# Standards for environmental impact assessment for offshore wind farms: overview of EIA work required in the EU and areas of special significance

Frank Thomsen, DHI

# DHI in short

We’re an independent, private and not-for-profit organisation

Our people are highly qualified

80% of our 1,100 employees hold an MSc or a PhD degree

Our knowledge represents 51 years of dedicated research

20% of our resources are allocated to R&D to enhance our knowledge and innovation

We make this knowledge globally accessible

through our local teams and unique software

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# Our areas of expertise

Aquaculture and agriculture

Energy

Climate change

Coast and marine

Surface and ground water

Urban water

Industry

Environment and ecosystems

Product safety and environmental risk

**Our in-house facilities and tools:** physical scale model testing, laboratories, ballast water centres, survey and monitoring systems for field studies

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# Our business lines

## Solutions
Consultancy services

## MIKE Powered by DHI
The most advanced water modelling tools

## THE ACADEMY by DHI
Training and knowledge sharing

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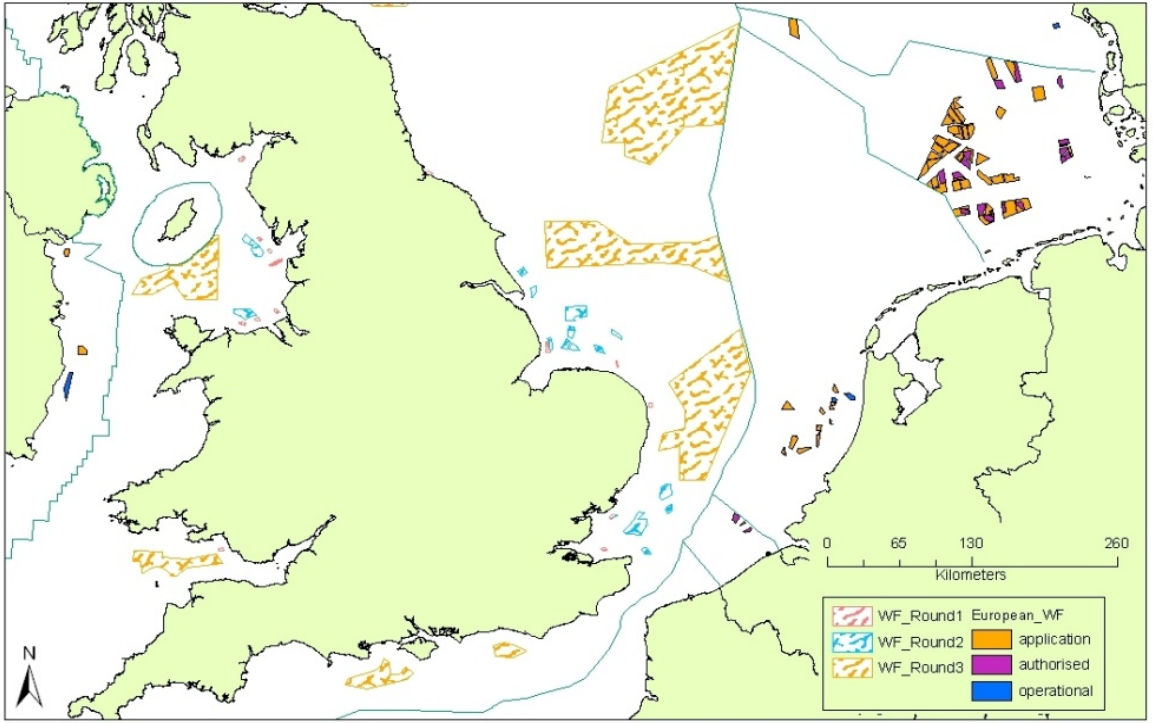
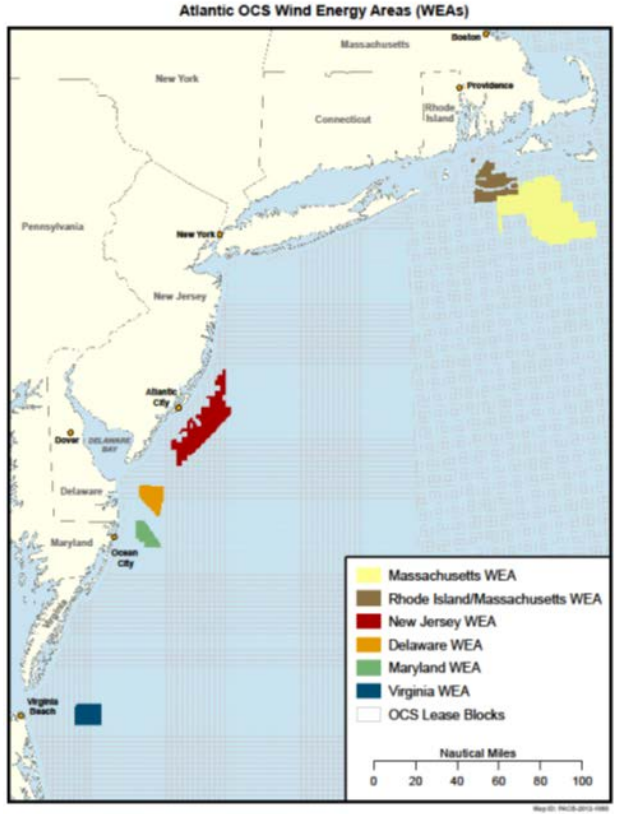
## Wind farm locations around the UK and neighbouring areas.

