Irminger Current Anticyclones in the Labrador Sea
observed in the Hydrographic Record of 1990-2004

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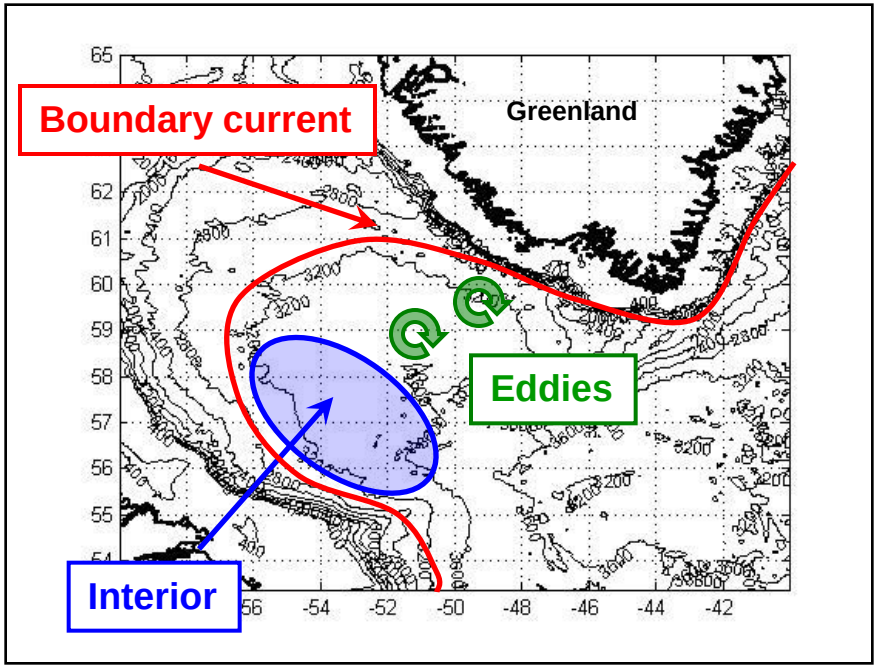
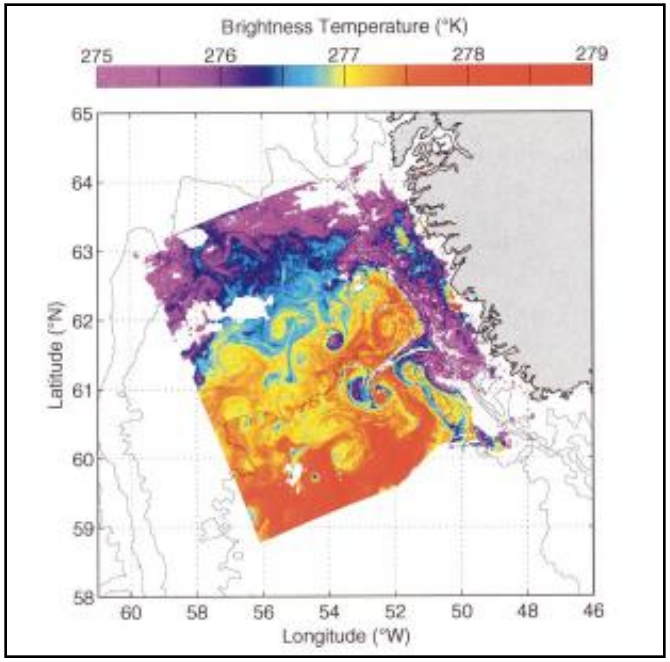
Motivation





Prater, 2002

Interior: LSW formation in winter under strong buoyancy fluxes;

Boundary current: warm and salty at 200-800m (Irminger Water)
cold and fresh at the surface (West Greenland Water)

Eddies:

- play a major role in restratification
- Irminger Current anticyclones (ICAs) balance up to 90% of heat loss
- ICAs can potentially provide 100% of observed fresh water

Questions to be addressed:

1. How and when do ICAs release their anomalies?

a) Can they survive cold fluxes?

