



Expanding Capabilities of Weather Forecasting Applications Through NUCAPS Data Assimilation



Jeff Szkodzinski

Remote Sensing Scientist – Science & Technology Corporation

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Rebekah Esmaili¹, Nadia Smith¹, Emily Berndt², Frank LaFontaine², Roger Allen², Tim Supinie³, Greg Blumberg⁴,
William Straka⁵

1: Science & Technology Corporation (STC)

2: NASA SPoRT

3: University of Oklahoma

4: Universities Space Research Association (USRA)

5: University of Wisconsin-Madison Space Science & Engineering Center (SSEC)



About Me



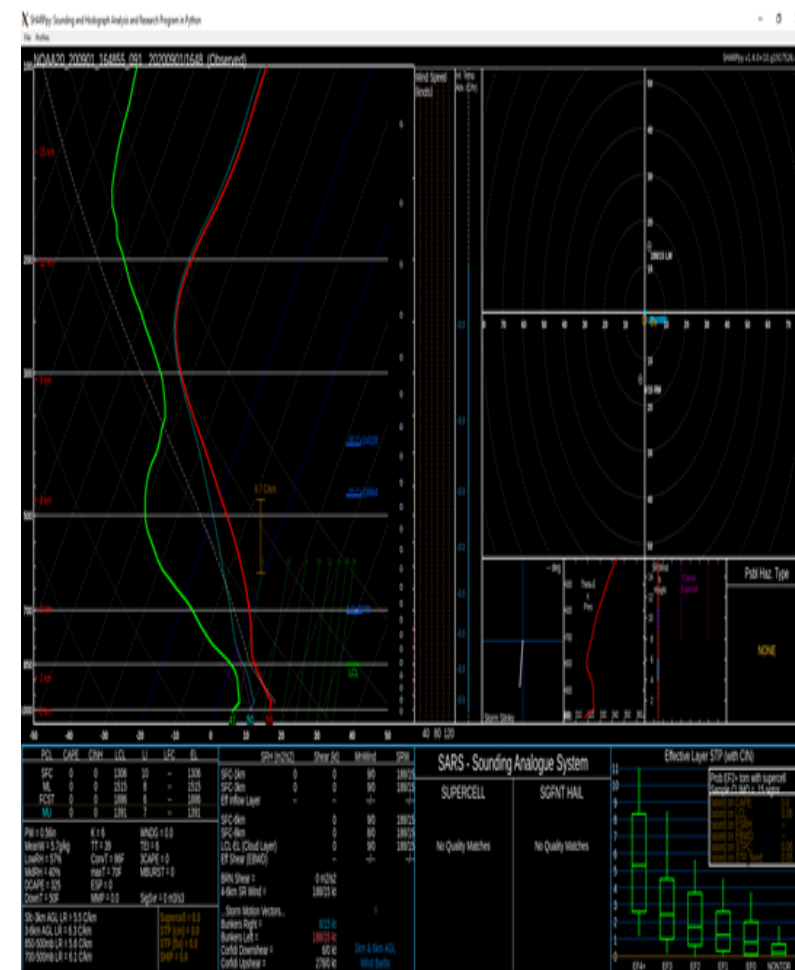
- Worked as a developer on the Advanced Weather Interactive Processing Systems (AWIPS) program.
 - AWIPS is the primary tools used by National Weather Service (NWS) forecasters.
 - Forecasters visualize atmospheric profile data in the form of a skew-T. These profiles are displayed through the National Center Sounding & Hodograph Analysis & Research Program (NSHARP) plug-in in AWIPS.
- Fixed software issues reported from the Weather Forecast Offices and national centers and helped design enhancements (i.e. Broadcast Message Handler (BMH) & Data Delivery)
- Gathered and documented software requirements from the user community.
- Demoed new software capabilities to government personnel and passed along feedback to team members.



NUCAPS in SharpPy



- SharpPy is a free, open-source version of NSHARP written entirely in Python.
- Forecasters can view temperature and moisture profiles, CAPE calculations and a hodograph for severe storm forecasting.
- Feedback from NUCAPS Users Group:
 - Access to more data sources, especially during times of infrequent observations or within regions where the observation network is sparse (open water or mountainous terrain).
 - SharpPy found to be more user friendly than NSHARP in AWIPS.
- Currently only displays RAOB and model data – Tailoring SharpPy to display real-time satellite sounding data.





