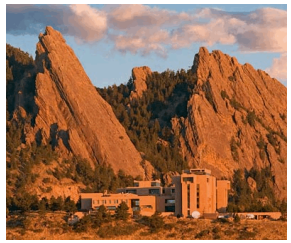
Interannual Coordinated Ocean-ice Reference Experiments (CORE-IAF) at GFDL

2009-2010 Activities

S. Griffies (GFDL)

WGOMD Panel Meeting



Boulder 24-25 September 2010

Outline

1. Status of CORE IAF Dataset
2. CORE IAF Experimental Design
3. Some diagnostics from CORE-IAF MOM-SIS ocean-ice
4. Concluding comments

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CORE-IAF dataset history A

- 27MAY2008: original release
- 08JUL2008:
  - bug in air temperature corrected data, which also affected corrected precipitation
  - time axes on all data files to standard netCDF file conventions
  - release of merged files containing all years.
- 05MAR2009: bug in uncorrected radiation for 2004-2006
  - The bug arose from problems with the lat-lon values in the original file, which in turn impacted the corrected radiation.
- 15JUNE2009: extended from 1958 to 1948
- 03DEC2009: extended from 2006 to 2007
- 22DEC2009: added missing file `ncar_rad.2007.nc`

CORE-IAF dataset history B

- 12FEB2010: made consistent with NCAR local version
  - Problems with inconsistent versions of both uncorrected and corrected data.
  - Metadata added to include physical dimensions of data.
- 04March2010: correction to IAF combined years time axis.
- 05April2010: sea level pressure and grids/calendars
  - Year 2007 sea level pressure bug, which resulted in modifications to other atmospheric forcing fields for 2007
  - Corrections/additions made for meta-information (grids and calendars) for certain of the fields and scripts used to make the NCAR corrections.

CORE-IAF dataset summary and recommendations

- The release of the CORE IAF dataset has been full of unfortunate mistakes.
- Many of these mistakes were identified by users of CORE, thus supporting the utility of a public release.
- Many mistakes could have been identified with more quality control cross-checking between GFDL and NCAR.

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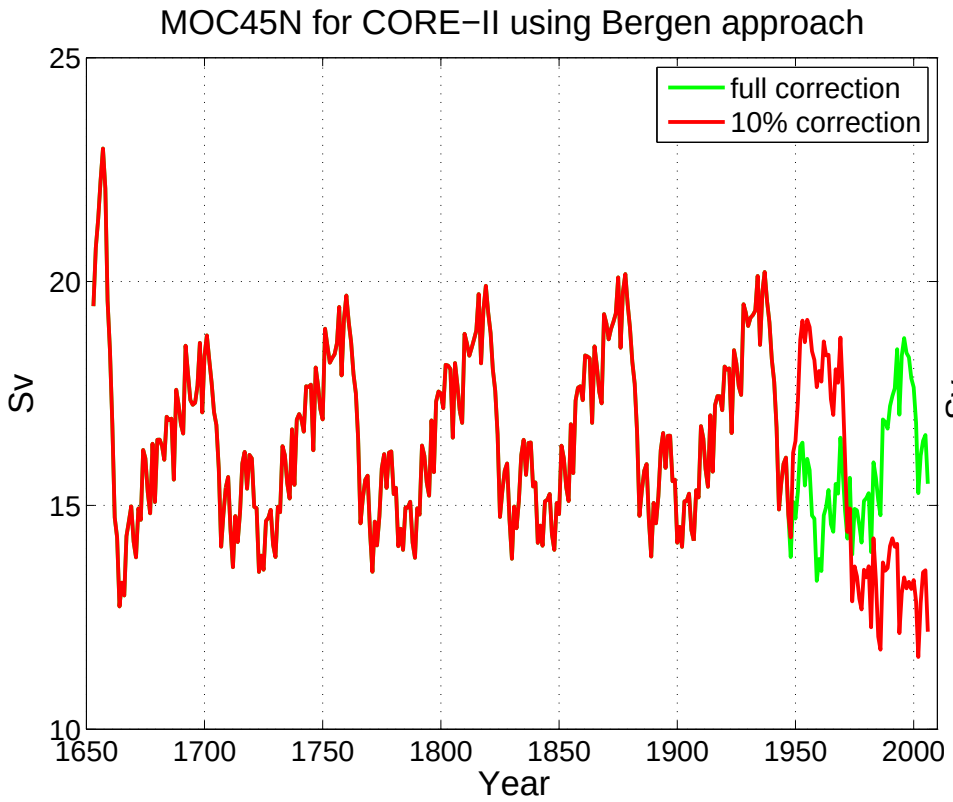
CORE-IAF experimental design: Bergen approach

