

Surface Temperature, Dewpoint, and Emissivity Assessment of CSPP HEAP v2 NUCAPS v3r0 Product

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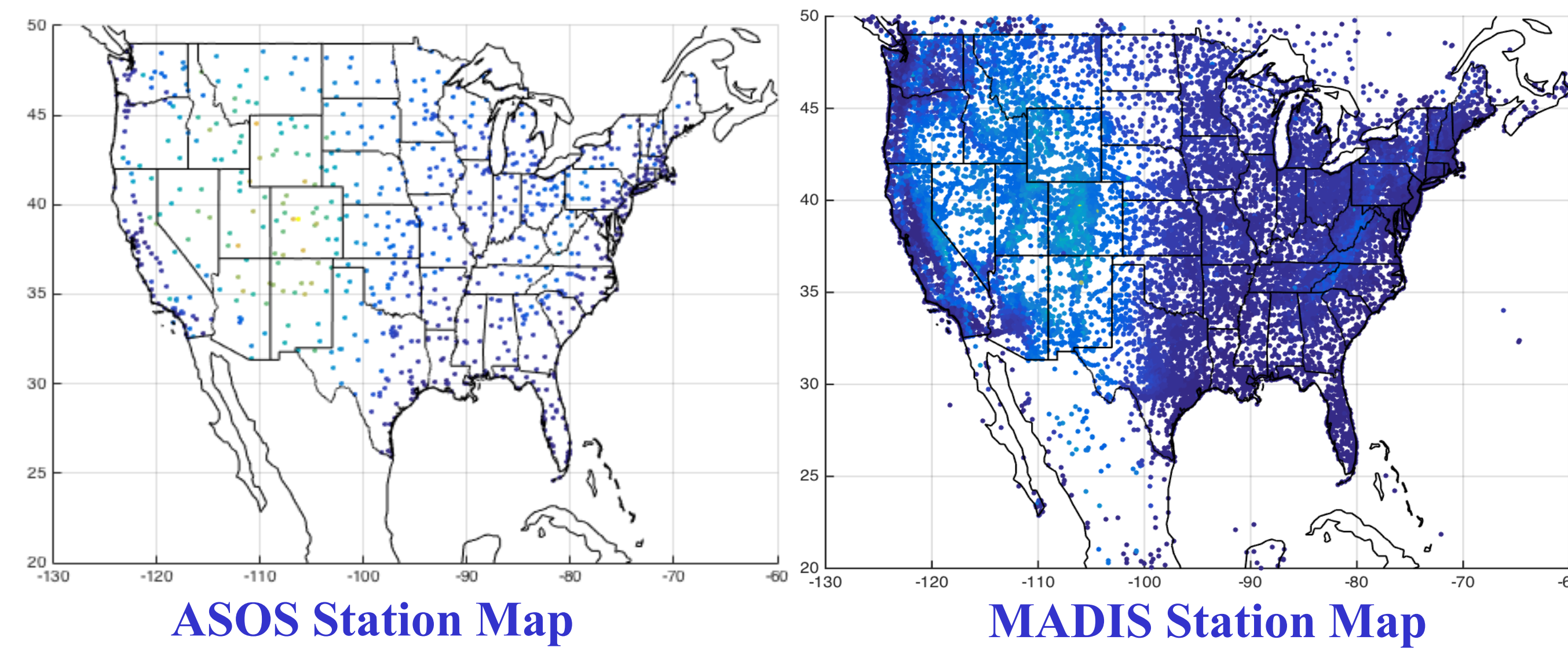
CSPP Users Group Meeting June 2022, Madison, Wisconsin



