26.5°N MOC Monitoring Proposal

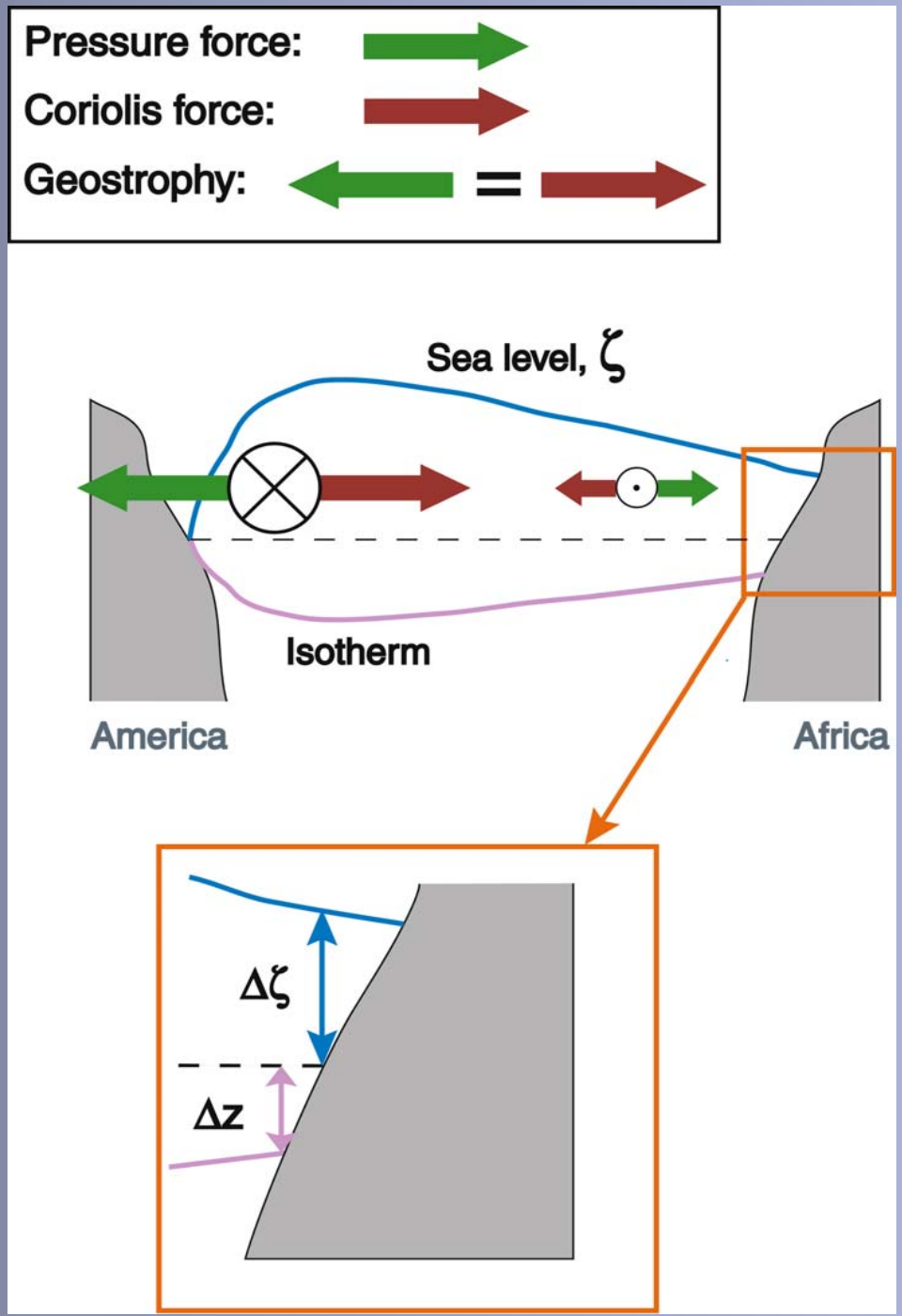
- PIs: Jochem Marotzke, Stuart Cunningham, Harry Bryden (SOC)
- Budget: £4.1M over 5 years
- Will support 2 Post-docs, 1 Research Assistant

Why 26.5°N?

