



Indian Ocean sea Turtles

Newsletter 5

February 2021

Project carried out by



In partnership with



BACK TO EUROPA 1 MISSION



Deployment of the network

From September 16 to October 20, 2020, three members of Ifremer's Indian Ocean delegation traveled to the island of Europa located in the Mozambique Channel to **set up the network of receiving stations and the satellite connection** for the turtle tagging operations scheduled for the first half of 2021.

The old receiving stations deployed as part of the pilot project (pIOT) were dismantled and replaced by new structures. Indeed, the screws were in an advanced state of corrosion due to the strong sea spray and the extreme conditions in this region.

Three new receiving stations now replace the five pilot stations in the lagoon area. The team's technological advances and the results of the pIOT project have shown that only three stations, equipped with the new, more efficient boxes and powered by larger batteries and solar panels, are sufficient to cover the entire lagoon and receive the signals from the tags deployed on the turtles. The team has also installed a satellite internet connection that will enable the data collected on the island to be sent directly to the project's scientists and to remotely monitor (from Ifremer's premises on Reunion Island) the proper functioning of the equipment.



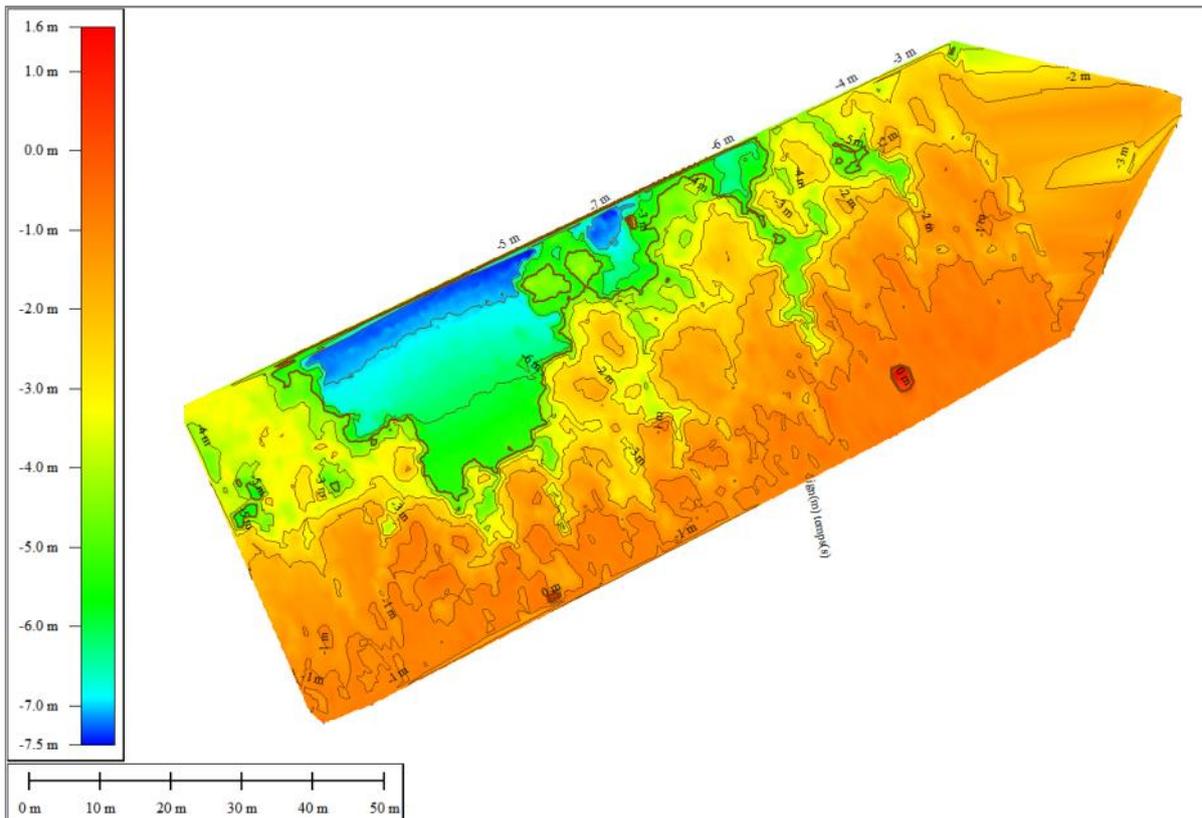
Installation of the satellite station on Europa
© Andréa GOHARZADEH/IFREMER