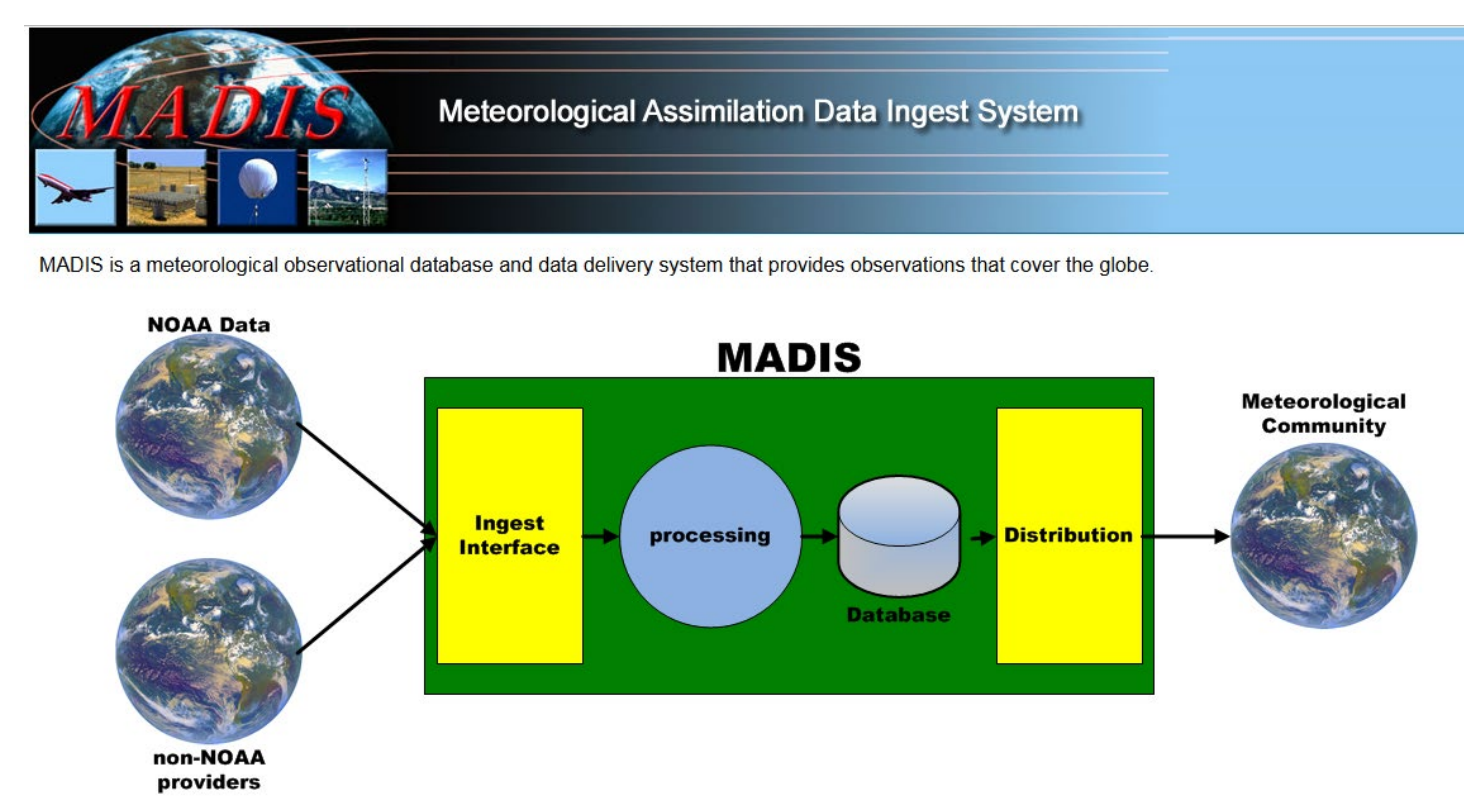
Introduction and Data

- Satellite data provides valuable spatial and temporal coverage between NWS radiosonde launch sites.
- Convective Available Potential Energy (CAPE) is a measure of atmospheric instability, computed from vertical profiles of temperature and water vapor and an air parcel, commonly used in NOWCASTING.
- Satellite estimates of the surface parcel introduce large uncertainties in satellite CAPE estimates. Gartzke et al. 2017 showed excellent agreement when surface obs were used combined with satellite soundings.
- Satellite soundings struggle in the lower tropospheric region due to the increased opacity of the atmosphere, particularly true over land areas where uncertainties in surface emissivity can degrade accuracy of PBL retrieval.
- Bloch et al. 2019 demonstrated merged surface station data and satellite sounding product is an accurate near-real time estimate of Surface-based CAPE (SBCAPE) consistent with SPC analysis.
- The Joint Polar Satellite System (JPSS) is the current polar-orbiting operational environmental satellite system. NOAA Unique Combined Atmospheric Processing System (NUCAPS) data from JPSS is used in this study. HEAP is the CSPP version of NUCAPS containing the most recent version release (v3r0).
- https://cimss.ssec.wisc.edu/cspp/heap_v2.0.shtml
- Satellite and Surface observations are processed by the same method to put them on the same scales.
 - Both temporal and spatial scales need to be consistent.
- The CAPE calculations are made using the python libraries contained in the SHARPPy code distribution (Blumberg et al. 2017, BAMS). <https://github.com/sharppy>
- The CSPP software was used to reprocess data from the NOAA CLASS archive in order to compare the same NOAA20 data processed with the latest NUCAPS version (compared v3 to v2 for NOAA-20).

Surface Met Observations Used for Reference



- ASOS (Automated Surface Observing System) station locations
 - Mostly located at U.S. airports.
- NOAA MADIS (Meteorological Assimilation Data Ingest System) station locations in right figure
 - <https://madis.noaa.gov/> includes stations from mesonet networks for transportation, etc. High density over CONUS.



