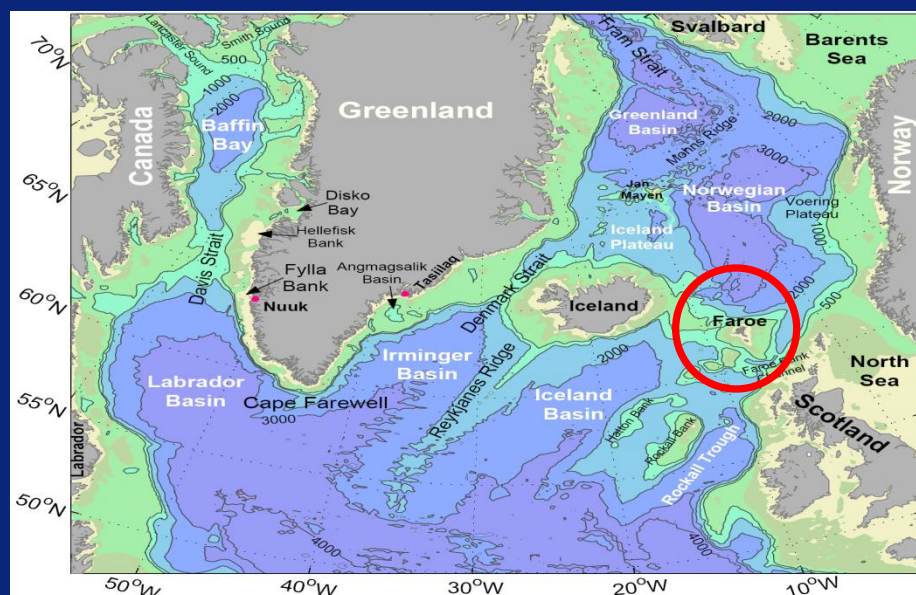




Faroe shelf circulation

- Link to the primary production



Till Andreas Soya Rasmussen¹, Steffen Maltkjær Olsen¹,

Bogi Hansen², Hjálmar Hatún² and Karin M H Larsen²

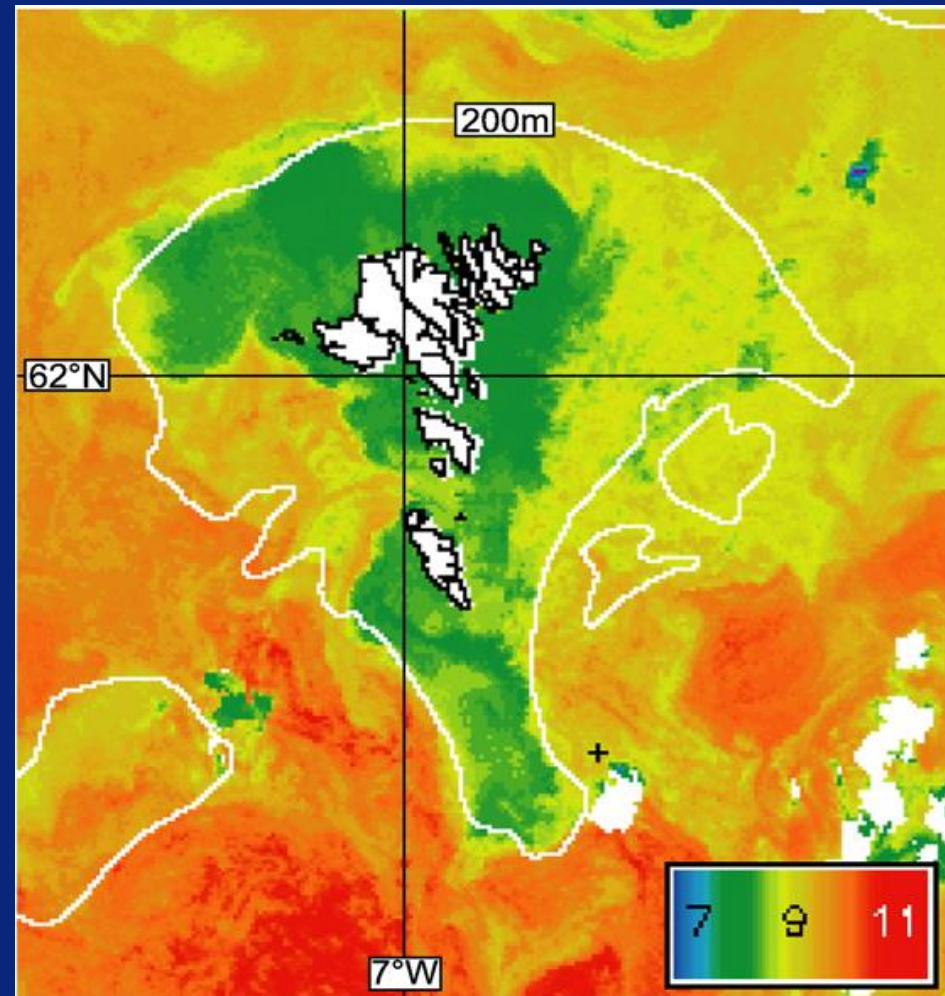
1) Danish Meteorological Institute

2) Faroe Marine Research Institute



Motivation

- Fisheries are important to the islands
- Large inter-annual variation of the primary production
- Observations indicates isolated well mixed water mass that is characterized by its temperature difference
- Is the model able to form this water mass?
- Can inter-annual variability of the physical properties be linked to the inter-annual variation of the primary production?



