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Assimilation of GOES satellite based convective initiation data into the Rapid Refresh and HRRR systems to improve aviation forecast guidance

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OVERVIEW

Preliminary evaluation of impact from assimilation of convection indicator into the Rapid Refresh (RAP)

GOES-R CI algorithm 10.7 μm T/B cloud top cooling rate (CTCR) data from University of Alabama Huntsville (UAH)

Helpful for avoiding model delay in storm development

Have used two values of CTCR as a lower bound, -3K and -5K change over 15 minutes

GOES-R CI algorithm fields are available during daylight hours and over the Eastern U. S.

Qualitative assessment encouraging, additional refinement and assessment ongoing

RAP GOES-R CTCR Assimilation Algorithm

Compute cloud top cooling rate (deg. K / 15 min) per RAP grid box

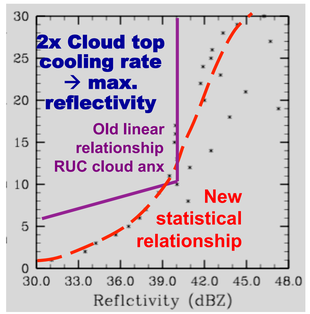
Seasonally varying statistical relationship between CTCR field and proxy column max reflectivity

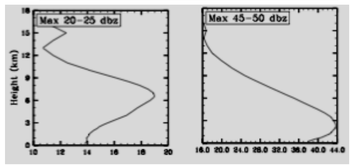
This replaces old empirical linear relationship first used in RUC

Seasonally varying relationship between proxy column max refl. and vertical profile of reflectivity

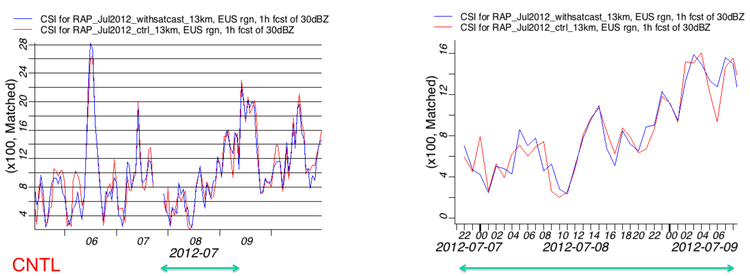
Use this proxy 3D reflectivity to obtain LH based temperature tendency for use in radar DFI

Radar DFI induces storm-scale convergent / divergent winds





CSI for all 1h forecasts of 30 dBz 5-11 July 2012

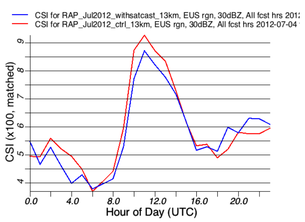


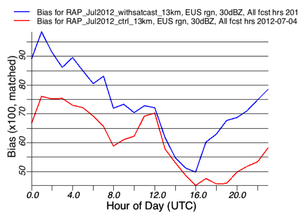
CNTL
CTCR -3

We will look in more detail at 8 July 2012

CSI and bias for all 1h forecasts of 30 dBz 5-11 July 2012 by hour of the day

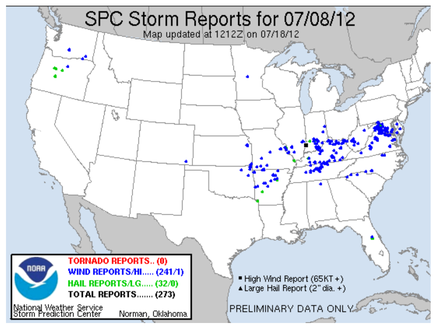
CNTL
CTCR -3



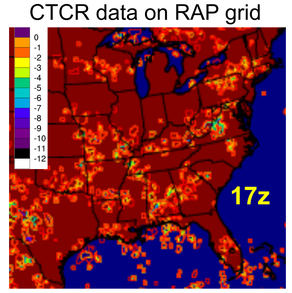


CTCR is a daylight product, and this is reflected in the CSI. Bias is reduced overall.

