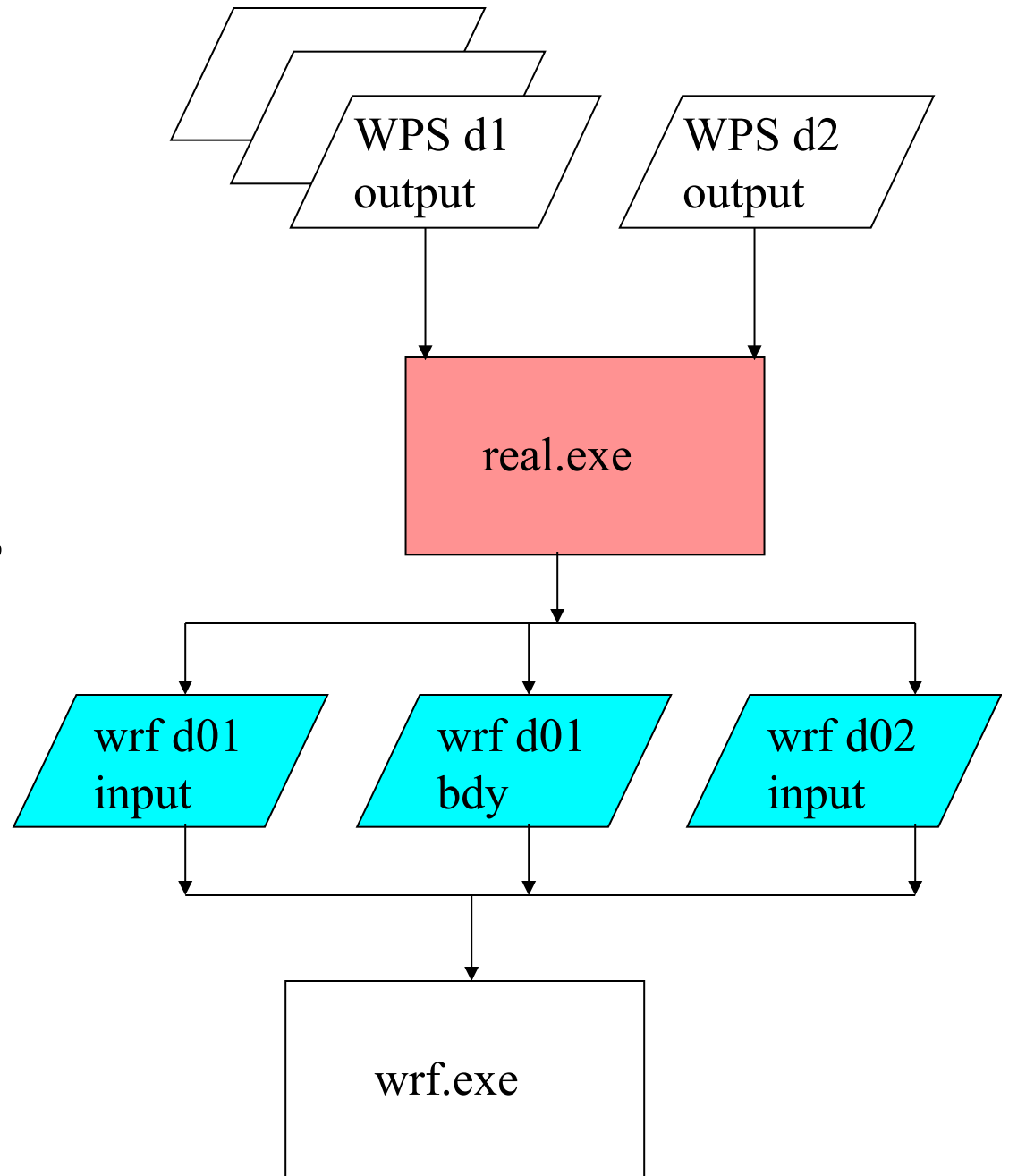


# Real

## Description of General Functions



# Real program in a nutshell

- Function
- Required input variables
- Base State
- Standard generated output
- Optional output
- Vertical interpolation
- Soil level interpolation
- Water temperature initialization
- Sea-ice initialization
- Land/Water mask
- Nested processing

