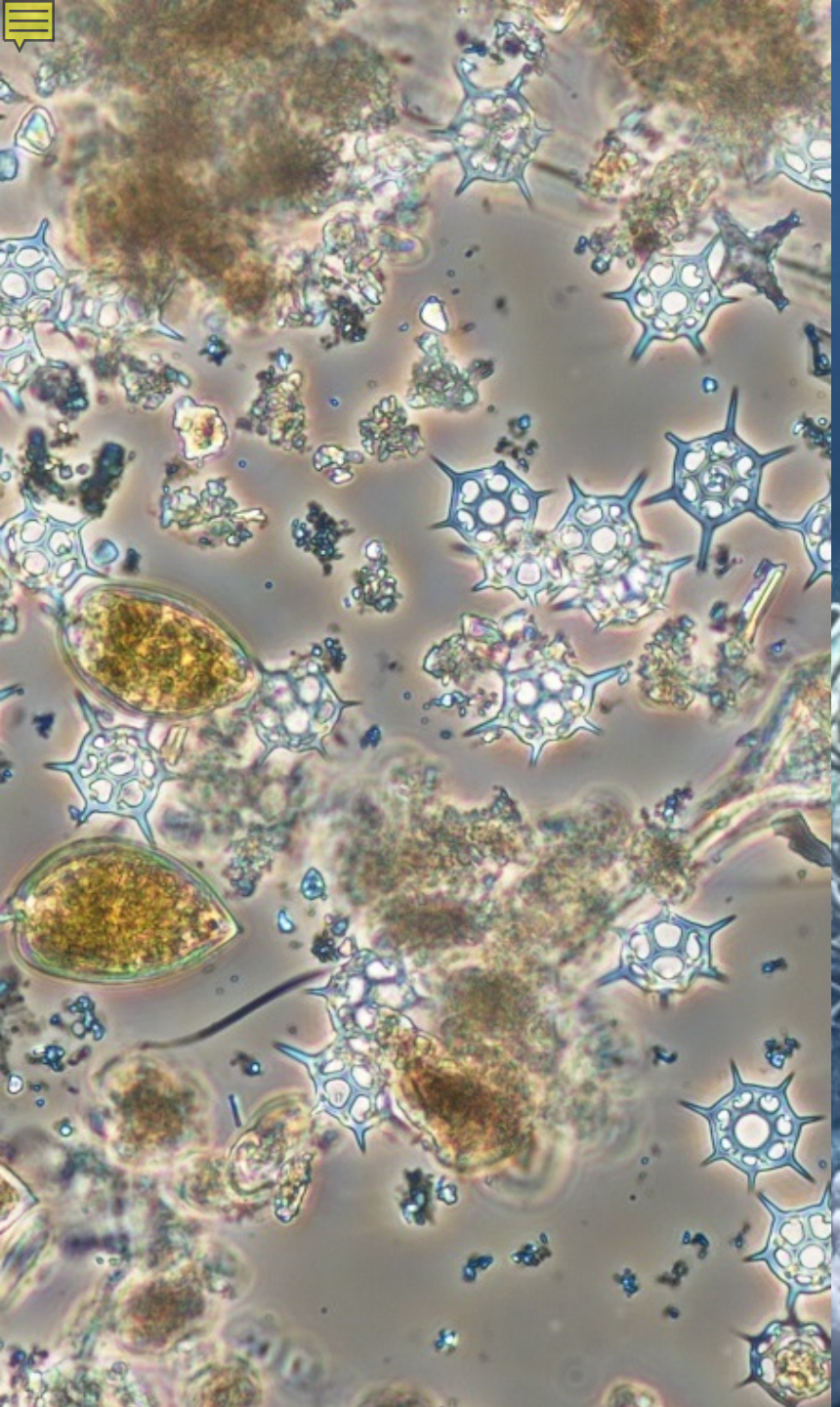
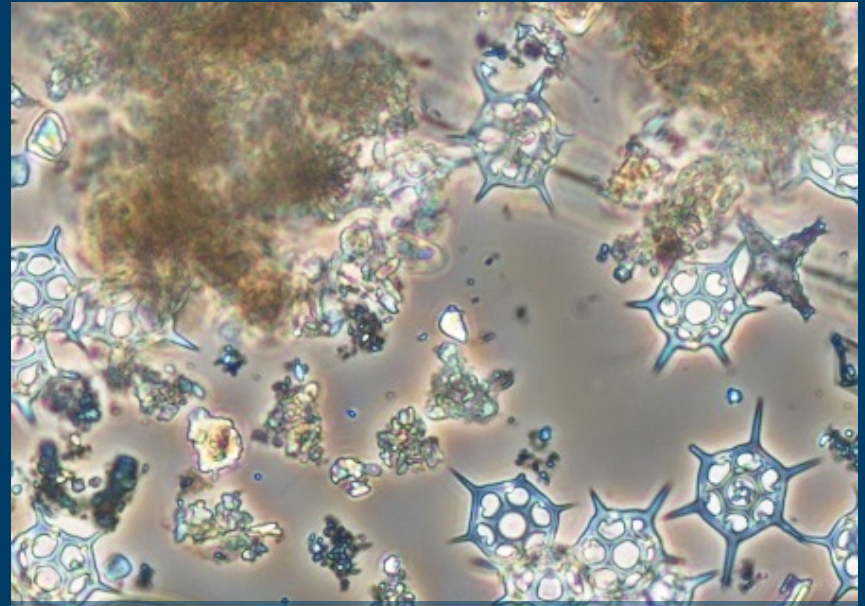


