

WRF

The Weather Research and Forecasting Model

- **Numerical weather prediction capability designed for:**
 - Research
 - Operational forecasting
- **Community Model**
 - A free resource with development from a variety of scientists and software engineers
 - Contributions provided by a large user community.
 - Community support provided by the National Center for Atmospheric Research (NCAR)



WRF History

• Background

- Initial ideas—1995
- First public release— 2000
- Next release (April)—
WRF Version 3.7
- June 2014— 15th WRF Users'
Workshop (att. 225)

• Initial WRF Partners

- ◆ NCAR
- ◆ Air Force Weather Agency
(AFWA)
- ◆ National Centers for Environmental
Prediction (NCEP)
- ◆ Federal Aviation Administration
- ◆ U.S. Navy— Naval Research
Lab
- ◆ NOAA Earth System Research Lab (ESRL)
- ◆ Oklahoma University



WRF MODEL USERS' PAGE

Welcome to the users' page for the Weather Research and Forecasting Model (here referred to as "WRF", for short). WRF is a state-of-the-art atmospheric modeling system that is applicable for both meteorological research and numerical weather prediction. It offers a host of options for atmospheric physical processes and can run on a variety of computing platforms. WRF is suitable for a broad range of applications across scales ranging from tens of meters to the global, including the following:

- Meteorological investigations
- Real-time NWP
- Idealized atmospheric simulations
- Data assimilation studies and development
- Coupling with other earth system models
- Modeling and model use instruction and training

The Mesoscale and Microscale Meteorology (MMM) Division of NCAR supports the WRF system to the user community and maintains the WRF code. MMM supports the wrfhelp service, which provides user assistance and delivers WRF news. MMM also issues WRF releases and hosts the annual WRF Users' Workshop.

WRF FORECAST

ANNOUNCEMENTS

Latest WRF Releases:

Effective 1/7/15 (1200 UTC), GFS Analysis Data will be upgraded. This will require a new [Vtable](#). Click [here](#) for NCEP's page regarding changes to the data.

2015 Winter WRF Tutorial [Registration](#) now open!

[Version 3.6.1 Release \(6/14/2014\)](#)

[Version 3.6 Release \(4/18/2014\)](#)

[Version 3.5.1 Release \(9/23/2013\)](#)

WRF Releases - Known Problems:

V3.6.1 (updated 10/9/14)

WRF Users' Page

www2.mmm.ucar.edu/wrf/users

WRF User Participation

Registered Users

(June 2014)

