More About CM2.X Files On GFDL's Data Portal

http://nomads.gfdl.noaa.gov/CM2.X

Background:

The GFDL Data Portal is ramping up, in terms of hardware, software, and web content, to allow GFDL to better serve its model related products to its customers. This server is part of the NOMADS collaboration (the NOAA Operational Model Archive & Distribution System). IPCC AR4 related CM2.0 and CM2.1 model output files are just one part of the GFDL Data Portal effort, but they currently are the fastest growing part. Recently, much work has been done to the GFDL Data Portal in response to the evolving demands of the US and international climate research communities. The server's storage capacity has been increased and software upgrades are underway to expand and enhance users' download options. This includes plans to fully incorporate NOAA PMEL's Live Access Server functionality (http://ferret.pmel.noaa.gov/Ferret/LAS).

CM2.0 and CM2.1 Specifics:

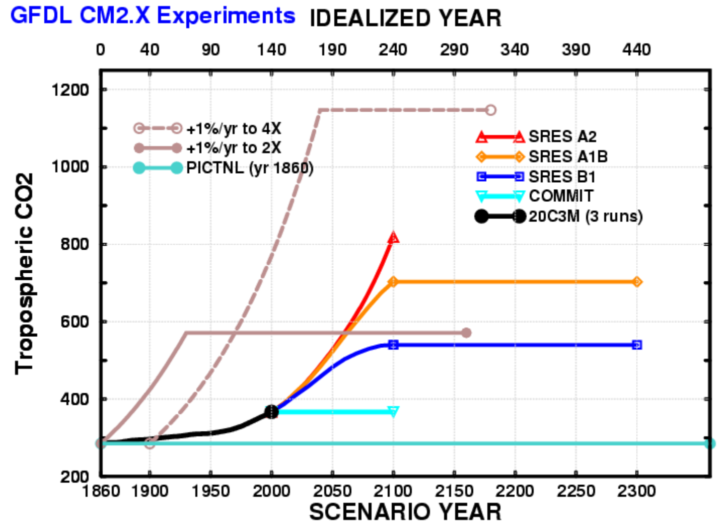
Web pages providing information and guidance regarding the use of the IPCC AR4 related CM2.x model output files continue to be developed. This includes a set of FAQs and links to manuscripts and papers reporting on the models and their simulations (available from http://nomads.gfdl.noaa.gov/CM2.X).

All CM2.x files sent to the PCMDI/IPCC archive will also be available on the GFDL Data Portal. Some variables and time periods beyond those specifically requested by the IPCC WGI will be added to GFDL's Data Portal over time. Additionally, most users of CM2.x ocean and sea ice model output will need to download files from the GFDL Data Portal. These "CMORized" files store ocean and ice output on the models' native tripolar grid and include supplementary grid information that allows for accurate calculations not possible when the model output is interpolated to a more regular grid.

Currently, users can navigate directories and download whole files (each <2 GB in size). When LAS and DODS networking are fully implemented, GFDL Data Portal users will have more options, including the ability to download spatial and temporal subsets of files, thus reducing the volume of data being downloaded.

Questions related to the GFDL CM2.x models can be directed to...

GFDL.Climate.Model.Info@noaa.gov



Ten Experiments Per Model:

After configuring and spinning up the GFDL CM2.0 and CM2.1 models, two sets of 10 experiments were run using the two models. As depicted above, they are:

PICTNL: the 1860 control; 500 years of output is available from these runs.

1%to2X & **1%to4X** : doubling and quadrupling of CO_2, plus stabilization periods.

20C3M (3 member ensembles): the 1861-2000 'historical' runs; 140 years each.

SRES A2: 100 year long runs (2001-2100) following SRES A2 emission scenario.

SRES A1B & **SRES B1:** 300 year long runs (2001-2300); stabilization post-2100.

COMMIT: 100 year long committed climate change experiments (2001-2100).

U.S. Dept. of Commerce / NOAA /
Geophysical Fluid Dynamics Laboratory
PO Box 308; 201 Forrestal Road
Princeton, New Jersey 08542 USA

GFDL Home Page: http://www.gfdl.noaa.gov
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GFDL's CM2.0 & CM2.1 Models: Efforts in Support of the IPCC AR4

1 March 2005

noaaresearch

In 2004, a new family of global coupled AOGCMs (the CM2.x family) was first used to conduct climate research studies at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL).

The GFDL CM2.0 & CM2.1 models represent a clean break from previous generations of GFDL climate models. All of the coupled model components (the atmosphere, ocean, sea ice, and land surface models) were developed from new codes.