- Near Atlantic heat transport maximum - captures total heat transport convergence into North Atlantic
- South of area of intense heat loss ocean $\Rightarrow$ atmosphere over Gulf Stream extension
- MOC dominates heat transport at 26.5°N
- Heat transport variability dominated by velocity fluctuations (Jayne & Marotzke, 2001)
- Florida Strait transport monitored for >20 years (now: Johns, Baringer & Beal, Miami, collaborators)
- 4 modern hydrographic occupations

Approach: Integrated thermal wind (geostrophy)

- Ekman contribution to MOC included
- Surface layer Ekman transport assumed to return independent of depth



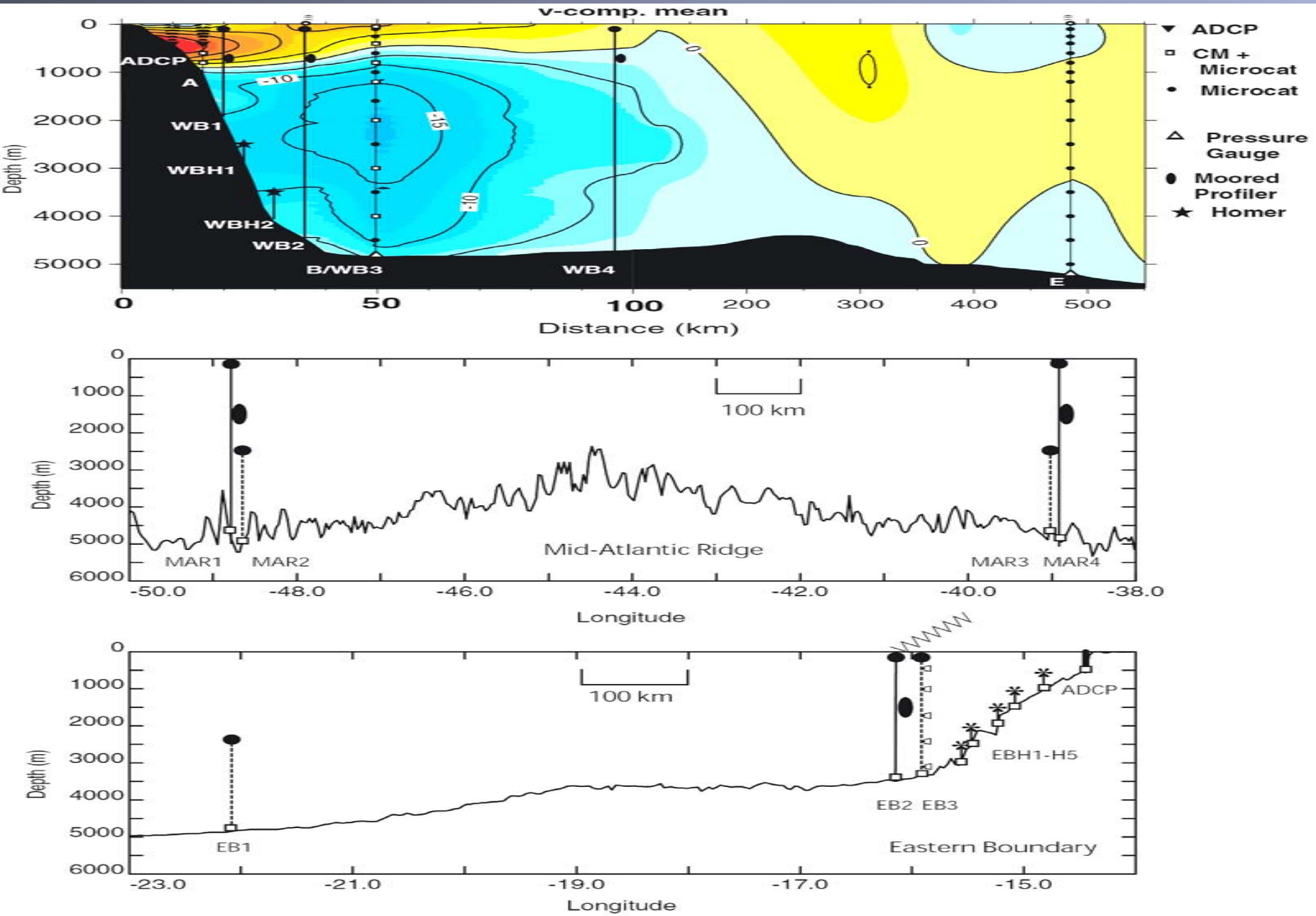
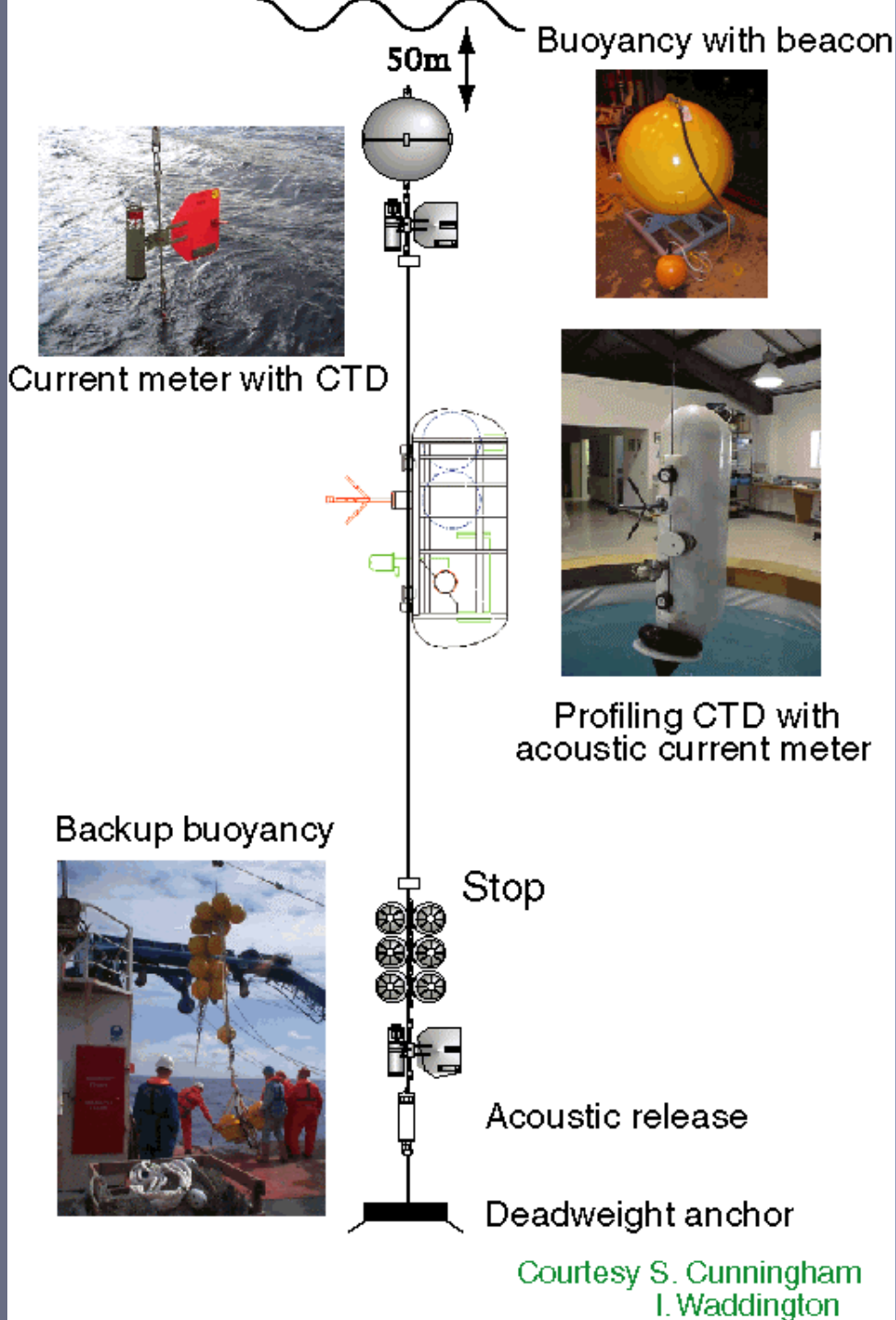
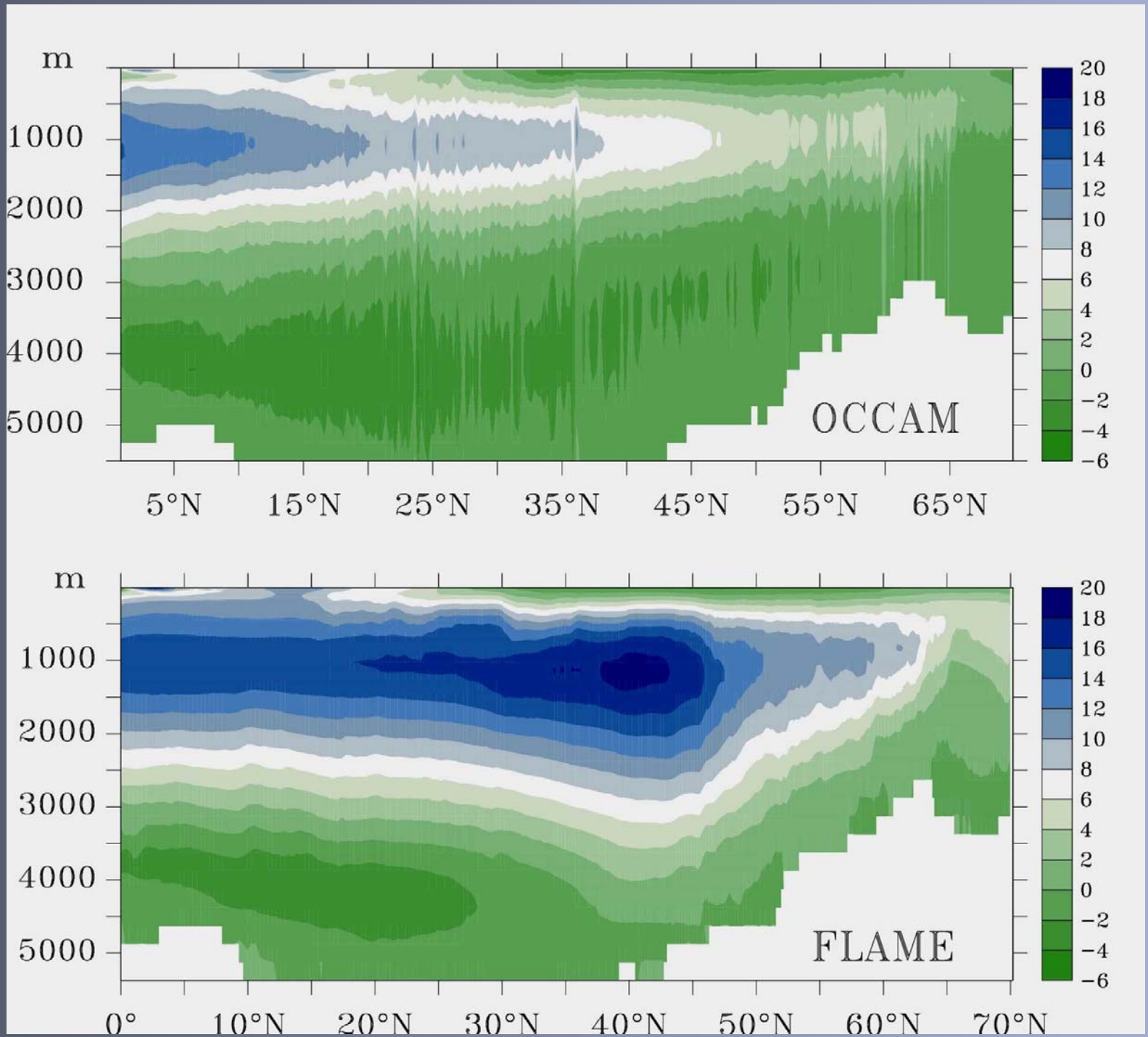


