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# WRF Modeling System Overview

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# What is WRF?

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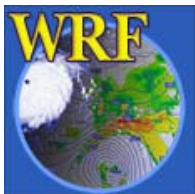
- WRF: Weather Research and Forecasting Model
  - Used for both research and operational forecasting
- It is a supported “community model”, i.e. a free and shared resource with distributed development and centralized support
- Its development is led by NCAR, NOAA/GSD and NOAA/NCEP/EMC with partnerships at AFWA, FAA, NRL, and collaborations with universities and other government agencies in the US and overseas



# Who uses WRF?

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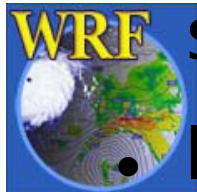
- Academic atmospheric scientists (dynamics, physics, weather, climate research)
- Forecast teams at operational centers
- Applications scientists (e.g. Air Quality, Hydrology, Utilities)



# What can WRF be used for?

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- Atmospheric physics / parameterization research
- Case-study research
- Real-time NWP and forecast system research
- Teaching dynamics and NWP
- Regional climate and seasonal time-scale research
- Coupled-chemistry applications
- Global simulations
- Idealized simulations at many scales (e.g. convection, baroclinic waves, large eddy simulations)



# Convective-scale Forecasting (4km)

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QuickTime™ and a  
BMP decompressor  
are needed to see this picture.



# Hurricane Katrina Simulation, using moving nest

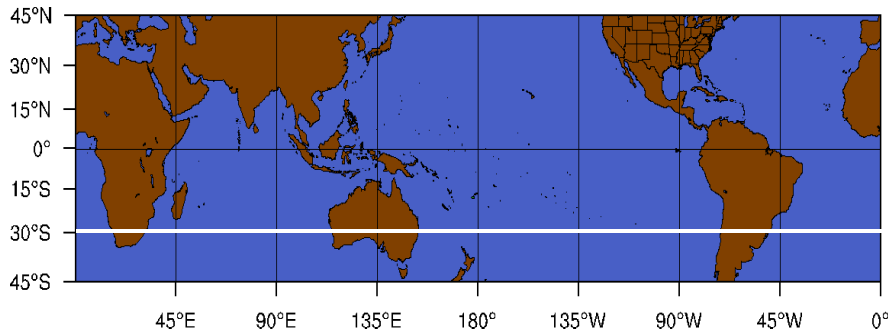
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QuickTime™ and a  
BMP decompressor  
are needed to see this picture.



# Channel configuration *(climate studies)*

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QuickTime™ and a  
BMP decompressor  
are needed to see this picture.



# Global WRF configuration

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QuickTime™ and a  
BMP decompressor  
are needed to see this picture.

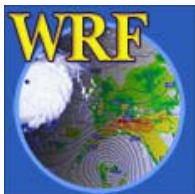




# Model, Key Features

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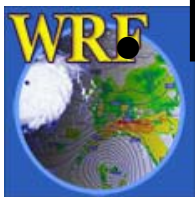
- 3rd-order Runge–Kutta time integration scheme
- High-order advection scheme
- Scalar-conserving (positive definite option)
- Complete Coriolis, curvature and mapping terms
- Two-way and one-way nesting



# Model, Key Features

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- Choices of lateral boundary conditions suitable for real-data and idealized simulations
  - Specified, Periodic, Open, Symmetric, Nested
- Full physics options to represent atmospheric radiation, surface and boundary layer, and cloud and precipitation processes
- Grid-nudging and obs-nudging (FDDA)
- Digital Filter Initialization option

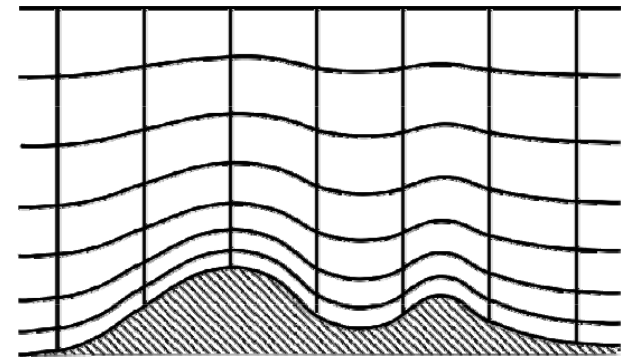


# Model, Dynamics

- Fully compressible, non-hydrostatic (with hydrostatic option)
- Mass-based terrain following coordinate,  $\eta$

