Ocean Modeling and ECCO

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How to get Estimating the Circulation and Climate of the Ocean (ECCO) output
Estimating the Circulation & Climate of the Ocean

THE ECCO CONSORTIUM

ECCO was established in 1998 as part of the World Ocean Circulation Experiment (WOCE) with the goal of combining a general circulation model (GCM) with diverse observations in order to produce a quantitative depiction of the time-evolving global ocean state. The importance of such an endeavor is recognized by numerous national and international organizations, such as the WMO’s World Climate Research Programme (WCRP) and UNESCO’s Intergovernmental Oceanographic Commission (IOC). These programs have all noted the necessity of synthesizing the diverse remotely-sensed and in-situ observations with known dynamics and thermodynamics through a GCM. ECCO products are in support of the Climate Variability and Predictability (CLIVAR) programme and the Global Ocean Data Assimilation Experiment (GODAE).

more

ECCO PRODUCTS

ECCO products as well as input fields and quality-controlled observations are freely available from several data servers through various applications (including DODS/OpeNDAP, LAS, GDS, Deeper, SRA, Ingrid).

A summary of available ECCO products and data servers can be found here.

ECCO'S GENERAL CIRCULATION MODEL

The ECCO code is based on the MIT general circulation model (MITgcm), a numerical model designed for study of the atmosphere, ocean, and climate. It comes with a variety of packages including physical parameterizations, a sea-ice model, biochemical components, and allows flexible porting across various HPC platforms.

For more details on the MITgcm click here.

AUTOMATIC/ALGORITHMIC DIFFERENTIATION (AD)

Since the mid-1990’s, groups at MIT, SIO, JPL and GFDL have applied automatic/algorithmic differentiation (AD) tools for generating tangent linear and adjoint code for ocean circulation and climate studies. ECCO relies heavily on the AD tool TAMC and its commercial successor TAF. The ECCO group is also involved in the development of a new open-source AD tool OpenAD.

More details can be found here.

IN THE NEWS

July 2017: ECCO version 4 release 3, covering 1992-2015, now available online:

The new release 3 extends the Version 4 estimate using additional observations. The product also incorporates improvements in modeling and estimation. A summary document describes details of the changes. Also available are descriptions of how to evaluate property budgets and how to reproduce the results and generate additional fields using MITgcm.

June 2017: A new 20-yr ECCO climatology is now available online:

ECCO version 4 has been used to calculate a uniform 20-year climatology as a time-mean over the period 1994-2013. The climatology is...
Estimating the Circulation & Climate of the Ocean

PRODUCTS

ECCO products listed below are freely available through several types of servers (a direct link is provided below via each product’s `Release Name` in the product table). We kindly ask users to refer to the citable identifier associated with the product they choose to use (provided below via the `Release Identifier` links). The products are listed in an order that reflects their time of publication (see `Release Identifier`). The following products are currently being extended: ECCO-v4 (JPL/AER/MIT), SDSE (UCSD), ECCO2 (JPL), ECCO-JPL (JPL), and GECCO2 (UH).

ECCO products are primarily released in the form of monthly field time series. These fields are primarily distributed on their native model grid to allow for accurate transport and budget computations. However fields interpolated to a simple longitude latitude grid may also be provided, which can most easily be plugged into third party software. Some of the products further provide the associated observational inputs, which allow users to e.g. assess model-data misfits. Examples of these supplementary data sets are indicated by a `>` under the associated `Release Identifier`.

For comments or questions please contact us via: ecco-support@mit.edu

<table>
<thead>
<tr>
<th>Product</th>
<th>Release Identifier</th>
<th>Release Name</th>
<th>Covered Time Period</th>
<th>Model Grid</th>
<th>Depth Levels</th>
<th>Estimation Method</th>
<th>Software Generation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECCO-V4</td>
<td>I.D.</td>
<td>Release 3</td>
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<td>LLC90</td>
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## Index of /Version4/Release3/

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ECCO Version 4: Third Release

- This directory contains the 'ECCO version 4, release 3' state estimate files:
  README
  doc
  nctiles_grid
  nctiles_monthly
  nctiles_monthly_snapshots
  nctiles_daily
  profiles
  interp_monthly
  input_forcing
  input_ecco
  input_init
  other
  quantities

- References:
  Forget, G., J.-M. Campin, P. Heimbach, C. N. Hill, R. M. Ponte, and C. Wunsch, 2015:
  ECCO version 4: an integrated framework for non-linear inverse modeling and global ocean
  Forget, G., J.-M. Campin, P. Heimbach, C. N. Hill, R. M. Ponte, and C. Wunsch, 2016:
  ECCO version 4: Second Release, http://hdl.handle.net/1721.1/102062

