Ocean Observation System

A FULL SCALE TEST ARENA FOR:

- maritime technologies and operations;
- navigation and ship traffic control technology and methods;
- search, rescue and safety technologies;
- the impact of the ocean coastal infrastructure;
- technology for harvesting ocean energies (wind, wave, current)
- technology for harvesting and cultivation of bio resources;

for research, education, innovation and business

NTNU
Norwegian University of Science and Technology

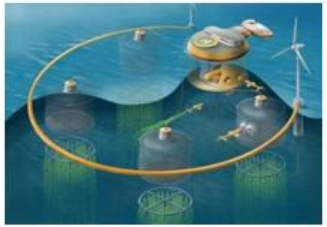
Ocean Space Centre

Ocean Space Centre

Shipping - godstransport

Fiskerier

Akvakultur



Olje og gass

Arktisk teknologi

Turisme

Havvind

Kystinfrastruktur

Overvåking og havvitenskap

Havbunnsmineraler

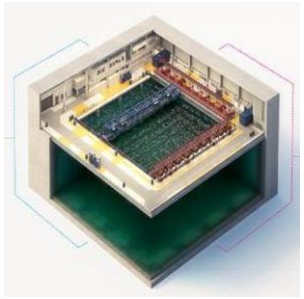
Why Ocean Space Observations Systems?

Modelling of physical phenomenon

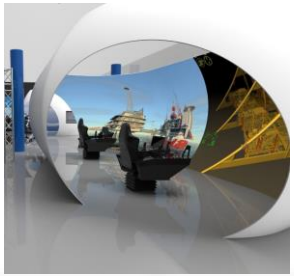
$$\frac{\partial(\rho u)}{\partial t}+\nabla\cdot(\rho uU)=-\frac{\partial p}{\partial x}+\nabla\cdot(\mu\cdot\nabla(u))$$
$$\frac{\partial(\rho v)}{\partial t}+\nabla\cdot(\rho vU)=-\frac{\partial p}{\partial y}+\nabla\cdot(\mu\cdot\nabla(v))$$
$$\frac{\partial(\rho w)}{\partial t}+\nabla\cdot(\rho wU)=-\frac{\partial p}{\partial z}+\nabla\cdot(\mu\cdot\nabla(w))-\rho\cdot g$$

Simulation

Scaled laobratories

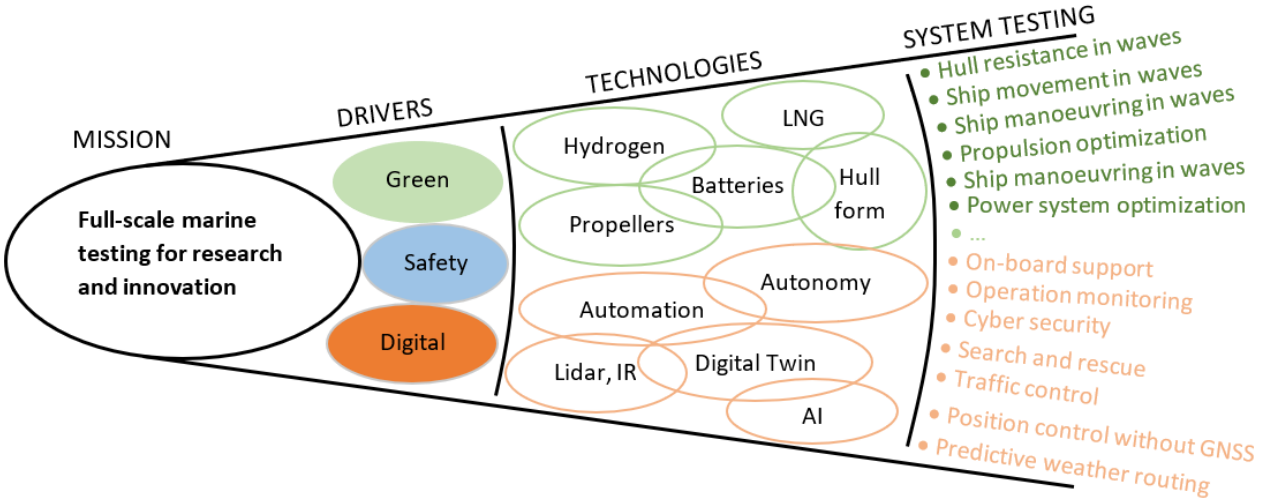


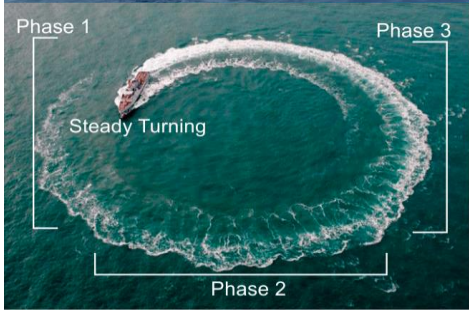
Full scale testing



From numerical models to scale laboratories to full scale testing

Why Ocean Space Observations Systems?





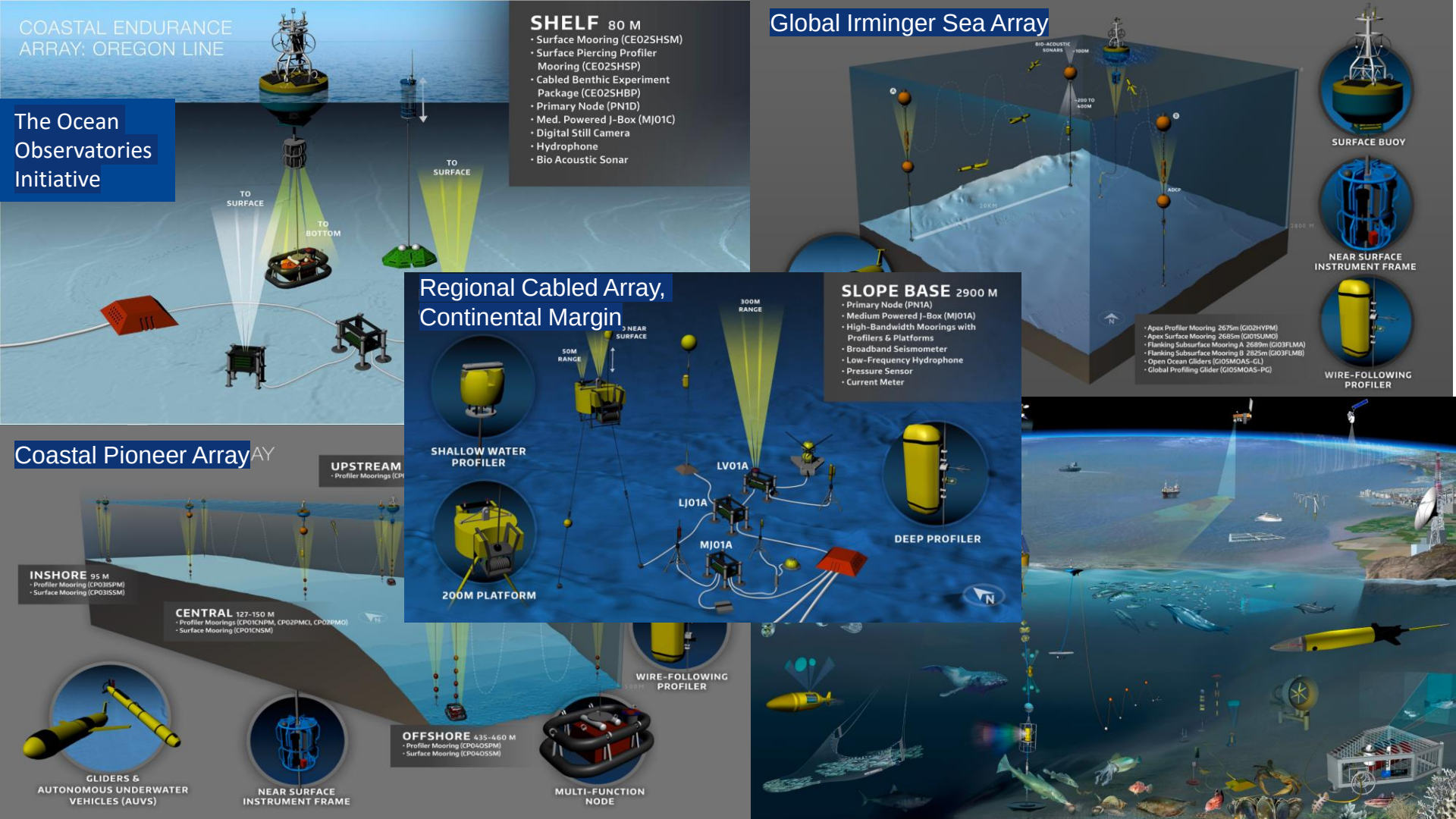
Why Ocean Space Observations Systems?

Availability of data throughout systems lifetime

https://ccrasocal.com/how- data-availability-is-changing-the-commercial-real-estate

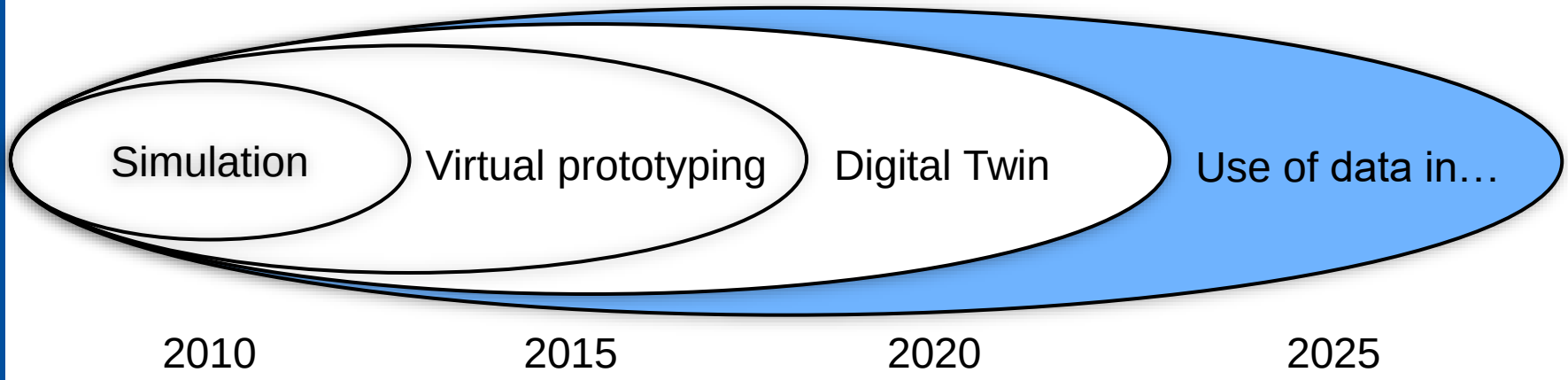
Why Ocean Space Observations Systems?

