WRF basics

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What is WRF?

WRF = Weather Research and Forecasting model

- WRF is a Limited Area Model (LAM) developed by NCAR, NOAA/ESRL, NOAA/NCEP/EMC and others.

- Is a community model, with distributed development and centralized support. The code is freely available on internet.

- It has 2 dynamical cores:

  - Advanced Research WRF (ARW) → Research

  - Non-Hydrostatic Mesoscale Model (NMM) → Operational

Why is it useful?

WRF is able to downscale coarser models to high resolutions ~ 1 km with non-hydrostatic dynamics. Furthermore, it offers many advantages with respect to other LAM:

• It is open source. It is possible to look into the code and modify it. Experiments are reproducible.

• Flexibility: Large amount of different configurations (physics, dynamics, boundaries) adaptable for higher or coarser resolutions, long-term or short-term simulations.

• Online support, and excellent documentation:

http://www.mmm.ucar.edu/wrf/users/

Applications

Parametrization research, case studies, short range forecast, data assimilation, air quality studies, renewal energy production forecast, and renewal energy potential evaluation, and of course **Regional Climate**

Most frequent experiments are **sensitivity experiments.** These experiments:

- Provide a better understanding of the physics and their shortcomings.

- Can be used to reduce model error and assess the uncertainty.

WRF workflow

- WRF Preprocessing System (WPS)

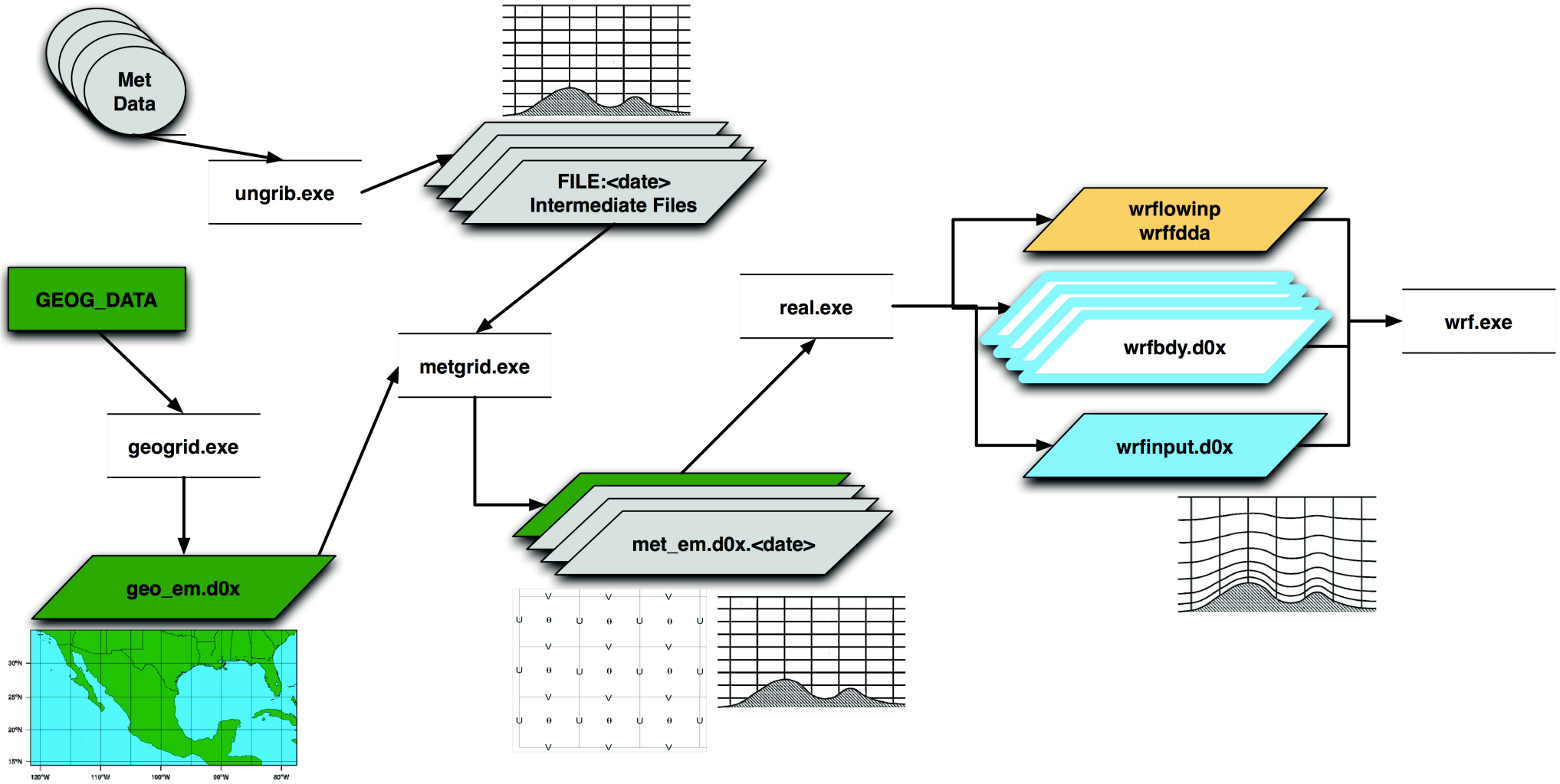
  - Tools to prepare the data that WRF is going to ingest (geogrid, ungrib, and metgrid). They process the driving model data as well as the static data.