- Software:
  The ECCO v4-r3 files were produced using the "checkpoint65u" versions of the general
  circulation model (MITgcm and ECCO v4 settings) and Matlab analysis toolboxes (gcmfaces and MITprof).
  These software versions are available at http://mitgcm.org/download/other_checkpoints/
  and http://mit.ecco-group.org/opendap/ecco_for_las/verson_4/checkpoints/contents.html

- Contact Us:
  ecco-support@mit.edu (please subscribe via http://mailman.mit.edu/mailman/listinfo/ecco-support)

README file revision history:

- Add directory other [Ou Wang] [2017/05/08]
- Add directory nctiles_daily [Ou Wang] [2017/05/03]
- README file creation [Ou Wang] [2016/08/02]
How to download and run the Massachusetts Institute of Technology general circulation model (MITgcm)
The MITgcm (MIT General Circulation Model) is a numerical model designed for study of the atmosphere, ocean, and climate. Its non-hydrostatic formulation enables it to simulate fluid phenomena over a wide range of scales; its adjoint capability enables it to be applied to parameter and state estimation problems. By employing fluid isomorphisms, one hydrodynamical kernel can be used to simulate flow in both the atmosphere and ocean.

You are welcome to download and use MITgcm.

Papers charting the development of MITgcm can be found here.

Latest News and Features

Plunging into Early Paleozoic Oceans with MITgcm

Story by Helen Hill

Apr 20th, 2017 by Helen Hill
The MITgcm code and documentation are under continuous development. The last official release was called "Release1_patch8" and the current development is stabilizing in anticipation of a "Release2_beta" announcement. Both the last stable release and the current CVS contents can be obtained at:

- View through the CVS code browser
- Download using CVS pserver

  bash or sh shell:
  $ export CVSROOT=":pserver:cvsanon@mitgcm.org:/u/gompack"
  $ cvs login
  ( enter the CVS password: "cvsanon" )
  $ cvs co -P MITgcm

  csh or csh shell:
  $ setenv CVSROOT ':pserver:cvsanon@mitgcm.org:/u/gompack'
  $ cvs login
  ( enter the CVS password: "cvsanon" )
  $ cvs co -P MITgcm

- Download the most recent checkpoint as a "tar" file.
- Download one of the daily snap-shots.
Several documents are currently available:

- The most recent online documentation
- The Release 1 online documentation (stable)
- Our on-line code browser provides a view of the various subroutines, functions and variables, showing how they are called and used.
- An MITgcm "Developer's HOWTO" manual is available in multiple formats:
  - Single-page or Multi-page (html)
  - PDF file or PostScript file

Papers charting the development of MITgcm can be found here.
Welcome to the web page for the development/testing version of MITgcm, a numerical model designed for the study of the atmosphere, ocean, and climate. For an overview, please see MIT’s Climate Modeling Initiative (CMI) which introduces the MITgcm model, its applications, and the development team.

MITgcm is freely available to all; we encourage you to download it, use it, and give us feedback to help us improve it.

MITgcm:
- can be used to study both atmospheric and oceanic circulation
- has a non-hydrostatic capability
- supports horizontal orthogonal curvilinear coordinates
- has a finite volume treatment of topography
- supports a wide range of physical parameterizations
- has tangent linear and adjoint code maintained alongside the forward model
- can run on your pc, workstation or parallel computer using flexible domain decomposition

Here you can:
- access the user manual (PDF), the online table of contents (HTML), and browse the overview section (HTML)
- read the description of downloading the code or go straight to our online CVS browser and download section
- follow tutorial examples of the use of MITgcm in the study of atmospheric and oceanic flows
- browse the Hypertext Code
- View the "Developer's HOWTO" in multiple formats:
  - Single-page HTML
  - Multi-page HTML
  - PDF file
  - PostScript file

If you have any comments or questions, please contact us here.

Alistair Adcroft, Jean-Michel Campin, Stephanie Dutkiewicz, Constantinos Evangelinos, David Ferreira, Gael Forget, Baylor Fox-Kemper, Patrick Heimbach, Chris Hill, Ed Hill, Helen Hill, Oliver Jahn, Martin Losch, John Marshall, Guillaume Maze, Dimitris Menemenlis and Andrea Molod

Earth, Atmospheric and Planetary Sciences,
Massachusetts Institute of Technology
3. Getting started with MITgcm

This chapter is divided into two main parts. The first part, which is covered in sections 3.1 through 3.7, contains information about how to run experiments using MITgcm. The second part, covered in sections 3.9 through 3.20, contains a set of step-by-step tutorials for running specific pre-configured atmospheric and oceanic experiments.

