Monitoring the Atlantic Meridional Overturning Circulation (MOC)

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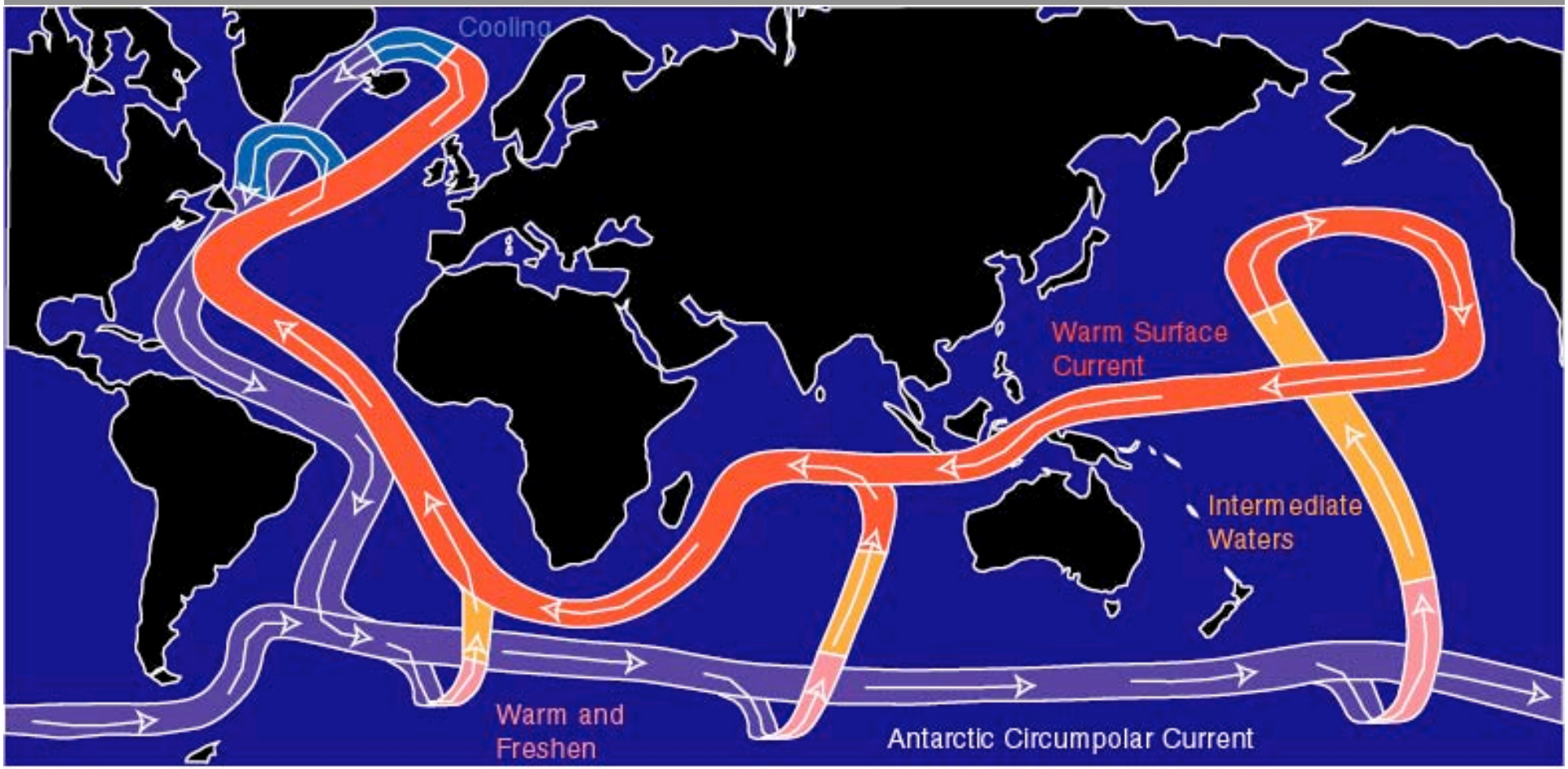
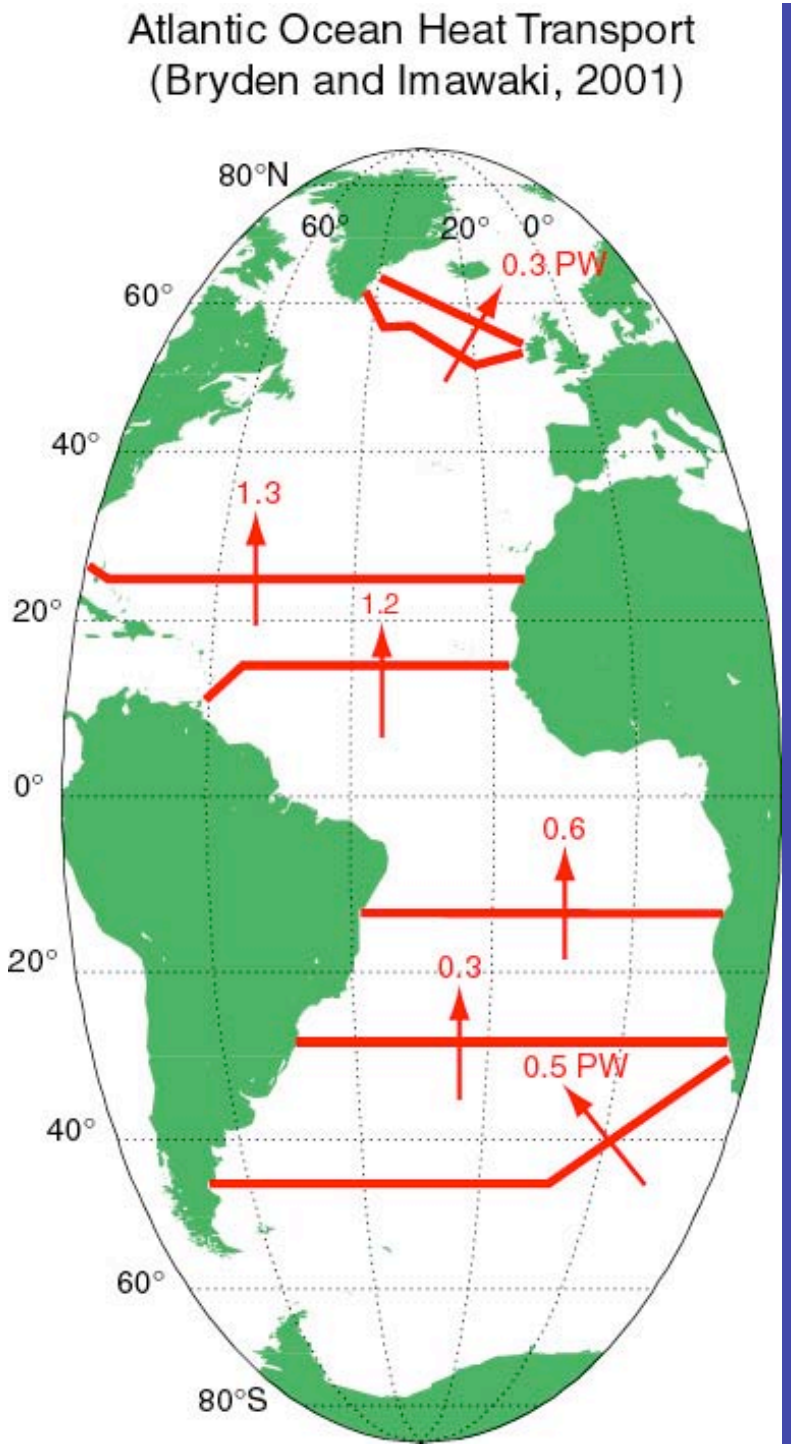
With Stuart Cunningham and Jochem Marotzke



