MARCIS

MARINE SPATIAL PLANNING AND
CUMULATIVE IMPACTS
OF BLUE GROWTH ON SEABIRDS

MARCIS

- Collaborative Project to meet Societal and Industry-related Challenges
- Land under pressure

NINA

equinor

Forskningsrådet

UK Centre for Ecology & Hydrology

eri environmental research institute

TOTAL

AKER OFFSHORE WIND

University of Reading

NORSK·POLARINSTITUTT

RWE

OFFSHOREWIND Norwegian Offshore Wind Cluster

Aim

- develop framework for assessing cumulative impacts on seabirds and migratory birds from human marine spatial use
- regional applicable, flexible and future-oriented
- Assess both anthropogenic and climate change impact on seabirds
- a tool for marine spatial planning
- basis for appropriate risk management

Overview of the project

WP 6
Reference group involvement

WP 1
Bird distribution and anthropogenic activity

WP 4
Impacts of offshore wind farms

WP 2
Individual bird behaviour and sensitivity

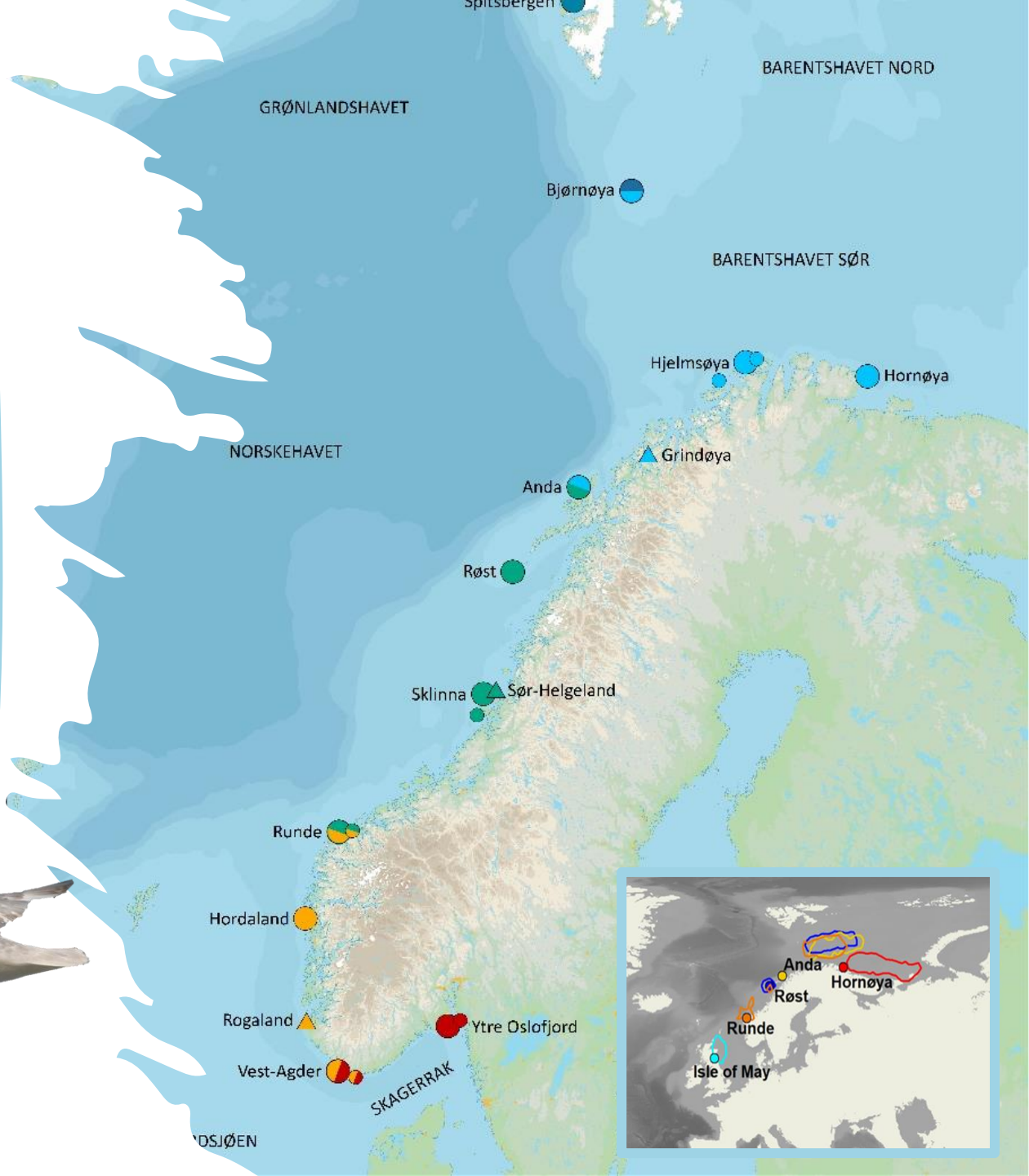
WP 3
Bird population vulnerability

SEAPOP and SEATRACK database

Mapping and monitoring of seabirds

Long-term data available from several sites in Norway

SEATRACK: known seasonal distributions from GLS data



Cumulative impact assessment (CIA)

