



IoT

Indian Ocean sea Turtles

Newsletter 2

January 2020

Project carried out by



In partnership with





The whole team of the Indian Ocean Delegation of Ifremer wishes you all the best for 2020

THE IOT TEAM EXPANDS

In September 2019, **Pierre GOGENDEAU**, who previously worked as an Electronics Engineer on the POPSTAR, IoCT, pIOT and IOT projects, started a **PhD** thesis co-supervised by CNRS-LIRMM and IFREMER and funded by IFREMER scientific Direction. The PhD thesis entitled "Intelligent integrated geolocation system based on multiple sources of heterogeneous and transient information" deals with the development of a marine animal geolocation system based on the fusion of data from different information sources (accelerometers, magnetometers, LoRa, ...).

In October 2019, **Andréa GOHAZARDEH** joined the delegation as an **Electronics Engineer**. His work mainly consists in continuing the development of the various electronic systems, namely the design and production of electronic boards and their programming, the mechanical design and production of prototypes for experimentation (3D printing, resin coating, ...), as well as carrying out of tests to validate the technological developments and geolocation algorithms. Before joining Ifremer, Andréa worked as a design engineer on space launcher control paths for the Ariane Group and holds an engineering degree in Automation and Industrial Computing from IMT Atlantique (formerly Ecole Nationale Supérieure des Mines de Nantes).

At the beginning of January 2020, **Julien FEZANDELLE** joined Ifremer as **Electronics – Telecommunications Engineer**. His job is to finalize the development of receiving stations (ground stations and marine buoys) based on LoRa transmission including environmental sensors (temperature, salinity, ...), to participate in the development of marine turtle tracking tags using LoRa transmission and to set up a server which will gather all the data collected and make access to them through a website (e.g. LoRaserver).

A telecommunications engineer, graduate of the Ecole Polytech'Nice-Sophia, Julien was previously manager of a company specializing in electronics and the Internet of connected objects.

Five Ifremer members are now working fully on the IOT project, supported from time to time by other members of the Indian Ocean delegation in Reunion Island.



IOT team: Sylvain BONHOMMEAU, Anne-Laure CLEMENT, Pierre GOGENDEAU, Andréa GOHAZARDEH, Julien FEZANDELLE © IFREMER

RECENT ACTIVITIES



Surface sensor consolidation and new in-situ tests :

Over the past few months, various tests have been conducted by the project team. While the pIOT pilot project mission conducted in April 2019 on the island of Europa confirmed and validated several technological developments, a few malfunctions did occur, especially the surface sensor which triggers the data transmission when turtles come up at the surface.

The project team **conducted various tests on new prototypes**. The surface sensor of the tags that seemed to be at the origin of a mechanical failure affecting the transmission of LoRa signals was tested for 3 weeks in the laboratory and in a tank. The results of all these tests made it possible to improve on the **electronic board**, the **mechanical design of the tag**, and the **software algorithms**.



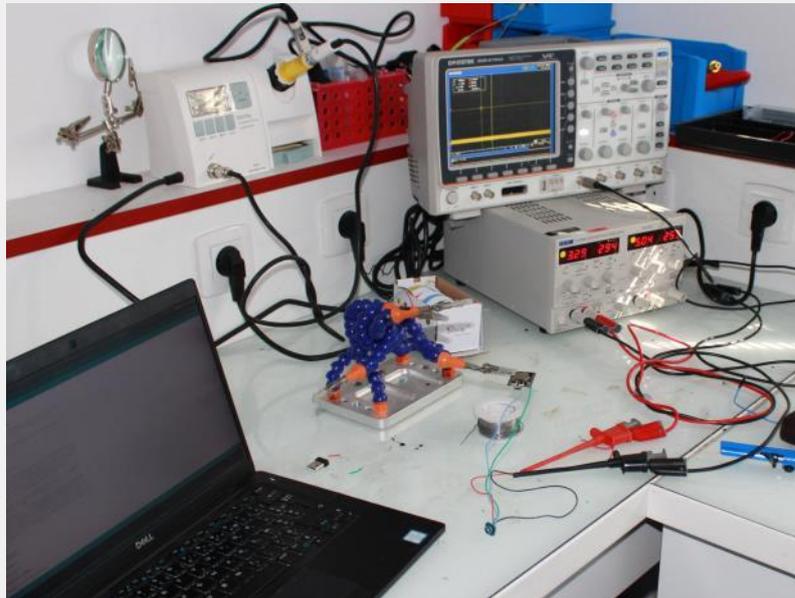
Electronic card developed for the project and version 2 of the tag © IFREMER

All technological advances and therefore prototypes undergo a battery of tests and improvements are constantly being made.