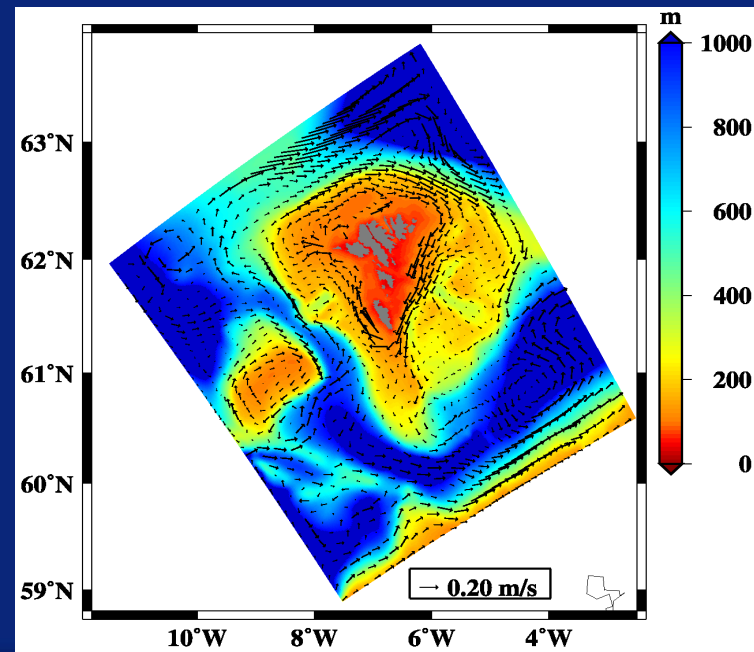
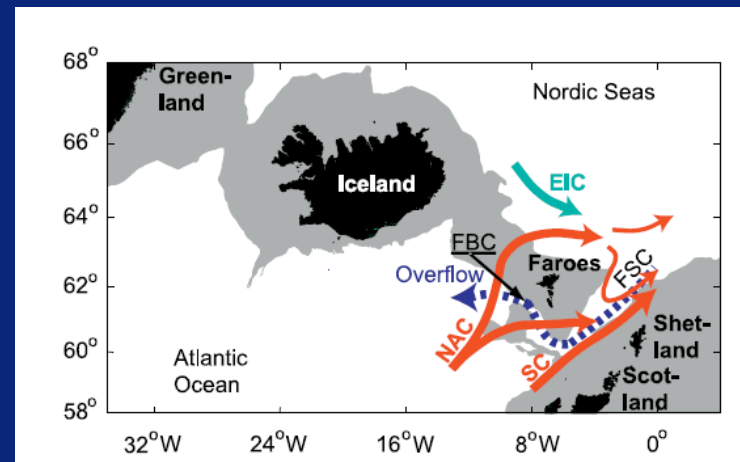
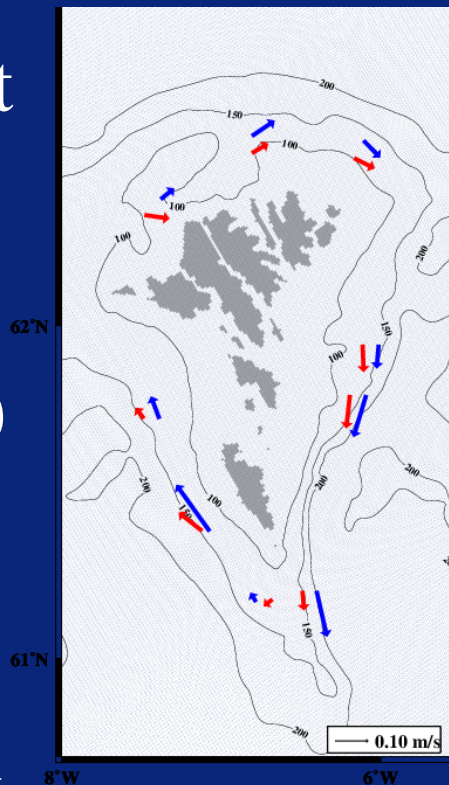


DMI

Center for Ocean and Ice

General circulation

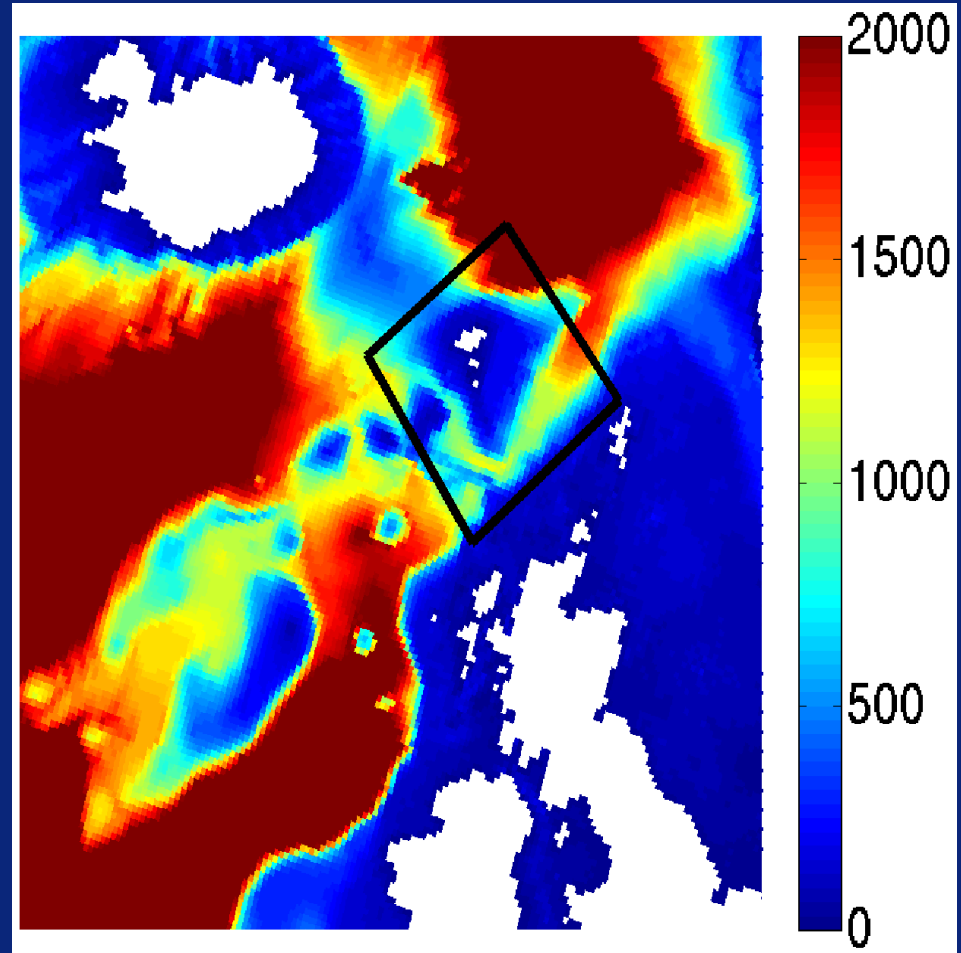
- Cold fresh East Icelandic current (EIC)
- North Atlantic Current (NAC)
- Faroe Bank “overflow” (FBO)
- Faroe Shetland channel (FSC)