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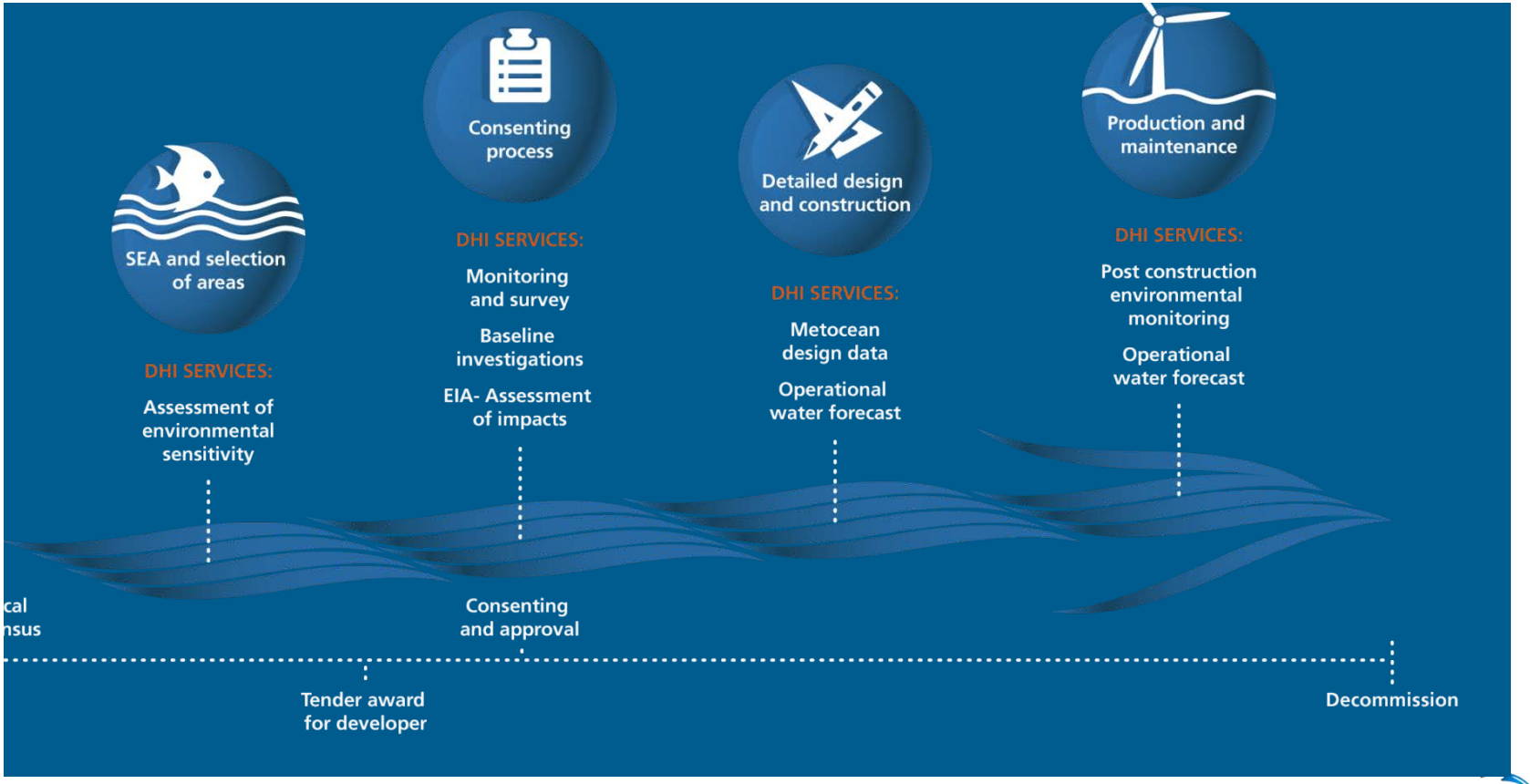
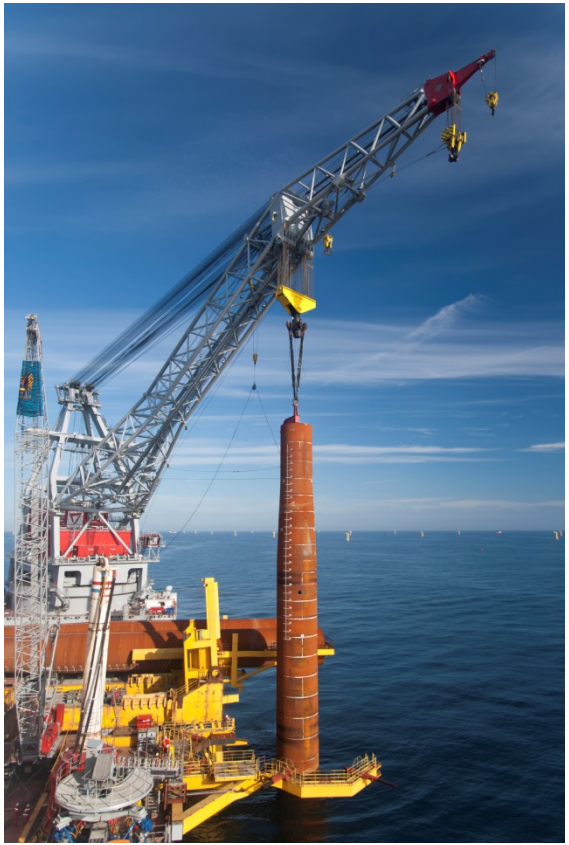
# Planning process: example wind farms

