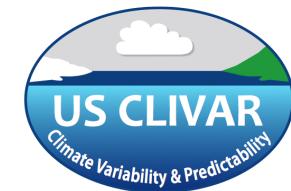




Coordinated Ocean-ice Reference Experiments phase II (CORE-II)



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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 Working Group on Ocean Model Development (WGOMD) - new name **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):

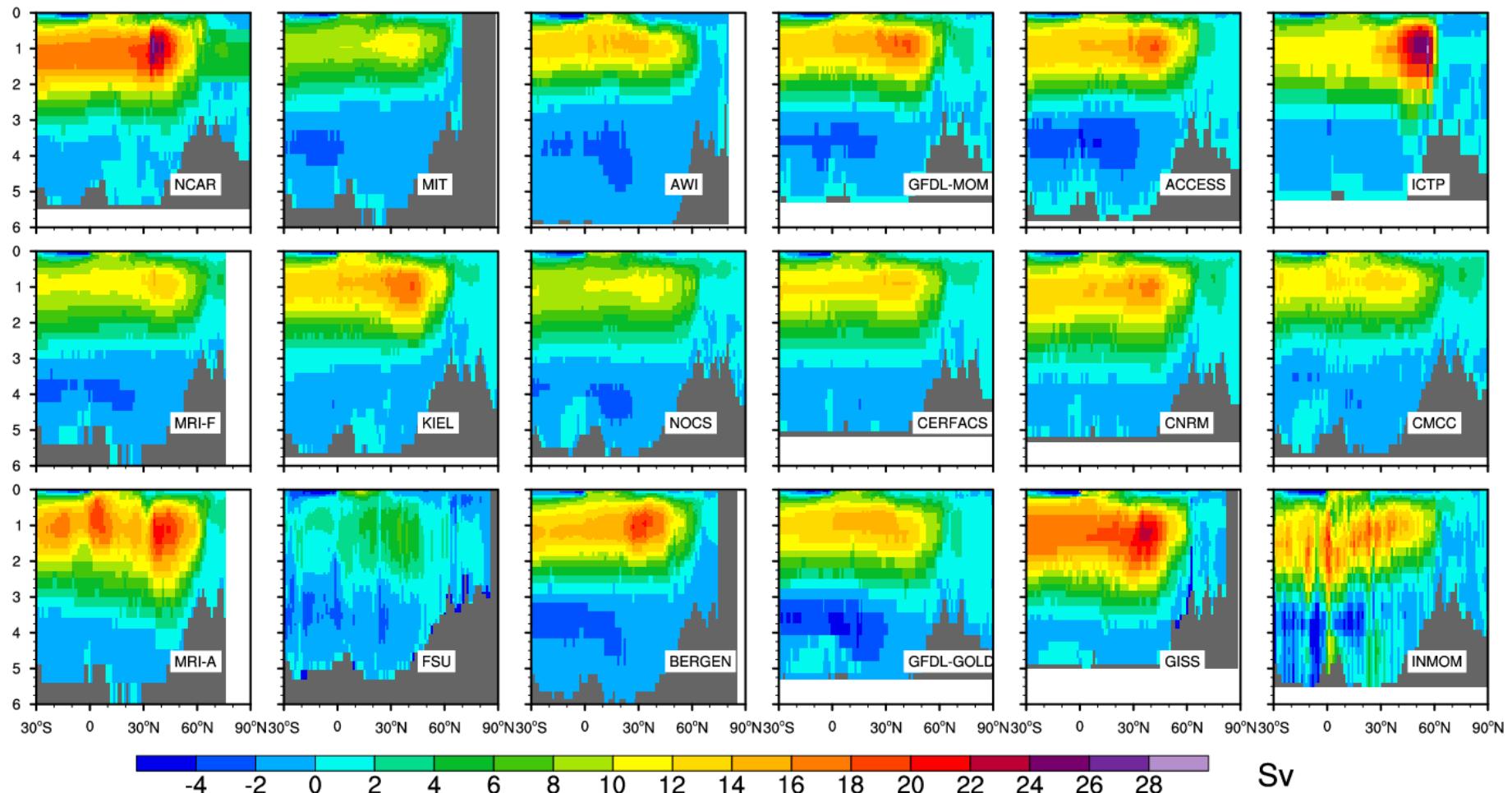
- Australia: CSIRO (ACCESS)
- France: CERFACS, CNRM
- Germany: AWI, IfM-GEOMAR (KIEL)
- Italy: CMCC, ICTP
- Japan: MRI (free, DA)
- Norway: U. Bergen
- Russia: RAS (INMOM)
- UK: NOCS
- USA: FSU (2), GFDL-GOLD, GFDL-MOM, MIT,
NASA GISS (2), NCAR

