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Decadal long simulations of mesoscale structures in the northern North Sea/Skagerrak using two ocean models

Jon Albretsen² and Lars Petter Røed¹

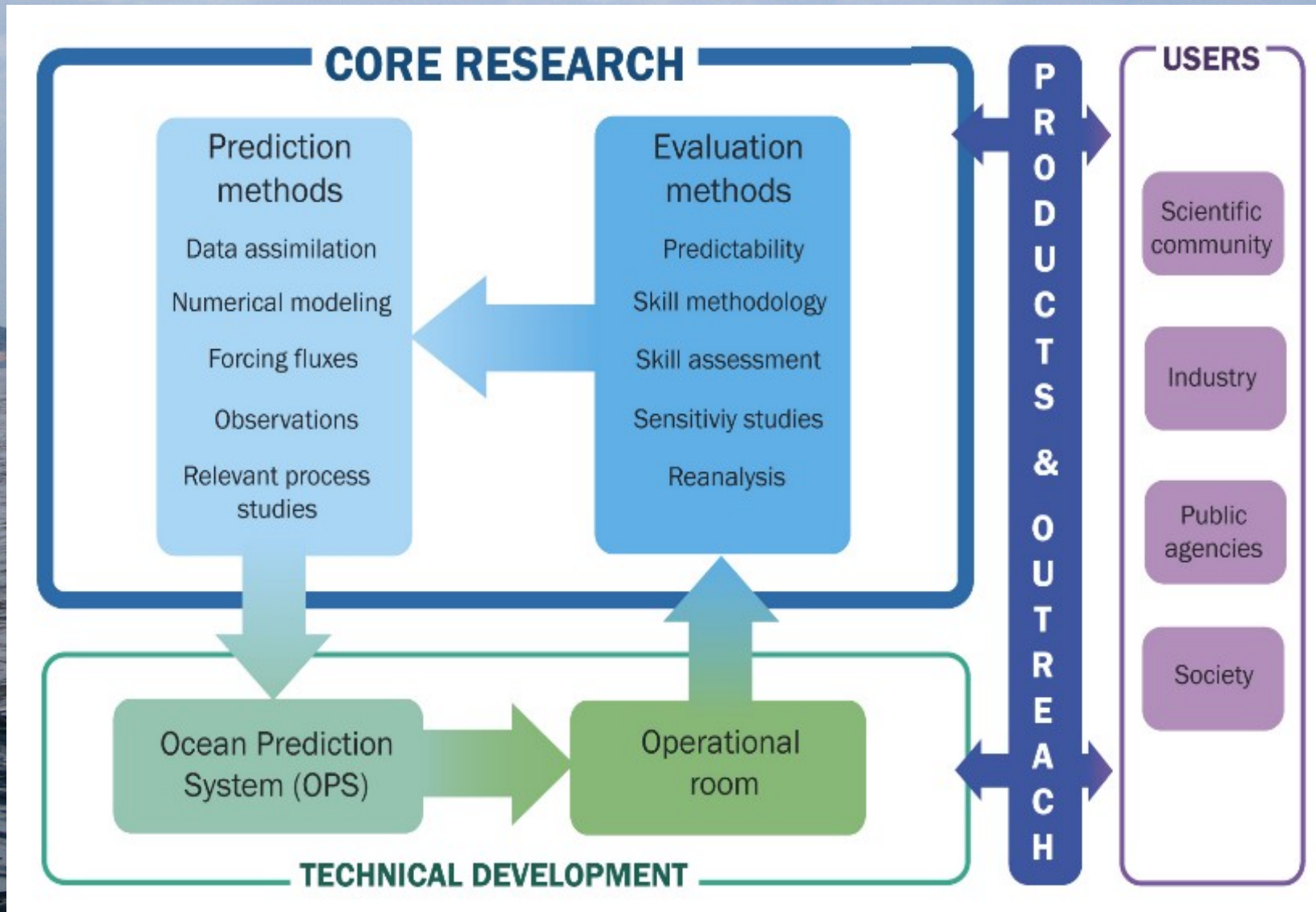
Presented at 15th Joint Numerical Modelling Group (JONSMOD)
Delft, The Netherlands, May 10 - 12, 2010,

¹Also affiliated with Department of Geosciences, University of Oslo, Norway

²Now at Institute of Marine Research, Flødevigen, Arendal, Norway



The research learning loop





The story ...

- Switching ocean forecast model
 - MIPOM -> ROMS
- Key question
 - New model as good as or better than the old one?
- Comparison of model results vs. observation
- Heat flux parameterization
 - Calibrating off shelf model version

LaCasce et al. (2007)

Albretsen and Røed (2010, *Ocean Dynamics*, in press)



