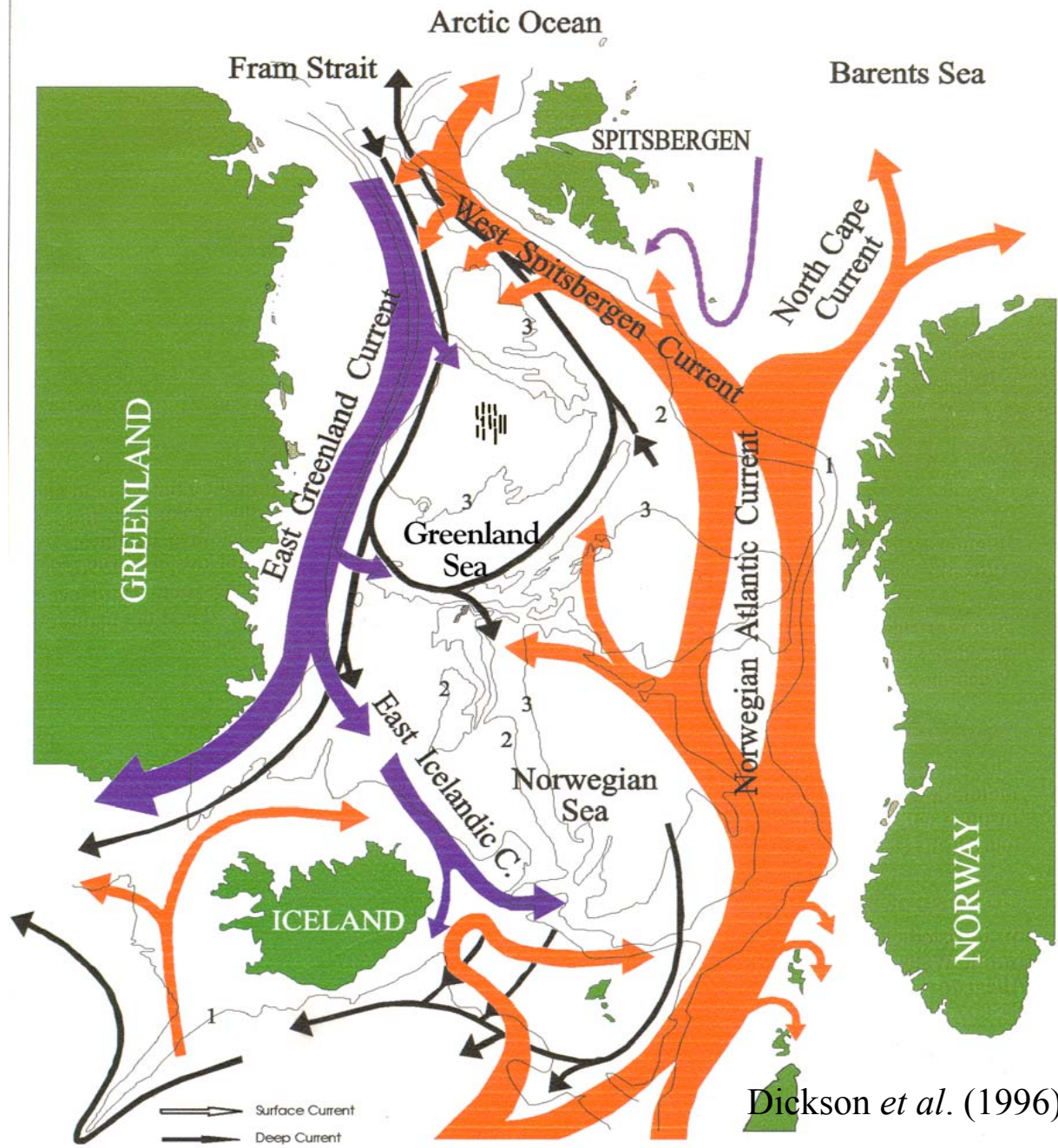


# Circulation, overflow and deep convection in the Nordic Seas studied using tracers