



Learning from the Experts Webinar Series

Movement Models & Offshore Wind



Henrik Skov
Senior Project Manager
DHI

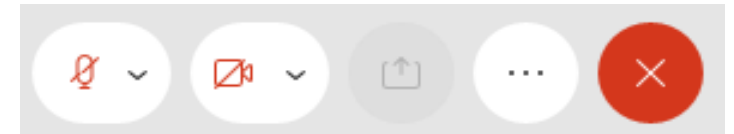
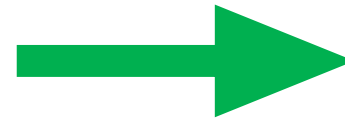
November 9, 2022


Meeting Procedures

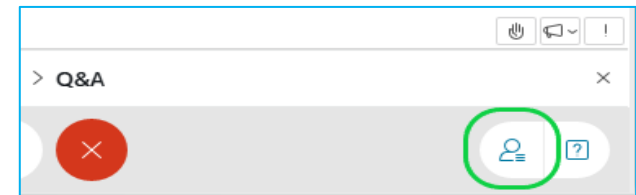
Webinar recordings and presentations will be available at:
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Participation for Members of the Public:

- > Members of the public will be muted upon entry.
- > Questions and comments may be submitted in writing through the Q&A feature at any time during the event.
- > If technical problems arise, please contact John.Necroto@nyserda.ny.gov



You'll see  when your microphone is muted



Learning from the Experts

This webinar series is hosted by NYSERDA's offshore wind team and features experts in offshore wind technologies, development practices, and related research.

DISCLAIMER:

The views and opinions expressed in this presentation are those of the presenter and do not represent the views or opinions of NYSERDA or New York State.

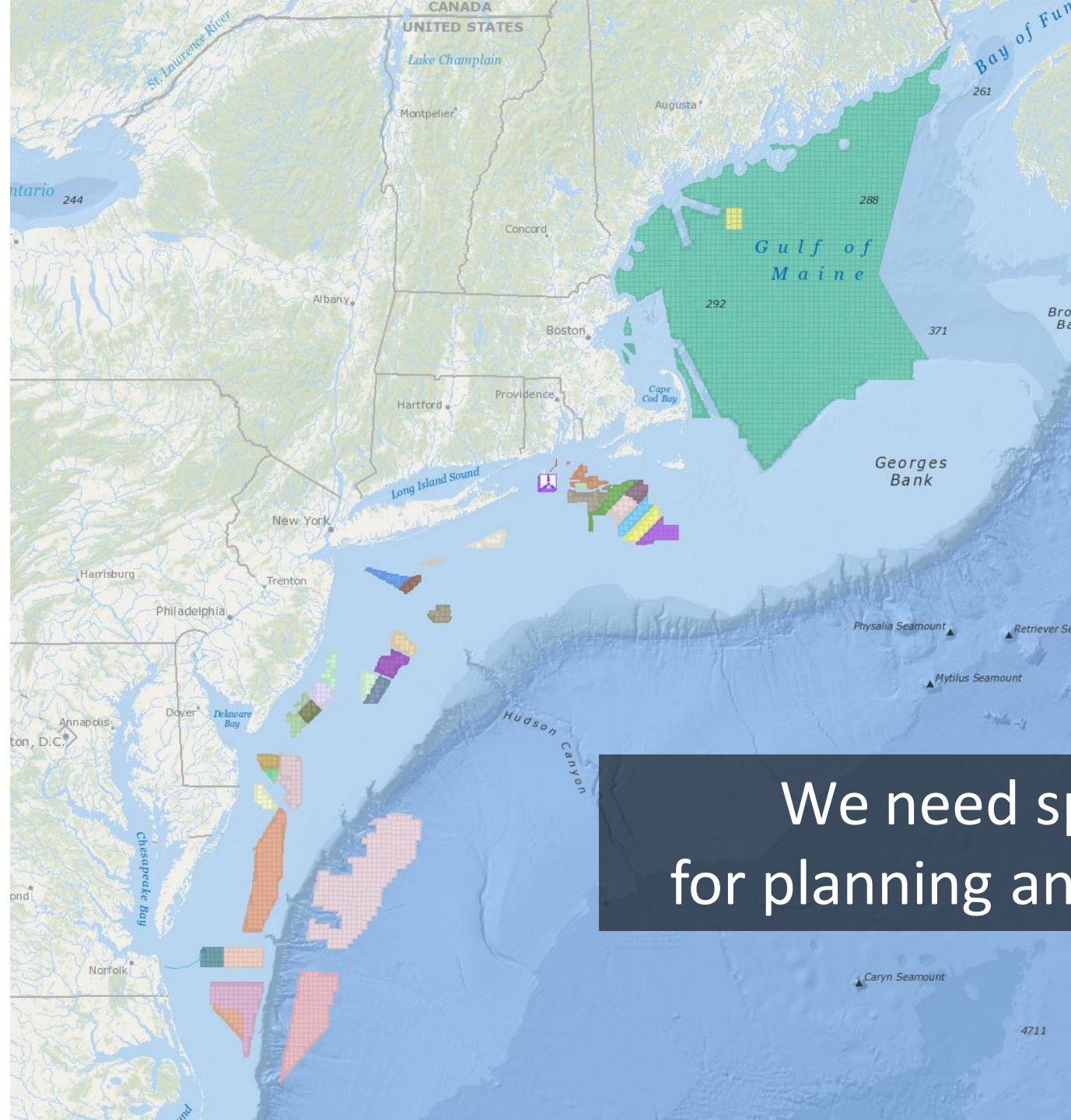


A photograph of an offshore wind farm with several turbines visible in the background. In the foreground, the ocean is turbulent with white-capped waves. Several birds, likely seabirds, are captured in flight against the sky. The overall scene is a mix of natural and industrial elements.

Movement models and offshore wind

Henrik Skov, DHI

hsk@dhigroup.com



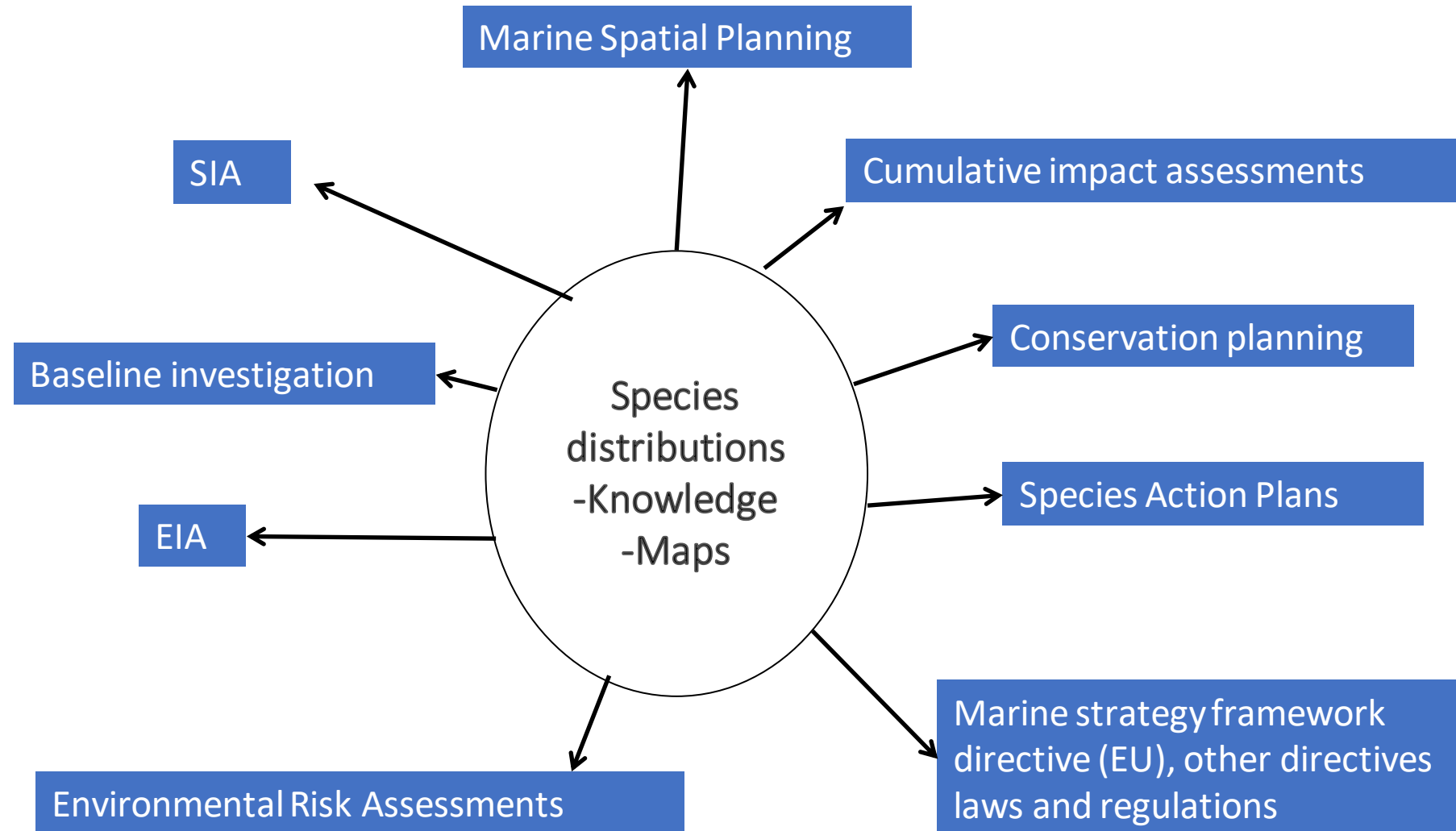
We need spatial tools
for planning and assessments

Ecosystem-based approach

Cross-sectorial management of human activities based on the best available information on the aquatic ecosystem and its dynamics