Thermohaline Conveyor Belt (after Doos and Webb)

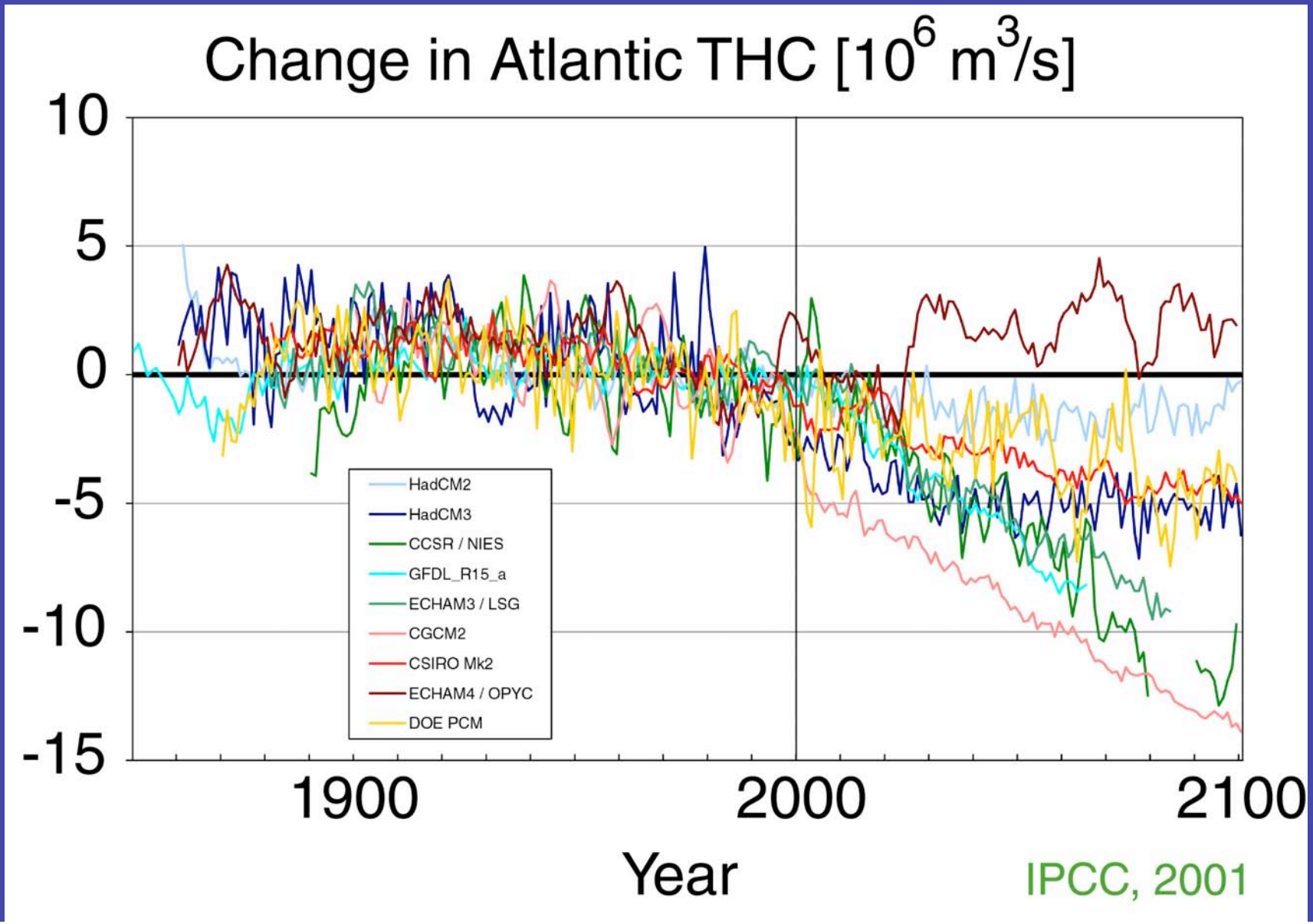
t96g_occam/thermohaline2



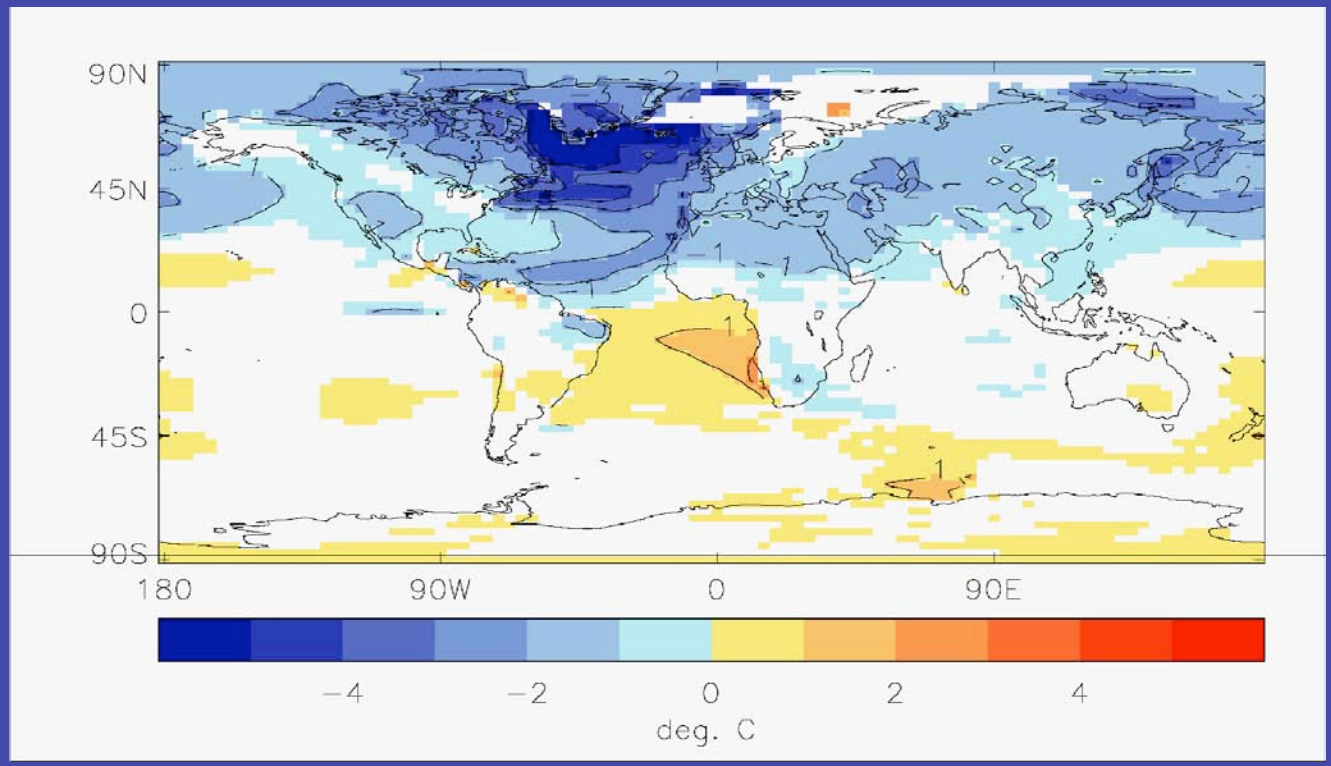
The Atlantic Meridional Overturning Circulation (MOC) transports heat northward throughout the Atlantic Ocean

The ocean heat transport across 25°N in the Atlantic accounts for 25% of the maximum poleward heat transport required of the combined ocean and atmosphere to balance the global radiation budget of the earth

Could the Atlantic MOC be slowing down?