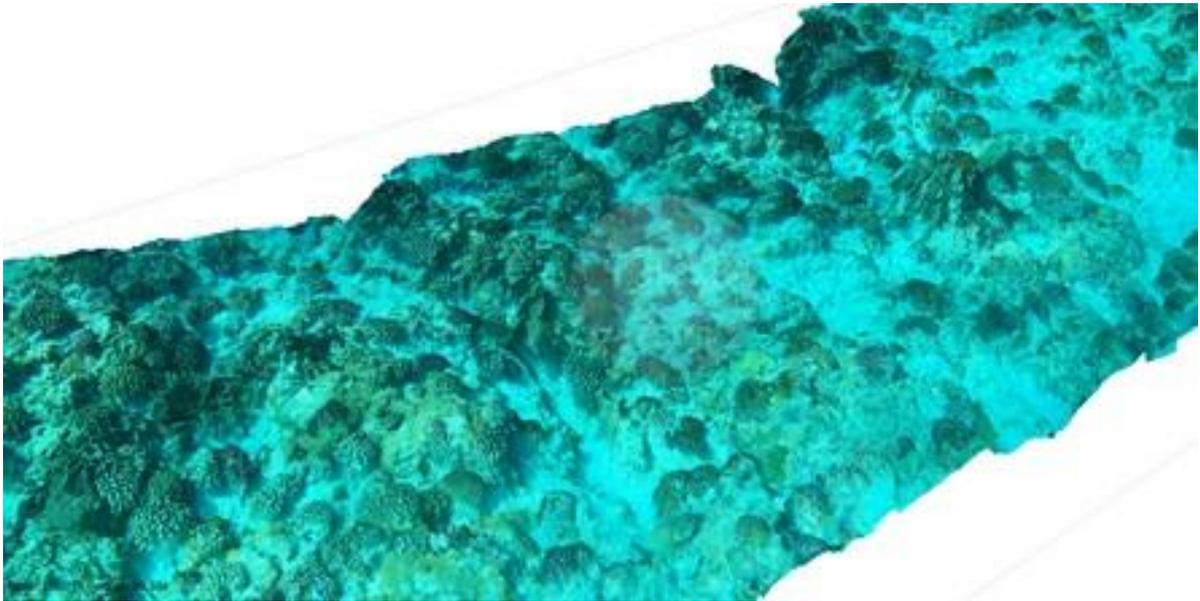
Cartographic surveys with the autonomous USV board

During this mission, the autonomous motorised USV (Unmanned Surface Vehicle) board developed by Ifremer and IDOCEAN was deployed on different areas of the lagoon in order to carry out **bathymetric and photogrammetric surveys** of the lagoon bottom. The long-term objective is to compare the turtle positioning data obtained from the tags with the bathymetric and photogrammetric measurements and to provide information on the **geographical occupation of habitats** by juvenile turtles in Europa.

For this purpose, the board is equipped with a single-beam echo sounder that measures depth (bathymetry), an underwater camera that takes 30 images/second and a GPS RTK with a positioning precision of around one centimetre. Despite fairly difficult weather conditions, a large amount of data has been collected and a major analysis of this data has begun but will still require time for processing.



Bathymetric surveys of an area surveyed during the Europa mission in September-October 2020 by the IOT team
© IFREMER



Example of preliminary photogrammetry results on an area surveyed during the Europa mission in September-October 2020 © Pierre GOGENDEAU/IFREMER

The team also took advantage of this long mission to carry out numerous *in situ* tests of the network using the autonomous board.



Experimental taggings

One of the other objectives of this mission was to test and validate the robustness of the mechanical design and on-board algorithms of the tags **in real conditions**, but also to confirm the reception and processing of the data provided by the tags via the LoRa network deployed on the island. To do this, the team **equipped two juvenile green turtles** with a new version of the tags.

Although no problems were detected during the tests previously conducted in the ponds of Kelonia in Reunion Island, the two tags unfortunately encountered problems shortly after their deployment. However, the data collected made it possible to highlight certain turtle behaviours never observed in the basins on Reunion Island. Indeed, the juveniles in Europa remain much less at the surface which does not make it possible to obtain precise GPS positions. To overcome this problem, the onboard software of the tags will be quickly adapted to this behaviour.

At the same time, **LoRa and GPS reception tests** were carried out using a tag kept on the boat used to navigate in the lagoon or on a board towed by the boat in order to get as close as possible to the behaviour of the turtles when they come to the surface to breathe and thus simulate the data transmission. The tag was programmed to transmit LoRa messages at regular time intervals (about 1 second) associated with the GPS position measured at same time. Depending on the GPS position and therefore the distance of the tag from the receiving stations on land, the reception level of each of the receiving stations was measured and mapped. The closer a tag is to a station, the better the reception of the LoRa signal, but regardless of the position of the tag in the lagoon, the signal was always received by one of the three stations. The quality of the GPS positions obtained with the tags was also validated during the mission.



Release of a juvenile green turtle equipped with a new tag during the Europa mission of September-October 2020 © IFREMER

The network of receiving stations and the satellite link are now operational and ready for phase two of the project on Europa: the deployment of the final version of the tag on eight juvenile turtles, scheduled for the first half of 2021.