# Function

- The WRF model pre-processor is *real.exe*
- The real.exe program is available *serial* or *DM parallel* (primarily for aggregate memory purposes, as opposed to timing performance)
- This program is automatically generated when the model is built and the requested use is for a real data case
- The real.exe program takes data *from WPS* and transform the data *for WRF*
- Similar to the ARW idealized data pre-processor, real.exe is tightly coupled to the WRF model through the *Registry*

# Function

- *3D forecast* or simulation
- *Meteorological input* data that primarily originated from a previous forecast or analysis, probably via the WPS package
- Anticipated *utilization of physics* packages for microphysics, surface conditions, radiation, convection, and boundary layer (maybe usage of nudging capabilities)

# Function

- A non-Cartesian *projected domain*
  - Lambert conformal, Mercator, polar stereographic, rotated latitude/longitude (global or regional)
- Selection of *realistic static fields* of topography, land use, vegetation, and soil category data
- Requirement of *time dependent* lateral boundary conditions for a regional forecast

# Function

- Not referring to the *Variational* or the *Digital Filtering* usage of Initialization
- Generation of *diagnostics* necessary for assumed WRF model input
- Input field *adjustment* for consistency of static and time dependent fields (land mask with soil temperature, etc.)
- ARW: computation of *reference* and *perturbation* fields
- Generation of *initial* state for each of the requested domains
- Creation of a *lateral boundary file* for the most coarse domain
- *Vertical interpolation* for 3d meteorological fields and for sub-surface soil data

# Standard Input Variables

- The metgrid program typically provides meteorological data to the real program.
- **Mandatory:**
  - 3d and surface: horizontal winds, temperature, relative humidity, geopotential height
  - 3d soil: soil temperature
  - 2d fields: surface pressure, sea-level pressure, land mask
- **Optional (but desirable):**
  - 3d soil: soil moisture
  - 2d fields: topography elevation of input data, SST, sea-ice, skin temperature

# Base State

- Several of the mass-point fields are **separated** into a time-independent **base state** (also called a reference state) and a **perturbation** from the base state
- The base state fields are only functions of the **topography** and a few user-selectable constants
- If the **topography changes**, such as with a moving nest, the base state fields are modified
- Feedback for 2-way nesting also impacts base state fields through topographic averaging
- No base state computations are required **prior to the real program**



# Standard Generated Output

- For regional forecasts, the real program generates both an initial (*wrfinput\_d01*) and a lateral boundary (*wrfbdy\_d01*)
- The boundary file is not required for **global forecasts** with ARW
- The **initial condition** file contains a **single time period** of data
- These files contain data used directly by the WRF model
- The initial condition file may be ingested by the **WRFDA** code (referred to as a *cold-start*)
- If *n* times were processed with WPS and real, the lateral boundary file contains *n-1* time slices