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

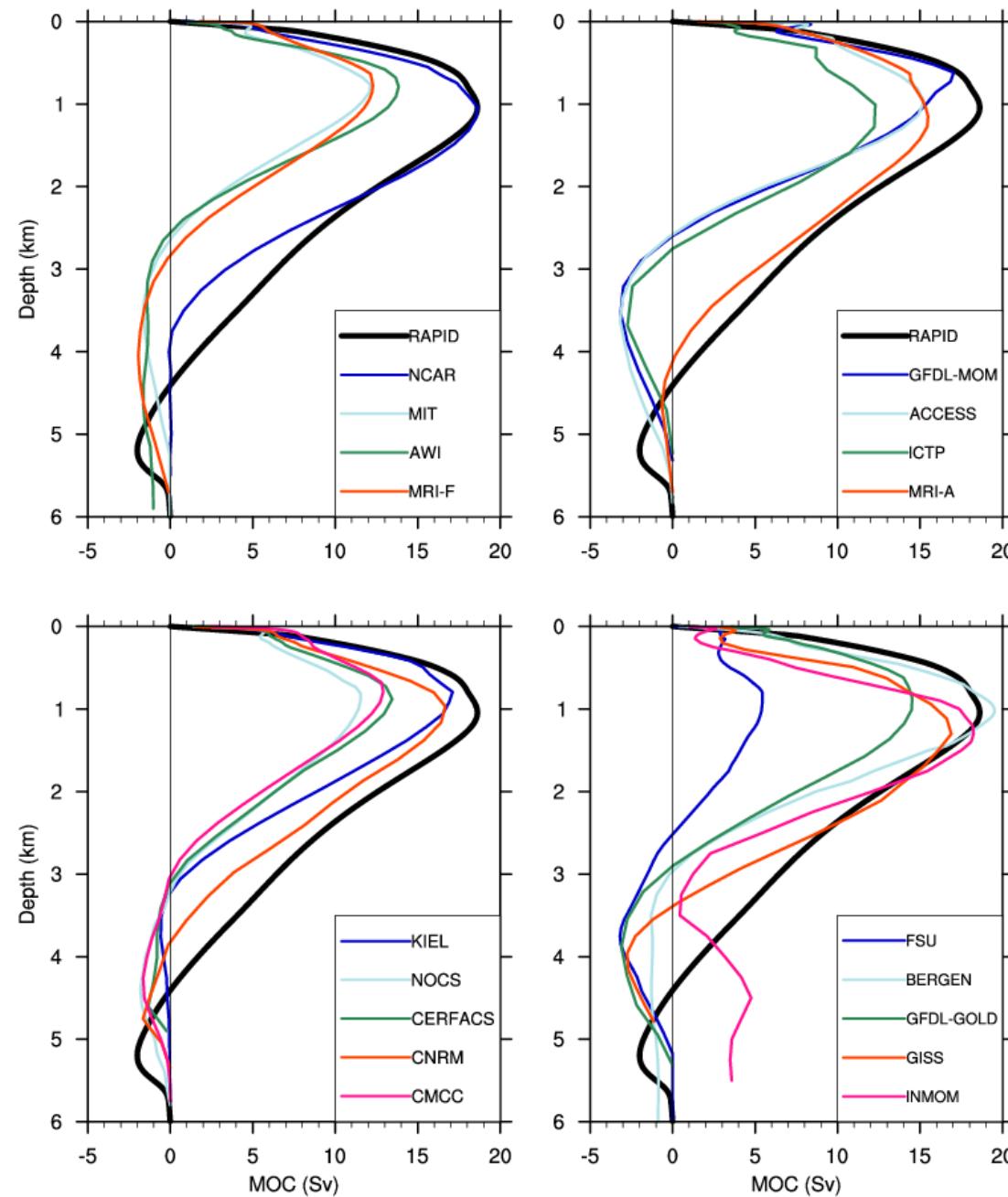
Manuscripts published, submitted, or in preparation
(CORE-II Special Issue of Ocean Modelling)

