Clearing the skies: weather representativeness issues in aviation from the lab, to the classroom, and to the airfield.

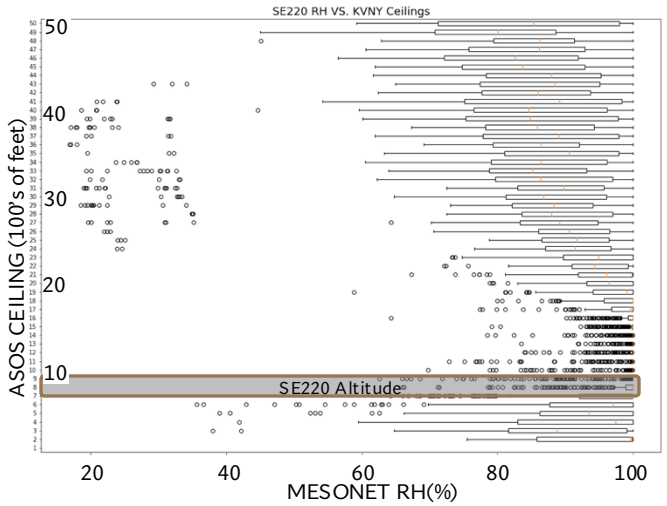
Prof. Michael Splitt

College of Aeronautics

Florida Tech

Wx Representativeness: Research to Applications

Operationalizing Mesonet Data



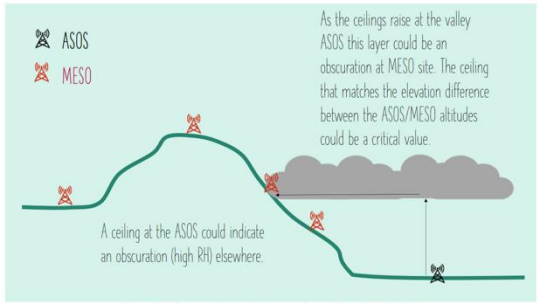
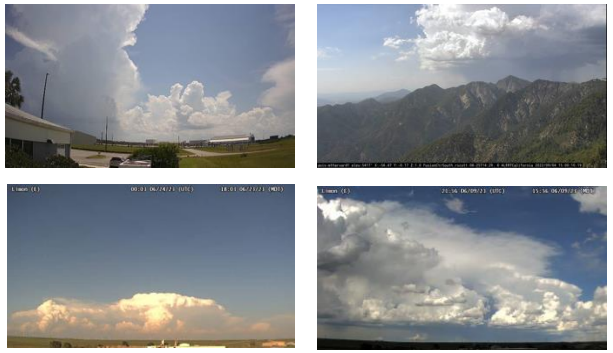


Figure 4. Elevated cloud layers above the ASOS/AWOS

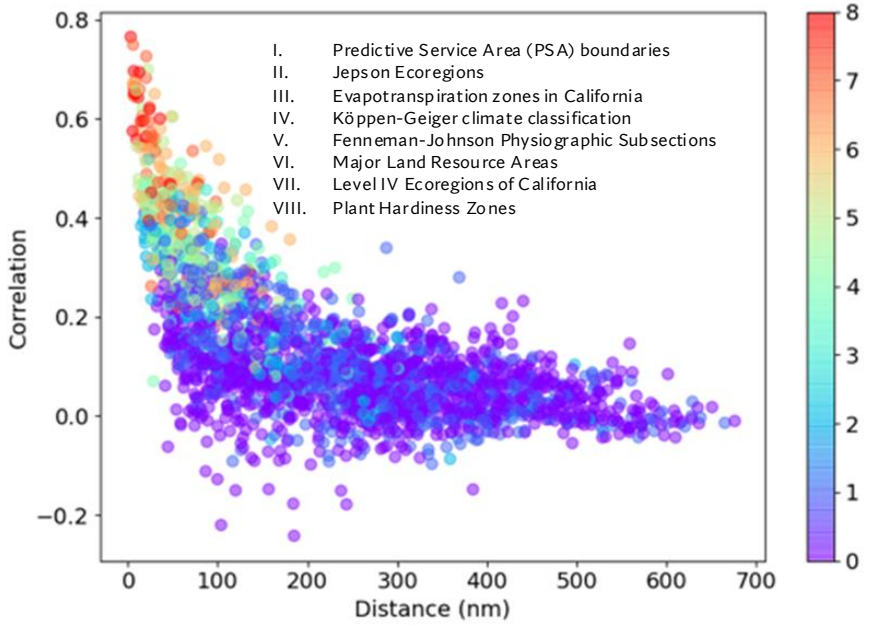
*Camera Cloud Type AI: advisory information