Smart City Initiatives


COASTAL ENDURANCE ARRAY: OREGON LINE
The Ocean Observatories Initiative
SHELF 80 M
• Surface Mooring (CE02SHSM)
• Surface Piercing Profiler Mooring (CE02SHSP)
• Cabled Benthic Experiment Package (CE02SHBP)
• Primary Node (PN1D)
• Med. Powered J-Box (MJ01C)
• Digital Still Camera
• Hydrophone
• Bio Acoustic Sonar
TO SURFACE
TO SURFACE
TO BOTTOM
Global Irminger Sea Array
SURFACE BUOY
NEAR SURFACE INSTRUMENT FRAME
WIRE-FOLLOWING PROFILER
• Apex Profiler Mooring 2675m (GI02HYPM)
• Apex Surface Mooring 2685m (GI01SUMO)
• Flanking Subsurface Mooring A 2689m (GI03FLMA)
• Flanking Subsurface Mooring B 2825m (GI03FLMB)
• Open Ocean Gliders (GI05MOAS-GL)
• Global Profiling Glider (GI05MOAS-PG)
Regional Cabled Array, Continental Margin
SLOPE BASE 2900 M
• Primary Node (PN1A)
• Medium Powered J-Box (MJ01A)
• High-Bandwidth Moorings with Profilers & Platforms
• Broadband Seismometer
• Low-Frequency Hydrophone
• Pressure Sensor
• Current Meter
SHALLOW WATER PROFILER
200M PLATFORM
DEEP PROFILER
LV01A
LJ01A
MJ01A
Coastal Pioneer Array
UPSTREAM
INSHORE 95 M
• Profiler Mooring (CP03ISPM)
• Surface Mooring (CP03ISSM)
CENTRAL 127-150 M
• Profiler Moorings (CP01CNPM, CP02PMCI, CP02PMO)
• Surface Mooring (CP01CNSM)
OFFSHORE 435-460 M
• Profiler Mooring (CP04OSPM)
• Surface Mooring (CP04OSSM)
WIRE-FOLLOWING PROFILER
GLIDERS & AUTONOMOUS UNDERWATER VEHICLES (AUVS)
NEAR SURFACE INSTRUMENT FRAME
MULTI-FUNCTION NODE

Why Ocean Space Observations Systems?

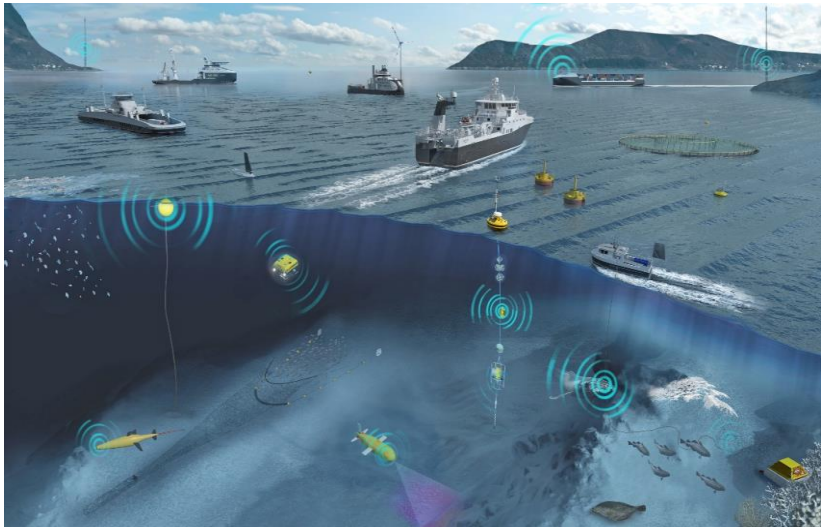
Why Ocean Space Observations Systems?



The Ocean Observation Systems

Application areas for testing

- Maritime technology & op.
- Navigation and ship traffic
- Search, rescue and safety
- Impact on infrastructure
- Technology for harvesting and cultivation of bio res.
- Ocean observation technologies and methods



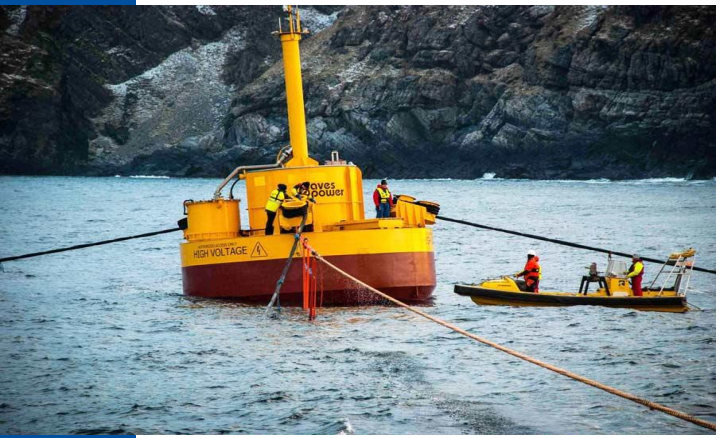
Infrastructure

- Wind
- Current
- Waves
- Tide
- Sea level
- Environmental
- Hydrophones
- Metrology

