




How does an oil slick move?


Observations, modelling, and two case studies

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ITOPF - background




Not-for-profit organisation established in 1968

Objective: to provide technical advice on ship source spills of oil and other products.


On-site experience of >800 spills in 100 countries

Remote support to 1000s of spills

Check our website at: ITOF.org



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How does oil moves?

esa

- Oil trajectory is affected by:
 - Currents: ~100%
 - Winds: ~3%

My presentation is done!

WIND (20 Knots)

CURRENT (2 Knots)

A 3% 100% B

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Trajectory modelling

esa

Trajectory models require:

- Spill size and source (instantaneous vs continuous)
- Location & distribution of oil (within a set timeframe)
- Oil type/properties (its behaviour and weathering will influence transport)
- Weather conditions and sea state (behaviour is also dependent on these factors)
- Currents & winds data + coastline boundary**
- ...

WIND (20 Knots)

CURRENT (2 Knots)

A 3% 100% B

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Trajectory modelling



Modelling @ ITOPF

- We use WebGNOME (NOAA) for trajectory & fate modelling
 - *WebGNOME was developed by the NOAA Office of Response and Restoration (OR&R) Emergency Response Division for use in oil spill response.*
- Input data from GOODS (GNOME Online Oceanographic Data Server)
 - Currents: Hybrid Coordinate Ocean Model (HYCOM) 1/12 degree
 - Winds: Global Forecast System (GFS) 1/4 degree
 - Oil properties: ADIOS oil database

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Trajectory modelling



Modelling @ ITOPF

- Models run up to 5 days (+ or -)
 - Inaccuracy increases with time
 - Forecasts & backcasts
- Re-run using satellite data or aerial surveillance observations
- For other types of modelling (e.g. stochastic models) we outsource the task



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Trajectory modelling



Modelling @ ITOPF

Issues & limitations of current models:

- Unknown/unaccounted for parameters & variables!
- Granularity of available current & wind data
- Gaps in knowledge regarding:
 - Nearshore data
 - Riverine input/Orography/Bathymetry
 - ...
- Computational power



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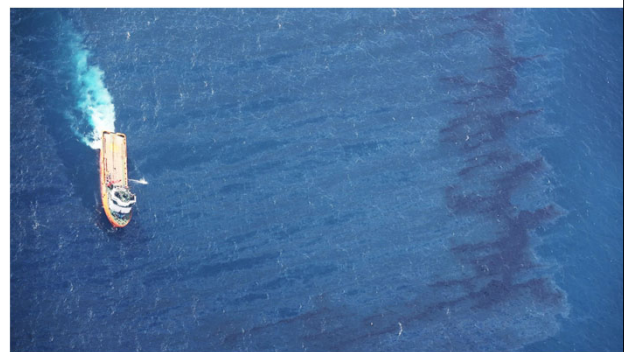
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Why all this trouble?



Modelling is required for operational purposes:

- Where will the oil go (offshore)?
 - Don't lose track of it (very easy in the ocean – it is BIG!)
 - Facilitate planning at-sea response
- Where will the oil land? So in advance we can:
 - Protect sensitive areas
 - Clean beaches from debris (to simplify later clean-up)
 - Direct to/prepare equipment in situ
 - Contingency planning (find which areas more likely to be affected by a spill – stochastic models)



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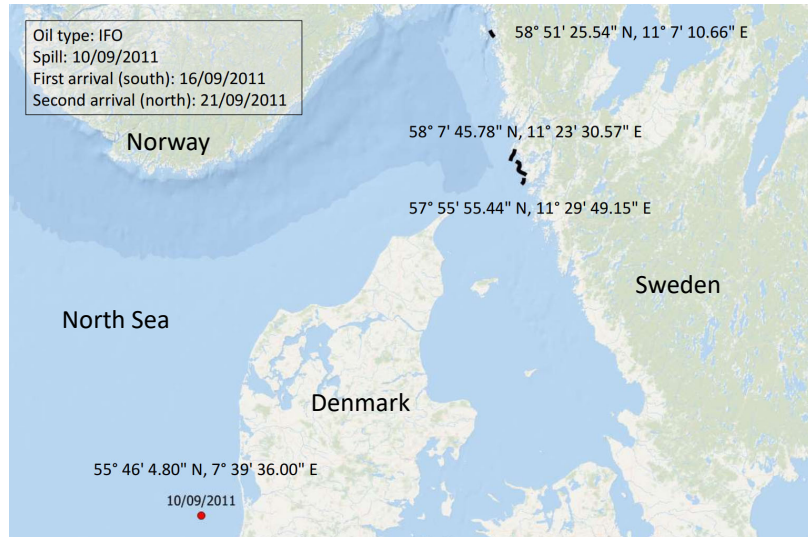
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Case study – GOLDEN TRADER



Bulk carrier

- Bunker fuel lost: ~450 m³ IFO 180 (estimation)
- Collision on 10th Sept 2011
 - North Sea, off the Danish coast
- Contamination:
 - None on the Danish coast
 - Two main areas on the Swedish coast – south on 9th Sept; north on 21th Sept.



