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# WRF installation procedure and running process

Wido Hanggoro

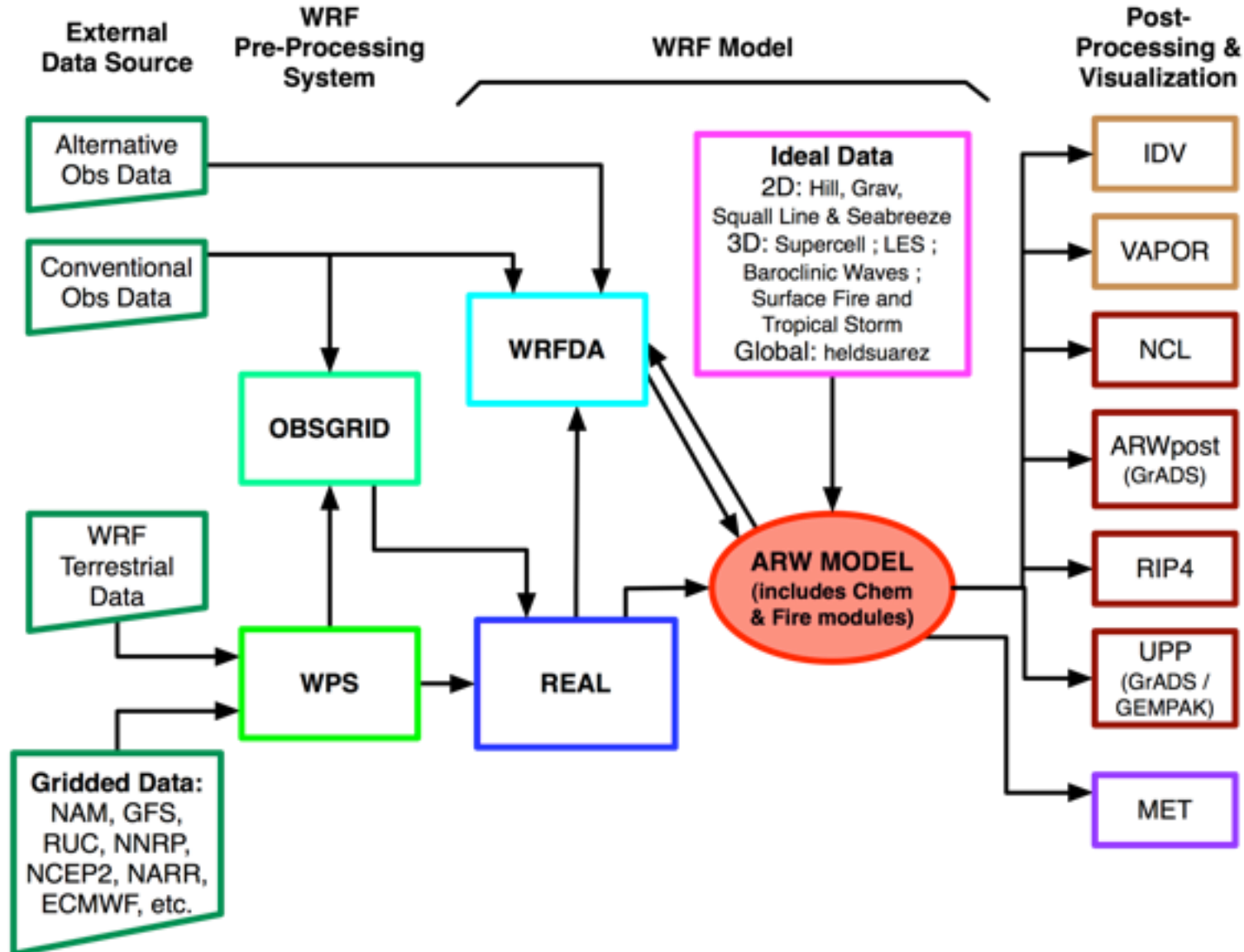
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Center for Research and Development BMKG

Group Fellowship Training Course on Numerical Weather Prediction (NWP)

26 September – 25 Oktober 2022

## WRF Modeling System Flow Chart



# Contents

- Day 1
  - WRF installation procedure and running process for standalone computer
  - WRF installation procedure and running process for HPC
    - Installation procedure (step-by-step)
    - Linker procedure (The assumption is that the WRF model has been installed previously)
- Day 2 Case Study