		Categorized validation images (truth)								
		Nonhazardous				Hazardous				
		Ac	Ci	Clear	Cu	Cb	Obsc	Precip	St	TCu
	Image total:	403	451	520	526	150	378	205	262	212
Model top-1 prediction	Ac	**357**	55	9	18	5	0	2	3	5
	Ci	28	**354**	26	14	4	0	0	0	0
	Clear	4	14	**478**	7	1	0	1	0	1
	Cu	8	17	5	**444**	27	0	4	0	64
	Cb	0	4	0	8	**44**	0	2	0	18
	Obsc	0	0	0	0	0	**370**	0	0	0
	Precip	0	1	0	1	3	6	**194**	17	0
	St	6	0	0	3	1	2	2	**242**	2
	TCu	0	6	2	31	65	0	0	0	**122**
	Top-1 Accuracy	88.6%	78.5%	91.9%	84.4%	29.3%	97.9%	94.6%	92.4%	57.5%

Cumulative top-1 accuracy: 2605/3107 = 83.8 %



Climate and geographical zone influence on representativeness

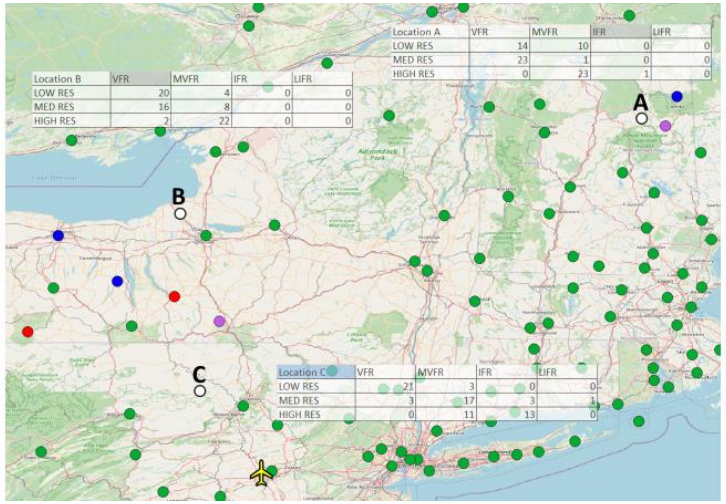


*Cote, M. P. (2022). Cloud Image Classification Using Machine Learning.

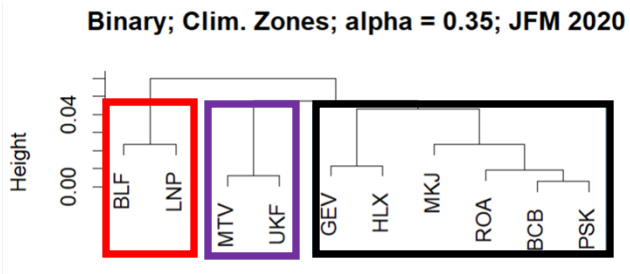
Wx Representativeness: Research to Applications

*Survey on Pilots' ability to spatially project wx info

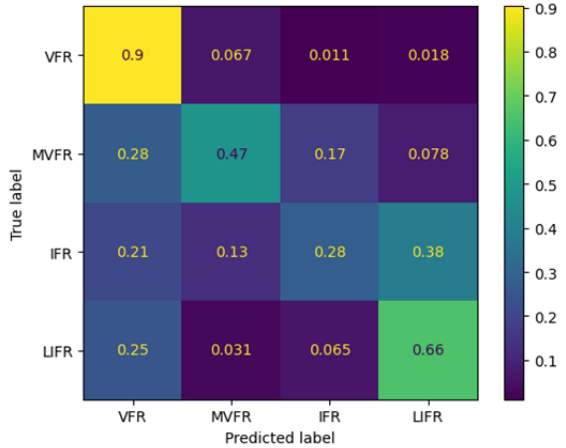
- Relatively low skill in estimating the correct wx flight rules category
- Increasing observation density didn't improve estimates
- Pilots were fairly to completely confident in their answers



