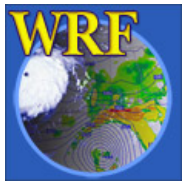
WRF Standard Initialization

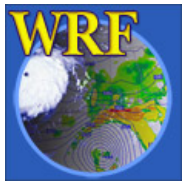
Wei Wang

July 25, 2005

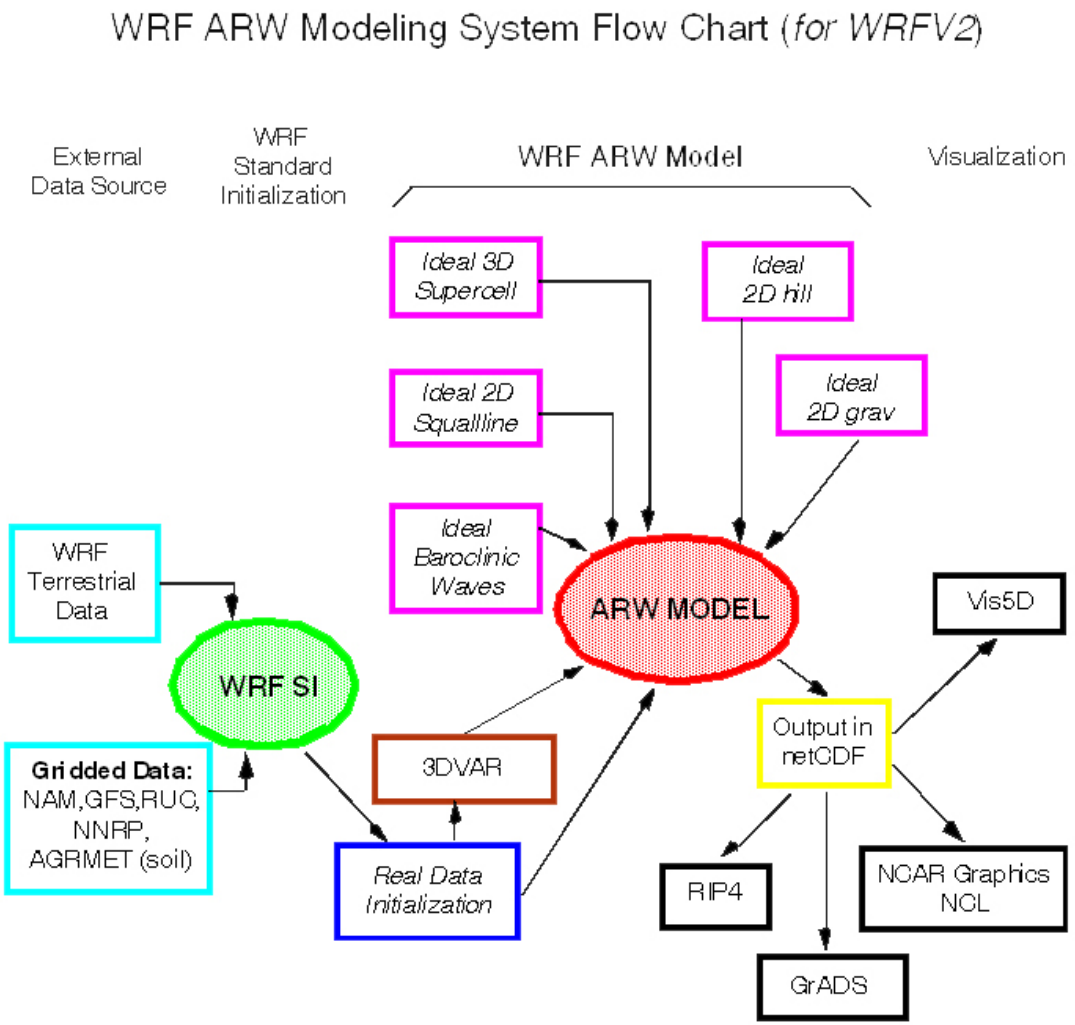


Outline

- Overview of the SI programs
- Functions of SI program components
- SI software requirement
- SI utility programs
- New capability in SI

