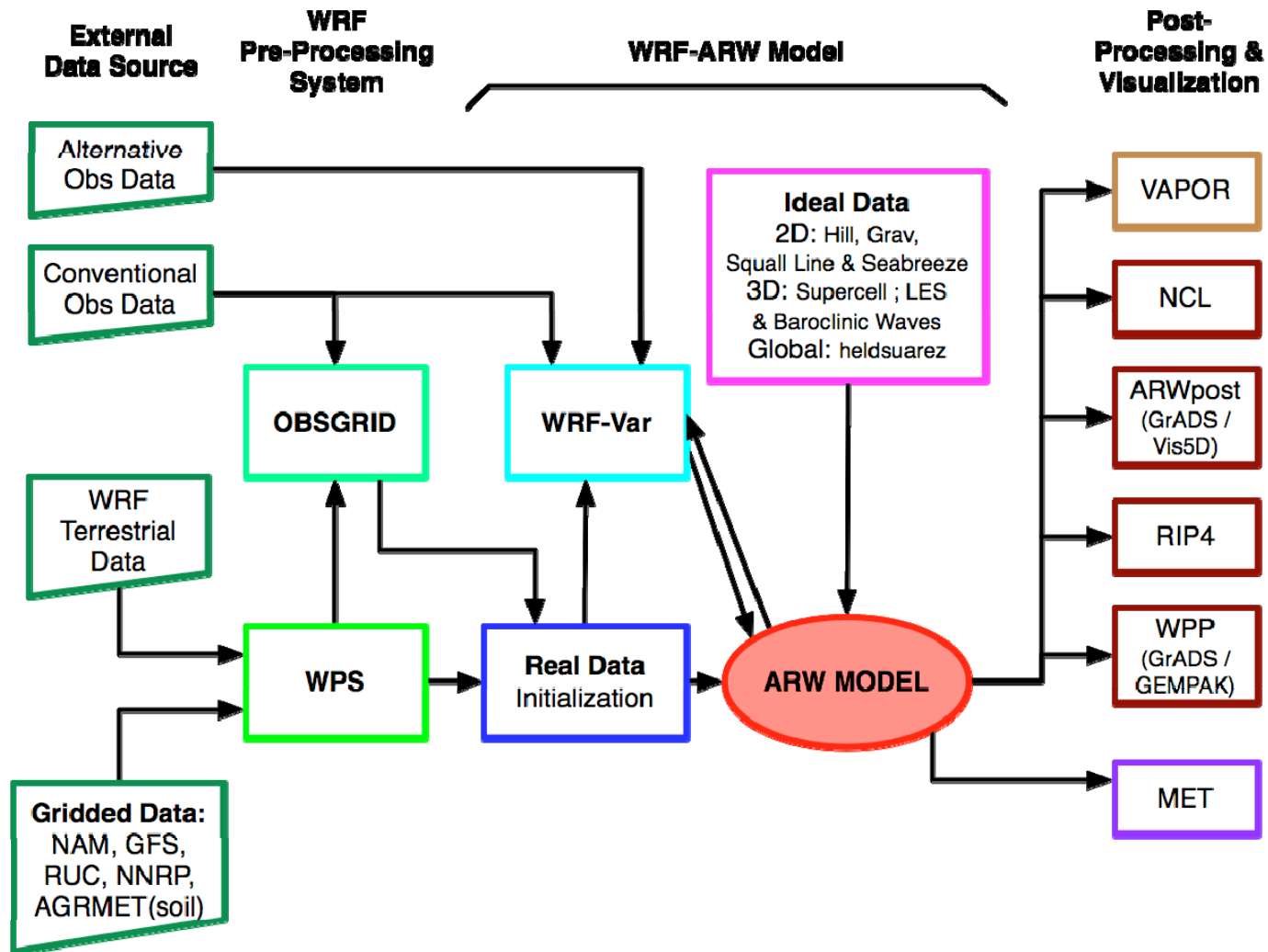# WRF and WPS: Compile

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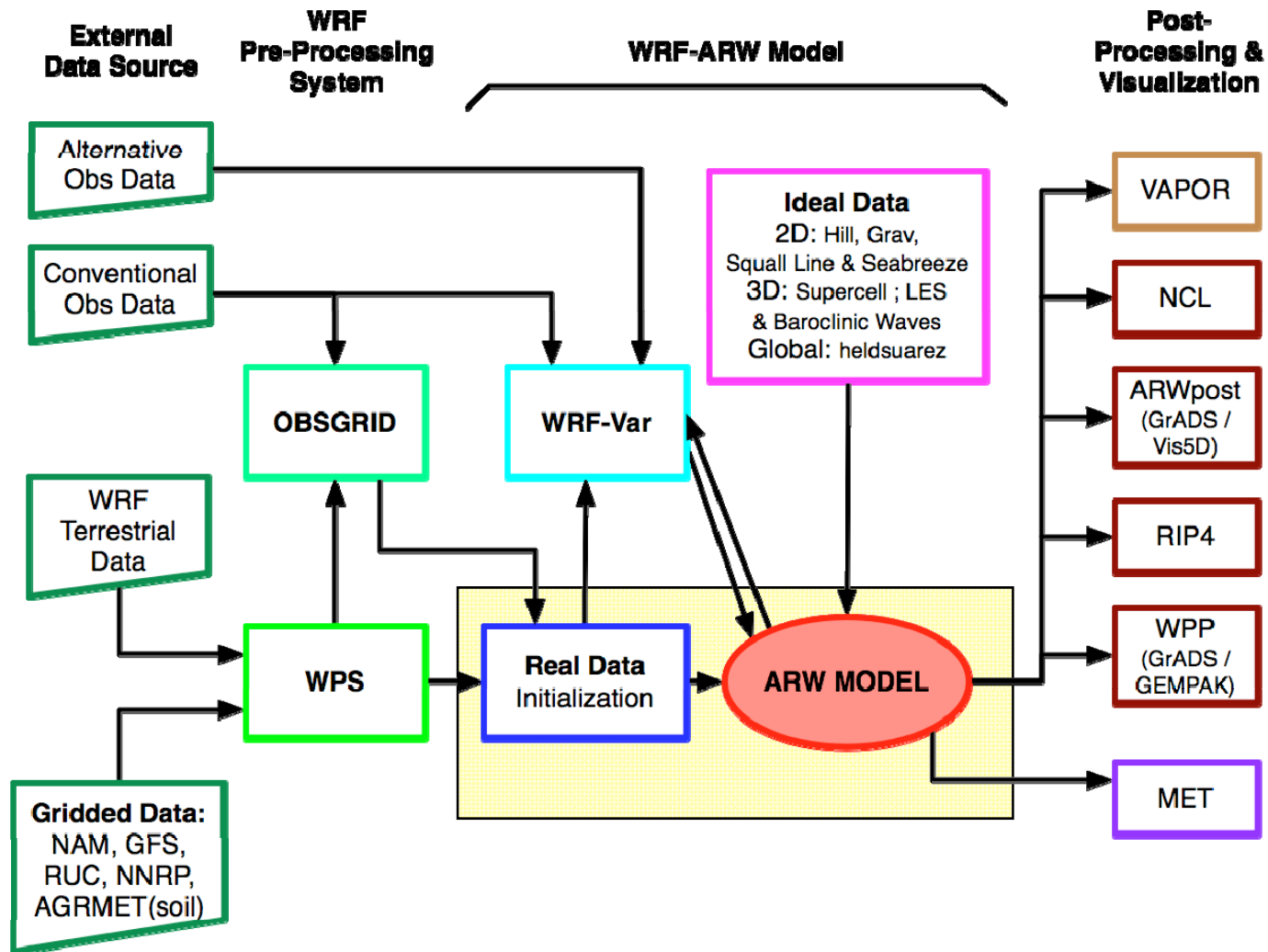Mesoscale and Microscale Meteorology Division (MMM)

Program Flow

WRF-ARW Modeling System Flow Chart

External Data Source

WRF Pre-Processing System

WRF-ARW Model

Post-Processing & Visualization

Alternative Obs Data

Conventional Obs Data

WRF Terrestrial Data

Gridded Data: NAM, GFS, RUC, NNRP, AGRMET(soil)

OBSGRID

WPS

WRF-Var

Real Data Initialization

Ideal Data
2D: Hill, Grav, Squall Line & Seabreeze
3D: Supercell ; LES & Baroclinic Waves
Global: heldsuarez

ARW MODEL

VAPOR

NCL

ARWpost (GrADS / Vis5D)

RIP4

WPP (GrADS / GEMPAK)

MET

Program Flow

WRF-ARW Modeling System Flow Chart

*First need to compile WRF and then WPS

System Requirements

Required libraries (WRF and WPS):

- FORTRAN 90/95 compiler

- C compiler

- Perl

- netCDF

- MPI (for distributed memory parallelism)

- NCAR Graphics (optional, but recommended – used by graphical utility programs)

Optional libraries* for GRIB2 support (WPS):

- JasPer (JPEG 2000 "lossy" compression library)

- PNG ("lossless" compression library)

- zlib (compression library used by PNG

*Installation of these libraries is not part of the WPS installation script

Installing WRF

- Download source code (not at tutorial, though)
- Set up environment for paths and libraries
- Configure and Compile WRF