Forcing

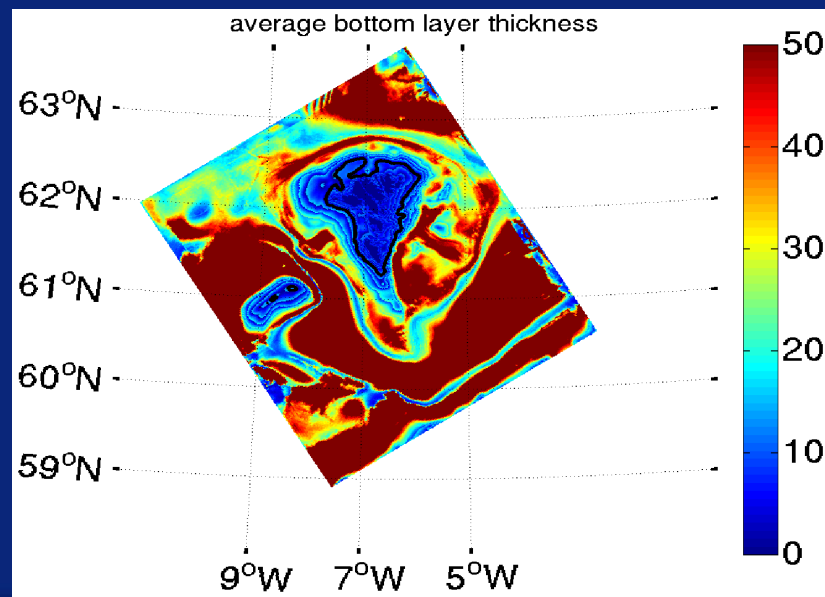
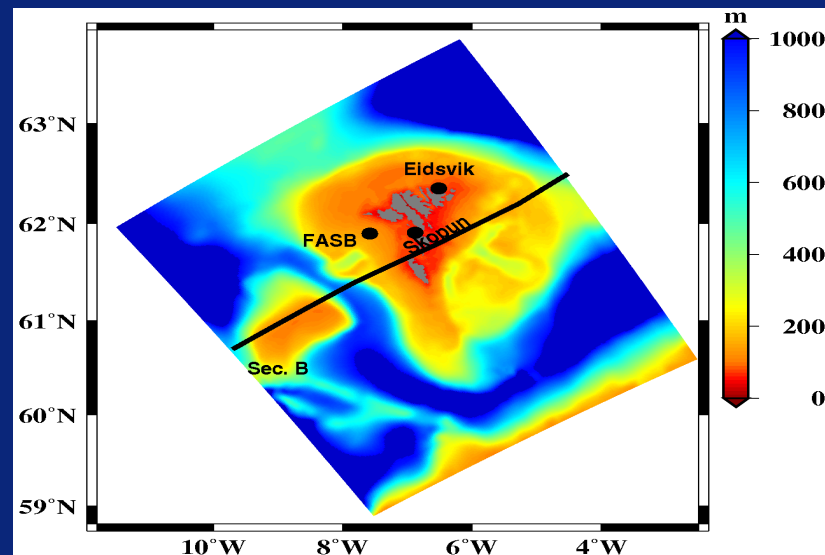
- Atmosphere
 - ERA Interim
- Oceanic Boundary conditions
 - HYCOM
 - Hindcast of North Atlantic and the Arctic
 - Horizontal resolution 10 km
 - 29 vertical layers
 - Period 2000 - 2009





Model setup

- Model: HYCOM
- Domain
 - 340x400 points
 - dx/dy 750-1300 m
 - Bathymetry merged between local observations and ETOPO1
- Change of vertical structure of the boundary conditions in order to get shallow layers near the bottom
 - From 29 to 32 layers
 - Added 5 "light" layers
 - Removed 2 layers



