

The Pi Day Downslope Wind Storm: An Aviation Perspective

14–17 March 2024, Northern Utah

Julie Cunningham
Meteorologist, NWS Salt Lake City



IWAWS 2024 – Salt Lake City, UT

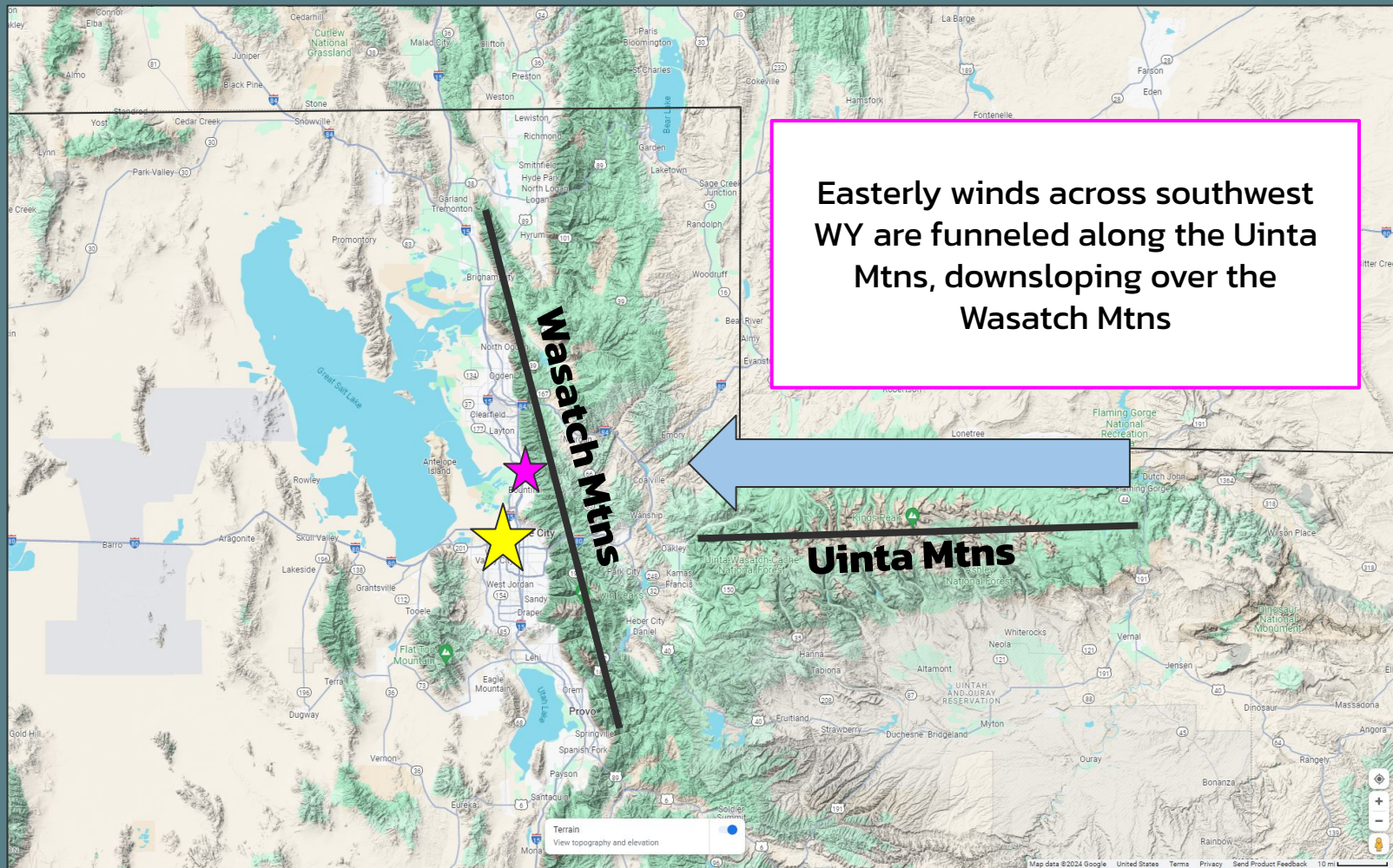
Rather than a purely
meteorological case study...



Operational successes
and challenges we
encountered through
the forecast process and
the event itself.