For forskning, undervisning, innovasjon og næringsliv

Ocean Observation Systems - energy

Wave energy farms



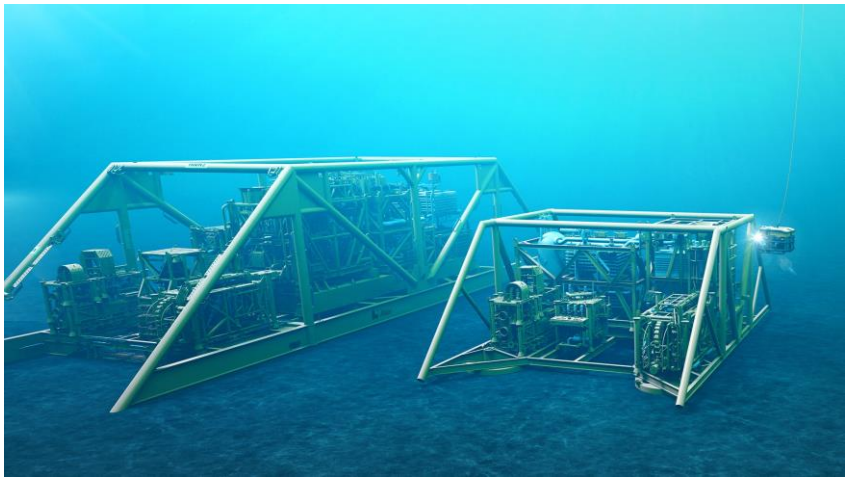
Current energy farms

Floating offshore wind

Ocean Observation Systems - subsea

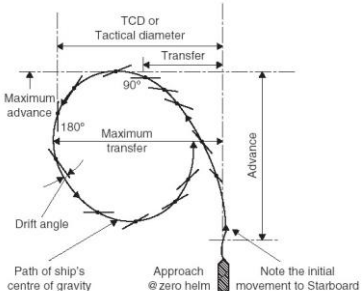
Subsea lifting

Subsea installation



Ocean Observation Systems - ship trial

Manoeuvring



Ship in a variety of conditions

Equipment

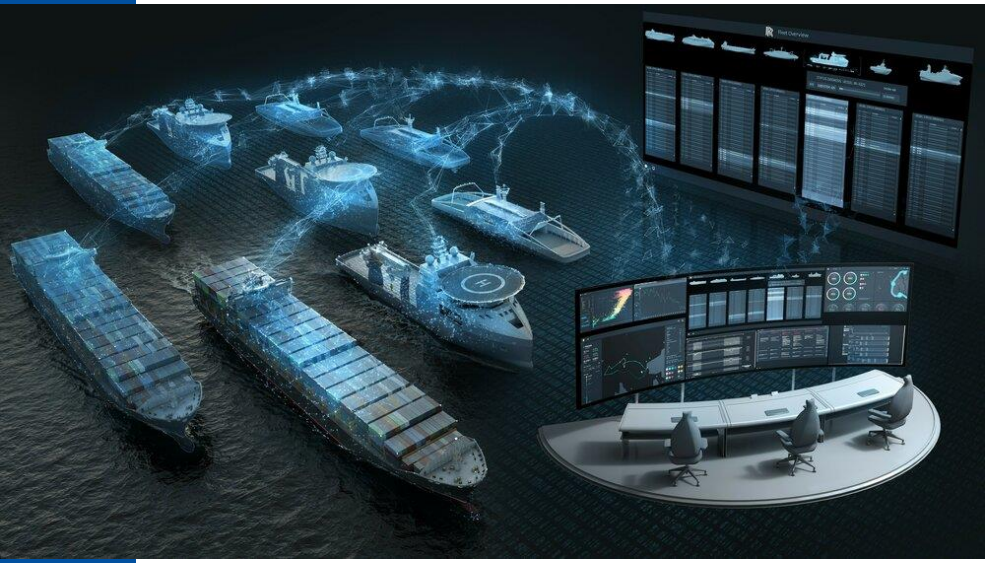
Ocean Observation Systems - fishing

Trawling

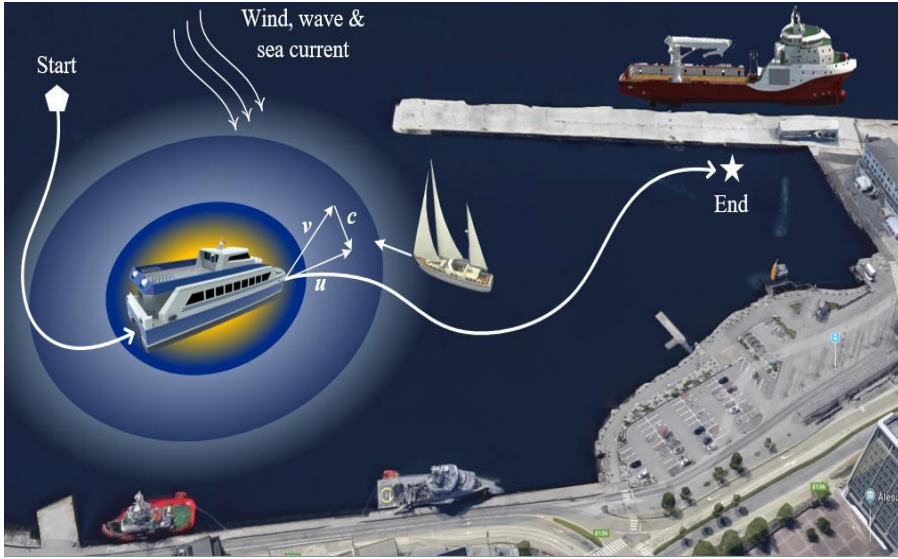
Spinning wad

Ocean Observation Systems - autonomy

Autonomy ROC



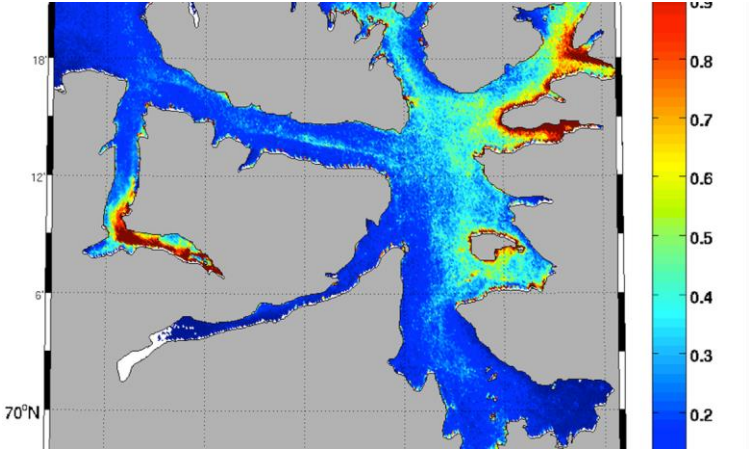
Automatic docking



Ocean Observation Systems - aquaculture

Ship – Aquaculture operations

Sea lice dispersal



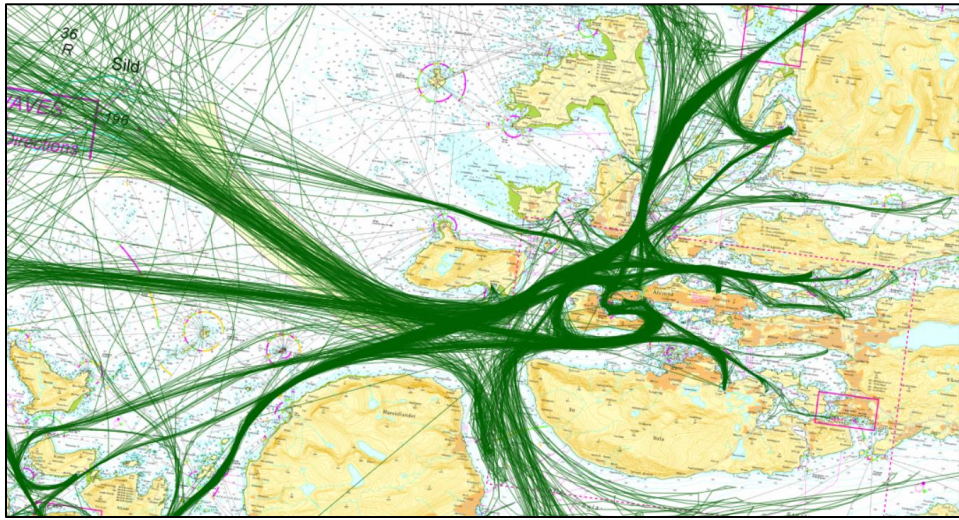
Ocean Observation Systems - infrastructure

Bridges & roads & quays

Cities and villages

Ocean Observation Systems - ship traffic

Ship traffic control & navigation & routing

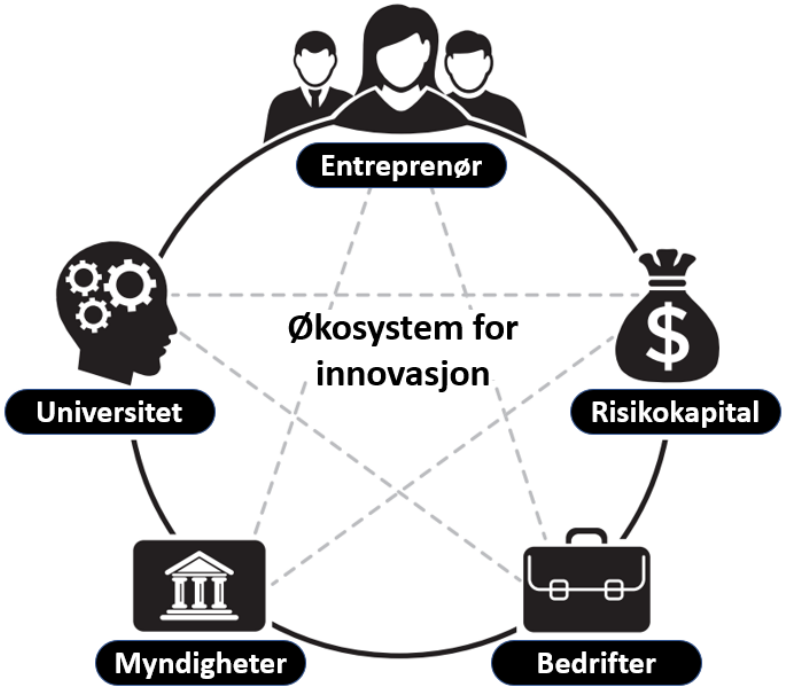


Ocean Observation Systems - innovation

Bluewild Finnøy Ulstein Evotec C-flow PTG Westcon

Ocean Observation System
- eco system for innovation

Growth strategy

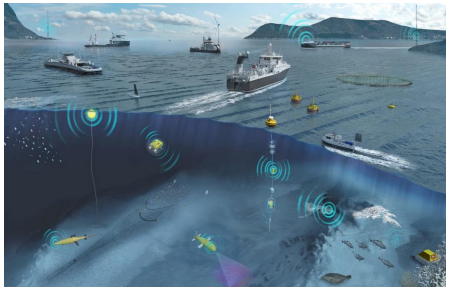


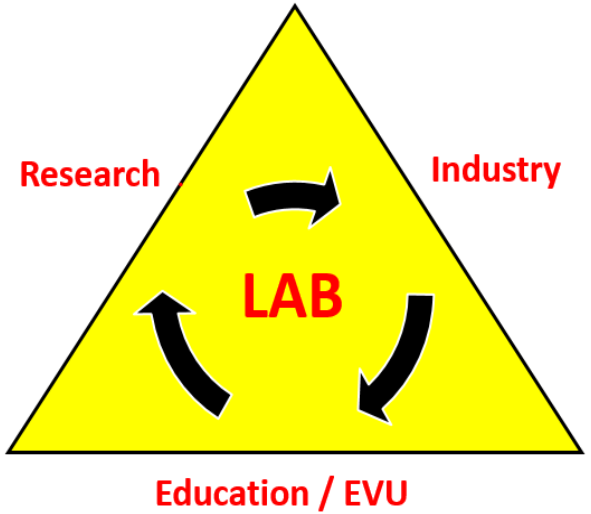
Ocean Observation System, - eco system for innovation

ManuLAB

ROC

Fjordlab Ålesund





Våre laboratorier som møteplass mellom akademia og nærings- og arbeidsliv

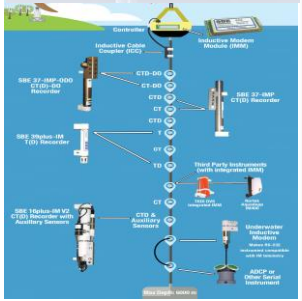
Marine Ocean Ecosystem

NTNU

Harbour

Work boat

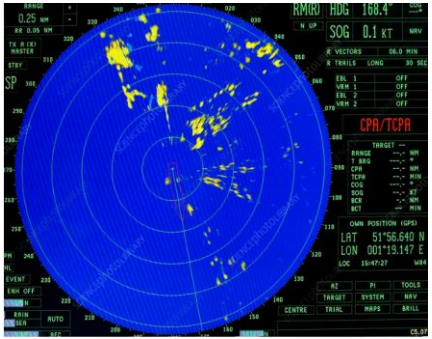
Buoys



USV

USV plattform

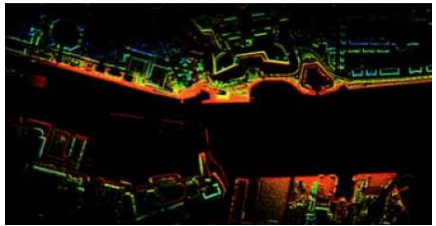
Radar



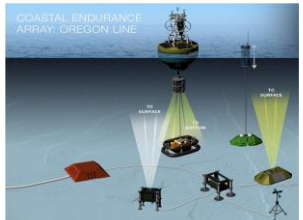
Visualisation and data management

Drone plattform

Lidar



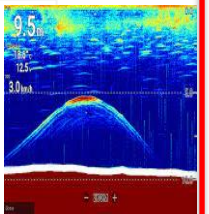
Sea-Bed Observations



ADCP

Hydrophones

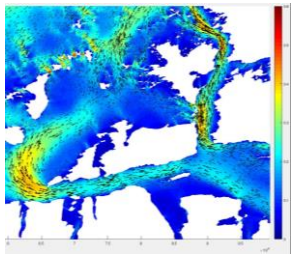
Sonar

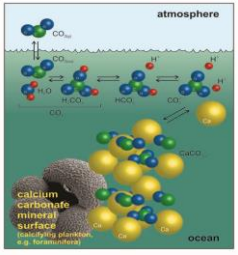


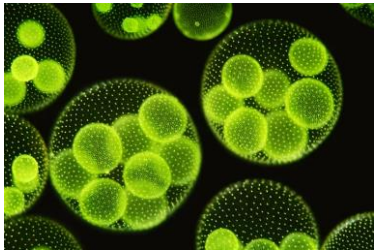
Marine Ocean Ecosystem

Hvordan forstå havet?