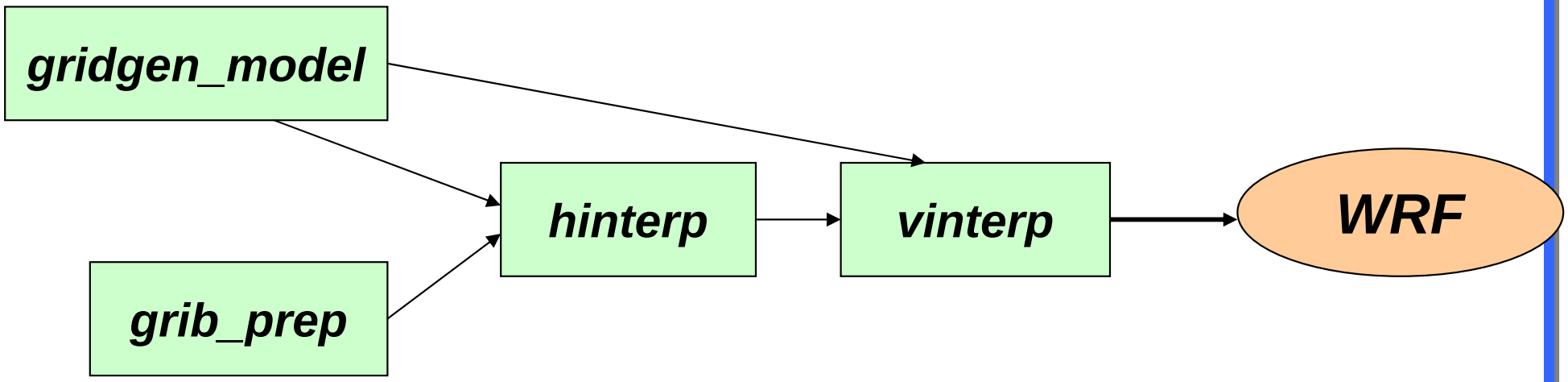


ARW Modeling System Flowchart



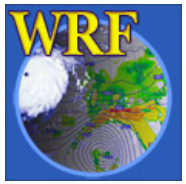
SI Program Overview

SI Program Components



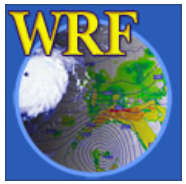
SI Program Overview

- Prepare data for ARW simulations using meteorological data
- Create mesoscale domains and associated latitude / longitude, terrain, landuse, soil type and other static (non time-varying) land state data
- Create time-varying meteorological data (including soil layers) on these domains



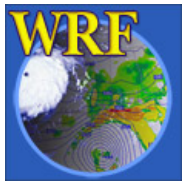
Functions of SI Program Components

- *gridgen_model*
- *grib_prep*
- *hinterp*
- *vinterp*



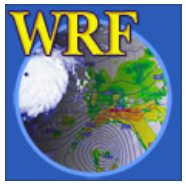
SI Program Components: *gridgen_model*

- Defining mesoscale domain, including nests
- Create static (non-time-varying) terrain and land state variables (such as landuse, soil types, etc.)
- Create latitude/longitudes, and Coriolis parameters of the mesoscale grid



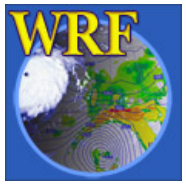
SI Program Components: *gridgen_model*

- Input static data: (on lat / long grid)
  - 30 second USGS topography;
  - 30 second landuse (based on USGS Version 2 Land Cover data);
  - 30 second top (0 – 30 cm) and bottom (30 – 100 cm) soil texture data (created from 30 sec. STAGSGO data over North America and 5 min. United Nation data over the rest of globe);
  - 10 minutes, monthly vegetation data (NCEP)
  - 10 minutes, monthly albedo data (NCEP)
  - 10 minutes maximum snow albedo data (NCEP)
  - 1 degree deep soil temperature (based on average ECMWF data)
  - 10 minutes terrain slope data (NCEP) – not currently used



SI Program Components: *gridgen_model*

- Input static data:
  - Need to be dowloaded before you run the program
  - All 30-second datasets are tiled in 10 x 10 degree files, and tared up for 4 quarters of globe (e.g. 0 – 180 E, 0 – 90 N in one tar file)



SI Program Components: *gridgen_model*

- Defining the mesoscale domains:

  Coarse grid parameters: (defined in namelist)

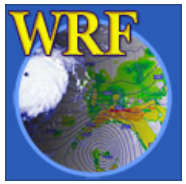
  – xdim, ydim

  – Map projection type: *Lambert-Conformal, Polar stereographic, and Mercator*

  – MOAD_KNOWN_LAT/LON: the lat and lon of the domain center

  – MOAD_STAND_LATS/LONS: the lats where earth distance is equal to map distance, and domain's meridian

  – MOAD_DELTA_X/Y: grid distance



SI Program Components: *gridgen_model*

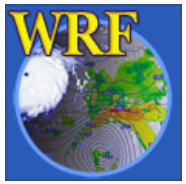
- Defining the mesoscale domains:

  nest grid parameters:

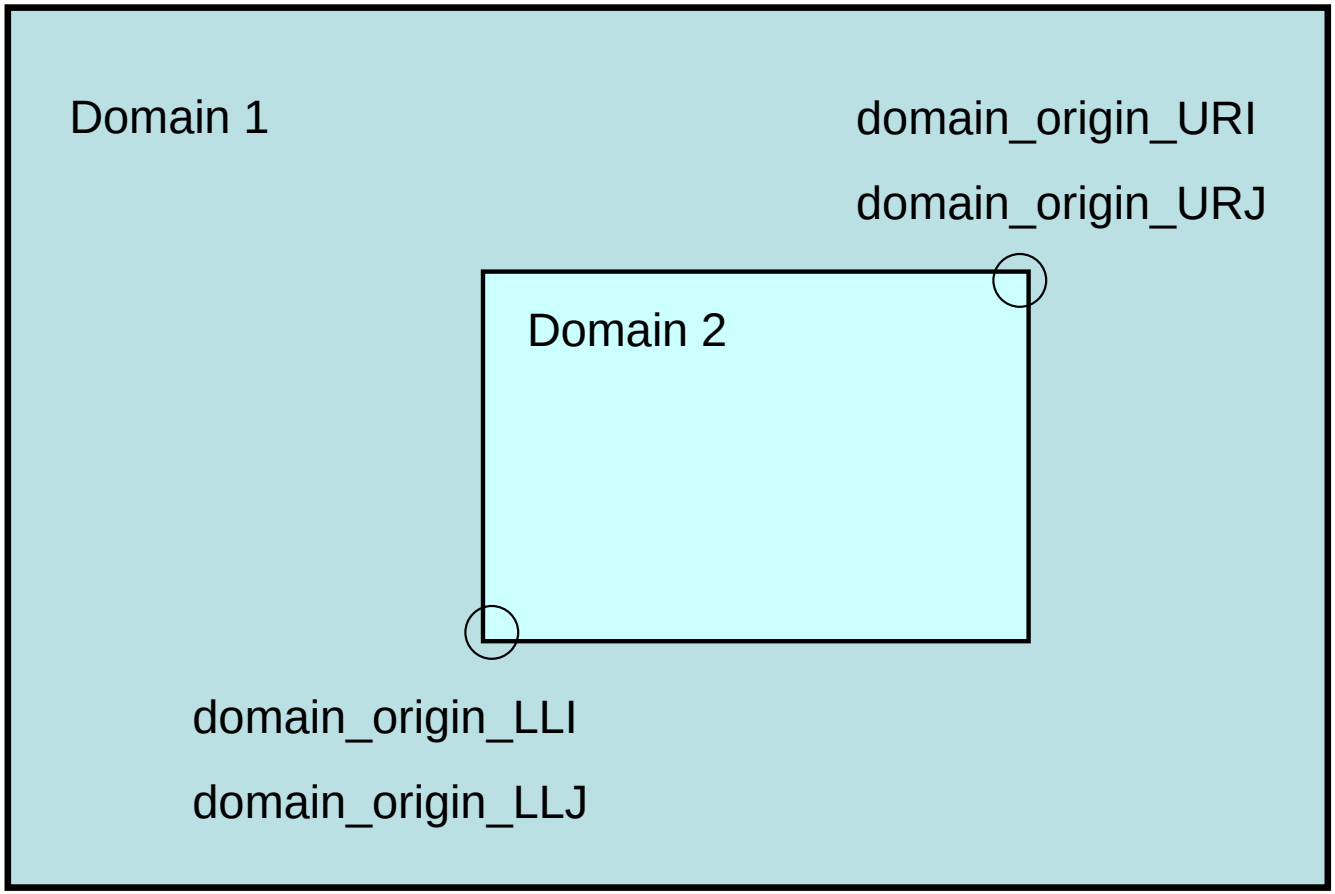
  – PARENT_ID, RATIO_TO_PARENT (any integer)