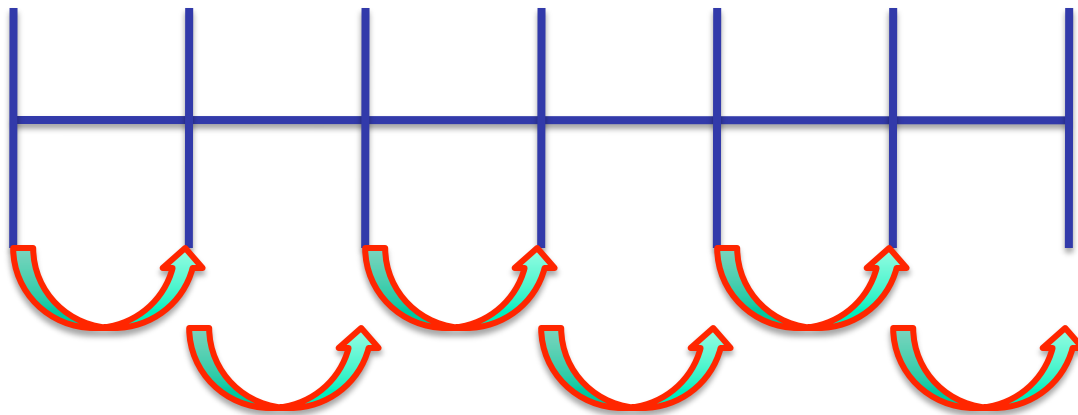
# Lateral Boundary Condition Times

0      6      12      18      24      30      36 h

Time periods  
from WPS

1      2      3      4      5      6      7

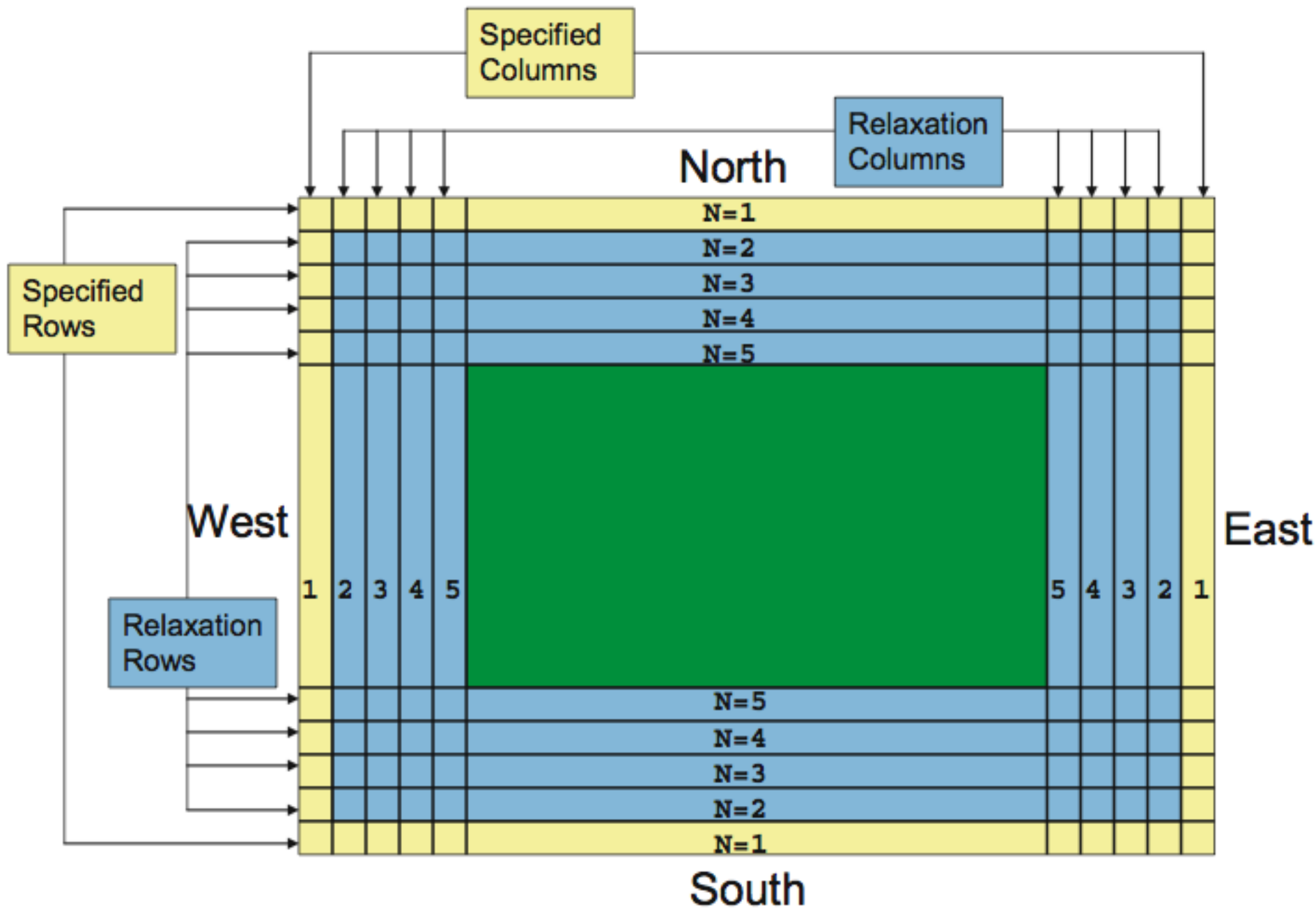
Time slices from  
WPS



Boundary  
tendency steps

1      2      3      4      5      6

# Real-Data Lateral Boundary Condition: Location of Specified and Relaxation Zones



# Optional Output

- WRF allows users to provide a lower boundary condition file (*wrflowinp\_d01*), containing slowly changing files such as SST, sea-ice, greenness fraction
- Users have a large amount of control over what appears in optional files, based on the Registry. Stream #4 is currently used for lower boundary data, such as for SST.

```
state real SST ij misc 1 - \  
i0124rhd=(interp_mask_water_field:lu_index,iswater) \  
"SST" "SEA SURFACE TEMPERATURE" "K"
```

# Vertical Interpolation

- A number of vertical interpolation options are available to users
- The options can have a significant impact on the initial conditions passed to the model
- More information is contained in the info file *README.namelist* in the *run* directory
- Options are located in the *&domains* namelist record of *namelist.input*

# Vertical Interpolation

- Select reasonable  $\eta$  levels, or let the real program do it for you
- Verify that the “thicknesses” are acceptable, generally about the same value in the free-atmosphere and less than 1000 m

# Vertical Interpolation

- Adjusted with a few parameters:

```
&domains
```

```
e_vert           = 50,      50,      50
```

```
p_top_requested = 1000,
```







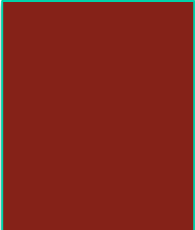



```
&dynamics
```

```
base_temp       = 290.
```

```
iso_temp        = 200
```

# Soil Level Interpolation

- The WRF model supports several Land Surface schemes:
  - `sf_surface_physics = 2`, Unified Noah scheme
  - 4 layers
