

# Instructions for reproducing ECCO Version 4 Release 4

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## 1 Introduction

The instructions describe how users can reproduce the ECCO Version 4, Release 4 (Fukumori et al., 2019) results that are archived at <https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/>. This document is an updated version of the instructions for reproducing Release 3 (Wang, 2017).

The document is organized as follows. Section 2 describes how to download MITgcm code from MITgcm main CVS repository. Section 3 describes how to obtain patch code for Release 4. Section 4 deals with the forcing, initial condition, and other auxiliary files that are needed to reproduce Release 4. Section 5 talks about how to compile and run the model. Normally, the model should be run non-stop for the whole time period. See more details about how to stop and then restart the model in Section 5.2.1.

## 2 Download source code

V4r4 was produced using the MITgcm code checkpoint66g that can be obtained from the MITgcm code repository on GitHub. The reason that we are not using the latest MITgcm code is that the code is evolving and checkpoint66g was the version used to produce V4r4.

First create a working directory, say, called WORKINGDIR. All directories and files downloaded thereof will be under WORKINGDIR.

```
mkdir WORKINGDIR  
cd WORKINGDIR
```

Then we clone the MITgcm checkpoint66g:

```
git clone https://github.com/MITgcm/MITgcm.git -b checkpoint66g
```

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Although not recommended, one could also download the source code from MITgcm cvs server. For bash or sh shell:

```
$ export CVSR00T=':pserver:cvsanon@mitgcm.org:/u/gcmpack'
$ cvs login
  ( enter the CVS password: "cvsanon" )
$ cvs co -P -r checkpoint66g MITgcm_code
```

tcsh or csh shell:

```
$ setenv CVSR00T ':pserver:cvsanon@mitgcm.org:/u/gcmpack'
$ cvs login
  ( enter the CVS password: "cvsanon" )
$ cvs co -P -r checkpoint66g MITgcm_code
```

### 3 Release 4 specific code

The Release 4 specific code is archived on GitHub and can be retrieved as follows:

```
cd MITgcm
mkdir -p ECCOV4/release4
cd ECCOV4/release4
git clone https://github.com/ECCO-GROUP/ECCO-v4-Configurations.git
mv ECCO-v4-Configurations/ECCOV4\ Release\ 4/code .
rm -rf ECCO-v4-Configurations
```

Alternatively, the patch code can be downloaded from MITgcm CVS repository by replacing the wget command with the following:

```
cvs co -P MITgcm_contrib/ecco_utils/ecco_v4_release4_devel/code
mv MITgcm_contrib/ecco_utils/ecco_v4_release4_devel/code .
\rm -rf MITgcm_contrib
```

### 4 Forcing and other input files

The forcing and other input files are stored on Release 4's data server at <https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/>.

Due to NASA's mandate to disallow the use of the ftp protocol for data access, ECCO's anonymous ftp server <ftp://ecco.jpl.nasa.gov> has been replaced by a WebDAV server called ECCO Drive at <https://ecco.jpl.nasa.gov/drive/files>. Each user must first register for an Earthdata account at <https://urs.earthdata.nasa.gov/users/new> in order to access the ECCO products.

ECCO Drive offers a familiar interface for users to browse and download data through their browser. Additionally, ECCO's WebDAV interface allows you to connect to ECCO as if it were a local drive on your computer. It also allows users

to access data via a command line interface, enabling scripted data extracting. A detailed help page can be found at <https://ecco.jpl.nasa.gov/drive/help>.

The required forcing and other input files can be downloaded using the following commands:

```
wget -r --no-parent --user YOURUSERNAME --ask-password \  
https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/input_forcing  
wget -r --no-parent --user YOURUSERNAME --ask-password \  
https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/input_init  
wget -r --no-parent --user YOURUSERNAME --ask-password  
https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/input_ecco
```

Replace YOURUSERNAME with your own Earthdata username. When prompted for password, you need to enter your ECCO Drive's WebDAV password, not your Earthdata account's password. To obtain the WebDAV password, log in with your Earthdata account from a web browser to <https://ecco.jpl.nasa.gov/drive>. Once successfully log in, you will be re-directed to the page of your WebDAV/Programmatic API credentials. Your ECCO Drive's WebDAV password is in the second box from top. This is the password that you would use for the wget command.

The total size of the forcing and other input files is about 200GB. All forcing and input files are necessary to reproduce Release 4.

## 4.1 Diagnostic output

Release 4 specifies a list of core diagnostic products in [https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/input\\_init/NAMELIST/data.diagnostics](https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/input_init/NAMELIST/data.diagnostics) that one can use to close property budgets for heat, salt, mass, volume, and momentum. A full list of pre-defined diagnostics variables is available at [https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/doc/available\\_diagnostics.log](https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/doc/available_diagnostics.log) Chapter 7 of the MITgcm manual, titled "Diagnostics and I/O - Packages II, and Post-Processing Utilities", available at [http://mitgcm.org/public/r2\\_manual/latest/online\\_documents/node264.html](http://mitgcm.org/public/r2_manual/latest/online_documents/node264.html), gives instructions about how to output different diagnostic variables, change the time-averaging period and vertical levels, and even define a new diagnostic variable.

## 5 Compile and run

The compilation and run of the model are compiler and platform specific. Given below is an example to compile and run the code on NASA Ames' Pleiades.