# WRF installation procedure and running process for standalone computer

- Virtual Machine
- Personal Computer
- Laptop

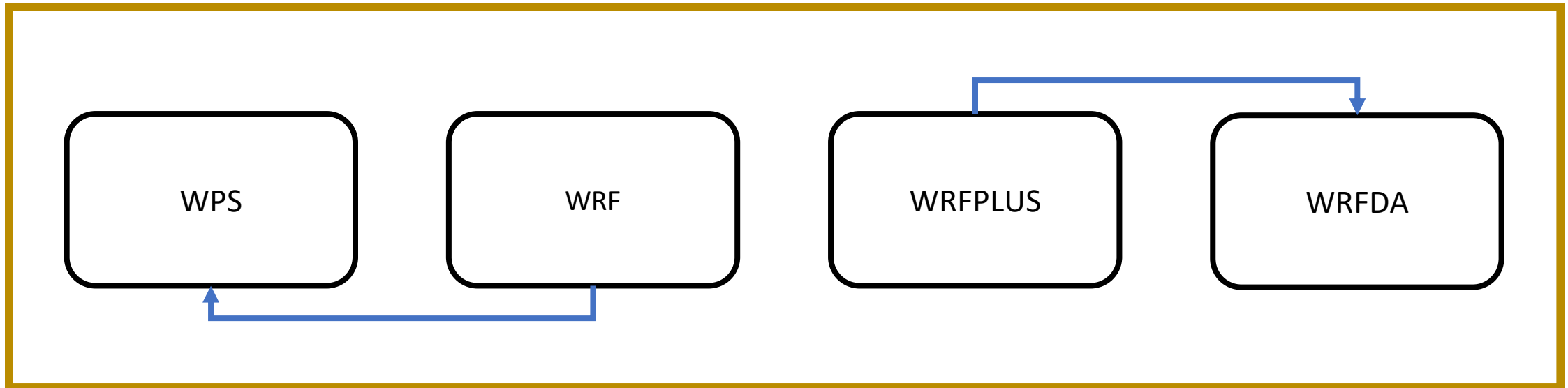
# WRF installation procedure and running process for standalone computer