  - Defined with layers: 0-10, 10-40, 40-100, 100-200 cm

Noah		RUC	
Layers	Mid point		Levels
	000 – 010 cm -- 005 cm		000 cm
	010 – 040 cm -- 025 cm		005 cm
	040 – 100 cm -- 070 cm		020 cm
	100 – 200 cm -- 150 cm		040 cm
			160 cm
			300 cm



# Soil Level Interpolation

- The real program accepts soil **temperature and moisture** from metgrid with an **arbitrary vertical distribution** (though it is explicitly defined in the ungrib Vtable via the naming convention)
- Vertical interpolation is **linear in depth below ground**, where “layers” are assumed defined at their mid-point
- Temperature **extrapolation**:
  - Near or at the surface uses the skin temperature
  - Below the deepest input soil level uses the annual mean temperature (assumed to be at 300 cm)
- Moisture extrapolation uses the closest level

# Water Temperature Initialization

- **Two** general types of **water temperatures** are input by the ungrib program
  - Identified as a water temperature (SST)
  - Identified as a “ground” temperature, but over water (SKINTEMP)
- The real program is able to preferably use an SST over a water body, if the input field exists
- An **in-land water body** capability in WPS is supported in the real program, with both the USGS and the MODIS sources
  - Locations identified as in-land water bodies use a daily-mean 2-m air temperature (if one exists)

# Nested Processing

- May read **multiple domain input files** from metgrid
- Requires only the **initial time for the fine domains**, unless doing nudging or SST update
- No horizontal interpolation from coarse to fine
- **No consistency checks** between domains (handled in the feedback step for the WRF model)
- A ***wrfinput\_d0x*** file is created for each processed input domain
- A **lateral boundary file** is created only for the **most coarse** domain

# Real program in a nutshell

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