

# Satellite Products in the Rapid Update Cycle and Plans for the Rapid Refresh

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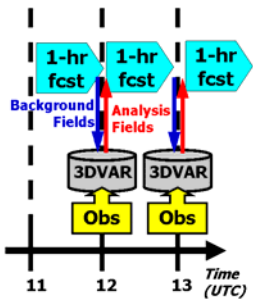
## Overview

The **Rapid Update Cycle (RUC)** is a regional data assimilation and forecasting system that has been running at the National Centers for Environmental Prediction (NCEP) since 1994. Producing analyses of atmospheric conditions and short-range forecasts every hour, it serves the needs of air and ground transportation, hazardous weather prediction, and routine forecasting for the general public.

A new, more advanced version for rapid updating called **Rapid Refresh (RR)** is under development at ESRL/GSD. In RR, NCEP's Gridpoint Statistical Interpolation (GSI) scheme will be adapted for regional data assimilation.

GSI is capable of assimilating a large variety of atmospheric observations, especially those from satellites—a major attraction. NCEP is still refining GSI, with contributions from several institutions, including NASA and NOAA/ESRL. Early results of GSI adaptation are presented below.

## The RUC One Hour Cycle



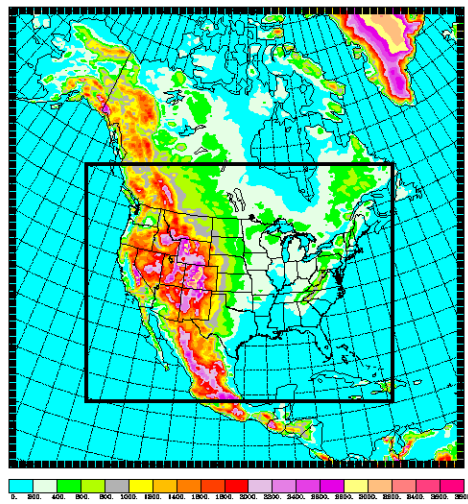
The 1-h RUC data assimilation cycle. Every hour a new 9-h forecast, and every three hours a 12-h forecast, is performed. For documentation, real-time forecasts, and operational forecasts from RUC, see <http://ruc.noaa.gov>.

## Observations Used in Operational RUC

Data Type	-Number	Freq.
Rawinsonde	80	/12h
NOAA Profilers	30	/1h
VAD Winds	110 - 130	/1h
Aircraft (wind, temp)	1400 - 4500	/1h
Surface/METAR	1500 - 1700	/1h
Buoy/Ship	100 - 150	/1h
GOES Precip Water	1500-3000	/1h
GOES Cloud Winds	1000 - 2500	/1h
GOES Cloud-Top Pres	~10km res	/1h
SSM/I Precip Water	1000-4000	/6h
GPS Precip Water	~300	/1h
Mesonet	~5000	/1h

(Used in Cloud Analysis)

Topography (m) MAX= 3702.432 MIN= 0.000 INT= 200.000



The RUC (smaller inner rectangle) CONUS and planned RR (larger outer rectangle) domains.

## Main Components of the RUC System

3DVAR analysis

Hybrid (isentropic and sigma) vertical coordinate forecast model.

References: Benjamin et al. 2004a, b in *Monthly Weather Review*, pp. 473 - 494 and 495 - 518.

## Satellite Products Used in RUC

In moisture analysis: GOES and SSM/I precipitable water

In mass/wind analysis: GOES cloud drift winds

In cloud analysis: GOES cloud top pressure and temperature (outside of 3DVAR)

## RR Will be a New System

New analysis based on GSI

New dynamical core based on WRF

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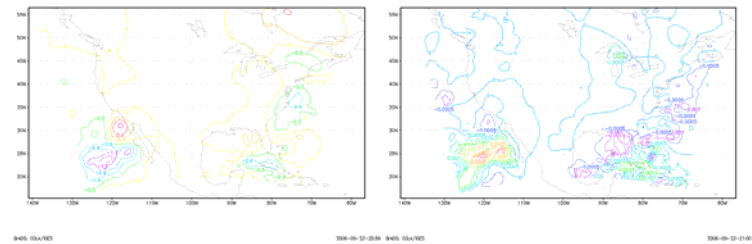
## Satellite Data Experiments for Rapid Refresh

Both HIRS and MSU

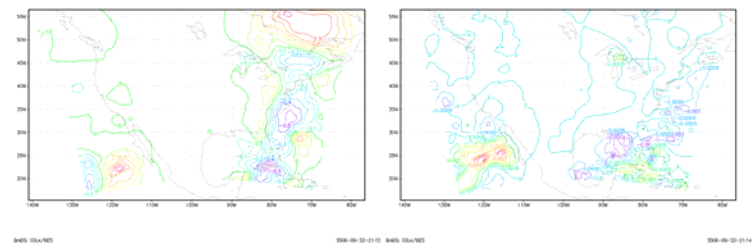
Use of Community Radiative Transfer Model (CRTM)

Preliminary experiments with satellite files from the North American Model (NAM) over CONUS domain using RUC background fields

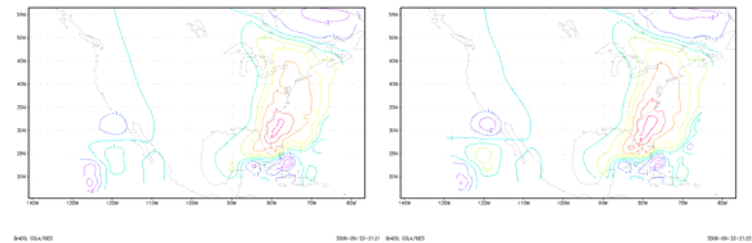
Case of 1200 UTC 11 April 2006



Difference between satellite and no satellite data analysis cases. Left - potential temperature ( $^{\circ}$ K), right - specific humidity. In satellite case all available satellite radiance information is used. Model level = 10 (~825 hPa).



Difference between no-HIRS and no-MSU satellite data analysis cases. Left - potential temperature ( $^{\circ}$ K), right - specific humidity. Model level = 10 (~825 hPa).



Difference between satellite and no satellite data analysis cases. Left - potential temperature ( $^{\circ}$ K) at model level 45 (~77 hPa), right - potential temperature at model level 50 (~50 hPa).

## Summary

Preliminary experiments to assimilate satellite radiance data into the Rapid Refresh have produced reasonable analysis increments. Further real-time experiments are in progress.