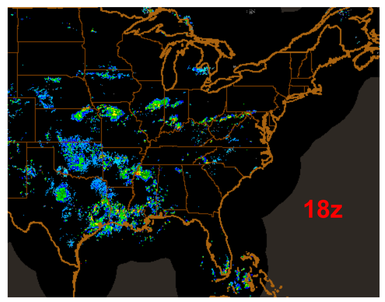
1h forecast 20 dBz CREF verification for 18z 8 July 2012



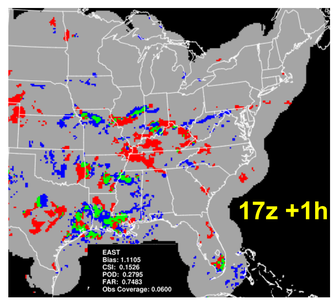
CTCR data on RAP grid



MRMS radar for 18z

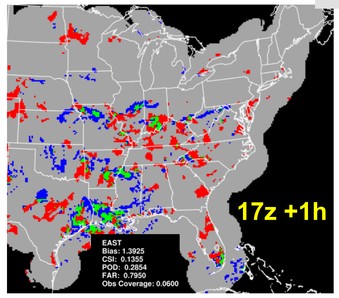


RAP control run 1h forecast valid 18z

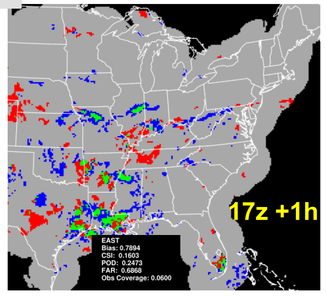


HIT
MISS
FA

RAP with CTCR -3



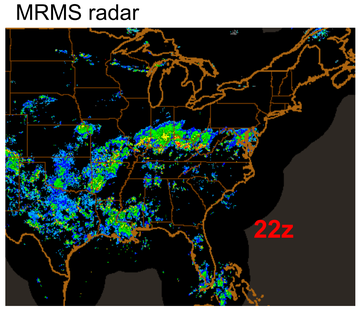
RAP with CTCR -5



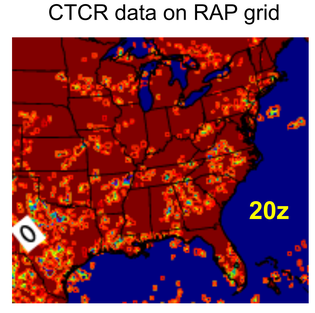
Using the lower bound of -3K/15 min results in a higher false alarm rate (FAR), but a better probability of detection (POD) than the control run. Upping the lower bound to -5K/15 min reduces the FAR at the expense of the POD, however, the critical success index (CSI) shows an overall improvement.