  – DOMAIN_ORIGIN_LLI/LLJ

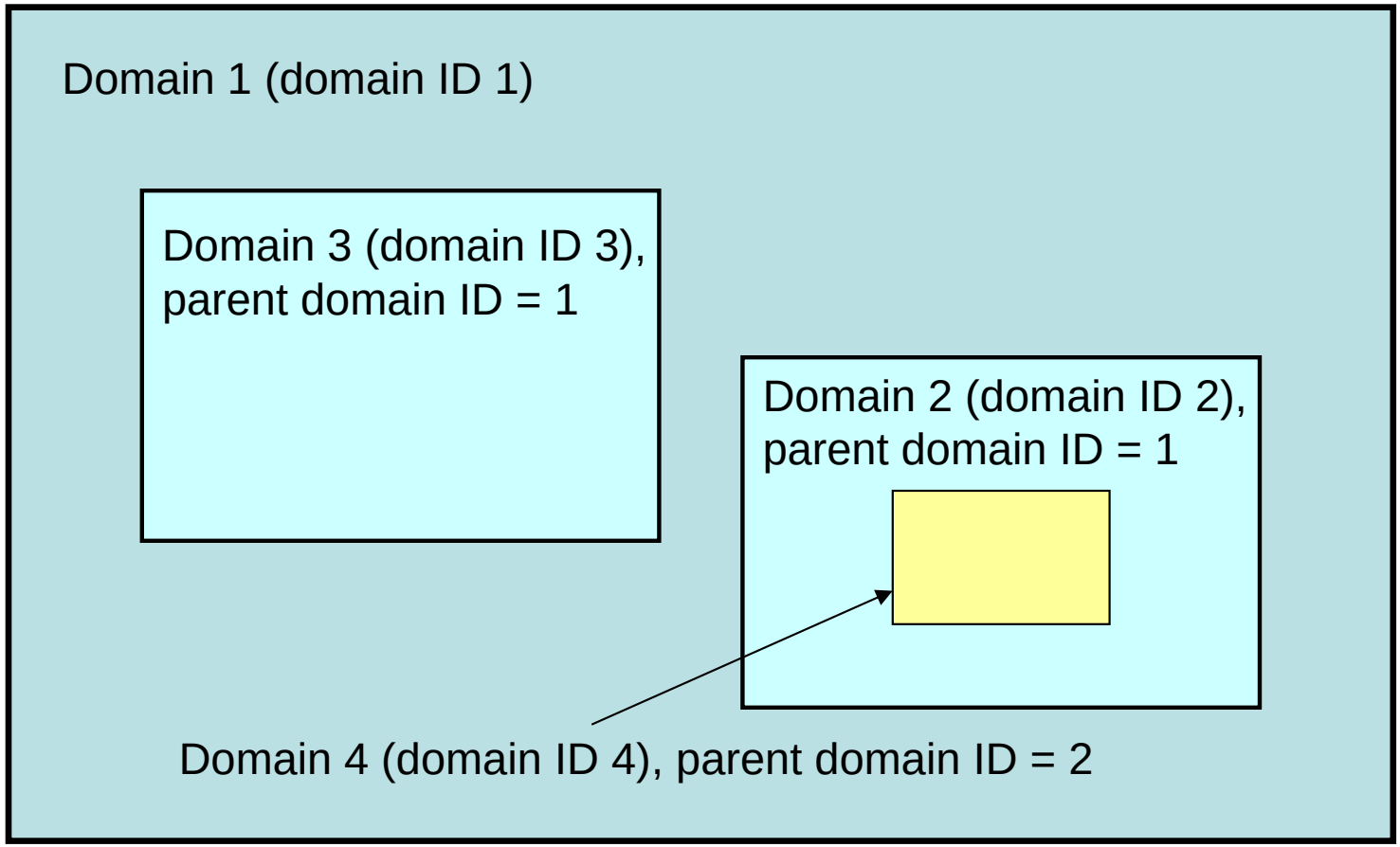
  – DOMAIN_ORIGIN_URI/URJ



SI Program Components: *gridgen_model*



SI Program Components: *gridgen_model*



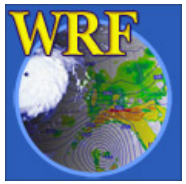
SI Program Components: *gridgen_model*

- Static data processing:
  - Some averaging is performed
  - For terrain, it can be controlled by two namelist parameters:

    SILAVWT_PARA_WRF

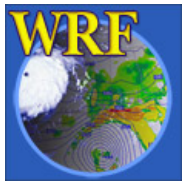
    TOPTWVL_PARA_WRF

For documentation of the terrain processing method, see Smart et al. (2004) (*http://www.mmm.ucar.edu/mm5/workshop/workshop-papers_ws04.html*)



SI Program Components: *gridgen_model*

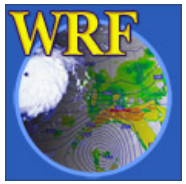
- Output:
  - *static.wrfsi.d0n* (where n is the domain ID)
    - Userd by *hinterp* and *vinterp* later
    - In netCDF, but not WRF I/O API conforming
  - Other outputs:
    - *wrfstatic_d0n*: netCDF and conforming to WRF I/O API. Not currently used, but will be used by ARW.
    - ASCII and binary output of gridded lat/lon and terrain data (e.g. *topography-mass.d01.dat*)



SI Program Components: *grib_prep*

- degrib GriB data and write data in an intermediate data format
- Interpolate data to missing times if necessary
- Create required data from related ones.

  e.g. RH from specific humidity or T_d

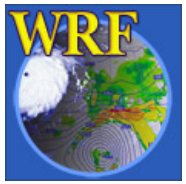


SI Program Components: *grib_prep*

- GriB 1 data are the primary data supported:
  - NCEP: NAM (Eta), GFS (AVN), AWIP (NAM data in AWIP format), NNRP, RUC, NARR (?)
  - ECWMF: TOGA, others
  - AFWA: AGRMET soil model data
