed in the Barents Sea in 1973. A master thesis with recordings by J. Nilsen of salinity, temperature and spectral irradiance in Oslofjorden 1973-1974, have been published as an institute report and on the internet (www.duo.uio.no), (Nilsen and Aas, 1977).

Oslofjorden February 14-15 and November 7-9 on RV Gunnar Knudsen, and July 3-5, on "Jonas"
The captain on RV Gunnar Knudsen was Tom Tønnesen. The Section for Oceanography at the Department of Geophysics had bought a small motor boat that was used for field work and courses at the master level. The boat was named Jonas in honour of the former professor in physical oceanography: Jonas Ekman Fjeldstad. It can be seen in the photo collection for 1969. Some results were published by Aas (1976).

Norwegian Coastal Waters - Storegga March 16-20 on RV Helland-Hansen
The cruise leader was professor Martin Mork. Other scientific participants were Gunnar Furnes, Arne Revheim, Kim Saunders and two geologists (names lost). I had been invited in
order to investigate if there were any signs of turbidity currents down the slope of the continental shelf at Storegga.

Weather conditions were not favourable, with wind speeds in the range from breeze to gale. This could create wire angles and thus problems for the depths of the water samplers. A vertical section in the east-west direction were recorded twice, and scatterance and fluorescence were measured with the Tyndall meter at 8 stations. No turbidity currents were observed. The mean values of the section have been presented earlier (Aas, 1981a), and all data are now transferred to NMDC.

**Barents Sea May 22 - June 8 on RV G. O. Sars**

The purpose of the cruise was to record the distribution and abundance of capelin in the Barents Sea. The cruise leader was Terje Monstad, and other members of the scientific staff were Oddgeir Alvheim, Birger Brynildsen, Anders Haug, Erling Klæt, Hans Petter Knudsen, Steinar Kongslevoll, Askjel Raknes and Bente Skarsten. In the crew there were Anders Lunde (captain), Monrad Veivåg (chief officer), Erling Kleven (first officer), Einar Kleppsvik (chief engineer), Eide (first engineer), Vea (trawl leader), Solli (fishing leader), and Søreide (telegraphist).

Secchi depth was observed at 101 stations. At 8 of these, blue irradiance, scatterance and fluorescence were also recorded. At Station 423, just south of Bear Island (Bjørnøya) in the western Barents Sea, there were no signs of the Bear Island Current. Neither was the East Spitsbergen Current apparent at Station 430, close to the south tip of Spitsbergen. A complete spectral irradiance recording was made there. Some data and results have been published earlier (Aas and Berge, 1976; Aas, 1979a, 1980, 1984b). All data for scatterance and fluorescence are now transferred to NMDC. Some views from Isfjorden and Longyearbyen are presented in the photo collection.

For several reasons this became the last of my expeditions to the big seas. Later cruises took place in the Oslofjord-Northern Skagerrak area.
2. The Oslofjorden-Skagerrak area 1974-2017
Many of the cruises in the period from 1974 were in remote sensing projects in collaboration
with NIVA, and the resulting data were mostly stored by NIVA. Other cruises were field
courses in physical oceanography at the University of Oslo, and those data are now sent to the
NMDC.

1974
Oslofjorden January 25, March 18, September 17-18 and November 22 on RV Gunnar
Knudsen, and July 18 on "Jonas"
The captain on RV Gunnar Knudsen was Tom Tønnesen. At some stations only the Secchi
depth was observed, otherwise the light scatterance and fluorescence were recorded by means
of the Tyndall meter. When temperature and salinity are reported with two decimals, they
have been determined by reversing thermometers in the sea and by conductivity
measurements of water samples in the laboratory. If temperature and salinity have one
decimal, they have been determined by a salinity-temperature bridge (Electronic Switchgear
MC5). Plankton analyses were made in July and September. In July the water was described
as brownish due to algal growth. The data have been transferred to the NMDC.

1976
Oslofjorden September 22 on RV Gunnar Knudsen
Temperature and salinity were recorded by the salinity-temperature bridge.

