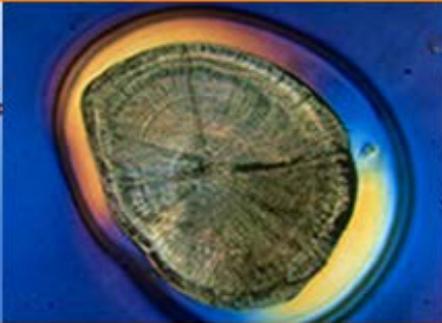




# INSTITUTE OF MARINE RESEARCH



## **NorKyst-800: A high-resolution coastal ocean circulation model for Norway**

St Augustine, Florida, 7-9 November 2011

**Jon Albretsen, Anne D. Sandvik and Lars Asplin**

**ECM12**

**Twelfth International Conference on Estuarine and Coastal Modeling**

# Content

- ✓ What is NorKyst-800 and why is it established?
- ✓ Short about the model system components
- ✓ How does NorKyst-800 perform?
- ✓ Summary



# What is NorKyst-800?

A numerical ocean modeling system suitable for reproduction of physical variables as sea level, temperature, salinity and currents for all coastal areas in Norway and adjacent seas.

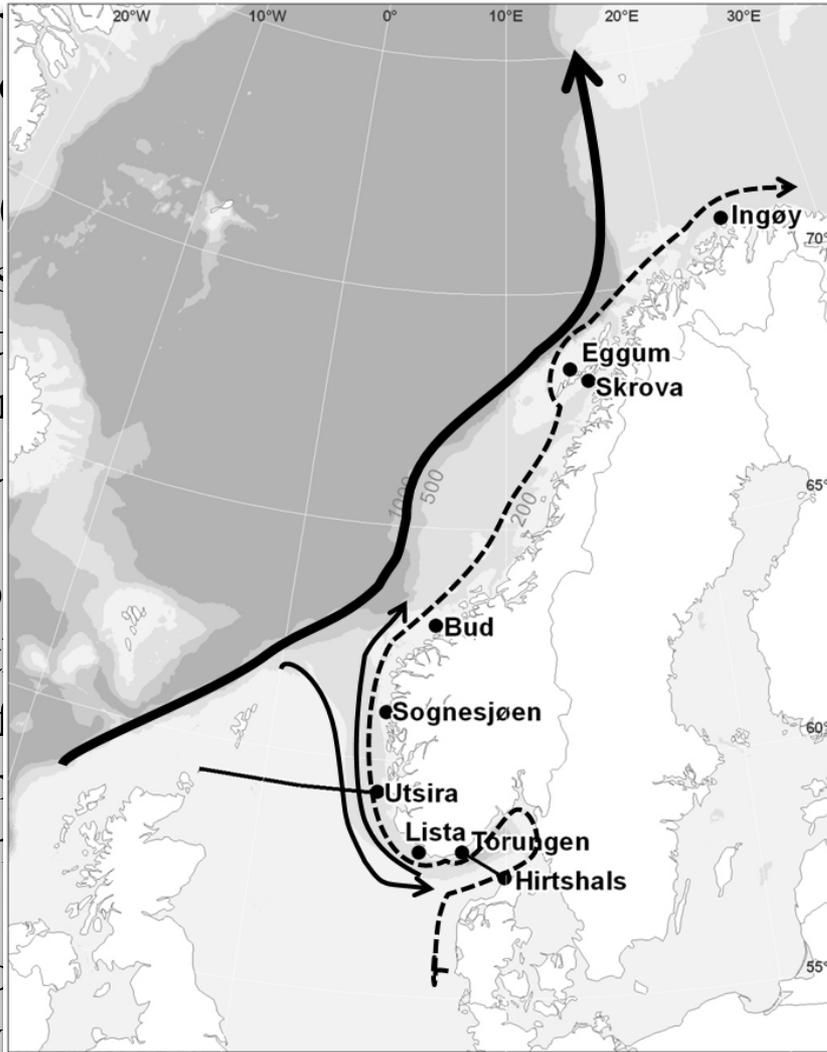
The NorKyst-800 model system can easily be defined to simulate an arbitrary part or potentially the entire Norwegian coast.

Initiated by the Institute of Marine Research (IMR), the Norwegian Meteorological Institute (met.no) and the Norwegian Institute for Water Research (NIVA).



# Main motivation for establishing NorKyst-800

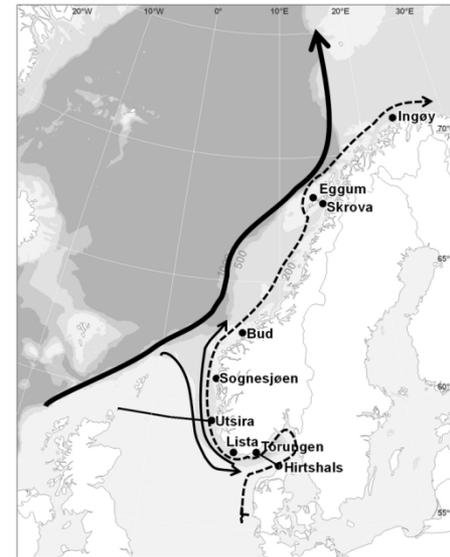
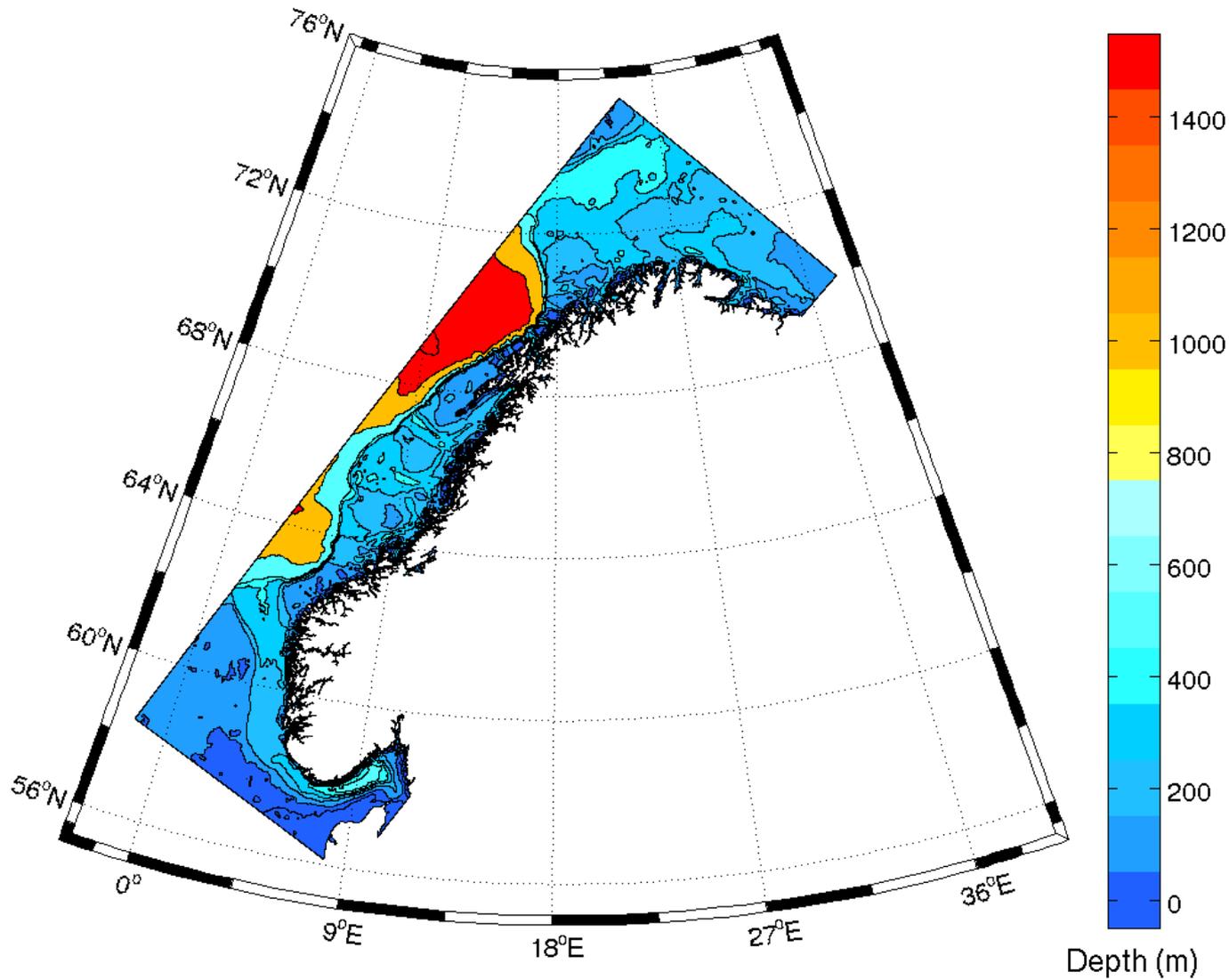
- ❑ Is capable of providing information on the environment with relatively high resolution along the border to Russia.
- ❑ The NorKyst-800 project is a fjord and fjord related information system simply for understanding the environment.
- ❑ The model interface is designed to be user friendly where both IMR and other users can access the model to avoid accidents.
- ❑ Other useful applications include monitoring of pollution or growth of salmon or egg and larvae in the fjords.
- ❑ By providing information on the environment is a necessary step in the development of the Norwegian fjords.
- ❑ Archives with data and information regarding model validation and results.