Halpern et al. 2008. Science

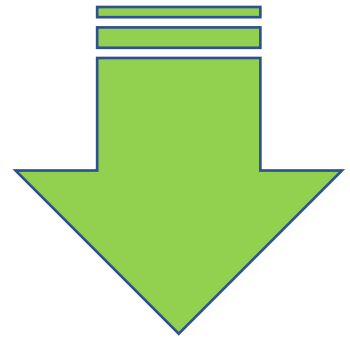
$$I(x,y) = \sum_{i-1}^{n} \sum_{j-1}^{m} P_i * Ej * \mu_{ij}$$

Sensitivity and vulnerability:
- Individual-level
- Population-level

Human offshore activites:
e.g fishery, oil-industry, offshore wind-farms etc

Seabirds with known distribution and avaialble longterm population data

Input to…..



CIA tool and basis for marine spatial planning

Google Cloud

Google Earth Engine

Integration with practical MSP

CIA Modelling

Scenario modelling

CIA Visualisation

Decision support

Project Archive WP1-WP4

Google Data Catalog

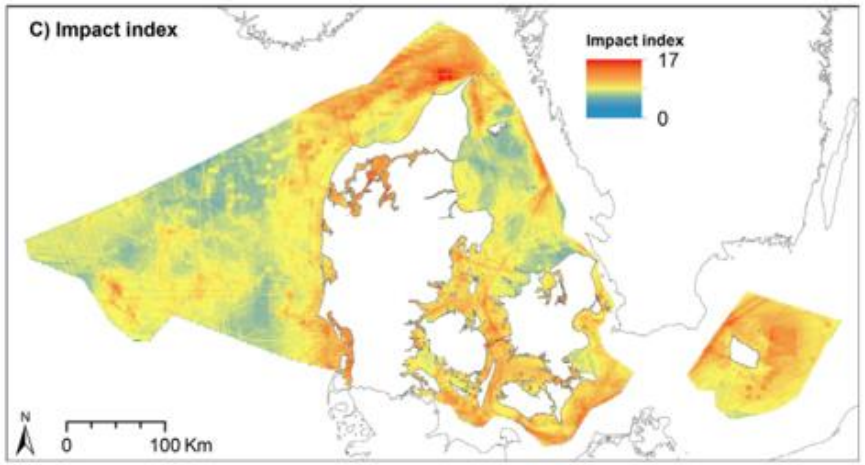
App framework

Vulnerability assessment for populations

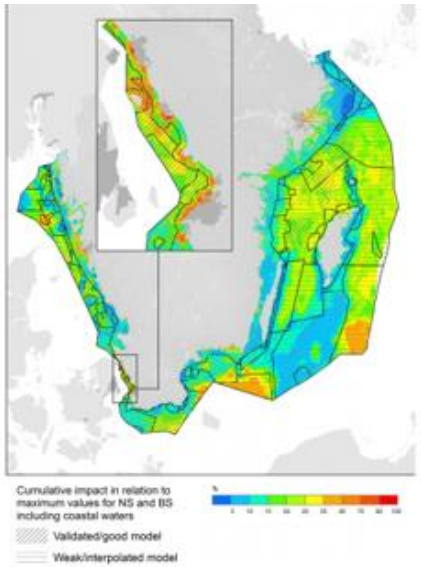
- Data products
- Pixel & Zonal statistics
- Accounting dashboards

What's different in our approach?