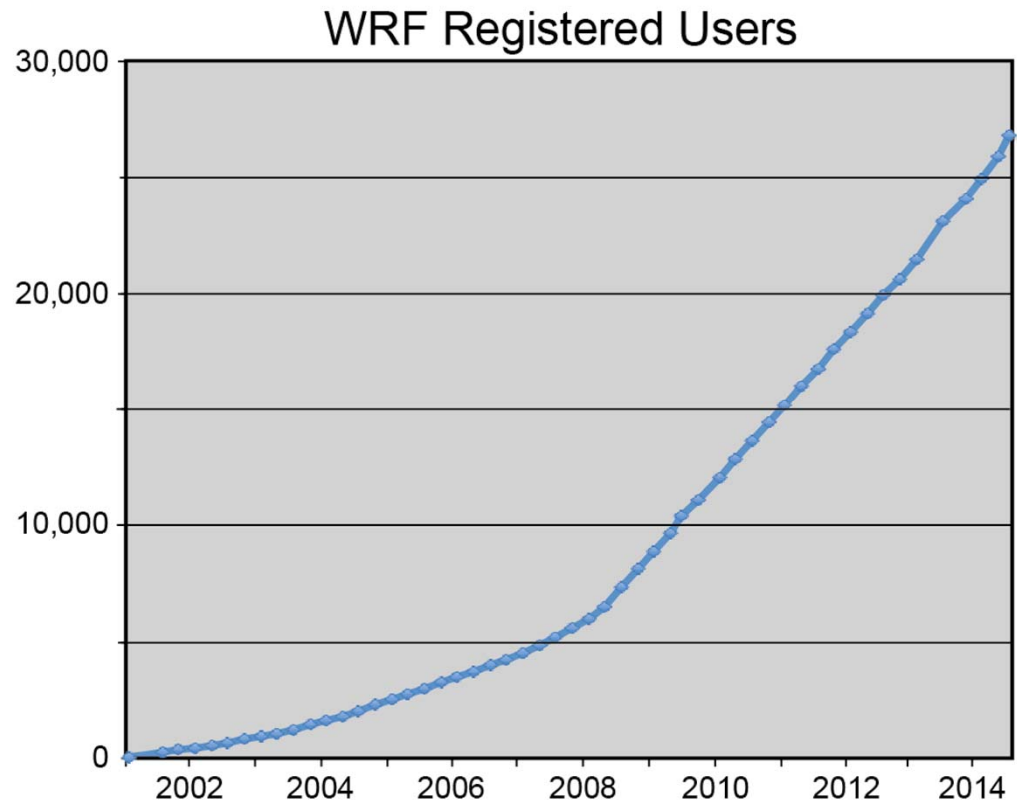
U.S. Universities 5,638

U. S. Gov't labs,
Private sector 2,494

Foreign users 18,718

26,850

Countries represented: 156



November 2014 registered users: 28,355

Active subscribers to wrf-news@ucar.edu: >8,250

WRF Registered User Countries



WRF for HAIC/HIWC

Four 48-h forecasts per day

400 x 284 x 52 grid

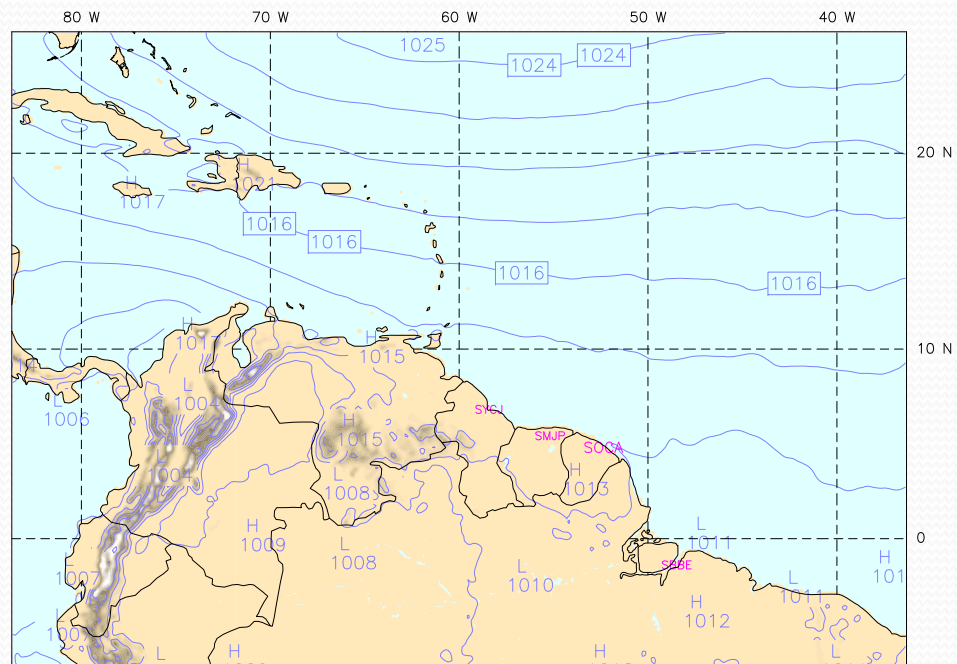
dx = 13 km

Model top of 30 hPa

Initial and lateral boundary conditions provided by NCEP/GFS

Scheduling still needs to be worked out, but the plots/output are usually available about 5 hours after synoptic time.