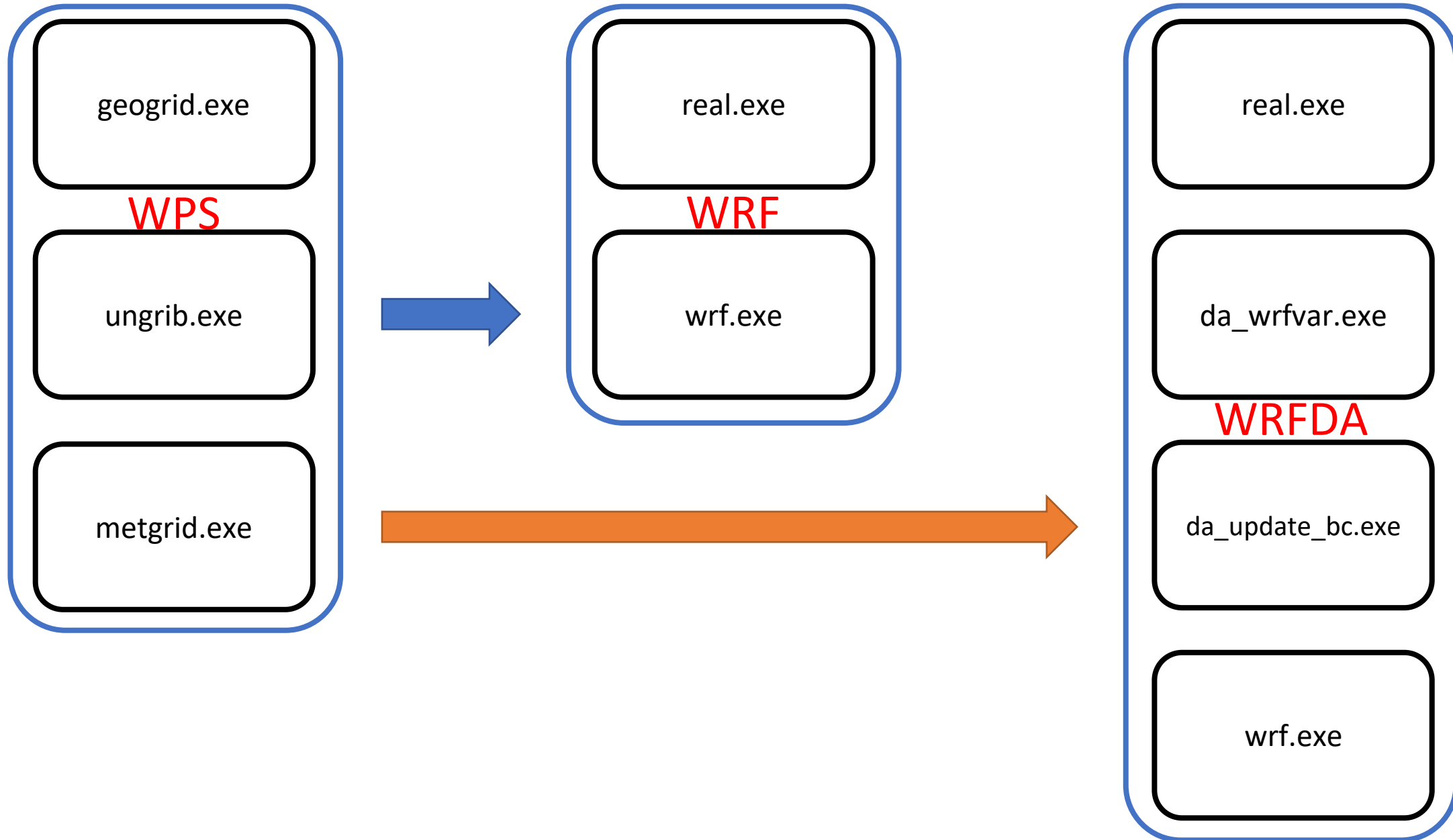
- For step by step installation and running process:  
[https://github.com/denyanto/nwo\\_nwp\\_training/README.md](https://github.com/denyanto/nwo_nwp_training/README.md)

# WRF installation procedure and running process for HPC

- High Performance Computing (HPC)
- PC Cluster
- Server

# Libraries







# Download Libraries

- <https://download.open-mpi.org/release/open-mpi/v4.1/openmpi-4.1.4.tar.gz> (openmpi)
- <https://support.hdfgroup.org/ftp/HDF5/releases/hdf5-1.12/hdf5-1.12.0/src/hdf5-1.12.0.tar.gz> (hdf5)
- <https://zlib.net/fossils/zlib-1.2.8.tar.gz> (zlib)
- <ftp://ftp.unidata.ucar.edu/pub/netcdf/netcdf-c-4.7.4.tar.gz> (netcdf-c)
- <ftp://ftp.unidata.ucar.edu/pub/netcdf/netcdf-fortran-4.5.3.tar.gz> (netcdf-fortran)
- <https://www.ece.uvic.ca/~frodo/jasper/software/jasper-1.900.1.zip> (jasper)
- <https://sourceforge.net/projects/libpng/files/libpng16/1.6.37/libpng-1.6.37.tar.gz> (libpng)
- <https://support.hdfgroup.org/ftp/lib-external/szip/2.1.1/src/szip-2.1.1.tar.gz> (szip)

# Download WRF

- <https://github.com/wrf-model/WRF/releases/download/v4.4/v4.4.tar.gz> (WRF)
- <https://github.com/wrf-model/WPS/archive/refs/tags/v4.4.tar.gz> (WPS)
- [https://www2.mmm.ucar.edu/wrf/src/ARWpost\\_V3.tar.gz](https://www2.mmm.ucar.edu/wrf/src/ARWpost_V3.tar.gz) (ARWPost)

- pwd ~ please make sure you are on the “/home/{your-home-name}”
- mkdir NWP\_{your\_name}
- cd NWP\_{your\_name}
- mkdir raw lib
- cd raw
- download all of the files (link of the previous slide)
- cd ../lib
- mkdir openmpi-4.1.4 zlib-1.2.11 szip-2.1.1 hdf5-1.12.0 netcdf-4.7.4  
jasper-1.900.1 libpng-1.6.37