- First of all: no CIA has been conducted for Norway so far. Denmark and Southern Sweden are covered already
- Traditionally, μ_{ij} *(sensitivity of each ecosystem component (j) towards each stressor (i))* is based on "expert opinion", and these values can be "guesstimates" rather than actual knowledge => large uncertainty about results
- We will build the CIA outcome on Agent Based (ABM) and population modelling → quantitative methods instead of «guesstimates»



Andersen et al. 2020, Science of the Total Environment

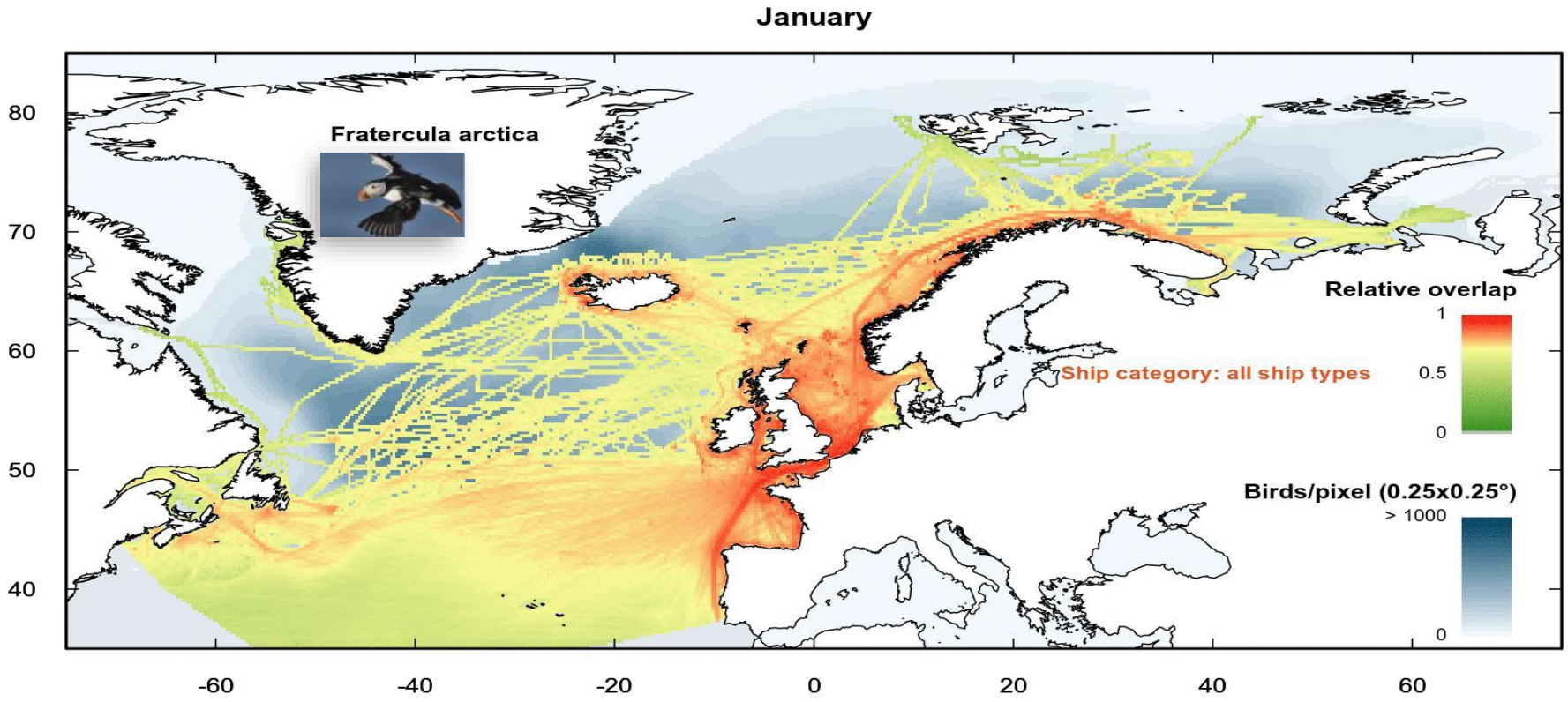


Hammar et al. 2020, Science of the Total Environment

WP 1

Spatial distribution of seabirds and anthropogenic marine activity

Eks: Overlap between ship traffic and Atlantic puffin throughout the year



WP 1 Spatial distribution of seabirds and human pressures

Goal: mapping the overlap between seabird populations and various human activities on a seasonal basis.

