

Current modelling using NorKyst800 and NorFjords

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Sustain Aqua avslutningskonferanse,

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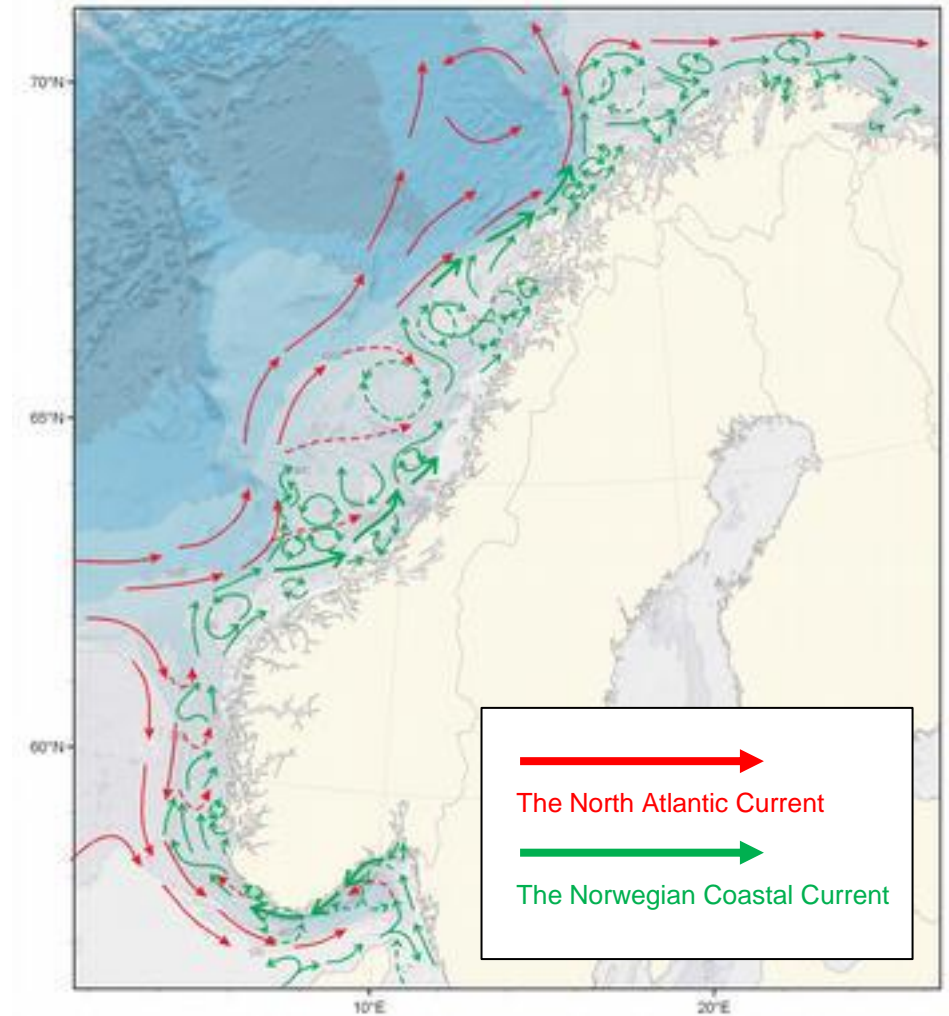
Outline

- Currents and hydrography along the coast
- Current modelling system at the IMR
- Differences between Northern and Southern Norway
- Applications for aquaculture



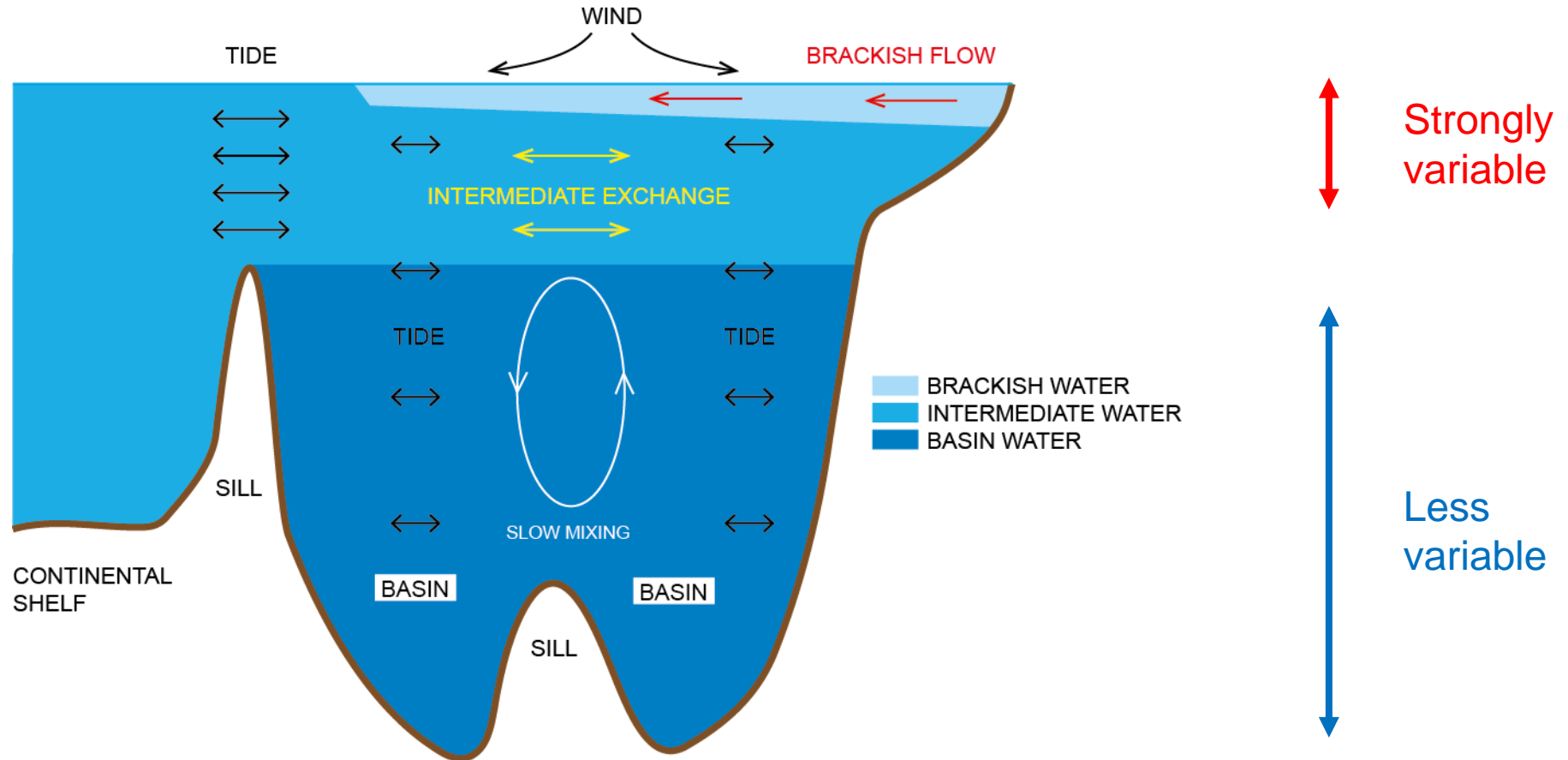
Strong forcing and stratified water in fjord- and coastal areas

- The Norwegian coast has complicated topography.
- The water masses along the coast are stratified = baroclinic currents.
- The tide acts as a Kelvin wave with amplitude 1-3 m increasing northwards.
- There are numerous freshwater discharges along the coast.
- The atmospheric Polar front crosses Norway with passage of low-pressure systems with episodic (1-2 d) strong winds.



Large vertical variability of current and hydrography

The forcing mechanisms acting are strongest towards the surface.



Need a combined information system from observations and numerical models

The large spatial and temporal variability of current, salinity and temperature in Norwegian fjord and coastal waters means that collecting information from observations alone usually is insufficient.

Numerical current models and various biological applications are a necessary tool to complement the understanding of the physical environment.



