

GEOS-Chem Reference, Volume 1: Makefiles

GEOS-CHEM SUPPORT TEAM

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1 Routine/Function Prologues

1.1 Module Interface Makefile (Main-level)

This is a "router" makefile. It calls the main GEOS-Chem Makefile (in the GeosCore sub-directory) to direct the Unix "make" utility how to build the GEOS-Chem source code.

REMARKS:

To build the programs, call "make" with the following syntax:

```
make -jN TARGET REQUIRED-FLAGS [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

Makefile uses the following variables:

Variable	Description
-----	-----
GEOSAPM	Specifies the directory where GEOS-Chem + APM routines are found
GEOSDIR	Specifies the directory where GEOS-Chem "core" routines are found
GTMM	Specifies the directory where the GTMM routines are found

REVISION HISTORY:

```
16 Sep 2009 - R. Yantosca - Initial version
24 Nov 2009 - R. Yantosca - Now call libbpch and libcore targets in
                           the Makefile in the GeosCore sub-directory
11 Dec 2009 - R. Yantosca - Now get SHELL from Makefile_header.mk
25 Jan 2010 - R. Yantosca - Added Makefile targets for TOMAS microphysics
16 Feb 2011 - R. Yantosca - Added Makefile targets for APM microphysics
04 Nov 2011 - R. Yantosca - Remove ESMF targets, those are not needed
24 Jan 2012 - R. Yantosca - Also add libnc target to build netCDF utils
11 May 2012 - R. Yantosca - Now make sure that all targets of the
                           GeosCore/Makefile are pointed to properly
20 Aug 2013 - R. Yantosca - Make sure Makefile names are consistent
18 Sep 2013 - R. Yantosca - Remove GeosTomas, that is now gone
18 Sep 2013 - M. Long      - Add Makefile target "hpc"
15 Jan 2014 - R. Yantosca - Updated comments
```

1.1.1 Makefile_header.mk

This sub-makefile defines the variables which specify compilation options for the different supported compiler/platform combinations. Also, the default makefile compilation rules are specified here.

REMARKS:

To build the programs, call "make" with the following syntax:

`make -jN TARGET REQUIRED-FLAGS [OPTIONAL-FLAGS]`
 To display a complete list of options, type "make help".

The following variables are exported to the main-level Makefile:

Variable	Description
-----	-----
CC	Contains the default C compilation commands (for PGI only)
F90	Contains the Fortran compilation commands
FREEFORM	Contains the command to force F90 "free format" compilation
LD	Contains the command to link to libraries & make executable
LINK	Contains the commands to link to GEOS-Chem built libraries
R8	Contains the command to force REAL -> REAL*8
SHELL	Contains the default Unix shell to use when building code
NCL	Contains the default netCDF library link commands

FFLAGS is a local variable that is not returned to the "outside world", but is only used locally. COMPILER, HDF5, and OMP are all input via the command line or via environment variables.

NOTE: We now use `SHELL :=/bin/bash` as the default Unix shell. This allows us to extend the Makefile ifeq statements so that we can test for more than one string. The following example is used to ensure that the met field name selected by the user is case-insensitive:

```
# %%%% GEOS-5 %%%%
REGEXP      :=((^[Gg][Ee][Oo][Ss])?5|.5)
ifeq ($(shell [[ "$(MET)" =~ $(REGEXP) ]] && echo true),true)
USER_DEFS += -DGEOS_5
endif
```

The `[[]]` in bash is an evaluation. The above ifeq statement uses regular expressions to test if the MET variable matches the string "GEOS" (case-insensitive) and either "5" or "any character and then a 5". This will return true (via the "echo true" statement) for combinations like "GEOS-5", "geos5", "Geos-5", "GeOs.5", etc. This is a robust way of evaluating the user's input, and will make errors less likely.

REVISION HISTORY:

```
16 Sep 2009 - R. Yantosca - Initial version
22 Sep 2009 - R. Yantosca - Bug fix, added -I$(HDR) to F90 compilation lines
24 Sep 2009 - R. Yantosca - added NONUMA option for PGI compiler
07 Oct 2009 - R. Yantosca - Replaced .SUFFIXES section w/ pattern rules
19 Nov 2009 - R. Yantosca - Now use OMP variable to determine whether to
                           turn on OpenMP parallelization options
23 Nov 2009 - R. Yantosca - Now use -module $(MOD) instead of -I$(MOD) to
                           specify the directory for *.mod files on both
```

IFORT and PGI compilers.

23 Nov 2009 - R. Yantosca - Now use -moddir=\$(MOD) and -M\$(MOD) instead of -I\$(MOD) to specify the directory for *.mod files on the SunStudio compiler.

23 Nov 2009 - R. Yantosca - Change DEBUG to allow for new version of Totalview which doesn't choke when debugging parallel code (Totalview 8.6.1-1)

02 Dec 2009 - R. Yantosca - Added SUN32 switch for building 32-bit executable on the SunStudio compiler

11 Dec 2009 - R. Yantosca - Now define SHELL here and export to other Makefiles, so as to have a single place where the Unix shell name is defined.

21 Dec 2009 - R. Yantosca - Add H5I and H5L variables to specify the HDF5 library and include paths. Also set the default to not link to the HDF5 libraries.

21 Dec 2009 - R. Yantosca - Now pass LINK back to the outside world, so that the Makefile that builds the executable can reference it.

19 Jan 2010 - R. Yantosca - Minor fix, add -m64 if SUN32 is not defined.

25 Jan 2010 - R. Yantosca - Now add -DTOMAS to FFLAGS if necessary

28 Jan 2010 - C. Carouge - Add -lisoropia to LINK, for ISORROPIA II

16 Feb 2011 - R. Yantosca - Now add -DAPM to FFLAGS if necessary

25 Aug 2011 - R. Yantosca - Add "-fp-model source" to FFLAGS for IFORT compiler. This will prevent aggressive optimizations from changing numerical results.

25 Aug 2011 - R. Yantosca - Add -CU (check for uninit'd variables) to FFLAGS when using IFORT w/ the DEBUG option.

26 Aug 2011 - R. Yantosca - Allow for deactivation of the "-fp-model source" option by using the PRECISE=no env variable

24 Jan 2012 - R. Yantosca - If NETCDF=yes, GEOS-Chem will link and include to the netCDF dir paths that are specified

24 Jan 2012 - R. Yantosca - Now use := for makefile assignment statements

10 Feb 2012 - R. Yantosca - When compiling with NETCDF=yes or HDF5=yes, we must also add the flags -mcmmodel=medium -i-dynamic to FFLAGS in order to avoid memory errors (for IFORT only)

10 Feb 2012 - R. Yantosca - Remove -CU from the DEBUG option (IFORT only)

19 Mar 2012 - R. Yantosca - Add optional NO_ISO switch, which will turn off the ISORROPIA ATE package for testing

05 Apr 2012 - R. Yantosca - Now assume netCDF is always used

05 Apr 2012 - R. Yantosca - Change BL_INC_NETCDF to INC_NETCDF

05 Apr 2012 - R. Yantosca - Change BL_INC_HDF5 to INC_HDF5

05 Apr 2012 - R. Yantosca - Change BL_LIB_NETCDF to LIB_NETCDF

05 Apr 2012 - R. Yantosca - Change BL_LIB_HDF5 to LIB_HDF5

30 Apr 2012 - R. Yantosca - Add NETCDF3=[yes|no] makefile option

30 Apr 2012 - R. Yantosca - Use separate netCDF link and include paths for netCDF3 and for netCDF4

30 Apr 2012 - R. Yantosca - Also add -mcmmodel=medium flag for PGI compiler

