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The Recopesca project: a new example of participative approach to collect in-situ environmental and fisheries data using fisheries vessels of opportunity

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Abstract

Face to the lack of data to assess precisely the spatial distribution of catches and fishing effort and for the environmental characterization of the fishing area, Ifremer has been implemented since 2005 a new project, Recopesca. It consists in fitting out a sample of voluntary fishing vessels with sensors recording data on fishing effort (and at mid-terms catches) and physical parameters such as temperature or salinity. Recopesca aims at setting up a network of sensors, for scientific purposes, to collect data allowing improving resources assessment and diagnostics on fisheries, and environmental data required for ecosystem-based management initiatives.

The challenge was to develop sensors with no trouble for the fishermen, tough enough to be fixed up on fishing gears, self powered and autonomous. Insofar as the sample of targeted vessels intends to be representative of all the metiers and fleets, the sensors are modular and scalable to collect new data.

Different sensors have been implemented: (i) a temperature-salinity sensor, able to record physical parameters, depth and duration of immersion, for passive and active gears, and (ii) a specific sensor to record number or length of passive gears. A GPS monitors the position of the vessels. Each sensor is equipped with a radio device transferring the data to a receiver on-board, called “concentrator” that sends the data to Ifremer central databases by GPRS. An anti-rolling weigh-scale is currently on development to record catches per species and fishing operation. The presentation will show the first data and results of this participative approach.

Keywords: fishing vessels, participative approach, fishing effort, catches, environmental parameters, temperature, salinity, ecosystem-based approach

Introduction

Even if different countries have implemented Fisheries Information System for a few years, especially in relation with the EU Data Collection Regulation (Council regulation (EC) No 1543/2000; Commission regulation (EC) No 1639/2001 modified by Commission regulation (EC) N° 1581/2004), a lack of reliable data to assess precisely the catches and fishing effort is an undeniable fact. The evaluation of fishing effort and catches and their spatial distribution are fundamental to assess the states of exploited resources and to make a diagnosis on fisheries. Data currently available for French fisheries comes mainly from the fishermen's declaration (log-books), at the scale of ICES statistical rectangles (30 minutes latitude, 1 degree longitude). This scale is inadequate for numerous research projects and a fine analysis of the "fishing system". Moreover, the coverage of these data is often partial and their reliability sometimes hard to appreciate.

Moreover, the local environmental conditions and their variability on the fishing area are often little-sampled by the scientific campaigns, especially because of the specific conditions where the fisheries take place: low depth, significant current (especially tidal current), various activities (professional and recreational) making vulnerable the measure devices. Thus, even for basic parameters such as temperature or salinity, most of the available measures are limited to the oceanographic campaigns held by Ifremer.

Face to this lack of data, Ifremer has been implemented since 2005 a new project, Recopesca, consisting in fitting out a sample of voluntary fishing vessels with sensors recording data on fishing effort (and at mid-terms catches) and physical parameters such as temperature or salinity. Recopesca aims at setting up a network of sensors, for scientific purposes, to collect data allowing improving resources assessment and diagnostics on fisheries, and environmental data required for an ecosystem approach to fisheries (EAF).

Recopesca is a project of national scale, including overseas island and is a concrete achievement of participative approach: scientists and fishermen team up to give to the voluntary fishermen a role of scientific observer. It consists in the implementation of specific sensors on the fishing gears and aboard a sample of vessels representative of the whole fishing fleets.

Recopesca provides an innovative tool to collect data, especially through the integrated multidisciplinary. The collected data can be used by both fisheries scientists and physicists, who dispose of information for areas non- or little-accessible till now.

Development of sensors suitable with conditions and constraints aboard fishing vessels

The existence of the project rested on the development of sensors and measure devices. The challenge was to develop devices tough enough to be fixed up on fishing gears, self powered, autonomous, affordable and able to run without any intervention of the fisherman neither trouble for the fishing activity. Insofar as the sample of targeted vessels intends to be representative of all the metiers and fleets, the sensors are modular and scalable to collect new data. Different sensors have been developed and implemented onboard.