HAIC-HIWC 13km ARW-GFS init NCAR/MMM Init: 00 UTC Thu 05 Mar 15
Fcst: 0 h Valid: 00 UTC Thu 05 Mar 15 (21 LST Wed 04 Mar 15)
Sea-level pressure sm= 5



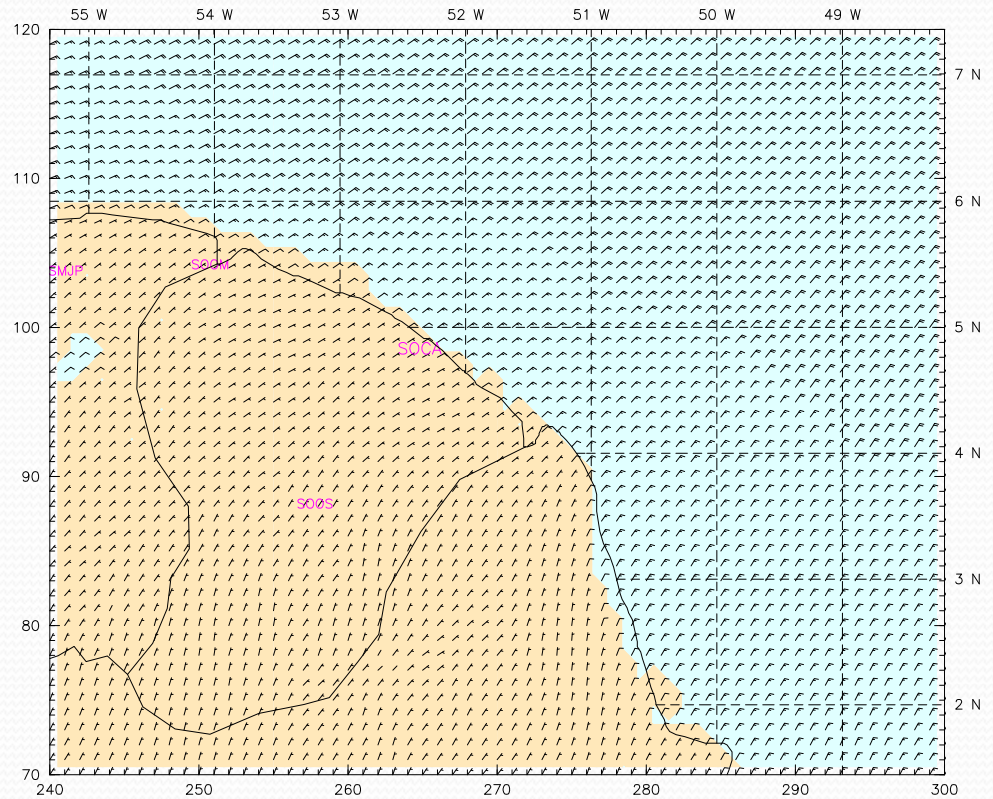
Model Info: V3.6.1 CU: G-F Ens MP: Thompson PBL: YSU SF: Noah LSM 13 km 51 levels 60 sec
CONTOURS: UNITS=hPa LOW= 1004.0 HIGH= 1024.0 INTERVAL= 2.0000
LW: RRTMG SW: RRTMG DIFF: full KM: 2D Smagor DAMP: Rayleigh3

WRF for HAIC/HIWC

Zoom of the flight operations region showing the full model resolution.

Wind barb located at every model grid point.

HAIC-HIWC 13km ARW-GFS init NCAR/MMM Init: 00 UTC Thu 05 Mar 15
Fcst: 0 h Valid: 00 UTC Thu 05 Mar 15 (21 LST Wed 04 Mar 15)
Horizontal wind vectors at k-index = 51



Model Info: V3.6.1 CU: G-F Ens MP: Thompson PBL: YSU SF: Noah LSM 13 km 51 levels 60 sec
LW: RRTMG SW: RRTMG DIFF: full KM: 2D Smagor DAMP: Rayleigh3

Strengths and Weaknesses of WRF

Strengths:

- Regional domain allows higher resolutions than the global models.
- State-of-the-art physics that can be optimized for the region of interest.
- Accurate numerics and dynamics.
- Higher-frequency and customized output fields.
- WRF is widely-used, extensively-tested and is robust.