Fysikk Kjemi Biologi



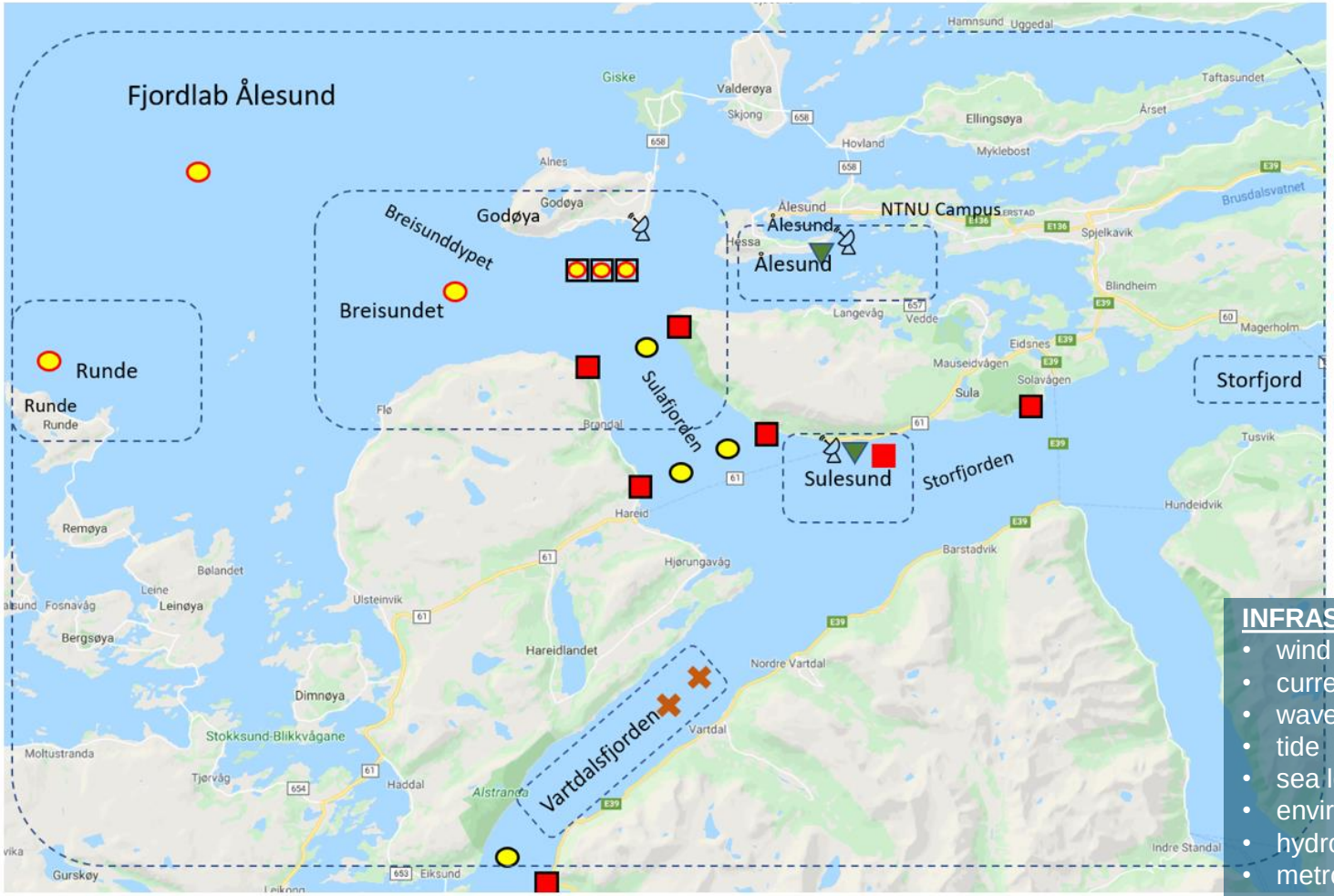




Forståelse → Analyse, visualisering, modeller → Konsekvenser

Vi trenger tidsserier og vi er nødt til å dekke store volum med målinger.

Marine Ocean Ecosystem

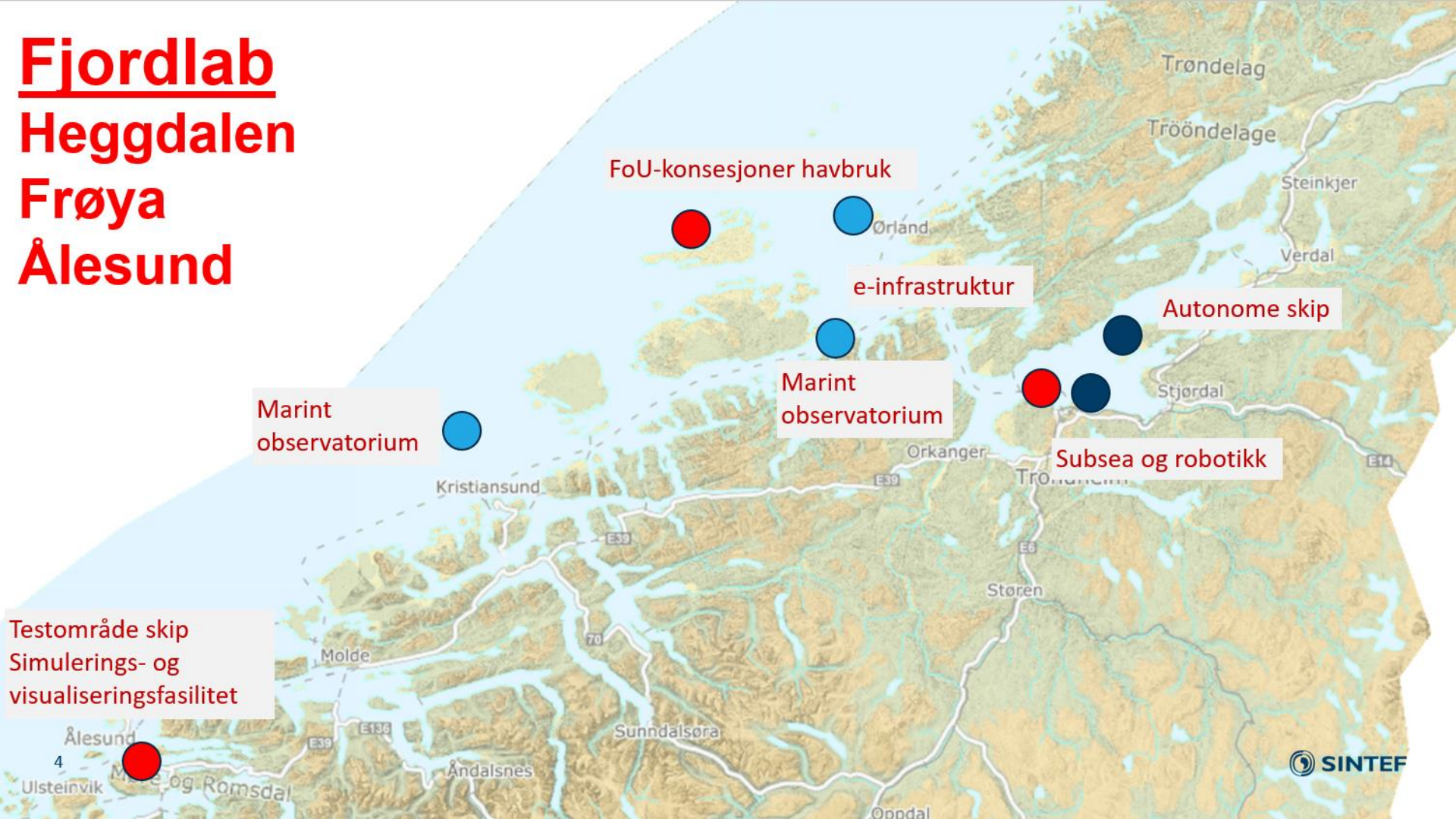


INFRASTRUCTURE

- wind
- current
- waves
- tide
- sea level
- environment
- hydrophones
- metrology