The measure of physical environmental parameters at the bottom and along the water column

A specific sensor allows to record physical parameters, pressure, and thus depth, and duration of immersion. A first version included only temperature sensor (Pictures 1a and 1b), a second one has been developed to integrate salinity. Autonomous and small-size, he is

tough enough to be fixed up on all types of fishing gears, active (trawls, dredges) or passive (nets, long-lines, pots). The sensor records the parameters along each stage of the fishing operation (descent, fishing action and raise of the gear) with a cadence configurable according to the gears and their carrying out. The device allows building temperature or salinity series and profiles. The maximum immersion depth varies from 300 to 1200 meters, depending the version.

The measure of fishing effort

A same sensor can have different functions. Thus, in addition to the environmental parameters, the measure of duration of immersion of the device previously described is a good indicator for the fishing time of the gear, active or passive.

Another specific sensor, called the “turns-counter”, has been specified to equip the passive gear (gill-nets, pots or lines) hauler. Fixed on the rotation axis, the sensor records the number of turns and allows deducing the number or length of passive gears hauled at each fishing operation. As well as the other sensors, this device is autonomous and small-size (Picture 2).

Recording the location of the data, and the course and speed of the vessel

In order to know the position of the physical measures and follow the course and areas of fishing activity of the vessels, a GPS is implemented on-board and tracks the location of a given vessel at configurable and regular intervals (for instance, a quarter hour). The knowledge of its speed allows moreover characterizing approximately the different actions of a fishing trip (on fishing, on route…).

Furthermore, in the European Community regulation framework, vessels over 15 meters overall length are concerned by the Vessel Monitoring System (VMS): electronic devices, or “blue boxes”, are installed on board vessels and automatically send data to a land base station and the appropriate monitoring centre (CROSS ETEL in France). Recopesca solicits the fishermen’s agreement to have an access to their VMS data in order to validate the Recopesca GPS data by cross-checking.

Assessment of the catches

A proposal of both scientists and fishermen was to develop and install an “anti-rolling” weigh-scale onboard (Picture 3). Recording the catches per species and fishing operation, and in association with the other Recopesca sensors, this device allows linking fishing effort and catches at the finest scale of the fishing operation.

A prototype of this weigh-scale has been tested onboard and the first implementations of an industrial version are planed for the second part of 2008.

Transmission of the data to land databases

Between 2005 and 2008, the developments and tests carried out with around thirty voluntary vessels allowed analyzing mechanic tolerance of the sensors, improving their resistance, validating their autonomy and their maintenance needs and optimizing their placement onboard and on the gears. During the period, the sensors have considerably evolved, especially to improve the quality and reliability of data, take into account the autonomy constraints and give more security and durability in their use.

Furthermore, each sensor has been equipped with a radio device transferring the data to a receiver on-board, called “concentrator” (containing the GPS device) that sends the data to Ifremer central databases (Picture 4). The automatic transmission of the data at land is done by GPRS, once the vessel is within range of GPRS network, without any human intervention. This approach (quasi real time) has been chosen in order to track quickly dysfunction, interruption or loss of sensors. The delayed mode data

Deployment of the sensors network

The development stage of the project (2005-2008) being almost achieved, Recopesca has begun the deployment of a operational and autonomous sensors network at the end of 2007. At the summer 2008, around 25 vessels are equipped (Figure 1). The aim of the project is to reach a 300 to 400 vessels sample, split along the French coast. The deployment plan is established in accordance of the need of both fisheries scientist (a sample representative of the diversity of the fleets and the fishing metiers) and physical oceanographers. The mobilization of fishermen is carried out by the observers’ network of the Fisheries Information System (FIS) of Ifremer.

Storage and dissemination of data

Regarding the computing infrastructure, Recopesca relies on existing operational data centers:

- *Coriolis*[1], for operational oceanography
- The Fisheries Information System, FIS[2] (Leblond et al., 2008) of Ifremer and its database *Harmonie*

Once the data emitted by the “concentrator” and received by Ifremer, the physical data (température series and profiles, salinity…) are stored in *Coriolis*. As for the fisheries data (per fishing operation), they are stored in *Harmonie*. This management of data by the thematic data centers ensures quality control and dissemination of data to the users. Confidentiality of individual data (especially fishing data) is also guaranteed.