- 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)

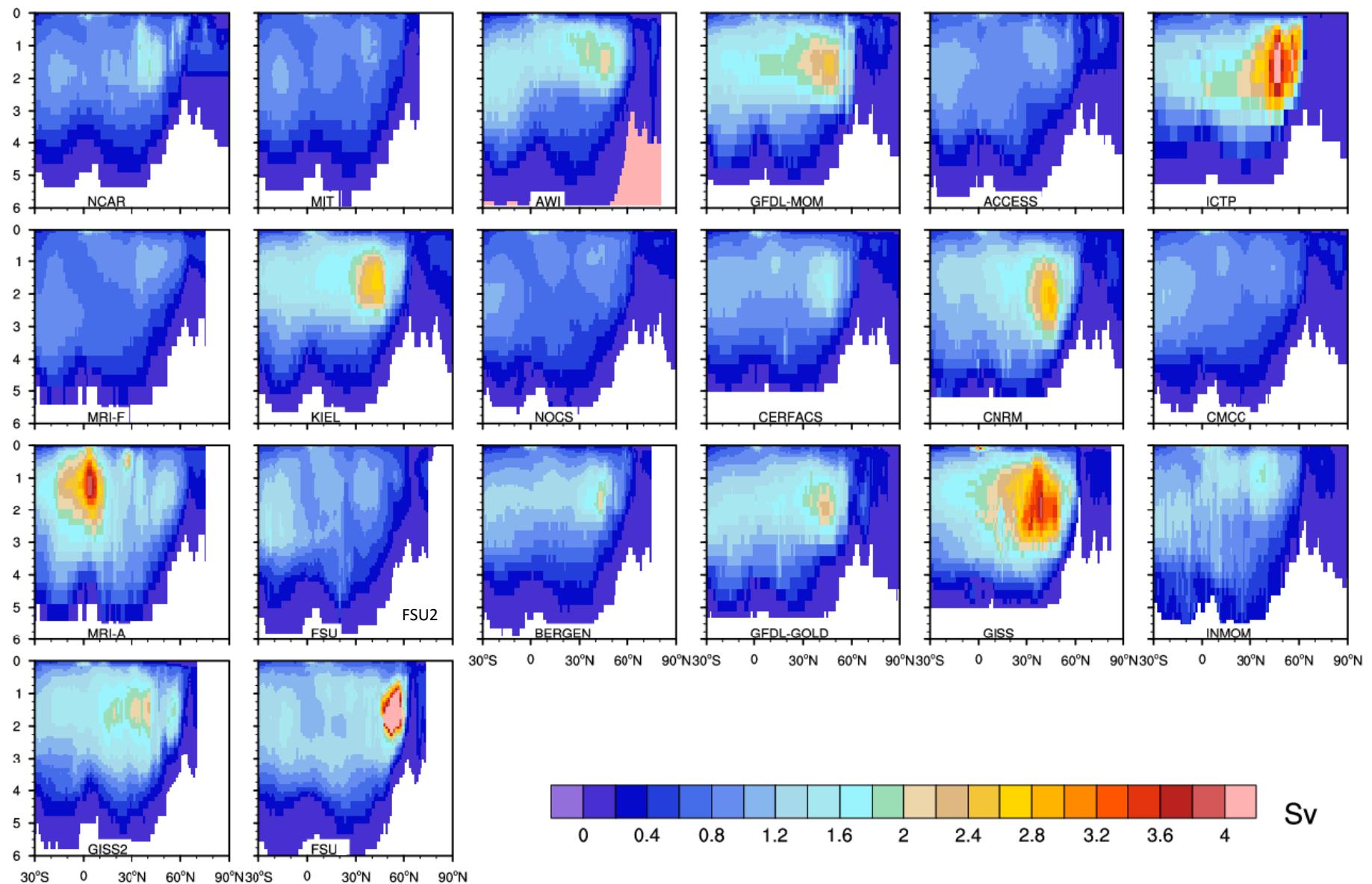


AMOC at 26.5°N (2004-2007)