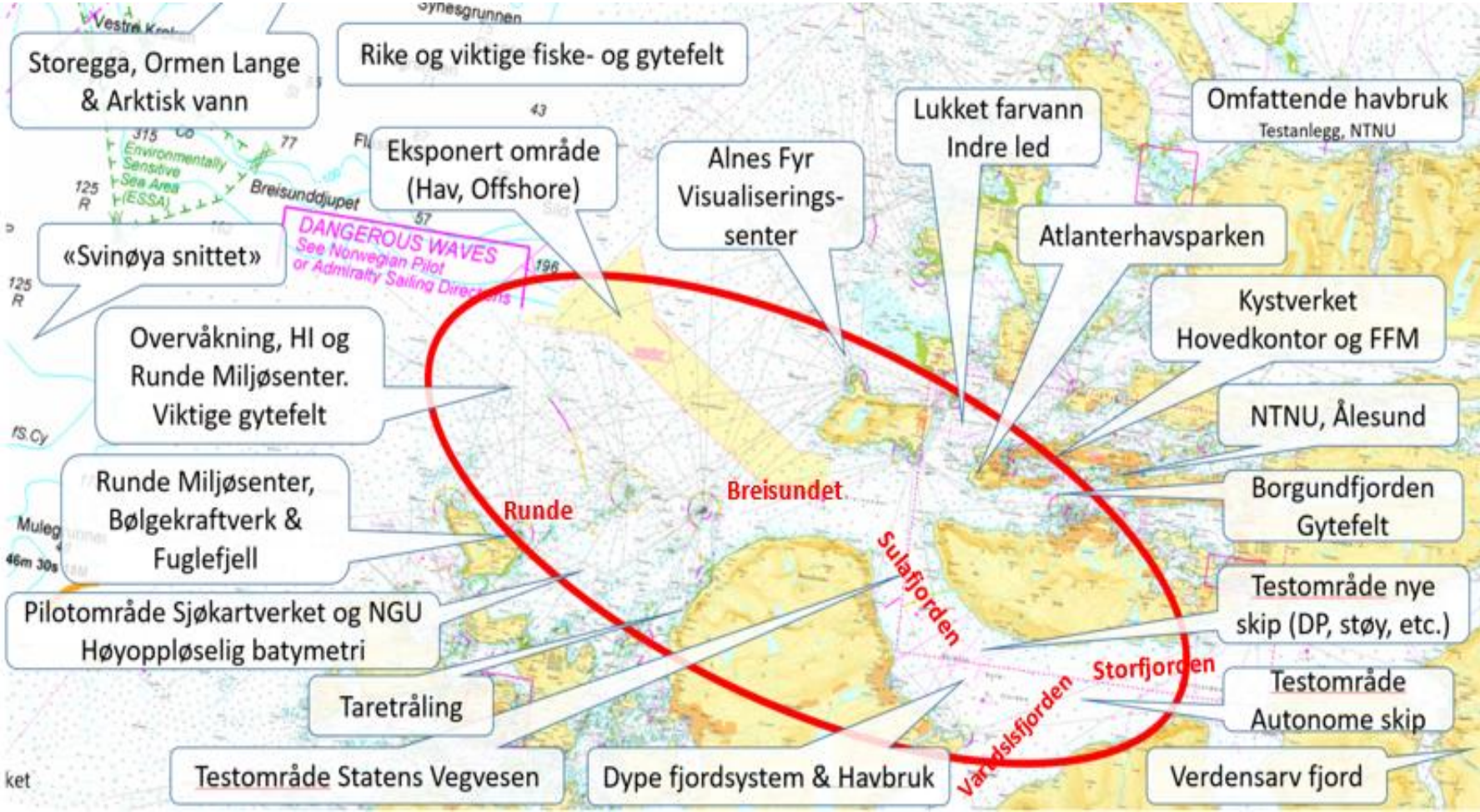
Fjordlab

Heggdalen
Frøya
Ålesund



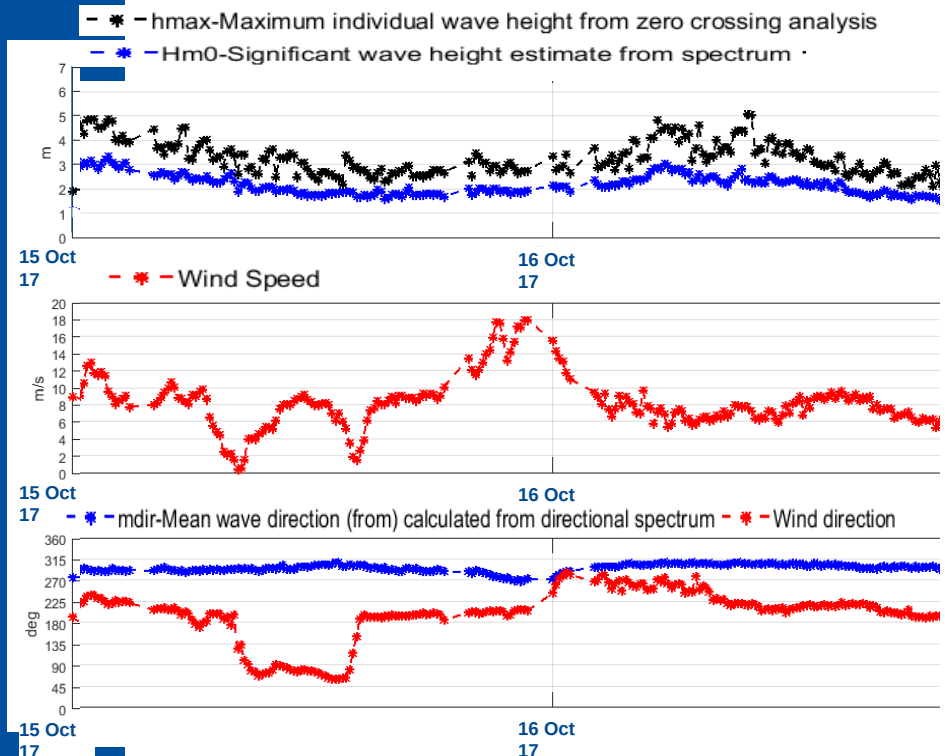
SINTEF

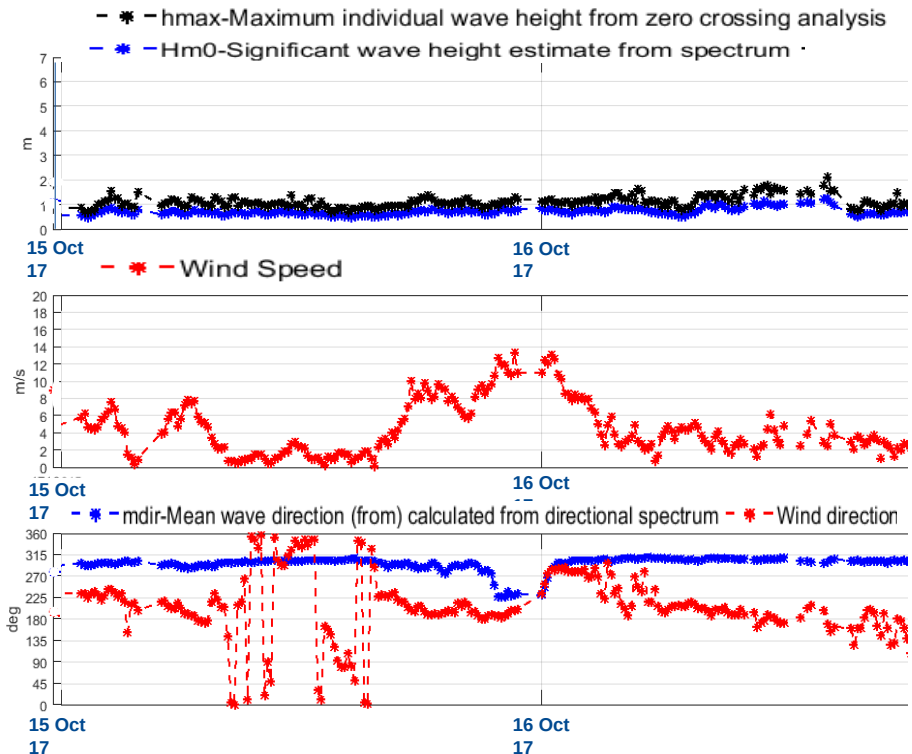
Why in Ålesund



Why in Ålesund

- Ulstein
- Havyard
- Rolls Rolls Marine





Why in Ålesund

Fortsett slik | Hopp tilbake

Storegga

Kant

Vigra

Borgundfjorden

Storfjorden

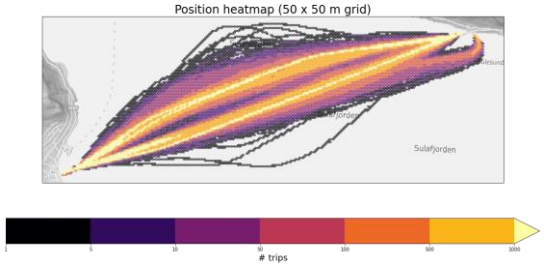
Breisunddjupet

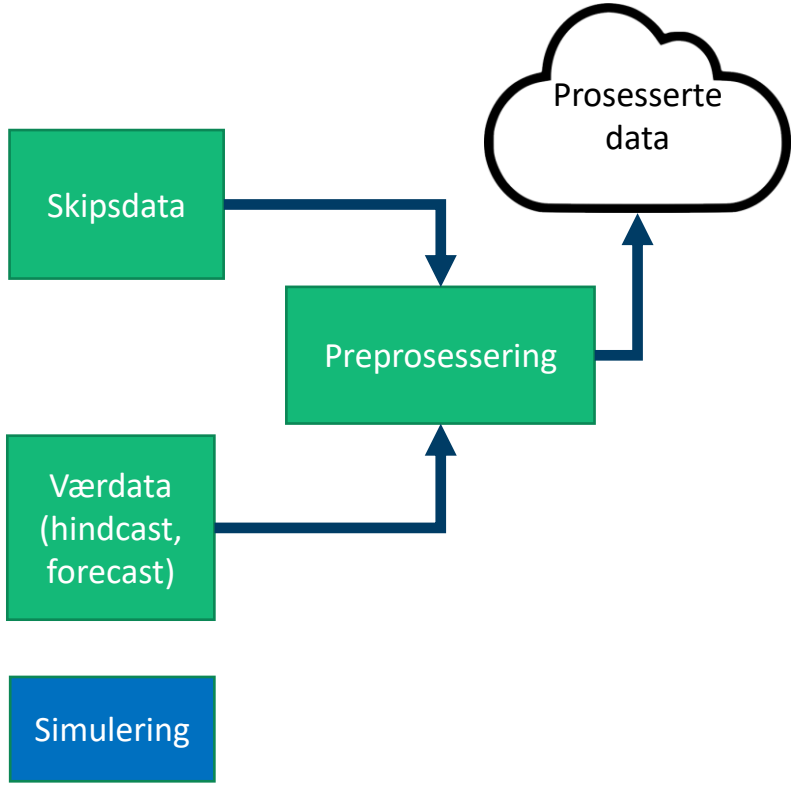
Strøm ---° --- knop | Pil | Mer | Strømkart

Dybdekoter 1 | 2 | 5 | 10 | 20 | 50 | 100 | Multistråle | Beregn | Filtre | Vinkler | Støy | Senter | Backscatter

Kartvalg | ChartWorld | Bakgrunn | Kartnavn | CD-oversikt | ChartWorld-versjoner

Vi har big data!!