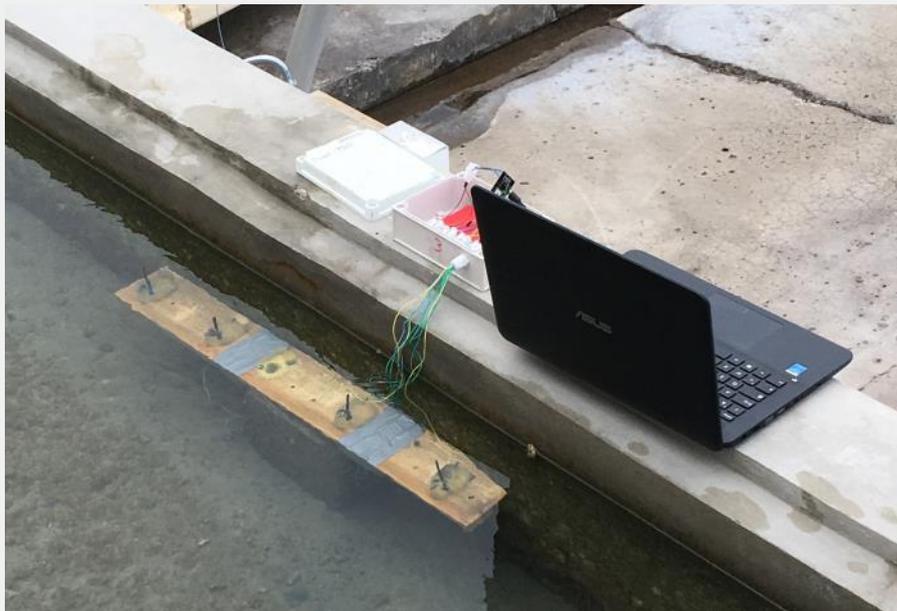
Focus on the operation of the surface sensor version 1:

The principle of the sensor consists in reading the measurement of a current going through two electrodes placed on the tag. When the tag reaches the surface, the two electrodes are in the contact of the air (a very good insulator) and the current no longer flows between the electrodes. The current measured value is thus supposed to be zero. However, sea water has an impact on the operation of the sensor: corrosion of the electrodes which degrades the reading of the current values, sediment deposition layer and degradation of the coating of the tag which retains a fine layer of water even when the tag is removed from the water. As a result, a current still flows between the electrodes and the surface is no longer detected.

Detecting the surface is essential because it is only out of the water that you can activate GPS and send LoRa messages.



Testing of the electronic board and surface sensor in the laboratory
© Anne-Laure CLEMENT/IFREMER



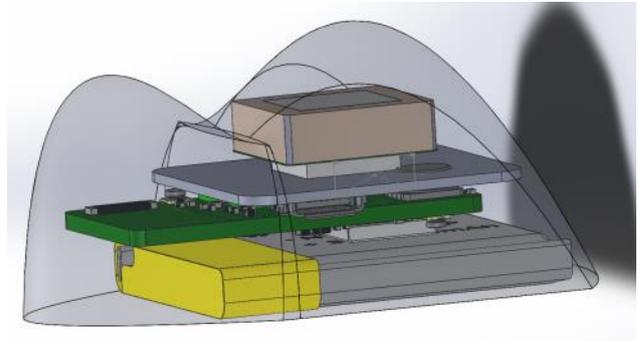
Testing of surface sensors in a seawater corridor at the Kélonia experimental platform and daily measurement of the parameters © Andréa GOHAZARDEH/IFREMER

UPCOMING ...

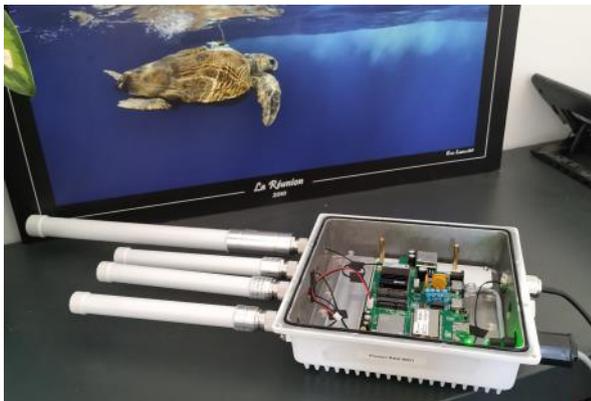


Testing of new tags and receiving stations (version 3):

The **new version 3 of the tag** will soon be tested, during 3 days in February 2020, this time on a sea turtle of the experimental platform of Kélonia, in order to confirm the improvements made and in particular of the geolocation algorithm.



