Hydrodynamic modelling in case study areas using VIKING20 boundary conditions: Setup, results, model validation

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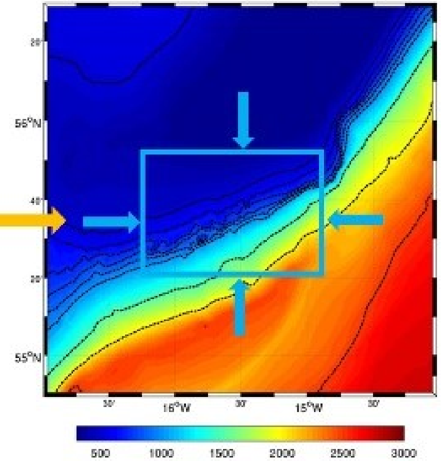
Model setup

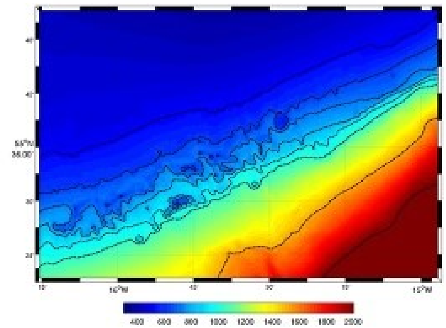
Rockall Bank

- VIKING20 boundary conditions : SSH, U, V, T, S
- OSU inverse tidal model: tidal forcing

Parent grid: GEBCO 30 arc sec bathymetry (model resolution 750 m)



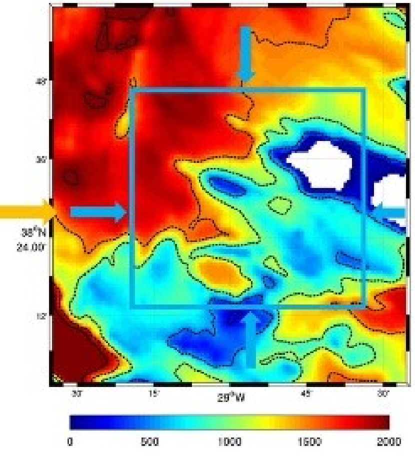
Embedded grid: INSS high resolution multibeam bathymetry (model resolution: 250 m)



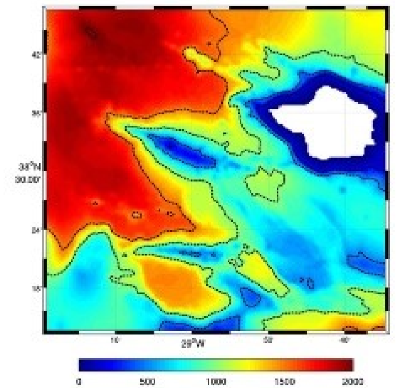
Condor Seamount

- VIKING20 boundary conditions : SSH, U, V, T, S
- OSU inverse tidal model: tidal forcing