- WRF model

  - Initialization program: real.exe

  - Numerical integration program: wrf.exe

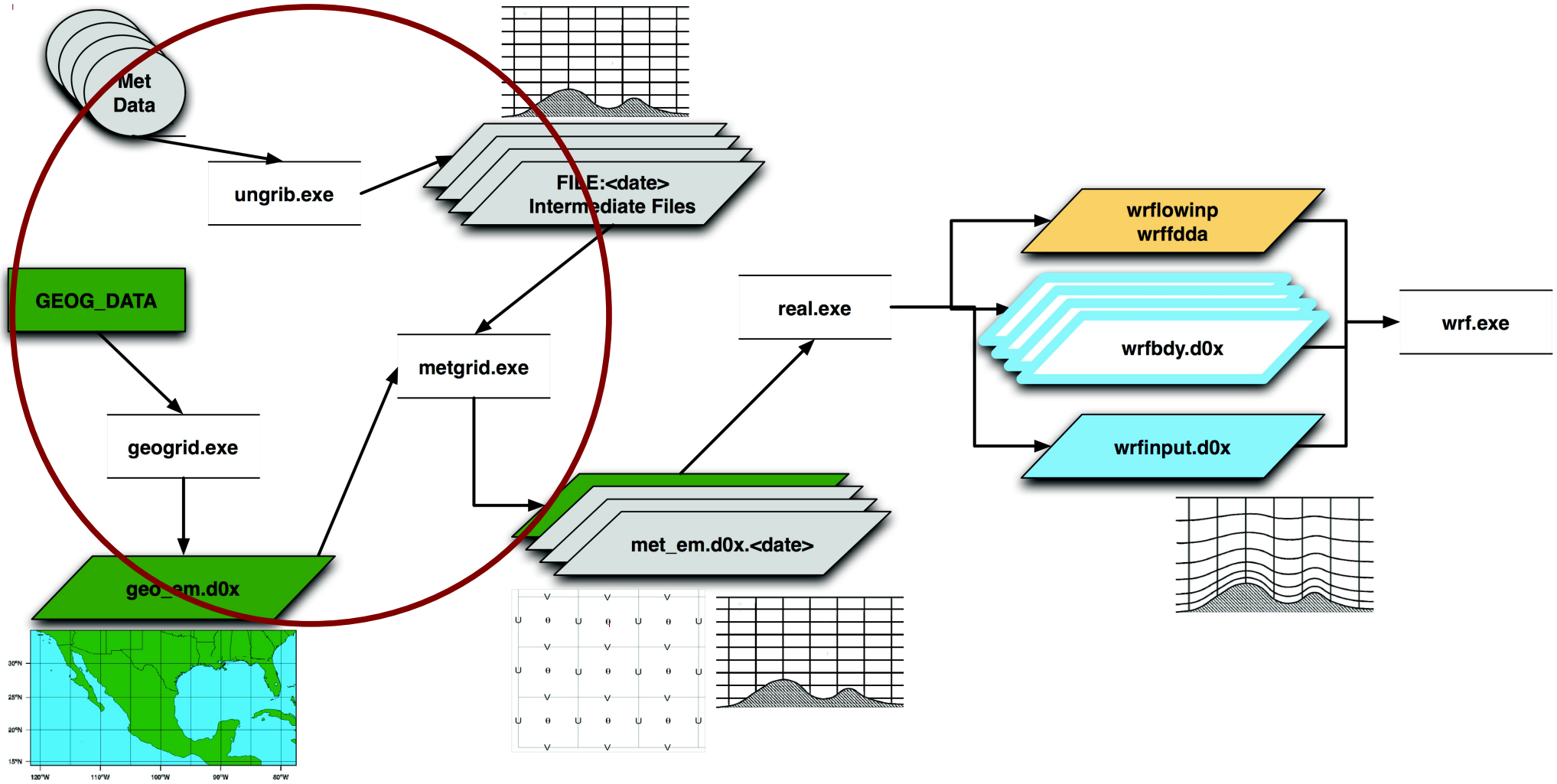
WRF workflow



Taken from