# OpenMPI

- `cd ../raw`
- `tar -zxvf openmpi-4.1.4.tar.gz`
- `cd openmpi-4.1.4`
- `./configure --prefix=/home/{your-home-name}/NWP_{your_name}/lib/openmpi-4.1.4`
- `make`
- `make check`
- `make install`
- `cd ..`

# Zlib

- `tar -zxvf zlib-1.2.11.tar.gz`
- `cd zlib-1.2.11`
- `./configure --prefix=/home/{your-home-name}/NWP_{your_name}/lib/zlib-1.2.11`
- `make`
- `make install`
- `cd ..`

# Szip

- `tar -zxvf szip-2.1.1.tar.gz`
- `cd szip-2.1.1`
- `./configure --prefix=/home/{your-home-name}/NWP_{your_name}/lib/szip-2.1.1`
- `make`
- `make install`
- `cd ..`

# Hdf5

- `tar -zxvf hdf5-1.12.0.tar.gz`
- `cd hdf5-1.12.0`
- `./configure --prefix=/home/{your-home-name}/NWP_{your_name}/lib/hdf5-1.12.0 \`  
`--with-zlib=/home/{your-home-name}/NWP_{your_name}/lib/zlib-1.2.11 \`  
`--with-szip=/home/{your-home-name}/NWP_{your_name}/lib/szip-2.1.1 \`  
`--enable-fortran`
- `make`
- `make install`
- `cd ..`

# Netcdf-c

- `tar -zxvf netcdf-c-4.7.4.tar.gz`
- `cd netcdf-c-4.7.4`
- `./configure --prefix =/home/{your-home-name}/NWP_{your_name}/lib/netcdf-4.7.4 \`  
`--enable-netcdf-4 \`  
`LDFLAGS="-L/home/{your-home-name}/NWP_{your_name}/lib/hdf5-1.12.0/lib" \`  
`CPPFLAGS="-I/home/{your-home-name}/NWP_{your_name}/lib/hdf5-1.12.0/include"`  
`CC=gcc`
- `make`
- `make install`
- `cd ..`



# Netcdf-fortran

- `export LD_LIBRARY_PATH=/home/{your-home-name}/NWP_{your_name}/lib/netcdf-4.7.4/lib`
- `tar -zxvf netcdf-fortran-4.5.3.tar.gz`
- `cd netcdf-fortran-4.5.3`
- `./configure --prefix=/home/{your-home-name}/NWP_{your_name}/lib/netcdf-4.7.4 \`  
`--enable-netcdf-4 LDFLAGS="-L/home/{your-home-name}/NWP_{your_name}/lib/netcdf-4.7.4/lib" \`  
`CPPFLAGS="-I/home/{your-home-name}/NWP_{your_name}/lib/netcdf-4.7.4/include" FC=gfortran \`  
`F77=gfortran`
- `make`
- `make install`
- `cd ..`

# Jasper

- unzip jasper-1.900.1.zip
- cd jasper-1.900.1
- ./configure --prefix=/home/{your-home-name}/NWP\_{your\_name}/lib/jasper-1.900.1 \ --enable-shared
- make
- make install
- cd ..

# Libpng

- `tar -zxvf libpng-1.6.37.tar.gz`
- `cd libpng-1.6.37`
- `./configure --prefix=/home/{your-home-name}/NWP_{your_name}/lib/libpng-1.6.37 --with-zlib-prefix=/home/{your-home-name}/lib/zlib-1.2.11`
- `make`
- `make install`

# WRF

- export NETCDF=/home/{your-home-name}/NWP\_{your\_name}/lib/netcdf-4.7.4
- export NETCDF4=1
- export HDF5=/home/{your-home-name}/NWP\_{your\_name}/lib/hdf5-1.12.0
- export jasper=/home/{your-home-name}/NWP\_{your\_name}/lib/jasper-1.900.1
- export JASPERLIB=/home/{your-home-name}/NWP\_{your\_name}/lib/jasper-1.900.1/lib
- export JASPERINC=/home/{your-home-name}/NWP\_{your\_name}/lib/jasper-1.900.1/include
- export WRFIO\_NCD\_LARGE\_FILE\_SUPPORT=1

