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Structure and transport of the water mass in the Atlantic ocean based on numerical models and hydrographic sections

Main goal:

- To compare the distribution of the numerical model parameters and real oceanographic sections

The tasks:

- to compare the values of interannual variability on various models

- to calculate the transport of main water masses and heat flux

- to calculate by the model data (SODA 2, ORA S4) averages for the decade of the values of the main oceanographic parameters, transport of water masses, heat flux

The models

	Parameters	*Horizontal resolution*	*Vertical resolution*	*Forcing and relaxation used*
SODA 2	Θ, S, D, U, V, W	0.5°x0.5°	40 levels, 10m top layer	Estimated via assimilation
ORA S4	Θ, S, D, U, V	1°x1° with equatorial refinement (0.3°)	42 levels, about 10m-15m level thickness in upper 200m, 5m top layer	Daily surface fluxes of heat, momentum and fresh water are used. ERA-40 and ERA-Interim reanalysis. From 2010 onwards fluxes were derived from the operational ECMWF atmospheric analysis.
ECCO 2	Θ, S, D, U, V	0.25°x 0.25°	50 levels, 10 in top 100m, 5m top layer	20CRv2 surface wind stress and variables for bulk formulae

WOCE A05 sections

1992

1998

Latitudinal gradient

(θ)
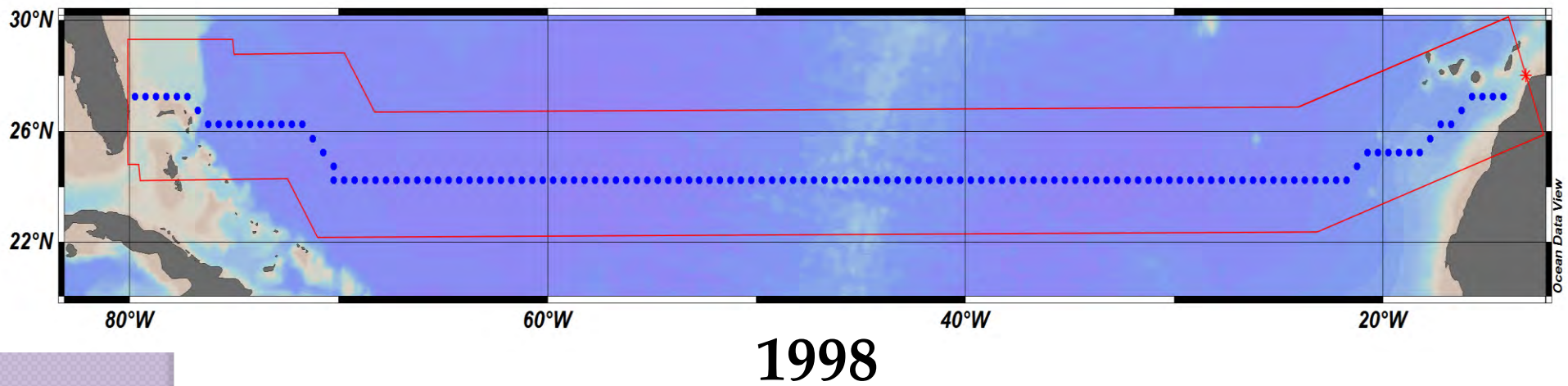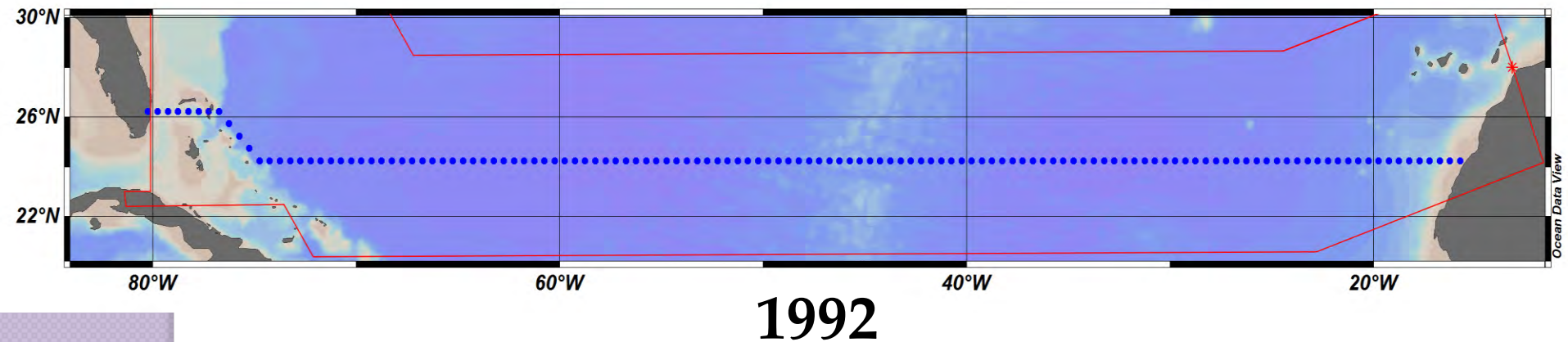
Fl	Bag		doMAR	zaMAR		total	pT			
-0,11	-0,18	-0,28	0	0	0,14	-0,06	uWNACW	0,23	GulfS	
-0,09	-0,11	0	0	0	0,11	0,04	lWNACW	0,08	Canar	
0,17	0,06	0	0	0	0,22	0,05	AAIW	0,00	MOC	
0	0	0	0	0	0,11	0,02	MIW	0,00	WB_MOC	
0	0	0	0	0	0,01	0	NADW1	0,00	EB_MOC	
0	0	0	0	0	0	0	NADW2	0,00	AABW	
0	0	0	0	0	0	0	AABW1	0,00		
0	0	0	0	0	0	0	AABW2	0,00		
0,23	0,01	0,08	0	0	0,06	0,02	total	0,00		

(S)

Fl	Bag		doMAR	zaMAR		total	SAL			
-0,01	-0,02	-0,01	0	0	0,04	0	uWNACW	0,02	GulfS	
0	-0,02	0,00	0	0	0,03	0	lWNACW	0,03	Canar	
0,03	0,01	0	0	0	0,05	0,01	AAIW	0,00	MOC	
0	0	0	0	0	0,02	0	MIW	0,00	WB_MOC	
0	0	0	0	0	0	0	NADW1	0,00	EB_MOC	
0	0	0	0	0	0	0	NADW2	0,00	AABW	
0	0	0	0	0	0	0	AABW1	0,00		
0	0	0	0	0	0	0	AABW2	0,00		
0,02	0,00	0,01	0	0	0,02	0	total	0,00		