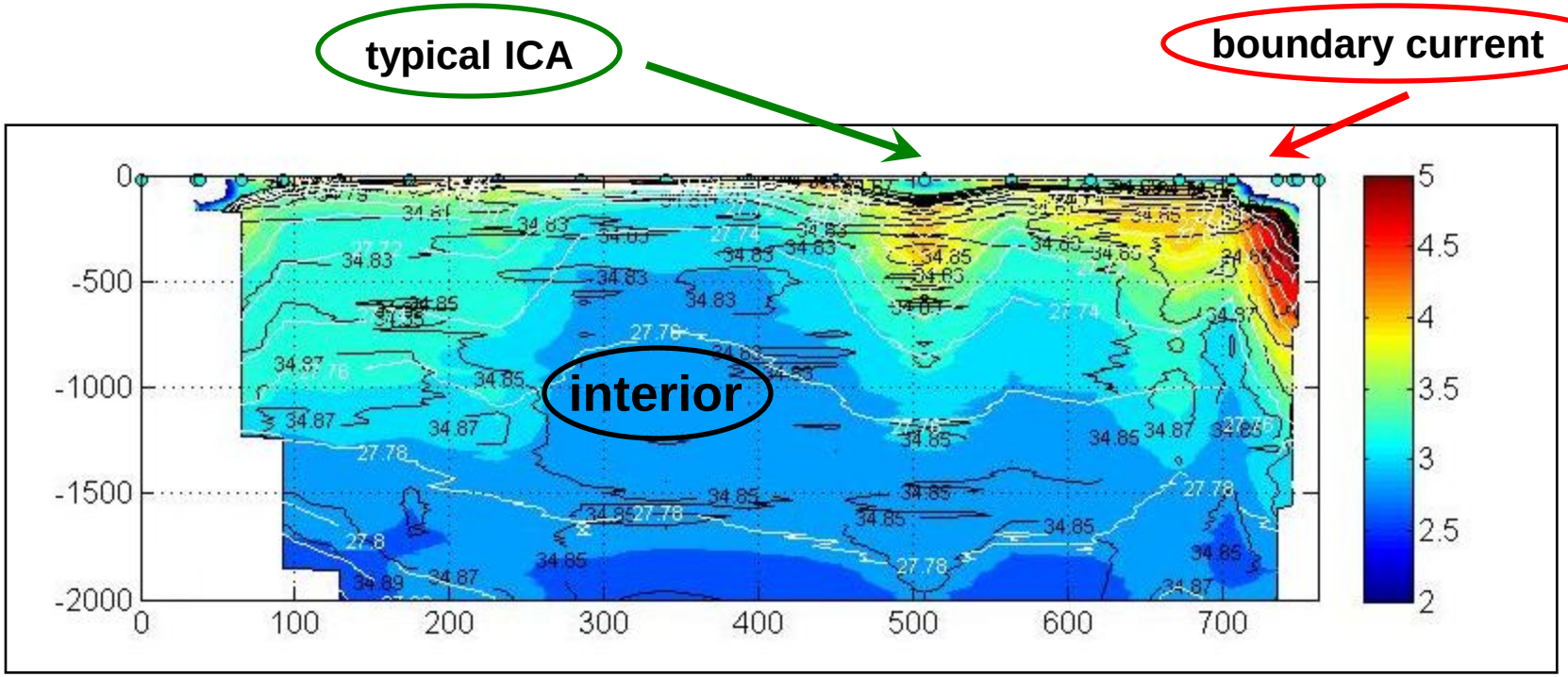
b) If yes, how are they transformed?

2. How do the properties of the ICAs change interannually?

Typical Irminger Current Anticyclone (ICA)

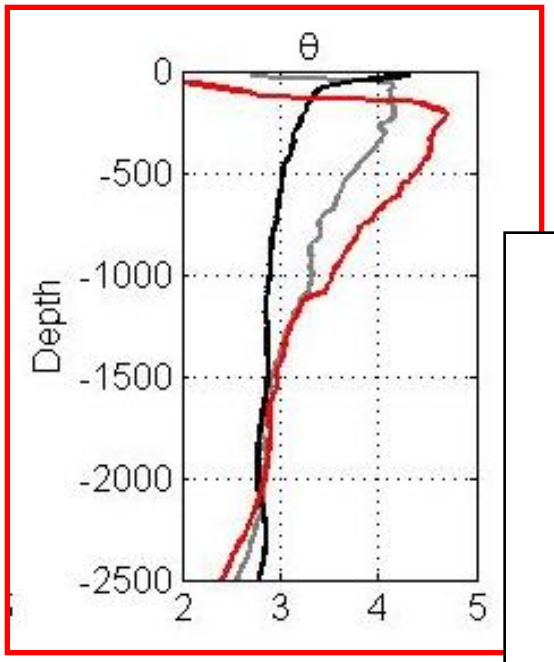
Hydrographic data: mostly WOCE AR7W, 1990-2004

