

# COPERNICUS & ME

## Diminishing the carbon footprint of ships



THE FRENCH SME D-ICE WAS LOOKING FOR WAYS TO DECREASE THE CARBON FOOTPRINT OF SHIPS.



COPERNICUS SATELLITES PROVIDE HISTORICAL DATA ON WEATHER, WIND, WAVES AND SEA CURRENTS ON SEA ROUTES TO SUPPORT WIND-PROPELLED SHIPS.



USING THESE HISTORICAL DATA, SHIPS CAN TAKE ROUTES WITH LOW POWER CONSUMPTION.



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# COPERNICUS



ESA/ATG medialab

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## COPERNICUS, EUROPE'S EYES ON EARTH

Copernicus is the Earth Observation Programme of the European Union, looking at our planet and its environment for the benefit of global citizens.

Five Copernicus missions are currently in orbit. The data they provide is coupled with ground-based, airborne, and seaborne measurements to make six information services focused on monitoring: Atmosphere, Marine environment, Land, Climate change, Security, and Emergency.

Such services are free and openly accessible and can be used by private, public and international organisations to improve life on Earth.

For more information about Copernicus, visit [www.copernicus.eu](http://www.copernicus.eu)

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## **SHIPS, BOATS AND VESSELS HAVE A HEAVY IMPACT ON THE OCEAN AND THE ENVIRONMENT.**

Indeed, they are responsible for a significant proportion of the global climate change problem.

More than 3% of global carbon dioxide emissions can be attributed to ocean-going vessels, which is equivalent to the annual greenhouse gas emissions from over 205 million cars.

Carbon dioxide emissions of ships are directly proportional to fuel consumption and speed.

Moreover, boats powered by fuel also cause noise pollution that negatively affects marine life.

**TO ALIGN WITH THE OBJECTIVES OF THE INTERNATIONAL MARITIME ORGANISATION. THE SHIPPING INDUSTRY IS NOW CHANGING, AND MORE AND MORE SHIP OWNERS ARE TODAY TRYING TO REDUCE THEIR ENVIRONMENTAL FOOTPRINT.**

The most studied solution is the hybridisation of ship propulsion, by combining wind-assisted propulsion with other means of green propulsion (hydrogen, solar panels, ammonia, etc.). This will lead to complex and innovative ships, with some uncertainties that need to be anticipated [1].





## D-ICE ENGINEERING

Type of organisation: SME

Country: France

Annual budget in 2020: €500k - €1m

Previous experience with Earth Observation data: Yes

**D-ICE IS A FRENCH SME  
WORKING ON  
TECHNOLOGICAL  
SOLUTIONS TO  
DIMINISH THE IMPACT  
OF BOATS ON THE  
ENVIRONMENT.**

The company is based in Nantes, with a team of 26 people, and operates in the fields of routing, clean energy and safety at sea.

D-ICE assists ship owners and operators to find solutions to diminish their impact on the environment. In particular, they work on assessing the interest of adding wind-assisted ship propulsion systems onboard merchant ships.



## THE SATORI SOFTWARE USES COPERNICUS DATA TO SUPPORT WIND-PROPELLED SHIPS.

The software is one of the latest created by D-ICE with the objective of analysing the performance of wind-assisted propulsion vessels on specific routes, according to historical weather data (wind, waves and currents).

Available since November 2020, the SATORI online service allows for the estimation of fuel consumption of ships on specific routes. The associated algorithm picks the routes with less power consumption.

Initially funded by the Copernicus Marine Environment Monitoring Service (CMEMS), SATORI relies on data from Copernicus satellites to acquire information on weather, wind, waves and sea currents on sea routes.

the Global Waves Reanalysis Waverys and the Global Ocean Physics Reanalysis.

Those historical data are made freely available by the Copernicus Marine Environment Monitoring Service through two products:

The data are used to calculate ships' motions and interactions with the environment. Indeed, the evaluation of wind, waves and currents is necessary for the model to calculate the speed of ships and their engine power between two points at a specific time.

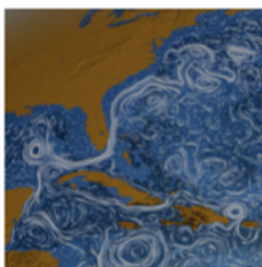
### Waves

Provider: CMEMS | Model: MFWAM reanalysis  
Resolution: 0.5 degrees / 6 hours  
Product:  
[GLOBAL\\_REANALYSIS\\_WAV\\_001\\_032](#)  
Our database is updated every 6 months



### Current

Provider: CMEMS | Model: NEMO 3.1  
Resolution: 0.2 degrees / 24 hours  
Product:  
[GLOBAL\\_REANALYSIS\\_PHY\\_001\\_030](#)  
Our database is updated every 6 months



### Wind

Provider: ECMWF | Model: ERA 5  
Resolution: 0.5 degrees / 6 hours  
Product: ERA5  
Our database is updated every 6 months



Source: D-ICE Engineering



SATORI is built for shipowners, naval architects and providers of propulsion systems. Customers access SATORI through a web portal, where they can enter the ships' data and their potential speed according to different directions and winds.