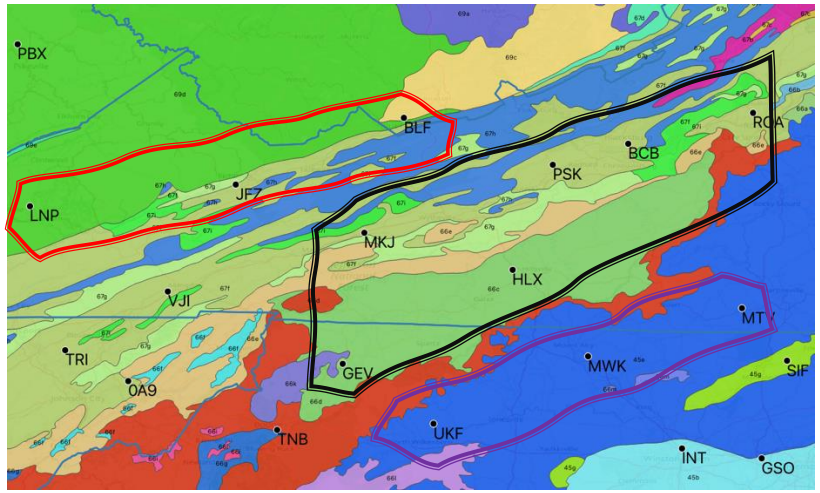
Wx Station Clustering



Neural Network Predictions



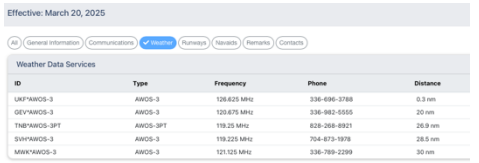
Cluster Applications



KUKF **Wilkes County Airport**
North Wilkesboro, North Carolina, USA

Airport Communications

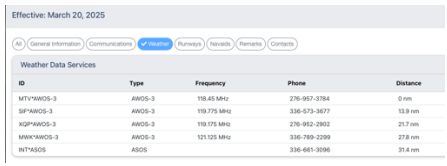
CTAF/UNICOM: 122.7
WX AWOS-3: 126.625 (336-696-3788)
WX AWOS-3 at GEV (20 nm NW): 120.675 (336-982-5555)



KMTV **Blue Ridge Airport**
Martinsville, Virginia, USA

Airport Communications

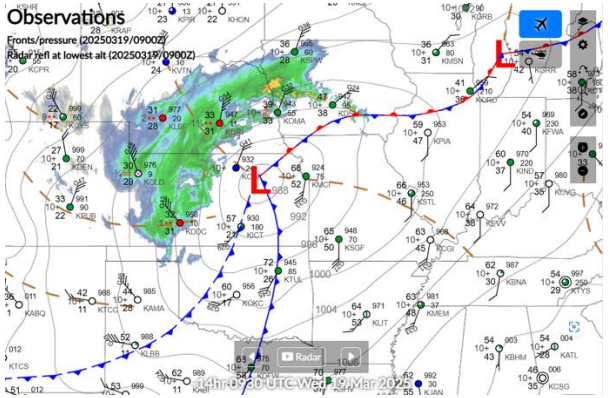
CTAF/UNICOM: 122.7
WX AWOS-3: 118.45 (276-957-3784)
GREENSBORO APPROACH: 124.35
GREENSBORO DEPARTURE: 124.35
CLEARANCE DELIVERY: 124.85
WX AWOS-3 at SIF (14 nm SE): 119.775 (336-573-3677)

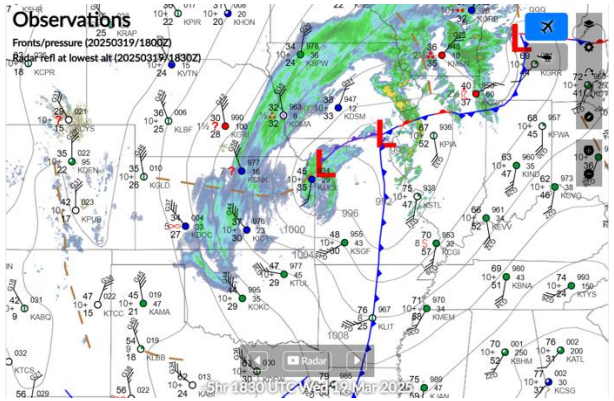


* Caldwell, B. S., Splitt, M. E., & Boerwinkle, A. E. (2024, September). Effects of Weather Information Observability and Uncertainty on Pilot Assessment of Weather Conditions and Decision Making. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 68, No. 1, pp. 65-69). Sage CA: Los Angeles, CA: SAGE Publications.

