Northwest Atlantic Fisheries Organization

Serial No. N1963 NAFO SCR Doc. 91/79

SCIENTIFIC COUNCIL MEETING - JUNE 1991

A New Method for Estimating a Hydrographic Situation

by

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Abstract

In a first step it will be built up a small expert-system with one knowledge base. The result is a software-tool which describes phases of the temperature regime by inputting temperature data. The pattern recognition method is used. Fyllas Bank is the area of the study.

Introduction

Long time series from Fyllas Bank are given. With the help of temperature measurements on standard sections it is possible to describe three hydroclimatic situations. The way to separate the hydrographic situations is more or less subjective, because we are not always able to take all influencing parameters into consideration. This fact is caused by the human spirit which is not able to think in more than three or four dimensions. With the help of the pattern recognition method we are hoping to solve the problem and explain a small knowledge base.

Material and Method

The Fyllas Bank gives the long time temperature measurements on the standard stations S2, S3, S4 and S5 from 1964-1990. The used pattern recognition method presumes a class definition. In relation to the objective of our knowledge base, we define the following hydro-climatical classes with the years belong to:

1. Phase : warming : 1973, 1974, 1984, 1985, 1990
2. Phase : warm : 1964-70, 1975-80, 1986, 1987
3. Phase : cooling : 1971, 1972, 1981, 1982, 1983, 1988, 1989

The phases are the classes which are to describe patterns. The patterns are the complex of the temperature measurements on each station in the horizons 0, 10, 20 30 meters. We use only 4 horizons because it is easy to survey.

The data sets look for instance like this: Year 1975 = phase warm with 16 features (for each section and for each horizon one feature). The features can be seen as the above described dimensions of thinking. The whole database is the total of all years. The expert system shell AUTOKLAS extracts from all 16 features the class characteristics.

The recognition is about the creation of equivalence classes and the discovery of relationships which are sufficient for two hydro-climatical phases to be equivalent.

Results and Discussion

In the first step it will be analyzed, how "good" are the features for describing the classes, i.e. the hydro-climatical phases. The ranging (integrated software module) gives a range of the 16 analysis features. The conclusion is that the station S4 is the best and the horizons 10 and 30 meters have more accuracy then the 20 meter and the surface.

Another module, the feature evaluating test, allows to simulate some situations. It is possible to see what happened with the accuracy of the system, if we do not use all features. If using S2, S3 and S5 alone, the accuracy of the answers of the system decreases. Station S4 gives the same accuracy of information as all 4 Stations together. This fact may be caused by the redundance of Stations S2, S3 and S5 in relation to Station S4.

The information module is the main point of an expert system. The software-tool works in the way that the temperature data are inputted and our knowledge base gives the percentile equivalence to the saved pattern. For example: The temperature data from the year 1963 were also given but not taken over, because the trend analysis at the beginning of a time series is difficult. But the input of the data from 1963 gives the following result:

77.08% equivalence to phase : warm, and
22.92% equivalence to phase : cooling.

An improvement of the equivalence values takes place in discussion later. However, the example shows how it is possible to simulate situations and how a quick analysis of a hydrographic situation looks like.

The accuracy of the knowledge base Fyllas Bank can increase by taking over more features which have an potential influence on the defined hydroclimatic phases. In the next step, we add the measurements of the deeper horizons. Also, the addition of meteorological data may be successful. Stein (1990) described the variations caused by wind direction, wind stress, air temperature and air pressure. If using these parameters as new features in the expert system, one is taking consideration to meteorology.

Another application can be a knowledge base with biological events in relation to the hydrographic situation. For example, the abundance of 0-group larvae of cod may be put into consideration to hydrographic standard sections.

The proposal for a multinational project on the coordination of fishery hydrographic activities (Fuchs, 1990) can help for the future to build up bigger international expert systems.

References

FUCHS, F. 1990. Proposal for a multinational project on the coordination of fishery hydrographic activities in the North Atlantic. NAFO SCR Doc., No. 79, Serial No. N1801, 3 p.

FUCHS, F. 1991. An expert system for analyzing relationships between fish and environment. For ICES in September 1991 (in print).

SCHINDLER, W. 1989. AUTOKLAS - ein neuarliges Expertensystem. PC Welt 22/87.

SCHINDLER, W. 1989. AUTOKLAS - KI ganz ohne Regeln. Die Computerzeitung 27/89: 27-28.

STEIN, M. 1990. Some remarks on time-series sampled on annual intervals. NAFO SCR Doc., No. 16, Serial No. N1733, 6 p.