Information needs

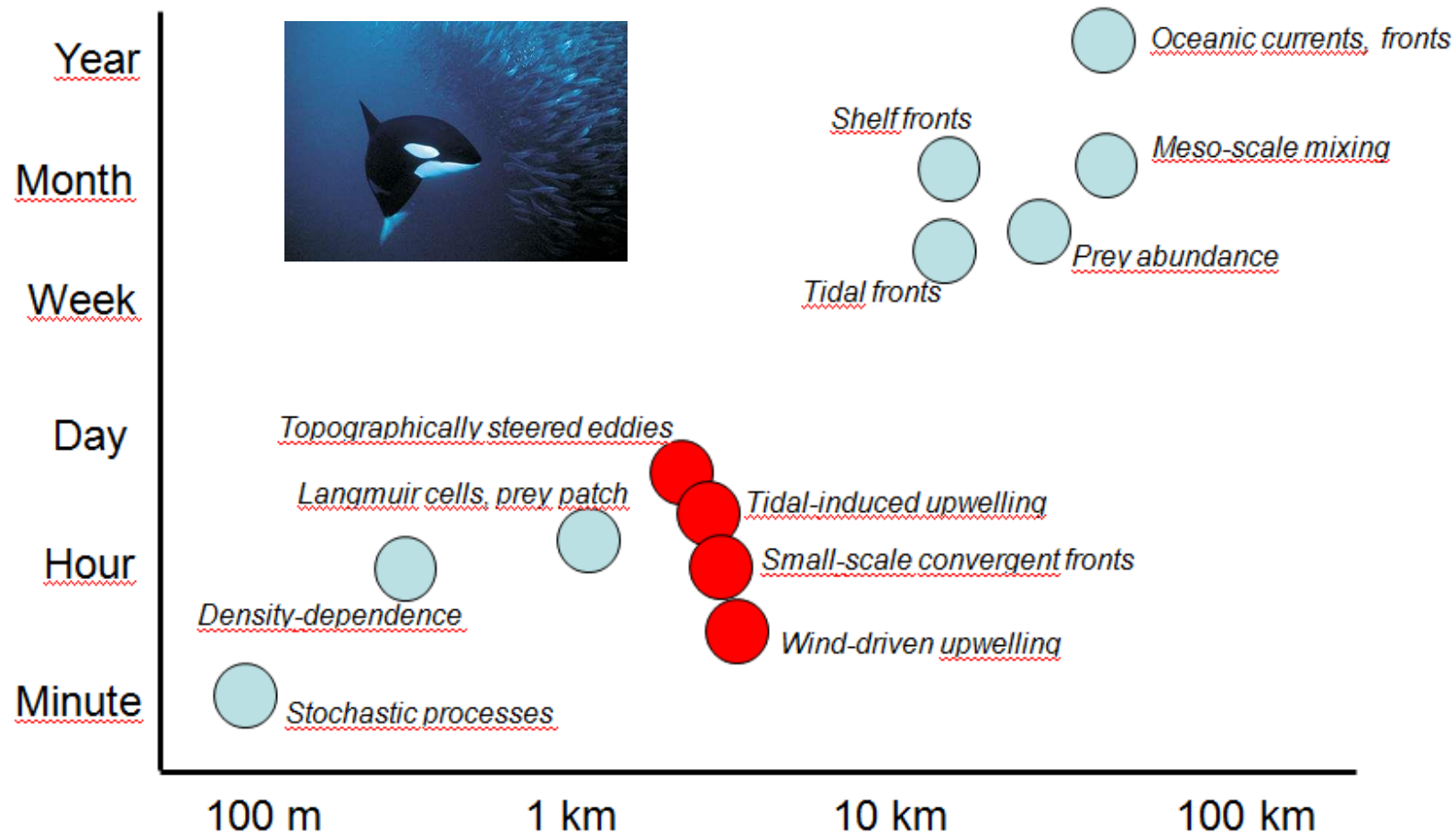




Existing spatial models based on assessments
on land

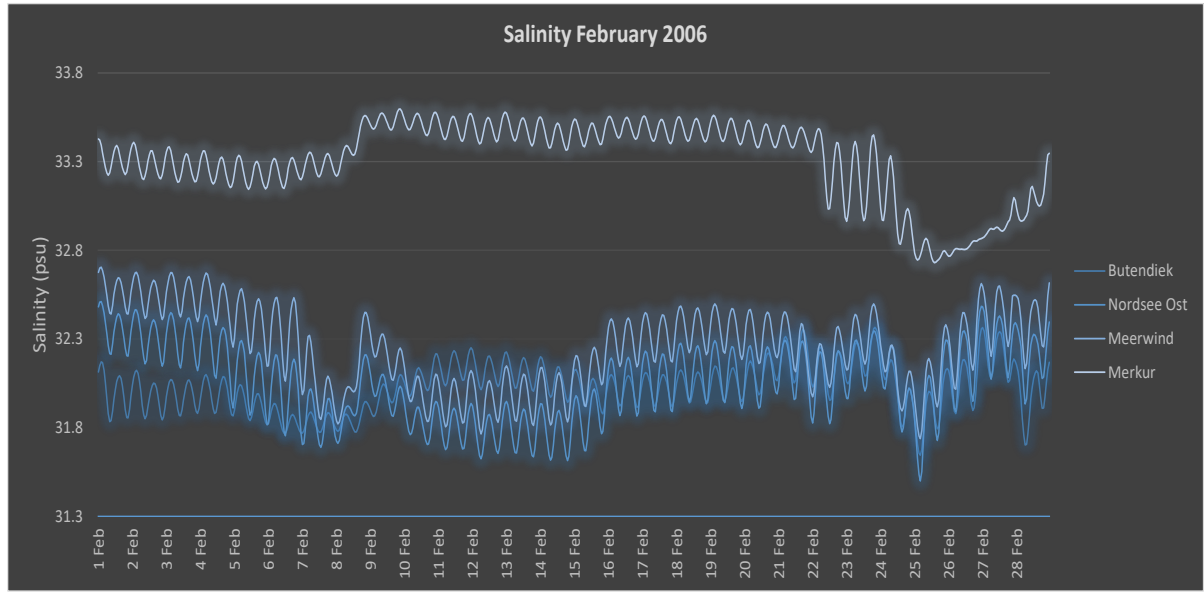
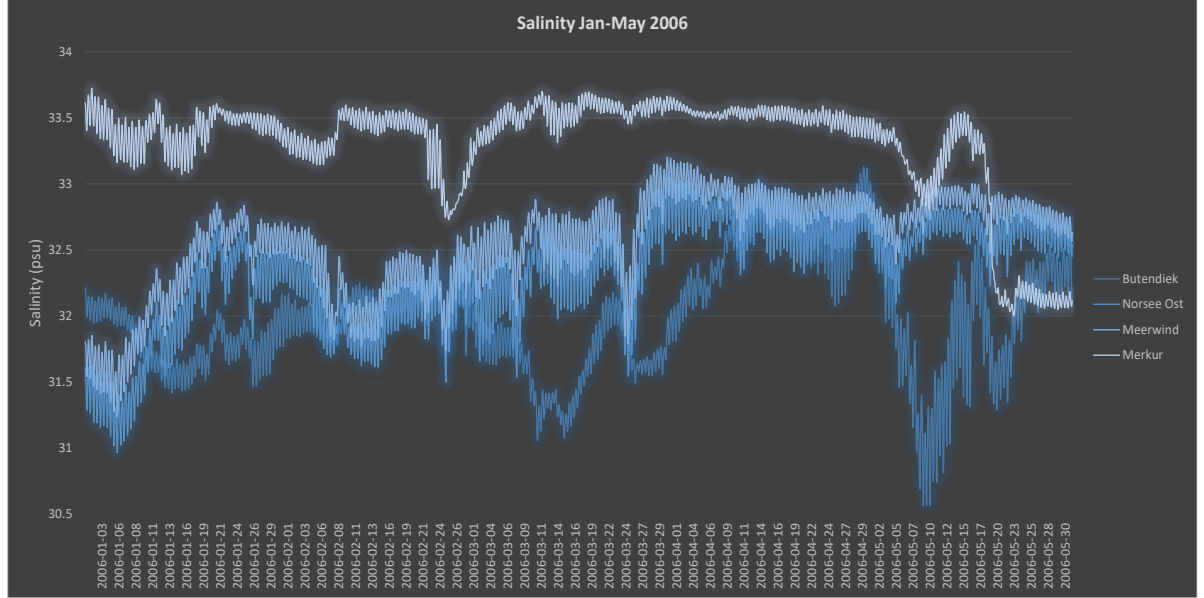
Oceanographic process knowledge is not fully integrated into marine spatial modelling practices

Spatial modelling at offshore wind farms



Important spatial scales for concentration of marine predators

Downscaling increases oceanographic variability



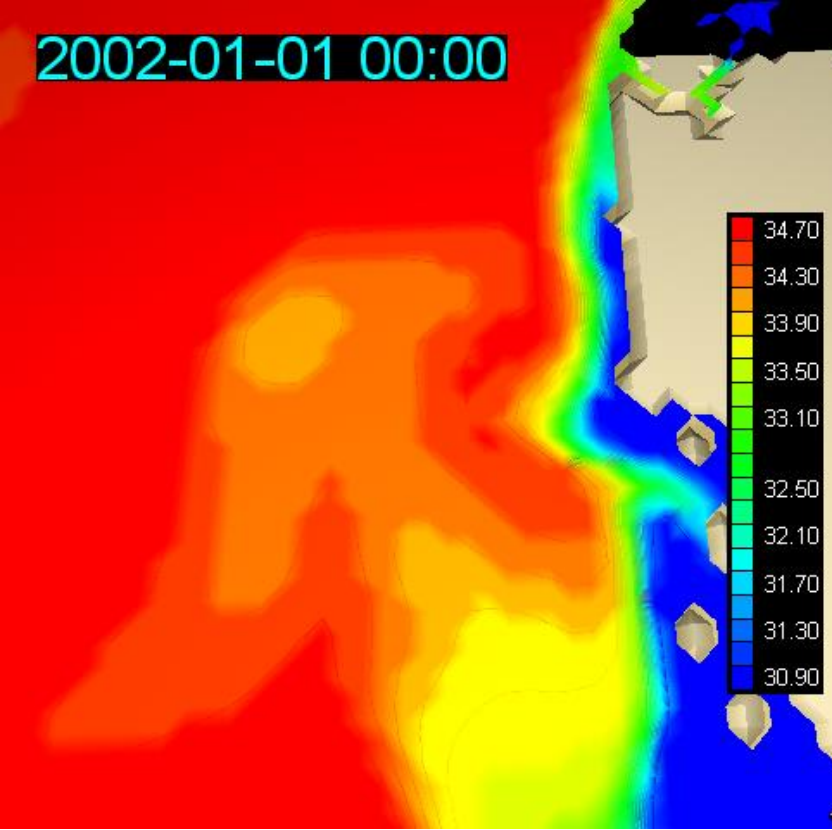
Source: DHI data –
Salinity German Bight

Downscaling increases oceanographic variability

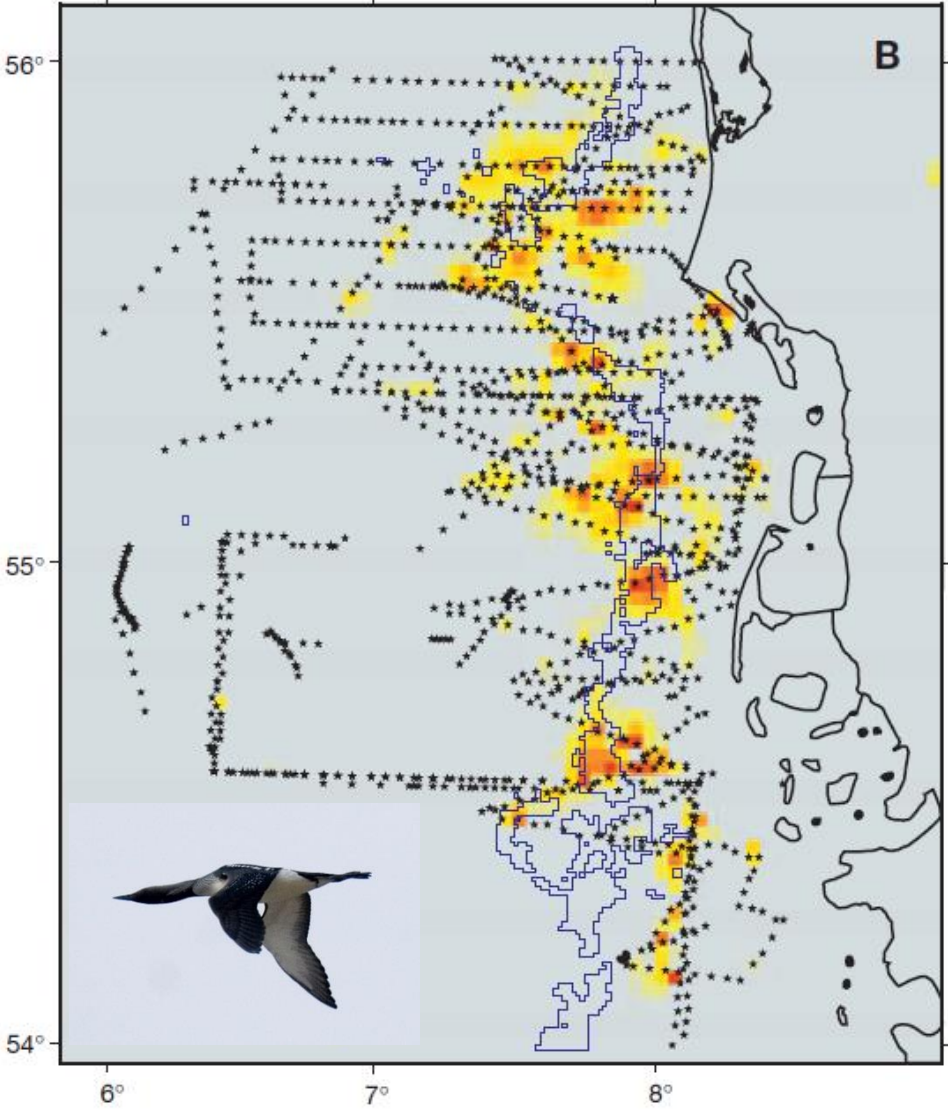


Red-throated diver winter

Surface salinity January 2002



Source:
Skov & Prins 2001. MEPS 2014





THE SOLUTION: INTEGRATED MODELLING OF MOVEMENTS

- **Hydrodynamic modelling**
- **Dynamic habitat modelling**
- **Agent-based modelling**

Modelling overview – Example from NYSerda project 2021-22

TASK 1 Project Inception

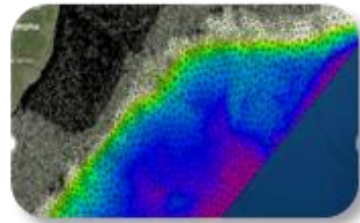
TASK 2

Data Collation
& Processing



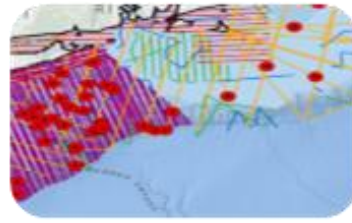
TASK 3

Hydrodynamic
Modeling



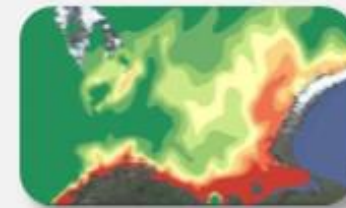
TASK 4

Analysis of Data
Coverage

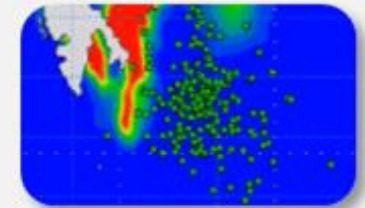


TASK 5: Ecological Modeling

(a) Dynamic Habitat
Modeling

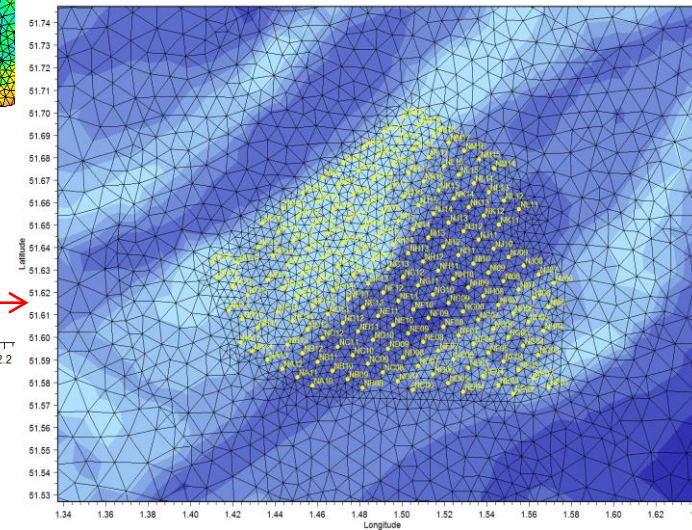
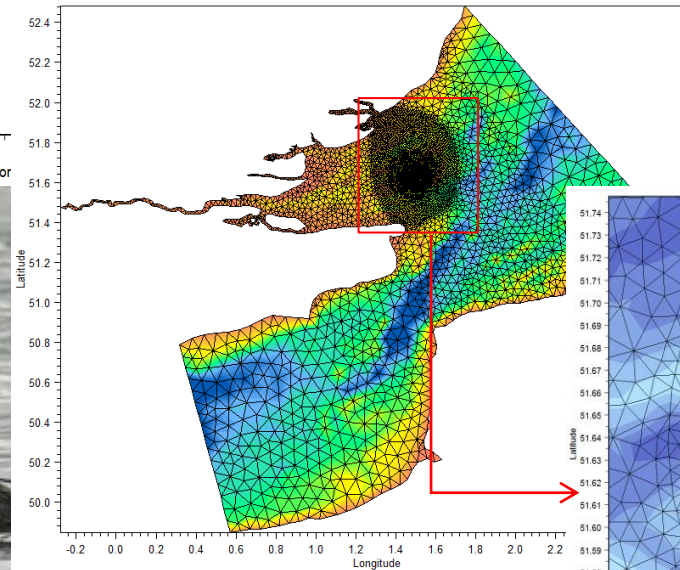
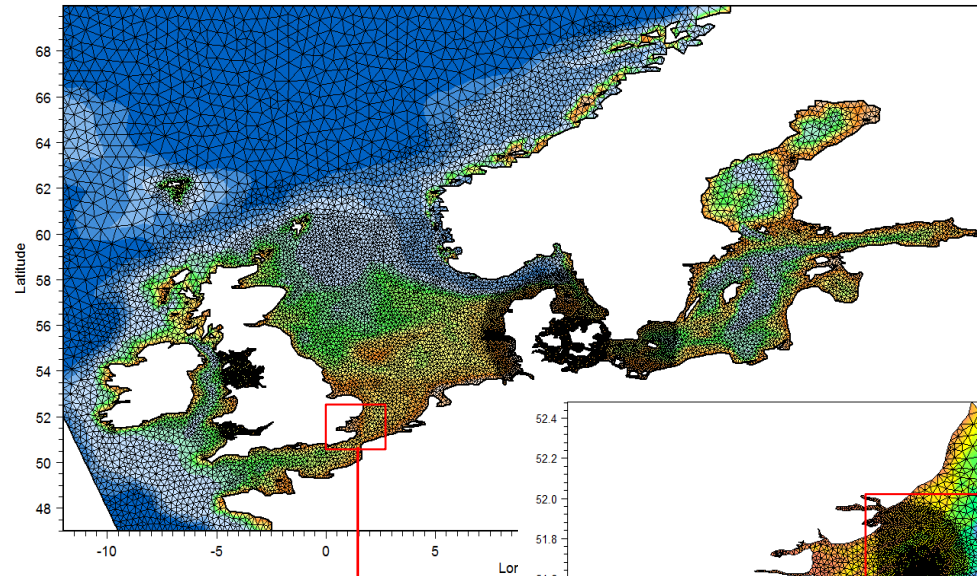