1977
Oslofjorden January 26 on RV Gunnar Knudsen
Temperature and salinity were recorded by the salinity-temperature bridge. Beam
transmittance and the resulting beam attenuation coefficient at 650 nm was recorded by an
instrument manufactured by Hydro-Bios.

1980
This year I obtained a permanent position as associate professor in physical oceanography at
the Department of Geophysics.

Oslofjorden September 18 on RV Apollo Øst
The captain on RV Apollo Øst was Tom Tønnesen. Temperature and salinity were recorded
by the salinity-temperature bridge. Quanta irradiance was recorded by a Lambda (Li-Cor)
Underwater Quantum Sensor with a similar deck instrument as reference.

1981
Oslofjorden September 9 and 30 on RV Apollo Øst
This year the captain was Einar Martinsen.
1982
Oslofjorden August 23 and October 7 on RV Apollo Øst
The captain may have been Einar Martinsen. Temperature and salinity were recorded by the salinity-temperature bridge. Temperature was also obtained from reversing thermometers mounted on Nansen bottles, and salinity was found by titration of water samples. Oxygen content was obtained by analysis of water samples.

1983
Oslofjorden May 30 on RV Apollo Øst
The program for 1982 was repeated.

1984

Oslofjorden August 22 and September 20 on RV Trygve Braarud
The captain on RV Trygve Braarud was Tom Tønnesen, and the second in command was Ivar Dyrkorn. Temperature and salinity were recorded by the Neil Brown CTD sensor, and quanta irradiance by the Li-Cor sensors. Vertical profiles of the beam attenuation coefficient at 380 nm was obtained by an instrument constructed by Sigurd Baalsrud and Knut Nielsen Hauge, both in Oslo.

1985
Oslofjorden May 8 and September 25 on RV Trygve Braarud
The captain on RV Trygve Braarud was Tom Tønnesen, and the second in command was Ivar Dyrkorn. Temperature, salinity and quanta irradiance were recorded.

1986
Oslofjorden September 24 on RV Trygve Braarud
The captain and the second in command on RV Trygve Braarud were probably Tom Tønnesen and Ivar Dyrkorn, respectively. Temperature, salinity and quanta irradiance were recorded.

1987
Oslofjorden September 23 on RV Trygve Braarud
The recordings from 1986 were repeated. More observations from 1986-87 have been published by Mikaelsen and Aas (1990).
1988

Oslofjorden-Skagerrak May-October on RV Trygve Braarud and MS Hankø

In 1988 the project "Eutrofisituasjonen i Ytre Oslofjord" (the Eutrophy Conditions in the Outer Oslofjord) was started in order to provide information for the Norwegian Pollution Control Authority. The field work began in May and ended in October. It was a collaboration between the Norwegian Institute for Water Research (NIVA), the University of Oslo and Veritec (a part of the Veritas company). The ships were RV Trygve Braarud and MS Hankø. The results from 1988 have earlier been published in a report from the Norwegian Pollution Control Authority (Aas et al., 1989), but because this report may not be easily accessible, they are now transferred to the NMDC. Data from a field course on September 21 have been added.

The captain on RV Trygve Braarud was Tom Tønnesen, and the second in command was Tom Pedersen. Temperature and salinity were recorded by the Neil Brown CTD sensor and by the salinity-temperature bridge MC5 from Electronic Switchgear London Ltd. Quanta irradiance was recorded by the Li-Cor Underwater Quantum Sensor. Colour index, defined as the ratio between upward radiances at 450 and 520 nm, were recorded at 0.2 and 1.0 m depths. The applied colour index meter was constructed by Niels K. Høyerslev and Henning Hundal in Copenhagen. Secchi depths for a white disk of diameter 30 cm were observed with the naked eye and through the Schott filters BG12 (peak influence 470 nm), VG9 (540 nm) and RG1 (620 nm). Surface samples were analyzed by NIVA for turbidity, total suspended material, chlorophyll $a$ and pheophytin.