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Case study – GOLDEN TRADER




- GOLDEN TRADER WebGNOME videos!

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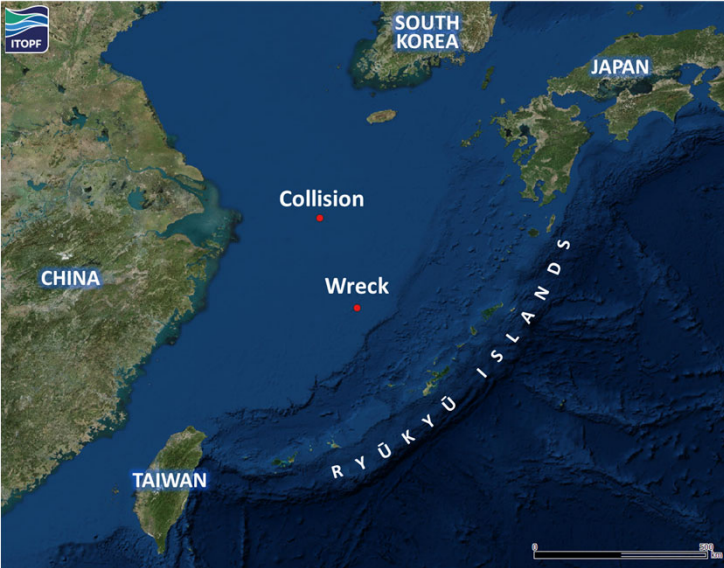
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Case study – SANCHI




Fully loaded tanker

- Cargo: 111,388 MT Condensate
 - More volatile than ethanol
- Bunker fuel: 1.900 MT IFO 380
- Collision on 6th January 2018
 - Breach of cargo tank & explosion
- Sinking on January 14th
 - Wreck at 115 m depth




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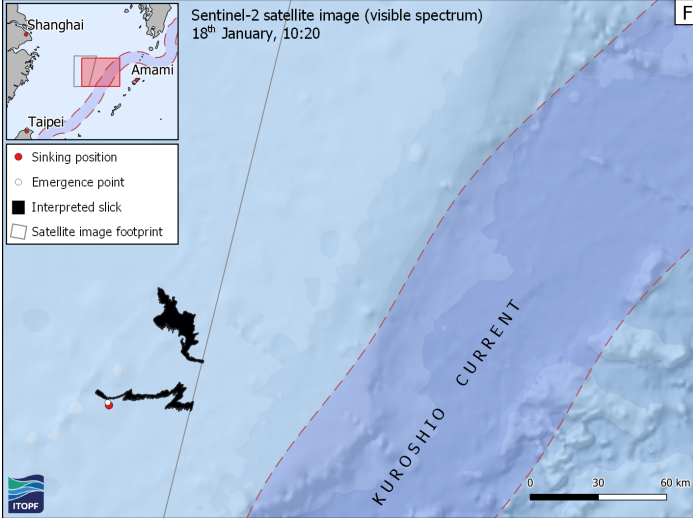
Case study – SANCHI




Fate of hydrocarbons on board:

Condensate (non-persistent HC cargo)
burned in the fire/evaporated

Bunker fuel – part spills from the wreck



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Case study – SANCHI



Contamination

Takarajima, oil arrived on 29-31 January

Amami (and the adjacent southern islands), Kikaijima and Tokunojima.

Other islands, both north and south of this core, were affected, tarballs only.



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Case study – SANCHI



- SANCHI WebGNOME videos!

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Conclusions



WOC current product:

- Spatial resolution is not ideal
- Works better on oceanic contexts
- Is a great start, and this product can be used for stochastic models (contingency planning)

Future work:

- There is lots of space in the market for new algorithms
- There is also the need for data products: currents (refine what was done) & winds
- Products can be tested in other areas – data exists in oceanic settings (way more in near-shore)
- Data products with forecasts...
- Nearshore data is sorely needed! Please!

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Well done, congratulations to the team!

PS: Now keep working!

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2023 applications open!

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