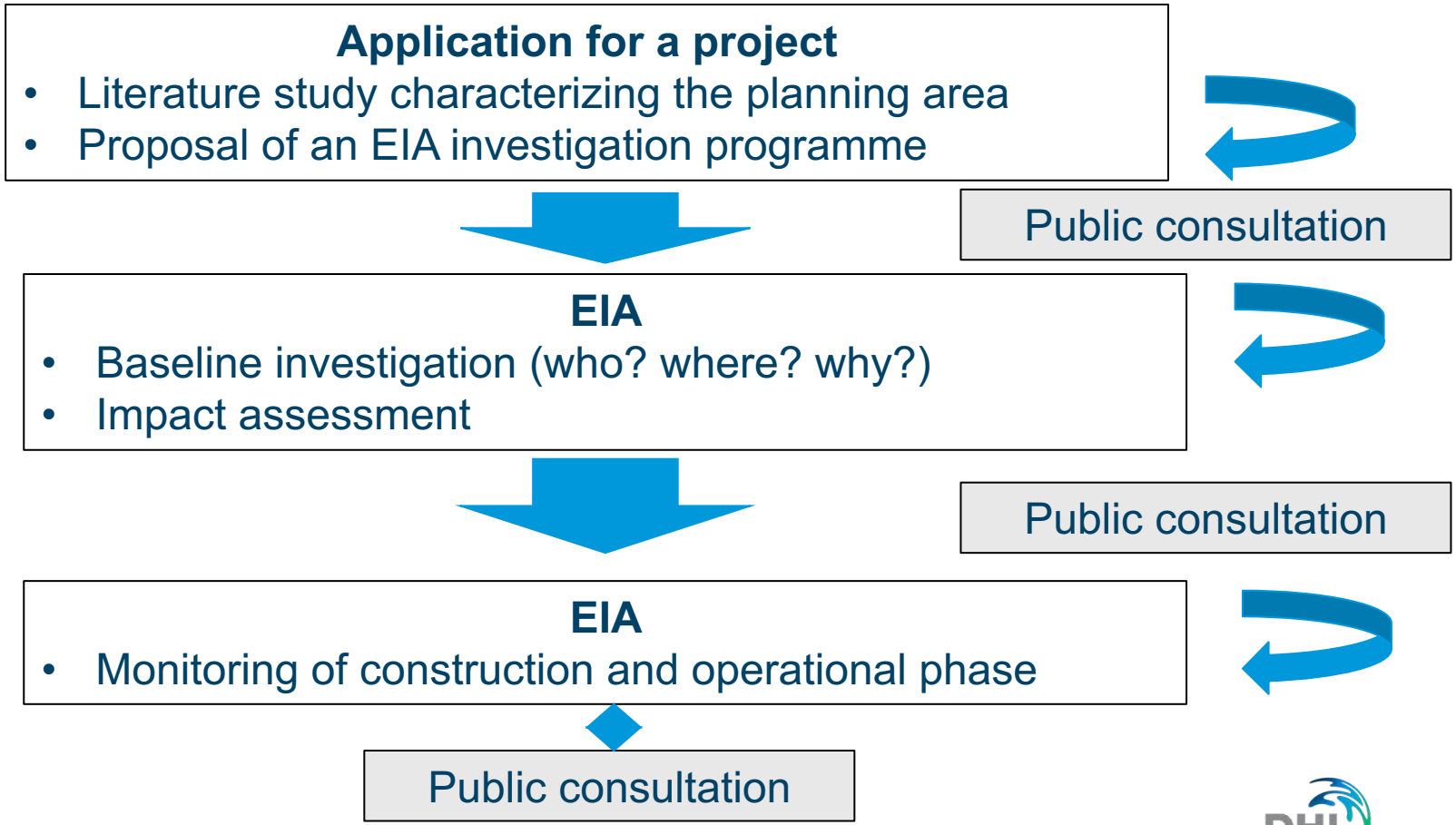


# Environmental impact assessment (EIAs)



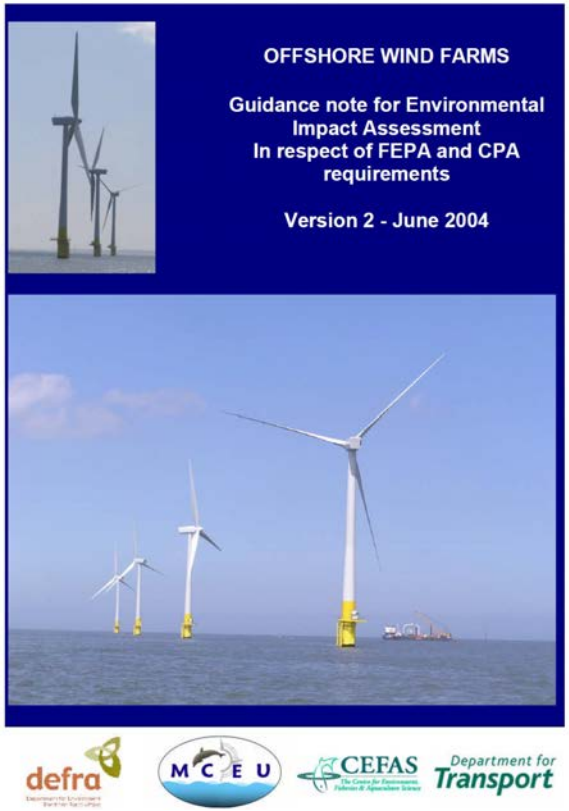
- Required by EU EIA Directive 85/337/EEC (as amended by 97/11/EC)
- Paid by developer
- Performed by independent research institutions
- Consent managed by authorities

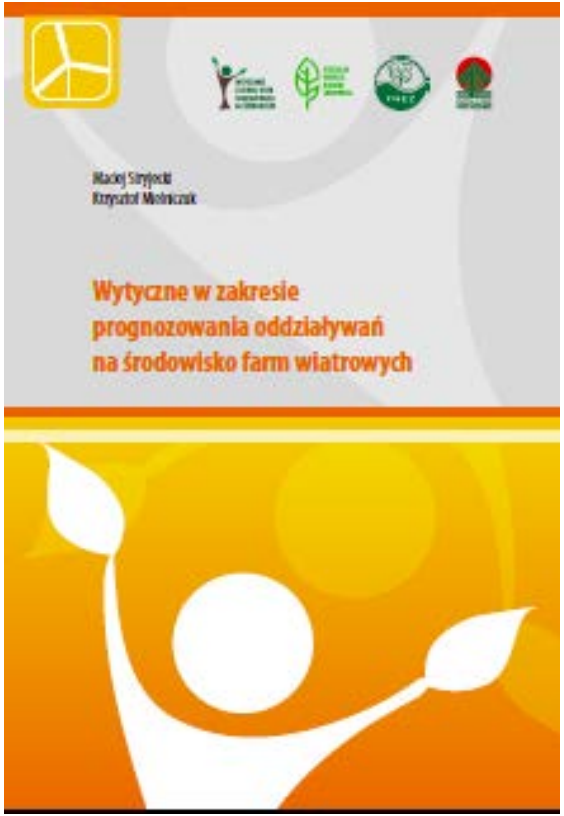
# The EIA process



| | | | | |
|---|---|---|---|---|
| Bottom topography and sediments | Hydrography (waves and currents) | Geo morphology | Coastal morphology | Water quality |
| Marine vegetation | Sea bed fauna | Benthic habitat | Fish | Birds |
| Marine Mammals | Landscape | Marine raw materials | Marine archeology | Recreation |
| Protected areas | Navigation and ship traffic | Air traffic | Commercial fisheries | Other |