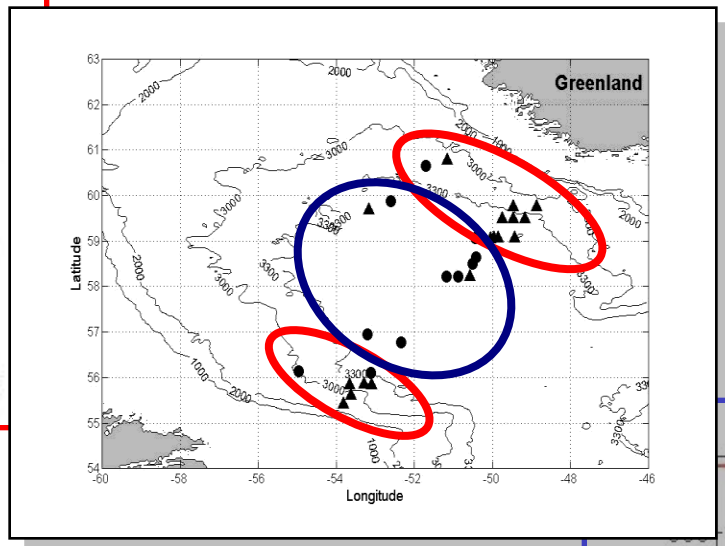
Seasonal distribution: winter: 1997, 1998
spring: 1996, 1997, 2000, 2004
summer: 1990, 1993-1995, 1997-2003
fall: 1996, 2002