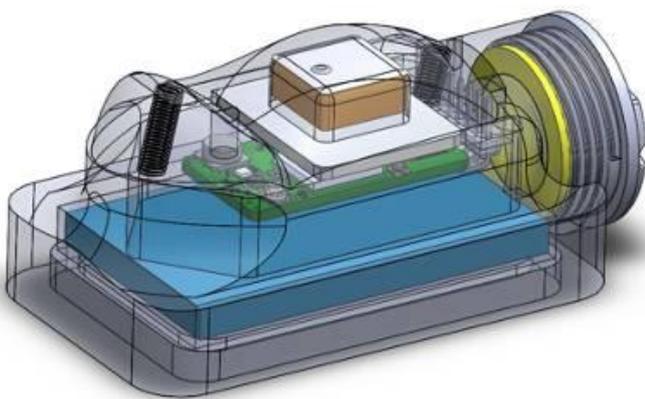
This first mission will have made it possible to **test the various equipment developed for the project under real conditions** and to make the **final adjustments** necessary for the successful completion of the project on the various study sites by 2021.

Ifremer would like to thank the French Southern and Antarctic Lands (TAAF), managers of the island, the Armed Forces in the southern Indian Ocean area (FAZSOI) and the French Navy for the logistical support without which the mission could not have been achieved.

NEW DESIGN FOR THE TAG

Following the mechanical problems that occurred on the two tags tested in real conditions during the mission to Europa in September-October 2020, the **manufacturing process** was entirely reviewed by Ifremer and the Montpellier Laboratory of Computer Science, Robotics and Microelectronics (LIRMM), the project's scientific and technological partner.

While keeping the same configuration, mechanical improvements were made to reduce potential water infiltration, facilitate the production and reproducibility of the tags thanks to a **3D printer**. A new, more resistant resin was used and manufacturing time was considerably reduced with this new manufacturing process.

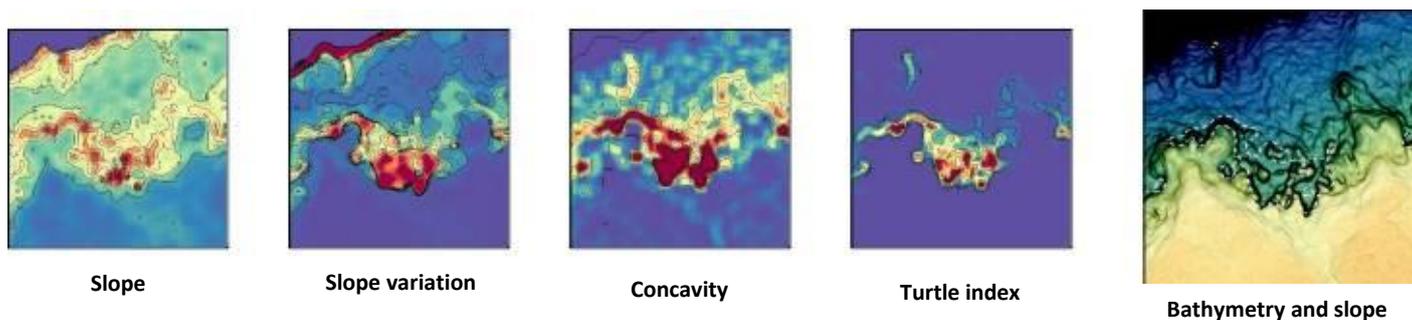


New tag design based on computer-aided design (left), printing of the new tag based on the new printing process (right) © LIRMM

HABITAT MAPPING

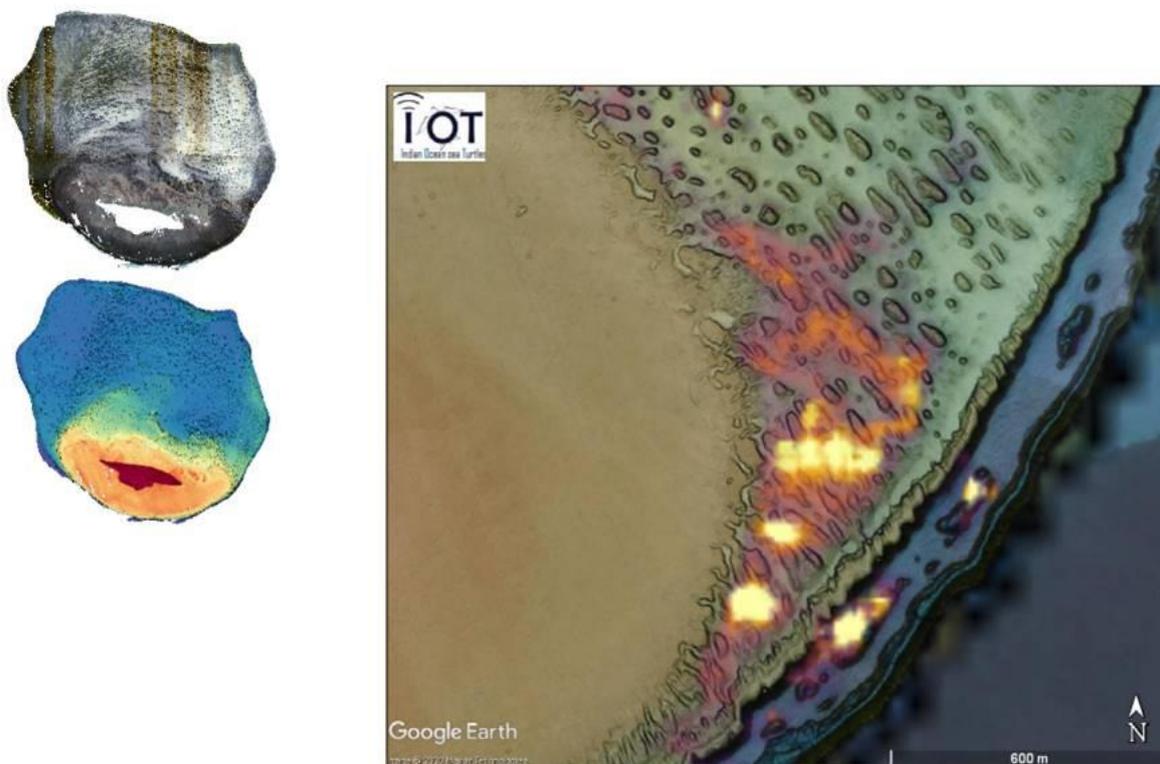
Work continued on mapping the marine habitats of the study sites through the analysis of aerial and satellite images.