environment with high resolution along the Swedish border to Russia. The NorKyst-800 project is a fjord and fjord related information system simply for understanding the environment. The model interface is designed to be user friendly where both IMR and other users can access the model to avoid accidents. Other useful applications include monitoring of pollution or growth of salmon or egg and larvae in the fjords. By providing information on the environment is a necessary step in the development of the Norwegian fjords. Archives with data and information regarding model validation and results. The NorKyst-800 project is also a resolution for easier access

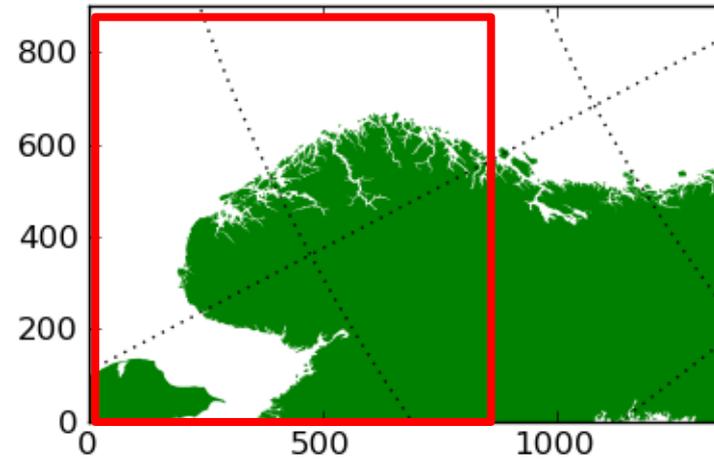


# Model area

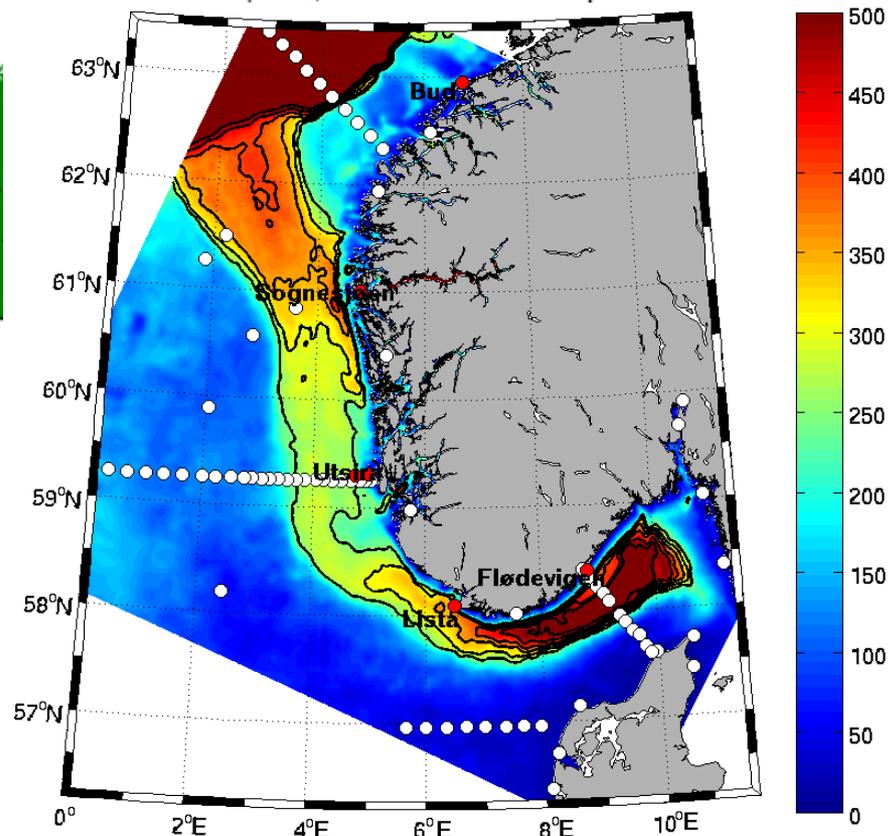


# Selection of model area

$$(i1,j1) = (850,893)$$

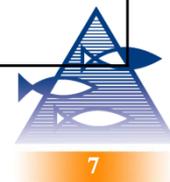


$$(i0,j0) = (1,1)$$



# User interface

Description	Value (defaults)	
Positions defining the model area based on a sub grid of the entire NorKyst-800 domain	(i0,i1) and (j0,j1) where (i1,j1) is maximum (2600,900)	
Simulation period	t0 and t1 define start and end date, respectively	
No. of tiles in both directions	NtileI=12, NtileJ=12	
No. of vertical levels	35	Parameters for configuration of vertical levels and grid resolution
S-coor. surface control param. (theta s)	8.0	
S-coor. bottom control param. (theta b)	0.1	
Width of surf/bott boundary (Tcline)	10 (m)	
Internal (baroclinic) time step (s)	60	
No. of hours between output of results	1 (stations) / 1 (inst) / 24 (avg)	
Data sources for nesting-fields	METNO4KM, ROMS4KM or MONCLI4KM	
Data sources for atm. forcing fields	METNO10KM, ERAINT	

