AGENDA

Thursday (29 January 2015):

G. Danabasoglu: Background on CORE-II framework and OMDP efforts; Requirements (from community and OMDP) on forcing data sets; OMIP; End products

W. Large: Data sets used in COREs (lessons learned and outstanding issues)

B. Barnier: Data sets used in DRAKKAR (lessons learned and outstanding issues)

C. Böning: Considerations on the CORE forcing and integration strategies

S. Josey: Climatological data sets that are available and can be used; Biases in data sets; What can and cannot be corrected?

B. Chapron: Satellite data sets that are available and can be used; Biases in data sets; What can and cannot be corrected

A. Andersson: Satellite derived data sets (HOAPS, radiation) and error budget estimation of products

M. Balmaseda: Reanalysis products vs. operational products; Reanalysis plans at ECMWF

H. Tsujino: JRA55-based products

G. Danabasoglu / W. Large: NCEP reanalysis plans

Friday (30 January 2015):

Guided discussions; Path forward.

16:00 Adjourn

Coordinated Ocean-ice Reference Experiments (COREs)

Experimental protocols for performing ocean – sea-ice coupled simulations forced with common atmospheric data sets, using the same bulk formulae.

The CORE effort is coordinated by the CLIVAR Ocean Model Development Panel (OMDP) – formerly known as Working Group on Ocean Model Development (WGOMD).

http://www.clivar.org/clivar-panels/omdp/core

CORE-I

Designed to investigate climatological ocean and sea-ice states obtained through multi-centennial simulations forced by idealized, repeating *normal-year* forcing constructed to retain synoptic variability.

For analysis of participating simulations see Griffies et al. (2009, Ocean Modelling)

CORE-II

An experimental protocol for ocean – sea-ice coupled simulations forced with inter-annually varying atmospheric data sets for the 1948-2007 period.

These hindcast simulations provide a framework for

- evaluation, understanding, and improvement of ocean and sea-ice components of earth system models,
- investigation of mechanisms for seasonal, inter-annual, and decadal variability,
- attribution of ocean-climate events to forced or natural variability,
- evaluation of robustness of mechanisms across models,
- bridging observations and modeling by complementing data assimilation,
- providing consistent ocean and sea-ice states that can be used to initialize climate (decadal) prediction simulations.

CORE Forcing Data Sets

Large and Yeager (2004, NCAR Tech. Note, NCAR-TN-460+STR)
Large and Yeager (2009, Climate Dynamics, v33, 341-364)

Table 1 Characteristics of datasets used for computing the CORE.v2 fluxes and for determining objective adjustments to forcing data

Variables	Source	Frequency	Duration	Resolution	Coverage	Basis
SST	Hadley-OI	Monthly	1871–2007[a]	1°	Global	Satellite
Atmospheric State	NCEP	6 hourly	1948–2006[a]	T62	Global	NWP
Radiation	ISCCP-FD	Daily	1984–2006[a]	2.5°	Global	Satellite
Precipitation	GPCP	Monthly	1979–2006[a]	2.5°	Global	Satellite
Precipitation	CMAP	Monthly	1979–2006[a]	2.5°	Global	Blend
Precipitation	S-H-Y	Monthly	Climatology	0.5°	50°N–90°N	In situ
Ice fraction	NSIDC	Daily	10/79–2006[a]	25 km	Global	Satellite
All	NOC	Monthly	1980–1995	1°	Global	Ships
All	TAO	Daily	1995–2004[a]	2°–20°	Pacific	Buoys
Most	PIRATA	Daily	1998–2004[a]	2°–20°	Atlantic	Buoys
Vector winds	QSCAT	6 hourly	1999–2004[a]	0.5°	Global	Satellite
Air temperature	POLES	12 hourly	1979–2003	100 km	60°N–90°N	In situ
Precipitation	MSU	Monthly	1979–1993	2.5°	55°S–55°N	Satellite

[a] Ongoing production of the dataset is expected beyond these durations

- Data set covers the 1948-2007 period. However, it is truly inter-annual starting in 1984.
- All data are on the T62 grid.

CORE Forcing Data Sets

River runoff:

The original runoff data were based on the 19 continental drainage basin approach described in Large and Yeager (2004).

In August 2010, inter-annually varying, monthly runoff data for the 1948-2004 period were made available. The data are based on Dai et al. (2009, J. Climate, v22, 2773-2791). Note that continental runoff from Antarctica was added.

Unfortunately, the runoff data are not kept up-to-date.

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

CORE-II Protocol

Griffies, S. M., Winton, M., Samuels, B., Danabasoglu, G., Yeager, S., Marlsand, S., Drange., H., and Bentsen, M., 2012: Datasets and protocol for the CLIVAR WGOMD Coordinated Ocean-sea ice Reference Experiments (COREs), WCRP Report No. 21/2012, pp. 21

- 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 protocol requests: i) use of the same bulk formulae, ii) no changes in the data sets; and iii) no deviations from the protocol.