Yellow marker shows different parts of sections
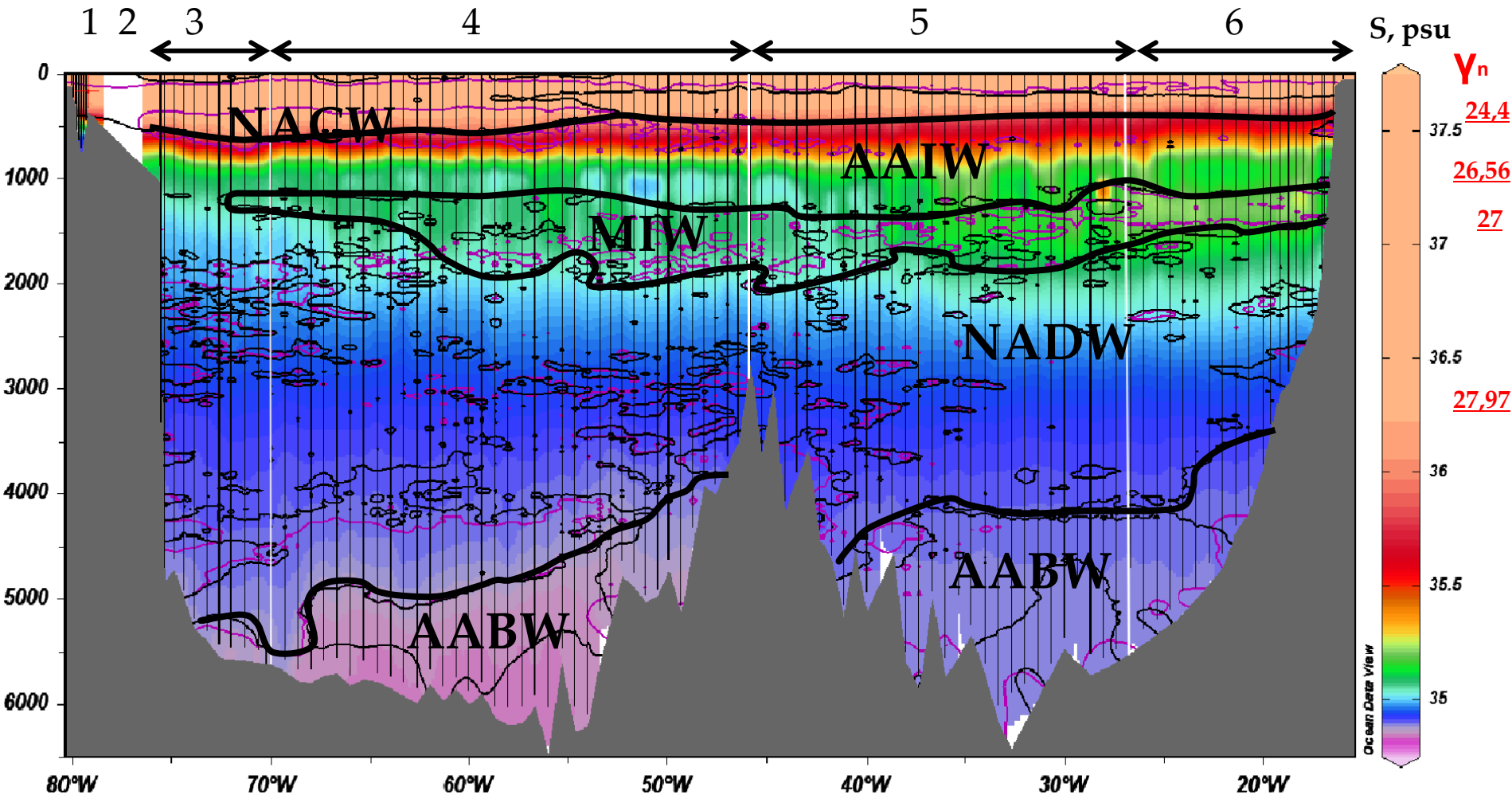
WOA 09 data

(θ)

Temperature - (Ref=Tatlas92) [°C]
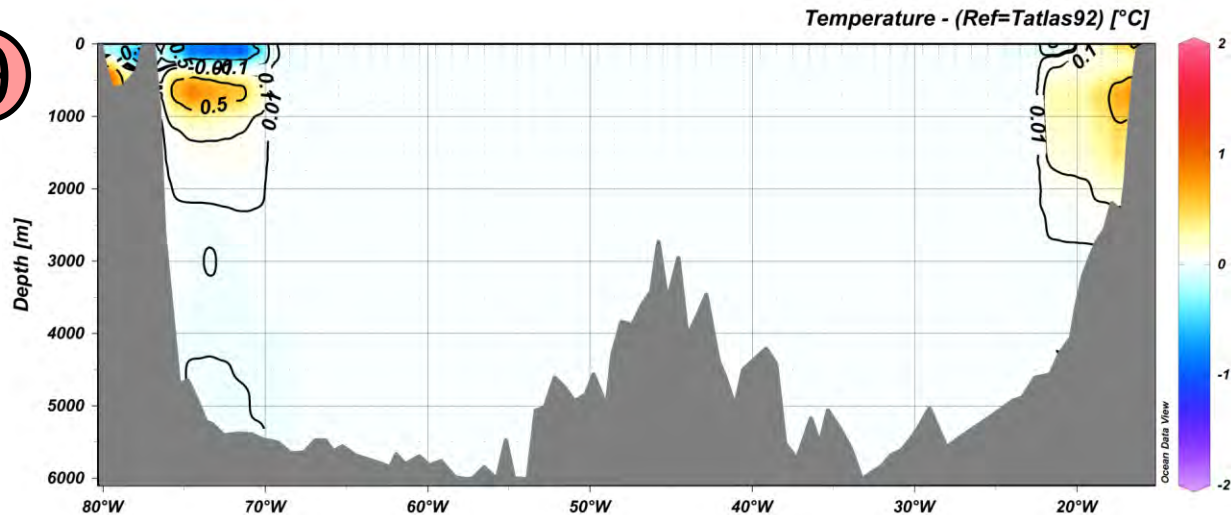
Water mass boundaries at A05 section

Water mass boundaries have good agreements with [Hall et al., 2004]

Differences

Θ

SODA 1998-1992
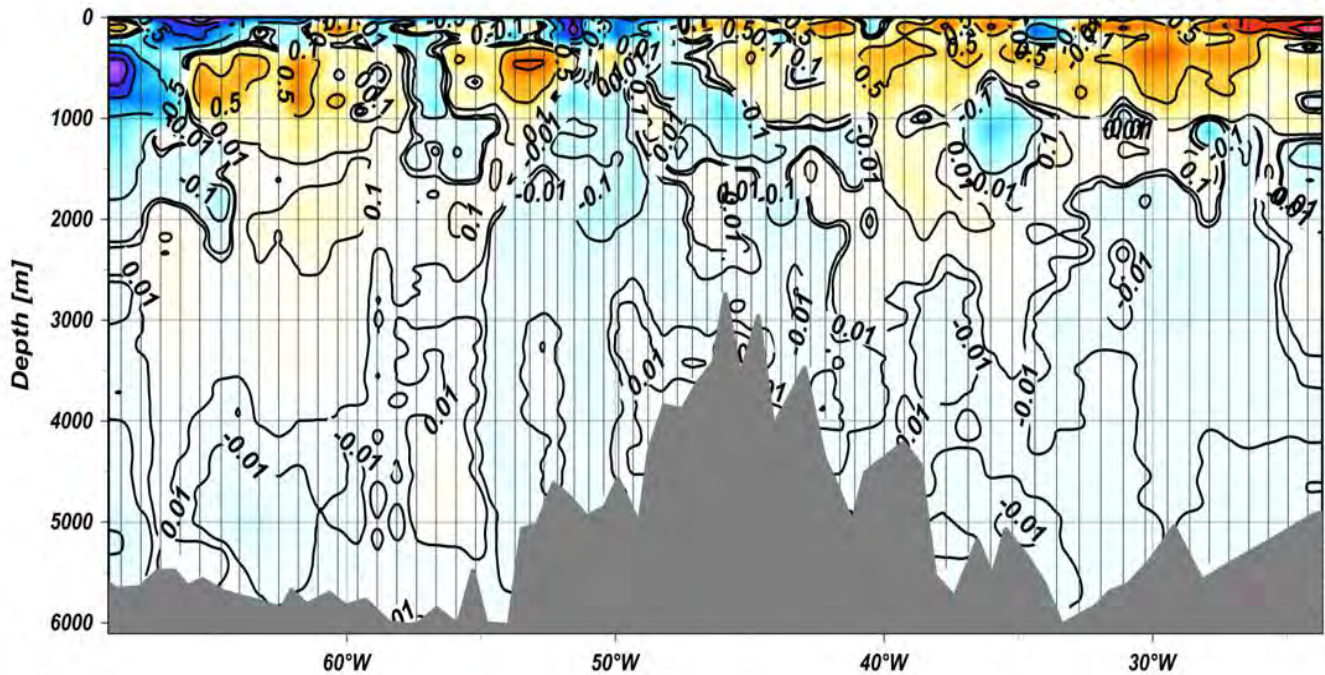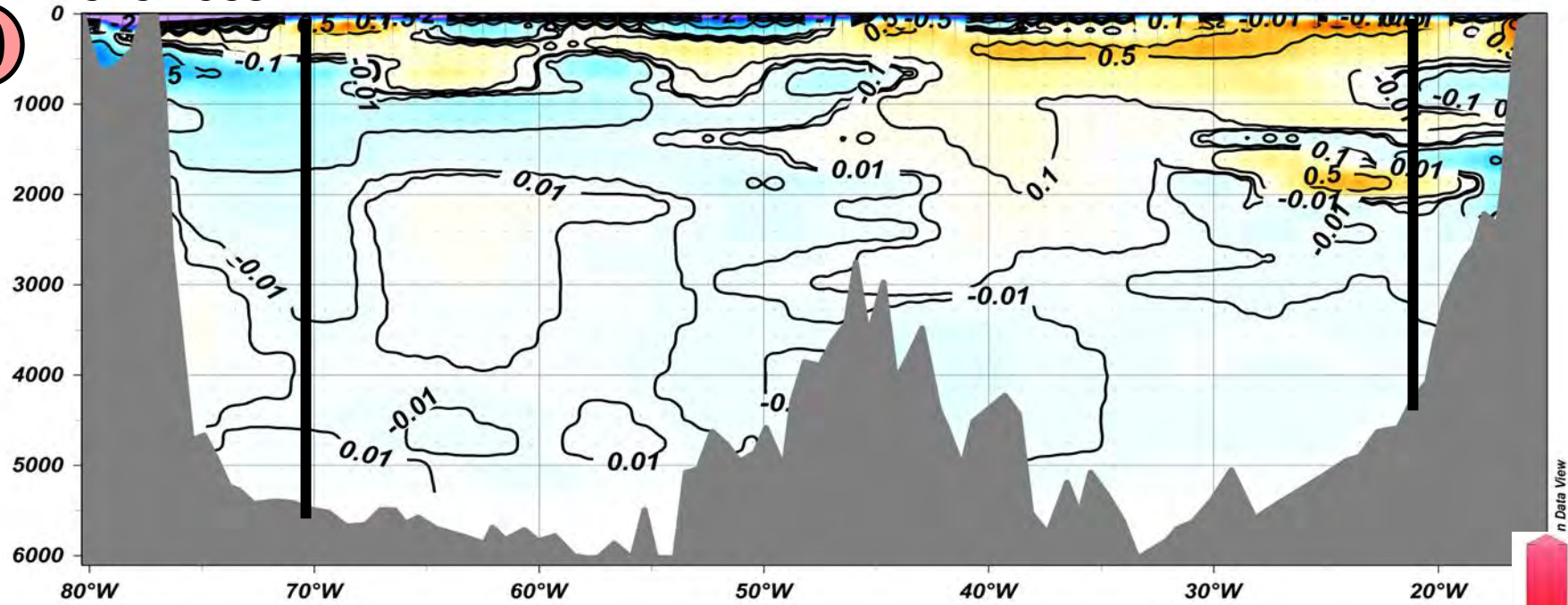
A05 1998-1992