and models

Andy Watson and Dave Stevens



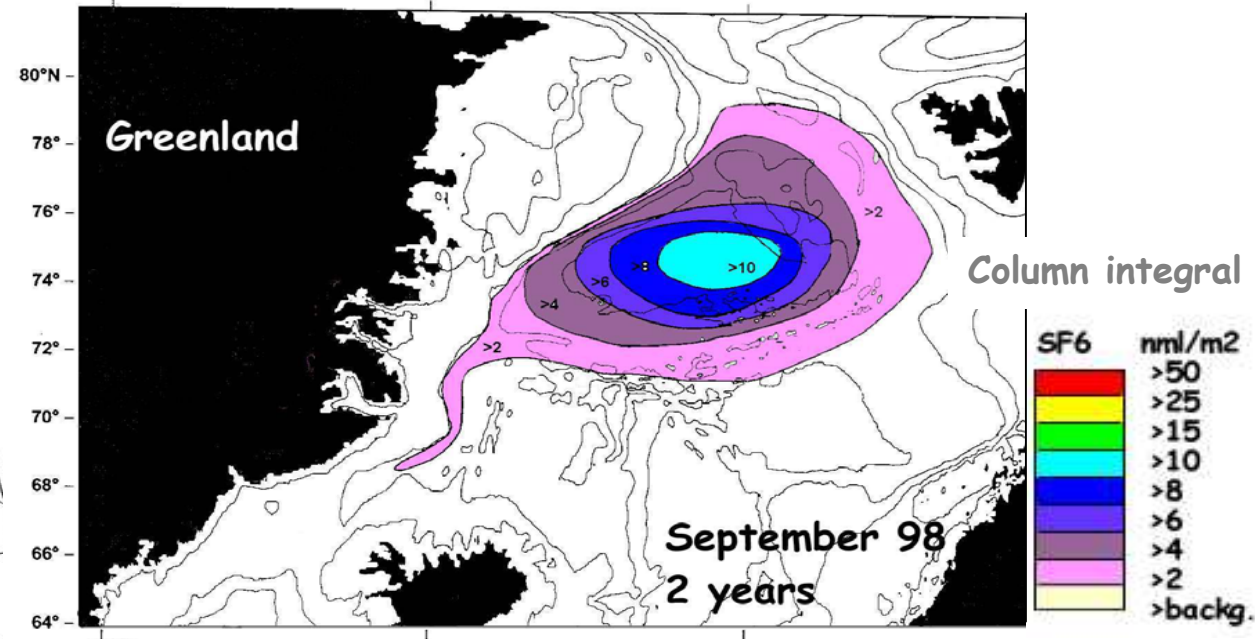
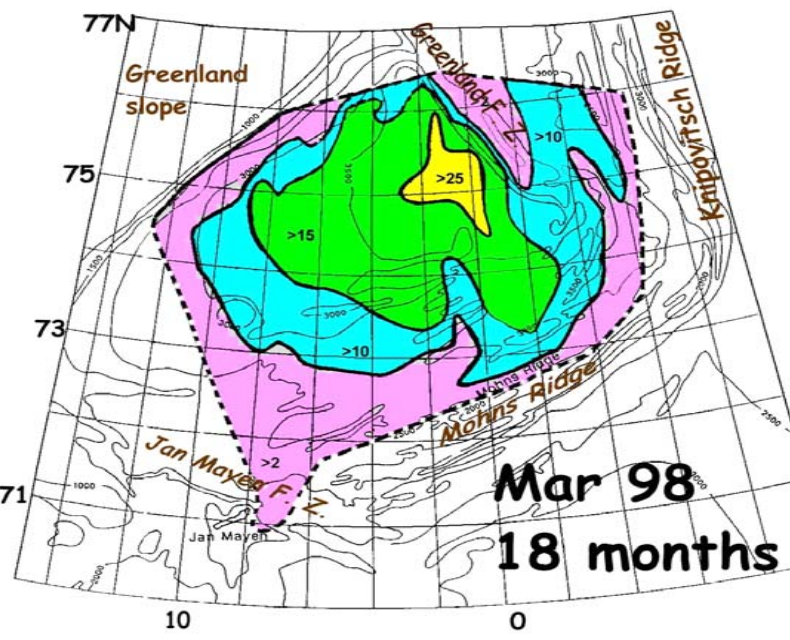