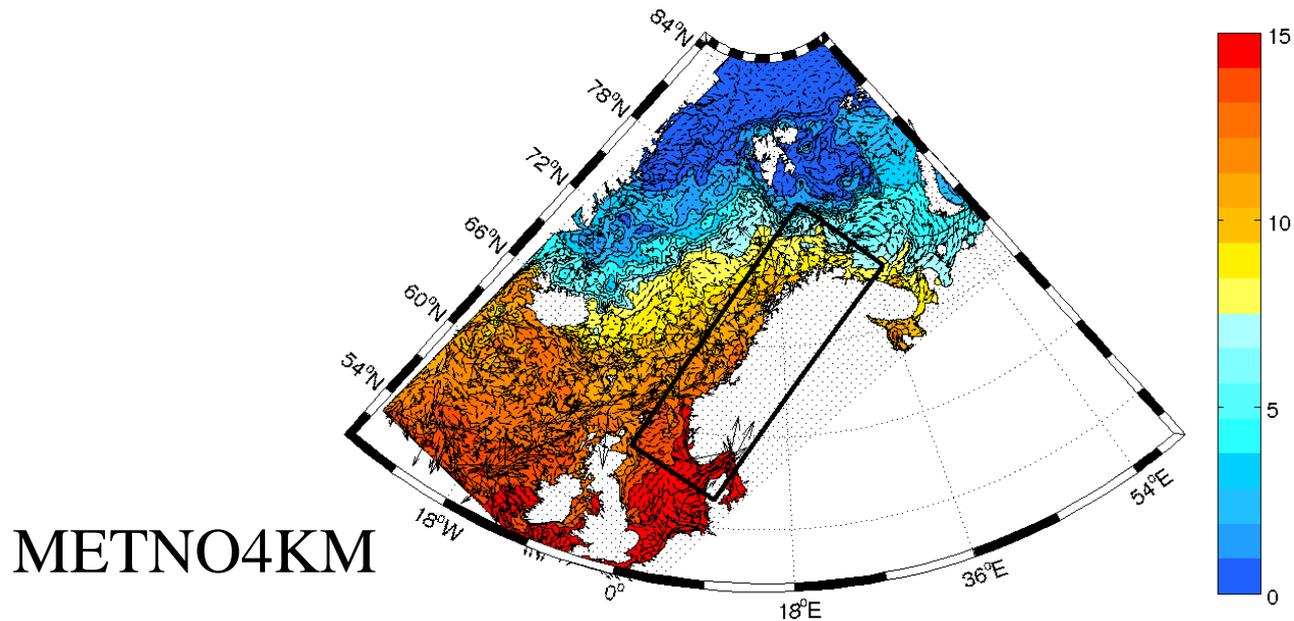


# Archive: nesting conditions

3D-fields of surface height, hydrography and currents (daily means)

Optional archives in NorKyst-800:

- **ROMS4KM**: Nordic Seas, 1989 – 2008
- **METNO4KM**: met.no operational, Nordic seas, 2008 – present
- **MONCLI4KM**: Monthly climatology based on ROMS4KM
- Upcoming: ROMS 4KM hindcast, Nordic Seas, 1958-2010

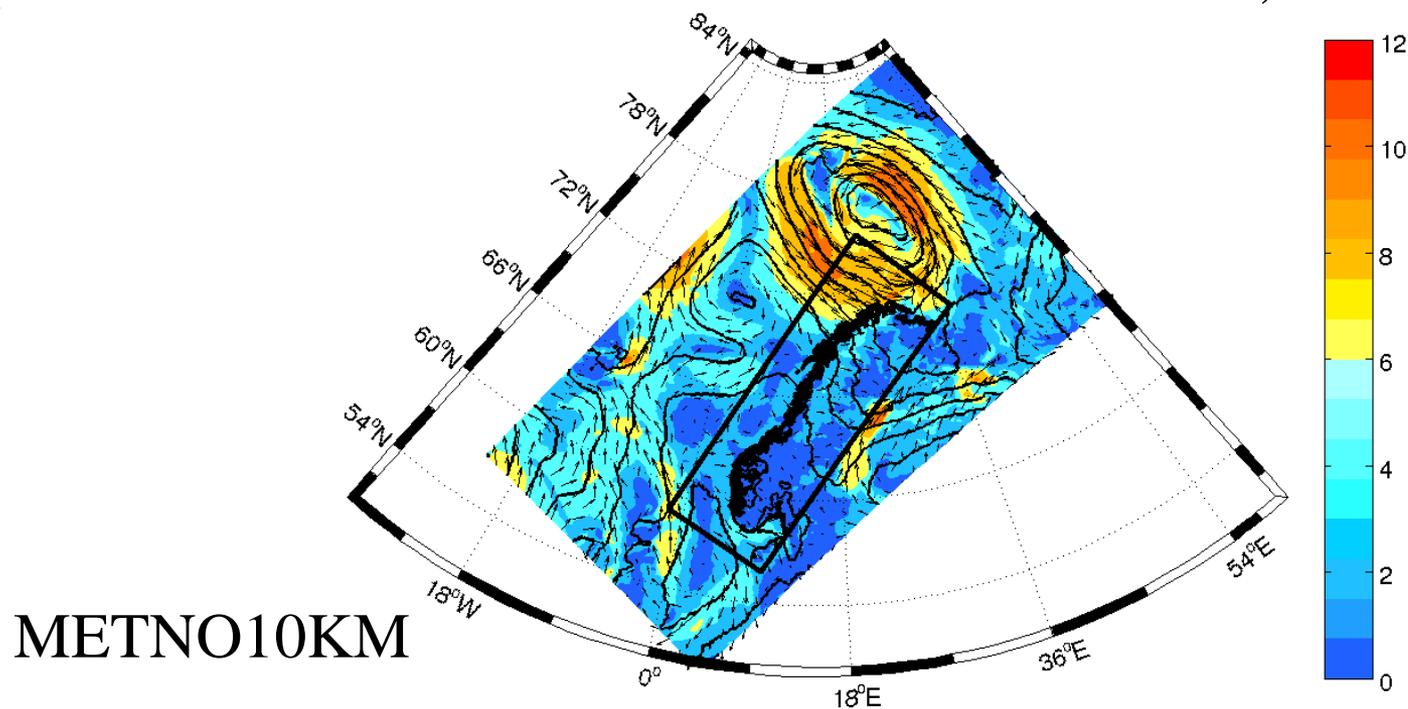


# Archive: atmospheric forcing

Surface fields of mslp, wind, temperature, specific humidity and fields of total cloud cover and precipitation

