

Réseau de neurones entièrement convolutif : une nouvelle méthode pour identifier automatiquement les comportements des tortues marines à partir de bio-loggers



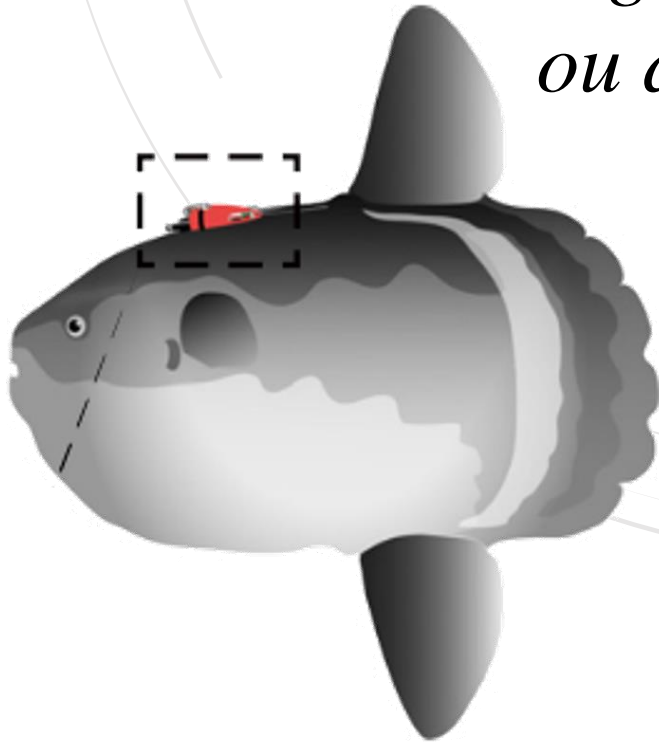
Lorène Jeantet

Directeur de thèse : Damien Chevallier



Science du Bio-logging

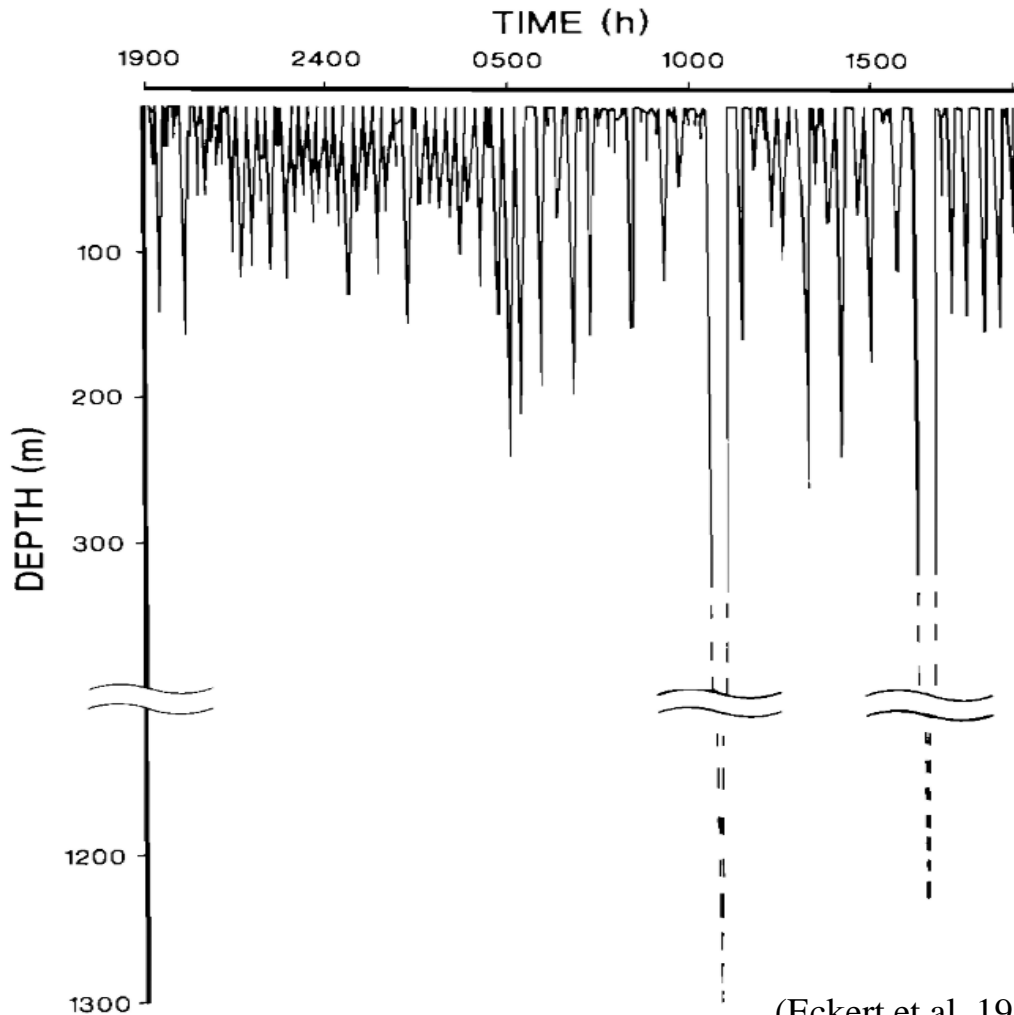
« l'investigation de phénomènes se rapportant à des organismes en liberté qui dépasse les limites du visible ou de notre expérience »



Boyd et al. (2004)

Le bio-logging chez les tortues marines

Capteur de Pression



(Eckert et al. 1986)

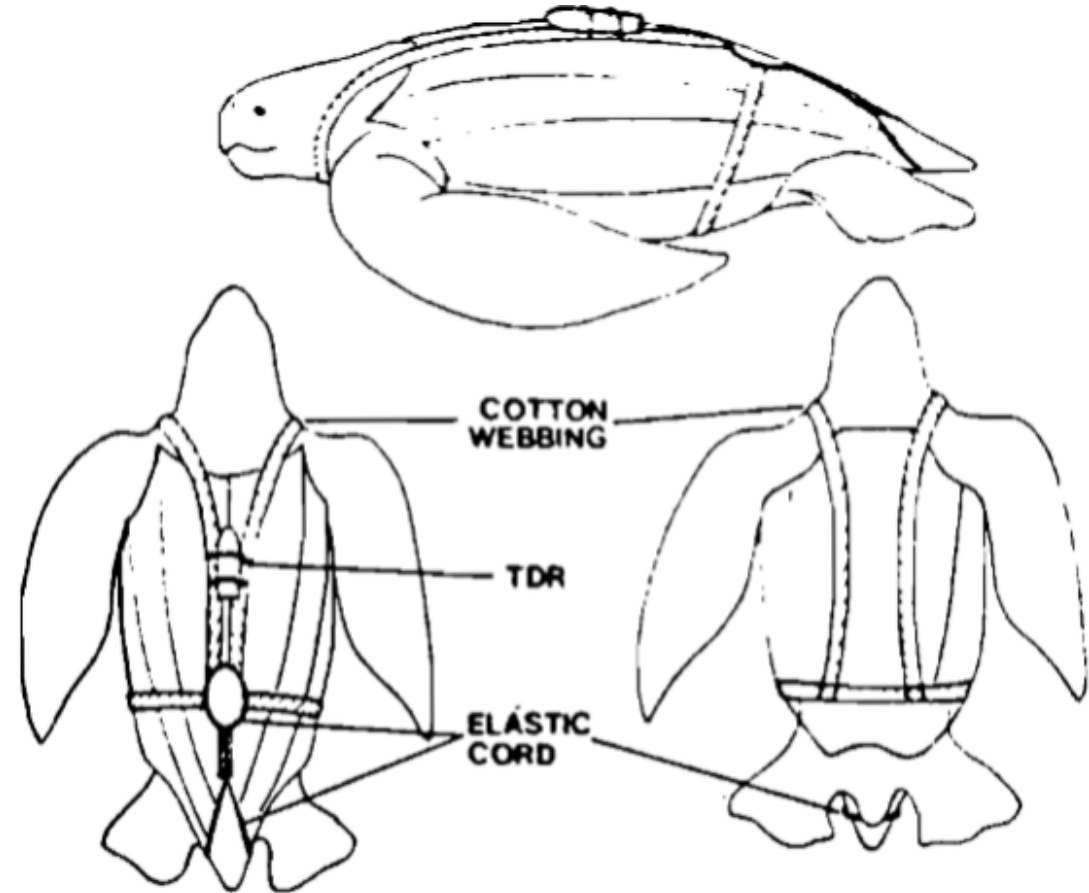


FIG. 1.—*Dermochelys coriacea* with harness and time depth recorder (TDR) in place.