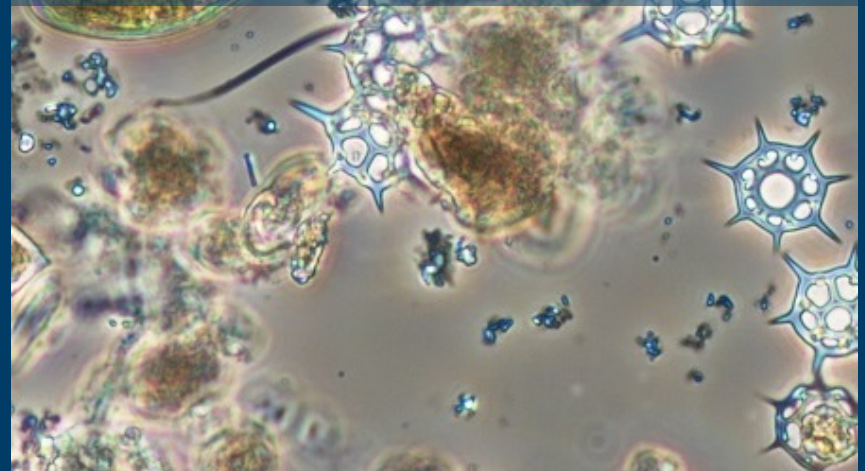
HAB IN NORTHERN NORWAY – WHAT IF WE WOULD HAVE KNOWN EARLIER?

Ute Brönner, Research Manager Marine Modelling,
SINTEF Ocean

SINTEF Ocean



How can we understand, predict and leverage the ocean in a sustainable way?



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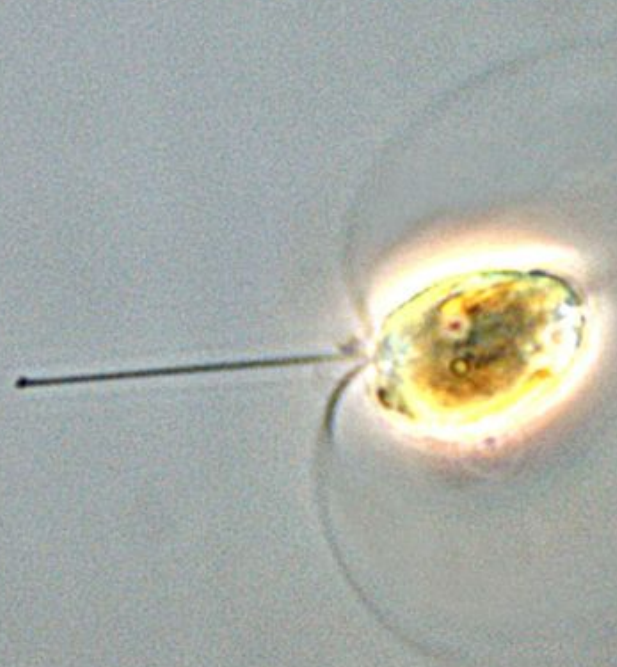
Picture courtesy : NASA

2019 Chrysochromulina leadbeateri

Picture courtesy: NRK, SINTEF

>8 mill. Fish
>16 500 tonnes biomass
12 companies with dead fish
4 companies who had to evacuate fish



May & June 1991
May 2008
May & June 2019

Picture courtesy: Institute for marine research, Algelaboratoriet

Chrysochromulina leadbeateri – common or special?

Common in Norwegian waters	Rather rare harmful blooms
Needs N + P	Needs light + CO_2
37 Chryso-chromulina species	Hemolytic compounds harm gills

Bloomed at the same locations each time

Shows vertical movement to nutrient rich layers

Mixotroph: ability to feed on DOM

Can sustain in deeper, brackish, fresh water

Picture courtesy: Institute for marine research, Algelaboratoriet

SINTEF Ocean staff supported monitoring of algae bloom by water samples

silje.forbord@sintef.no

Silje onboard “KV Heimdal” (coast guard) from 22.05, Johanne Arff, IMR

Sampling program planned with IMR, Directorate of Fisheries and farmers based on (near) hourly updates

Sampling strategies planned and maps/models from SINTEF updated for common understanding of the situation

