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Relevant CMEMS products to predict oil slick drift in the Grande America accident

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Grande America sinks in the Bay of Biscay

- On the evening of March 10, 2019, a fire broke out on board the commercial vessel Grande America.
- On March 12, 2019, the vessel sank at a depth of 4,600 m, 350 km from the French coast with about 2,200 tonnes of bunker fuel, 365 containers and 2,000 vehicles on board.
- On 13th March, an oil slick around 10 km long and 1 km wide was observed by the maritime patrol aircraft. The Maritime Prefect for the Atlantic ordered the pollution response vessel Argonaute to be sent onsite and to begin spill response operations.

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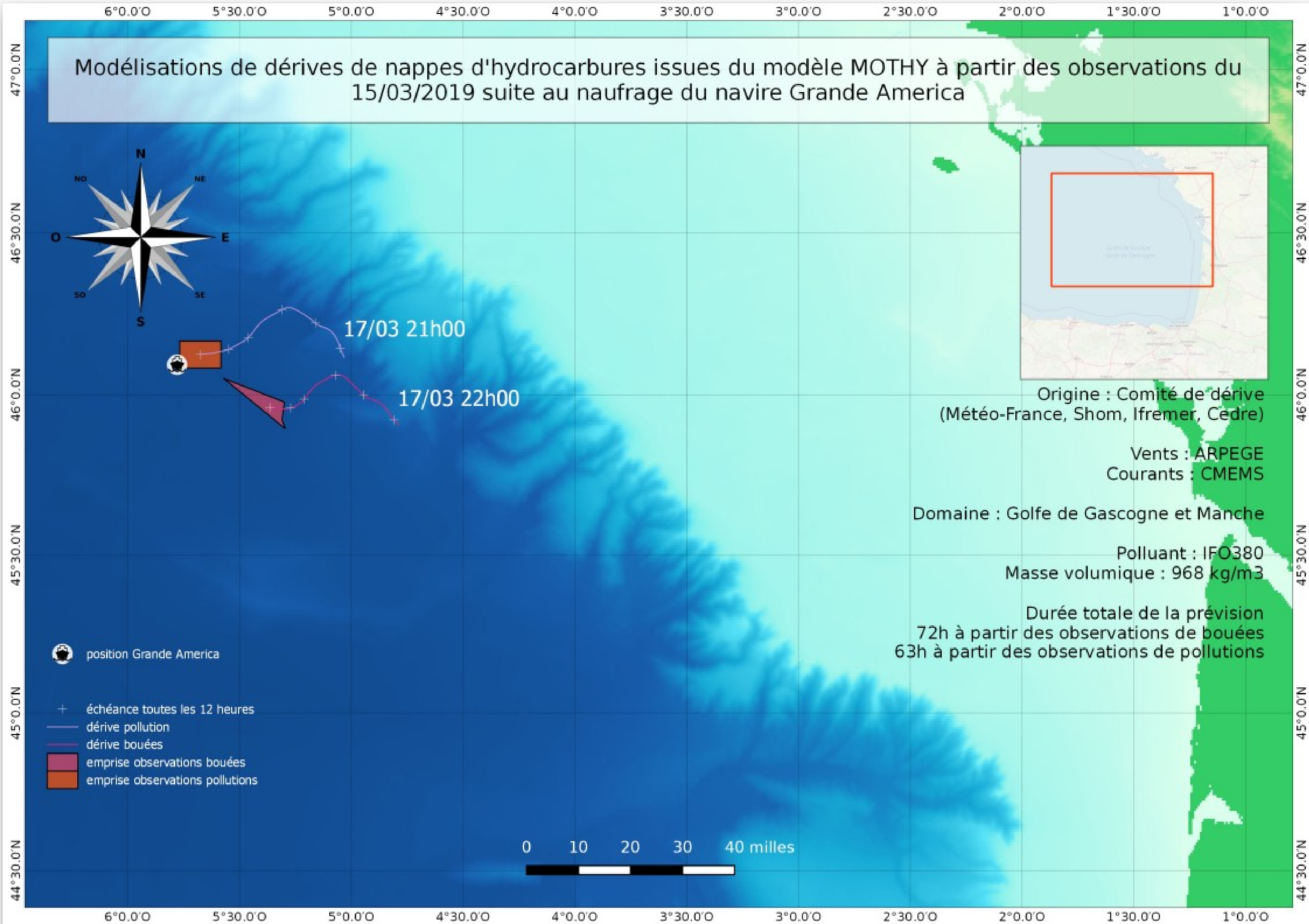
The drift committee