Model facts

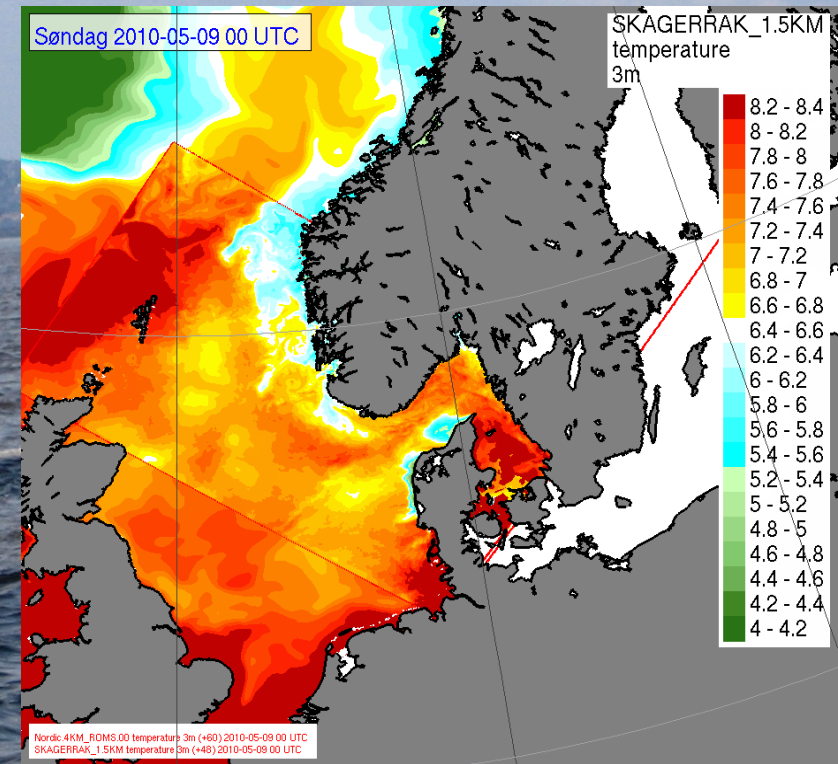
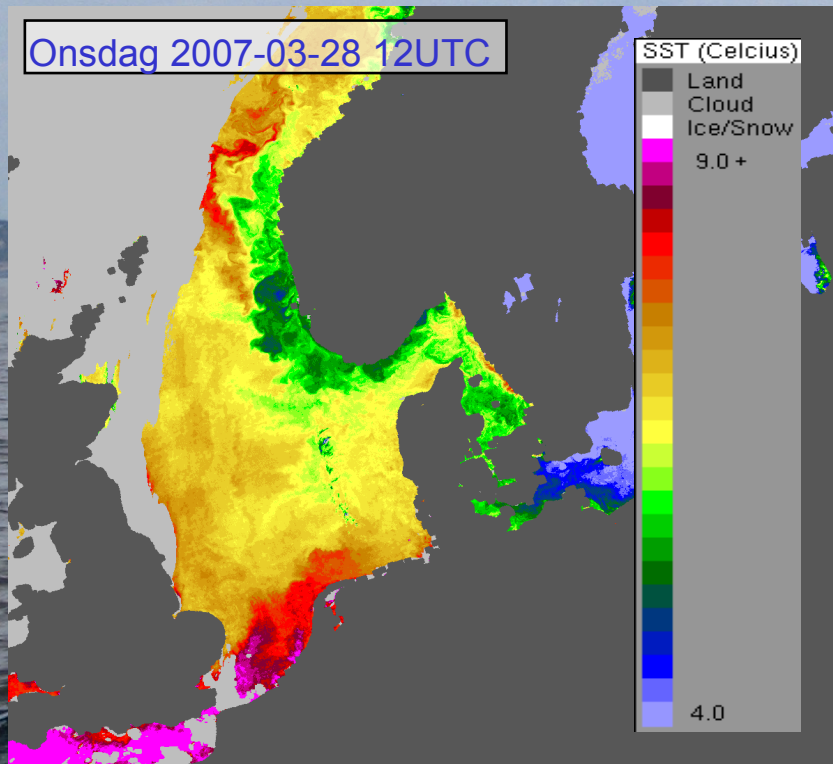
Item	MIPOM		ROMS v1	
	4 km	1.5 km	4 km	1.5 km
Resolution	4 km	1.5 km	4 km	1.5 km
# of vertical levels	26	21	32	32
Long (internal) time step	150 s	60 s	120 s	90 s
Ratio of internal to external time step	30	40	30	30
Horizontal dissipation	Smagorinsky		No explicit diffusion	
Vertical mixing	Mellor-Yamada 2.5 level		GLS mixing scheme	
Horizontal advection scheme	2nd order centered		3rd order upwind	
Surface fluxes	MI-IM		Standard ROMS bulk fluxes (analytic)	



Area of interest:

Satellite image

Last Friday's forecast

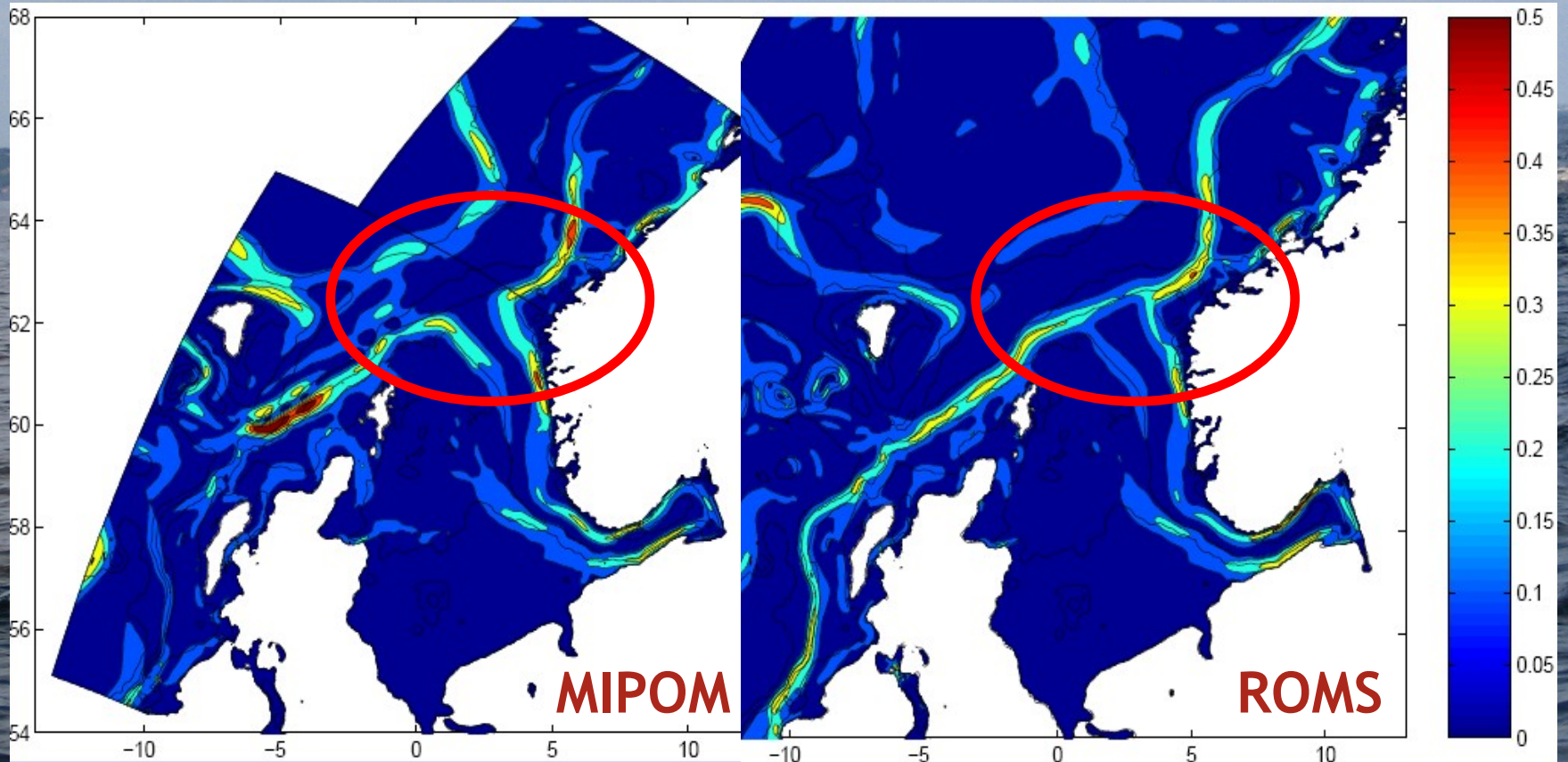


Note mesoscale patterns in SST



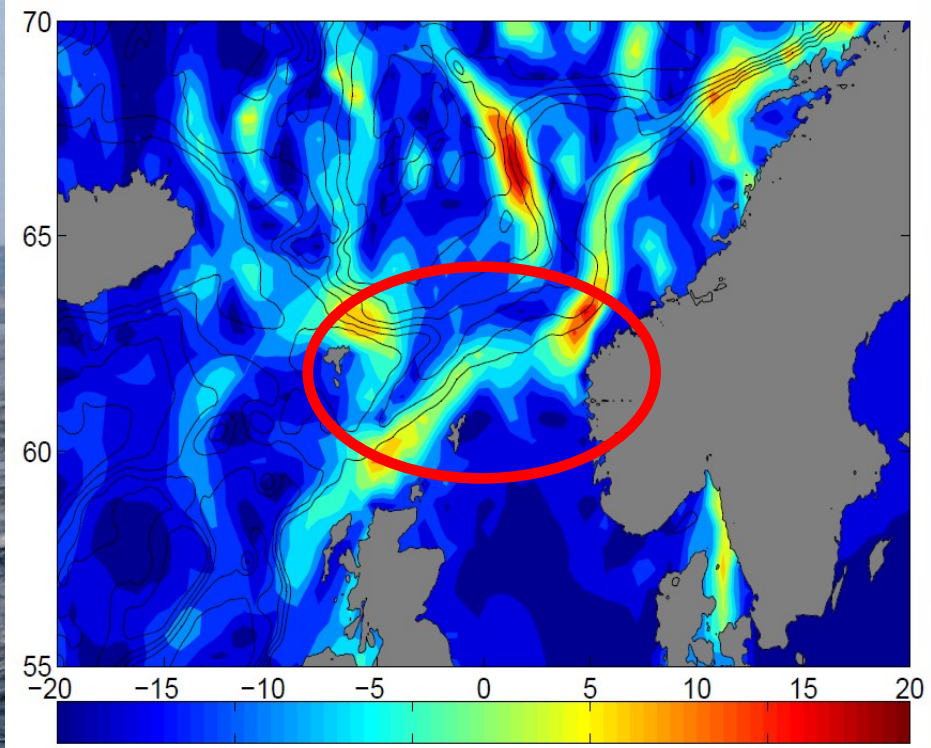
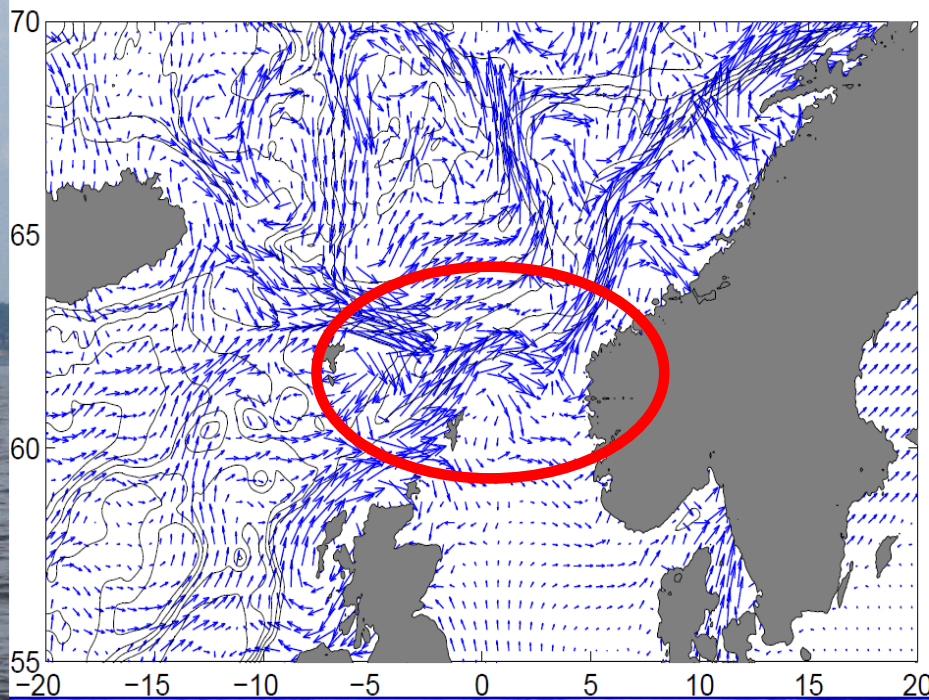
First comparison LaCasce et al. (2007)

Average speed at 50 m (2004-2006)





Observed surface velocities:

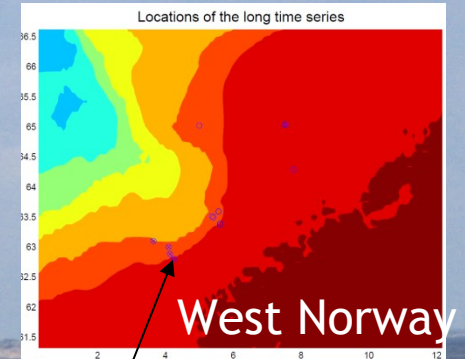
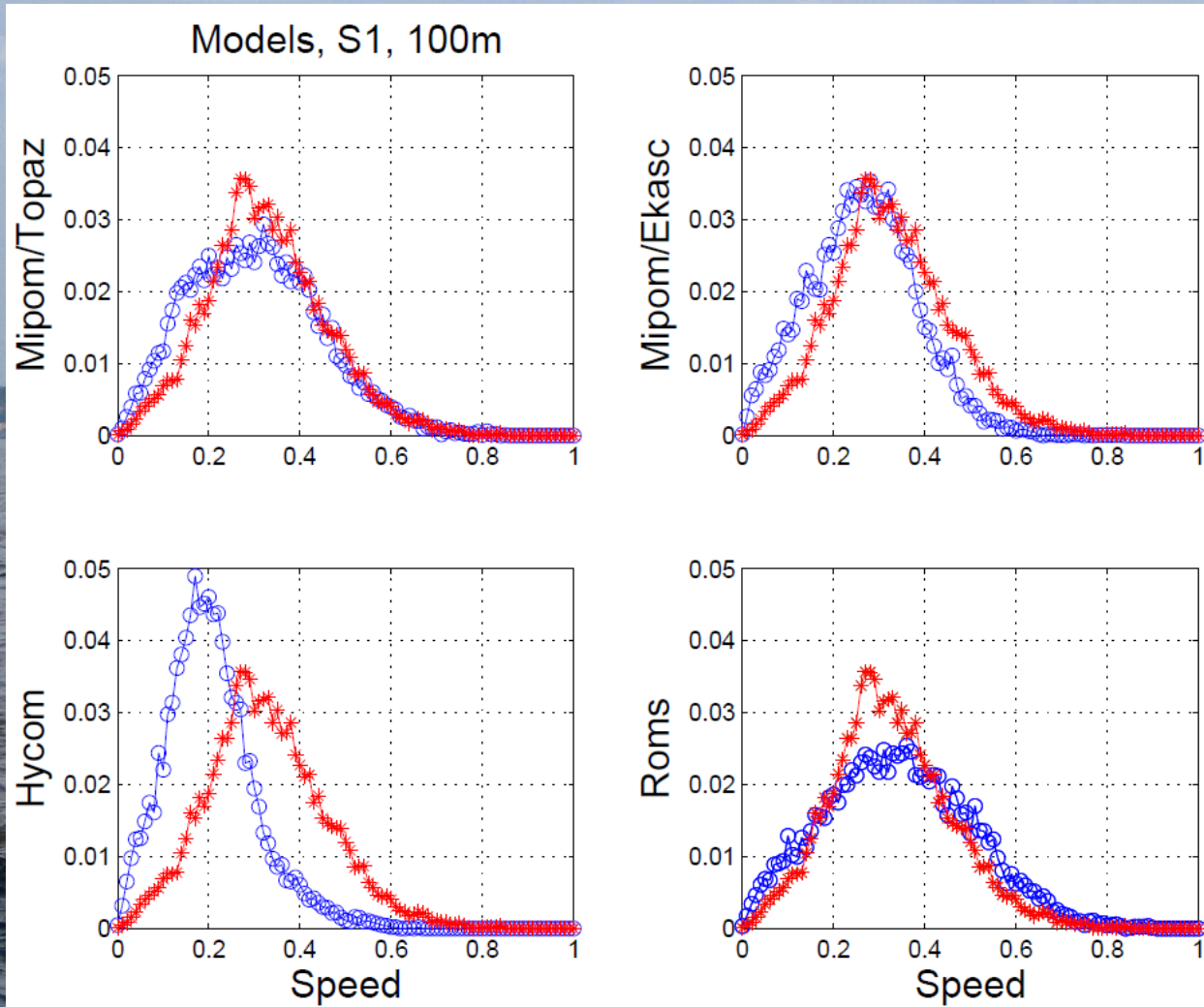


Speed

- Courtesy: Rio05, CLS Space Oceanography Division, AVISO



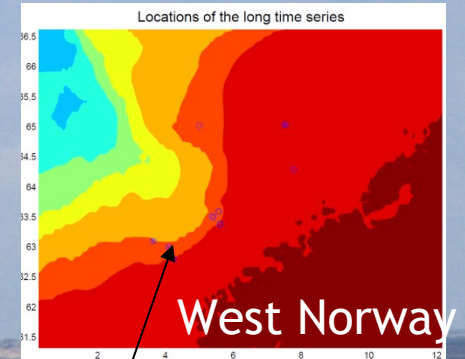
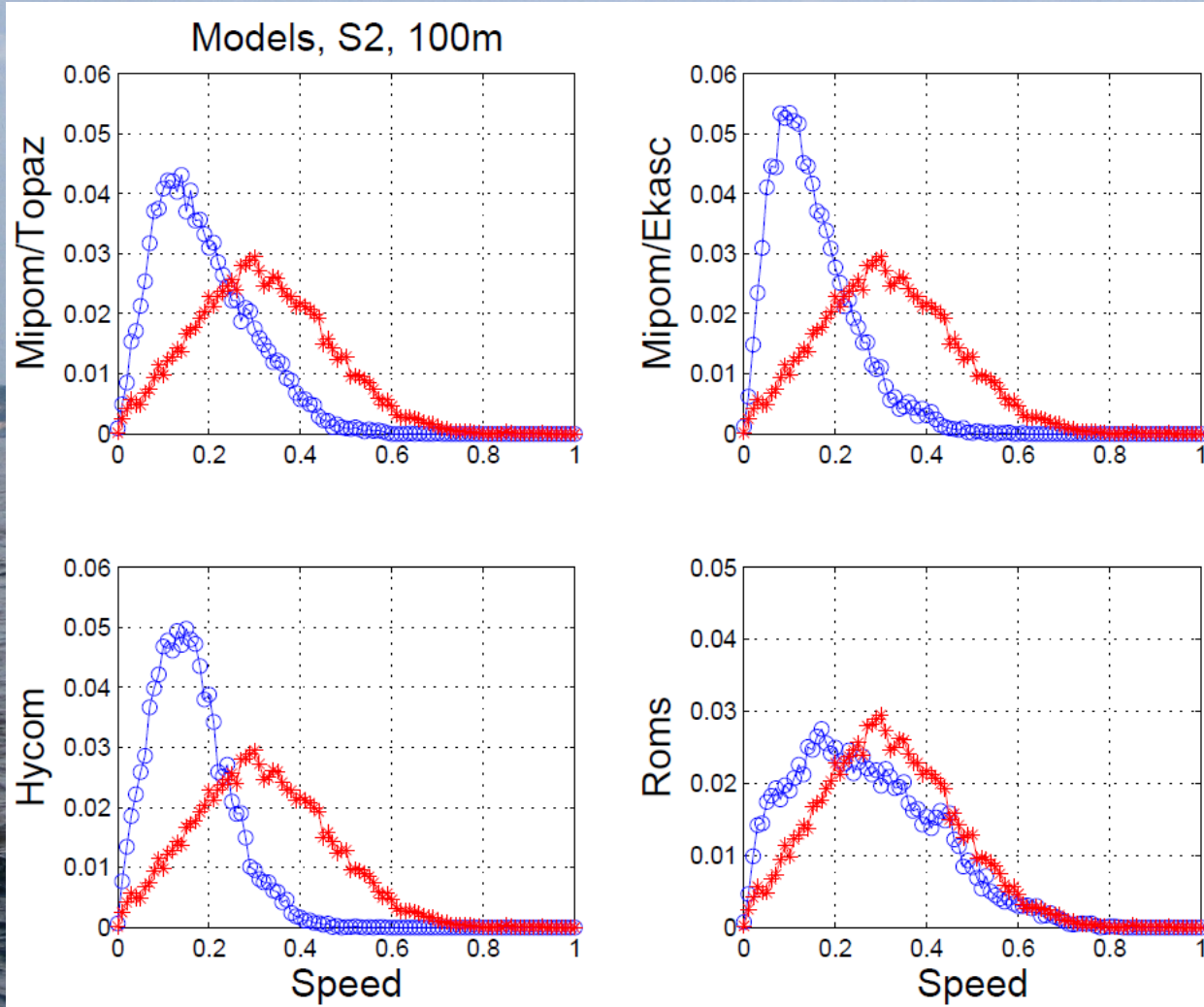
Speed at S1 at 100 m