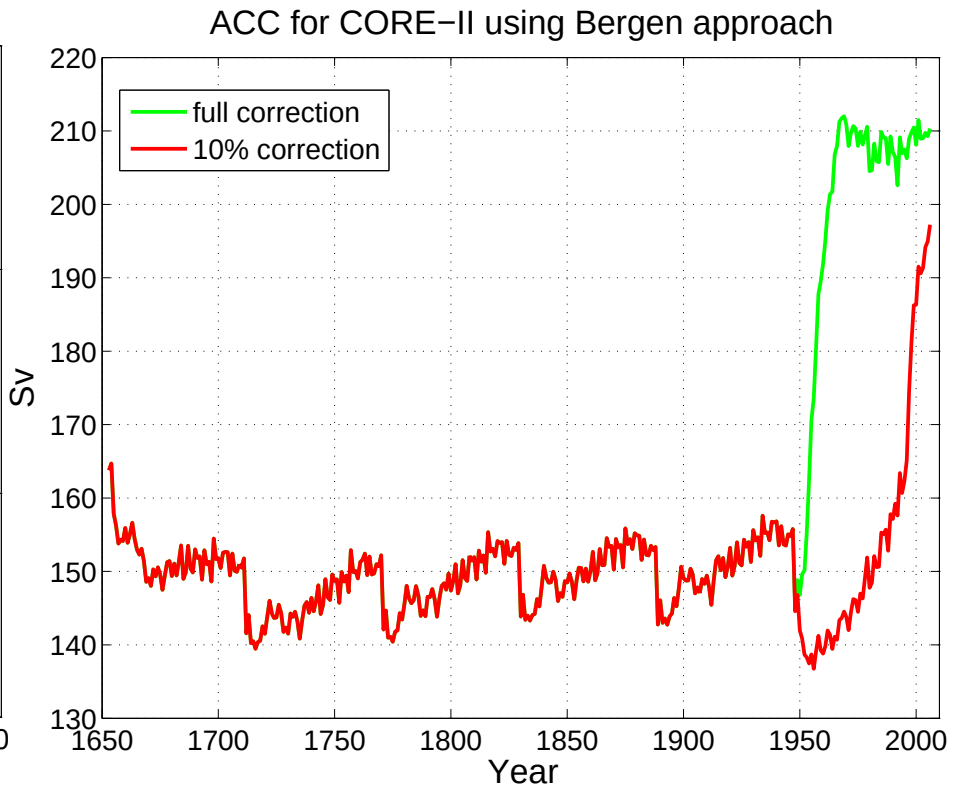
- Spin-up w/ strong salinity restoring for multiple realizations of CORE-IAF
  - Place a cap on the maximum ΔSSS used for computing salinity restoring. This approach reduces over-freshening subpolar NAtl due to large restoring fluxes in poor Gulf Stream region.
- Final realization for analysis
  - Diagnose salt flux from previous realization for use as a “flux correction”
  - Also add a very weak SSS restoring

GFDL-MOM implementation of Bergen approach

- Five realizations with $10\text{m}/6\text{d}$ restoring
- One realization with $10\text{m}/300\text{d}$ restoring plus diagnosed salt flux corrections from final iteration of strong restoring.
  - One case using full salt flux correction
  - One case using 10% of the salt flux correction
- $(\Delta SSS)_{\text{max}} = 0.5\text{psu}$.
- Salt flux **not** converted to a water flux.
- Total salt flux globally set to zero each time step.
- No salinity restoring under sea ice.
- No salinity restoring in marginal seas (Hudson, Med, Baltic, Red)

GFDL-MOM Drake and AMOC w/ Bergen approach





- Not satisfied with the transition to the final “analysis” segment.

CORE-IAF experimental design: NCAR approach

- Use the same salinity restoring for all realizations.
- No “flux correction” step.