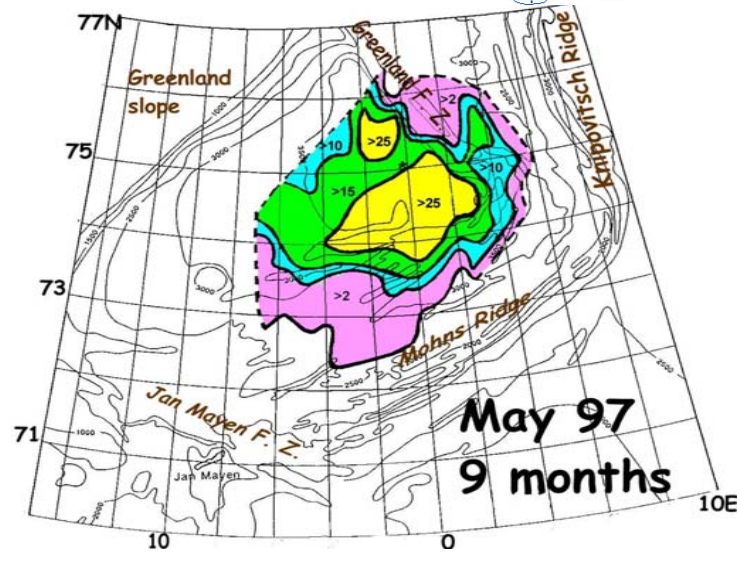
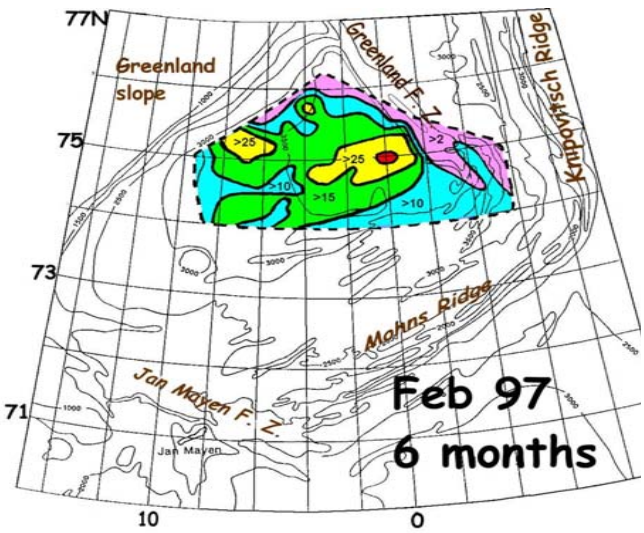
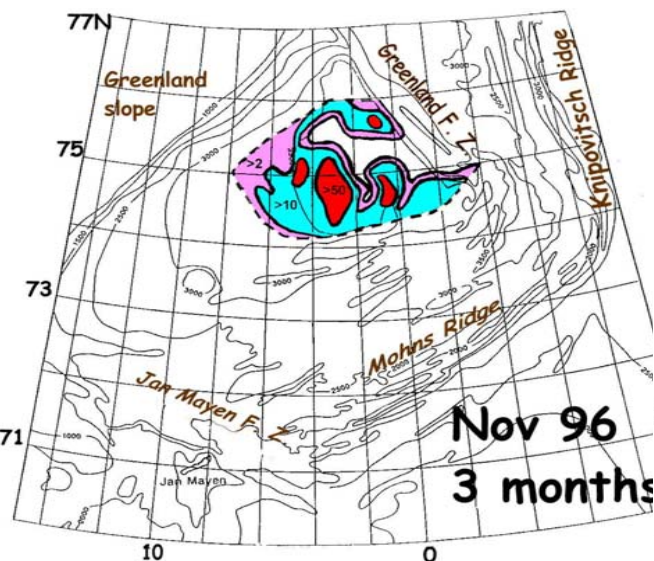