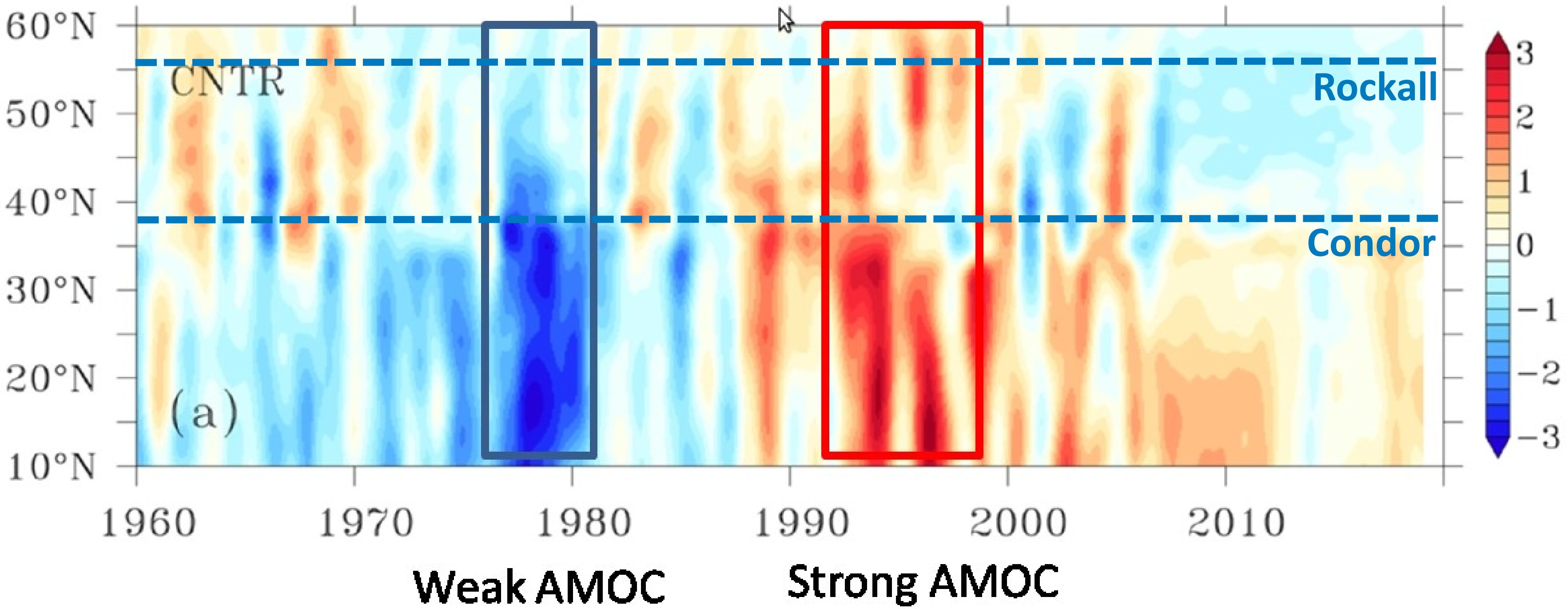
Parent grid: GEBCO 30 arc sec bathymetry (model resolution 750 m)



Embedded grid: IMAR high resolution multibeam bathymetry (model resolution: 250 m)



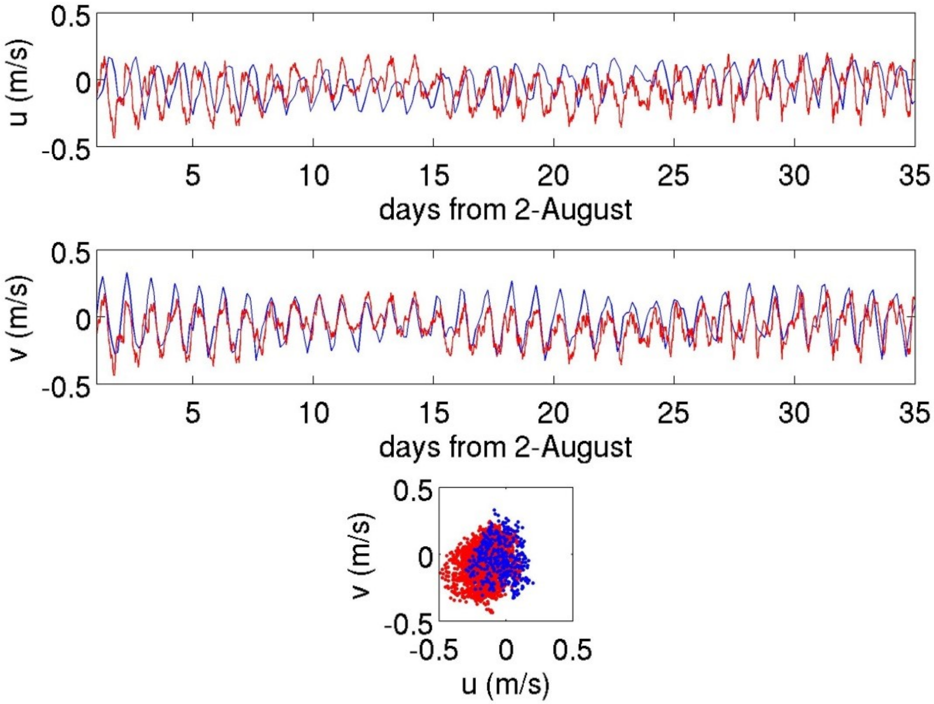
VIKING20 North Atlantic Basin-Wide AMOC anomalies (reproduced from Böning et al 2016)