# Guidelines and Standards



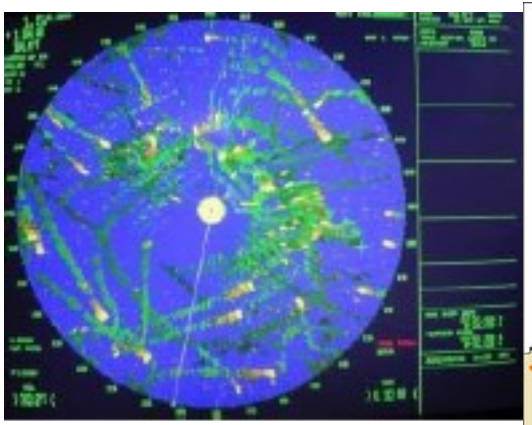



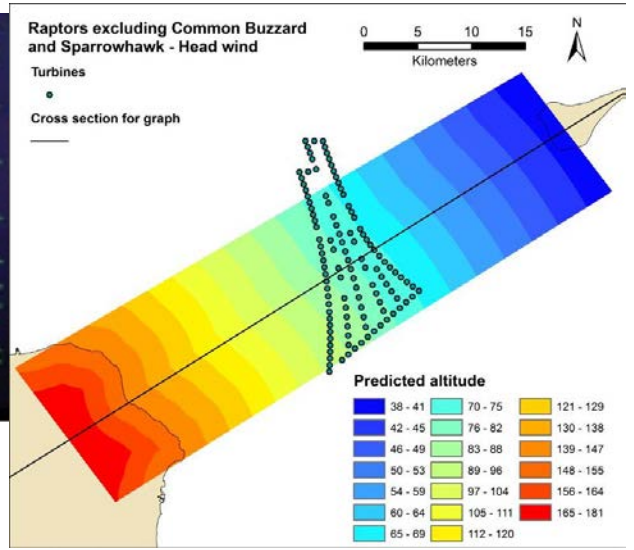
# Seabirds at Sea Methodology

- Aerial and shipboard surveys
- Distance sampling
- Estimate number of affected birds
- Collision risk modelling of resident seabirds

# Migrating Seabirds Methodology

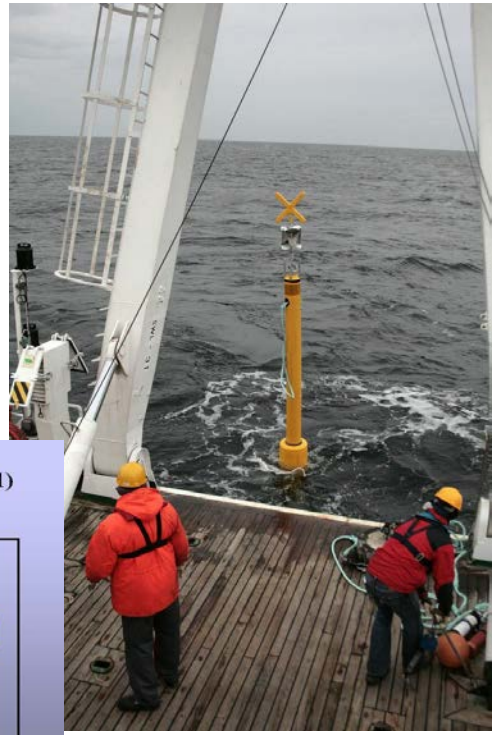
- Radar investigations
- Visual observations
- Acoustic observations
- Collision risk assessment

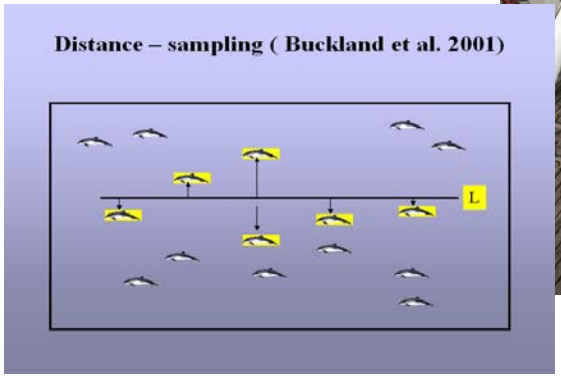




# Marine mammal methodology

- Visual surveys
- Passive acoustic monitoring
- Ambient noise monitoring
- Effects of noise assessments





# Typical results: Seabirds at Sea

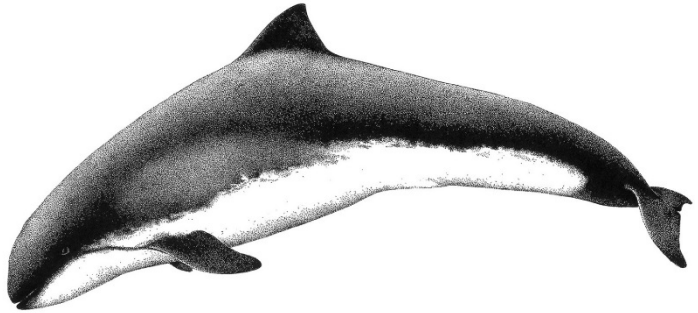
- Displacement of some species from the wind farm areas and 2 km around (e.g. divers, auks and seaducks)
- Some species are attracted (e.g. cormorants and gulls)
- Collision risk estimates are varied

# Typical results: Migrating birds

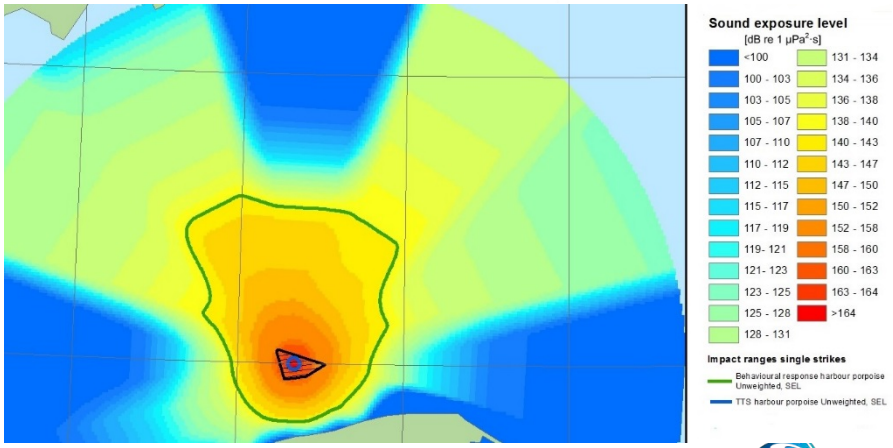
- Majority of waterbirds fly below rotor height
- Majority of landbirds migrate above rotor height and at night
- Large soaring birds are most vulnerable (raptors, cranes)
- Many unknowns (e.g. avoidance rates)
- Collisions are weather dependent