Differences

Θ

ORA S4 1998-1992

A05 1998-1992
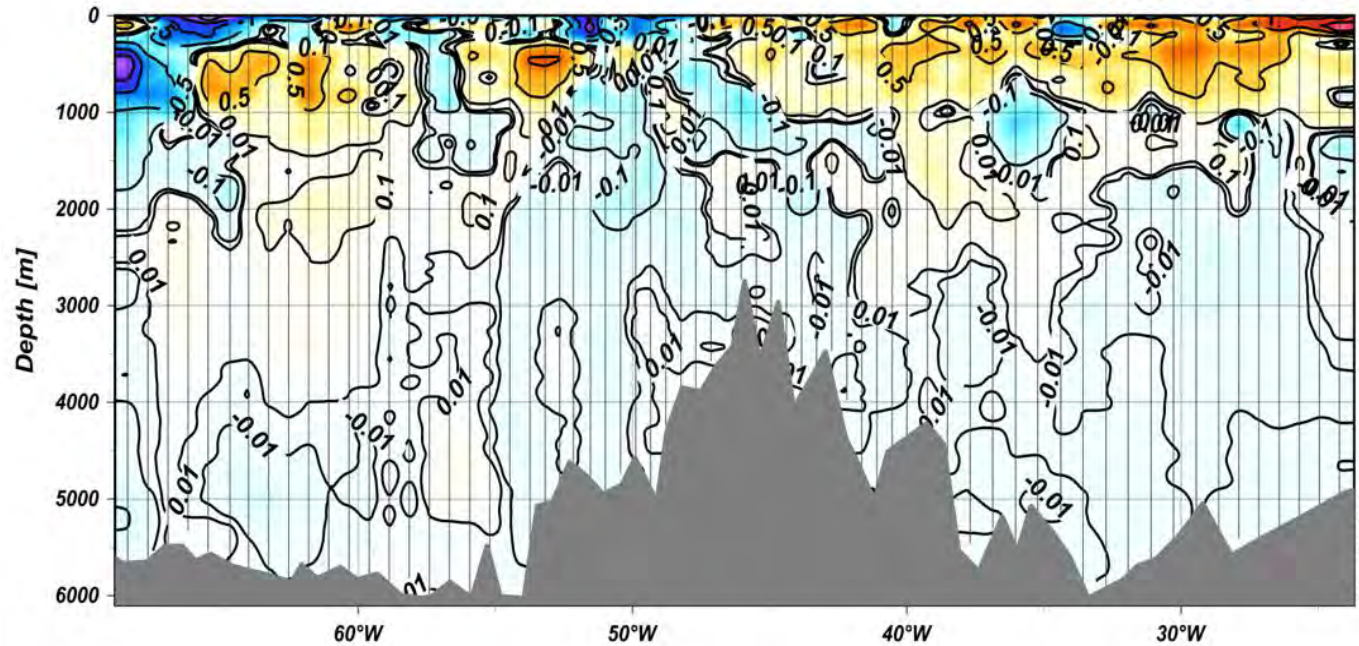
Differences

SODA 1998-1992
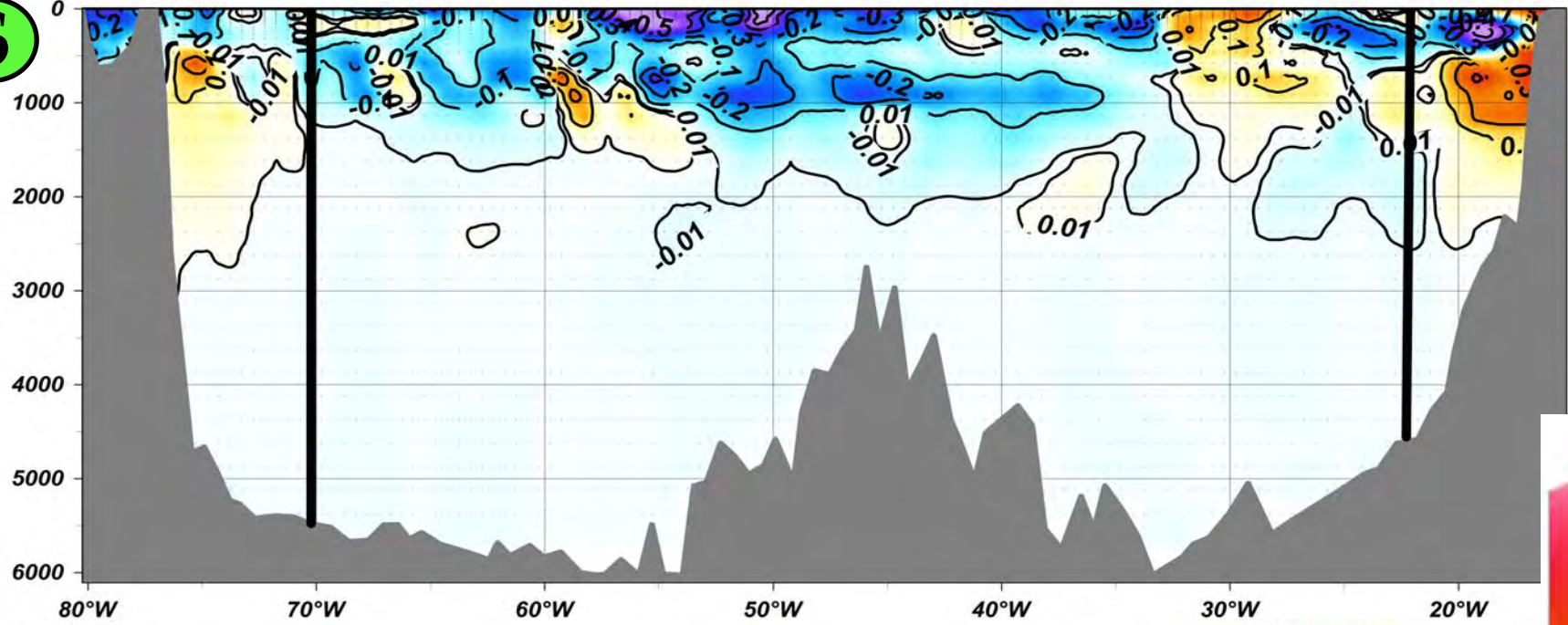