- For the supported GriB data, Vtables are provided which are used to extract required variables
- For not-yet supported GriB data, it might be a simple matter of creating a new Vtable

SI Program Components: *grib_prep*

- For non-GriB data, a user can rewrite the data to the intermediate format (output from *grib_prep*)
  - Format described in *wrfsi/README* file, section 3.2.1

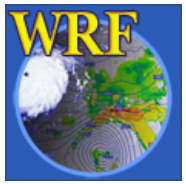


SI Program Components: *grib_prep*

- Output:
  - One per time, and per data source type
  - File names: e.g. if AVN and SST data and Vtables are used:

    AVN:2005-07-10_00

    SST:2005-07-10_00

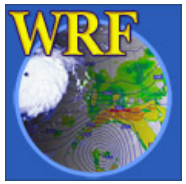


SI Program Components: *grib_prep*

- Where does one get GriB data?
  - User's responsibility
  - Some free data are available from NCAR and NCEP. See

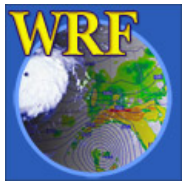
    http://www.mmm.ucar.edu/wrf/users/

    > *Download*
    - Some NCEP data in the past year
    - NCEP optional data available everyday



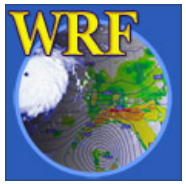
SI Program Components: *grib_prep*

- MM5 users:
  - You may use *pregrid*, and then run an intermediate file conversion program to convert MM5 intermediate files to that from *grib_prep*.
  - This conversion program will be available soon.



SI Program Components: *hinterp*

- Horizontally interpolate meteorological data from an external model (processed by *grib_prep*) to ARW domains (defined by *gridgen_model*).
  - The 3-D met data are interpolated to non-staggered grid.
  - LSM data are interpolated to c-grid.