# Typical results: Marine mammals

- Construction sound can be harmful to marine mammals (TTS, PTS)
- Large scale but temporal avoidance during construction (impact piling)
- Positive, negative and zero effects documented during operation



**Check out MaRVEN project for more details!!!!**

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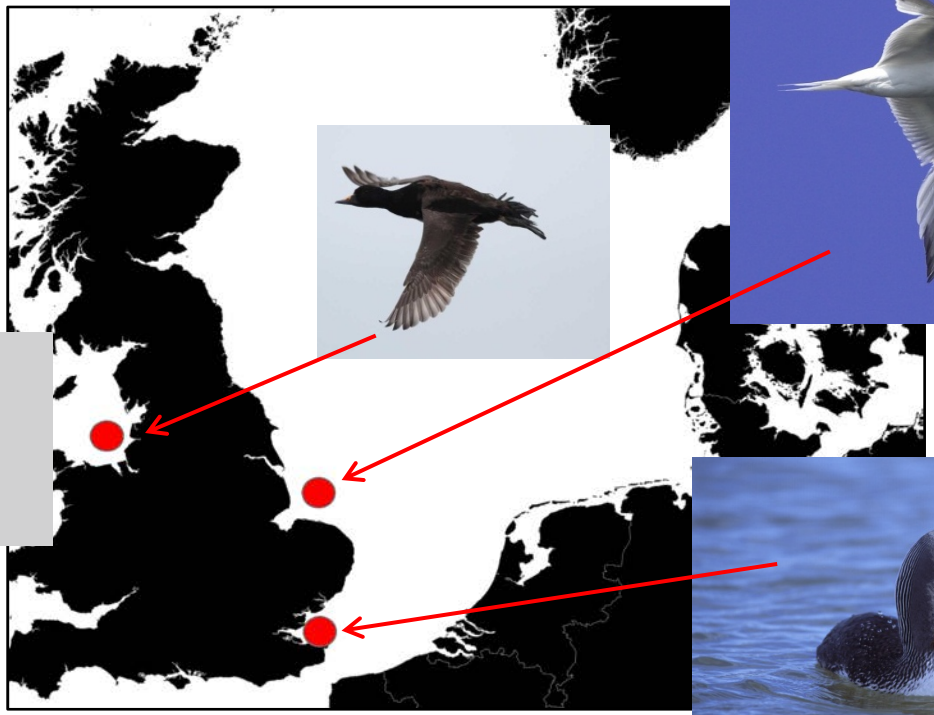
# Problem Issues

- Lack of good baseline data
- No holistic view, i.e. why are the animals there in the first place?
- Assessment based on static animal models

# Consequences: stop of projects

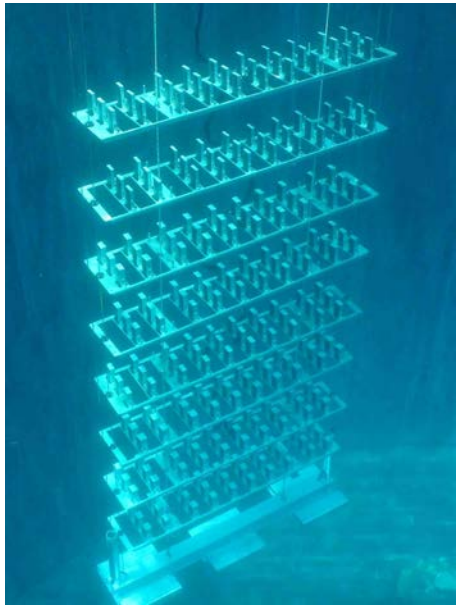


Docking Shoal:
Sandwich Tern

Shell Flats:
Common
Scoter

London Array
(Phase 2):
Red-throated Dive

# Consequences: Increase in costs



Helmholtz Resonator
(Wochner *et al.* 2015)

Hydro-sound dampers
(Elmer *et al.* 2015)

IHC NMS
(Schiedek *et al.* 2015)