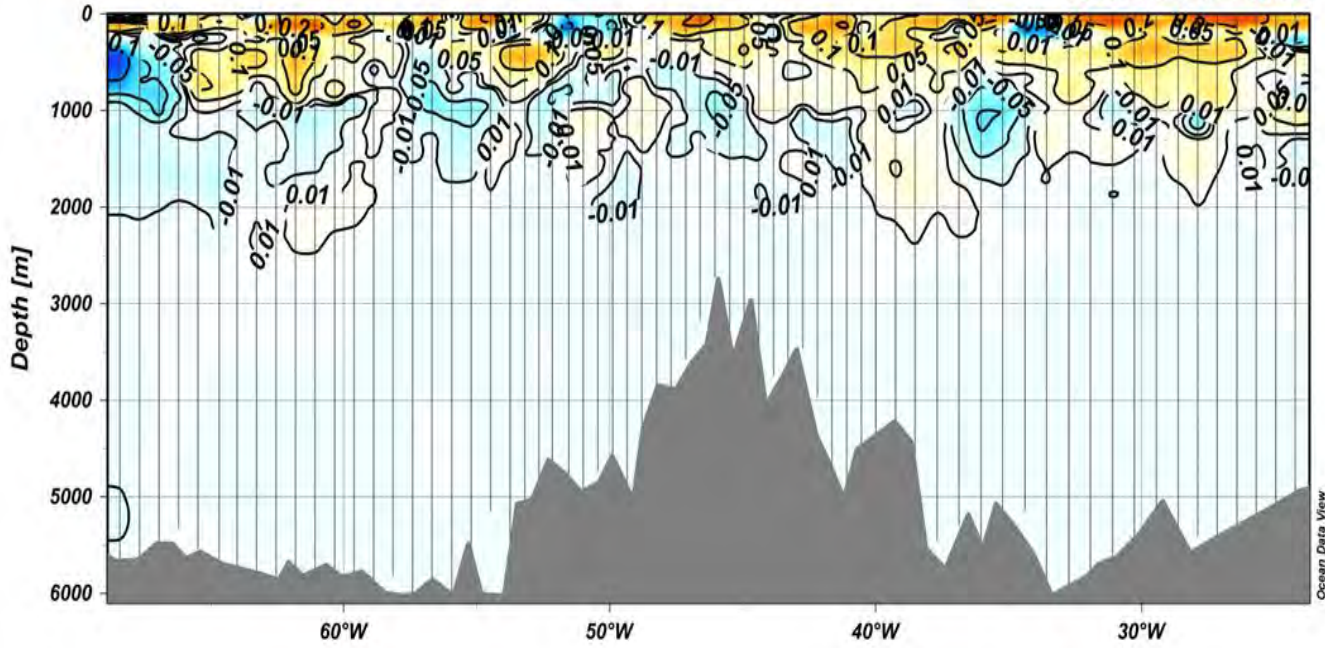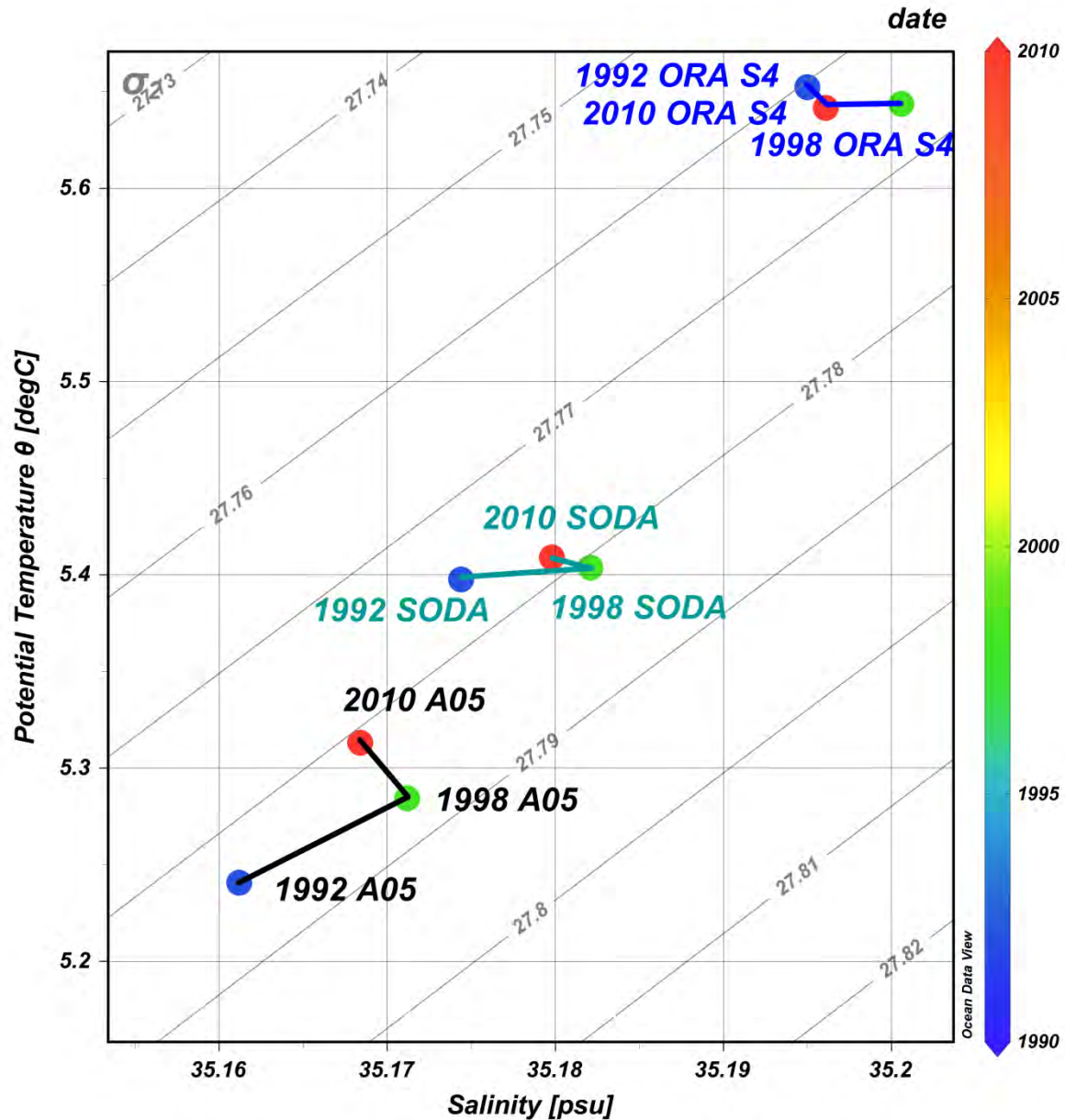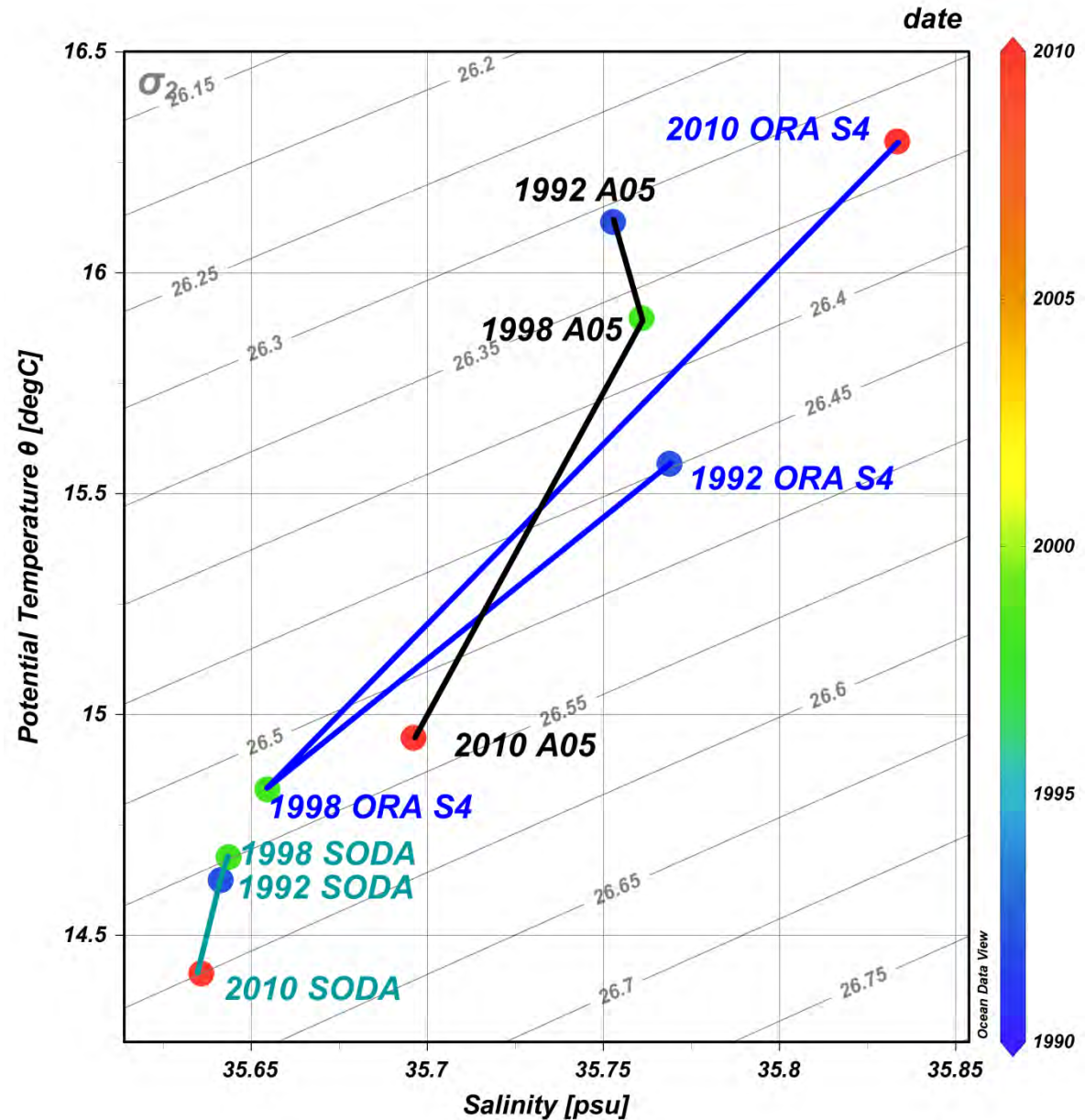
A05 1998-1992