Several types of algorithmic treatments have been applied to the hyperspectral and Lidar aerial data which have allowed the development of relevant **indicators** based on slope, slope variation, roughness or bottom concavity. They were grouped together in a **turtle index** corresponding to the identification of areas potentially favourable to marine turtles.

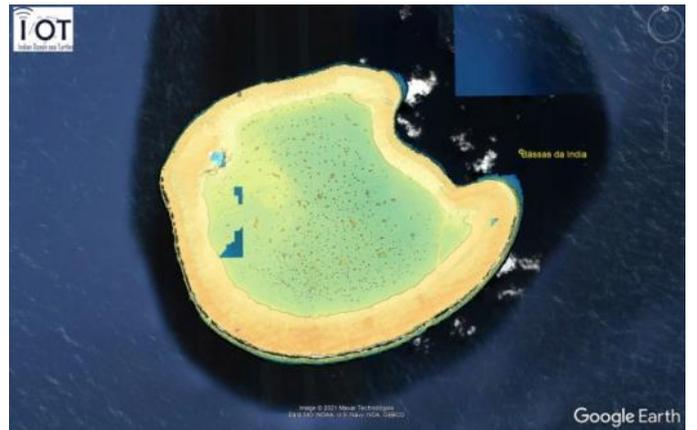
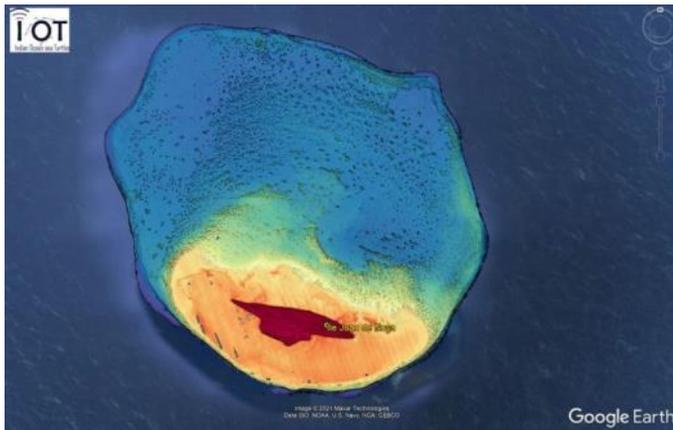
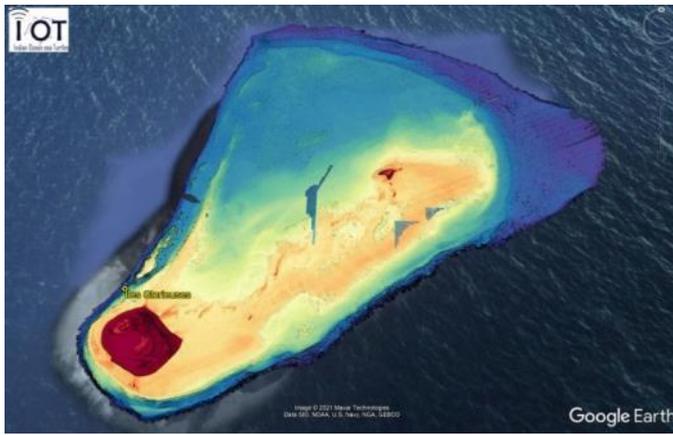


Mapping of different indicators on the same site in order to arrive at the turtle index © Pascal MOUQUET

This work was carried out on the island of Europa for the "**plOT**" pilot project and on the other Scattered Islands for the **IOT** project. The next step will be to complete this work by adding recent satellite images and to apply this work on the other study sites.