1989

Oslofjorden-Skagerrak April-September on RV Trygve Braarud, RV G. M. Dannevig and MS Hankø

The eutrophy project which started in 1988, continued. The ships were RV G. M. Dannevig from the Institute of Marine Research, Bergen, RV Trygve Braarud from the University of Oslo, and the MS Hankø. Terje Løyning represented the University of Oslo at most of the cruises. Data were also collected during university courses. Observations were similar to those of 1988, but in addition vertical profiles of the beam attenuation coefficient was obtained by an instrument from Martec.

Part of the results from 1989 were published in a report from the Norwegian Pollution Control Authority (Sørensen et al., 1990), and also in a department report (Aas et al., 1994). More complete sets have now been transferred to the NMDC.

1990

Oslofjorden September 20 on RV Trygve Braarud

"The Skagerrak Experiment" (SKAGEX) was an international project supported by ICES. Most of the field work took place in 1990. The ships were RV G. M. Dannevig in the Skagerrak and RV Trygve Braarud in the Oslofjord.

The captain on RV Trygve Braarud was Tom Tønnesen, and the second in command was Eskil Odberg. Current speed and direction were recorded outside Elle by an ADCP from Nortek A/S, Norway. Hydrography was recorded by a salinity-temperature bridge. Most of the data were published by Aas et al. (1994), but more complete data sets have been sent to the NMDC.
1991
Skagerrak November 18-19 on RV G. M. Dannevig
The observations in the Skagerrak continued in 1991, thanks to support from the Nordic Council for Physical Oceanography. Most results were published by Aas et al. (1994).

1992
Oslofjorden September 30 on RV Trygve Braarud
The captain on RV Trygve Braarud was Per Arvid Holt, and the second in command was Tom Pedersen. Current speed and direction together with temperature and salinity were recorded in the river Lysakerelva and at Rolfstangen by the ultrasonic current meter UCM-40 from NE Sensortec A/S, Norway. Hydrography at the other stations was recorded by a salinity-temperature bridge. Quanta irradiance was recorded by the Li-Cor sensor, and colour index by an instrument from Dansk Havteknik a/s.

1993
Oslofjorden September 22 on RV Trygve Braarud
The captain on RV Trygve Braarud was Per Holt, and the second in command was Richard Wærvågen. Current speed and direction together with temperature and salinity were recorded in the river Lysakerelva by the ultrasonic current meter UCM-40. Hydrography at the other stations was recorded by a salinity-temperature bridge, and quanta irradiance and colour index were also recorded.

1994
Oslofjorden May 9 and September 22 on RV Trygve Braarud, and September 19 on Pilen
The captain on RV Trygve Braarud was Per Holt, and the second in command was Richard Wærvågen (May) or Sindre Holm (September). Hydrography was recorded by the Mark IIIb CTD from Neil Brown and the salinity-temperature bridge MC5 from Electronic Switchgear London Ltd. Quanta irradiance and colour index were recorded.

On September 19 the data originate from a co-project with the Norwegian Institute for Water Research (NIVA). The captain on Pilen was Anders Flingtorp. Quanta irradiance was recorded.

1995
The PhD project "Influence of particles, yellow substance and solar altitude on the upward scattered light from coastal waters" funded by the Norwegian Research Council. It started in the fall of 1995 and ended in 1998. The candidate was Jo Høkedal. In addition to Høkedal's thesis, papers to result from the project were Aas and Høkedal (1996, 1999), Høkedal and Aas (1998), and Høkedal (2000). The latter paper presented data from the period 1996-1999.

Oslofjorden May 29-30 and October 12 on RV Trygve Braarud
During field courses the captain on RV Trygve Braarud was Sindre Holm, and the second in command was Jens Vedal (May) or Richard Wærvågen (October). Hydrography and quanta irradiance were recorded.
1996
Oslofjorden September 19 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was Richard Wærvågen. During field courses hydrography and quanta irradiance were recorded.

1997
Oslofjorden October 16 on RV Trygve Braarud
The captain on RV Trygve Braarud was Richard Wærvågen, and the second in command was Lars Myhrvold. Hydrography, colour index and Secchi disk depth were recorded.