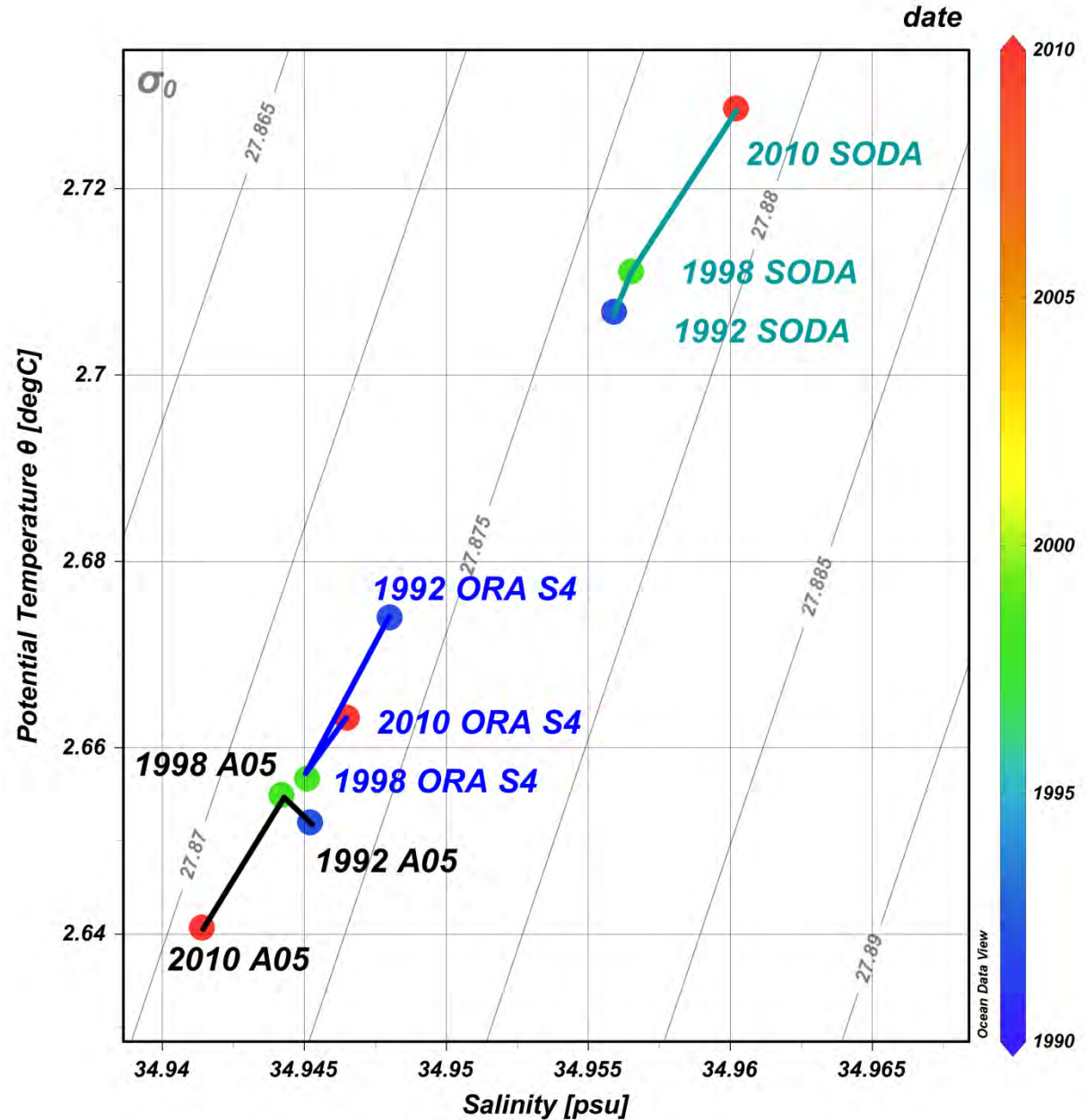# Differences
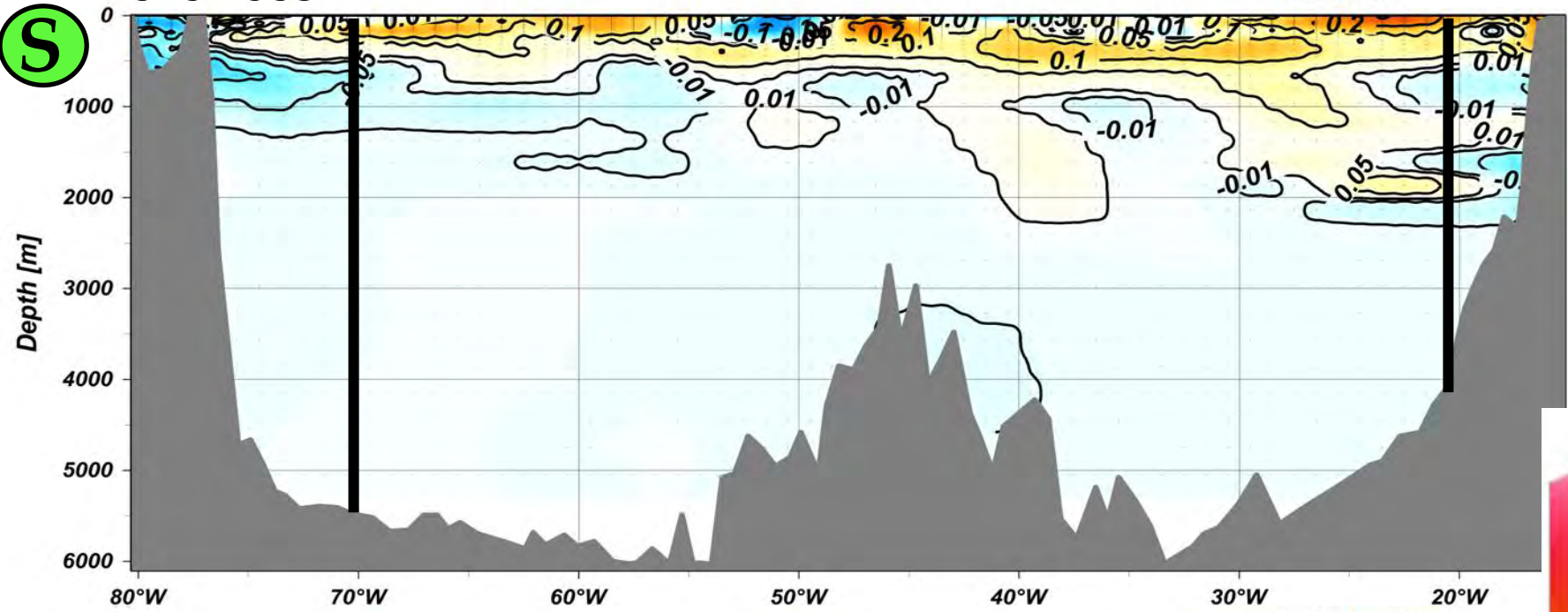
A05 1998-1992