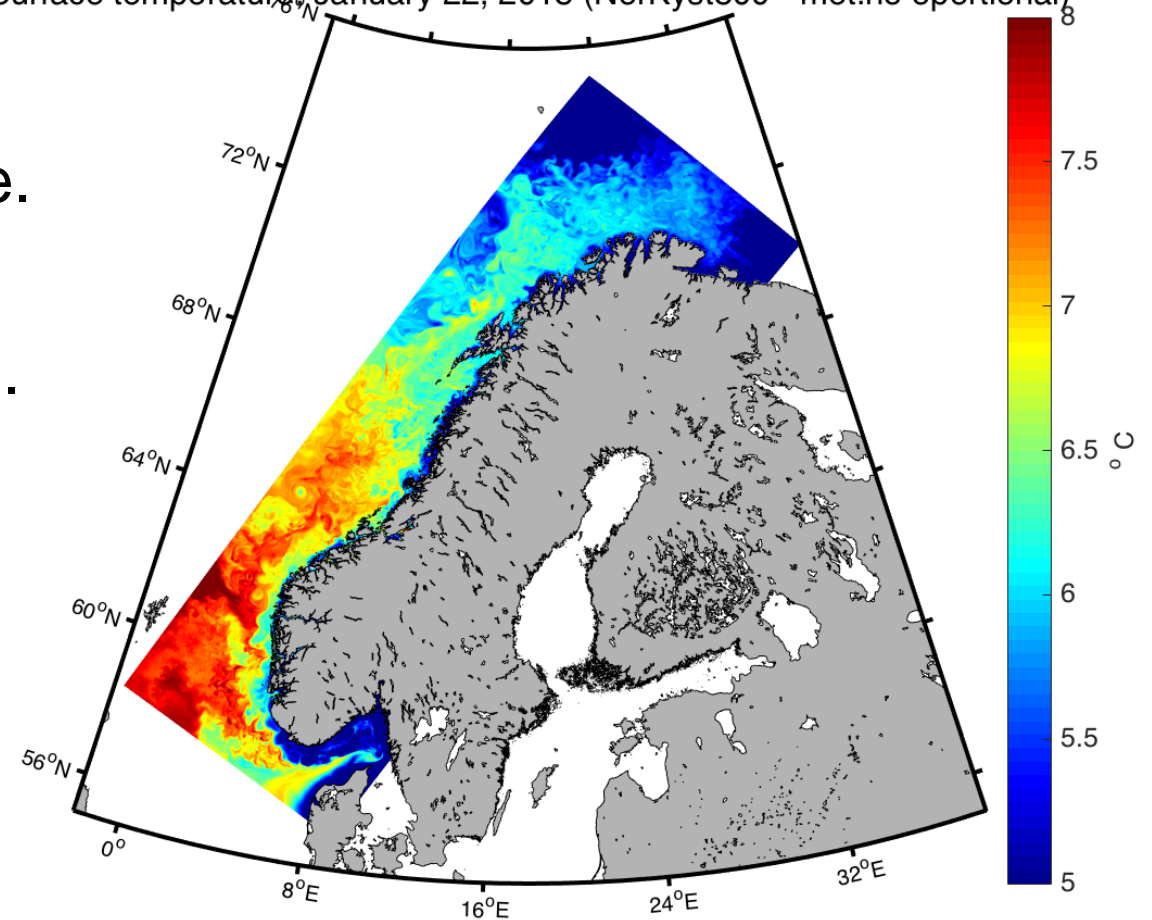
NorKyst800 – a current model for the whole Norwegian coast

IMR has developed and operates NorKyst800 in a collaboration with the Norwegian Meteorological institute.

NK800 uses 800m horizontal grid resolution, and have 35 vertical layers.

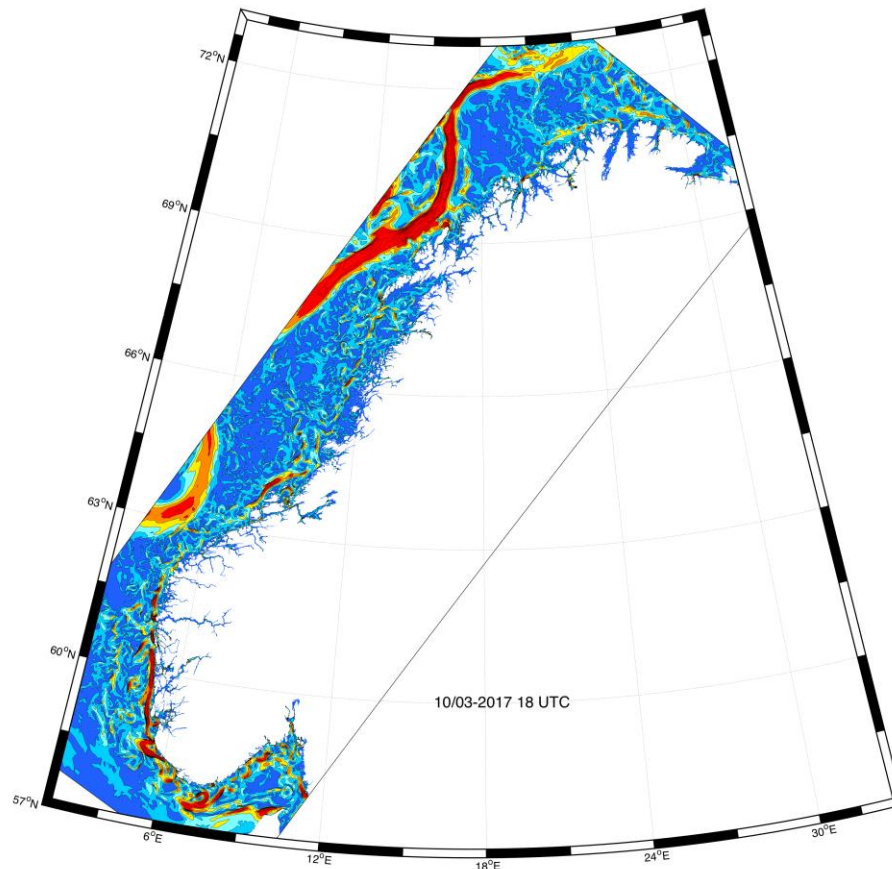
Model results from 1995 until today (+ 66t) are available (thredds.met.no).

Surface temperature, January 22, 2018 (NorKyst800 - met.no operational)

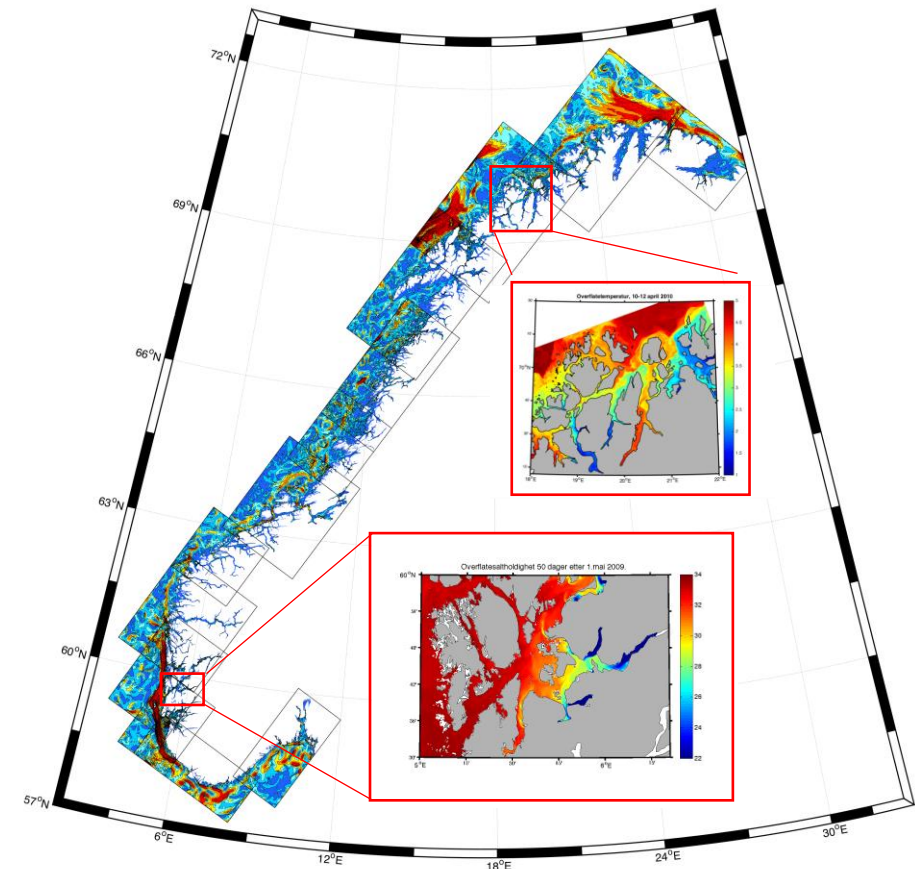


When necessary finer grid models are used

NorKyst800



NorFjords 160m



Composite of 13 domains



Validation of the numerical model results is important

Usually numerical model results are compared to observations in order to assess their quality or usefulness.