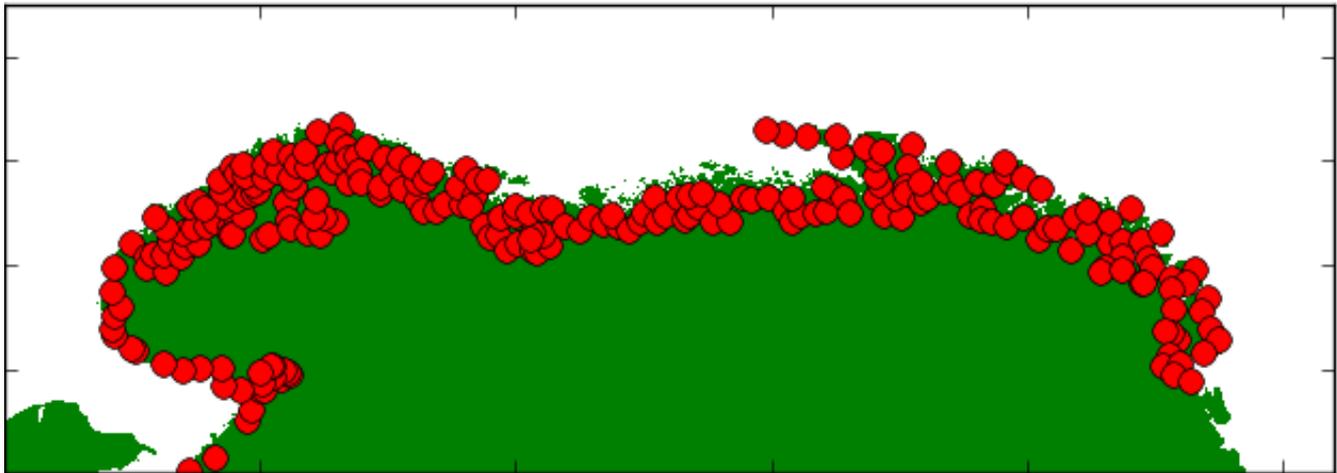
Optional archives in NorKyst-800:

- **ERAINT**: ECMWF re-analysis,  $0.7^\circ \times 0.7^\circ$ , 1989 -> present
- **METNO10KM**: Hirlam 10km hindcast, 1958 – 2009
- Operational model fields from met.no: Hirlam 8km, UM 4km



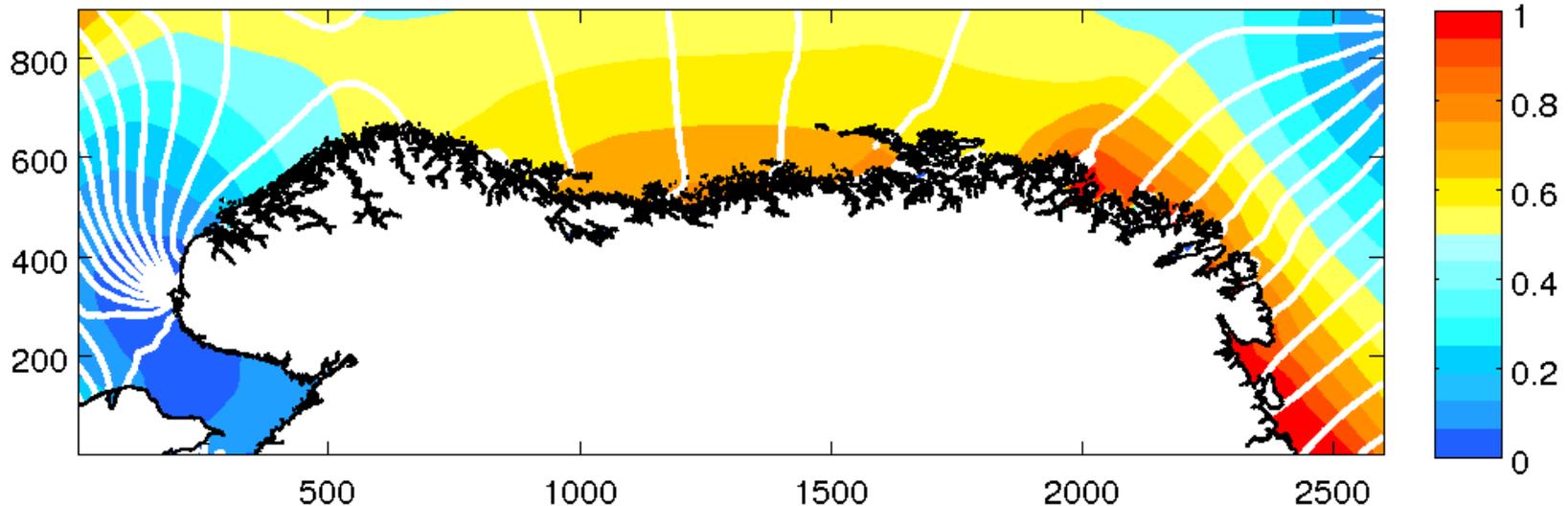
# Archive: river runoff

- Based on modelled (HBV) discharge from the 247 main Norwegian catchment areas that drain to the sea
- The HBV-model is a conceptual rainfall-runoff model including snow accumulating and melting, soil moisture accounting with hydrological response and river routing
- Provided by the Norwegian Water Resources and Energy Directorate (NVE)
- Daily values, valid from 1962 – present (provided with a 1/2 year time lag)
- The discharge is distributed linearly from the surface down to a prescribed depth for each river



# Archive: tidal forcing

- Based on the global inverse barotropic model of ocean tides, TPXO7.2 (hor. res. of  $0.25^\circ$ )
- Amplitude and phase for sea surface elevation and currents for eight primary harmonic constituents (M2, S2, N2, K1, K2, O1, P1, Q1) of diurnal and semidiurnal frequencies



Co-tidal range (colors, 0.1m) and co-tidal lines (white lines, 1h) interpolated from the TPXO database to the entire NorKyst-800 grid