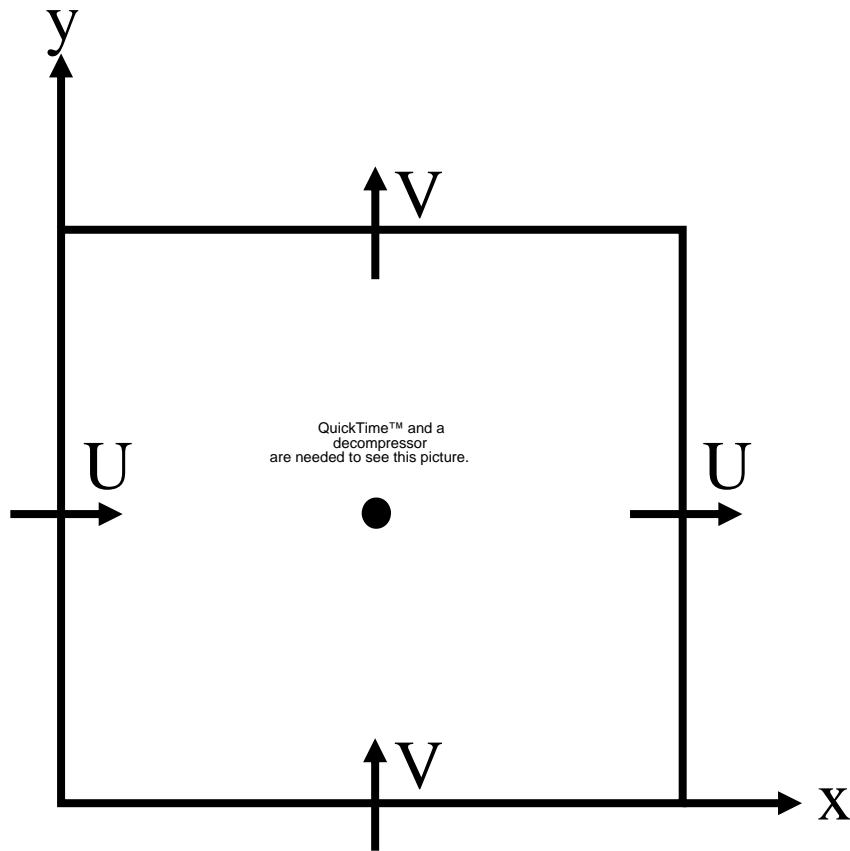
$$\eta = \frac{(\pi - \pi_t)}{\mu}, \quad \mu = \pi_s - \pi_t$$