Weaknesses:

- Regional models such as WRF require lateral boundary conditions which can introduce error.
- Initialization is not as good as those the operational global centers can produce especially over the tropical oceans.
- Microphysics parameterizations have biases (e.g. too much ice vs. too much snow).
- Tropical convection is weakly-forced and a model can have trouble with the details (i.e. timing, location, intensity).

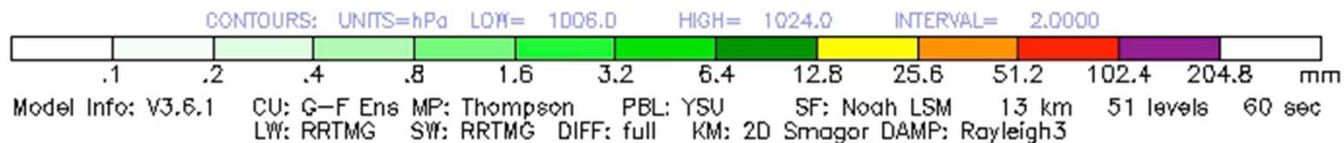
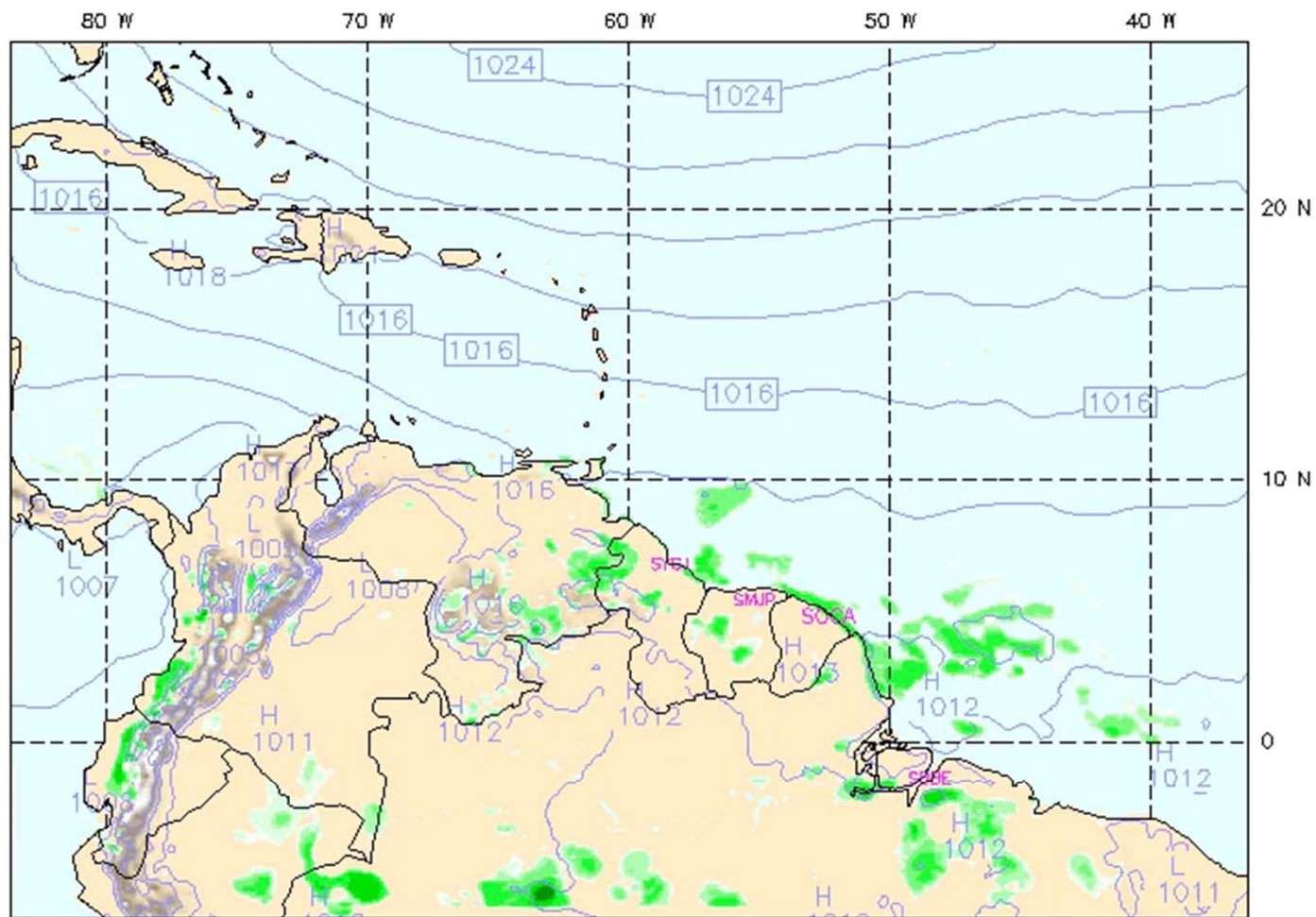
HAIC-HIWC 13km ARW-GFS init
Fcst: 1 h
Total precip. in past 1 h
Sea-level pressure