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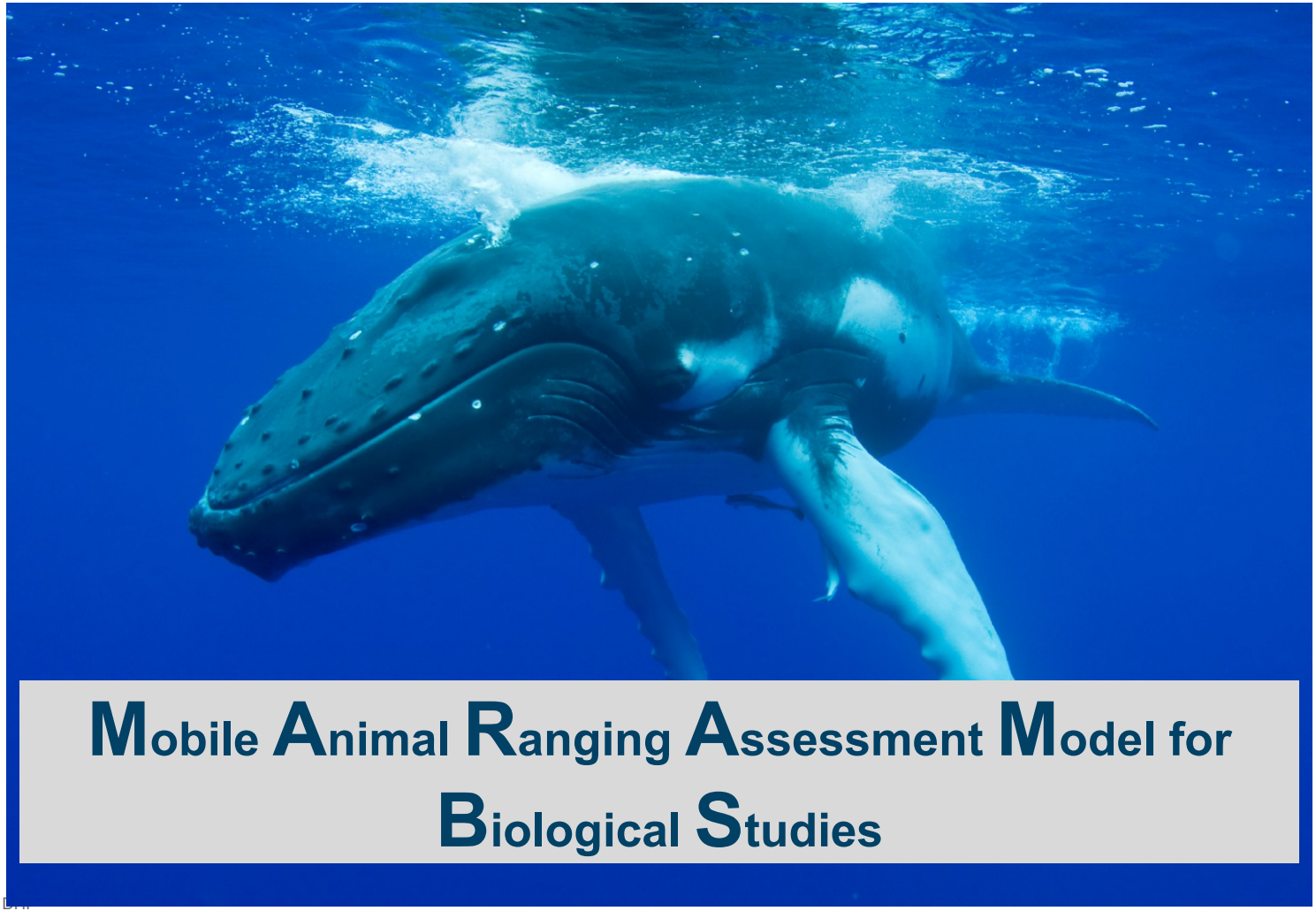

# Mobile Animal Ranging Assessment Model for Biological Studies

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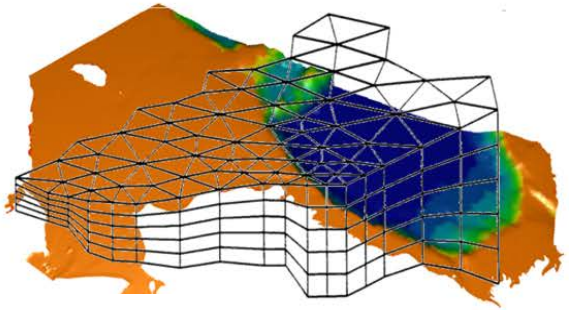
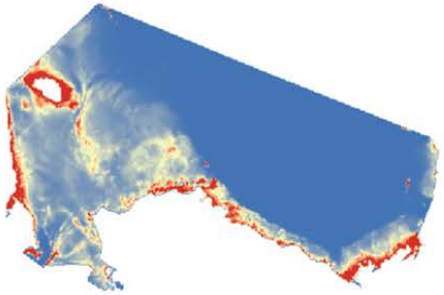
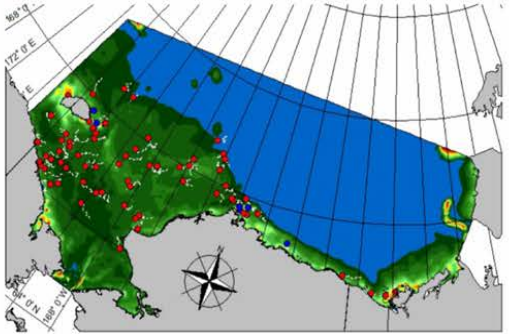
Hydrodynamic model



