

## WRF Version and Land Information System (LIS) Sensitivity Test - Archive Overview

The Weather Research and Forecasting (WRF) Version and Land Information System (LIS) Sensitivity Test consisted of a year-long retrospective time period from 1 July 2011 – 29 June 2012, with a focus on assessing both different versions of WRF (v3.3.1 and v3.4) and the impacts of running a LIS with two different versions of the Noah Land Surface Model (LSM) (v2.7.1 and v3.3). Three configurations of WRF-ARW were tested utilizing a 6-hour warm start spin-up with the WRF Data Assimilation (WRFDA) system and initialized every 36 h with a 48 h forecast integration; forecasts were generated on a 15-km grid with output files written every 3 h. The initialization times included both 00 and 12 UTC for a total of 244 cases. The dates for which forecasts were generated are listed below.

00 UTC Initialization	12 UTC Initialization
July 2011: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31	July 2011: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29
August 2011: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30	August 2011: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31
September 2011: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29	September 2011: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30
October 2011: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29	October 2011: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30
November 2011: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28	November 2011: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29
December 2011: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31	December 2011: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29
January 2012: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30	January 2012: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31
February 2012: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29	February 2012: 3, 6, 9, 12, 15, 18, 21, 24, 27
March 2012: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30	March 2012: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31
April 2012: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29	April 2012: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30
May 2012: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29	May 2012: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30
June 2012: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28	June 2012: 2, 5, 8, 11, 14, 17, 20, 23, 26, 29

The archive resides on the NCAR High Performance Storage System (HPSS). The following paragraphs describe the overall directory structure of this archive.

**/DTCRT/RefConfig/INPUT\_DATA:** Root directory for all data used to generate the initial and lateral boundary conditions for the retrospective forecasts. The input files are grouped into subdirectories named **yyyymmdd**, where *yyyy* corresponds to the year of the forecast cycle, *mm*

corresponds to the month, *dd* corresponds to the day. The following types of files are archived under the **INPUT\_DATA** subdirectory:

**yyyymmdd\_ihh\_GFS004.tar.gz:** contains GFS forecast grids, used for the warm-start runs, initialized every 36 h (starting on 20110630 18 UTC) with the file naming convention *yyyymmdd\_ihh\_fhhh\_GFS004.grb2*, where *yyyy* corresponds to the year *mm* corresponds to the month, *dd* corresponds to the day, *hh* corresponds to the hour of the forecast initialization (06 or 18 UTC) and *hhh* corresponds to the forecast hour (available every 3 h from 000 to 054).

**Noahv2.7.1\_yyyyymmdd\_03h.tar.gz:** LIS analysis grids using Noah v2.7.1, where *yyyy* corresponds to the year, *mm* corresponds to the month, and *dd* corresponds to the day (available every 3 h from 00 to 21).

**Noahv3.3\_yyyyymmdd\_03h.tar.gz:** LIS analysis grids using Noah v3.3, where *yyyy* corresponds to the year, *mm* corresponds to the month, and *dd* corresponds to the day (available every 3 h from 00 to 21).

**navysst.tar.gz:** SST analysis grids valid at 12 UTC daily.

**obs.yyyyymmdd.3dvar.tar.gz:** Special Sensor Microwave Imager (SSM/I; denoted as *obs\_ssmi\**) and Global Telecommunication System (GTS; denoted as *obs\_gts\**) observation files for the 6-hour warm start (denoted as *\*.INIT*) and 48-hour forecast (denoted as *\*.FCST*) (available every 6 h from 00 to 18).

**/DTCRT/RCv3.4/AFWA\_LSM:** Root directory for all output files, METViewer plots, code, scripts, and static files.

**static:** Subdirectory containing all time-independent namelists used to run the forecast system.

Subdirectory **DOMAINS** has the files **AFWAv3.3.1\_static.tar.gz** and

**AFWAv3.4\_static\_RERUN.tar.gz**, which contain namelists to run the WRF Pre-Processor (WPS), WRFDA, WRF, and the Unified Post-Processor (UPP) for the ARW dynamic core as well as the seasonal background error files for running WRFDA.

Subdirectory **EXT\_DATA** has the files **AFWAv3.3.1\_static.tar.gz** and

**AFWAv3.4\_static.tar.gz**, which contain the *geogrid* and *metgrid* TBL files, along with the Variable Tables used to run the *ungrib* program of WPS, and **met\_config.tar.gz** which contains the configuration files for running the Model Evaluation Tools (MET).

**code:** Subdirectory containing all source codes and scripts used in the end-to-end system. The code used was WPS (v3.3.1 and v3.4\_r675), WRFDA (v3.3.1 and v3.4), WRF (v3.3.1 and v3.4), UPP v1.1, and MET v4.0. Scripts used to run individual steps of the process, workflow manager, and output log files are also located in this subdirectory.

**ADJ\_HGT\_TRUE/AFWAv3.3.1, RERUN/AFWAv3.4\_Noahv2.7.1, and**

**RERUN/AFWAv3.4\_Noahv3.3:** The subdirectories under these three headings are as follows:

**yyyymmddhh:** Subdirectories contain output files for each forecast cycle, where *yyyy* corresponds to the year of the forecast cycle or initial time of the forecast, *mm* corresponds to the month, *dd* corresponds to the day, and *hh* corresponds to the hour.