GFDL-MOM implementation of NCAR approach

- Five realizations with $10\text{m}/60\text{d}$ restoring (same as MOM used in CORE-NYF paper)
- $(\Delta SSS)_{\text{max}} = 0.5\text{psu}$ for computing salt restoring flux.
- Salt flux **not** converted to a water flux.
- Total salt flux globally set to zero each time step.
- No salinity restoring under sea ice.
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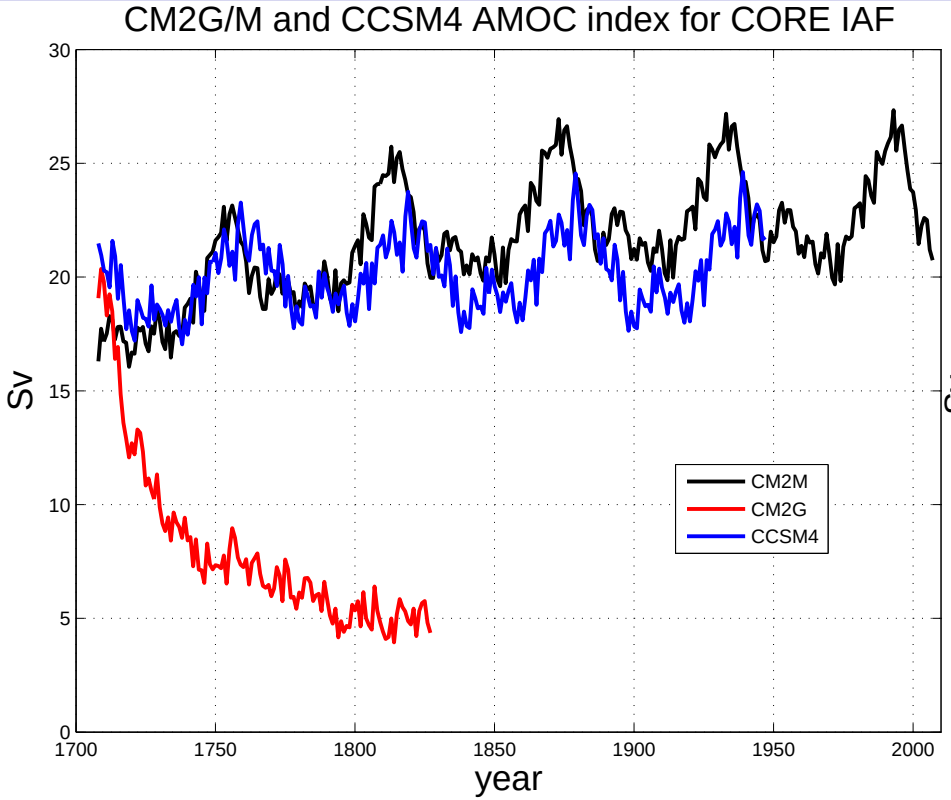
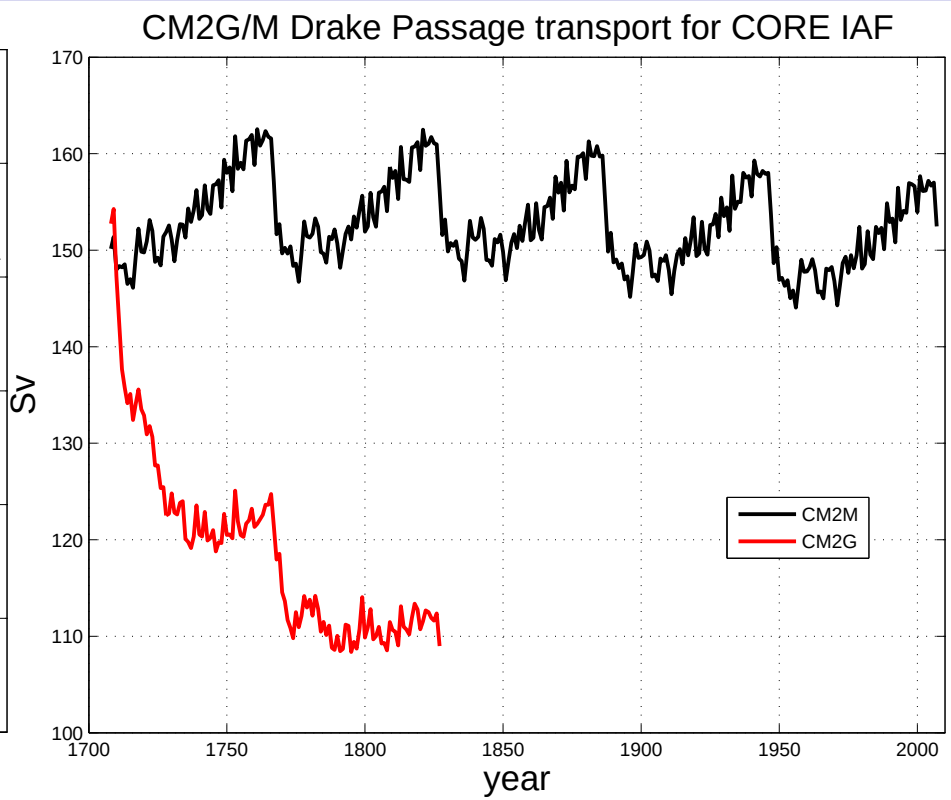
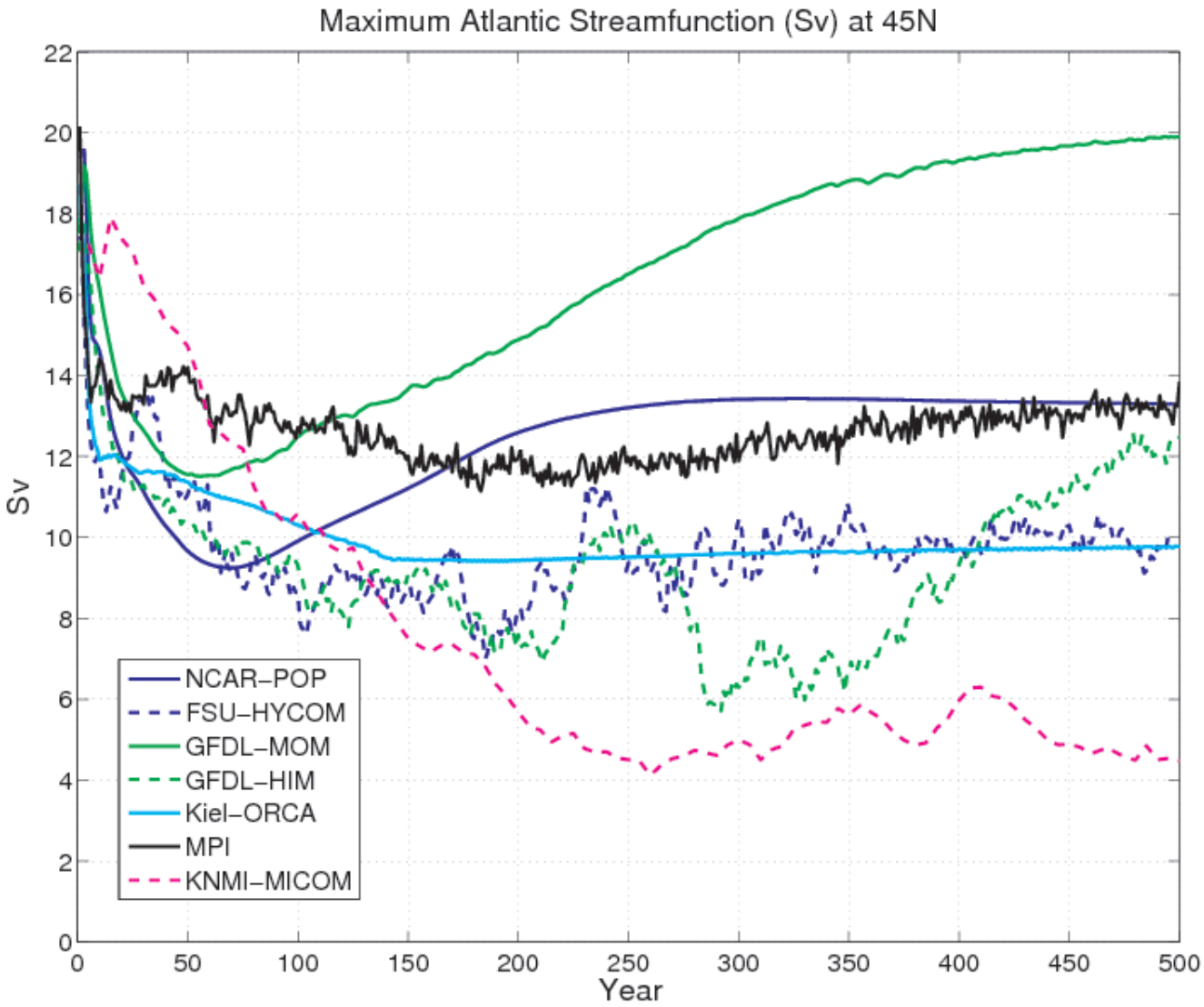
GFDL-MOM/GOLD Drake AMOC w/ NCAR approach