# Objectives

- 1) Construct inverse and forward models of the Nordic Seas system using reservoir-flux geometry, optimised for temperature, salinity, CFC,  $^{129}\text{I}$ , and  $\text{SF}_6$ . Diagnose flows within the system, and in particular find the present (late 1990s) contribution of Atlantic Water, Greenland Sea Water and Iceland Sea water to the Denmark Strait and Faroe-Bank channel overflows. Compare with available GCM simulations.
- 2) Construct a very high resolution, non-hydrostatic model of the Greenland Sea to investigate the role of the gyre circulation and sub-mesoscale eddy structures in promoting convection. Use this to examine the role of local hydrodynamics and topography in influencing convection, and compare to results obtained with parameterisation in coarser resolution OGCMs.

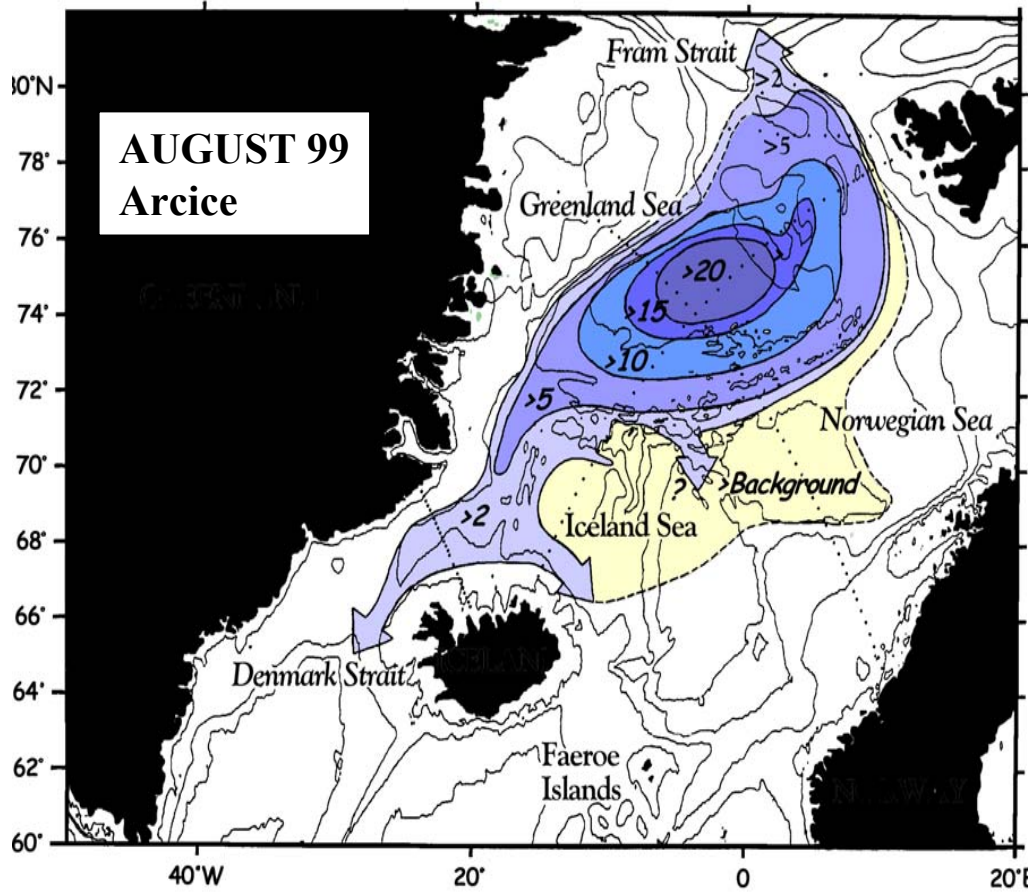
# Horizontal spread:

Rapid spreading initially ( $K_h \sim 3000 \text{ m}^2/\text{s}$ )

