University of Utah
UBOS Status Report
May 1, 2013

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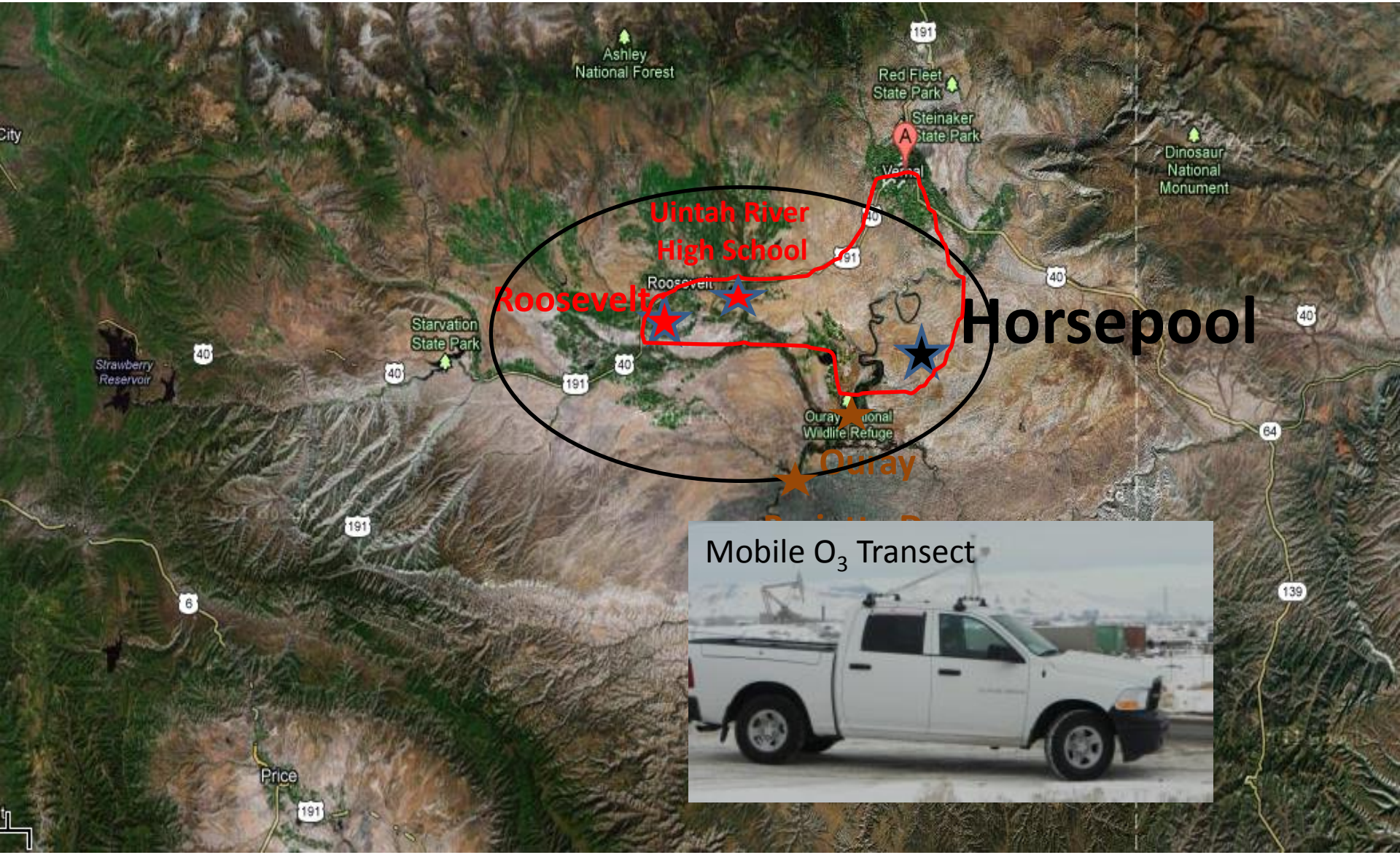
http://home.chpc.utah.edu/~u0198116/uintahbasin.html

Observation Locations in the Basin during 2013



Roosevelt: The “Center of Our Universe”

Sleeping trailer

UU trailer met instrumentation

Sonde launches near UU trailer

Burgers and wireless at Cody’s Café

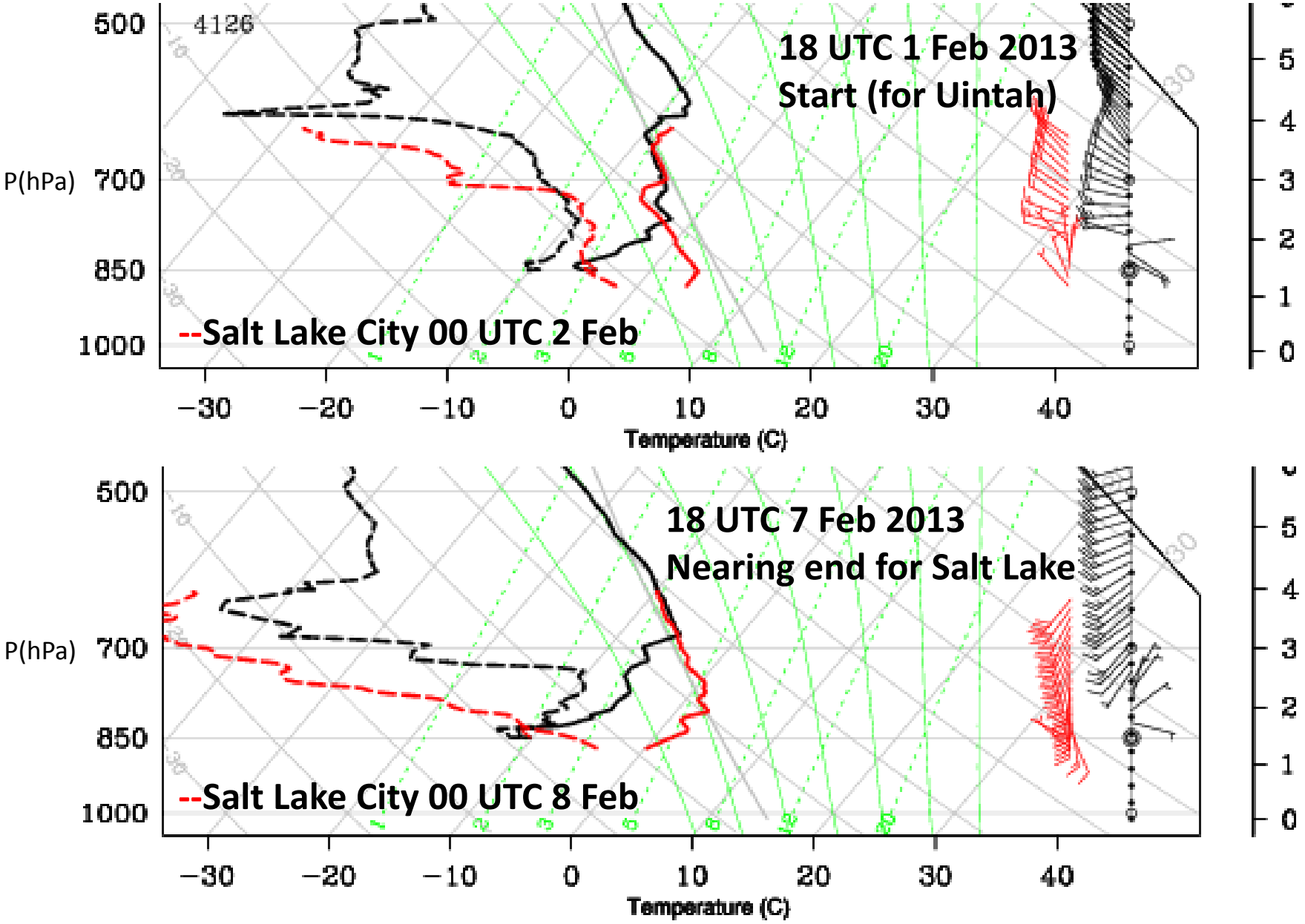
U/Utah Data and Graphical Assets Available

