Oceanography Committee

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REPORT OF THE

WORKING GROUP ON SHELF SEAS OCEANOGRAPHY

Gothenburg, Sweden
16–18 March 1998

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK-1261 Copenhagen K Denmark

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1 WELCOME AND OPENING

The chairman Einar Svendsen opened the meeting and welcomed all the participants. Bjorn Sjoberg welcomed the meeting on behalf of the Swedish Meteorological and Hydrographic Institute. The list of participants is given in Appendix II.

2 APPOINTMENT OF RAPPORTEUR

Phil Gillibrand was elected as rapporteur.

3 ADOPTION OF AGENDA

Due to the absence of relevant members, the agenda was modified slightly and approved. Two extra items were added:

12. To consider a change to new units of measurement for oxygen and nutrient data.

13. To discuss a drifter experiment for calibration and evaluation of numerical models.

4 REPORTS OF NATIONAL ACTIVITIES OF SPECIFIC INTEREST TO WG MEMBERS

Roald Saetre described the preparation and publication by The Institute of Marine Research in Bergen of an annual report describing the environmental status of Norwegian waters. The report contains updates of ecosystem and climate indicators from monitoring stations in the seas surrounding Norway. There are also reports on items of interest from the particular year, for example detailing the invasion of jellyfish into several fjords which resulted in major kills of farmed salmon. The final section of the report contained a prognosis for the following year, which is based on analysis of results from monitoring stations and standard sections. So far, in the years since the first prediction for 1995, the prognosis for the ocean climate, production and fish distribution has been reasonably accurate.

Francois-Jacques Saucier described a significant amount of effort in Canada to improve ocean monitoring. A proposal is presently being considered for physical and biological monitoring on the east coast of the country. There has been a big reduction in the Canadian Arctic research programme, but some projects are now being rejuvenated. Climate research is of great importance to Canada because the Kyoto conference stipulated that the country must reduce CO_2 emissions by 20% before 2010. Regional climate models are being developed to focus results from general climate models to improve predictions of climatic events e.g. flooding. It was also noted that very long term environmental monitoring has been maintained in Hudson Bay by the Hudson Bay Company since the 17th century.

Thomas Pohlman reported on two new German projects. The first, named SYKON, is a 2.5 year project with three components: (i) to synthesise the current state of North Sea research, (ii) assess research deficiencies and (iii) to identify new challenges. A series of groups have been established to review the current knowledge of physical, biological and fisheries related oceanography of the North Sea. The project commences in May 1998. The second proposal is entitled "Low pressure systems and the Climate System in the North Atlantic" and will run for 3 years. It also has three parts: a theoretical analysis of climate systems, a modelling component (employing the North Atlantic model at the Max Planck Institute and several regional models) and a field programme. An international conference on "Coastal Ocean and semi-enclosed seas circulation and ecology, modelling and monitoring" in Moscow on 8–12 September is being organised (contact person J. Suundermann).

Einar Svendsen presented some time series showing a strong correlation between modelled transport into the northern North Sea during winter (first quarter) and landings of horse mackerel approximately half a year later. The mechanism behind the correlation was unclear, although it seemed likely that the strong transport into the North Sea would lead to warmer, nutrient- and plankton-rich water in the basin.

Pekka Alenius reported on the present status of Finnish monitoring programmes (including the Baltic Monitoring Programme). An increased use of ships of opportunity has produced projects like Algaline (Kiel - Helsinki) with the data available on the WWW. Ferry companies have provided valuable financial support to the programmes.

Didrik Danielssen presented a long (30+ years) time series of oxygen measurements from a section in the Skagerrak between Denmark and Sweden. Measurements have been made monthly and show that oxygen concentrations are relatively low at present. This is reflected in the low oxygen levels observed in the Oslofjord, where the bottom waters have not been renewed since early 1996. Oxygen consumption in the fjord is estimated to have increased by 50% since the late eighties.

Temperature measurements illustrated the warm summers and winters that have prevailed over the past two years. There was also a report of low nutrient levels in the Skagerrak and eastern North Sea during the past winter.

Martin Schmidt reported on Baltic monitoring, which consisted of three research cruises annually and two permanent stations. However, modelling studies remain event specific, rather than becoming operational.

Hans Dahlin compared the response in Sweden to the Kyoto Conference to that of Canada: in Sweden, CO2 emissions are increasing because at present they are much lower than the specified levels. He also highlighted the latest HELCOM report on the Baltic environment. The series of reports each cover approximately a 5-year period. Dahlin also reported on the present state of BOOS (Baltic Operation Oceanographic Systems), which is using modelling and observational methods to obtain required products (such as physical, chemical and biological parameters).

Bjorn Sjoberg described some modelling and measurement of the Baltic plume. Shortcomings in the modelling and remote sensing data had been identified. The models required improved meteorological forcing, finer vertical resolution and more accurate freshwater input forcing.

5 CONTINUE THE EVALUATION OF THE EFFECTIVENESS IN ENVIRONMENTAL MONITORING PROGRAMMES (WITH FOCUS ON THE NORTH SEA) IN DETERMINING TRENDS AGAINST THE BACKGROUND OF NATURAL SPACE AND TIME FLUCTUATIONS, AND THE POSSIBLE SUPPORT FROM MODELS

The absence of G. Becker, who was mainly responsible for this item, resulted in a shortened discussion. However, Einar Svendsen presented a Norwegian report on eutrophication monitoring and related some of its conclusions about sampling methods. The report's summary included some general points concerning the focus of monitoring programs and emphasised the importance of considering the possibility of detecting changes and the statistical significance of monitoring results. The report also compared the importance of monitoring standard sections, using ship of opportunity and fixed coastal stations.

A general discussion followed about the aims of monitoring and how to focus a sampling strategy. There was some debate over whether monitoring should be justified as part of programs with wider aims or whether it is justified *per se*. It was decided that selected items from the Norwegian report would be adopted as recommendations (Ottersen et al., 1998. "Utarbeidelse av et program for overvåkning av eutrofitilstand og -utvikling i norske kystfarvann basert på både tradisjonelle og høyteknologiske metoder". Fisken og Havet nr.1 - 1998):

1) A main aim for a monitoring program is to detect a slowly developing trend against a background of large natural variations. The statistical basis for allowing a sound answer to this requires at minimum the answer to the following two questions: a) What size of changes in concentration is it important to be able to detect? b) Which probability level is wanted for the conclusion to be right?

2) For most parameters it is difficult to estimate realistic changes in yearly means based on traditional observations. This suggests that a year to year comparison should be made on a seasonal basis, for instance for those seasons when the variability is low compared to the mean value. This indicates that a uniform observation frequency throughout the year for all variables is not advisable.

3) Cruises with good spatial coverage is the form of surveillance giving the most thorough information for a given area and time. This kind of data gathering is most important for characterisation of water masses and spatial distribution. The spatial information from such cruises could be enhanced further by co-ordinating with other methods. Numerical models could be initialised with fields interpolated from cruise data and results from models used to evaluate the degree of representability of measurements from fixed stations.

4) The main purpose of fixed sections is to monitor large scale variability. Station spacing of about 10 km near shore and in frontal regions, and 20–30 km in more homogeneous water seems to be adequate for resolving most of the spatial variance.

5) Measurements from ships of opportunity are a reasonable and effective method for the gathering of many different kinds of data from the marine environment, but the potential of the method is at present far from fully utilised.

6) Fixed coastal stations play a central part in most monitoring programs, and long historical time series exist. It is therefore natural to build future monitoring programs around such stations. Choice of variables, position and number of stations, depths and frequency of observations are important. In the upper layers (such as in the Skagerrak), measuring once a week is recommended to include most of the variance, while further down measurements 1–2 times per months seems suitable. Reducing the number of stations to allow for higher intensity at some selected locations must be considered.

7) Several of the most important environmental parameters have a significant part of their (near surface) variability at frequencies so high that they in practice can not be captured by traditional measurement methods. Automatic buoys can register most of the total variability, however, like fixed stations, the great spatial variability perpendicular to the dominating current pattern, even at short distances, leads to the measurements from single buoys being relevant only for small areas. With the cost of some of today's buoys, they are recommended for monitoring in straits, some fjords and otherwise in situations where single buoys are adequate. To cover larger, more open areas, the use of buoys must be combined with other methods.

8) Satellites are able to give information about the sea surface with a relative high resolution both in space and time. For many years, ocean currents has been estimated from satellite monitoring of the sea surface topography (using altimeter), and wind speed and wave height estimated from the same instrument are regularly used in weather forecasting. Sea surface temperature is the most commonly used remotely sensed parameter, and the sea ice distribution has also been monitored for many years. Even accounting for shortcomings related to cloudiness and low solar altitude (just a restriction for some of the parameters) the remote sensing method has a potential beyond that which is utilised in the current surveillance programs. The potential within coastal monitoring has lately been significantly enhanced by the introduction of the SeaWiFS sensor on one of the NASA satellites. Further advancement follows in the near future when the MERIS is launched and later the ENVISAT. To utilise the large amount of information from satellites it is necessary for some of the parameters to move beyond the usual pictures and make the information available as reliable statistical material.

9) Three dimensional circulation models, some coupled with a chemical-biological component, can give a valuable contribution to surveillance programs. Still such models need refinements and to be properly validated, and so far chemical-biological models are not much used in operational monitoring programs. An important property of models is that they can be used to separate between anthropogenic and natural variability, and that probable effects of future management measures can be simulated.

10) The perhaps least costly area for enhancement relates to the methods currently used for analysing sampled data. Many of the data series are under sampled compared to what is necessary to catch most of the variability. Methods taking this aspect into consideration are presently seldom used.

11) The great differences regarding strength and weaknesses of monitoring programs indicates that a lot can be gained by utilising the best of several methods by a close co-ordination. Numerical models should to a larger degree be used to put scattered data into a spatially and temporally continuous context. The large amount of data from satellites can be made more reliable and valuable by linking them to data from research vessels, ships of opportunity and automatic buoys.

6 CONTINUE TO SUMMARISE THE ROLE OF FLUCTUATIONS IN FRESHWATER INFLOW TO THE MARINE ENVIRONMENT, AND REVIEW THE OUTCOME OF THE THEME SESSION IN THE 1997 ANNUAL SCIENCE CONFERENCE

Again, the absence of T. Osborn who was mainly responsible for this topic, led to a shortened discussion. The group was reminded that the role of freshwater fluctuations had been raised in connection with the occurrence of harmful algal blooms. It was generally agreed that shelf seas oceanography is important to the formation, spread (dispersion) and transport of blooms, but without any expertise in the biological aspects the group felt unable to do justice to the topic.