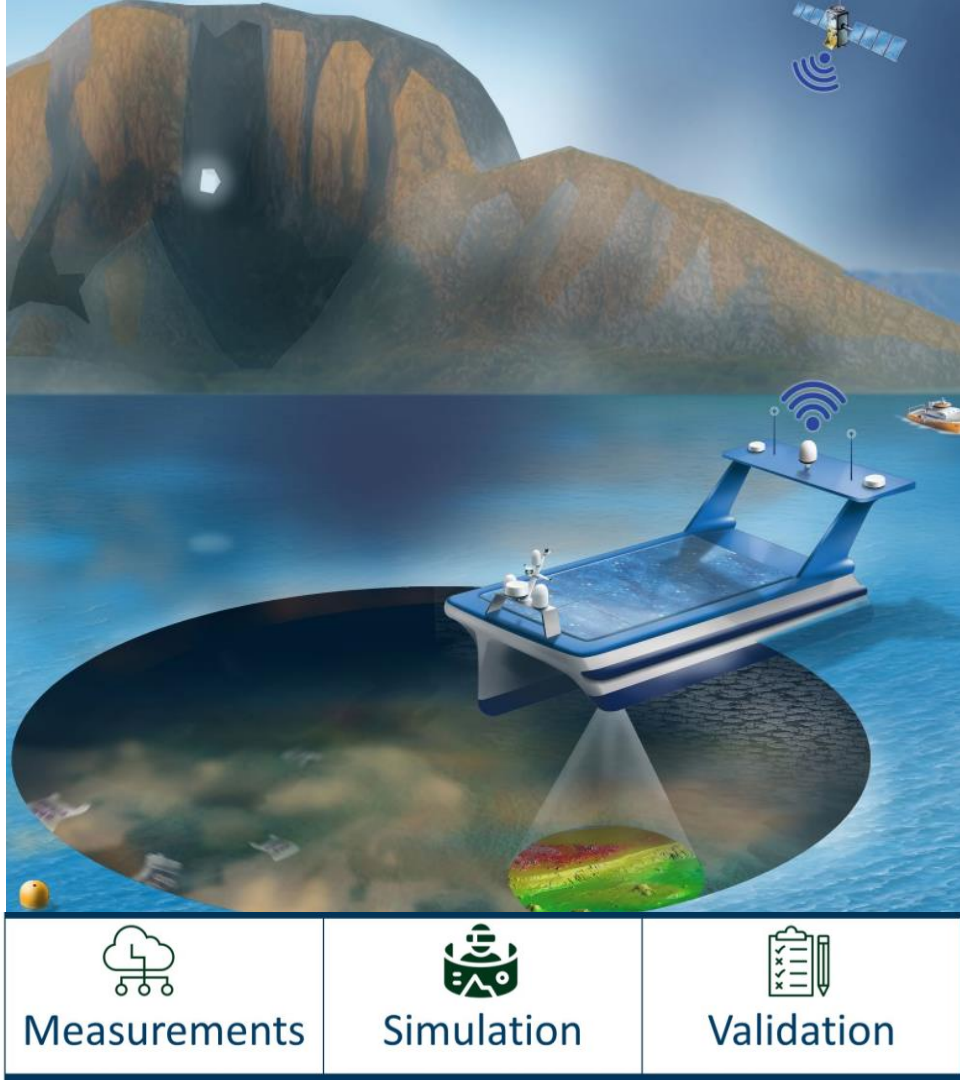




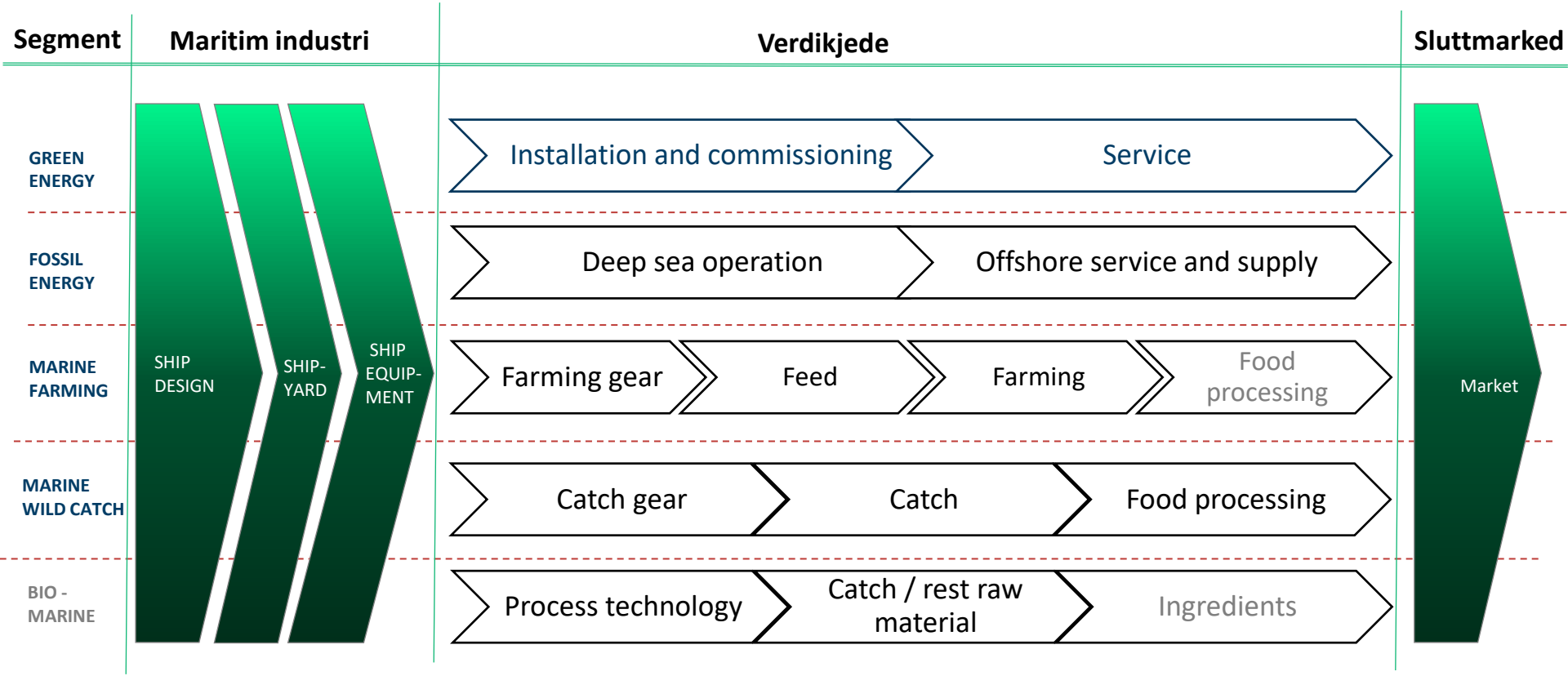
Møre Ocean Lab

Klyngerelevans:

- Produktutvikling
- Design av skip
- Marine operasjoner
- Bærekraftig fiskeri og ressursutnytting
- Prosessering av marine ingredienser