Diving behaviour during the internesting interval for loggerhead turtles *Caretta caretta* nesting in Cyprus

Jonathan D. R. Houghton¹, Annette C. Broderick¹, Brendan J. Godley¹,
Julian D. Metcalfe², Graeme C. Hays^{1,*}

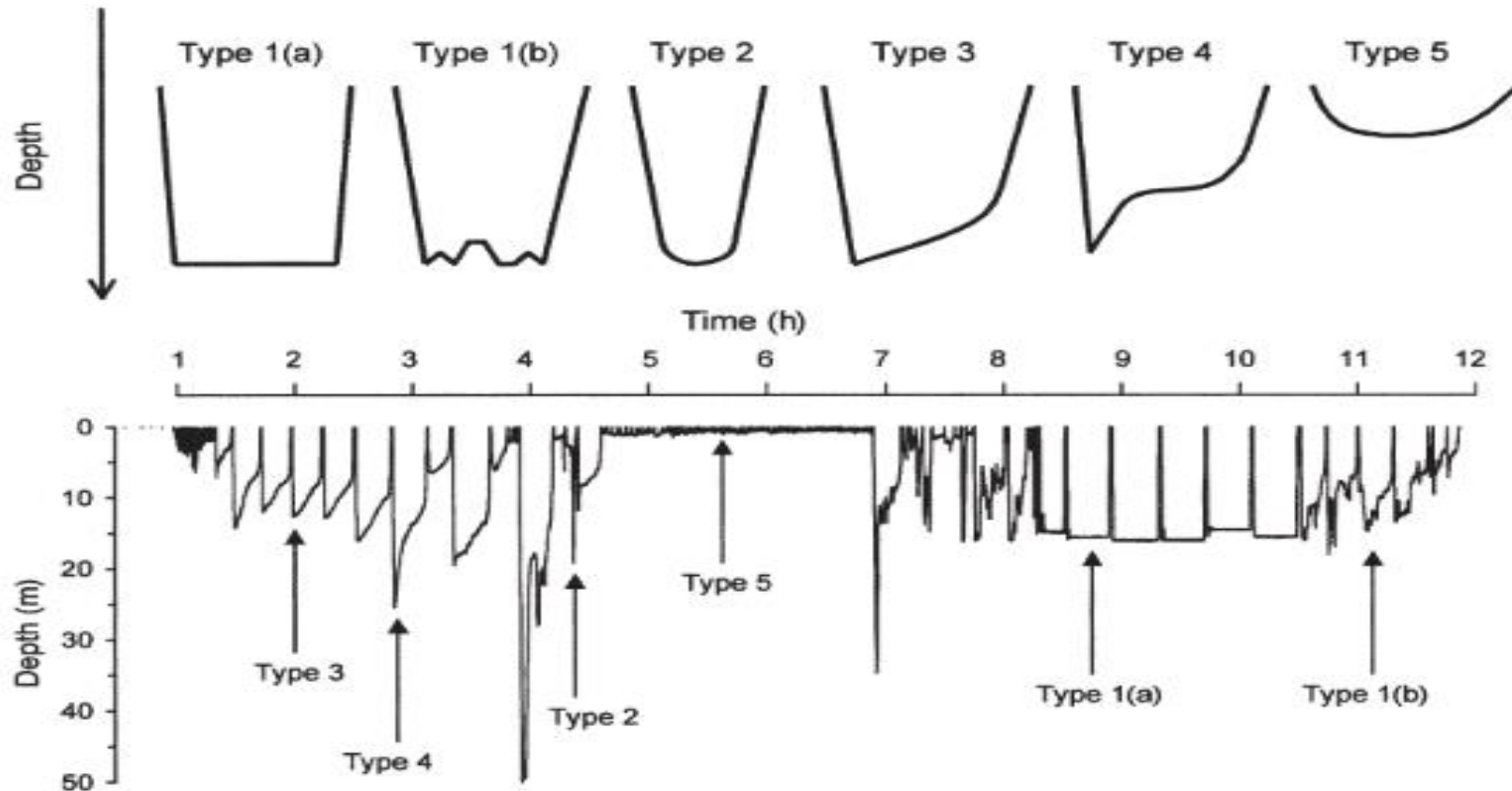
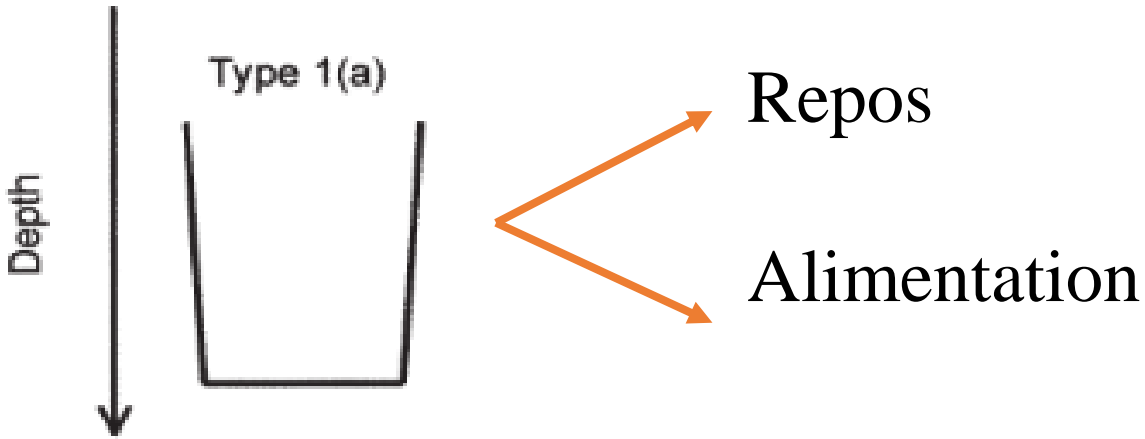


Fig. 1. Generalised diagram (top panel) and typical dive profile for turtle 1 (bottom panel) highlighting the 6 dive types