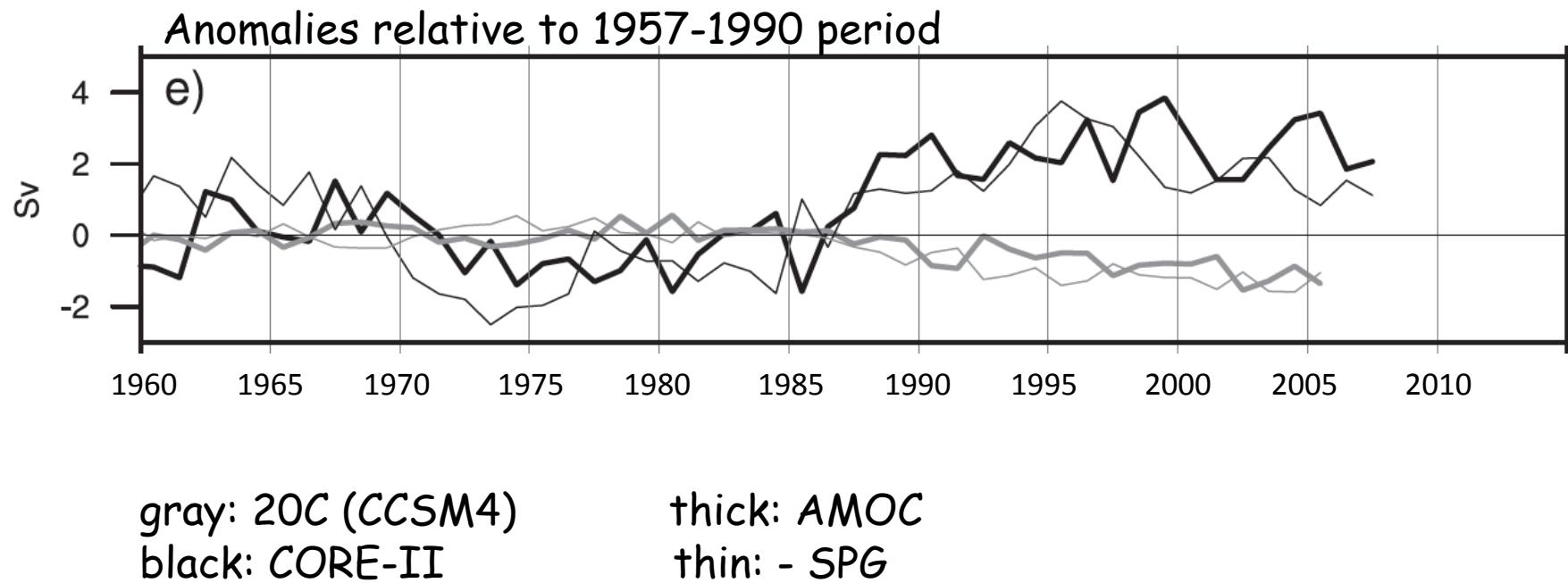
Danabasoglu et al. 2014, *Ocean Modelling*, 73, 76-107, 10.1016/j.ocemod.2013.10.005