Tasks:

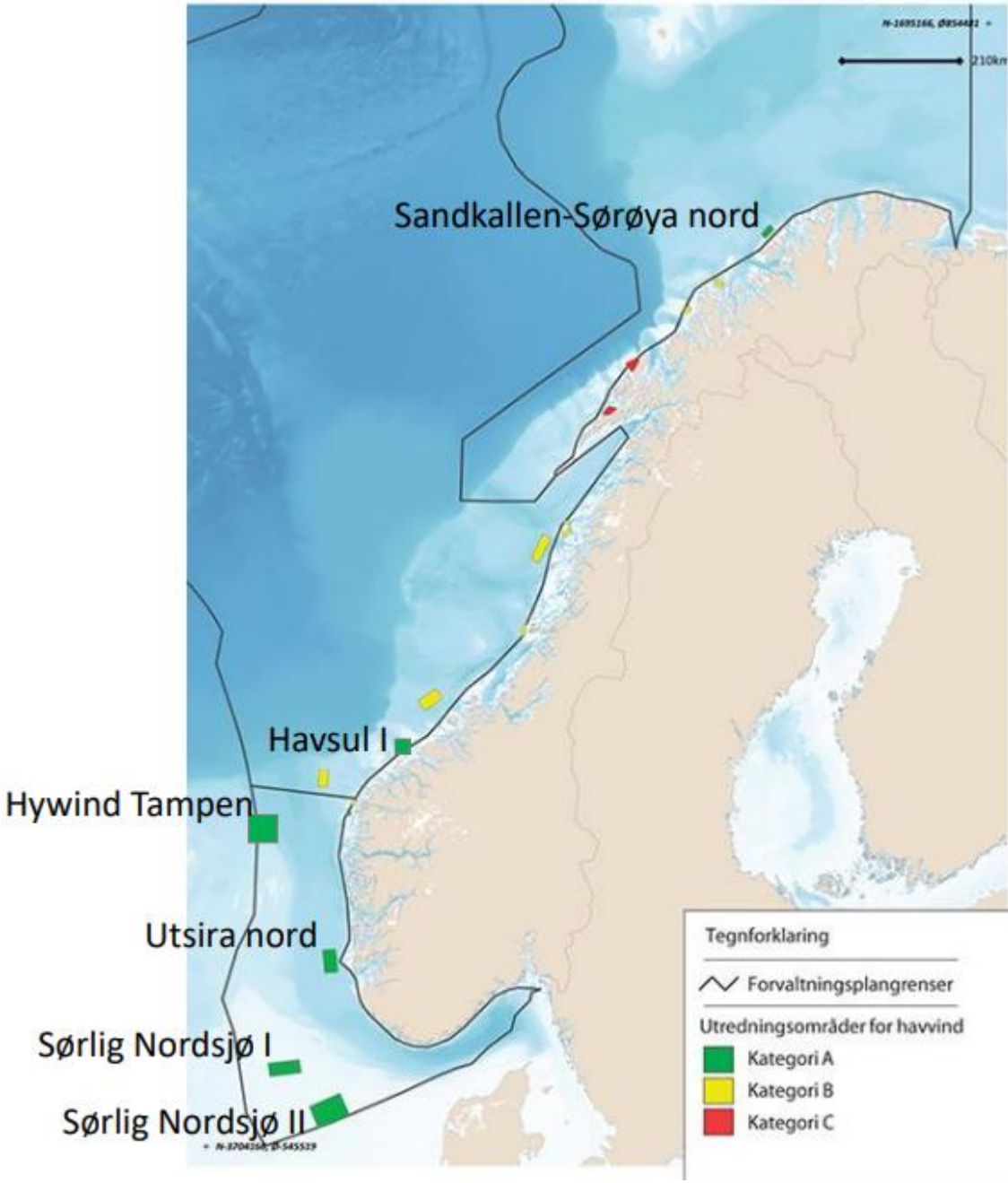
- **Map layers of seabirds and human pressures** will be compiled and combined to cover Norwegian and adjacent ocean areas with a resolution of 10x10 km^2 on a monthly basis. Data include:
    - Map layers of the **population-specific distribution** of six pelagic seabird species → to identify critical areas and time-periods
    - **Map layers of human activities** (wind farms, ship traffic, oil/gas installations, fishery activity, marine aquaculture) → identify the distribution of human pressures

- Co-design a spatial tool for quantifying and visualizing spatial overlap and **sensitive areas**.
- Co-develop **spatial scenarios** of growth in marine industries and identify possible implications for sensitive areas and seabird populations

- Provide map layers as input to WP3, WP4 and WP5.

