

Coordination of Forward Model - Ocean Reanalysis Intercomparisons

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MOTIVATION

Improve communication between the forward modeling and ocean reanalysis / data assimilation communities

Inform the wider user community

Analyze solutions from both and use differences (and similarities) to improve both modeling frameworks; identify robust features

Provide physical understandings of differences between inter- and intra-model frameworks

Important for:

- ocean state (particularly for representing unobserved fields, characteristics, etc.)
- mechanisms (mean, variability, trends)
- initialization of decadal predictions
- model improvements

Coordinated Ocean-ice Reference Experiments phase II (CORE-II)

An experimental protocol for ocean - ice coupled simulations forced with inter-annually varying atmospheric data sets for the 1948-2007 period (Large and Yeager 2009). This effort is coordinated by the CLIVAR Ocean Model Development Panel (OMDP).

These hindcast simulations provide a framework for

- evaluation, understanding, and improvement of ocean models,
- investigation of mechanisms for seasonal, inter-annual, and decadal variability,
- evaluation of robustness of mechanisms across models,
- complementing data assimilation in bridging observations and modeling and in providing ocean initial conditions for climate (decadal) prediction simulations.

CORE-II PROTOCOL

- The models are integrated for a minimum of 300 years, corresponding to 5 cycles of the 60-year forcing period.
- After an assessment of degree of equilibrium achieved, the solutions from the last cycle are analyzed.
- Participants are free in their choices of ocean parameterizations, their parameter values, surface freshwater / salt flux treatments, and sea-ice models.

The CORE datasets are periodically updated (currently through 2009) and collaboratively supported by NCAR and GFDL. They can be accessed via

- WGOMD CORE web pages

Participating groups (20+ models):

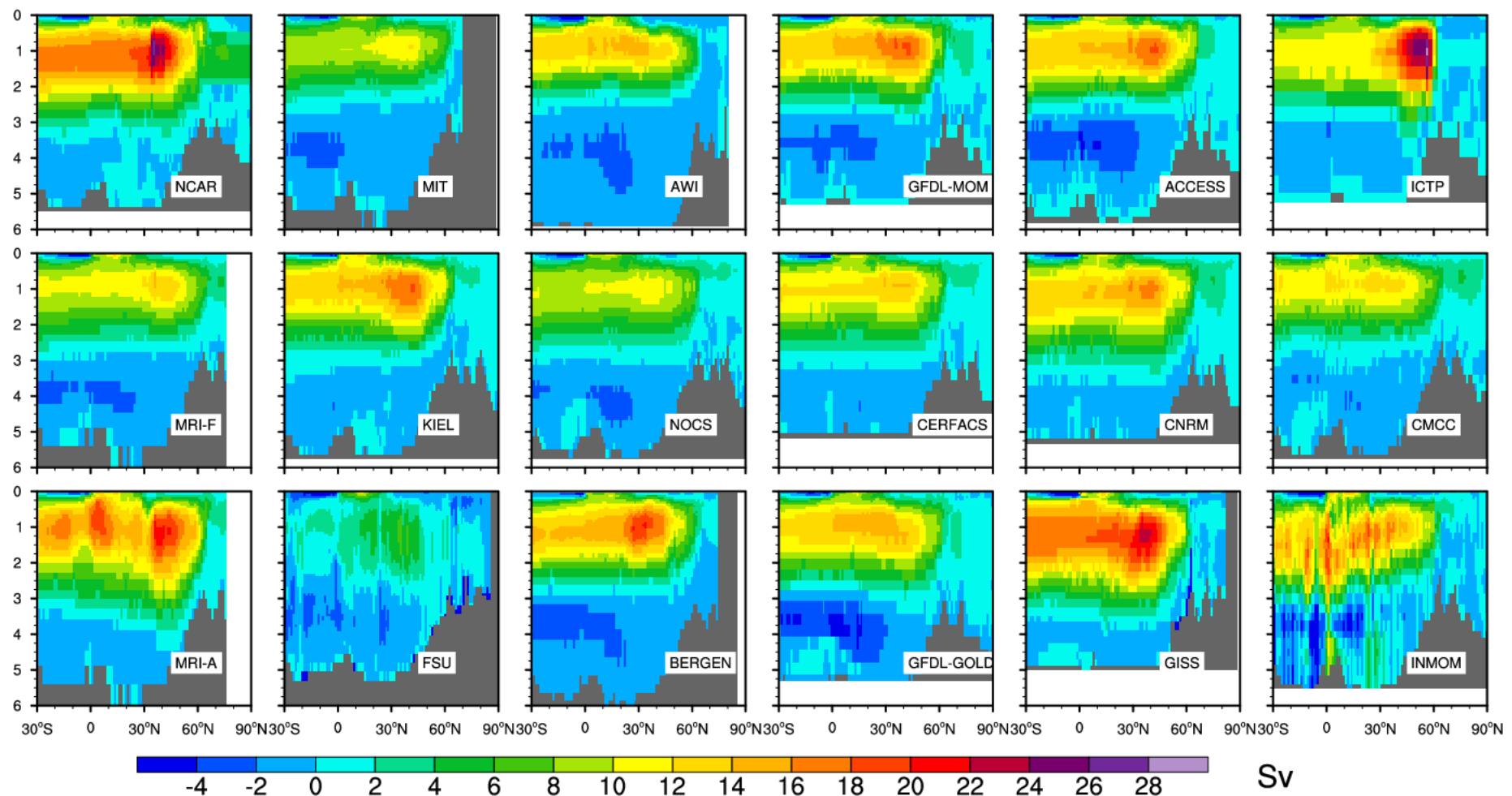
- Australia: CSIRO (ACCESS)
- France: CERFACS, CNRM
- Germany: AWI, IfM-GEOMAR (KIEL)
- Italy: CMCC, ICTP
- Japan: MRI (free, DA)
- Norway: U. Bergen
- Russia: RAS (INMOM)
- UK: NOCS
- USA: FSU (2), GFDL-GOLD, GFDL-MOM (2), MIT,
NASA GISS (2), NCAR

Level, isopycnal, hybrid, mass, and sigma coordinates;
unstructured finite element ocean model; mostly nominal 1°
horizontal resolutions