Under each data subdirectory and contain the following data:

**metprd:** contains **metverif.tar.gz**, which has all the verification output files. All of these files were produced by the MET (v4.0). The Point-Stat tool statistics files ("point\_stat\*.stat") contain surface and upper air point verification statistics. The Grid-Stat tool statistics files ("grid\_stat\*.stat") contain traditional and neighborhood verification statistics for 24-h and 3-h Quantitative Precipitation Forecasts (QPF). Also included is the **wrfpcp.tar.gz** file that contains the NetCDF files with 3-h and 24-h precipitation accumulations that have been run through PCP-Combine.

**nclprd:** contains the file **images.tar.gz**, which has all the image files, generated with NCAR Command Language (NCL), for the forecast.

**postprd:** contains post-processed output files. All of these files were produced by the UPP and are in GRIB format. The **wrfprs.tar.gz** file contains the GRIB files with 3D grids on pressure surfaces and 2D grids (files used by DTC for verification and image generation), the **wrftwo.tar.gz** file contains the GRIB files with 2D grids, and the **WRFNAT.tar.gz** file contains the GRIB files with the 3D grids on the model native vertical coordinates.

**varprd:** contains the file **varprd.tar.gz**, which consists of the WRFDA analysis files, updated lateral boundary files, and WRFDA diagnostic files of the cost function, gradient function, and statistics of the analysis increments for all three configurations

**wpsprd:** contains final output from the WPS process *metgrid* (**met\*** files). WPS was ONLY run for the AFWAv3.3.1 and AFWAv3.4\_Noahv3.3 configurations and the output for the AFWAv3.4\_Noahv3.3 configuration was used as input for the AFWAv3.4\_Noahv2.7.1.

**wrfprd:** contains the raw WRF output files on the native grid (**wrfout\***). Output was generated every 3 h over the 48 h forecast with each forecast time (or valid time) written to a separate file. Additionally, this directory contains output files from *real* (**wrfinput\_d01** and **wrfbdy\_d01**).

Two additional subdirectories (**RERUN/AFWAv3.3.1\_AFWAv3.4\_Noahv2.7.1** and

**RERUN/AFWAv3.4\_Noahv2.7.1\_AFWAv3.4\_Noahv3.3**) contain the file

**nclprd/images.tar.gz** with the images of the difference fields between AFWAv3.3.1 and AFWAv3.4\_Noahv2.7.1 as well as AFWAv3.4\_Noahv2.7.1 and AFWAv3.4\_Noahv3.3.

**METViewer:** Subdirectory containing all load and batch XMLs (**metviewer\_xmls.tar.gz**) as well as all vertical level, lead series, and threshold plots for the stand-alone AFWAv3.3.1, AFWAv3.4\_Noahv2.7.1, and AFWAv3.4\_Noahv3.3; LIS differences (AFWAv3.3.1 – AFWAv3.4\_Noahv3.3); version differences (AFWAv3.3.1 – AFWAv3.4\_Noahv2.7.1). These are named **plots\_AFWAv3.3.1.tar.gz**, **plots\_AFWAv3.4\_Noahv2.7.1.tar.gz**, **plots\_AFWAv3.4\_Noahv3.3.tar.gz**, **plots\_AFWA\_lsmdiff.tar.gz**, and **plots\_AFWA\_vdiff.tar.gz**, respectively.

**/DTCRT/OBS:** Root directory for all the observation files used for the forecast verification. The observation files are collected into subdirectories for each type named **NDAS\_03h** (point observations), **SINGLE\_RC/ST2\_24h** (gridded 24-h precipitation accumulations valid at 12 UTC), and **SINGLE\_RC/ST2\_03h** (gridded 3-h precipitation accumulations valid every 3 h). Each has subdirectories named **yyyymmdd**, where yyyy corresponds to the year, mm corresponds to the month, and dd corresponds to the day for which the observations are valid. The following types of files are archived under the observation subdirectory tree:

**ndas\_prepbufr.yyyyymmdd.nc.tar.gz:** contains NDAS prepbufr files used for the surface and upper air point verification every 3 h.

**ST2mlyyyyymmdd.24h.nc.tar.gz:** contains Stage-II national multi-sensor hourly precipitation analysis data summer over a 24-h interval, valid at 12 UTC.

**ST2mlyyyyymmdd.03h.nc.tar.gz:** contains Stage-II national multi-sensor hourly precipitation analysis data summed over 3-h intervals.

Data with problems:

**Missing forecasts:**

Affected Cycle	Missing data	Reason
2011080112	WRF output	Bad SST input data
2011082400	WRF output	Missing SST input data
2012050312	WRF output	Missing GFS input data
2012050612	WRF output	Bad obs_gts input data
2012060400	WRF output	Bad SST input data

**Missing verification:**

Affected Cycle	Missing data	Reason
2011072500	Missing 3-h QPF verification for 18 – 21-h Missing 24-h QPF verification for 36-h	Missing ST2 analysis