Air temperature change with no-MOC (HadCM3)



Surface air temperature change 20-30 years after THC shutdown by large freshwater input. THC recovers after 120 years (Vellinga & Wood, 2002).

Rapid

Initially a UK NERC £20M Programme to study past and present climate change

Inspired by Jochem Marotzke, developed by Phil Newton and a broad-based Steering Committee to include

Paleo Studies
Field Experiments
Modelling
Monitoring Component

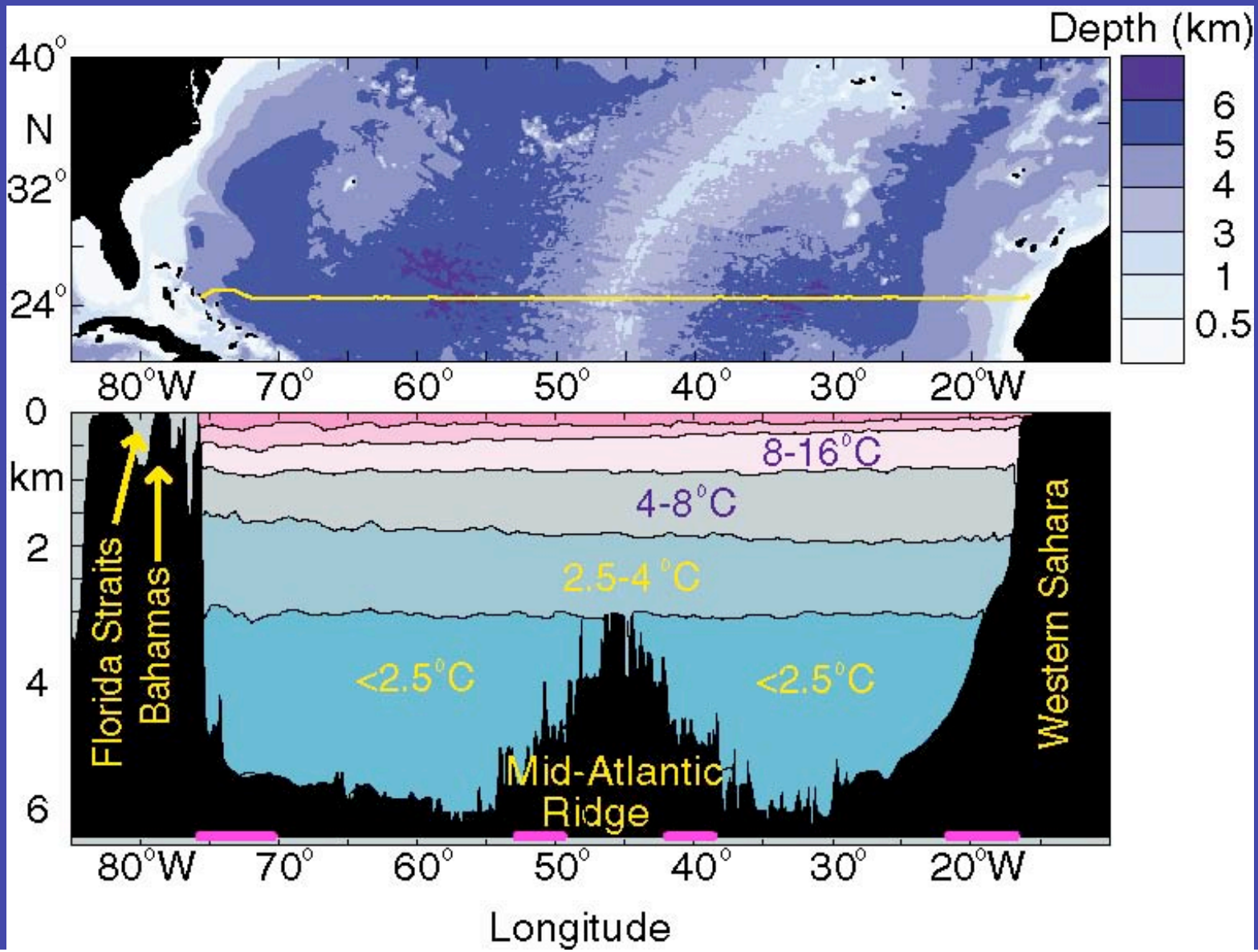
Key Decision to identify separate substantial funding for monitoring

Rapid

Cooperation between UK and US: NERC and NSF and NOAA joint proposals and funding for monitoring arrays

Development of cooperative projects among UK Norway and Netherlands

An array of moored instruments on the eastern and western edges of the 26°N section and over the flanks of the Mid Atlantic Ridge was designed to monitor the MOC