Example of application of the turtle index developed within the framework of the IOT project superimposed on the image and topography of the seabed © Pascal MOUQUET



Fine bottom topography thanks to the merging of bathymetry and slope (PEMNTEs) for the Scattered Islands - IOT project © Pascal MOUQUET

ANNUAL MEETING

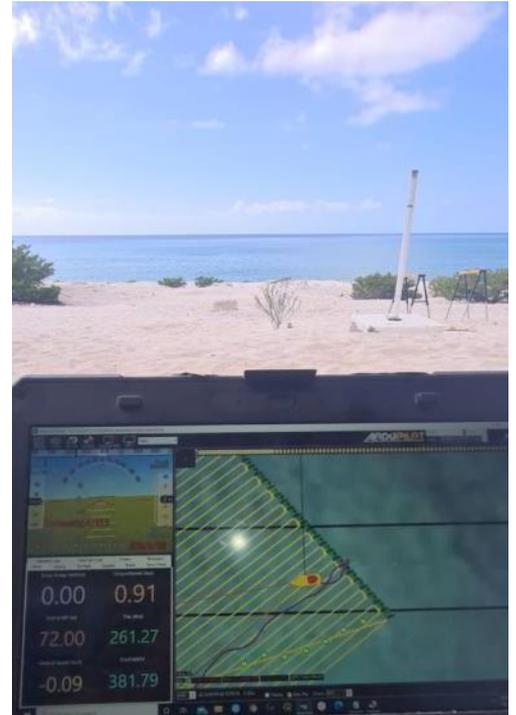
On **December 14, 2020**, the annual meeting was held by videoconference with all the partners of the IOT project (LIRMM-CNRS, SIF, TAAF, Mayotte Departmental Council, OFB-PNMM). On this occasion, Ifremer and the partners reviewed all the work carried out over the past year, the progress made but also the obstacles related to the health crisis. Luckily, the IOT project's progress was only slightly affected in 2020 compared to other projects. Only a few tests had to be rescheduled after the confinement period, which had the effect of postponing deployments in the natural environment. The year **2021** will be marked by the **deployment** of the project on each of the study sites and the acquisition of data before the final restitution.

In addition, Ifremer and the Reunion Region, managing authority of the Ocean-India INTERREG V cooperation programme, agreed at the beginning of 2021 to **extend the IOT project until September 30, 2021**, which will give scientists time to acquire and process data before the end of the project.