NUCAPS in SharpPy



Project Overview

- Developing a process to plug NUCAPS into SharpPy (i.e. NOAA-20, Suomi-NPP, Metop-A, B, C, ...eventually Aqua)
- Data obtained from the Community Satellite Processing Package (CSPP) direct broadcast system at the University of Wisconsin-Madison.
 - Real-time data < 20 min of an overpass
- Script downloads CSPP NUCAPS netCDFs, extracts relevant fields, performs surface adjustments and water vapor conversions.
- Save thinned NUCAPS to SharpPy compatible file.

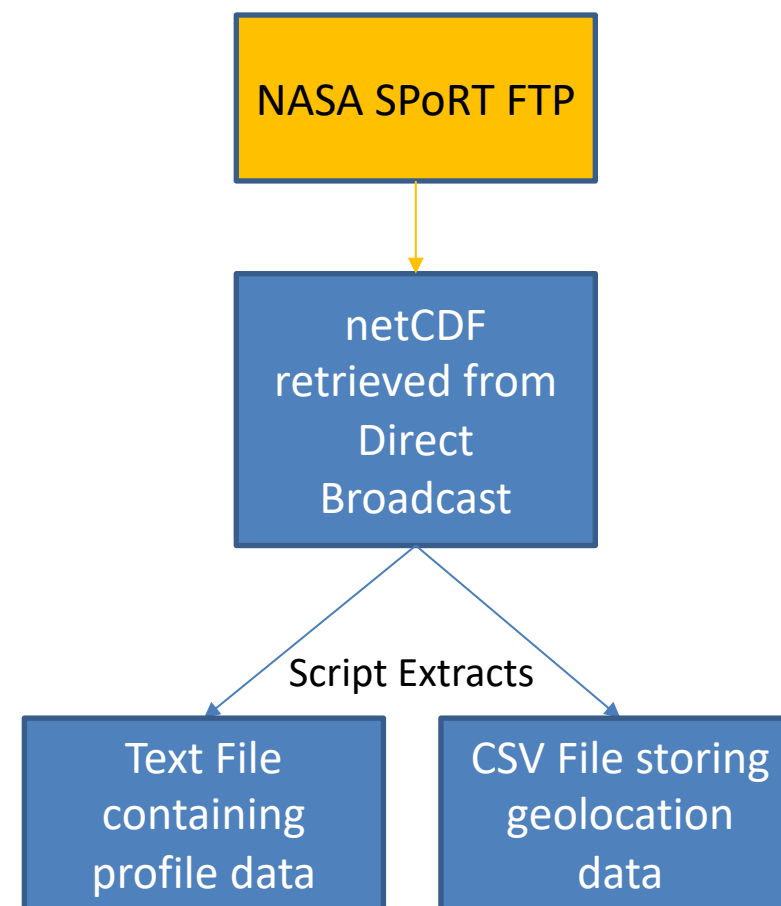


NUCAPS in SharpPy



Getting into Operations

- Scripts to ingest and thin out NUCAPS run routinely on a remote ftp server hosted by NASA SPoRT.
- Then SharpPy will **automatically** know where to look to retrieve NUCAPS thinned files.
- Advantage: The forecaster will not need to interact with the scripts to get the latest data. They have no time!