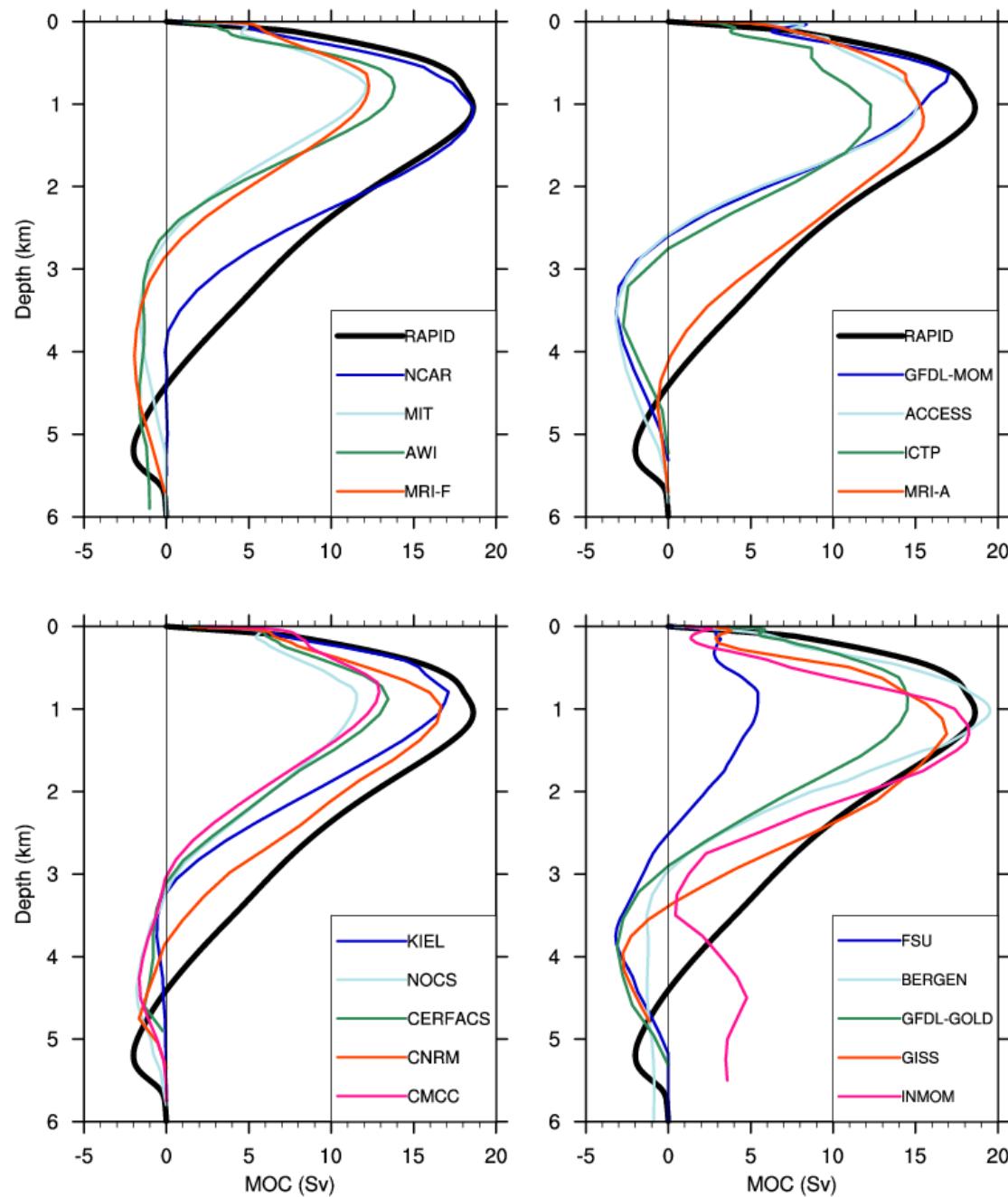
Manuscripts published, submitted, or in preparation (CORE-II Special Issue of Ocean Modelling)

- North Atlantic and Atlantic meridional overturning circulation (AMOC)
Part I: Mean states (Danabasoglu & Yeager), PUBLISHED
Part II: Variability (Danabasoglu & Yeager),
- Global and regional sea level (Griffies & Yin), PUBLISHED
- Southern Ocean water masses, ventilation, and sea-ice (Downes & Farneti),
- Antarctic Circumpolar Current and Southern Ocean overturning circulation (Farneti & Downes),
- Arctic Ocean and sea-ice (Gerdes, Wang, & Drange),
- South Atlantic simulations (Farneti, Deshayes, & Treguier),
- Ocean circulation in temperature and salinity space (Nurser & Zika),
- Indian Ocean (Ravichandran, Rahaman, Harrison, Swathi, & Griffies),
- Pacific Ocean circulation and its variability (Tseng).

AMOC in depth space (1988-2007)