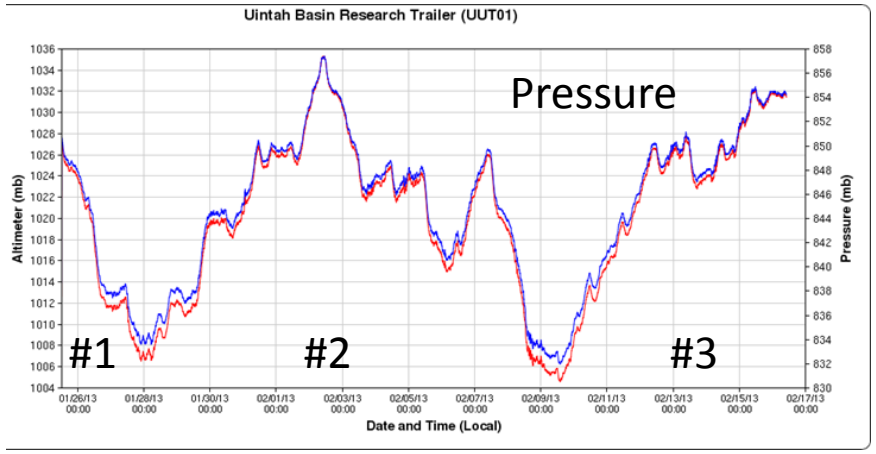
- Primary sensors deployed: January 19-Feb 16
- Core Intensive Observations: 1-8 February
- Mid-day Soundings: T, RH, wind
- Roosevelt 20 ft Tower: 3-D wind; temp; RH; pressure; solar radiation; 5 min averages
- Transects: Ozone, p, (T, RH available but value?); 10 sec resolution
- Roosevelt CL-31 ceilometer: 1 min aerosol backscatter; 10 m resolution
- Uintah River High School CT-12K ceilometer: 1 min aerosol backscatter; 15 m resolution; much lower quality than Roosevelt CL-31
- Hourly estimates of aerosol layer depth and relative aerosol intensity
- Surface observations from many stations available via MesoWest
- MODIS/Landsat imagery of clouds & snow cover
- UU2DVAR 2.5 km resolution gridded surface analyses (T, RH, Wind)
- Model simulations in progress by Erik Neemann M.S. thesis
- **Available at: http://home.chpc.utah.edu/~u0198116/uintahbasin.html**

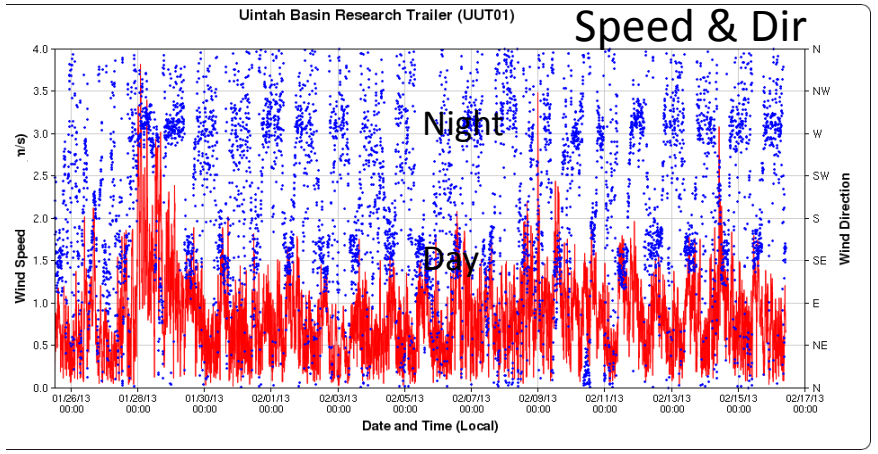
Observations, Modeling, and Analysis of Cold-Air Pools in Uintah Basin

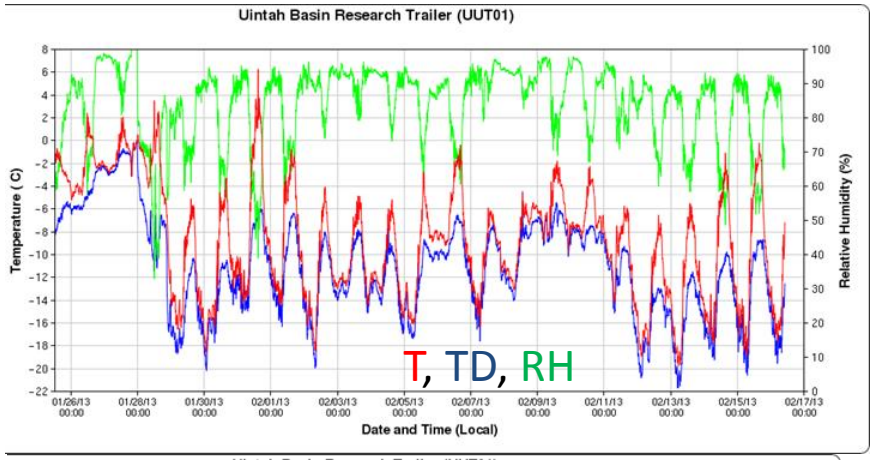
- **Duration and vertical structure**
- **Boundary-layer clouds**
- **Boundary-layer flows**
- **Terrain-flow interactions**
- **Evolution of aerosol layers**