NUCAPS in SharpPy

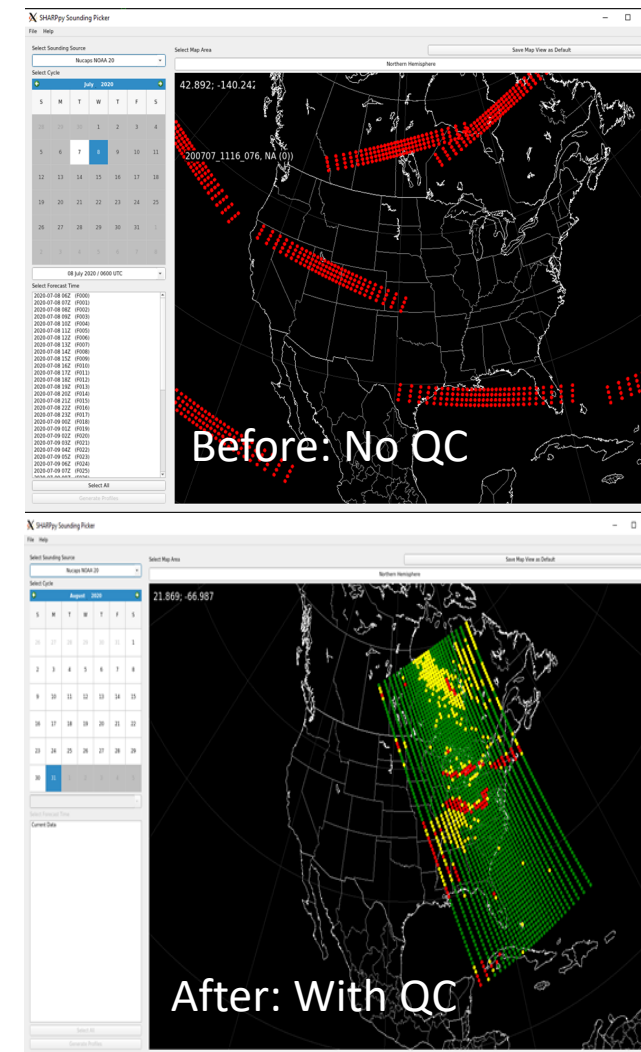


Getting into Operations (Cont.)

- Adding functionality to SharpPy.
 - Cloud top pressure and fraction (Cold Air Aloft forecasting in northern latitudes).
 - Microwave-only retrievals (to aid forecasters in assessing the quality of the scene).
- Visually inspect QC information for each profile.
 - http://cimss.ssec.wisc.edu/goes/OCLOFactSheetPDFs/QuickGuide_NUCAPS.pdf
- NUCAPS granules vary in size depending on the source. Our code seamlessly integrates NUCAPS from any source.

Dot Color Meaning

Green	Yellow	Red
Successful infrared (IR) + microwave (MW) NUCAPS retrieval under clear or partly cloudy conditions	Failed IR + MW NUCAPS retrieval. Successful MW-only NUCAPS retrieval under cloudy conditions	Failed IR + MW NUCAPS retrieval. Failed MW-only NUCAPS retrieval under precipitating cloudy conditions





NUCAPS in SharpPy



What is a skew-T?

- Graph which plots temperature and moisture with changing height in the atmosphere.
- Alerts forecasters to the potential for severe weather. Calculates stability indicators such as Convective Available Potential Energy (CAPE).
- Displays a hodograph showing how wind speeds change with height.
- Provides information as to the moisture content of the atmosphere.



201013_162842_032_M01_CONUS 20201013/1628 (Observed)