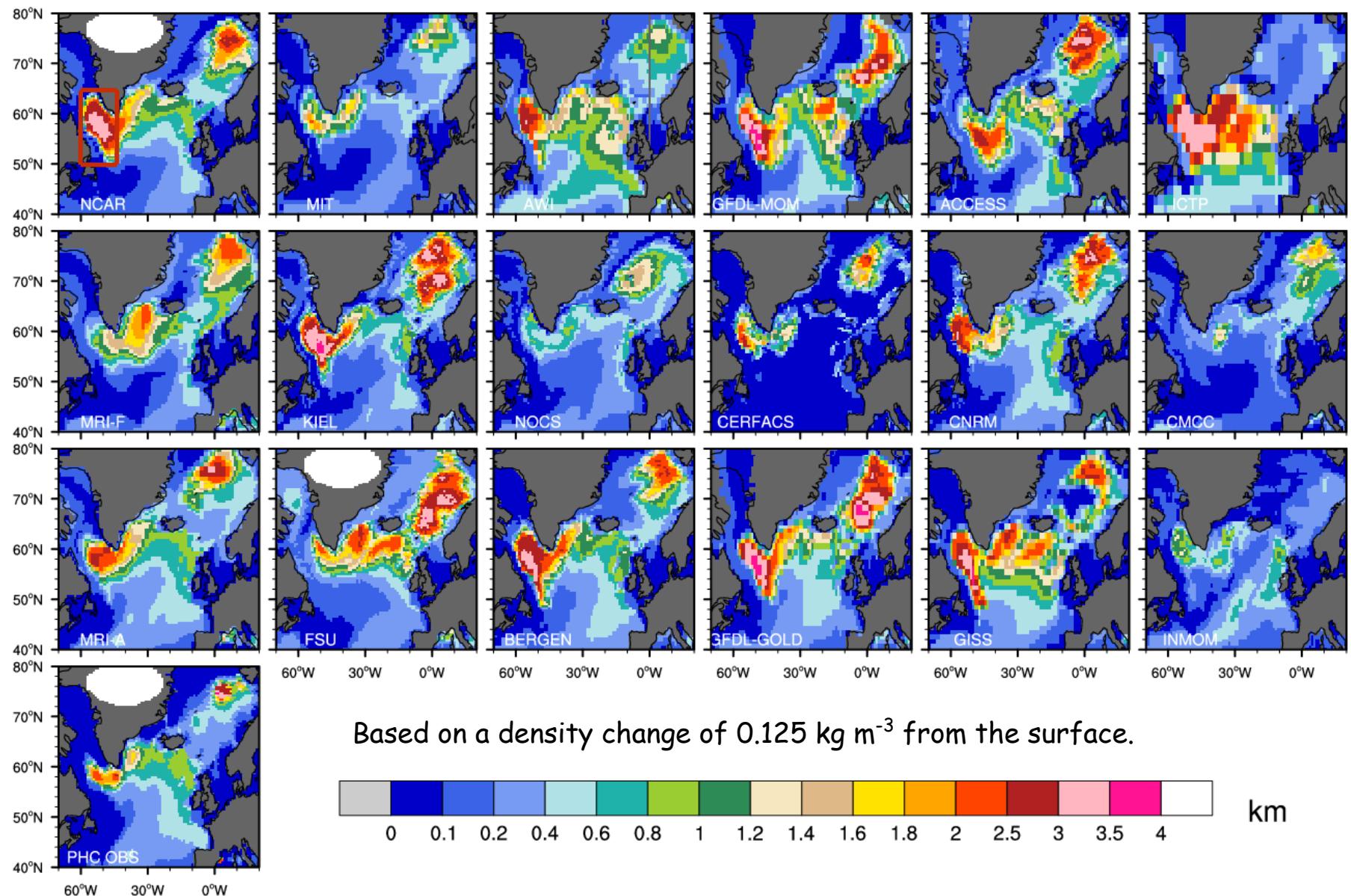


AMOC at 26.5°N (2004-2007)



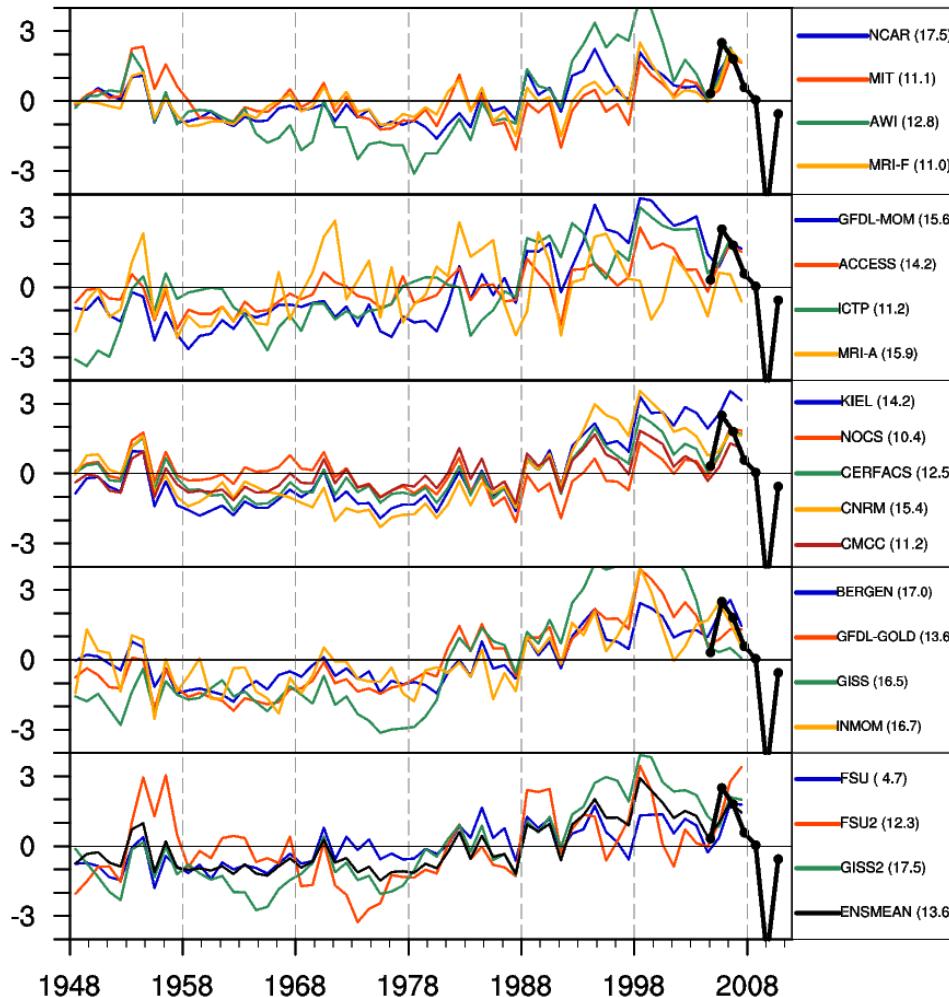
Danabasoglu et al. 2014, *Ocean Modelling*, 73, 76-107, 10.1016/j.ocemod.2013.10.005

March-Mean Mixed Layer Depth (MLD) (1988-2007)