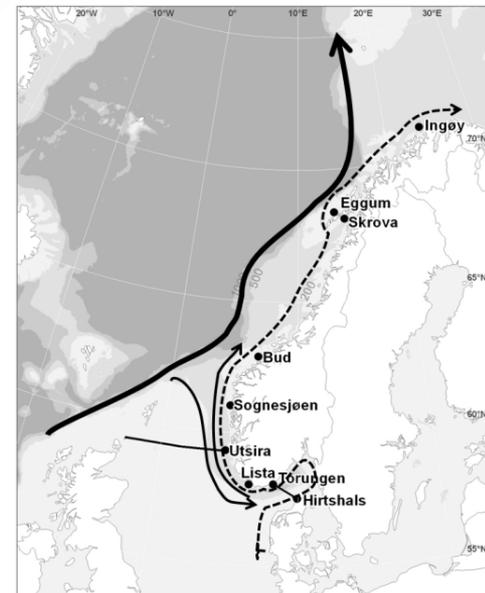
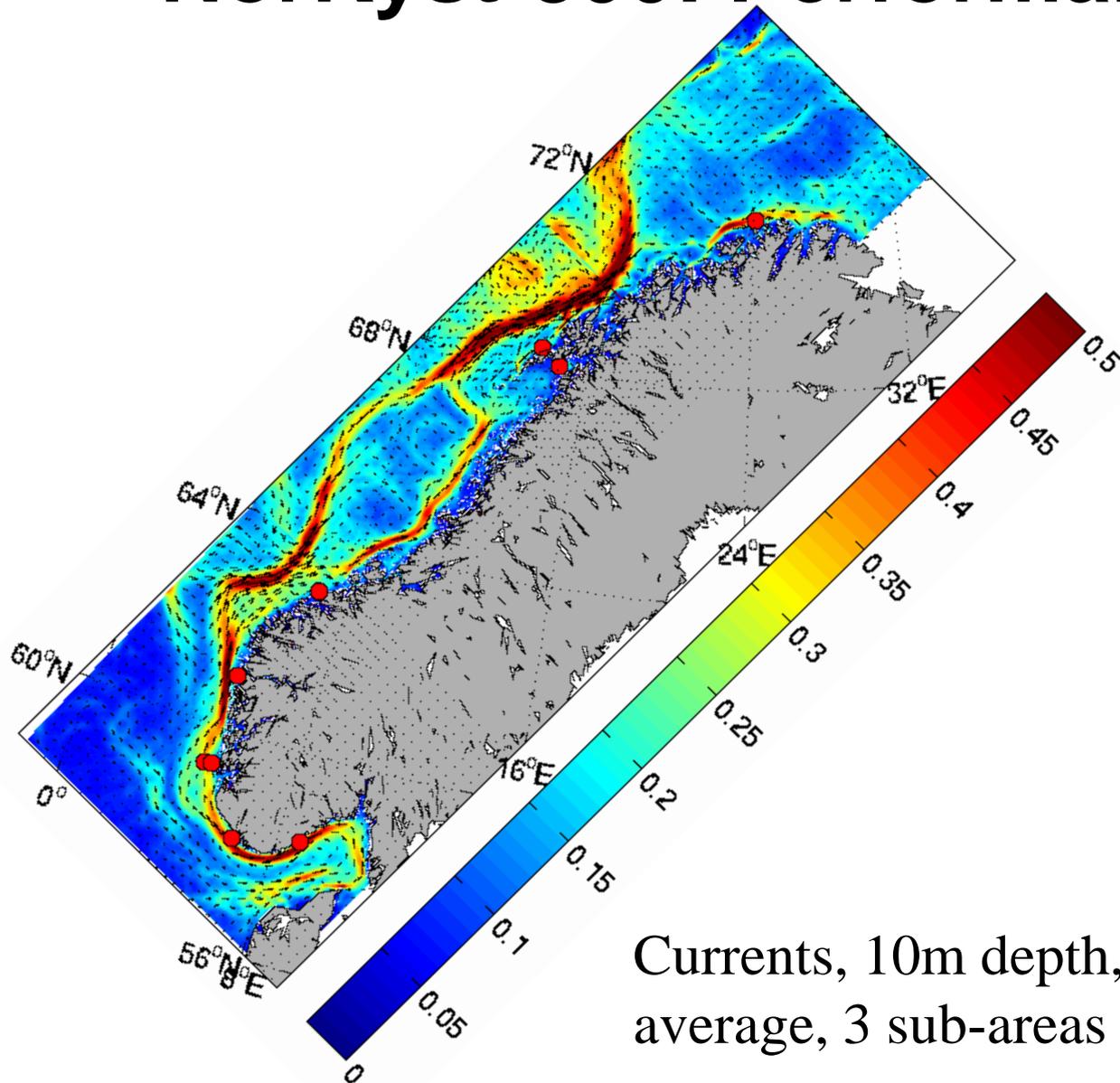


# Ocean model: ROMS

- ✓ The Regional Ocean Modeling System (<http://myroms.org>) is used in the NorKyst-800 model system and is a 3D free-surface, hydrostatic, primitive equation ocean model using terrain-following s-coordinates in the vertical.
- ✓ Sea ice is included.
- ✓ The NorKyst-800 system is not bound to keep ROMS as the solver of the primitive equations, but we are very satisfied with its behavior from several validation experiments.