1998
Oslofjorden September 10-11 and 16 on RV Trygve Braarud
The crew on RV Trygve Braarud consisted of Sindre Holm and Richard Wærvågen. Temperature, salinity, Secchi depth and quanta irradiance were recorded.

2000
Oslofjorden April 10-11, May 22, June 8 and 26-27, and September 11-12 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was Richard Wærvågen. Irradiance was recorded by the PRR-600 from Biospherical Instruments Inc., with the PRR-610 on deck as a reference. The white Secchi disk was a standard type, with diameter 30 cm.

2001
Oslofjorden May 7-8 and September 25 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was Per Anderson (May) or Gunder Falck (September). Temperature, salinity and the Secchi depth were recorded.

2002
Observations for the project "Validation of MERIS Products" (VAMP), funded by ESA, were taken in 2002 and 2003. Similar observations were made for "Regional Validation of MERIS Chlorophyll Products in North Sea Coastal Waters" (REVAMP) during 2002-2004. The latter project was funded by the European Commision. Data from the projects were stored in the archives of NIVA, and some were sent to ESA. Papers resulting from these two projects were Peters et al. (2005a,b), Sørensen et al. (2007), and Aas et al. (2009, 2014).

Oslofjorden May 6, June 3, September 2-3 and October 3 on RV Trygve Braarud
The captain on RV Trygve Braarud during the field courses was Sindre Holm, Gunder Falck or Jan Sundøy, and the second in command was Per Heldal Anderson. Temperature, salinity, quanta irradiance and Secchi depth were recorded.
2003
In this year the departments of geophysics, geography and geology merged into a new Department of Geosciences.

2004
Oslofjorden January 8, March 3-4, May 5, September 23 and December 22 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was Tor Eigil Wold, Jan Sundøy, Svein-Erik Omland, Henrik Domre or Steffen Holm. The main instrument was an ICTD from Falmouth Scientific Inc. There was problems with the instrument, and some data have been rejected. Quanta irradiance was recorded by a Li-Cor Underwater Quantum Sensor with a similar deck instrument as reference.

2005
Oslofjorden February 15, March 7-8, April 7-8 and 26-27, May 3-4, and September 22-23 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm or Jan Sundøy, and the second in command was Stian Pedersen or Jan Sundøy. The main instrument was the ICTD. Quanta irradiance was measured. Time-series of temperature were recorded by Tinytag aquatic temperature loggers. The master thesis for which the Tinytag recordings were intended, was never completed.

2006
Oslofjorden September 21 on RV Trygve Braarud
The captain on RV Trygve Braarud was Jan Sundøy, and the second in command was Ronny Pedersen. The ICTD had been damaged in August and was not used during this cruise. Instead hydrography was recorded by the salinity-temperature bridge MC5 from Electronic Switchgear London Ltd. Quanta irradiance was recorded by a Li-Cor Underwater Quantum Sensor with a similar deck instrument as reference. Irradiance on deck varied by a factor of up to three on this day, which may be why the in-water recordings are of different quality.

2007
Oslofjorden September 20-21 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was Tom Erik Baade. Temperature, salinity and quanta irradiance were recorded.

2008
Oslofjorden February 29, April 04, September 18 and October 30 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was Jan Sundøy or Tor Eigil Wold. The main instrument was an ICTD from Falmouth Scientific Inc. Quanta irradiance was recorded by a Li-Cor Underwater Quantum Sensor with a similar deck instrument as reference. Irradiance was not observed in February and October. In October the
ICTD was not used, but salinity and temperature just below the surface were recorded with the salinity-temperature bridge MC5 from Electronic Switchgear London Ltd.

2009
Data for the project VAMP2, supported by ESA, were collected in 2009-2011, and they were stored by NIVA and sent to ESA. Some results were published by Kleiv et al. (2015).

Oslofjorden February 20, March 27, April 30, September 24 and October 30 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm or Jan Sundøy, and the second in command was Tom Erik Baade, Jan Sundøy or Tor Eigil Wold. Temperature, salinity and quanta irradiance were recorded. Irradiance was not observed in February, March and October. In October recordings were taken at 3 m depth for one hour in order to detect internal waves.