Instead, Francois Saucier gave a presentation of a field and modelling study of St. Lawrence Estuary. A three-dimensional nested baroclinic model has been developed of the estuary. It is run operationally on a daily basis, using weather forecasts as forcing. The modelling has been calibrated against approximately 50 current meter deployment records and 2000 drifter releases. The model illustrates the freshwater outflow from the estuary, the balance between the freshwater and tidal flows and many other aspects of the oceanography of the estuary.

7 REVIEW THE PROGRESS OF ICES-RELEVANT PRODUCTS ON THE WWW

After some discussion, it became clear that the exact meaning of the topic had been misunderstood by several members of the group, who had looked at only the ICES home page rather than looking for any pages that might be of interest to ICES.

Hans Dahlin suggested that a role model for ICES might be the Swedish Environmental Network, which consists of a homepage with links to relevant pages at all Swedish Institutes. Since several ICES institutes already make data available on the WWW, it may be sufficient for an ICES homepage to establish links to relevant institute pages. It was suggested that the group could recommend to ACME exactly what data products should be included in an ICES "environmental report" web page.

Bjorn Sjoberg suggested that ICES could have a list of the grey literature produced by ICES institutes (e.g. annual environmental reports, eutrophication surveillance reports etc.) could be listed and possibly linked.

8 REVIEW THE CURRENT AND FUTURE APPLICATIONS OF REMOTE SENSING IN SHELF SEAS STUDIES

Because J. Johannessen, an invited guest from the European Space Agency, was unable to attend, this topic was not discussed.

9 CONTINUE THE SENSITIVITY STUDIES OF OPEN BOUNDARIES

Thomas Pohlmann presented results from some sensitivity analysis with the Hamburg North Sea Model. Five numerical experiments had been performed, investigating the impact of changes in boundary salinity on internal conditions in the North Sea. Four simulations, each raising or lowering the boundary salinity at the northern or southern boundary of the model by 1 psu, were compared to a baseline simulation. Each simulation ran for one year with the modified boundary salinity. Time series of salinity from various locations in the North Sea were presented.

The change of +/- 1 psu at the northern boundary propagated into the central North Sea within about 4 months and after 12 months the difference from the baseline was about 0.5 psu. In the German Bight, the changes had less impact, but in the Skagerrak the salinity change was amplified to +/- 5 psu. This was thought to be due to the imbalance between the barotropic and baroclinic forces brought about by the simple boundary modification. Changes to the southern boundary (in the English Channel) had less impact through the general North Sea region, although the difference from the baseline in the southern North Sea (Dover Strait to German Bight) was greater than that caused by the northern boundary. In the German Bight, salinities were modified by about 10% of the boundary effect.

Pohlmann also presented mean velocity difference fields throughout the North Sea between the baseline simulation and a simulation with a salinity change at the northern boundary. In the central and southern North Sea, velocity differences were small. However, in the Skagerrak and northern North Sea, differences were much more significant, in the order of tens of centimetres per second.

Einar Svendsen presented results from the NORWECOM model with a change to salinity of -1 at the open boundary. This model showed much weaker impact on salinities and velocities than the Hamburg model. He suggested that the flow relaxation method applied at the open boundary helped modify the impact of boundary salinity changes.

Following these presentations, there was a general discussion about the sensitivity analyses, and in particular about how the barotropic and baroclinic forcing was modified by the purely baroclinic boundary changes. It seemed likely that at least some of the differences predicted by the simulations were the result of the model re-establishing the equilibrium between barotropic and baroclinic forcing. However, it was also clear that the North Sea is sensitive to its boundaries (at least in terms of salinity) and that a regular sampling strategy at the boundaries would be beneficial to model performances. There was some discussion of possible sampling strategies, including ships of opportunity and fixed buoys. Harry Dooley suggested that more should be attempted with the existing North Sea dataset and the models before embarking on a programme of observations. It was also suggested that GOOS may provide a means of providing salinities at various locations on a regular basis, and these data could then be available for modellers to exploit.

10 COMPILE A COMPLETE SET OF TIME SERIES IN THE SKAGERRAK AREA TO ILLUSTRATE THE USEFULNESS OF THE SAME

Harry Dooley commenced by noting that about 25% of Skagerrak data had been collected during Skagex. He also pointed out that care must be taken when examining the data for trends; there were significant differences between data collected by Swedish institutes and other nations. Harry had collated and distributed Skagerrak times series and there was a general discussion about some of the features in the T, S and nutrient time series presented. In general it was felt that trends were very unclear whereas particular events, such as the cold winters in the sixties and mild winters in the late eighties and nineties, were more noticeable.

Didrik Danielssen presented some long time series (1960–1997) of parameters in the Skagerrak which revealed long periods (i.e. several years) of gradual warming of bottom water interspersed with rapid reductions in temperature. These were interpreted as periods of deep water renewal, while the downward vertical transport of heat was due only to diffusion separated by cascades of colder, denser water.

Einar Svendsen then presented plots showing a correlation between the NAO Index and the surface location of the 35 psu isohaline in the Norwegian Sea. He also presented a time series of the cubed wind speed from Utsira, which shows an increasing trend since the 1960's. Model results (with realistic wind forcing) suggest a very clear relationship between inflow of Atlantic Water to the northern North Sea during the first quarter of the year and horse mackerel catches about half a year later.

There followed a general discussion about other data time series and suggestions as to how to make best use of them. For example, the collation of such time series could allow investigation of particular events, such as the gadoid outburst in the sixties.

Francois Saucier emphasised that it was important to establish mechanisms between the NAO and observed time series if hindcasting and forecasting were to be improved. Simply finding correlations was not sufficient, although it is the first step in identifying relationships.

Finally, it was proposed to gather together all the available long time series in digital format, which could then be made available for distribution on CD-ROM.

11 CONTINUE TO COMPILE INFORMATION ON LONG TIME SERIES IN THE ICES AREA

Harry Dooley presented an inventory of long (> 20 years) time series which he had collated from ICES and other sources (Appendix VI). The inventory had increased slightly from the version presented the previous year (an additional source from the NCAR Climate and Global Dynamics Division) and was to remain available on the groups web page, possibly with links established. It was agreed that other time series known to members of the WG would be forwarded to ICES. Dooley also suggested he may modify the format of the report to improve its accessibility. The meeting recognised the value of Dooley's work.

12 ASSIST THE CONVENOR OF THE FOURTH BACKWARD FACING WORKSHOP (1999) ON THE 1960S AND 1970S ANOMALIES IN THE NORTH SEA IN PREPARING HINDCAST OF DATA ON THE PHYSICAL ENVIRONMENT DURING THIS PERIOD

The meeting decided that the first step in achieving this goal was to collate time series of relevant physical parameters, the aim being to explain large shifts in the North Sea ecosystem. Time series to be included should be at least 20 years long, have a sampling resolution of at least one year and should be presented with a maximum resolution of one month. The list of parameters to be compiled and the person/institute responsible for each is presented in Appendix V. These data should be prepared by the end of 1998.

13 CONSIDER FUTURE WORK PROGRAMME IN RELATION TO REMIT OF OCEANOGRAPHY COMMITTEE AND THE NEED FOR AN ICES FIVE-YEAR PLAN, INCLUDING CO-OPERATION WITH OTHER WORKING GROUPS

Einar Svendsen introduced this topic by relating the letter from Harald Loeng to the chairmen of all the working groups which mentioned two suggested themes for the Oceanography Committee to address. These were (I) climate variability and its effect on the ecosystem and (ii) transport of contaminants in the ocean and in the foodweb and what are the consequences for the foodweb.

There followed a discussion over whether (ii) clashed with the remit of other environment agencies and commissions (e.g. OSPARCOM), and whether it was a suitable topic for ICES. It was felt that the topic opened up the possibility of further developing coupled hydrodynamic-ecosystem numerical models and integrating them and other ecological aspects into fisheries management on a more routine basis.

There was general acceptance about a theme of climate variability and ecosystem impact. There was a suggestion that climate variability should be broken down into three components: climate detection, climate prediction and climate effect.

With the general support of the proposed themes, the meeting discussed the future of the Working Group on Shelf Seas Oceanography and working groups in general. There were suggestions for an "ecological group" with a strong emphasis on ecological numerical model development and use, but there were fears that this would slowly metamorphose into a physical modellers group. More acceptable suggestions were for two new working groups: (I) climate and climate effects, (ii) ecosystem processes and modelling. For the time being, however, until the ICES Five-Year Plan is settled and adopted, the meeting decided the group should continue as it is.

The ideas discussed were summarised by Roald Saetre as follows:

(I) Ocean Climate Variability - causes, effects and prediction

- monitoring; strategies and methods
- dynamic and statistical models
- limits of predictability
- teleconnections
- effects of recruitment, growth and distribution of fish stocks
- operational oceanography on non-meteorological (seasonal) time scales

(ii) Ecosystem Dynamics

- process/system studies
- ecological classification quality objectives and measures
- environmental data and knowledge into fish stock assessment
- ecological coupled models
- ecosystems as unit for management
- integration of fishery and environmental management
- transport and fate of contaminants

14 COMMENT ON THE 1997 ACME STATEMENT CONCERNING THE DEVELOPMENT OF GOOS INITIATIVES IN ICES

This topic was introduced by Roald Saetre who had formulated four possible alternatives for ICES involvement in GOOS. In brief, the four options were as follows:

(i) "Business as usual" i.e. involvement of ICES on all GOOS fora, but no specific ICES activity.

(ii) Establish an official GOOS pilot project within the ICES area, with ICES taken an advisory and service role for the regional GOOS component e.g. data management, quality assurance.

(iii) ICES take responsibility to establish and run a centre for operational fisheries oceanography on a time scale of fish stock assessments (i.e. months) for the whole North Atlantic or a part thereof.

(iv) ICES establish a centre for operational fisheries oceanography on time scales of days to years.

After some discussion, Sartre's personal choice of (iii) was generally favoured. It was suggested in the document that a pilot project area be chosen and the North Sea was duly selected by the group. There was some discussion between the relative merits of the North Sea and the Baltic, but the North Sea has more surrounding active participants and much suitable data are already available. Bjorn Sjoberg suggested that choosing the North Sea would require more resources than the Baltic and also noted that GOOS was missing fishery data which ICES is ideally placed to provide. However, the general feeling was that choosing the North Sea would complement GOOS, and that much could be learned from the Baltic experience.

It was suggested that the eventual aim should be to establish operational oceanography throughout the ICES area (including Canada). A similar collation of North Sea time series as that planned for the Skagerrak (Agenda Item 6) would form the basis of a useful operational dataset provided it was regularly updated as new data became available.

Hans Dahlin presented details of an operational model of the Baltic Sea which predicts (in real time) sea level, currents, ice cover and other parameters. The model is used to forecast given parameters based on predicted atmospheric forcing, and is run daily for the subsequent 24-hour period. Results from the model have been used in search-and-rescue operations.