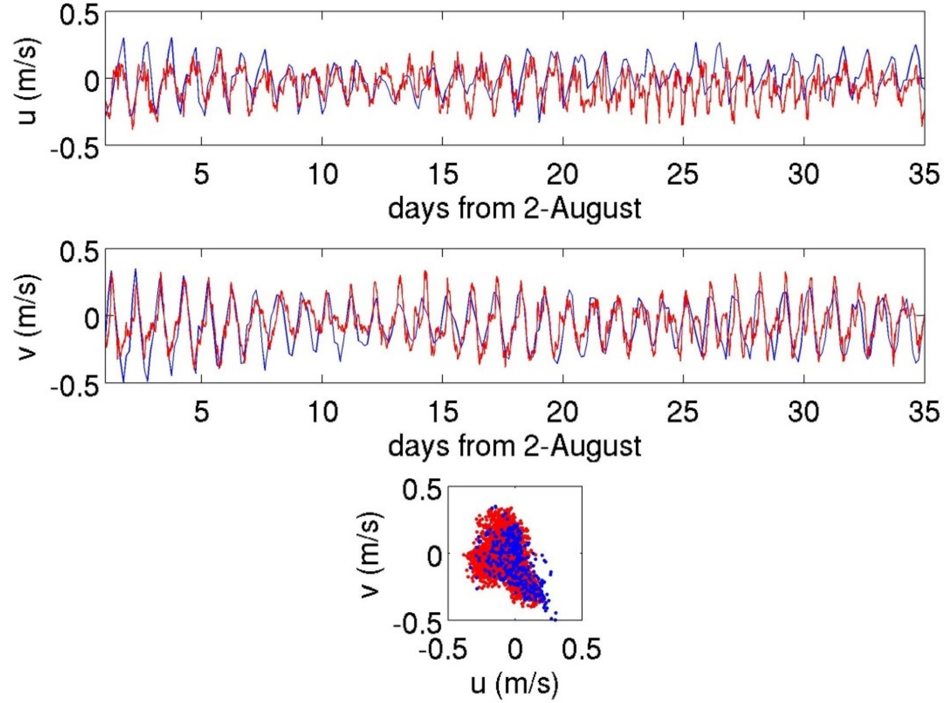
Model-data comparison: Rockall

Logachev Mounds, water depth: 818 m

150 m above bottom



10 m above bottom

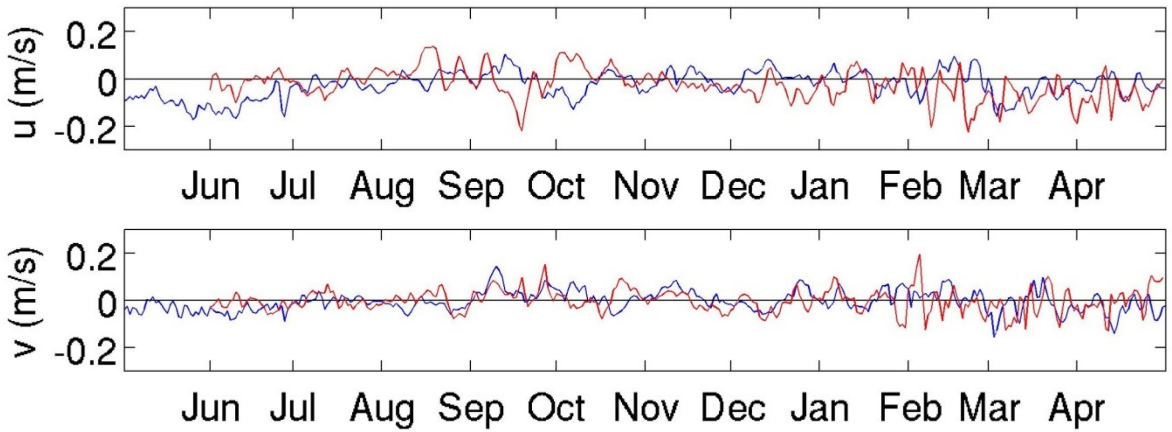


1979 – model

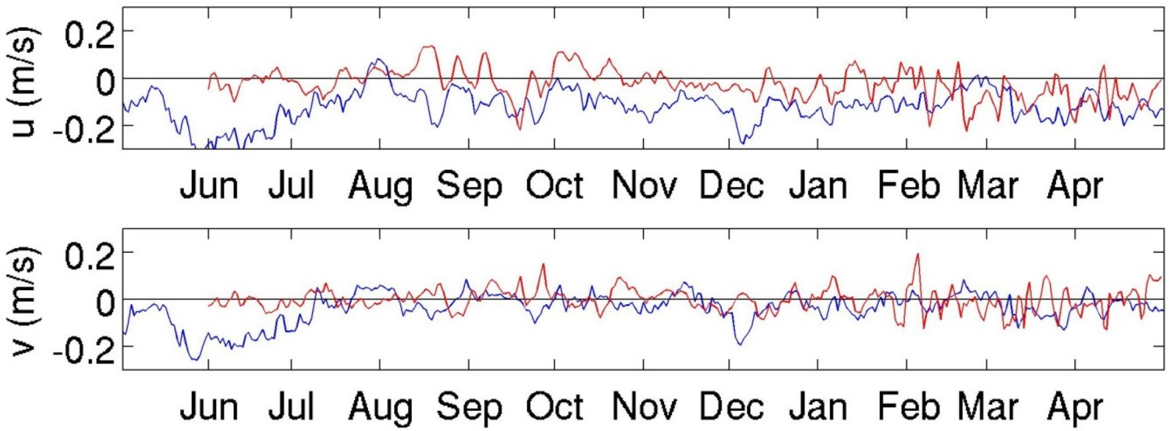