```

09 May 2012 - R. Yantosca - Now try to get the proper linking sequence
                        for netCDF etc w/ nf-config and nc-config.
11 May 2012 - R. Yantosca - Now export NCL (netCDF linking sequence)
07 Sep 2012 - R. Yantosca - Now add OPT variable to set global opt levels
07 Sep 2012 - R. Yantosca - Also set TRACEBACK for PGI compiler
17 Apr 2013 - R. Yantosca - Add switch to set -DKPP_SOLVE_ALWAYS, which
                        will force KPP to get past nonconvergences
25 Feb 2013 - S. Farina  - Add flag for TOMAS40
22 Apr 2013 - R. Yantosca - TOMAS40=yes option now sets -DTOMAS -DTOMAS40
28 Apr 2013 - S. Farina  - Add flags for TOMAS15 and TOMAS12
13 Aug 2013 - R. Yantosca - Removed "define.h"; now set all GEOS-Chem
                        user options via the Make command
14 Aug 2013 - R. Yantosca - Now use regular expressions to test the
                        validity of command-line inputs
21 Aug 2013 - R. Yantosca - Improved error checking for command line inputs
26 Aug 2013 - R. Yantosca - Add -debug all as an IFORT debugging option
16 Sep 2013 - R. Yantosca - Now set GIGC Cpp switches first. This allows
                        us to skip the GRID setting if we are using
                        EXTERNAL_GRID=yes or EXTERNAL_FORCING=yes.
18 Sep 2013 - M. Long    - Add edits for HPC Grid-Independent GEOS-Chem
26 Sep 2013 - R. Yantosca - MET=geosfp now sets Cpp switch w/ -DGEOS_FP
07 Nov 2013 - R. Yantosca - NEST=se to now sets CPP switch w/ -DNESTED_SE
08 Nov 2013 - R. Yantosca - Add FPEX flag to avoid conflicting with the
                        ESMF/MAPL environment variable FPE

```

1.2 Module Interface Makefile (in the GeosUtil subdirectory)

This makefile compiles the various GEOS-Chem utility modules, which provide basic functionality for:

- Collapsing vertical levels in the stratosphere
- Date and time computations
- Defining data directories
- Defining the GEOS-Chem horizontal grid
- Defining the GEOS-Chem pressure coordinate grid
- Defining the logical units for GEOS-Chem file I/O
- Defining various Unix commands
- Platform-specific error handling
- Manipulating string variables
- Regridding data (horizontally) from fine to coarse resolution

REMARKS:

To build the programs, call "make" with the following syntax:

```
make -jN TARGET REQUIRED-FLAGS [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% NOTE: Normally you will not have to call this Makefile directly,  %%
%% it will be called automatically from the Makefile in the directory  %%
%% just above this one!                                             %%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Makefile uses the following variables:

Variable	Description
-----	-----
SHELL	Specifies the shell for "make" to use (usually SHELL=/bin/sh)
ROOTDIR	Specifies the root-level directory of the GEOS-Chem code
HDR	Specifies the directory where GEOS-Chem include files are found
LIB	Specifies the directory where library files (*.a) are stored
MOD	Specifies the directory where module files (*.mod) are stored
AR	Sys var w/ name of library creator program (i.e., "ar", "ranlib")
MAKE	Sys var w/ name of Make command (i.e, "make" or "gmake")

REVISION HISTORY:

```
19 Nov 2009 - R. Yantosca - Initial version
23 Nov 2009 - R. Yantosca - Now don't copy module files; they will be
                           automatically written to the mod directory
11 Dec 2009 - R. Yantosca - Now get SHELL from Makefile_header.mk
21 Dec 2009 - R. Yantosca - If HDF5=yes, then look for hdf5.mod in the
                           HDF5 include path $(HDF5_INC).
01 Mar 2012 - R. Yantosca - Replace grid_mod.F with grid_mod.F90, to
                           facilitate work on the GI model
03 Apr 2012 - M. Payer    - Add new module regrid_a2a_mod.F90 (M. Cooper)
03 Aug 2012 - R. Yantosca - Add dependency for inquireMod.F90
```

1.3 Module Interface Makefile (in the ISOROPIA/ subdirectory)

This makefile compiles the ISOROPIA code. Object files (*.o) are bundled into the libIsoropia.a library (located in the LIB directory). Module files (*.mod) are copied to the MOD directory.