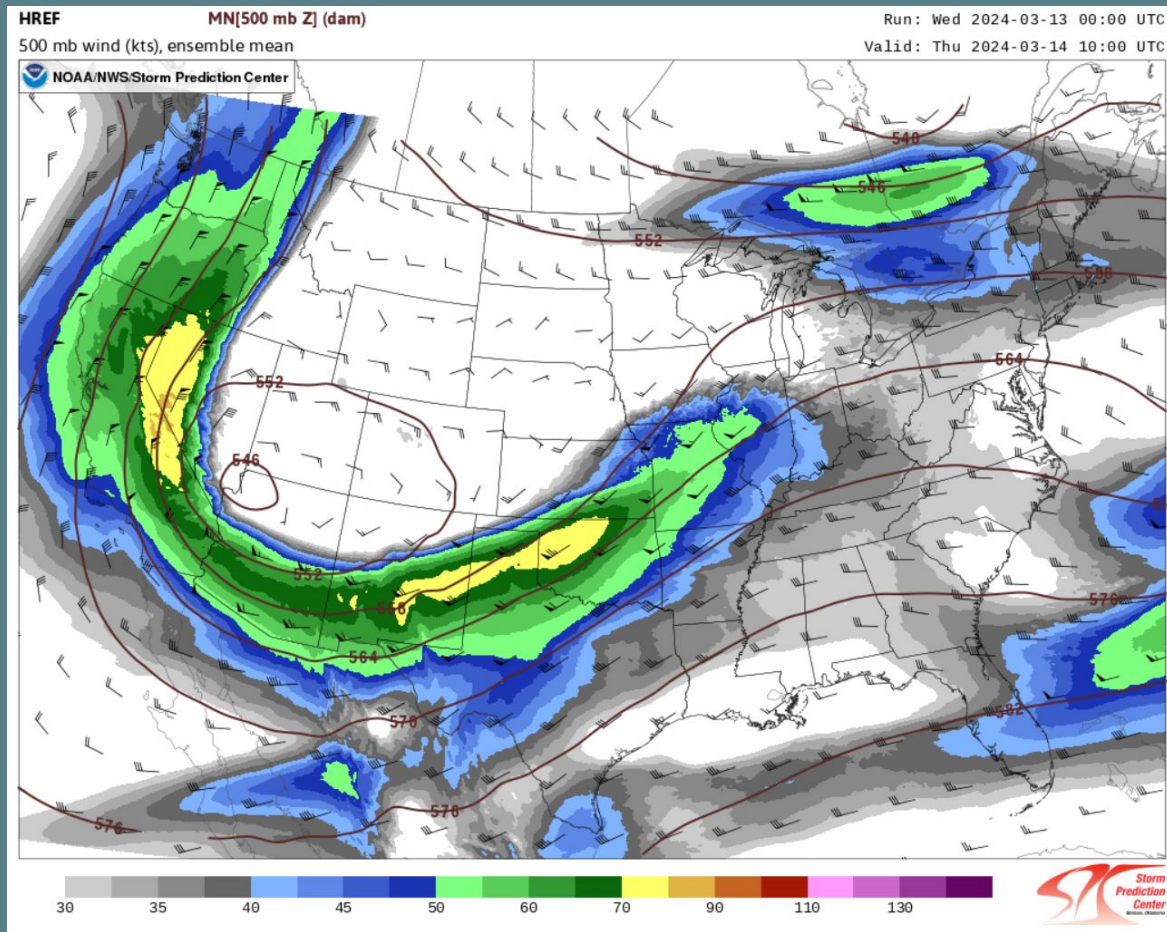
Local Topography and Downslope Winds



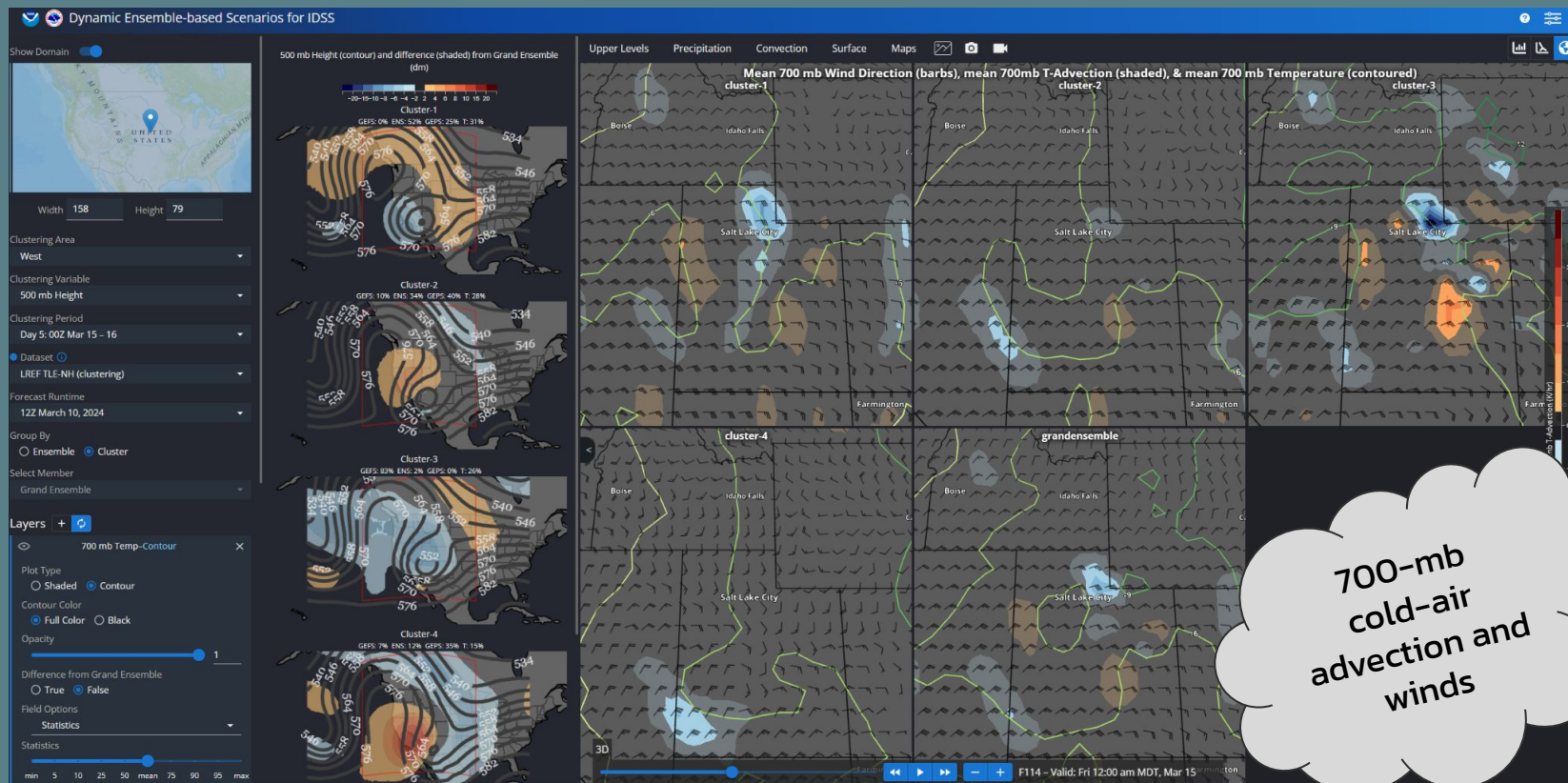
1. Days Ahead

Synoptic Pattern

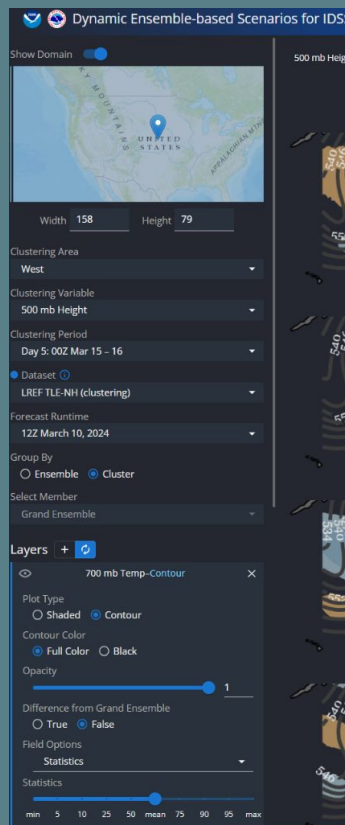
- Many of our downslope wind events typically have a closed low over southern UT and northern AZ
- We saw this days in advance and were able to start messaging the downslope wind storm potential pretty early
- Long-range models do not resolve surface gusts well! Thus, pattern recognition is key



Other Tools



Other Tools



ECM				Probability of High Wind Warning Criteria between SLC and Ogden:	
Fcst Time	Index	RKS-OGD Grad (mb)	U-Wind (m/s)	Green 0%	
2024-03-12 00:00:00	12	-3	9	Light Green less than 25%	
2024-03-12 06:00:00	5	4	9	Yellow 25-50%	
2024-03-12 12:00:00	5	3	8	Orange 50-75%	
2024-03-12 18:00:00	9	-1	8	Red 75-99%	
2024-03-13 00:00:00	8	-3	5	Magenta 100%	
2024-03-13 06:00:00	9	-4	5		
2024-03-13 12:00:00	4	-1	3		
2024-03-13 18:00:00	4	-2	2		
2024-03-14 00:00:00	8	-5	3		
2024-03-14 06:00:00	4	-1	-5		
2024-03-14 12:00:00	17	2	-15		
2024-03-14 18:00:00	29	9	-20		
2024-03-15 00:00:00	23	9	-14		
2024-03-15 06:00:00	23	10	-13		
2024-03-15 12:00:00	25	10	-15		
2024-03-15 18:00:00	21	9	-12		
2024-03-16 00:00:00					

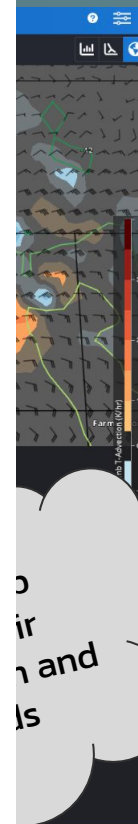
Three numbers are shown for each model and forecast lead time...

The first number in each row is the total downslope wind index, which controls the shading

The second number is the surface pressure gradient from Rock Springs to Ogden in MB

The last number is the V component of the 700MB wind at Ogden in m/s

[For more info on the methodology, click here](#)



2. The Day of the Event

Time to Write TAFs!



Logan (LGU)

- Anecdotally the most difficult to forecast for during downslope events



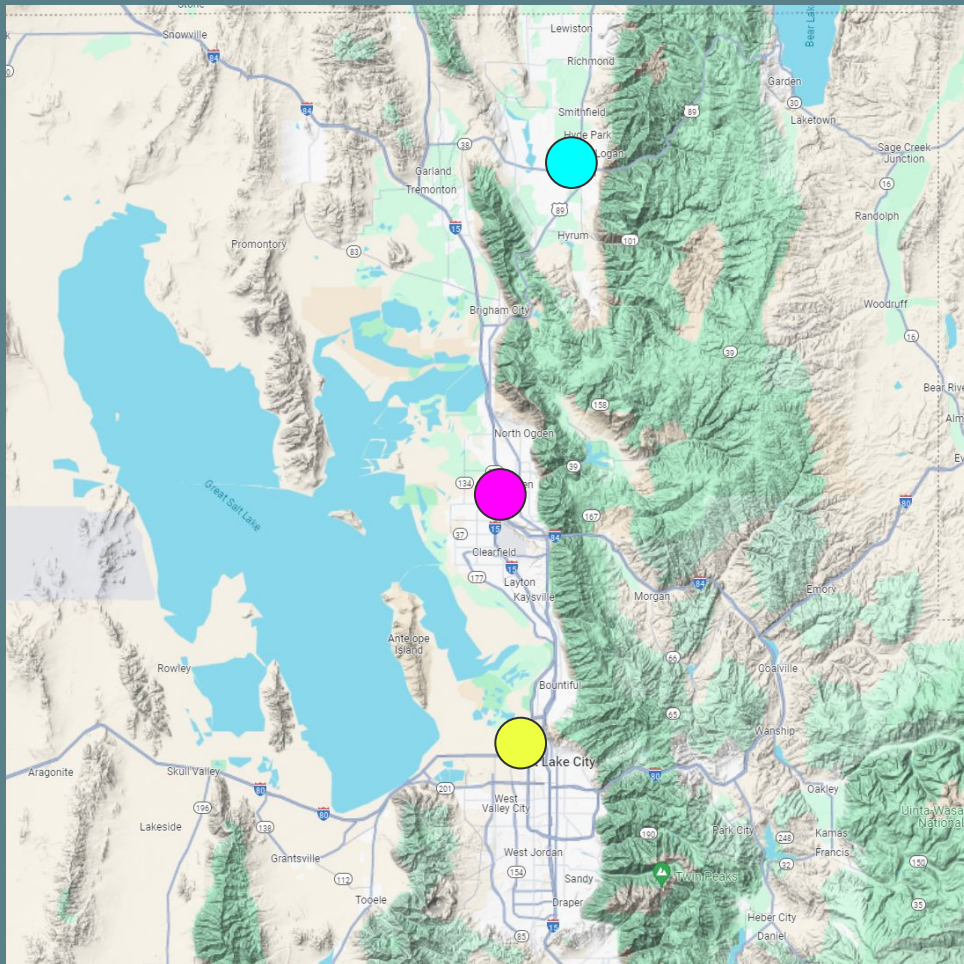
Ogden (OGD)

- The closest TAF site to the Wasatch/higher terrain
- Most persistent E winds



Salt Lake City (SLC)

- Most air traffic



18Z Package: 3/14

- Often, these TAF sites fluctuate between gusty easterly winds and light westerly winds
- Can make it a challenging forecast
- Has implications especially for busy airports such as KSLC
 - Air traffic impacts
 - Strong crosswinds that may be challenging for some aircraft
 - LLWS

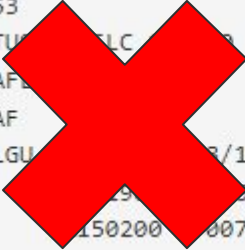
```
553
FTUS45 KSLC 141740
TAF LGU
TAF
KLGU 141740Z 1418/1518 29007KT P6SM BKN080
FM141900 08026G40KT P6SM SCT100
FM150200 27007KT P6SM FEW100 WS020/08045KT=
```

```
472
FTUS45 KSLC 141740
TAF OGD
TAF
KOGD 141740Z 1418/1518 07025G45KT P6SM SCT060 SCT100
```

```
357
FTUS45 KSLC 141740
TAF SLC
TAF
KSLC 141740Z 1418/1524 03010G19KT P6SM SCT060 SCT120
FM141815 05018G25KT P6SM SCT120 WS020/07040KT
FM141900 07025G40KT P6SM SCT120
FM150300 28006KT P6SM FEW120 WS020/08040KT
FM151700 09016G28KT P6SM FEW080 FEW150
FM152100 08010G19KT P6SM FEW080 FEW150=
```

18Z Package: 3/14

- SLC and OGD turned out fairly well
- LGU however...
 - Remained gusty out of the east overnight!
 - Models did not capture this well
- *I wished we had a local climatology of these sites during downslope winds*
 - Make up for model limitations in the Cache Valley by improving your conceptual model with the local climatology in mind
 - More on this later...



```
553  
FTW... SLC  
TAF...  
TAF...  
KLGU... 1518 29007KT P6SM BKN080  
... 0640KT P6SM SCT100  
... 150200... 007KT P6SM FEW100 WS020/08045KT=
```

```
472  
FTUS45 KSLC 141740  
TAF...  
TAF...  
KOGD 141740Z 1418/1518 07025G45KT P6SM SCT060 SCT100
```