Severe Weather: Precipitation

Large CAPE

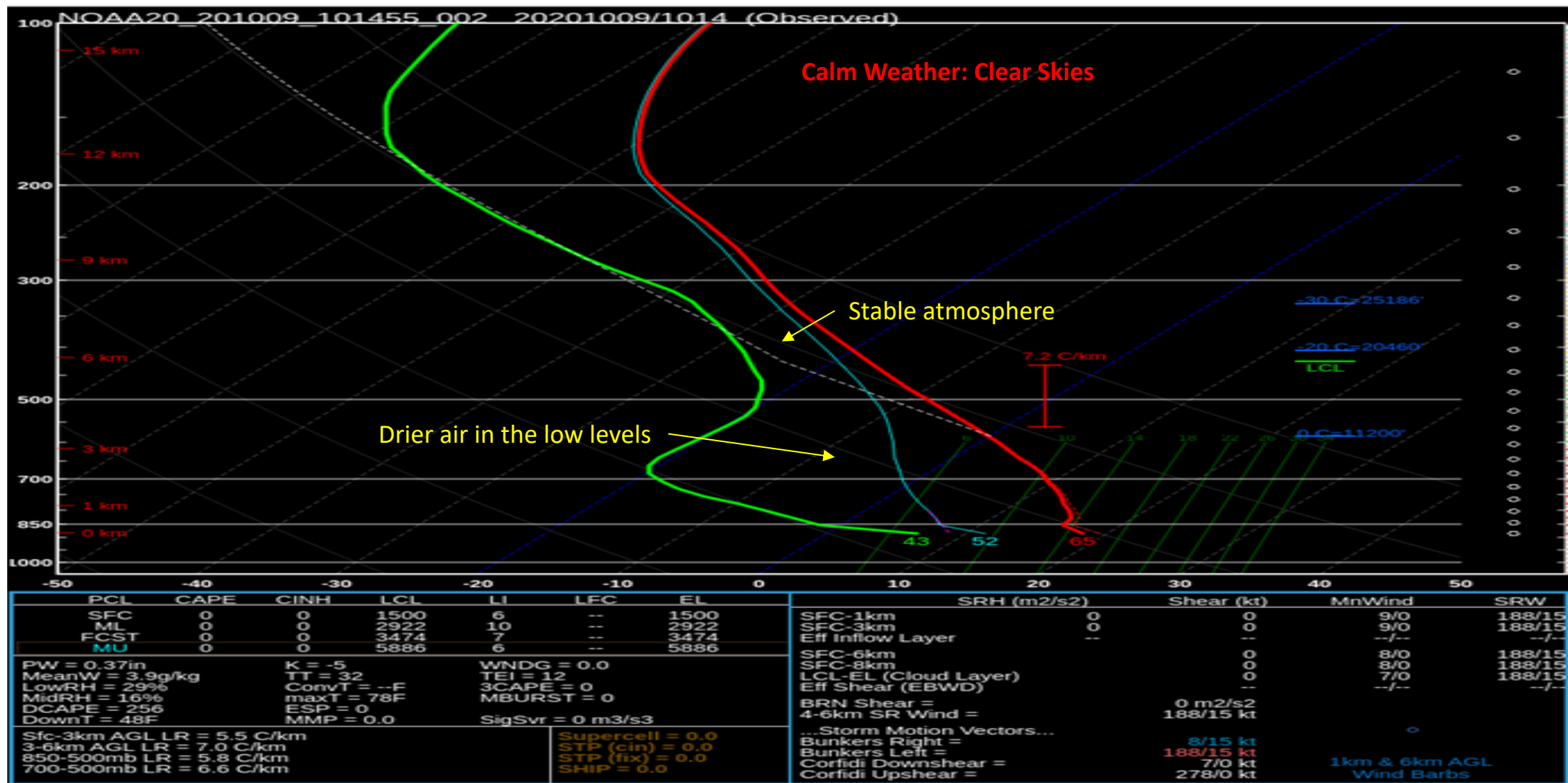
High moisture content

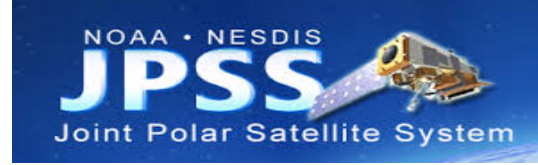
PCL	CAPE	CINH	LCL	LI	LFC	EL
SFC	7675	0	0	-12	45	17000
ML	5136	-1	450	-9	719	16084
FCST	6539	0	981	-11	981	16853
MU	7675	0	0	-12	45	17000

SFC-1km	SFC-3km	Eff Inflow Layer	SFC-6km	SFC-8km	LCL-EL (Cloud Layer)	Eff Shear (EBWD)	BRN Shear =	4-6km SR Wind =	Storm Motion Vectors...	Bunkers Right =	Bunkers Left =	Corfidi Downshear =	Corfidi Upshear =
0	0	0	0	0	0	0	0 m2/s2	188/15 kt	8/15 kt	188/15 kt	6/0 kt	278/0 kt	

MnWind	SRW
9/0	188/15
9/0	188/15
9/0	188/15
9/0	188/15
9/0	188/15
9/0	188/15
9/0	188/15