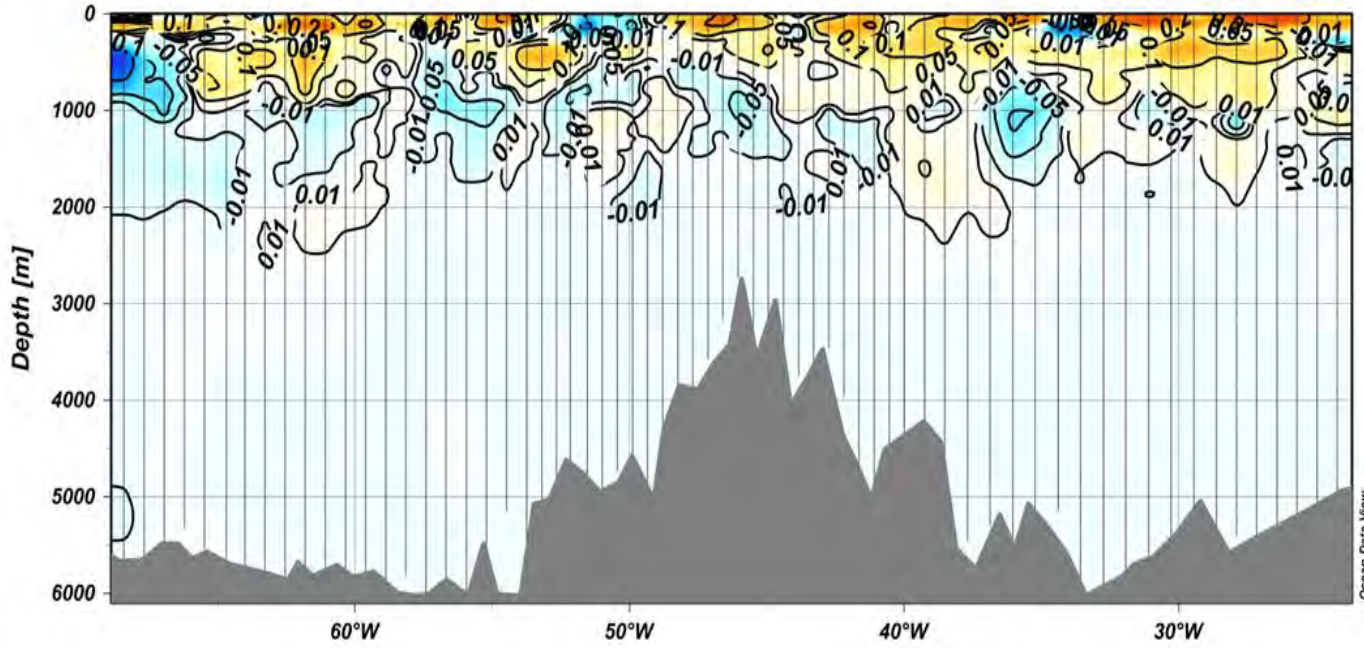
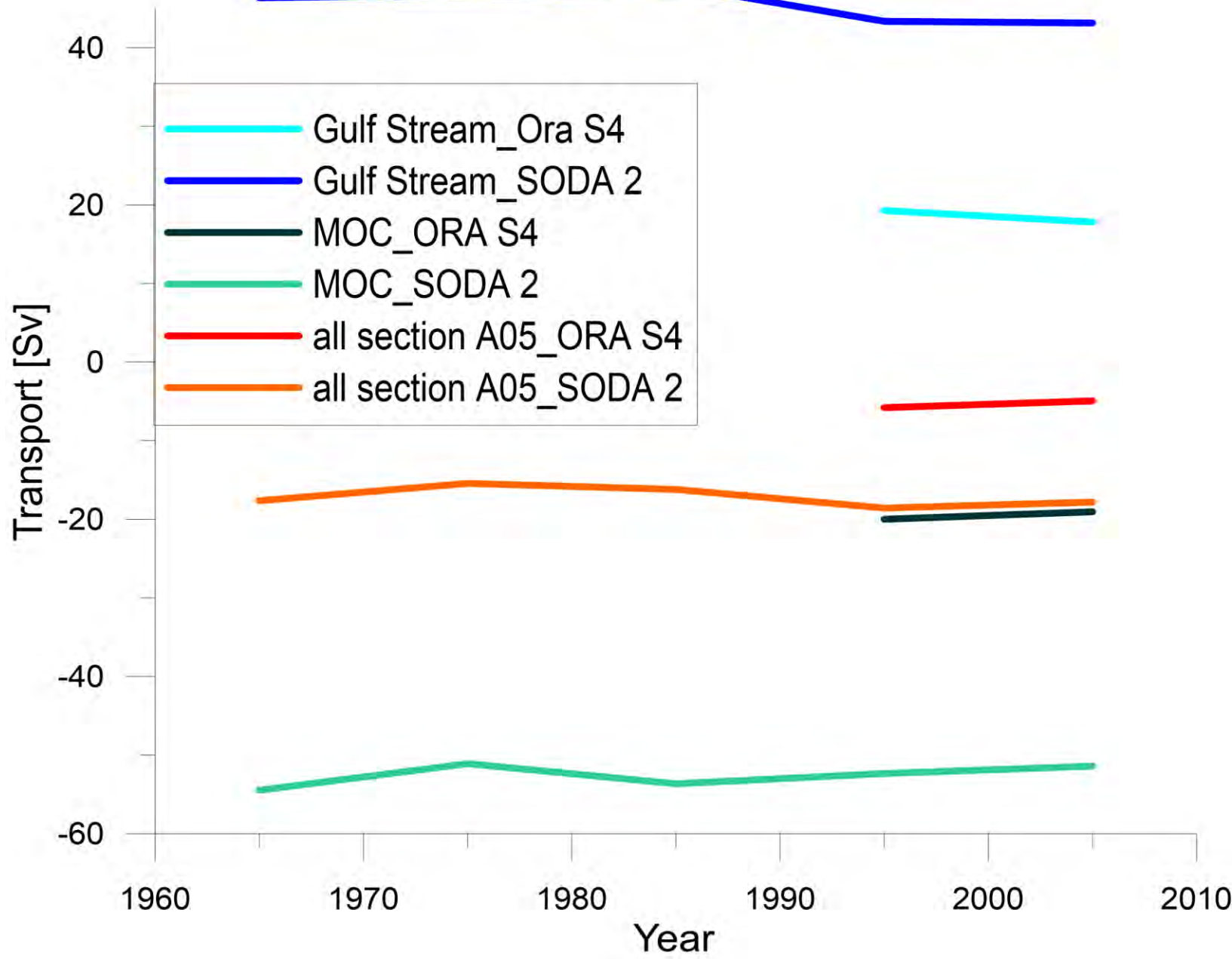# TS diagram. Comparison of the section mean real and models data