Measurement period 2.5 years



Speed at S2 at 100 m





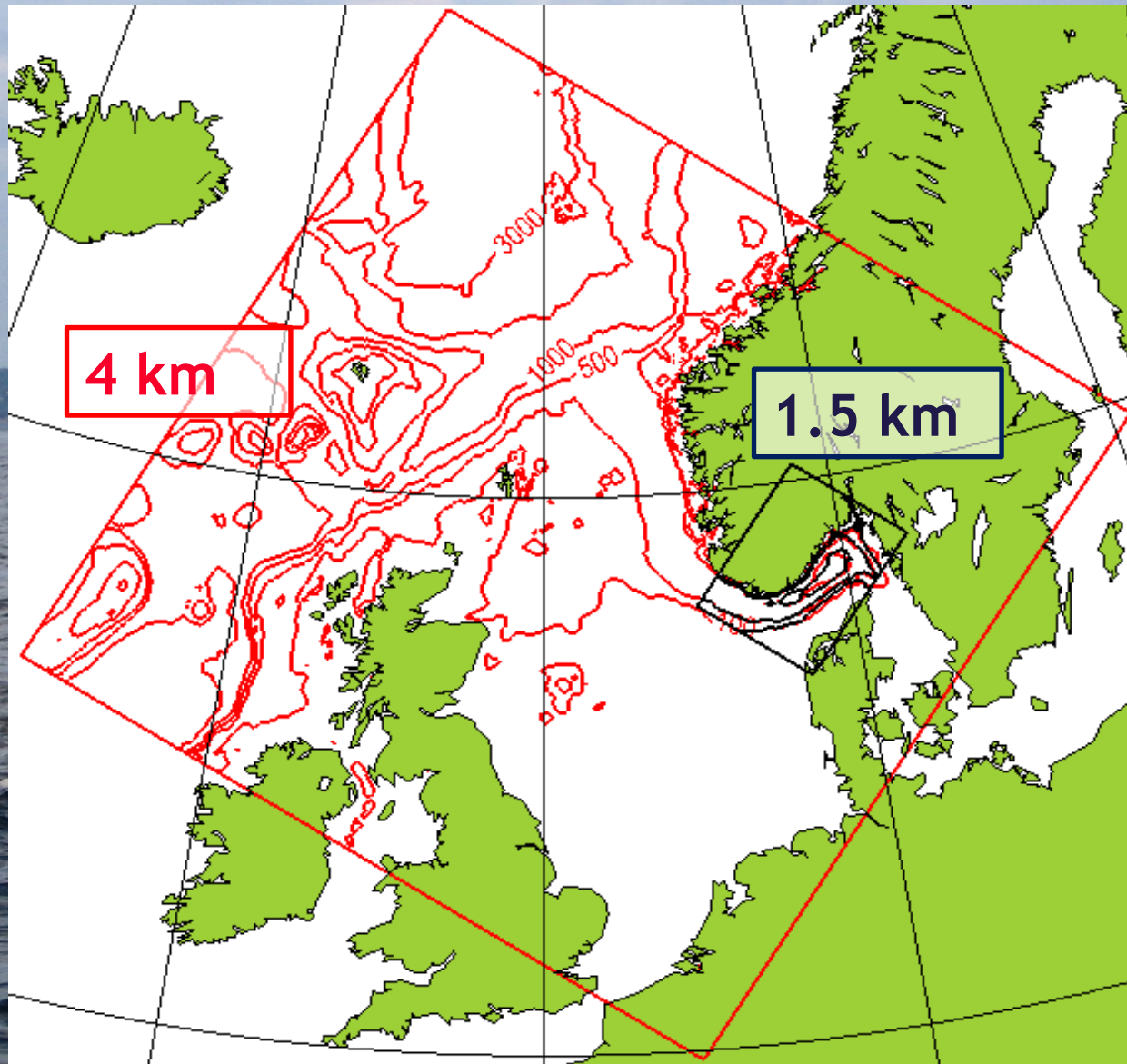
LaCasce et al. (2007) concluded:

- The ROMS velocities are more energetic and compare more favorably with in situ observations, as do the ROMS-derived means