CORE-II Participants

- 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^{o} horizontal resolutions

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 (Wang, Ilicak, Gerdes, & Drange),
- South Atlantic simulations (Farneti),
- Ocean circulation in temperature and salinity space (Nurser & Zika),
- Indian Ocean (Ravichandran, Rahaman, Harrison, Swathi, & Griffies),
- Pacific Ocean circulation and its variability (Tseng),
- Indonesian Throughflow (England & Santoso).

Missing Feedbacks and Problems with CORE

- No feedback between the evolving ocean and sea-ice states and the atmospheric data sets
- Missing atmospheric response to changes in sea-ice cover
- Atmosphere acts as a fluid with infinite heat capacity
- Mixed boundary conditions due to differing time scales of heat and freshwater fluxes
- Spin up and cycling of forcing
- Salinity restoring and normalization
- ….

Maturing of CORE-II

- The CORE-II framework is now widely recognized as the community standard for global ocean – sea-ice simulations.
- It is being adopted by many groups world-wide for evaluation of ocean and sea-ice components of their coupled models.
- It has become a *right-of-passage* as the modeling groups compare their solutions to those provided as *benchmarks* in the manuscripts published in the CORE-II Special Issue of *Ocean Modelling*.
- As a signal to the success of the CORE-II effort, modeling groups and analysts (from the U.S. and internationally) have requested that we propose the CORE-II experiments as an Ocean Model Inter-comparison Project (OMIP) for inclusion in CMIP6 (Coupled Model Inter-comparison Project phase 6).

Ocean Model Inter-comparison Project (OMIP)
Application for CMIP6-Endorsed MIPs

28 October 2014

Name of MIP: Ocean Model Inter-comparison Project (OMIP)

Co-chairs of MIP:

Gokhan Danabasoglu, NCAR, US (gokhan@ucar.edu)
Stephen M. Griffies, GFDL/NOAA, US (stephen.griffies@noaa.gov)

Members of the Scientific Steering Committee:

CLIVAR Ocean Model Development Panel (OMDP) and collaborators:
Claus Boning (Germany)
Eric Chassignet (US)
Enrique Curchitser (US)
Helge Drange (Norway)
David Holland (US)
Yoshiki Komuro (Japan)
William Large (US)
Simon Marsland (Australia)
Simona Masina (Italy)
George Nurser (UK)
Andreas Oschlies (Germany)
Anna Pirani (CLIVAR ICPO, Italy)
Anne-Marie Treguier (France)
Mike Winton (US)
Stephen Yeager (US)

Context for the Mini Workshop

- While the success and visibility of the CORE-II effort have been steadily increasing, no significant new developments or maintenance of the data sets or the protocol have occurred during the last 5-6 years.
- Various shortcomings with the present CORE-II data sets and the protocol have been identified during the course of CORE-II studies.

Context for the Mini Workshop

- Given the widespread use of CORE-II, and the associated broad advances to ocean and climate science, we believe that there is an urgent need to advance the scientific and engineering foundations of CORE-II.
- This advance must proceed in a timely manner for the benefit of the ocean modeling communities around the world.
- The primary goal of this mini workshop is to reignite both science and engineering efforts to advance the foundations of CORE-II.

Requests / Requirements from the Ocean Modeling Community (roughly in priority order)

- Keep all forcing data sets current,
- No tuning and / or adjustments of the data sets based on model results,
- Balanced forcing data sets – heat and water budgets balanced together,
- Create finer spatial and temporal resolution versions of the data sets that can be used to force high-resolution (e.g., eddying, coastal) ocean and sea-ice models,
- Consider alternative (all available) base data sets, e.g., other reanalysis products, radiation data sets, etc.,
- Keep a consistent normal-year forcing data set,

Requests / Requirements from the Ocean Modeling Community (roughly in priority order)

- Revisit a few aspects of the CORE-II protocol such as surface salinity restoring. A specific goal is to investigate in a systematic way if ocean – sea-ice integrations without any surface salinity restoring could be achieved.
- Consider extending the data sets to years prior to 1948.
- Consider a thermodynamically active atmospheric boundary layer model that responds to model SSTs, e.g., CheapAML.
- Consistency of the atmospheric data sets and use of the corresponding bulk formulae in applications.
- Should continental runoff be part of the data sets?
- Seasonal cycle of runoff around Antartica
- Ice runoff?

Opportunity to Revisit Various Other Aspects of Forcing Data Sets

- Assumptions and corrections used in Large and Yeager (2009) during the creation of the atmospheric data sets,
- Incorporation of new corrections based on new / different observational data,
- Forcing over sea-ice covered regions,
- Wave fields,
- Runoff data sets,
- Diurnal cycling of wind and solar forcing,
- Missing subgrid scale processes in forcing,
- Relative vs. absolute winds in bulk formulae,
- ……

Workshop Outcomes

A clear path forward to advance CORE-II approach, considering the above requests / requirements and existing opportunities; Division of labor towards accomplishing various tasks.

Although we hope to do more, a default outcome may be simply to provide some basic updates to our existing protocol and data sets to be current.