

SEMMACAPE: Monitoring and study of marine megafauna in wind farms by automatic characterisation



Context: offshore renewables and artificial intelligence

Project developers must produce environmental impact studies, particularly on marine megafauna (birds, mammals, turtles, large fish...). The analysis of the impacts of an offshore windfarm project requires aerial observations of marine megafauna in order to better characterise the frequentation of species in the proposed areas. This includes monitoring during the construction, operation and decommissioning phases, a total of about 30 years.

These observations are classically based on aerial overflights by specialised naturalist observers. However, in the age of big data, recent scientific and technological developments offer new prospects for radically improving the cost-effectiveness of such monitoring. The SEMMACAPE project aims at demonstrating the ability of aerial photography processing and analysis software to automatically inventory marine megafauna.

A fully integrated scientific and technical content:

- Aerial megafauna observation campaign (standard visual method and very high resolution digital photography system), integrating the seasonal variability of species and environmental conditions ;
- Development and qualification of 2 types of automatic aerial photography processing algorithms for animal identification and classification: 1) detection by deep neural (end-to-end) network, moving directly from the global image to bounding boxes; 2) detection of anomalies by unsupervised deep learning ;
- Assessment of the performance of each detection method tested based on indicators classed by species or group of species, as well as according to environmental conditions.

Partners:

This project is led by the research unit IRISA (University of Bretagne Sud), with contributions from WipSea company, France Energies Marines (institute for energy transition) and two public organisations: IFREMER and French Office for Biodiversity (OFB).

The total project budget is €600K, partly funded by the French Agency for Energy Transition (ADEME) under the auspices of the call for sustainable energy research projects (2018-2019).



Fig. 1: Two planes were used in May and October 2020 to acquire simultaneously visual observations and digital HD images, within the SPEE campaign (2019-2020) in collaboration with Pelagis Observatory.