15 SAMOA/OSPARCOM QUALITY STATUS REPORTS

Einar Svendsen introduced this topic by stating that he was responsible for producing the physical oceanography component of the next North Sea CSR. He wished to include more results from numerical models than has been done in the past, such as time series of transport and other parameters. There were suggestions that it was now important to raise the issues of variability in the ocean rather than concentrate on climatological mean conditions.

16 NUTRIENT/OXYGEN STANDARD UNITS AND USE OF DATA

In a letter from the chairman of the ICES Working Group on Marine Chemistry, the meeting was requested to consider a suggestion that nutrient and oxygen data should be submitted to ICES in terms of mass rather than volume i.e. units would change from $\mu M\ l^{-1}$ to $\mu M\ kg^{-1}$. The reason for this change stems from the adoption by WOCE of the mass-based units. In turn, WOCE have adopted the units for analytical reasons, because the procedure that samples be analysed at 20^0 C (giving a standard sample volume) is not strictly adhered to by institutes. Hence WOCE sees units of $\mu M\ kg^{-1}$ as more reliable and consistent. After some discussion, the meeting decided simply to note the conclusions of WGMC and refer to UNESCO standards at present (which require analysis to be carried out at 20^0 C).

The second part of the request from WGMC concerned the use (and "misuse") of marine chemistry data, in particular the need for spatial and temporal resolution of sampling and the accuracy of analysis. In response, the group agreed that sampling strategy is driven by the requirements of a particular field/monitoring programme and could not be predetermined. In terms of accuracy, it was suggested that WGMC should be asked to provide estimates of accuracy of marine chemistry data, and to demonstrate specific examples of how such data may have been "misused".

17 NORTH SEA DRIFTER EXPERIMENT

Einar Svendsen raised this subject as a possible collaborative exercise between member institutes, with the aim of evaluating the performances of various North Sea models. Given sufficient interest, he plans to submit a proposal for funding to the Nordic Council of Ministers to equip and deploy a number of drifting buoys in the central and southern North Sea. The experiment should last for about 3–6 months, possibly starting early in 1999, and involve about 30 drifters. The results could then be compared to predictions or hindcasts from numerical models in order to evaluate them.

There was general support for the proposal among members and Svendsen agreed to submit a proposal to the Council by May. It was emphasised that the models should be run as normal, and not tuned specifically to improve results from the comparative exercise.

18 ANY OTHER BUSINESS

Einar Svendsen resigned his position as chairman of the working group. Bjorn Sjoberg was elected as the next chairman.

19 PLACE, DATE AND TOPICS FOR NEXT MEETING

It was suggested that a standing invitation was in place for the WG to visit BSH at Hamburg and this was accepted (subject to agreement from G. Becker). The meeting will take place during 15–17 March 1999.

The topics will be:

1. Commence the synthesis of available time series related to the Skagerrak ecosystem variability. (responsibility all)

2. Prepare input to the Fourth Backward Facing Workshop.(resp. all, within 1998)

3. Summarise and review the outcome of the theme session on skill assessment of environmental modelling. (main resp E. Svendsen/B. Sjoberg)

4. Continue the evaluation of the effectiveness in environmental monitoring programmes (with focus on the North Sea) in determining trends against the background of natural space and time fluctuations, and the possible support from models. (main resp. G. Becker)

5. Review the current and future applications of remote sensing in shelf sea studies. (invited guest ?)

6. Review the progress of the North Sea drifter experiment and agree a protocol for evaluating model performances. (main resp. E. Svendsen)

7. Examine the effects on the coastal zone of regulating freshwater runoff (with focus on the Baltic) and the effects of long-term shifts in runoff patterns. (main resp. F. Saucier)

8. Improve estimates of transit times along the Scottish west coast and around the North Sea. (main resp J. Brown)

9. Extend the sensitivity studies of open boundary conditions on model performance. (resp. T. Pohlmann)

The terms of reference and justification for these agenda items are at Appendix I.

20 CLOSING

The meeting closed at 1230 18 March 1998.

APPENDIX

I – RECOMMENDATIONS AND JUSTIFICATIONS

The Oceanography Committee recommends that:

The Working Group on Shelf Seas Oceanography (Chairman Bjorn Sjoberg, Sweden) will meet in Hamburg, Germany from 15–17 March 1999 to:

1. Commence the synthesis of available time series related to the Skagerrak ecosystem variability.

2. Prepare input to the Fourth Backward Facing Workshop.

3. Summarise and review the outcome of the theme session on skill assessment of environmental modelling.

4. Continue the evaluation of the effectiveness in environmental monitoring programmes (with focus on the North Sea) in determining trends against the background of natural space and time fluctuations, and the possible support from models.

5. Review the current and future applications of remote sensing in shelf sea studies.

6. Review the progress of the North Sea drifter experiment and agree a protocol for evaluating model performances.

7. Examine the effects on the coastal zone of regulating freshwater runoff (with focus on the Baltic) and the effects of long-term shifts in runoff patterns.

8. Improve estimates of transit times along the Scottish west coast and around the North Sea.

9. Extend the sensitivity studies of open boundary conditions on model performance.

Justification

1. The previous meeting (this report) prepared a list of parameters related to the Skagerrak which could be compiled to provide a meaningful and useful dataset to investigate ecosystem variability in the region. These data must now be brought together to form a coherent set in a regular format that could be made widely available.

2. The Fourth Backward Facing Workshop takes place during 1999. In order to investigate past anomalies in the North Sea during the 60s and 70s, long time series of relevant parameters covering the period in question are required. A list of suitable available parameters has been drawn up and must be collated into a coherent dataset in preparation for the workshop.

3. A theme session at the ICES Annual Science Conference 1998 was "Skill Assessment of Environmental Modelling". The meeting should summarise the methods of skill assessment that were described at the conference and review the statistical accuracy and reliability of the methods and examine the applicability of the methods to various models.

4. During a discussion on the Baltic Monitoring Program at the WG in 1997, some clear criticism were raised especially with respect to under sampling, weak objectives and general status. Changes in strategy are underway, but before firm conclusions on the general functioning of monitoring programs, the WG wants at least to review the monitoring in the North Sea. Some ongoing monitoring programs have problems with funding and some are heavily criticised. Therefore it is important to evaluate the effectiveness of individual environmental monitoring programs in determining possible trends against the natural variability. Since Bundesamt fur Seeschiffahrt und Hydrographie is responsible for the production of the MURSYS environmental status report for the North Sea and the Baltic, we suggest Dr. G. Becker presents the monitoring behind this to see what general conclusions can be drawn.

5. The basic marine research tools today are observations from ships and fixed (or drifting) platforms/buoys, remote sensing from satellites (and aircraft), numerical modelling and laboratory/mesocosm experiments. The WG therefore feels the need to be updated on the current and future application of remote sensing in shelf areas and will invite an expert in the field to present the topic.

6. At the previous meeting (this report), it was agreed to conduct a drifter experiment in the southern North Sea (subject to funding being forthcoming). The experiment was planned to commence in February, so during the present meeting it should be underway. The meeting should assess the progress of the experiment to date and modify or confirm future plans as required. In addition, the meeting should discuss and agree on a protocol for evaluating the performance of the numerical models which will attempt to simulate the field results.

7. Freshwater runoff plays a vital role in the dynamics of the coastal zone. The regulation of freshwater discharge for hydroelectric schemes is increasing and the impact of such schemes on coastal zone dynamics and ecosystems is presently unknown. On longer time scales, climate change may lead to shifts in runoff patterns with similarly unknown effects on coastal waters.

8. Estimates of transit times from the Irish Sea into the North Sea are still based on tracer experiments and modelling studies (simulated under climatological mean conditions) conducted in the late seventies and early eighties. Recent pulsed discharges into the Irish Sea have been traced round the shelf sea as far as the Norwegian coast and should allow for improved estimates of transit times to and around the North Sea. Recent current meter deployments on the Scottish west coast shelf may confirm estimates of transport rates.

9. Open boundary conditions are a crucial point for numerical models, especially those seeking to simulate nature. Since the North Atlantic exhibits strong variability on different scales, a study on how these variabilities influence the shelf seas and to what extent these variabilities have to be included in the boundary conditions is necessary. A preliminary study has been conducted, but it is proposed to extend the study to increase the realism of the changes to the boundary conditions i.e. to balance the barotropic and baroclinic forces at the boundary.

APPENDIX II - LIST OF PARTICIPANTS

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APPENDIX IIIA - AGENDA (1998)

i) Welcome and opening (Monday 10 March, 0900 am)
ii) Appointment of rapporteur
iii) Approval of the agenda
iv) Reports on national activities of specific interest to WG members

1. continue the evaluation of the effectiveness in environmental monitoring programmes (with focus on the North Sea) in determining trends against the background of natural space and time fluctuations, and the poss. support from models. (Becker)

2. continue to summarise the role of fluctuations in freshwater inflow to the marine environment, and review the outcome of the theme session in the 1997 Annual Science Conference. (main resp. T. Osborn)

3. review the progress of ICES-relevant products on the WWW. (resp. all)

4. review the current and future applications of remote sensing in Shelf Seas studies. (J. Johannessen from ESA is invited)

5. continue the sensitivity studies of open boundaries (resp. Pohlman/Svendsen)

6. compile a complete set of time series in the Skagerrak area as to illustrate the usefulness of the same. (main resp. D. Danielssen/ H. Dooley)

7. continue to compile information on long time series in the ICES area. (Dooley)

8. assist the Convenor of the Fourth Backward Facing Workshop (1999) on the 1960s and 1970s anomalies in the North Sea in preparing hindcast of data on the physical environment during this period. (main resp. E. Svendsen)

9. consider future work programme in relation to remit of Oceanography Committee and the need for an ICES Five-Year Plan, including co-operation with other Working Groups. (resp. all)

10. comment on the 1997 ACME statement (Agenda Item 21.3) concerning the development of GOOS initiatives in ICES (resp. H. Dahlin ? / R. Sætre)

11. If time permits, I will also have a discussion on input to the new ASMO/OSPARCOM Quality Status Reports to be written.

12. Nutrient/Oxygen standard units and use of data

v) Any other business (election of new chairman etc.)
vi) Place, date and topics for the next meeting
vii) Closing of the meeting (Wednesday 12 March, 1600)

As we suggested last year, a theme session for ASC-1998 will be:

"Skill assessment of Environmental Modelling"
Convenor Einar Svendsen, Co-convener Björn Sjöberg

We should also decide if we want to keep our suggested theme session for ASC-1999 (together with WGCC and WGOH) on "Long time series".