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Chrysochromulina leadbeateri model

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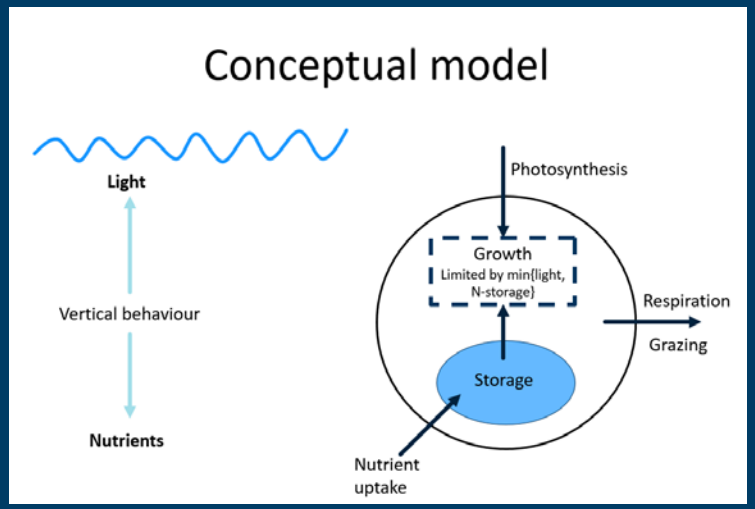
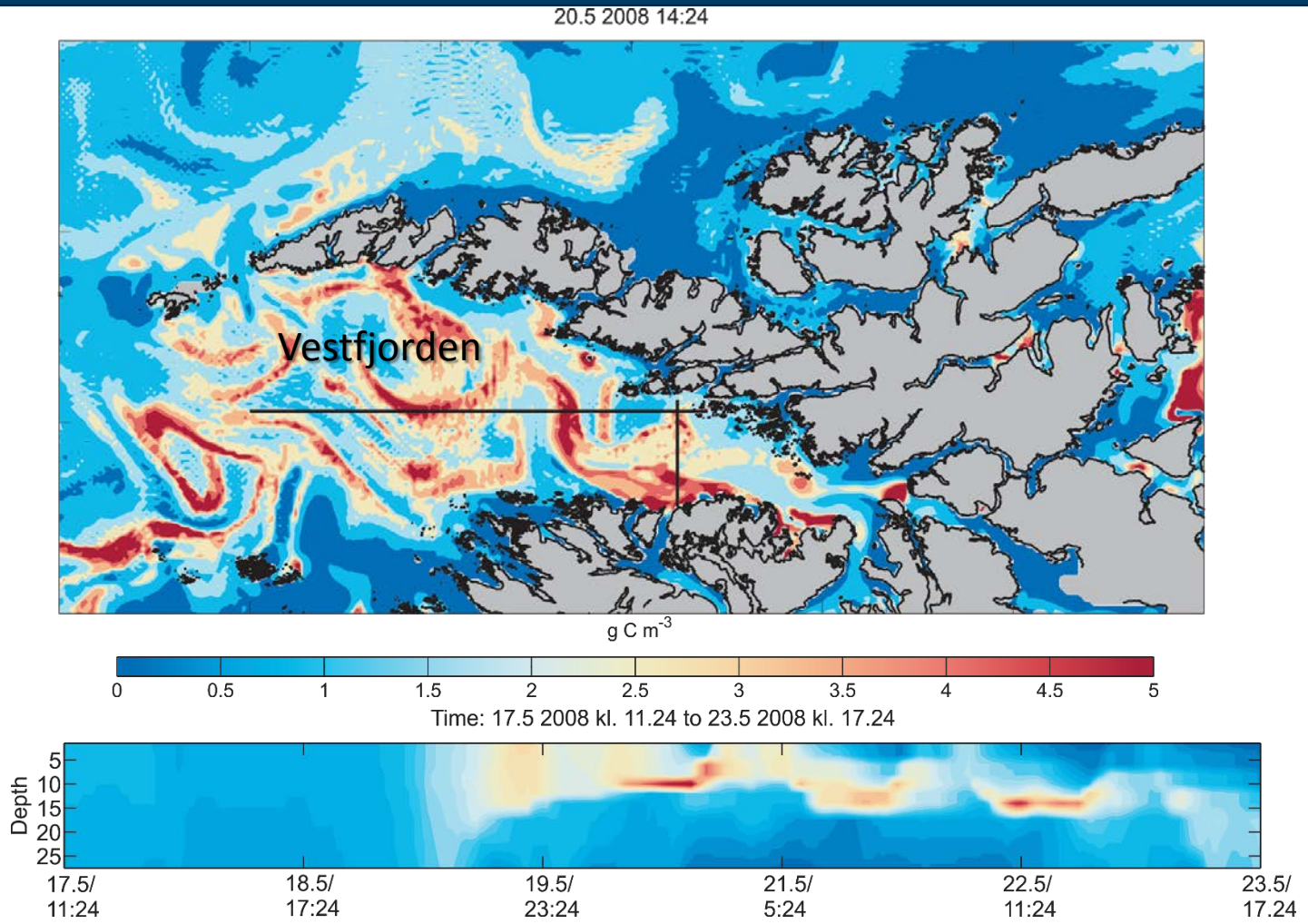
ole.Jacob.broch@sintef.no