- The drift committee, made up of experts in the fields of meteorology, oceanography, the behaviour of petroleum products and marine pollution response is coordinated by the Maritime Prefecture for the Atlantic.
- The drift committee met from March 14 to April 2 to analyse observations and forecast monitoring of pollutant drift.
- Lead by Cedre, the committee is composed of representatives from Meteo-France, Ifremer and Shom.

- The drift committee was able to confirm that the risk of coastal pollution could not be excluded in the long term, but that there was no risk in the medium term. This allowed the authorities to organize the response at sea without mobilizing resources ashore.

Example of chart produced by the drift committee



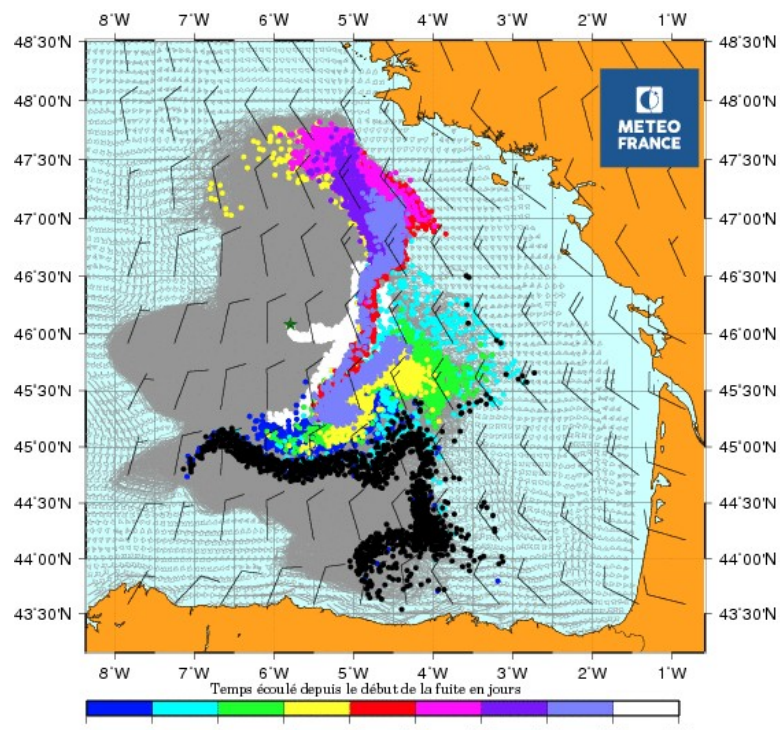
Meteo-France drift products

- Meteo-France produced daily, with its drift model MOTHY:
  - deterministic 3-day forecasts of the drift of oil slicks and containers.
    - guiding offshore oil recovery operations
  - probabilistic 10-day forecasts.
    - assess the risk of coastal pollution
  - Continuous release from the wreck
    - don't forget the oil that wouldn't have been observed

Continuous oil leak from the wreck

MOTHY output from a simulated 2 month-leak from the Grande America wreck (dark green star near 46°N-6°W). The black spots are the oil released on the day of the accident. The colour dots are the oil released during the 35 days of continuous leakage from the wreck. The white dots represent a potential risk after the leaks have been sealed. In grey, the trajectories where the oil has been during the 2 months. Ocean current data are from the operational Mercator global ocean analysis and forecast system. Wind data are from ARPEGE model.

Due to the distance to the coast and variable wind regimes, 2-month drift forecasts did not indicate any oil arrival at the coast.



A few arrivals of tarballs occurred on the French coast during winter storms 10 months after the accident.