2000 – observations (White et al 2007)

→ Weak AMOC

Model-data comparison: Rockall



Depth-averaged velocity – **Upper Rockall Slope**, water depth: 507 m



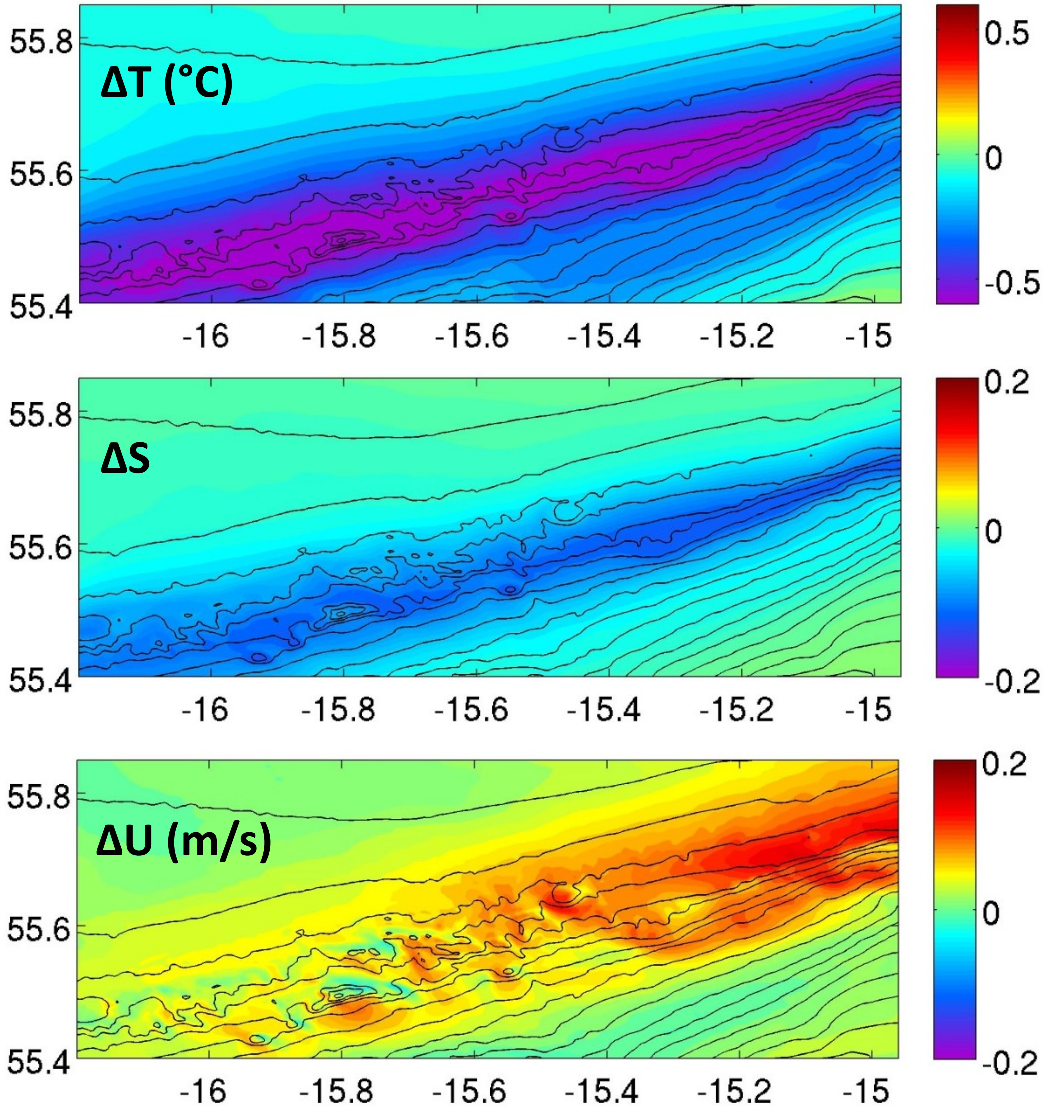
Depth-averaged velocity – **Oreo Mound**, water depth: 781 m