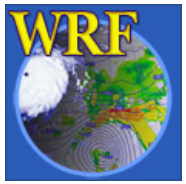


SI Program Components: *hinterp*

- Interpolation methods are controlled by namelist options:
  - HINTERP_METHOD

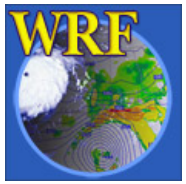
    3 options supported: nearest neighbor, 4-pt bi-linear, and 16-pt parabolic
  - LSM_HINTERP_METHOD

    Same options supported, but only nearest neighbor and 4-pt bilinear options are recommended



SI Program Components: *hinterp*

- The program supports the use of multiple data sources through namelist options:
  - INIT_ROOT: data used for IC
  - LBC_ROOT: data used for lateral boundary
  - LSM_ROOT: data used for LSM
  - CONSTANTS_FULL_NAME: constant fields



SI Program Components: *hinterp*

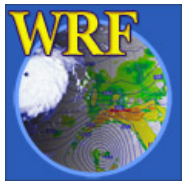
- An example:

  INIT_ROOT = ‘TOGA’

  LBC_ROOT = ‘AVN’

  LSM_ROOT = ‘AVNLSM’

  CONSTANTS_FULL_NAME = ‘SSTDATA’



SI Program Components: *hinterp*

- Output files:

  binary met data:

  hinterp_d01_2005-07-10_00:00:00

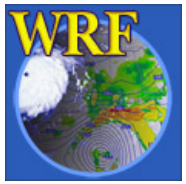
  hinterp_d01_2005-07-10_06:00:00

  hinterp_d02_2005-07-10_00:00:00 > nest

  Meta data file:

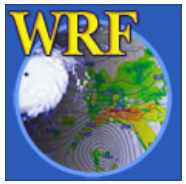
  hinterp.global.metadata

  - used only by *vinterp*



SI Program Components: *hinterp*

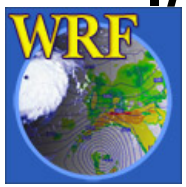
- MM5 users:
  - You may use *TERRAIN, REGRID and LITTLE_R/RAWINS*, and then run a conversion program to convert MM5 pressure-level data to that from *hinterp*, and then a modified *vinterp* program
  - This conversion program will be available soon.



SI Program Components: *vinterp*

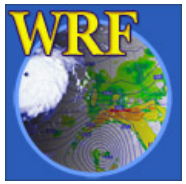
- Vertically interpolate meteorological data to ARW coordinate, η
  - Horizontally stagger the data to c-grid
- Diagnose required WRF variables:

  e.g. potential temp and μ
- Add static data generated in *gridgen_model*
- Write data out for ARW in netCDF (WRF I/O API conforming)



SI Program Components: *vinterp*

- The ARW coordinate is defined in namelist variable: LEVELS
- Vertical interpolation is linear from pressure to pressure levels



SI Program Components: *vinterp*

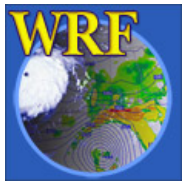
- Output files: e.g.