APPENDIX IV – TERMS OF REFERENCE AND JUSTIFICATIONS (1998)

The Working Group on Shelf Seas Oceanography [WGSSO] (chairman: Einar Svendsen, Norway) will meet in Gothenburg, Sweden from 16–18 March 1998 to:

1. continue the evaluation of the effectiveness in environmental monitoring programmes (with focus on the North Sea) in determining trends against the background of natural space and time fluctuations, and the possible support from models. (main resp. G. Becker)

2. continue to summarise the role of fluctuations in freshwater inflow to the marine environment, and review the outcome of the theme session in the 1997 Annual Science Conference. (main resp. T. Osborn)

3. review the progress of ICES-relevant products on the WWW. (resp. all)

4. review the current and future applications of remote sensing in Shelf Seas studies. (J. Johannessen from ESA is invited)

5. continue the sensitivity studies of open boundaries (main resp. T. Pohlman/E. Svendsen)

6. compile a complete set of time series in the Skagerrak area as to illustrate the usefulness of the same. (main resp. D. Danielssen/ H. Dooley)

7. continue to compile information on long time series in the ICES area. (resp. H. Dooley)

8. assist the Convenor of the Fourth Backward Facing Workshop (1999) on the 1960s and 1970s anomalies in the North Sea in preparing hindcast of data on the physical environment during this period. (main resp. E. Svendsen)

9. consider future work programme in relation to remit of Oceanography Committee and the need for an ICES Five-Year Plan, including co-operation with other Working Groups. (resp. all)

10. comment on the 1997 ACME statement (Agenda Item 21.3) concerning the development of GOOS initiatives in ICES (resp. H. Dahlin ? / R. Sætre ?)

As we suggested last year, a theme session for ASC-1998 will be

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Convenor Einar Svendsen, Co-convener Björn Sjöberg

We should also decide if we want to keep our suggested theme session for ASC-1999 (together with WGCC and WGOH) on "Long time series"

Justification

1. From last meeting discussion on the Baltic Monitoring Program, some clear criticism were raised especially with respect to under sampling, weak objectives and general status. Changes in strategy are underway, but before firm conclusions on the general functioning of monitoring programs, the WG wants at least also to review the monitoring in the North Sea. Some ongoing monitoring programs have problems with funding and some are heavily criticised. Therefore it is important to evaluate the effectiveness of individual environmental monitoring programs in determining possible trends against the natural variability. Since Bundesamt fur Seeschiffahrt und Hyrographie is responsible for the production of the MURSYS environmental status report for the North Sea and the Baltic, we suggest Dr. G. Becker to present the monitoring behind this to see what general conclusions can be drawn.

2. The frontal dynamics and variability of coastal plumes and processes over very sharp pycnoclines typical for estuaries are generally not resolved by standard measurement programs and large scale numerical models. Estuaries and coastal zones are also areas where harmful algal blooms occur, thus it is important to increase our knowledge on how these finer scale processes influence the environment and how this influence varies with varying amounts of freshwater input.

3. In the ACME discussion on the feasibility of an ICES Environmental Status Report, it was concluded that relevant oceanographic and environmental information should be readily available to potential users (including fisheries biologists) in a timely way, and this could best be achieved by making use of WWW capabilities. ACME also noted that electronic dissemination of data is quicker and more economical than the production of a printed report. Products to be put on the web pages were clearly suggested on the last WG meeting.

4. The basic marine research tools today are observations from ships and fixed (or drifting) platforms/buoys, remote sensing from satellites (and aircraft), numerical modelling, and laboratory/ mesocosm experiments The WG therefore feel the need to be updated on the current and future application of remote sensing in shelf areas and will invite an expert in the field to present the topic.

5. Open boundary conditions are a crucial point for numerical models, especially those claiming to simulate nature. Since the North Atlantic exhibits strong variability on different scales, a study on how these variabilities influence the shelf seas and to what extent these variabilities have to be included in the boundary conditions is necessary. Due to the severe results presented in the last meeting, modellers are urged to make similar studies to check the sensitivity in different model set-ups. This study can also give advice for the configuration of monitoring stations that are able to provide the necessary boundary data.

6. A first overview of long time-series have been collated, and it was decided as an example to compile a complete set of oceanographical, meteorological and fisheries data (+ model results) for the Skagerrak (in many ways also representing much of the North Sea) to see the usefulness of such integrated information.

7. From the first compilation of available time-series, it was suggested to include not only measurements, but also indexes (e.g. the NAO) and info on how to get the data. In order to predict possible changes in regional seas due to climate change, the understanding of large scale long-term climate variability and its affects to the physical, chemical, biological and geological system of shelf seas are of fundamental interest. The answers to questions arising in this context (see report from 1996) are of fundamental importance to management activities, as well as to sustainable development. The understanding of interannual and interdecadal variability and the functioning of the system is a great challenge in marine science and important for human society living in coastal areas.

The justification for the theme sessions was:

The need for better quantified knowledge (within reasonable costs) of the marine environment has strengthened the need for numerical simulations. Results from such simulations are increasingly being used by management. So far there is a grate lack of evaluation, or "quality assurance" of model results claiming to reproduce nature.

Numerical models can also be used for estimating the typical scales and magnitude of natural environmental variability, which is a crucial factor to know for evaluating ongoing or planned monitoring activities. Therefor we suggest a theme session on this topic for the ASC 1998.

For the reasons stated under 7) above, a theme session on the use of long time series for ecological and climatological research is suggested for the ASC 1999.

APPENDIX V – LIST OF TIME SERIES PARAMETERS TO BE COLLATED FOR THE FOURTH BACKWARD FACING WORKSHOP

A list of long time series parameters to be collated (and those responsible for preparation) for the Fourth Backward Facing Workshop, 1999.

Modelled Time Series(Pohlmann/Svendsen)

Modelled monthly volume transports
Turbulent kinetic energy in mixed layer
Mixed layer temperature, salinity and thickness
Freshwater content

Observed Time Series

River Flows (Baltic, SMHI; Glomana, IMR; Gota, SMHI)
Cloud cover (SMHI)
Wind data (wind cubed + E & N stress) at outer Skagerrak (Svendsen)
Air temperature, humidity, ice index at Vinga (SMHI)
NAO + local pressure index (SMHI)
SST at Toringen (Svendsen)
Skagerrak S, T, O_2 at 600 m (Danielssen)
Sea level at Hanstrom (?) and Mandal (Saetre)
Atlantic inflow (approx 200 m) (Danielssen)
Deep nutrients (Dooley)
Benthos (SMHI)
Fish, shrimp, herring, cod (ICES/SMHI)
CPR (Brown)
JONSIS temperature and salinity (Gillibrand)

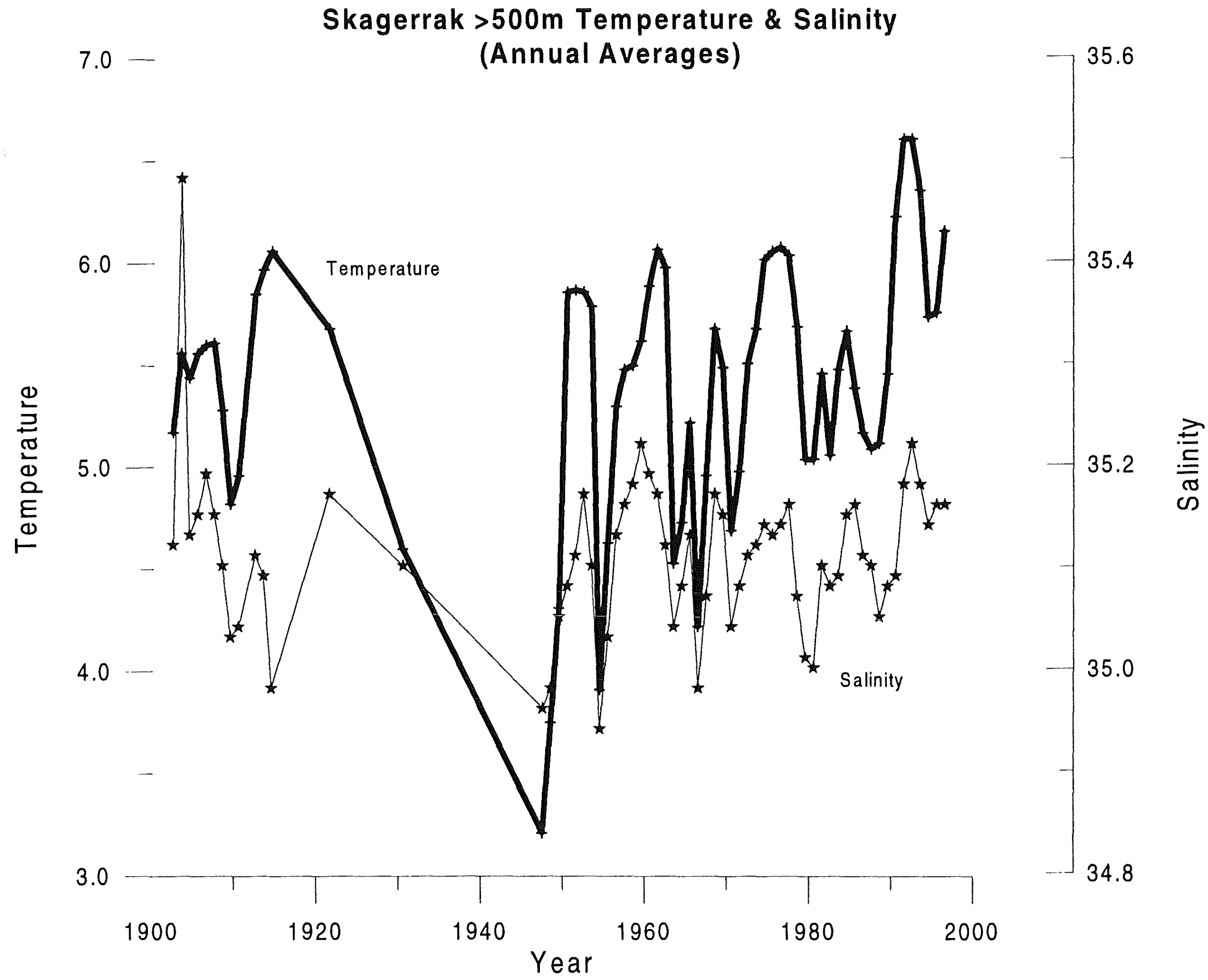
V – INVENTORY OF LONG TIME SERIES

Inventory of long (>20 years) time series

of

Oceanographic, meteorological, fisheries and astronomical observations and model results

A Second Compilation (1998)



Background

The Working Group decided to develop an inventory of time series of observations and model data during its 1996 meeting. The decision followed from its discussion on how to set up a programme of work in the North Sea to establish the ecological effects of cold "Ice" winters in the North Sea. According to the background justification for this compilation, the working group believed that, in order to predict changes in regional seas due to climate change, the understanding of large-scale, long term, climate variability and its effects on the physical, chemical, biological and geological systems of shelf seas are of fundamental interest, especially in the coastal zone where the vast majority of the human population resides.