We found **29** ICAs based on the property anomalies

Unconvected and Convected ICAs



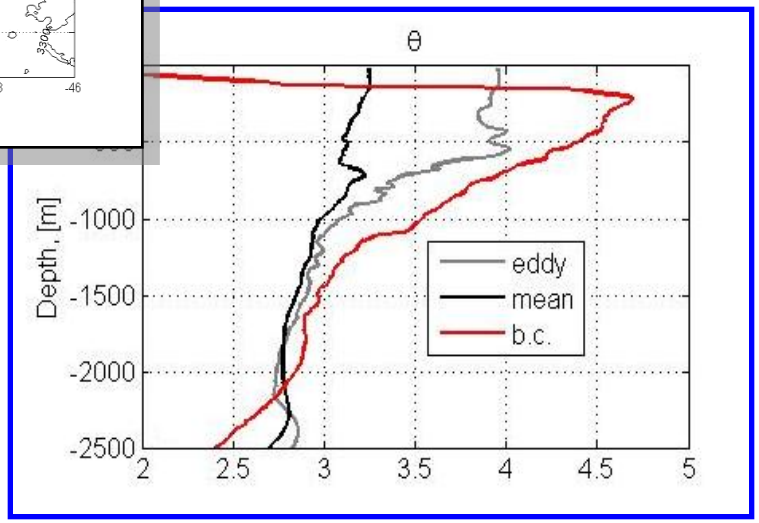


Convected ICAs

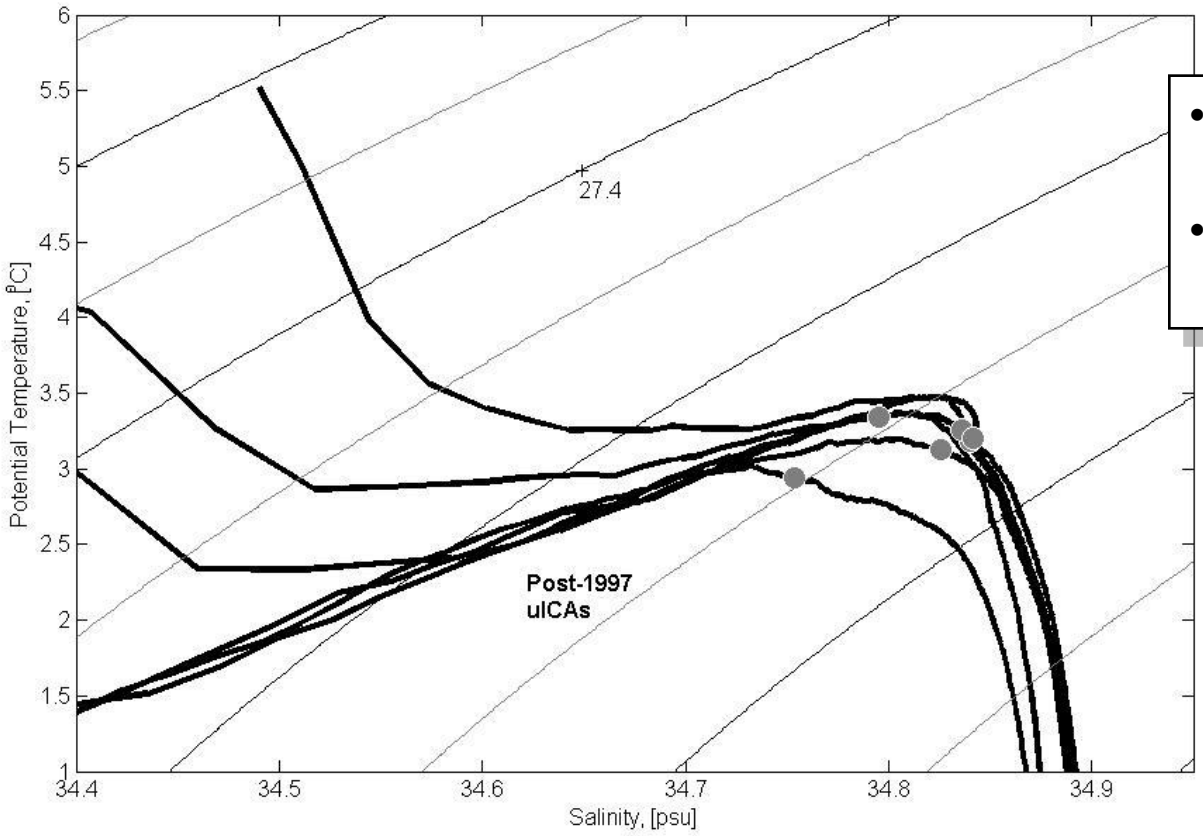
- have at least 1 mixed layer
- have fresher Irminger Water
- are found in the interior
- observed after 1997

Unconvected ICA

- resemble boundary current
- have FW cap even in interior
- are found near boundaries
- none are observed in winter



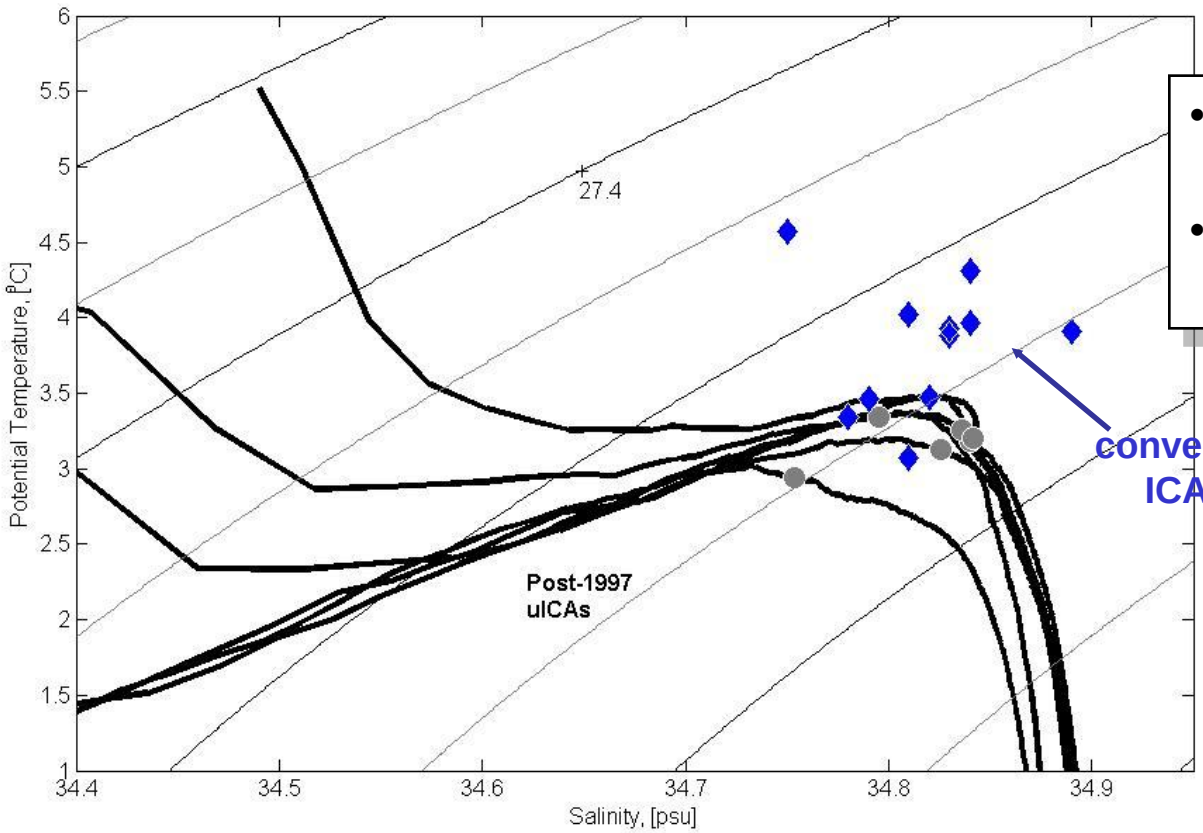
Can I get mixed layer properties of cICAs from uICAs?