Download WRF Source Code

- The WRF source code can be obtained from:
  http://www.mmm.ucar.edu/wrf/users/download/get_source.html
  - Click 'New Users', register and download, or
  - Click 'Returning User', enter email and download

- After ***gunzip*** and ***untar of WRFV3.1.1.TAR.gz***, should see a directory **WRFV3/**

  tar –zxvf WRFV3.1.1.TAR.gz

- ***cd*** to **WRFV3/** directory

Set environment

- If the *netCDF* is not in the standard */usr/local* then set the **NETCDF** environment variable before typing '*./configure*':

  Example: *setenv NETCDF /usr/local/netcdf-pgi*

- WRF needs both the *lib* and *include* directories

- As a general rule for LINUX systems, make sure the *netCDF* and *MPI* libraries are installed using the same compiler (PGI, Intel, g95) that will be used to compile WRF.

Configuring WRF

- To create a WRF configuration file for your computer, type:

    ./configure

- This script checks the system hardware and software (mostly *netCDF*), and then offers the user choices for configuring WRF:

    - Type of compiler

    - Serial, OpenMP, or MPI

    - Type of nesting (basic, preset moves, vortex following)

List of Configure Options - I

Choices for 32-bit LINUX operated machines are:

1. Linux i486 i586 i686, gfortran compiler with gcc (serial)
2. Linux i486 i586 i686, gfortran compiler with gcc (smpar)
3. Linux i486 i586 i686, gfortran compiler with gcc (dmpar)
4. Linux i486 i586 i686, gfortran compiler with gcc (dm+sm)
5. Linux i486 i586 i686, g95 compiler with gcc (serial)
6. Linux i486 i586 i686, g95 compiler with gcc (dmpar)
7. Linux i486 i586 i686, PGI compiler with gcc (serial)
8. Linux i486 i586 i686, PGI compiler with gcc (smpar)
9. Linux i486 i586 i686, PGI compiler with gcc (dmpar)
10. Linux i486 i586 i686, PGI compiler with gcc (dm+sm)
11. Linux x86_64 i486 i586 i686, ifort compiler with icc (serial)
12. Linux x86_64 i486 i586 i686, ifort compiler with icc (smpar)
13. Linux x86_64 i486 i586 i686, ifort compiler with icc (dmpar)
14. Linux x86_64 i486 i586 i686, ifort compiler with icc (dm+sm)
15. Linux i486 i586 i686 x86_64, PathScale compiler with pathcc (serial)
16. Linux i486 i586 i686 x86_64, PathScale compiler with pathcc (dmpar)

Choices for Nesting are:

0. no nesting (only available for serial and smpar)
1. basic
2. preset moves
3. vortex following

- default is option 0 for serial/smpar, 1 for dmpar

- KEY: smpar = Shared Memory Parallelism, and dmpar = Distributed Memory Parallelism

- The *./configure* command will create a file called *configure.wrf*

  - This file contains compilation options, rules, etc. specific to your computer and can be edited to change compile options, if desired.

- WRFV3 compile options are provided for a number of platforms. In addition, the *arch/configure_new.defaults* file can be edited to add a new option if needed.

Configuration File

- The *configure.wrf* file is built from three pieces within the *arch* directory

   1. **preamble_new**: uniform requirement for the code, such as maximum number of domains, word size, etc.

   2. **configure_new.defaults**: selection of compiler, parallel, communication layer
      - User edits if a change to the compilation options or library locations is needed

   3. **postamble_new**: standard make rules and dependencies

Compiling WRF

- Type the following command to compile:

./compile test_case >& compile_wrf.log

where ***test_case*** is one of the following:

compile em_b_wave
compile em_quarter_ss
compile em_heldsuarez   **3D Ideal Cases**
compile em_les
compile em_grav2d_x
compile em_hill2d_x
compile em_squall2d_x   **2D Ideal Cases**
compile em_squall2d_y
compile em_seabreeze_x
compile em_real   **Real Data Case**

→

Compiling WRF: Real Data Case

- If the real data case compilation is successful:

    - Creates five executables in the *main/* directory:
        - ✓*real.exe*: used for initialization of real data cases.
        - ✓*wrf.exe*: used for model integration.
        - ✓*ndown.exe:* used for one-way nesting
        - ✓*nup.exe* (not used much)
        - ✓*tc.exe*: used for tropical cyclone bogus

- These executables will be linked to both *test/em_real* and *run/* directories.