### 5.1 Compile

The example given here is to compile the code on NASA Ames' Pleiades. Before compiling the code and running the model, one has to load the required modules, including compiler and netCDF packages, with the following commands:

```

module purge
module load comp-intel/2018.3.222
module load mpi-hpe/mpt.2.21
module load mathematica/11.0.0
module load hdf4/4.2.12 hdf5/1.8.18_mpt netcdf/4.4.1.1_mpt
module list

```

The modules listed above are the current versions of the available modules on Pleiades as of October 26, 2020. It is recommended to use newer versions of modules when they become available.

The commands to compile are listed below. The set of build options is specified in the file

```

../../../../tools/build_options/linux_amd64_ifort+mpi_ice_nas

```

A different set of build options may be required for other machines. Sets of build options for various platforms and compilers have been provided in MITgcm/tools/build\_options. Users may need to create their own build options that are deemed suitable to their unique platform and/or compilers.

```

cd MITgcm/ECCOV4/release4
mkdir build
cd build
../../../../tools/genmake2 -mods=../code -optfile=../../../../tools/
  build_options/linux_amd64_ifort+mpi_ice_nas -mpi
make depend
make all
cd ..

```

If compiled successfully, the executable will be `./build/mitgcmuv`.

## 5.2 Run

Below is an example of the run script for Pleiades. The run directory will be `MITgcm/ECCOV4/release4/run/`. This run script will reproduce v4r4's 26-yr results from 1992 through 2017 without stopping. The requested wall clock time in the script is set to 24 hours

```

#!/PBS -l walltime=24:00:00

```

in the run script. While the requested time of 24 hours is usually sufficient to finish V4r4's 26-year model integration time period on Pleiades with the provided `data.diagnostics` files, one may have to increase the time if to run the job on a different machine or to output significantly more model diagnostics.

```

#!/PBS -S /bin/csh
#!/PBS -l select=4:ncpus=24:model=has
#!/PBS -l walltime=24:00:00
#!/PBS -j oe

```

```

#PBS -o ./
#PBS -m bea

limit stacksize unlimited
module purge
module load comp-intel/2018.3.222
module load mpi-hpe/mpt.2.21
module load mathematica/11.0.0
module load hdf4/4.2.12 hdf5/1.8.18_mpt netcdf/4.4.1.1_mpt
module list

setenv LD_LIBRARY_PATH ${LD_LIBRARY_PATH}
setenv FORT_BUFFERED 1
setenv MPI_BUFS_PER_PROC 128
setenv MPI_DISPLAY_SETTINGS

set nprocs = 96
set basedir = ./
set inputdir = ./ecco.jpl.nasa.gov/drive/files/Version4/Release4/
if ( -d ${basedir}/run) then
echo 'Directory ' ${basedir} '/run exists.'
echo 'Please remove it and re-submit the job.'
exit 1
endif
mkdir ${basedir}/run
cd ${basedir}/run

ln -s ${inputdir}/input_init/NAMELIST/* .
ln -s ${inputdir}/input_init/error_weight/ctrl_weight/* .
ln -s ${inputdir}/input_init/error_weight/data_error/* .
ln -s ${inputdir}/input_init/* .
ln -s ${inputdir}/input_init/tools/* .
ln -s ${inputdir}/input_ecco/** .
ln -s ${inputdir}/input_forcing/eccov4r4* .

python mkdir_subdir_diags.py

cp -p ../build/mitgcmuv .
mpiexec -np ${nprocs} dplace ./mitgcmuv

```

### 5.2.1 Stop and restart a run

Normally, the model should be run non-stop for the whole time period. If one has to stop and then restart the model for any reason, for each restart one has to set the correct time step and to disable the initial UVTS and ssh control adjustments, which essentially involves modification of the two namelist files:

data and data.ctrl. Note that the pickup file where the model stops should have been generated with v4r4's configuration. When one restarts the model, the run directory should contain a copy of or a link to this pickup file.

To set the correct time step number for the restart, one has to set the variable "nIter0" in the namelist file "data" to the number of time step at which the model stopped previously.

For users' convenience, a version of the namelist file "data.ctrl" that disables the initial control adjustments is provided in [https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/input\\_init/NAMELIST/data.ctrl.restart](https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/input_init/NAMELIST/data.ctrl.restart). When to restart the model, one can unlink data.ctrl and rename/copy data.ctrl.restart to data.ctrl.

## 6 Concluding remarks

If there are any questions, please contact us at [ecco-support@mit.edu](mailto:ecco-support@mit.edu) (please subscribe via <http://mailman.mit.edu/mailman/listinfo/ecco-support>)

## 7 Acknowledgement

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## 8 References

- Fukumori, I., O. Wang, I. Fenty, G. Forget, P. Heimbach, and R. M. Ponte 2019: ECCO Version 4 Release 4 Notes. Available at [https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/doc/v4r4\\_synopsis.pdf](https://ecco.jpl.nasa.gov/drive/files/Version4/Release4/doc/v4r4_synopsis.pdf).
- Wang, O., I. Fukumori, and I. Fenty, 2017: An Overview of ECCO Version 4 Release 3's ftp site [https://ecco.jpl.nasa.gov/drive/files/Version4/Release3/doc/v4r3\\_overview.pdf](https://ecco.jpl.nasa.gov/drive/files/Version4/Release3/doc/v4r3_overview.pdf).