Weather **T**est **F**ail! **Occlusions**

Professor Splitt, I was asked a WX question.....and received an UNSAT.





"A **cold front occlusion** occurs when a fast-moving cold front is colder than the air ahead of the slow-moving warm front. "

"A **warm front occlusion** occurs when the air ahead of the warm front is colder than the air of the cold front."

WARM OCCLUSIONS, COLD OCCLUSIONS, AND FORWARD-TILTING COLD FRONTS

BY MARK T. STOELINGA, JOHN D. LOCATELLI, AND PETER V. HOBBS

A relationship between the slope of a front and the static stability contrast across the front provides new insights into warm and cold occlusions and forward-tilting cold fronts.

"an occluded front slopes over the statically more stable air, not the colder air."

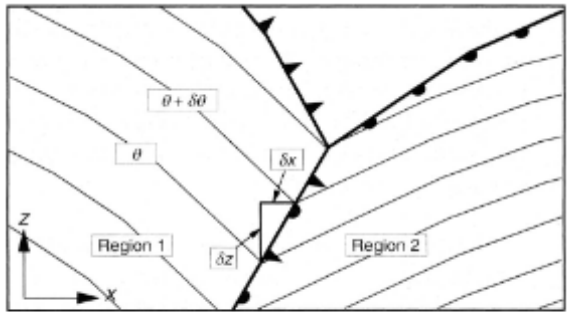


FIG. 6. Schematic vertical cross section through an idealized occluded frontal surface, with potential temperature (solid contours) and frontal positions.

Stoelinga, M. T., Locatelli, J. D., & Hobbs, P. V. (2002). Warm occlusions, cold occlusions, and forward-tilting cold fronts. *Bulletin of the American Meteorological Society*, *83*(5), 709-722.

What is representative weather associated with an occluded front? How does are training and testing help with this?

Weather Test Fail! Occlusions

OCCLUDED FRONTS AND THE OCCLUSION PROCESS

A Fresh Look at Conventional Wisdom

BY DAVID M. SCHULTZ AND GERAINT VAUGHAN

TENET 1: THE OCCLUDED FRONT FORMS AND LENGTHENS AS A FASTER-MOVING COLD FRONT CATCHES UP WITH A SLOWER-MOVING WARM FRONT.

TENET 1—REALITY: The occluded front forms as a result of the wrap-up of the baroclinic zone and lengthens due to flow deformation and rotation around the cyclone.

TENET 2: TWO TYPES OF OCCLUSIONS ARE POSSIBLE, DEPENDING ON THE RELATIVE TEMPERATURES OF THE AIR ON EITHER SIDE OF THE OCCLUDED FRONT

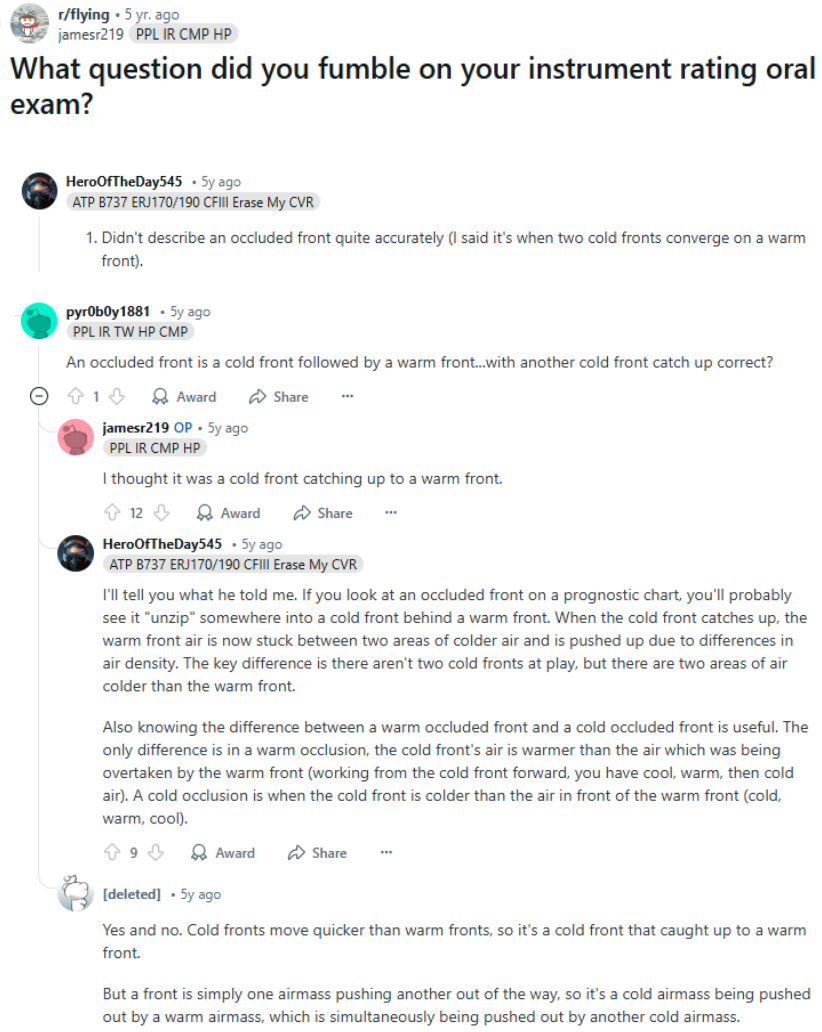
TENET 2—REALITY: Two types of occlusions are possible, depending on the relative static stabilities of the air on either side of the occluded front. However, warm-type occlusions are more common, in general