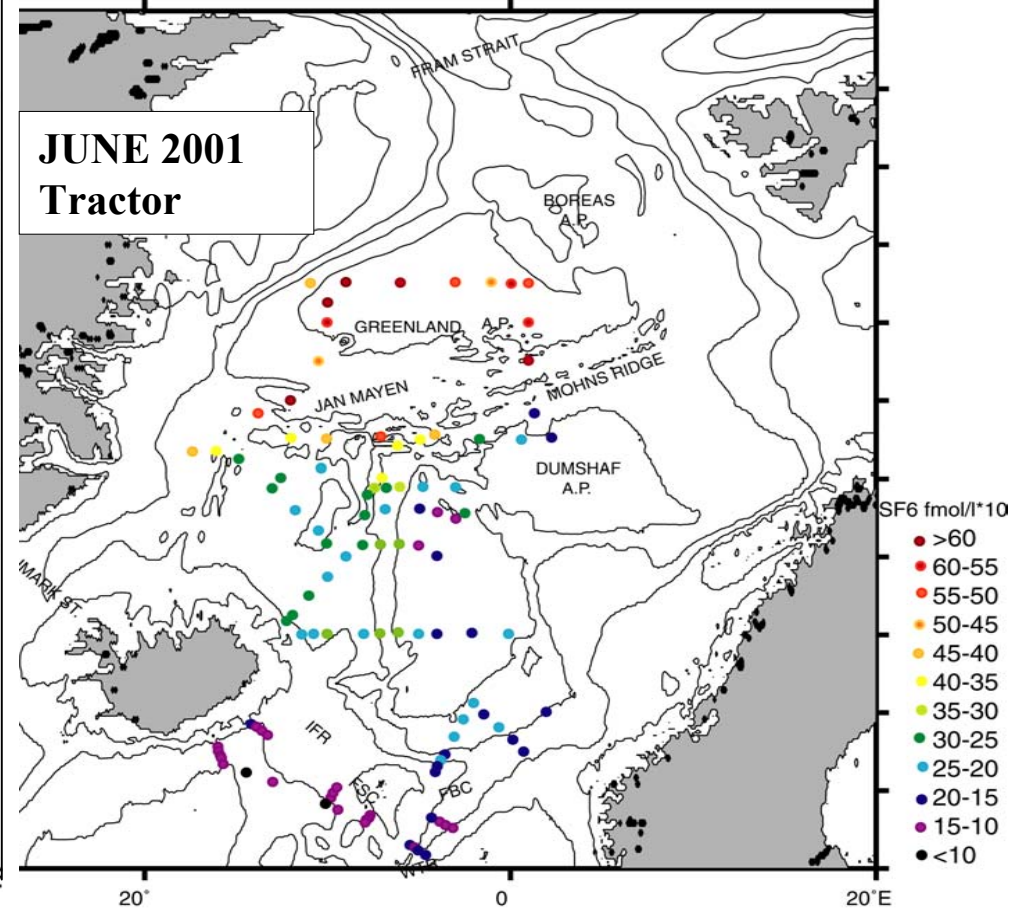


2 years after the release the tracer occupies all the GS and is heading towards the Atlantic outflows.

# Greenland Arctic Intermediate Water reservoirs and paths towards the Greenland - Faroe - Scotland Ridge



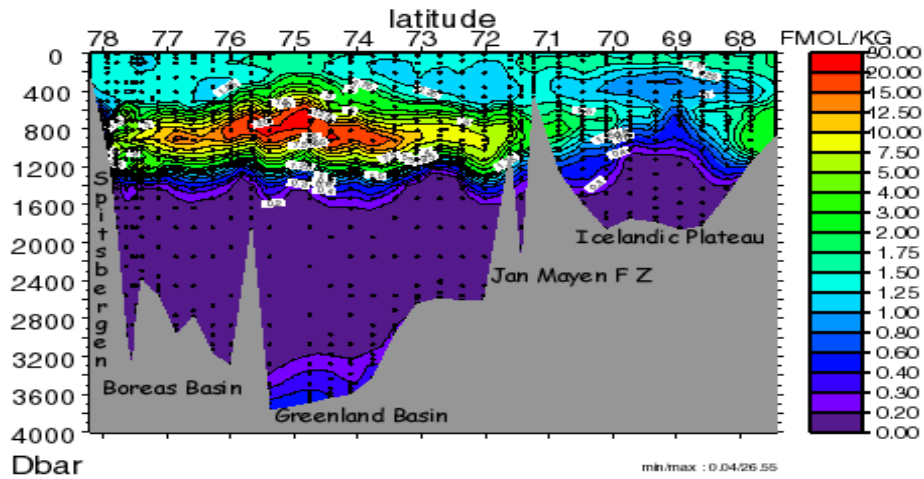
Horizontal map of SF6 distribution (fmo/l)



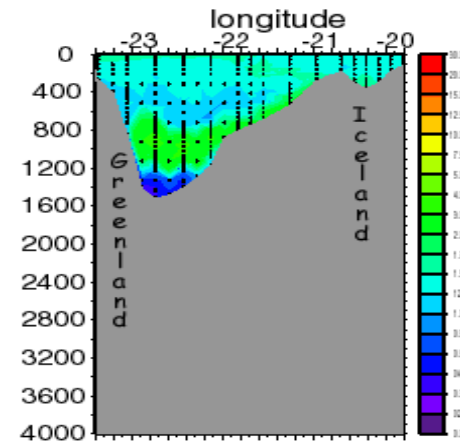
Map of stations with SF6 concentrations (fmo/l)