TS diagram. The same for Gulf Stream

TS diagram. The same for MOC

Decadal mean models transport

Decadal mean models heat flux
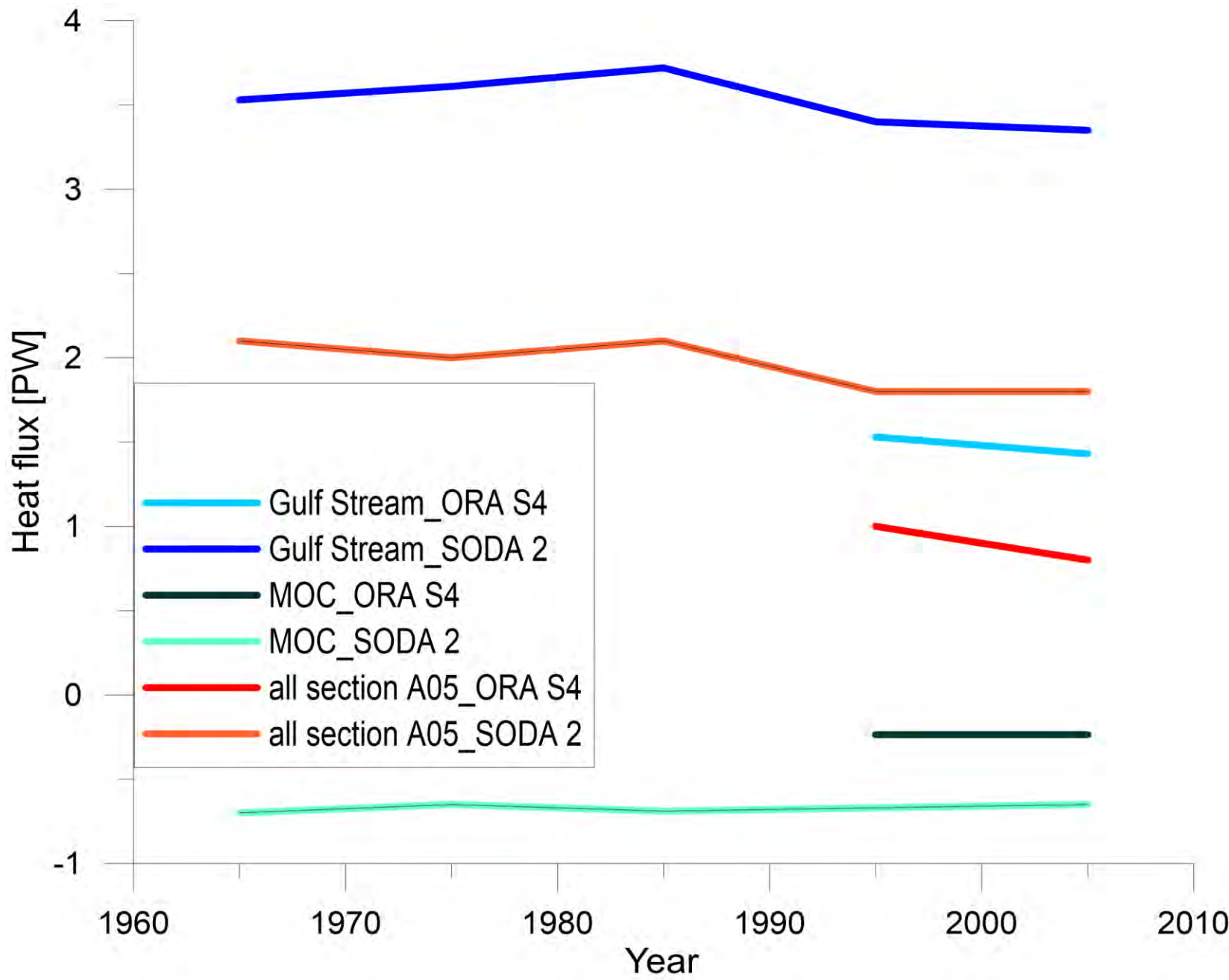
Decadal mean models water mass transport
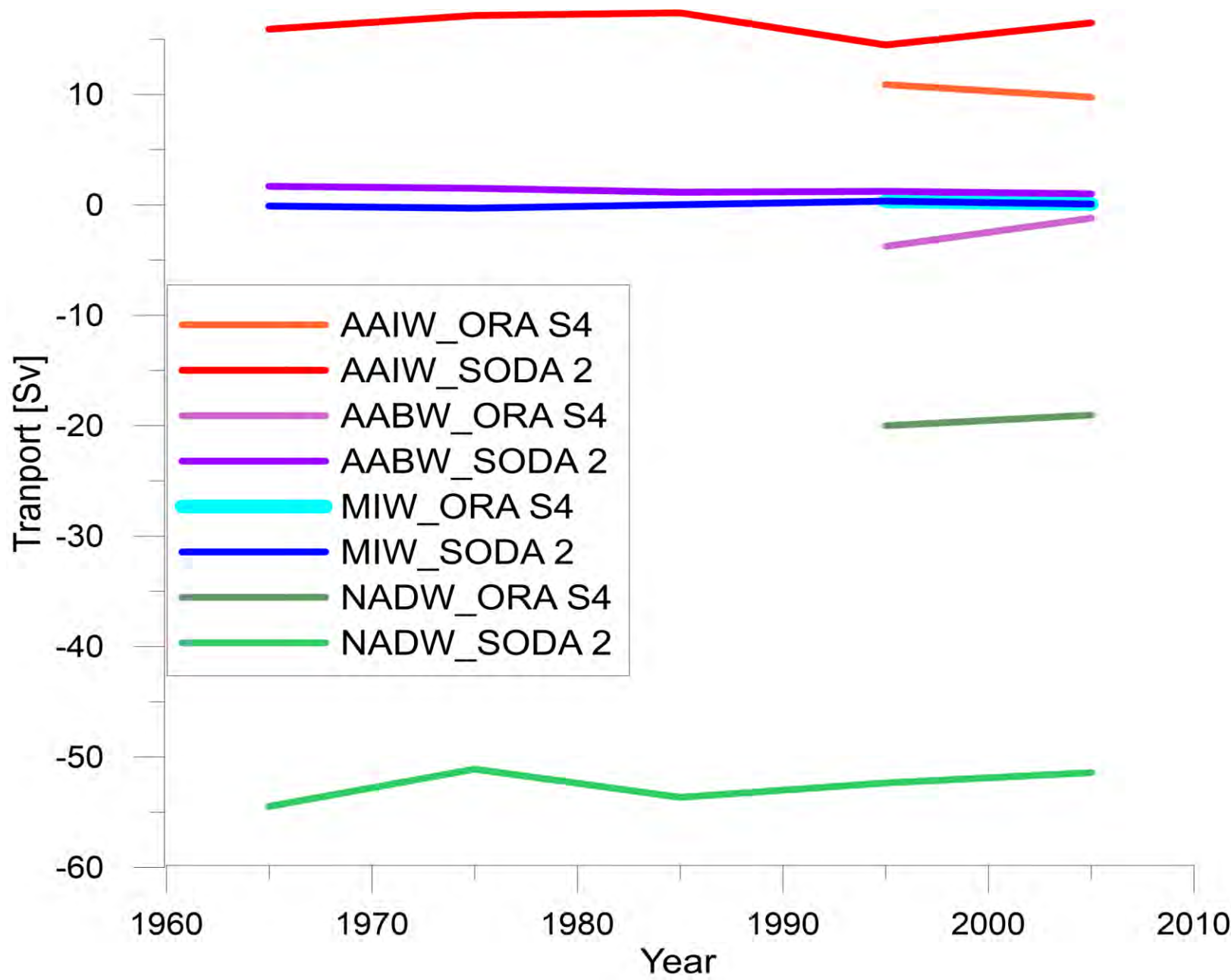
Results

- SODA 2 and ORA S4 don't reproduce real variability of water mass characteristics in the real oceanographic section in 24N
- Decadal variability of water mass transport according to models during the last 50 years doesn't exceed 5%
- Values of water mass and Gulf Stream transport calculated by models SODA 2 and ORA S4 don't correspond to each other
- The latitudinal gradient must be considered because its degree is comparable with variability

Future work

- to make the estimations for ECCO 2 model

- to estimate the same parameters for 8N, 8S, 24S WOCE sections (A06, A08, A09)

- to compute volume mean characteristics of main Atlantic water mass

- to run Princeton Ocean Model (POM)

