Development of a Rapid-Update Real-Time Mesoscale Analysis of Ceiling and Visibility

Runhua Yang[1,2], Manuel Pondeca[1,2], Steven Levine[2,3], Geoff DiMego[2], Jeff Whiting[1,2], Geoff Manikin[2], Annette Gibbs[1,2], Jacob Carley[1,2]

[1] I.M. Systems Group, Inc,.[2] NOAA NWS/National Centers for Environmental, [3] Systems Research Group, Colorado Springs, CO

Objective and background

- A Rapid-Update Real-Time Mesoscale Analysis (RU-RTMA) system is an extension of RTMA from hourly analysis to sub-hourly analysis, which is developed specifically to provide near-real time grid analysis of surface visibility and ceiling height for the **Helicopter Emergency Medical Services (HEMS)** tool running at the Aviation Weather Center.
- The data product is grid surface analysis variables including surface visibility and ceiling height (C and V), surface pressure, surface temperature and moisture at 2 meter, wind speed at 10m, and surface gust over the CONUS (the big area in the map below), 20 minutes after the real-time.
- Advances in three relevant fields enable the development of RU-RTMA:

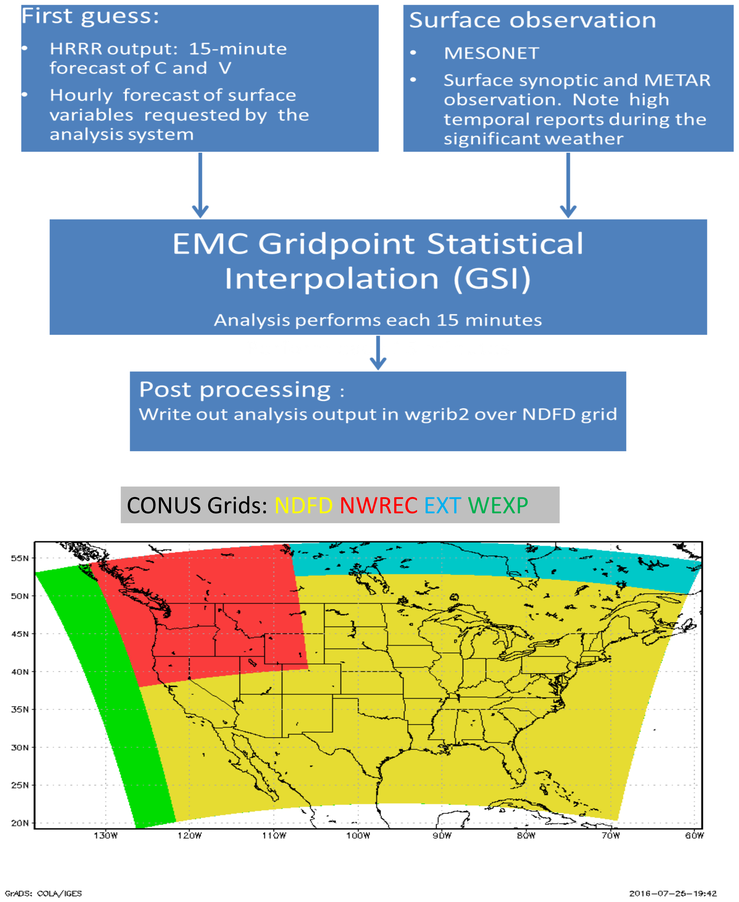
(1) a high resolution numerical weather forecast model with sophisticated cloud prediction scheme, HRRR

(2) a reliable network and timely collection of observations

(3) RTMA surface analysis including C and V particularly (Pondeca et al. 2016)

- Intense effort has been applied to the computing efficiency in order to deliver RURTMA analysis products at 20 minutes from the real-time time. With the emphasis on C and V, a few simplifications have been considered.
- The typical window of the observations ranges from 30 minutes before to 8 minutes after the analysis time (when the data is dumped).
- Special observation selection: most C and V observations are from METAR sites, which are normally reported hourly. But when affecting-flight weather systems come, sub-hourly reports are generated. These sub-hourly special observations (SPECIs) are especially important. Though SPECI reports are not particularly numerous, they are extremely important for RU-RTMA to reflect the current weather conditions. Therefore, a modified observation selection algorithm has been established. In RU-RTMA only one observation per site is selected, which is the one whose observation time is closest to the analysis time. This ensures the SPECIs get the strongest weight in the analysis.