WP2:
Novel marine stressors and receptors

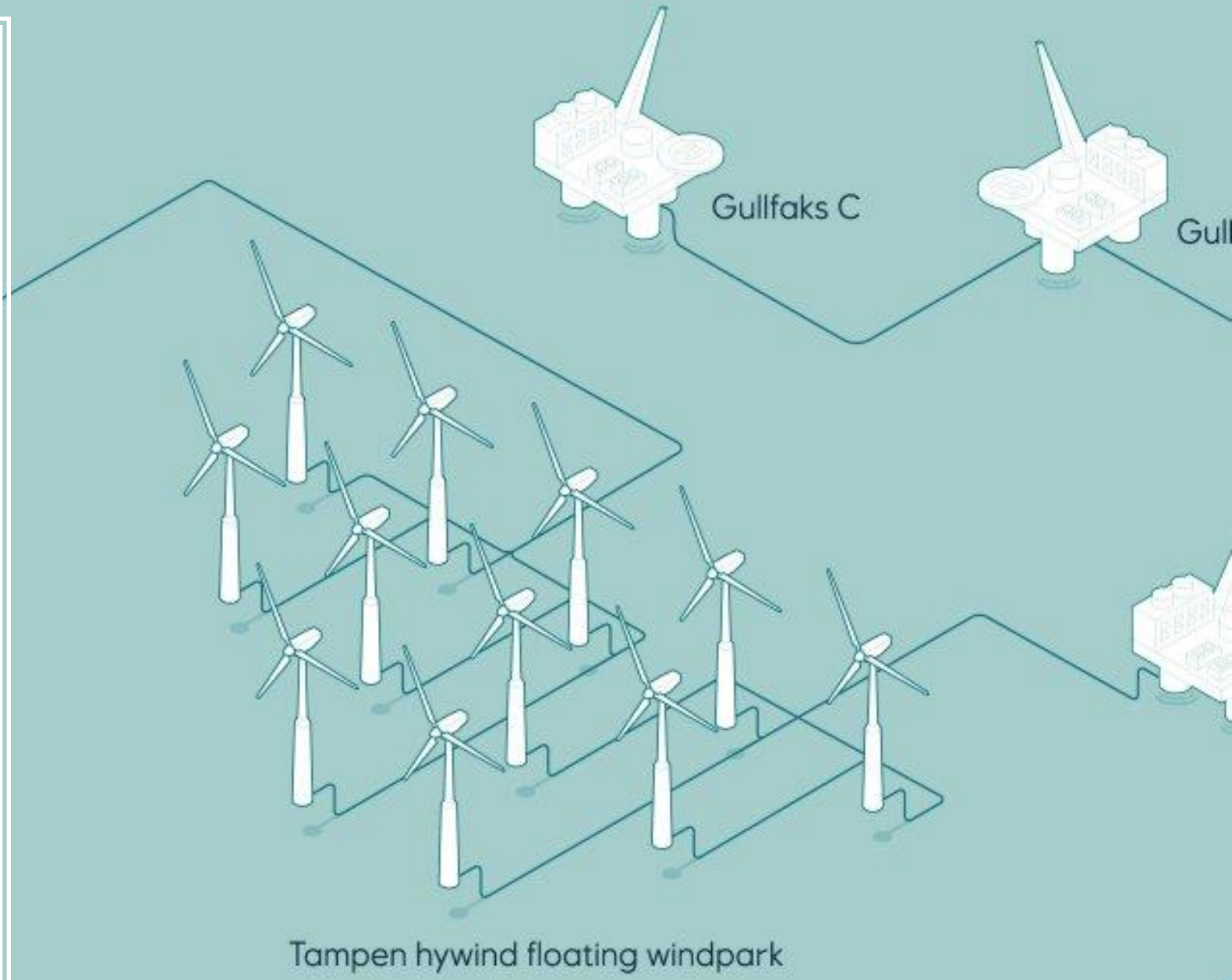
- Rationale: New stressor in the system. What are the impacts on birds from offshore wind farms?
- Goal: Quantify the impact of an active wind farm on seabirds and migratory birds from radar data
- WP2 knowledge base development will feed into data and model development in WP3-4 and WP5.



WP2 Case study Tampen Hywind

- Investigate behavioural responses to turbine proximity
  - Avoidance
  - Collision risk
  - Displacement