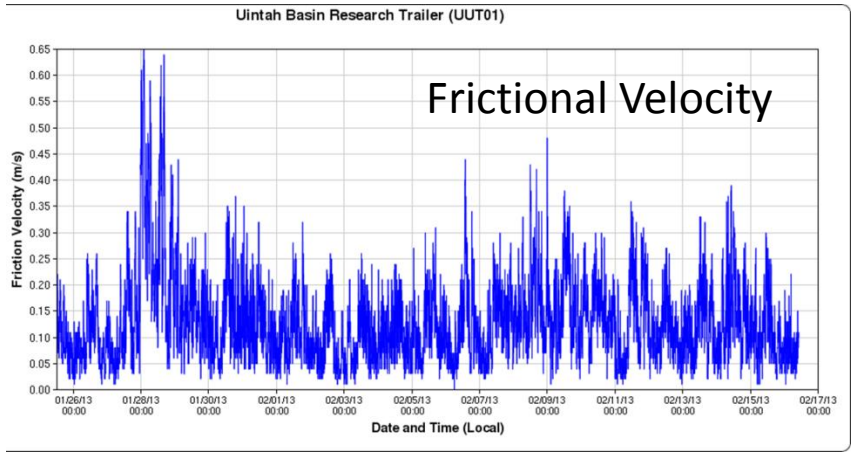
Long-lived and intense cold air pools

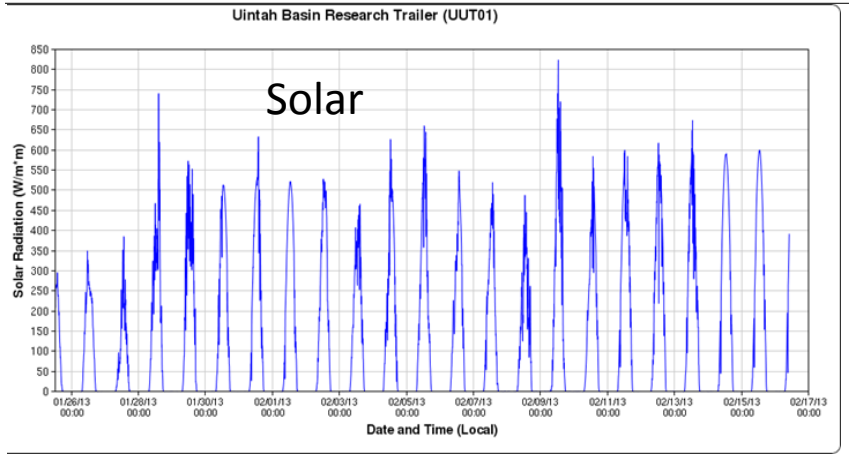








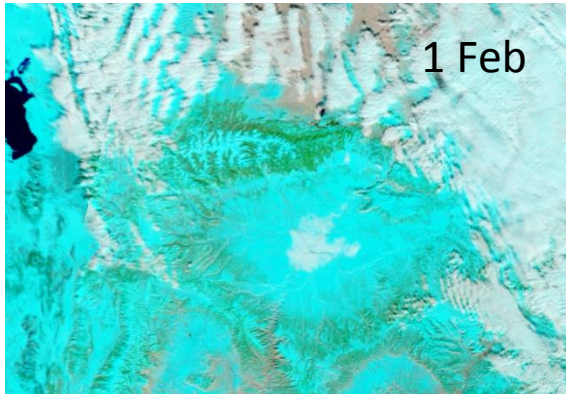


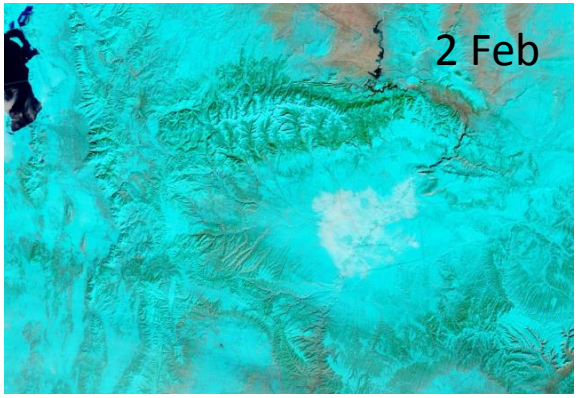


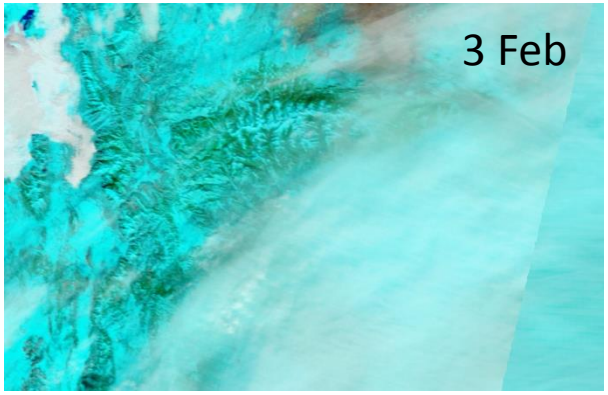
Weather at Roosevelt UU trailer:

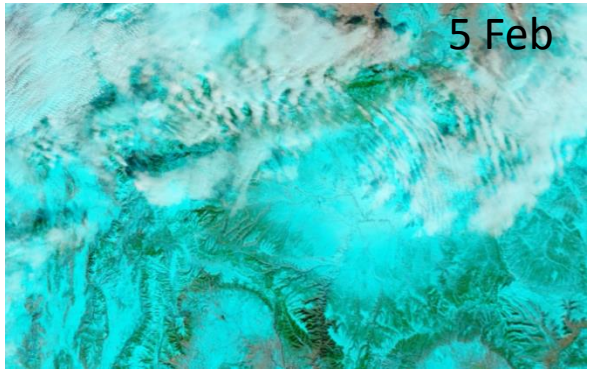
26 Jan – 16 Feb

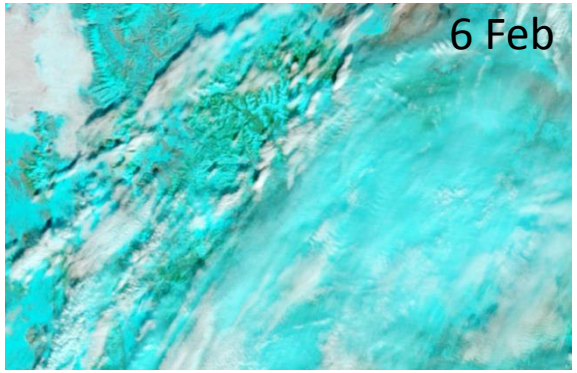
Low Clouds

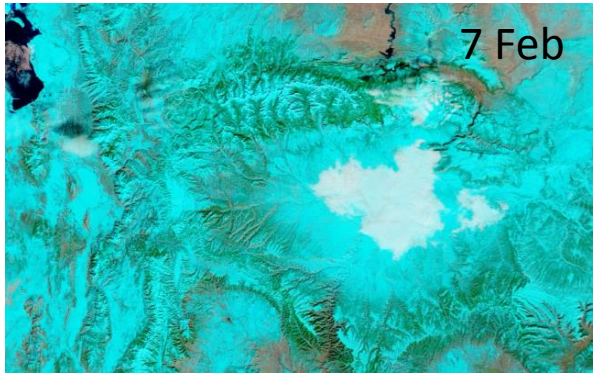








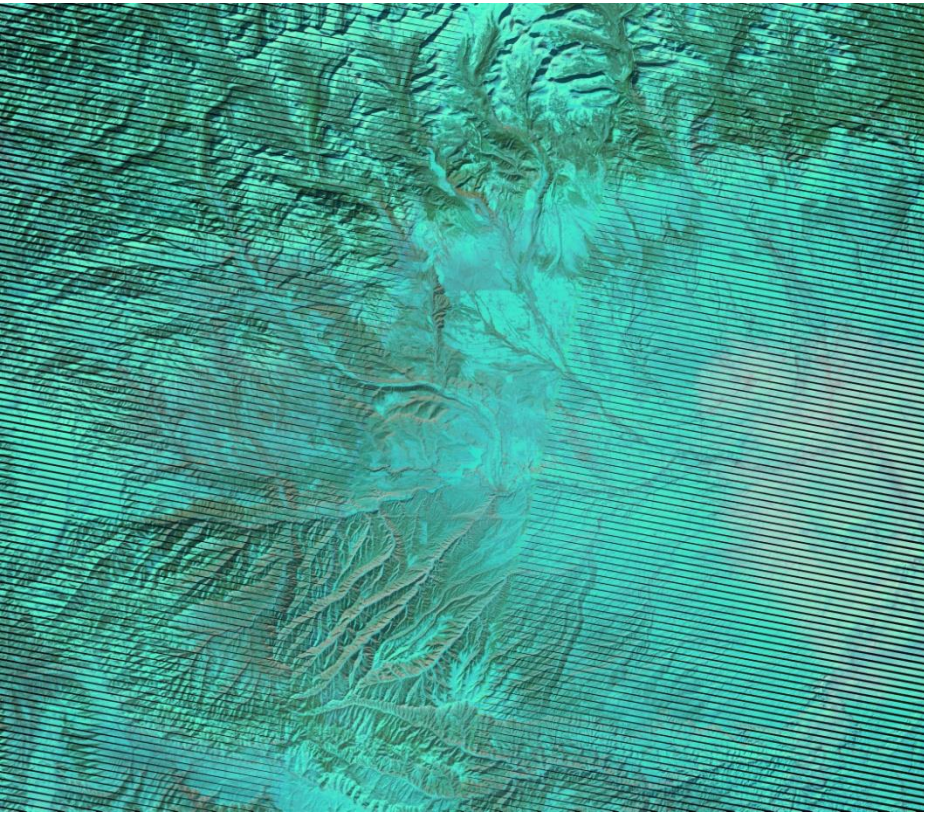




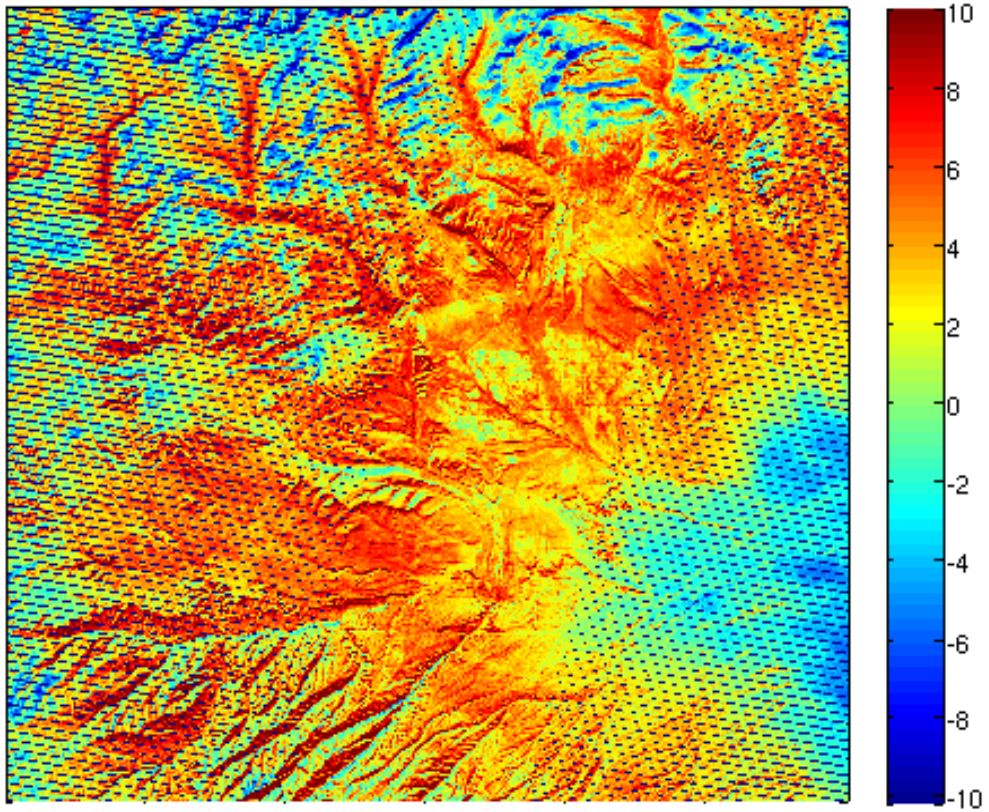
Uintah Basin frequently has shallow fog/low clouds in lowest portion of Basin. Very rare in foothills around basin

Weak Surface Flows Driven By Differential Surface Heating of Terrain & Snow Covered/Snow Free Areas