- GFDL-MOM and NCAR-POP
  - Far more stationary simulation than MOM under Bergen approach.
  - Phase shift likely related to use of different latitude ($45°N$ in MOM versus $28°N$ in POP) to develop the AMOC index.
- GFDL-GOLD: May need stronger salinity restoring.
  - Note that we use the same restoring as HIM used in CORE paper.
  - But overturning was weak there, so may need stronger anyhow...

Recal the overturning from CORE-NYF paper



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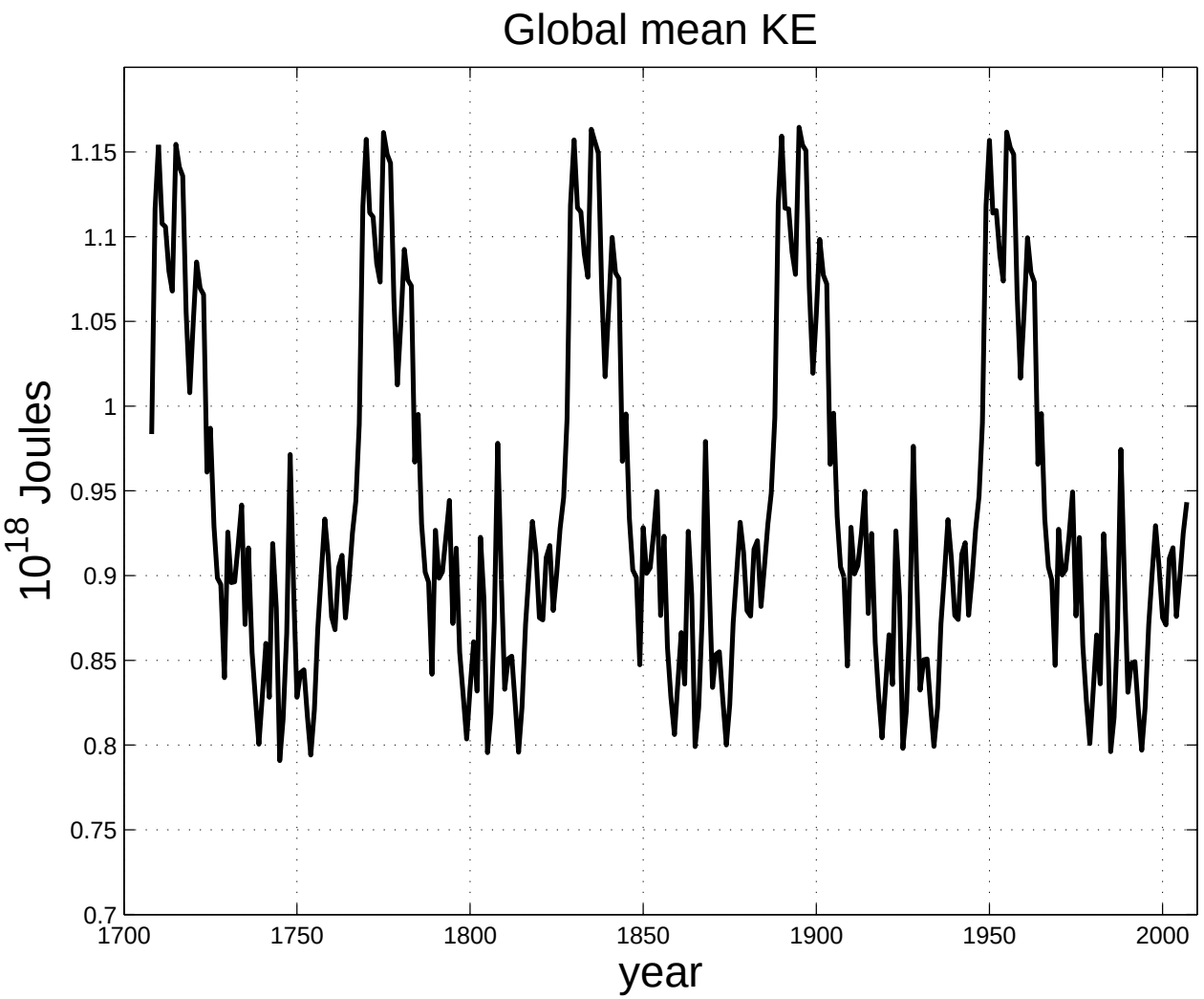
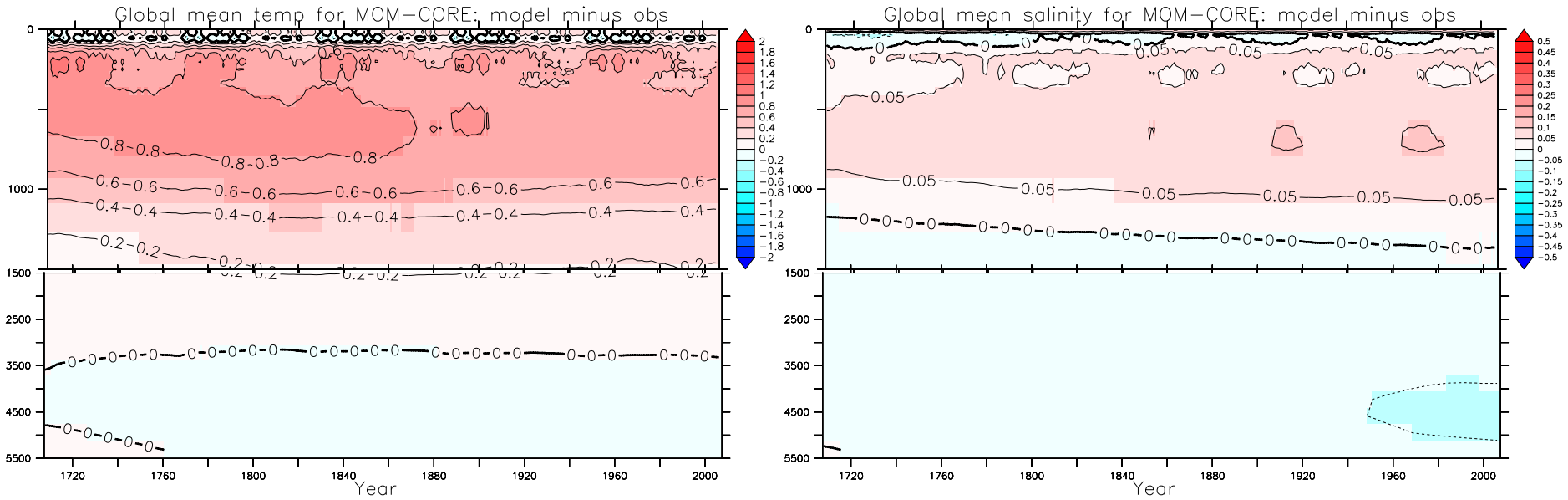
Global kinetic energy