http://www.mmm.ucar.edu/wrf/users/tutorial/201207/WRF_Overview_Dudhia.pdf

WPS

WRF workflow



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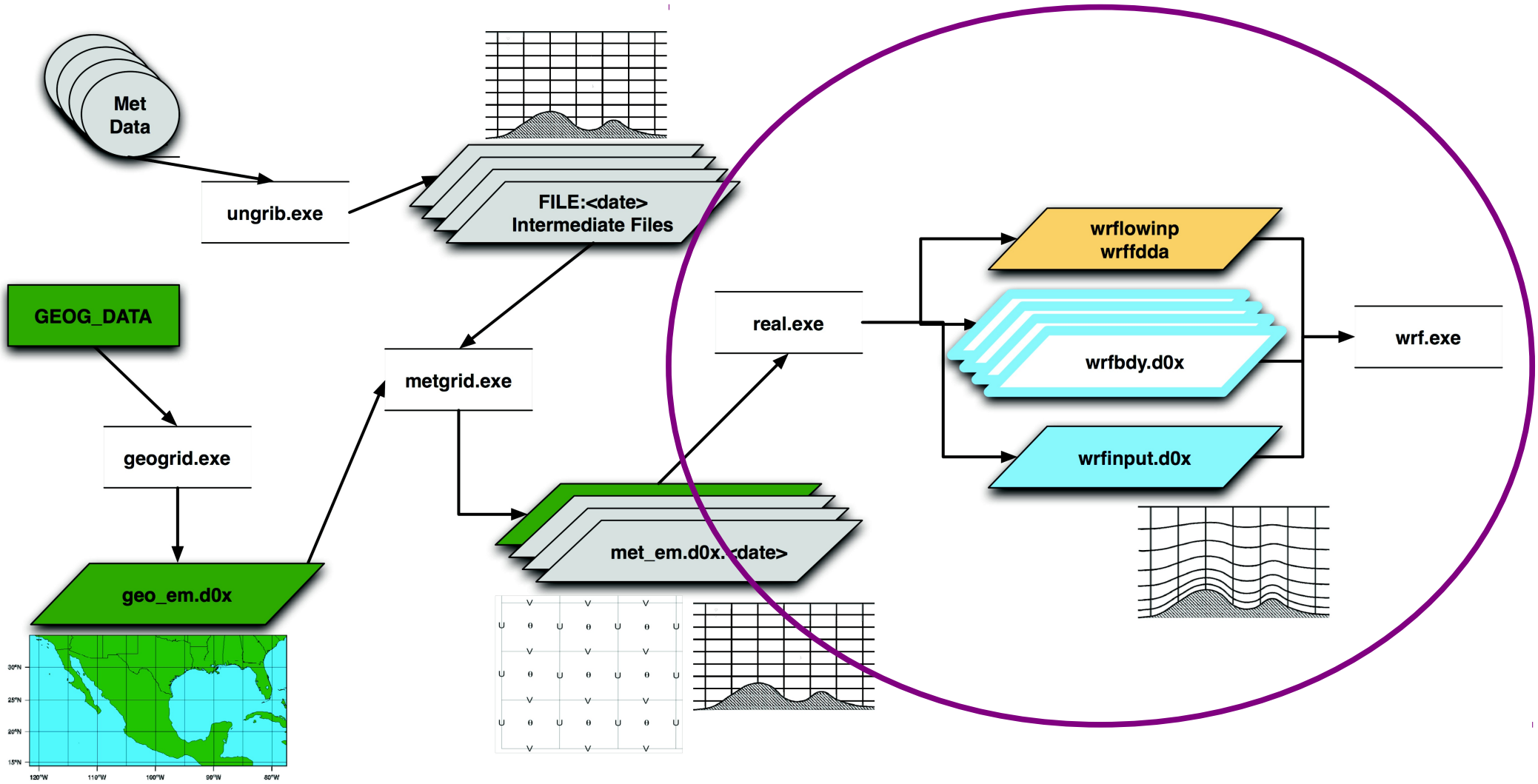
WRF workflow