2010
Oslofjorden February 19, April 23 and October 28-29 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was Tom Erik Baade or Tor Eigil Wold. Temperature, salinity and quanta irradiance were recorded. On October 29 a time series was taken at 10 m depth in order to detect internal waves.

2011
This year I retired from the university. Because no replacement had been made, I was asked to do some teaching including field courses. This continued till the fall of 2017.

Oslofjorden February 18, April 15 and September 22 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was Tor Eigil Wold. Temperature, salinity and quanta irradiance were recorded.

2012
Oslofjorden February 17, March 16, April 20 and September 27 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was either Tor Eigil Wold, Tom Opsahl or Jan Sundøy. Hydrography and quanta irradiance were observed.

2013
Oslofjorden February 15, March 15, April 19 and October 15 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was either Tom Opsahl or Jan Sundøy. Hydrography and irradiance were recorded. Some data have been lost.
2014
Oslofjorden February 13, March 13, April 10 and September 23-25 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was either Tom Opsahl, Jan Sundøy or Thor Eigil Wold. Hydrography and irradiance were recorded. Some data have been rejected.

2015
Oslofjorden February 19, March 19, April 16 and September 8-10 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm, and the second in command was either Tom Opsahl, Jan Sundøy or Thor Eigil Wold. Hydrography and irradiance were recorded.

2016
Oslofjorden September 26 and October 24-25 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm. The ship officers in September were Tom Opsahl and Jan Sundøy, and in October Opsahl and Morten Spiten. Hydrography and irradiance were recorded.

2017
Oslofjorden October 23-24 on RV Trygve Braarud
The captain on RV Trygve Braarud was Sindre Holm. The ship officer was Tom Opsahl. Hydrography and irradiance were recorded.

In addition to this survey of field data transferred to the NMDC, it may be mentioned that there are two PhD theses that were based on a lot of field work:

Eirik Sørgård: Turbulent friction in a salt wedge flow, 1991
André Staalstrøm: Tidally-induced turbulent mixing in a sill fjord, 2015

Before and after these theses related papers were published.
References


Part 2. Photos
The cruise 3-28 July, 1966

R/V Helland-Hansen in Bergen
A buoy is launched.
Second engineer Asbjørn Næss

Mate Kristoffer Vigsø
Thor Kvinge searching for buoys.

Fredrik Svendsen and Luiz Bruner de Miranda.
Bente Baalsrud

Tom McClimans and Eyvind Aas
Kvinge testing voltage on dental fillings.

Aas

A phytoplankton haul being made.
Oslofjorden 1967

The RV Gunnar Knudsen in Oslo Harbour.

Captain Bjarne Søreng.
Bjarne Søreng in his captain's cap.

(photo Jahn Thronsen)
Weather conditions were not perfect.
Rounding the Stad area.
Making a plankton haul.

Herman Bjørke sampling the zooplankton.

Aas injecting formalin to the phytoplankton samples.
Baltic Sea June 1-24, 1967

The patrol frigate HDMS Fylla

Fylla is a maid from the Norse mythology.
Kjell Nygård and the laser scatterance meter for small angles.

The multi-angle scatterance meter.

The deck reference cell and the sub-surface irradiance meter.
Milan Thamsborg and Bo Lundgren launching the radiance meter.

The radiance meter.

Bo Lundgren in the laboratory.
Gunnar Kullenberg and the Ekman current meter.

Kim Larsen

Aas and a sextant.
Milan Thamsborg (turned towards camera) and Willi Brogmu (behind wire wheel).

Kim Larsen taking a break.
The mouth of Simadalsfjorden is seen behind RV Gunnar Knudsen at station H1 in Eidsfjord. The mountainous terrain reduces the irradiance significantly at low sun heights.

Captain Bjarne Søreng.
Roald Sætre, Bente Baalsrud and Lars Føyn.

Ulf Aabel Lillemoen taking a plankton sample.
Lars and Ernst Føyn inspecting the water samples.

Roald and Lars pulling a rope.
RV Gunnar Knudsen in Ulvik. Rolf Lange in white hat in front of the wheelhouse.