REMARKS:

To build the programs, call "make" with the following syntax:

%% from the router Makefile in the top-level directory. However, if %%
 %% you are in the ./GeosCore directory, then you can call this Makefile %%
 %% to build the GEOS-Chem source code, libraries, and executables. %%
 %%

Makefile uses the following variables:

Variable	Description
-----	-----
SHELL	Specifies the shell for "make" to use (usually SHELL=/bin/sh)
ROOTDIR	Specifies the root directory for the GEOS-Chem code
BIN	Specifies the directory where executable files are stored
BPCH	Specifies the directory where the G-C bpch routines are stored
DOC	Specifies the directory for generating documentation w/ ProTeX
EXE	Specifies the name of the executable file
HDR	Specifies the directory where include files are found
LIB	Specifies the directory where library files (*.a) are stored
LINK	Specifies the link commands to the GEOS-Chem library files
KPP	Specifies the directory where the KPP solver files reside
MOD	Specifies the directory where module files (*.mod) are stored
NCDF	Specifies the directory where netCDF utilities are stored
OBJ	Specifies the list of object files (*.o) to be created.
UTIL	Specifies the directory where the G-C utility modules are found
AR	Sys var w/ name of library creator program (i.e., "ar", "ranlib")
MAKE	Sys var w/ name of Make command (i.e., "make" or "gmake")
NTRAC	Cmd line argument; specifies either 43 or 54 tracer simulation
KPPSOLVER	Cmd line argument; specifies the type of integrator to use

NOTE: CC, F90, FREEFORM, LD, R8 are included from "Makefile_header.mk".

%%%
 %% You can compile GEOS-Chem in parallel using the "make -jN" option! %%
 %%
 %% N = number of processes that you want to run simultaneously (i.e. %%
 %% (when one file is finished compiling, "make" will immediately start %%
 %% on the next one). Usually N is the # of processors on your system. %%
 %%

REVISION HISTORY:

- 16 Sep 2009 - R. Yantosca - Initial version
- 18 Sep 2009 - P. Le Sager - Removed -lKppInt
- 21 Sep 2009 - R. Yantosca - Now call Makefile in help directory to display the help screen options
- 19 Nov 2009 - R. Yantosca - Now compile the various GEOS-Chem utility modules in the GeosUtil subdirectory
- 19 Nov 2009 - R. Yantosca - Now compile the GEOS-Chem bpch module separately in the GeosBpch subdirectory
- 19 Nov 2009 - R. Yantosca - Now list all object dependencies explicitly,

to be able to use "make -j" (parallel make)

23 Nov 2009 - R. Yantosca - Remove "main.o" explicitly form the "exe" makefile target. This will be now compiled in the proper sequence given the dependency ordering. This allows "make -j" to work.

23 Nov 2009 - R. Yantosca - Now don't copy module files; they will be automatically written to the mod directory

23 Nov 2009 - R. Yantosca - Removed libbpch; bundled that into libutil

23 Nov 2009 - R. Yantosca - Added separate target libcore. lib is now a synonym for "libkpp libutil libcore"

01 Dec 2009 - R. Yantosca - Modified the "exe" target for SunStudio compiler which chokes at link time if the list of object files is not explicitly passed

02 Dec 2009 - R. Yantosca - Add conditional statements in dependencies list for the SunStudio compiler

11 Dec 2009 - R. Yantosca - Now get SHELL from Makefile_header.mk

21 Dec 2009 - R. Yantosca - Now get LINK from Makefile_header.mk

25 Jan 2010 - R. Yantosca - When making "realclean", also call "clean" in the \$(GEOSTOM)/Makefile. Also make sure to remove executables in the \$(BIN) directory.