1h forecast 30 dBz CREF verification for 22z 8 July 2012

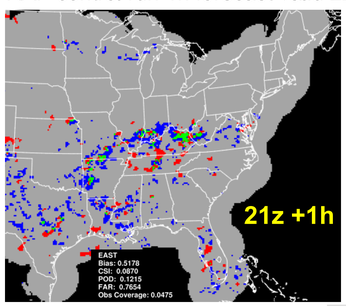
MRMS radar

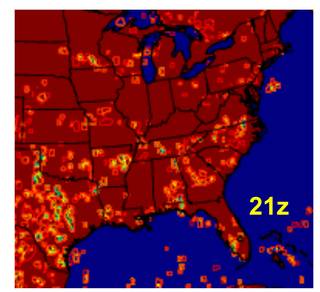


CTCR data on RAP grid



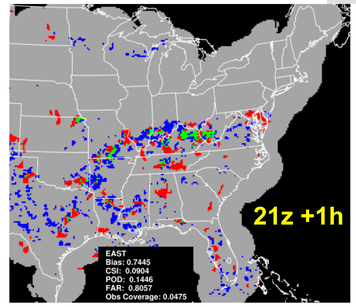
RAP control run 1h forecast valid 22z



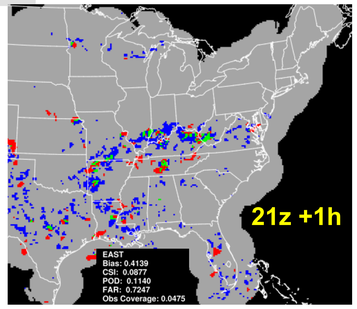


HIT
MISS
FA

RAP with CTCR -3



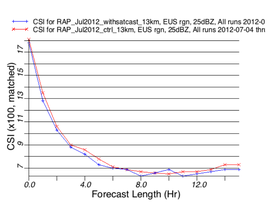
RAP with CTCR -5

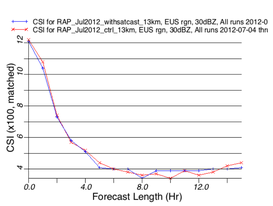


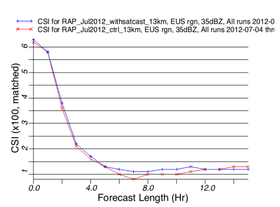
Later in the afternoon, using the lower bound of -3K turned out to be the better choice for CSI, but still has a greater FAR than either of the other runs. Future assimilation of the data will use additional GOES-R CI algorithm fields to help refine the areas of interest and reduce the FAR while keeping the POD.

CSI by forecast hour 5-11 July 2012

CNTL
CTCR -3
CTCR -5







1h forecasts 8 July

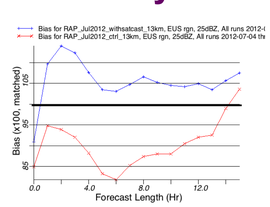
dBz	CNTL	-3	-5
20	0.152	0.135	0.160
25	0.129	0.116	0.144
30	0.087	0.084	0.105
35	0.007	0.008	0.011

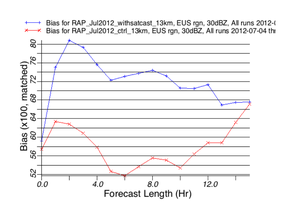
3h forecasts 8 July

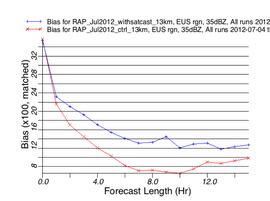
dBz	CNTL	-3	-5
20	0.109	0.108	0.109
25	0.089	0.088	0.085
30	0.058	0.057	0.056
35	0.003	0.010	0.007

CTCR improves the CSI at longer forecasts and higher dBz. Using -5 as the lower bound improved the CSI at every level of dBz for the 1h forecasts 8 July.

Bias by forecast hour







1h forecasts 8 July

dBz	CNTL	-3	-5
20	1.1105	1.3925	0.7894
25	1.1994	1.4351	0.7621
30	0.8751	1.0069	0.4891
35	0.1012	0.1700	0.0850

3h forecasts 8 July

dBz	CNTL	-3	-5
20	1.2329	1.4638	1.2716
25	1.2545	1.4888	1.3452
30	0.7801	1.0309	0.8969
35	0.1134	0.1680	0.1457

In general, CTCR data improves the bias, particularly at the higher dBz.

SUMMARY and FUTURE WORK

Preliminary evaluation of impact from assimilation shows sensitivity to the CTCR values

Looking at additional CI indicator fields from UAH to improve CI detection and reduce noise

Have used two values of CTCR as a lower bound, -3K and -5K change over 15 minutes, could look at other values

When time and computer resources allow, the data will be implemented in the 3km HRRR, which should be a better fit for this high resolution data source

Planned implementation into parallel test versions of the RAP and HRRR at ESRL