(b) Agent Based
Modeling



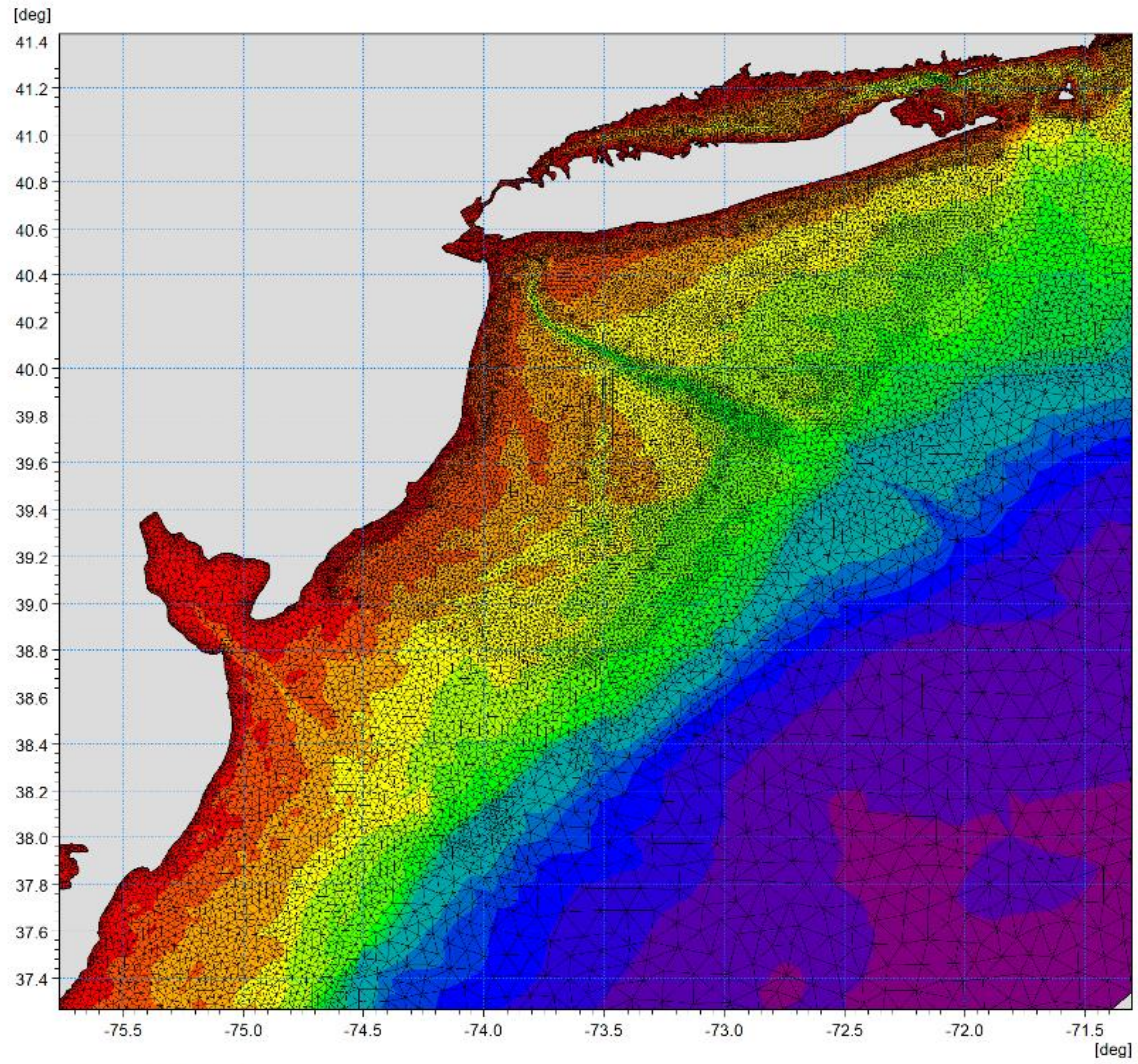
*Executed with input from HDM results data and, selectively, with other datasets to allow for a comparative analysis of model performance

Resolving oceanographic variability by detailed flow modelling: The Outer Thames Model



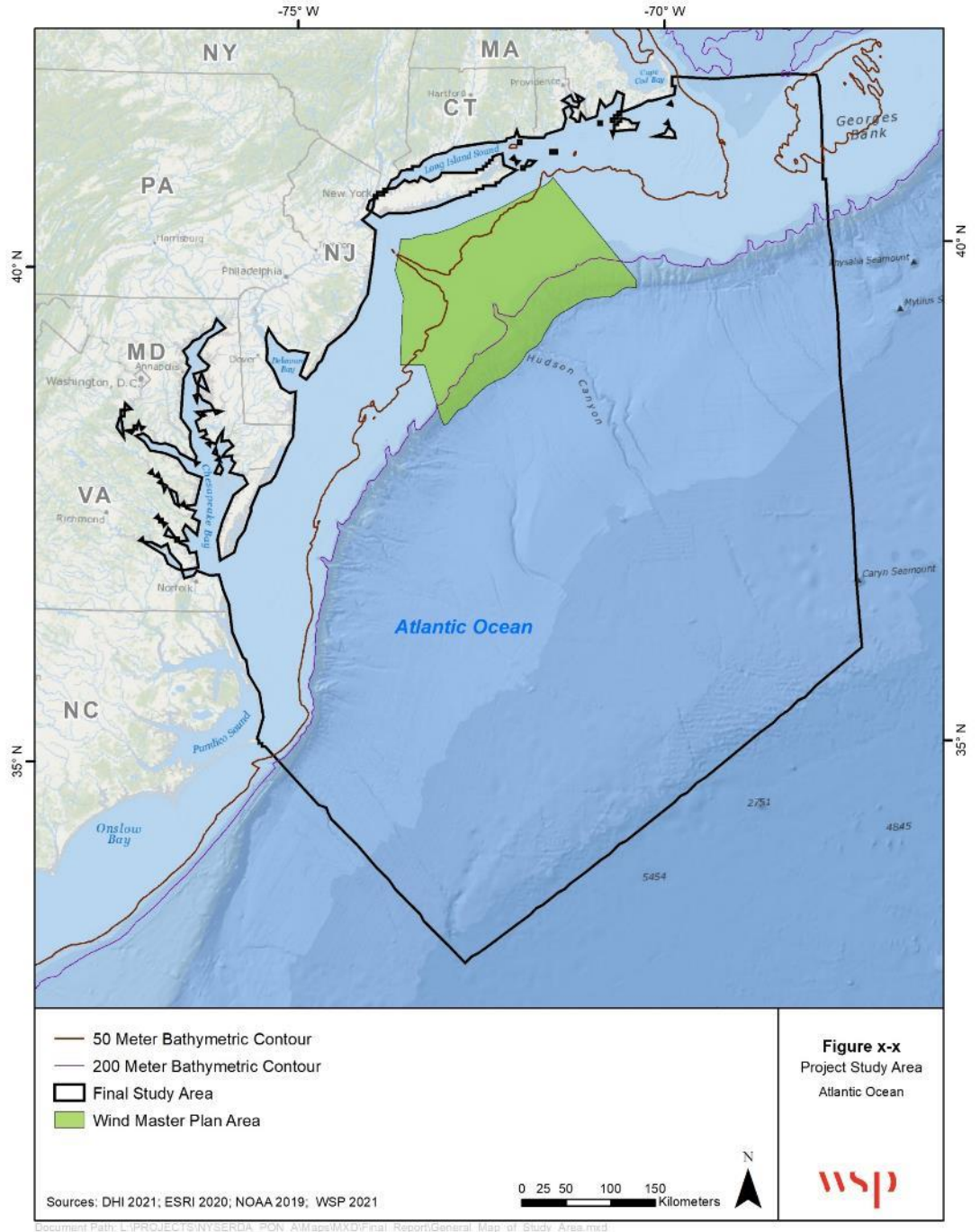
MIKE3 system for currents utilizing flexible mesh – 4 domains: 5000m, 2000m, 300m and 100m
10 sigma layers

New York Bight HD model



Bathymetry [m]

Red	Above	-15.56
Orange	-26.11	-15.56
Yellow-Orange	-36.67	-26.11
Yellow	-47.22	-36.67
Yellow-Green	-57.78	-47.22
Green	-68.33	-57.78
Light Green	-78.89	-68.33
Green	-89.44	-78.89
Teal	-100.00	-89.44
Blue-Teal	-583.33	-100.00
Blue	-1066.67	-583.33
Dark Blue	-1550.00	-1066.67
Very Dark Blue	-2033.33	-1550.00
Purple	-2516.67	-2033.33
Dark Purple	-3000.00	-2516.67
Black	Below	-3000.00
Grey	Undefined Value	



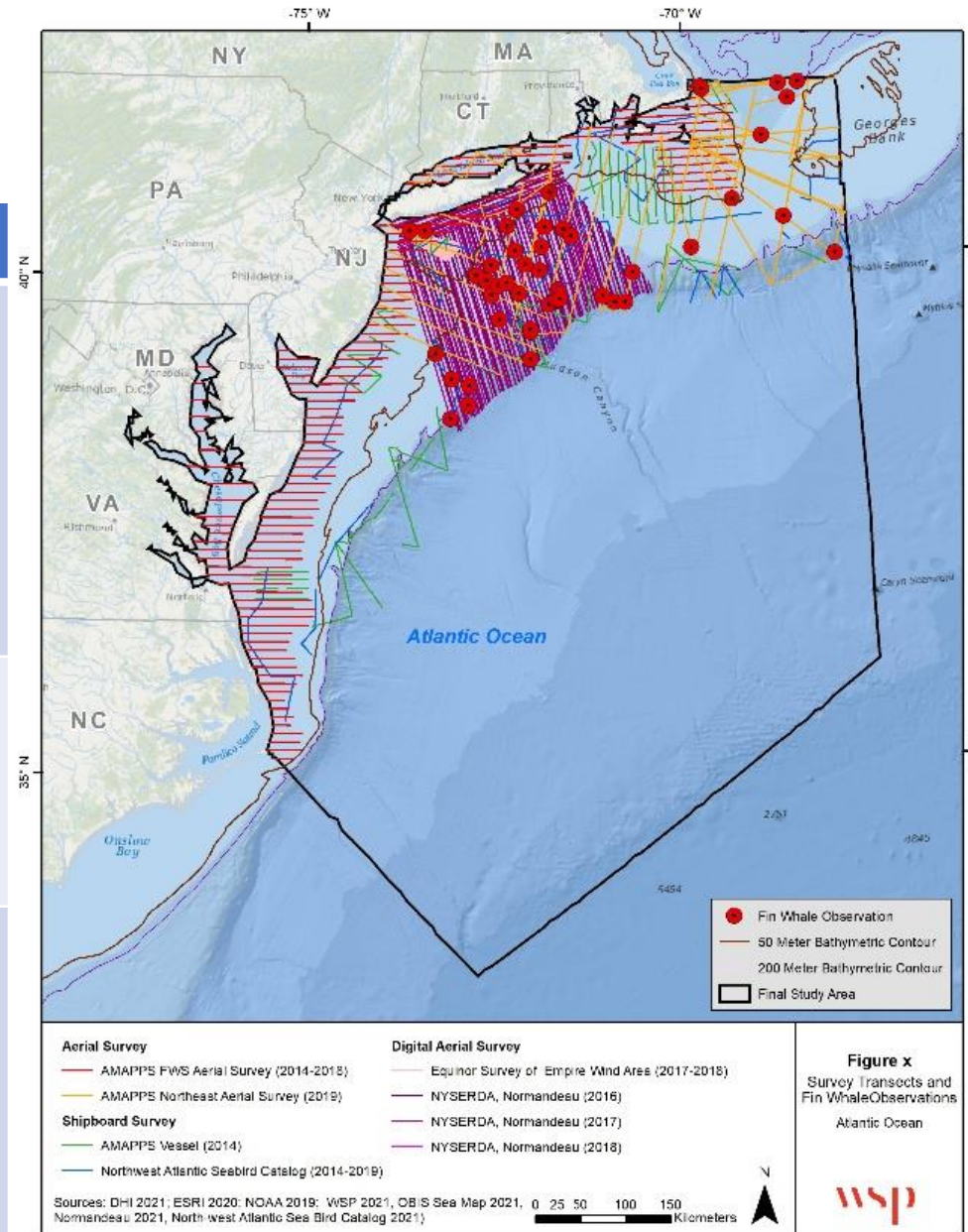
Sources: DHI 2021; ESRI 2020; NOAA 2019; WSP 2021