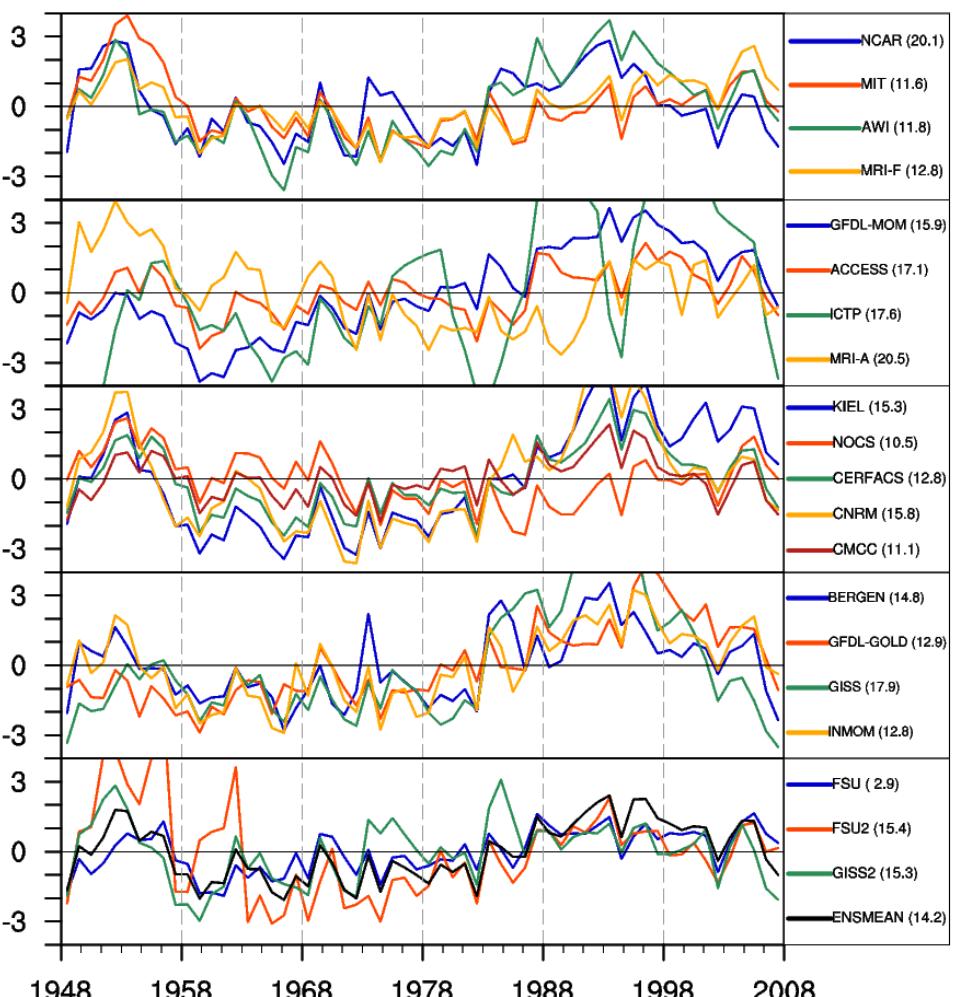


AMOC(z) Maximum Transport Anomaly Time Series for the Last Cycle (base period 1948-2007)