- `cd /home/{your-home-name}/NWP_{your_name}/raw-mod`
- `tar -zxvf wrf.v4.4.tar.gz`
- `mv wrf.v4.4 WRF`
- `cd WRF`
- `./configure`
- `./compile em_real >& compile.log &`
- `cd /home/{your-home-name}/NWP_{your_name}/raw-mod`
- `mv WRF /home/{your-home-name}/NWP_{your_name}`

# WPS

- export JASPERLIB=/home/{your-home-name}/NWP\_{your\_name}/lib/jasper-1.900.1/lib
- export JASPERINC=/home/{your-home-name}/NWP\_{your\_name}/lib/jasper-1.900.1/include
- export WRF\_DIR=../WRF
- export NETCDF=/home/{your-home-name}/NWP\_{your\_name}/lib/netcdf-4.7.4
- cd /home/{your-home-name}/NWP\_{your\_name}/raw-mod
- tar -zxvf wps.v4.4.tar.gz
- mv wps.v4.4 WPS
- cd WPS
- ./configure
- ./compile >& compile.log &
- cd /home/{your-home-name}/NWP\_{your\_name}/raw-mod
- mv WPS /home/{your-home-name}/NWP\_{your\_name}

# ARWPost

- `cd /home/{your-home-name}/NWP_{your_name}/raw-mod`
- `tar -zxvf ARWpost_V3.tar.gz`
- `mv ARWpost_V3 ARWpost`
- `cd ARWpost`
- `./configure`
- `./compile`
- `cd /home/{your-home-name}/NWP_{your_name}/raw-mod`
- `mv ARWpost /home/{your-home-name}/NWP_{your_name}`

# WRFPLUS

- `cd /home/{your-home-name}/NWP_{your_name}/raw-mod`
- `tar -zxvf wrf.v4.4.tar.gz`
- `mv wrf.v4.4 WRFPLUS`
- `cd WRFPLUS`
- `export NETCDF=/home/{your-home-name}/lib/netcdf-4.7.4`
- `./configure wrfplus`
- `./compile wrfplus`
- `cd /home/{your-home-name}/NWP_{your_name}/raw-mod`
- `mv WRFPLUS /home/{your-home-name}/NWP_{your_name}`



# WRFDA

- `cd /home/{your-home-name}/NWP_{your_name}/raw-mod`
- `tar -zxvf wrf.v4.4.tar.gz`
- `mv wrf.v4.4 WRFDA`
- `cd WRFDA`
- `export WRFPLUS_DIR=/home/{your-home-name}/WRFPLUS`
- `export NETCDF=/home/{your-home-name}/lib/netcdf-4.7.4`
- `export NETCDF4=1`
- `export HDF5=/home/{your-home-name}/lib/hdf5-1.12.0`
- `export WRFIO_NCD_LARGE_FILE_SUPPORT=1`
- `./configure 4dvar`
- `./compile -j 10 all_wrfvar`
- `cd /home/{your-home-name}/NWP_{your_name}/raw-mod`
- `mv WRFDA /home/{your-home-name}/NWP_{your_name}`

- vi .bashrc
- export PATH={all-your-bindir}:\$PATH
- export LD\_LIBRARY\_PATH={all-your-libdir}:\$LD\_LIBRARY\_PATH

# WRF installation procedure and running process for HPC

- For step by step installation and running process:  
[https://github.com/denyanto/nwo\\_nwp\\_training/README-HPC.md](https://github.com/denyanto/nwo_nwp_training/README-HPC.md)

-

# WRF installation procedure and running process for HPC

- WRFDomainWizard
- For creating domain and running easily

# Geogrid

- `cd /opt/ohpc/pub/model/WRFDomainWizard/`
- `./run_DomainWizard`





wido — wrfadmin@master:/opt/ohpc/pub/model/WRFDomainWizard — ssh -p 1234 -X wrfa...

```
[wrfadmin@master WRFDomainWizard]$ ls
jsch-0.1.44.jar          SwingCalendar.jar
readme_dwiz.txt         swing-layout-1.0.3.jar
run_DomainWizard        WRFDomainWizardImages.jar
run_DomainWizard.bat    WRFDomainWizard.jar
SQLExecutorFramework.jar

[wrfadmin@master WRFDomainWizard]$ ./run_DomainWizard
INFO: Mac or Linux computer detected. Setting Mac/Linux fonts
INFO: JVM memory=679477248
INFO: WRF Domain Wizard version 2.84
```