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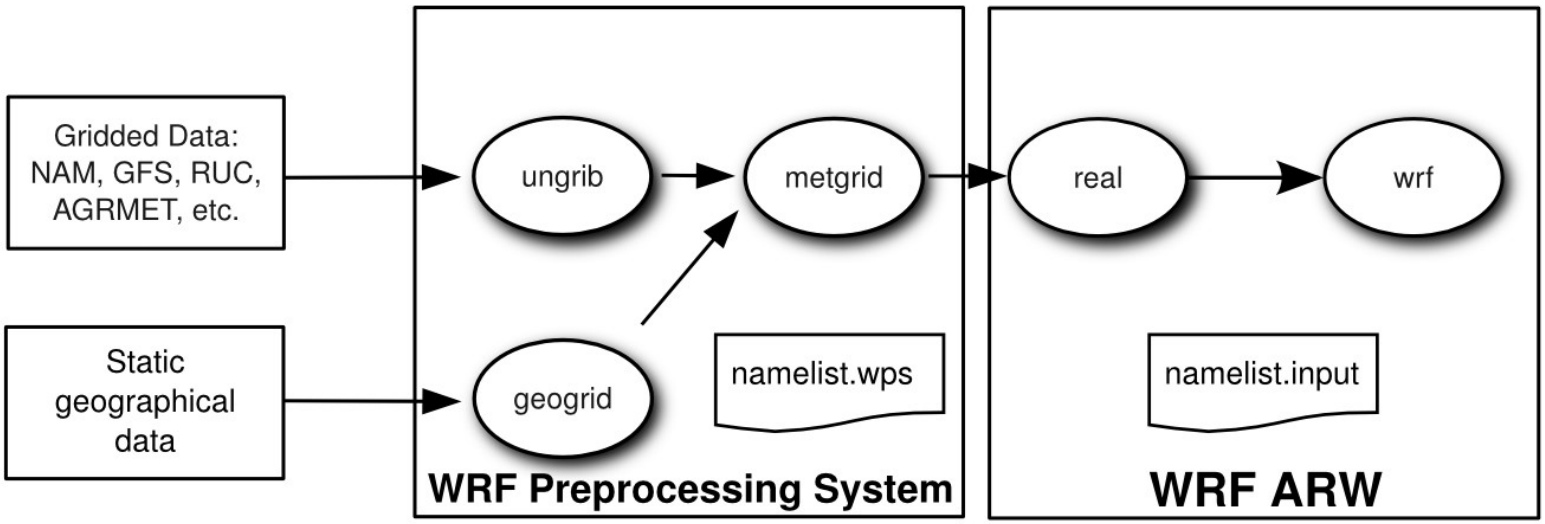
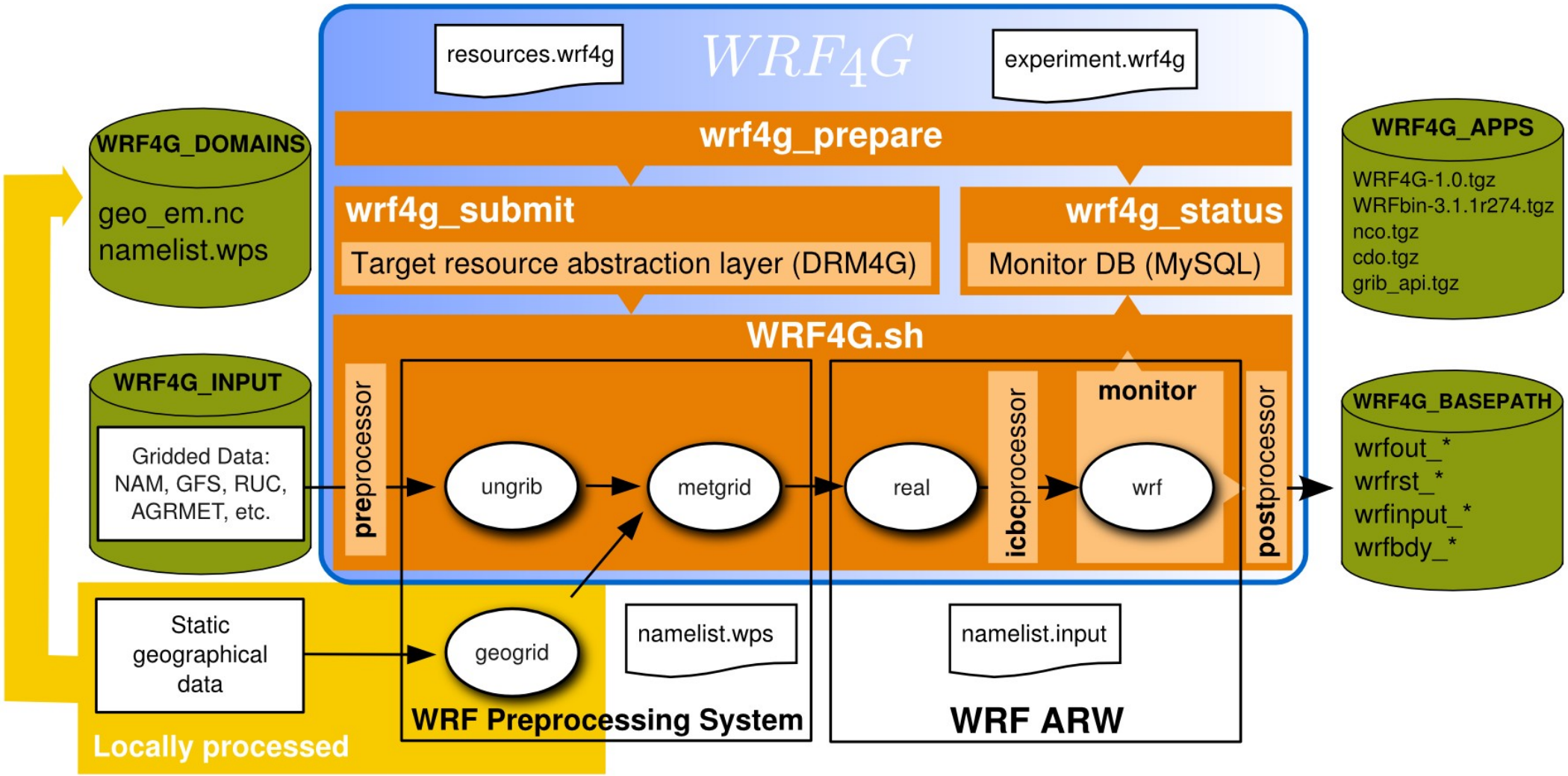
Wrf workflow