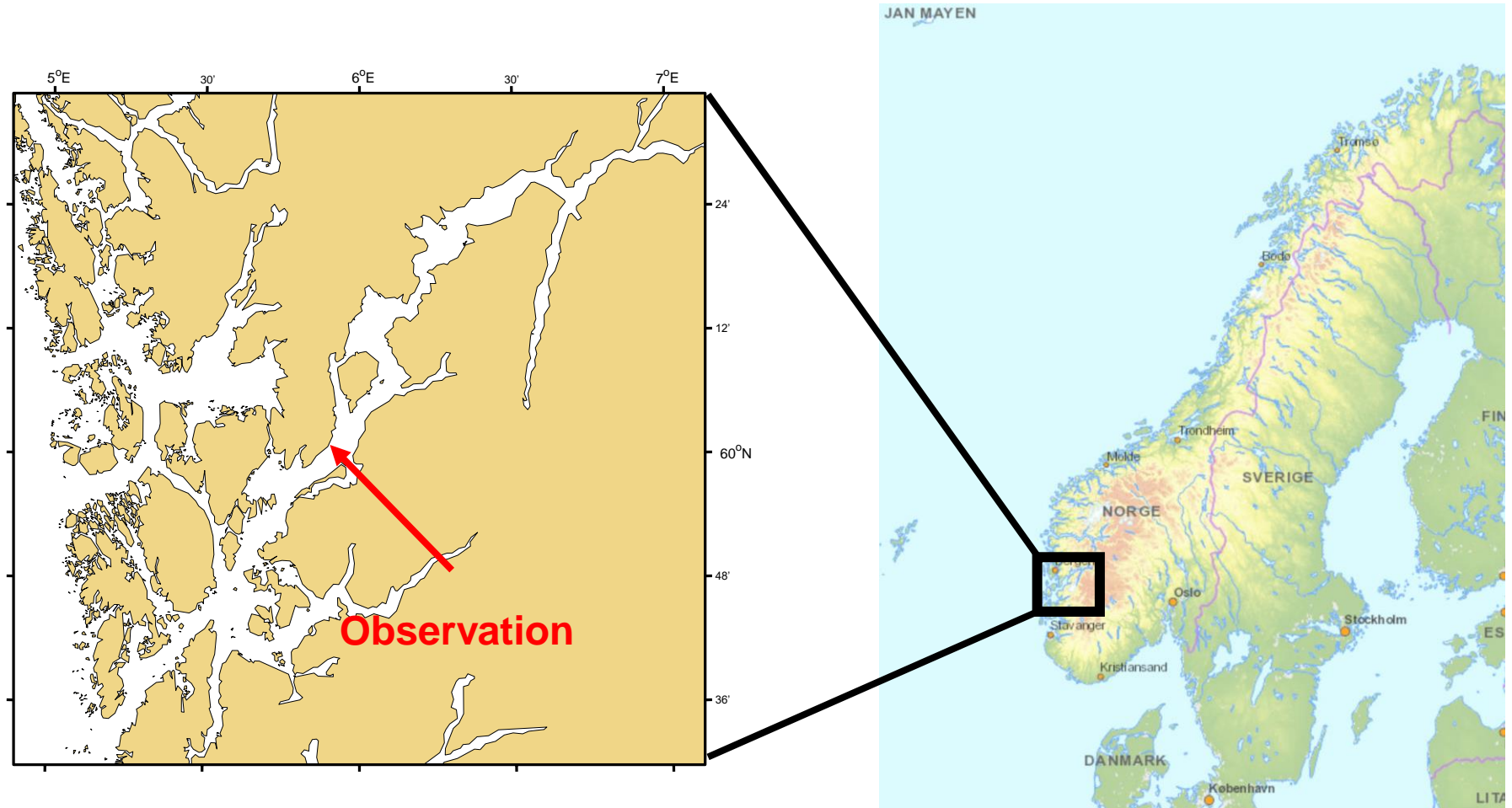
No subjective way to validate numerical model results exists.

A «bad» model result might still be useful.



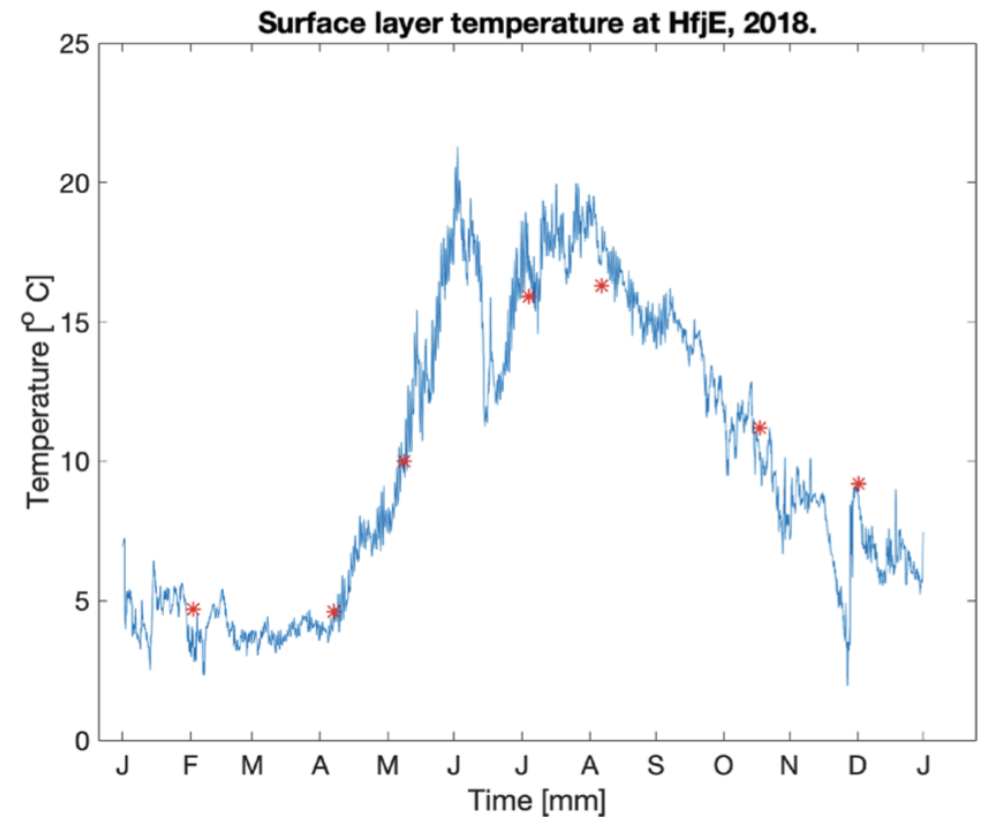
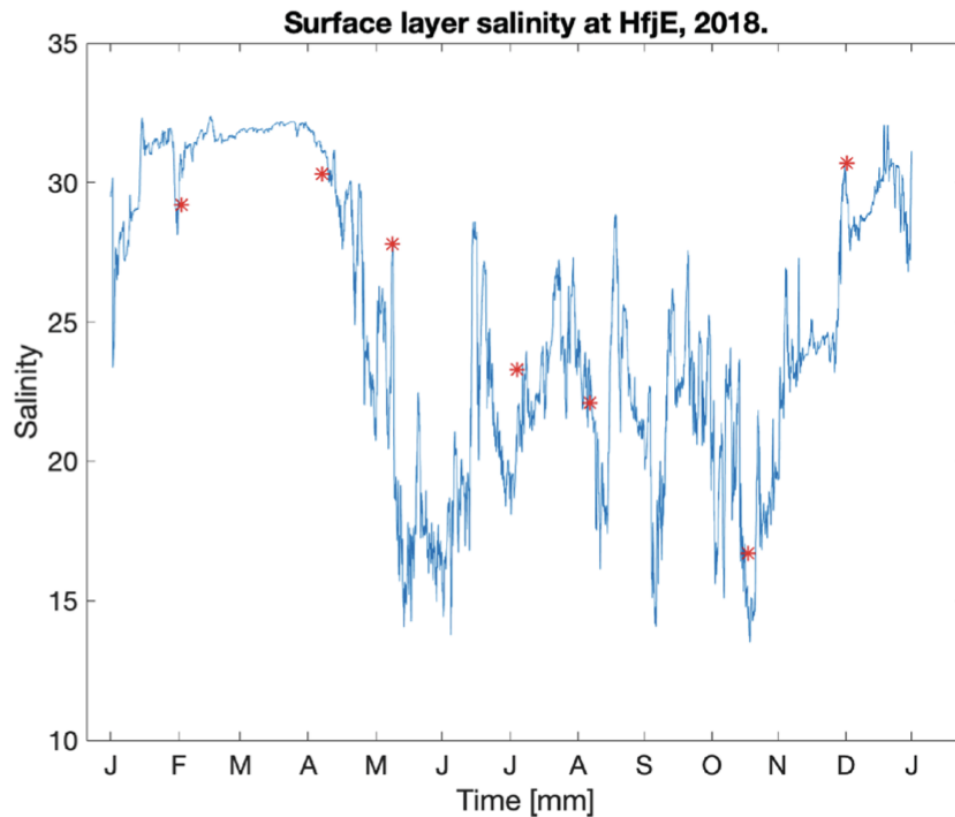
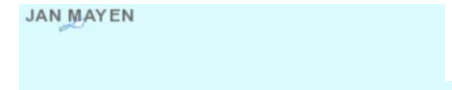
Model results validation