- 1-d mixed layer model (Lilly et al., 1999);
- realistic fluxes: 1-2GJ (Straneo 2006a)

Time evolution of the mixed layer properties of uICAs under buoyancy forcing

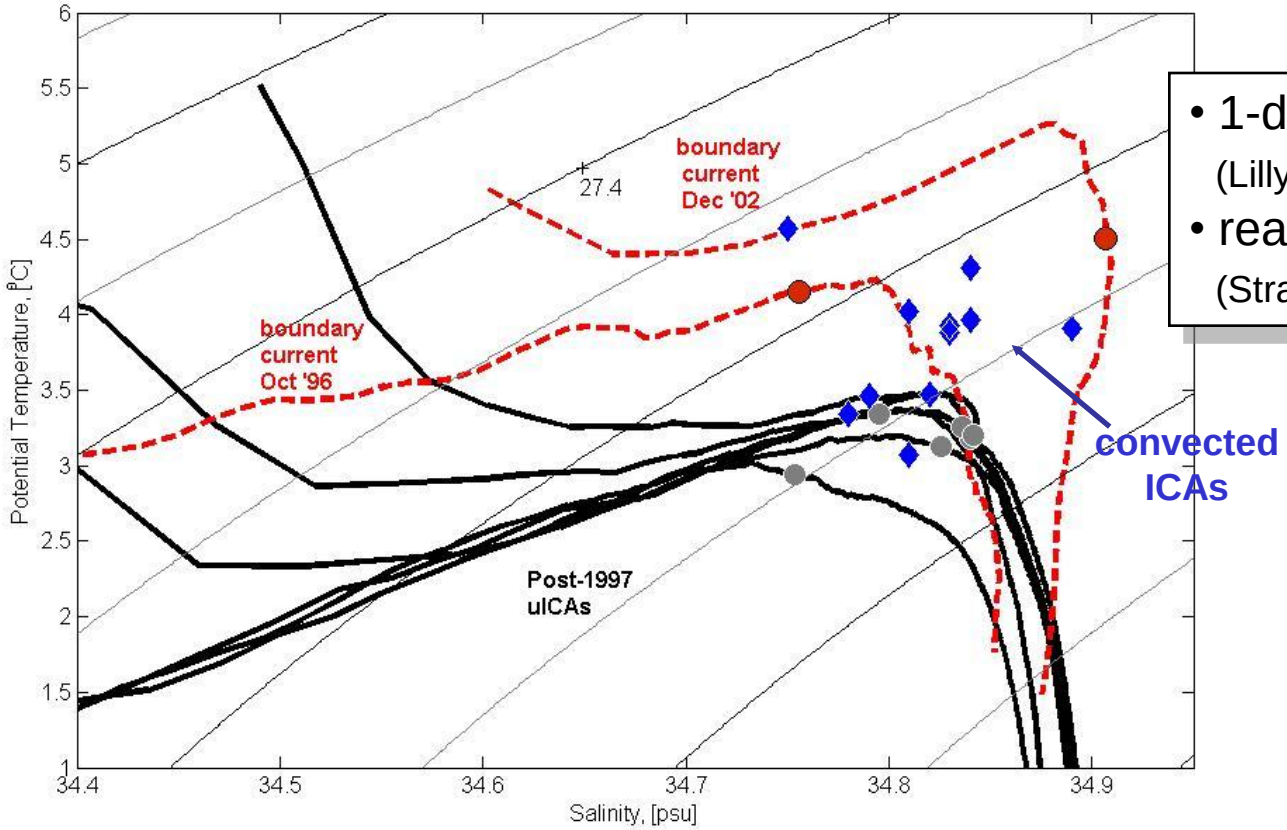
Can I get mixed layer properties of cICAs from uICAs?