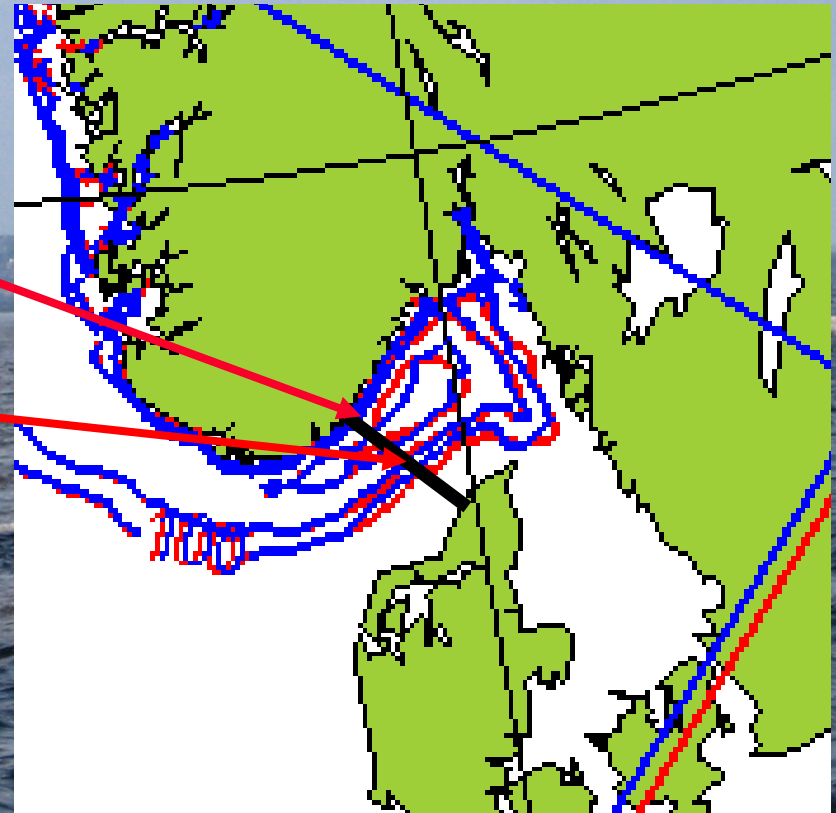
Two models => 4x27 year long runs:





Observations used

- Institute of Marine Research:
 - 160 days currents at one location
 - Monthly S&T data from the Hirtshals - Torungen section (12 stations, all years)
- ICES database
 - Irregular data in time and space: ~ 250 000 S and T in Skagerrak

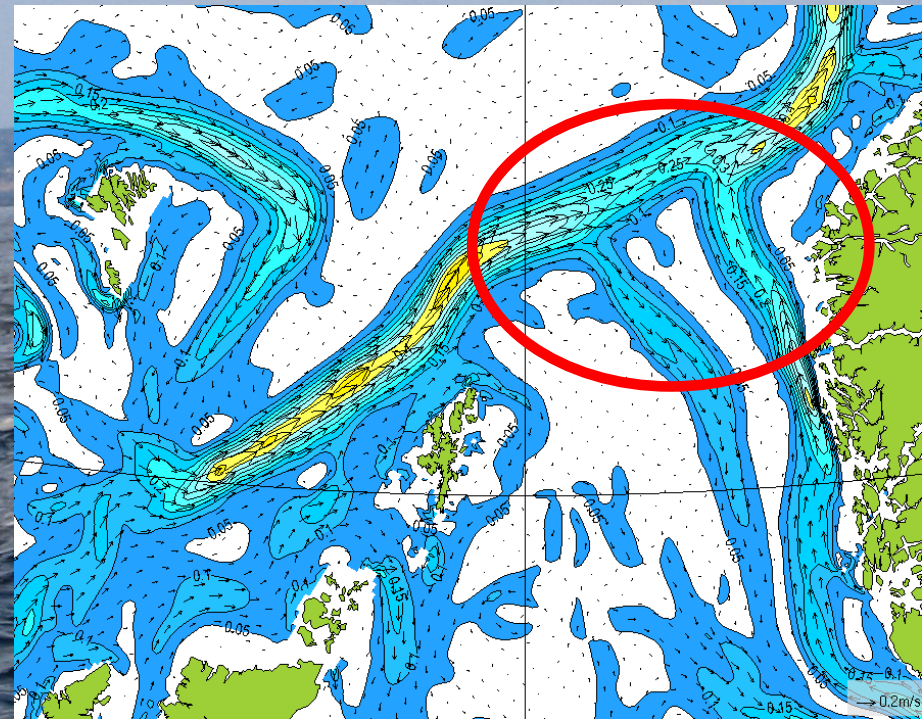
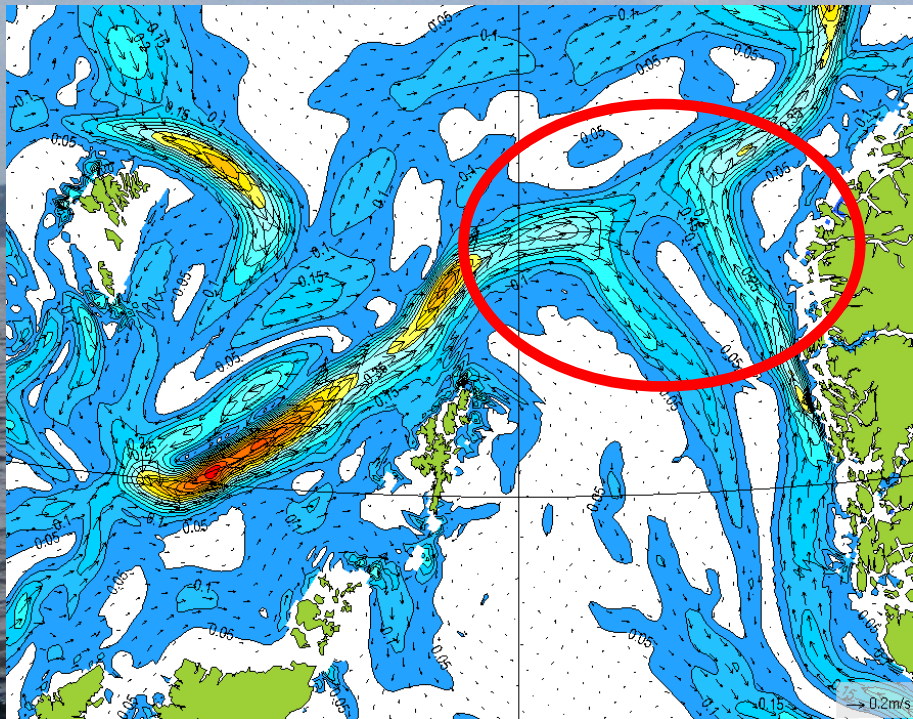




Currents at 50 m 1981-2007 average (m/s)