References and Contact

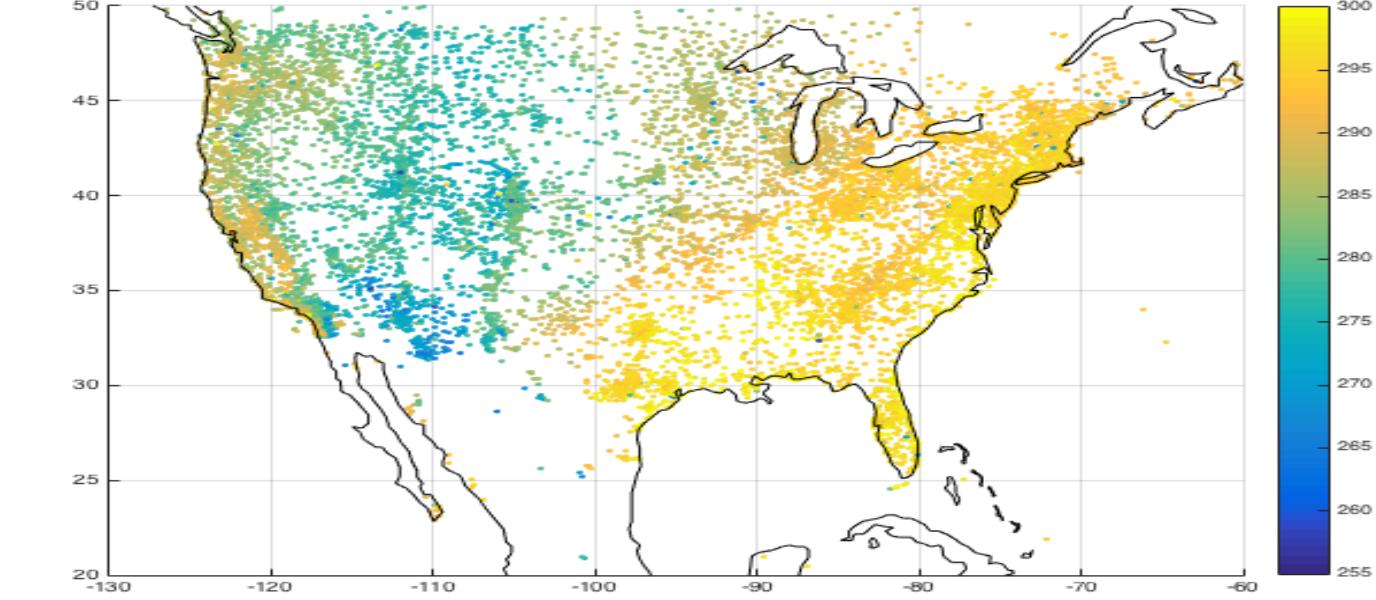
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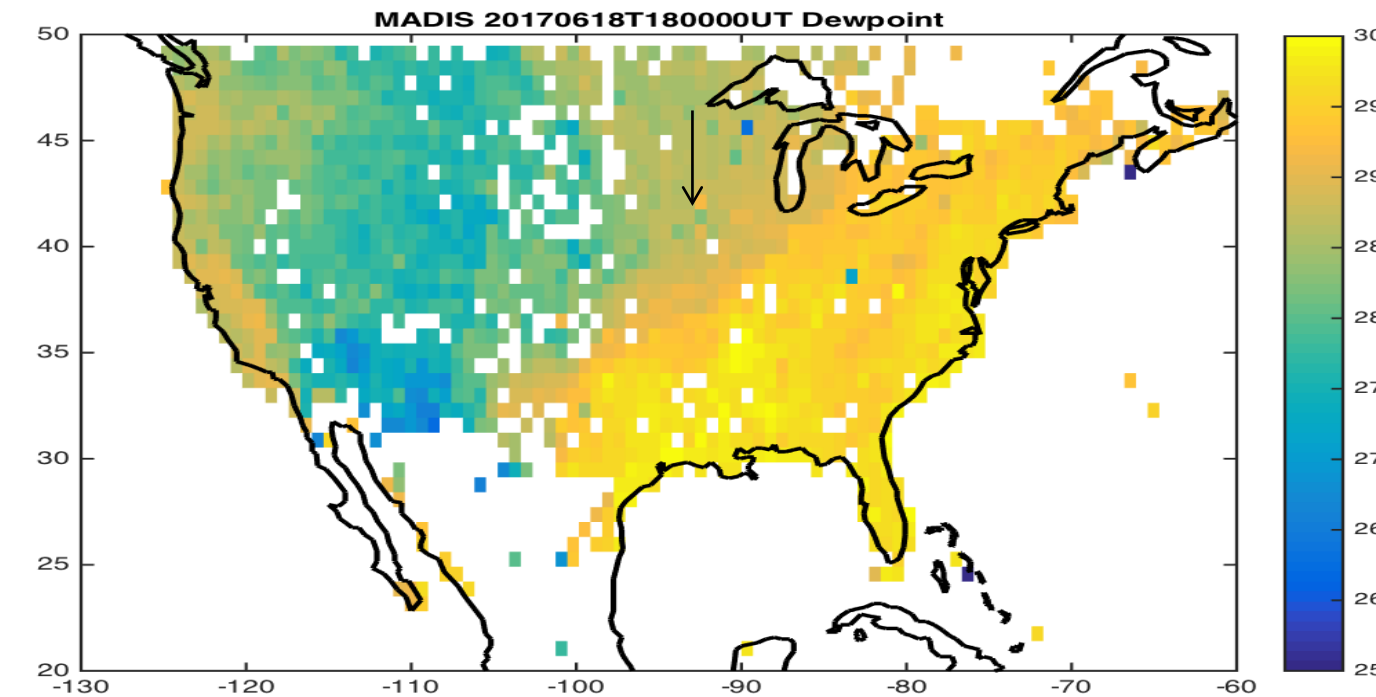
Methodology

- Surface Met Observations are obtained hourly from the NOAA MADIS site <https://madis.ncep.noaa.gov/>.
- NUCAPS v2r0 (CLASS) compared with NUCAPS v3r0 (reprocessed using CSPP HEAP).