Array to monitor interior geostrophic flow

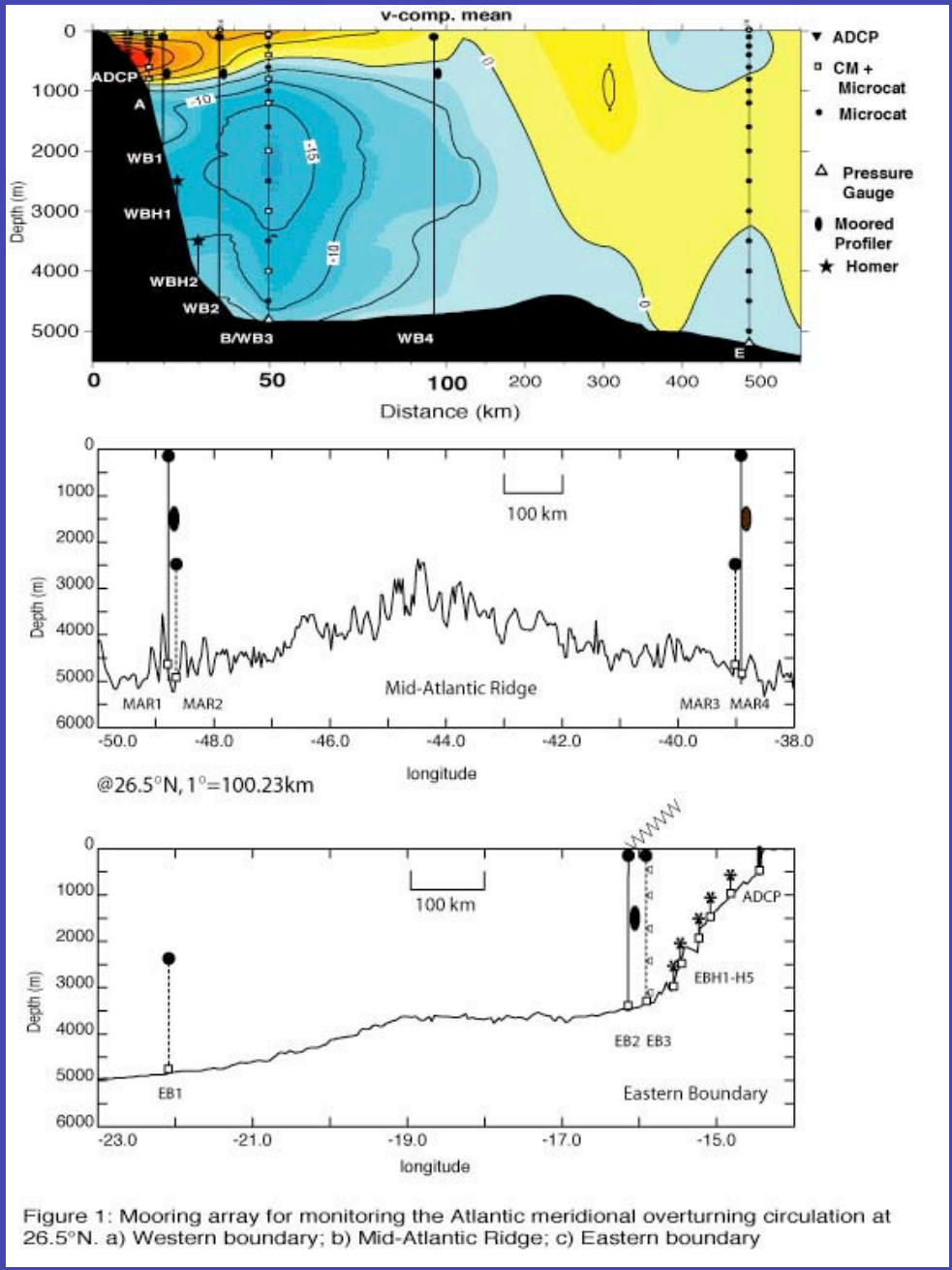


Figure 1: Mooring array for monitoring the Atlantic meridional overturning circulation at 26.5°N. a) Western boundary; b) Mid-Atlantic Ridge; c) Eastern boundary

Western Boundary

Mid Atlantic Ridge

Eastern Boundary

The array was tested in two numerical ocean circulation models
Hirschi, Baehr, Marotzke, Stark, Cunningham and Beismann (2003)

Blue:

Covered

OCCAM 26.4N

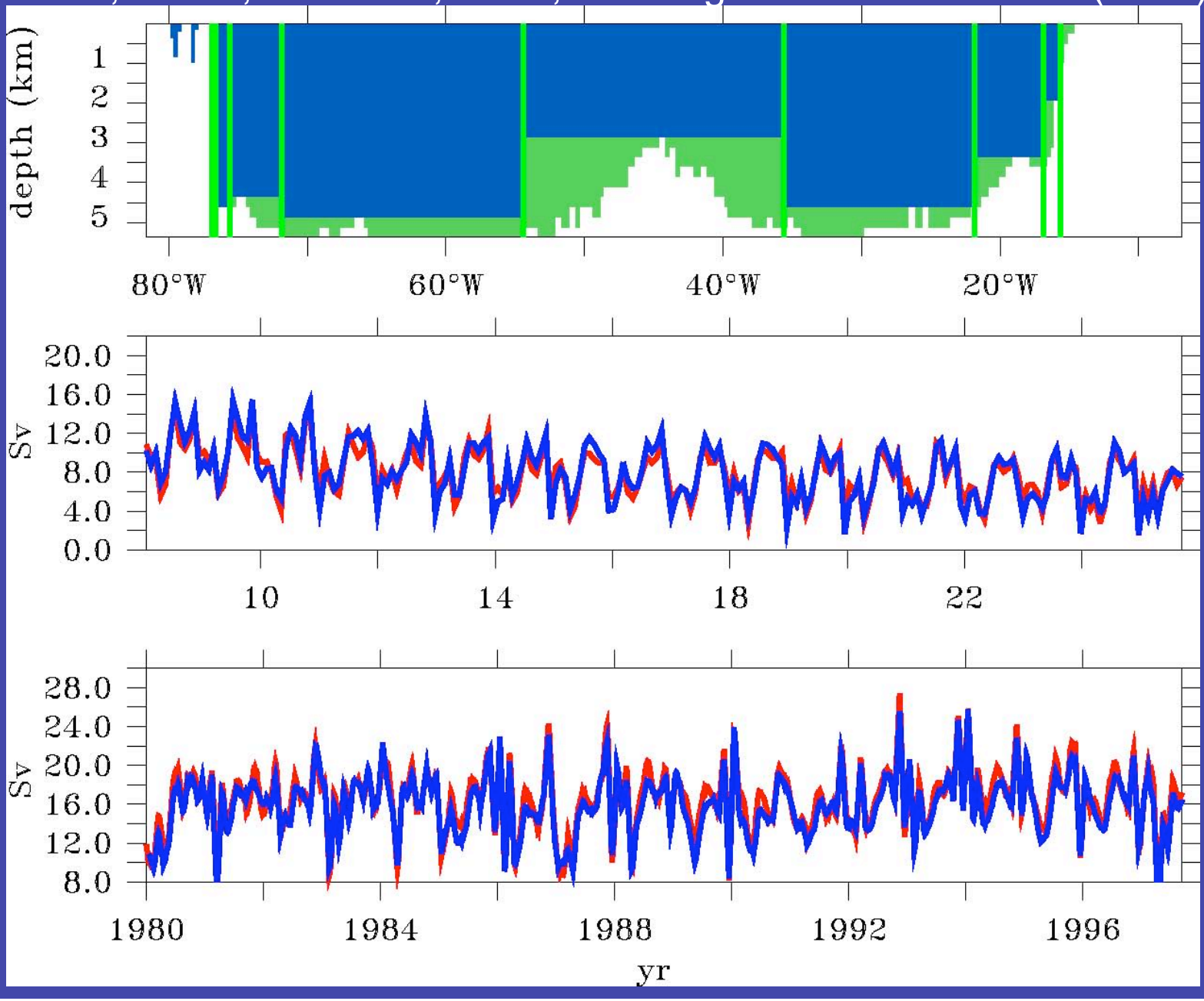
Red:

MOC

Blue:

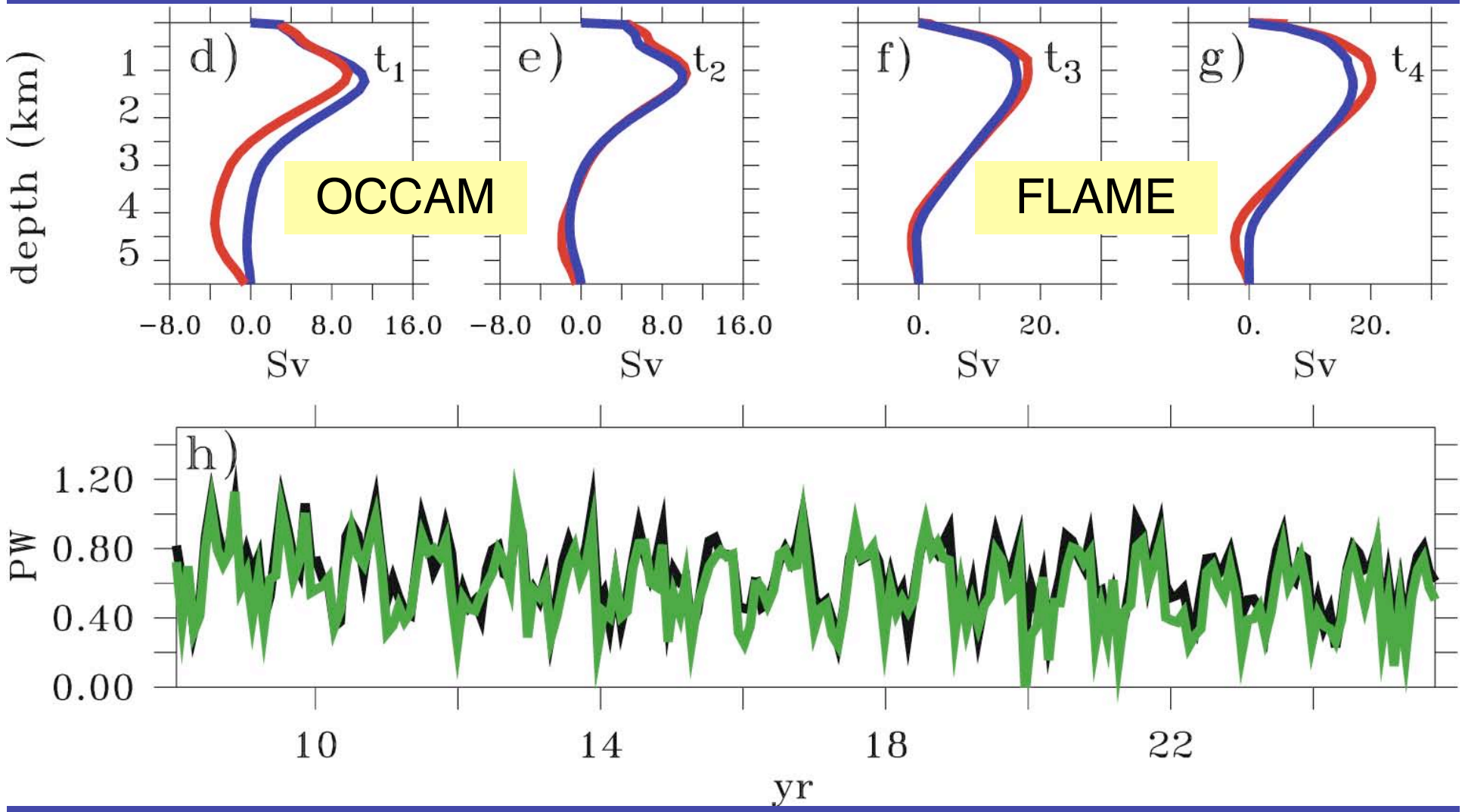
Recon-
struction

FLAME 26N

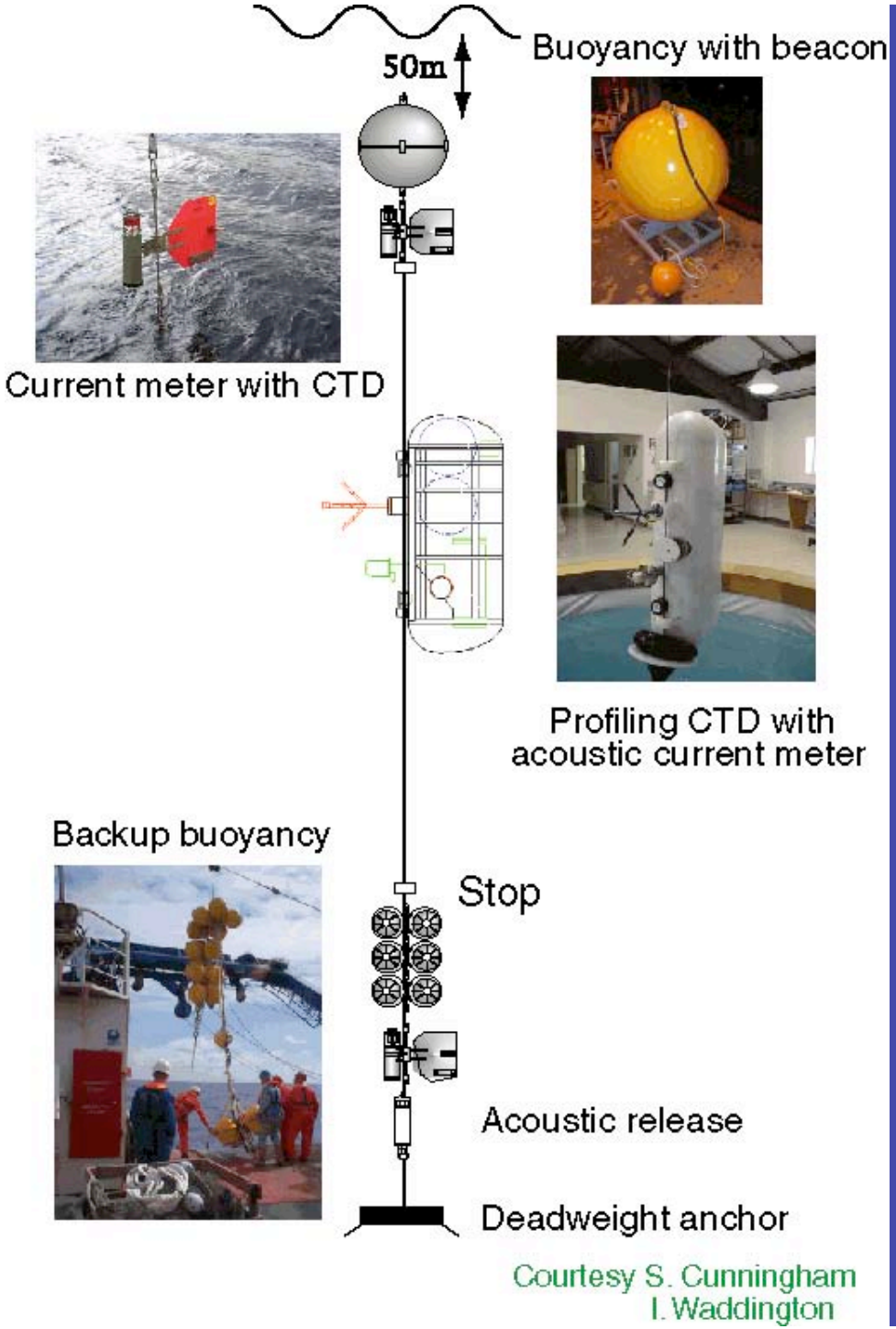


Hirschi, Baehr, Marotzke, Stark, Cunningham and Beismann (2003)