Figure x-x
Project Study Area
Atlantic Ocean



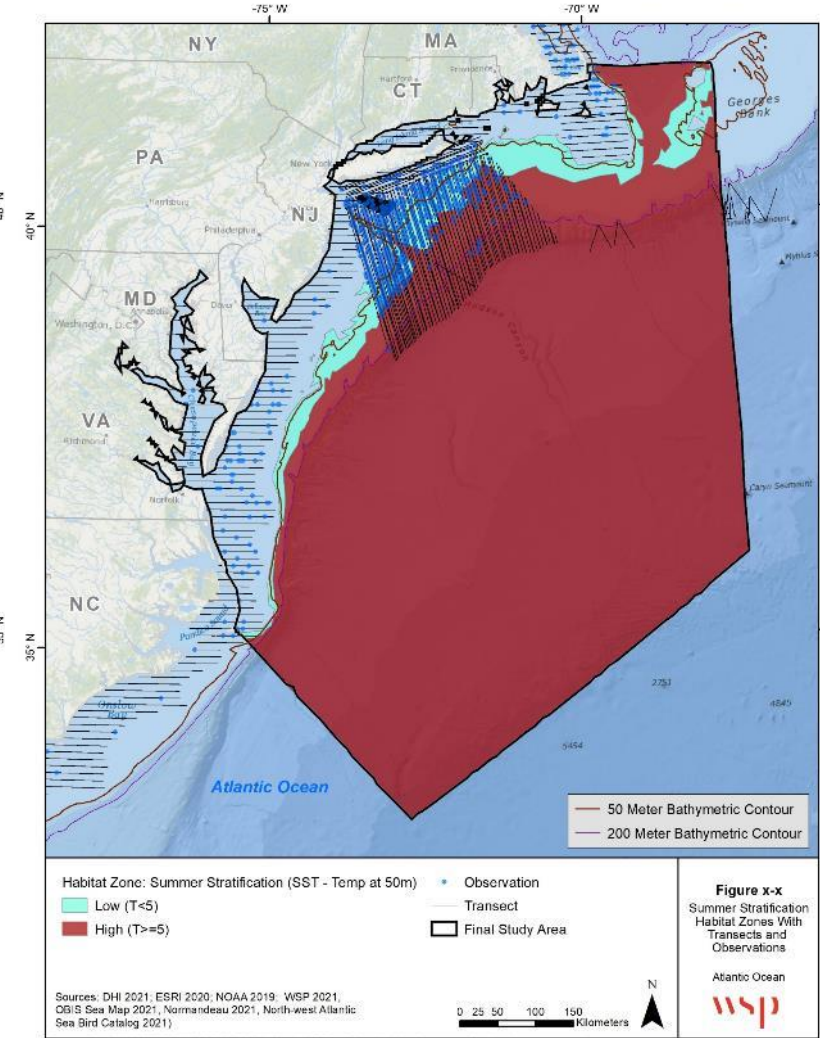
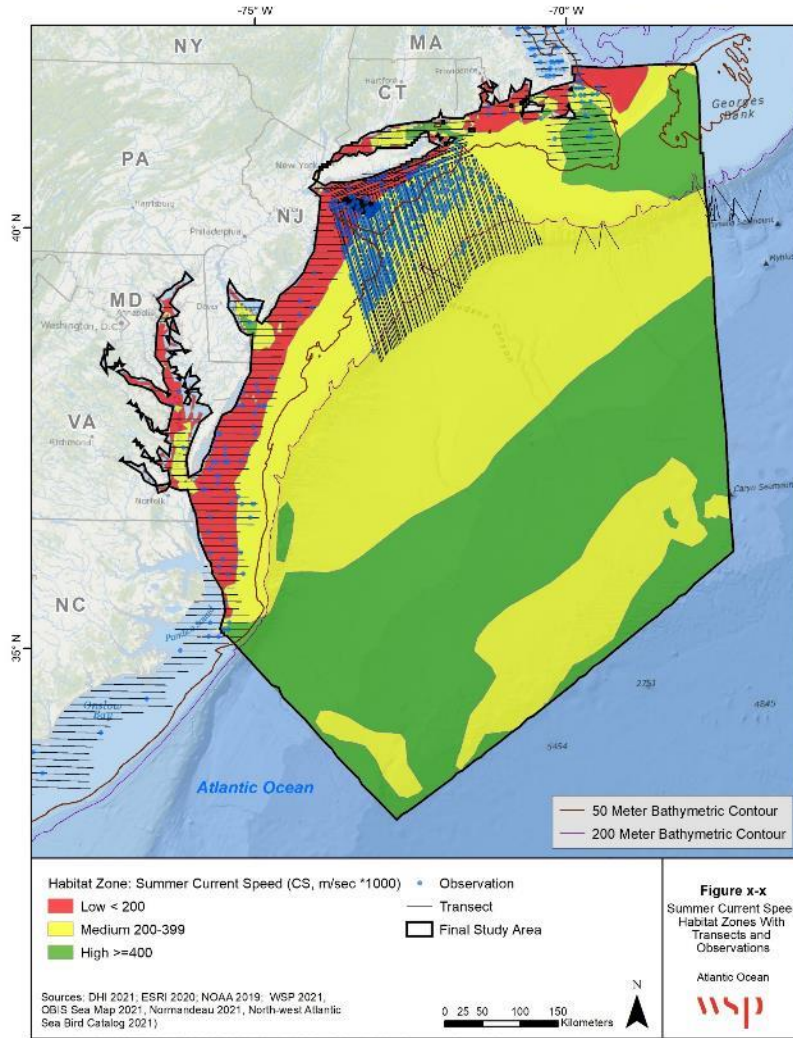
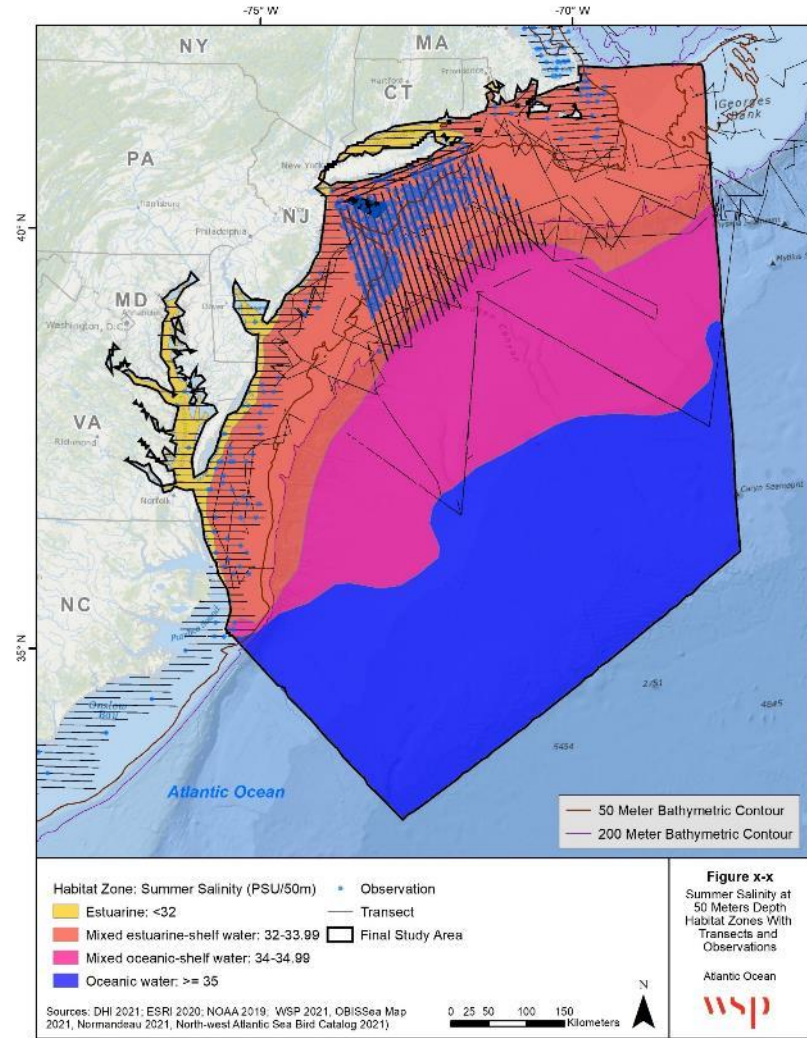
Data Collection

Model	Example Data Need
Hydrodynamic	<ul style="list-style-type: none"> Field survey, modeling, satellite data, e.g.: <ul style="list-style-type: none"> Bathymetry Met-Ocean Buoys (meteorology, current, waves) CTD casts (temperature and salinity profiles) Measured riverine discharges Measured or modelled wind direction and speed (e.g., CFSR)
Dynamic Habitat	<ul style="list-style-type: none"> Mainly abundance surveys and environmental data, e.g.: <ul style="list-style-type: none"> aerial visual, aerial optical, ship-based abundance data pertinent environmental datasets (see those under hydrodynamic modeling, chlorophyll-a, AIS data, etc.)
Agent-based	<ul style="list-style-type: none"> Literature, or telemetry/ stationary/ abundance surveys regarding: <ul style="list-style-type: none"> Habitat / migration characteristics Movement characteristics (e.g., swimming rates, depths, diving, etc.) Feeding characteristics Social characteristics

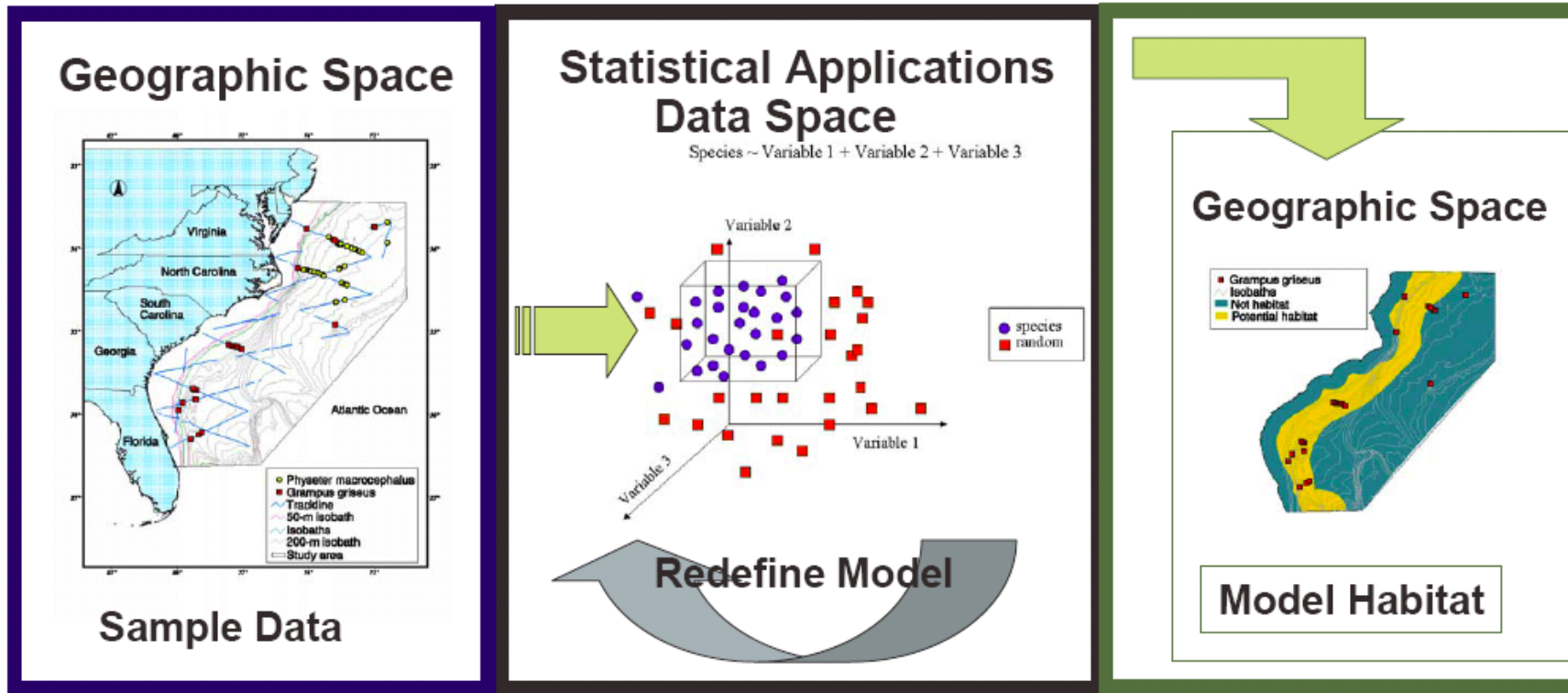


*portions of the Fin whale data used for DHM modeling were sourced from Tt-NYSDEC NYB Aerial Survey Project (Ann Zoidis, Meghan Rickard, and Kate Lomac-MacNair), carried out by Tetra Tech.

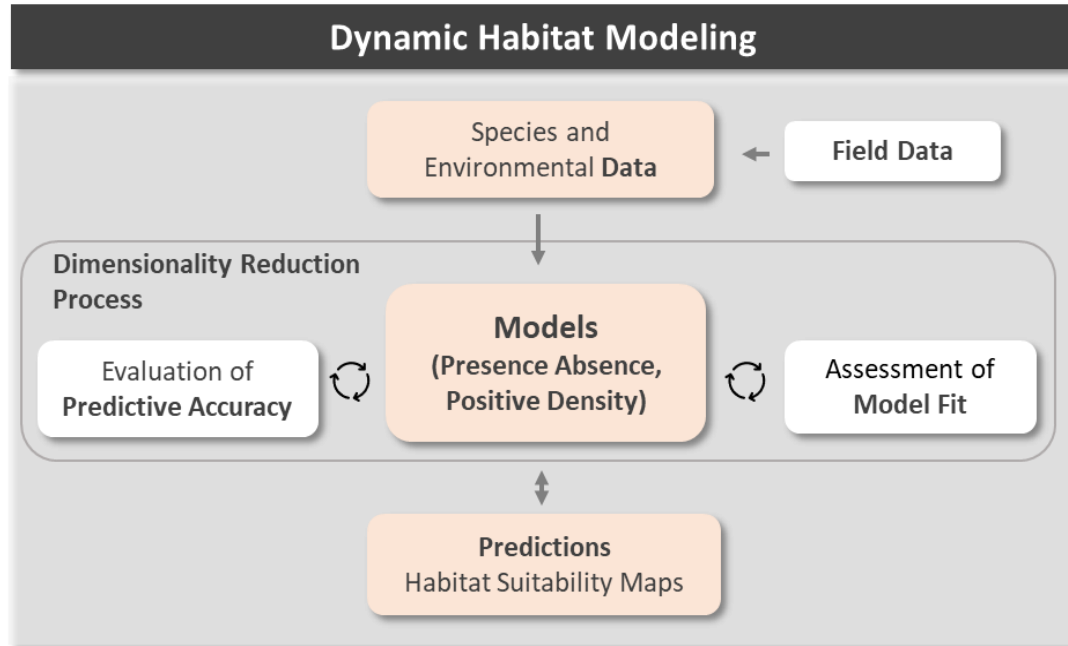
Data Quality Assessment



Dynamic Habitat Modeling Concept



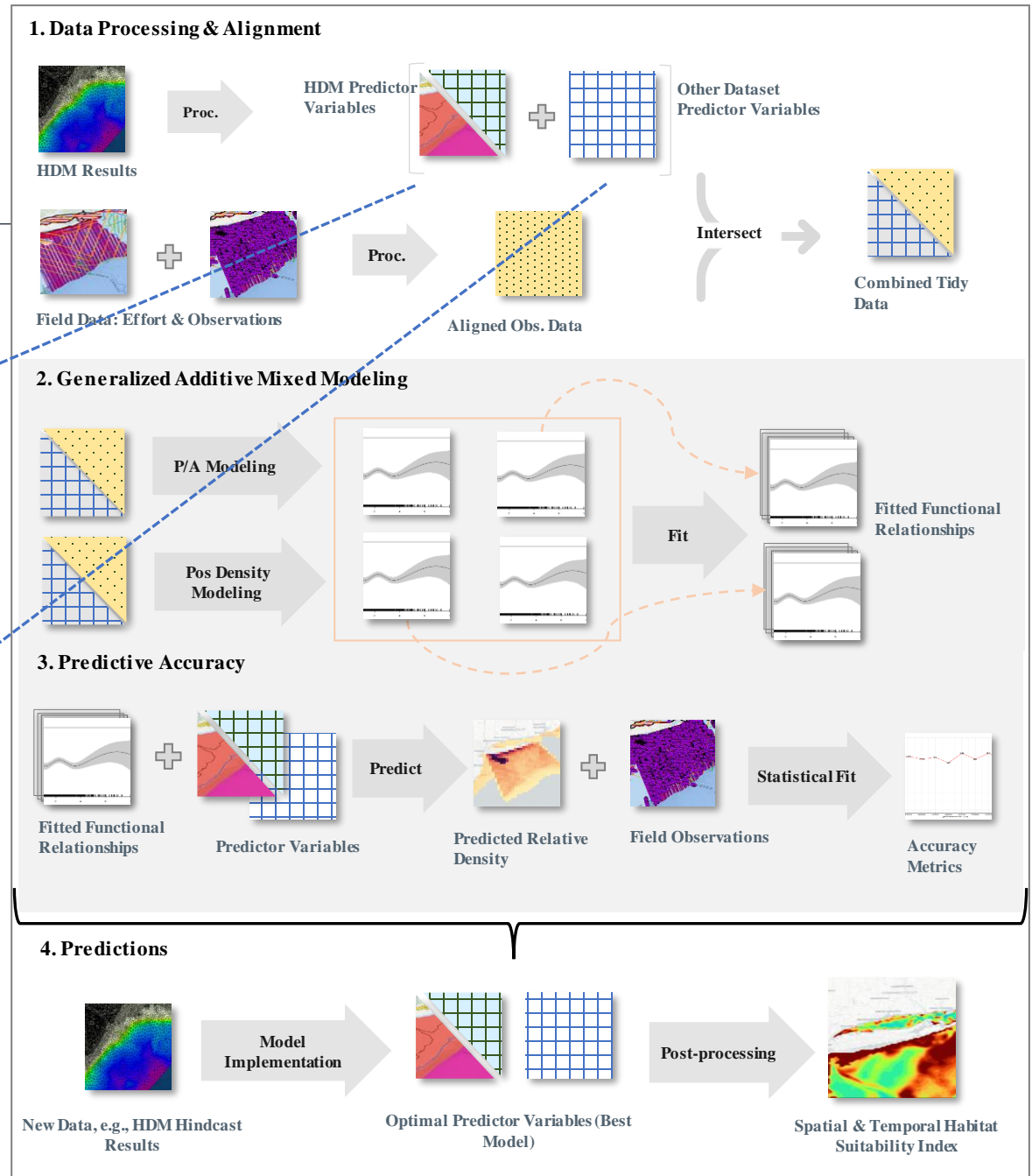
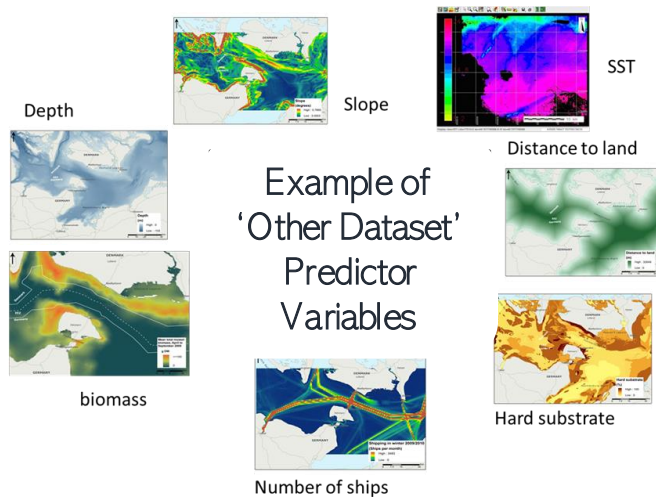
Dynamic Habitat Modeling (DHM)