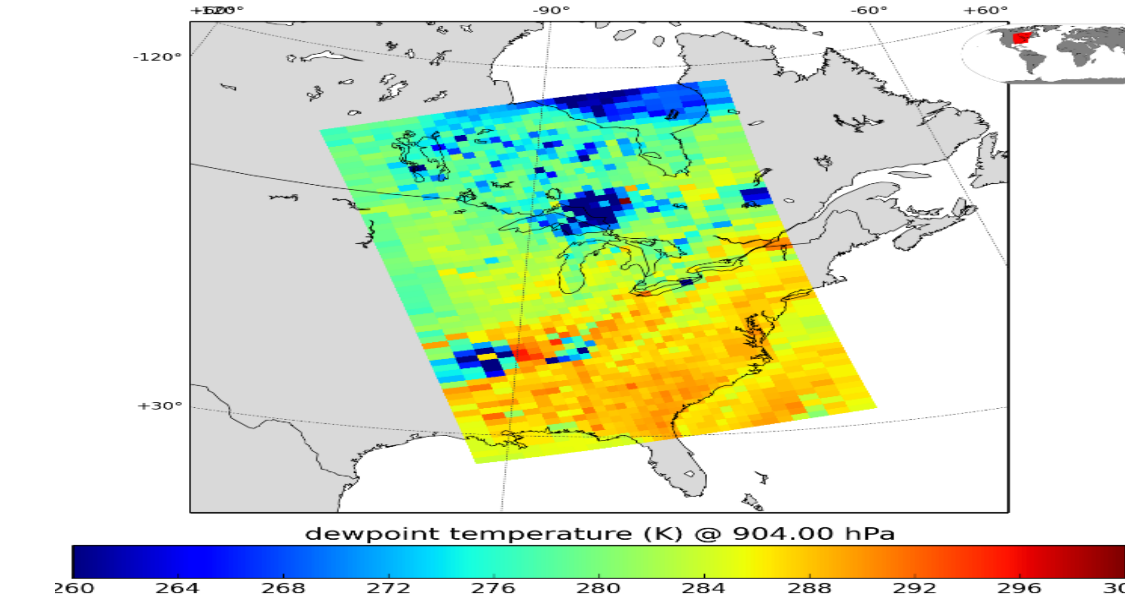
MADIS Surface Met Observations



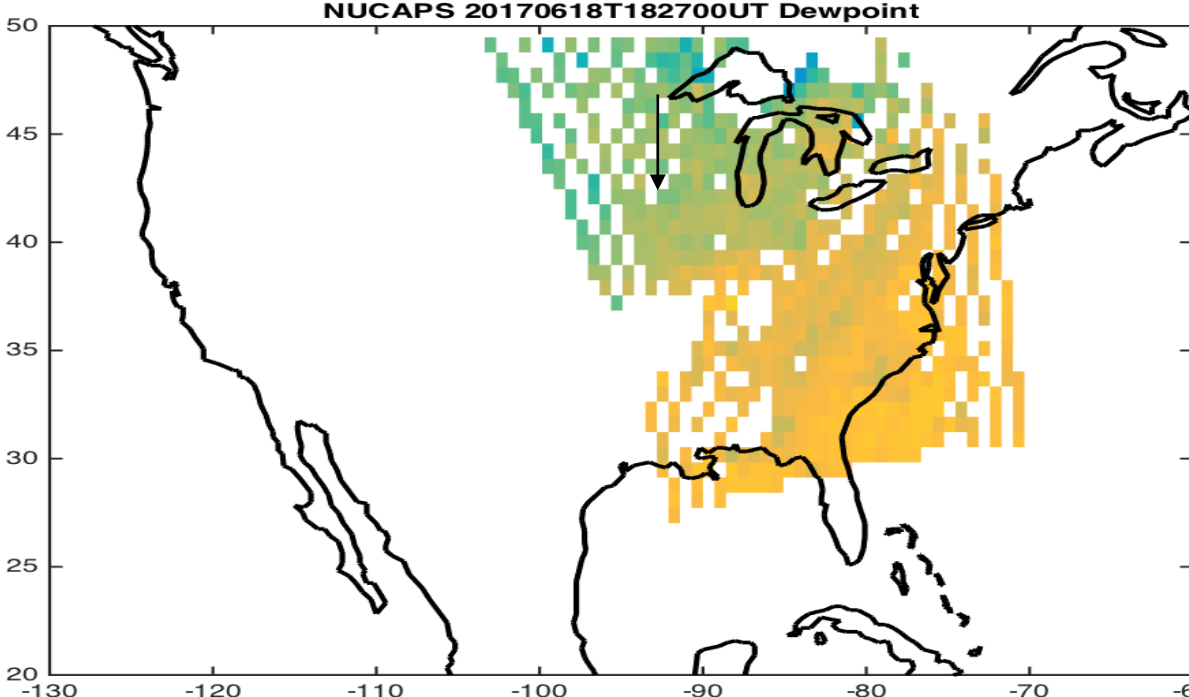
Extract hourly station averages



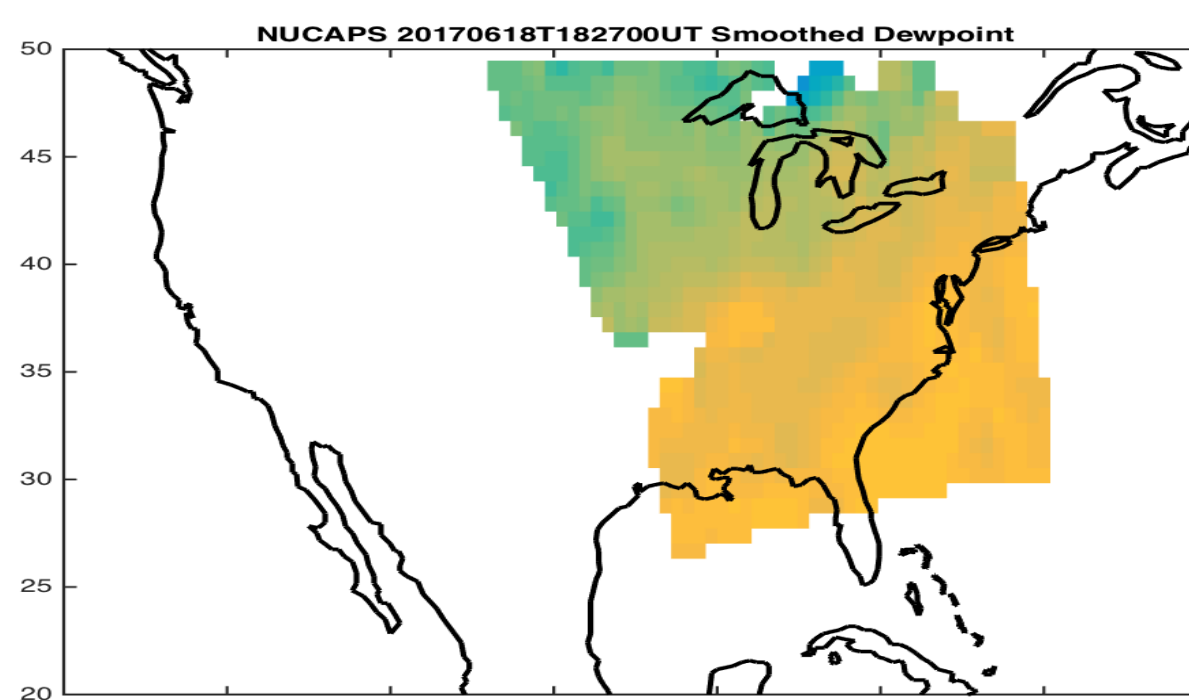
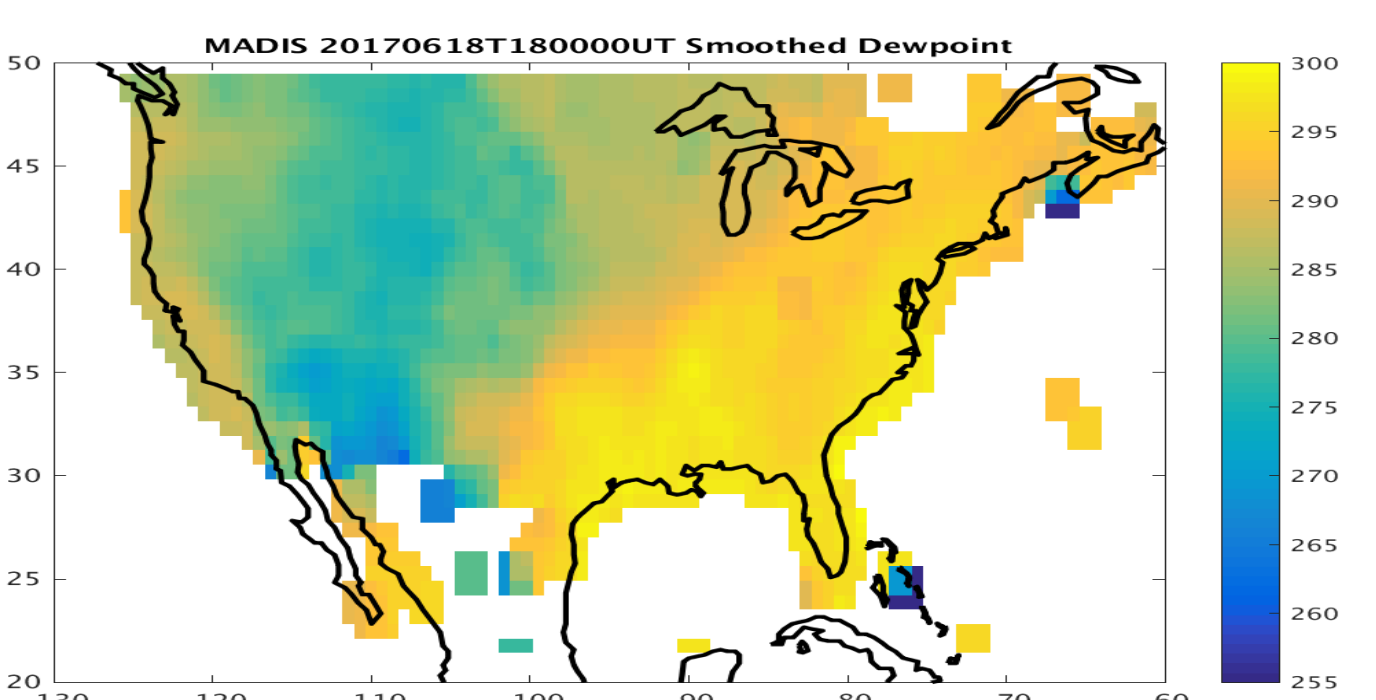
NUCAPS Satellite Surface Estimate



Extract near surface dewpoint



Both surface obs and satellite obs are averaged to a 0.7x0.7 degree grid. This is an example of the gridded dewpoint surface observations and satellite surface estimate for 18 June 2017.



Both the surface met observations and satellite surface estimates are smoothed by a 2-dimensional 3x3 boxcar convolution. This is the same gridded data after spatially smoothing.