Design of the version 3 tag based on computer-aided design
© Pierre GOGENDEAU/IFREMER



Version 3 of the gateways or receiver boxes
© Anne-Laure CLEMENT/IFREMER

Freshly arrived at Ifremer, the **new receiver stations** will soon be tested in order to check their correct operation.



Characterization of the LoRa radio signal:

Further tests are scheduled in February to **characterize the LoRa radio signal on the water surface**. For this purpose, several receiving stations will be placed on sites at different heights in order to measure the power of the received signal and to determine on the one hand the importance of the height and positioning of the stations for reception and on the other hand the maximum transmission distance.

In parallel with the technological developments of the equipment, the team is working with a Reunionsese company, IDOCEAN, on the design of an **autonomous USV** (Unmanned Surface Vehicle) **board** controlled by an autopilot. The objective is to use this board to characterize the LoRa radio channel by emitting LoRa signals at defined positions at sea surface. The motorization of this board allows it on the one hand to follow a predefined trajectory and on the other hand to keep a sub-centimetric GPS position even in case of current or swell.

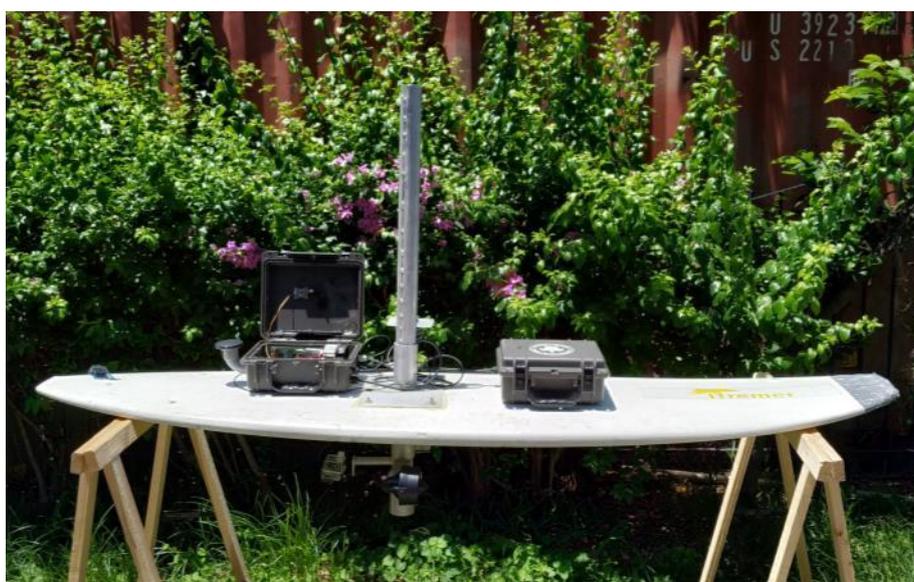


All the information transmitted by the board as well as the sending of commands to the board is done remotely via a 3G and 4G mobile network. This mobile network also allows the reception of a live video stream thanks to the presence of a camera placed on the board, which is used to steer the board in manual mode if necessary.

The board is also equipped with an **echosounder** to carry out **bathymetric surveys** of the project sites. This bathymetry will enable us to improve the geolocation algorithms by coupling the information on the depth of sea turtles and bathymetry at the same spot.

Coupled to the bathymetry sensor, a **camera** takes underwater pictures with the aim of mapping these images and then making a **3D reconstruction of the seabed visited**. At shallow depths, this camera will also enable us to reconstruct the bathymetry using photogrammetry.

By combining all these information, IDOCEAN is developing an open source software which will allow us to reconstruct the habitats in 3D and produce bathymetry maps for each study sites. These information will be used to **link the turtle trajectories to their habitats**.



Autonomous USV board © IFREMER

COMMUNICATION ABOUT THE PROJECT IN 2019



Communication for the general public :

In 2019, the IOT project was presented to the general public at various events.