- Integrated with coupled ecosystem-ocean model (SINMOD)
- Species specific: Internal nutrient reserve, vertical movement determined by whether light or internal nutrients are limiting

Current status

New or returned bloom of Chrysocromulina in Ofotfjorden (Cermaq/Ballangen)

- 50 000 fish
- 150 tonnes biomass

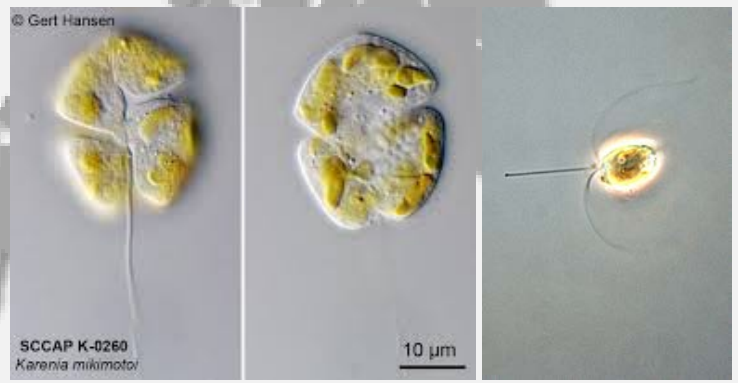
Reported dead fish and behavioural change in Troms (Lerøy Aurora, Kvaløya)
Still high concentrations of
Chrysochromulina and other algae (Phaeocystic)

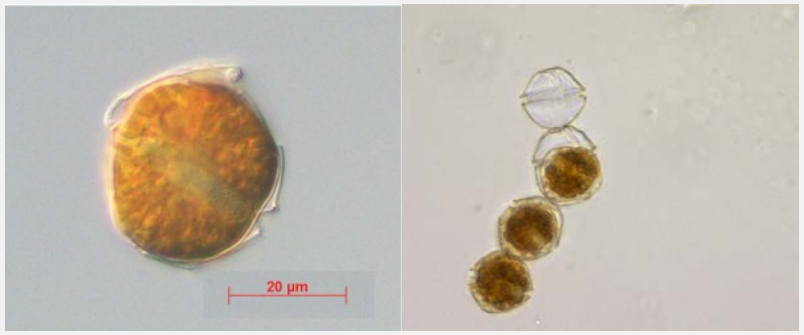
Shifting current direction and transport regime

Picture courtesy: Ballangen Sjofarm

This probably isn't over, yet

Northern Norway: Karenia, Chrysochromulina, toxic

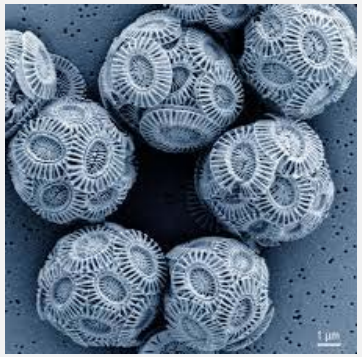


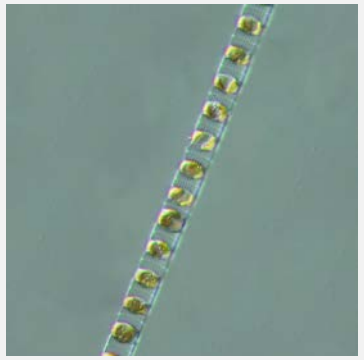


Alexandrium fundyense. Photo credit: Gary Wikfors, NOAA
Alexandrium tamarense. Photo credit: SINTEF

Middle Norway: Alexandrium, PSP

Emiliana huxleyi. Photo credit Max Planck institute
Skeletonema. Photo credit: Nordic Microalgae





Southern Norway: Emiliana, Skeletonema

Gill damage, O_2 depletion

What comes when the crisis is over?