  wrf_real_input_em.d01.2005-07-10_00:00:00

  wrf_real_input_em.d01.2005-07-10_06:00:00

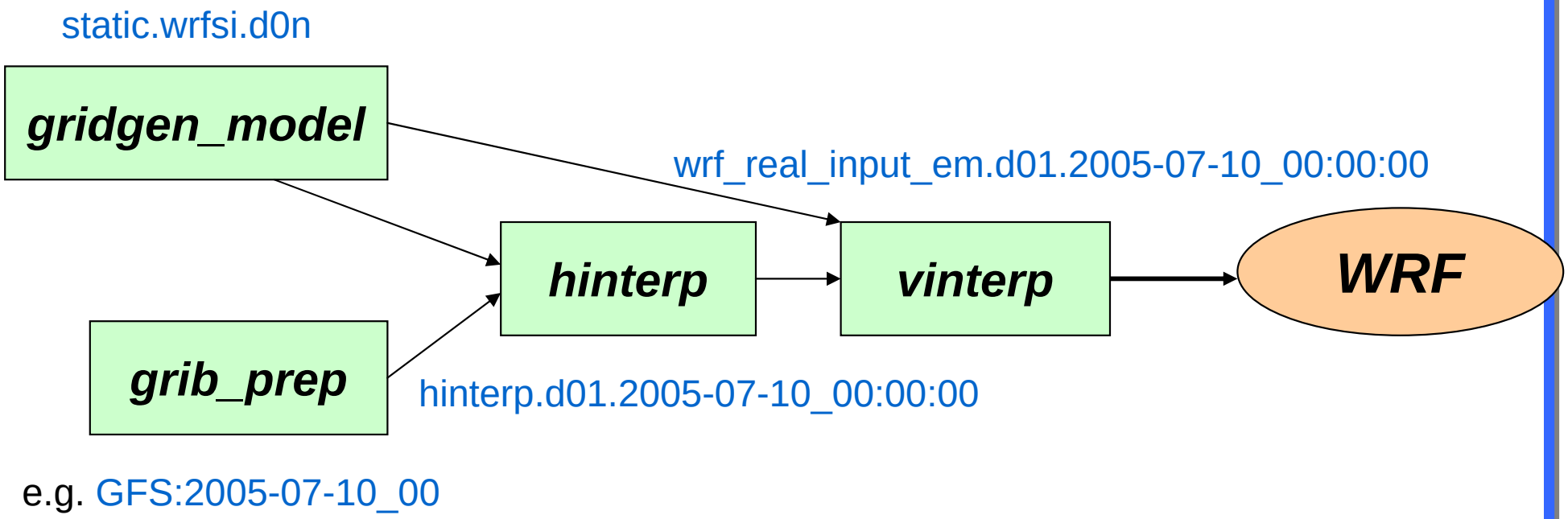
  wrf_real_input_em.d02.2005-07-10_00:00:00

  > nest



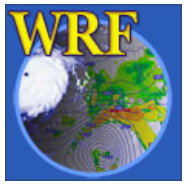
SI Program Overview

SI Program Components and output



SI Utility Programs

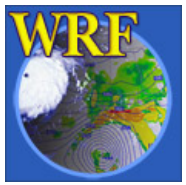
- NCL scripts
  - May be used to view *gridgen_model* output files, *static.wrfsi.d0n*
  - Scripts in *wrfsi/graphics/ncl* directory
- For intermediate formatted data:
  - *plotfmt.exe*: plot all fields in an intermediate file



SI Utility Programs

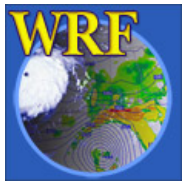
- For *hinterp* output data:
  - *siscan*: read and print maximum and minimum values from

    hinterp.d01.yyyy-mm-dd_hh:mm:ss



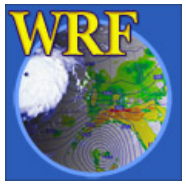
Check Output

- Utility programs can be used to check data from each SI program.
- For final output from SI, various supported graphical programs may be used.
- netCDF utility programs, such as '*ncdump*' may be used to look at any netCDF files



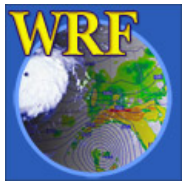
SI Software

- SI is written in Fortran 77, 90, and c.
- Runs on Unix and Linux computers
- Required packages:
  - Fortran 90 compiler
  - c compiler (gcc is sufficient)
  - make utility
  - Perl
  - netCDF library (built with the same compiler used for installing SI code)



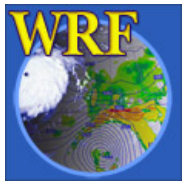
SI Software

- Supported for
  - Linux using PGI, Intel, and g95 compilers, SGI Altix, IBM, Alpha, Alpha Linux, Mac using IBM xlf compiler
  - May work on SGI IRIX, and Sun
- SI also supports a Graphical User Interface (or GUI) that may be used to run the program.



New in SI

- GriB 2 data
  - Both pressure-level data and native grid data from GFS (NCEP Global Forecast System) are tested
  - Enabling higher resolution and native grid data to be used
  - New *grib_prep* program (GriB2 decoder)
- Currently only available on 32-bit Linux



Acknowledgement

The SI program is developed and maintained at FSL/NOAA by

Paula McCaslin, *Brent Shaw (currently at WNI)*, *and John Smart*

WRF SI home page:

http://wrfsi.noaa.gov/