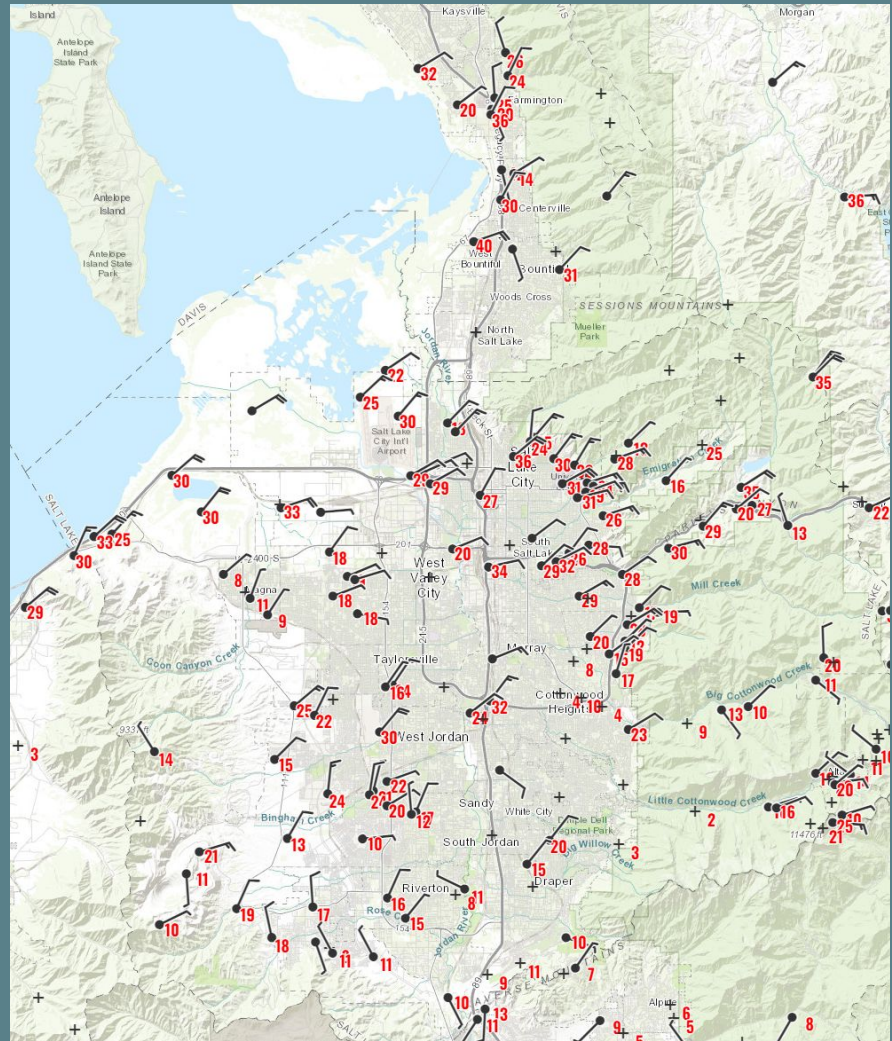
```
357  
FTUS45 KSLC 141740  
TAFSLC  
TAF...  
KSLC 141740Z 1418/1524 03010G19KT P6SM SCT060 SCT120  
FM141815 05018G25KT P6SM SCT120 WS020/07040KT  
FM141900 07025G40KT P6SM SCT120  
FM150300 28006KT P6SM FEW120 WS020/08040KT  
FM151700 09016G28KT P6SM FEW080 FEW150  
FM152100 08010G19KT P6SM FEW080 FEW150=
```

3. During the Event

Salt Lake Valley

3/14/2024 3PM

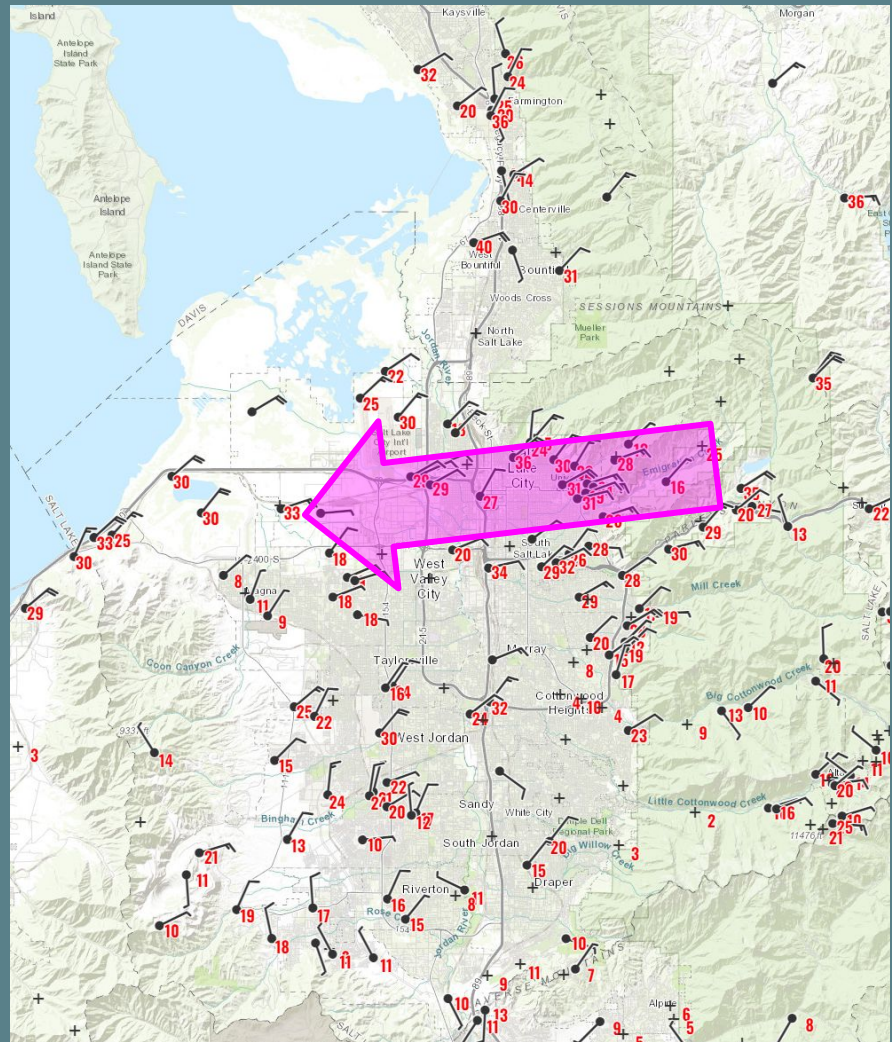
- Start of the event:
 - Persistent E winds through the northern Salt Lake Valley



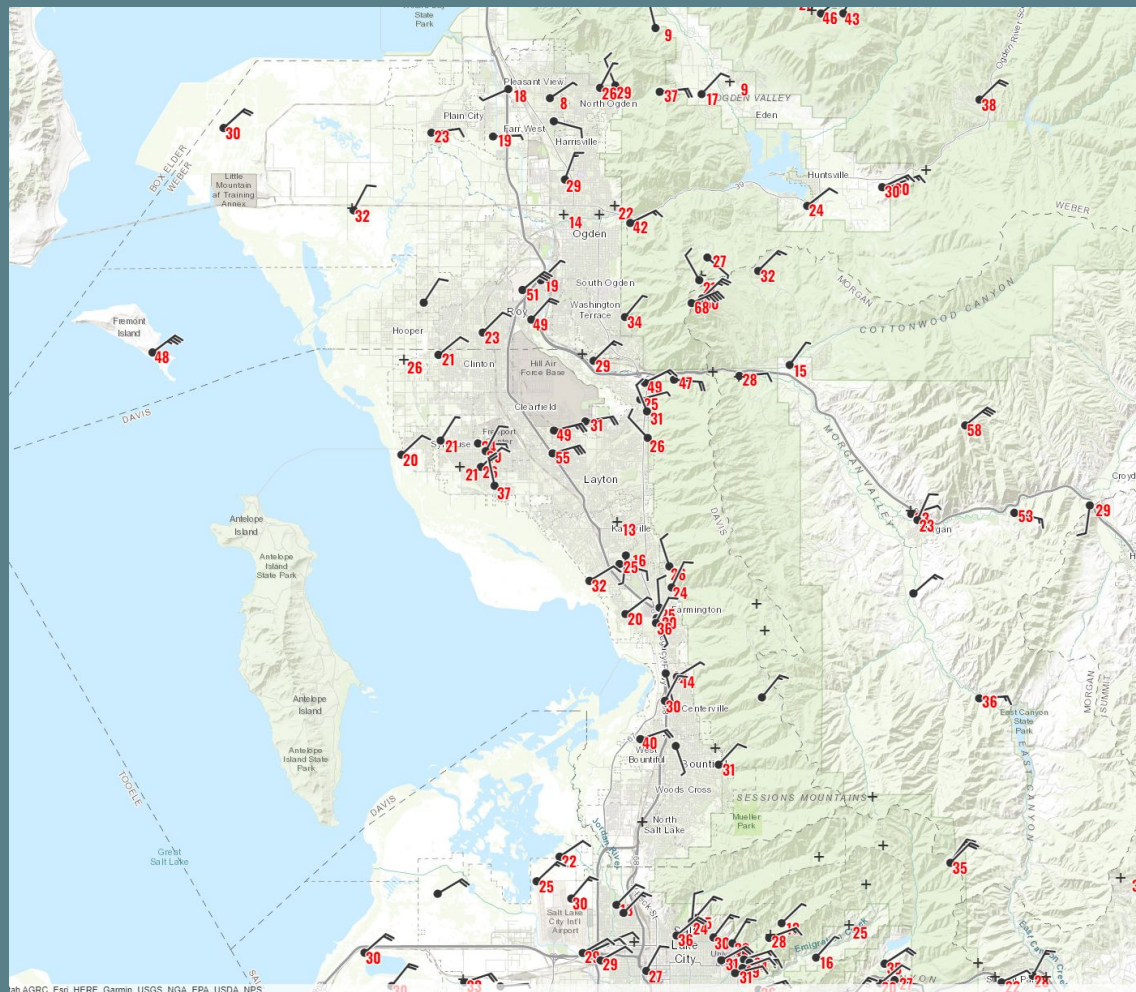
Salt Lake Valley

3/14/2024 3PM

- Start of the event:
 - Persistent **E winds** through the northern Salt Lake Valley