Salinity and temperature in the Hardangerfjord



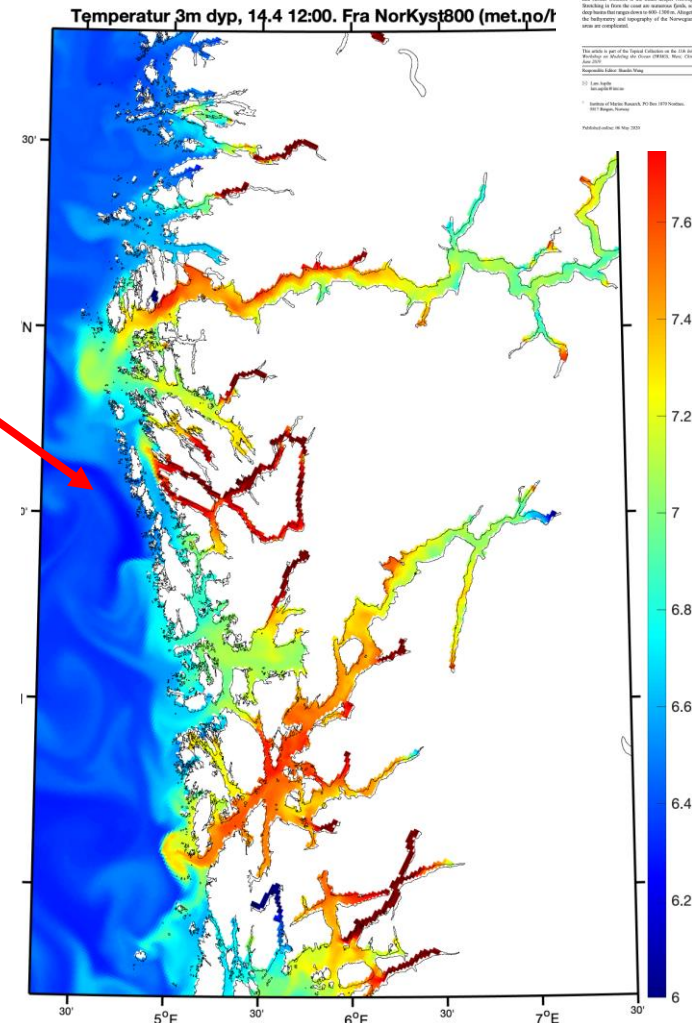
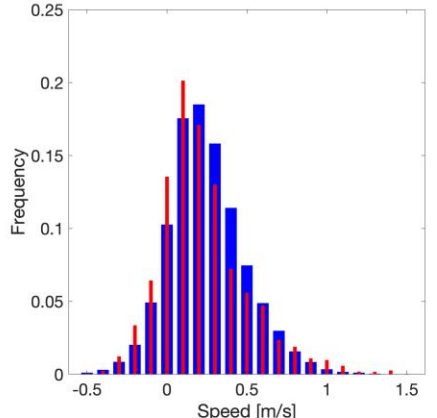
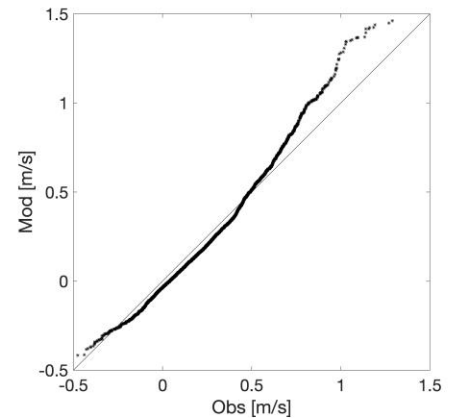
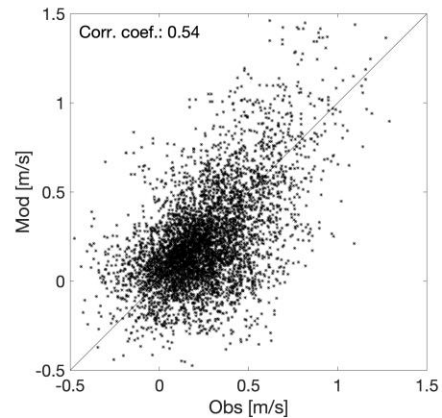
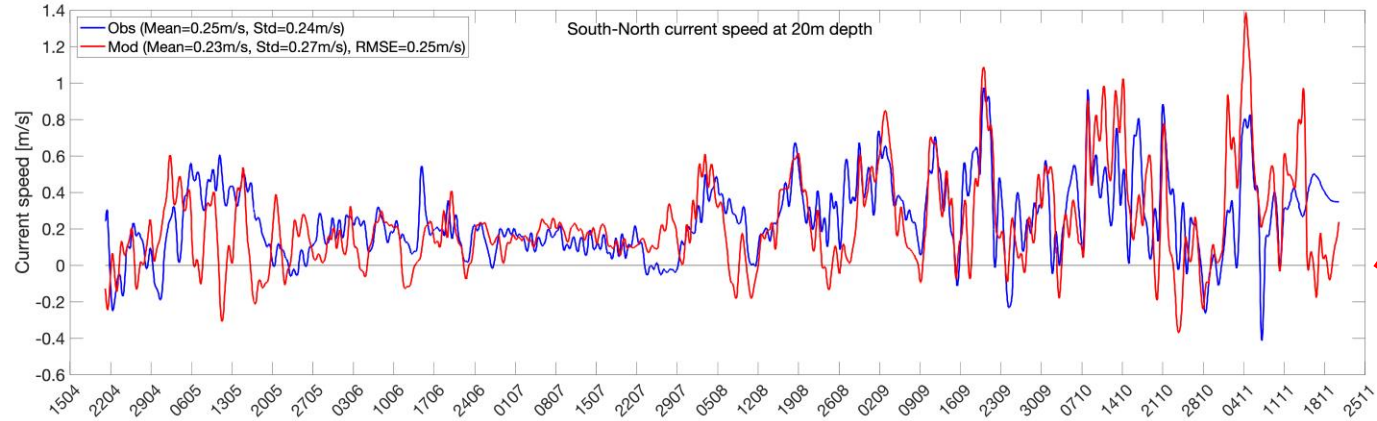
Model results validation

Salinity and temperature from observations (*) and NorKyst800 (~ deviation less than a unit).



Model results validation

Currents from **NorKyst800** and **ADCP** at the coast outside Bergen



The hydrodynamic foundation for salmon lice dispersion modeling along the Norwegian coast

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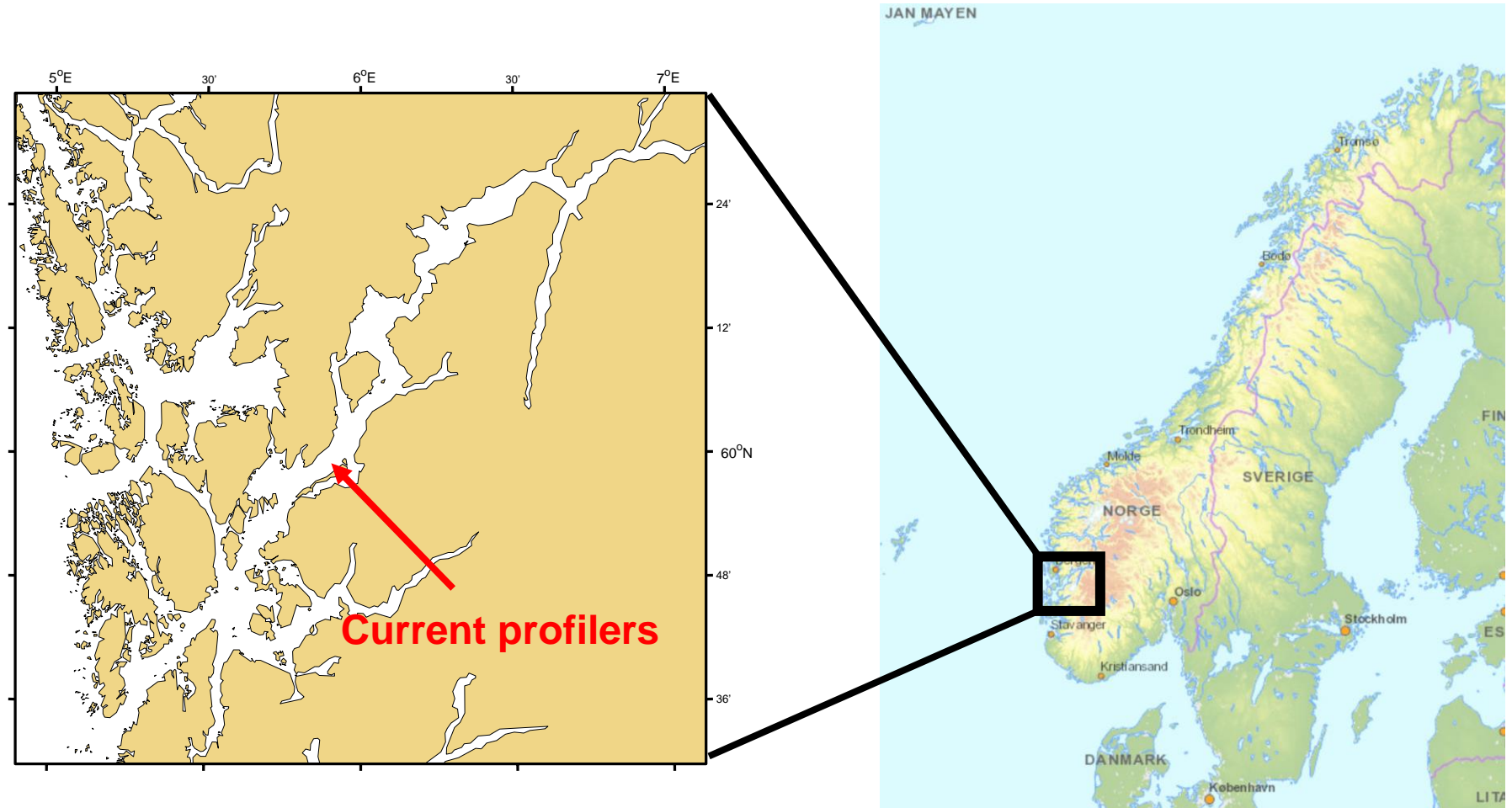
Abstract
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Keywords High Resolution Oceanography; Salinity; Temperature; Model validation; Norway

1 Introduction
The coast of Norway is about 2000 km long from south to north. The average depth of the continental shelf is 200 m. The average depth of the continental shelf is 200 m. The average depth of the continental shelf is 200 m.