1978/1979 – model

2017/2018 – ATLAS

→ Weak AMOC

Rockall: T, S, U annual averages near-seabed 1993 - 1979



- Largest changes in the depth range 600 – 1200 m
- 1993: colder, less saline, stronger bottom currents
- Larger differences in bottom currents upstream of the coral mounds, but differences are smaller inside the coral mound corridor.
- Smaller differences in bottom currents due to stronger local dissipation of energy in areas of intensified flow-topography interaction?

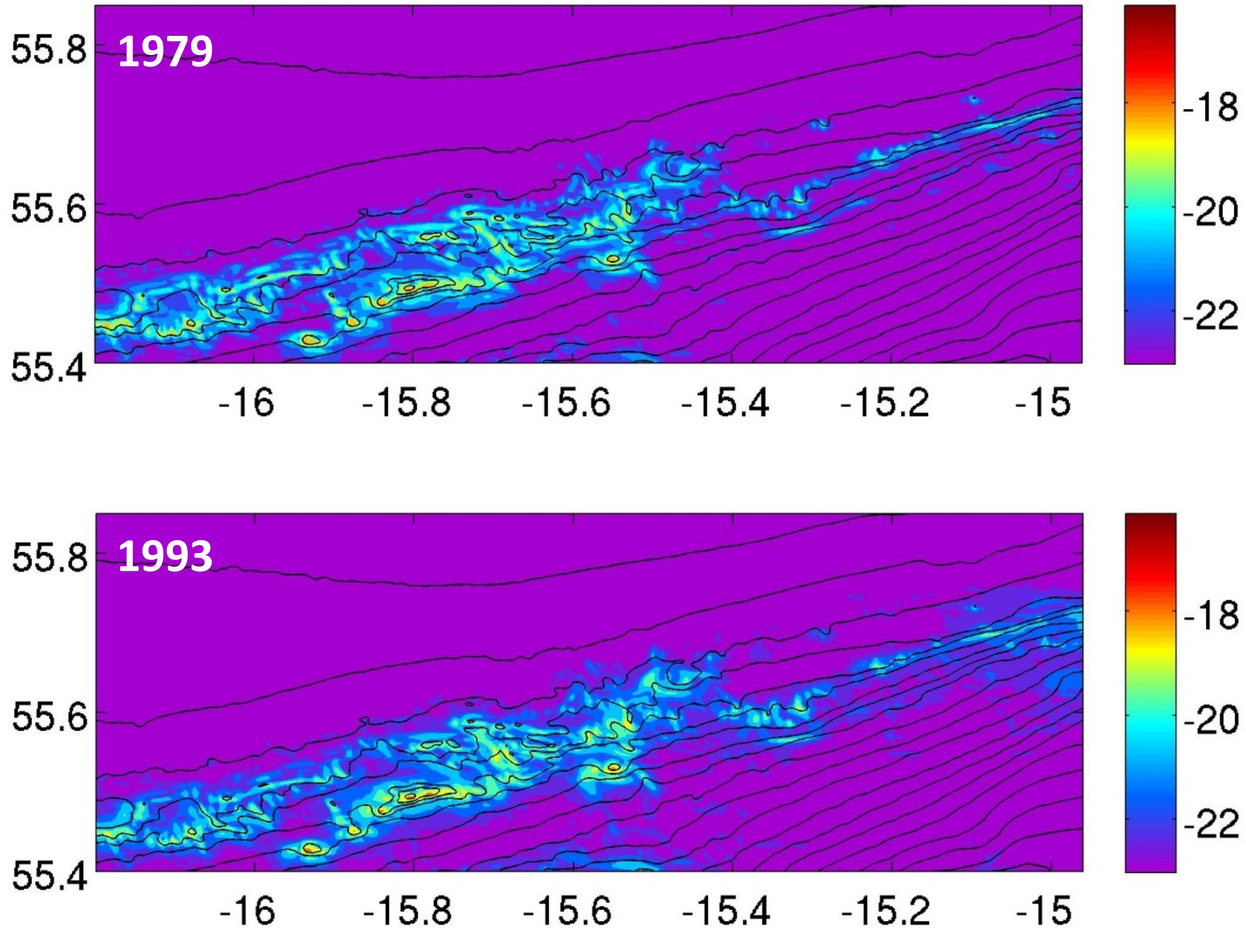
Energy dissipation calculated from daily averages of bottom velocity u, v