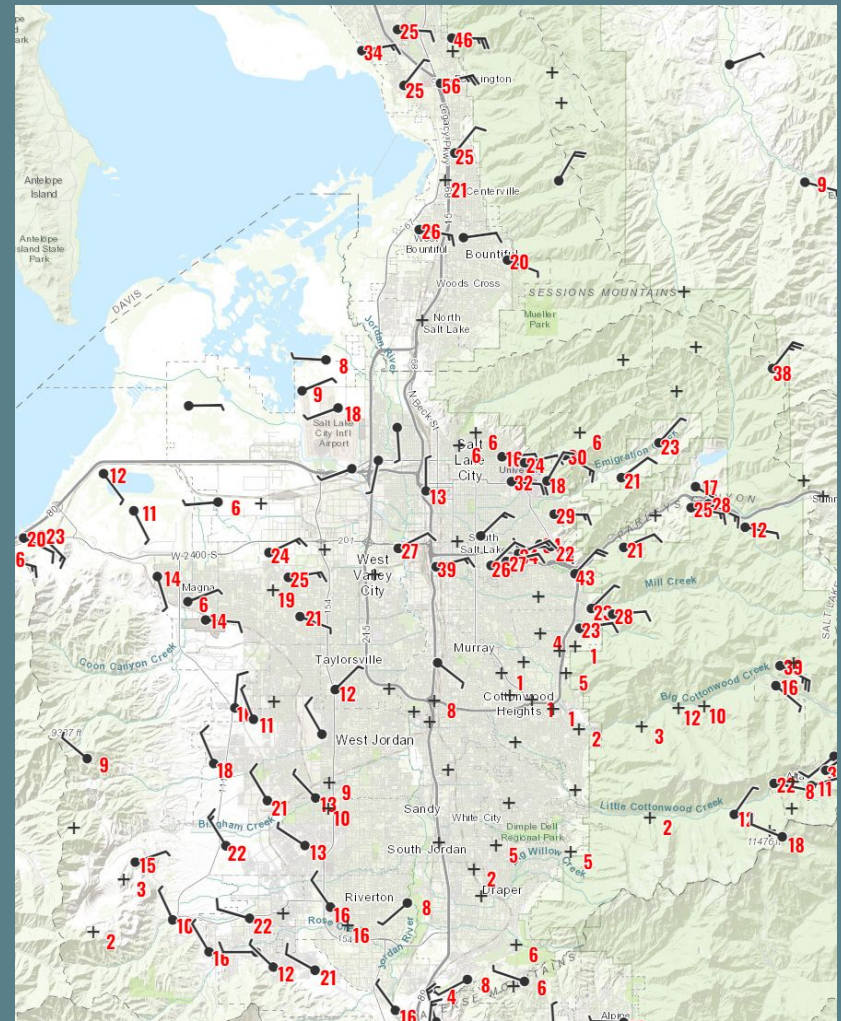
3/14/2024 3PM



Salt Lake Valley

3/15/2024 9AM

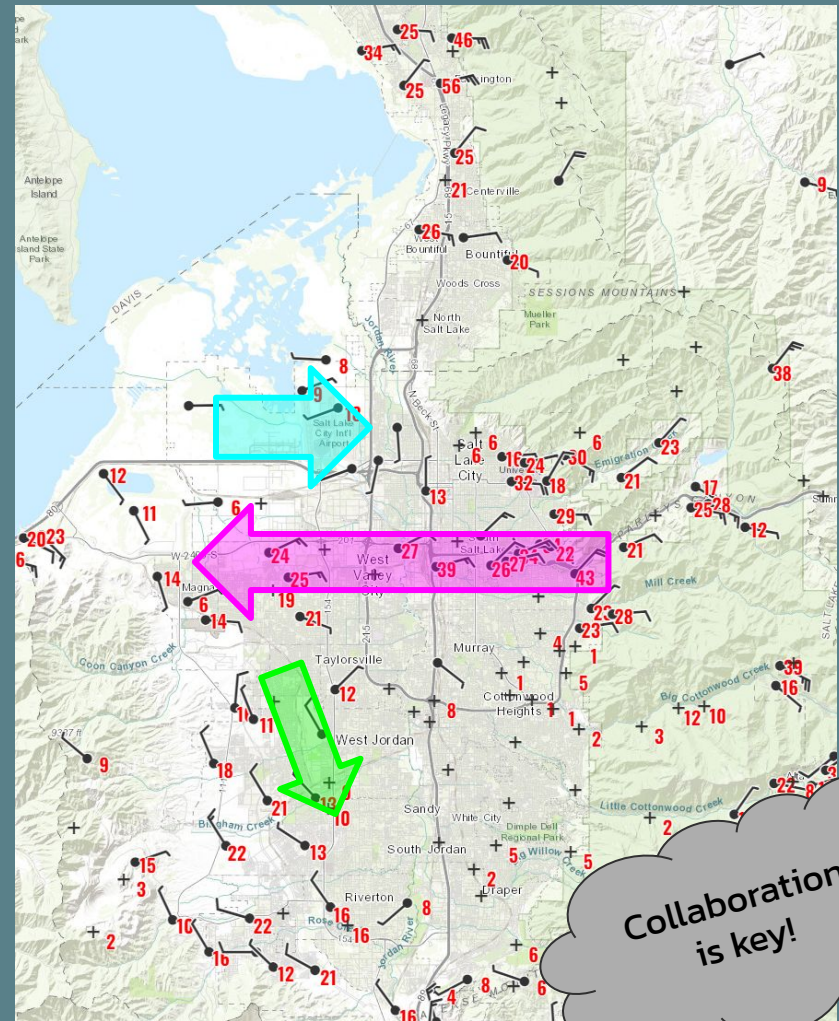
- E winds enhanced by Parley's Canyon
- Light W winds at KSLC
 - Led to some confusion from the Tower about why the winds transitioned and when/if E gusts would return
- N winds at KU42



Salt Lake Valley

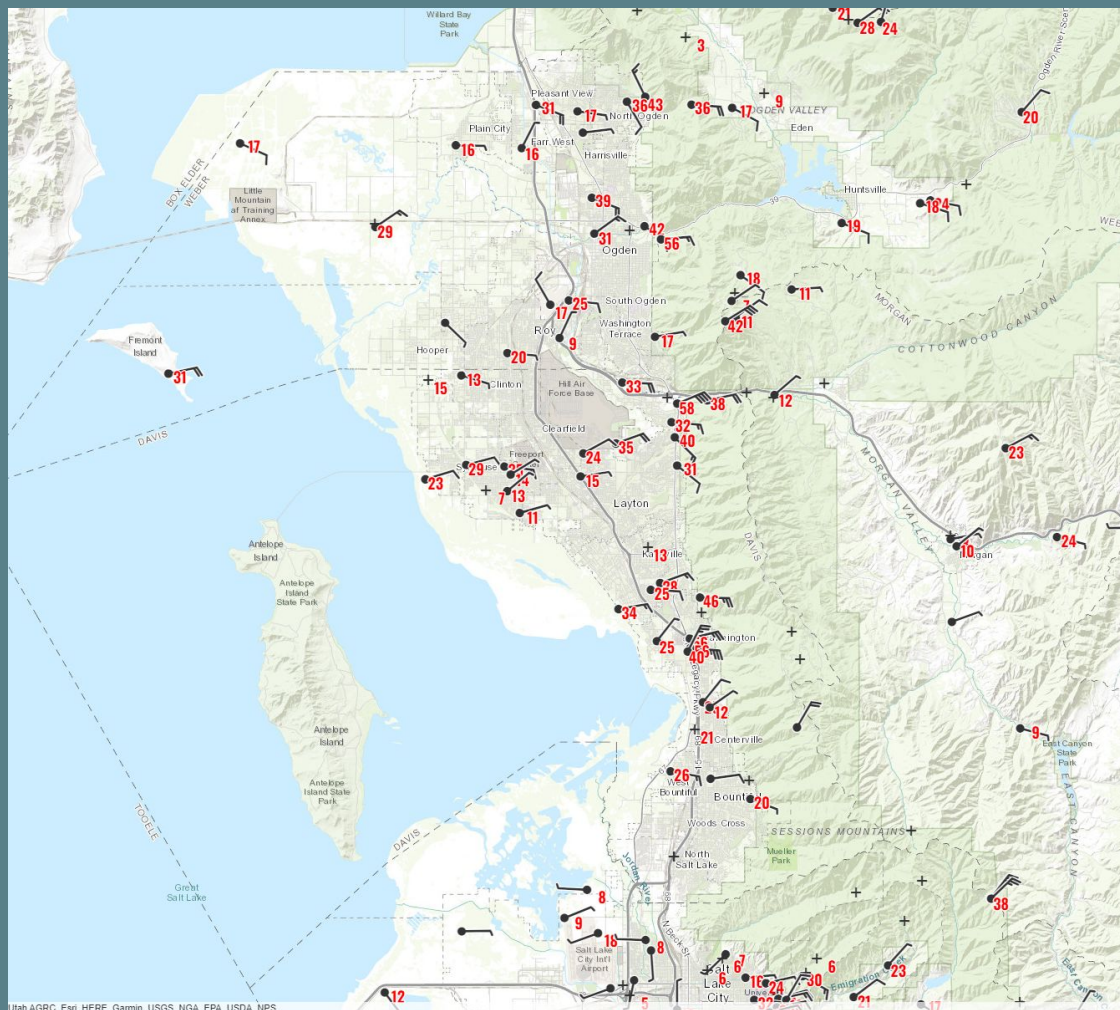
3/15/2024 9AM

- **E winds** enhanced by Parley's Canyon
- Light **W winds** at KSLC
 - Led to some confusion from the Tower about why the winds transitioned and when/if E gusts would return
- **N winds** at KU42