TENET 3: OCCLUSION MEANS THAT THE CYCLONE WILL STOP DEEPENING.

TENET 3—REALITY: Many cyclones continue to deepen after occlusion or never occlude at all

TENET 4: OCCLUDED FRONTS ARE ASSOCIATED WITH WIDESPREAD CLOUDS AND PRECIPITATION FOLLOWED BY ABRUPT CLEARING AFTER SURFACE FRONTAL PASSAGE.

TENET 4—REALITY. Occluded fronts are associated with a variety of cloud and precipitation patterns, including dry slots and banded precipitation



r/flying • 5 yr. ago
jamesr219 PPL IR CMP HP

What question did you fumble on your instrument rating oral exam?

HeroOfTheDay545 • 5y ago
ATP B737 ERJ170/190 CFIII Erase My CVR

1. Didn't describe an occluded front quite accurately (I said it's when two cold fronts converge on a warm front).

pyr0b0y1881 • 5y ago
PPL IR TW HP CMP

An occluded front is a cold front followed by a warm front...with another cold front catch up correct?

1 Award Share

jamesr219 OP • 5y ago
PPL IR CMP HP

I thought it was a cold front catching up to a warm front.

12 Award Share

HeroOfTheDay545 • 5y ago
ATP B737 ERJ170/190 CFIII Erase My CVR

I'll tell you what he told me. If you look at an occluded front on a prognostic chart, you'll probably see it "unzip" somewhere into a cold front behind a warm front. When the cold front catches up, the warm front air is now stuck between two areas of colder air and is pushed up due to differences in air density. The key difference is there aren't two cold fronts at play, but there are two areas of air colder than the warm front.

Also knowing the difference between a warm occluded front and a cold occluded front is useful. The only difference is in a warm occlusion, the cold front's air is warmer than the air which was being overtaken by the warm front (working from the cold front forward, you have cool, warm, then cold air). A cold occlusion is when the cold front is colder than the air in front of the warm front (cold, warm, cool).

9 Award Share

[deleted] • 5y ago

Yes and no. Cold fronts move quicker than warm fronts, so it's a cold front that caught up to a warm front.

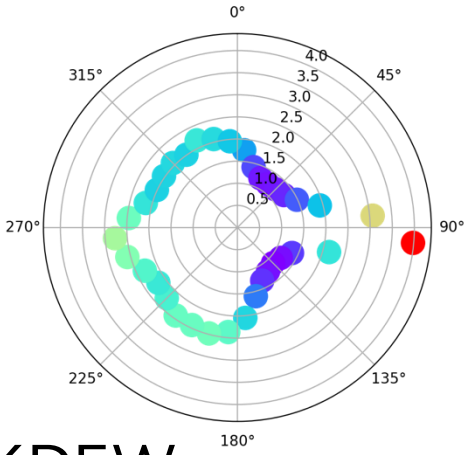
But a front is simply one airmass pushing another out of the way, so it's a cold airmass being pushed out by a warm airmass, which is simultaneously being pushed out by another cold airmass.