- Utilizes a specialized model script trains Generalized Additive Mixed Models (GAMMs) and executes the trained GAMMs to the applicable results in DHI's MIKE 3/21 to produce Dynamic Habitat Suitability maps
 - GAMMs run to produce 'Presence Absence' (P/A) and 'Positive Density' (PosD) models
 - iterative isolation of significant habitat Predictors (variables) via review of related correlation statistics and adequate 'Model Fit' and 'Predictive Accuracy'
 - training applicable GAMMs results in DHI's MIKE 3/21 to produce Dynamic Habitat Suitability maps
- Statistical analysis that links sighting survey observations to oceanographic conditions referred to as 'habitat drivers', or 'Predictors'

DHM in More Detail

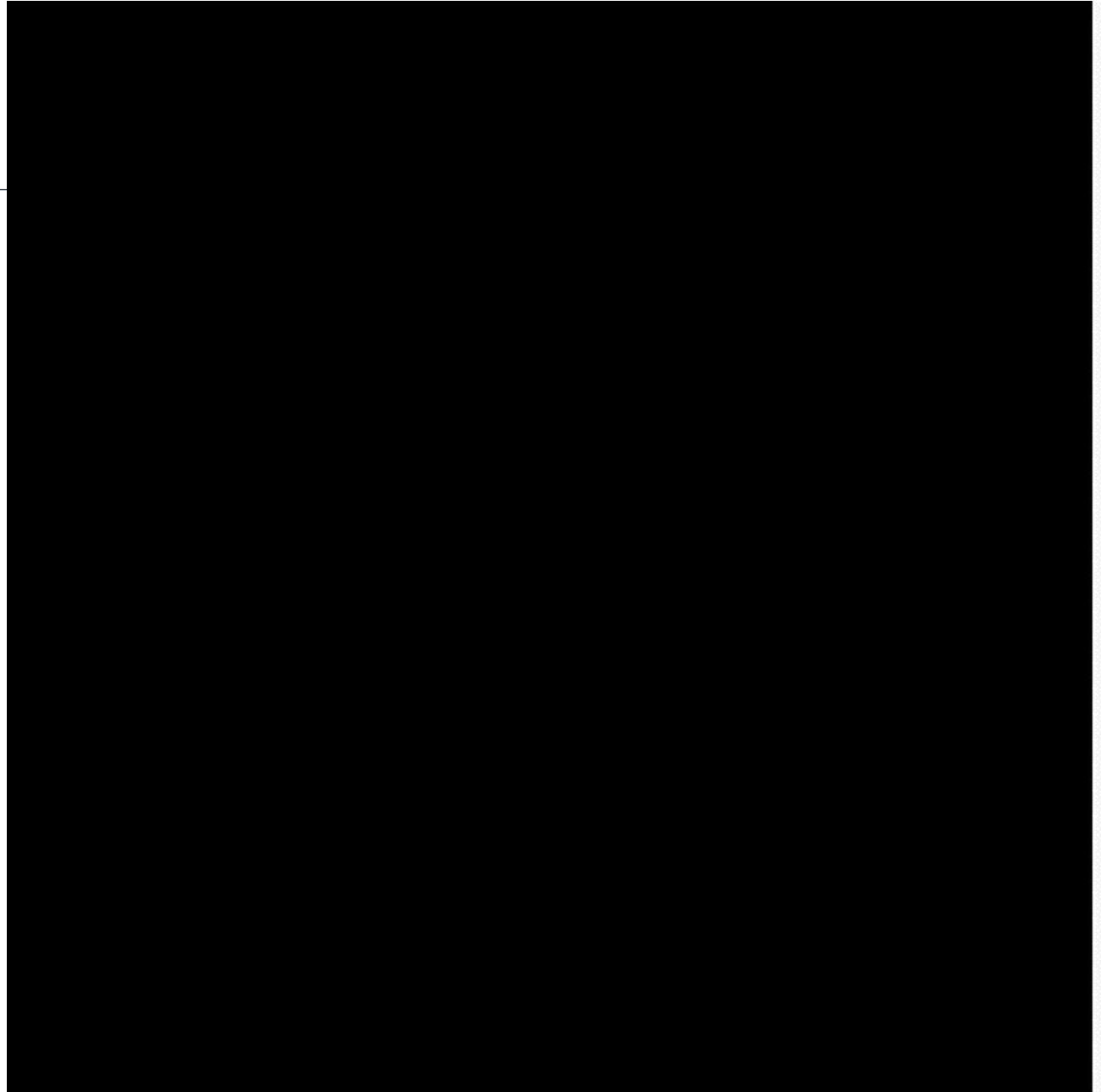
Example of Predictor Variables derived from HDM:
 Brunt-Väisälä, Current speed, Current Gradients, Current Vorticity, Water Temperature, Salinity, Salinity Gradients, etc.



Northern Gannet—

DHM results during short-term
period of significant habitat change

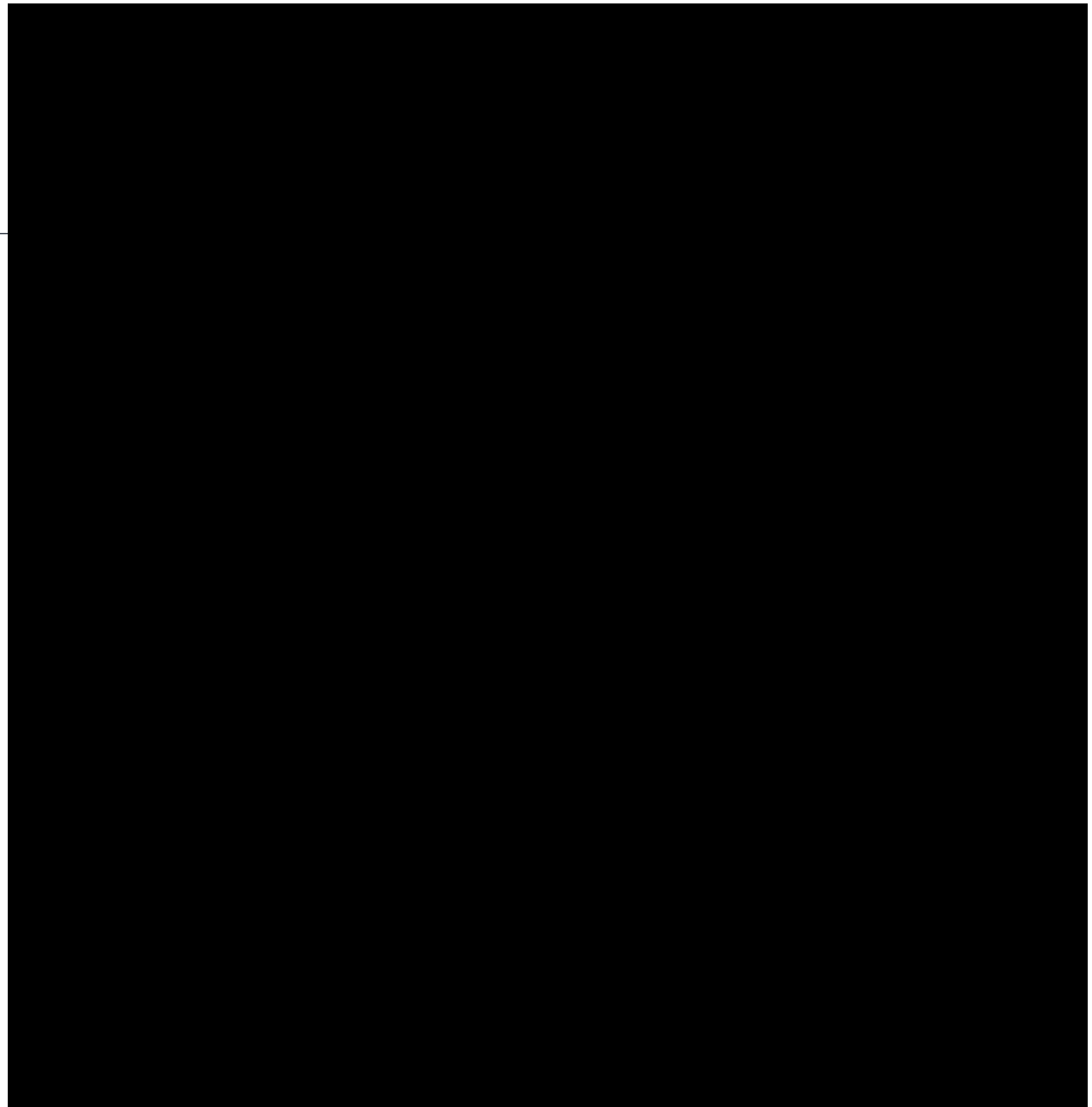
- Example of animated
Habitat Suitability
results



Fin Whale –

DHM results during short-term
period of significant habitat change

- Example of animated
Habitat Suitability
results

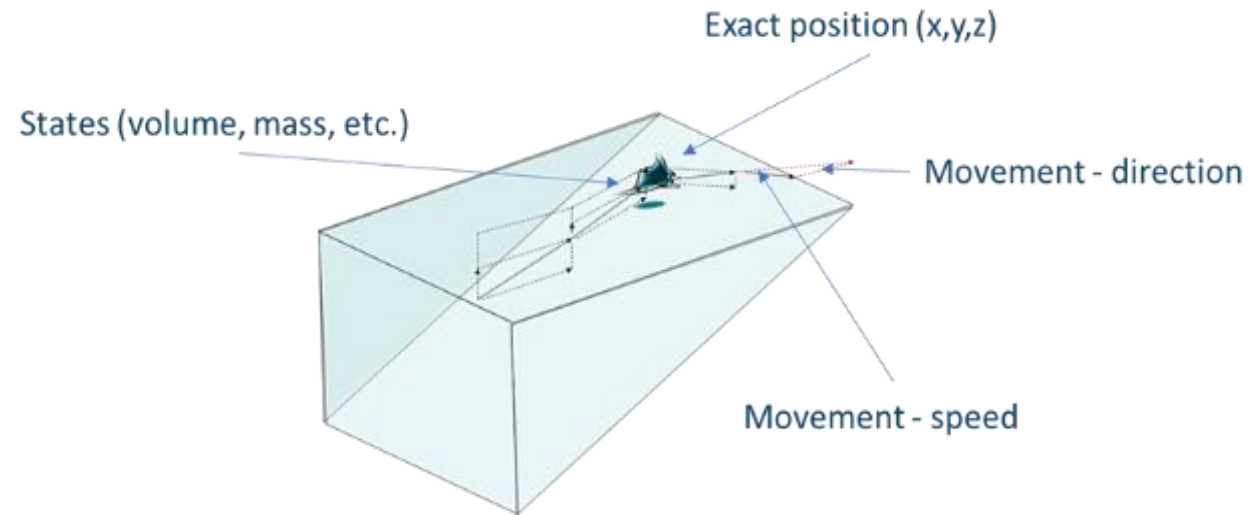
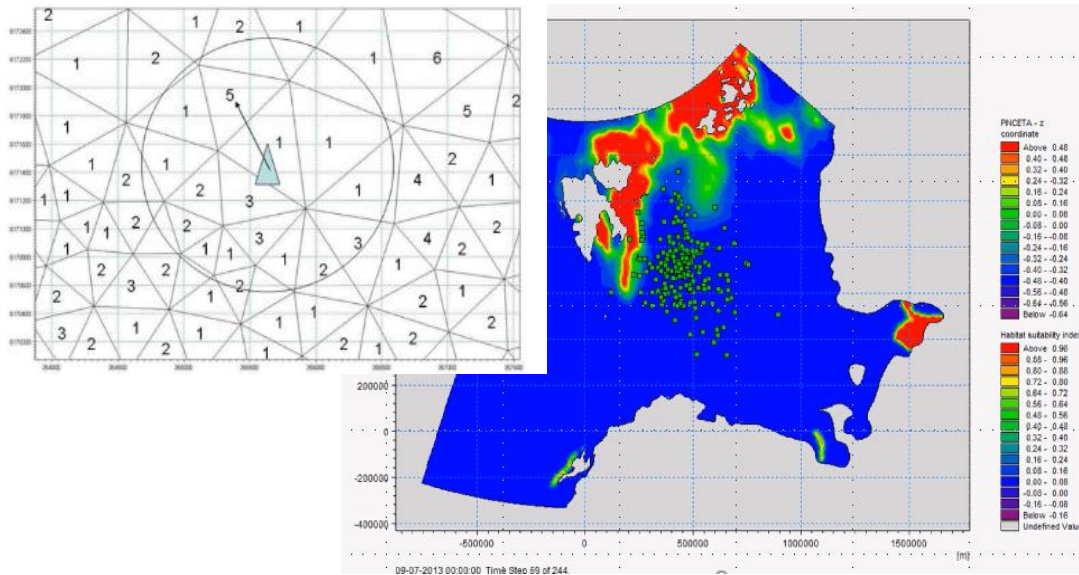