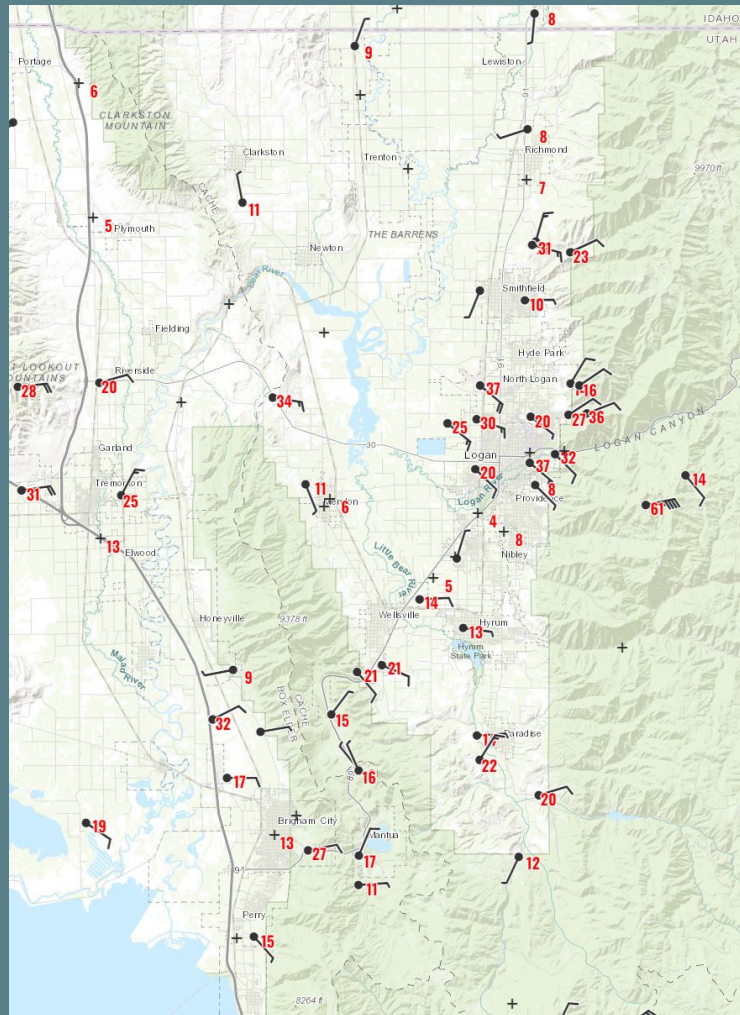
Northern Wasatch Front

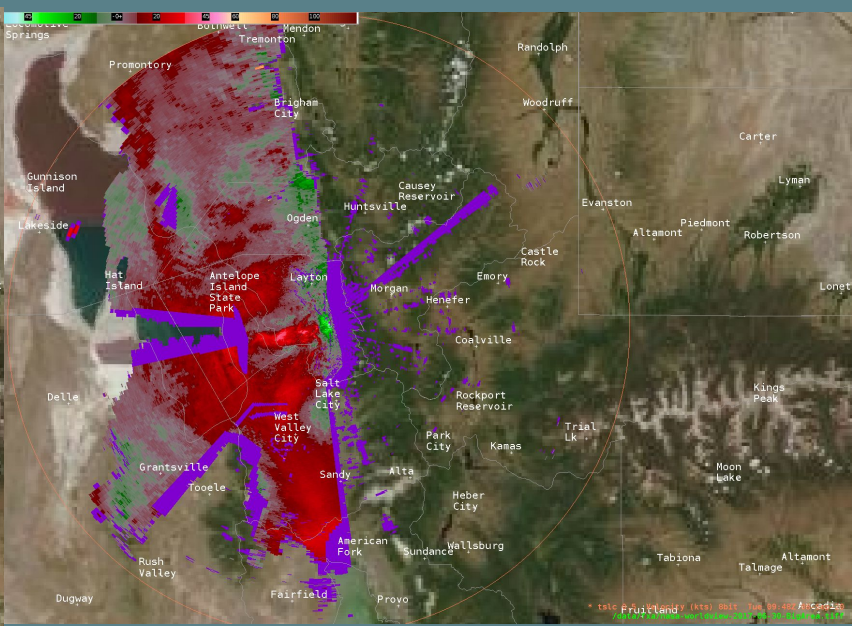
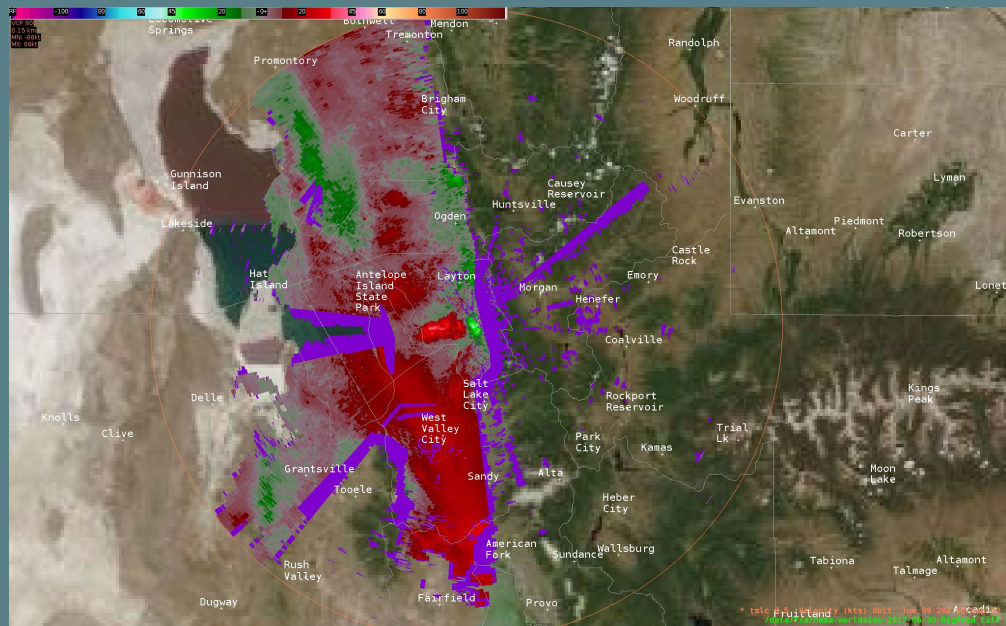
3/15/2024 9AM

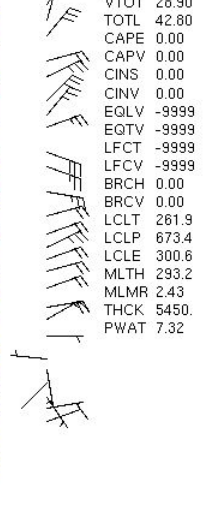
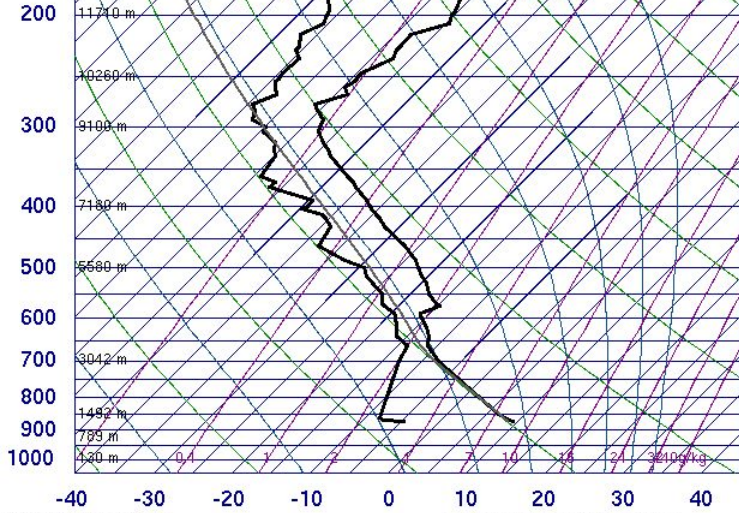
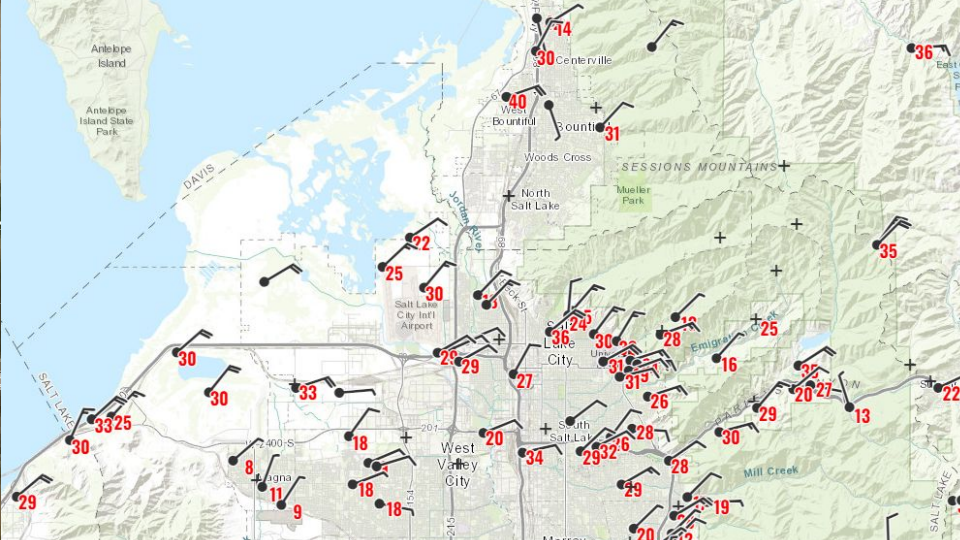
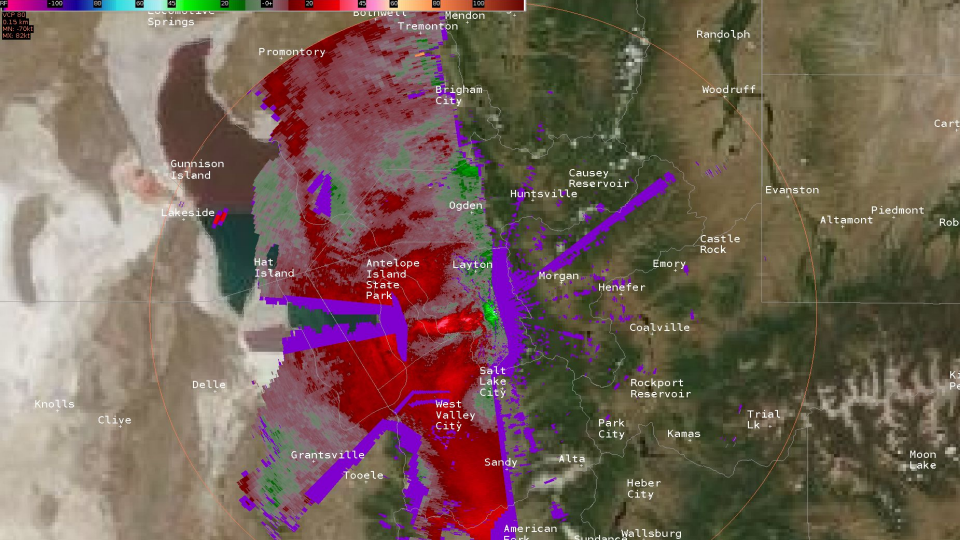


Cache Valley

3/15/2024 9AM







Using all of our available observations to monitor and anticipate changes:

- + TDWR
- + Upper-air soundings
- + MDCRS soundings
- + Surface observations
- + Satellite
- + PIREPs