First uses of data

Recopesca constitutes an innovative tool to collect data and contributes to supply the existing information systems. It must be considered as a means and not as a goal in itself.

The physical environmental data of Recopesca are thus available in *Coriolis* which supplies oceanographic research, operational oceanography tools or hydrodynamics models. The current activity of Coriolis represents around 350.000 stations (profiles) per year. The perspective of Recopesca, with a 400 vessels sample, could be more than 200.000 further stations.

The physical data are already used by the *Previmer* program[3]. Some illustrations of temperature and salinity profiles available through Recopesca are presented in the figures 2 and 3 (Anonymous, 2007 and Anonymous, 2008).

[1] http://www.coriolis.eu.org/
[2] http://www.ifremer.fr/sih
[3] http://www.previmer.org/

The fisheries data (activity, fishing effort and catches), resulting from direct measures, and no more from fishermen's declarations or estimation by survey, supply the Fisheries Information System of Ifremer. Especially, Recopesca provides an objective measure of activity and fishing effort for vessels less 15 meters overall length, part of the fleet generally poorly known because less followed up and less framed by regulation. Through the FIS, the fisheries Recopesca data can contribute to the whole fisheries research projects, especially in the framework of an ecosystem approach to fisheries, and assessments. They are complementary with log-books and VMS data.

The table 1 and figures 5, 6 and 7 illustrate the kind of results obtained through Recopesca, and especially:

- the development and progress of the fishing trip, including a description of the different fishing operation (table 1 and figures 5 and 6) : duration, location, environmental conditions around the fishing operation depth, temperature)
- the estimation of fishing effort variable par fishing sector (figure 7).

Table 1: Description of the different fishing operations of a nephrops trawler fishing trip (Fishing port: Le Guilvinec)

	Beginning of the fishing operation				End (Hauling of the trawl)				Duration	Mean parameters of the operation	
Op	Date	Hour	Position		Date	Hour	Position			T°C	Depth
			Lat N	Long W			Lat N	Long W			
1	27/10/2007	05:59:14	47,74	4,62	27/10/2007	09:09:50	47,74	4,69	03:10:36	10.37	111
2	27/10/2007	09:35:36	47,74	4,7	27/10/2007	11:41:50	47,715	4,7	02:06:14	10.35	109
3	27/10/2007	12:12:26	47,72	4,69	27/10/2007	13:08:50	47,73	4,7	00:56:24	10.34	106

Finally, to ensure the durability of the volunteers, Recopesca will give back the data measured onboard to the vessel owners. A document, synthesis of the data collected by the sensors of a given vessel, is currently designed.

Conclusion

Recopesca constitutes an innovative, affordable and modular solution for collection of data. It must be considered as a means and not as a goal in itself, and intends to provide to different observation system a new platform to collect their data: the fishing vessels. The project being modular, it can be expanded to other kinds of physicochemical data, such as turbidity, fluorimetry, dissolved oxygen…) or fisheries data (other variables of fishing effort, fuel consumption…). Different sensors will be under consideration.

The fisheries data (activity, fishing effort and catches), resulting from direct measures, and no more from fishermen's declarations or estimation by survey, supply the Fisheries Information System of Ifremer et will allow to improve the knowledge of the fishing fleet activity, especially for the small scale vessels. Indeed, Recopesca provides an objective measure of activity and fishing effort, notably for vessels less 15 meters overall length (not tracked by the VMS), part of the fleet generally poorly known because less followed up and less framed by regulation.

Up to now, the research of volunteers doesn't constitute a difficulty, especially thanks to the close relationship existing between the fishermen and the observers of the Fisheries Information System of Ifremer. Teaming up scientists and fishermen for scientific purposes,

in a participative approach, the project gives to the voluntary fishermen a role of scientific observer and can be certainly attractive.

But the use of the data collected onboard can constitute another interest of the fishermen. Fishermen are required to declare their activity in logbooks (Commission Regulation (EEC) No 2807/83, modified by Commission Regulation (EC) No 2737/1999) or national fishing form for vessels less than 10 meters length. This document records catches per species, fishing effort, gears and fishing zones, namely the current data measured or recorded by the Recopesca system. Recopesca could then contribute to provide onboard to the fishermen the data required by the Regulation, and thus ease the fill in of their documents, or even supply an e-logbook system.