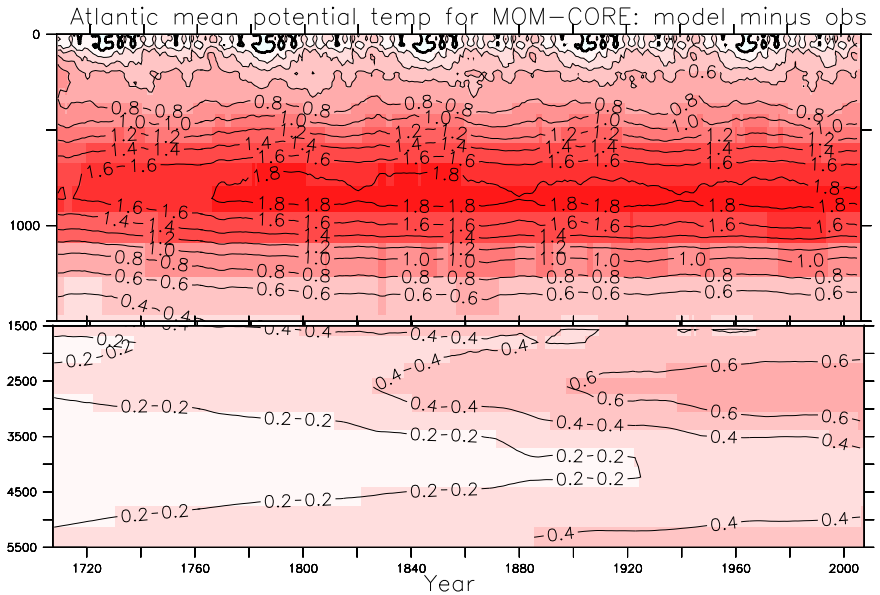
Stationary time series for each of the five cycles.

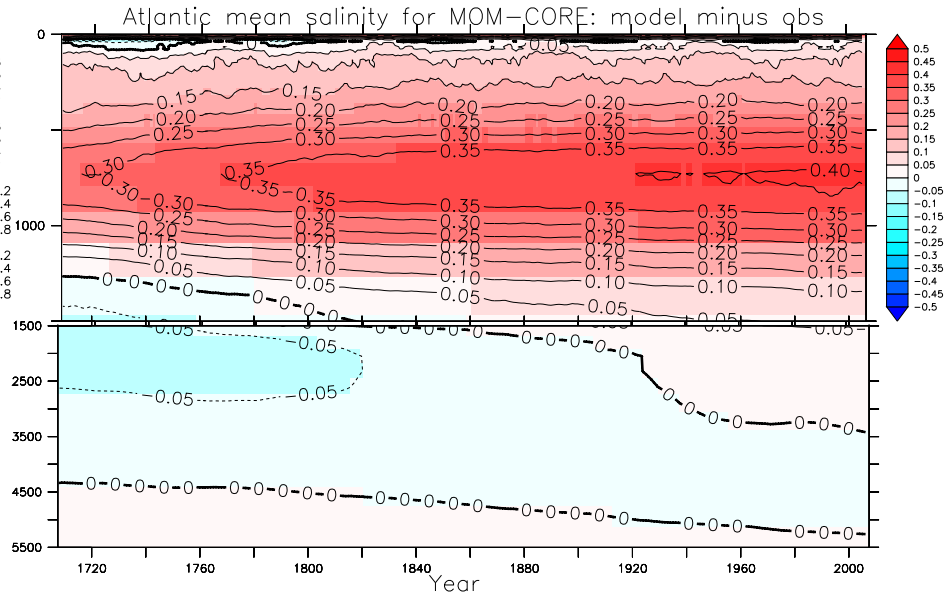
Global mean temperature and salinity anomaly