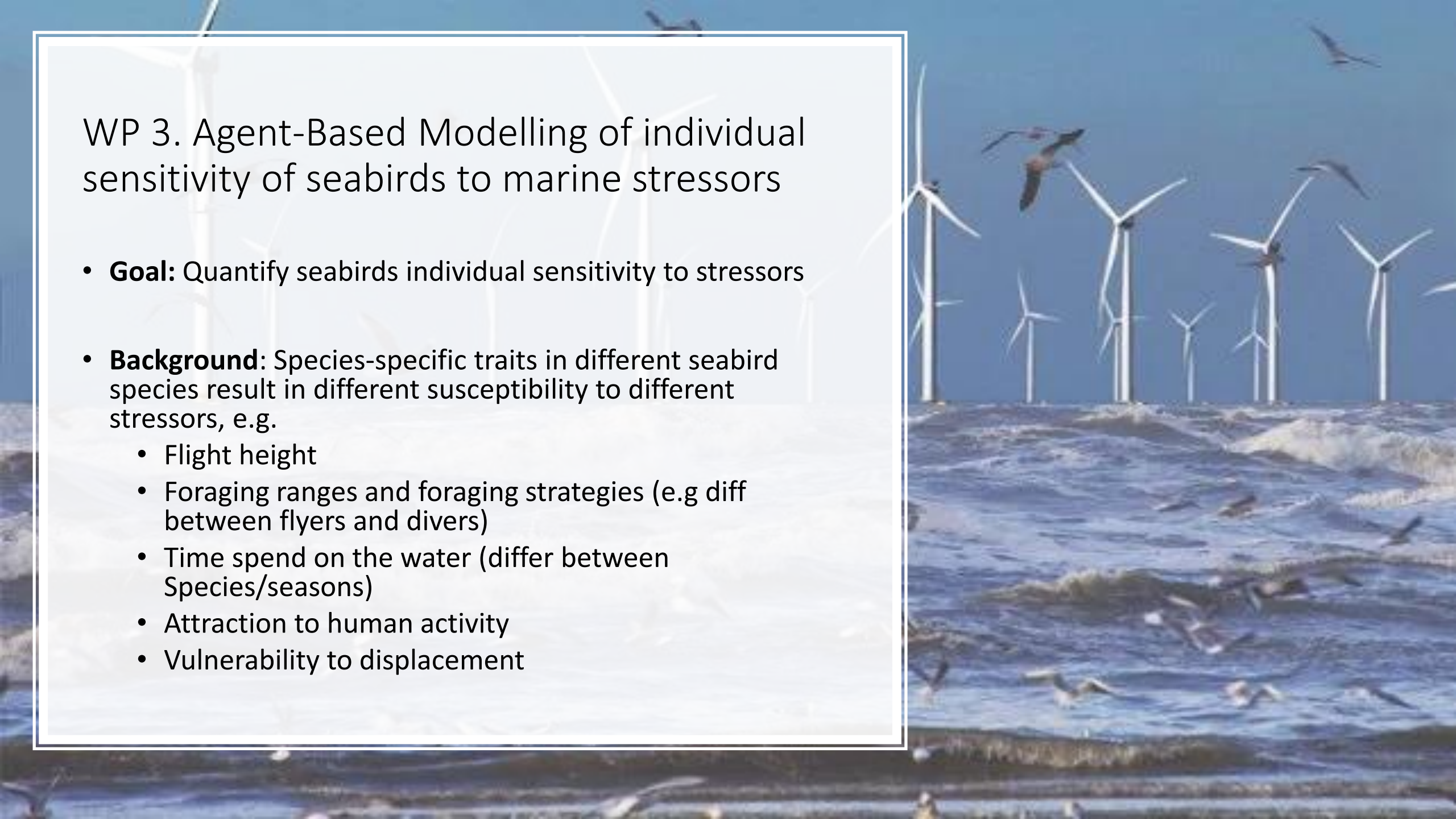
- Birds will be tracked by a Robin 3D MAX avian radar
- Develop machine learning algorthms to identify species and assess species related responses to turbines



WP 3. Agent-Based Modelling of individual sensitivity of seabirds to marine stressors

- **Goal:** Quantify seabirds individual sensitivity to stressors

- **Background**: Species-specific traits in different seabird species result in different susceptibility to different stressors, e.g.
  - Flight height
  - Foraging ranges and foraging strategies (e.g diff between flyers and divers)
  - Time spend on the water (differ between Species/seasons)
  - Attraction to human activity
  - Vulnerability to displacement



WP 3. Agent-Based Modelling of individual sensitivity of seabirds to marine stressors