Users can perform statistical weather routing studies on the online interface, choose a route and the time periods on which they wish to assess the ships' average consumption, and then create their own data visualisation to obtain the required forecasts (environmental conditions to be encountered, fuel saving associated with wind-assisted propulsion, ship motions).

The results can be filtered according to sea state, wind direction or speed, or engine power.

**WITH THIS INFORMATION, USERS OF SATORI CAN ASSESS THE REDUCTION OF CONSUMPTION THAT WILL BE REACHED THANKS TO THE INSTALLED WIND-ASSISTED SHIP PROPULSION SYSTEM, EITHER ON A DIRECT ROUTE OR ON AN OPTIMISED ROUTE.**

## California to Japan

With D-Hybrid ship by Sylvain Faguet

Customize display



Select a date range

Waves Height



0 m - 10 m



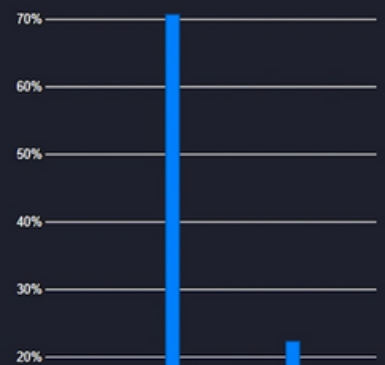
Route



Engine Power

Delta Operator

250



© D-ICE



## SATORI HAS BEEN ALREADY USED BY SOME NOTABLE SKIPPERS.

For example, Total and Z&B are today using the software on some of their ships, while AYRO and Chantiers de l'Atlantique rely on it to design wind-assisted ship propulsion systems.

The same algorithm which powers SATORI was used to perform a study for the design team of the new Banque Populaire trimaran after their boat capsized during the Route du Rhum yacht race in 2018.

In 2021, the boat Maître Coq won the greatest sailing race around the world, solo, non-stop and without assistance: the Vendée Globe.

D-ICE provided the skipper, Yannick Bestaven, with a software that contained a database of historical routes.

This database was computed with the same algorithm as SATORI. This tool helped him to confirm his routes' choices and to eventually win the race.

*"Thanks to this new technology, the shipping community can now validate business models around the new targets of the International Maritime Organization and take action to reduce greenhouse gases emissions globally".  
Sylvain Faguet, D-ICE Engineering.*



**FOR D-ICE, SATORI REPRESENTS AN OPPORTUNITY TO HELP SHIPOWNERS IN THEIR CARBON FOOTPRINT REDUCTION PROCESS, AND TO CREATE TRUSTFUL RELATIONSHIPS TO DEVELOP NEW PRODUCTS IN THE FUTURE.**

Indeed, thanks to SATORI, shipowners can assess the convenience of installing wind-assisted propulsion systems to reduce the carbon footprint of their fleet.

Also, developers of wind-assisted ship propulsion (WASP) systems, can convince shipowners that their solutions will entail significant fuel consumption reductions, while ensuring a good return on investment.

Finally, naval architects can validate the sizing and configuration of WASP systems onboard ships to obtain the best fuel reduction with the lowest impact on ships' structure and operations.

Among current developments, D-ICE is now working on the OCEANiCS solution, a new-generation navigation and control system aimed at optimising and securing operations, while significantly reducing fuel consumption





## REFERENCES

[1] Copernicus Marine Service,  
SATORI: Online statistical weather  
routing:  
[https://marine.copernicus.eu/services/  
use-cases/satori-online-statistical-  
weather-routing](https://marine.copernicus.eu/services/use-cases/satori-online-statistical-weather-routing)

## LINKS

D-ICE Engineering: [dice-engineering.com](http://dice-engineering.com)  
International Maritime Organization:  
[www.imo.org](http://www.imo.org)  
Copernicus Marine Environment Monitoring  
Service: [marine.copernicus.eu](http://marine.copernicus.eu)  
SATORI: [dice-engineering.com/satori/](http://dice-engineering.com/satori/) ;  
[satori.d-ice.net](http://satori.d-ice.net)  
SATORI Use Case Demo: [satori.d-ice.net/cmems\\_dedicated\\_webpage/index.h  
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[resources.marine.copernicus.eu/?  
option=com\\_csw&view=details&product\\_id=  
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option=com\\_csw&view=details&product\\_id=  
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Presentation “Use case SATORI by D-ICE” at  
the Copernicus Marine General Assembly:  
[youtu.be/yYVTTfBFMPo](https://youtu.be/yYVTTfBFMPo)  
Le système OCEANiCS pour la navigation, le  
routage, le pilotage et l’optimisation de  
performances de CANOPEE: [dice-  
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Canopee-Communique-FR.pdf](http://dice-engineering.com/wp-content/uploads/2021/01/2021-01-20-Canopee-Communique-FR.pdf)

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<https://dice-engineering.com/>

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