We believe the best way to familiarize yourself with the model is to run the case study examples provided with the base version. Information on how to obtain, compile, and run the code is found here as well as a brief description of the model structure directory and the case study examples. Information is also provided here on how to customize the code when you are ready to try implementing the configuration you have in mind. The code and algorithm are described more fully in chapters 2 and 4.

Subsections

- 3.1 Where to find information
- 3.2 Obtaining the code
  - 3.2.1 Method 1 - Checkout from CVS
  - 3.2.2 Method 2 - Tar file download
- 3.3 Model and directory structure
- 3.4 Building MITgcm
  - 3.4.1 Building/compiling the code elsewhere
  - 3.4.2 Using gmake2
  - 3.4.3 Building with MPI
- 3.5 Running MITgcm
  - 3.5.1 Output files
  - 3.5.2 Looking at the output
- 3.6 Customizing MITgcm
  - 3.6.1 Parameters: Computational domain, geometry and time discretization
  - 3.6.2 Parameters: Equation of state
  - 3.6.3 Parameters: Momentum equations
  - 3.6.4 Parameters: Tracer equations
  - 3.6.5 Parameters: Simulation controls
- 3.7 Testing
  - 3.7.1 Using testreport
  - 3.7.2 Automated testing
… but before running MITgcm you need a Unix-based operating system. I recommend VirtualBox and Ubuntu (or Lubuntu)
VirtualBox

Welcome to VirtualBox.org!

VirtualBox is a powerful x86 and AMD64/Intel64 virtualization product for enterprise as well as home use. Not only is VirtualBox an extremely feature rich, high performance product for enterprise customers, it is also the only professional solution that is freely available as Open Source Software under the terms of the GNU General Public License (GPL) version 2. See "About VirtualBox" for an introduction.

Presently, VirtualBox runs on Windows, Linux, Macintosh, and Solaris hosts and supports a large number of guest operating systems including but not limited to Windows (NT 4.0, 2000, XP, Server 2003, Vista, Windows 7, Windows 8, Windows 10), DOS/Windows 3.x, Linux (2.4, 2.6, 3.x and 4.x), Solaris and OpenSolaris, OS/2, and OpenBSD.

VirtualBox is being actively developed with frequent releases and has an ever growing list of features, supported guest operating systems and platforms it runs on. VirtualBox is a community effort backed by a dedicated company: everyone is encouraged to contribute while Oracle ensures the product always meets professional quality criteria.

Download VirtualBox 5.1

Hot picks:

- Pre-built virtual machines for developers at Oracle Tech Network
- Hyperbox Open-source Virtual Infrastructure Manager (project site)
- phpVirtualBox AJAX web interface (project site)
- IQEmu automated Windows VM creation, application integration (http://mirage335-site.member.hacdc.org:6380/wiki/Category:IQEmu)

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Unravelling IoT monetisation, skills and security challenges.

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Ubuntu Server
Whether you want to configure a simple file server or build a fifty thousand-node cloud, you can rely on Ubuntu Server and its five years of guaranteed free upgrades.

Ubuntu Cloud
Ubuntu is the reference OS for OpenStack. Canonical’s OpenStack Autopilot is a fully automated deployment of an OpenStack cloud on Ubuntu — just add servers.

Ubuntu Core

My favorite flavor of Ubuntu is Lubuntu because it uses minimal resources and can run on old laptops or workstations.
Lubuntu is a fast and lightweight operating system. The core of the system is based on Linux and Lubuntu. Lubuntu uses the minimal desktop LXDE, and a selection of light applications. We focus on speed and energy-efficiency. Because of this, Lubuntu has very low hardware requirements. Lubuntu was founded by Mario Behling and is currently mainly developed by Julien Lavergne. Please join us and contribute to an exciting International Free and Open Source Software project. Install Lubuntu on your computer and start getting involved. Quick links for direct Downloads of the latest version:

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[Download lubuntu 64-bit (AMD64) desktop CD] [Download Torrent]

PCs with the Windows 8 logo or UEFI firmware, choose the 64-bit download. Visit the help pages for more info about which download is best for you. The section discusses both the standard installs and those required for computers with low memory (RAM), old chipsets (i586) and low disk-space (netbooks).
Hands-on demo of VirtualBox/Lubuntu/MITgcm

or

movies of km-scale global-ocean + tides simulation

(you pick)