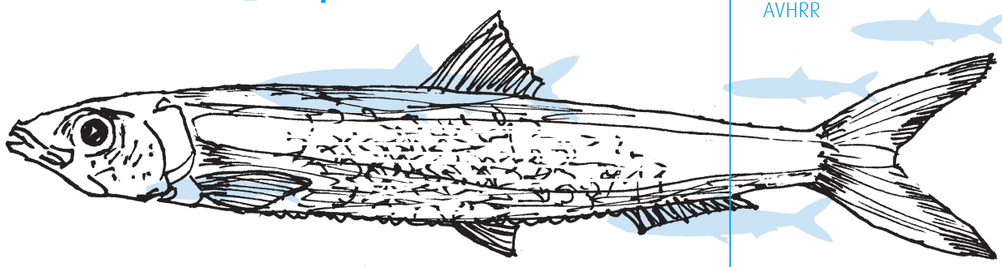
A forecasting model for Lake Tanganyika fisheries

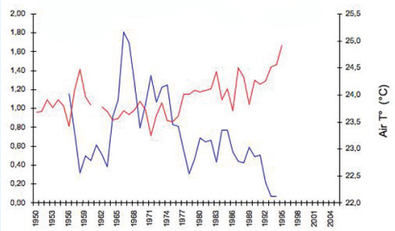
Observation area
Lake Tanganyika
Satellite imagery
MODIS
AVHRR



Optimal planning of fishing campaigns

Lake Tanganyika is almost 700 kilometres long and covers an area as big as Belgium, stretching across the borders of the Democratic Republic of Congo, Tanzania, Burundi and Zambia. For these countries it plays a vital socio-economic role. For decades local village communities have fished its waters intensively while more recently semi-industrial fishing has been introduced. However, Lake Tanganyika is very sensitive to climate variations and its productivity has always varied considerably from one season to another and also from one year to another. Among others, the El Niño phenomenon with its associated higher air temperatures in the tropics has an impact on the lake's fish resources. This is because changes to the lake's surface temperatures and wind speed disturb the water circulation in the lake and consequently the availability of nutrients and phytoplankton. In addition to the cyclical variations in the species caught and in overall productivity, over the past 20 years or more there has been an overall downward trend in catches of a number of species. This decline is now posing a threat not only to commercial fishing but also to the local populations. The aim of CLIMFISH is to arrive at a better understanding of the mechanisms of these changes and to determine to what extent they are linked to climate changes and increasing human pressure. Developing six-month forecasting tools or defining likely trends in the catches of the principal species over the coming years would be useful for fishery managers to anticipate and plan future campaigns more effectively. Such tools would also be useful to inform the other parties involved – fishermen, traders, development agencies – of changes in a sector that every year supplies over a million consumers with more than 200,000 tonnes of fish.

Photo © Pierre-Denis Plisnier



The impact of the global warming since 1976 in combination with the warm years which are linked to the El Niño phenomenon appears as a decisive element in the abundance of fish stocks.

Multi-input modelling

The eco-hydrodynamic model used in this project was developed under a previous project and incorporates a wide range of data relating to climate, hydrodynamics, water chemistry and the development of plankton. The Royal Museum for Central Africa joined forces with three university teams and two local research institutes in order to improve this fishery forecasting model. Satellite data derived water surface temperatures, chlorophyll *a* concentrations and water attenuation coefficients greatly supplemented the point sampling. Using the model, it is possible to simulate the plankton quantities produced for given climatic conditions. These results are then analysed statistically and compared to field observations, such as the fish specie that will be present in abundance. The model becomes increasingly refined and its potential as a reliable tool for forecasting catches is evaluated. This should allow an optimal exploitation of the fish that will be present in abundance, the best choice of nets, conservation and packaging methods, and transport and distribution networks, etc.

Objective › › ›

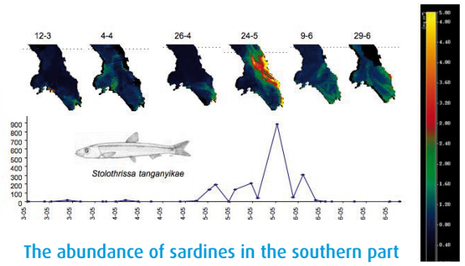
To investigate the impact of climate changes on the fisheries of Lake Tanganyika using an eco-hydrodynamic model developed by a previous research project that has been improved thanks to a combination of in situ and satellite data.

Methodology › › ›

- Campaign of measurements (meteorological, limnological, biological data and fishery statistics) carried out between November 2004 and September 2006 in close cooperation with the Kigoma and Mpulungu stations.
- Production of a time series of low resolution images (1km) over three and a half years characterising the spatio-temporal variability of surface temperature, chlorophyll *a* concentration and the lake water attenuation coefficient.
- Use of these data to refine and validate the eco-hydrodynamic model. Comparison of the results produced by the model with recent fishery statistics (2002-2006).
- Use of historical data (environment and fisheries) to check model suitability.
- Evaluation of the model for drawing up plausible scenarios for forecasting future fishery conditions.

Result › › ›

The project has completed the series of field data collected during a previous project, CLIMLAKE, to result in more than four full years of meteorological, limnological and biological data. Temporal series of images were produced from MODIS and AVHRR data. These provide the surface temperature, the chlorophyll *a* concentration and attenuation coefficient of the waters of Lake Tanganyika between 2004 and 2006 (between 1985 and 2004 for the temperature, but at less precise spatial resolution and on a weekly basis). A correlation was established between the chlorophyll *a* concentrations and the attenuation coefficient calculated through remote sensing and measured in the euphotic zone. The eco-hydrodynamic model was validated with the field data collected at the Kigoma and Mpulungu stations. For the three principal species of fish found in the lake, correlations were established between, on the one hand, the data obtained by satellite imagery and, on the other hand, the biological data and fishery statistics. The model was used to estimate the lake's primary productivity under present conditions of water circulation and sunshine as well as under the conditions supplied by the general circulation models in such a way as to be able to examine the influence of the climate since 1970 on the lake's ecosystem. There were significant correlations, not only between fishery statistics and the results of the model, but also between said statistics and global oceanic data such as surface temperature and atmospheric pressure. Atmospheric pressure values are linked to local climate variations which have a bigger impact on fishing than human influences.



The abundance of sardines in the southern part of the lake is linked to the high concentration of phytoplankton as measured by satellites (mg chlorophyll *a*/m³).

www.geo.ulg.ac.be/cornet/climfish/

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