# Distribution of the tracer 3 years after the release

## August 1999



**East Fram Strait to Iceland**



**Denmark Strait**

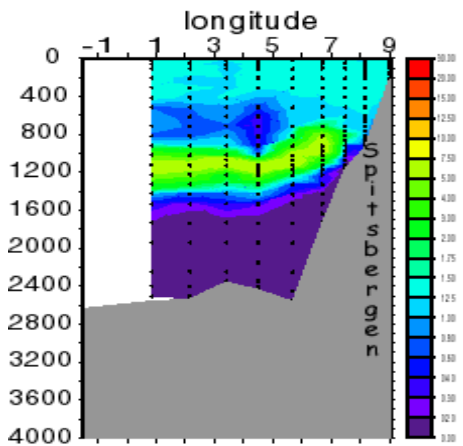
**Greenland Sea 184kg (102 CG)**  
 SF6= 26.55 fmol/l  
 28.025<28.049<28.062  
 Depth SF6max= 780 db

**Norwegian Sea 22kg**  
 SF6= 1 fmol/l  
 28.022<28.049<28.060  
 Depth SF6max= 1200 db

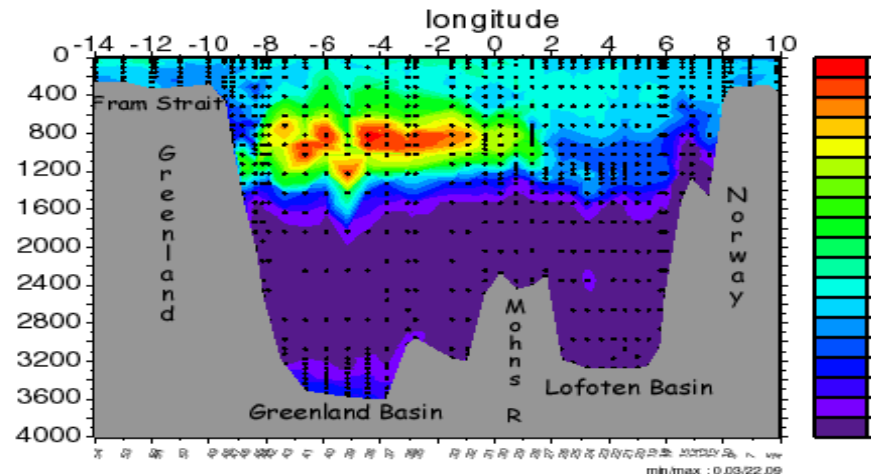
**Fram Strait 10 kg**  
 SF6= 6.35 fmol/l  
 28.022<28.049<28.068  
 Depth SF6max= 970db

**Iceland Sea 8.6 kg**  
 SF6= 2.45 fmol/l  
 28.024<28.048<28.059  
 Depth SF6max= 825 db

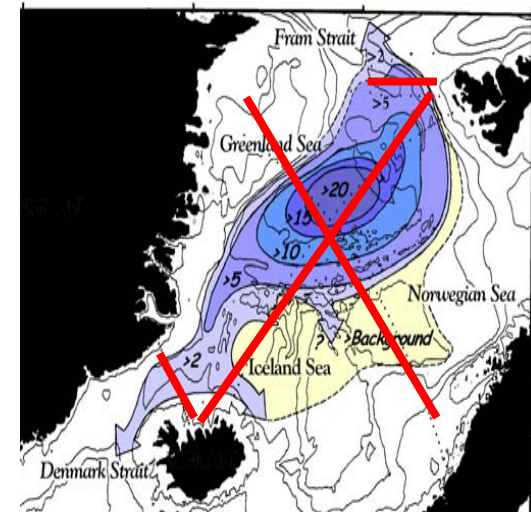
**North Denmark Strait 4.7 kg**  
 SF6= 3.5 fmol/l  
 28.022<28.049<28.068  
 Depth SF6max= 970 db