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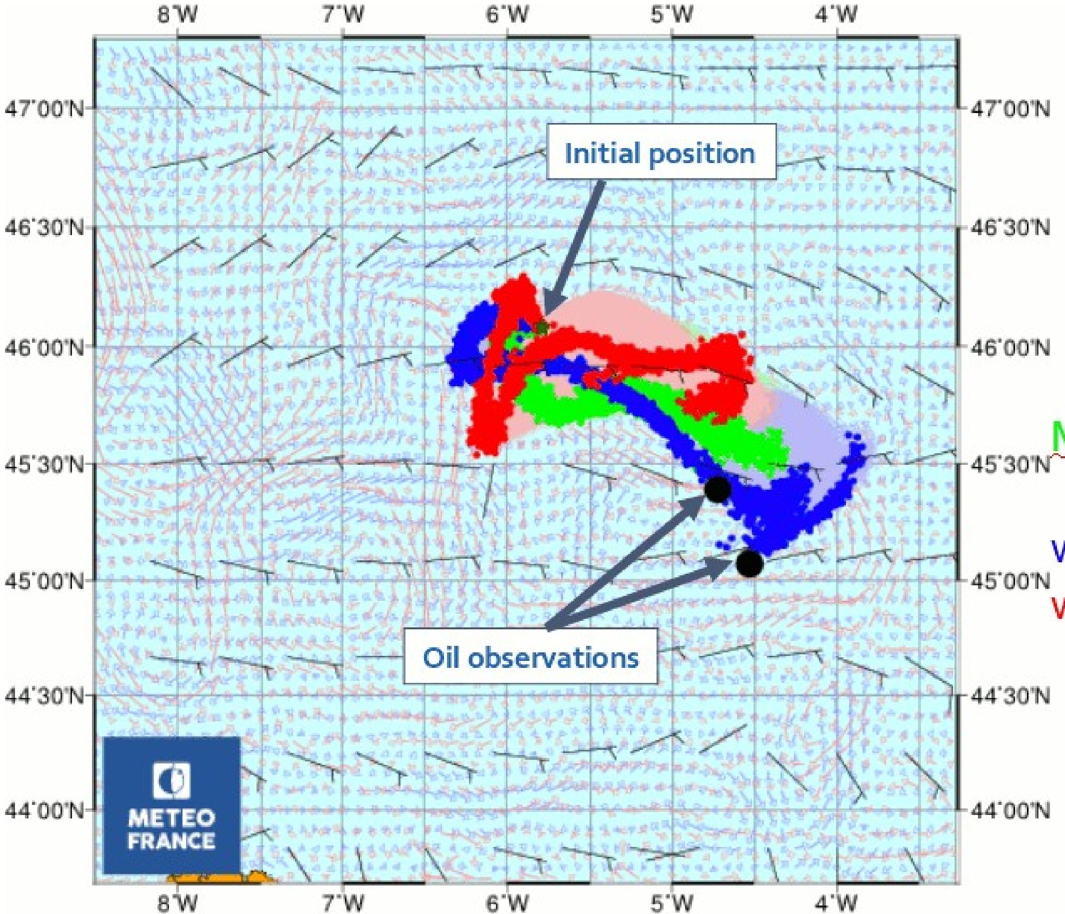
Environmental data

- Wind
  - ARPEGE (Meteo-France) for 3 days forecasts
  - IFS (ECMWF) for 10 days forecasts
- Current
  - CMEMS GLOBAL_ANALYSIS_FORECAST_PHY_001_024
  - CMEMS IBI_ANALYSIS_FORECAST_PHYS_005_001

CMEMS currents

MOTHY output from a simulated 10 day-leak from the Grande America wreck. Black disks are aerial observations. Particle drift: in green without ocean current data, in red using ocean current data from the operational IBI ocean analysis and forecast system at 1/36°, in blue using ocean current data from the operational Mercator global ocean analysis and forecast system at 1/12°.