RURTMA system



Preliminary Results

The reliability of RTMA surface analysis depends on several aspects, to name a few, forecast error statistical estimation and observation error statistical estimation, non-normal distribution of C and V. Currently, only static and 1-dimentional error statistics are used in RTMA.
Similarly, RU-RTMA faces the same challenges, in addition, because the change of the observation time window, less observation data are included in each 15-min dump window than that in RTMA, which has a dump window roughly +/- 30 minutes around the center of each hour.

The first overall check is to compare the number of observation read in and the observation assimilated between RU-RTMA and RTMA, as shown in the Table below for a selected date 17Z 16 Dec. 2016.

RU-RTMA: number of observation read in within each 15-min dump window (Top). Number of assimilated data only one observation selected at a site (bottom). VIS denotes visibility, CIG denotes cloud ceiling height.

RURTMA	00min	15min	30min	45min	SUM
VIS	87356	104171	63212	60031	314770
CIG	83213	97509	57254	56424	294400

RURTMA	00min	15min	30min	45min	SUM
VIS	49534	53648	33508	30509	167199
CIG	42409	44882	28341	26849	142481

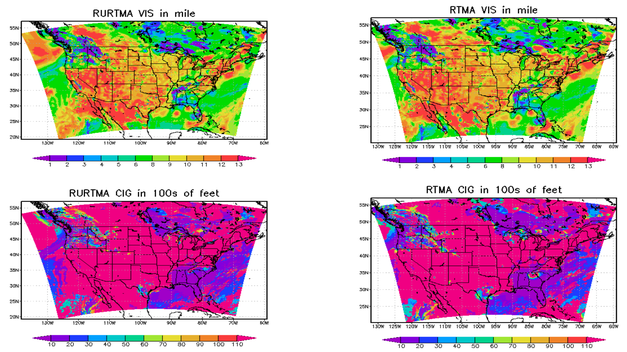
RTMA: Total number of observation read in within one hour window (top). Number of observation assimilated within one hour dump window (bottom). VIS denotes visibility; CIG denotes cloud ceiling height.

Hourly RTMA	One hour dump window @ 00min
VIS	280639
CIG	132122

Hourly RTMA	assimilated
VIS	102258
CIG	97777

The number of observation for each 15-min window is less than that in RTMA, but the sum is more than that in the RTMA as expected. Similar feature in the number of assimilated observation.

Fig. 1. Comparison of surface visibility (in mile, top panels) and ceiling height (in 100's of feet, bottom panels) between RU-RTMA (left column) and hourly RTMA (right column) at a selected analysis time from 17 Dec. 2016. The pattern and magnitude are quite similar.



On-going work

To extend 15-minute RU-RTMA into Alaska.
To prepare verification observation dataset.
To assess initial 15-min C&V products from CONUS and Alaska, including compute verification statistics; comparing with independent data product.

Current RU-RTMA data information
Contact Runhua.Yang@noaa.gov or Steven.Levine@noaa.gov

Reference:
Pondeca et al. 2016: Research Activities in Atmospheric and Oceanic Modeling (Blue Book).
Pondeca et al. 2016RTMA/URM v2.5.0
https://docs.google.com/presentation/d/1NQt_FIeS082uPwEzpZ7Ec4pEfI7s6Ly9F81CDM78GX0/edit#slide=id.p

Acknowledgement:
We are grateful to Wesley Ebisuzaki at NOAA for his wgrib2 software.

*Contact Information : Runhua.Yang@noaa.gov