4. Post-Event Thoughts

Peak Gusts

2024:

...Wasatch Back...				
I-84 at MP 108 Taggarts	61 MPH	0250 PM 03/14	41.05N/111.60W/5187	
...Southwest Wyoming...				
First Divide	55 MPH	1026 AM 03/14	41.28N/110.80W/7466	
Painter	53 MPH	1236 PM 03/14	41.27N/110.87W/6961	
Evanston-Uinta Cnty Airport	53 MPH	0312 PM 03/16	41.27N/111.03W/6956	
...Southern Mountains...				
Badger Spring	57 MPH	0752 AM 03/15	37.15N/113.95W/3990	
...Northern Wasatch Front...				
US-89 at Park Lane	72 MPH	0755 AM 03/16	40.99N/111.90W/4288	
Kaysville	66 MPH	0940 PM 03/14	41.02N/111.93W/4406	
Us-89 At Mp 406 Weber River	65 MPH	1210 PM 03/14	41.14N/111.91W/4540	
1 NMW Centerville	64 MPH	0110 AM 03/15	40.93N/111.88W	
1.1 W Farmington	62 MPH	0757 AM 03/16	40.98N/111.90W/4258	
Farmington	61 MPH	0856 AM 03/16	40.98N/111.90W/4232	
Layton	60 MPH	1115 AM 03/14	41.11N/111.91W/4864	
Ogden-Hinckley Airport	60 MPH	0221 PM 03/14	41.20N/112.02W/4437	
Fremont Island - Miller Hill	58 MPH	0220 PM 03/14	41.15N/112.33W/4700	
I-15 At Mp 333 Antelope Driv	58 MPH	0240 PM 03/14	41.09N/111.99W/4501	
Centerville	58 MPH	1100 PM 03/14	40.95N/111.89W/4230	
I-15 Farr West	58 MPH	1210 AM 03/15	41.32N/112.03W/4257	
Harrisville	58 MPH	1056 AM 03/16	41.26N/111.98W/4311	
Centerville	56 MPH	1006 PM 03/14	40.93N/111.90W/4215	
Us-89 At East Layton Bench	55 MPH	1140 PM 03/14	41.10N/111.91W/4914	
Legacy Parkway	54 MPH	0140 PM 03/14	40.91N/111.92W/4214	
Ogden	54 MPH	1226 AM 03/15	41.24N/111.98W/4284	
1.2 W Uintah	54 MPH	0822 AM 03/15	41.15N/111.96W/4469	
Hill Air Force Base	52 MPH	1208 AM 03/15	41.12N/111.97W/4794	
Bountiful Bench	52 MPH	0715 AM 03/16	40.89N/111.85W/4950	
North Ogden Bench	50 MPH	0500 AM 03/15	41.32N/111.94W/5120	

Logan: 47 mph
SLC: 35 mph

Sep 2020:

***** Wind Reports *****	Time	Windspeed
...Cache Valley/Utah Portion...		
Logan - Cache Airport - 4446 ft	3 AM Tue	68 MPH
Logan Campbell Hq - 4455 ft	4 AM Tue	55 MPH
North Logan - 4875 ft	3 AM Tue	51 MPH
...Northern Wasatch Front...		
US-89 at Park Lane - 4288 ft	9 AM Tue	99 MPH
Hill Air Force Base - 4787 ft	6 AM Tue	84 MPH
I-15 at Willard Poe - 4220 ft	5 AM Tue	75 MPH
Centerville - 4220 ft	5 AM Tue	75 MPH
Brigham City Airport - 4301 ft	4 AM Tue	75 MPH
Riverdale Rd at I-84 - 4415 ft	7 AM Tue	67 MPH
Ogden - Hinckley Airport - 4440 ft	6 AM Tue	64 MPH
Fremont Island - Miller Hill - 4700 ft	8 AM Tue	61 MPH
Legacy Parkway - 4215 ft	5 AM Tue	61 MPH
I-15 at Tremonton - 4295 ft	4 AM Tue	61 MPH
North Ogden Bench - 5120 ft	7 AM Tue	52 MPH
Roy	7 AM Tue	50 MPH
Great Salt Lake Minerals - 4212 ft	10 PM Mon	50 MPH
I-15 at Plymouth - 4495 ft	10 PM Mon	46 MPH
Beus Canyon - 5100 ft	8 AM Tue	45 MPH
...Salt Lake and Tooele Valleys...		
University of Utah - 4806 ft	6 AM Tue	89 MPH
Salt Lake Intl Airport - 4226 ft	10 AM Tue	69 MPH
SLC Airport Centerfield - 4227 ft	2 PM Tue	67 MPH
I-215 at Olympus Cove - 4972 ft	11 AM Tue	67 MPH
Baccus Highway - 5172 ft	10 AM Tue	67 MPH
I-15 at 500 S - 4400 ft	9 AM Tue	63 MPH
Lake Point I-80 - 4301 ft	1 PM Tue	62 MPH
Mouth Parleys - 4915 ft	2 PM Tue	59 MPH
Mountain View at Dannon Way - 4910 ft	8 AM Tue	59 MPH
I-15 at I-215 - 4407 ft	3 PM Tue	58 MPH
Flight Park South - 5202 ft	11 PM Mon	58 MPH
North Holladay - 4600 ft	7 AM Tue	57 MPH
Point Of The Mountain - 4750 ft	5 PM Tue	56 MPH
Salt Lake Muni 2 Airport - 4603 ft	12 PM Tue	55 MPH
Trans-jordan Landfill - 5201 ft	1 PM Tue	53 MPH
Vernon - 5639 ft	12 PM Tue	53 MPH
Burmester - 4219 ft	10 AM Tue	53 MPH
Tooele 2 - 4318 ft	11 AM Tue	52 MPH
I-80 at Mp 78 - 4213 ft	8 AM Tue	48 MPH
Flux - 4219 ft	2 AM Tue	45 MPH
Nws SLC Office - 4220 ft	9 AM Tue	44 MPH

In Review

Successes:

- Pattern recognition using tools other than model surface gusts to get more lead time
- Using the AFD to describe uncertainty
- Utilizing all of our available observations

Opportunities for improvement:

- Discussed with CWSU that we could meet with the Tower/TRACON/local airports to discuss downslope winds in our annual meetings
 - Better than trying to explain how downslope winds work during the event
 - Can also explain that these will be a low confidence forecast
- Developing local TAF site climatologies for these events...

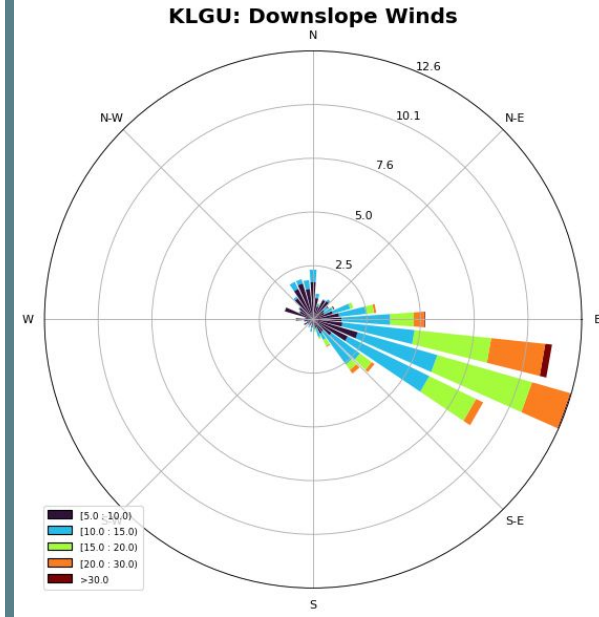
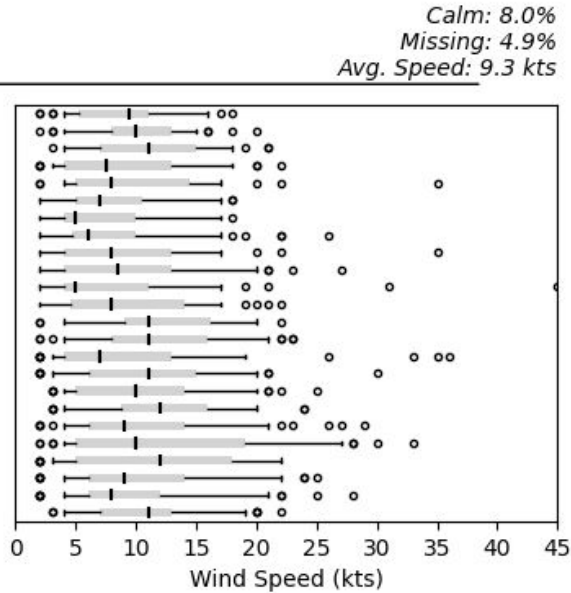
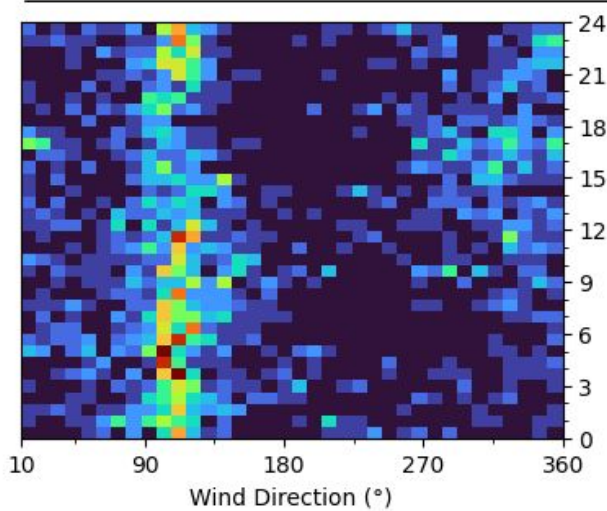