28 Jan 2010 - C. Carouge - Modifications for ISORROPIA II

08 Feb 2010 - C. Carouge - Modifications for F. Paulot's isoprene scheme

10 May 2010 - R. Yantosca - Add dependency for RD_AOD.f

14 May 2010 - C. Carouge - Updates for mercury simulation

20 Aug 2010 - R. Yantosca - Modifications for MERRA met fields

16 Feb 2011 - R. Yantosca - Add modifications for APM (G. Luo)

05 Aug 2011 - M. Long - Now compile module files in Headers/ directory

04 Nov 2011 - R. Yantosca - Remove references to ESMF subdirectory

08 Dec 2011 - M. Payer - Remove obsolete GEIA biogenic emissions routines

24 Jan 2012 - R. Yantosca - Also add libnc target to build netCDF utils

25 Jan 2012 - R. Yantosca - Add ncdftime target to check netCDF install

05 Apr 2012 - R. Yantosca - Now assume netCDF will always be used

05 Apr 2012 - R. Yantosca - Now retire rdlai.F, readlai.F

11 Apr 2012 - R. Yantosca - Now retire obsolete lai_mod.F

11 Apr 2012 - R. Yantosca - Reference modis_lai_mod.F90 in timeseries diag

11 Apr 2012 - R. Yantosca - Remove all references to obsolete lai_mod.F

12 Apr 2012 - R. Yantosca - Remove reference to findmon.F

19 Apr 2012 - R. Yantosca - Remove reference to rd_prof.F

30 Oct 2012 - R. Yantosca - Remove reference to rdsoil.F

27 Nov 2012 - R. Yantosca - Remove reference to getifsun.F

30 May 2013 - R. Yantosca - Remove reference to GEOS-3 TPCORE routines

13 Aug 2013 - M. Sulprizio - Remove reference to soaprod_mod.F (no longer needed) (SOAupdate, hotp 7/25/10)

20 Aug 2013 - R. Yantosca - Make sure Makefile target names are consistent

20 Sep 2013 - R. Yantosca - Bug fix for make realclean: Don't try to make clean unless we compile for target hpc

27 Jan 2014 - R. Yantosca - Add tomas_mod.o to wetscav_mod dependency list

03 Feb 2014 - R. Yantosca - Add linoz_mod.o to input_mod.o dependency list

1.5 Module Interface Makefile (in the KPP subdirectory)

This is main "router" makefile for the KPP solver. It compiles the KPP code for one of the following types of GEOS-Chem simulations:

1. GEOS-Chem "standard" simulation (43 tracers)
2. GEOS-Chem "secondary organic aerosol" simulation (54 tracers)

The KPP code will be compiled using one of the following numerical solvers:

1. rosenbrock (This is the default option.)
2. lsodes
3. radau5
4. runge_kutta

REMARKS:

To build the programs, call "make" with the following syntax:

```
make -jN TARGET REQUIRED-FLAGS [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% NOTE: Normally you will not have to call this Makefile directly, %%
%% it will be called automatically from the main GEOS-Chem Makefile in %%
%% GeosCore directory! %%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Makefile uses the following variables:

Variable	Description
-----	-----
SHELL	Specifies the shell for "make" to use (usually SHELL=/bin/sh)
ROOTDIR	Specifies the root-level directory of the GEOS-Chem code
DOC	Specifies the directory where GEOS-Chem documentation is found
HDR	Specifies the directory where GEOS-Chem include files are found
LIB	Specifies the directory where library files (*.a) are stored
MOD	Specifies the directory where module files (*.mod) are stored
AR	Sys var w/ name of library creator program (i.e., "ar", "ranlib")
MAKE	Sys var w/ name of Make command (i.e., "make" or "gmake")
NTRAC	Cmd line argument; specifies either 43 or 54 tracer simulation
KPPSOLVER	Cmd line argument; specifies the type of integrator to use

REVISION HISTORY:

23 Nov 2009 - R. Yantosca - Now don't copy module files; they will be
 automatically written to the mod directory
 11 Dec 2009 - R. Yantosca - Now get SHELL from Makefile_header.mk

1.7 Module Interface Makefile (in the KPP/SOA subdirectory)

This makefile compiles the KPP solver code for the GEOS-Chem SOA simulation (with aromatic formation of secondary organic aerosol tracers). Object files (*.o) are bundled into the libKpp.a library (located in the LIB directory). Module files (*.mod) are copied to the MOD directory.

REMARKS:

To build the programs, call "make" with the following syntax:

```
make -jN TARGET REQUIRED-FLAGS [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% NOTE: Normally you will not have to call this Makefile directly,  %%
%% it will be called automatically from the Makefile in the directory %%
%% just above this one!                                             %%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Makefile uses the following variables:

Variable	Description
-----	-----
SHELL	Specifies the shell for "make" to use (usually SHELL=/bin/sh)
ROOTDIR	Specifies the root-level directory of the GEOS-Chem code
HDR	Specifies the directory where GEOS-Chem include files are found
LIB	Specifies the directory where library files (*.a) are stored
MOD	Specifies the directory where module files (*.mod) are stored
AR	Sys var w/ name of library creator program (i.e., "ar", "ranlib")
MAKE	Sys var w/ name of Make command (i.e, "make" or "gmake")