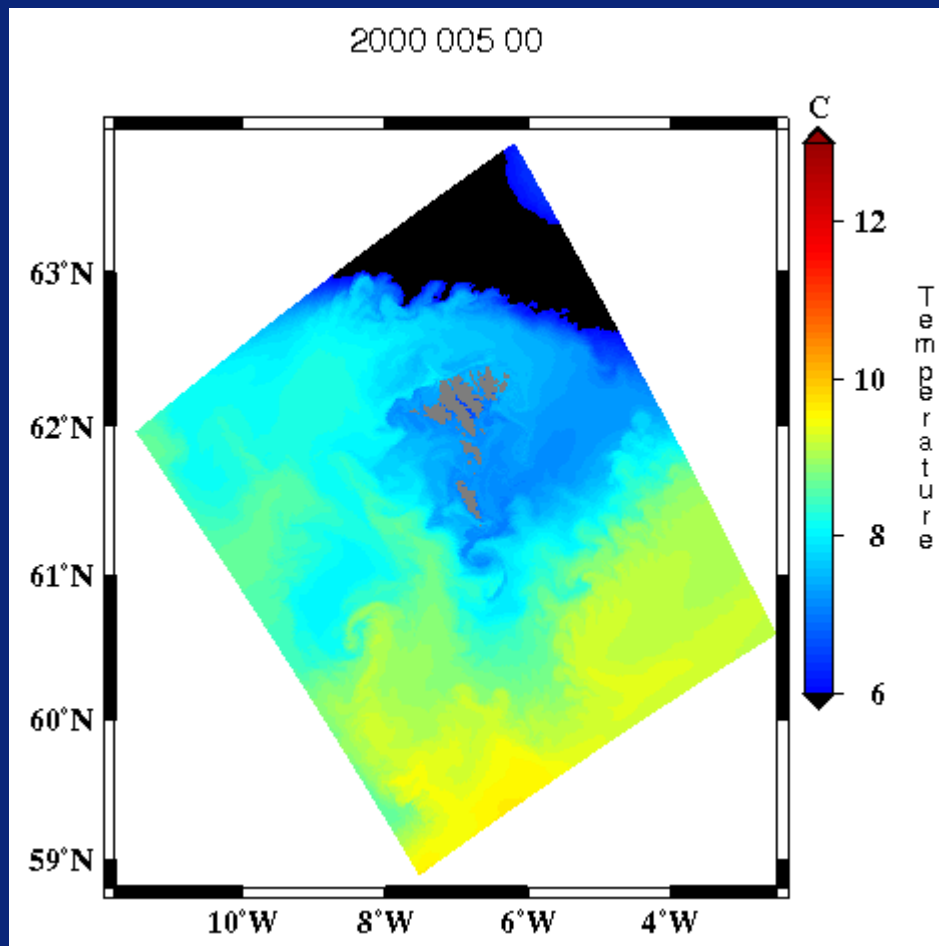


DMI

Center for Ocean and Ice



Temperature variation 2000



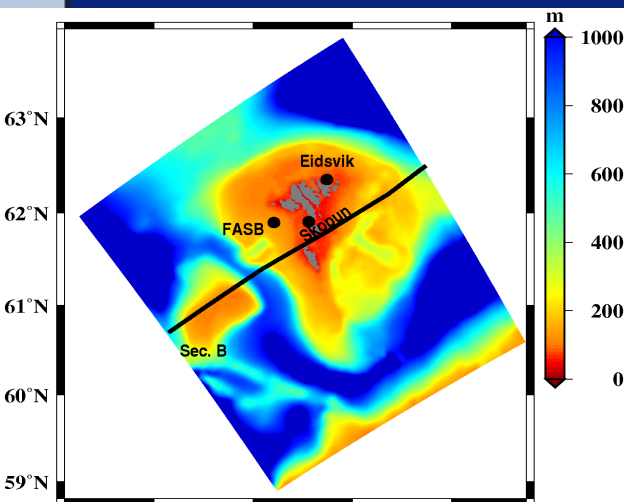
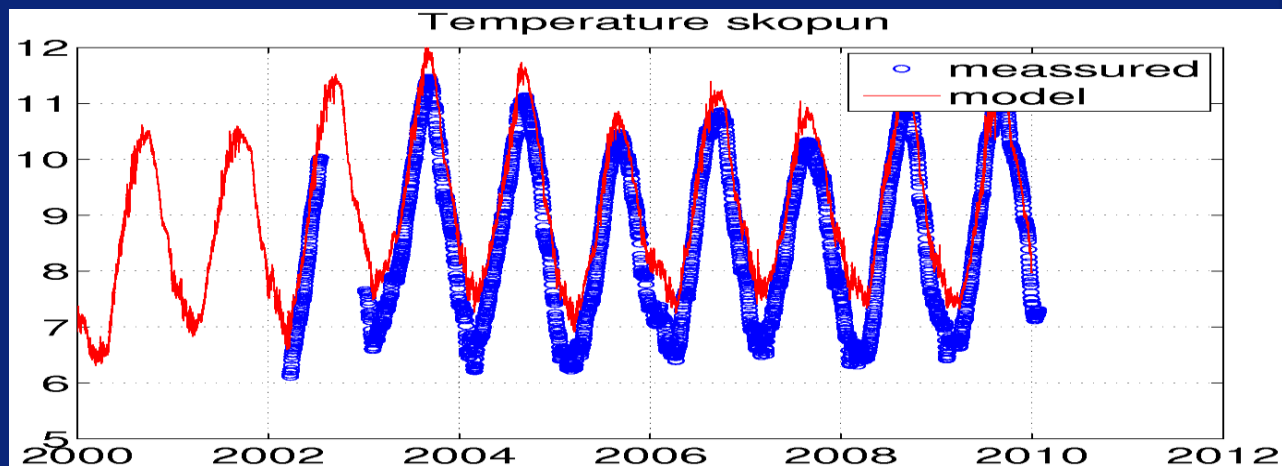
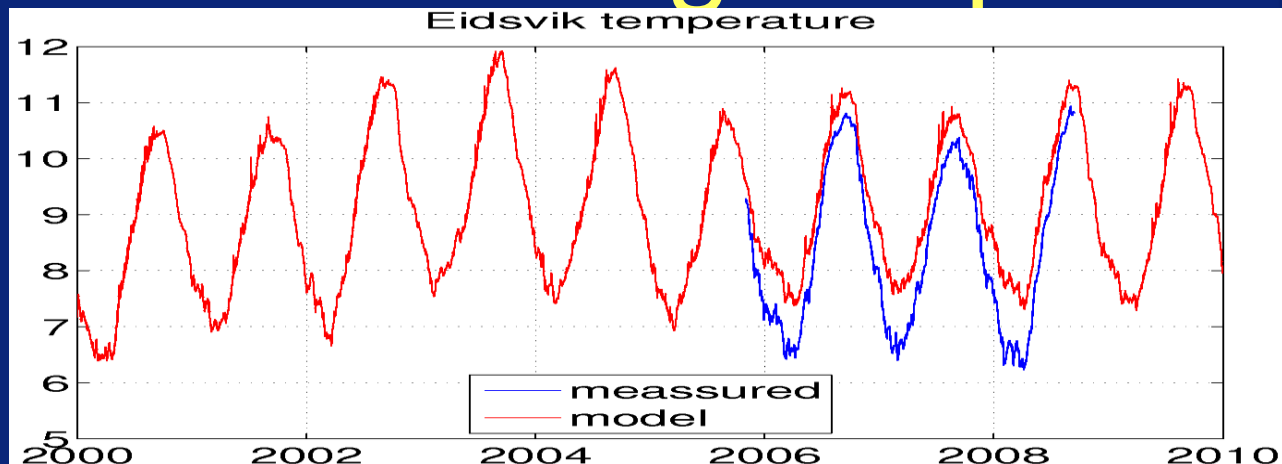