Caméra embarquée couplée avec capteur de pression

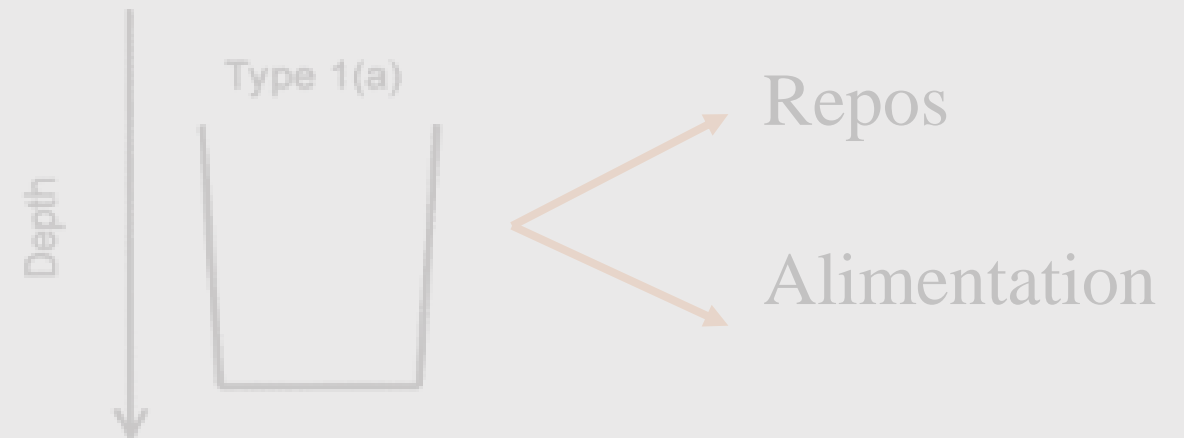


Seminoff et al. 2006

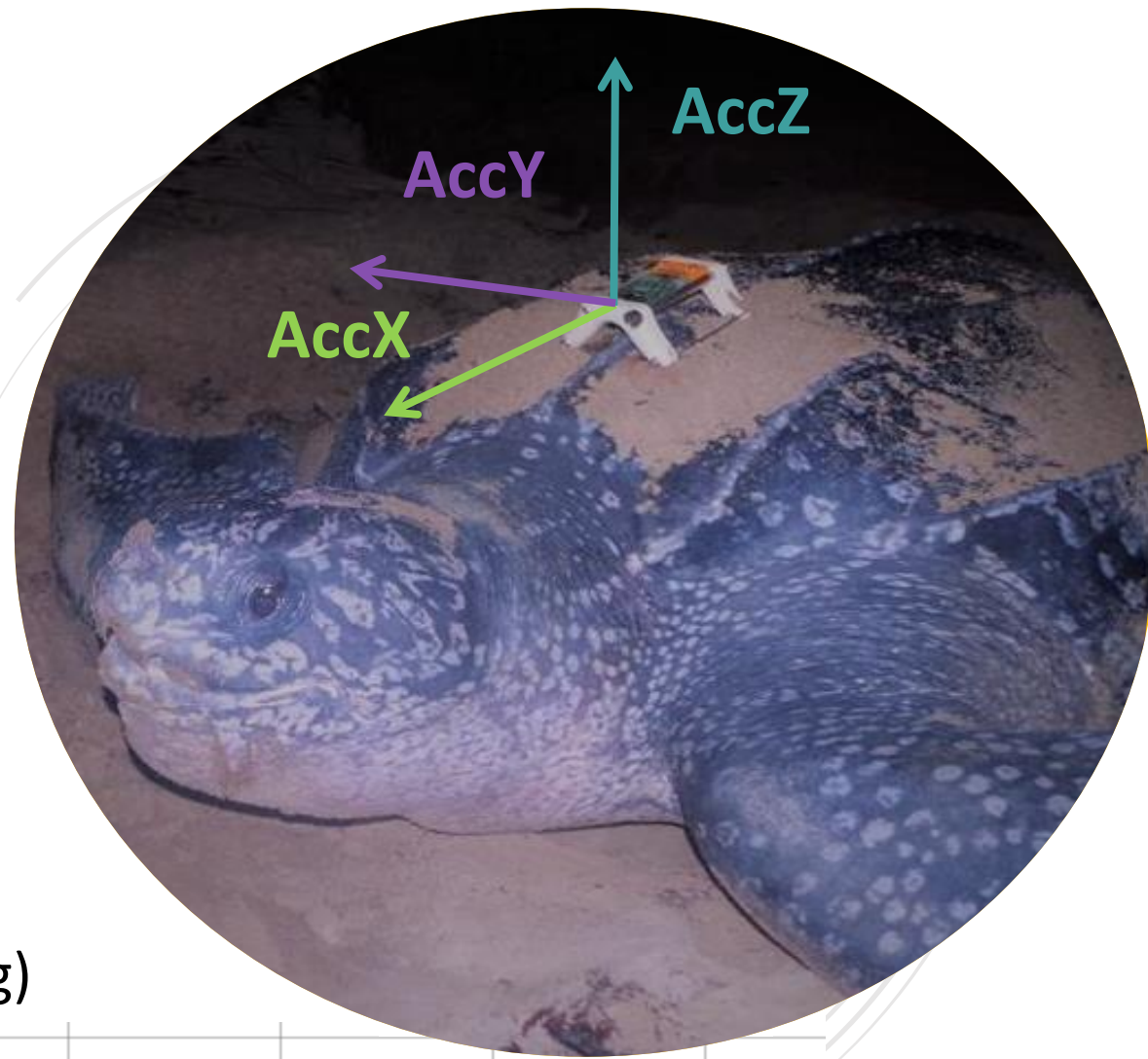
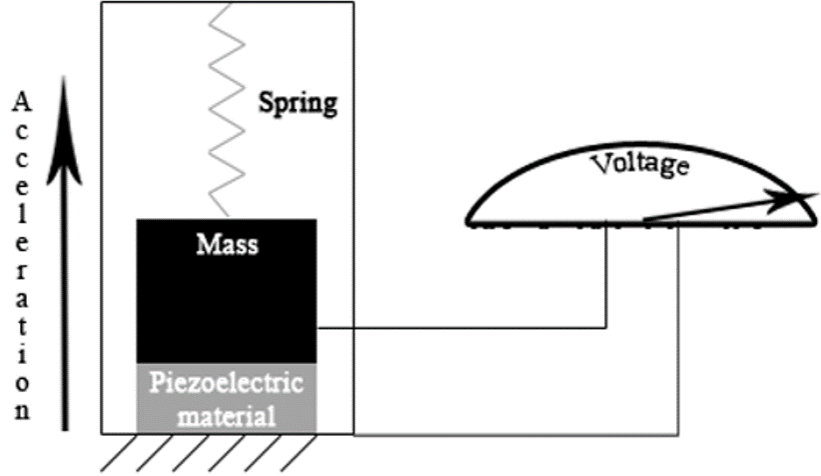


Caméra embarquée couplée avec capteur de pression

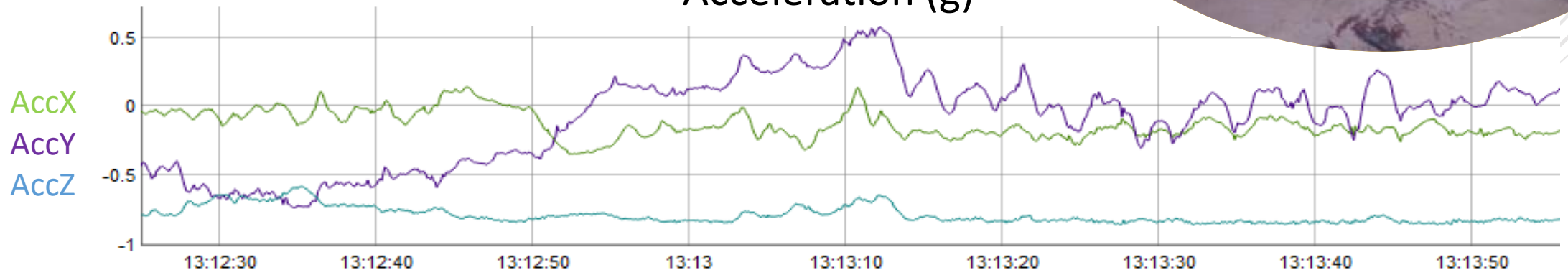
Nécessité de développer une méthode pour identifier les comportements sous l'eau des tortues marines



Accéléromètre



Acceleration (g)



Validation des signaux accélérométriques des tortues marines



Behavioural inference from signal processing using animal-borne multi-sensor loggers: a novel solution to extend the knowledge of sea turtle ecology

Jeantet et al. 2020

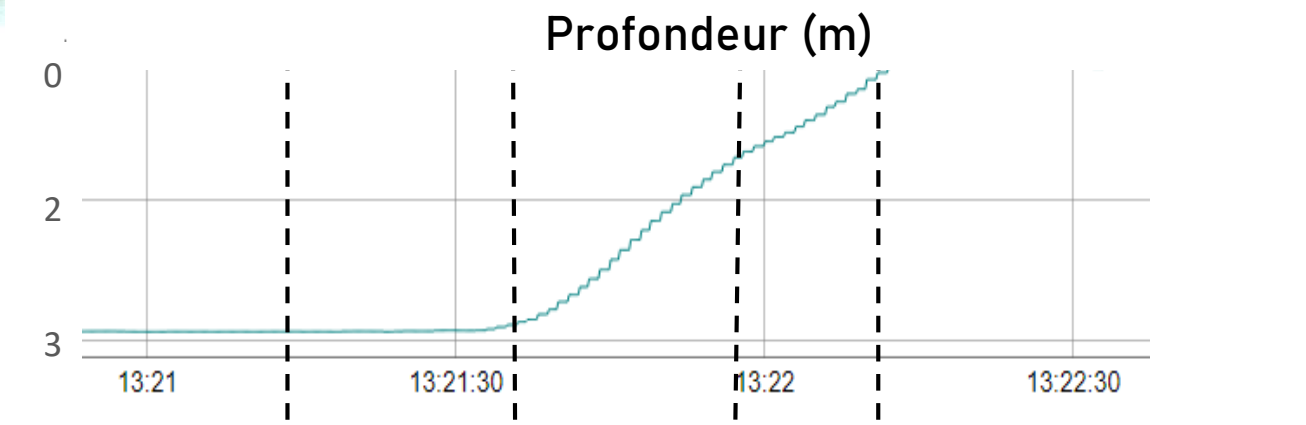
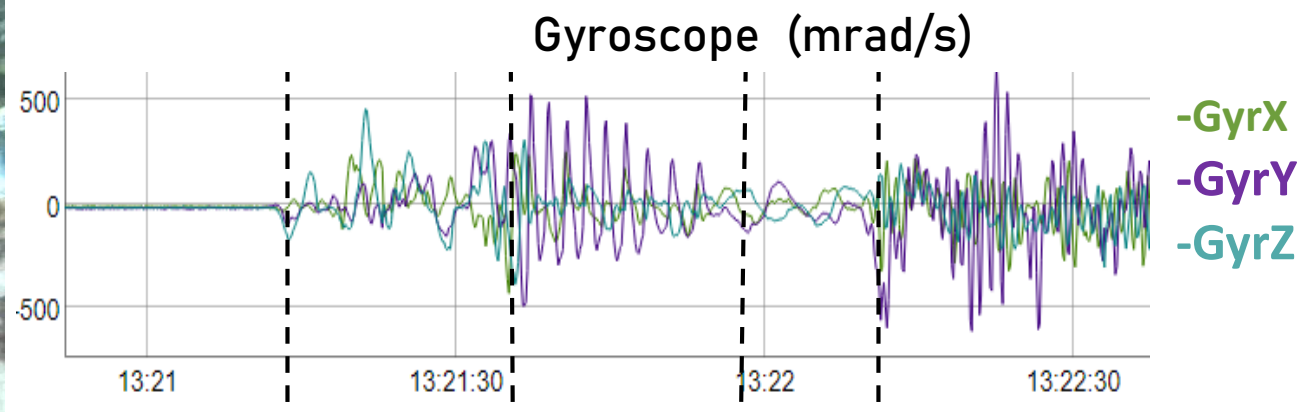
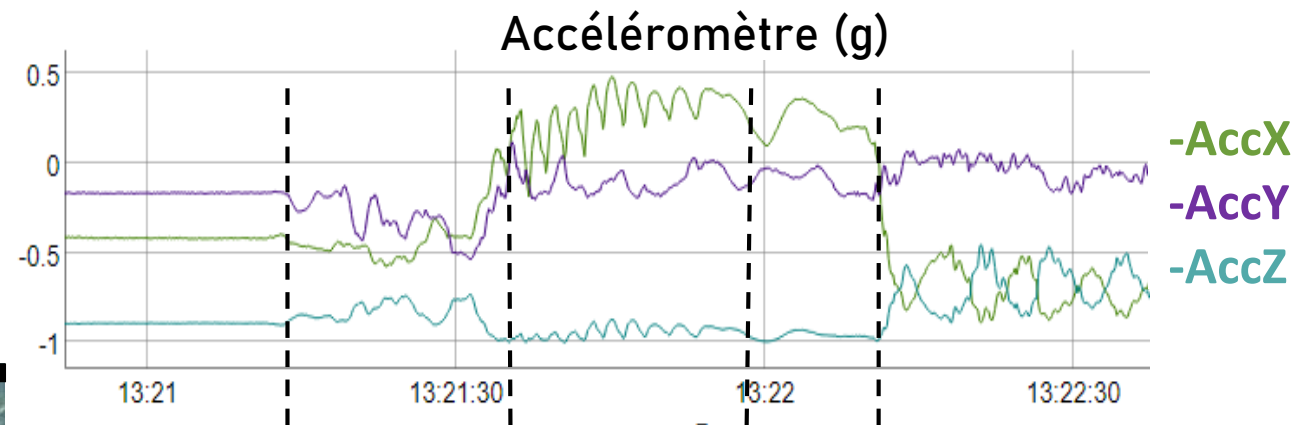
- **13 individus** équipés
- **66 h** d'enregistrement
- **46** comportements identifiés
- Regroupés dans **7 catégories**