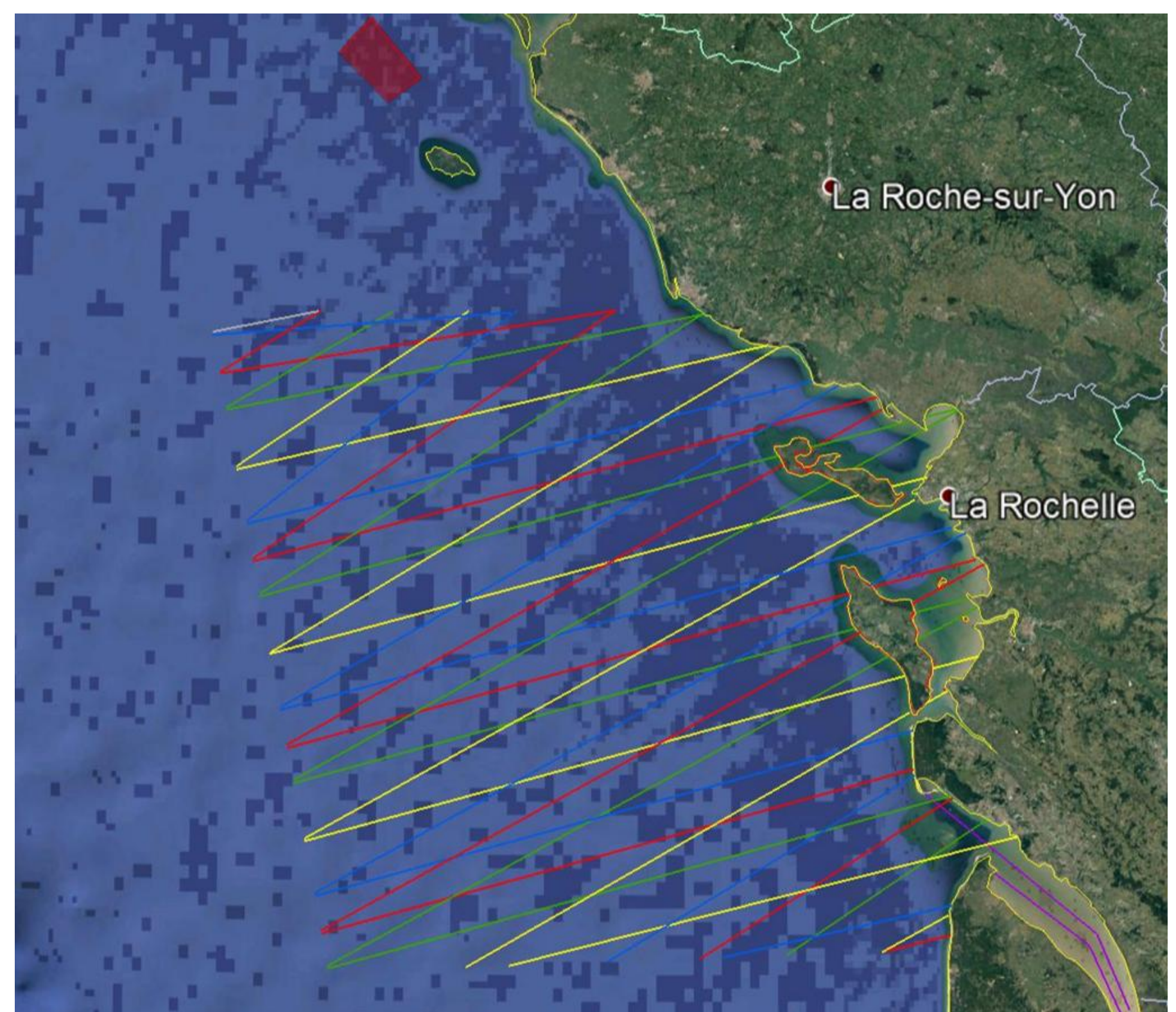


Fig.2: The visual data and HD images were acquired over a large sector (>1000 km²) in the Gulf of Biscay, during 3 legs in spring, summer and autumn. NB: the Yeu-Noirmoutier offshore windfarm site can be seen at the North of the surveyed area (in red).

