

Earth System Modeling Framework

Part II - JMC Code L Baseline: User's Guide

Chris Hill, Stephanie Dutkiewicz, Jean-Michel Campin

NASA High Performance Computing and Communications Program

Earth and Space Sciences Project

CAN 00-OES-01

<http://www.esmf.ucar.edu>

Contents

1	Introduction	2
2	Downloading JMC Code L Baseline Code and Data	2
3	Directory Structure	2
4	Build	2
4.1	System Requirements	3
5	Execution	3
5.1	System Requirements	3
6	Verification	3

1 Introduction

This document provides a brief synopsis of the download, compilation and execution procedure for the the Earth System Modeling Framework (ESMF) JMC Code L Baseline. The code and its time to solution measurements are part of ESMF joint milestone E. Code L is a coupled 2.8° ocean atmosphere configuration of the MIT General Circulation Model (MITgcm). This configuration is actively in use for research into air-sea dynamical and biogeochemical couplings, especially on interannual and greater timescales. Details of the code configuration can be found under the *Applications* link at <http://www.esmf.ucar.edu>. Reference material for the MITgcm code can be found at <http://mitgcm.org> and specific information on the current JMC code L baseline setup and its future evolution over the ESMF project can be found at <http://mitgcm.org/projects/ESMF/JMCLbaseline>.

The baseline configuration provides a starting reference point for a time to solution metric that will be used to evaluate ESMF framework overheads. As the ESMF project progresses, code L will evolve internally and the framework will replace the codes' native infrastructure. Two forms of code L will exist throughout the ESMF project one outside the framework and one that is fully framework compliant. These two forms will be used, all through the ESMF project, to establish that the time to solution, for an identical problem, of the framework compliant code is less than 10% longer than the time to solution for the non-framework form.

The problem used to measure time to solution is a ten-day coupled simulation starting from the saved state of a 50 year coupled spin-up. Subsequent milestones will give the time to solution for both framework and non-framework code. At this stage, prior to the framework development, only a single time to solution is calculated and reported. Section 2 describes downloading Code L Baseline. Sections 4, 5 and 6 describe the steps for compilation, execution and validation of the results. The exact procedures and pathnames described are tailored to the configuration of the NASA Goddard HP Alpha system, halem.gsfc.nasa.gov. However, the code executes on many other platforms and many of the steps are the same for other platforms and systems.

2 Downloading JMC Code L Baseline Code and Data

The JMC Code L Baseline code and data can be downloaded from the download link under <http://mitgcm.org/projects/ESMF/JMCLbaseline>. This link will fetch a compressed tar archive called `JMCLbaseline.tar.gz`. After downloading, this file needs to be uncompressed using the command `gzip -d JMCLbaseline.tar.gz` and its contents extracted using the command `tar -xvf JMCLbaseline.tar` into an appropriate workspace directory (for example a directory under `/work` on the halem.gsfc.nasa.gov system).

3 Directory Structure

The top-level JMC Code L Baseline directory contains `atm`, `ocn`, and `cp1` subdirectories along with scripts and files required to build (`build.sh`), execute in batch (`run.sh`, `tj`, `tj-driver`) and validate (`STDOUT.0000.ref`) the baseline code. The file `README`, also at the top-level, contains details of the contents of each of these directories, files and scripts as well as pointers to the MITgcm release1 documentation (<http://mitgcm.org/sealion>).

4 Build

The script `build.sh` in the JMC Code L Baseline top-level directory creates three executables.

- `ocn/src/tutorial_examples/global_ocean.128x64x15/mitgcmuv` is the executable for the ocean component and is built from sources in sub-directories under `ocn/src`.
- `atm/src/tutorial_examples/aim_51.LatLon/mitgcmuv` is the executable for the atmosphere component and is built from sources in sub-directories under `atm/src`.

- `cpl/src/tutorial_examples/aim.5l_LatLon+global_ocean.128x64x15/mitgcmuv` is the executable for the atmosphere ocean coupling component and is built from sources in sub-directories under `cpl/src`.

The three sets of directories `ocn/src`, `atm/src` and `cpl/src` are all organized using the MITgcm release1 scheme that is described at <http://mitgcm.org/sealion>.

4.1 System Requirements

A Fortran 90 compiler and system library and a compatible MPI library are required to compile and link this code. All routines are in Fortran except for a single timing routine that uses C. This routine requires a C compiler and a C library with the `gettimeofday()` function. Appropriate macros for calling a C procedure with a pointer to a 64-bit float are required and are included for most common platforms.

5 Execution

The script `run.sh` in the JMC Code L Baseline top-level directory is used to run the executables created by `build.sh` (section 4). The script takes the ocean component executable and input files from `ocn/src` and `ocn/input`, the atmosphere component executable and input files from `atm/src` and `atm/input` and the ocean-atmosphere coupling component executable from `cpl/src` and assembles run directories for each component. These directories are called `ocn/run`, `atm/run` and `cpl/run` for the ocean component, atmosphere component and ocean-atmosphere coupling components respectively. After assembling the run directories the `run.sh` script submits a batch job to the **halem.gsfc.nasa.gov** LSF queue system using the **esto-big** queue. The job scripts `tj-driver` and `tj` are used for this procedure. Together, these three scripts launch an MPMD parallel processing MPI job that assigns 8 processes to the atmosphere component, 8 processes to the ocean component and a single process to the ocean-atmosphere coupler component.

5.1 System Requirements

An MPI implementation that provides support for MPMD multi-process execution is required.

6 Verification

After the `run.sh` executes the MPMD coupled simulation, it carries out an output check and extracts timing information to determine time to solution. The output check compares the daily global mean atmospheric potential temperature with a previously stored set of values for this configuration. The previously computed set of values are in the file `STDOUT.0000.ref` in the JMC Code L Baseline top-level directory. These stored values are checked against the time series of mean potential temperature written to the file `atm/run/STDOUT.0000` by the script `run.sh`.

Time to solution information is also extracted from the `atm/run/STDOUT.0000` output file. The compute phase wall-clock time for the 17 processor, 10-day simulation used for the Code L Baseline is converted into a measure of the time required for one year of simulation. This is printed in the summary output file `output.txt`. Startup and shutdown time costs for the code are excluded to avoid skewing short benchmark results with respect to extended simulation performance.