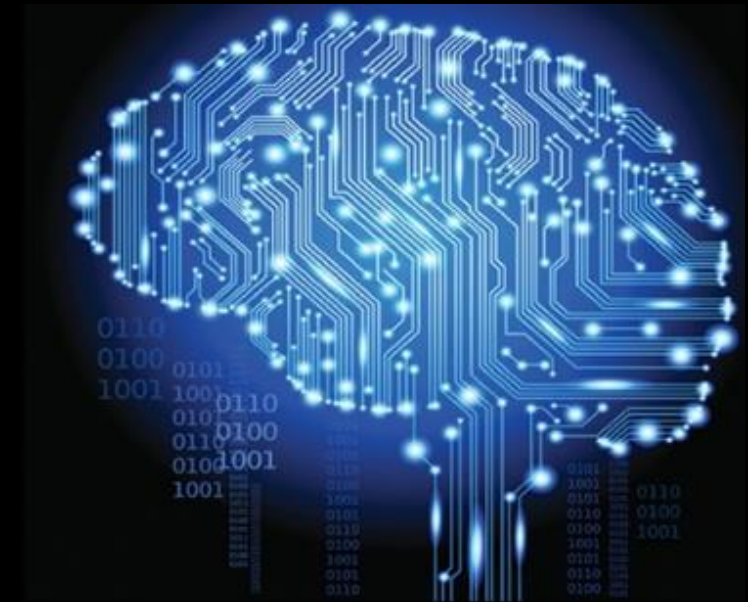
- | | |
|----------------|----------------|
| ▪ Nage Active | ▪ Alimentation |
| ▪ Nage Passive | ▪ Repos |
| ▪ Respiration | ▪ Autre |
| ▪ Se gratte | |





Validation des signaux

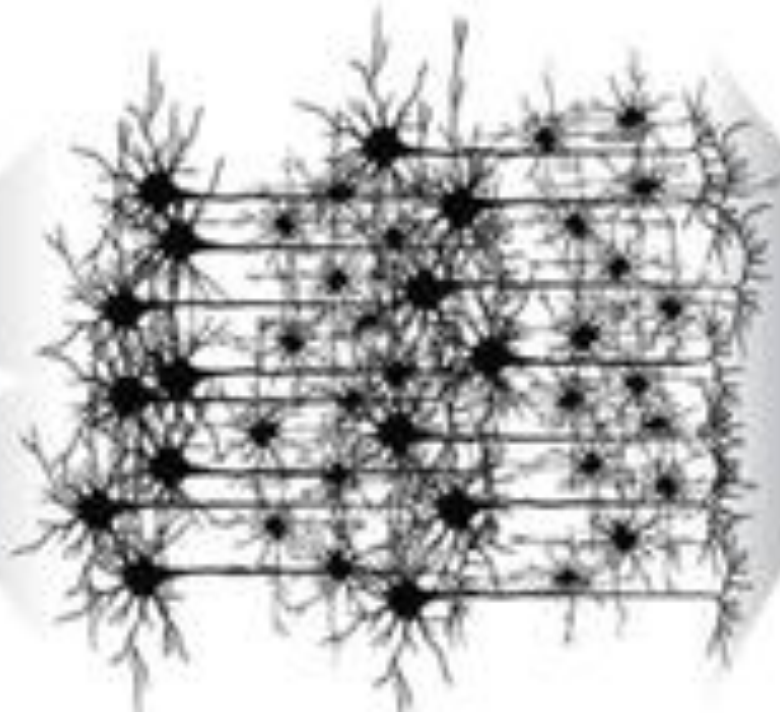
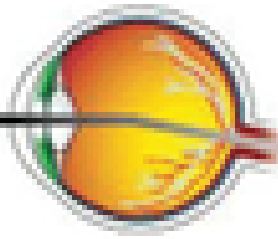
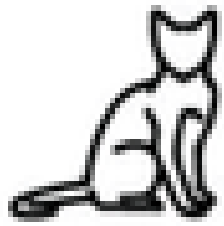




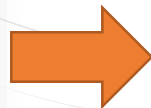
Fully Convolutional Neural Network: a solution to infer animal behaviours from multi-sensor data

Lorène Jeantet, Vincent Vigon, Sébastien Geiger, Damien Chevallier (2021)

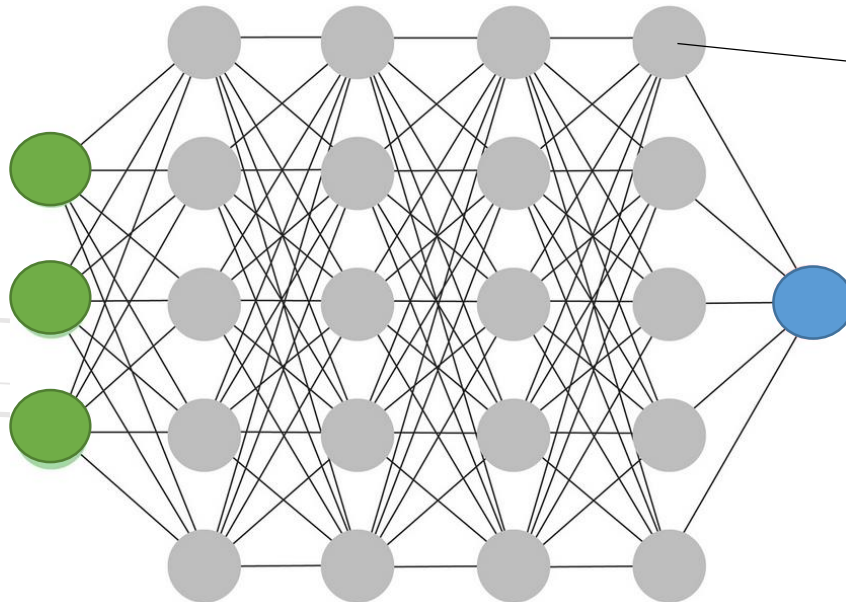
Deep learning



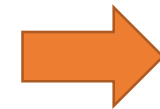
Réseau de neurones :



Entrée



Neurones



Sortie

chat



Convolution



Input

[Submitted on 15 Jun 2016]

V-Net: Fully Convolutional Neural Networks for Volumetric Medical Image Segmentation

Fausto Milletari, Nassir Navab, Seyed-Ahmad Ahmadi

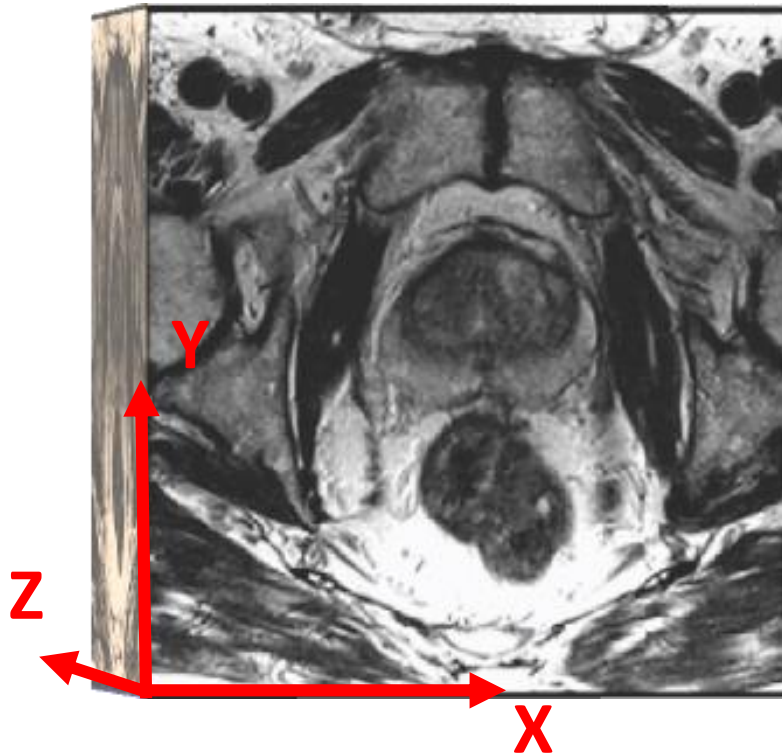
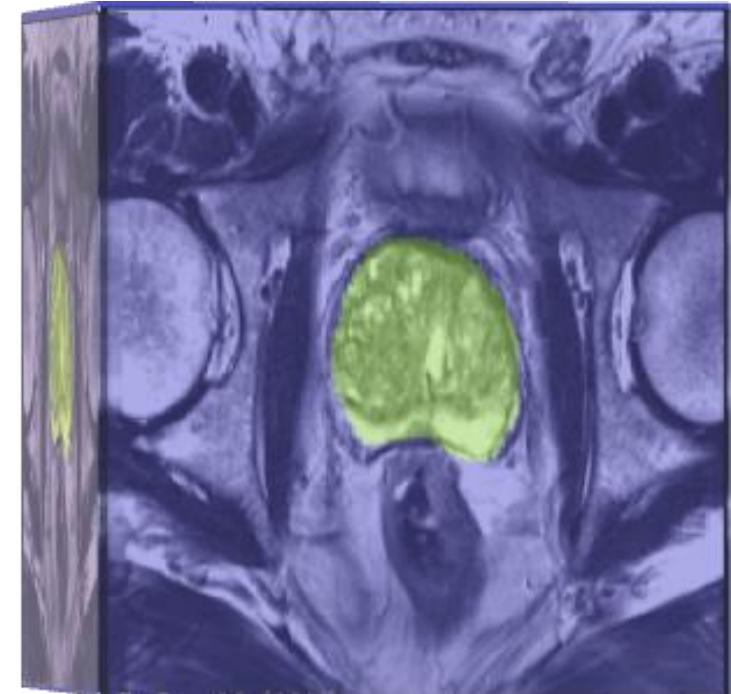