**Fram Strait**

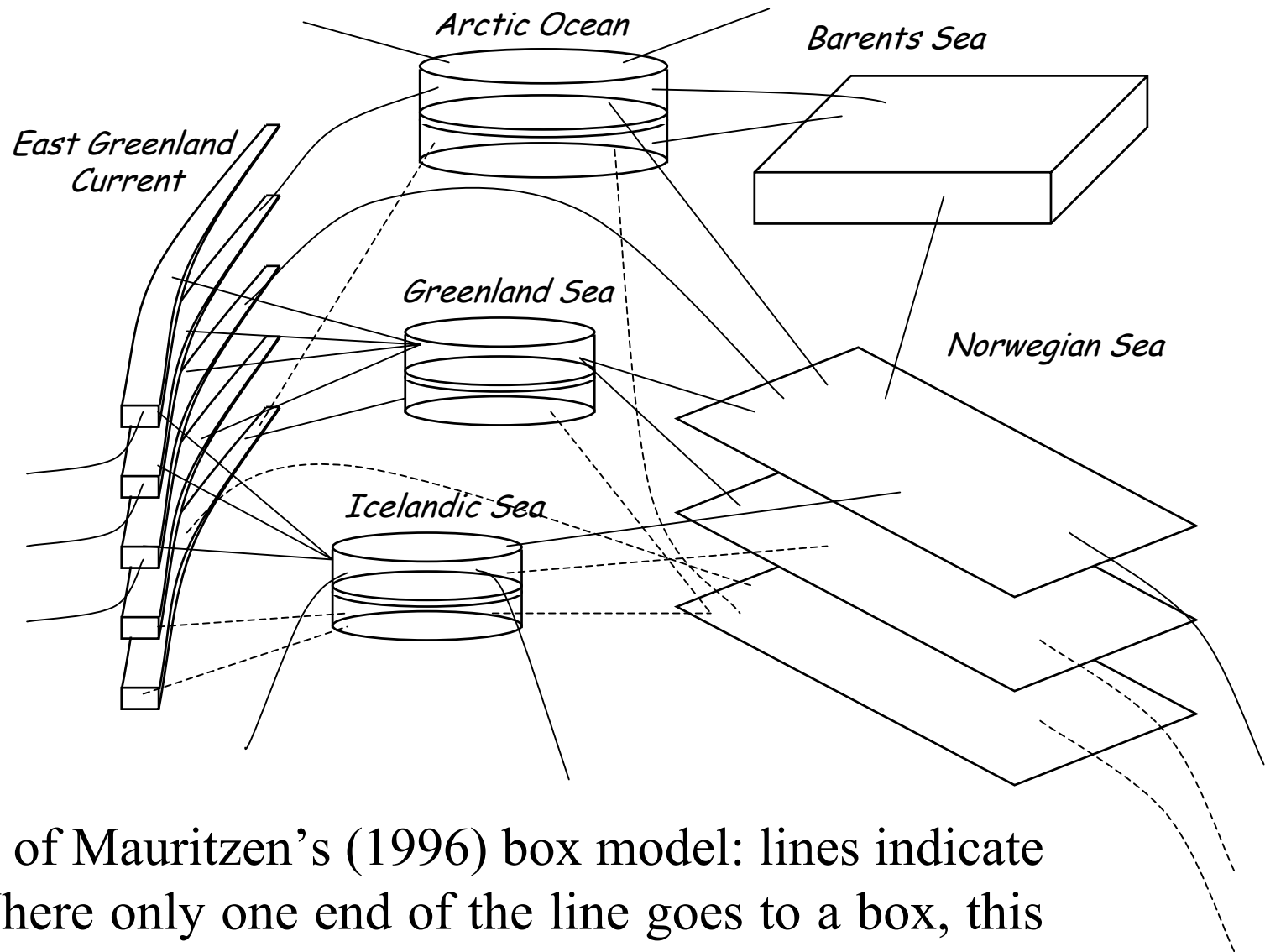


**West Fram Strait to Norway**



# Inverse Modelling

- Use Mauritzen's (1996) model as a starting point
- Include better representation of Iceland-Scotland overflow
- A combination of inverse and forward optimisation techniques
- Make use of large volume of recently collected data
- Make use of transient tracer data
- Comparison with state of art GCM output



Structure of Mauritzen's (1996) box model: lines indicate flows. Where only one end of the line goes to a box, this is a net flow into or out of the system.

# High resolution model of Greenland Sea

- MIT GCM in non-hydrostatic mode
- ~1km horizontal resolution
- parameterised convection
- Explore role of sub-mesoscale coherent vortices, gyre circulation and local topography in promoting convection
- Process study approach rather than realistic simulations
- SF<sub>6</sub> like tracer in some runs
- Collaboration with Nansen Center