Credit: AP Photo/Rick Bowmer

Sep 2020

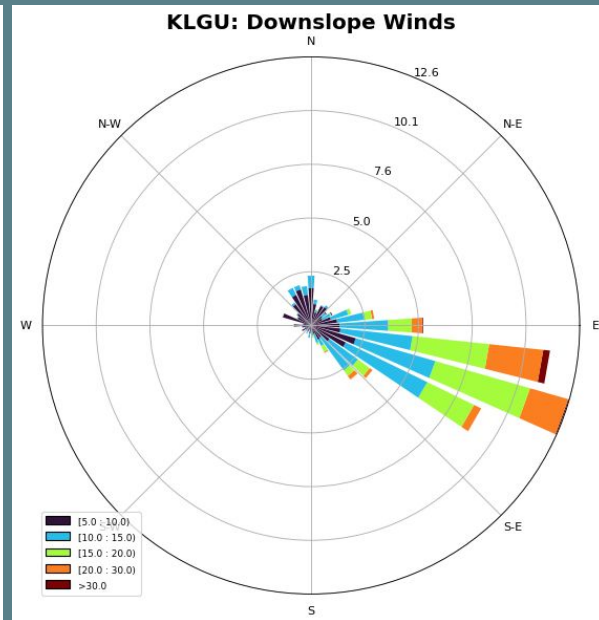
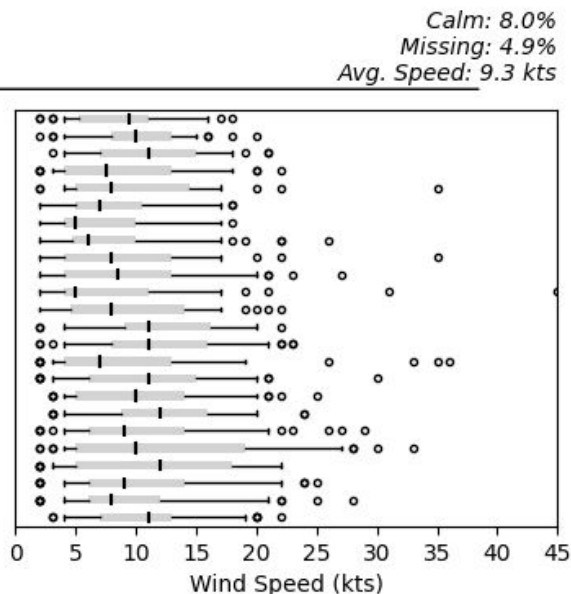
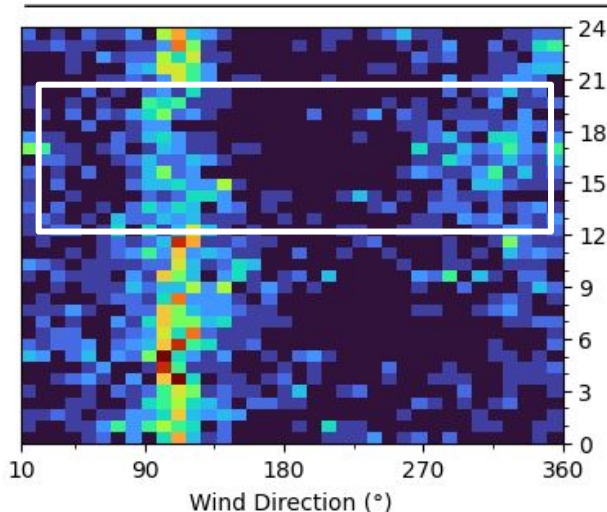
Reference of Local TAF Sites During Downslope Events

KLGU: Downslope Events



Reference of Local TAF Sites During Downslope Events

KLGU: Downslope Events



Key Takeaways

Be proactive in reaching out to your partners!

Encourage the development of local TAF climatologies for events like these (or other infrequent events)

Questions?

Contact:

julie.a.cunningham@noaa.gov
nws.saltlakecity@noaa.gov



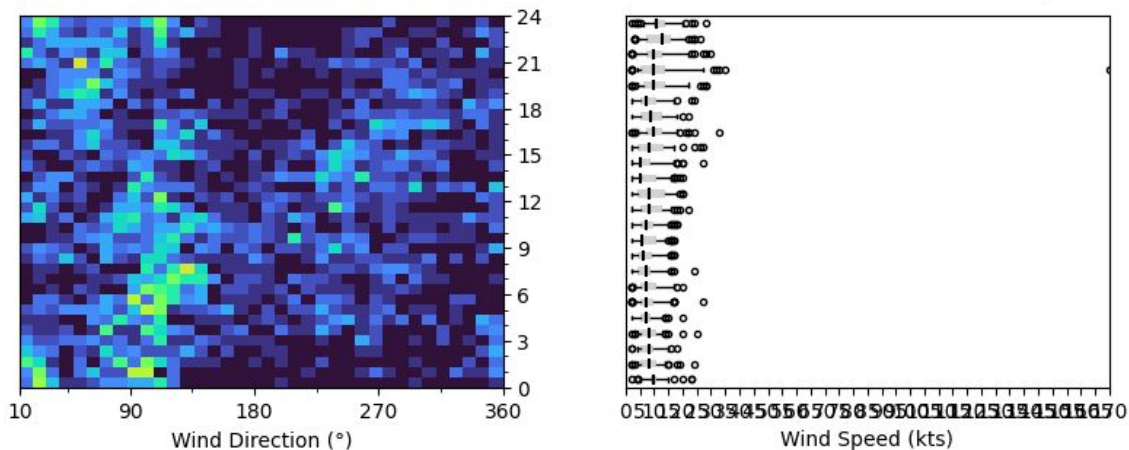
PIREPs

SLC UUA /OV BTF/TM 1642/FLO66/TP P28A/TB MOD-**SEVERE**/RM NORTHBOUND I-15/SHORELINE
SLC UA /OV 5 MILES NORTH OF/TM 1655/FLO90/TP B190/TB MODERATE TO **SEVERE** TURBULENCE AT BUBBY
SLC UUA /OV OGD270015/TM 1740/FL120/TP DH8A/TB **SEV** 120-140
SLC UA /OV TCH357014/TM 2015/FL350/TP B752/TB MOD/RM MOD MTN WAVE -20KTS /ZLC
SLC UUA /OV 10 NE SLC/TM 2149/FLO80/TP C210/TB **SEVER** TURB/RM OVER I15 FREEWAY
SLC UA /OV KSLC010012/TM 0516/FL145/TP A21N/WV 13017KT/TB MOD 130-150/IC NEG/RM DURC RUGGD3
SLC UA /OV TCH 350005/TM 1245/FLO80/TP B763/TB MOD CHOP/RM DURD
LGU UA /OV LHO140030/TM 1356/FL250/TP A321/TB LGT-MOD CHOP 250/ZLC
SLC UA /OV TCH160006/TM 1431/FLO60/TP E75L/WV 09030/RM DURGD WIND **09030 TO 300FT AGL THEN CALM 100FT AGL**
SLC UA /OV TCH 165 007/TM 1733/FLO53/TP B38M/WV 060/27/RM RWY 34R CROSS WIND CHANDES TO A HEADWIND @300 FEET AGL.
SLC UA /OV SLC/TM 1436/FLO65/TP C172/WV 090040/TB MOD/RM STRONG CROSSWINDS OUT OF THE CANYONS
SLC UUA /OV TCH005010/TM 1515/FLO70/TP EA50/TB **SEV**/RM OVR I15 FREEWAY NB
SLC UUA /OV TCH010009/TM 1550/FLO65/TP C152/TB **SEV**
SLC UUA /OV VPLGN/TM 1632/FLO60/TP DA40/TB **SEV** 060VP
OGD UA /OV OGD/TM 2021/FL380/TP B737/TB MOD /ZLC
OGD UA /OV OGD/TM 0240/FL380/TP B737/TB CONS MOD 380 /ZLC
SLC UUA /OV TCH020010/TM 0330/FL 065/TP DA42/TB **SEV**
SLC UUA /OV 18 N SLC/TM 0647/FLO65/TP A320/TB SEV TURB/RM DURD +-20KTS
SLC UUA /OV TCH030001/TM 0917/FLO60/TP BE9L/TB **SEV** 065-055/RM DURD ON FINAL RWY 17
SLC UA /OV TCH 238 001/TM 1149/FLO48/TP B763/WV 25KT CROSSWIND AT 500 FT AGL 10KT CROSSWIND 300 FT AGL/RM ON APPROACH TO RWY 16R
SLC UUA /OV TCH012010/TM 1415/FLO65/TP C172/TB MOD-**SEV**/RM IN I-15 VFR CORRIDOR NEAR LAGOON AMUSEMNT PARK
SLC UA /OV TCH347023/TM 1425/FL110/TP CRJ7/WV +/- 30KTS/TB LGT TO MOD T/RM DURD
SLC UUA /OV TCH350008/TM 1535/FLO80/TP B737/TB MODERATE TO SEVERE /RM ALTITUDE 105 TO 075
SLC UA /OV IVOCY/TM 1540/FLO90/TP B739/TB MOD-**SEV**/RM ILS RWY 17
SLC UA /OV TCH030010/TM 1630/FL175/TP B739/SK **LINTICULAR CLOUDS 165-185**/TB LT-MOD /RM DUR C