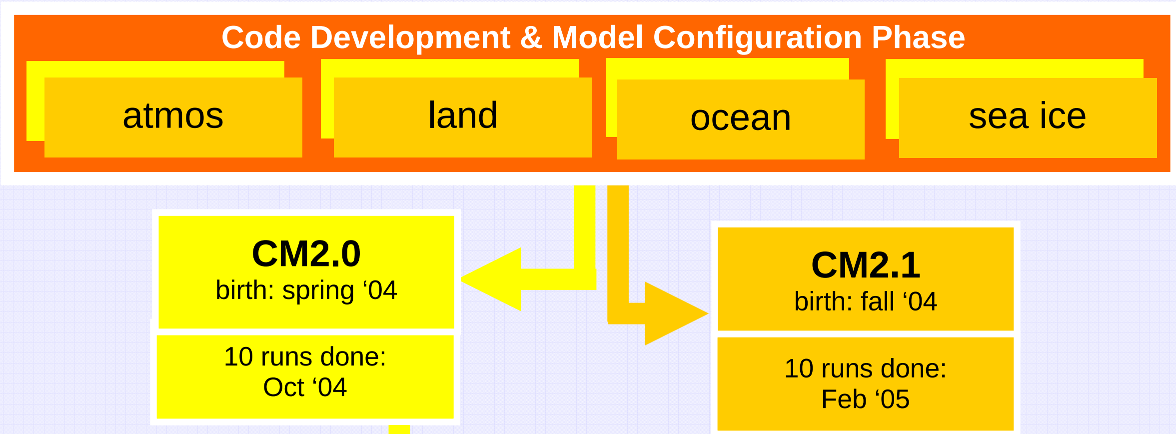
Two sets of 10 IPCC AR4 related simulations have been run; one using the GFDL CM2.0 model and one using the GFDL CM2.1 model.

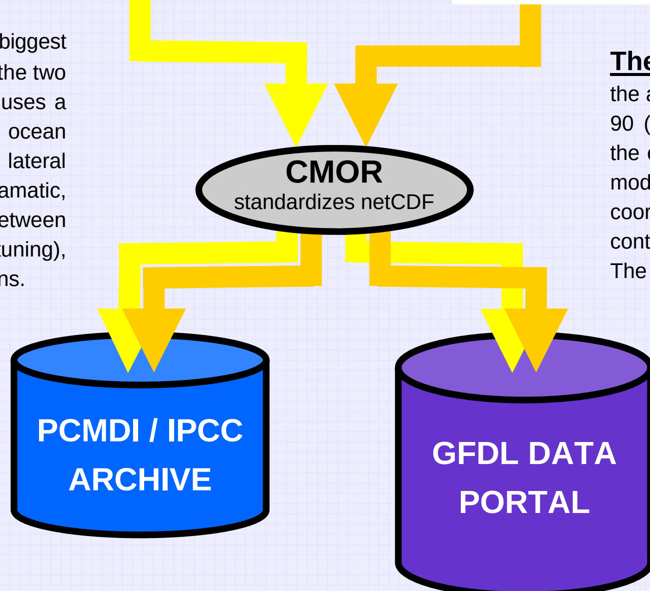
Processed model output files from the GFDL CM2.x simulations are available to researchers via both the PCMDI/IPCC WGI Archive & the GFDL Data Portal.

Many GFDL CM2.x ocean and sea ice model output files will be available for download only from the GFDL Data Portal. Additional documentation, preprints, and FAQs are also available there.

GFDL Data Portal: ... http://nomads.gfdl.noaa.gov
Email: .... GFDL.Climate.Model.Info@noaa.gov

GFDL CM2.0 and CM2.1 Model Simulations





How do CM2.0 & CM2.1 differ? The biggest difference is that the atmospheric component of the two models have different dynamical cores. CM2.1 uses a Finite-Volume (FV) dynamical core. Also, the ocean component's time stepping scheme and lateral viscosity differ in the two models. Other less dramatic, but still potentially significant, differences exist between the CM2.0 & CM2.1 atmosphere (e.g. cloud tuning), ocean, and land surface component configurations.

Equilibrium climate sensitivities: The equilibrium global mean temperature response to a doubling of atmospheric CO_2 for the atmospheric component of CM2.0 coupled to a slab ocean is 2.9K. For CM2.1, the equilibrium climate sensitivity is 3.4K.