- WPS dir = /opt/ohpc/pub/model/WPS
- Geography dir = /opt/ohpc/pub/model/WPS\_GEOG
- Domains dir = /home/{**your-home-name**}/NWP\_{**your\_name**}



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Actions Help

1) Wizard Option 2) Choose Domain 3) Horizontal Editor 4) Namelist.input Editor 5) Run Preprocessors 6) Visualize NetCDF

Choose

- ☒ New domain
- ☐ Open or Delete a domain

choose "New domain"  
and click Next >

User Hints & Info

Choose between creating a new domain and opening (or deleting) an existing one

< Back

Next >



### New Domain

Name My\_domain

Description This is my first domain

☐ Hurricane WRF (v3.5+) domain

Clear

Fill in "Name" and "Description" column  
and click Next >

User Hints & Info  
Create a new domain

< Back

Next >

The screenshot shows the NetCDF Visualizer application. At the top, there's a menu bar with 'Actions' and 'Help'. Below it is a toolbar with six numbered steps: 1) Wizard Option, 2) New Domain, 3) Horizontal Editor, 4) Namelist.input Editor, 5) Run Preprocessors, and 6) Visualize NetCDF. The main area is a map of Southeast Asia and Australia with a grid overlay. A white rectangle is drawn on the map, indicating a selected domain. To the right of the map is a panel with settings and actions. The 'Domain' tab is active, showing a 'Map' section with a 'Scale' of 12.5% and a 'GMT' button. Below this is a 'Type' section with 'Mercator' selected, and a table of coordinates: Standard Lon (127.347), True Lat 1 (-0.48), True Lat 2 (0), Centerpoint Lon (127.347), and Centerpoint Lat (-0.48). The 'Grid Options' section includes 'Horizontal dimension X' (0), 'Horizontal dimension Y' (0), 'Grid points distance (km)' (10m), and 'Geographic data resolution' (10m). At the bottom of the panel are 'Actions' with buttons for 'Start Over', 'Reset Grid', and 'Update Map'. At the very bottom of the window, there's a 'User Hint & Info' section with the text: 'First draw a rectangle around your domain, next choose a projection, then click the Update Map button'. Red boxes and arrows are overlaid on the image to highlight specific steps: a red box around the map area with an arrow pointing to it labeled '1. Drag and drop your domain'; a red box around the 'Centerpoint Lat' field with an arrow pointing to it labeled '2. C'; a red box around the 'Update Map' button with an arrow pointing to it labeled '3. C'; and a red box around the 'Next' button with an arrow pointing to it labeled '4.'.

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Actions Help

1) Wizard Option 2) New Domain 3) Horizontal Editor 4) Namelist.input Editor 5) Run Preprocessors 6) Visualize NetCDF

Domain Nests Display Options

Map

Scale 12.5%

GMT

1. Drag and drop your domain

Type Mercator

Standard Lon 127.347

True Lat 1 -0.48

True Lat 2 0

Centerpoint Lon 127.347

Centerpoint Lat -0.48

Grid Options

Horizontal dimension X 0

Horizontal dimension Y 0

Grid points distance (km) 10m

Geographic data resolution 10m

Actions

Start Over

Reset Grid

Update Map

2. C

3. C

4.

User Hint & Info {36.21 S, 169.83 E}

First draw a rectangle around your domain, next choose a projection, then click the Update Map button

< Back

Next >

WRF Domain Wizard: 'My\_domain'

Actions Help

1) Wizard Option 2) New Domain 3) Horizontal Editor 4) Namelist.input Editor 5) Run Preprocessors 6) Visualize NetCDF

Domain Nests Display Options

Nested Domain Properties

ID	PID	Ratio	Left	Right	Top	Bot	NX	NY	Res
1	1	1	1	100	48	1	100	48	10m

3. Drag and drop your child domain

2. Click "New"

1. Click "Nests"

4. Click "Next >"

User Hint & Info (20.92 S, 171.08 E)  
Select a nest by clicking on its number, or by clicking on a row in the table on the right. You can't edit/resize a nest if it has a child nest (you must delete the child first).  
Hold down the Ctrl key to lock a nest in place while resizing it.