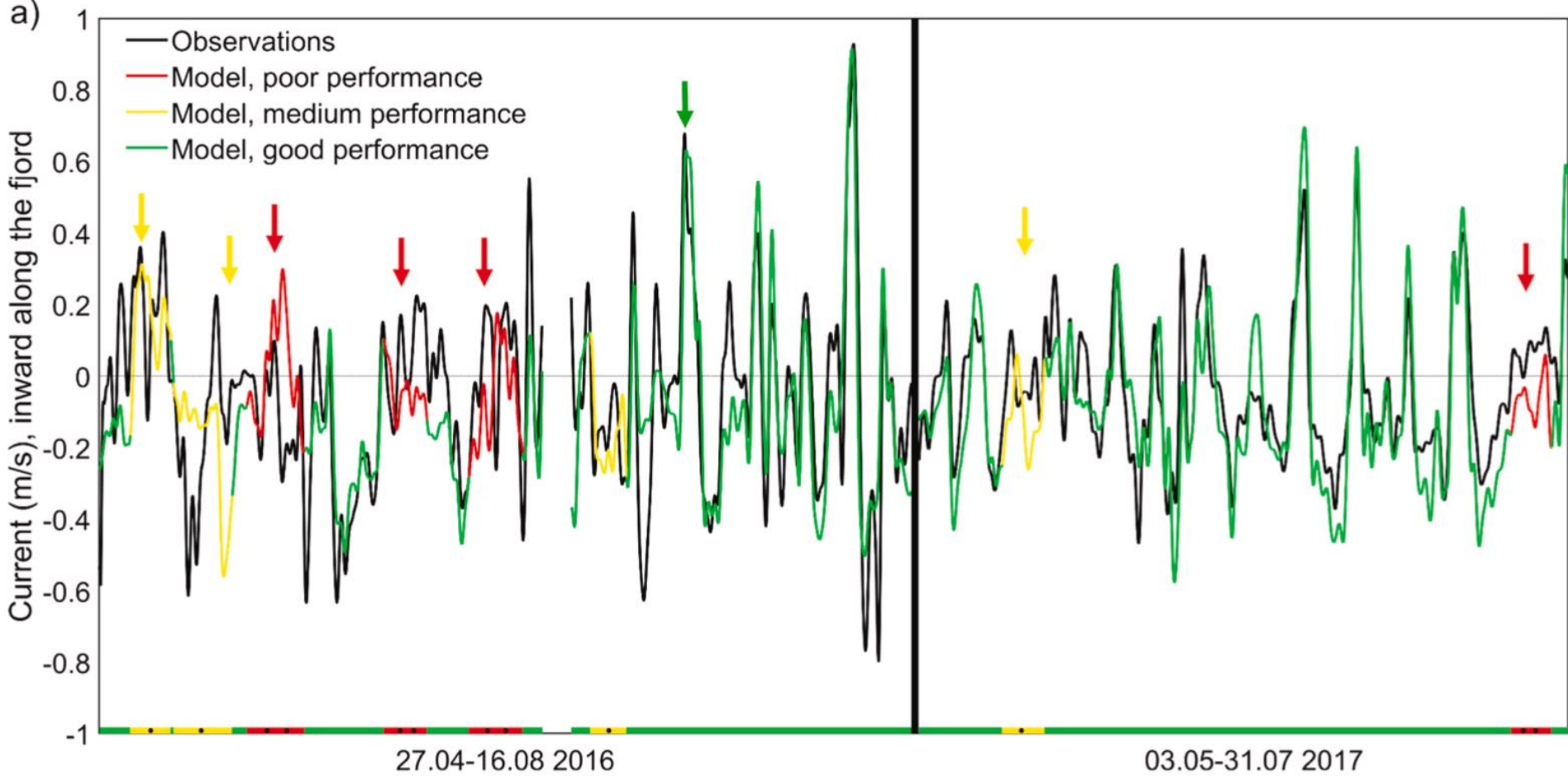
Model results validation – creating a quality index

Current in the Hardangerfjord



Model results validation – creating a quality index

Along-fjord current near the surface.
2016 ok for 64% of the time. 2017 ok for 87% of the time.



Estuarine, Coastal and Shelf Science (2017) 17(10)

Estuarine, Coastal and Shelf Science
Journal homepage: <http://www.elsevier.com/locate/estuar>

New validation method for hydrodynamic fjord models applied in the Hardangerfjord, Norway

Rig B. Dalaveri, Jan Arntsen, Lars Anglin

ARTICLE INFO

ABSTRACT

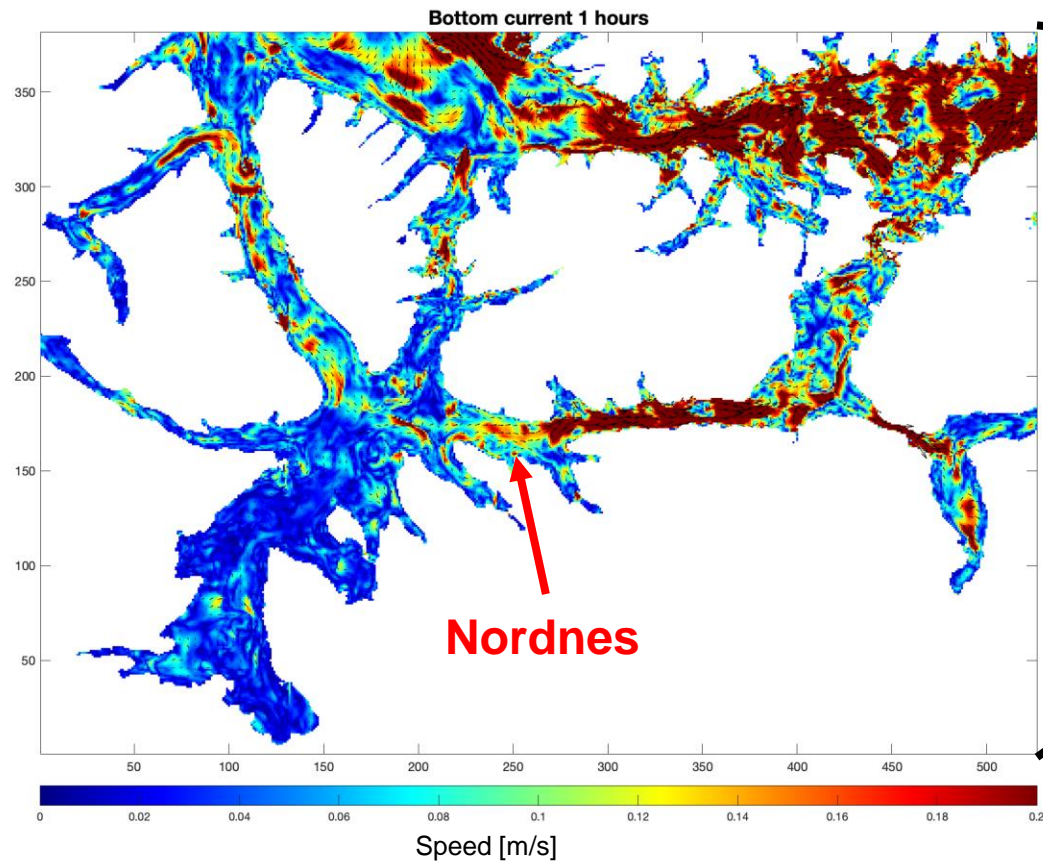
1. Introduction

of the traditional test indices such as the Pearson correlation coefficient (R), coefficient of determination (R²) and root mean square error (RMSE) after the use of a new development and a new validation method. The proposed method is applied to the Hardangerfjord, Norway, and the results are compared with the traditional test indices. The proposed method is applied to the Hardangerfjord, Norway, and the results are compared with the traditional test indices. The proposed method is applied to the Hardangerfjord, Norway, and the results are compared with the traditional test indices.



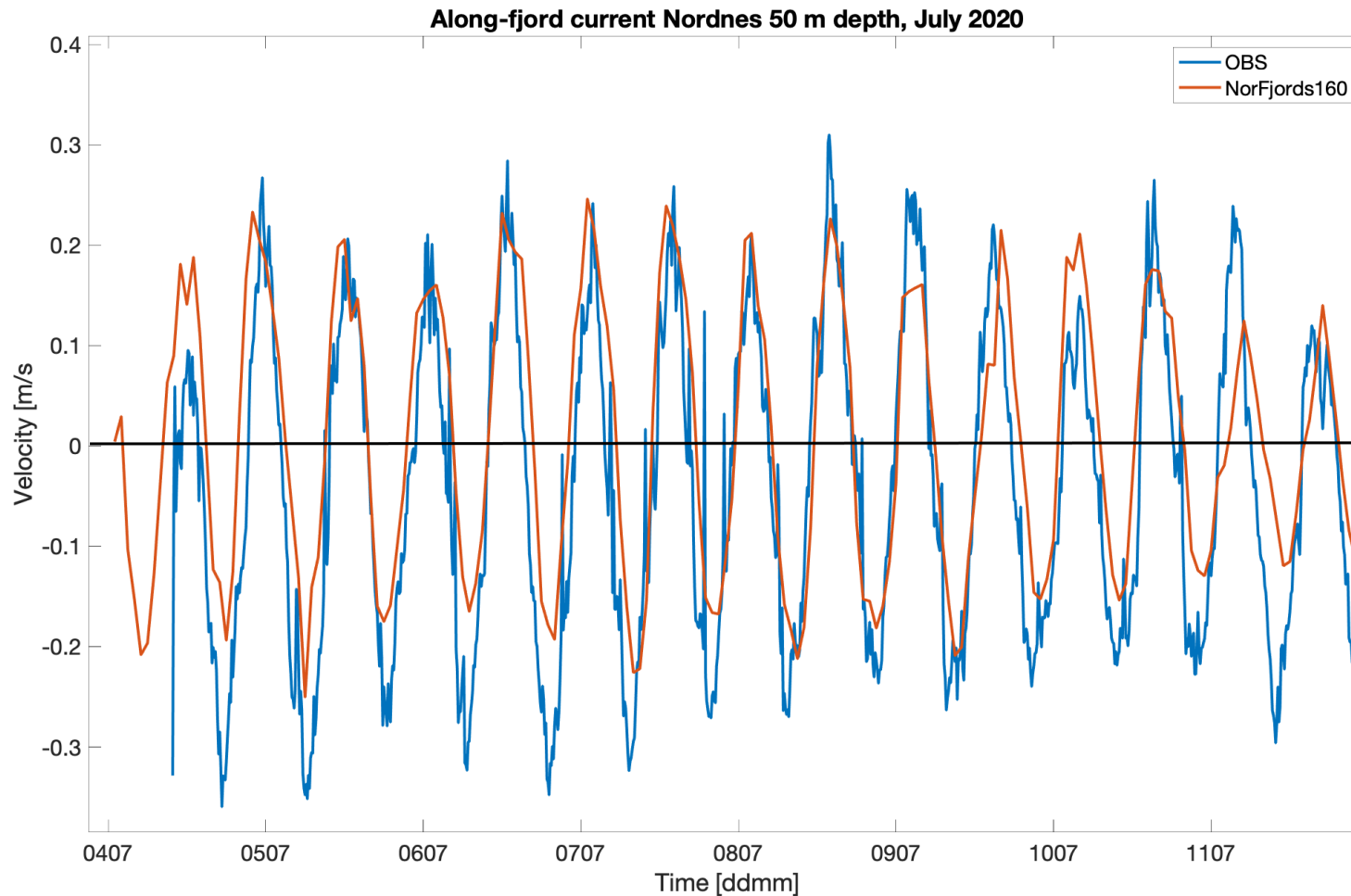
Model results validation

Current in the Altafjord (note the large spatial variability of the model result)