REVISION HISTORY:

16 Sep 2009 - R. Yantosca - Initial version
 21 Sep 2009 - R. Yantosca - Now call Makefile in help directory to
 display the help screen options
 23 Nov 2009 - R. Yantosca - Now don't copy module files; they will be
 automatically written to the mod directory
 11 Dec 2009 - R. Yantosca - Now get SHELL from Makefile_header.mk

1.8 Module Interface Makefile (in the GTMM subdirectory)

This is main "router" makefile for the GTMM model. It compiles the GTMM code for GEOS-Chem mercury simulations. **REMARKS:**

To build the programs, call "make" with the following syntax:

```
make -jN TARGET REQUIRED-FLAGS [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% NOTE: Normally you will not have to call this Makefile directly,    %%
%% it will be called automatically from the main GEOS-Chem Makefile in  %%
%% GeosCore directory!                                                %%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Makefile uses the following variables:

Variable	Description
-----	-----
SHELL	Specifies the shell for "make" to use (usually SHELL=/bin/sh)
ROOTDIR	Specifies the root-level directory of the GEOS-Chem code
DOC	Specifies the directory where GEOS-Chem documentation is found
HDR	Specifies the directory where GEOS-Chem include files are found
LIB	Specifies the directory where library files (*.a) are stored
MOD	Specifies the directory where module files (*.mod) are stored
AR	Sys var w/ name of library creator program (i.e., "ar", "ranlib")
MAKE	Sys var w/ name of Make command (i.e, "make" or "gmake")

REVISION HISTORY:

```
16 Sep 2009 - R. Yantosca - Initial version
18 Sep 2009 - P. Le Sager - Added kppintegrator target & commented
                        "make -C int" calls
21 Sep 2009 - C. Carouge - Adapted to use with GTMM model.
```

1.9 Module Interface Makefile (in doc subdirectory)

Makefile for building the documentation (in PDF and PostScript formats) for the GEOS-Chem model source code, makefiles, and related scripts.

REMARKS:

To build the documentation, call "make" with the following syntax:

```
make -jN TARGET REQUIRED-FLAGS [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

You must have the LaTeX utilities (latex, dvips, dvipdf) installed on your system in order to build the documentation.

REVISION HISTORY:

16 Sep 2009 - R. Yantosca - Initial version
 21 Sep 2009 - R. Yantosca - Now call Makefile in help directory to display the help screen options
 19 Nov 2009 - R. Yantosca - Now build documentation for Makefiles in the GeosUtil and GeosCore subdirectories
 11 Dec 2009 - R. Yantosca - Now get SHELL from Makefile_header.mk
 28 Jan 2010 - R. Yantosca - Now add the Makefiles in the GeosTomas and ISOROPIA subdirs to the documentation
 27 Aug 2010 - R. Yantosca - Brought up to date for newly documented code
 31 Aug 2010 - R. Yantosca - Add documentation for GTMM routines
 14 Sep 2010 - R. Yantosca - Now split make commands into include files
 20 Aug 2013 - R. Yantosca - Remove GeosTomas directory, that is obsolete

1.9.1 Makefile_SrcDoc.mk (in doc subdirectory)

This Makefile fragment contains commands to build the documentation for the GEOS-Chem Source Code. It is inlined into the Makefile (in the doc subdirectory) by an "include" command.

REMARKS:

To build the documentation, call "make" with the following syntax:

```
make TARGET [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

You must have the LaTeX utilities (latex, dvips, dvipdf) installed on your system in order to build the documentation.

REVISION HISTORY:

14 Sep 2010 - R. Yantosca - Initial version, split off from Makefile
 14 Sep 2010 - R. Yantosca - Added optdepth_mod.f to list
 15 Sep 2010 - R. Yantosca - Added diag_2pm, diag_56, diagoh, ohsave
 16 Sep 2010 - R. Yantosca - Added diag_pl_mod
 04 Nov 2010 - R. Yantosca - Added acetone_mod
 10 Nov 2010 - R. Yantosca - Added lightning_nox_mod
 19 Nov 2010 - R. Yantosca - Added anthroems, RnPbBe_mod, tagged_ox_mod
 19 Nov 2010 - R. Yantosca - Added tcorr, emfossil, emf_scale
 01 Dec 2010 - R. Yantosca - Added global_br_mod, global_no3_mod
 01 Dec 2010 - R. Yantosca - Added global_nox_mod, global_old_mod

01 Dec 2010 - R. Yantosca - Added global_oh_mod, toms_mod
 02 Dec 2010 - R. Yantosca - Added upbdflex_mod, diag41_mod, diag42_mod
 02 Dec 2010 - R. Yantosca - Added diag03_mod, diag49_mod, diag50_mod
 02 Dec 2010 - R. Yantosca - Added diag51_mod, diag51b_mod, boxvl, rdmonot
 02 Dec 2010 - R. Yantosca - Added rdlight, rdland, rdsoil, emmonot
 16 Dec 2010 - R. Yantosca - Renamed output files to "GC_Ref_Vol_3.*"\n
 21 Dec 2010 - R. Yantosca - Added comode_mod
 11 Jul 2011 - R. Yantosca - Added restart_mod
 19 Jul 2011 - R. Yantosca - Changed *.f* to *.F* for ESMF compatibility
 29 Jul 2011 - R. Yantosca - Added planeflight_mod
 22 Aug 2011 - R. Yantosca - Added retro_mod
 07 Sep 2011 - R. Yantosca - Added gfed3_biomass_mod, *jv*_mod files
 22 Dec 2011 - M. Payer - Added aerosol_mod, drydep_mod, seasalt_mod,
 and sulfate_mod
 07 Feb 2012 - M. Payer - Added paranox_mod, diag63_mod
 08 Feb 2012 - R. Yantosca - Added geos57_read_mod.F90
 28 Feb 2012 - R. Yantosca - Added pbl_mix_mod
 05 Mar 2012 - M. Payer - Added tracer_mod
 06 Mar 2012 - R. Yantosca - Added photoj.F and set_prof.F
 07 Mar 2012 - M. Payer - Added global_ch4_mod
 19 Mar 2012 - M. Payer - Added EF_MGN20_mod
 22 Mar 2012 - M. Payer - Added c2h6_mod, olson_landmap_mod
 29 Mar 2012 - R. Yantosca - Added lai_mod
 29 Mar 2012 - R. Yantosca - Added modis_lai_mod and mapping_mod
 09 Apr 2012 - R. Yantosca - Added modules from Headers/ directory
 13 Apr 2012 - R. Yantosca - Removed findmon.F, rdlai.F, lai_mod.F
 19 Apr 2012 - R. Yantosca - Added read_jv_atms_dat.F90
 15 May 2012 - R. Yantosca - Added tpcore_bc_mod.F
 22 May 2012 - M. Payer - Add bromocarb_mod.F, cldice_HBrHBr_rxn.F,
 and ssa_bromine_mod.F
 31 Jul 2012 - R. Yantosca - Added FAST-J routines etc.
 03 Aug 2012 - R. Yantosca - Added benchmark_mod, etc.
 06 Aug 2012 - R. Yantosca - Added gcap_read_mod, etc.
 14 Aug 2012 - R. Yantosca - Added gc_environment_mod, etc.
 23 Oct 2012 - R. Yantosca - Added modules in ESMF
 23 Oct 2012 - R. Yantosca - Added tagged_co_mod
 23 Oct 2012 - M. Payer - Added soil NOx modules; Removed upbdflex_mod.F
 27 Nov 2012 - M. Payer - Added modules for POPs simulation
 13 Dec 2012 - R. Yantosca - Added biofit, sunparam, and removed some
 obsolete functions
 22 Jul 2013 - M. Sulprizio- Added rcp_mod
 01 Aug 2013 - M. Sulprizio- Added aeic_mod
 20 Aug 2013 - M. Sulprizio- Added carbon_mod
 20 Aug 2013 - R. Yantosca - Remove reference to "define.h"
 05 Sep 2013 - M. Sulprizio- Added global_hno3_mod
 15 Jan 2014 - R. Yantosca - Now only create *.pdf file output
 25 Feb 2014 - M. Sulprizio- Added a3_read_mod, a6_read_mod, and i6_read_mod

1.9.2 Makefile_UtilDoc.mk (in doc subdirectory)

This Makefile fragment contains commands to build the documentation for the GEOS-Chem utility modules. It is inlined into the Makefile (in the doc subdirectory) by an "include" command.

REMARKS:

To build the documentation, call "make" with the following syntax:

```
make TARGET [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

You must have the LaTeX utilities (latex, dvips, dvipdf) installed on your system in order to build the documentation.