In the same way, the data could be used by the fishermen themselves for seafood value chain purposes: for instance, in the framework of the setting up of a controlled origin certification, the vessels' location data could be used to guarantee the origin and traceability of the products.

These avenues of reflection for the use of Recopesca data will be further explored with the fishermen.

Acknowledgements

Recopesca thanks the voluntary fishermen who accepted to integrate the Recopesca network of vessels and put their vessels at the disposal of the project. We thank also the technical team of Recopesca, especially Thomas Loubrieu and Karen Cordier, and the observers of the FIS.

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Commission regulation (EC) N° 1639/2001 of 25 July 2001 establishing the minimum and extended Community programmes for the collection of data in the fisheries sector and laying down detailed rules for the application of the Council Regulation (EC) N° 1543/2000 – OJ L 222, 17.8.2001, p.53-115

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Pictures

Picture 1a: Temperature-depth sensor fixed on a net

Picture 1b: Temperature-depth sensor fixed in a pot

Picture 2: The “turns-counter” fixed in a gill-net hauler

Picture 3: Recopesca weigh-scale (pan and command module)

Picture 4: “Concentrator” of data onboard

Figures

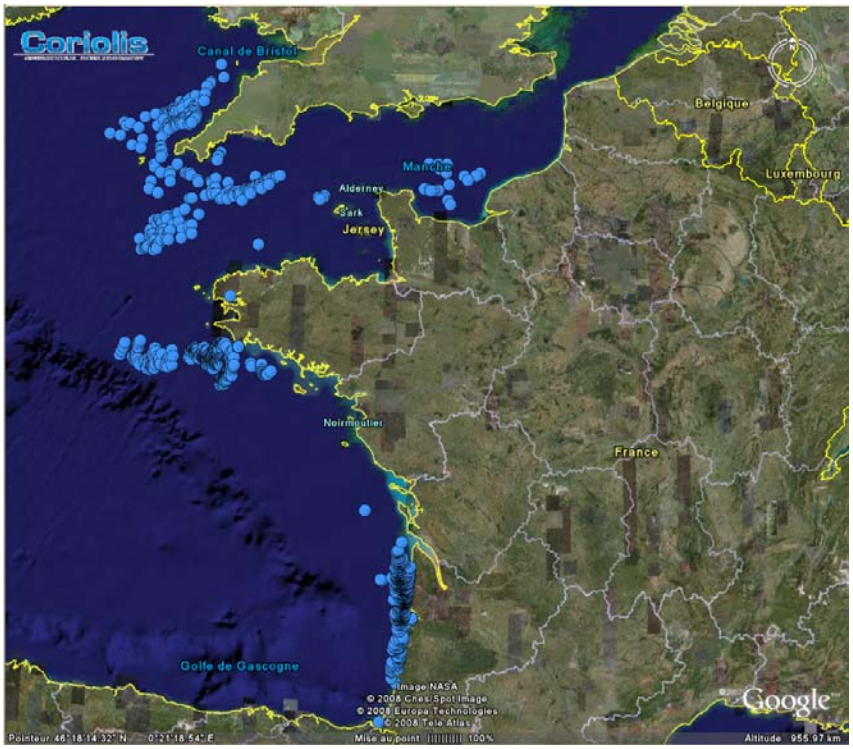
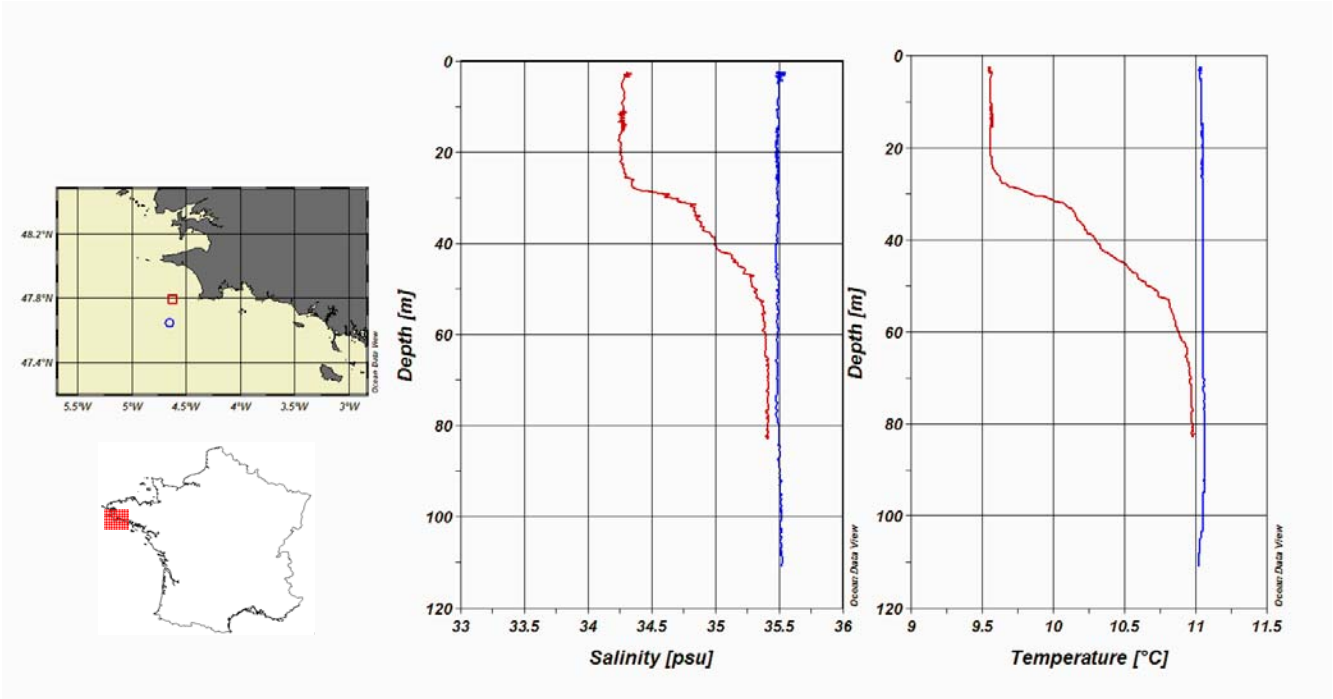
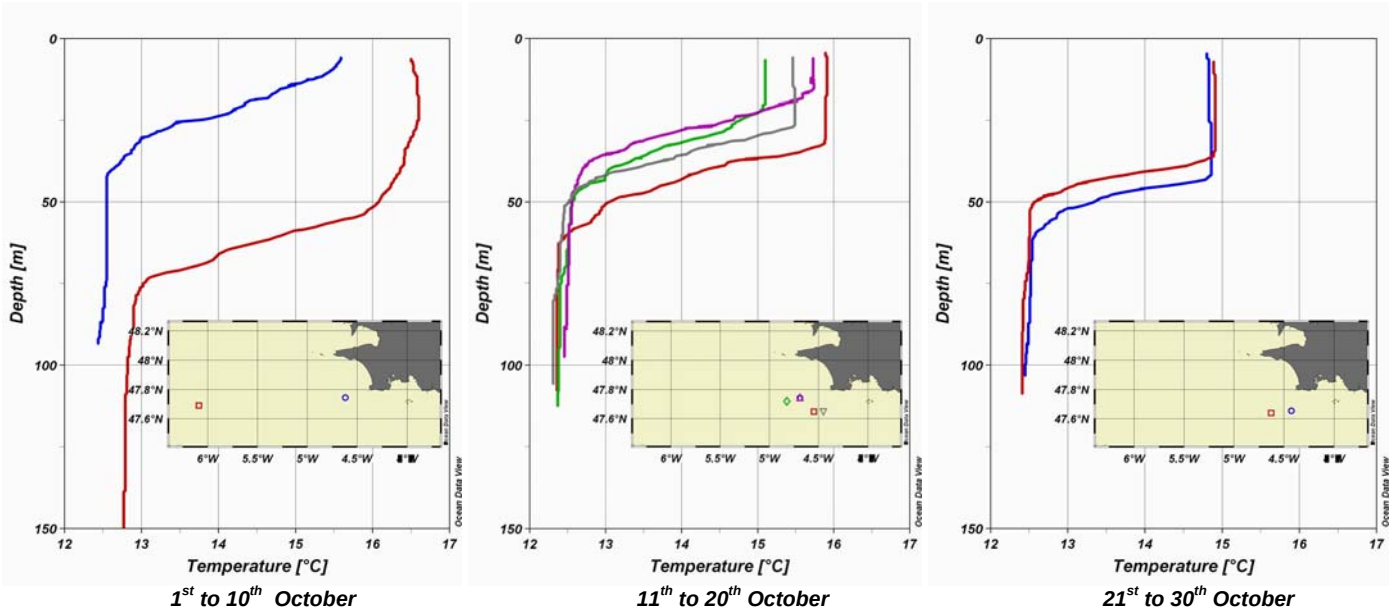