where  $\pi$  is hydrostatic pressure,  
 $\mu$  is column mass

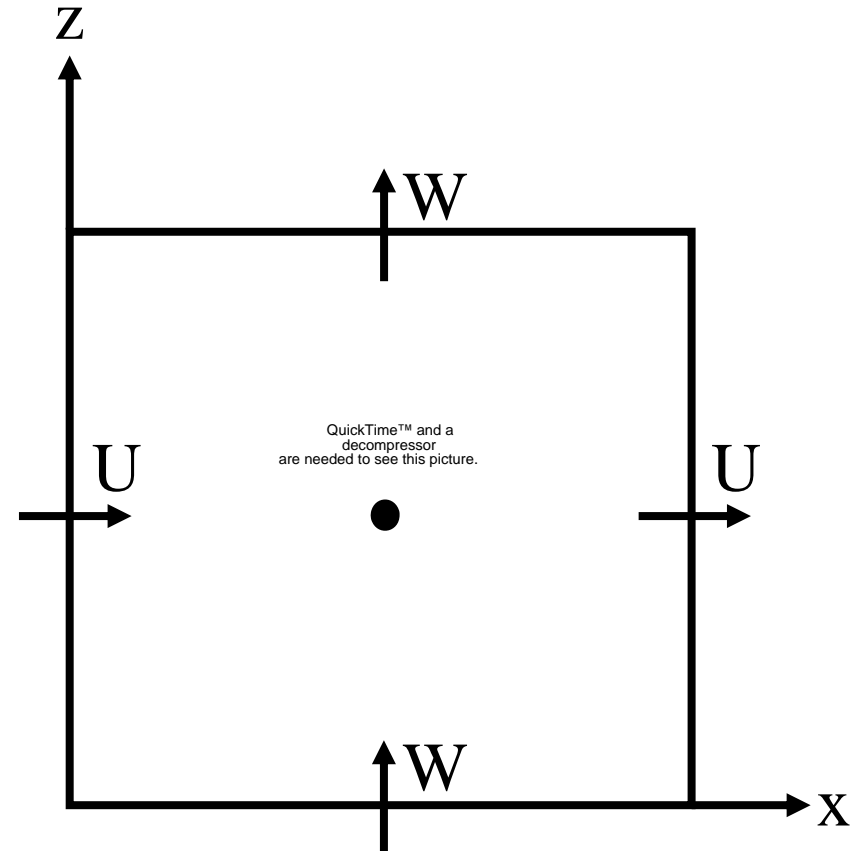


# Model, Grid Staggering

## C-grid staggering



horizontal

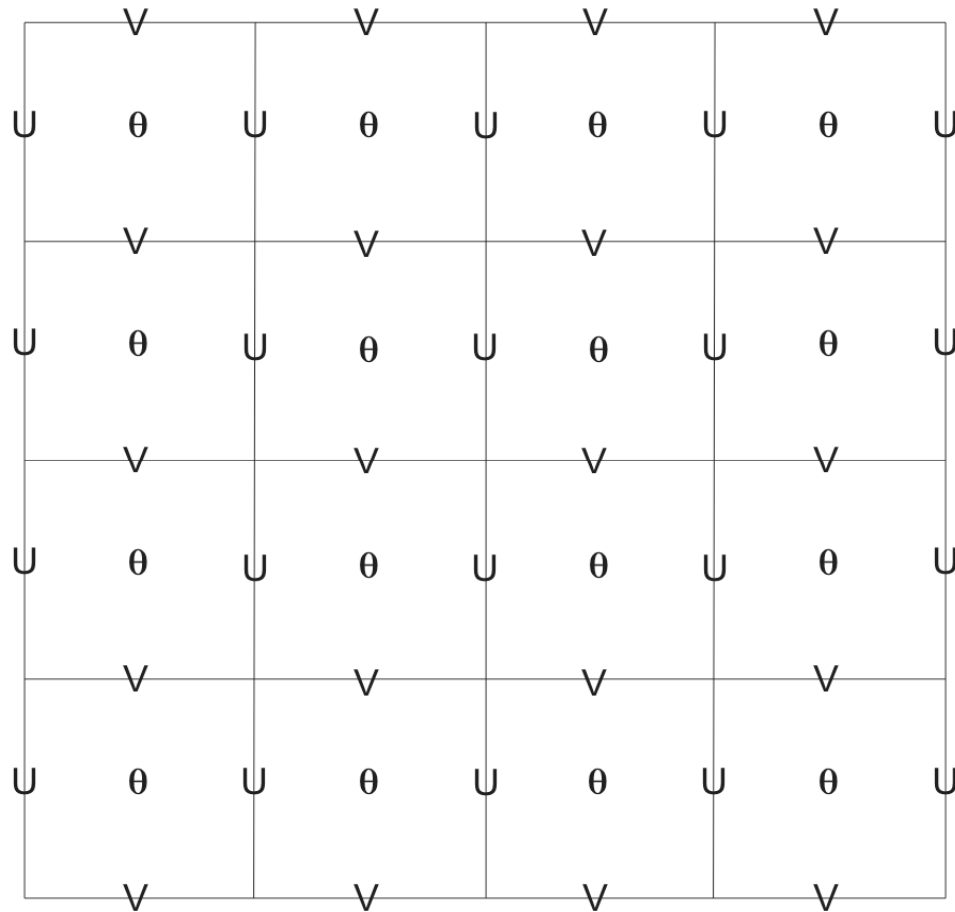


vertical



# Model, Grid Staggering

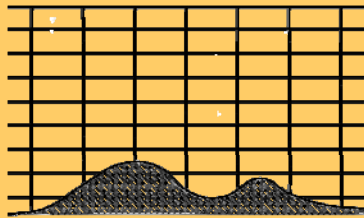
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# Requirements to run WRF