- 1-d mixed layer model (Lilly et al., 1999);
- realistic fluxes: 1-2GJ (Straneo 2006a)

- **cICAs are uICAs which have been modified by the surface fluxes;**
- **Fresh surface layer is mixed down to the intermediate layers;**
- **Model prediction agrees with real data;**

Can I get mixed layer properties of cICAs from uICAs?



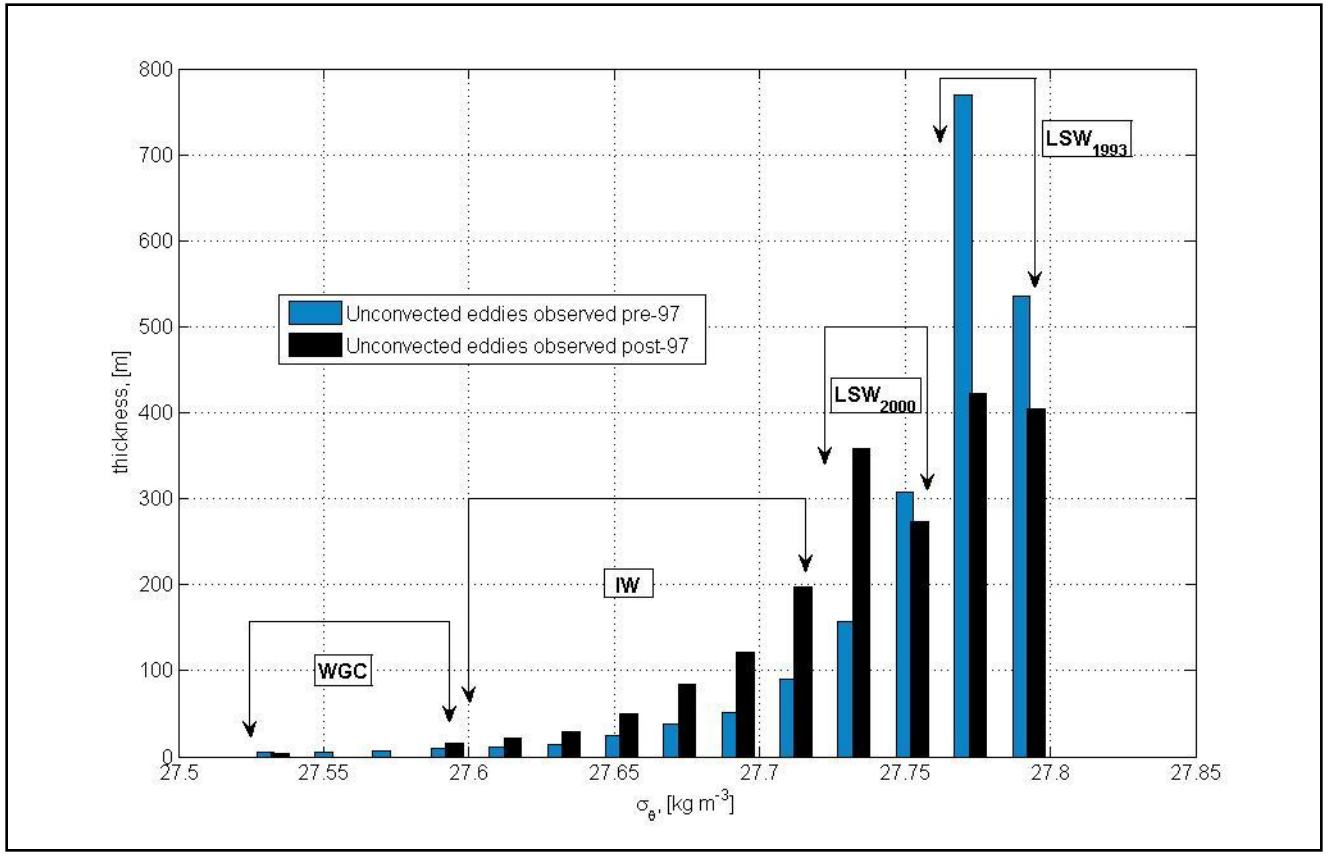
- 1-d mixed layer model (Lilly et al., 1999);
- realistic fluxes: 1-2GJ (Straneo 2006a)

YES!