Test run of Princeton ocean model

Fl	Bag		doMAR	zaMAR		total	pT		
-1,36	-0,05	0,10	0,11	-0,33	-0,50	-0,09	uWNACW	-1,11	GulfS
0,30	0,15	-0,17	-0,10	-0,19	-0,30	-0,08	lWNACW	-0,11	Canar
0,35	-0,03	0,04	0,13	0,05	0,01	0,09	AAIW	0,01	MOC
0	0	0	-0,16	-0,07	0,01	-0,09	MIW	-0,02	WB_MOC
0,00	0,26	-0,07	0,00	0,01	0,02	0,00	NADW1	0,04	EB_MOC
0,00	0,27	0,04	0,00	0,03	0	0,02	NADW2	0,03	AABW
0	0	0	0	0,02	0	0,02	AABW1	0	
0	0	0,02	0,02	0	0	0,02	AABW2	0	
-1,11	2,20	0,26	0,31	0,28	0,19	0,32	total	0	

WOA 13 quarter data (POM). Smiths and Sandwell relief

The difference with real data A05
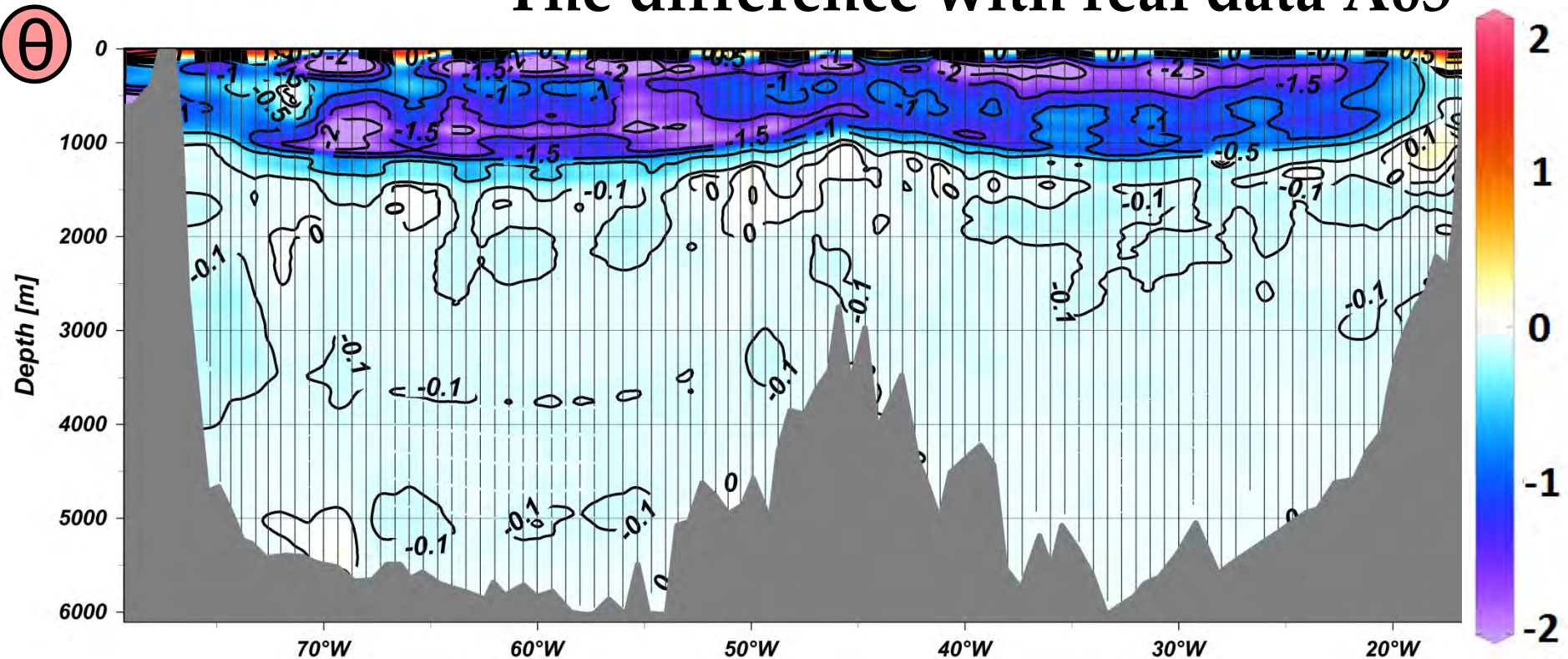
The same for salinity

Fl	Bag		doMAR	zaMAR		total	SAL		
-0,06	0,05	-0,05	-0,05	-0,09	-0,11	-0,05	uWNACW	0,03	GulfS
0,08	0,03	-0,04	-0,03	-0,05	-0,08	-0,04	lWNACW	-0,05	Canar
0,16	-0,02	-0,02	-0,01	-0,01	-0,01	-0,01	AAIW	0	MOC
0	0	0	-0,02	-0,01	0	-0,01	MIW	0	WB_MOC
0,00	0,01	0	0	0	0,01	0	NADW1	0	EB_MOC
0,00	0,02	0,01	0	0	0	0	NADW2	0	AABW
0	0	0	0,00	0,00	0	0,00	AABW1	0	
0	0	0	0,00	0,00	0	0,00	AABW2	0	
0,03	0,15	0,01	0,02	0,03	0,01	0,02	total	0	

The difference with real data A05
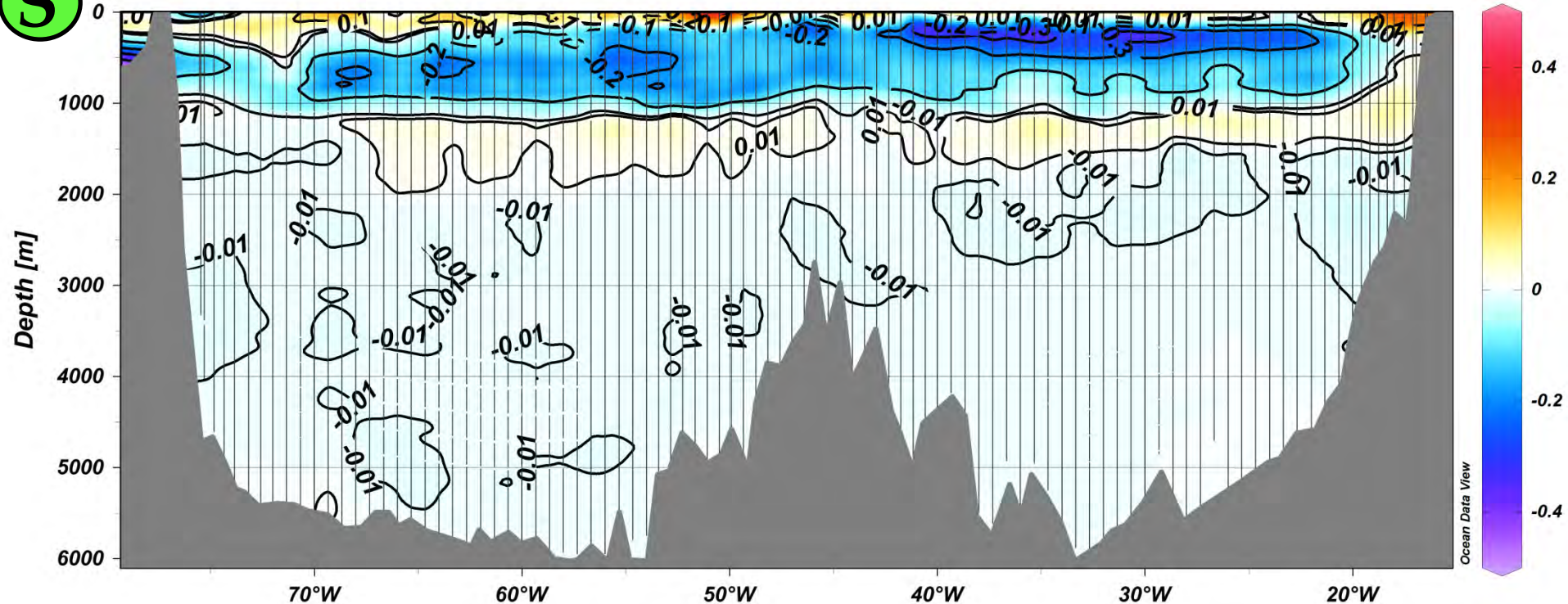
Thank you for attention!
Obrigado pela atenção!

Спасибо за внимание!