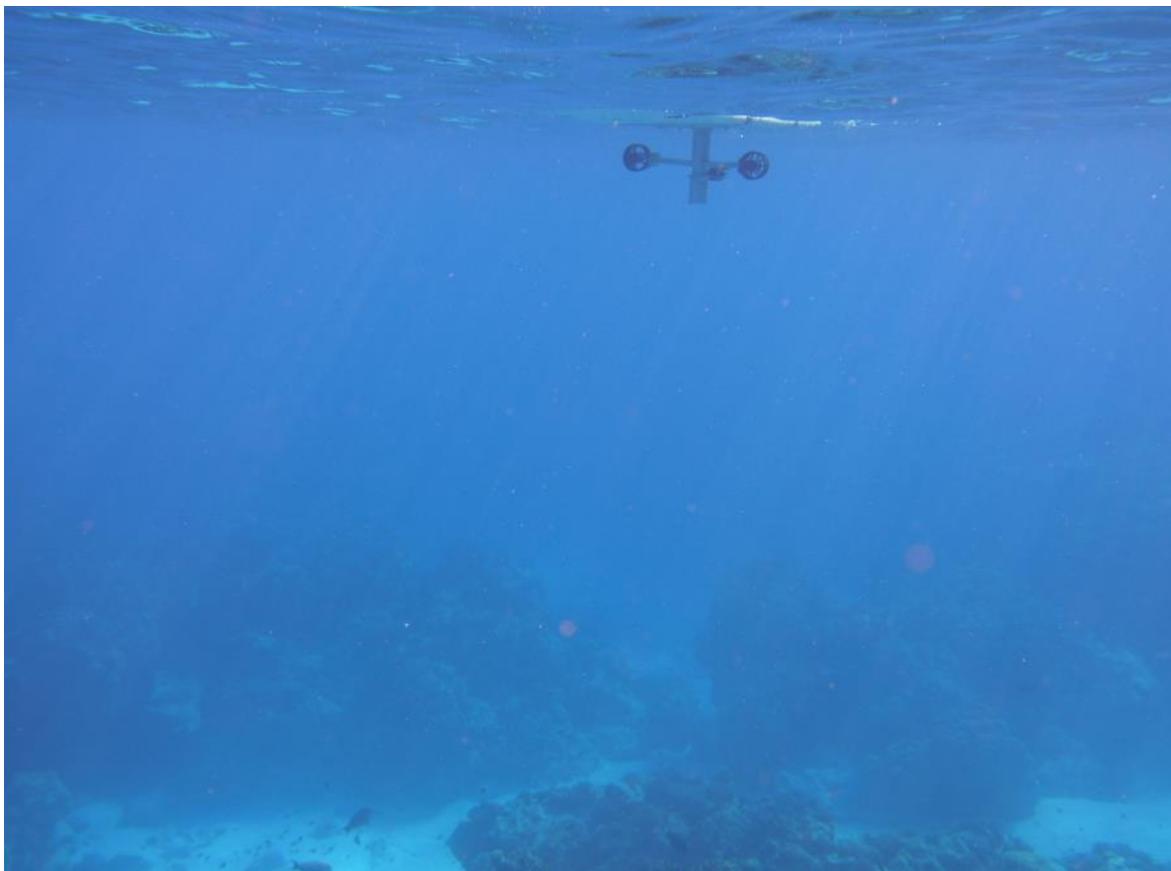
USV AT THE CORAL'S BEDSIDE

On January 11 and 12, 2021, Sylvain BONHOMMEAU, head of the IOT project, visited the island of Europa in order to check the proper operation of the LoRa network and the state of the equipment deployed in September-October 2020 with a view to the deployment of tags on turtles, which will take place in the first half of 2021.

The other objective of this trip was to **monitor the state of health of the Europa coral reef** at the request of the French Southern and Antarctic Lands using the **USV motorised autonomous board**. The board was deployed on sites historically monitored by scientists within the framework of the GCRMN (Global Coral Reef Monitoring Network) in order to assess the impact of the last episode of coral bleaching that occurred in 2020.



Transects carried out by the autonomous board on one of Europa's GCRMN sites
© Sylvain BONHOMMEAU/IFREMER



USV autonomous board deployment on Europa © Pierre GOGENDEAU/IFREMER

COMMUNICATION



Follow the Europa 1 mission alongside scientists via Twitter

While the three members of the IOT team were on mission for 45 days on the island of Europa (see above), the general public was able to **follow their daily life** and **discover part of their work** through the social networks **Twitter** and **Instagram**. From the installation of the receiving stations, to the joy of the members when the satellite connection was established, to the tagging of two turtles and the acquisition of the first bathymetric data with the autonomous board, the four posts broadcast by Ifremer had a very good impact in terms of communication and promotion of the IOT project.



At the same time, the Europa mission was highlighted on **Ifremer's institutional website** alongside another mission carried out in parallel on Reunion Island as part of the Next project led by an Ifremer team based in mainland France.

<https://wwz.ifremer.fr/Actualites-et-Agenda/Toutes-les-actualites/Suivre-le-quotidien-des-tortues-marines-pour-mieux-les-proteger> (french only)



Presentation of the IOT project to "TAAF" labelled classes

Within the framework of the **"TAAF class" label** created by the French Southern and Antarctic Lands (TAAF) and the Academic Delegation for Arts Education and Cultural Action of Reunion Island (DAAC-Reunion), Ifremer, as a privileged partner of the TAAFs for many years, participated in 2020 in the educational project led by one of the TAAF-labelled classes. Thus, in compliance with health regulations, a member of Ifremer's Indian Ocean delegation presented the **pIOT and IOT projects** to a 8th grade class of a middle visiting Kelonia.



Students from the TAAF-labelled class of the Jules Reydellet College in Saint Denis visiting Kelonia
© Jean-Max Vaïtilingom

Back in class, the students were then able to deepen the notions discussed during the presentation of the projects in relation to mathematics, technology or biology and the environment.



Students from the TAAF-labelled class of the Jules Reydellet College in Saint Denis discovering sea turtles in Kelonia © Jean-Max Vaïtilingom

TRAINING

On December 18, 2020, several Ifremer partners from Reunion Island took part in a training day on the USV autonomous board. After a morning of **technical presentation** of the board, the partners have **practiced piloting** and data collection in the marina of the Port in Reunion Island.



Training in the use of the autonomous board at Ifremer's Indian Ocean delegation © Laura BABET/IFREMER



Training in piloting the autonomous board at the marina of the Port © IFREMER

PARTNER PRESENTATION



The **French Southern and Antarctic Lands** (TAAF) are formed by the Crozet and Kerguelen archipelagos, the islands of Saint-Paul and Amsterdam, the Adélie Land (Antarctic) and the Scattered Islands. The latter include the tropical islands of Juan de Nova, Europa and Bassas da India, the Glorieuses archipelago in the Mozambique Channel, and Tromelin north of Reunion Island.

The TAAFs carry out **sovereignty, scientific research support, biodiversity preservation** and **logistics missions** in these territories. Charles Giusti, Prefect, senior administrator of the TAAFs, is both the representative of the State and head of the territory.