MOTHY (only)

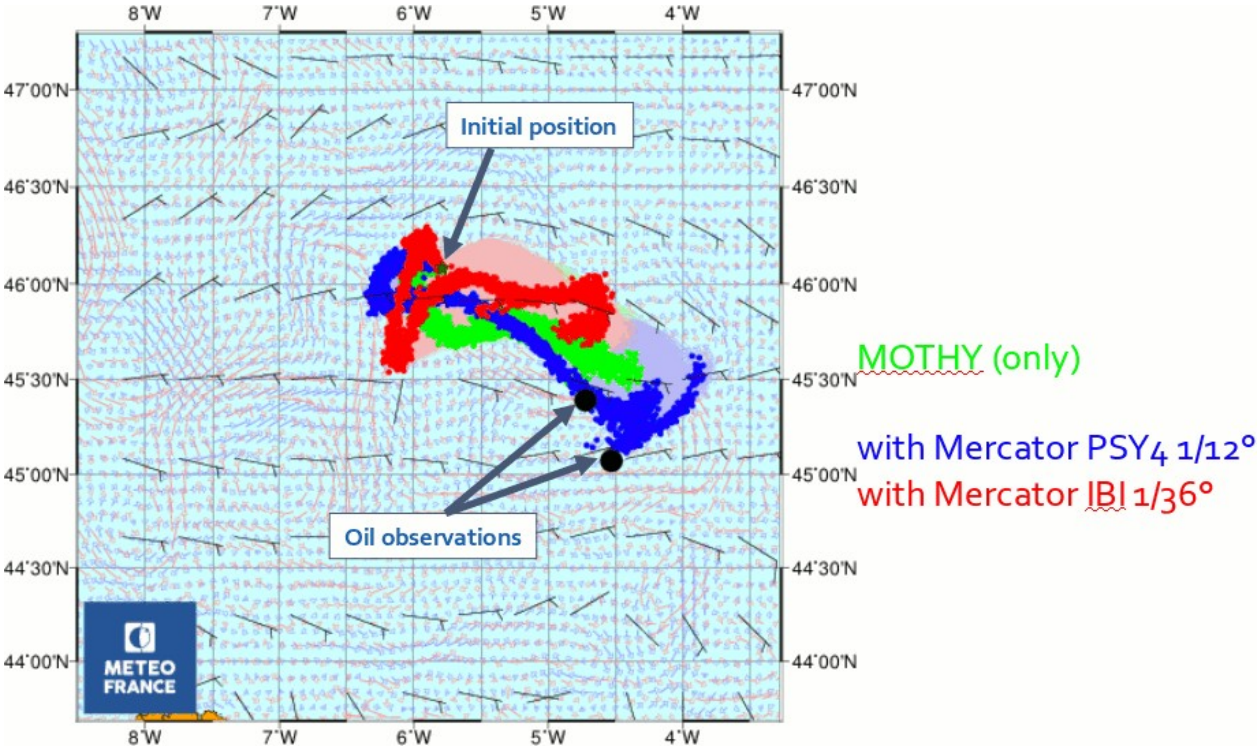
with Mercator PSY4 1/12°

with Mercator IBI 1/36°

CMEMS currents

The drift predictions closest to the observations are achieved with the currents provided by the lower resolution ocean model.