Figure 1: Mooring array for monitoring the Atlantic meridional overturning circulation at 26.5 N. a) Western boundary; b) Mid-Atlantic Ridge; c) Eastern boundary


Buoyancy with beacon
50m
Current meter with CTD
Profiling CTD with
acoustic current meter
Backup buoyancy
Stop
Acoustic release
Deadweight anchor
Courtesy S. Cunningham
I. Waddington

Model-based experiment design:

- Funded through NERC prior to conception of RAPID
- Joël Hirschi (post-doc), Johanna Baehr (M.Sc. student)
- “Deploy” antenna in high-resolution models, OCCAM (1/4°; SOC, Webb et al.; Hirschi), FLAME (1/3°; IfM Kiel, Böning et al.; Baehr)


m
1000
2000
3000
4000
5000
OCCAM
5°N
15°N
25°N
35°N
45°N
55°N
65°N
20
18
16
14
12
10
8
6
4
2
0
−2
−4
−6
m
1000
2000
3000
4000
5000
FLAME
0°
10°N
20°N
30°N
40°N
50°N
60°N
70°N
20
18
16
14
12
10
8
6
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2
0
−2
−4
−6

Blue:

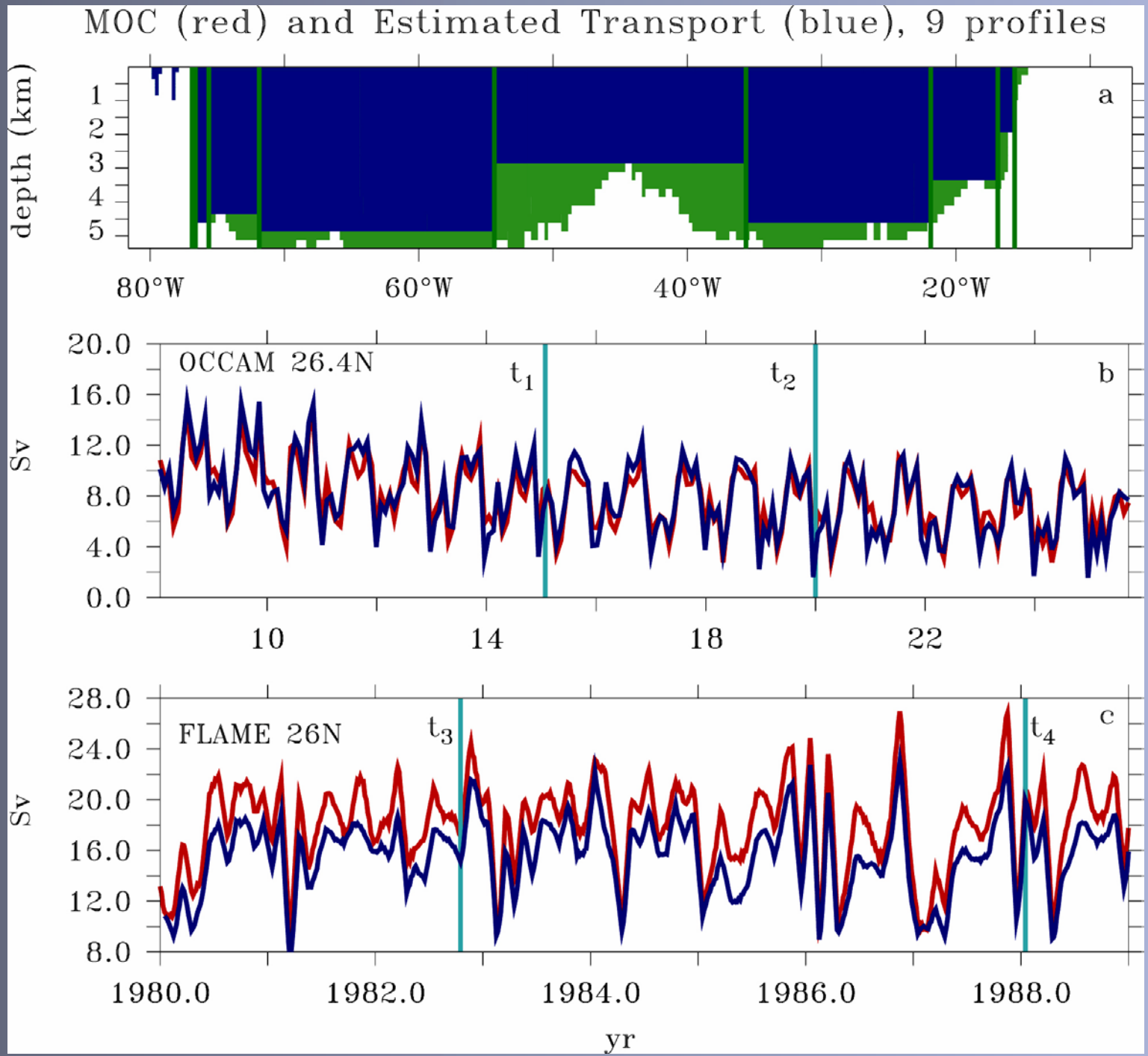
Covered

Red:

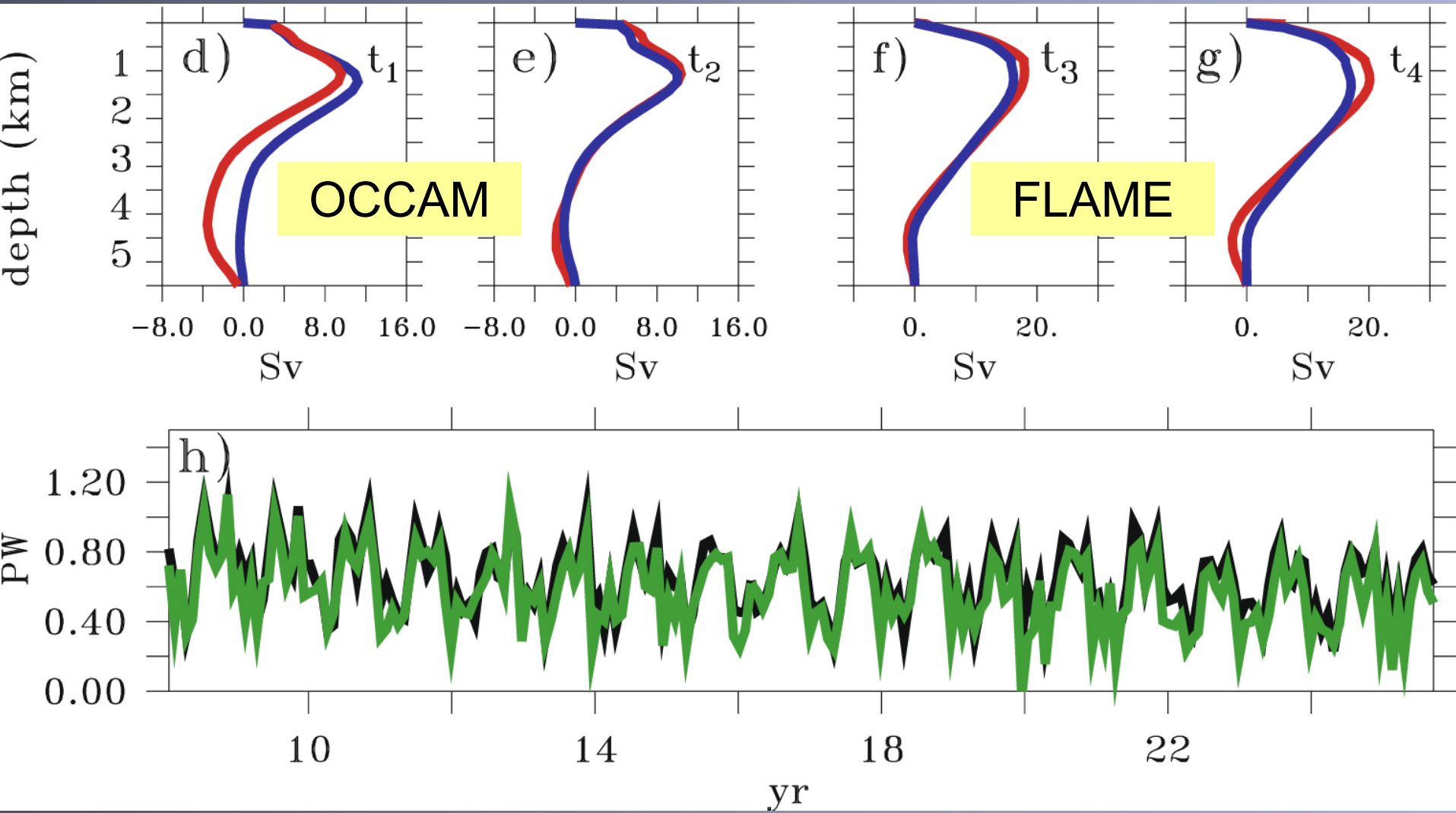
MOC

Blue:

Recon-
struction



Red: MOC Blue: Reconstruction



Black: OCCAM Heat Transport Green: Reconstruction

Science Objectives

- Produce time series of MOC profile (3 stages: Real-time through telemetry; procedure of expt. design; synthesis of density profile, BPR, CM, and altimeter data
- Compare MOC estimate from deployment year 1 against that based on 2004 hydrographic cruise
- Investigate timescales of variability
- Analyse data for redundancy
- Contribution of eastern boundary variability to MOC
- Compare altimeter data to sea level fluctuations inferred from the density and pressure information from moorings.
- Year 1: refine strategy using output from the 1/12° OCCAM
- Synthesis of data using linear or nonlinear least-squares; construct most sophisticated version of the MOC time series
- Compare measured MOC variability against models, OCCAM, FLAME, Hadley Centre, ECCO
- Assess feasibility of monitoring strategy for operational use.