Predictive flight modelling

BIG video file omitted
from check

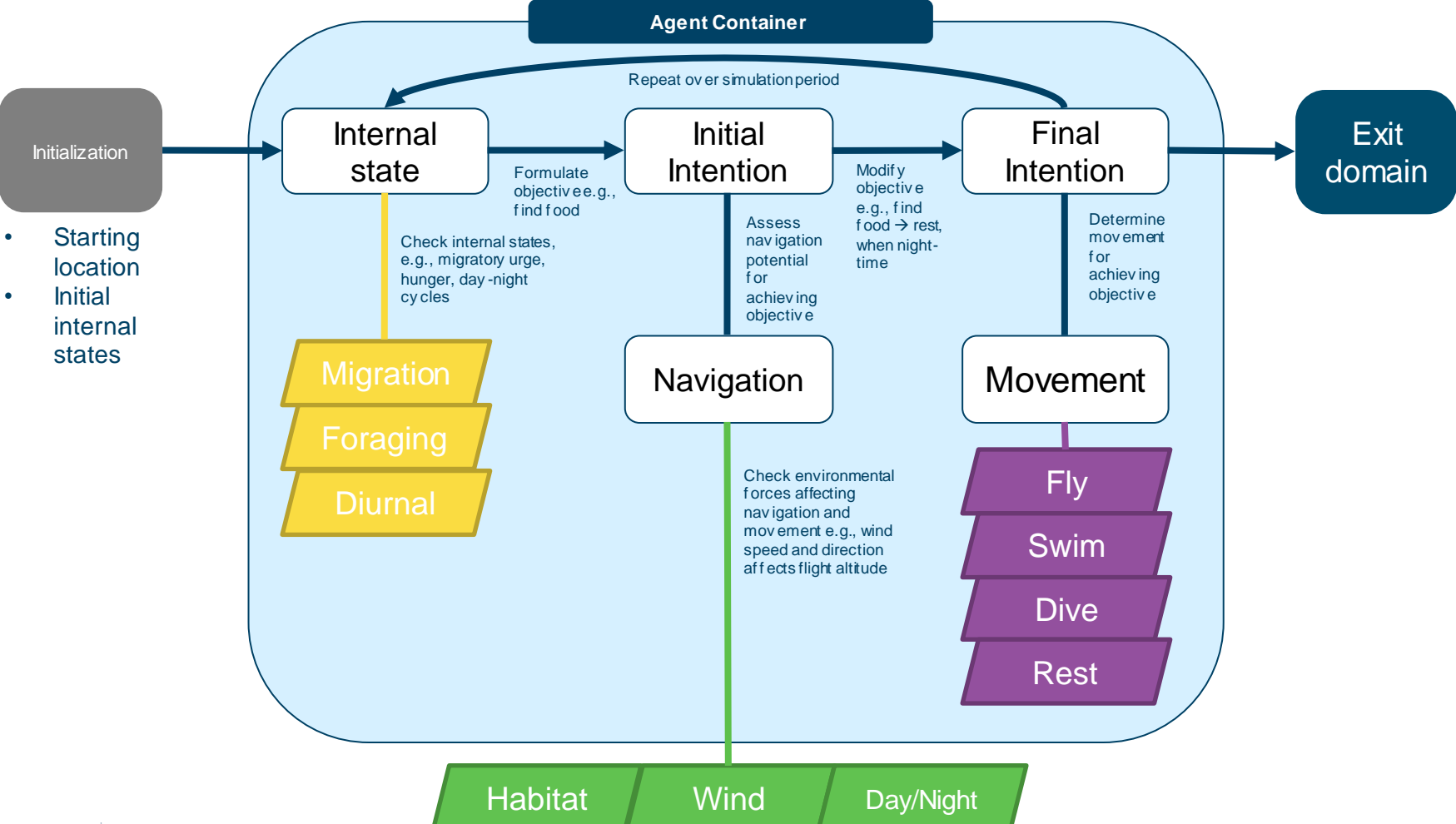


Agent Based Modeling (ABM)

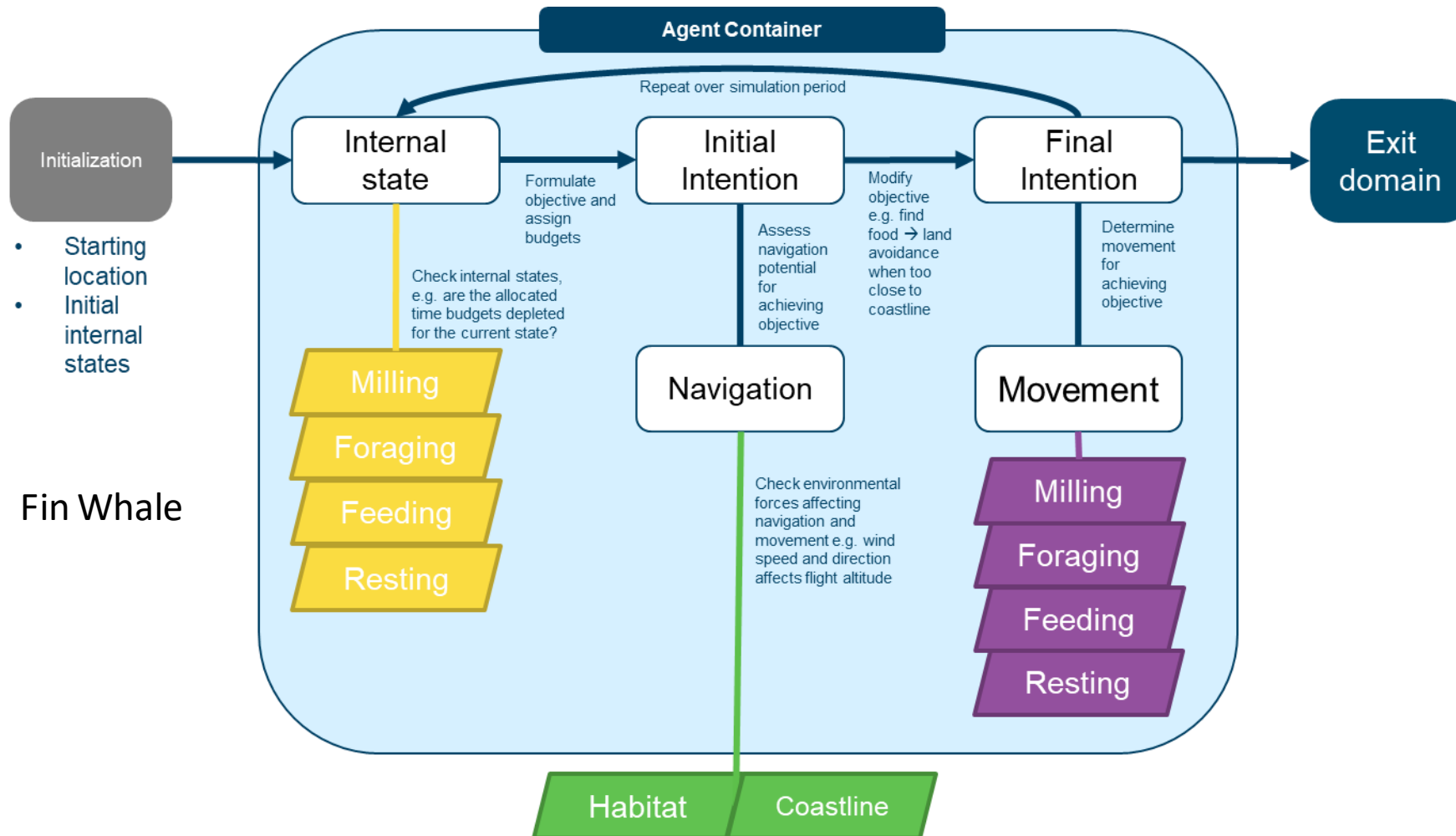


- Applied ABM technique entails simulating a series of steps within a model domain, wherein an agent makes a series of action 'decisions' (e.g., movement, diving) based on information made available to it in a sensory sphere around it

Red-throated Loon ABM

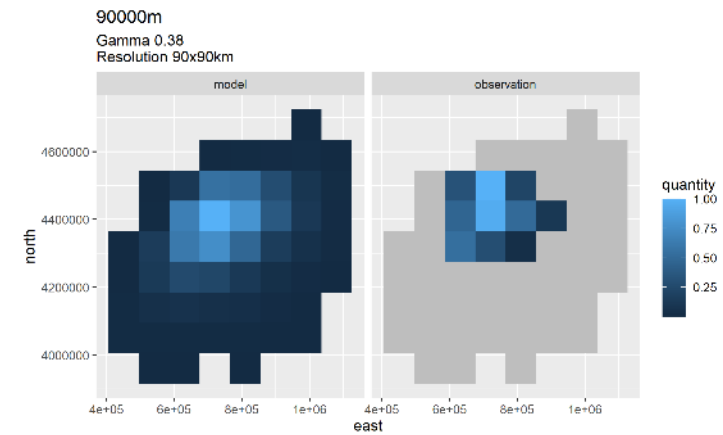
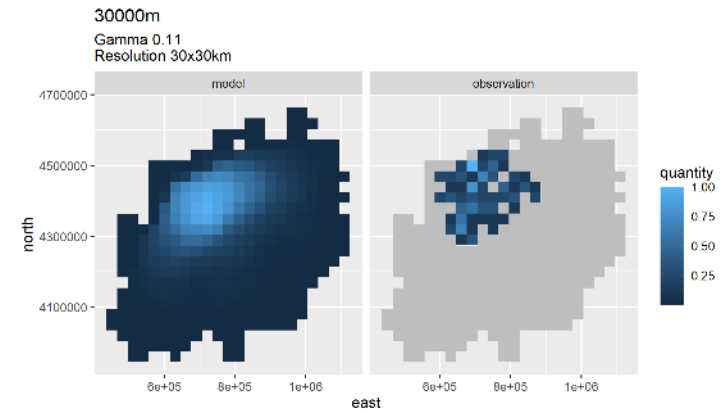
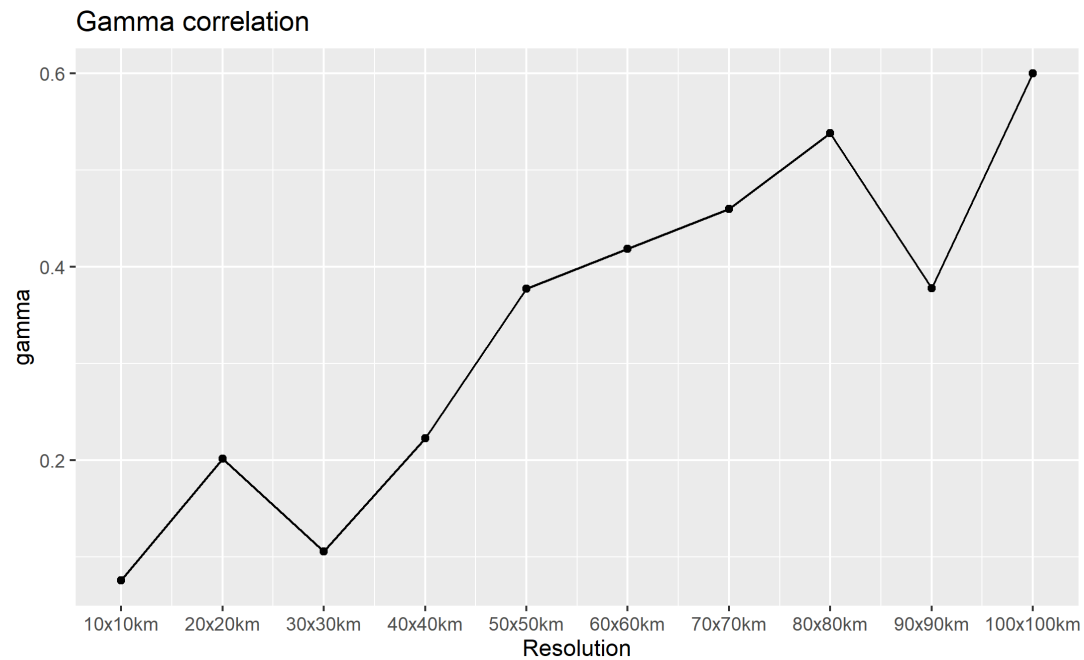


Fin Whale ABM



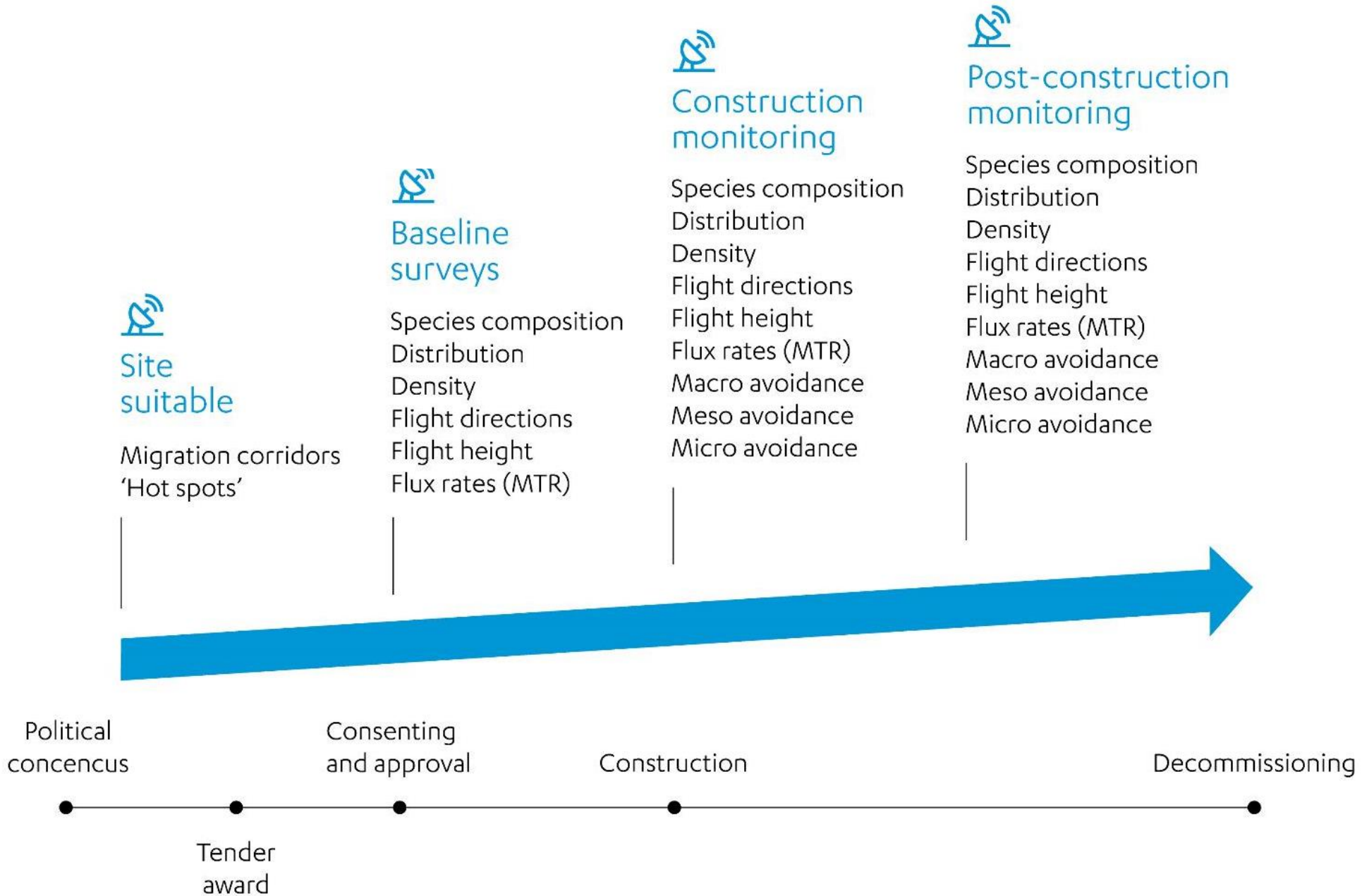
Fin Whale ABM

Calibration & Validation Analyses



A grayscale photograph of a coastal scene. In the background, a wind farm with several turbines is visible against a hazy sky. In the foreground, the ocean is filled with waves, with white foam from the breaking surf. Several birds are captured in flight, scattered across the sky. The overall tone is muted and atmospheric.