The Atmospheric Grids: In both CM2.0 and CM2.1, the atmospheric model's horizontal grid dimensions are 144 by 90 (about 2.5° longitude by 2.0° latitude spacing). However, the exact horizontal grid locations are not the same in the two models. Both have 24 vertical levels and use a hybrid coordinate grid, in which sigma surfaces near the ground continuously transform to pressure surfaces above 250 hP. The lowest model level is about 30m above the surface.

CM2.1 Strengths vs. CM2.0: CM2.1 has [a] better surface winds that improve the ocean gyres, [b] reduced high latitude cold biases over land, [c] an improved Southern Ocean circulation, and [d] reduced N. Atlantic sea ice biases. Also, CM2.1 uses ~50% less cp time to run 1 year than does CM2.0. However, CM2.1's tropical simulation is slightly degraded from CM2.0.

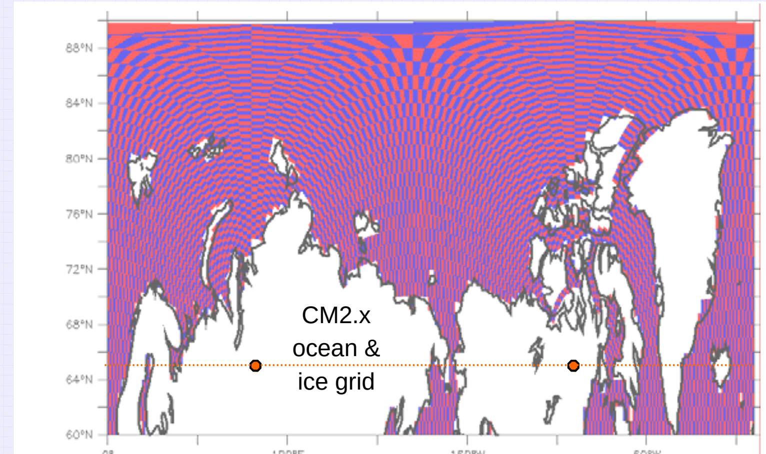
The Workhorse Model: The CM2.x models are being applied to topics focusing on decadal-to-centennial time scale issues (including multi-century control experiments and climate change projections), as well as to seasonal-to-interannual problems, such as El Niño research and experimental forecasts. Though we continue to analyze both CM2.0 and CM2.1, the CM2.1 model is expected to be the dominant workhorse for GFDL's dec-cen climate research.

CP Time & Bytes on Tapes: Since early 2004, the model integrations associated with IPCC AR4 have required a commitment of between 30% and 60% of GFDL's monthly supercomputer resources (i.e., cp time) and have produced more than 300 terabytes of archived model output.

Data Preparation Priorities: In tackling the sizable task of converting several terabytes of GFDL model output into the IPCC mandated form, we set priorities so as to meet the needs of the largest share of users as early as possible. CM2.0 files were processed before CM2.1 (because of when the experiments ran), atmosphere & land files before ocean & sea ice files (due to grid issues), monthly mean time series before daily & 3hr data, followed by the very labor intensive extreme indices. After processing 20 experiments' worth of CM2.x model output, we will process files from the one IPCC requested AMIP run & the 2 requested atmosphere GCM-slab ocean runs.

Some Ocean & Sea Ice Grid Issues:

The GFDL CM2.x ocean and sea ice model components have a 200 x 360 horizontal grid. South of 65°N the grid is not unusual … in the X direction there is uniform 1° longitude spacing, and for the Y axis all points along a given J-row lie at the same latitude. However, the grid is not so regular north of 65°N. To avoid having a singularity at the North Pole, the grid has two poles in the Northern Hemisphere 180° of longitude apart at 65°N; one in Russia, the other in Canada. Those two, plus the South Pole, lead to the "tripolar" name.



While interpolating from the tripolar grid to a regular grid is generally acceptable for some applications, such interpolation precludes highly accurate quantitative analyses. This is because horizontal interpolation introduces a lack of conservation of quantities such as ocean surface areas, especially around coastlines. Similar limitations occur in the vertical, a factor that is complicated by the CM2.x ocean's use of partial bottom cells.

While allowing a better representation of the ocean in the model, the tripolar grid does present challenges to analysis software when considering the region north of 65°N. Grid point latitudes and longitudes must be treated as 2-D fields, not 1-D axes, and surface areas are not the same for all points along a given J-row. Also, the use of partial cells renders a 1-D Z axis inadequate for describing quantities near the ocean floor .

To address these grid issues, and to allow for accurate off line analyses, supplementary grid information has been included in the ocean_tripolar and ice_tripolar netCDF files available for download from the GFDL Data Portal. Separate "grid_spec" files are also being made available.

See **http://nomads.gfdl.noaa.gov/CM2.X/** for more information.

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