Sources of Information

For this first compilation, information on time series was collated from a circular email to the three Hydrography Committee Working Groups, and also by a cursory search on the World Wide Web. In addition, time series available from within the ICES Data Centres were also surveyed and summarised.

There was a low number of responses from the Working Groups, nevertheless the following pages probably provides a useful first attempt at identifying those time series that do exist. Emphasis has been put on those time series that are readily available free of charge. For example, amongst the many time series that are not included are much of the light vessel data from around the North Sea which is only available at considerable cost from respective meteorological agencies.

For this initial compilation, no attempt is made to sort the time series by discipline. Instead the listings are provided by "Source" but with a clear identification of the type of time series.

SOURCE : WORLD WIDE WEB

Meteorology:

Climate data for ADVANCE-10K

Source of Information: http://www.cru.uea.ac.uk/advance10k/climdata.htm

Unix	MS-DOS	Size	Description
cuwld.all02.Z	cruwlda2.zip	3.6MB	monthly temperature station data up to 1990
glform9196b.dat.Z	glf9196b.zip	120KB	above updated to 1996
gridbox.f		1KB	Fortran code to read the above file format
Average temperature anomaly (relative to 1950–79) in each 5°x 5° box from a variable number of stations. Not normalised. See: *The Holocene*, vol. 2 no. 2 (1992)			
globalnew91.Z	glonew91.zip	3.3MB	5°x5° gridded monthly temperature data 1854–1991
globjandec92.dat.Z	globjd92.zip	76KB	above updated for 92/93
globjandec94.dat.Z	globjd94.zip"	35KB	above updated for 94
globjandec95.dat.Z	globjd95.zip	36KB	above updated for 95
sstcoads.f		2KB	Fortran code to read the above file format
presmslpup.dat.Z	prmslpup.zip	1.3MB	mean monthly SLP 1873–1991. For millibar divide by 100 and add 1000 (eg. 555 = 1005.55mb)
PRES.FOR		1KB	Fortran code to read presmslpup.dat

MET-OCEAN

Comprehensive Ocean-Atmosphere Data Set (COADS)

SOURCE: http://www.scd.ucar.edu/dss/pub/COADS.html

Overview of COADS

The Comprehensive Ocean-Atmosphere Data Set (COADS)* has been created by combining, editing, and summarising global in situ marine data from many different sources. Merchant ship observations back to 1854 have been supplemented in more recent years by automated measurements, e.g., from drifting and moored buoys. COADS currently covers the period 1854–1992. Two COADS products are most often requested by users (decadal summaries and other products are also available):

I) Marine reports: These contain the basic individual observations (e.g., of air and sea surface temperatures, winds, atmospheric pressure, cloudiness, and humidity) taken from the ocean-atmosphere boundary layer.

II) Global monthly summaries for 2-degree latitude x 2-degree longitude boxes. Fourteen statistics, such as the median and mean, were calculated for each of 19 observed and derived variables. The statistics are global only to the extent that observations were actually recorded at a given time and place (i.e., statistics were calculated for each year, month, and 2-degree box containing "acceptable" data). Due to data volume, statistics are often requested in the form of group files, each group containing eight selected statistics for four variables.

Ordering COADS products

COADS products for Release 1 (1854–1979) and Release 1a (1980–92) are available from:

Steve Worley
Data Support Section

e-mail: worley@ncar.ucar.edu
National Center for Atmospheric Research
P.O. Box 3000
Boulder, CO 80307
Phone: 303–497–1248, Fax: -1298 USA

Data requests are filled by NCAR at a one-for-one copy cost (currently $6 per 10 Mbytes) plus additional cost for tape media and overseas shipping if required. Any subsetting not part of the general storage file structure is subject to an additional charge (individual marine reports are generally available in global monthly files, while the 2-degree monthly summaries are normally distributed in global annual files).

In addition, Release 1 individual marine reports can be obtained from:

Director
National Climatic Data Center
NOAA, Federal Building
Asheville, NC 28801
USA

Selected Data for Oceanographic Research

SOURCE: http://www.scd.ucar.edu/dss/catalogs/odl.html

1. Definitions
2. Ship Observations
    - COADS Documentation, ASCII (version, 6 April 1994)
    - COADS Documentation, Hypertext (version, 6 April 1994)
3. Sea Surface Temperature
4. Surface Wind and Wind Stress
5. Air-sea Heat Budgets
6. Ocean Depth and Land Elevation
7. Moored and Drifting Buoys
8. Sea Ice
9. Data Derived from Satellite Sensors
10. Subsurface Climatology / Model Input and Output
11. Datasets from Operational Atmospheric Analyses
12. Miscellaneous
13. Data Requests and Further Information

2 Ship Observations

DS540.0 :>Comprehensive Ocean-Atmosphere Data Set (COADS), Marine Observations

Geographic Coverage :
global oceans
Temporal Coverage :
1854 - 1993
Product Type:
CMR, Compressed Marine Reports (1854–1979), 71 million observations - 29 most used parameters, 1.7 GB.

DS540.1 :>Comprehensive Ocean-Atmosphere Data Set (COADS), Statistical summaries of DS540.0

DS535.0 :>Observations from Ocean Weather Ships

Geographic Coverage :
approx. 14 locations
Temporal Coverage :
1945 - 1992

Dataset Size :
470 MBytes

DS285.0 :>Levitus' World Ocean Atlas, 1994

Geographic Coverage :
global analyzed 1 x 1 grids and observed profiles
Temporal Coverage :
based on data approx. 1900 - 1992
Dataset Size :
928 MB analyzed, 2278 MB observed

DS533.0 :>USSR Marine Ship Archive

Geographic Coverage :
global oceans
Temporal Coverage :
1888 - 1990
Dataset Size :
2.7 GB

DS277.0 :>Global SST from Natl. Centers for Environ. Prediction (formerly NMC), by Reynolds, Stokes, and Smith

ProductType:
In situ and global blended analyses. These were the first developed SST analyses. Work on this time series has been discontinued. The OI and Reconstructed SST products supersede these products.

DS289.1 :>Global Ocean Surface Temperature Atlas (GOSTA) March 1990, by Bottomley et. al.; UK Met. Office and MIT

Geographic Coverage :
global, 5 and 1 degree resolution
Temporal Coverage :
longterm climatology
Dataset Size :
68 Mbytes

DS277.2 :>GISST.1 UK Met. Office Global Ice an SST

Geographic Coverage :
global, 1x1 degree resolution
Temporal Coverage :
1948–1993, yr-mo
Dataset Size :
150 MB Description : SST observations for ship have been analysed by Parker to form a monthly time series. This is a proprietary dataset and special permission is required for data access.

DS552.0 :>UNESCO: Flow Rates of Selected World Rivers

Geographic Coverage :
global
Temporal Coverage :
approx. 1800 - 1972
Dataset Size :

2.1 MBytes

Free datasets available via ftp (ftp://ncardata.ucar.edu/pub/)

Data files for the following sets may be compressed (.Z) and groups of files may be combined with tar (.tar). If you are unable to use the files in this form, the data can be provided in other forms using our standard pricing. For some datasets, only certain files or subsets are available for free.Some data files are also available via our special projects page, which points to our ftp "pub" directory.

ds010.1 Monthly mean NH Sea Level Pressure grids
ds090.1 NMC Global Reanalysis Anals, 6-hrly, monthly files only
ds085.1 Monthly mean 700- 500- mb heights/temperatures
ds195.5 NH Time Series Grids monthly only
ds205.0 NCDC/NCAR Climatology
ds207.0 Rand's global climatology
ds209.0 Esbensen - Kushnir, Global Ocean Heat and Wind
ds209.3 Hastenrath's Tropical Atlantic heat budget, monthly
ds215.0 Jones long period gridded temp anomalies
ds232.0 Hellerman, GFDL Monthly Global Wind Stress
ds233.0 Walsh's Arctic Ice Anals, monthly 1953–1988
ds234.0 Ropelewski's CAC Antarctic Ice Anals, monthly 1973–1990
ds237.0 Willmott's Terrestrial Water Budget, monthly
ds270.2 Monthly SST and Ice-Pack Limits (Alexander &)
ds277.0 Parts of the monthly SST set
ds280.0 Seasonal World Ocean Surface Currents
ds289.0 Global Monthly SST Climatology (D. Shea)
ds290.0 Climatology by D. Shea, NCAR
ds315.0 Dewey&Heim's Snow Cover, wkly monthly 1966 Nov-1988 monthly files only
ds318.1 GFDL Climate Model Outputs for CO2 Studies
ds318.2 UK Climate Model Outputs for CO2 Studies
ds318.3 CCC Climate Model Outputs for CO2 Studies
ds318.4 GISS Climate Model Outputs for CO2 Studies
ds318.6 German Climate Model Tropo Anals for EPA CO2 studies
ds474.0 Univ Washington Russian Ice Station Obs, daily 1950–1990
ds483.0 Indonesian monthly data from Asian Station set
ds552.0 River discharge from UNESCO publications
ds564.0 Global Historical Climatology Net (GHCN) Temp, Precip, Pressure
ds570.0 World Monthly Sfc Station Climatology, 1738-cont US stations only
ds572.0 So. American Monthly Precip (Harnack)
ds578.1 China monthly temp and precip
ds582.0 Univ Wisconsin Antarctica Sfc Obs, monthly 1980–1989
ds718.5 Arkin's 1/2 Monthly Outgo LW Radia, 1974Jun-con
ds728.1 Xie and Arkin Merged Monthly Precipitation Estimates
ds740.1 Highly Reflective Clouds Longterm Means/Std.Dev
ds750.1 One degree global elevation values
ds754.0 Navy 10 minute Elevation
ds756.1 Defense Mapping Agency (DMA) US 30-Sec Elevations
ds757.0 2.5 degree global elevation and land-sea mask
ds759.1 NGDC ETOPO5 Global Ocean Depth & Land Elevation, 5-Min
ds759.2 TerrainBase Global 5-minute Ocean Depth and Land Elevation
ds765.0 Vegetation, Land Use, and Albedo (Matthews)
ds765.5 Matthew's GSFC Global Wetlands & Methane Emission, 1-Degr
ds766.0 Argonne Land-use & Deposition Data, 0.2-Degr
ds767.0 Vegetation, Soils (Wilson, Henderson-Sellers)
ds768.0 Global Precip Climatology & Topography (Cogley&Briggs)
ds769.0 World Ecosystems (Olson)
ds770.0 Staub & Rosenweig's GISS Soil & Sfc Slope, 1-Degr
ds780.0 Continental Outline Data Set
ds808.0 NSSFC Severe Local Storms Log (SELSLOG), 1955–1972 June
ds816.0 Wind Energy at Global Stations, Battelle PNL

ds824.0 NCDC Global Tropical Cyclone Position Data, 1886–1991
ds825.0 Central England Temperatures, Manley, 1659-con
ds834.0 Sunspot Numbers from NGDC
ds863.0 SPECMAP Ocean Core Data, 400,000 yr record
ds866.0 GISS Methane & Livestock Distribution, 1-Degr
ds867.0 Matthew's GISS Methane from Rice Cultivation
ds885.1 NCDC TD9640 US Palmer Drought Indices, monthly 1895–1987
Basic station dictionary info
- ds900.0 WMO station library from USAF
- ds900.1 WBAN station library
- ds901.0 COOP station library