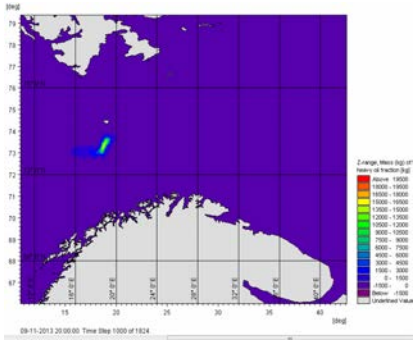
Statistical Habitat Model



Agent-based Model

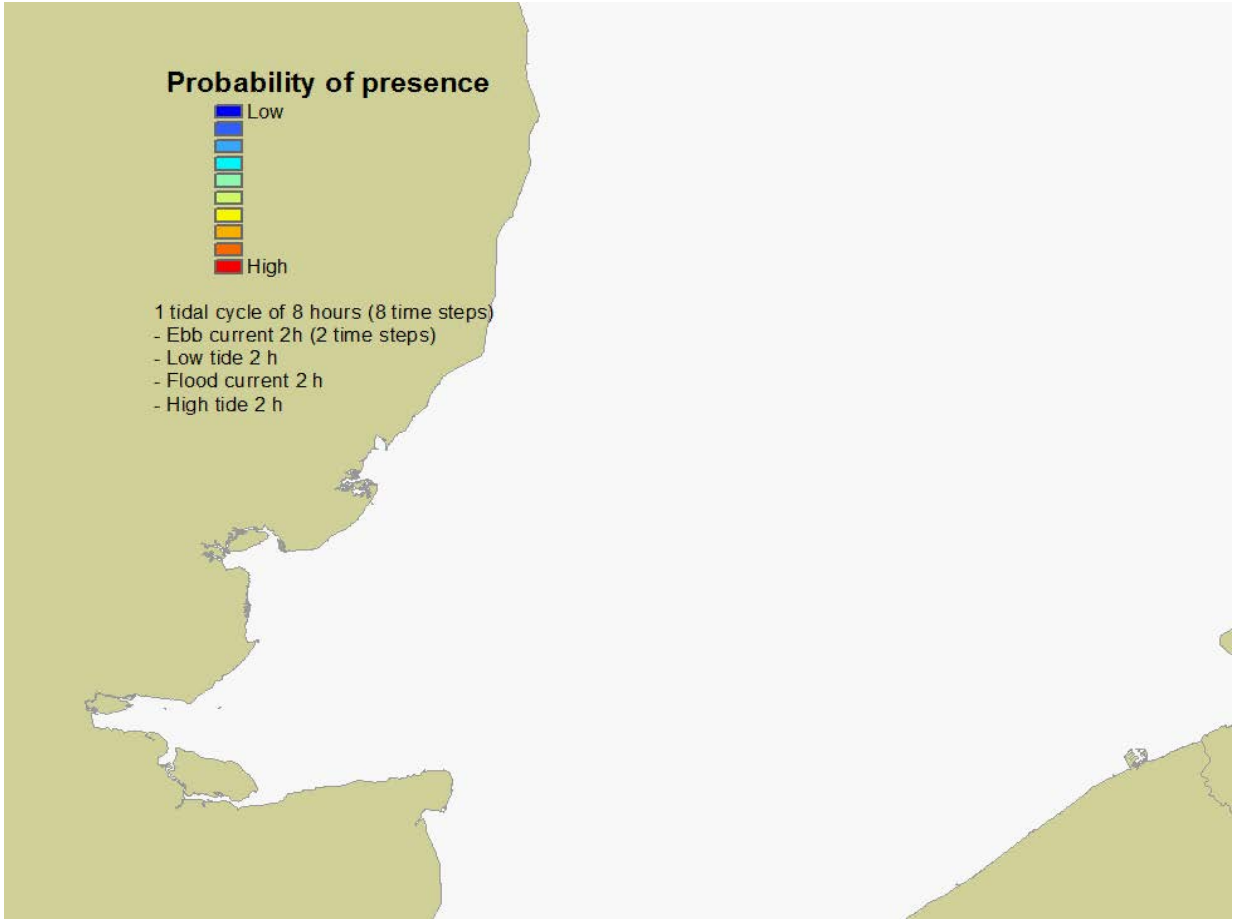


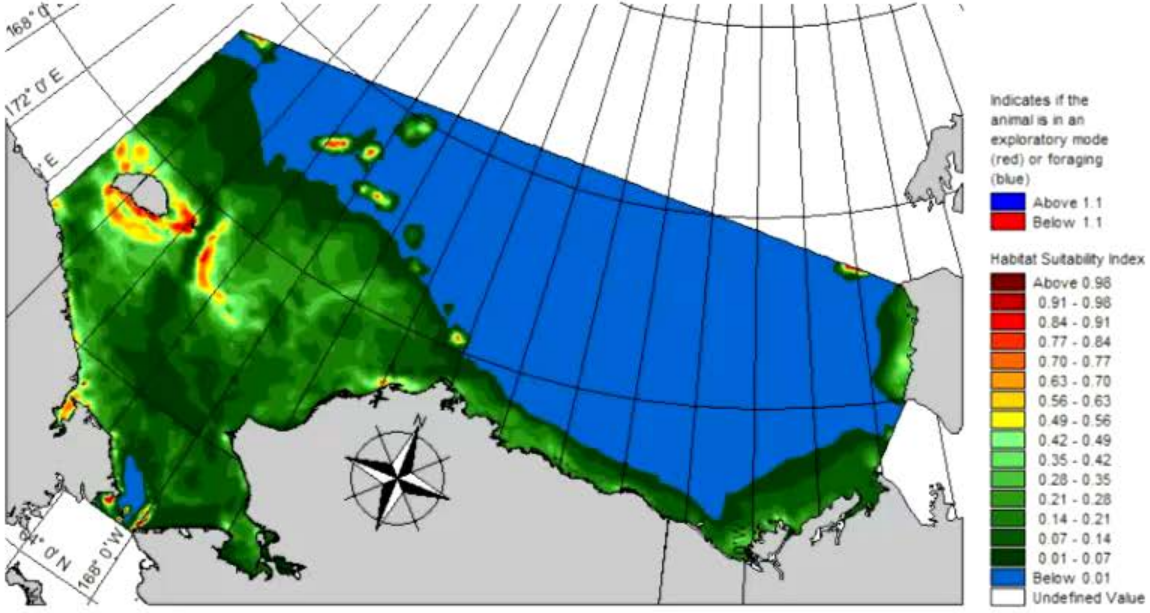
Pressure modelling

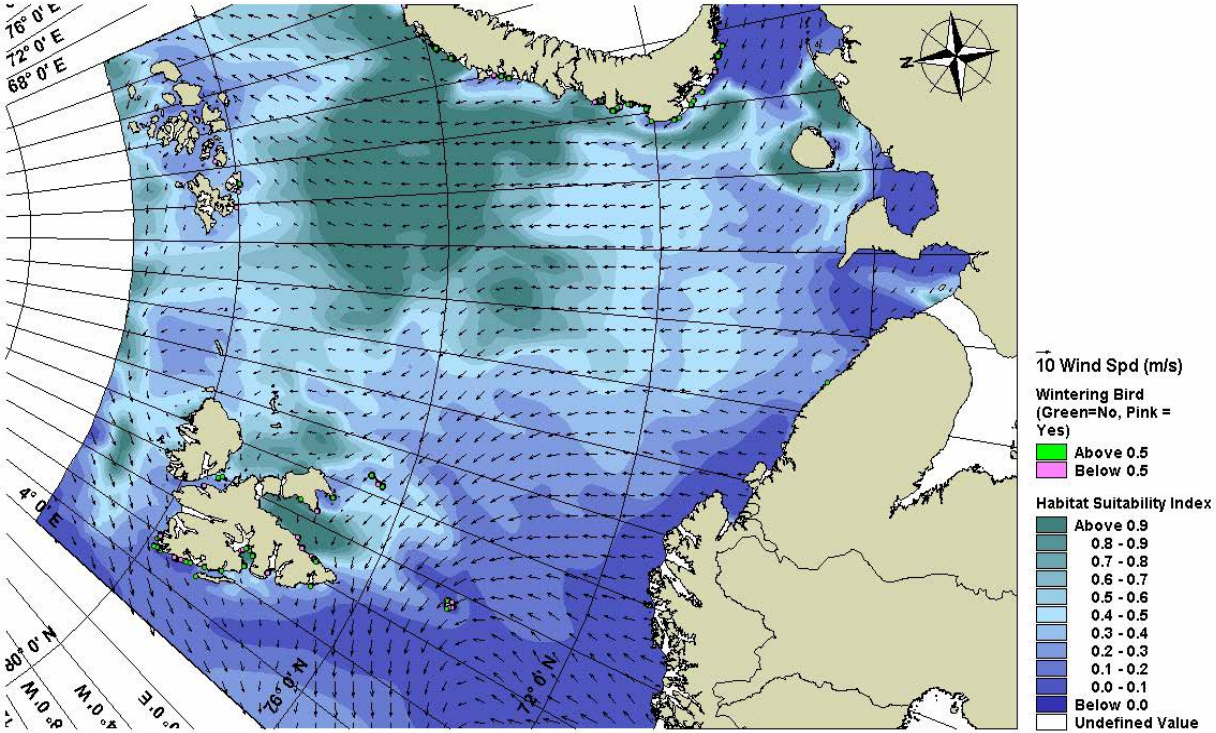


MIKE
Powered by DHI

DHI


Probability of presence
Low
High
1 tidal cycle of 8 hours (8 time steps)
- Ebb current 2h (2 time steps)
- Low tide 2 h
- Flood current 2 h
- High tide 2 h


168° 0' E
172° 0' E
64° 0' N
168° 0' W
Indicates if the animal is in an exploratory mode (red) or foraging (blue)
Above 1.1
Below 1.1
Habitat Suitability Index
Above 0.98
0.91 - 0.98
0.84 - 0.91
0.77 - 0.84
0.70 - 0.77