DMI

Center for Ocean and Ice

Temperature Eidsvik og Skopun

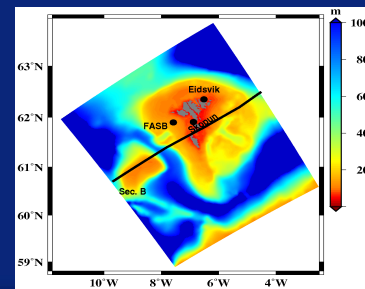
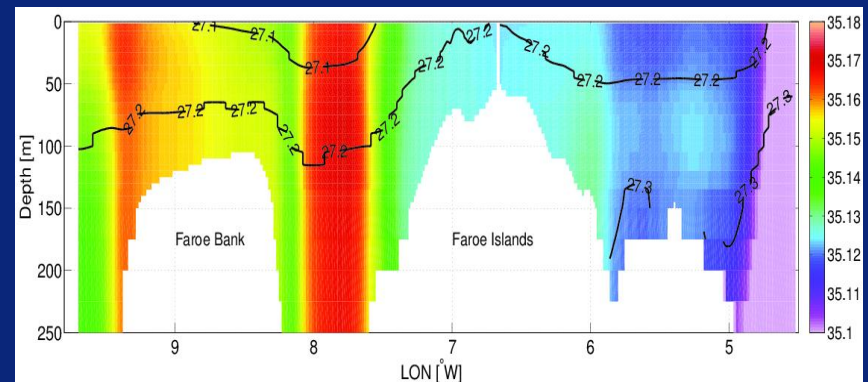
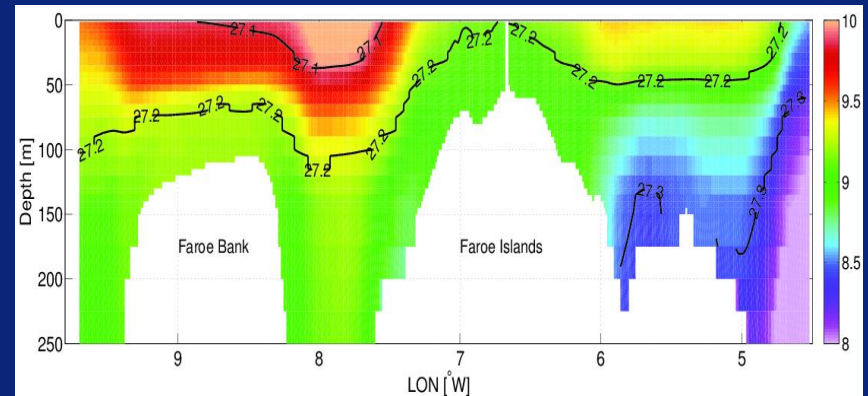
- Modeled temperatures are generally to warm
- Annual cycle is reasonably well represented
- Highest temperatures around year 2004
- No general trends





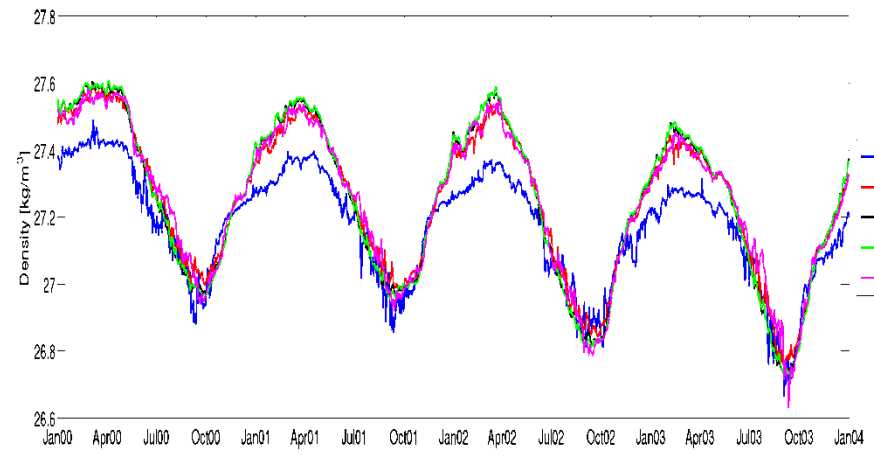
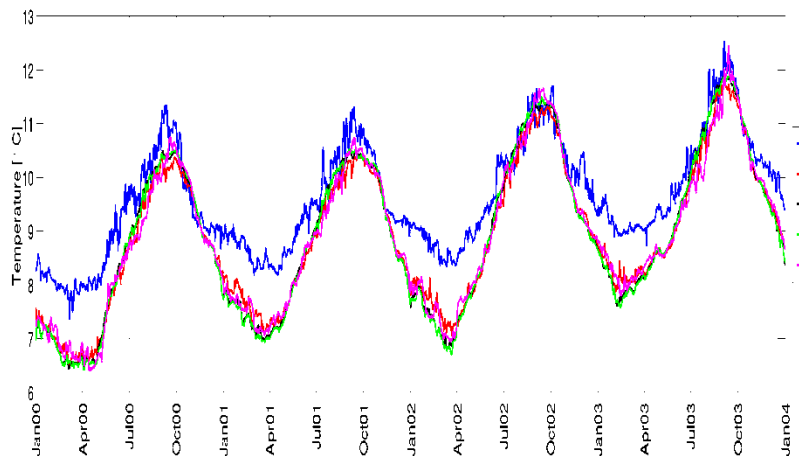
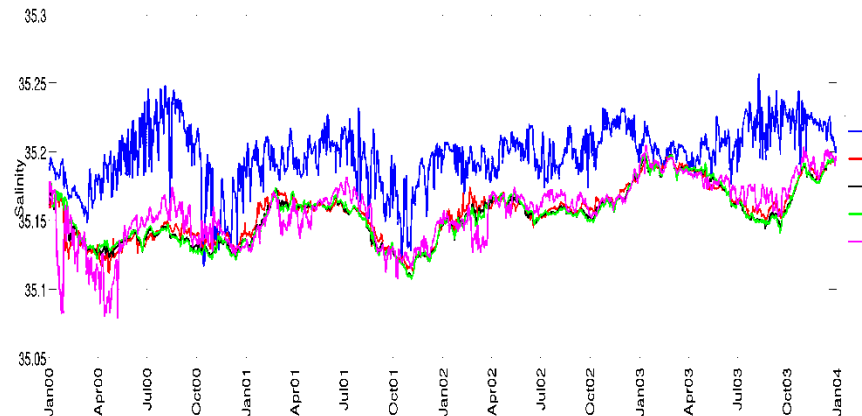
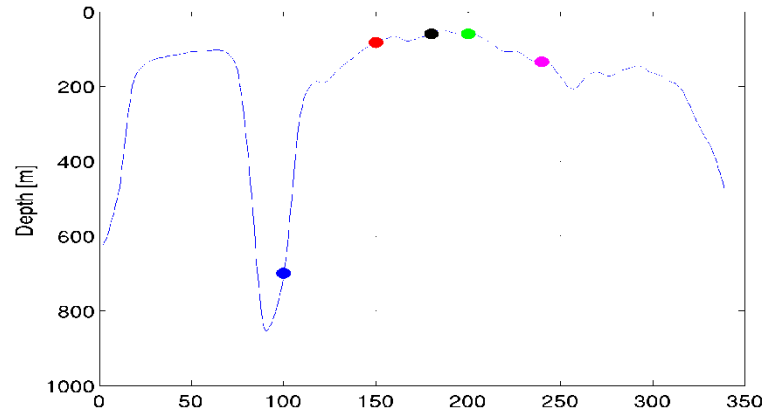
Average of T and S at cross section