Royal penguins in the Bay of the sailor in Crozet © Nelly Gravier/TAAF

The TAAFs therefore extend over a large latitudinal gradient, from the 13th parallel south (with the Glorieuses Islands) to the 66th parallel south (with the Dumont D'Urville base, in the Adélie land). All of this land provides an exclusive economic zone (EEZ) of more than 2.2 million km², which contributes to giving France the second largest maritime right of way in the world. The largest property on the **UNESCO World Heritage List**, the **French Southern Lands National Nature Reserve** is also one of the largest marine protected areas in the world.



Island of Grande Glorieuse © Lucia Simion

As part of their multiple partnerships with the main French research players, notably with the French Polar Institute (IPEV), the French Institute for Research and Exploitation of the Sea (Ifremer), the French Office for Biodiversity (OFB), the National Museum of Natural History (MNHN), the National Centre for Scientific Research (CNRS-Inee), the University of Réunion, the University Training and Research Centre of Mayotte (CUFR Mayotte), the Research and Development Institute (IRD), the National Centre for Space Studies (CNES), the Atomic Energy and Alternative Energies Commission (CEA), the TAAF welcomed and provided support in 2020 to 363 scientists involved in 69 research programmes.

In the Adélie region, as in the French Southern Territories, national and international scientific programmes are coordinated by IPEV to study the evolution of biodiversity and climate. The international atmospheric reference station in Amsterdam (IPCC, NASA), for example, gives France a strategic place in the global atmospheric monitoring network (World Meteorological Organisation). Ifremer coordinates oceanographic campaigns in this part of the country.



Scientific monitoring in the Scattered Islands © TAAF/MAREX

In the **Scattered Islands**, it is the TAAF administration, alongside members of an **inter-agency research consortium** that coordinates the development of research programmes.

With the support of the INTERREG V Indian Ocean 2014-2020 programme, the TAAF and Ifremer have joined forces within the framework of the IOT project to continue the development of innovative tags for monitoring juvenile marine turtles and the deployment of the network of receiving stations to **Europa**, initiated by the pIOT* pilot project. Indeed, the beaches of the Scattered Islands are one of the most important nesting sites in the south-western Indian Ocean for marine turtles (mainly green turtles and hawksbill turtles).



Green turtle laying eggs at Tromelin © Alexandre Trouvillier/TAAF

Within the framework of the IOT project, the TAAFs provide **logistical and human support** in the implementation of the project on their territory and a reflection is also underway to **strengthen this system on other sites in the Scattered Islands**. However, the synergy between these two partners goes beyond this, it extends to other collaborative projects on the sustainable management of the natural heritage of the Scattered Islands.

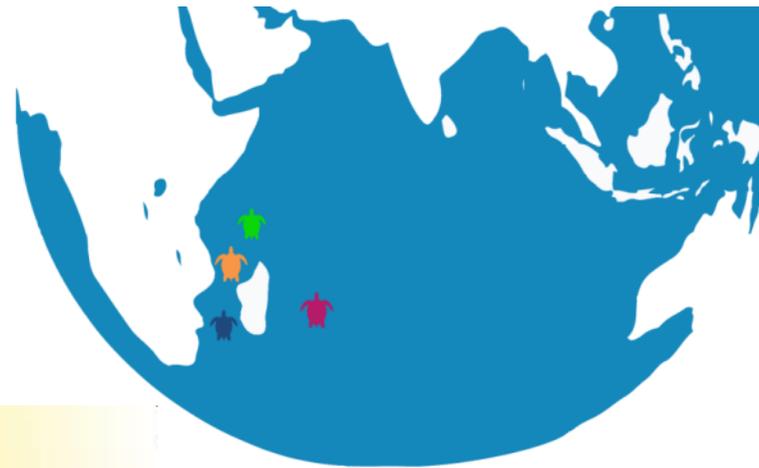
TAAFs in a few figures (2020) :

- 2.2 million km² of EEZs
- 129,000 km covered by the ships Marion Dufresne and L'Astrolabe
- 3,000 tonnes of materials transported to the territories
- 30,000 m² of maintained infrastructure
- 69 research programmes hosted and supported
- 250 species in the French Southern Lands National Nature Reserve
- 4,646 species, 80% of which are marine species in the Scattered Islands



***Pilot project for Indian Ocean sea Turtles (pIOT):**

The pIOT project, started at the end of 2018 as part of the multidisciplinary research consortium "îles Eparses 2017-2020" and led by Ifremer's Indian Ocean delegation, made it possible to test the first prototype of an innovative tag and receiving stations in a natural environment, on the island of Europa, the premise of the IOT project.