IOWA Tornado Outbreak 14 July 2021

SPC Mesoscale analysis: SBCAPE and CIN

Acknowledgements

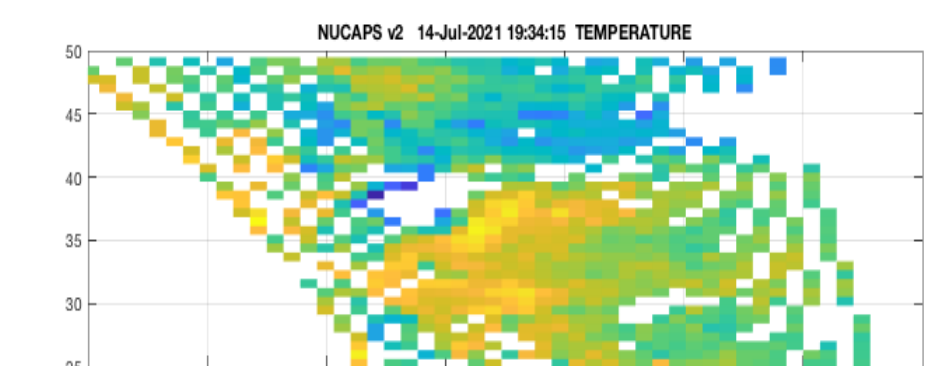
This work was supported by the CIMSS Cooperative Agreement grant NA20NES4320003 under the project CIMSS JPSS NUCAPS Emissivity Support in collaboration with STAR scientist Ken Pryor.

Assessment

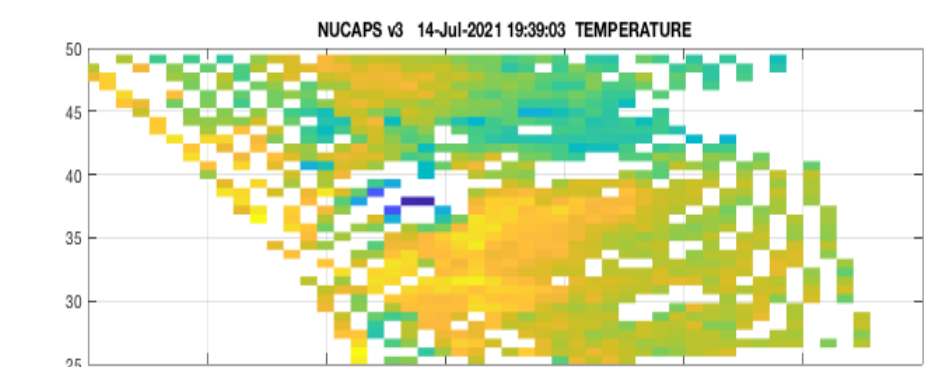
- An assessment was made of the CSPP HEAP NUCAPS v3r0 product by comparing
1. NUCAP v3 to NUCAPS v2 surface variables for the same NOAA-20 ATMS/CrIS data
 2. SBCAPE estimated from the NUCAPS soundings using NUCAPS surface variables, and
 3. SBCAPE estimated from the NUCAPS soundings using MADIS surface observations.

NUCAPS Surface Air Temperature

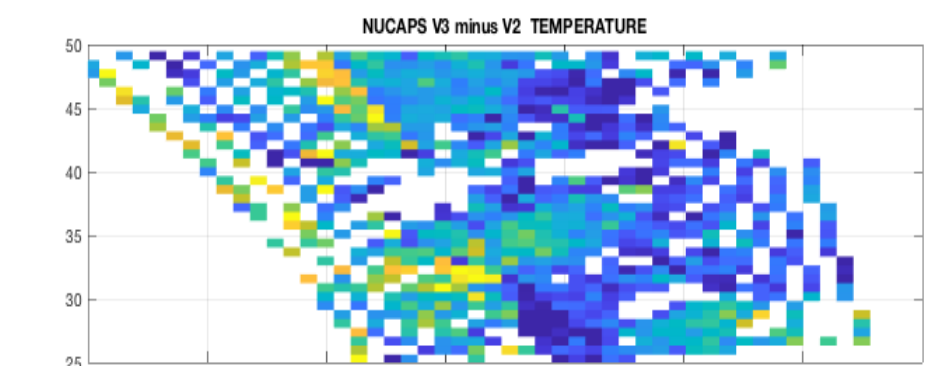
NUCAPS v2r0 (K)