SOURCE : ICES and its Secretariat

Ocean Time Series at ICES (including working groups)

ICES Standard Stations (Oceanic Hydrography WG (OHYD))

Location	Position	Depth	Period at ICES	No at ICES (Hyd/Che)
Greenland Sea	75°00N 05°00W 71°00N 04°00E			
West Greenland	63°53N 53°22W	900 to 1300	1934–1994	157(82)
Norwegian Sea	64°30N 06°00W	3250	1953–1993	9(3)
Iceland Basin	60°00N 20°00W	2730	1977–1991	1(0)
Faroe-Shetland Channel	61°28N 03°42W	860	1905–1995	156 (9)
Faroe Bank Channel	61°16N 08°00E	1260	1959–1972	2(1)
Porcupine Abyssal Plain	50°00N 17°00W	2700	1976–1990	11(8)
Weathership A	62°00N 33°00W		1954–1974	1444(0)
Weathership B	55°47N 51°53W		1928–1974	2234(0)
Weathership C	52°45N 35°30W		1910–1990	10393(2974)
Weathership D	44°00N 41°00W		1962–1984	1668(3)
Weathership E	35°00N 48°00W		1910–1979	2116(24)
Weathership H	38°00N 71°00W		1927–1982	730(98)
Weathership I	59°00N 19°00W		1955–1975	708(0)
Weathership J	52°30N 20°00W		1950–1975	994(0)
Weathership K	45°00N 16°00W		1949–1973	505(0)
Weathership L	57°00N 20°00W		1975–1989	454(0)
Weathership M	66°00N 02°00E		1948–1990	8011(46)
Weathership R	47°00N 17°00W		-	0(0)
Canadian Eastcoast				
Prince 5	44°57N 66°49W		-	0(0)
Station 27	47°33N 52°35W		-	0(0)

OHYD List of Standard Sections in the North Atlantic

COUNTRY/NAME	STARTPOINT	ENDPOINT	NO at ICES	PERIOD
CANADA				
Flemish Cap	47°00N 52°02W	47°00N 42°00W	1191 (49)	1913–1991
Bonavista	48°44N 52°58W	50°00N 49°00W	199 (4)	1931–1989
White Bay	50°40N 55°00W	52°07N 49°45W	134 (1)	1950–1989
Seal Island	53°14N 55°39W	59°38N 44°09W	302 (4)	1931–1994
DENMARK				
C. Farewell	59°38N 44°09W	58°46N 45°50W	46 (19)	1952–1988
C. Desolation	60°50N 48°45W	60°02N 51°27W	26 (9)	1928–1988
Frederikshaab	61°57N 50°00W	61°34N 52°30W	110 (53)	1924–1987
Fylla Bank	63°57N 52°22W	63°48N 53°56W	669 (276)	1908–1988
Sukkertop	65°06N 52°55W	65°06N 54°58W	294 (134)	1908–1988
Holsteinsborg	66°53N 54°10W	66°41N 56°38W	308 (133)	1908–1988
FAROES				
Northern Section	62°20N 06°05W	64°30N 06°05W	366 (20)	1904–1989
Nolsey-Shetland	62°00N 06°12W	61°01N 01°36W	2099 (746)	1902–1993
Troellhoevdi - Faro Bank	61°50N 07°00W	60°28N 09°20W	159 (18)	1904–1989
GERMANY				
Dohrn Bank I	65°27N 28°38W	65°53N 30°53W	56 (11)	1903–1988
Dohrn Bank II	65°58N 29°24W	65°21N 30°06W	38 (4)	1955–1988
Gauss Bank	65°22N 34°30W	64°50N 33°33W	12 (1)	1933–1988
Heimland Ridge	64°09N 37°12W	63°33N 36°33W	7 (0)	1932–1988
Cape Moesting	63°38N 40°05W	63°04N 39°12W	13 (2)	1933–1988
Cape Bille	62°10N 41°24W	61°56N 40°27W	42 (16)	1933–1988
Discord Bank	60°57N 42°17W	60°48N 40°18W	14 (2)	1958–1988
ICELAND				
Faxafloi	64°20N 22°25W	64°20N 28°00W	627 (342)	1903–1991
Latrabjerg	65°30N 24°34W	66°09N 27°15W	680 (255)	1904–1990
Kogur	66°30N 23°00W	67°20N 23°40W	829 (293)	1904–1990
Siglunes	66°16N 18°50W	68°00N 18°50W	1066 (448)	1908–1990
Langan N	66°37N 14°16W	68°00N 12°40W	508 (239)	1929–1990
Langan A	66°22N 14°22W	66°22N 09°00W	813 (308)	1904–1990
Krossan	65°00N 13°30W	65°00N 09°00W	468 (187)	1902–1990
Stokksn	64°12N 14.50W	63°40N 13°40W	414 (204)	1933–1990
Selv.B.	63°41N 20°41W	63°00N 21°28W	820 (495)	1934–1990
Iceland Sea	68°15N 16°32W	70°35N 13°25W	29 (3)	1958–1986
NORWAY				
Torungen	58°24N 08°46E	57°38N 09°52E	4489 (1993)	1902–1993
Oksø	58°03N 08°05E	74°14N 08°33E	1596 (742)	1906–1994
Hansth.-Aberdeen	57°00N 07°57E	57°00N 01°28W	3208 (1010)	1903–1995
Utsira	59°17N 05°02E	59°17N 02°14W	5159 (1642)	1902–1994
Feie	60°45N 04°37E	60°45N 00°40W	3356 (612)	1902–1994
Svinøy	62°22N 05°12E	64°40N 00°00E	1315 (158)	1901–1990
Gimsøy	68°24N 14°05E	70°24N 08°12E	883 (24)	1923–1990
Bjørnøy	70°30N 20°00E	74°15N 19°10E	1963 (49)	1926–1995
Vardø	70°30N 31°13E	76°30N 31°13E	1356 (79)	1913–1995
Sem Islands	69°05N 37°20E	76°30N 37°20E	691 (40)	1904–1990
Bjørnøya-W	74°30N 18°30E	74°30N 07°00E	1104 (108)	1929–1993
SCOTLAND				
FIM	60°10N 03°44W	61°12N 06°22W	651 (322)	1902–1993
FS (see Faroe)	62°00N 06°12W	60°56N 01°00W	1827 (635)	1902–1993
MR	56°40N 06°08W	57°35N 13°38W	597 (48)	1908–1993
JONSIS (see Norway)	59°17N 05°02E	59°17N 02°14W	Utsira	
SPAIN				
Vigo	42°08N 09°18W	42°13N 08°51W	28 (13)	1952–1992

COUNTRY/NAME	STARTPOINT	ENDPOINT	NO at ICES	PERIOD
La Coruna	43°25N 08°26W	43°21N 08°22W	2 (0)	1987–1992
Santander	43°30N 03°47W	43°42N 03°47W	6(1)	1952–1994
Cudillero	43°36N 06°08W	43°46N 06°10W	5 (0)	1992–1993

FIXED North Sea Stations for surface temperature and salinity at ICES

(not exhaustive list)

LIGHT VESSELS

Platform	Name	Position	Year	Nos. of Stations
06HR	Helgoland Reede	5410N ; 750E	1933–1937	456
11WH	West-Hinder	5122N ; 228E 5123N ; 226E	1905–1961 1961–1979	6194
64GE	Goeree	5156N ; 340E	1955–1993	3072
64NH	Noordhinder	5139N ; 234E	1955–1982	19.932
64TB	Terschellingerbank	5328N ; 508E	1950–1970	4630
64TE	Texel	5301N ; 422E	1952–1975	9860
74BY	L.H. Bardsey*	5245N ; 448W	1957–1985	3199
74GA	Galloper	5144N ; 158E	1920–1977	2715
74LP	Liverpool*	5245N ; 448W	1934–1956	3318
74LV	Liverpool Bar	5332N ; 319W	1957–1973	1489
74MB	Morecombe Bay	5355N ; 329W	1957–1965	1215
74SK	Smith's Knoll	5243N ; 217E 5244N ; 218E	1920–1951 1952–1971	4395
74SS	Seven Stones	5003/5004N ; 604/605 W	1906–1987	5990
74VA	Varne	5056N;116/117W 5104N ; 124E	1905–1967 1967–1985	 6771

Examples of Other Time Series at ICES - fixed Profile data

Name of Station	Location	Number of Stations	Period	Parameters
E1	50 02N 4 22W	454	1903–1992	t, s, nutrients
Cypris (IOM)	54 05N 4 50W	1014 (996)	1954–1982	t, s, nutrients
Breakwater (IOM)	54 05N 4 46W	28810	1904–1982	t
Norwegian coastal stations	various	1770	1927–1994	t,s,oxygen
Skagerrak >600m includ-ing M6	58 08 -58 12N;9 10 - 9 32E	659 (357)	1902–1996	t,s,oxygen,nutrients, etc

SOURCE: EDMED

Time Series referred to in EDMED (European Directory for Marine Environmental Data)