Clean Compilation

- To remove all object files (except those in *external/*) and all executables, type:

    clean

- To remove all built files, including ***configure.wrf***, type:

    clean –a

  - ➢ Recommended if
    - ▪ compilation failed
    - ▪ registry changed
    - ▪ want to compile different dynamic core
    - ▪ want to change configuration file
    - ▪ ***want to change to or from the chemistry option***

Installing WPS

- Download static terrestrial data (not at tutorial)
- Download source code (not at tutorial)
- Configure and Compile WPS

Reminder: A successful compilation of WRF is required prior to WPS compilation!

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Download Static Terrestrial Data

- The terrestrial fields interpolated by ***geogrid*** may be downloaded from same page as the code:

  http://www.mmm.ucar.edu/wrf/users/download/get_source.html

  – Two options for data: low-res and all resolutions

- Data are static: only need to be downloaded when updates are provided (such as v3.1 with gravity wave drag fields)

Download Static Terrestrial Data, Cont.

- Uncompress the data into a directory with ~10 GB of available space (264 MB for low-res only)!

    tar -zxvf geog.tar.gz

- Data can be shared by users on the same machine by placing files in a common directory

    – Recommended due to size!

Download WPS Source Code

- The WPS source code can be obtained from:

  http://www.mmm.ucar.edu/wrf/users/download/get_source.html

- WPS is designed to work closely with WRF
  - *WPS programs use WRF I/O API libraries to do file input and output*
  - *These I/O libraries are built when WRF is installed*
  - *Does not share Registry with WRF*

- For simplicity, install WPS/ in the same location as WRFV3/

- After **gunzip** and **untar**, should see a directory WPS/
  tar –zxvf WPSV3.1.1.TAR.gz *(or the latest release available)*

  ls
  WPS/   WRFV3/

- **cd** to WPS/ directory

Configure WPS

- To create a WPS configuration file for your computer, type:
  - *./configure*

- This script offers the user choices for configuring WPS:
  - Type of compiler
  - **Serial** or Distributed memory
  - GRIB1 or **GRIB2**

- The *./configure* command will create a file called ***configure.wps***

  – This file contains compilation options, rules, etc. specific to your computer and can be edited to change compile options, if desired (same idea as with WRF and configure.wrf file).

List of WPS Configure Options

Will use NETCDF in dir: /usr/local/netcdf-pgi
  $JASPERLIB or $JASPERINC not found in environment, configuring to build without
  grib2 I/O...

Please select from among the following supported platforms.

    1. PC Linux i486 i586 i686, PGI compiler   serial, NO GRIB2
    2. PC Linux i486 i586 i686, PGI compiler   serial
    3. PC Linux i486 i586 i686, PGI compiler   DM parallel, NO GRIB2
    4. PC Linux i486 i586 i686, PGI compiler   DM parallel
    5. PC Linux i486 i586 i686, Intel compiler   serial, NO GRIB2
    6. PC Linux i486 i586 i686, Intel compiler   serial
    7. PC Linux i486 i586 i686, Intel compiler   DM parallel, NO GRIB2
    8. PC Linux i486 i586 i686, Intel compiler   DM parallel
    9. PC Linux i486 i586 i686, g95 compiler,   serial, NO GRIB2
    10. PC Linux i486 i586 i686, g95 compiler,   serial

    Enter selection [1-10] :

Configuration successful. To build the WPS, type: compile

Compile WPS

- If configuration was successful, compile WPS:

    ./compile >& compile_wps.log

- If the compilation is successful, it will create the three primary executables:
    - ✓ *geogrid.exe*: define size/location of domain(s)
    - ✓ *ungrib.exe*: extract meteorological fields from GRIB files
    - ✓ *metgrid.exe*: horizontally interpolate meteorological fields (from *ungrib*) to simulation grid(s) (defined by *geogrid*)

Compile WPS, Cont.

- If compilation is EVEN MORE successful, it will create the following executables in *util/*:
  - ✓ *avg_tsfc.exe*
  - ✓ *g1print.exe*
  - ✓ *g2print.exe*
  - ✓ *mod_levs.exe*
  - ✓ *rd_intermediate.exe*
  - ✓ *calc_ecmwf_p.exe*
- If NCAR Graphics libraries are available it will also create in *util/*:
  - ✓ *plotgrids.exe*
  - ✓ *plotfmt.exe*

  – These utilities are described in more detail in the Post-Processing talk

Additional Resources

- For more detailed information on installation of WRF and WPS, please see:
  - ARW Users Guide

  - Online Users Pages:
    - *http://www.mmm.ucar.edu/wrf/users/*

- For further assistance regarding WRF and WPS:
  - WRF Users Forum: *http://forum.wrfforum.com*
  - WRF Email list: wrf_users@ucar.edu

  - WRF Help email: *wrfhelp@ucar.edu*