Schultz, D. M., & Vaughan, G. (2011). Occluded fronts and the occlusion process: A fresh look at conventional wisdom. Bulletin of the American Meteorological Society, 92(4), 443-466.

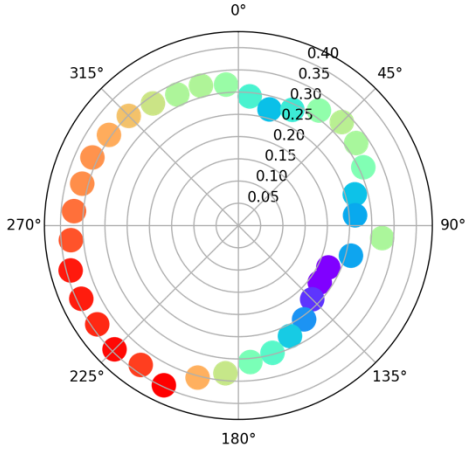
Advanced Wx Analytics in the Classroom I: GUSTS

KABQ

Avn Gust Factor.

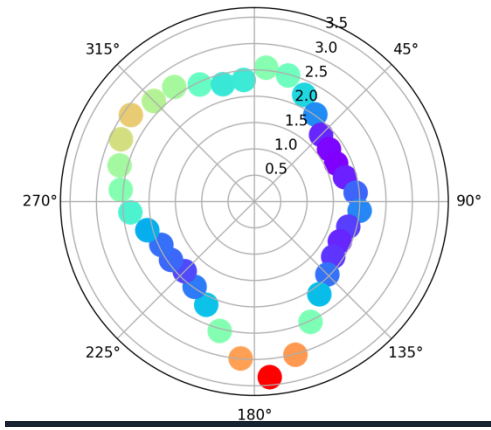


Met Gust Factor

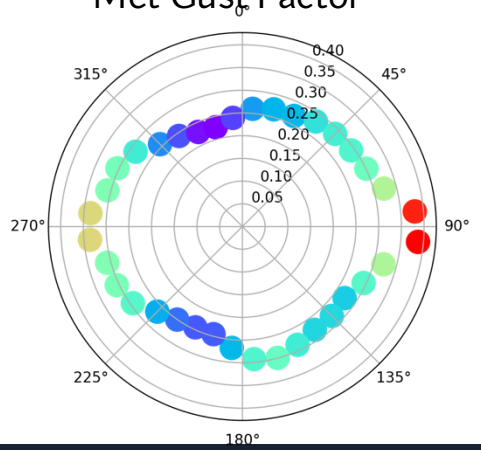


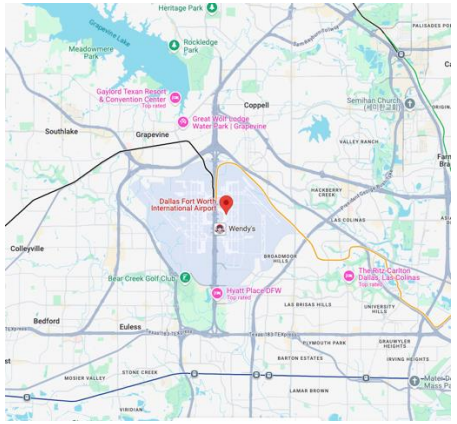
KDFW

Avn Gust Factor.