< Back Next >

Add or Edit ETA Levels

Reset For This Domain

Validate

Help

/home/wrladmin/TRAINING/my\_domain/my\_domain/namelist.input

GUI Editor Text Editor

Number of Domains (max\_dom): 2

Parameter	Master Domain	Nest 1
<i>&amp;time_control</i>		
run_days	0	
run_hours	12	
run_minutes	0	
run_seconds	0	
start_year	2000	2000
start_month	01	01
start_day	24	24
start_hour	12	12
start_minute	00	00
start_second	00	00
end_year	2000	2000
end_month	01	01
end_day	25	25
end_hour	12	12
end_minute	00	00
end_second	00	00

### WRF NAMELIST.INPUT FILE DESCRIPTION

The namelist.input file is used for both the real.exe and wrf.exe executables. Within the file, multiple columns are used for multiple domains (nests) and the "max\_dom" parameter determines the number of domains (and nests) to use. So, for example, if you define 3 columns for parameter in the namelist but set max\_dom = 2, the last column will be ignored. Note that not all parameters have multiple columns.

#### User Hint & Info

Edit this domain's namelist.input file. The following parameters have been defaulted for this domain: max\_dom, s\_we, e\_we, s\_sn, e\_sn, dx, dy, i\_parent\_start, j\_parent\_start, time\_step. Right click in the window to Copy, Paste, or Find.

Click "Next >"

< Back

Next >

WRF Domain Wizard: 'my\_domain'

Actions Help

1) Wizard Option 2) New Domain 3) Horizontal Editor 4) Namelist.input Editor 5) Run Preprocessors 6) Visualize NetCDF

Configure Preprocessor Variables for Ungrib and Metgrid

Grib Vtable Name Vtable.GFS

Grib Files Dir [Enter path to GRIB]

Select DirSelect FilesJulian Calc

Grib Files

Grib Start Date 2022-09-21 hh:mm:ss 00:00:00

Grib End Date 2022-09-21 hh:mm:ss 12:00:00

Grib Interval (hr) 6

Run Preprocessors to Generate Input Data Fields Required for WRF

Step	Run	List	View
1	geogrid	Output	Log
2	ungrib	Output	Log
3	metgrid	Output	Log

Job CommandKill JobDel Temp Files

Progress Status running System Commands

Domain is located on master at /home/wrfadmin/TRAINING/my\_domain/my\_domain (ARW core)

Geography files are in /opt/ohpc/pub/model/WPS\_GEOG

List Vtable found

Vtable-> /opt/ohpc/pub/model/WPS/ungrib/Variable\_Tables/Vtable.GFS

Vtable.GFS-> /opt/ohpc/pub/model/WPS/ungrib/Variable\_Tables/Vtable.GFS

0%

Clear

User Hint & Info

< BackNext >

1. Click “geogrid”

2. Click “Next >”

**Important:** after clicking 'View In Panoply' button, you must 'Quit' Panoply before viewing another netCDF file.

**NetCDF Files** In /home/wrfadm/n/TRAINING/my\_domain/my\_domain

geo\_em.d01.nc

geo\_em.d02.nc

View in Panoply (and Google Earth)

**User Hint & Info**

Choose a netCDF file and click 'View in Panoply' button. When the Datasets Browser window pops up, simply double-click on a field of interest (e.g. GREENFRAC) to view your map. Then, select File menu, 'Export to KMZ' to export to a Google Earth .kmz file.

Click "Exit"

< Back

Exit



wido — wrfadmin@master:~/TRAINING/my\_domain/my\_domain — ssh -p 1234 -X wrfadmin...

~

...n — ssh -p 1234 -X wrfadmin@182.16.251.51

+

[wrfadmin@master my\_domain]\$ ls

geo\_em.d01.nc

METGRID.TBL

projection.jpg

geo\_em.d02.nc

namelist.input

Vtable

geogrid.log

namelist.wps

Vtable.GFS

geogrid.log.exitCode

nest7grid\_d02.parms

GEOGRID.TBL

nest7grid.parms

[wrfadmin@master my\_domain]\$

	Objectives	Learning Location	Date	Hours
		Airport to Hotel	26/9	
		Jakarta		09
RTC		Jakarta	27/9	
	Describe the plan of developing the final output of the planning process and serves as a blueprint for implementation	Jakarta		
allation	Demonstrate Ubuntu-Linux Installation	Citeko	28/9	
C	Demonstrate Ubuntu-Linux Basic Command	Citeko	29/9	
ess	Demonstrate WRF-ARW V4.0 installation procedure and running process	Citeko	30/9	