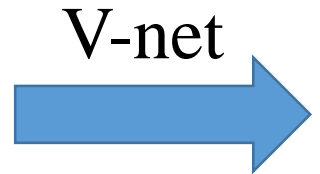
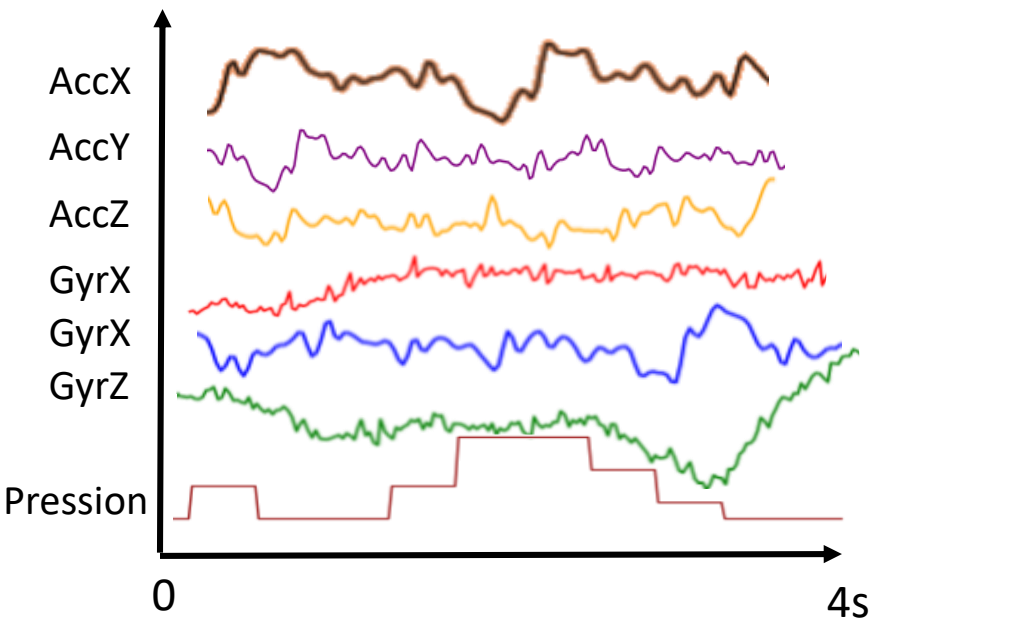
Image biomédicale 3D

V-net
→



Fully Convolutional Neural Network: a solution to infer animal behaviours from multi-sensor data

Jeantet et al. 2021



1 1 1 2 2 2 2 4 4 4 4 2 2 2

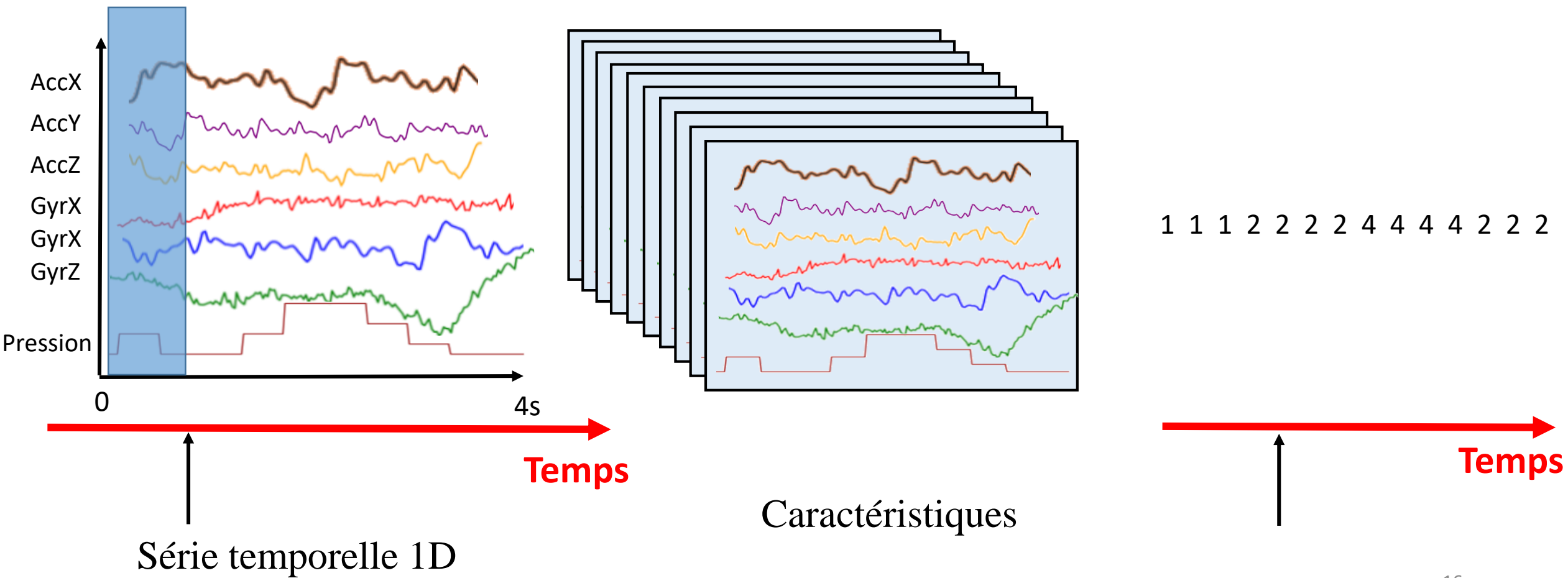


Série temporelle 1D



Fully Convolutional Neural Network: a solution to infer animal behaviours from multi-sensor data

Jeantet et al. 2021





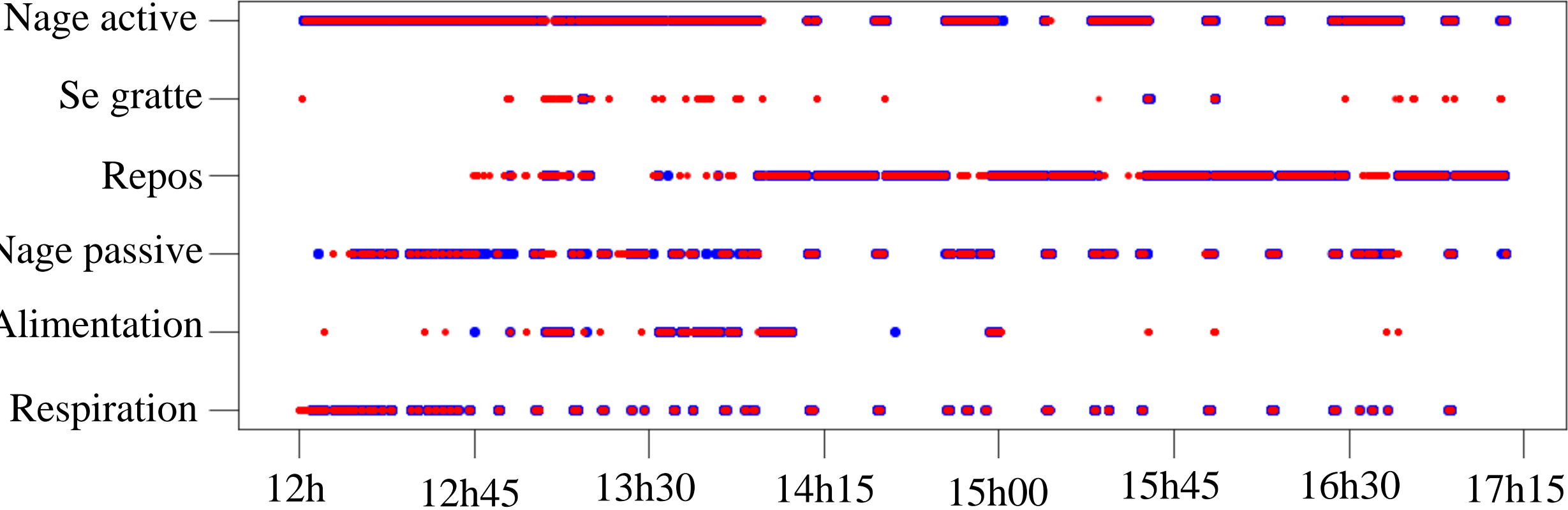
Forces du V-net :