# NorKyst-800: Performance

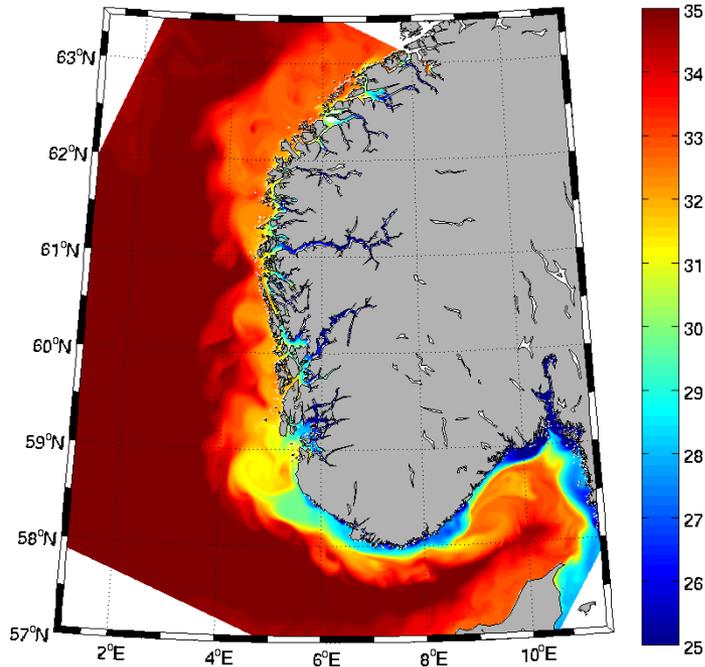


Currents, 10m depth, 2009-  
average, 3 sub-areas merged

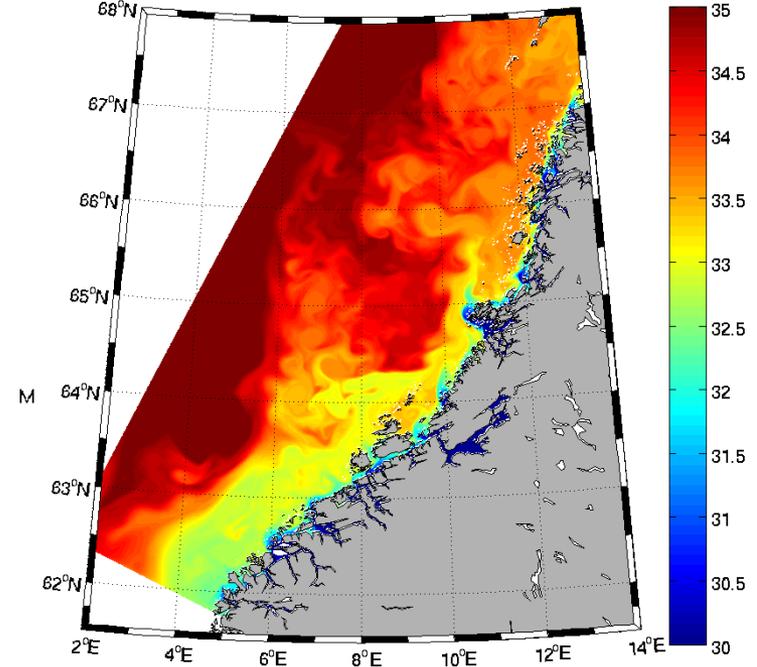


# NorKyst-800: Performance

NorKyst800: Surface Salinity, 12 UTC, 01/05 2009

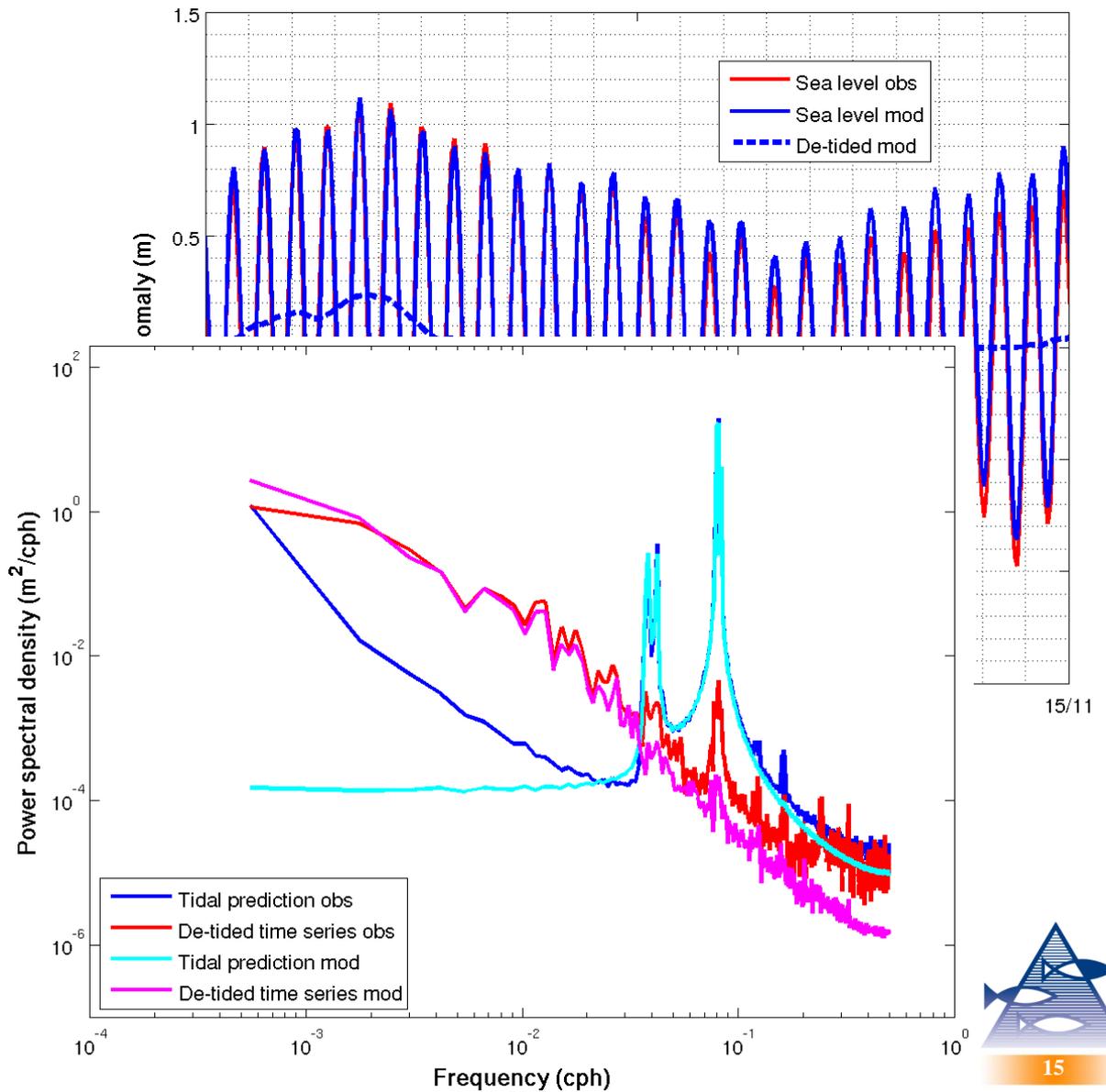
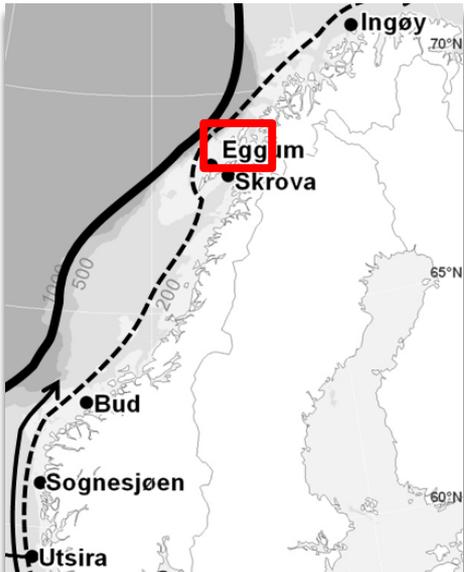


NorKyst800: Surface Salinity, 12 UTC, 01/05 2009

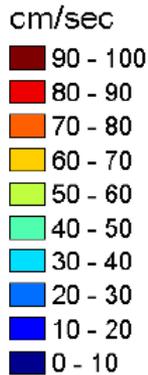
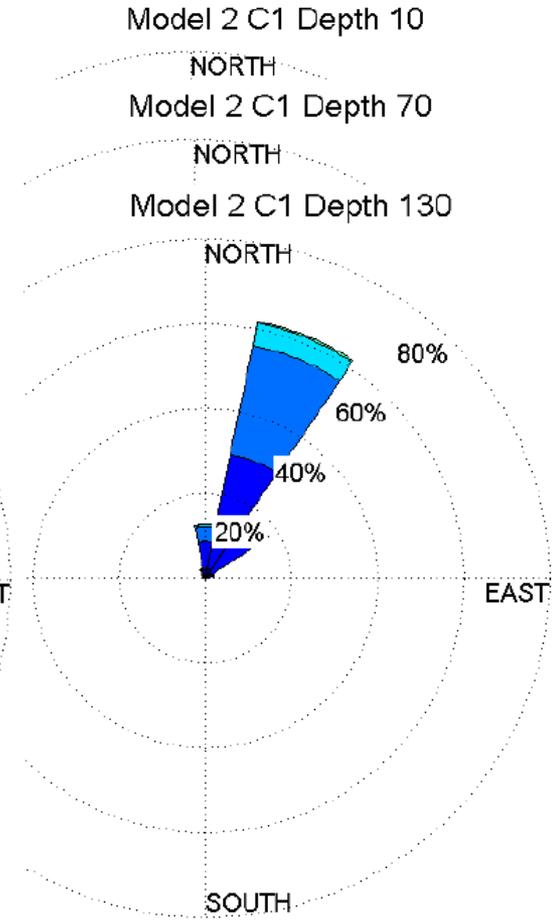
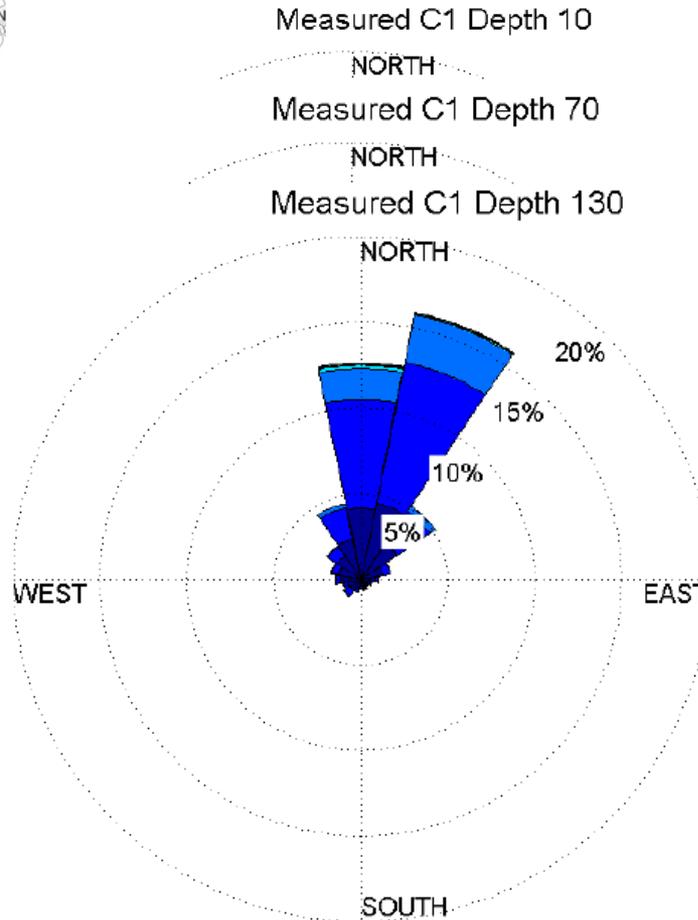
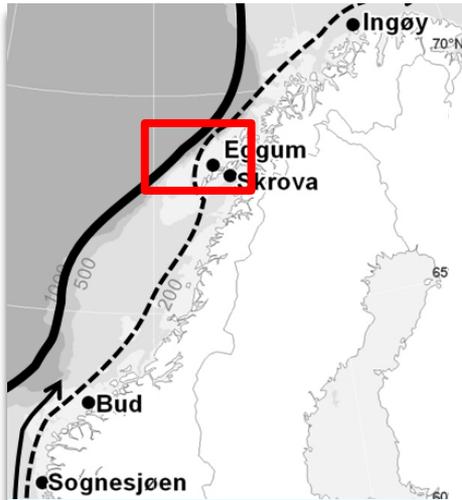