Figure 1: Locations of Recopesca temperature profiles available in *Coriolis* (spring 2008), displayed in Google Earth.



Salinity has evolved between the two dates: the band of desalinated water in the first 30 meters depth obvious in February disappears in March. These desalinated waters were colder than underlying seawater as shown in the temperature profile of February. This situation is typical of winter situation along the coasts. (Anonymous, 2008)

Figure 2: Salinity and temperature profiles obtained by a Recopesca vessel the 18th February (red line) and 31st March 2008 (blue line).



1st to 10th October | *11th to 20th October* | *21st to 30th October*

Temperature profiles show that warmer waters are on the surface. The transition with the bottom waters is made in a few meters in an area called thermocline. During October, in the south of Britany, a drop in temperature of 1,5°C and a deepening of the thermocline are observed. At the end of October, surface waters are homogenous in a depth range from 0 to 40m (around 15°C). Durant the whole month, the temperature of bottom waters doesn't vary and stay at about 12,4°C (Anonymous, 2007).

Figure 3: Examples of temperature profiles measured during the 3 decades of October 2007

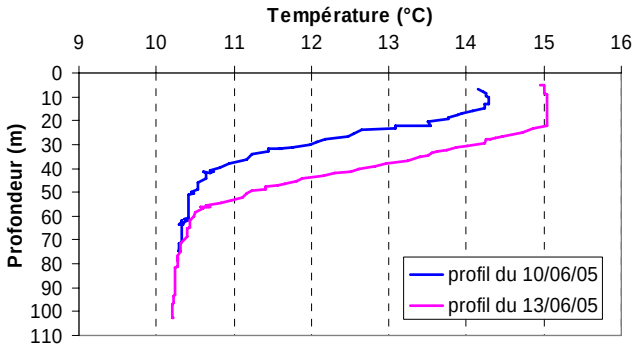


Figure 4: Examples of temperature profiles obtained by a trawler

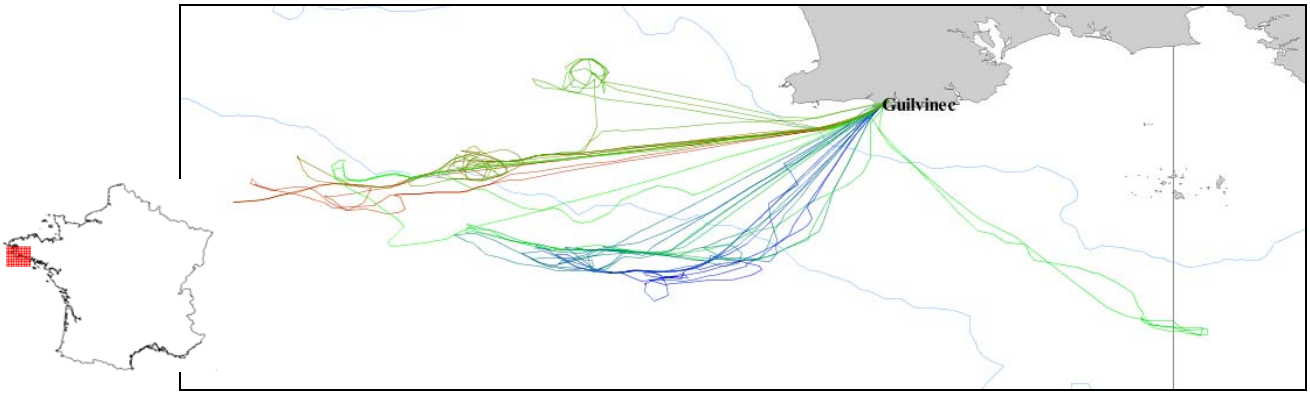


Figure 5: Route of the whole fishing trips operated by a nephrops trawler in October 2007 (Fishing port: Le Guilvinec)