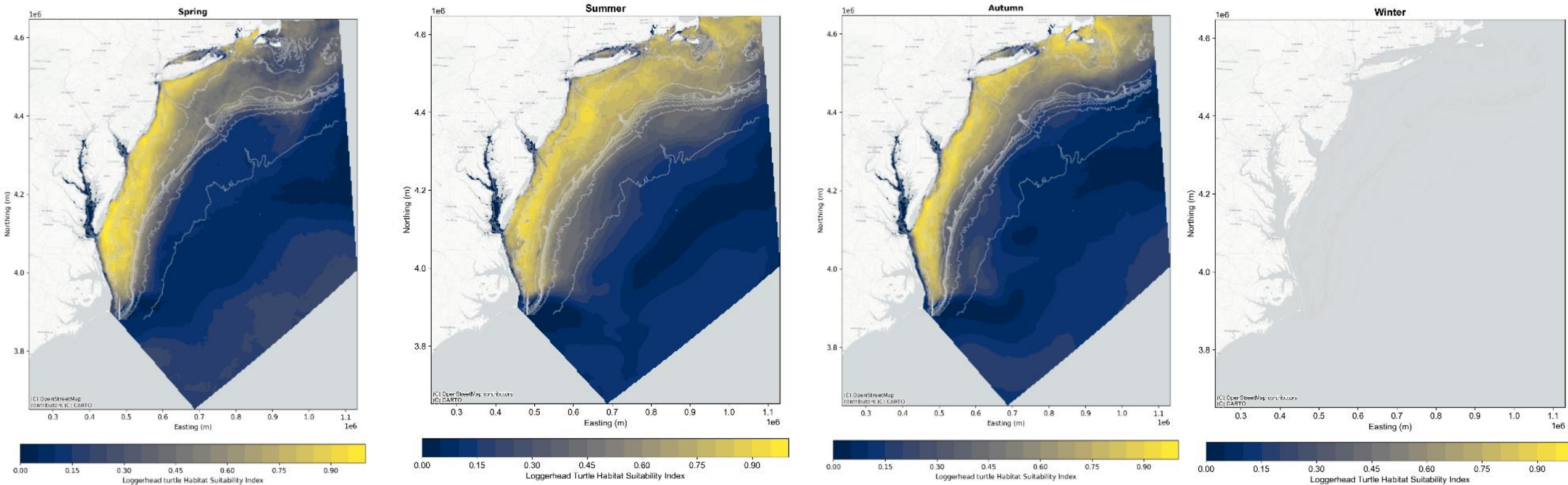
APPLICATIONS



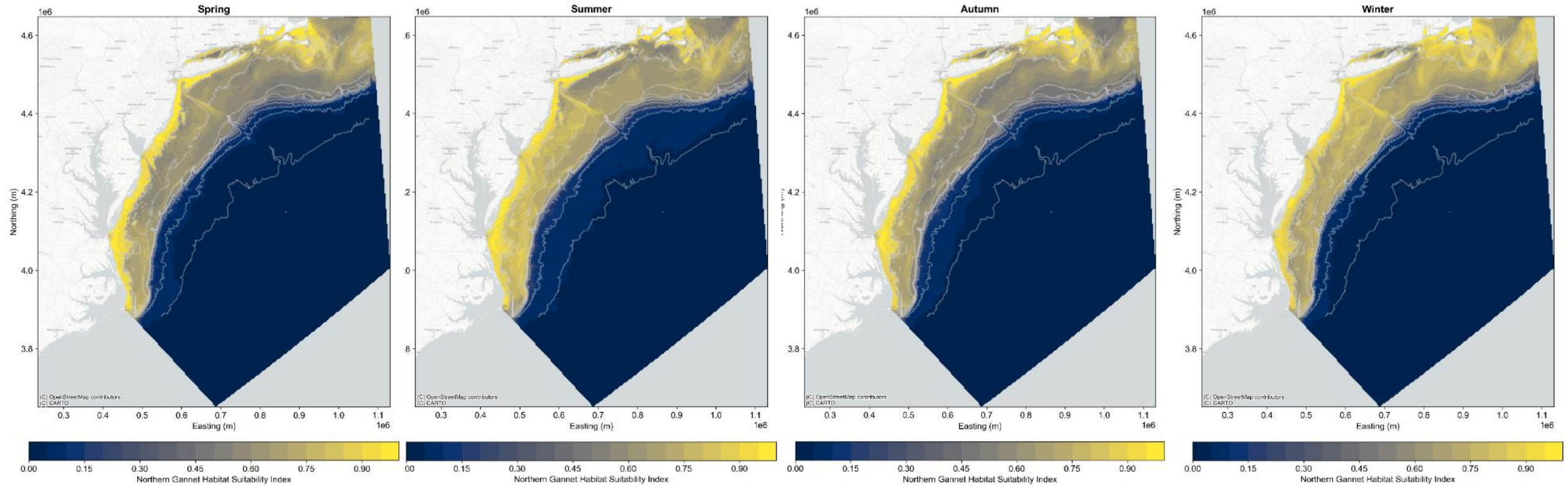


STRATEGIC AND BASELINE

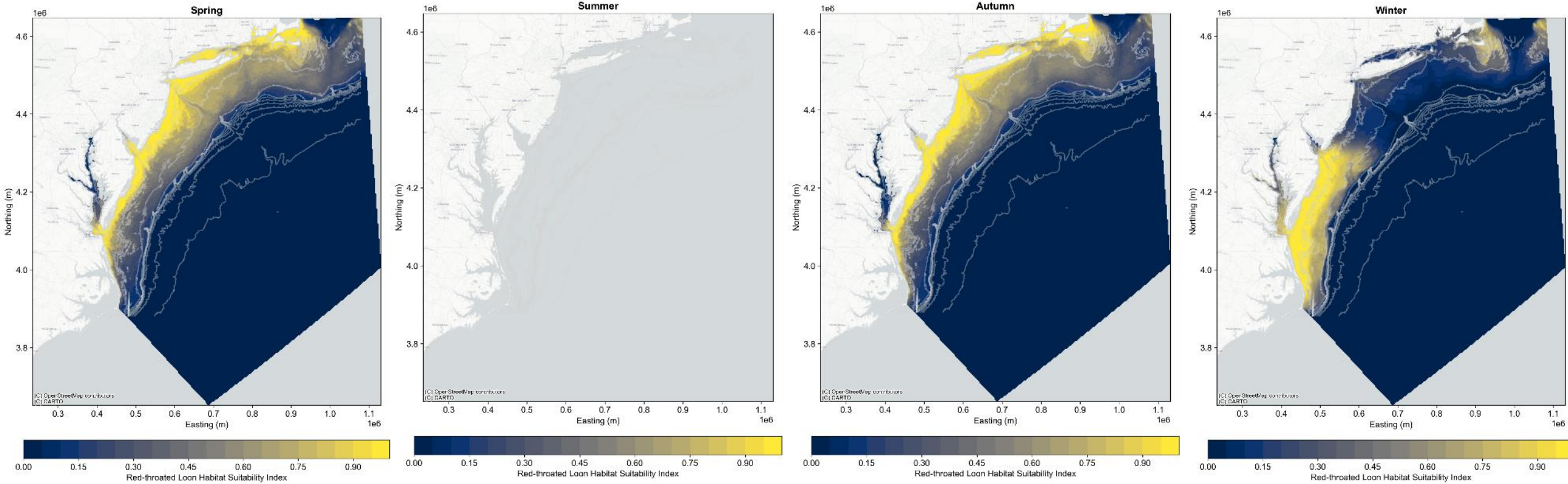
Loggerhead Turtle DHM Average Seasonal Habitat Suitability



Northern Gannet DHM Average Seasonal Habitat Suitability

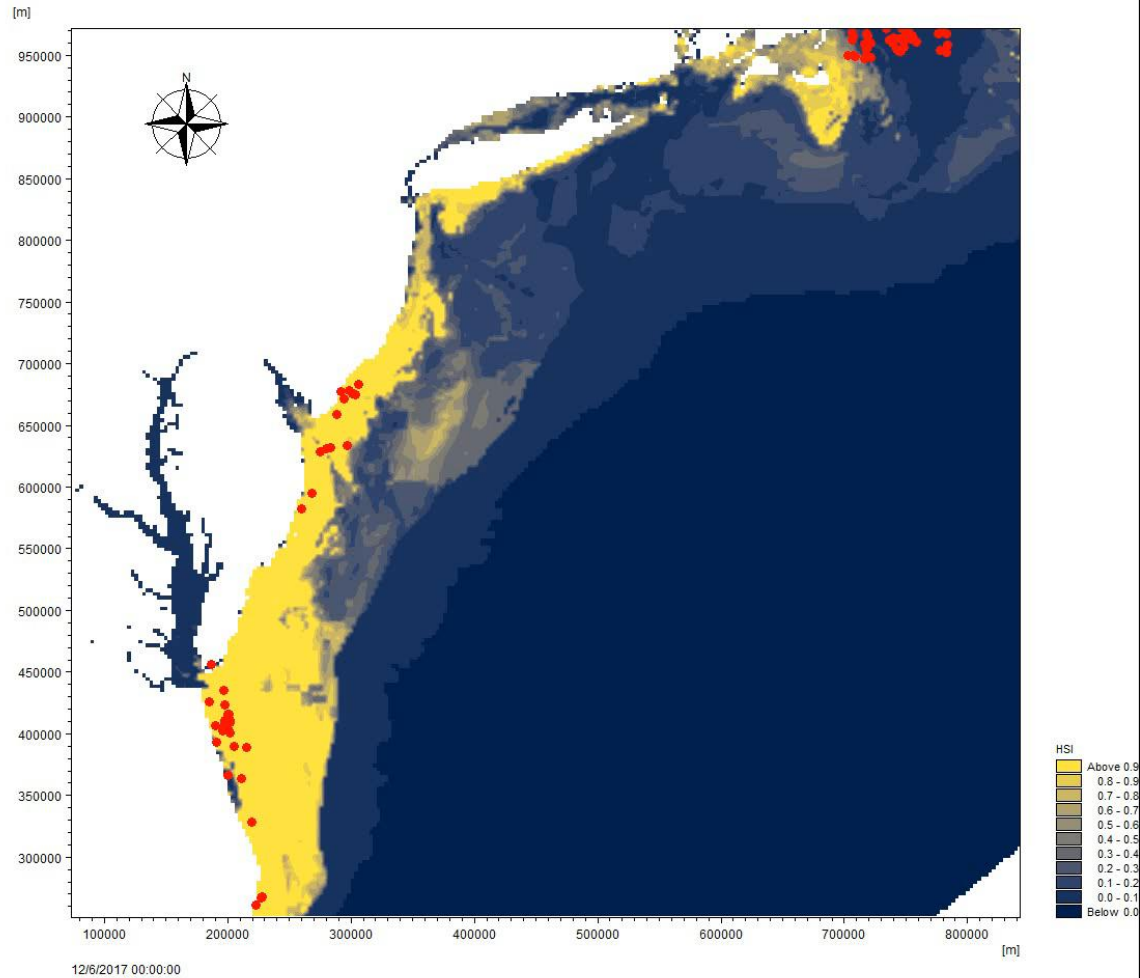


Red-throated Loon DHM Average Seasonal Habitat Suitability

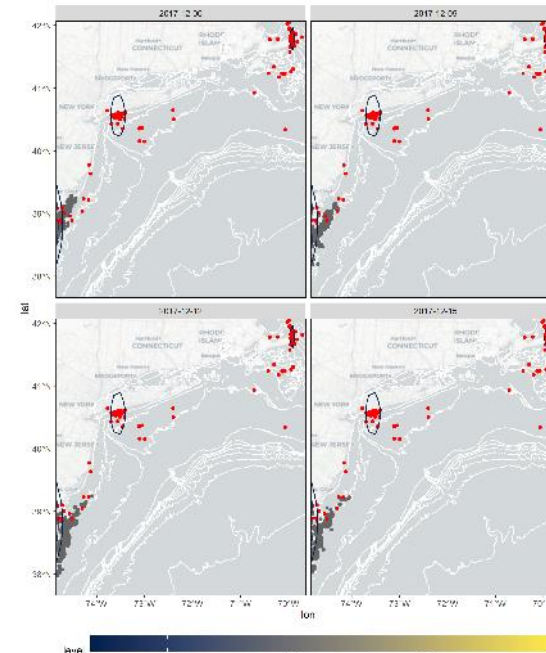


Red-throated Loon ABM

Movement results during short-term period (December) of significant habitat change

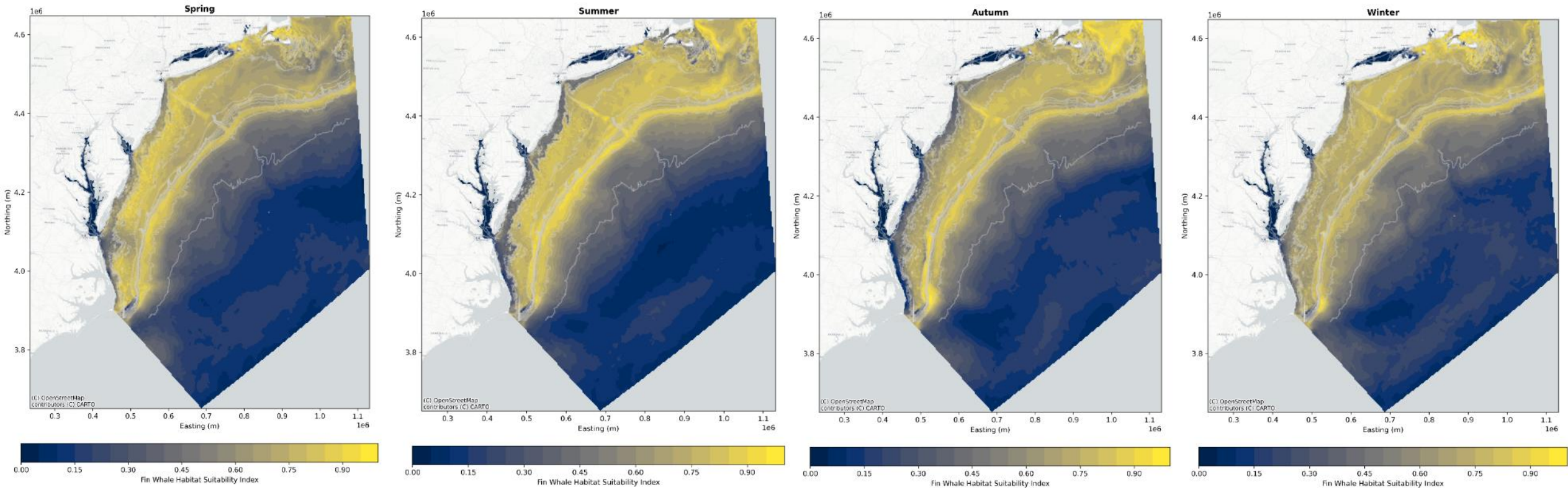


- Left: results animation of Red-throated Loon agents movement during short-term period of significant habitat change
- Below: Static output of results during the same period (red dots indicate observation data positions, grey dots - model output positions)