0.63 - 0.70
0.56 - 0.63
0.49 - 0.56
0.42 - 0.49
0.35 - 0.42
0.28 - 0.35
0.21 - 0.28
0.14 - 0.21
0.07 - 0.14
0.01 - 0.07
Below 0.01
Undefined Value




01/08/2013 1:00:00 Time Step 1 of 3672.

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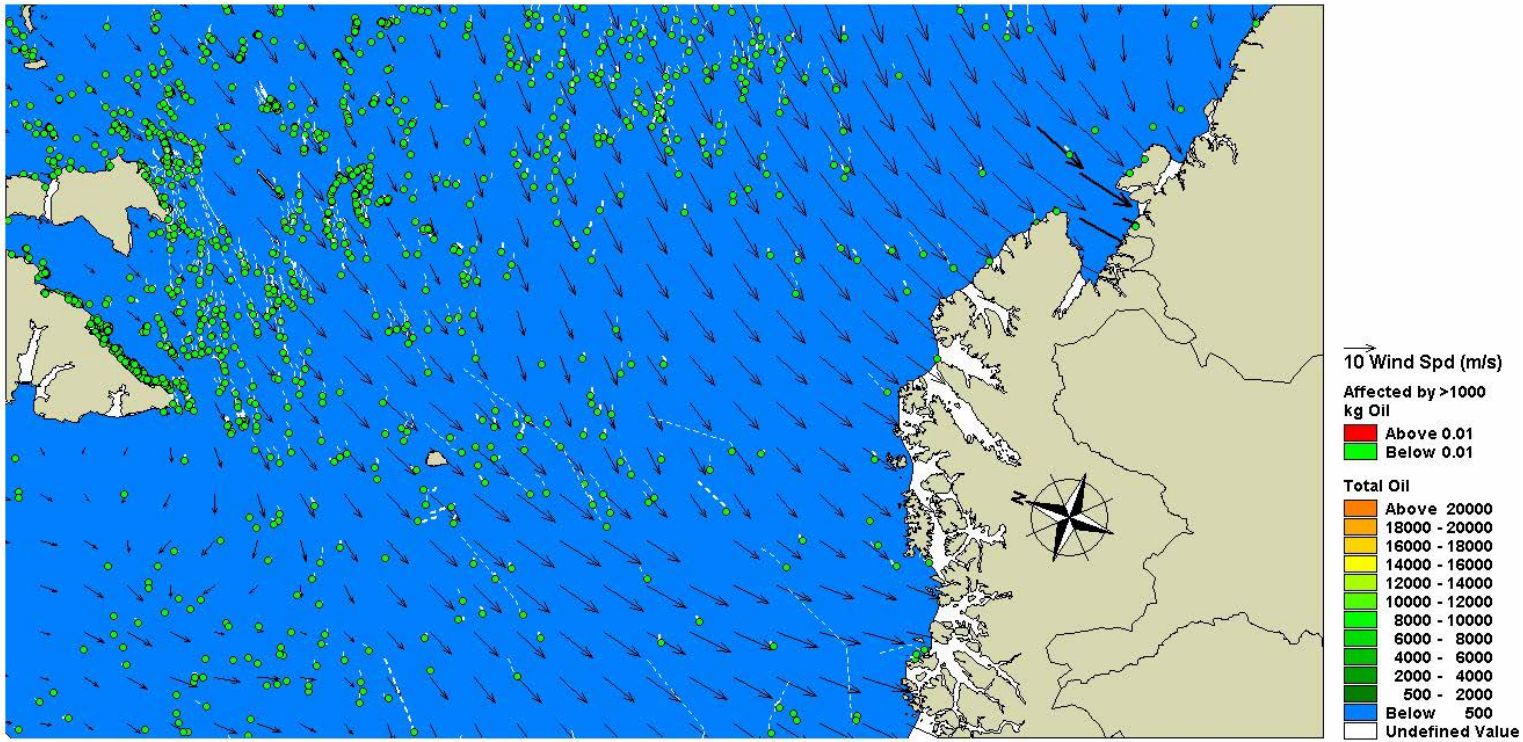


19/10/2013 23:00:00 Time Step 1919 of 3672.

# MUSE

# Take home

- Europe has developed some comprehensive standards for Offshore Wind Farm EIAs
- Lack of baseline data, better assessment tools and ignoring a holistic view can lead to risks to projects
- These risks can be reduced significantly using ecosystem modelling and cutting edge monitoring