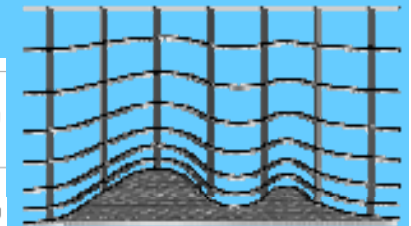
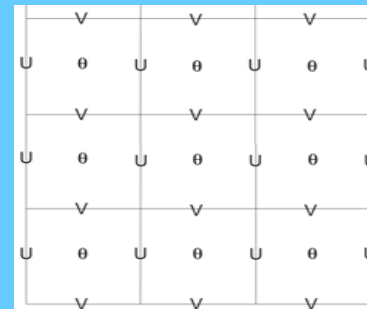
Global terrain information  
(static data) on projection "a"

Meteorological data  
(regional/global) on  
projection "b" (*GRIB*)



**WPS**  
(*geogrid,*  
*ungrid,*  
*metgrid*)  
&  
**real**

Meteorological and  
terrain information for  
our domain. (*netCDF*)



**Source Data**

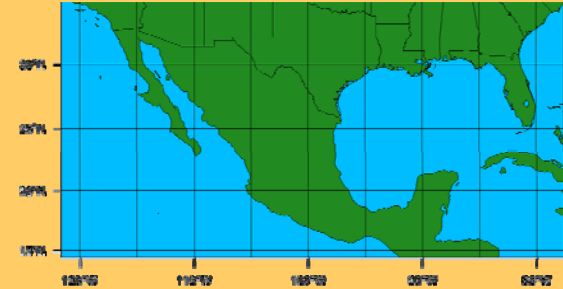
**WRF**



# Requirements to run WRF

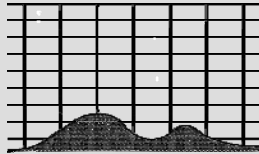
## geogrid

Create domain  
Project static data onto this domain  
`geo_em.d01.<date>`



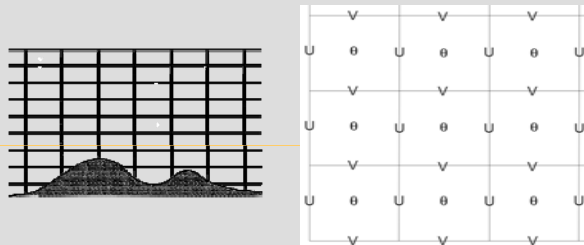
## ungrib

Reformat meteorological data  
(*GRIB*  $\Leftrightarrow$  *IM* format)  
No re-projection  
`FILE:<date>`



## metgrid

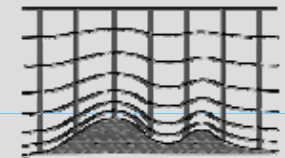
Project meteorological data  
onto model domain  
`met_em.d01.<date>`



## real

Vertically interpolate to  
eta levels.