Red: MOC Blue: Reconstruction



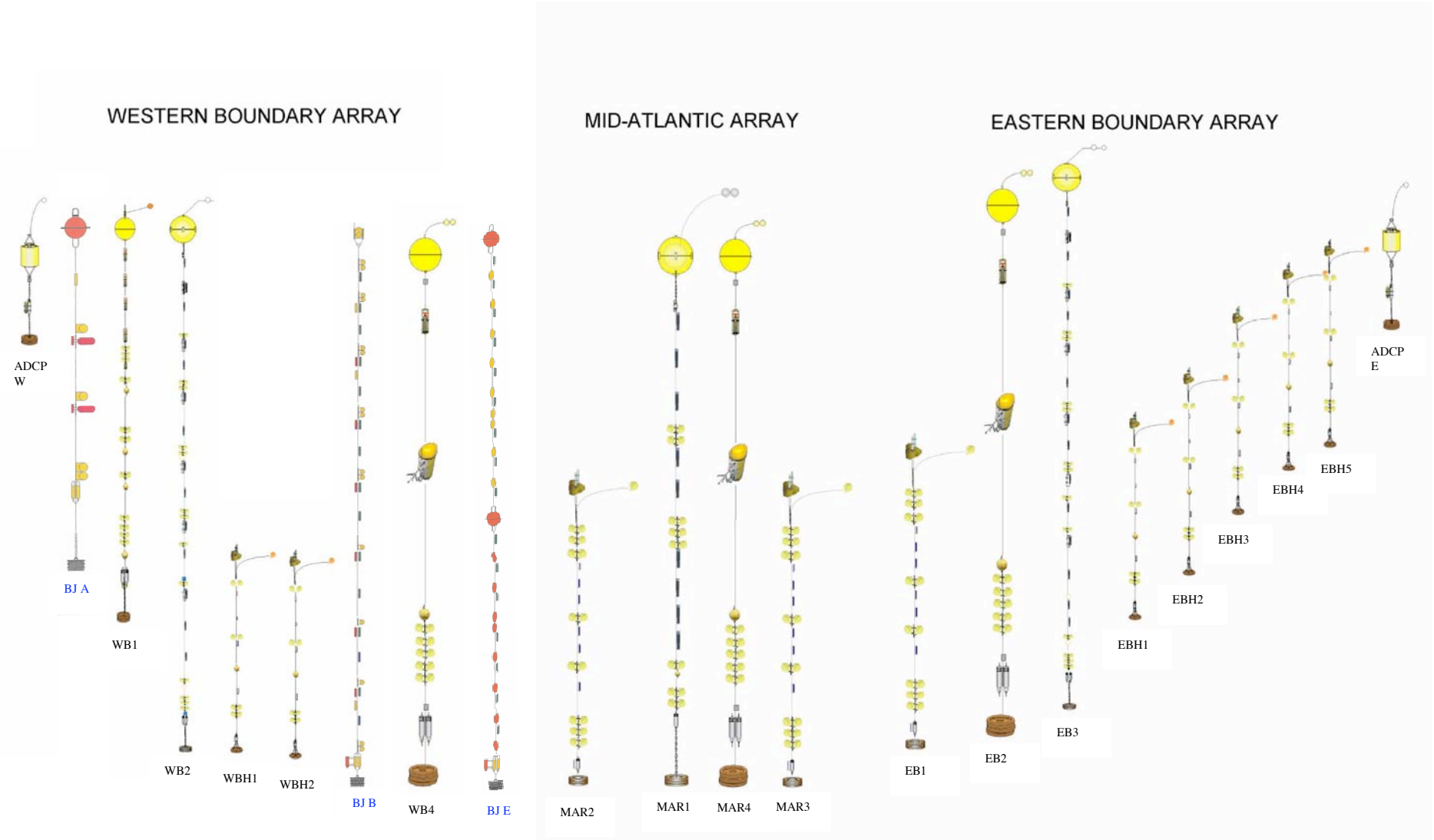
Black: OCCAM Heat Transport Green: Reconstruction



The array relies on top-to-bottom profiles of temperature and salinity, continuous hydrographic stations from which geostrophic velocity can be estimated

Key instrument is the profiling CTD

The Complete Array Deployed February-March 2004



Monitoring the Atlantic Thermohaline Circulation & Abrupt Climate Change

- The array is to be recovered and redeployed each year.
- Funding is secure for the first 4 years from NERC, NSF and NOAA
- Array is designed to measure the variability in the Atlantic MOC and its components
- Array may also be an “early warning system” for changes to the Atlantic thermohaline circulation
- Model-based observing system design