26.5°N

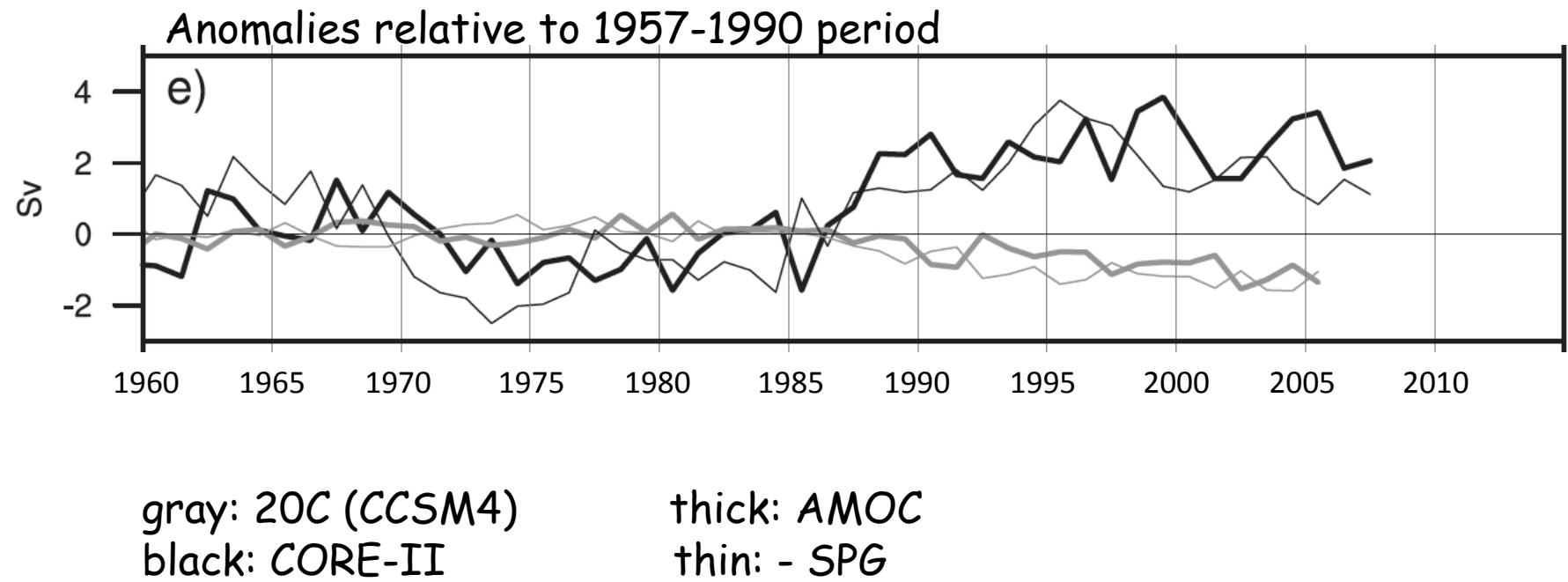


45°N

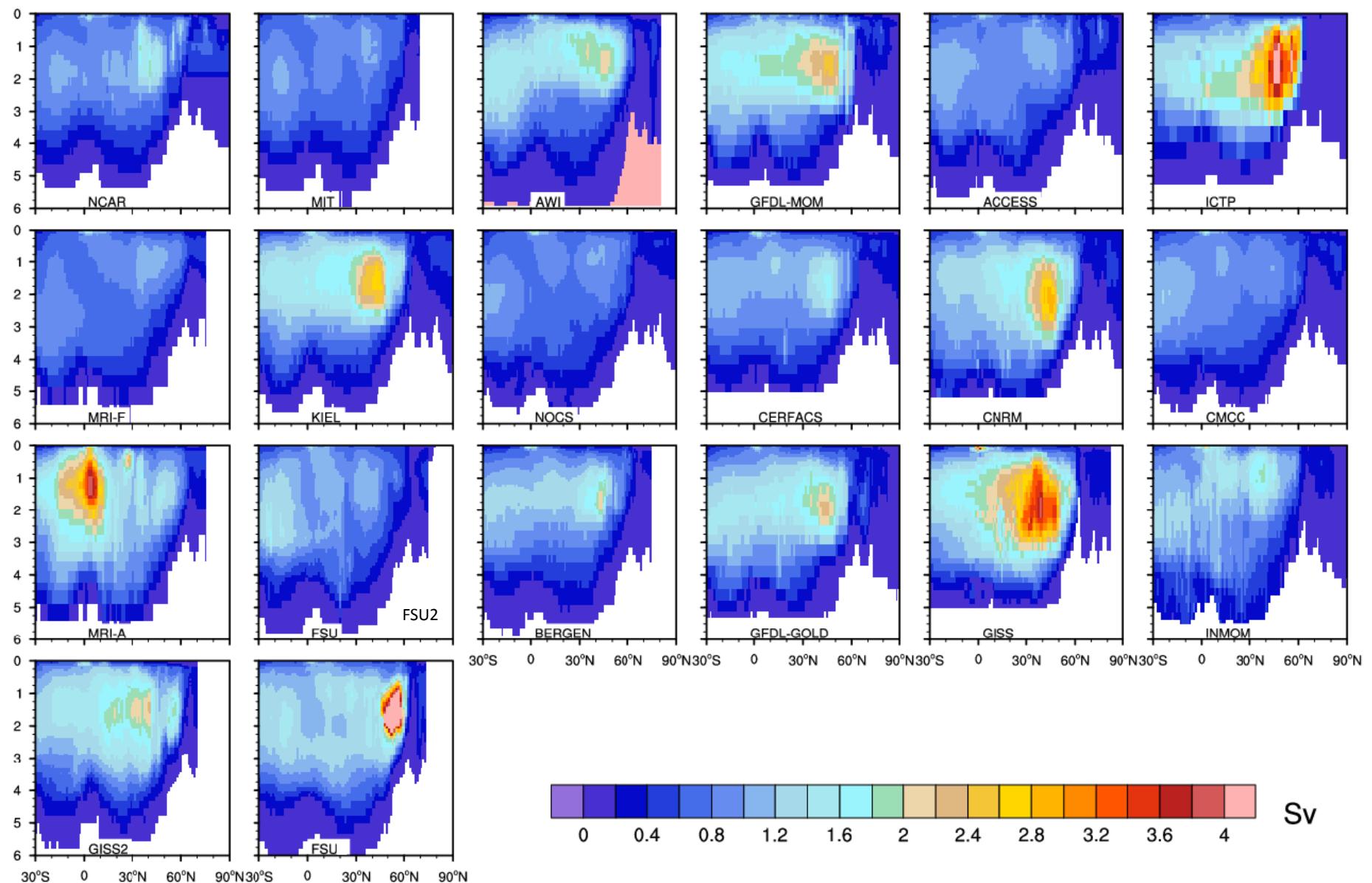


in Sv

COMPARISON OF AMOC AND SPG TRANSPORTS FROM 20C and CORE-II SIMULATIONS

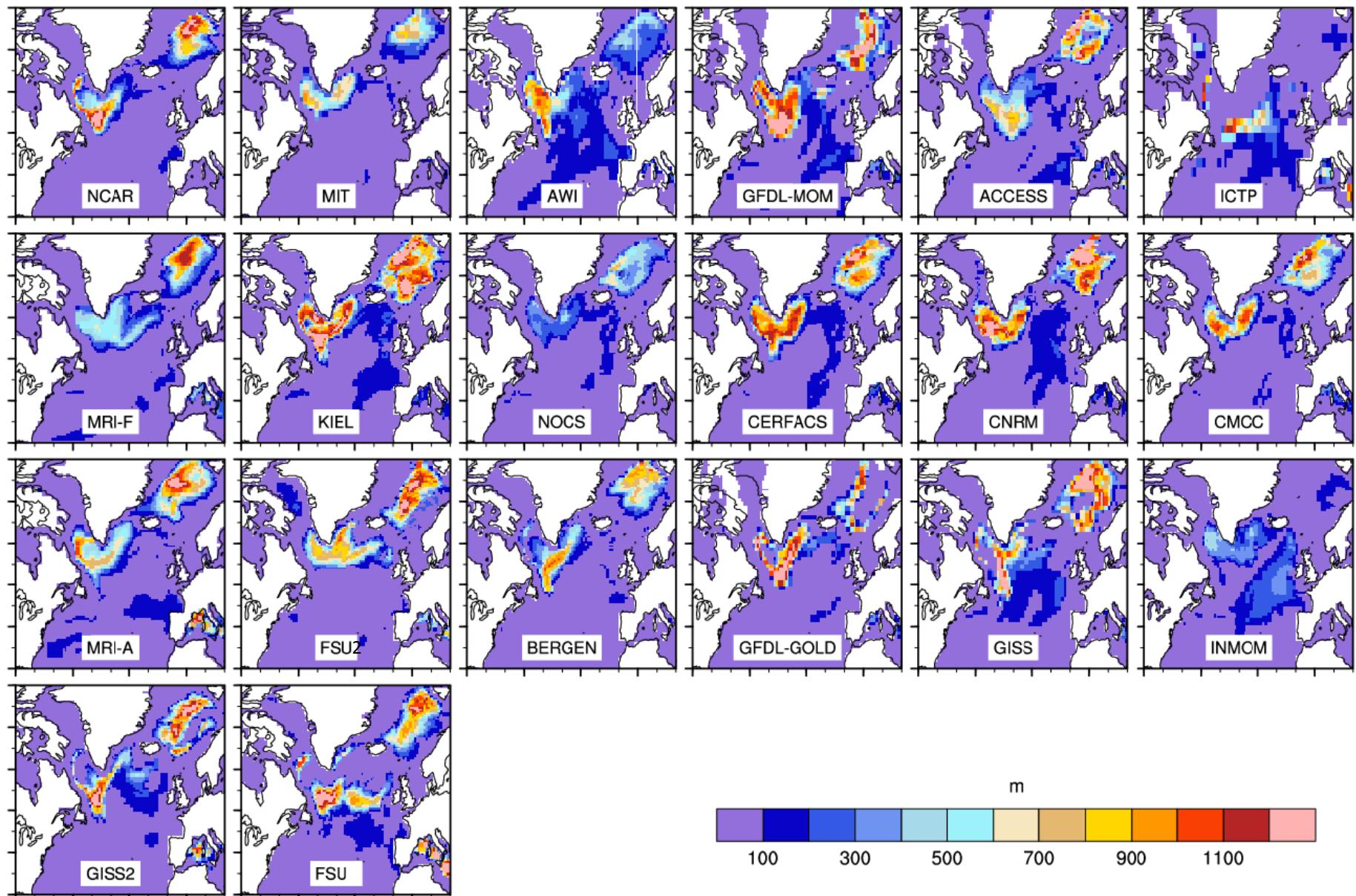


AMOC standard deviation (1958-2007)



Danabasoglu et al. 2014b (in preparation)

March-Mean MLD Standard Deviation (1958-2007)



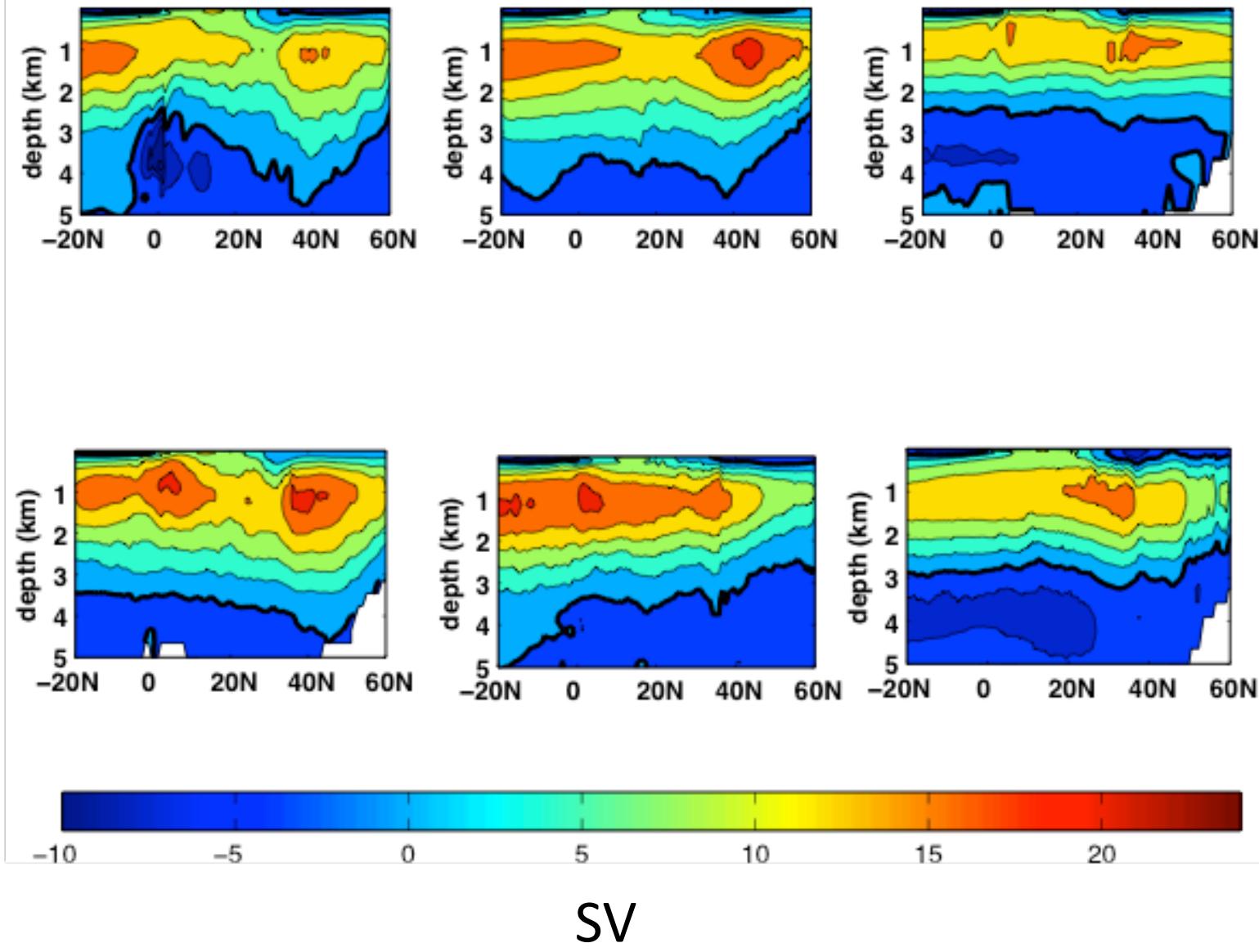
Inter-comparison of historical AMOC reconstruction in a set of ocean synthesis products

Preliminary results compiled on 7/8/2014

The following slides show some basic AMOC time-mean and variability characteristics for six ocean synthesis products. (Only products that extend to 1960 or earlier are included here). All of these products make use of available ocean observing networks to create their reanalysis; all include in situ TEMP and SALT observations -- some include satellite SST and altimetry.