- Deep learning
- Prédiction à la centi-seconde
- Très peu de prétraitement

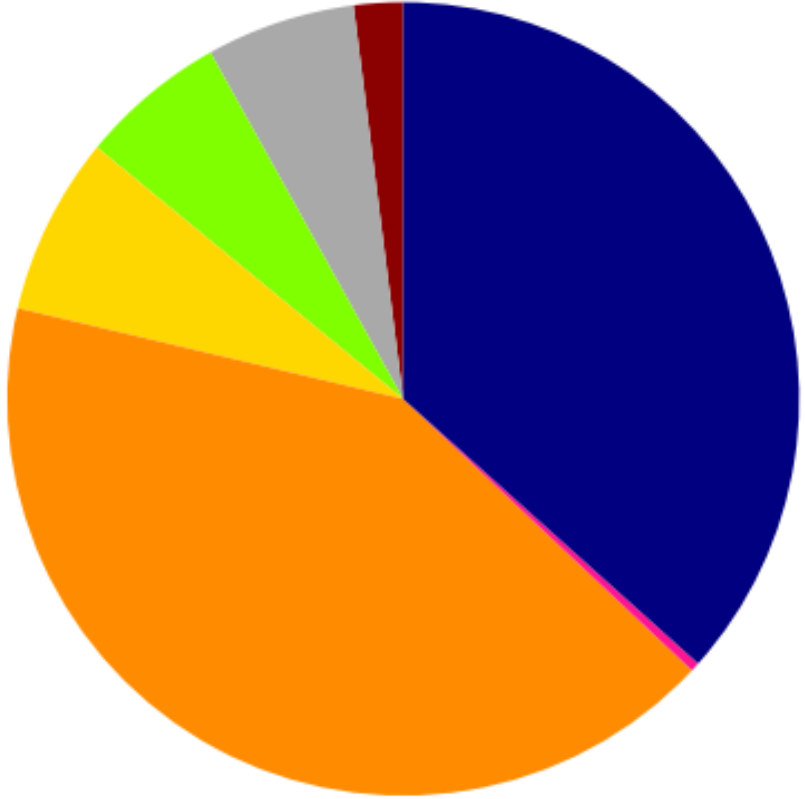
Précision globale :
98%

Tortue #1

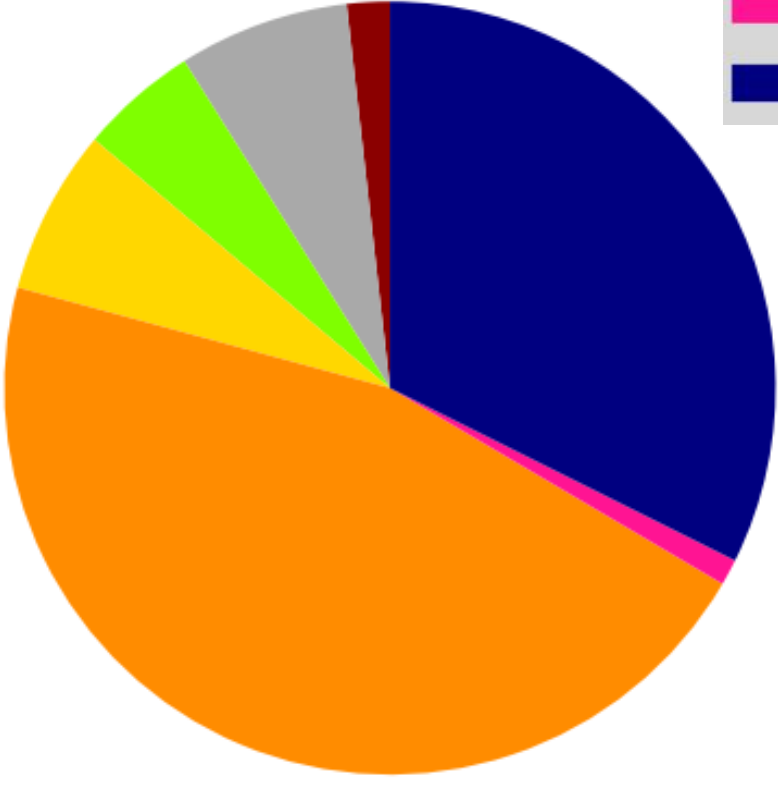
● Comportement observé ● Comportement prédit