Model results validation

Along-fjord current at 50 m depth for the Nordnes location, 4-11. July 2020.



Differences in the physical environment between Northern and Southern Norway

Generally the dynamics of the fjords and coastal waters are similar.

In Northern Norway the tidal amplitude is higher.

Slightly warmer water at depth in the south.

The seasonal signal in upper water temperature is less in Northern Norway.

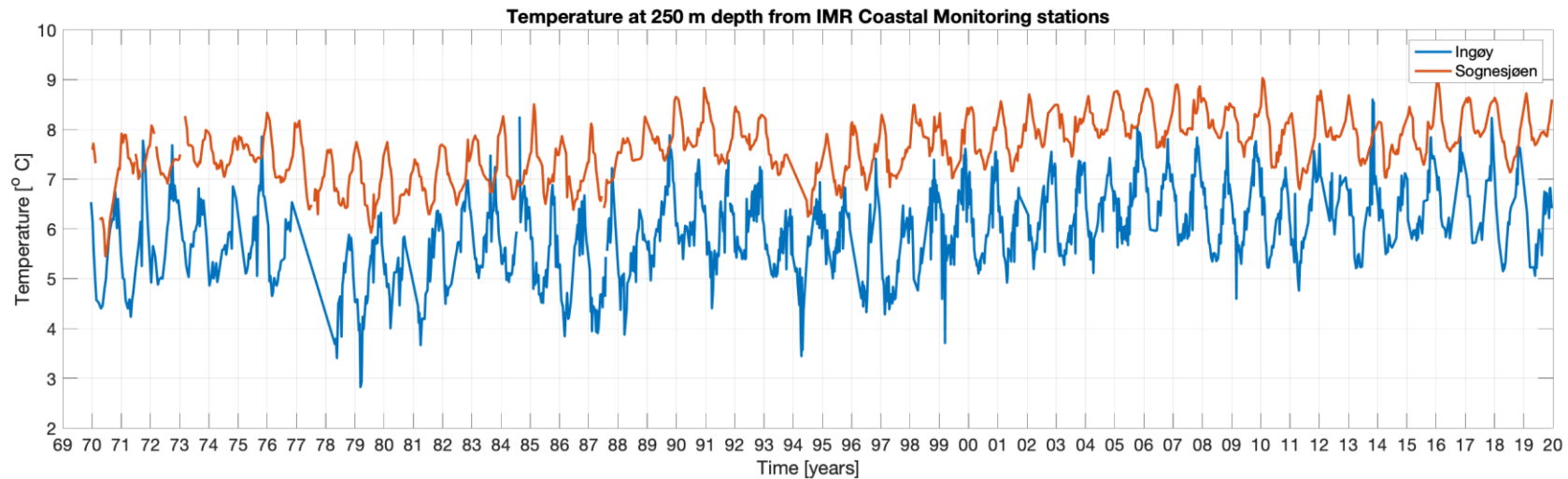
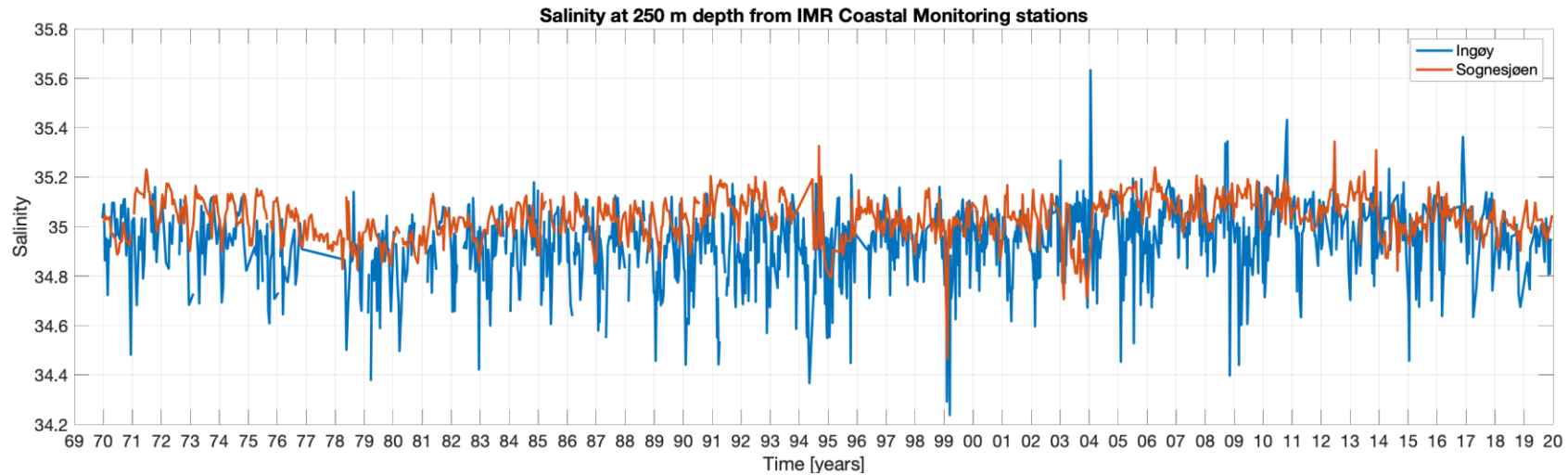
The fjords in Northern Norway are slightly wider and shallower.

The effect of the Earth's rotation is slightly stronger in the north.



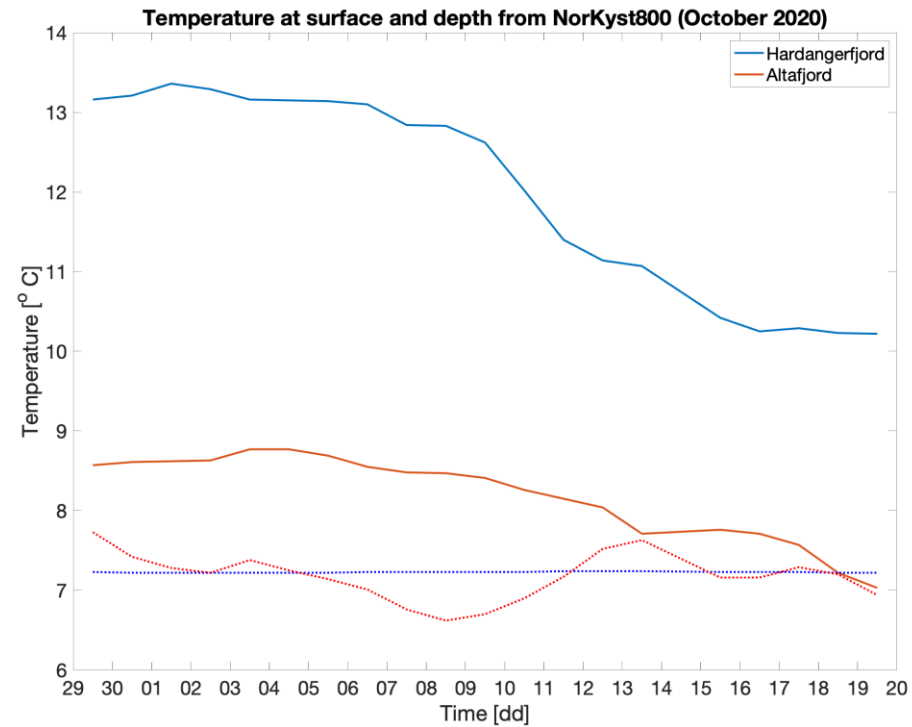
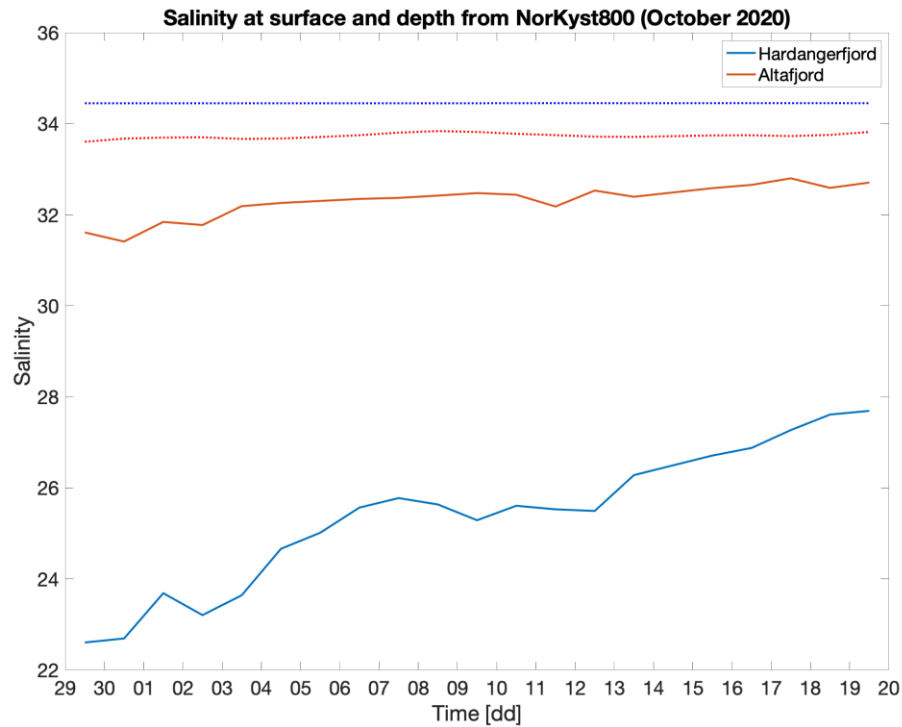
Deep water salinity and temperature