MIPOM 4km

ROMS 4km

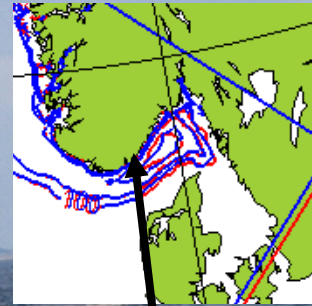
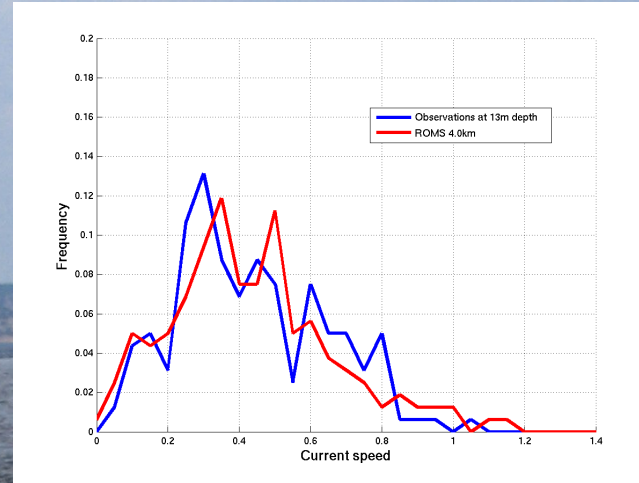
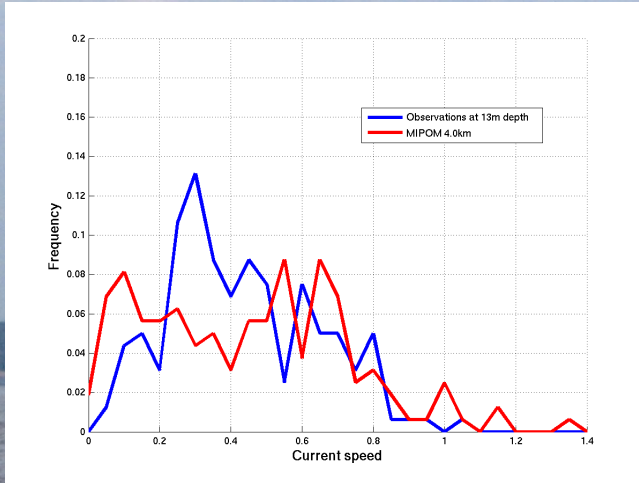




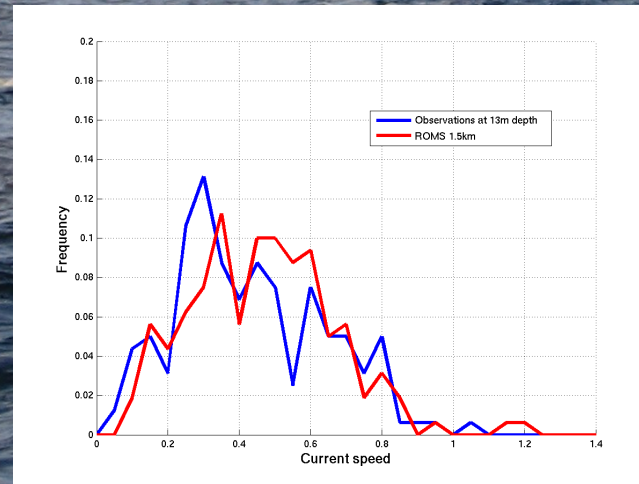
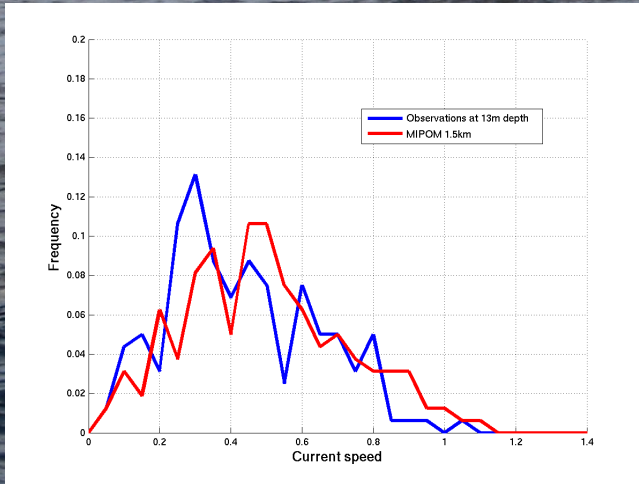
Current speed at 13 m

160 days (27.10.1992-4.4.1993)

4km



1.5km



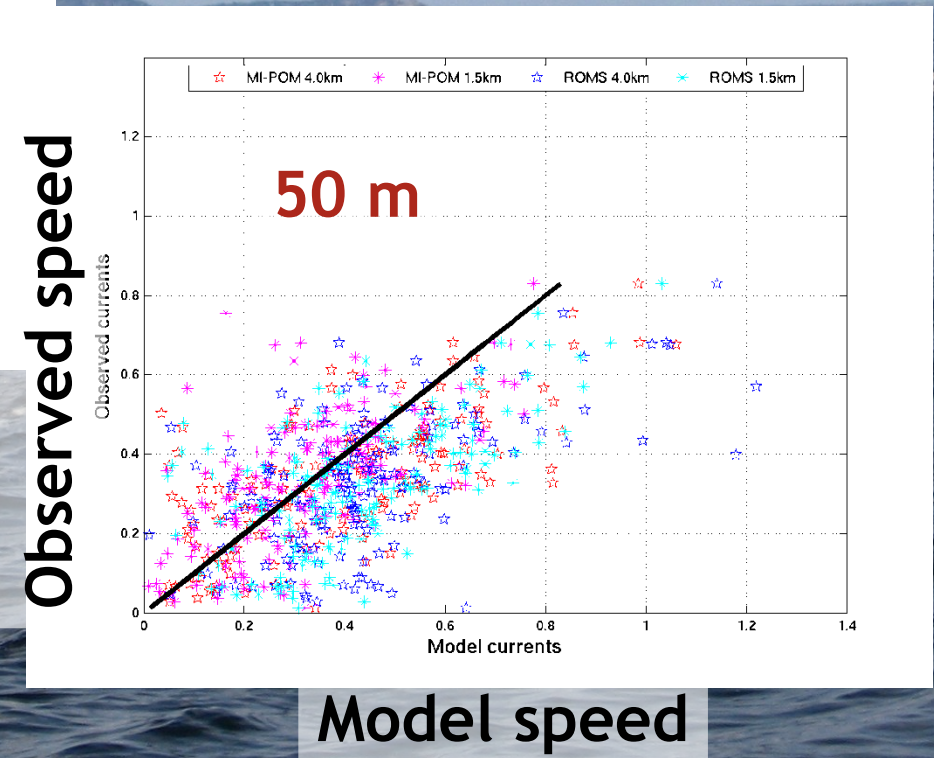
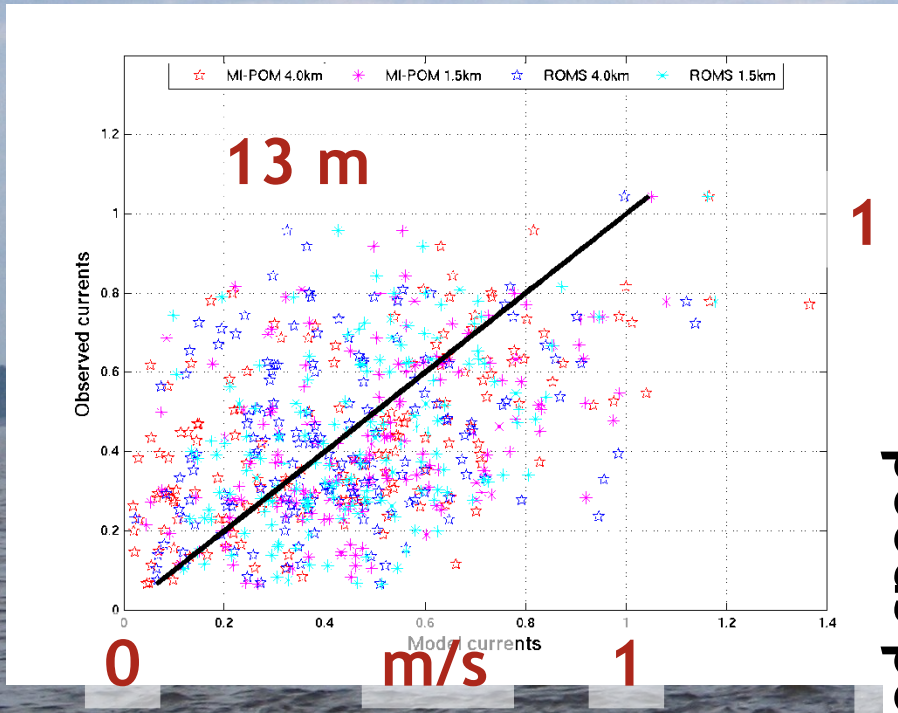
58.37N, 8.51E
Measured
depth: 120m
Equilibrium
depth:
4km: 233m
1.5km: 163m