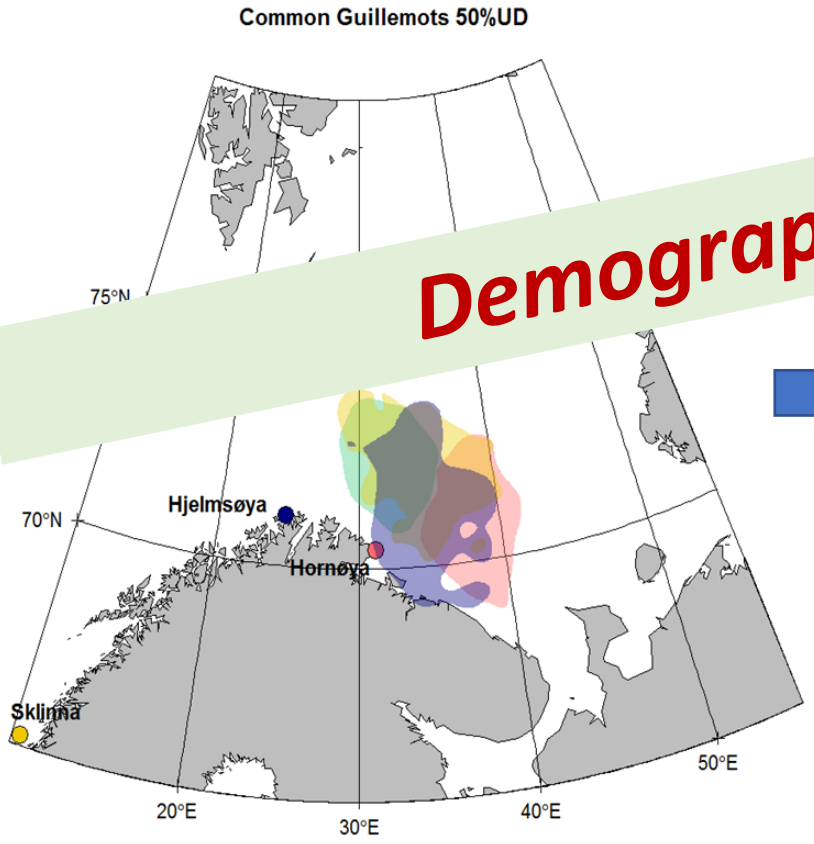
- Use agent-based models that quantify individual susceptibility with respect to different stressors, e.g.
  - exposure to oil spills
  - response to disturbance, displacement
  - attraction to fishing vessels
  - collision risk with respect to wind turbines
  - susceptibility to by-catch in different fishing gears

WP 4. Vulnerability of seabird populations to marine stressors and climate change

Goal: quantify the relative impacts of human offshore activities at the population-level, via effects on demographic rates, and knowledge of seabird distributions

WP 4 Vulnerability of seabird populations to anthropogenic activity and climate change

Demographic and population modeling



Longterm timeserie data on:

Adult survival

Fecundity

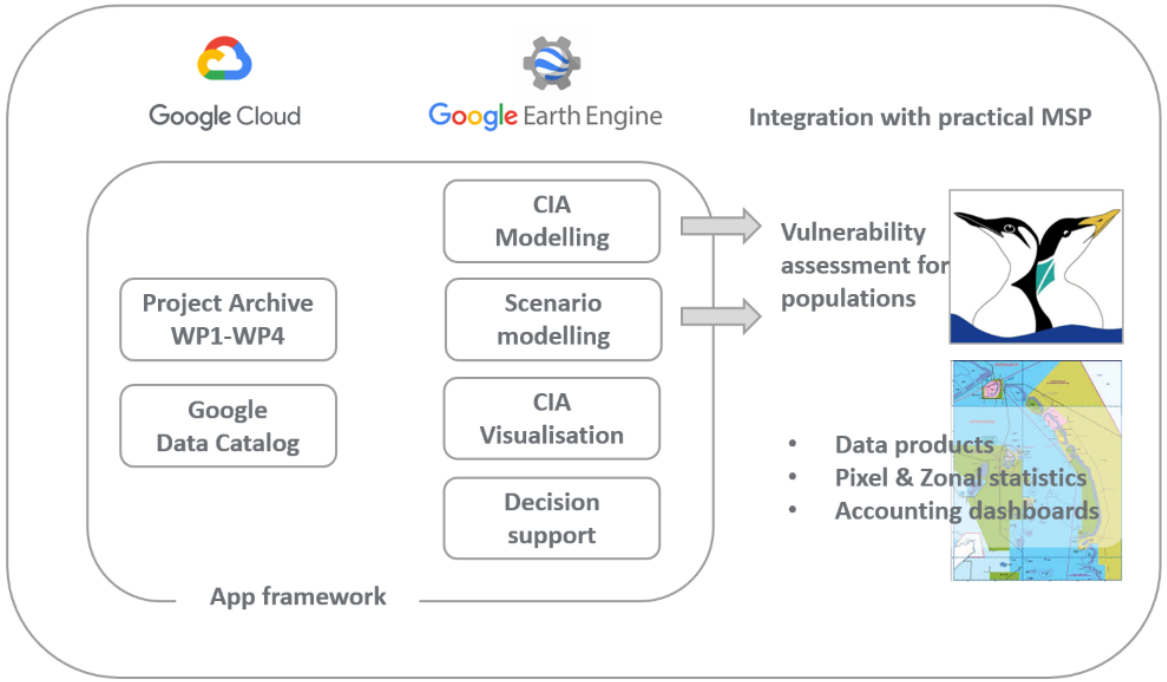
Population trends

WP5 Toolbox for Cummulative Impact Assessment and Marine Spatial Planning (MARCIS App)