Surface salinity, animation, May 1-31, 2009, daily averages

# Validation, sea level



# Validation, currents, offshore

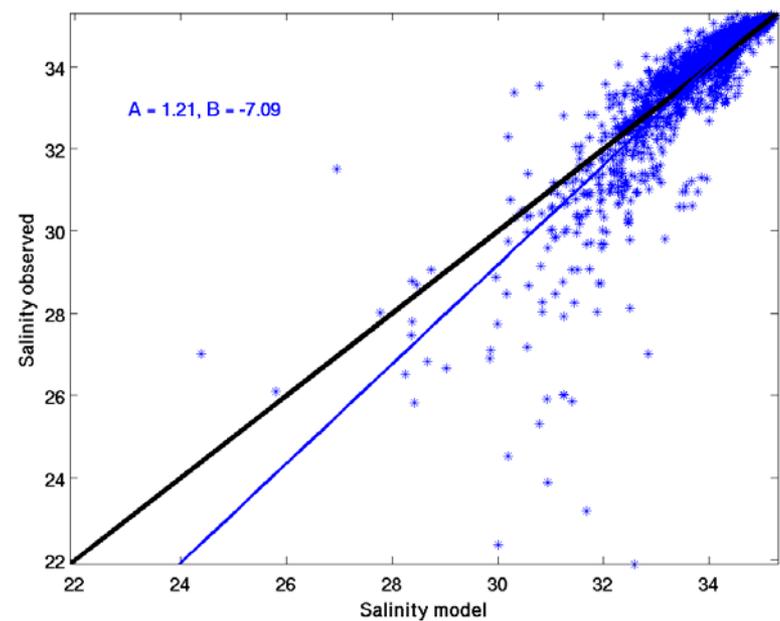
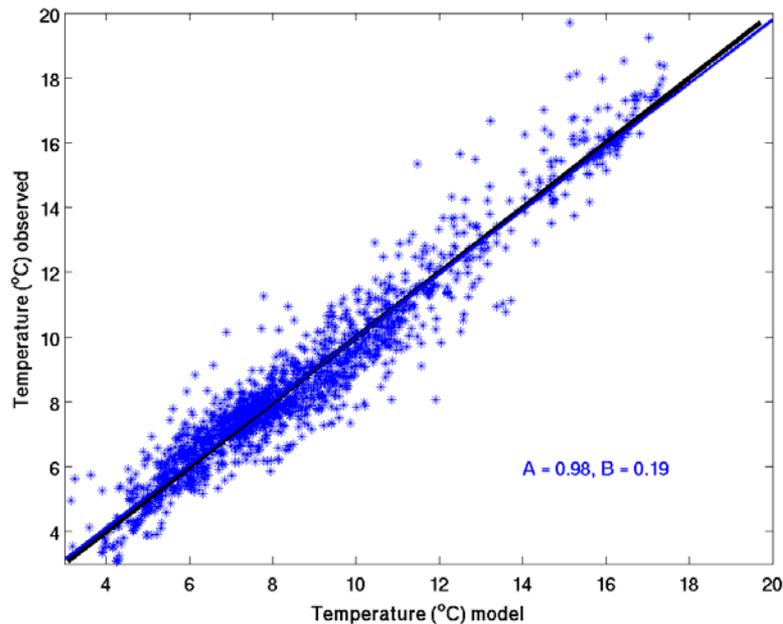
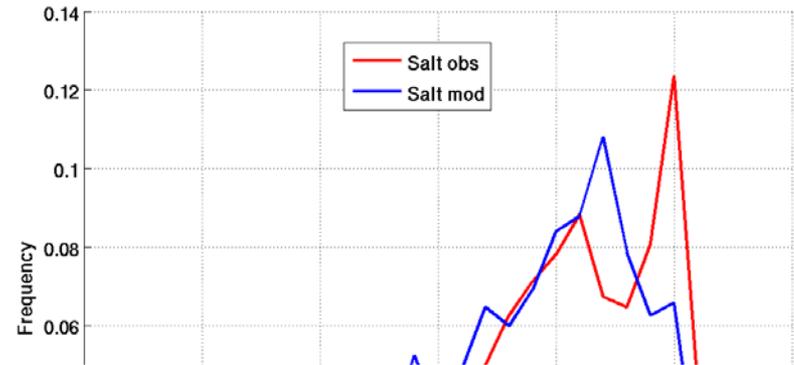
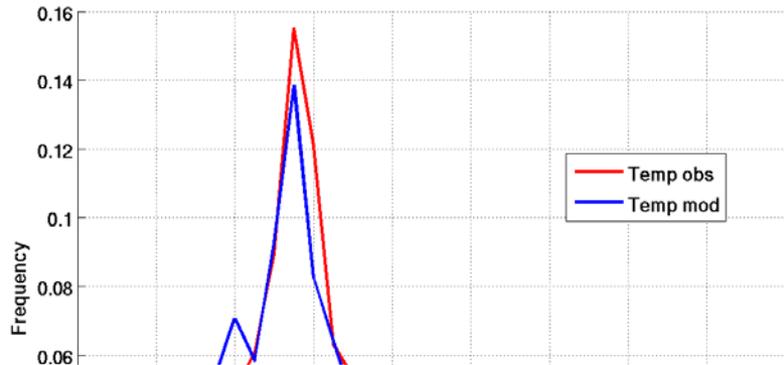


