ATMS 261 – Final Project Description and Requirements – Spring 2020

Your final ATMS 261 project will consist of a Powerpoint presentation on the weather event that impacted western North Carolina from 0000 UTC 18 December to 0000 UTC 21 December 2009. The presentation will include weather maps and analyses providing a description of what happened during the 72-hour period. If interested and you have access and expertise to go beyond a Powerpoint presentation, you may add a voice-over to the Powerpoint presentation (which can be done within Powerpoint) to add narration to the weather maps and analyses. If you are REALLY looking for a challenge, you could create a 15 minute video documentary (the original intent of the final project). However, given our at-home limitations, a voice-over or video documentary is NOT expected or required since we are all working by ourselves on this project.

The project is due at 4:00 pm on the last day of final exams (May 6, 2020) and consists of [1] the Powerpoint file and [2] a brief document in which you describe how you created the weather information included in the Powerpoint presentation (e.g., GARP, VIS5D, web page URL, Fortran program, Python, Excel, MovieMaker, etc.) defined in Parts [A]-[D] below. In order to receive a passing grade, the following information and analysis **must** be included in the Powerpoint presentation,

[A] Discussion of the synoptic features associated with the event using weather maps of

* + SLP (hPa) / 1000-500 Thickness (dam)
	+ 850 hPa level Geopotential Height (m) & Equivalent Potential Temperature (θe)
	+ 700 hPa level Geopotential Height (m) & RH (%)
	+ 500 hPa level Geopotential Height (m) & Absolute Vorticity (s-1)
	+ 300 hPa level Geopotential Height (m) & Isotachs (knots)

valid every 12 hours (0000 and 1200 UTC) [<https://www.spc.noaa.gov/exper/ma_archive/>]. [**must**]

[B] Discussion of animation loops of

* + IR satellite imagery (national)
	+ WSR88D imagery (national)

with images valid near the top of each hour (e.g., 0305 UTC or 0315 UTC). [**must**]

[C] Mesoscale analysis of events that transpired at the Asheville airport (AVL, lat=35.4361oN, lon=82.5417oW) and at Poga Mountain, NC (Avery County, lat=36.2526 oN, lon=81.9136 oW) by including a discussion of

* + Meteogram at AVL (see Plymouth State University Atmos. Sci. Dept. web site)
	+ Regional WSR88D radar imagery (KMRX or KGSP), base reflectivity loops only for the time periods when you feel something particularly interesting was happening at AVL or at Poga Mtn
	+ Sounding analysis at Poga Mountain
		- Show UNCA-ASU sounding plots of vertical profiles of temperature, dewpoint temperature, and winds every 6 hours (0000, 0600, 1200, and 1800 UTC) over the 72-h period
	+ Time series plots at Poga Mountain
		- Snow-to-liquid ratio (SLR) observations made by Dr. Baker Perry (ASU)
		- 1050-1100 and 1950-2000 meter ASL layer average potential temperature (θ [K], using UNCA-ASU sounding information every **three** hours)
		- 1050-1100 and 1950-2000 meter ASL layer average mixing ratio (*w* [g kg-1], using UNCA-ASU sounding information every **three** hours)
		- 850 hPa level speed [m s-1] of the wind component along 320o (blowing from the northwest, using UNCA-ASU sounding information every **three** hours)

[C] Mesoscale analysis {continued}

* + Time series plots at Poga Mountain {continued}
		- Froude number (**Fr**, using UNCA-ASU sounding information every **three** hours). This number is important for diagnosing if northwest flow snowfall might spill over into the lee of the primary spine of the Appalachian Mountains. A **Fr** > 1.0 indicates air parcels have sufficient kinetic energy to make their way over the mountain barrier and the northwest flow snowfall “spill-over” is more likely to occur. Froude number is defined as

**Fr** [no units] = U/(N H)

where

U = 850 hPa level wind speed [m s-1] component along 320o (blowing from the northwest)

N = Brunt-Vaisala Frequency [s-1] $=\sqrt{\frac{g}{θ}\frac{∆θ}{∆z}}$

H = 1067 m (3500 feet) ASL, mean altitude of southern Appalachian Mtns

* + - Precipitable water (mm or kg m-2, using UNCA-ASU sounding information every **three** hours)
	+ 24-h trajectory analysis; find where the air parcels came from 24 hours previous that ended up at AVL and Poga Mountain at 1.5 km ASL (~850 hPa level) at 1200 UTC 19 December and 1200 UTC 20 December 2009 and plot their vertical and horizontal positions on a map over the 24-h period
	+ Mountain ridgeline-parallel vertical cross sections every six hours (0000, 0600, 1200, and 1800 UTC), with endpoints at AVL and Poga Mtn, covering the 1000 – 500 hPa layer of the troposphere
		- Include the following fields on the vertical sections; potential temperature (θ [K], dashed contours plotted every 2 Kelvin), relative humidity (color shading every 10% from 70 to 100 %), and section-normal wind speed (solid contours plotted every 20 m s-1, with shading starting at 15 m s-1)
	+ AVL and Poga Mountain snowfall accumulation totals [centimeters] for the event

You **must** include **four** of the eight open circle bullet products in your mesoscale analysis. Completion of mesoscale analyses beyond four categories represents extra credit.

[D] **Extra extra credit** 🡪 a brief description of the societal impacts of the weather event in western North Carolina, focusing particularly on Asheville, NC

Data files for mesoscale analyses can be found in the Google Drive (shared) folder ‘https://drive.google.com/drive/folders/1Pes5HsjvK7SUMBFd-M5H-E9YmZXjvD1\_?usp=sharing’

 1) text files of UNCA-ASU soundings launched at Poga Mountain can be found in files having the names ‘nwfs0910\_iop2snd##.txt’

 2) Dr. Baker Perry’s SLR and other surface observations (inspect the ‘Totals’ and ‘Details’ tabs) can be found in the file “PM\_09-10snow\_met\_class.xls”

HYSPLIT fields based on any global model or reanalysis can be used to assist trajectory analysis.

**Hint:** you can compile the Fortran program “uwyo\_snd.f” (using “gfortran”) found in directory /home/atms261/programs to convert the UNCA-ASU sounding text files to a text file that is readable as input to the Python Skew-T Log-P script from Project #5.