First of all, on **Sea Day**, organized on June 15 2019 in Le Port by the Cluster Maritime de La Réunion and Sciences Réunion, presentations of the pIOT and IOT projects were made and a prototype of a new generation beacon for sea turtles was exhibited on the Ifremer stand.



Ifremer stand at 2019 Sea Day
© Magali DUVAL/IFREMER

As part of the conference "**A new technology at the service of marine turtles**" organised on October 23 by Kélonia, CEDTM and Ifremer as part of the exhibition OUsa OUva - the migration of marine turtles, Pierre GOGENDEAU presented the IOT project to a packed room! An information panel on the project is also visible at the exhibition hall.



Presentation of the IOT project at the public conference © Stéphane CICCIONE/Kélonia



Panel presenting the new tag (version 2) for the exhibition Ousa OUva in Kélonia © Anne-Laure CLEMENT/IFREMER

Then it was as part of the **2019 Science Festival** that Ifremer held a stand at Kélonia to present to the public and visitors the projects related to the development and deployment of tags and tags for monitoring marine turtles (pIOT and IOT projects) and sword fish (FLOPPED).

During this event, a **treasure hunt** for kids (primary and secondary schools) was organized on the theme of monitoring marine turtles using the new innovative tags. 180 children were able to take part in it and thus become aware of this theme.



Presentation of the IOT project and tags to the schoolchildren coming to Kélonia for the Science Festival 2019 © Patricia GONTIER/IFREMER

Poster presenting the animations proposed by Ifremer, Kélonia and CEDTM for the 2019 edition

In 2019, a flyer presenting the research projects pIOT and IOT was produced by the Indian Ocean delegation of Ifremer. They are available on the Archimer platform by clicking on the following links <https://doi.org/10.13155/61976> (FR) and <https://archimer.ifremer.fr/doc/00508/62003/> (EN) as well as on the delegation's website at: <https://wwz.ifremer.fr/lareunion/Projets/Innovations-technologiques/pIOT-2018-2020-IOT-2018-2021>





Scientific communication :

In July 2019, two major international scientific events were held to communicate on the project within the scientific community:

- the 11th WIOMSA Scientific Symposium which took place from 1 to 6 July in Mauritius,
- the 3rd International Conference on Island ecology, evolution and conservation (IBS 2019) organized from 8 to 13 July in Reunion Island.



The **scientific poster** and the **projects presentation** can be consulted on Archimer:

POSTER

Bonhommeau Sylvain, Gogendeau Pierre, Salvatico Pauline (2019). Projects pIOT & IOT For Indian Ocean Sea Turtles. 11 th Scientific Symposium WIOMSA “People, Coasts and Oceans: Opportunities for a changing futures”. 1st – 6th July 2019, Mauritius. <https://archimer.ifremer.fr/doc/00509/62036/>

PRESENTATION

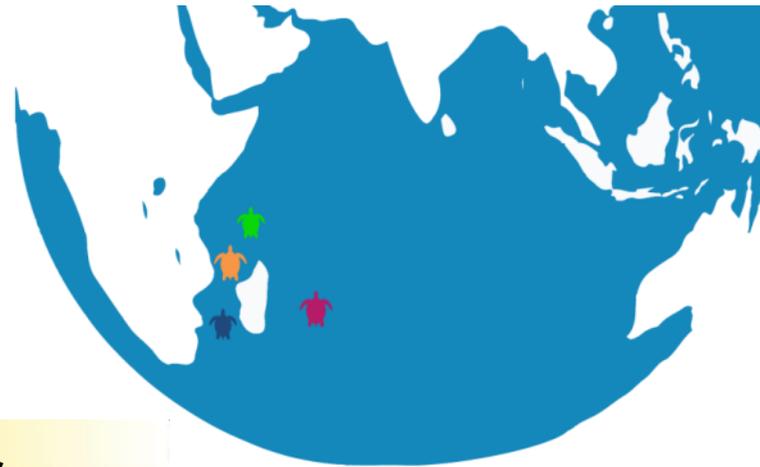
Sylvain Bonhommeau, Serge Bernard, Vincent Kerzerho, Pierre Gogendeau, Tristan Rouyer, Anne-Elise Nieblas. An open network to monitor marine environment and species. 3rd International Conference on Island ecology, evolution and conservation . 8 -13th July 2019, Reunion island.