- *Goal: develop the MARCIS App bases on the CIA framework of Halpern et al. 2008*

$$\mathrm{I}(\mathrm{x},\mathrm{y}) = \sum_{i-1}^{n}\sum_{j-1}^{m} P_i * Ej * \mu_{ij}$$

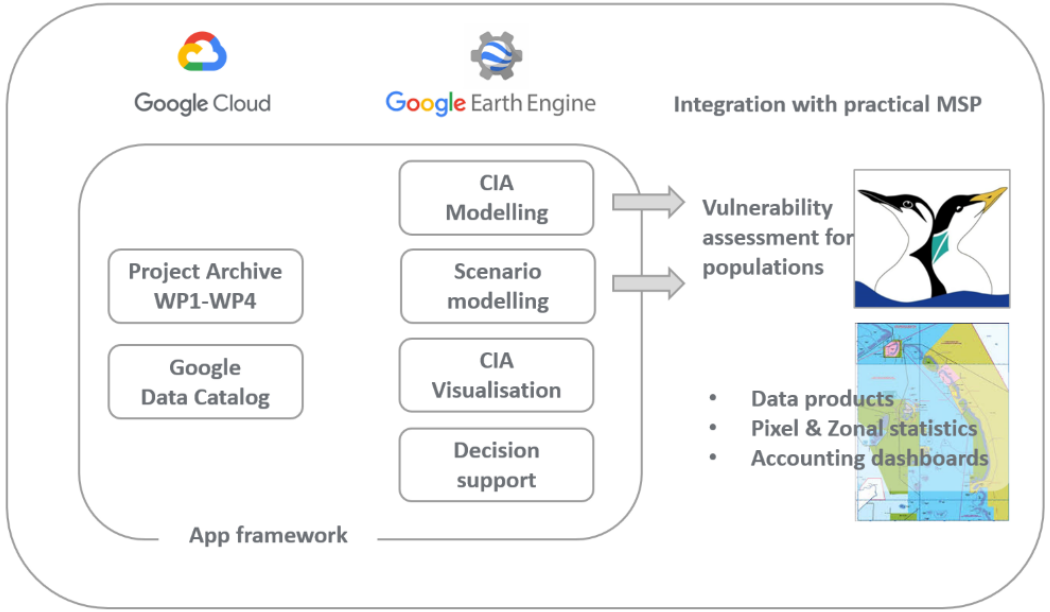
- *Sensitivity weights will be based on input from WP1, 2, 3 and 4*
- *App will be developed in Google Earth Engine*



WP5 MARCIS App Deliverable:

- Web-based decision-support tool to
  - assess spatially-explicit consequences of marine development (and value creation) on seabird populations
  - assess consensus-based development scenarios

  - Future oriented and flexible:
    - Possible to include new areas and species



WP6 Stakeholder involvement and science-policy interface

Goal: ensure co-design and co-development of future scenario-based cummulative Impact Assessment and marine spatial planning

- Involves representatives from relevant industry, management and NGOs

- Meetings and workshops (first meeting planned in Feb 2022)

Thank you!

List of participants:

NINA: Tone Kristin Reiertsen (PI), Per Fauchald, Arnaud Tarroux, Roel May, Anna Nilsson, Børge Moe, Signe Christensen-Dalsgaard, Kate Layton-Matthews, Kjell Einar Erikstad, Tycho Anker-Nilssen, Nina Dehnhard, Frank Hanssen, Geir Systad, Tessa Bargman, Berit Köhler

ERI-UHI: Elizabeth Masden

CEH, UK: Francis Daunt and Kate Searle

Uni Reading: Kevin Hodges

NPI: Hallvard Strøm, Sebastien Descamps

Equinor: Tonje Rogstad (PI), Arne Myhrvold, Anne Laure-Szymanski, Kari Mette Murvold, Endre Aas

NTNU: Vidar Grøtan

IMR: Ulf Lindstrøm and Elena Eriksen

Forskningsrådet

NINA

equinor

UK Centre for Ecology & Hydrology

eri environmental research institute

TOTAL

AKER OFFSHORE WIND

University of Reading

NORSK·POLARINSTITUTT

RWE

OFFSHOREWIND Norwegian Offshore Wind Cluster