Results from observations at Sognesjøen and Ingøy



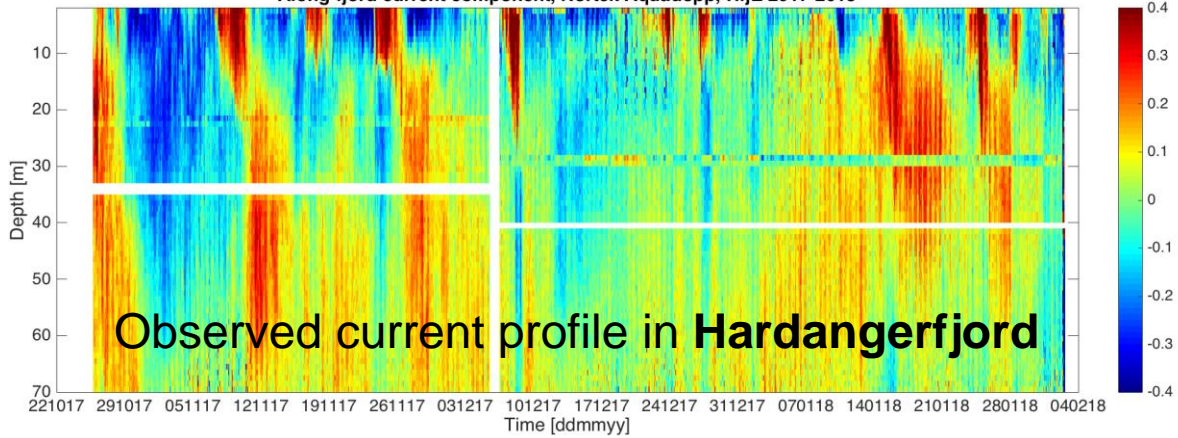
Salinity and temperature from Alta- and Hardangerfjord

Results from NorKyst800, October 2020.

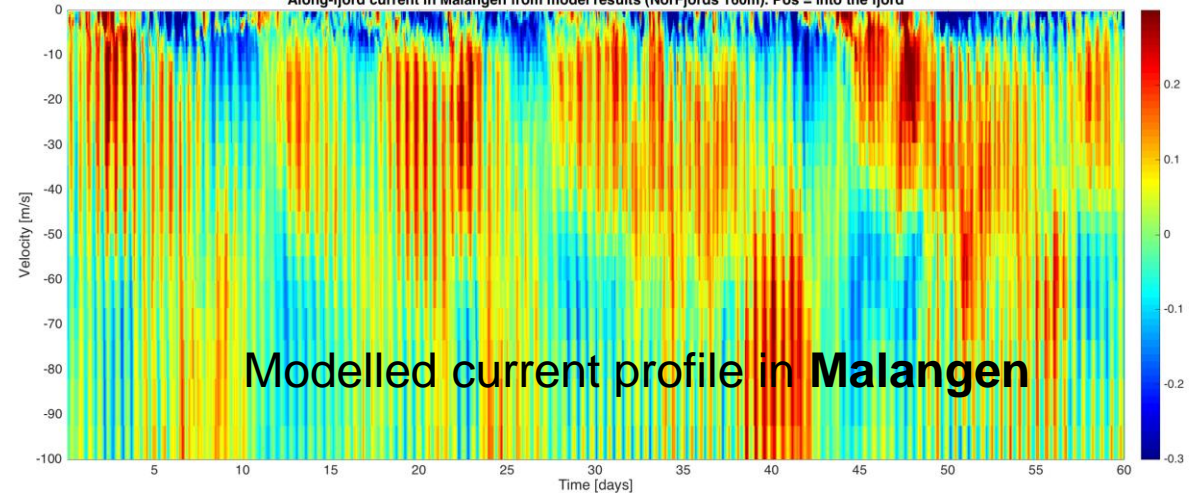


Similar upper layer dynamics all along the coast

Along-fjord current component, Nortek Aquadopp, HfjE 2017-2018

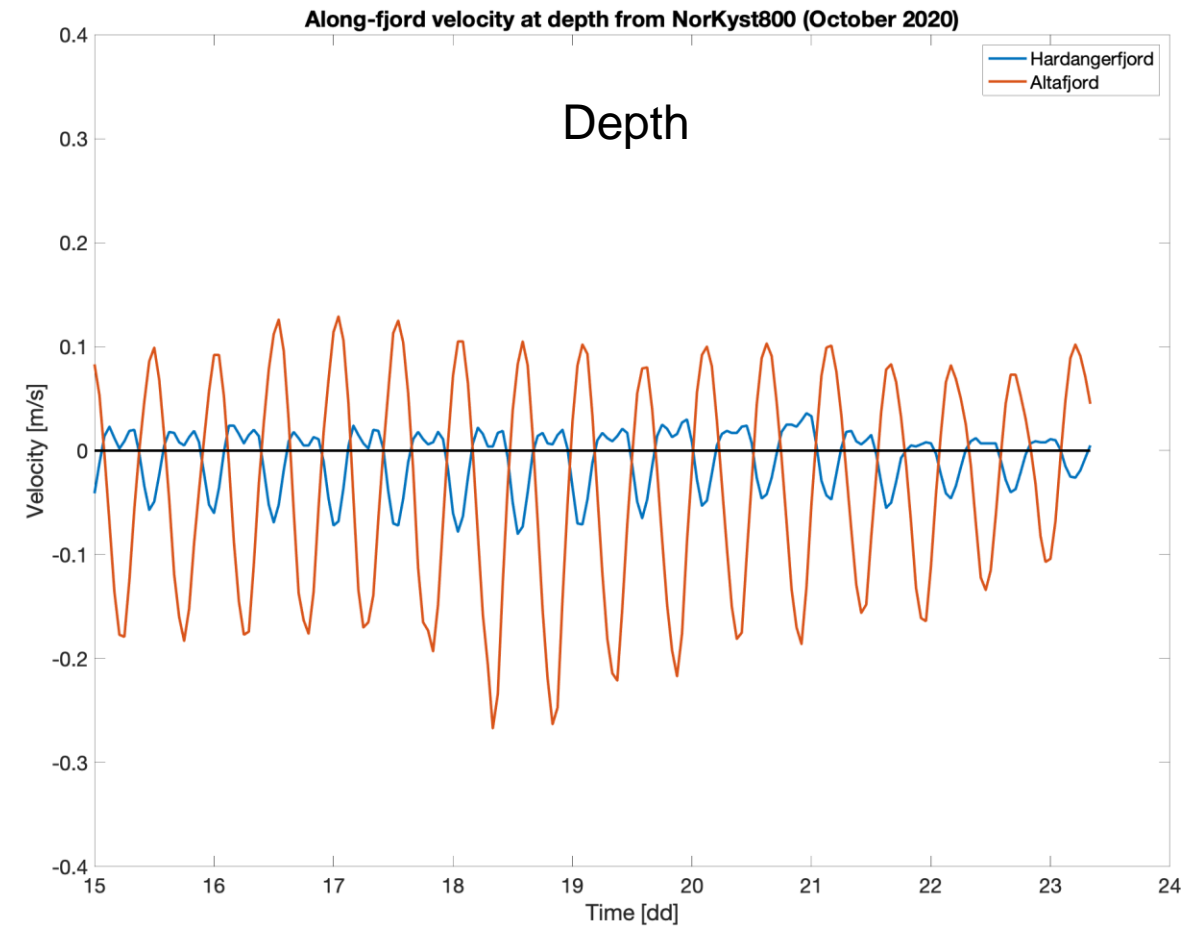
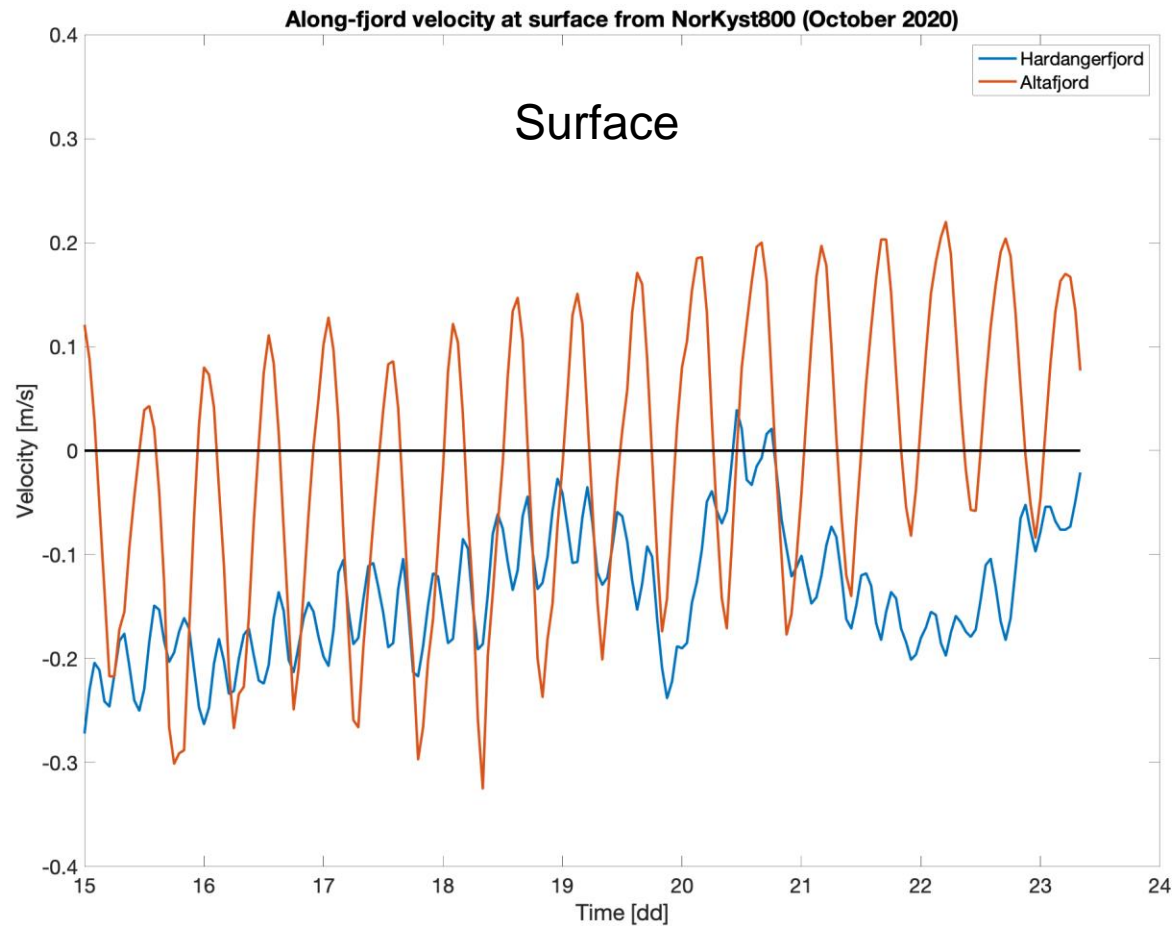