- data
- technology
- (fast) implementation

Picture courtesy : NASA

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Flaws of the current system

Sampling only takes place when the situation is serious	There is no information for the period before sampling started	Samples are usually sent, causing a time delay	Algae communities have a huge variation in time and grow rapidly	Sampling results in a **patchy** distribution of algae numbers

→ Information needs to be continuous and (earlier) available

→ Monitor N + P before sampling algae

Picture courtesy: www.biosciencetoday.co.uk

Technology – spaceborne

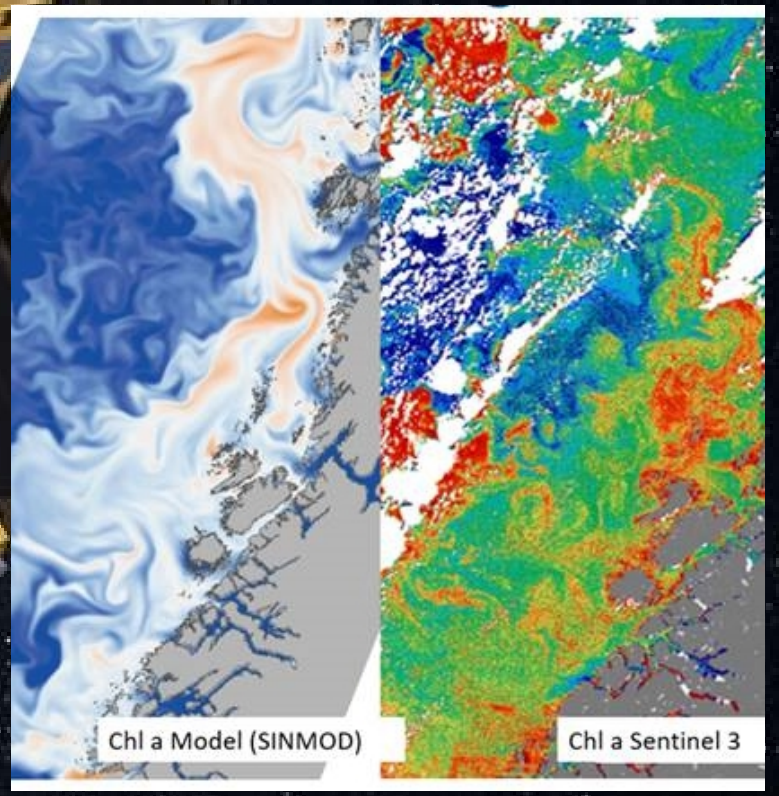
Small satellites for early warning and a combination of satellite data and ecosystem models for

- Planning of sampling and closer monitoring

→Preparedness

- Data assimilation and prediction

→ Early evacuation



Picture courtesy: NTNU smallsat & SINTEF Ocean

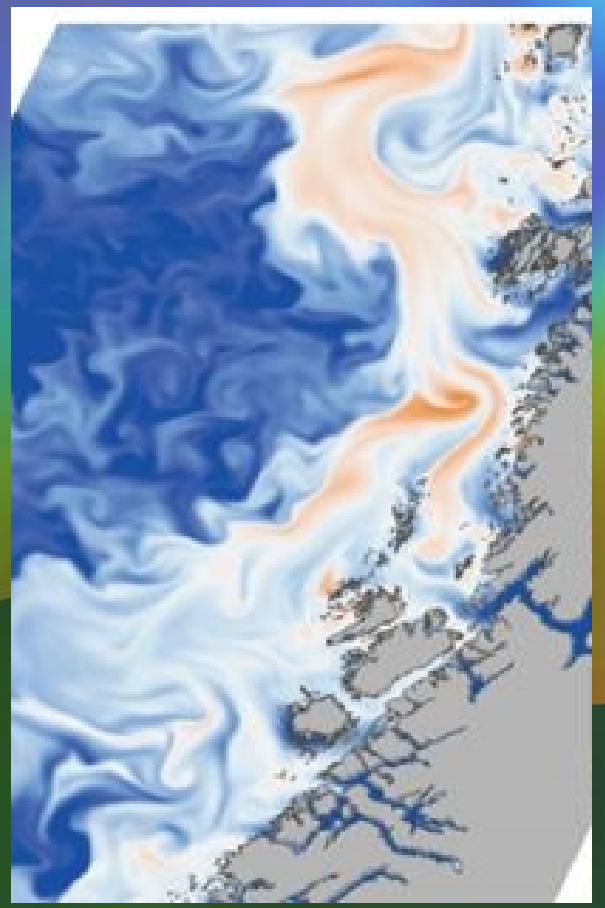
Technology – waterborne

Autonomous underwater vehicles can do 3D mapping and identification of algae ***in bloom situations***

→in-situ particle imaging with the help of domain experts and machine learning

and before (!)

→ 3D mapping of favourable conditions (temperature, N, P)



Artistic illustration from https://geminiresearchnews.com/2019/03/ocean-life-in-3-d-mapping-phytoplankton-with-a-smart-auv/