$$\epsilon = \mu \rho^{-1} \left((\partial u/\partial x)^2 + (\partial v/\partial y)^2 \right)$$

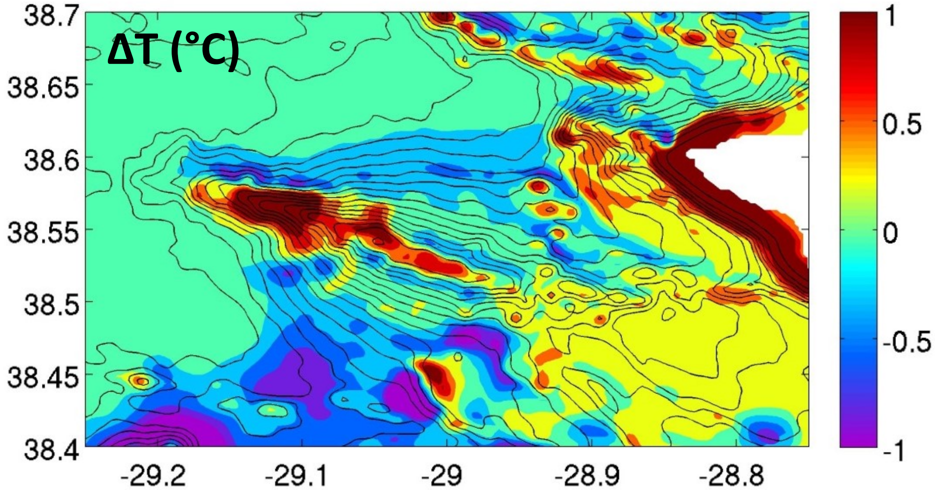
μ=dynamic viscosity, ρ=density

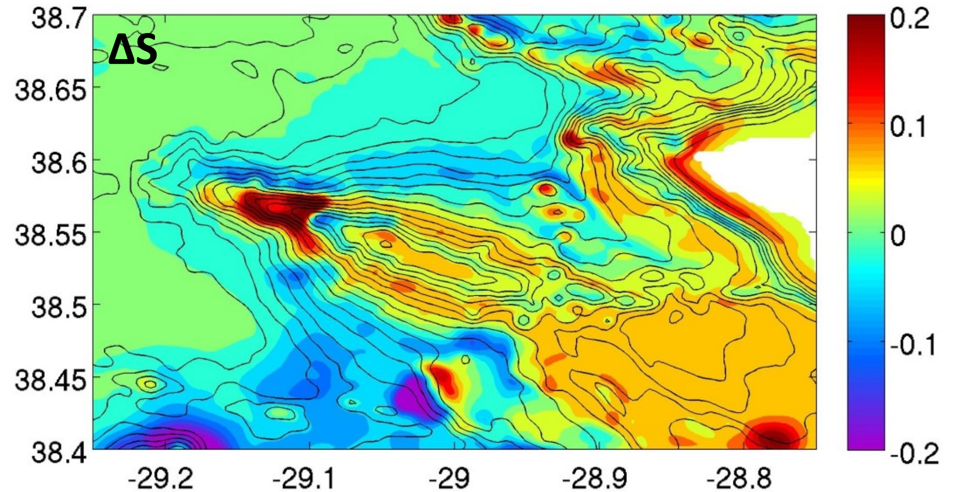
High local energy dissipation rates (flow-topography interaction) indicate energy transfer towards higher frequencies, e.g. internal waves, turbulent mixing. Dynamical link to coral ecology?