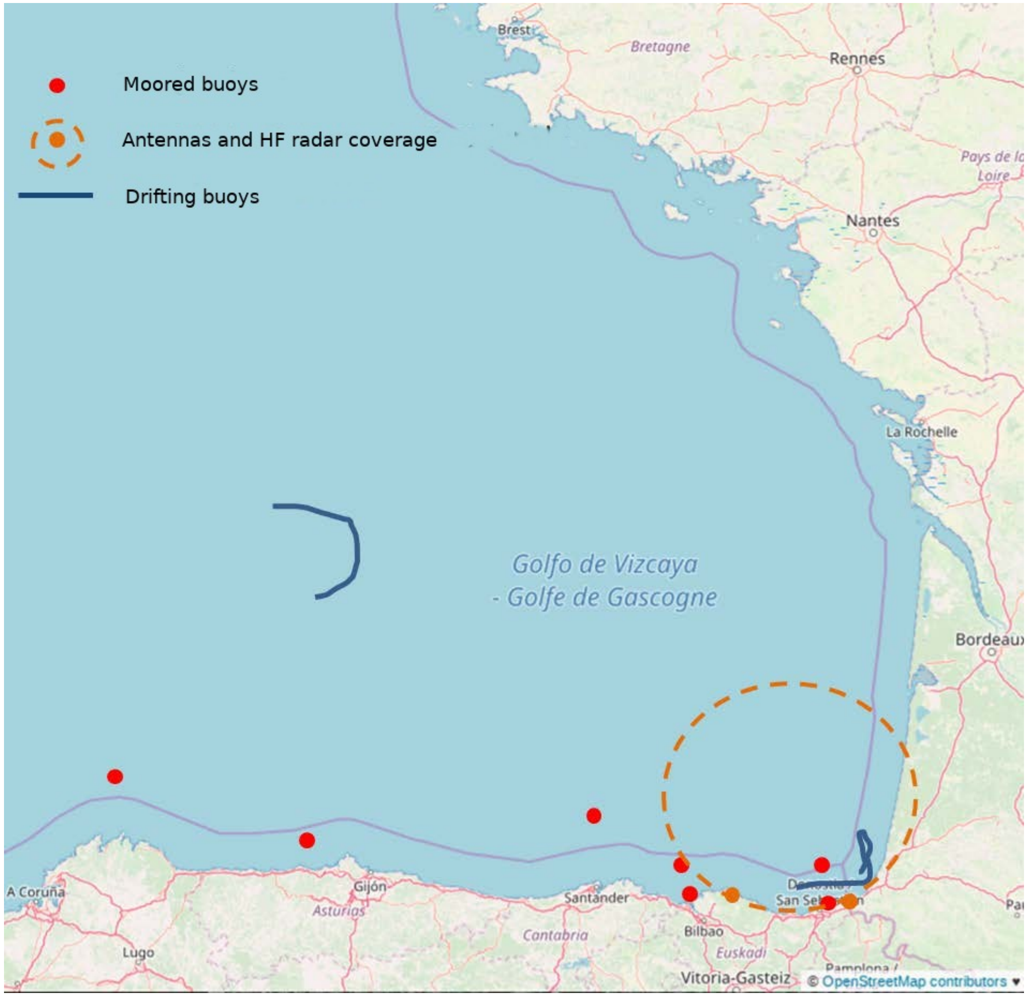
This shows the importance of having several ocean models and the difficulty of using high-resolution ocean forecasts that generate many eddies whose precise location is sometimes difficult to model.



http://www.meteorologie.eu.org/mothy/egu-2020-grande-america/mothy-animation.gif

Direct current measurements

Currents are generally poorly measured making it difficult to evaluate systems for drift applications.



Measurements of currents available in real time in the Bay of Biscay in March 2019

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Conclusions

Based on previous validation studies, the IBI solution generally presents more realism than PSY4 in the representation of the physics of the Bay of Biscay area, and a satisfactory behaviour.

The smoother PSY4 solution, whose variability scales are closer to the scales constrained by data assimilation, may give better results for "drift" type applications because the IBI variability scales are certainly more realistic but were not, at the time of the accident, constrained by data assimilation.

In the current state of knowledge, and due to the lack of observations to constrain the models, it is important to adopt a "ensemble" or multiple scenario approach.

Conclusions

This example highlights the main challenge for data providers in the future, which is to improve the accuracy of current forecasts.

Therefore, international collaboration should continue to consolidate work on validation measurements and model comparisons.

In particular, it is necessary to include spatially explicit estimates of uncertainty, both for forcing data and for the results of the oil spill model.

From this point of view, ensemble forecasting is a very promising research area for quantifying the uncertainties inherent in drift prediction at sea. It should be further studied.

Products should be delivered to users efficiently and should be provided with adequate spatial and temporal resolution.

The interaction between users and modelling software developers must be an important criterion for future advancements in pollution modelling capability.