2 February 2013 1836 UTC Landsat 7 ETM+ (60 m resolution)

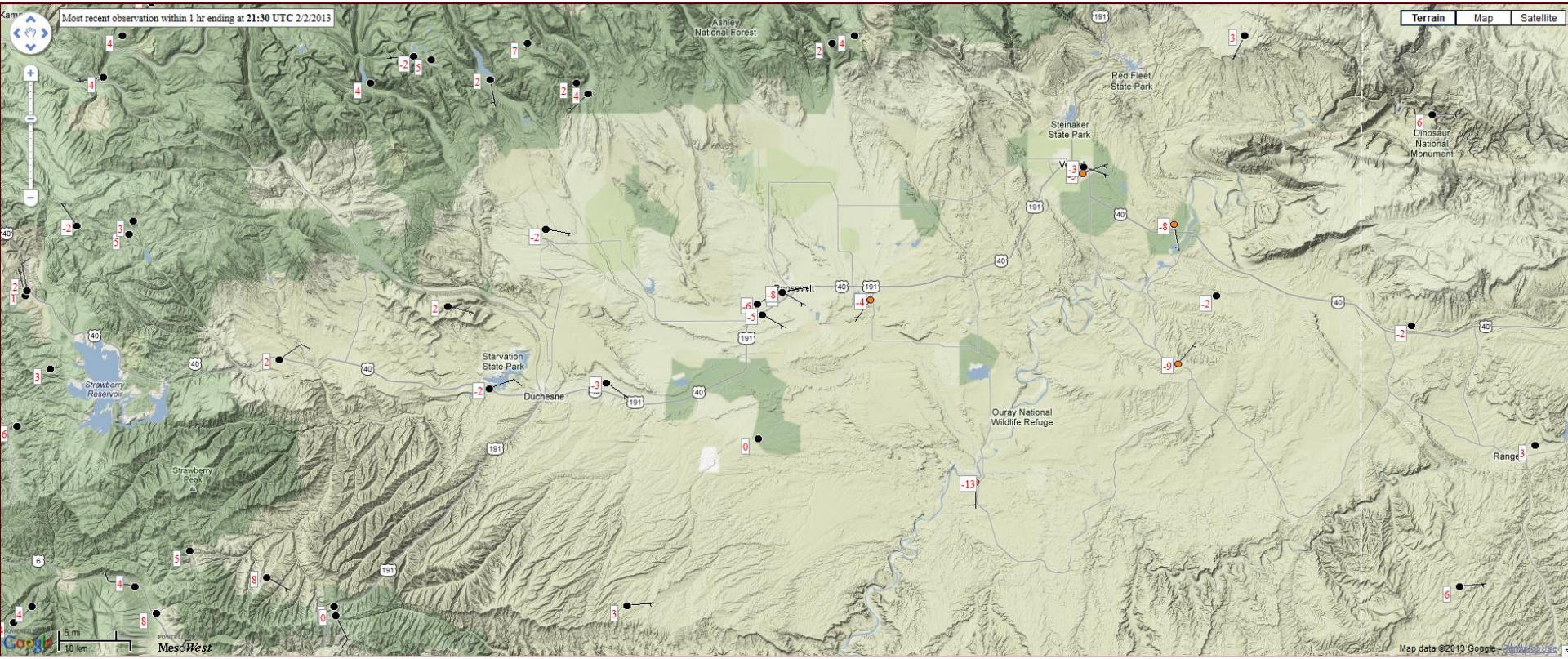


Visible: Cyan- snow; light grey- cloud



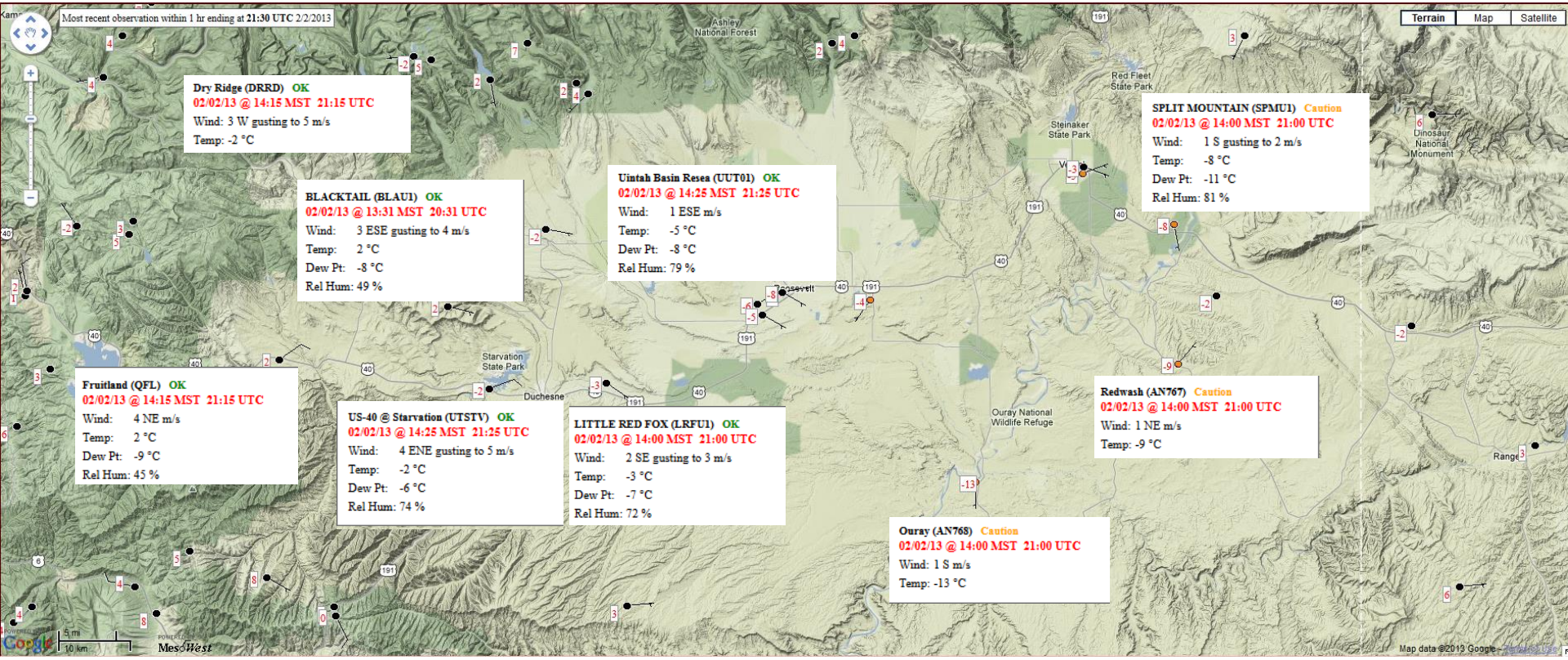
Skin temperature (°C)

Surface T & Wind, 2:30 PM MST 2 Feb 2013



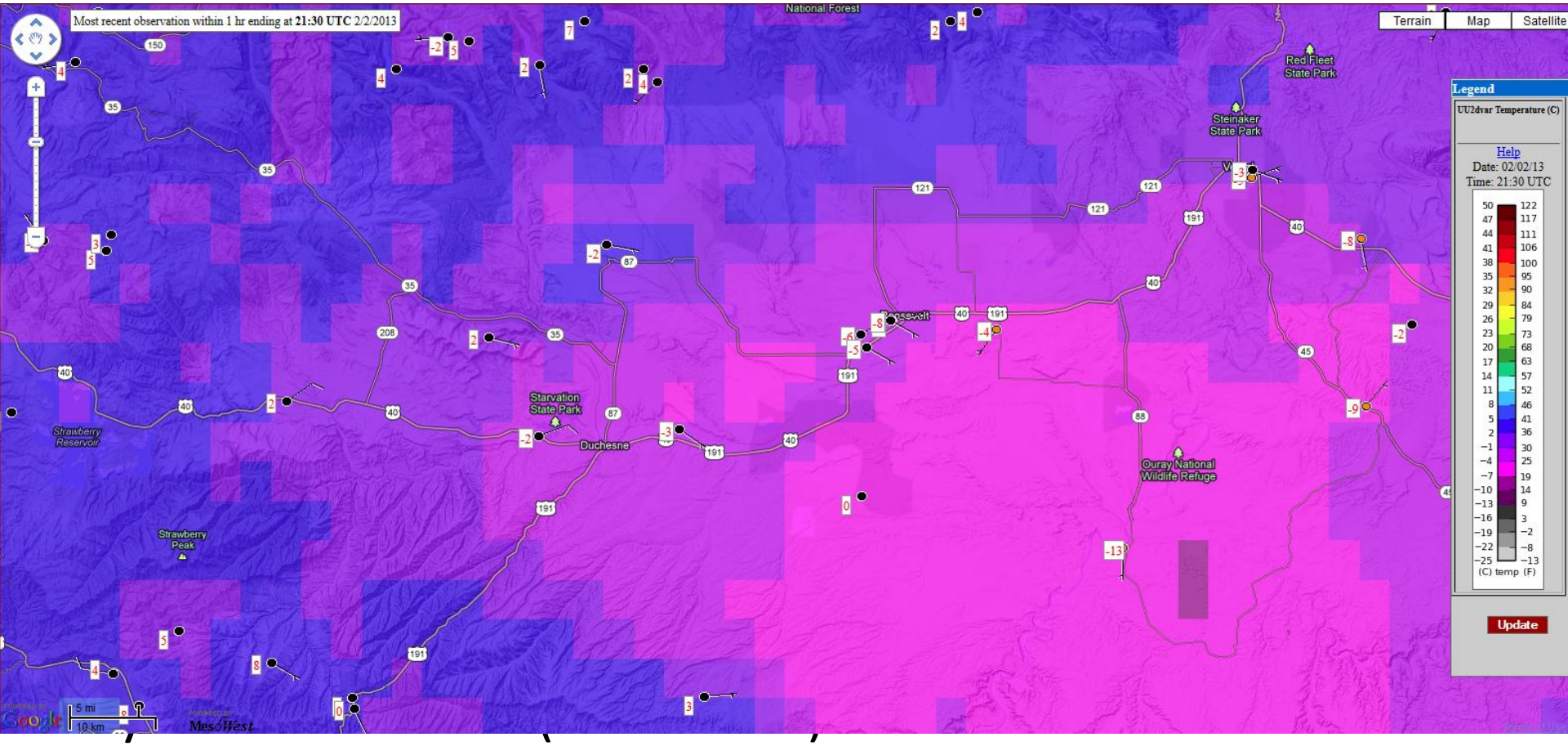
- Weak up valley surface flows in afternoon
- Weaker down valley surface flows at night