Rockall Channel CTD section time series (1975-)
Rockall Channel surface temperature and salinity time series (1948-)
Hunterston Power Station, Clyde sea area, temperature time series (1960–1985)
Hunterston Power Station, Clyde sea area, biological time series (1960–1985)
A long time series of meteorological data from Genova, Italy
French national archive of time series data, particularly current meter and thermistor data
LPO Current meter and temperature time series in the North Atlantic
LPO Subsurface Lagrangian floats time series from the Atlantic
Sea level time series in the Indian Ocean
Sea level time series in the Tropical Atlantic
Lagrangian time series from drifting buoys in the Tropical Global Ocean
ORSTOM current meter and time series data from the global tropical ocean
Sea surface temperature time series from German Baltic Sea coastal stations (1953–90)
Sea surface salinity time series from German Baltic Sea coastal stations (1953–90)
Meteorological and sea surface hydrography time series from KIEL Lightship, Baltic Sea (1936–39,47–67)
Hydrographic station time series at UFS KIEL Lighthouse, Baltic Sea (1985–90)
Meteorological, sea surface hydrography and hydrographic station time series from ELBE 1 Lightship, German Bight (1920–39,47–88)
Meteorological, sea surface hydrography and hydrographic station time series from ELBE 2 Lightship, German Bight (1935–39)
Meteorological, sea surface hydrography and hydrographic station time series from ELBE 3 Lightship, German Bight (1935–39)
Meteorological, sea surface hydrography and hydrographic station time series from FEHMARN BELT Lightship, NE Germany (1922–9,47–84)
Hydrographic station time series from FEHMARN BELT Buoy, NE Germany (1985–89)
Meteorological, sea surface hydrography and hydrographic station time series from ELBE 4 Lightship, German Bight (1920–39)
Meteorological, sea surface hydrography and hydrographic station time series from AUSSEN JADE Lightship, German Bight (1935–39)
Meteorological, sea surface hydrography and hydrographic station time series from MINSENERSAND Lightship, German Bight (1921–39)
Meteorological, sea surface hydrography and hydrographic station time series from NORDERNEY Lightship, German Bight (1935–39)
Meteorological, sea surface hydrography and hydrographic station time series from S2 Lightship, German Bight (1947–53)
Meteorological, sea surface hydrography and hydrographic station time series from DEUTSCHE BUCHT Lightship, German Bight (1948–86)
Temperature and salinity depth profile time series at UFS DEUTSCHE BUCHT Automatic Lightship, German Bight (1989–90)
Meteorological, sea surface hydrography and hydrographic station time series from TW EMS Lightship, German Bight (1947–78)
Temperature and salinity depth profile time series at UFS TW EMS Automatic Lightship, German Bight (1989–90)

Meteorological, sea surface hydrography and hydrographic station time series from BORKUMRIFF Lightship, German Bight (1921–39,47–88)
Temperature and salinity depth profile time series at UFS ELBE Automatic Lightship, German Bight (1989–90)
Meteorological, sea surface hydrography and hydrographic station time series from WESER Lightship, German Bight (1921–39,47–81)
Meteorological, sea surface hydrography and hydrographic station time series from BREMEN Lightship, German Bight (1922–39)
Meteorological, sea surface hydrography and hydrographic station time series from AUSSEN EIDER Lightship, German Bight (1921–39)
Meteorological, sea surface hydrography and hydrographic station time series from AMRUMBANK Lightship, German Bight (1921–39)
Meteorological and sea surface hydrography time series from ADLERGRUND Lightship, Baltic Sea (1921–39)
Meteorological and sea surface hydrography time series from FLENSBURG Lightship, Belts (1936–39)

SOURCE: Einar Svendsen

IMR Bergen, The Norwegian Met. Inst., Oslo, Norway

OCEANOGRAPHY

Fixed stations (50 +/-20 years)

9 hydrographic stations (vertical profiles) along the Norw. coast
20 surface T,S along the Norw. coast and across the North Sea
20 fjords (hydrography, nutrients and oxygen)
Station M-Norwegian Sea (hydrography)

Fixed sections (20–30 ++ years)

12 hydrographic sections normal to the Norwegian coast into deep water (one with oxygen)
Russian Kola section since 1901

Regional Observations (20–30 years)

Hydrography in the "whole" ice-free Barents Sea 3 times a year.
Norwegian Coast (hydrography) twice a year
North Sea (northern & central) twice a year
Lofoten once a year

METEOROLOGY

Standard coastal weather stations:
40–50 standard weather stations at the coast/islands of Norway, including
Jan Mayen,
Svalbard,
Bear Island and
Hopen.

This "covers" an area from 58 to 79 degrees northern latitude, and from 11 degrees east to 8 degrees west. Some of these includes sea state and sea surface temperature. Most of the monitoring started in the early 1900.

Gridded (75x75 km) wind, atmospheric pressure and wave parameters every 6 hour since 1955 over parts of the North Atlantic and Arctic ocean and the total Nordic, North and Barents seas. (3000 grid-points/ time-series).

Gridded sea ice coverage and ice type once a week since 1966

Gridded SST once a week since 1972

FISHERIES (ICES/IMR, Bergen, Norway/other Many long time-series from the commercial fish stocks on recruitment, individual age classes and spawning stock biomass are available at ICES, together with catch distributions.

Indexes of the amount and maps of distribution of Atlanto Scandian Herring and Norwegian Arctic Cod larvae/ 0-group from IMR and russian research cruises.

ASTRONOMICAL

The main astronomical periods which also are found in measured time-series (in addition to the standard short term tidal and yearly cycles) is the: 11.2 years (mean) solar activity cycle

- 18.61 years nodal tide
- 8.85 years
- 2.3 years
-

The solar activity cycle (from the average number of sunspots and the mean area) fluctuate over time in a more or less regular manner with a mean period of about 11.2 years.

The Nodal tide, Mn: 18.61 yr tidal component. From Burroughs (1992): "The 18.61 yr period in the regression of the longitude of the node - the line joining the points were the Moon's orbit crosses the ecliptic".

8.85 yrs: Tidal component connected to the variation in the alignment of the Moon's perigree and the Earth's perihelion. From Burroughs (1992): "The 8.85 yr period in the advance of the longitude of the Moon's peri gee which determines the times of the alignment of the perigee with the Earth's perihelion"

SOURCE: H Van Aken, NIOZ, Texel

Timeseries of Sea Surface Temperature and Salinity from the Marsdiep estuary.

Samples are taken daily at 08:00 local time. In order to remove oscillations due to the interference of tides and sample time these daily values are reduced to monthly mean values. The time series started in July 1860 in Den Helder and was continued there until 1962. From 1947 onwards a similar timeseries is collected from the Texel side of the Marsdiep, near 't Horntje, the present location of NIOZ. From the 16 years overlap monthly mean correction have been determined to transform the monthly mean values from 't Horntje to Den Helder.

The data from 1860 to 1981 have been described by P.C.T. van der Hoeven in "Observations of surface water temperature and salinity, State Office of Fishery Research (RIVO): 1860–1981" KNMI Scientific Report W.R. 82–8, KNMI, De Bilt, 1982

This report also contains time series from several other positions in the Wadden Sea and in the former Zuiderzee, as well as from Dutch light vessels. KNMI owns even more timeseries of sea surface temperature along the whole Dutch coast, but colleagues of NIOZ who tried to obtain these data from KNMI did so in vain. Possibly they were lost some time. Perhaps you can put some pressure on KNMI to uncover these data.

Only the Marsdiep data are available from H. Van Aken (aken@nioz.nl) as computer files (Excel).

Algal timeseries from the Marsdiep estuary

Dr. G. Cadee from NIOZ maintains this time series.

Timeseries of shellfish from plates in the Wadden Sea of at least 25 years.

Beukema of NIOZ maintains this time series .

SOURCE: Finnish Institute for Marine Research (Ari Seina)

Baltic Sea:

1) **Maximum extent of ice cover 1719/20-**

In Seina and Palosuo 1996: the classification of the maximum annual extent of ice cover in the Baltic Sea 1720–1995.- MERI-report series of the Finnish Institute of Marine Research No 27.

2) **Ice seasons 1830–1996.**

Further information from http://ice.fmi.fi

3) **Freezing, maximum annual ice thickness and breakup of ice on the Finnish Coast 1830–1984**

Published in Geophysica 21(2) by Lepparanta and Seina, 1985. Data used in the paper is published in FIMR Internal report 1985(2), email: parkkonen@fimr.fi.

SOURCE: NERC, UK (L Rickards - The "Environment in Time")

Marine Biology

- **Zooplankton and fish larvae densities, 1924–1988**

Western Approaches of English Channel. Maintained by MBA, Plymouth

- **Pelagic zooplankton and phytplankton, since 1931**

NE Atlantic and North Sea, funded largely under CPR programme. Regular work along 20W by SOC (to 100m and 10 degree intervals)

- **Littoral-sublittoral communities, 1963–1986**

In Firth of Clyde, by DML, Oban.

- **Pup production of grey seals, since 1959**

All major UK seal colonies by SMRU.

Physical Oceanography

- **Mean Sea Level, since 1806**

Worldwide, POL coordinates data for IOC, 400 stations in GLOSS.

- **Tidal Changes since 1950s (some since mid-19th century)**

- **Wave Height, 1954–1988**

North Atlantic. Data from OWS. UK wave climate atlas in press.

SOURCE: J Dippner (DKRZ, Germany)

Various links concerning time series are available from:

http://www.dkrz.de/forschung/project/klimadatenkatalog.html

Including:

Climate Data Catalog - Germany

A list of climate research centers in Germany and available datasets.

Climate Data Catalog - Europe

Information on European centers for climate, atmospheric and oceanographic research.

Climate Data Catalog - Worldwide

Climate data centers with online accesable data and informations all over the world.

Climate Models and Diagnostics

Links to technical reports on climate models and diagnostic programs.

SOURCE: PICES Inventory of Long Term Series relevant to the North Pacific

http://pices.ios.bc.ca/data/longterm/lttsintr.htm

The Technical Committee on Data Exchange (TCODE) has undertaken the task of assembling a list of important datasets that are relevant to the study of long term trends in the physical, chemical and biological environment of the North Pacific. These datasets are particularly important for the retrospective analyses that are to be carried out in the PICES Climate Change and Carrying Capacity (CCCC) studies.

The primary objective of TCODE in assembling this inventory was to provide short descriptions and "pointers" to the locations of the datasets, to assist researchers in selecting and accessing a diverse set of long term data. The criteria for inclusion were loose - we were interested in any data that was considered to be relevant to the PICES area that spanned (or will eventually span) a period of 10 years or more. We have included references to some global datasets, as well as references to some observations in equatorial waters which are know to

have impacts on the North Pacific.