`wrfinput_d01`  
`wrfbdy_d01`

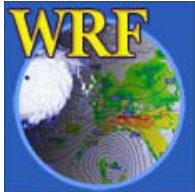
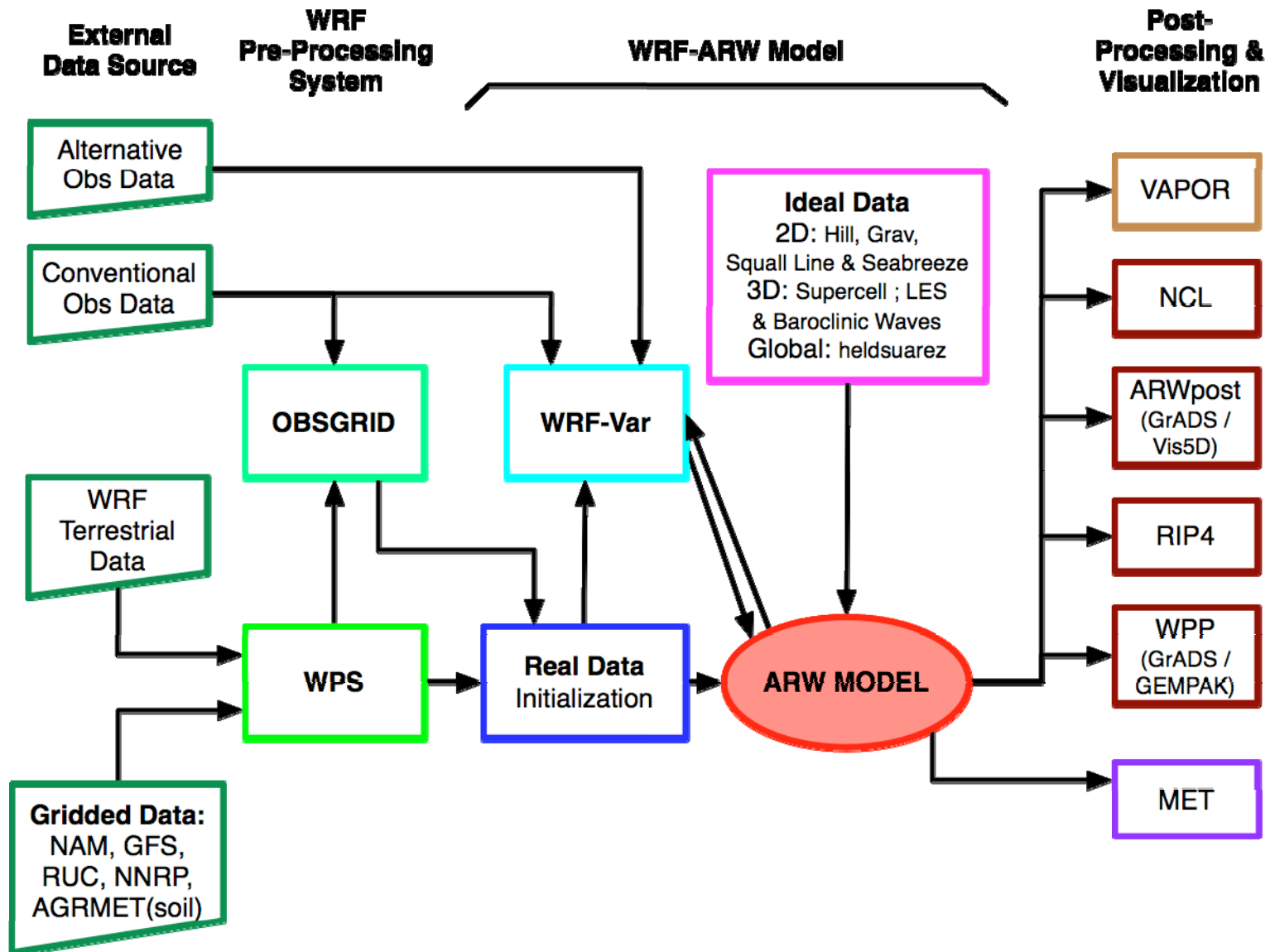


**Source Data**

**WRF**



# WRF-ARW Modeling System Flow Chart

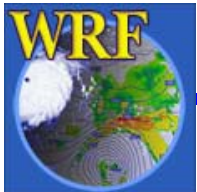




# Basic Software Requirement

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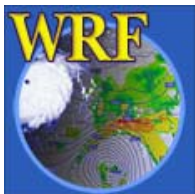
- Fortran 90/95 compiler
- C compiler
- Perl
- netCDF library
  
- Public domain mpich for MPI
- Graphical display package



# Portability

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- Runs on Unix single, OpenMP and MPI platforms:
  - IBM SP AIX (xlf)
  - Linux (PGI, Intel, g95, gfortran, Pathscale compilers)
  - SGI Altix (Intel)
  - Cray XT (PGI, Pathscale)
  - Mac Darwin (xlf, PGI, Intel, g95 compilers)
  - Others (HP, Sun, SGI Origin, Compaq)



# User Support

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- Email: [wrfhelp@ucar.edu](mailto:wrfhelp@ucar.edu)
- User Web pages:
  - <http://www.mmm.ucar.edu/wrf/users/>
  - Latest update for the modeling system
  - WRF software download
  - Various documentation
    - Users' Guides
    - Technical Note