Wrf workflow



WRF namelists:

Namelists are simple ASCII files which are used to define a large amount of parameters of WRF configuration.

WPS → namelist.wps

WRF → namelist.input

Other configuration files: GEOGRID.TBL, METGRID.TBL, Vtables, etc.

```
&time_control
run_days                            = 0,
run_hours                           = 12,
run_minutes                         = 0,
run_seconds                         = 0,
start_year                          = 2000, 2000, 2000,
start_month                         = 01,   01,   01,
start_day                           = 24,   24,   24,
start_hour                          = 12,   12,   12,
start_minute                        = 00,   00,   00,
start_second                        = 00,   00,   00,
end_year                            = 2000, 2000, 2000,
end_month                           = 01,   01,   01,
end_day                             = 25,   25,   25,
end_hour                            = 12,   12,   12,
end_minute                          = 00,   00,   00,
end_second                          = 00,   00,   00,
interval_seconds                    = 21600
input_from_file                     = .true.,.true.,.true.,
history_interval                    = 180,  60,   60,
frames_per_outfile                  = 1000, 1000, 1000,
restart                             = .false.,
restart_interval                    = 5000,
io_form_history                     = 2
io_form_restart                     = 2
io_form_input                       = 2
io_form_boundary                    = 2
debug_level                         = 0
/

&domains
time_step                           = 180,
time_step_fract_num                 = 0,
time_step_fract_den                 = 1,
max_dom                             = 1,
e_we                                = 74,    112,   94,
e_sn                                = 61,    97,    91,
e_vert                              = 28,    28,    28,
p_top_requested                     = 5000,
```

WRF-ARW online tutorial

- The best way to familiarize with Wrf workflow is to follow the online tutorial available in http://www.mmm.ucar.edu/wrf/OnLineTutorial/

- In this lecture, we are going to run the default case of the tutorial. Please go to

http://www.mmm.ucar.edu/wrf/OnLineTutorial/CASES/JAN00/index.html