Surface T & Wind, 2:30 PM MST 2 Feb 2013



- Strong Inversion
- Weak up valley surface flows in afternoon
- Weaker down valley surface flows at night

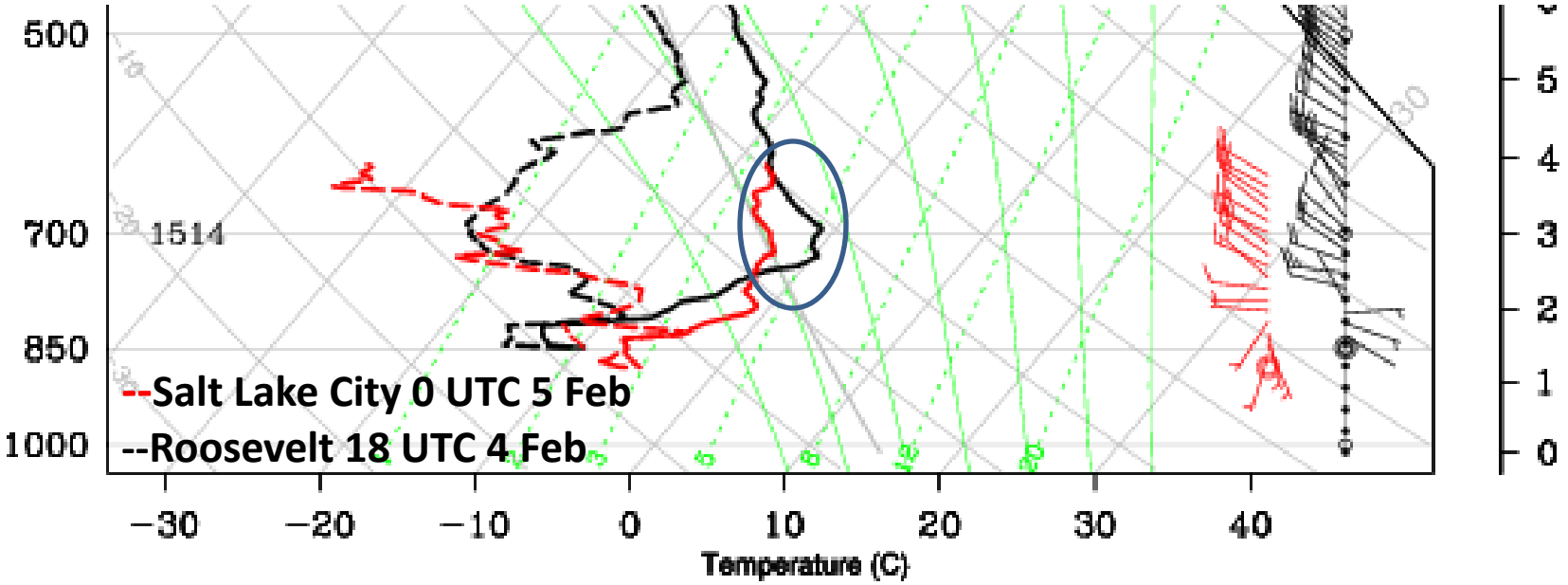
UU2DVAR Variational Surface Temperature Analysis 2 PM MST 2 Feb



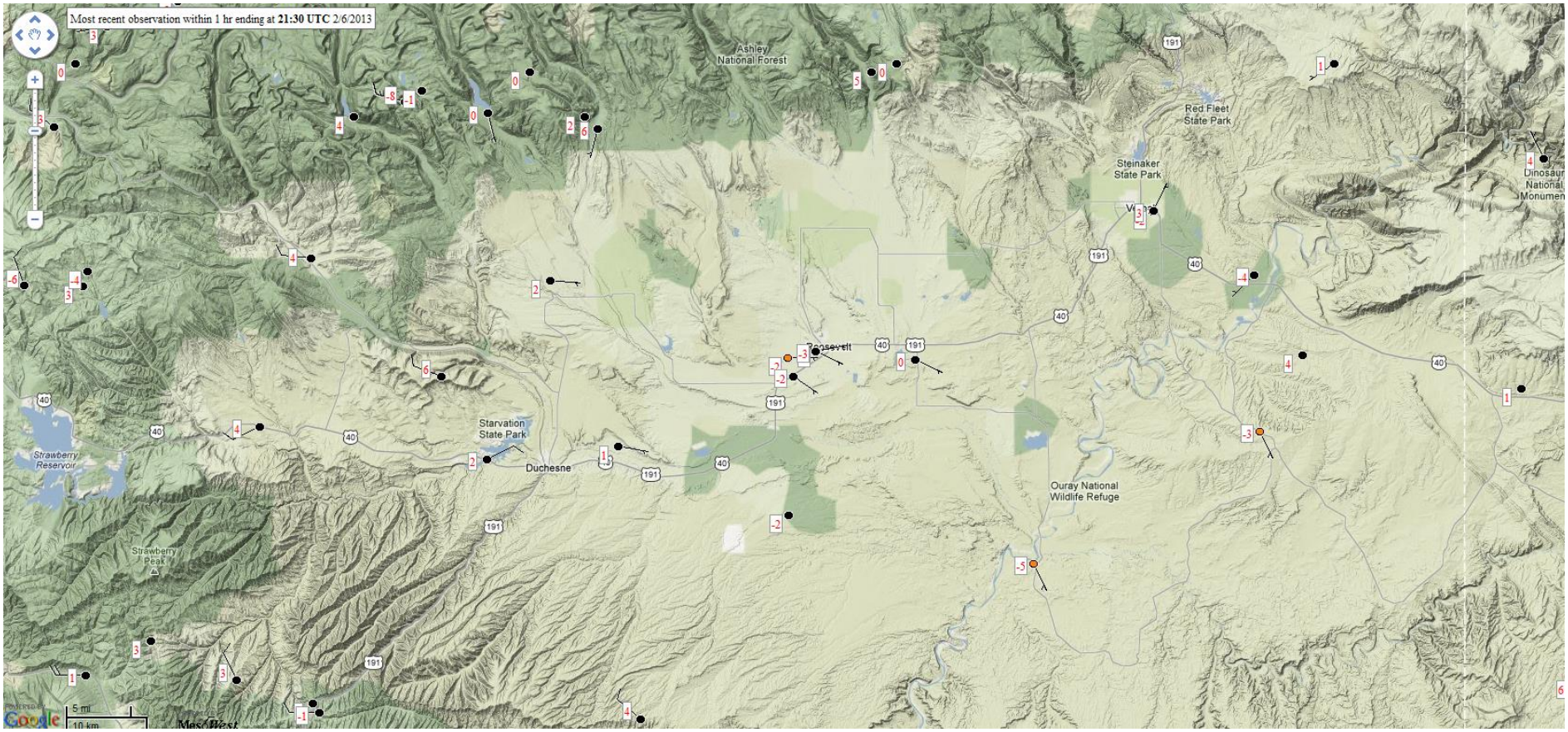
Hourly Analyses of T, Td and Wind at 2.5 km resolution