For convenience, we have classified the datasets into four types: 1. Biological Oceanographic Data 2. Fisheries data 3. Meteorological data 4. Physical and Chemical Oceanographic data

1 Biological Oceanographic Time Series

TINRO Biological Oceanographic Profile data - Russia
OWS Papa - Chlorophyll and primary production
OWS Papa - zooplankton biomass and composition
HOTS- Hawaii Ocean Time Series

2 Fisheries Time Series

Auke Creek- Salmon escapement and environmental conditions

North Pacific Salmonid Coded Wire Tag (CWT) Database
Pink Salmon escapement and env. factors - Sashin Creek
US/Japan Fisheries Resource Assessment Surveys
NMFS Longline Survey
Pacific Coast Acoustic/Trawl Hake Survey
Standard Trawl surveys - West Coast of US to BC
US Commercial Fishery Landing Statistics
Standard Trawl surveys - West Coast of US to BC
Groundfish catch and Composition - US Observer Program
Standard Trawl Surveys - Gulf of Alaska and Aleutians
Standard trawl surveys - Eastern Bering Sea (US)
Northern Fur seals - Pribilof Islands
Groundfish stomach contents - US Waters
TINRO - fish biomass and composition from trawls- Russia
Aboriginal Catch Database (Canada)
Recreational Catch Database (Canada)
Groundfish Catch Database (Canada)
Herring Catch Landings (Canada)
Herring Spawn Data (Canada)
Herring Biological Sample Data (Canada)
Mark Recovery Program (Canada)
Groundfish Biological Database (Canada)
Eastern Bering Sea Acoustic/Trawl Pollock Survey
Bogoslof Island Acoustic/Trawl Pollock Survey
Commercial Catch Database (Canada)
Salmonid Enhancement Program (Canada)
Mark Recovery Program Commercial Biological Sampling (Canada)
Mark Recovery Program Multiple Finclip Database (Canada)
Gulf of Alaska Acoustic/Trawl Pollock Survey
Shellfish Harvest Log Databases (Canada)

3 Meteorological Time Series

COADS SST and surface met. data - NODC CDROM-56/57
NOAA Climate Prediction Center-Teleconnection Indices (See entry below)
Canada-Regional air temperature anomalies 1895 - present
FNMOC SLP, winds and upwelling indices
Global air temp anomalies - with and without ENSO
NOAA Marine Environmental Buoy Database
Offshore meteorological.oceanographic buoys (Canada)
global and hemispheric air temperature anomalies

4 Physical and Chemical Oceanographic Time Series

OWS Papa - Nutrient profiles
OWS Papa - Temp, Salinity and Oxygen profiles (WOCE PR6)
JODC Temp, Salinity, Oxygen and nutrient profiles
JODC Currents (includes ADCP)
Sea Level Heights - Japan - 1961 to present
Offshore meteorological/oceanographic buoys - Canada
JODC Moored Current Meter data
Sea Level heights (Canada -West Coast)
World Ocean Atlas 1994
Canada-MEDS Sea Level Height database
Canada - MEDS oceanographic data profiles
NODC/WDC-A Oceanographic Station Profile Time Series
NOAA/NODC Sea Level Height CD-ROM

FNMOC Sea Level Pressure and Ocean flow fields
Arctic and Southern Ocean Sea Ice Concentration
T&S profiles - NW Pacific, Bering, Okhotsk (Russia)
Joint Archive for Shipboard ADCP (JASADCP) at the UH
Lighthouse SST and SSS - (Canada-West Coast)
TINRO Temperature and Salinity Profiles - Russia
Canada- MEDS world archive for drifting buoy data (DRIBU)
Monthly SST and anomalies - WC US, Alaska, Eastern Pacific
Temperature and Salinity profiles - Gulf of Alaska (GAK 1)
CALCOFI Temp, salinity and nutrient profiles (US-Calif)
NODC Ocean Current Drifter Data
NOAA Climate Prediction Center-Teleconnection Indices
http://nic.fb4.noaa.gov/data/cddb/

CPC - Data: Current Monthly Atmospheric and SST Index Values Updated around the 10th of each month. Also available through anonymous ftp to nic.fb4.noaa.gov:/pub/cac/cddb/indices

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Winds
•200 MB Zonal Winds Equator (165W-110W): Data, Graphic
•850 MB Trade Wind Index(135E-180W) 5N-5S West Pacific: Data, Graphic
•850 MB Trade Wind Index(175W-140W) 5N-5S Central Pacific: Data, Graphic
•850 MB Trade Wind Index(135W-120W) 5N-5S East Pacific: Data, Graphic
•QBO.U30.Index (replaces 30 MB Singapore Winds [see FAQ]: Data, Graphic
•QBO.U50.Index (replaces 50 MB Singapore Winds [see FAQ]: Data, Graphic

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Sea Level Pressure
•Darwin Sea Level Pressure: Data, Graphic
•Tahiti Sea Level Pressure:Data, Graphic
•Darwin (SLP) 1882 - 1950: Data
•Tahiti (SLP) 1882 - 1950: Data

Southern Oscillation Index (SOI)
•(Stand Tahiti - Stand Darwin) Sea Level Pressure: Data, Graphic
•(Stand Tahiti - Stand Darwin) SLP 1882 - 1950: Data

Sea Surface Temperature
•Nino 1+2 (0–10S)(90W-80W) Nino 3 (5N-5S)(150W-90W) Nino 4 (5N-5S) (160E-150W) Nino 3.4 (5N-5S)(170–120W): Data, Graphic
•North Atlantic (5–20N, 60–30W), South Atlantic (0–20S, 30W-10E), Global Tropics (10S-10N, 0–360): Data
•West Coast of Americas SST (Known as Ship Track 1): Data
•Hawaii Fiji SST (Known as Ship Track 6): Data
•West Coast of Americas SST 1921 - 1950 (Ship Track 1): Data
•West Coast of Americas SST 1921 - 1950 (Ship Track 6): Data

Temperatures
•Zonally Average 500 MB Temperature Anomalies: Data, Graphic

Outgoing Long Wave Radiation
•Outgoing Long Wave Radiation Equator (160E-160W): Data, Graphic

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Northern Hemisphere Teleconnection pattern indices
•Standardized Amplitudes of NH teleconnection patterns

SOURCE - CPC: STANDARDIZED NORTHERN HEMISPHERE TELECONNECTION INDICES

http://nic.fb4.noaa.gov/data/cddb/

column 1: Year (yy)
column 2: Month (mm)
column 3: North Atlantic Oscillation (NAO)
column 4: East Atlantic Pattern (EA)
column 5: East Atlantic Jet Pattern (EA-JET)
column 6: West Pacific Pattern (WP)
column 7: East Pacific Pattern (EP)
column 8: North Pacific Pattern (NP)
column 9: Pacific/ North American Pattern (PNA)
column 10: East Atlantic/West Russia Pattern (EA/WR)
column 11: Scandinavia Pattern (SCA)
column 12: Tropical/ Northern Hemisphere Pattern (TNH)
column 13: Polar/ Eurasia Pattern (POL)
column 14: Pacific Transition Pattern (PT)
column 15: Subtropical Zonal Pattern (SZ)
column 16: Asia Summer Pattern (ASU)
Documentation for teleconnection patterns

SOURCE: NCAR Climate and Global Dynamics Division (CGD)

http://www.cgd.ucar.edu/

CGD is broken into a number of sections, and each section may be working on a number of projects. This page consists mainly of links to individual sections and projects.

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•Climate Modeling
•Climate Analysis (see below) (CAS)
•Global Dynamics •Climate Change Research •Oceanography •Ecosystem Dynamics and the Atmosphere

http://www.cgd.ucar.edu/cas/

The CAS Mission

The mission of the Climate Analysis Section is to increase understanding of the atmosphere through empirical studies and diagnostic analyses of the atmosphere and its interactions with the earth's surface and oceans

on a wide range of time scales. Emphasis is on the atmospheric general circulation, meteorological phenomena, and climate variations over several time scales, such as those in blocking events; 40- to 50-day tropical oscillations; interannual variations, such as the El Niño-Southern Oscillation phenomenon; the 1988 North American drought;

solar-weather relationships; and longer-period trends.

Publications

•ONLINE Papers •Abstracts of Current Works •CAS Tech Notes
•An Introduction to Atmospheric and Oceanographic Datasets

Dataset Activities and Holdings

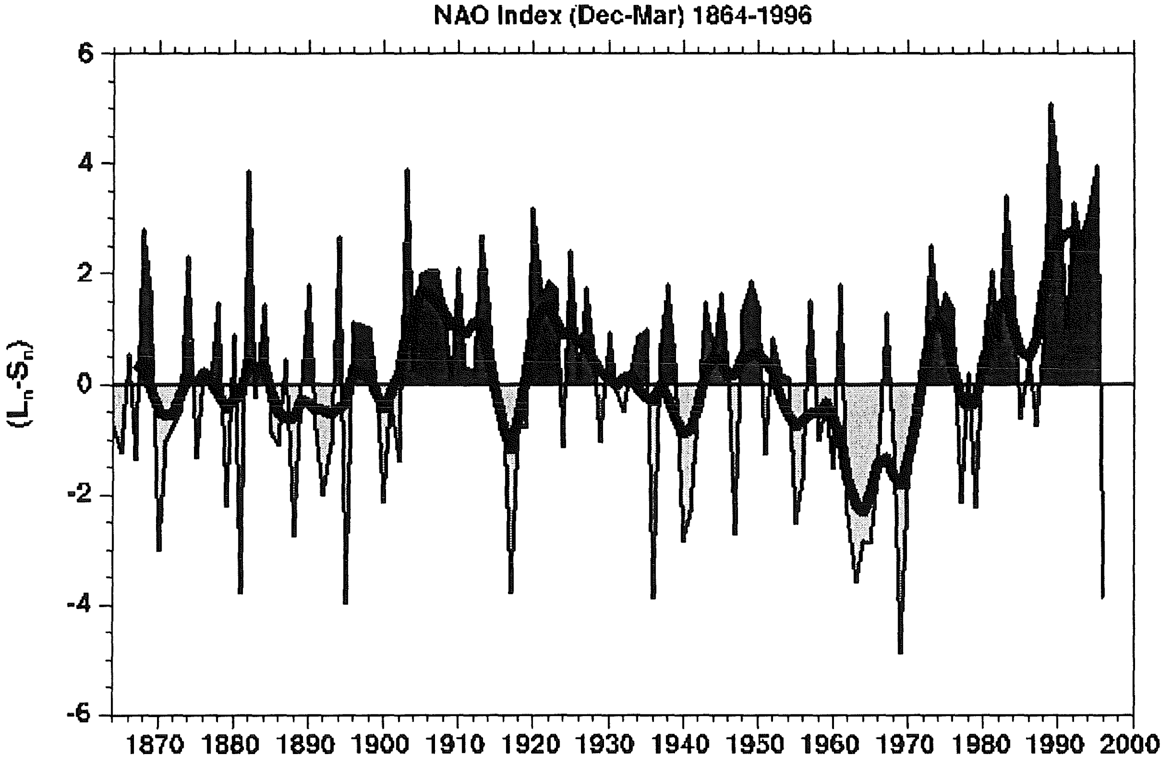
•CAS Data Catalog •Climate Indices •Atlantic Climate Variability

Model Validation

•Community Climate Model, version 3 (CCM3)

Software

•RD2CFM/CIRCE: For putting data into CCM history tape format (for local use)
•EZPLOT: For Publication-Quality Plots (for local use)


NAO Index (Dec-Mar) 1864-1996
6
4
2
0
-2
-4
-6
(Ln-Sn)
1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000