Fin Whale DHM

Average Seasonal Habitat Suitability

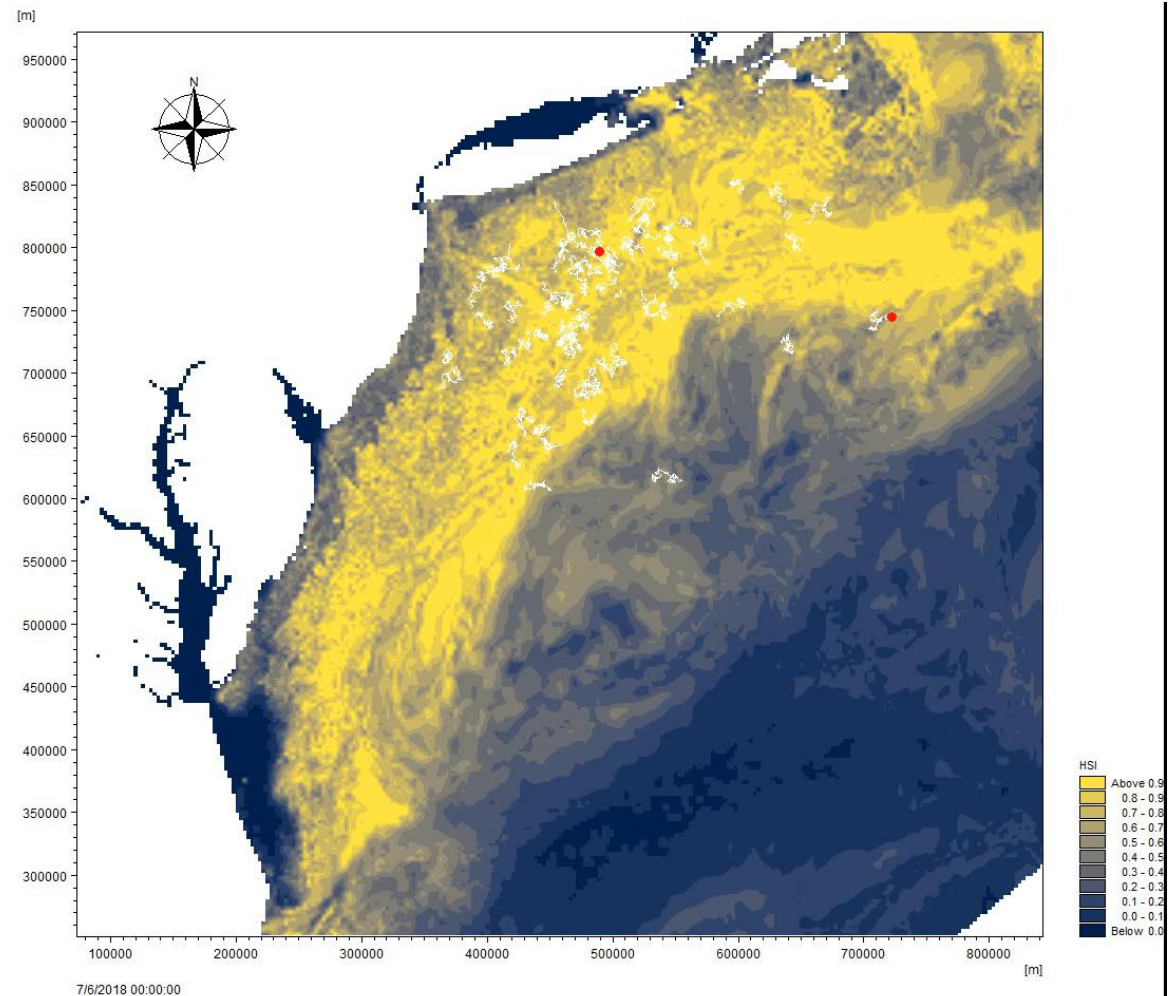
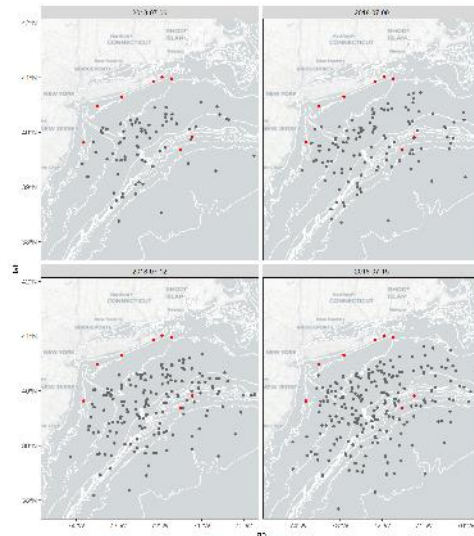


Fin Whale ABM

Movement results during short-term period of significant habitat change



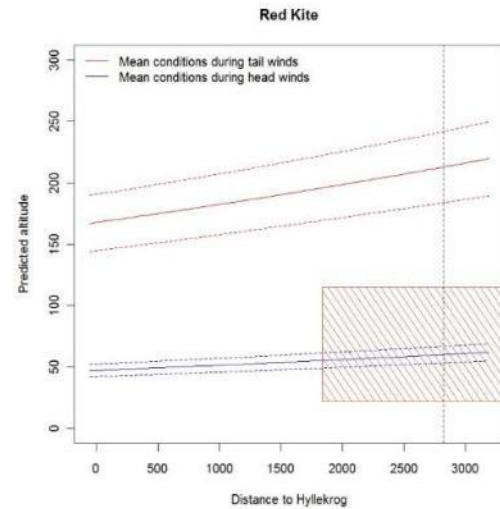
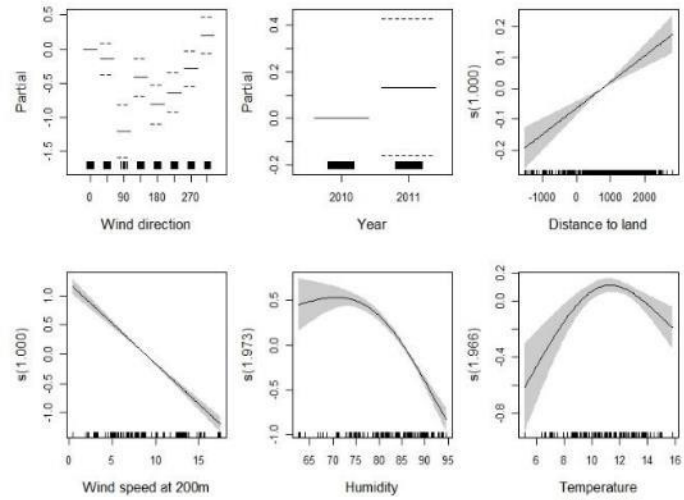
- Right: results animation of Fin Whale agent movement during short-term period of significant habitat change
- Below: static output of results during the same period (red dots indicate observation data position, grey - model output of positions in time-step intervals)





IMPACT ASSESSMENT

Model applications for local risk assessments



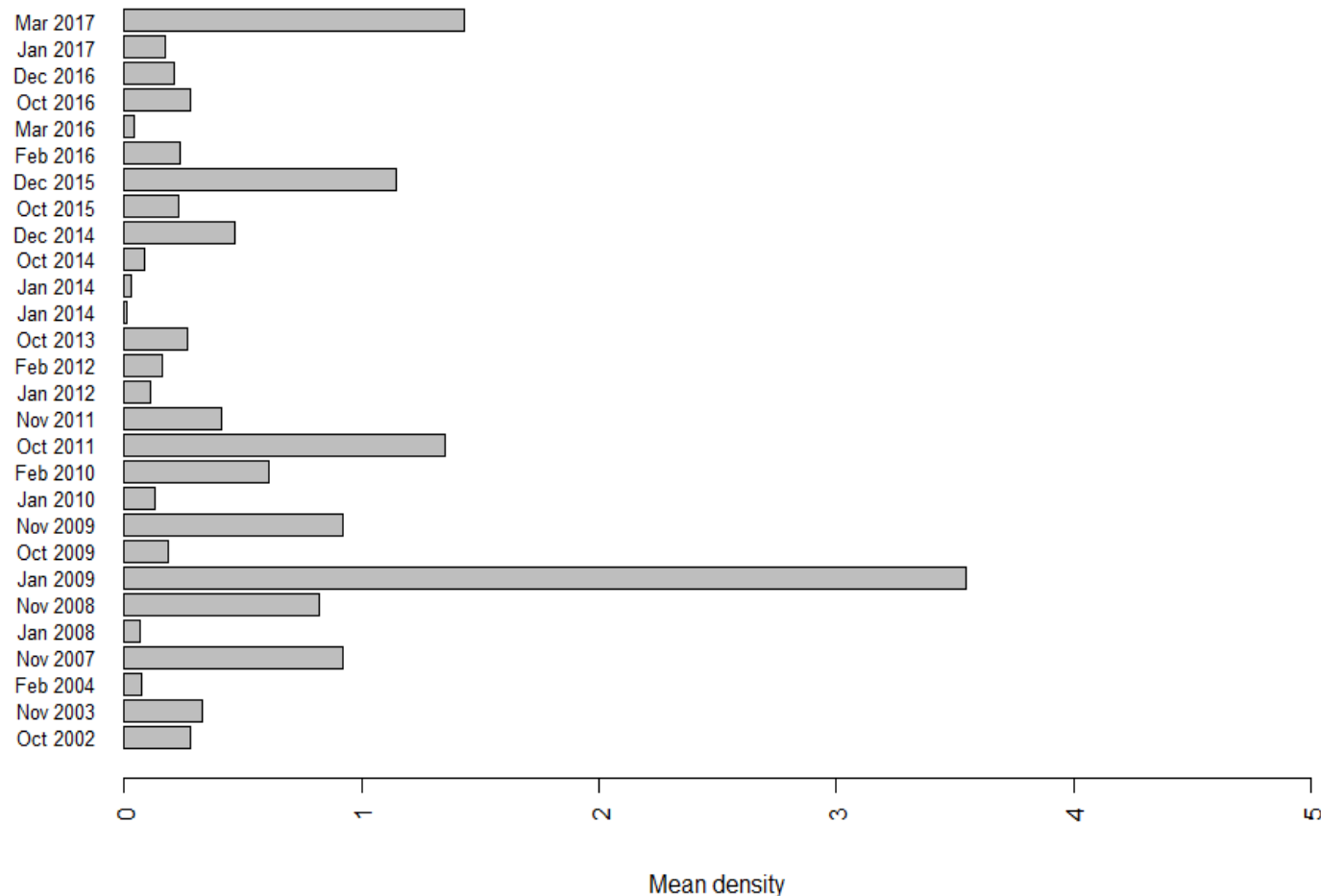


POST-CONSTRUCTION

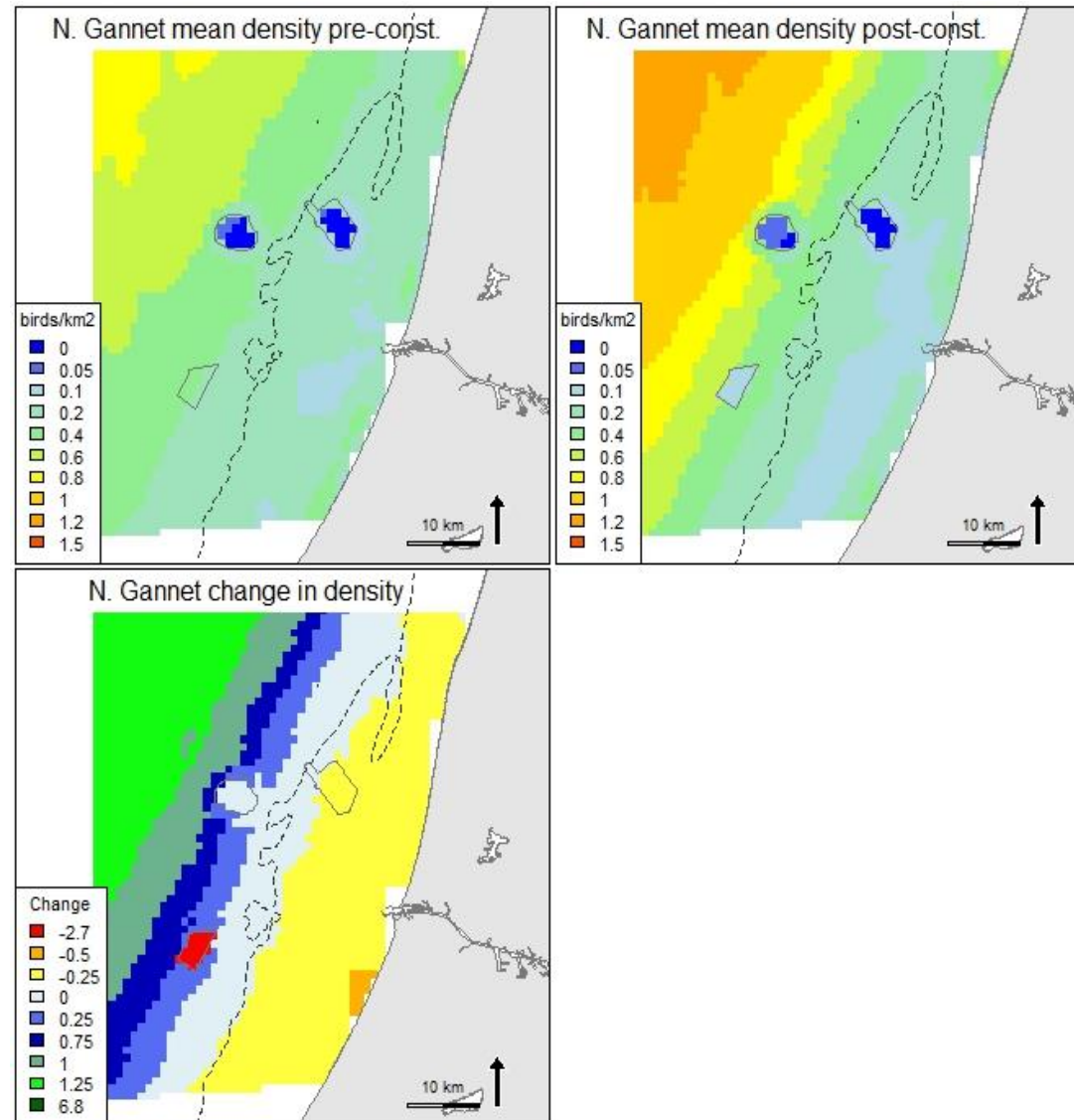
High level of observed variation of wildlife in OWFs means low power for detecting impacts



Northern Gannet, 2002-2017



Using spatial models to improve the power of post-construction monitoring



The background of the slide is a photograph of a sunset. The sun is a large, bright yellow-orange orb in the lower-left corner, partially obscured by a large, fluffy white cloud. The sky is a deep orange, and a flock of birds is silhouetted against it in the upper half. The foreground shows the dark silhouettes of grass or reeds.

Thank you !

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- National Historic Preservation Act, Section 106
- Offshore Wind Data Collection and Management

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