- Temperature (top)
- Salinity (Bottom)
- Shelf water is seen as vertically well mixed area on the Faroe Islands shelf





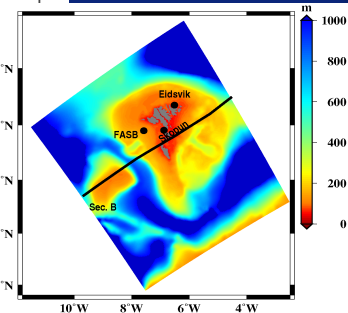
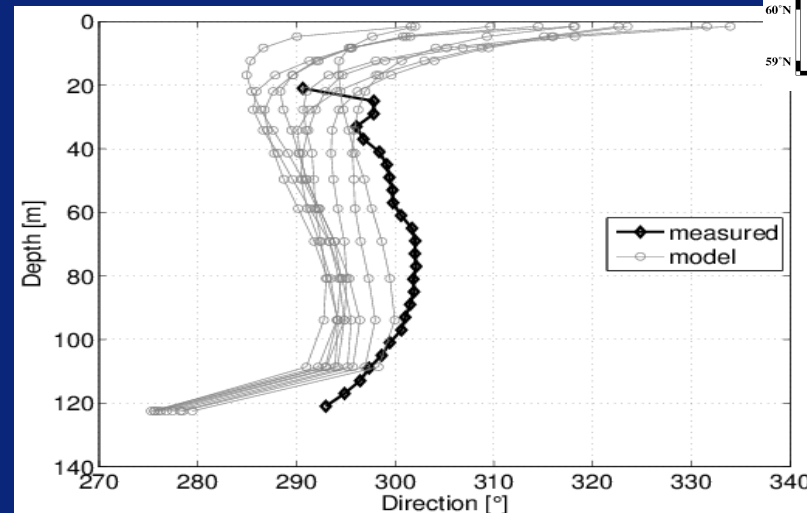
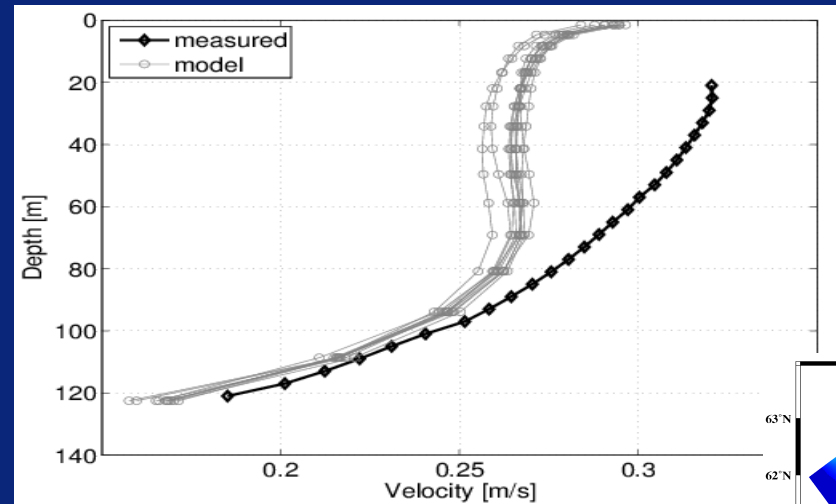
Section B – model results at 50m's depth





Currents velocity and direction

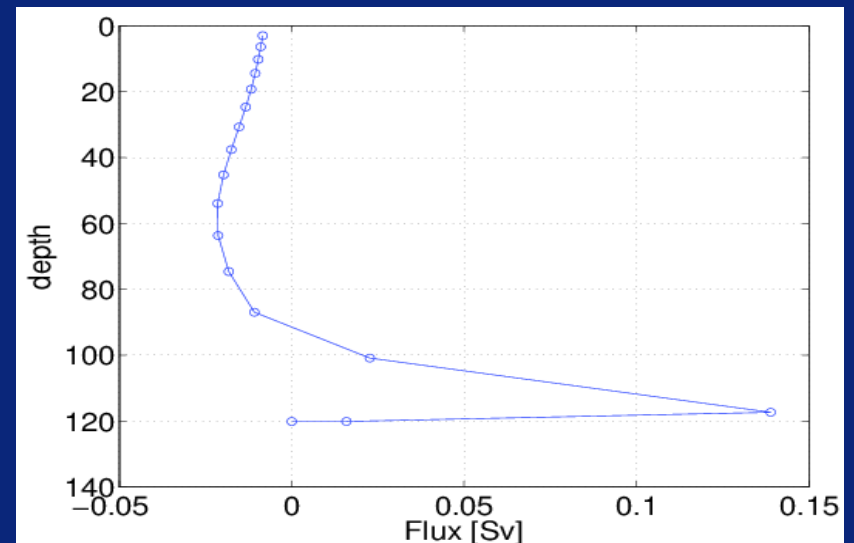
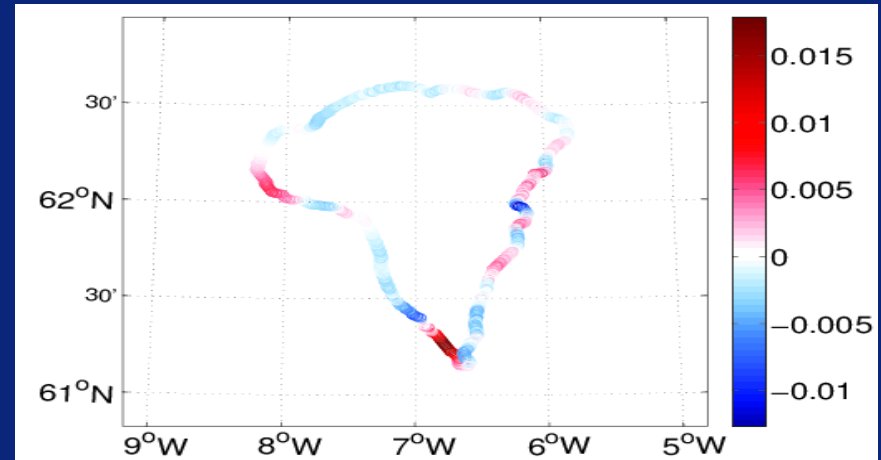
- Model average 2000-2009
- Measurements Feb 2010-Nov. 2010
- General an ok match
- Profiles are averages of tidal influenced profiles
- Amplitude near bottom is ok
 - In the middle of the profile around 80%