AMOC standard deviation (1958-2007)

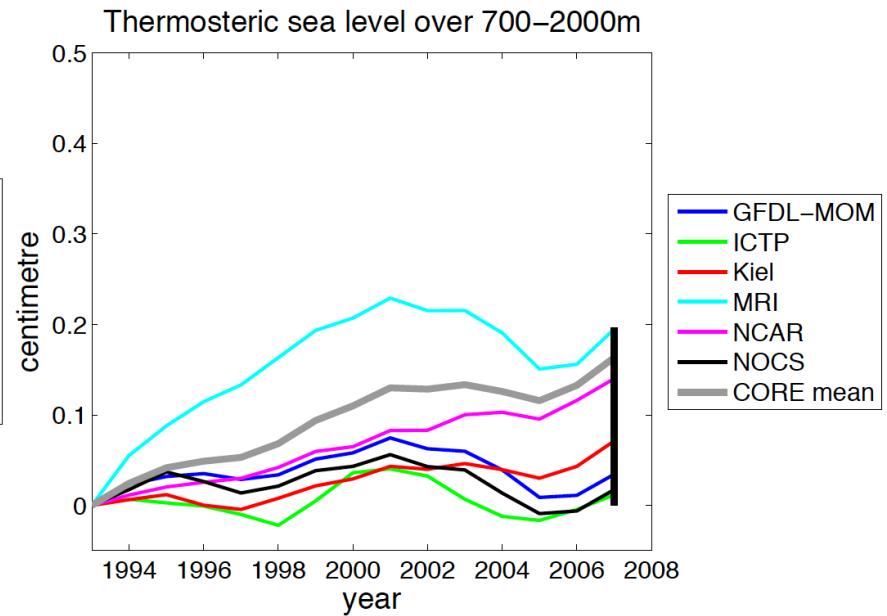
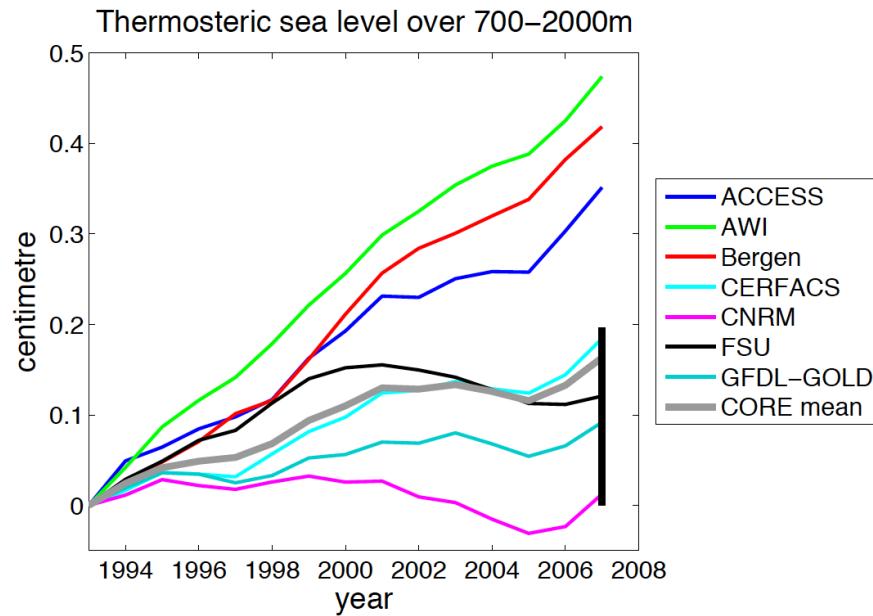


Danabasoglu et al. 2014b (in preparation)