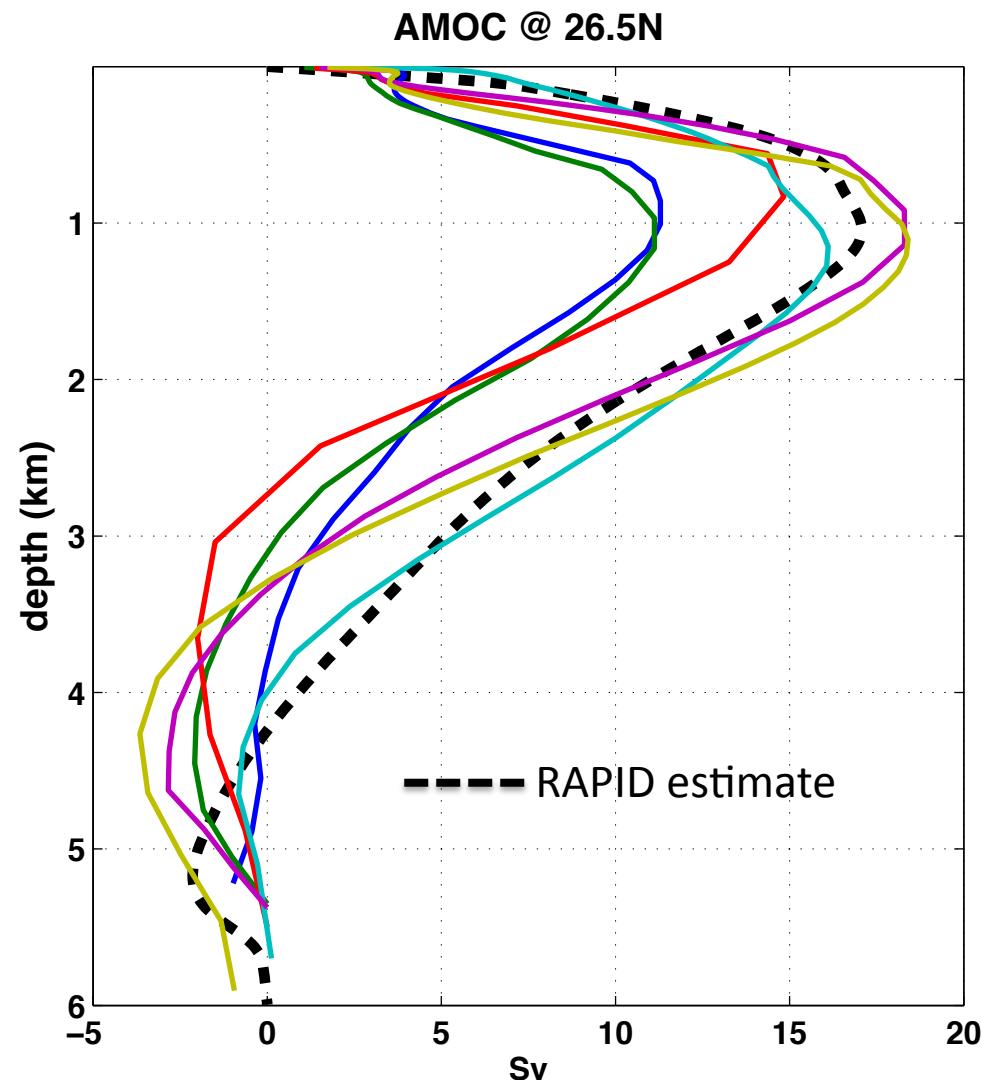
Note: participating groups are note identified.

Time mean AMOC from 1960-present

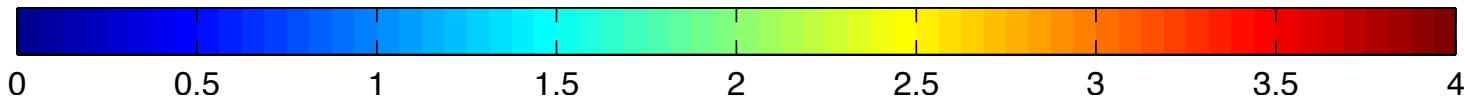
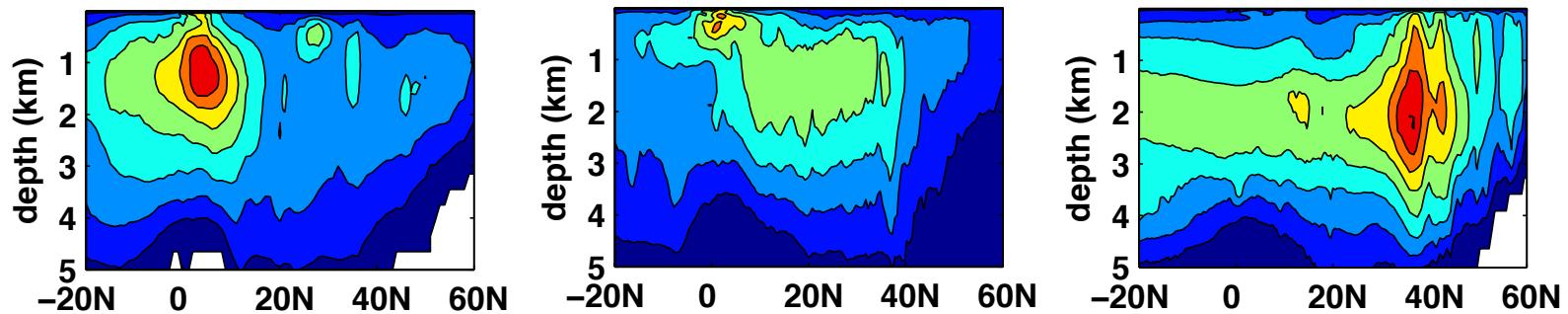
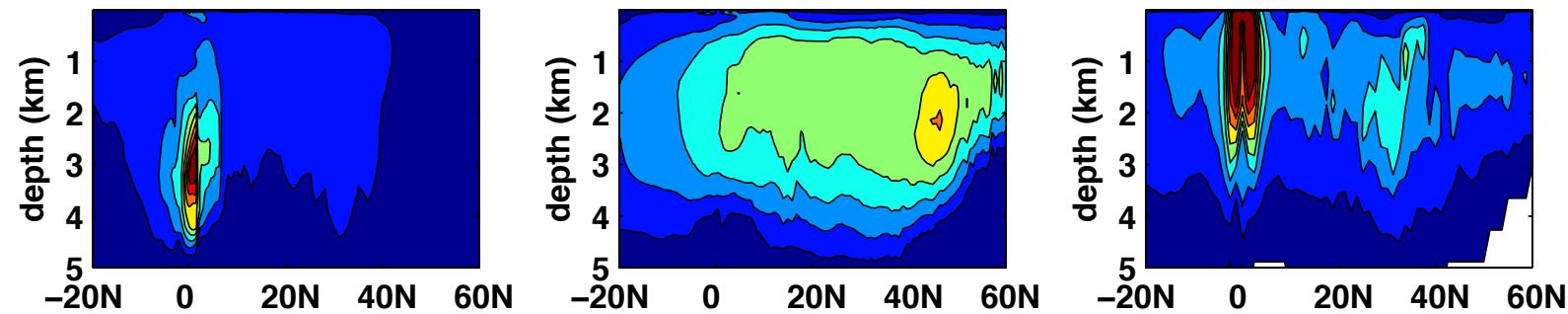


