Rapid Refresh (RR) and High Resolution Rapid Refresh (HRRR)

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BACKGROUND

A strong societal need exists for precise short-range forecasts of high impact weather:

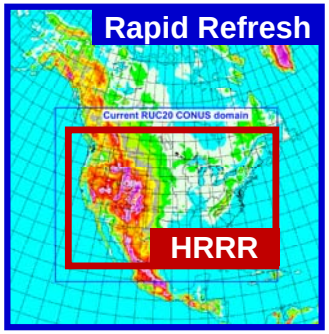
Aviation and surface transportation – NextGen, etc.
Severe weather – Warn-on-Forecast, etc.
Renewable Energy and other applications

To address these needs, NOAA ESRL has developed:

Rapid Update Cycle (RUC) – Operational at NCEP
First hourly cycling weather prediction system at NCEP
First operational radar reflectivity assimilation
Upgrade package to NCEP about every 2 years since 1994

Rapid Refresh (RR) – Replacement for RUC
Runs in real-time at ESRL, NCEP implement in 2010
First hourly cycling on domain covering all North America
Advanced community codes (GSI 3DVAR, WRF ARW)

High Resolution Rapid Refresh (HRRR) – Real-time hourly updating CONUS convection resolving model
Key for NextGen, Warn-on-Forecast & renewable energy



DOMAINS

13-km Rapid Refresh
Full coverage over North America and adjacent oceans - hourly updating for Alaska, Puerto Rico

3-km HRRR
CONUS coverage with hourly updating assimilation of radar reflectivity

RR & HRRR versions of WRF moded and GSI

RR & HRRR use specialized versions of **WRF ARW model** and **Gridpoint Statistical Interpolation (GSI)** analysis, with specific enhancements for **aviation and severe weather**

GSI (with NCEP & NCAR)

Add for RR/HRRR
- Generalized cloud analysis
- PBL-depth surface assimilation
- Reflectivity / lightning assimilation

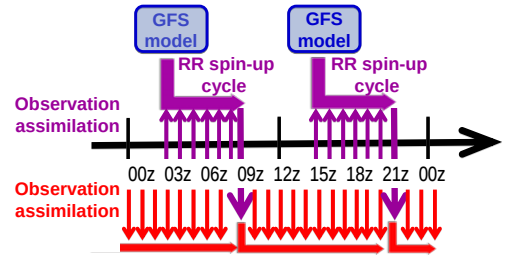
WRF (with NCAR & NCEP)

Add for RR/HRRR
- RUC-LSM , MYNN PBL
- Convection and microphysics schemes
- Digital Filter Initialization

Rapid Refresh / HRRR Data Assimilation

Partial Cycling

Use partial cycling with update from GFS 2 times/day improves treatment of large-scale upper level features

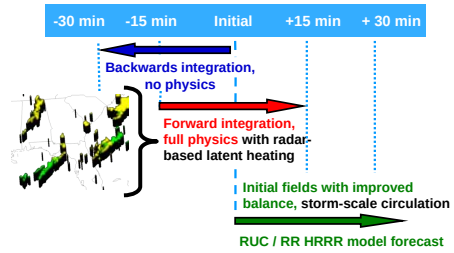


RR hourly-cycled 12-h forecasts throughout the day

Hourly cycling of land surface model fields
6 hour spin-up cycle for hydrometeors, surface fields

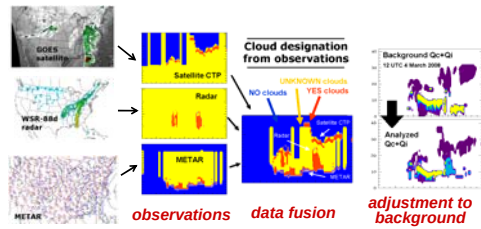
Radar Reflectivity Assimilation

Digital filter-based reflectivity assimilation initializes ongoing precipitation and storm



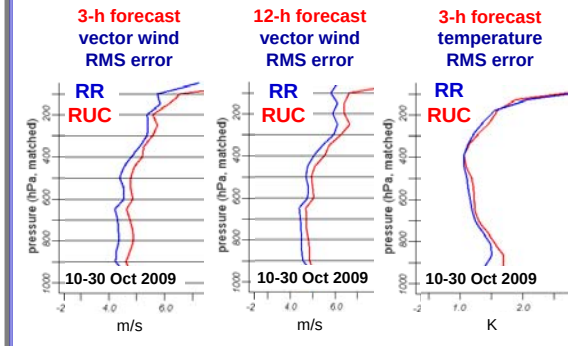
Cloud Analysis

Incremental adjustment to cloud hydrometeors based on information from multiple observations types



Rapid Refresh Upper-Air Verification

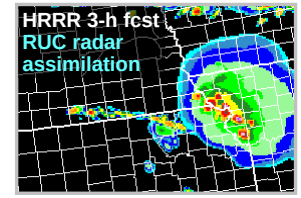
RR with partial cycling has better skill than RUC

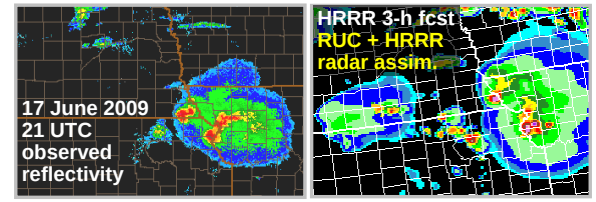


HRRR Radar Reflectivity Assimilation

More skill is achieved by HRRR that initialized from RUC/RR radar DFI fields than that with no radar assimilation

Skill is further improved by 2nd pass of DFI-based radar assimilation on 3-km HRRR domain





ONGOING AND FUTURE

RR implementation at NCEP in 2010 and planned **6 member Rapid Refresh ensemble in 2012.**

HRRR – real-time CONUS runs for evaluation in support of NextGen and requested by NWS and others

Probabilistic guidance hazardous weather, renewable energy, etc. from **time-lagged ensembles.**

MAIN REFERENCE

Stan Benjamin, et al, 2004: An Hourly Assimilation – Forecast Cycle: The RUC. *MWR*, **132,** 495–518.

78 citations by other journal articles in only 6 years