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

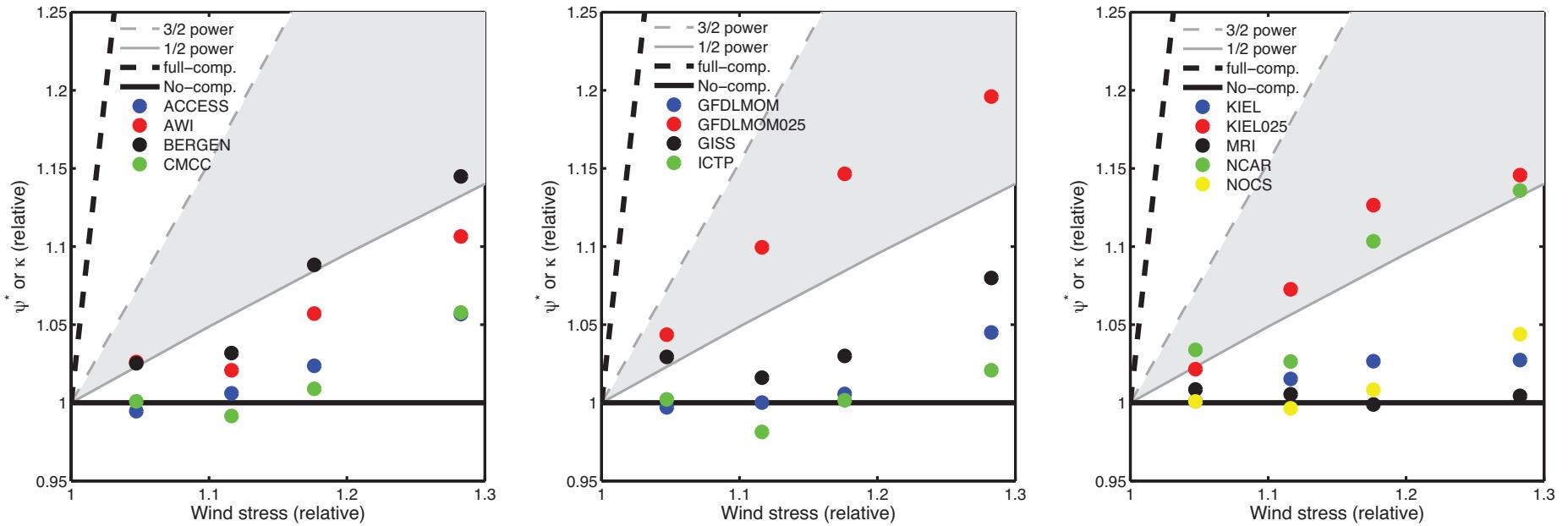


Time series of thermosteric sea level



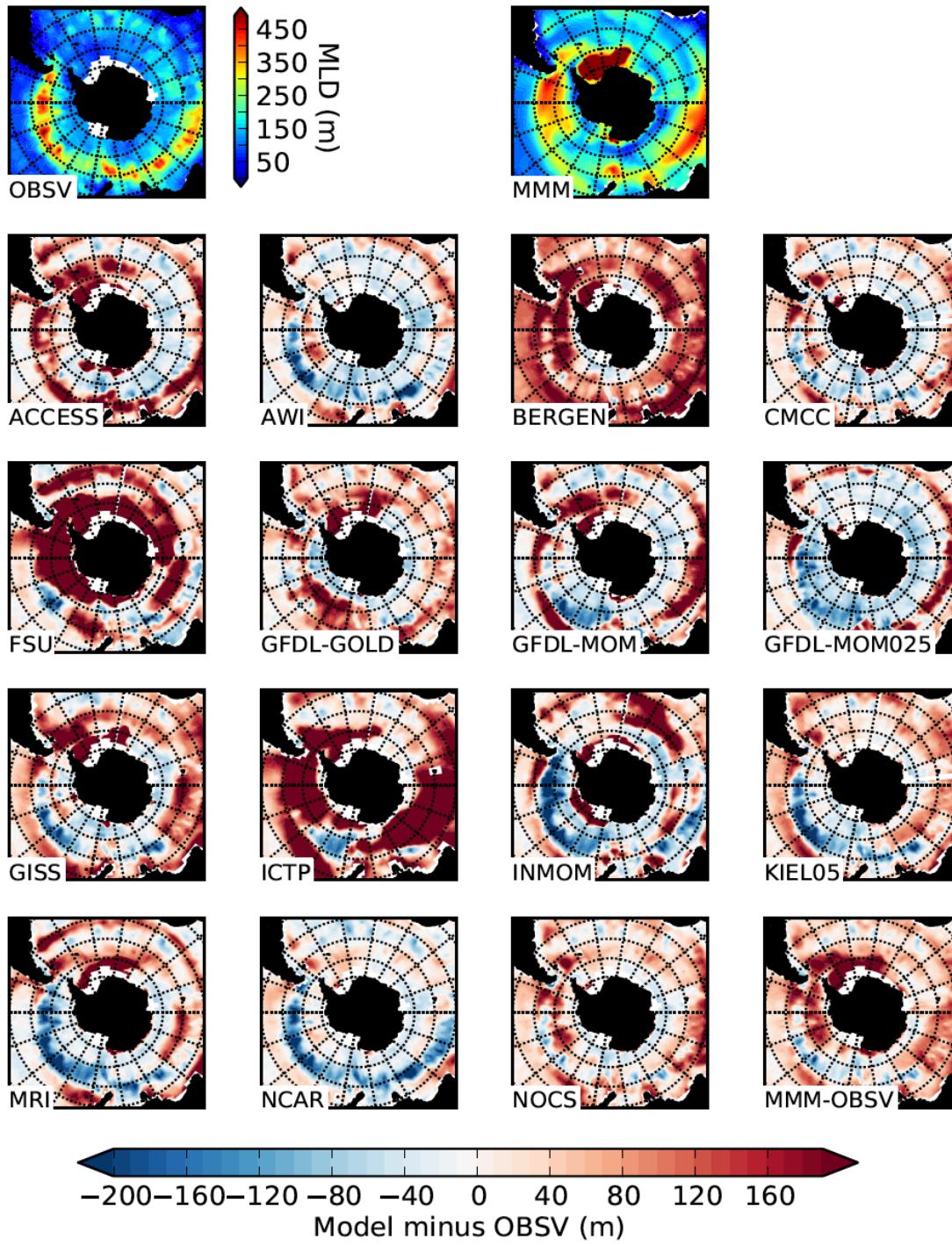
- Time series are relative to 1993
- Vertical line represents an estimate of the spread in the available observational estimates

The Southern Ocean Residual Overturning Circulation: partial compensation



- **Good degree of compensation:**
BERGEN, GFDL-MOM025, KIEL025, NCAR, (AWI, GISS)
 - **Not so good:**
ACCESS, CMCC, GFDL-MOM, ICTP, KIEL, MRI, NOCS

Farneti et al. 2014 (in preparation)



**Mixed layer depth:
September-mean for
1988-2007**
(based on 0.03 kg m^{-3} density
change from surface)

deBM: de Boyer Montegut et al. (2004)
MMM: Multi-model mean

Downes et al. 2014 (submitted)

SUMMARY

- Entrained participation of many (ocean) modeling groups.
- CORE-II framework is being used for:
 - Evaluation, understanding, and improvement of ocean components of coupled climate models,
 - Investigation of variability mechanisms,
 - Evaluation of robustness of mechanisms across models,
 - Initialization of decadal prediction simulations.
- CORE-II simulations show differences in solutions, both in the mean and variability.
- No grouping of model solutions based on model family or vertical coordinate representation is obvious.
- Solution differences are primarily due to differences in ocean model parameterizations and their parameter choices. Use of a wide variety of sea-ice models also contributes to the solution differences.

Initiated preliminary inter-comparison projects (e.g., related to AMOC and MLD) with the data assimilation community.