NCAR/MMM

Init: 00 UTC Thu 05 Mar 15
Valid: 01 UTC Thu 05 Mar 15 (22 LST Wed 04 Mar 15)

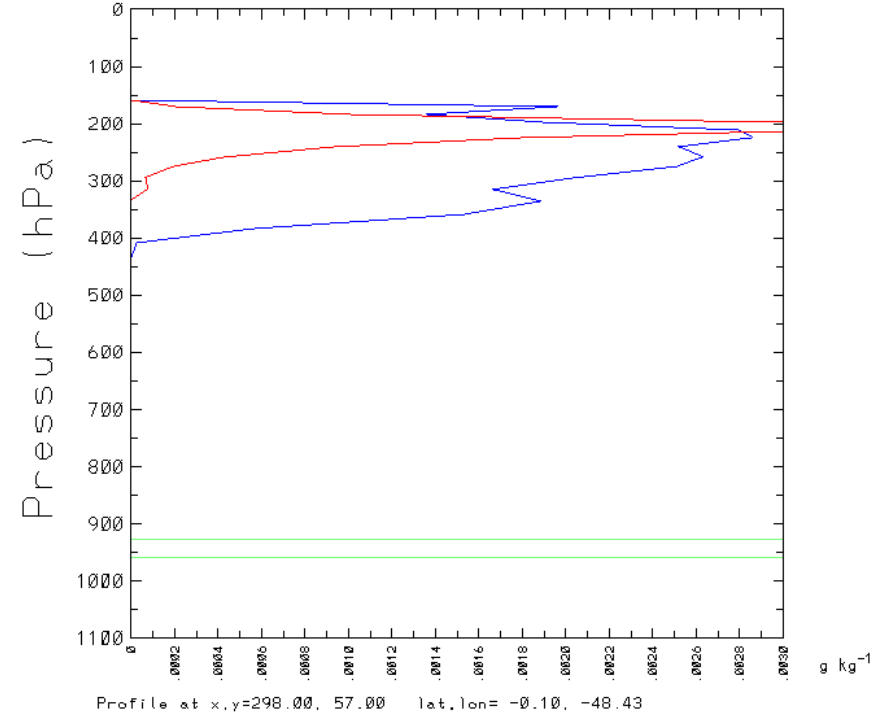
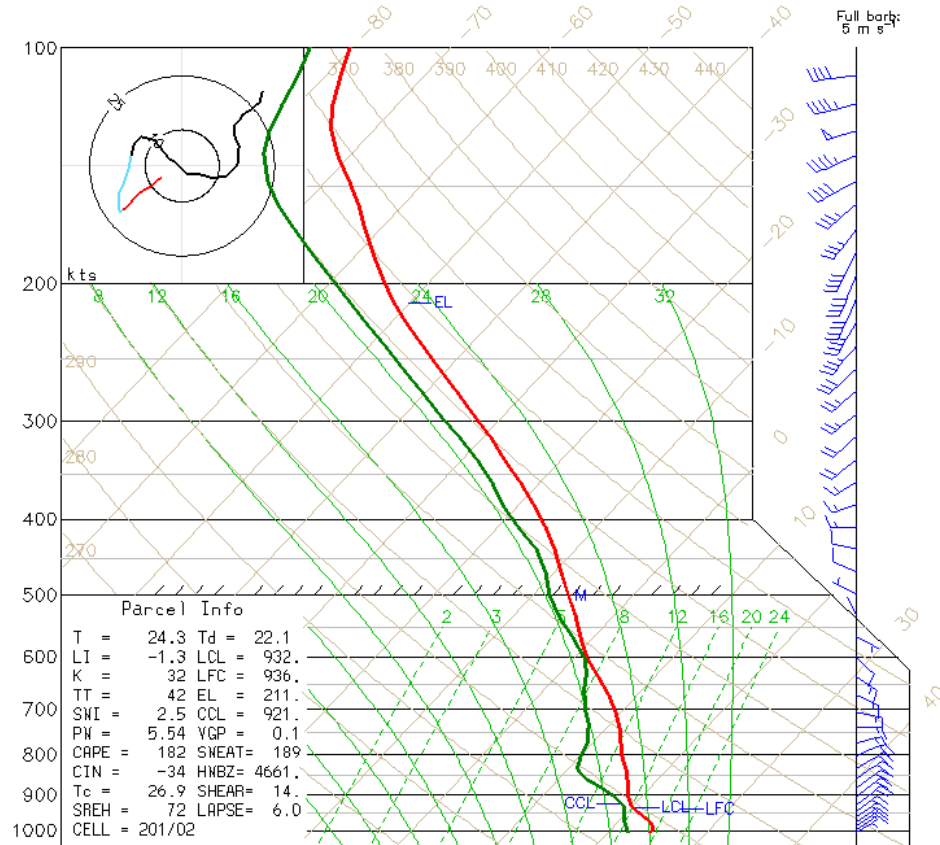
sm= 5