Courtesy: Statoil and met.no (Lofoten-Vesterålen Currents)





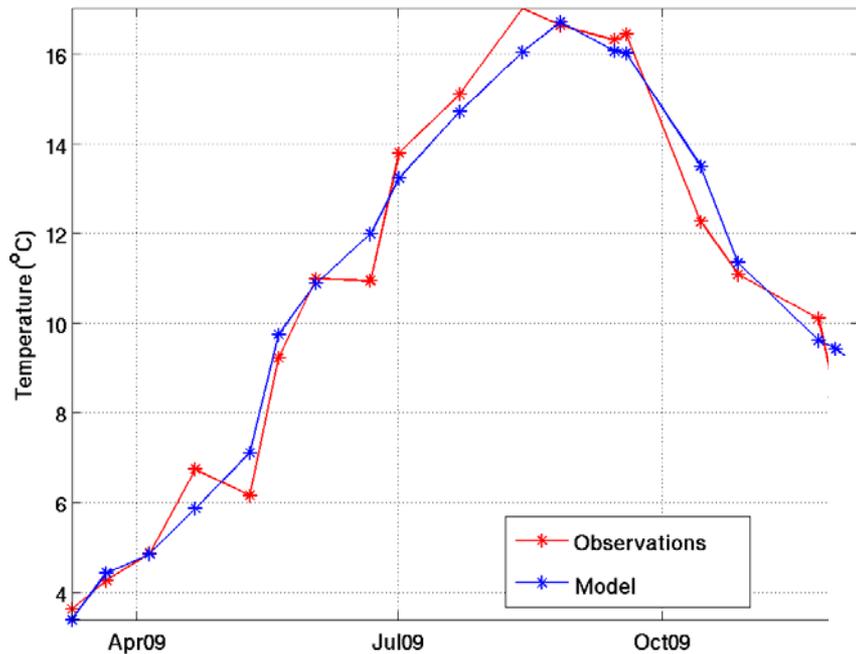
# Validation, hydrography



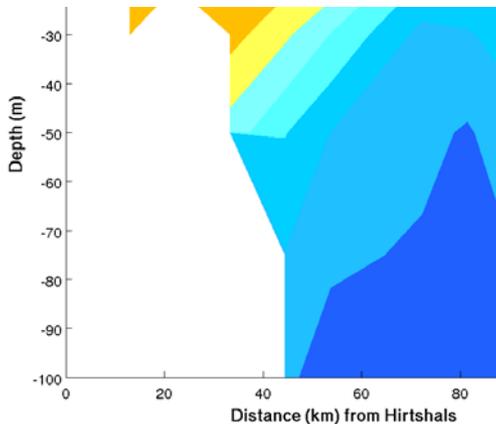
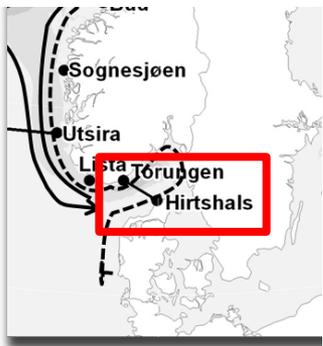
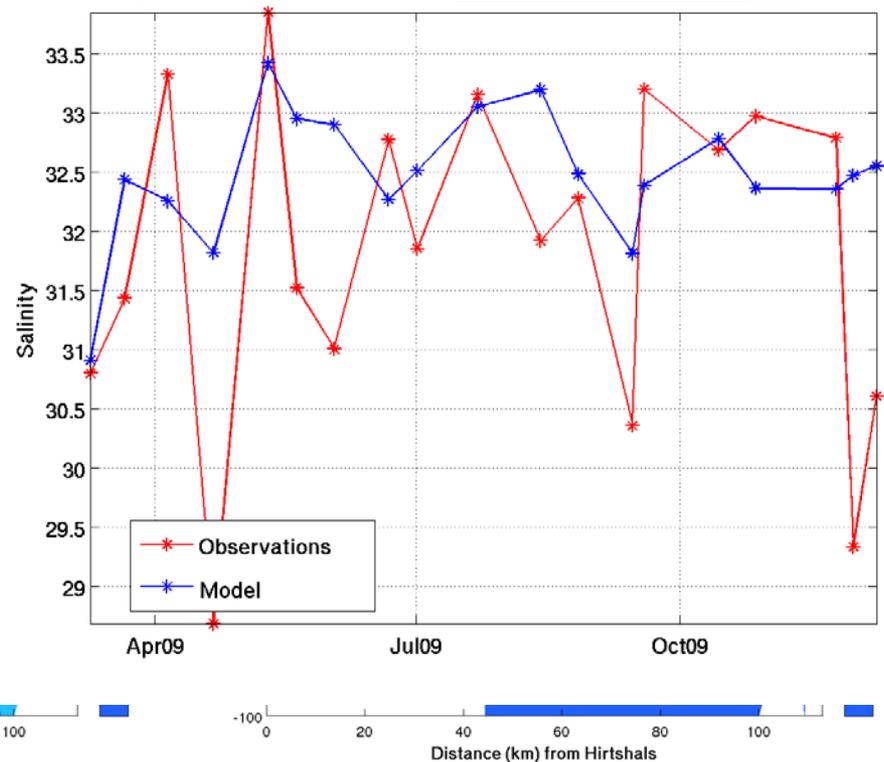
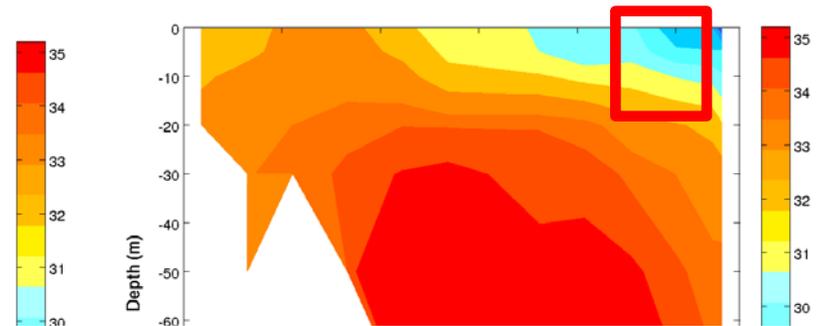
All fixed stations

# Validation, hydrography

NorKyst 800



Measurements



The Skager

# Summary

- ✓ NorKyst-800 is established to provide information on the physical environment with relatively high resolution along the Norwegian coast (for oil spills, man-over-board, algae blooms, input to salmon lice/cod egg tracking models, input to fjord models etc.
- ✓ NorKyst-800 contains an ocean model (ROMS), several data bases with external forcing for both hindcast and forecast simulations and scripts/programs to have the forcing easily arranged.
- ✓ NorKyst-800 is run by several users and validated towards an increasing number of observations.
- ✓ NorKyst-800 behaves satisfactorily off- and onshore, but most Norwegian fjords need a higher resolution model to resolve their dynamics properly.