Test and deployment sites and periods:

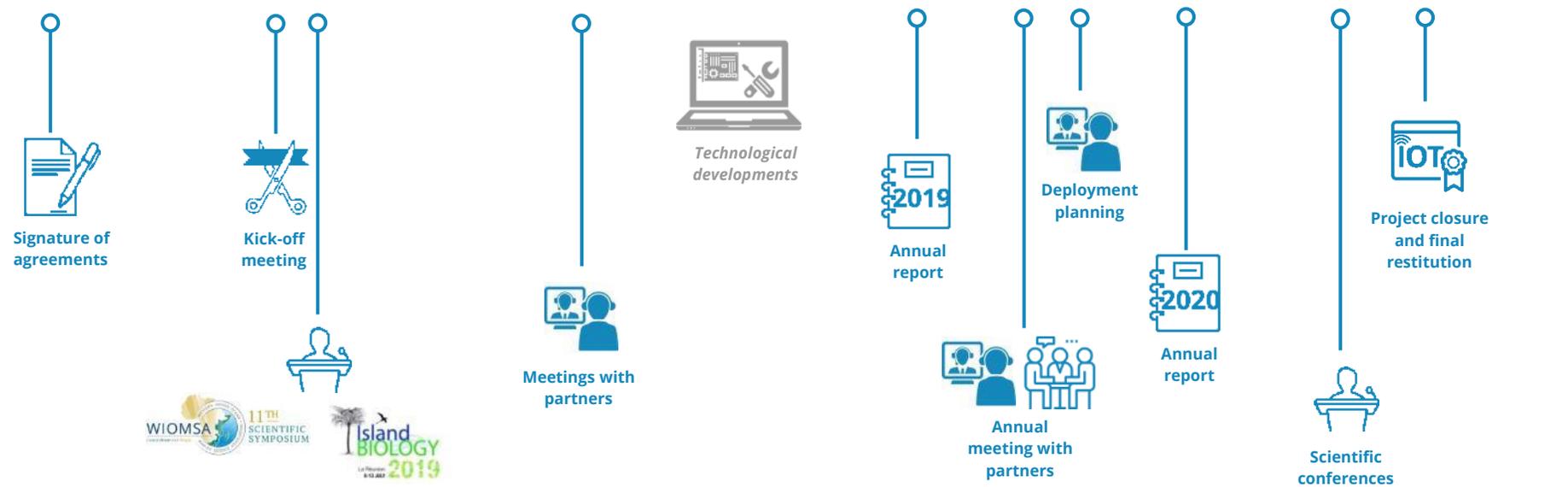
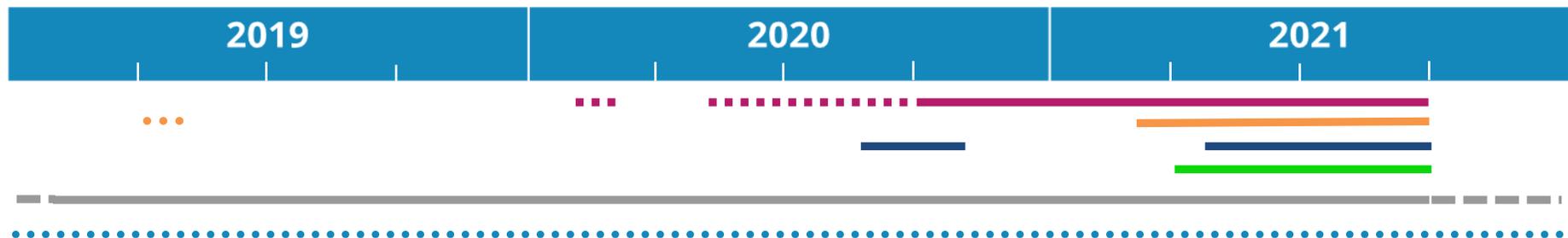
Reunion Island:
 ■■■ tests
 — deployment

Mayotte Island:
 ●●● prospecting
 — deployment

Scattered Islands (TAAF):
 — deployment

Aldabra Island (Seychelles):
 — deployment

PROGRAMMING AND PROGRESS





To know more about it, visit the web site :

https://www.ifremer.fr/lareunion_eng/Projects/Technological-innovations/piOT-2018-2020-IOT-2018-2021

CONTACTS OF PROJECT LEADERS	SCIENTIFIC AND TECHNOLOGICAL CONTACTS
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<p>IFREMER</p> <p>S. BONHOMMEAU sylvain.bonhommeau@ifremer.fr A.L. CLEMENT anne.laure.clement@ifremer.fr P. GOGENDEAU pierre.gogendeau@ifremer.fr</p>	<p>LIRMM</p> <p>S. BERNARD serge.bernard@lirmm.fr V. KERZERHO vincent.kerzerho@lirmm.fr</p>
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<p>FUNDS</p> <div style="display: flex; justify-content: space-around; align-items: center;"> </div>	
<p style="text-align: center;">PARTNERS</p> <div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> </div> <div style="display: flex; flex-wrap: wrap; justify-content: space-around; margin-top: 10px;"> </div>	<p style="text-align: center;">TECHNICAL AND TECHNOLOGICAL SUPPORT</p> <div style="display: flex; flex-wrap: wrap; justify-content: space-around; margin-top: 10px;"> </div> <div style="display: flex; flex-wrap: wrap; justify-content: space-around; margin-top: 10px;"> </div>