Précision globale :
98%



Budget temps **observé**



Budget temps **prédit**

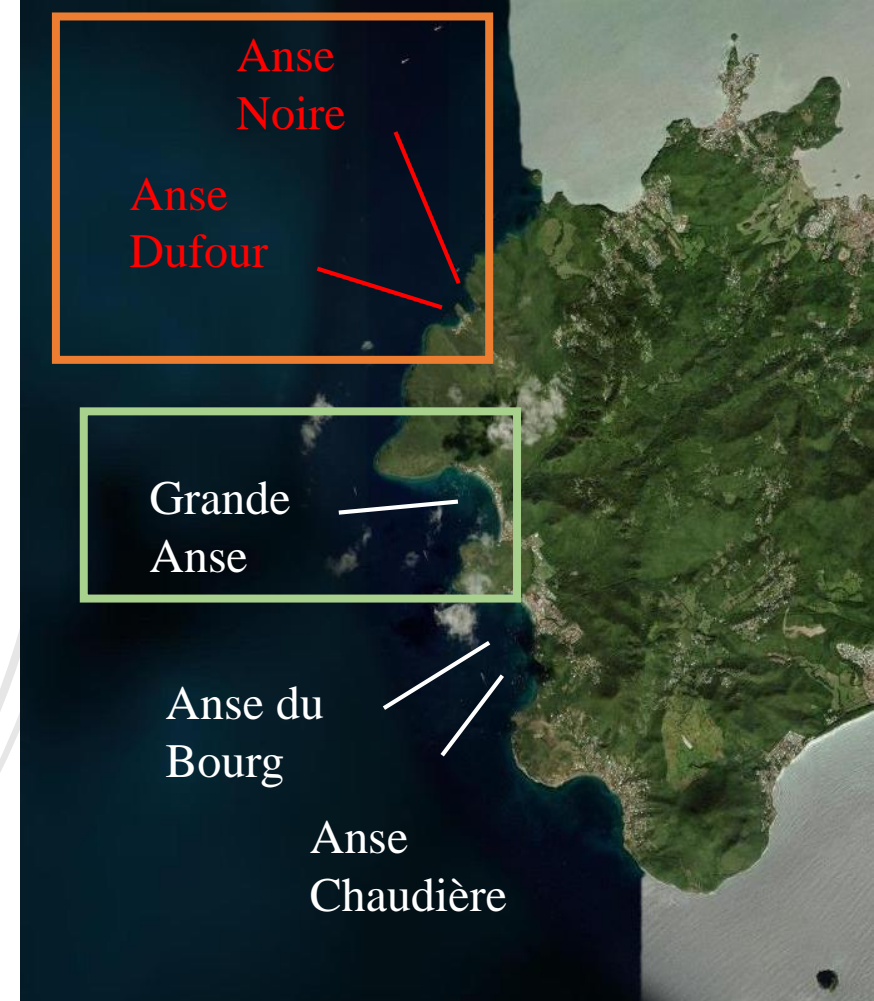


n=21 tortues équipées d'AGM

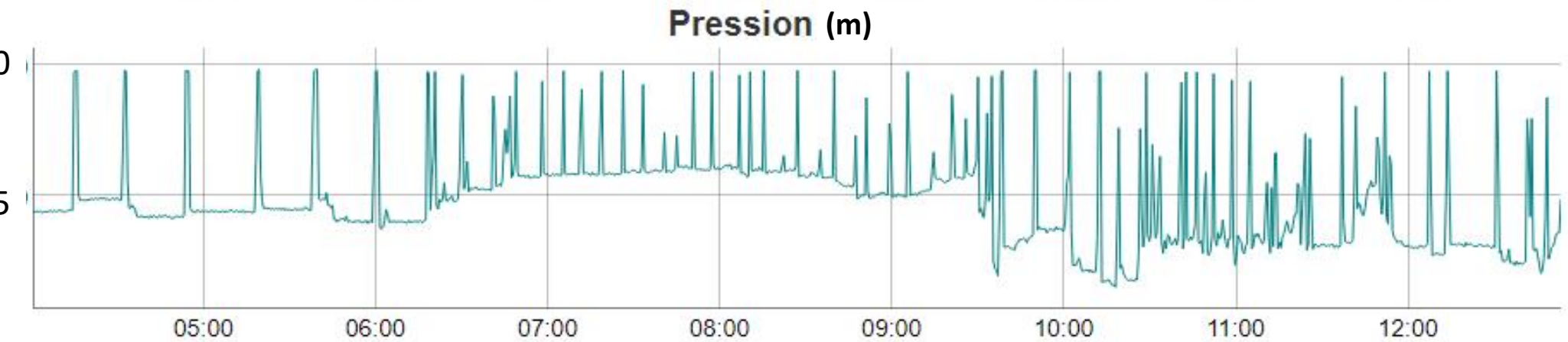
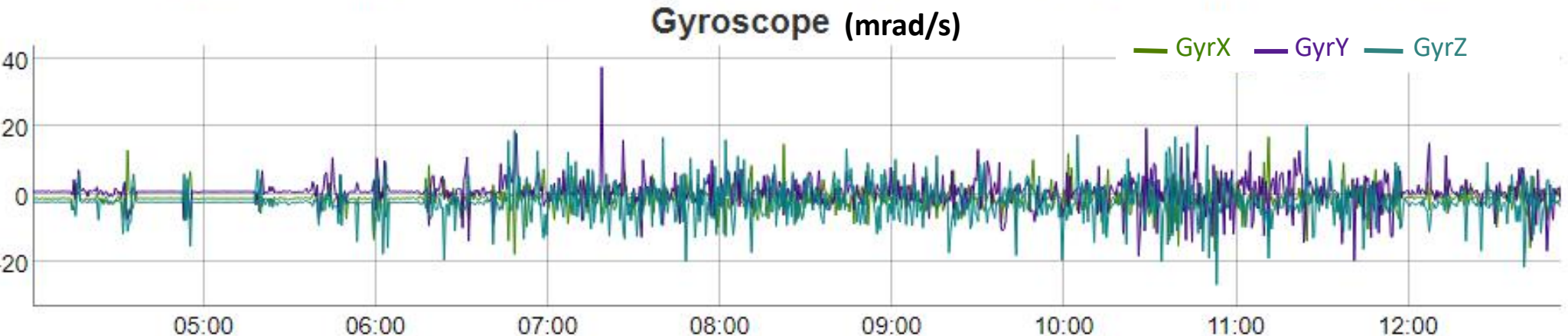
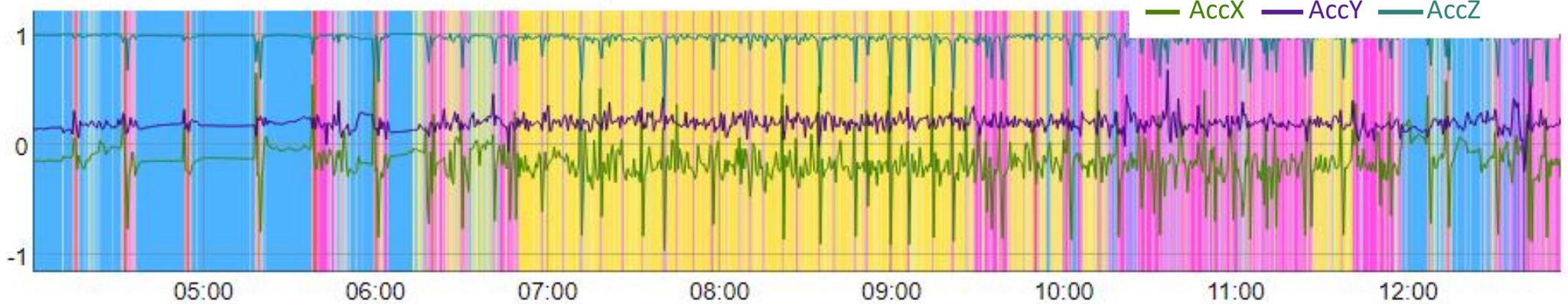
Anse Noire/Anse Dufour (**ANAD**) : **n=11**

Grande Anse (**GA**) : **n=10**

3-5 jours de déploiements à 20 Hz

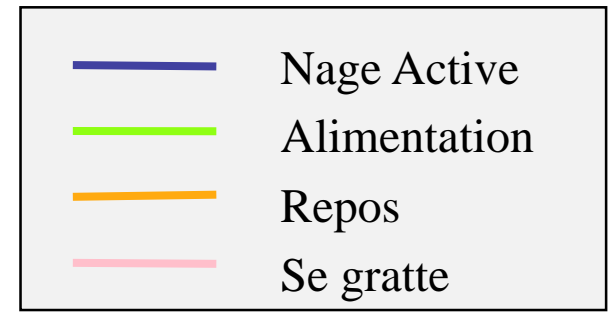



Application **Accéléromètre (g)**

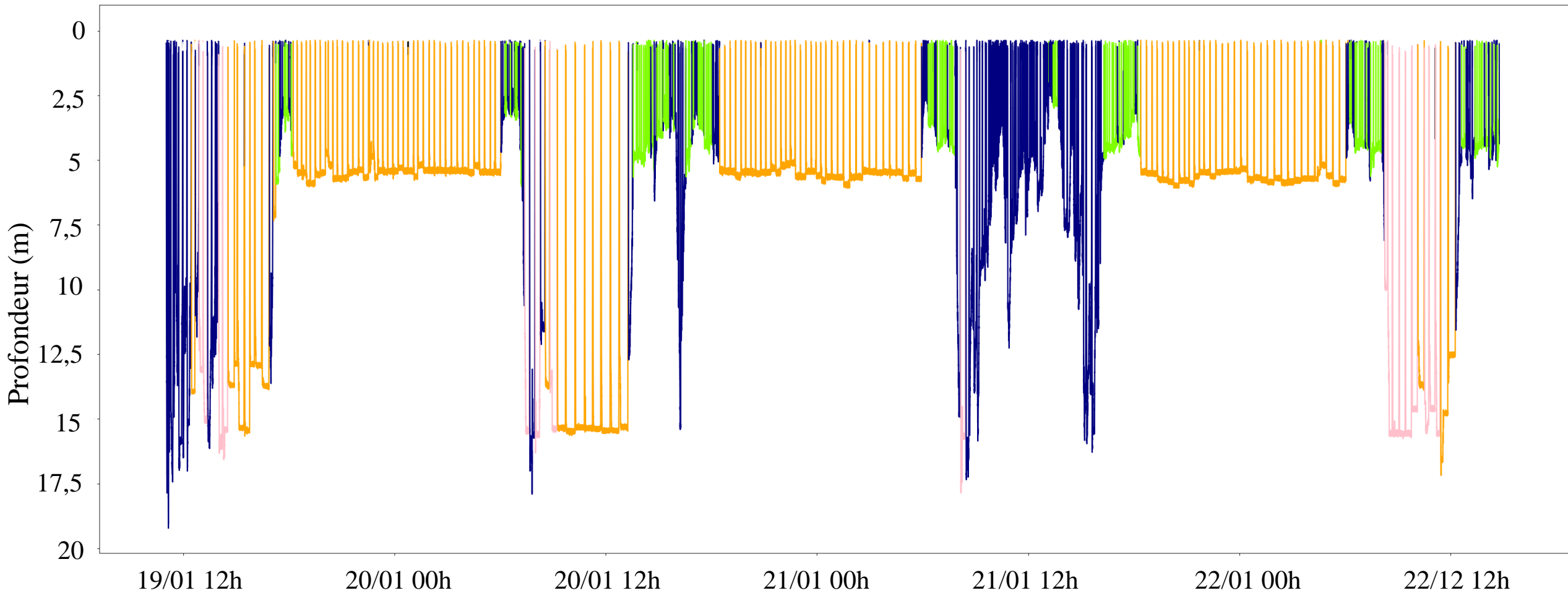


Comportement:

- Alimentation
- Nage Active
- Nage Passive
- Respiration
- Repos
- Se gratte



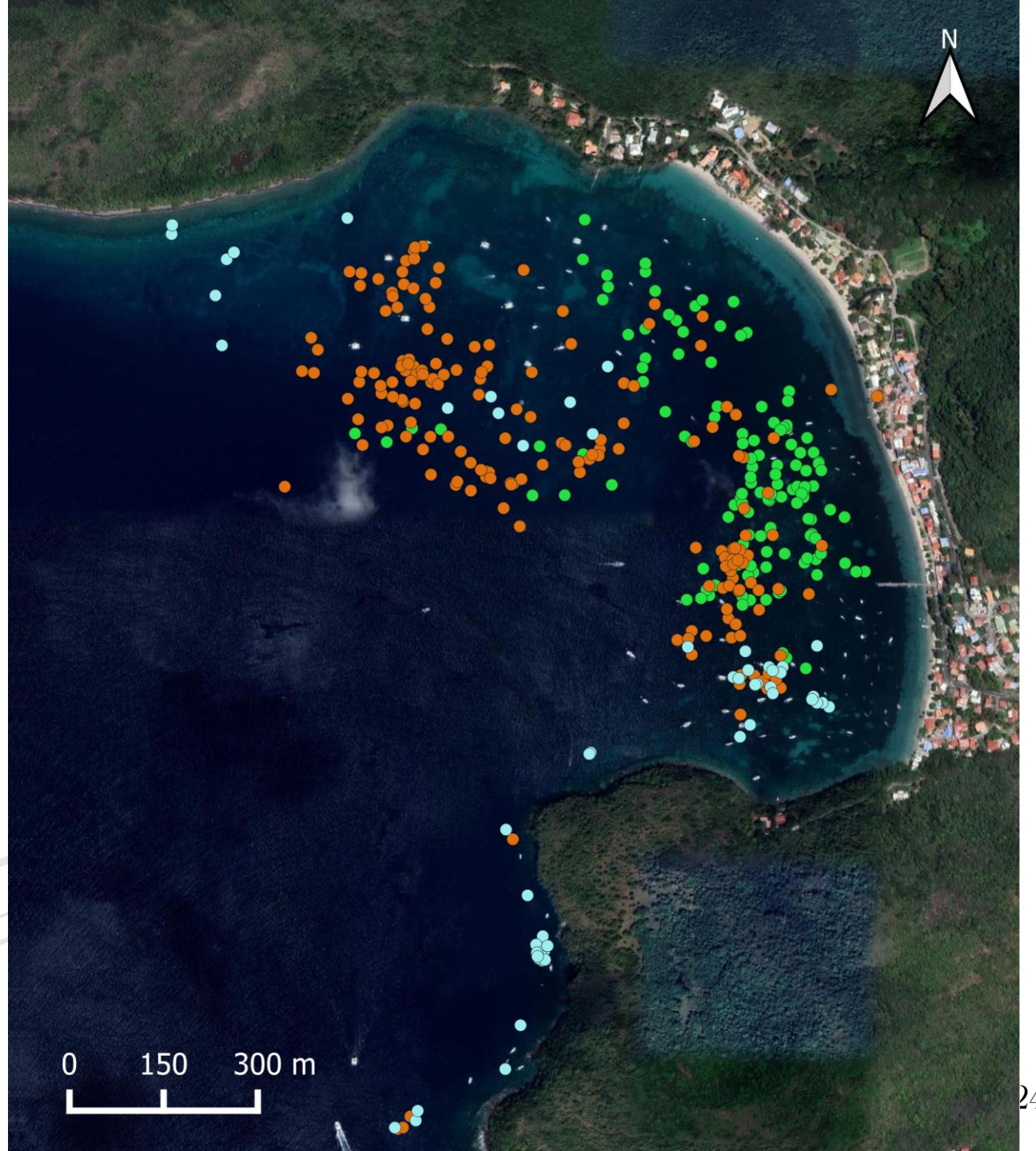
Individu #7 _ Anse Noire





Utilisation de l'habitat

**Points GPS points
associés avec le
comportement :**

- Alimentation
- Repos (jour)
- Repos (nuit)

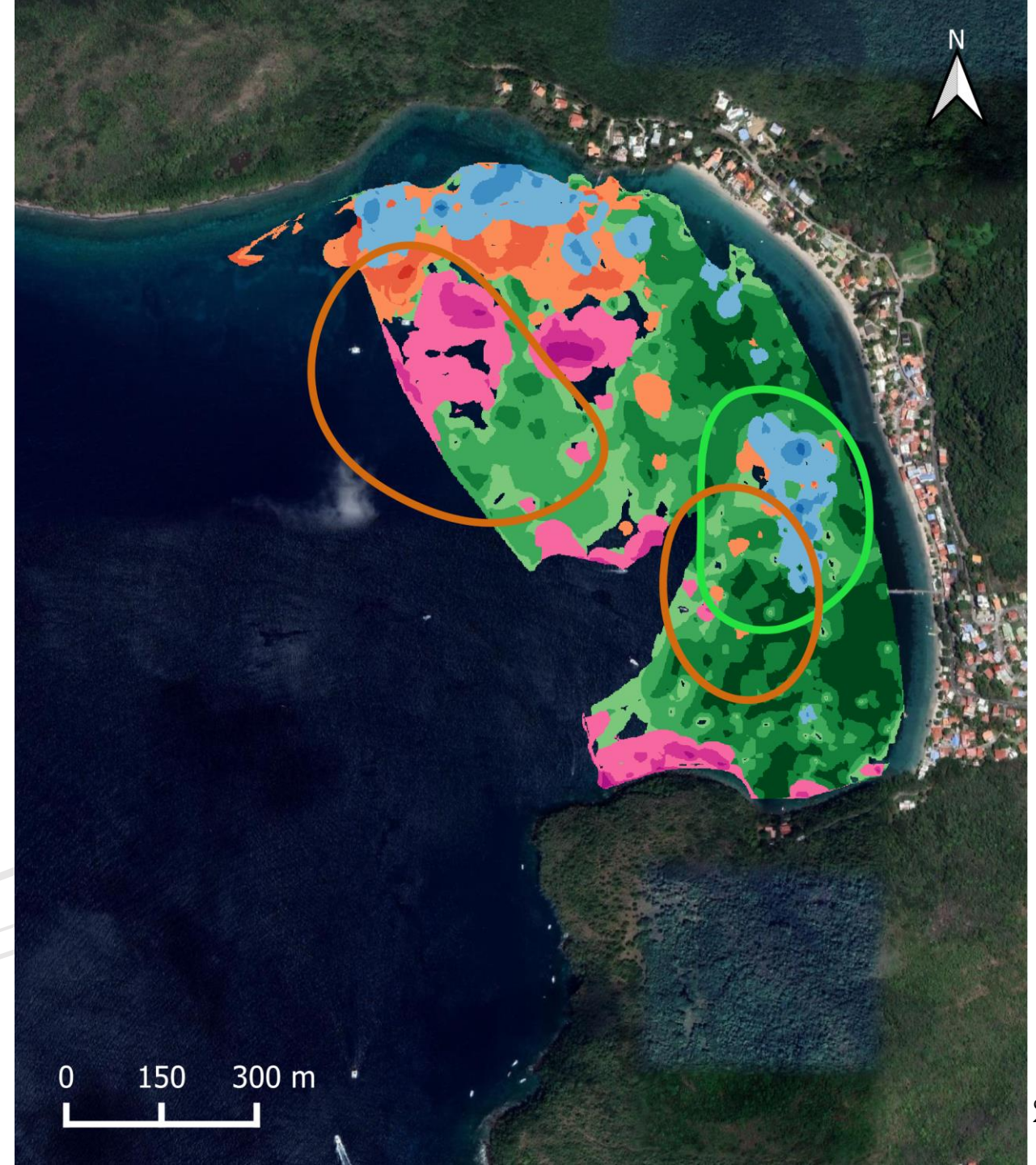


Utilisation de l'habitat

-  Alimentation
-  Repos (jour)

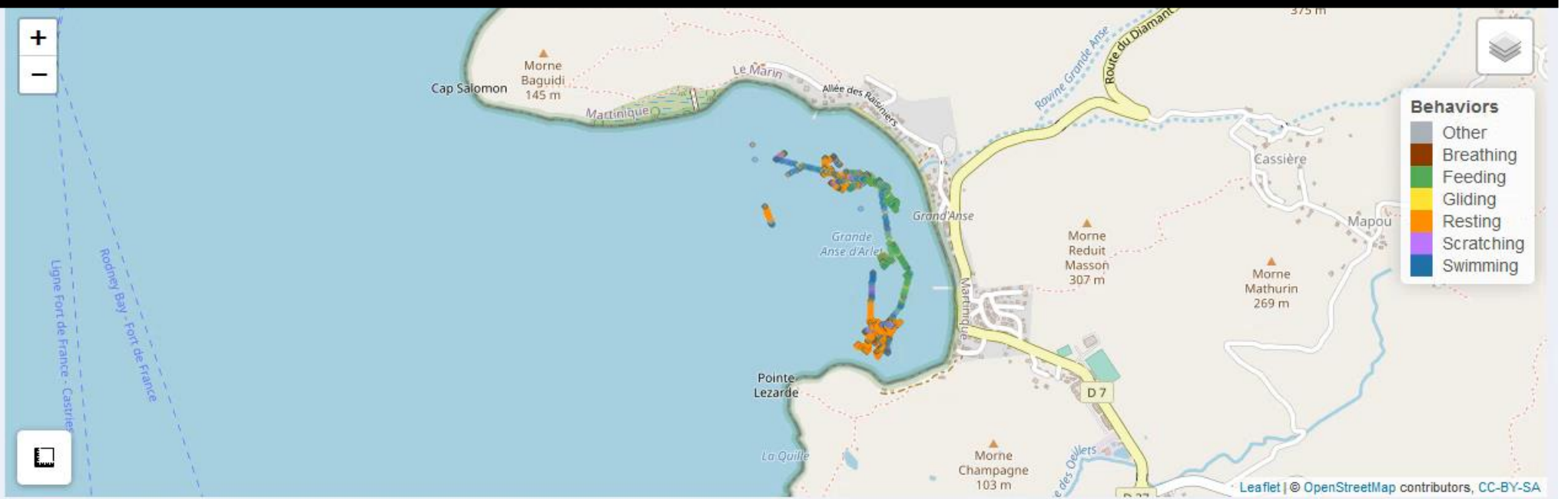
Couvert végétal (%)

<i>S. filiforme</i>	<i>Algae</i>
 26-50	 26-50
 51-75	 51-75
 76-99	 76-99
 100	 100
<i>T. testudinum</i>	<i>H. stipulacea</i>
 26-50	 26-50
 51-75	 51-75
 76-99	 76-99
 100	 100

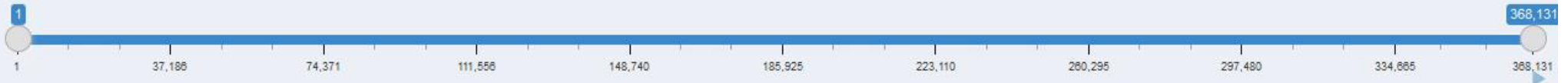


① -Démocratisation des outils via une **interface** de traitement des signaux accélérométriques (ANTIDOT)

- Home
- GPS Maps
- 3D Maps
- Statistics
- Settings
- About



track period (second) :

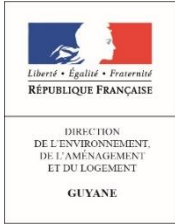


② -Etendre la **méthode** à d'autres populations et espèces

- Populations de tortues vertes
- Autres espèces de tortues marines
- Autres espèces marines ou terrestres ?



Merci pour votre attention



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AIMS African Institute for
Mathematical Sciences
SOUTH AFRICA