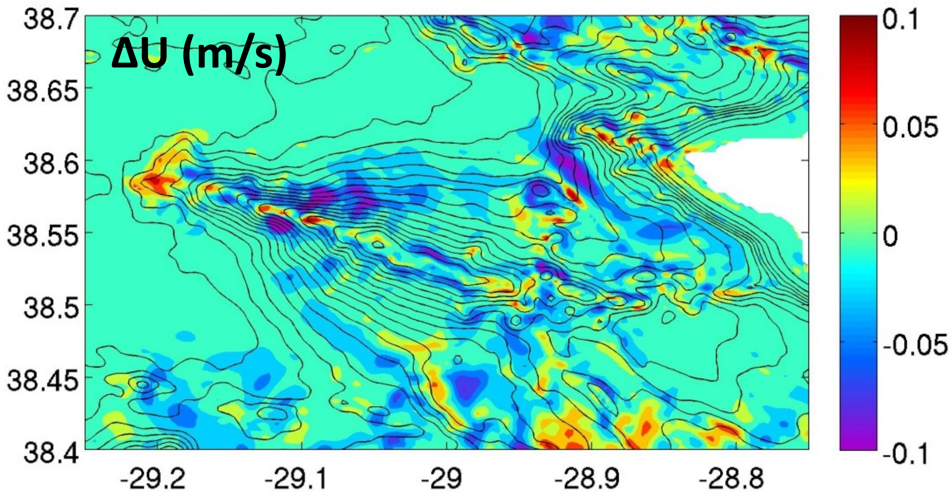
Energy dissipation $\log_{10}(\epsilon)$ $[m^2 s^{-3}]$