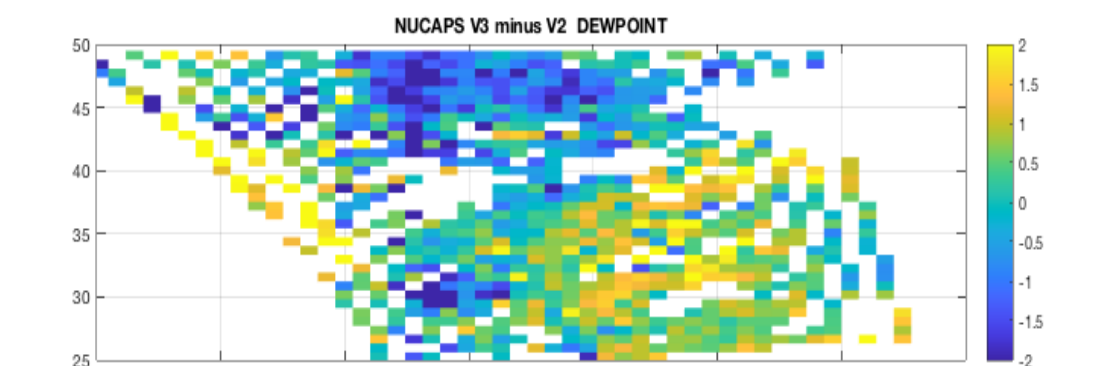
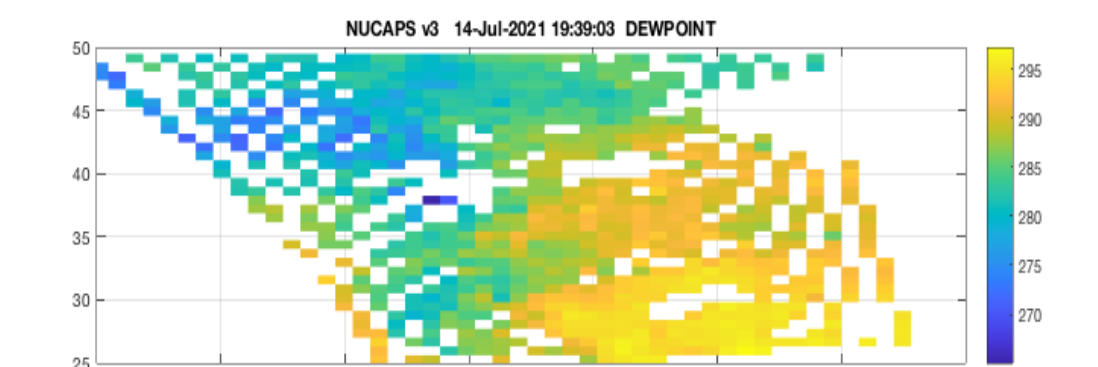
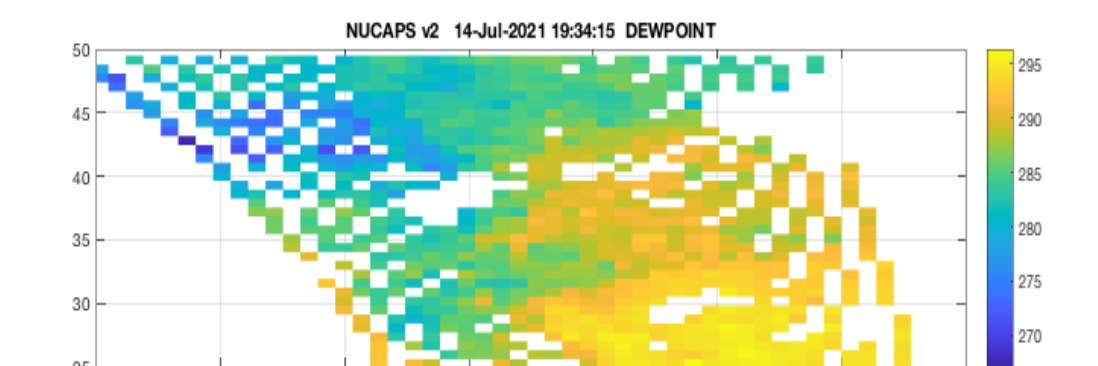
NUCAPS v3r0 (K)



NUCAPS v3r0 Minus v2r0 (K)



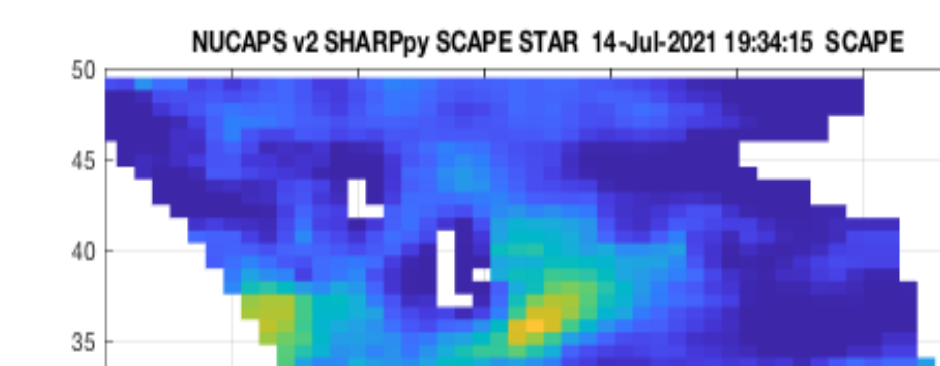
NUCAPS Surface Air Dewpoint



The difference maps indicate small changes in both near surface air temperature (<2K) and dewpoint (<2K).

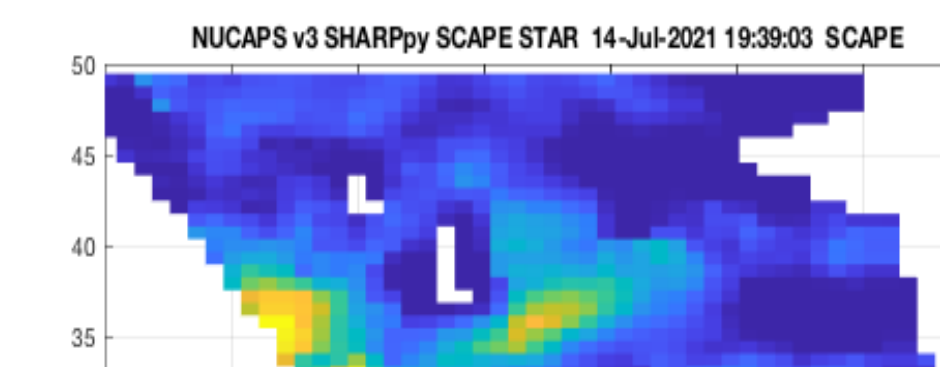
NUCAPS CAPE

NUCAPS v2r0 SBCAPE (J/Kg)