REVISION HISTORY:

14 Sep 2010 - R. Yantosca - Initial version, split off from Makefile
16 Dec 2010 - R. Yantosca - Renamed output files to "GC_Ref_Vol_2.*"
19 Jul 2011 - R. Yantosca - Changed *.f* to *.F* for ESMF compatibility
03 Apr 2012 - M. Payer - Added *.F90 so that grid_mod.F90 and
 regrid_a2a_mod.F90 are included
15 Jan 2014 - R. Yantosca - Now only create *.pdf output

1.9.3 Makefile_GtmmDoc.mk (in doc subdirectory)

This Makefile fragment contains commands to build the documentation for the Global Terrestrial Mercury Model (GTMM). It is inlined into the Makefile (in the doc subdirectory) by an "include" command.

REMARKS:

To build the documentation, call "make" with the following syntax:

```
make TARGET [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

You must have the LaTeX utilities (latex, dvips, dvipdf) installed on your system in order to build the documentation.

REVISION HISTORY:

14 Sep 2010 - R. Yantosca - Initial version, split off from Makefile
16 Dec 2010 - R. Yantosca - Renamed output files to "GC_Ref_Vol_4.*"
19 Jul 2011 - R. Yantosca - Changed *.f* to *.F* for ESMF compatibility
15 Jan 2014 - R. Yantosca - Now only save *.pdf output

1.9.4 Makefile_MakeDoc.mk (in doc subdirectory)

This Makefile fragment contains commands to build the documentation for the GEOS-Chem Makefiles. It is inlined into the Makefile (in the doc subdirectory) by an "include" command.

REMARKS:

To build the documentation, call "make" with the following syntax:

```
make TARGET [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

You must have the LaTeX utilities (latex, dvips, dvi2pdf) installed on your system in order to build the documentation.

REVISION HISTORY:

```
14 Sep 2010 - R. Yantosca - Initial version, split off from Makefile
16 Dec 2010 - R. Yantosca - Renamed output files to "GC_Ref_Vol_1.*"
15 Jan 2014 - R. Yantosca - Now only create *.pdf output
15 Jan 2014 - R. Yantosca - Now only prints prologues, avoids printing code
```

1.10 Module Interface Makefile (in the help subdirectory)

Displays the makefile help screen for GEOS-Chem.

REMARKS:

To build the programs, call "make" with the following syntax:

```
make -jN TARGET REQUIRED-FLAGS [ OPTIONAL-FLAGS ]
```

To display a complete list of options, type "make help".

Makefile uses the following variables:

Variable	Description
-----	-----
SHELL	Specifies the shell for "make" to use (usually SHELL=/bin/sh)

REVISION HISTORY:

```
21 Sep 2009 - R. Yantosca - Initial version
24 Sep 2009 - R. Yantosca - Added info about NONUMA option for PGI
24 Sep 2009 - R. Yantosca - Now list rosenbrock as default solver
19 Nov 2009 - R. Yantosca - Updated comments
23 Nov 2009 - R. Yantosca - Updated comments
11 Dec 2009 - R. Yantosca - Now get SHELL from Makefile_header.mk
```

21 Dec 2009 - R. Yantosca - Added info about HDF5 option
25 Jan 2010 - R. Yantosca - Added info about TOMAS option
10 Mar 2010 - C. Carouge - Remove info about TOMAS option. Keep info
about tomas target.
26 Aug 2011 - R. Yantosca - Added info about APM targets
26 Aug 2011 - R. Yantosca - Add info about the PRECISE=no option
11 May 2012 - R. Yantosca - Updated to include info about new make options