<https://drive.google.com/file/d/1xNxXHUaKpmKFFOXbZgNcp-sQuJqGdFa7/view?usp=sharing>



Presentation of the scientific poster on the pIOT and IOT projects at the 11th WIOMSA Scientific Symposium by Sylvain Bonhommeau (right) and Pierre Gogendeau (left)

© IFREMER



Test and deployment sites and periods:

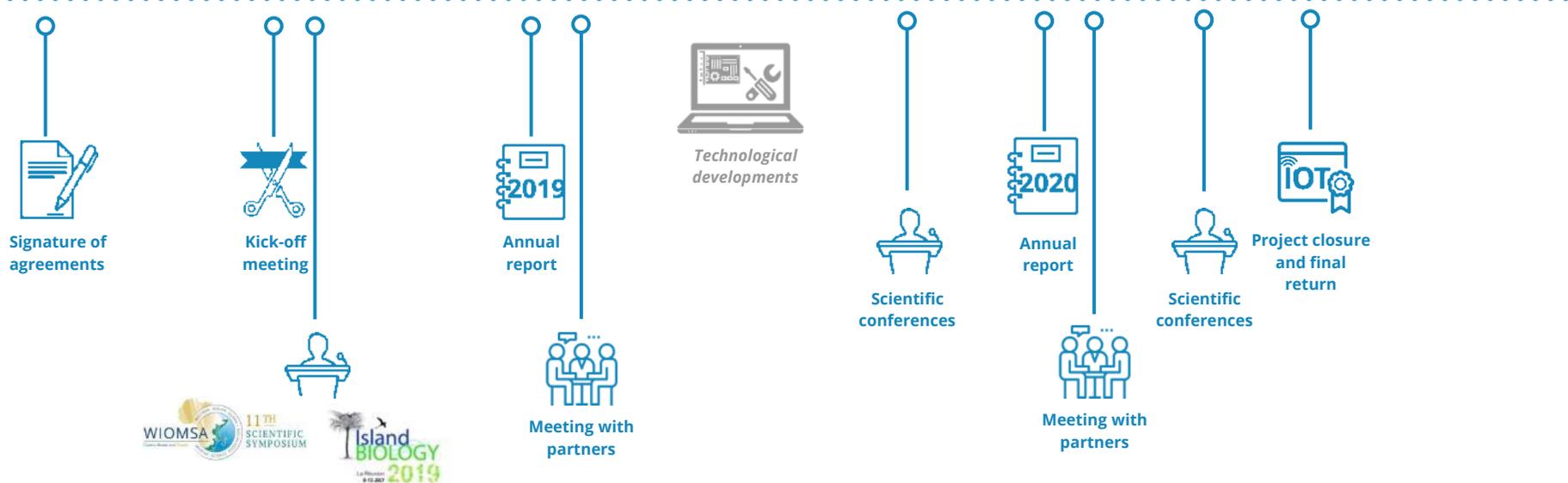
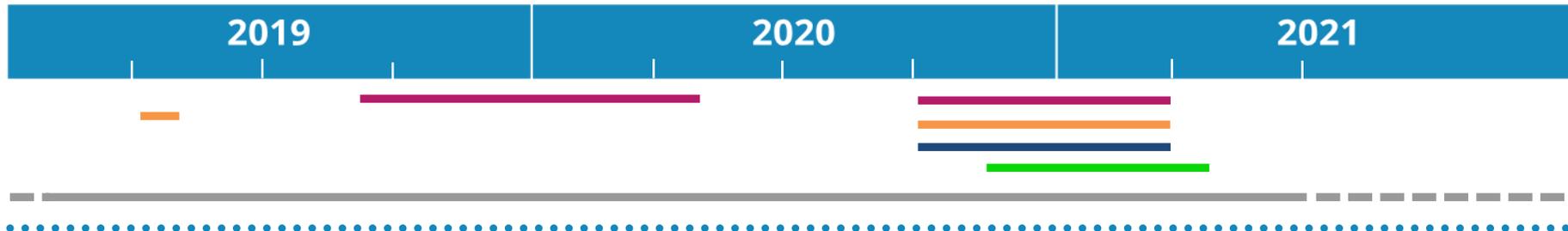
Reunion Island

Mayotte Island

Scattered Islands (TAAF)

Aldabra Island (Seychelles)

PROGRAMMING AND PROGRESS





To know more about it, visit the web site :

<https://wwz.ifremer.fr/lareunion/Projets/Innovations-technologiques/pIOT-2018-2020-IOT-2018-2021>

CONTACTS OF PROJECT LEADERS	SCIENTIFIC AND TECHNOLOGICAL CONTACTS
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