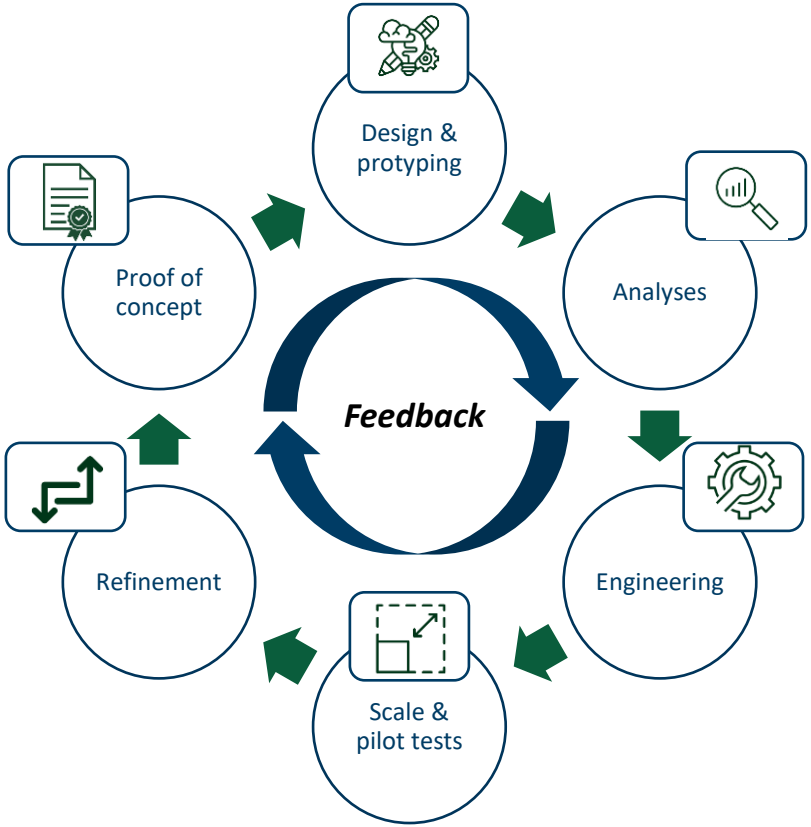


Møre ocean lab - Heile verdikjeden



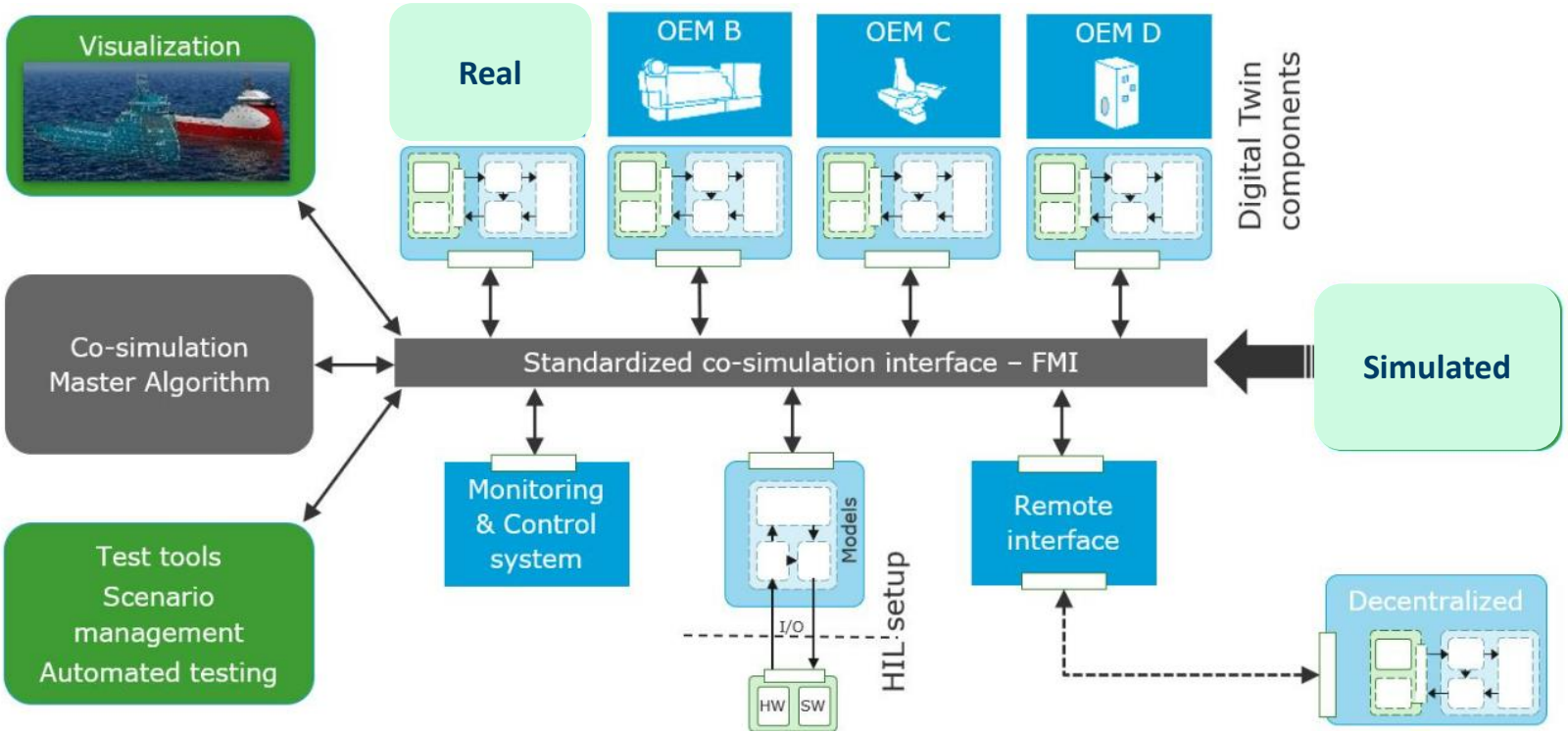
Positiv spiral

Prosessering av marine ingredienser



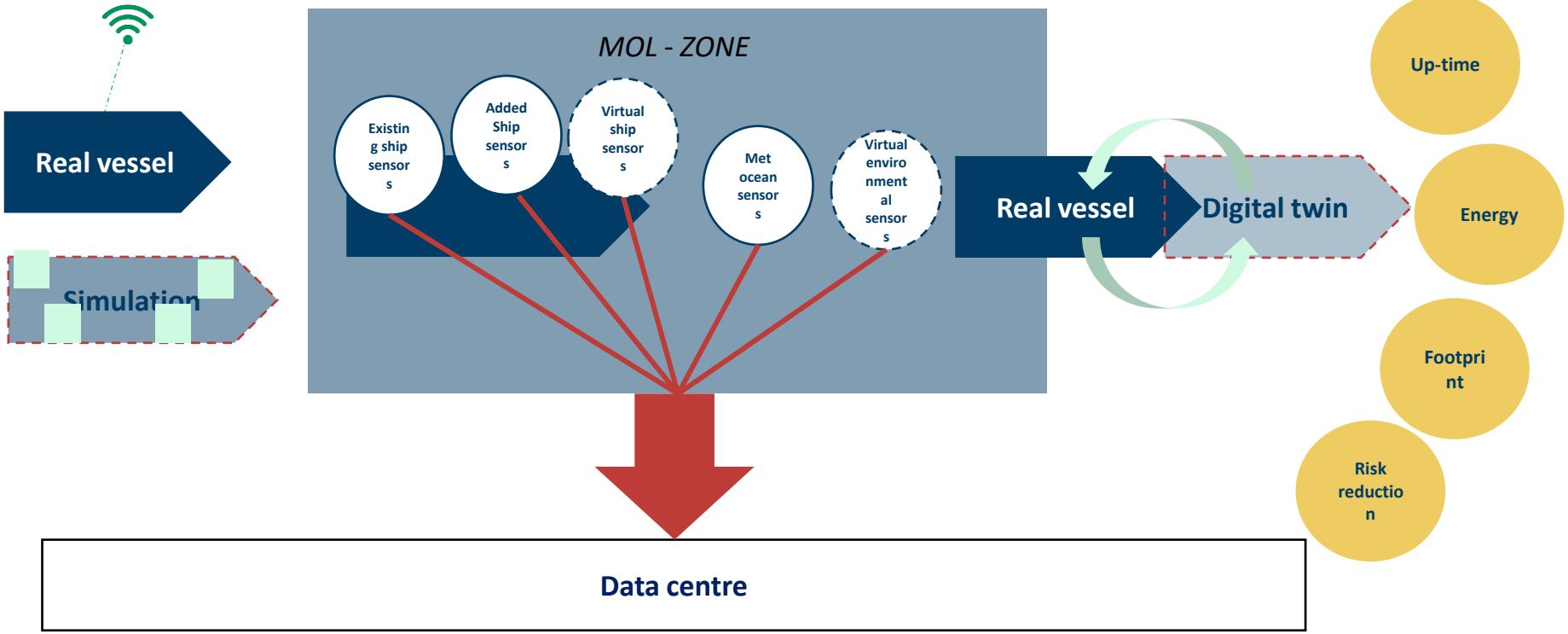
>>>>>>> Accelerator >>>>>>>

Møre Ocean Lab – “x-in-the-loop” / “para-loop”

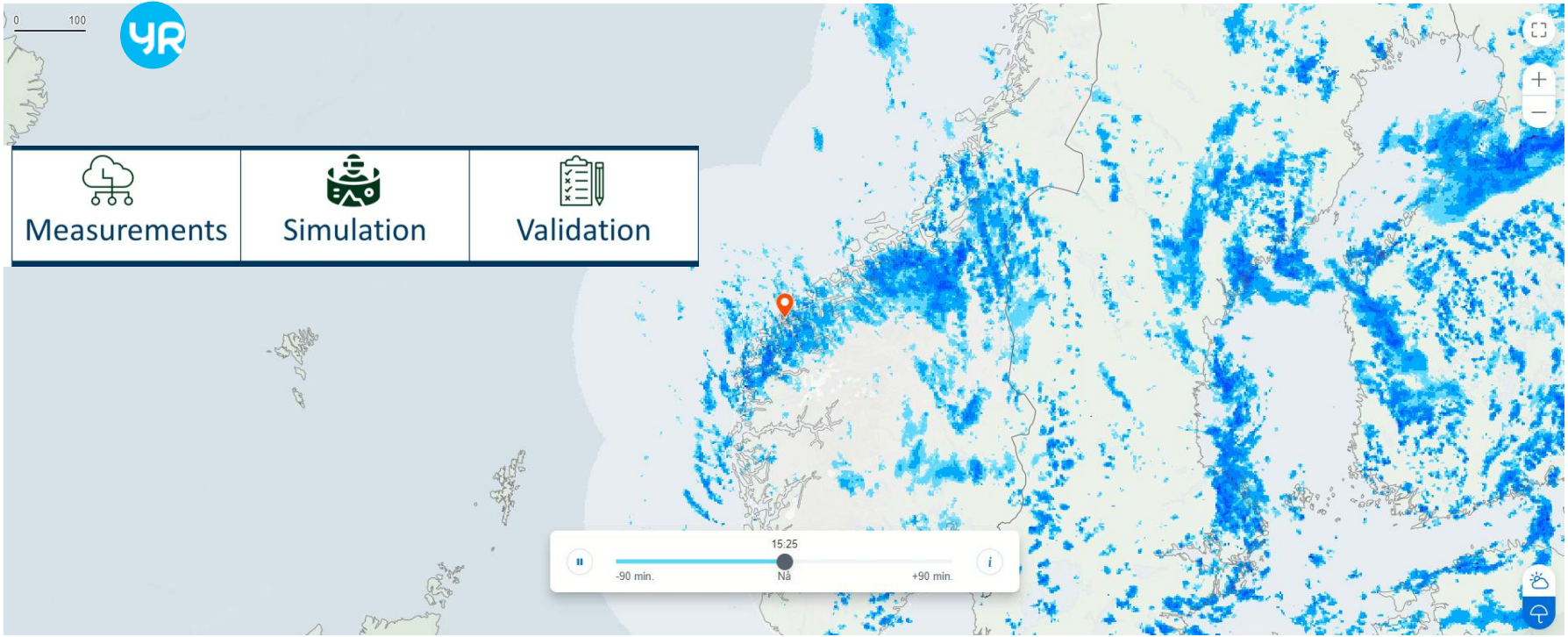


[Open Simulation Platform - Open Simulation Platform]