Flux at 120m contour – annual mean

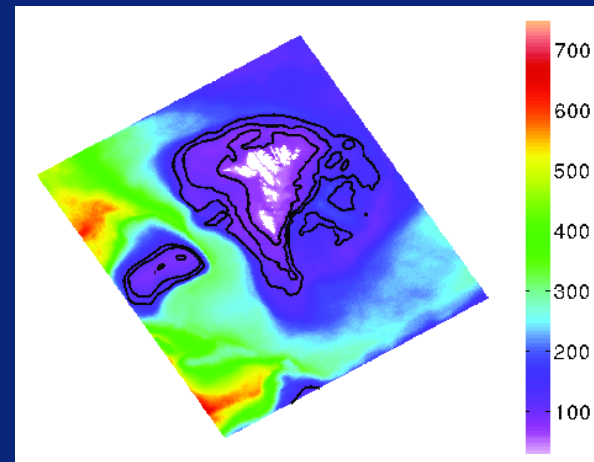
- Calculated based on all grid points on the contour
- Top: hot spots of water flowing in and out
- Bottom: Variation of flux as function of depth
- Based on 0.15 Sv a full exchange rate of 60 days is found



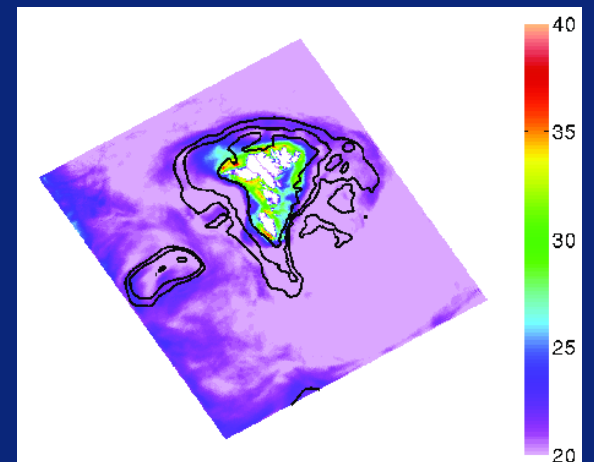


Mixed layer depth

- Top February mixed layer depth
- Bottom: June Mixed layer depth
- Mixed layer depth decreases in summer
 - Especially in the off-shelf domain
- Mainly due to surface heating



Av.
Feb

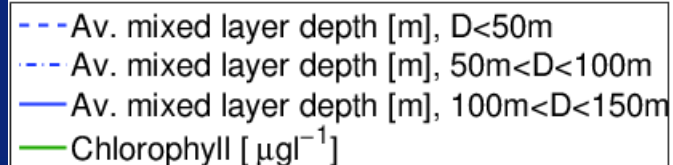
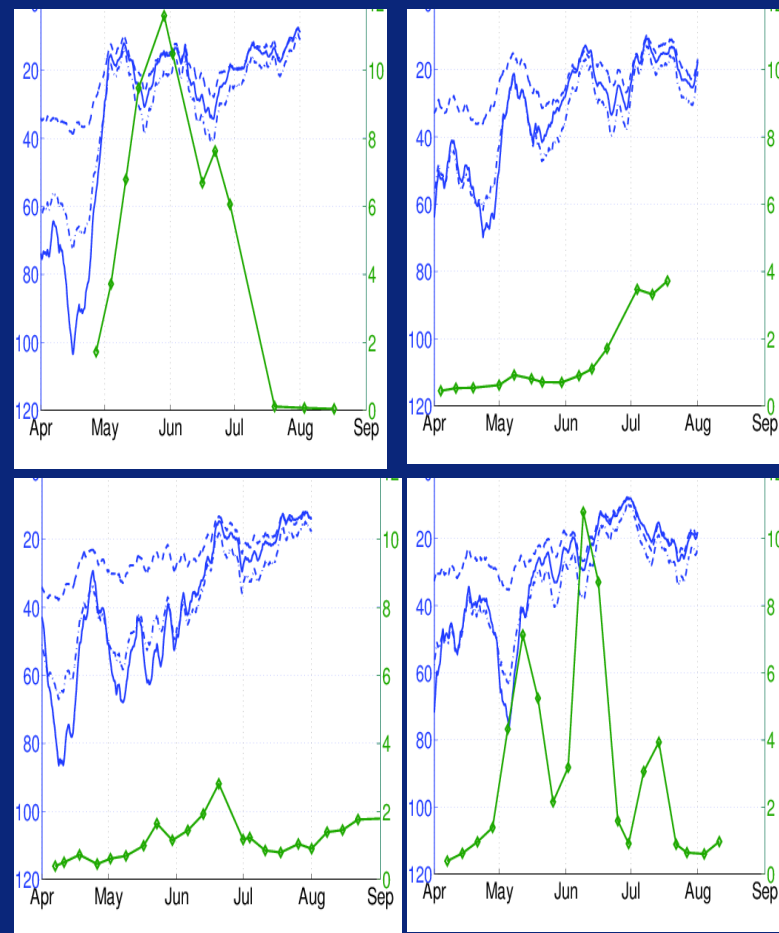