MIPOM

ROMS



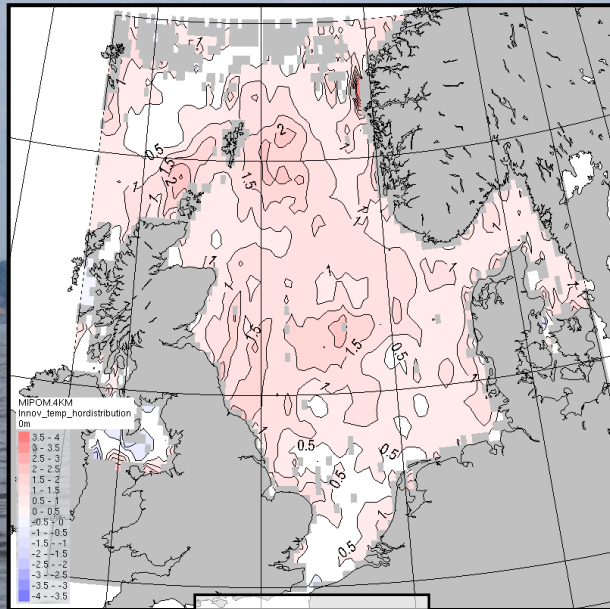
Currents at 13 m and 50 m: Any skill?



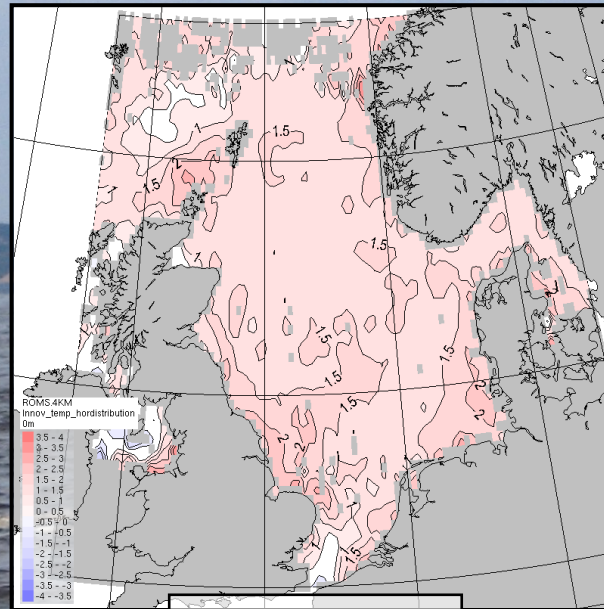


Significance of heat flux forcing

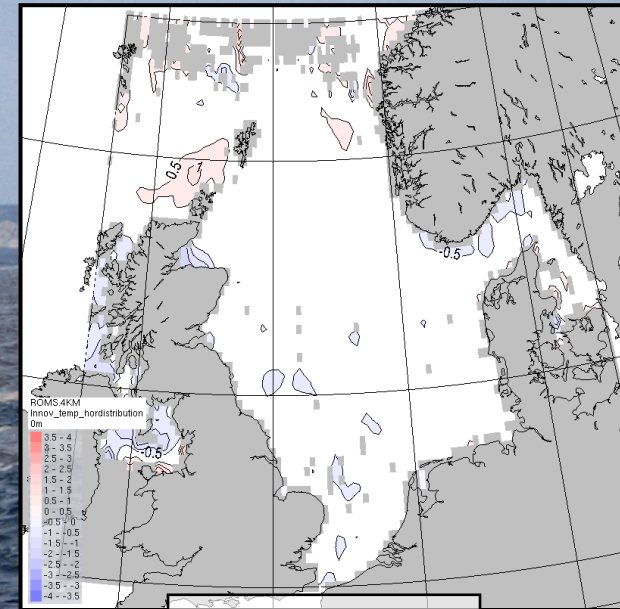
Red shading: Model too warm (ci: 0.5°C)



MIPOM



ROMS v1



ROMS v2

Temperature difference: 0-20m



Conclusions

- Overall new model (ROMS) performs better than the old model (MIPOM)
 - Better current frequency distributions
 - Slightly better skill
- Surface flux parameterization important
 - Large impact on the heat content
 - Modified ROMS version superior in both temperature and salinity distributions

Thank you



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