1km & 6km AGL Wind Barbs



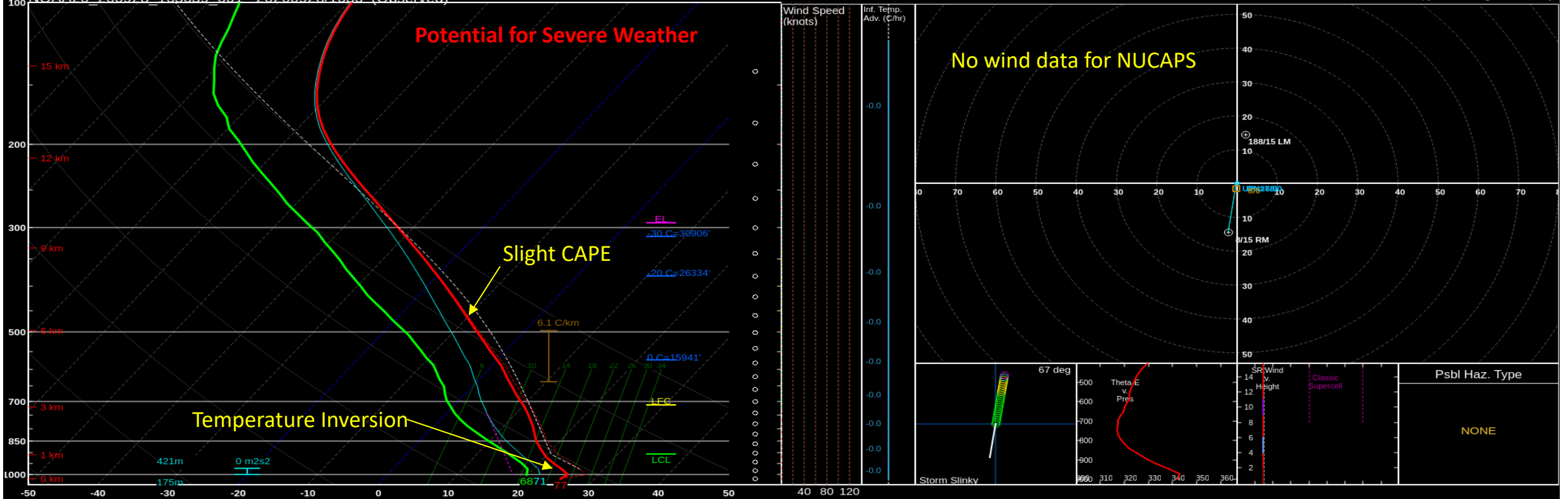


SHARPPy: Sounding and Hodograph Analysis and Research Program in Python

File Profiles

NOAA20_200928_163639_001 20200928/1636 (Observed)

SHARPPy v1.4.0+10.g1917526.dirty



PCL	CAPE	CINH	LCL	LI	LFC	EL	SRH (m2/s2)	Shear (kt)	MnWind	SRW	SARS - Sounding Analogue System		Effective Layer STP (with CIN)										
SFC	--	--	--	--	--	--	SFC-1km	0	9/0	188/15	SUPERCELL	SGFNT HAIL	11	Prob EF2+ torn with supercell Sample CLIMO = 15 sigior	based on CAPE: --								
ML	--	--	--	--	--	--	SFC-3km	0	9/0	188/15						No Quality Matches	No Quality Matches	10	based on LCL: --				
FCST	--	--	--	--	--	--	Eff Inflow Layer	0	10/0	188/15										No Quality Matches	No Quality Matches	9	based on ESRH: 0.06
MU	246	-32	1036	-2	3066	9880	SFC-6km	0	9/0	188/15													
PW = 1.49in							SFC-8km	0	9/0	188/15	No Quality Matches	No Quality Matches	7	based on STP: --									
MeanW = 13.9g/kg							LCL-EL (Cloud Layer)	0	8/0	188/15					No Quality Matches	No Quality Matches	6	based on STP fixed: --					
LowRH = 74%							Eff Shear (EBWD)	0	9/0	188/15									No Quality Matches	No Quality Matches	5		
MidRH = 54%							BRN Shear =	0 m2/s2		No Quality Matches													No Quality Matches
DCAPE = 519							4-6km SR Wind =	188/15 kt			No Quality Matches	No Quality Matches	3										
DownT = 64F							...Storm Motion Vectors...								No Quality Matches	No Quality Matches	2						
MMP = 0.0							Bunkers Right =	8/15 kt											No Quality Matches	No Quality Matches	1		
SigSvr = -- m3/s3							Bunkers Left =	188/15 kt		No Quality Matches													No Quality Matches
Sfc-3km AGL LR = 4.7 C/km							Corfidi Downshear =	6/0 kt	1km & 6km AGL		No Quality Matches	No Quality Matches	NONTOR										
3-6km AGL LR = 6.0 C/km							Corfidi Upshear =	278/0 kt	Wind Barbs						No Quality Matches	No Quality Matches							
850-500mb LR = 5.6 C/km							Supercell = 0.0										No Quality Matches	No Quality Matches">					
700-500mb LR = 5.9 C/km							STP (cin) = --			No Quality Matches">									No Quality Matches">				
							STP (fix) = --				No Quality Matches">	No Quality Matches">											
							SHIP = 0.0						No Quality Matches">	No Quality Matches">									



Long-Term Milestones & Conclusions



- Provide forecasters with a greater variety of data sources to choose from for severe weather forecasting.
 - NUCAPS soundings in SharpPy will supplement radiosonde and model output during the pre-convective period.
 - Satellite profiles can also serve as a validation tool in case study analysis. How well did the infrared and microwave retrievals resolve certain atmospheric features before a major severe weather event?
- Since only NWS forecasters have access to AWIPS, the integration of NUCAPS data in SharpPy will have the benefit of reaching a wider user community.
 - HWT feedback: Many users already favored using SharpPy over NSHARP because of its intuitive design and display capabilities.
 - Improvements made to SharpPy could pave the way for future refinements of the skew-T display in AWIPS.
- When NUCAPS Aqua goes live on the CSPP Direct Broadcast server...
 - Downstream applications like SharpPy and gridded NUCAPS will be able to assimilate real-time AIRS granules in a similar fashion to what is currently being done for CrIS/ATMS.
 - Will increase overlapping data coverage for the CONUS.
 - No need to invent new python data readers for each new data source.