Met Gust Factor

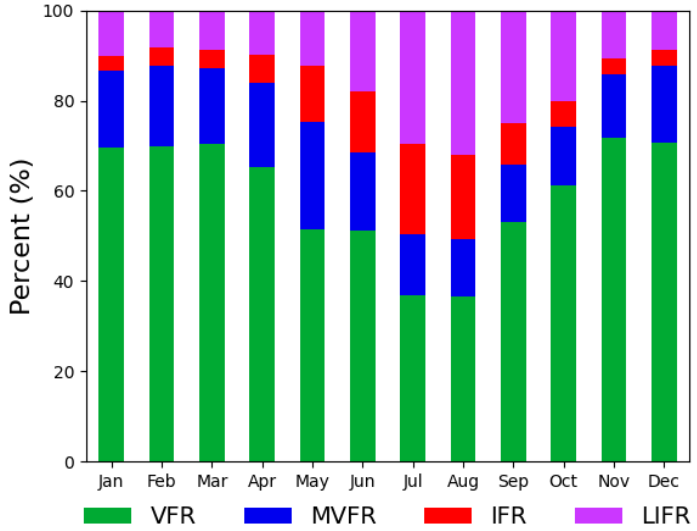




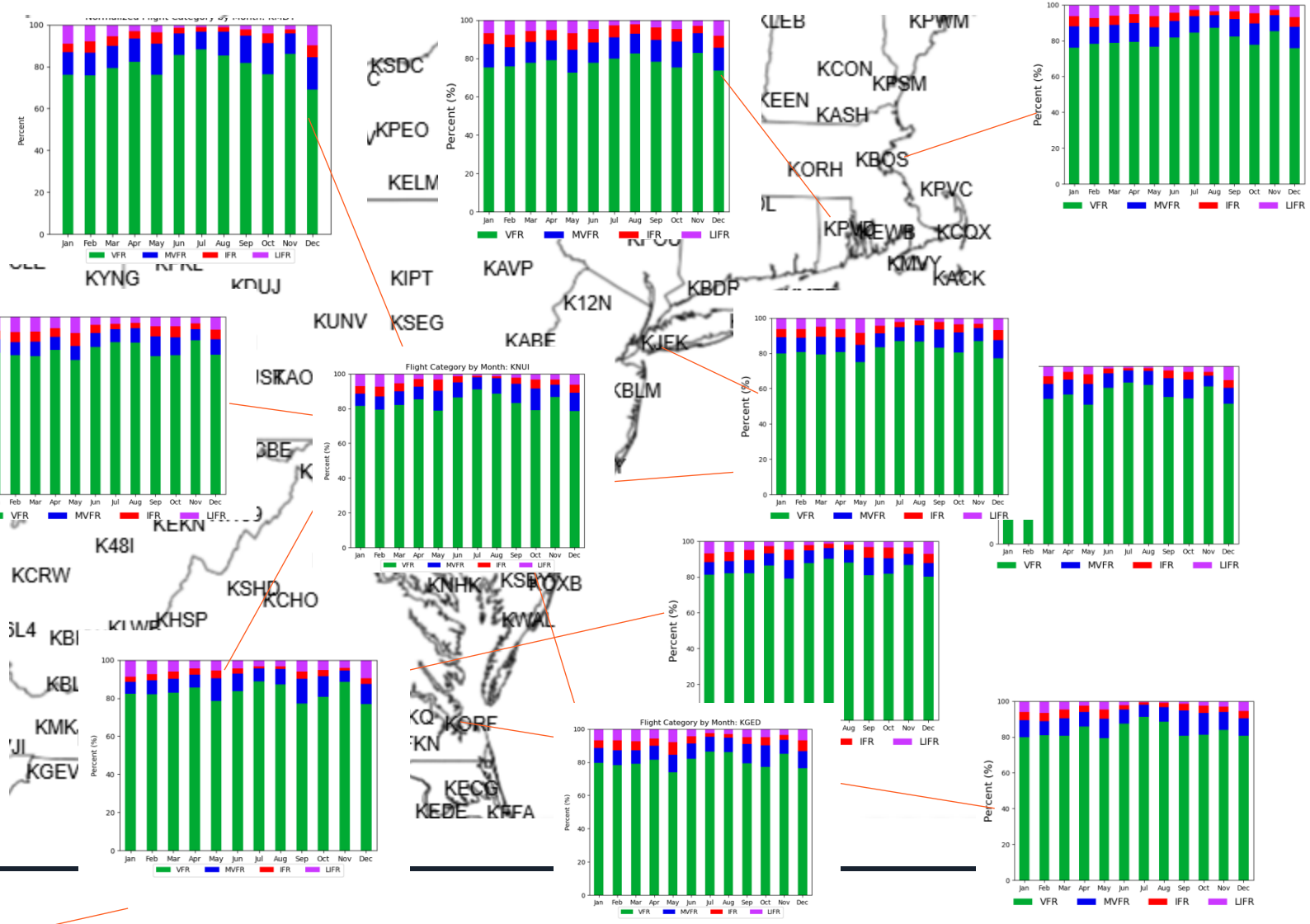
Advanced Wx Analytics in the Classroom 2: C & V

June Gloom!

California Redwood Coast-Humboldt County Airport
Arcata/Eureka, California, USA



Meet “Murky May”?
& “No so bad November”?



Opinions expressed here are solely my own and do not express the views or opinions of my employer, Florida Tech, nor any funding agencies, such as the Federal Aviation Administration.