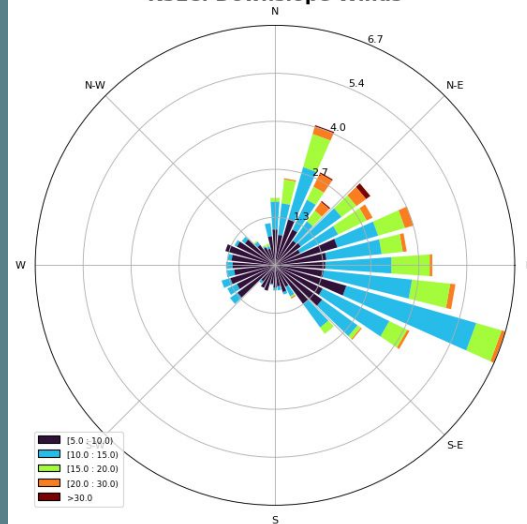
Local TAF Sites During Downslope Events

KSLC: Downslope Events

Calm: 8.1%
Missing: 2.1%
Avg. Speed: 8.2 kts

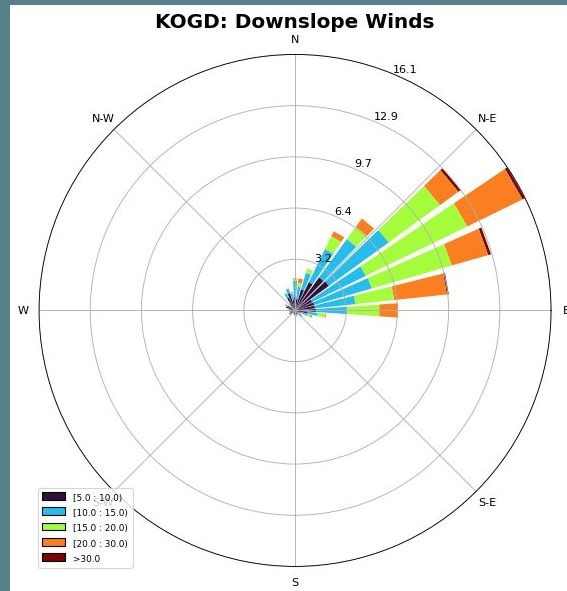
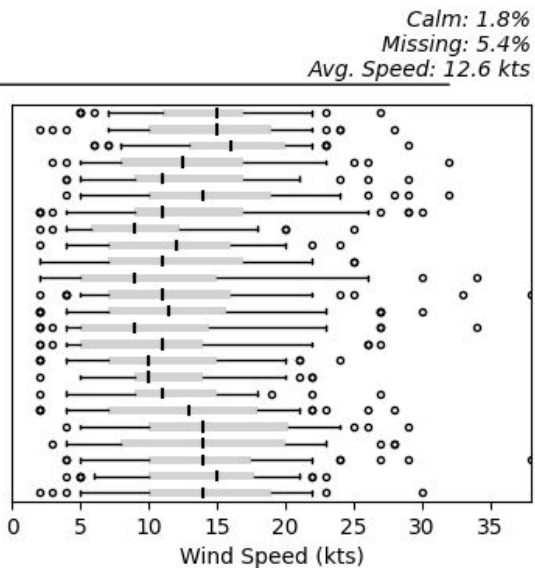
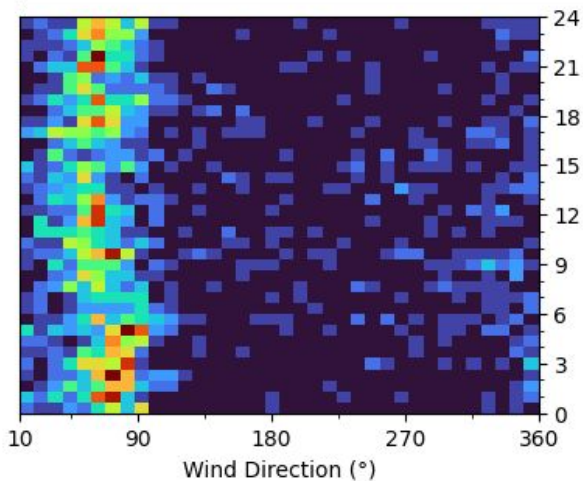


KSLC: Downslope Winds



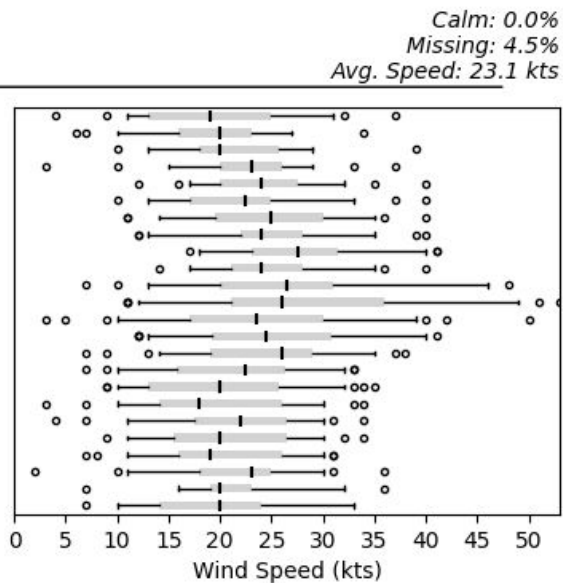
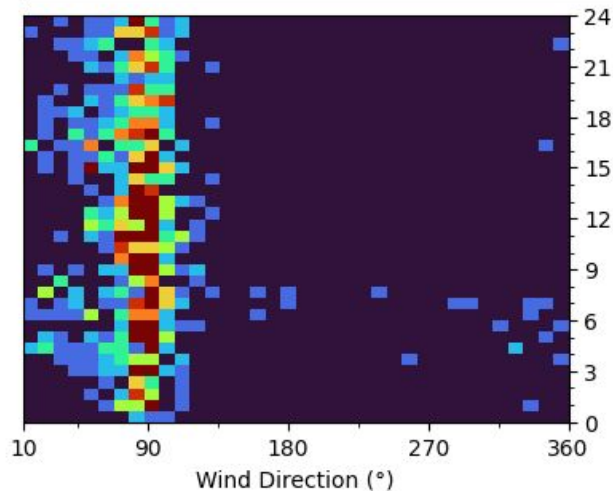
Local TAF Sites During Downslope Events

KOGD: Downslope Events



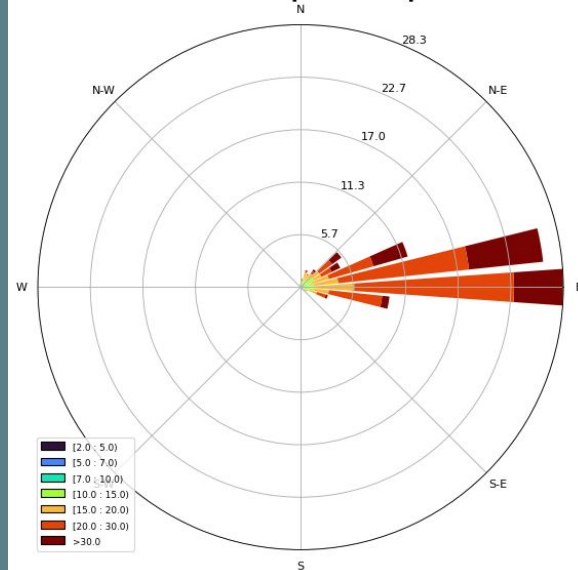
Local TAF Sites During Downslope Events

KHIF: Downslope Events

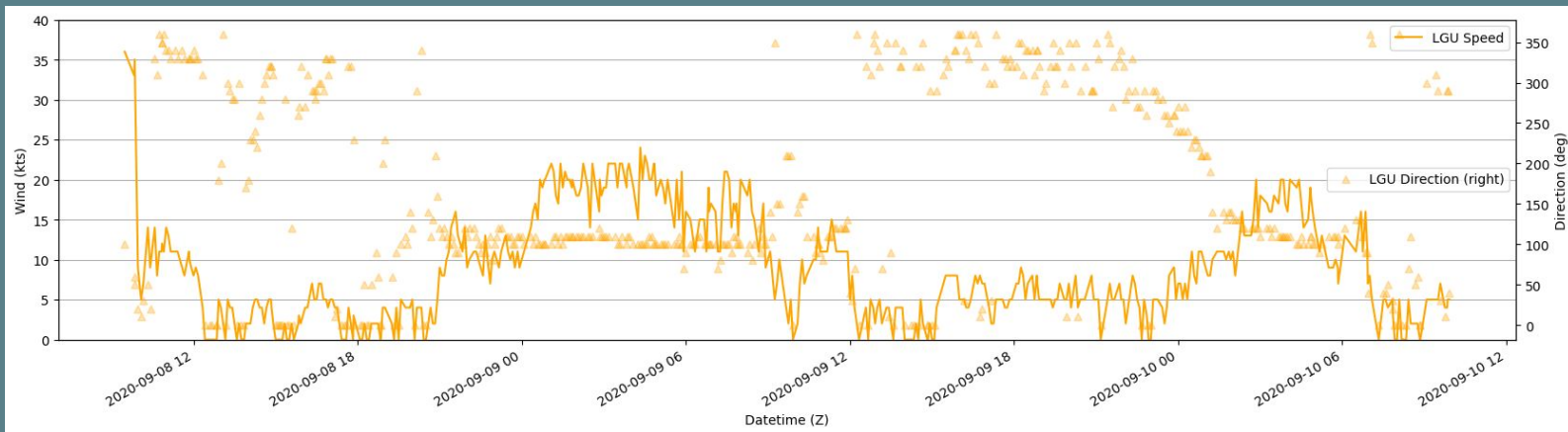
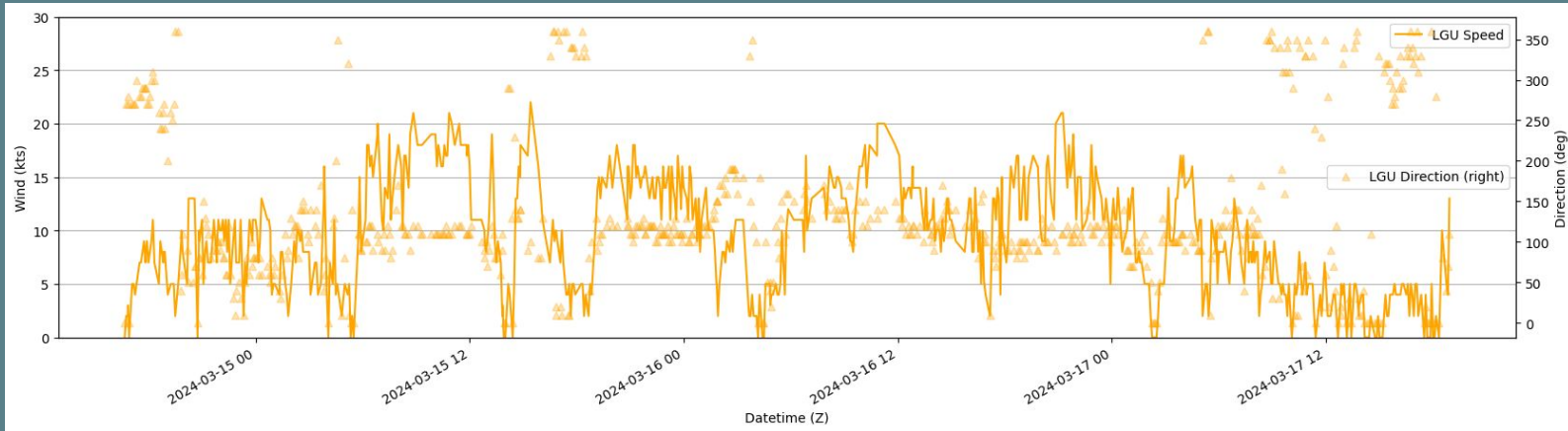


Calm: 0.0%
Missing: 4.5%
Avg. Speed: 23.1 kts

KHIF: Downslope Wind Speeds



LGU



SLC