- **cICAs are uICAs which have been modified by the surface fluxes;**
- **Fresh surface layer is mixed down to the intermediate layers;**
- **Model prediction agrees with real data;**
- **Upper cluster of cICAs can be obtained from warmer initial conditions**

Interannual variability of the uICAs

1. Changes in the core structure

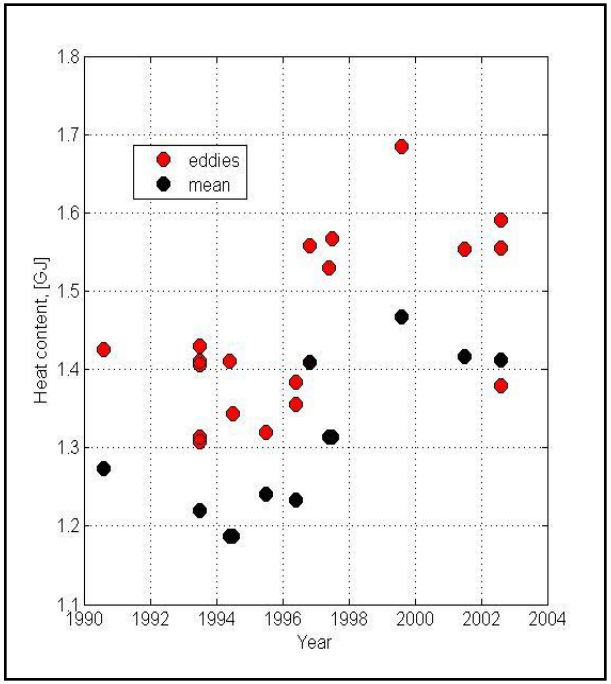


Post-1997: Irminger Water becomes thicker, warmer and lighter

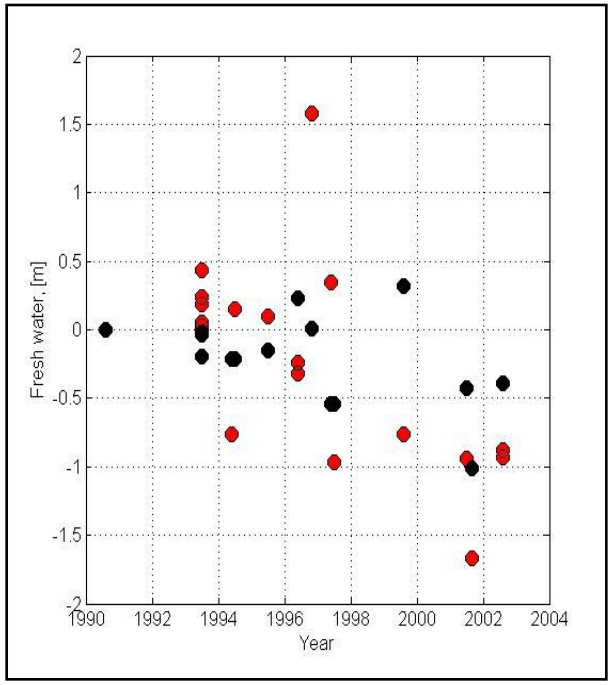
Interannual variability of the uICAs

2. Changes in heat and fresh water content

Heat content of the upper 2000m



Fresh water content of the upper 1000m



- eddies and mean are warming at the same rate;
- increase in heat content of the ICAs due to IW layer;
- increase in heat content of the interior due to LSW layer (Straneo 2006a, Yashayaev 2007…)
- decrease in fresh water content of the ICAs due to IW layer

Results:

1. Irminger Current Anticyclones (ICAs) can survive convection:
   - Surface fresh water mixes down to the intermediate layers
   - Convection can penetrate to Irminger Water layer

2. ICAs and the Labrador Sea interior heat contents increase at the same rate

3. The freshest ICAs are found near the Labrador side implying a new fresh water pathway to the interior