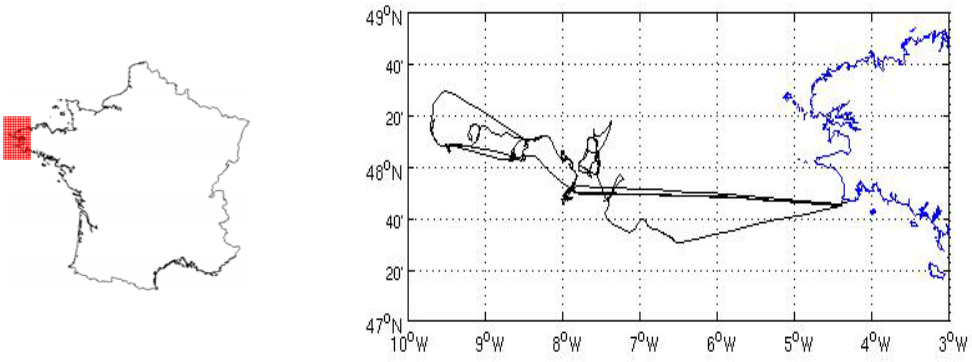


Figure 6: Example of the route of a vessel tracked by a GPS Recopesca.

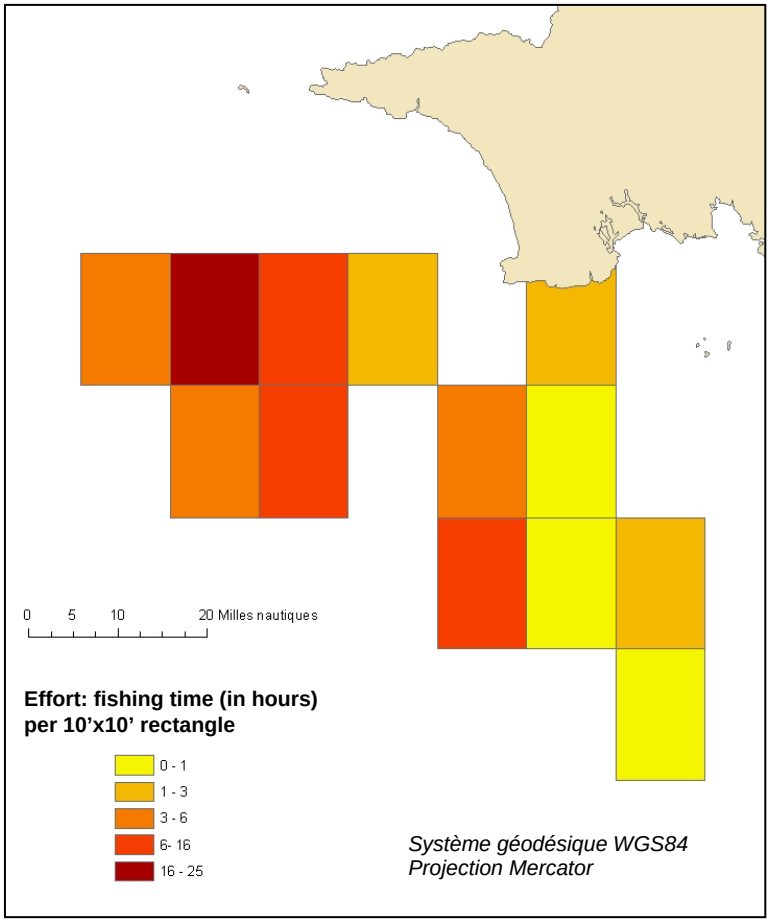


Figure 7: Spatial distribution (10' latitude x10' longitude rectangle) of fishing time of a Bay of Biscay nephrops trawler during May 2008.