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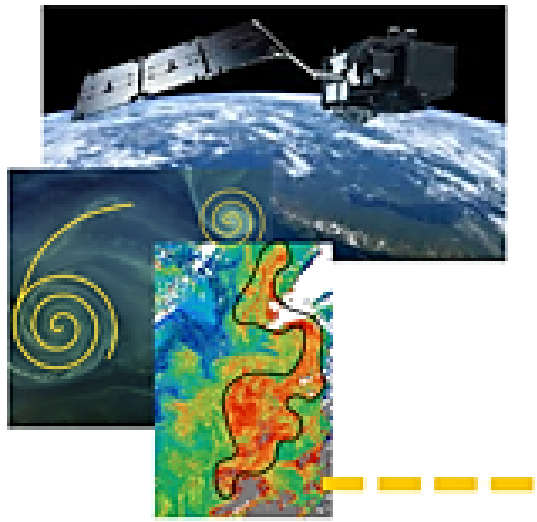
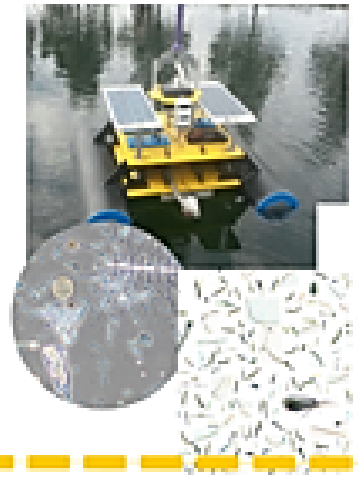
RESPOND – web based information for decision support, COP

Data collection, processing and analysis



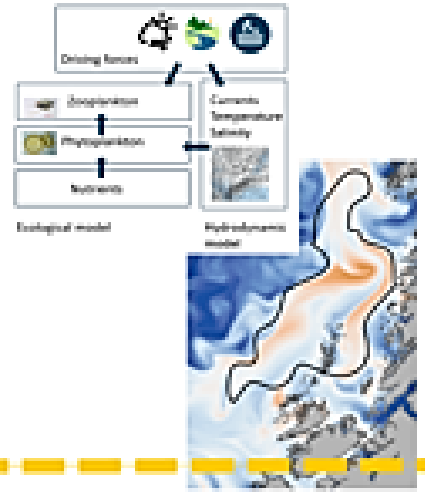
Automatic download of sattelite data
Analysis of phytoplankton
size and taxonomic structure
Analysis of hydrodynamical connectivity
combined with in-situ data

In-situ monitoring of plankton



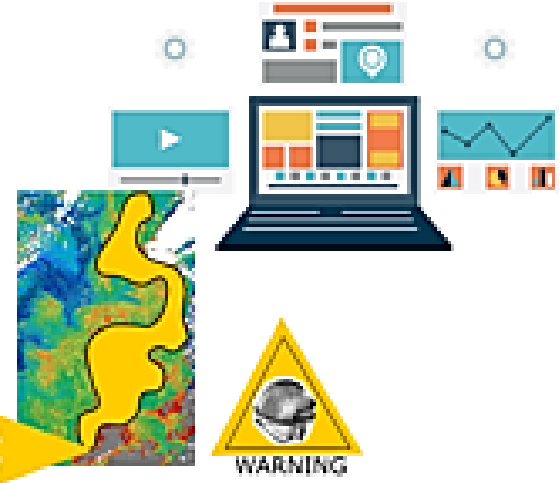
In-situ sampling
Automatized identification of plankton
Microscopy identification of plankton
Barcoding

Modelling and prediction



Data assimilation of RS data
Model development to include more
phytplankton size classes
Bloom developments (transport,
active and passive blooms)

Web based information system



Early warning of HAB blooms for
Aquaculture industries and other
relevant stakeholders

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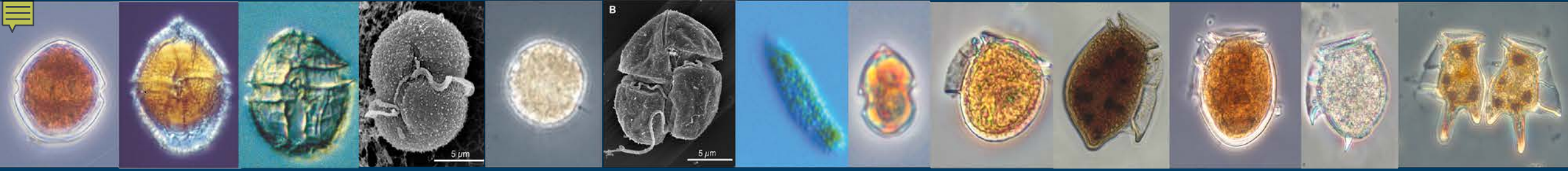
So, why haven't we done this already?