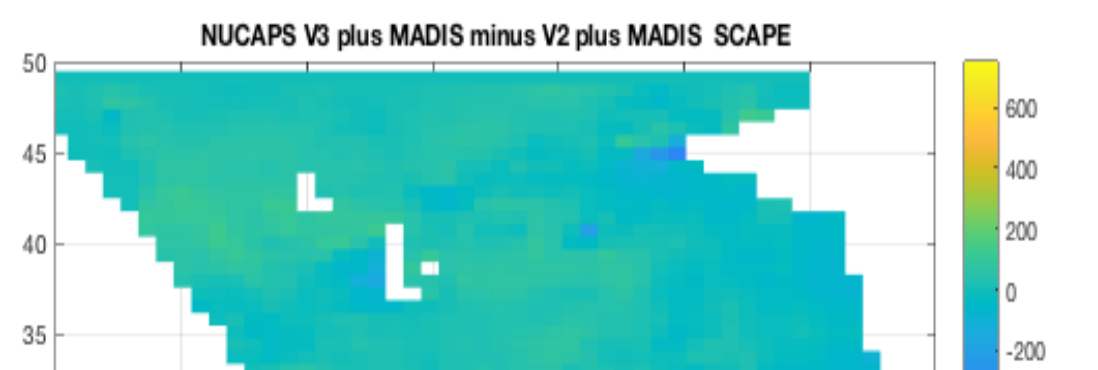
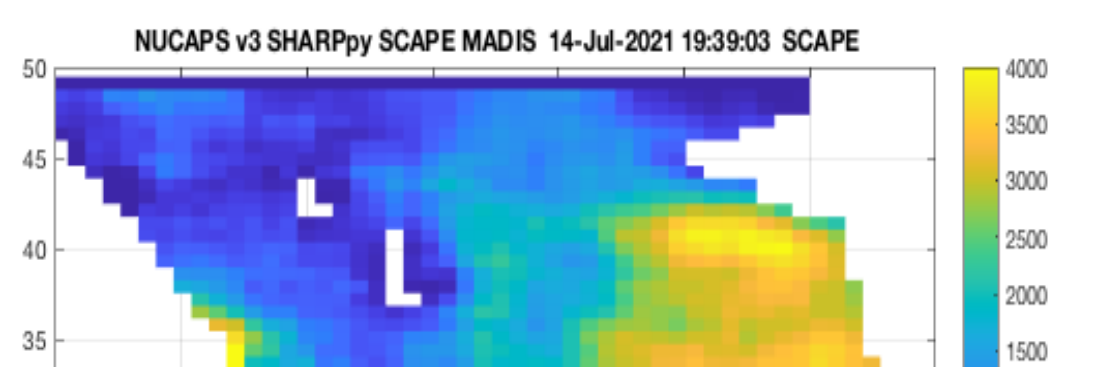
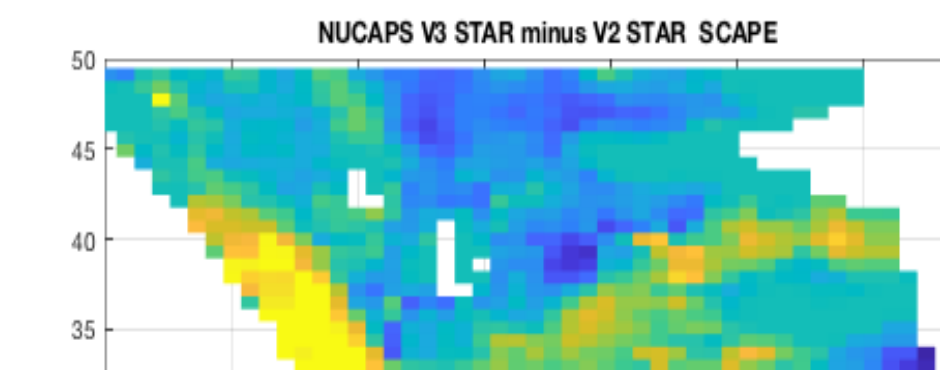


NUCAPS+MADIS CAPE

NUCAPS v3r0 SBCAPE (J/Kg)



NUCAPS v3r0 Minus v2r0 SBCAPE (J/Kg)



- The NUCAPS CAPE uses the sounding to estimate the surface air parcel to compute CAPE. The NUCAPS CAPE shows relatively small changes in CAPE between v2 and v3.
- The NUCAP+MADIS uses the MADIS surface obs of T, Tdew for the air parcel to compute CAPE but the NUCAPS Temp/WV sounding for the atmospheric vertical profile. The NUCAP+MADIS CAPE agrees much better with SPC analysis for both v2 and v3!

Conclusions

- The CSPP HEAP software was used to reprocess a case study allowing comparison of NUCAPS v2 and v3.
- The changes in the surface temperature and dewpoint are found to be relatively small (+/- 1 deg C).
- The use of NUCAPS satellite profile data combined with NOAA MADIS surface observations improves the Surface-Based CAPE (SBCAPE) estimates dramatically.
- When MADIS surface observations are used to estimate the surface parcel in the SBCAPE calculation, both NUCAPS v2 and v3 soundings generate the same SBCAPE estimate.