# Ungrib

- `cd /home/{your-home-name}/NWP_{your_name}`
- `mkdir ungrib`
- `cd ungrib`
- `ln -sf {your-WPS-dir}/ungrib/Variable_Tables/Vtable.GFS ./Vtable`
- `cp {your-WPS-dir}/link_grib.csh .`
- `ln -sf {your-WPS-dir}/ungrib.exe .`
- `./link_grib.csh /opt/ohpc/pub/SHARED/wido-wrf1_data/gfs.0p25.2021040* .`
- `cp /home/{your-home-name}/NWP_{your_name}/my_domain/namelist.wps .`
- “edit namelist.wps”





```
&share
wrf_core = 'ARW',
max_dom = 1,
start_date = '2021-04-03_00:00:00', '2022-09-21_00:00:00',
end_date   = '2021-04-03_09:00:00', '2022-09-21_12:00:00',
interval_seconds = 10800,
io_form_geogrid = 2,
opt_output_from_geogrid_path = '/home/wrfadmin/TRAINING/my_domain/
my_domain/',
debug_level = 0,
/

&geogrid
parent_id          = 1,1,
parent_grid_ratio  = 1,3,
i_parent_start     = 1,16,
j_parent_start     = 1,9,
e_we               = 100,88,
"namelist.wps" 81L, 1950C
```

- ./ungrib.exe

# Metgrid

- `cd /home/{your-home-name}/NWP_{your_name}`
- `mkdir metgrid`
- `cd metgrid`
- `ln -sf ../ungrib/FILE* .`
- `cp /home/{your-home-name}/NWP_{your_name}/ungrib/namelist.wps .`
- `ln -sf {your-WPS-dir}/metgrid/METGRID.TBL .`
- `ln -sf {your-WPS-dir}/metgrid.exe .`
- `mpirun -np 5 ./metgrid.exe`

# Real

- `cd /home/{your-home-name}/NWP_{your_name}`
- `mkdir real`
- `cd real`
- `ln -sf ../metgrid/met_em* .`
- `ln -sf {your-WRF-dir}/run/real.exe .`
- `cp {your-WRF-dir}/run/namelist.input .`
- edit "namelist.input"
- `./real.exe` or `mpirun -np 3 real.exe`

# Wrf

- `cd /home/{your-home-name}/NWP_{your_name}`
- `mkdir wrf`
- `cd wrf`
- `ln -sf {your-WRF-dir}/run/wrf.exe .`
- `cp ../wrf/namelist.input .`
- `cp ../real/wrfbdy_d01 .`
- `cp ../real/wrfinput_d01 .`
- `ln -sf {your-WRF-dir}/run/CAMtr_volume_mixing_ratio .`
- `ln -sf {your-WRF-dir}/run/LANDUSE.TBL .`
- `ln -sf {your-WRF-dir}/run/ozone_plev.formatted .`
- `ln -sf {your-WRF-dir}/run/ozone_lat.formatted .`
- `ln -sf {your-WRF-dir}/run/ozone.formatted .`

- ln -sf {your-WRF-dir}/run/RRTMG\_LW\_DATA .
- ln -sf {your-WRF-dir}/run/RRTMG\_SW\_DATA .
- ln -sf {your-WRF-dir}/run/VEGPARM.TBL .
- ln -sf {your-WRF-dir}/run/SOILPARM.TBL .
- ln -sf {your-WRF-dir}/run/GENPARM.TBL .
- edit "job\_example.sh
- sbatch job\_example.sh

# ARWpost

- `cd /home/{your-home-name}/NWP_{your_name}`
- `mkdir arwpost`
- `cd arwpost`
- `cp {your-ARWpost-dir}/namelist.ARWpost .`
- `ln -sf {your-ARWpost-dir}/ARWpost.exe .`
- `ln -sf ../wrf/wrfout* .`
- `edit "namelist.ARWpost"`

# Case Study

- Please make a WRF simulation of the next 6 hours using 0.25 degree GFS data, in your respective area. Give the model output per hour. You can use a virtual machine or HPC to run it.