Av.
June



Mixed layer depth and primary production

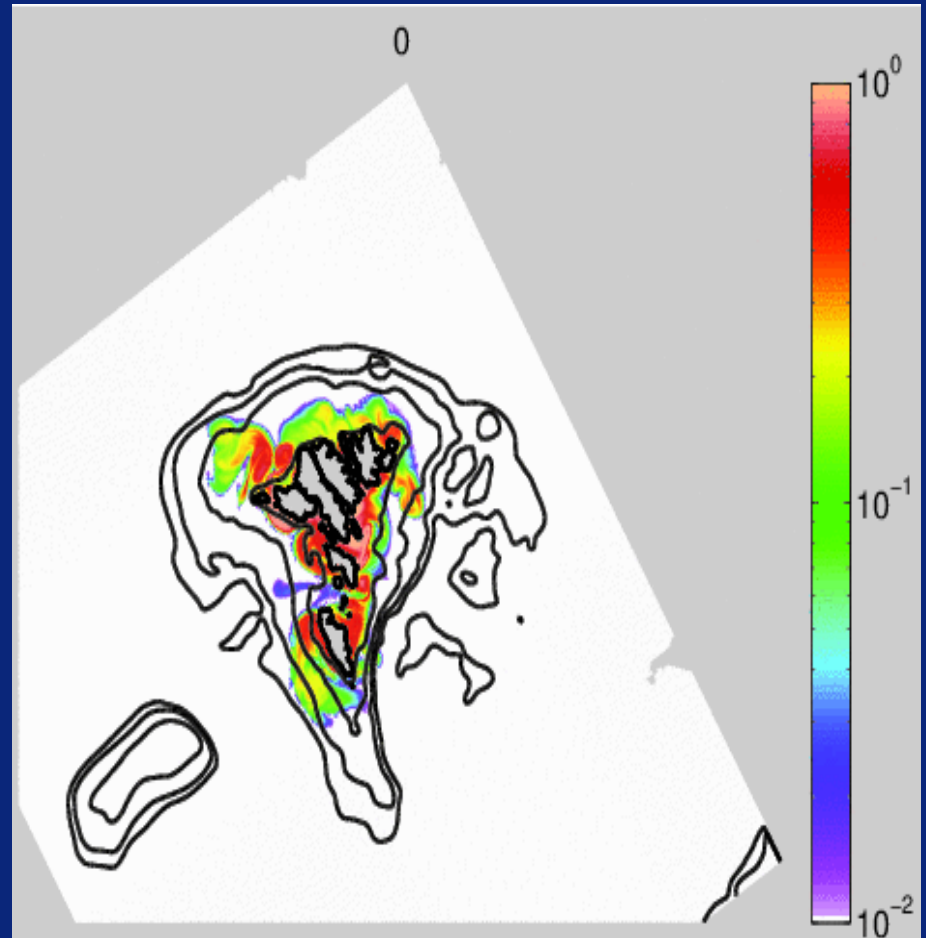
- Good primary production years are characterized by:
 - high chlorophyll content
 - Early and stable stratification
 - 1 exception = not the full explanation





Passive tracer - surface

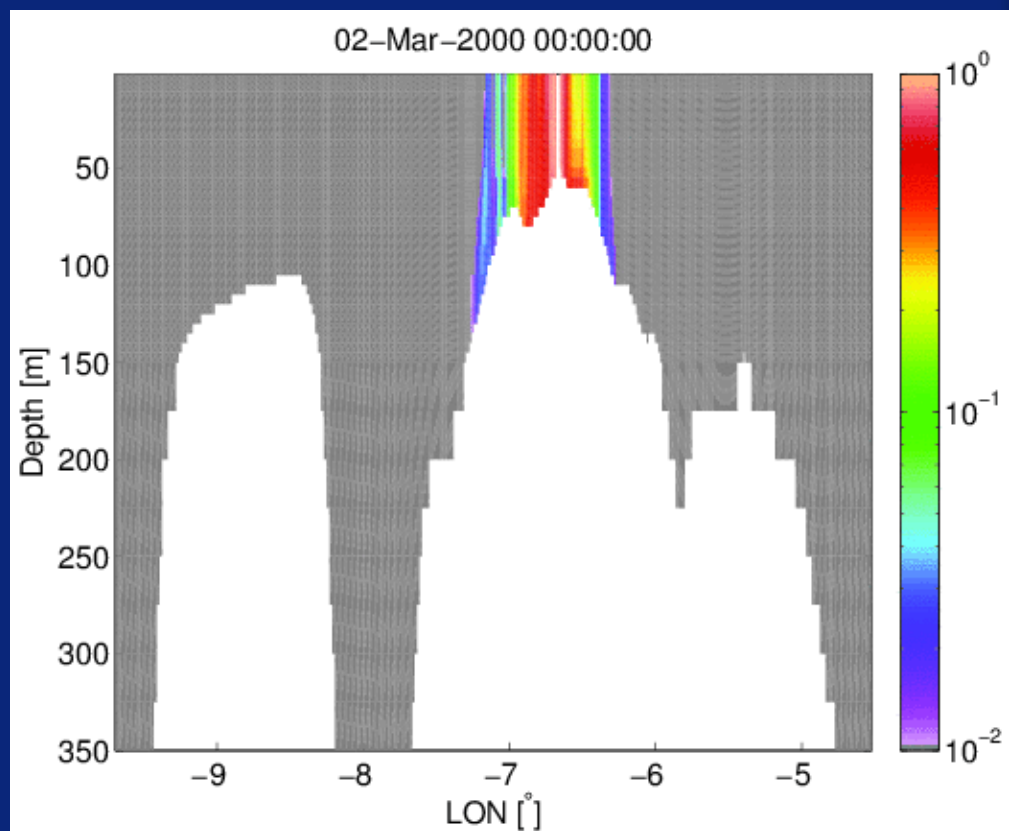
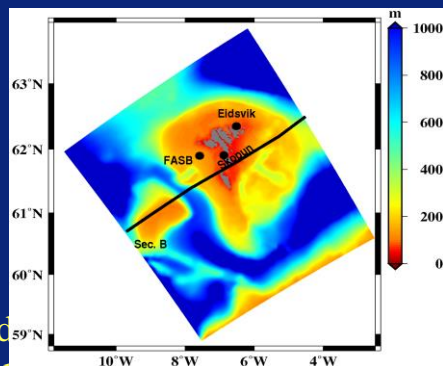
- Set to 1 within the 80m contour (conservative shelf water mass)
 - 0 elsewhere
- Experiment starts on March 1 every year.
- Year 2000 is shown
- Shelf water:
 - Dynamic
 - Clearly defined
 - Tracer spins off and short term reductions of the concentration is seen





Tracer tværsnit b

- Shelf water vertical:
 - Vertical stable
 - Tracer spins off near bottom
 - Clearly defined border to off shelf area
- Half life 30-40 days





Conclusions and future work

- The model generally represents the observations
- Timing of the reduction of the mixed layer depth matches the variation of the primary production. However this is not the full explanation.
- Passive tracer shows the shelf water mass and the leakages from this.
- Half life found to be 30+ days based on tracers
- Passive tracer simulations should be extended
- Based on full exchange of the water volume with 0.15 Sv the renewal of the shelf water mass is found to be ~65
- Previous study showed exchange rates of ~70 days based on a 2D model
- Net flux inwards near surface and outwards near bottom
- Biological tracers to be implemented. (This is likely being funded)