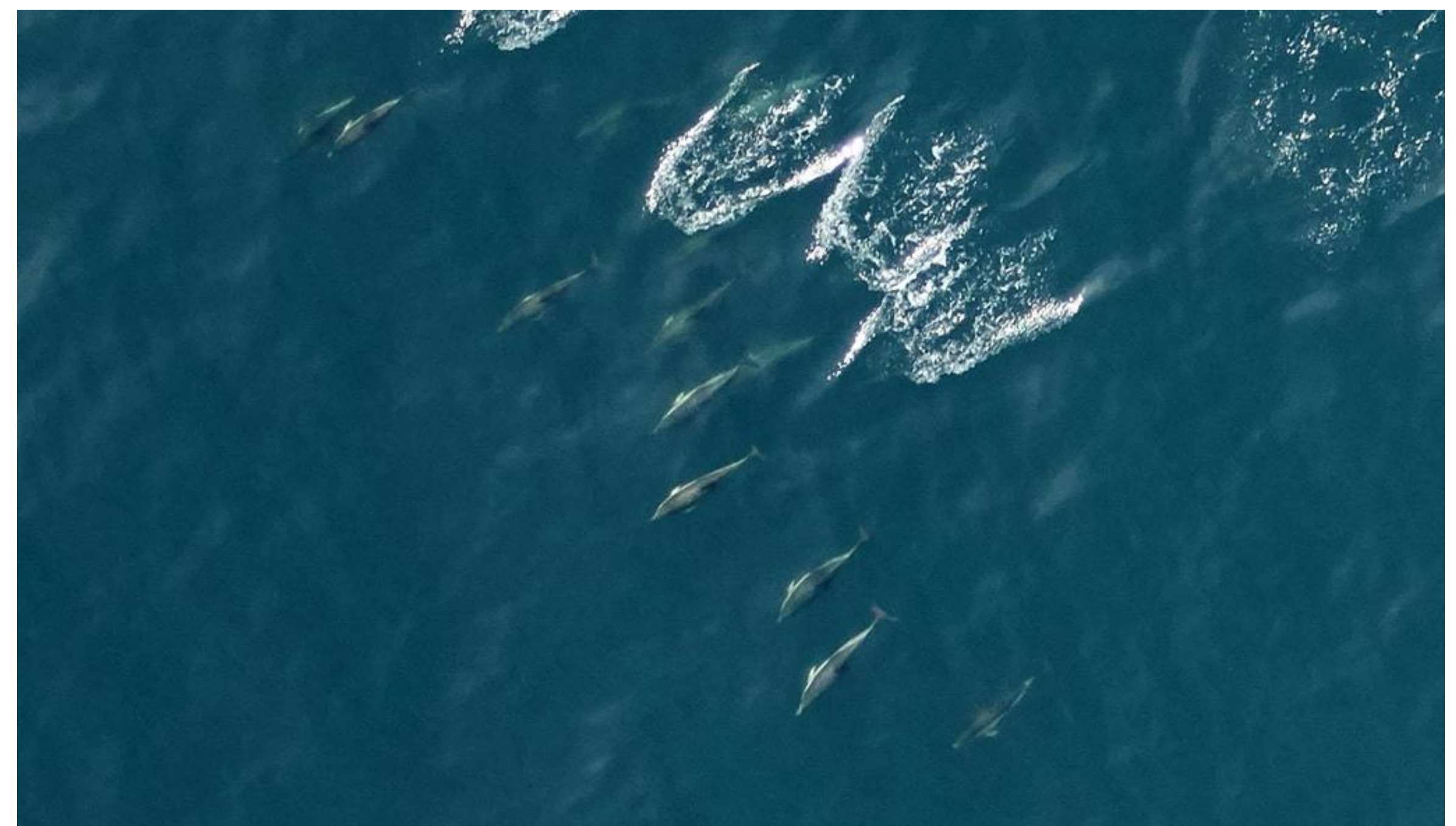


Fig. 3: A group of Common dolphins (*Delphinus delphis*) photographed by the dual-objective LAMA system during one of the flights in May 2020. Individuals can be found both at the surface and a few meters below.

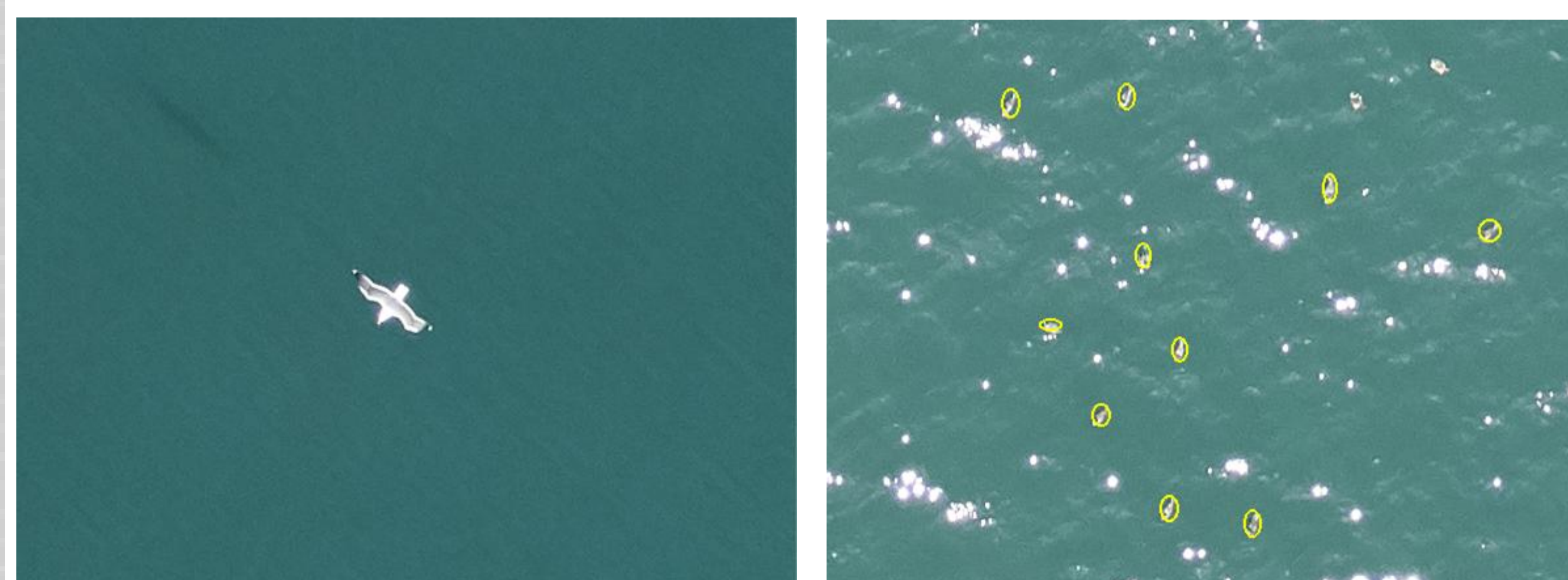


Fig. 4: Detecting and identifying a single seabird flying over a uniform background can be an easy task for both visual observers and neural network algorithms (left: a Herring gull, *Larus argentatus*). However, in the case of a large number of white birds resting at the sea surface among sun glares, a much higher expertise level is needed (right: a group of small shearwaters, *Puffinus sp.*; automatically detected individuals are circled in yellow).

Expected results:

- Demonstration of the feasibility of a fully automated image analysis solution for aerial monitoring of marine megafauna at the scale of an OWF project area;
- Proposal of a software solution adapted to the monitoring of the marine megafauna present in metropolitan France, and more particularly in the areas of future French and European offshore wind farms;
- Guarantee the technical feasibility of aerial monitoring after the installation of offshore wind turbines, thanks to a combination of technologies allowing observations at an altitude imposed by safety constraints (300 m and more) and freeing the massive recourse to naturalist experts for their interpretation.

ADEME



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