Because we do crisis management instead of preparedness …

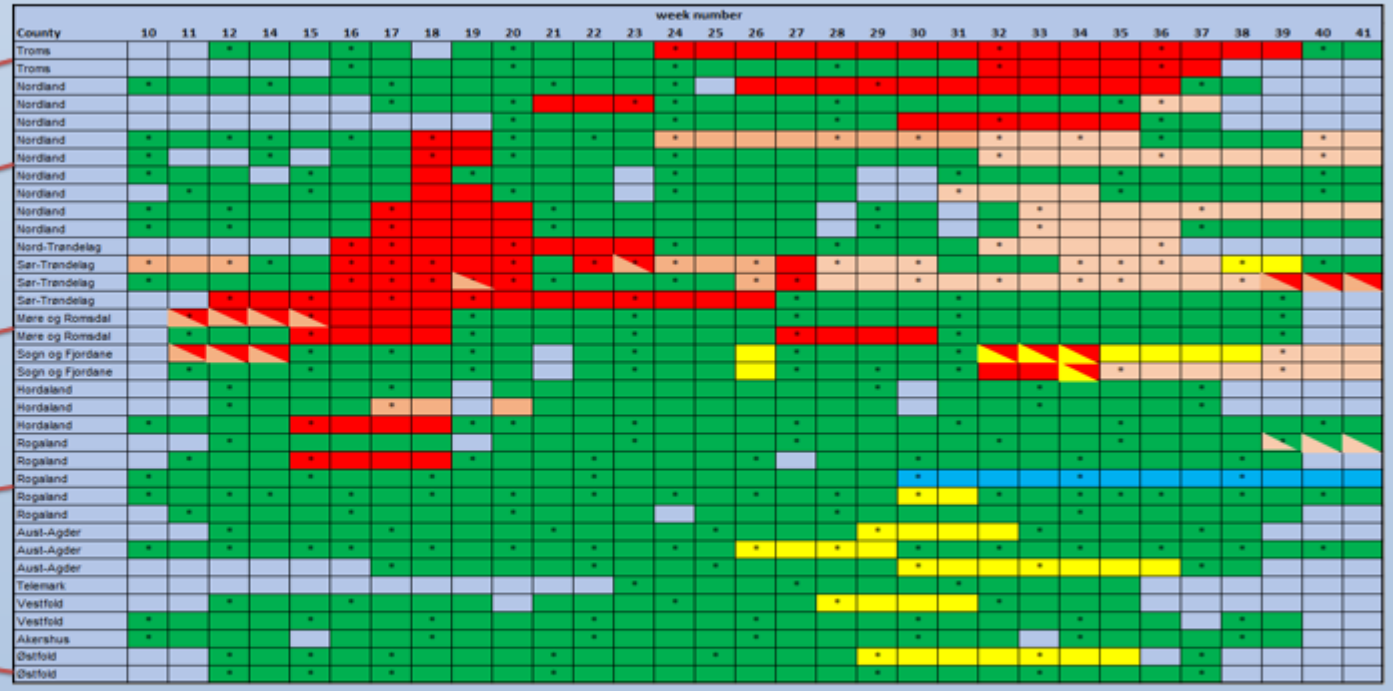
Ecosystem / ocean models need to be run operational in high resolution as part of a monitoring system

- Transport and distribution
- Resolution of Fjord topography

Data needs to be analysed and shared



National monitoring program for blue mussel 2018



The weekly public advice given by the Norwegian Food Safety Authority in 2018. The color indicates: **Green** – open for consumption of blue mussel, **Bright blue** – no samples. Closed areas due to: **Yellow** – DST/*Dinophysis* spp.; **Red** – PST/*Alexandrium* spp.; **Blue** – ASP/*Pseudo-nitzschia* spp.; **Pink** – E.coli. * indicates chemical analyses.

Gustad et al. "Norw. Monitoring Progr. For Harmful Algae", poster at 18th Int. Conf. On Harmful Algae, Nantes (France).

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This is a team effort

Information gathering

Processing

Forecasts

Information services (maps & context)

Data interpretation

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Algae monitoring 4.0

"Open and public interface":
Data from labs to map

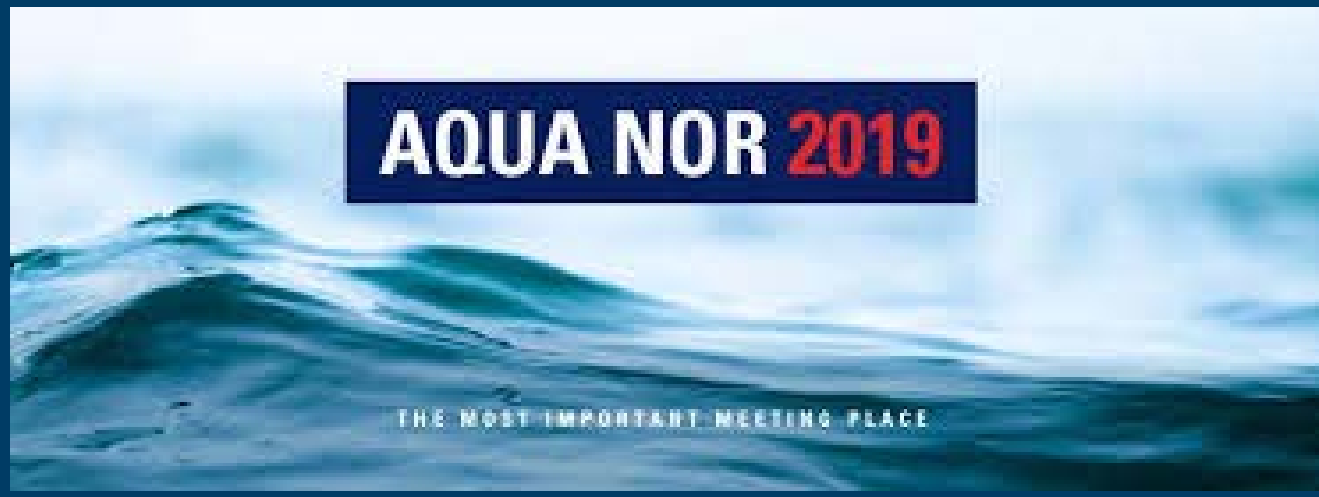
Information based on area / water mass systems