Bente and a cup of tea.
Lars and Ulf hauling wire.

Bente with the Ekman current meter.
Lars in the wetlab.

Lars examining a water sample.
Cruise on G. O. Sars April 16-30 1968

RV G. O. Sars meeting RV Helland-Hansen

Captain Dagfinn Sætre
Taking a plankton haul.

Chief
Grim Berge and Sigmund Agdestein

Kjell Seglem

Lars Kalvenes
A visit by RV Asterias from Tromsø Museum.

The ship has turned southwards, and Agdestein is enjoying the sun.
Oslofjorden 1969, on "Jonas"

"Jonas" in Svelviksundet, 1969, with Finn-Erik Dahl and Tom McClimans.
Cruise on Johan Hjort May 2-5 1969

The crew is taking advantage of the weather.

Measurement of primary production by the C\textsuperscript{14} method and bottles in a water bath.
Kjell Seglem and his machine.

Self-portrait in Vestfjorden.
Hardangerfjorden January 1970 on RV Helland-Hansen

Helland-Hansen in Sørfjorden
On the stretches between stations the bridge is a popular place.
Ranafjorden April 20-24 and Norwegian Sea April 24 - May 7, 1971, on RV G. O. Sars

Torkild Carstens and Kjell Seglem taking the CTD onboard. A member of the crew maneuvering the winch.

Inspection of the catch. Cruise leader Odd Nakken is number two from the right.
Mediterranean Sea June 24 - July 13, 1971, on RV Helland-Hansen

RV Helland-Hansen in Cagliari on Sardinia.

The city of Cagliari.
J. Ronald V. Zaneveld (from the first part of the optical cruise), Bo Lundgren, and a sleeping local.

Bo and Ron out sailing.
Jørn Holck, Bo Lundgren, Ronald Zaneveld and Niels Berg Olsen.

A little rusty RV Helland-Hansen out in the Mediterranean.
Bo Lundgren with the irradiance meter, and Raymond C. Smith. Jørn Holck in the background.

Ray Smith working on his underwater camera under the black carpet. Jørn to the left.

Ray and the underwater camera.
RV Helland-Hansen and E. Aas inside the Snell cone, photographed by the underwater camera at 5 meter depth by Ray Smith.

The underwater camera being launched.
The radiance meter of Bo Lundgren.

Chief Leif Herland giving a concert.
Engineer Asbjørn Næss.

Captain Magnus Hauge.
Eyvind Aas.

Bo Lundgren.

Jørn Holck.
A visiting turtle.

A visiting dolphin.
RV Helland-Hansen heading for Malaga.
In Malaga: Arne Nielsen

In Malaga: Ray Smith and Bo Lundgren
Barents Sea August 1-23, 1972 on RV Johan Hjort

G. O. Sars visiting.
Trawling attracts the sea birds.
Barents Sea 1973, on RV G. O. Sars

Bear Island in the background.

Isfjorden.
An old churchyard outside Longyearbyen

Longyearbyen, Adventsfjorden in the background.
Oslofjorden 1974 on RV Gunnar Knudsen

Captain Tom Tønnesen onboard the RV Gunnar Knudsen in 1974. (Photo by Ivar H. Hesthagen)

Captain Tom Tønnesen. Photo possibly supplied by Inger Berg.
Oslofjorden 1988 on RV Trygve Braarud

Captain Tom Tønnesen onboard the RV Trygve Braarud, probably in 1988.
(Photo by Jahn Throndsen)
Tom Tønnesen and Kai Sørensen, date unknown.
Oslofjorden 2008-2015

RV Trygve Braarud 04.04.2008

Instructor Lars Grinde (red jacket) and chief Tor Eigil Wold (left) 22.09.2011.
Chief Tor Eigil Wold to the left. Secchi disk on deck. 22.09.2011.

Tor Eigil Wold and Lars Grinde. 17.02.2012.
Chief Tom Opsahl. 15.10.2013.

Captain Sindre Leif Holm and chief Tom Opsahl, 15.10.2013.
Captain Sindre Holm, 25.09.2014.

Chief Tor Eigil Wold, 09.09.2015.