Impact of Downslope Flow on Basin Circulation

- Downsloping W/NW Flow strengthens (warms) upper portion of Uintah CAP compared to SLC

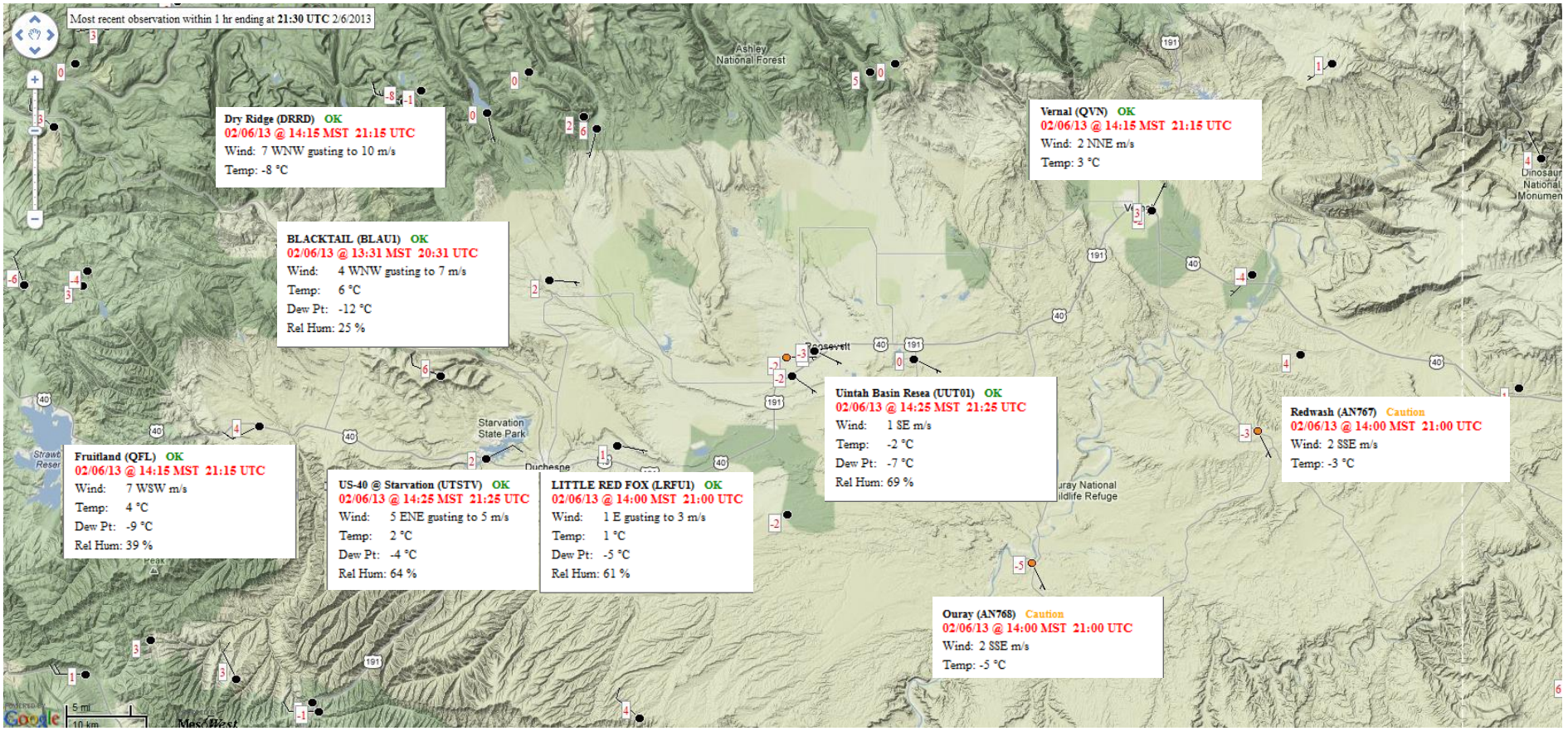


Surface T & Wind, 2:30 PM MST 6 Feb 2013



- Weak surface flows within cold pool
- Frequent synoptic and nighttime down valley injection of clean air from terrain to west and northwest