Early warning to all stakeholders

Model **forecasting**

- algae status before and during operations: delicing, transport, etc.
- coordination with national emergency procedures

Meet us at



to discuss further!

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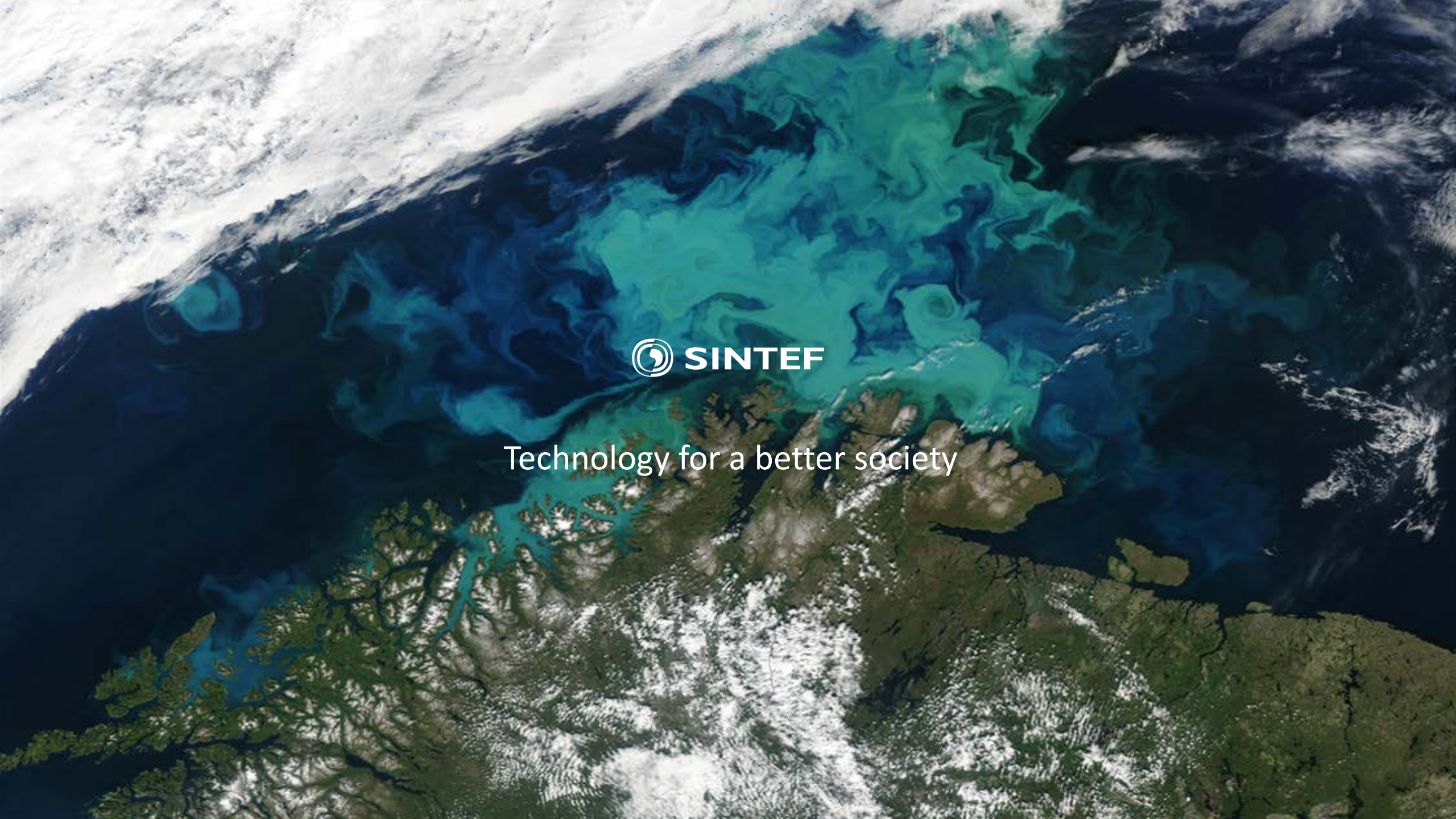
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