Condor: T, S, U annual averages near-seabed: 1993 - 1979

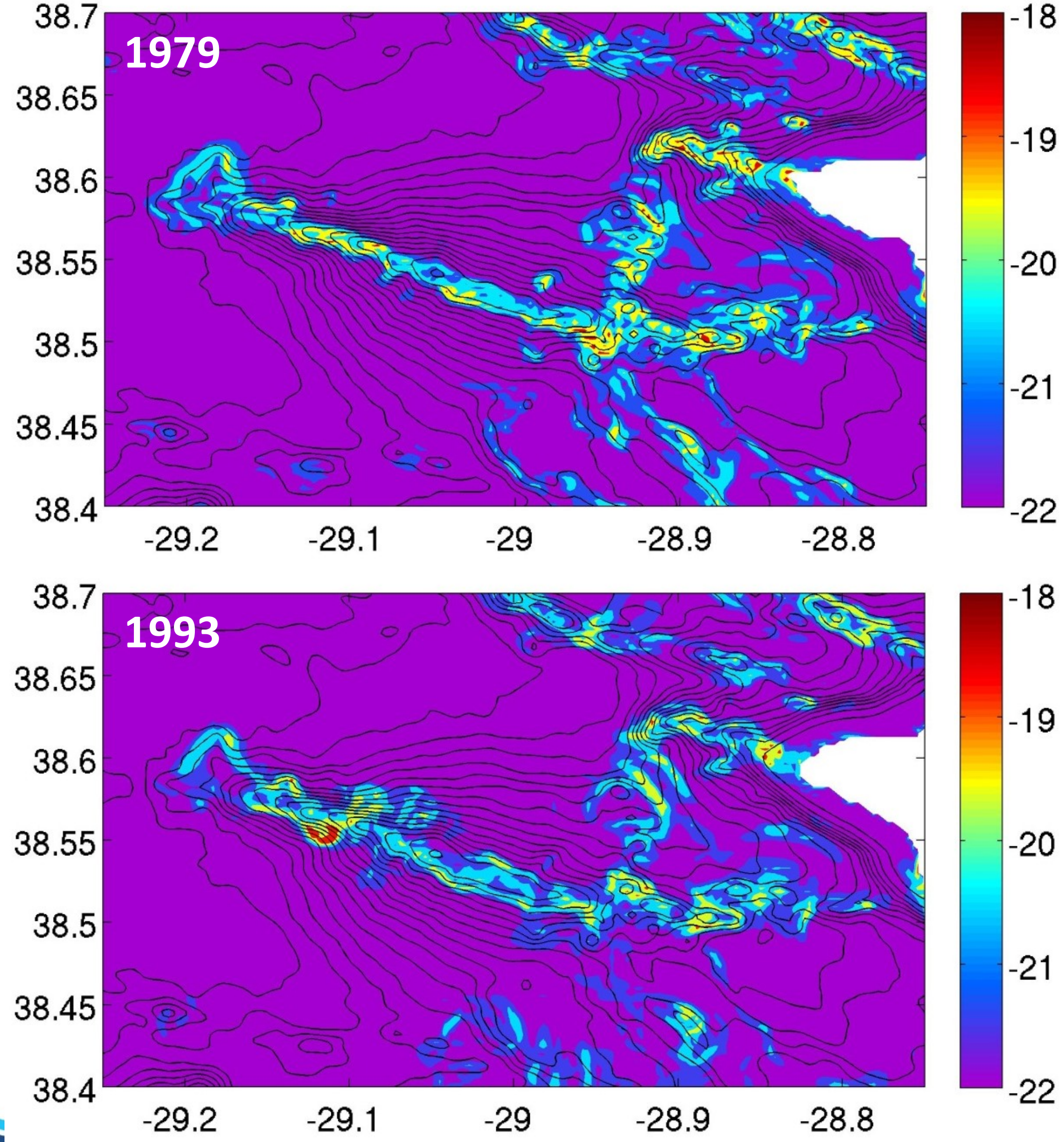






- Seamount summit and upper slopes decoupled from conditions at larger depths
- 1993: colder and less saline at bottom depths > 800 m
- 1993: warmer, more saline and stronger bottom currents along the seamount major axis

Energy dissipation $\log_{10}(\epsilon)$ [m^2s^{-3}]



Summary

AMOC related trends in the far field ocean climate are most pronounced in local case study areas at depths > 600 m (Condor Seamount: Opposite trend in T, S at upper slopes and seamount summit).

SE Rockall Bank Coral Mounds and Condor Seamount are areas of locally enhanced energy dissipation (potentially increasing sediment resuspension through intense turbulent mixing, see also Deliverable D1.2).

Thank You

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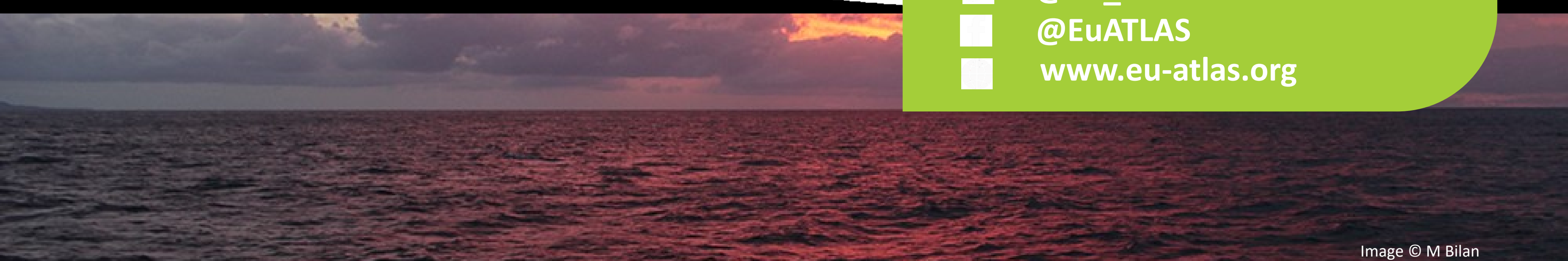

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Data inventory

Area	Resolution	Prognostic Variables	File Format	File Size
Rockall Bank	750 m, 32 vertical levels	• 3D: T, S, U, V, W • 2D: SSH • Daily averages: 1978-1980, 1992-1994	NetCDF, 60 days	2.4 Gbyte
Rockall Bank	250 m, 32 vertical levels	• 3D: T, S, U, V, W • 2D: SSH • Daily averages: 1978-1980, 1992-1994	NetCDF, 60 days	3.0 Gbyte
Condor Seamount	750 m, 32 vertical levels	• 3D: T, S, U, V, W • 2D: SSH • Daily averages: 1978-1980, 1992-1994	NetCDF, 60 days	0.7 Gbyte
Condor Seamount	250 m, 32 vertical levels	• 3D: T, S, U, V, W • 2D: SSH • Daily averages: 1978-1980, 1992-1994	NetCDF, 60 days	2.4 Gbyte