Reasonably stationary, though some drift in deeper ocean

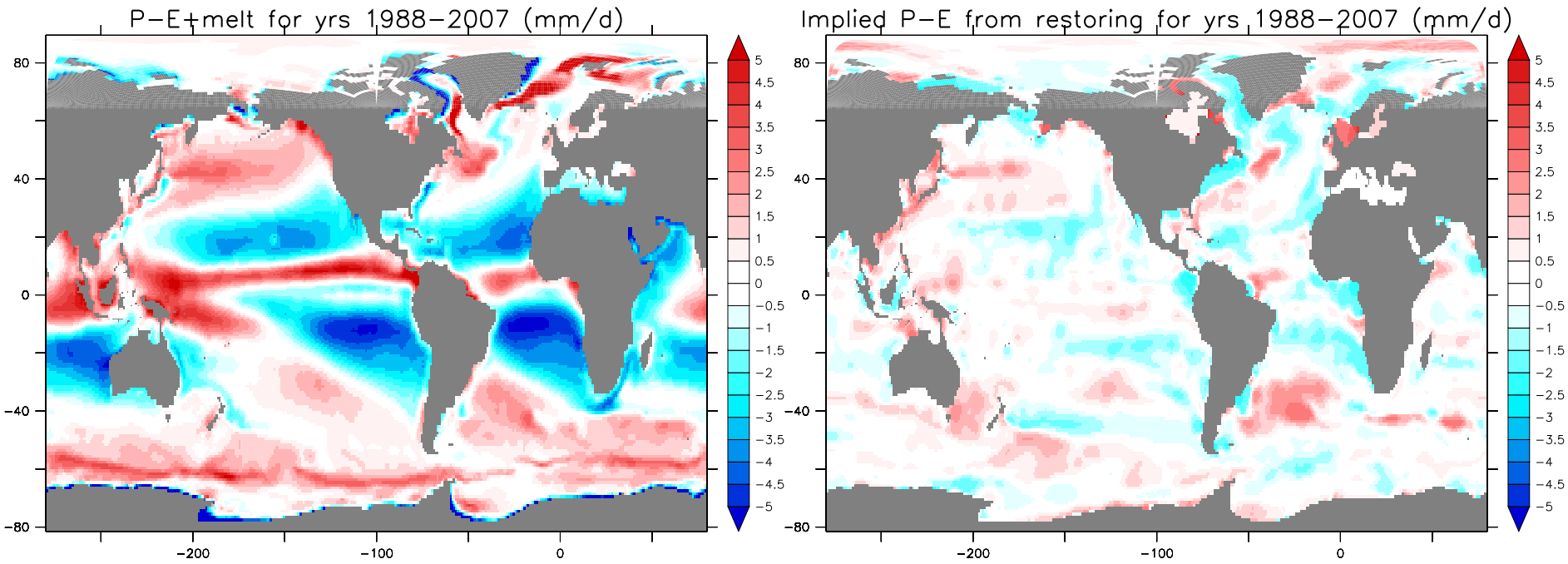
Atlantic/Arctic mean temperature and salinity anomaly





Reasonably stationary, warm and salty bias

P-E from coupling versus P-E implied by salt flux



$$(P-E)_{\text{implied}} = \frac{V_{\text{piston}}\,\Delta SSS}{SSS}$$

Implied P-E from restoring flux is suitably smaller than physical P-E flux.

Note added after presentation: There appears to be a sign error in the diagnosed implied P-E from restoring flux.

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Comments on CORE-IAF protocol

- Reasonably satisfied with CORE-IAF with MOM-SIS coupled ocean-ice.
- Five cycles seems sufficient for upper ocean physics.
- Very interested in using seasonal cycle for rivers from Dai and Trenberth.

GFDL Plans for CORE

- Protocol
  - We prefer the NCAR-motivated approach, which uses same salinity restoring throughout all cycles.
  - No plans to test sensitivity to strength of salinity restoring in MOM simulations, though may be convinced otherwise.
  - Plan to test sensitivity of GOLD simulations to salt restoring, both formulation of restoring and strength. Aim is to have a more stable circulation.
- Research uses for CORE
  - Variability of ocean biogeochemistry
    - Our standard CORE-IAF simulations use interactive ocean biogeochemistry. In particular, prognostic chlorophyll impacts on solar penetrative radiation.
    - According to biogeochemists, understanding variability of observed record is critical for assessing whether recent observations indicate a trend or natural variability.
  - Regional modeling in Indian Ocean, in collaboration with Indian scientists.
  - Develop a resolution suite of models forced under CORE-IAF.
  - Atlantic variability intercomparison (next page)

WGOMD Atlantic Variability Comparison w/ CORE-IAF

Purpose: characterize physical mechanisms of Atlantic variability in a suite of realistic global ocean-ice models run under the CORE-IAF protocol.

- Interannual modes, including tropical and higher latitudes directly related to wind forcing
- Multi-decadal modes more tied to buoyancy forcing
- Identify common model practices to facilitate research into the Atlantic variability question.
- Direct comparison to data
  - What are the key observations that can be used to evaluate the simulations?
  - Can we clearly rule out any model behaviour as unrealistic?
  - Where can observations be enhanced to better assist in evaluating simulations?
- Provide direct feedback to efforts aimed at state estimation and prediction.
- Direct comparison to companion coupled models (where exist).
  - Are relations in CORE similar to coupled models?
- We need to do this study! We are ready to do this study!