Comparison to RAPID estimates

time means from Jan 2005 – present

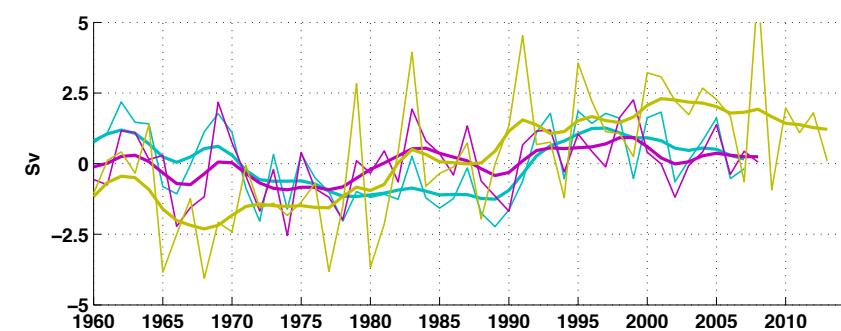
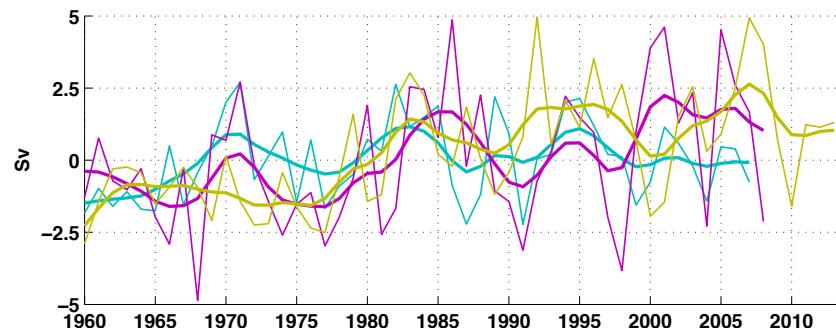
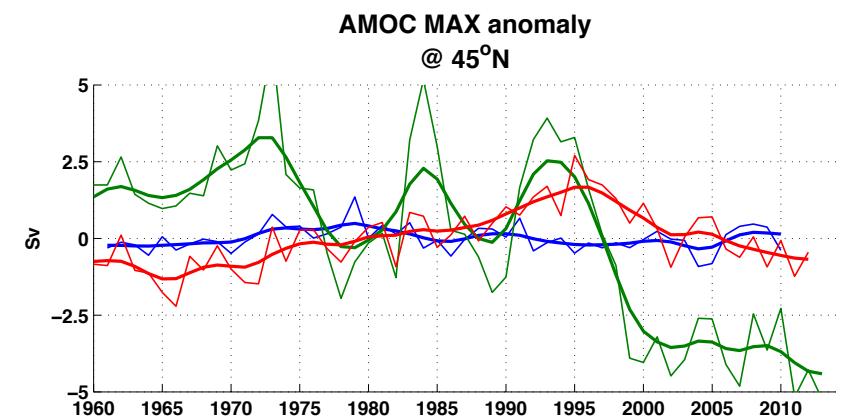
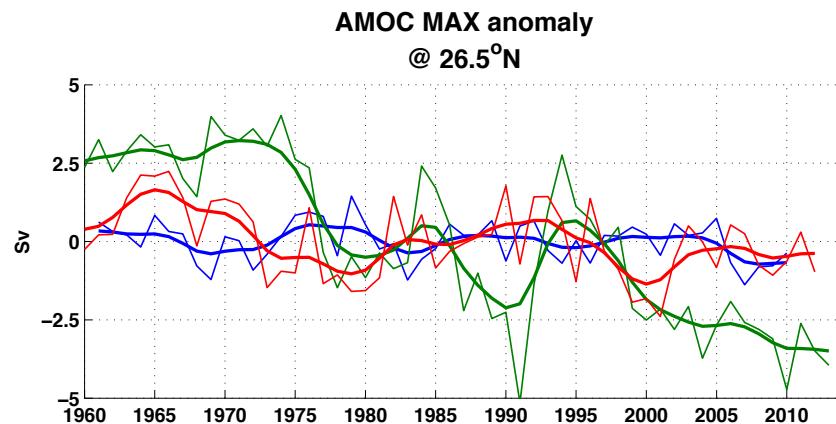


Standard deviation of AMOC from 1960-present (annual and longer timescales)



SV

Comparison of low-frequency AMOC variability at 26.5 and 45N. (anomalies relative to 1960 – present)



Data needs for inter-comparison

- Monthly mean **AMOC** (lat/depth)
from 1960-present
- Monthly mean **TEMP, SALT, DENSITY** (3-D)
from 1960- present
- Monthly mean **mixed layer depth** (2-D)
from 1960-present
- Monthly mean **atm surface forcing** (2-D)
from 1960-present

Sea Surface Temperature EOF1 (1958-2007)