Rainfall animation



Sample WRF output plots

HAIC-HIWC 13km ARW-GFS init NCAR/MMM Init: 00 UTC Thu 05 Mar 15 HAIC-HIWC 13km ARW-GFS init NCAR/MMM Init: 00 UTC Thu 05 Mar 15
 Fcst: 0 h Valid: 00 UTC Thu 05 Mar 15 (21 LST Wed 04 Mar 15) Fcst: 47 h Valid: 23 UTC Fri 06 Mar 15 (20 LST Fri 06 Mar 15)
 Temperature x,y=264.80, 98.80 lat,lon= 4.83, -52.37 stn=SOCA,81405 Snow mixing ratio
 Dewpoint temperature x,y=264.80, 98.80 lat,lon= 4.83, -52.37 stn=SOCA,81405 Rain water mixing ratio
 Cloud water mixing ratio
 Cloud ice mixing ratio
 Graupel mixing ratio



Model Info: Y3.6.1 CU, G-F Ens MP, Thompson PBL, YSU SF, Noah LSM 13 km 51 levels 60 sec
 LW, RRTMG SH, RRTMG DIFF, full KM, 2D Smagor DAMP, Rayleigh3

Skew-T plot with wind barb at every model level

Profile of microphysics components

Preliminary list of WRF products in the field catalog

- 150 hPa winds/temperature
- 300 hPa winds/temperature
- 500 hPa winds/temperature/vorticity
- 700 hPa winds/temperature/Vertical velocity
- 850 hPa winds/temperature/relative humidity
- CAPE
- ceiling
- cirrus (150 and 200 hPa RH)
- 12-km cloud mixing ratio
- 15-km cloud mixing ratio
- total cloud cover
- cloud-top temperature
- surface temperature
- surface dewpoint
- surface theta_e
- surface wind speed
- 3-h precipitation and SLP
- accumulated precipitation
- convective and non-convective precipitation product
- simulated reflectivity
- precipitable water
- Forecast soundings
- Surface meteograms for operations base and alternate airports
- north-south and west-east cross sections of hydrometeors
- north-south and west-east cross sections of RH

Plots can be customized for HAIC users (e.g. levels, variables, colors)