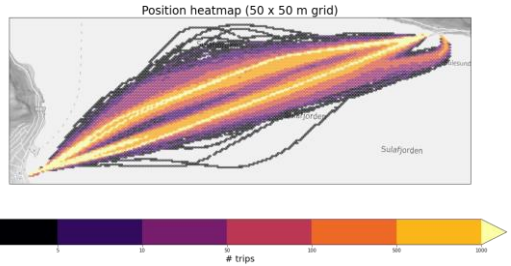
Møre Ocean Lab – **real** digital twin

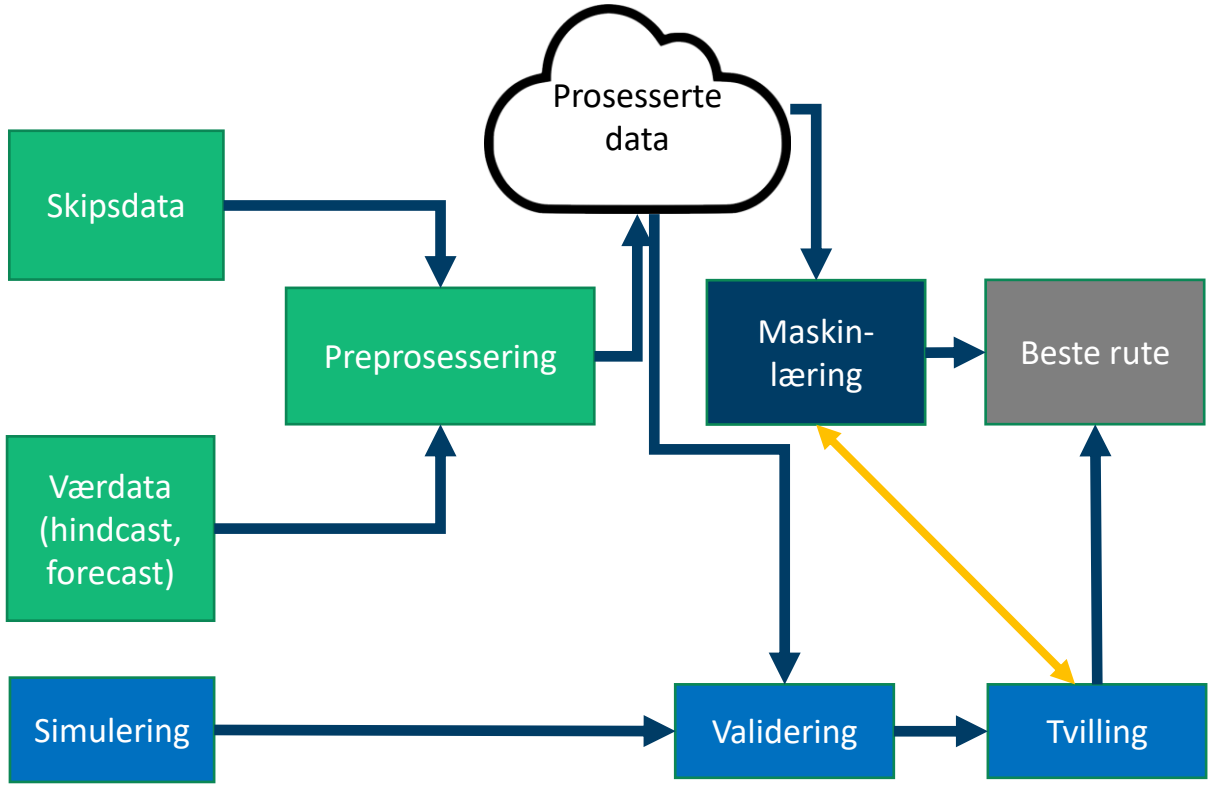


Kvardagseksempel – “Now-casting”

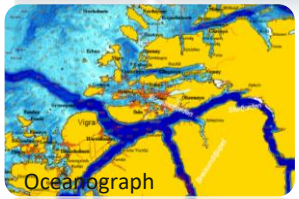


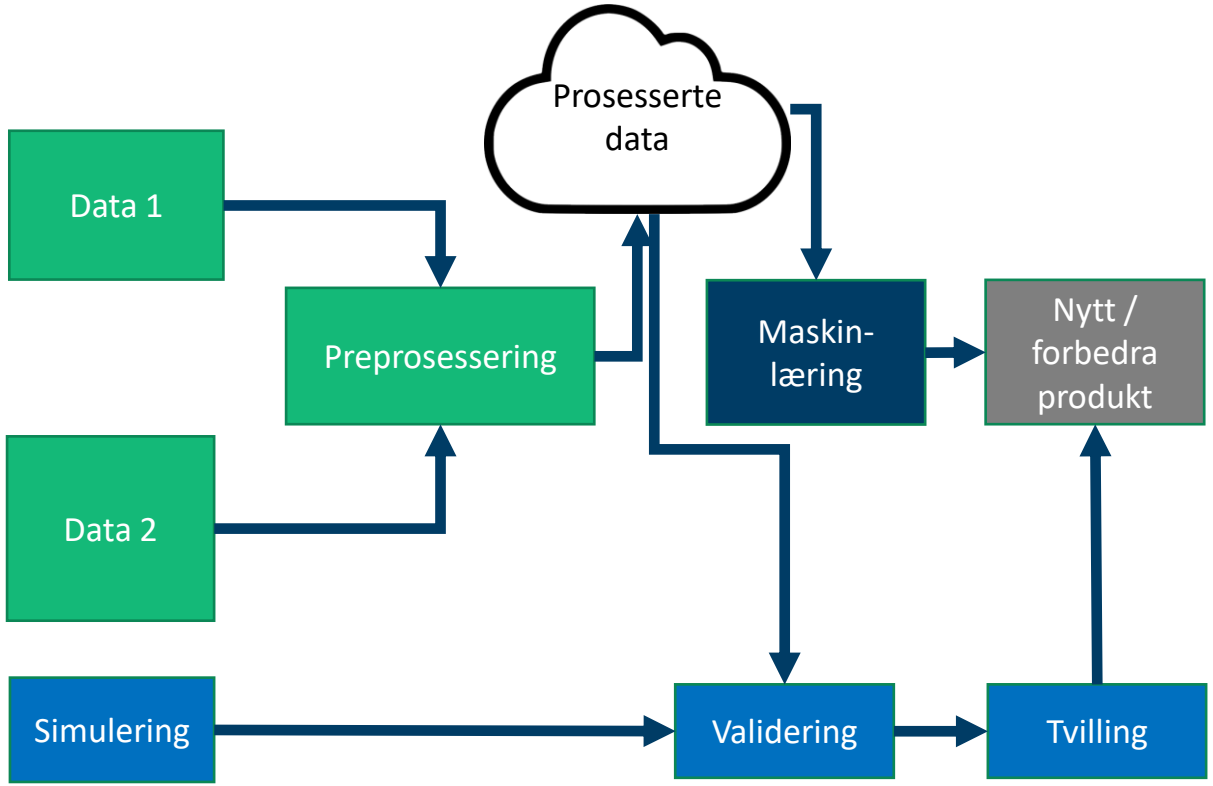
Frå Big data til verdiskaping



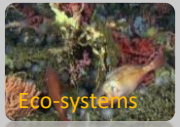
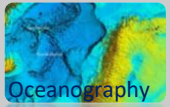
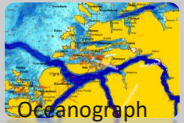


Frå Big data til verdiskaping





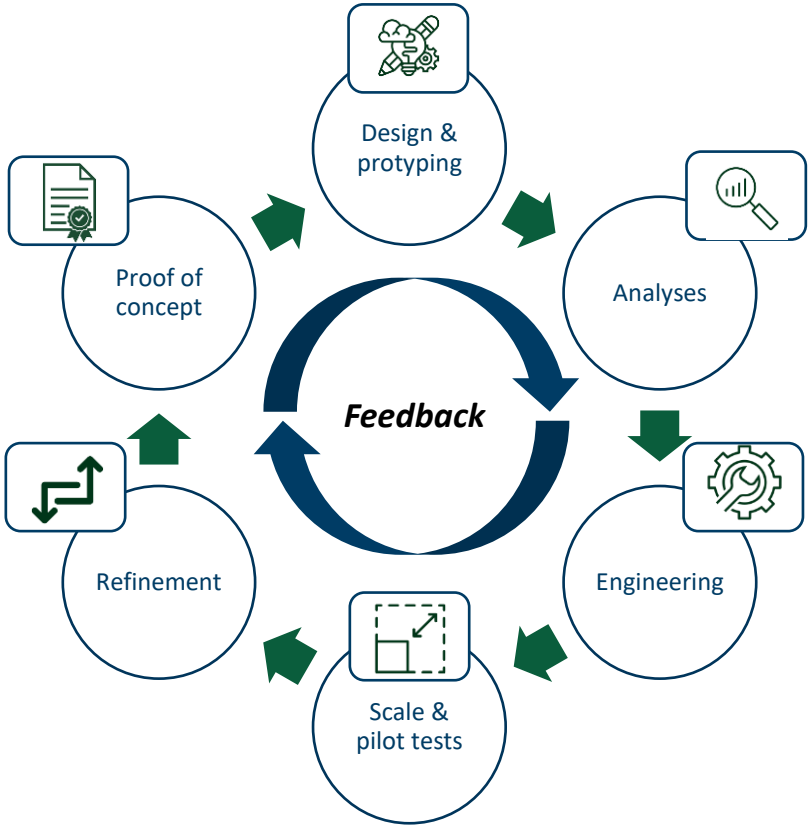
Datatilgang

Ocean Energy	Ship testing	Aqua culture	Sub Sea	Maritime equipment	Control systems	Coastal structures	Bio-marine	Marine ingredients
 Wind	 Energy	 Farms	 ROV / AUV	 Energy saving	 New functions	 Bridges & tunnels	 Eco-systems	 Quality
 Waves	 Properties	 Operations	 Lifting	 Ship equipment	 Autonomy	 Infrastructure	 Oceanography	 New utilization
 Current	 Operations	 Oceanography	 Installation	 Mission equipment	 Stress testing	 Navigation	 Topograpgy	 Processes

Infrastruktur

Kva treng vi?

Measurements	Simulation	Validation



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Teknologi for et bedre samfunn