Along-fjord current in Malangen from model results (NorFjords 160m). Pos = into the fjord



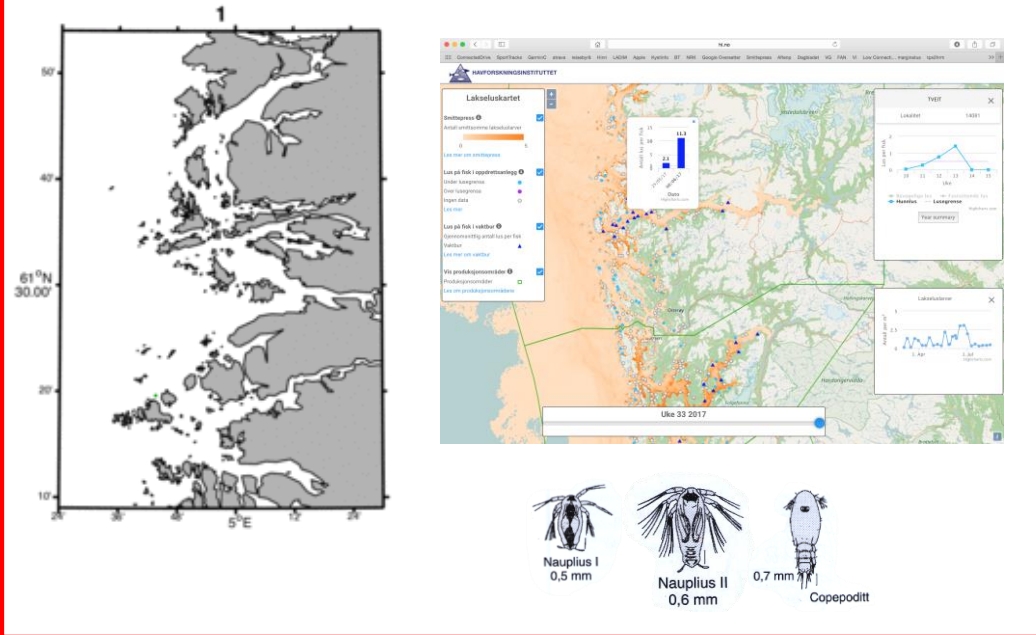
Current at the surface and depth in **Alta-** and **Hardangerfjord**

Results from NorKyst800, October 2020.

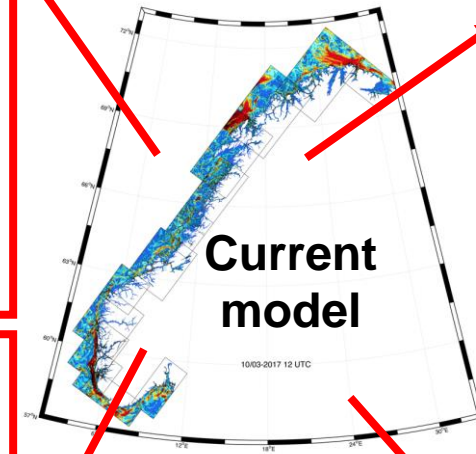


Applications of the current model results

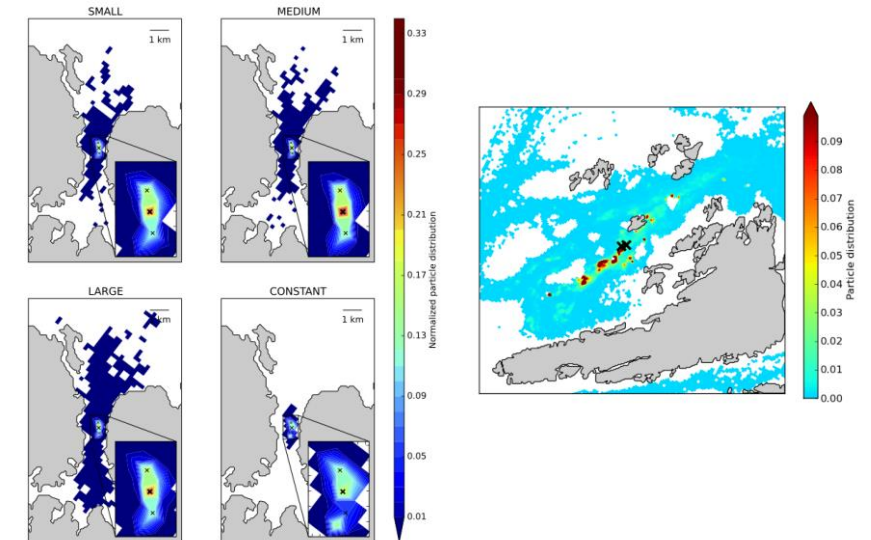
SALMON LICE



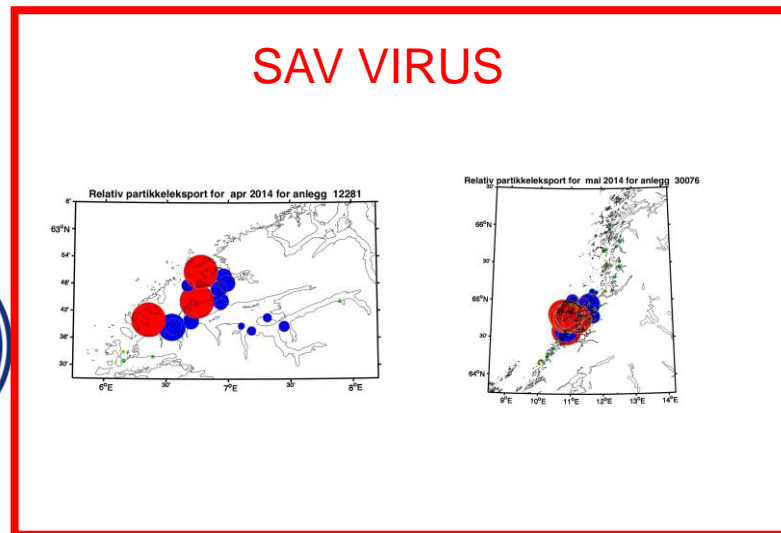
Particle tracking LADiM



ORGANIC LOAD FROM FISH FARMS



SAV VIRUS



- PRIMARY PRODUCTION
- FISH EGG & LARVAE
- POLLUTION
- MINE TAILINGS
- ETC.



Conclusions

- The physical environment is highly variable in time and space all along the coast.
- Some characteristic differences exist between regions.
- Numerical current model results along with observations are an efficient way to collect necessary information.
- Numerical current model results of a high quality from all of Norway are available from 1995 - +66hr forecast (<https://thredds.met.no>).