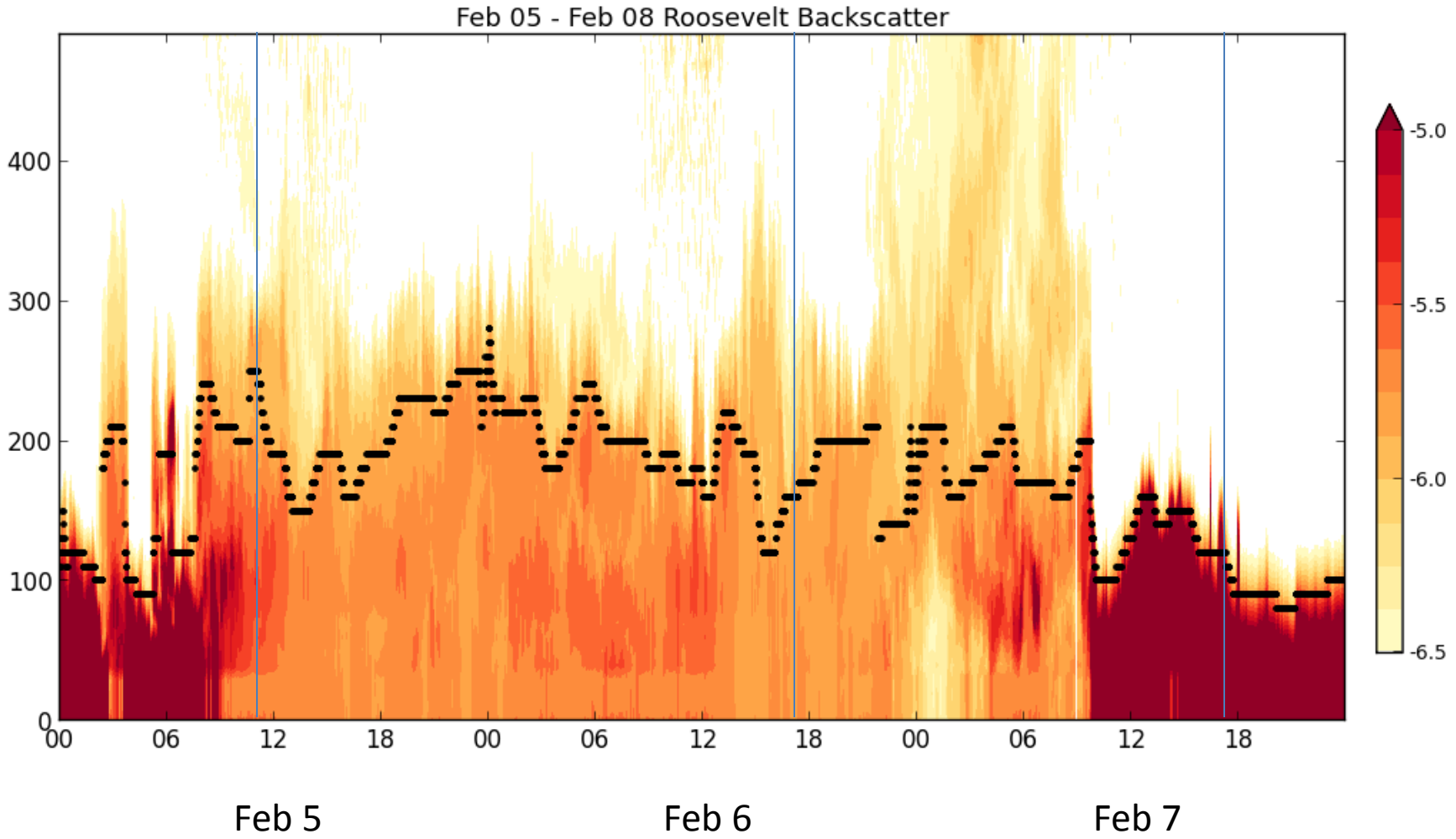
Surface T & Wind, 2:30 PM MST 6 Feb 2013



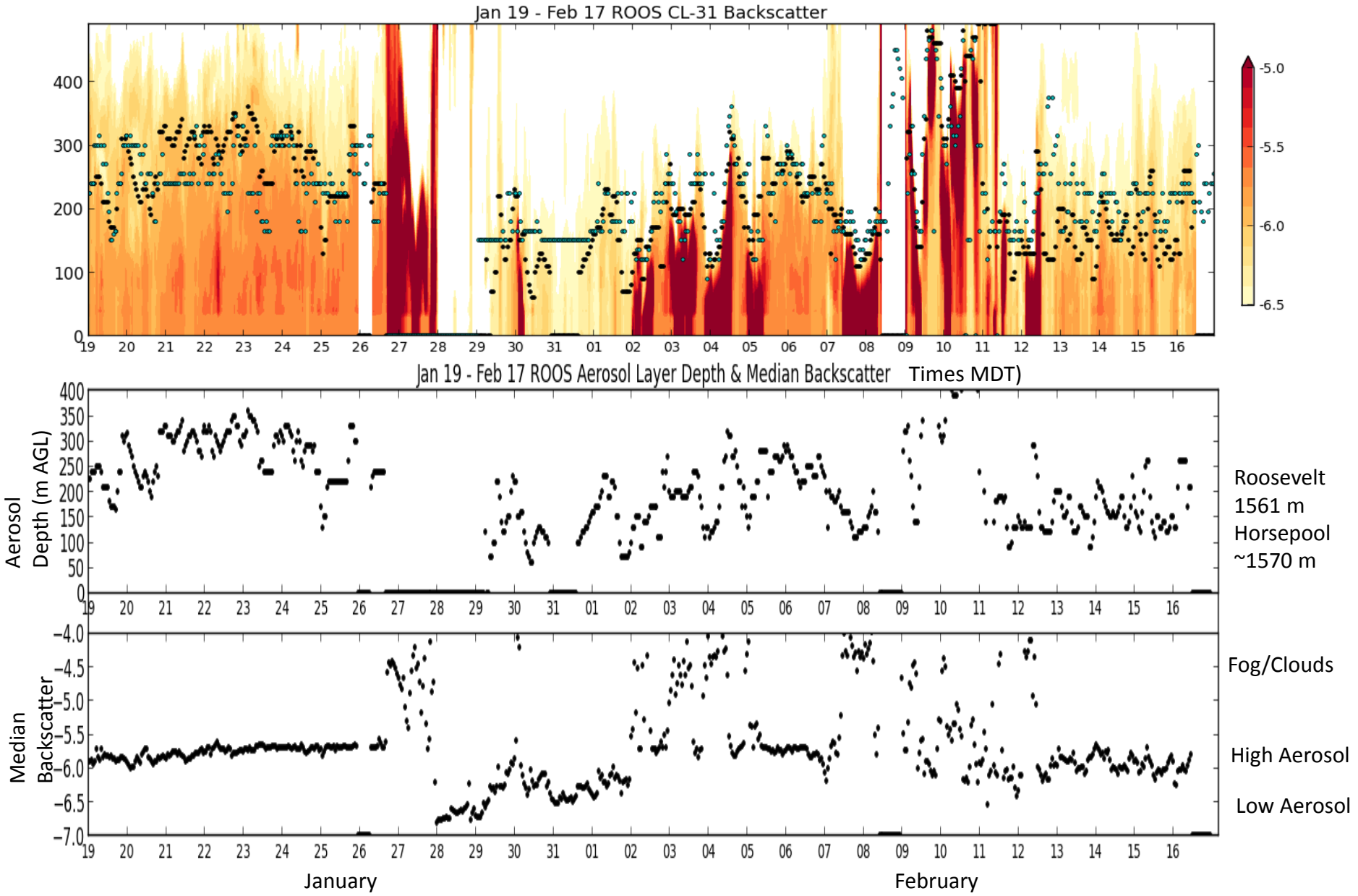
- Weak surface flows within cold pool
- Frequent synoptic and nighttime down valley injection of clean air from terrain to west and northwest

Aerosol Backscatter at Roosevelt

Darker shades indicate higher concentrations;
dark red is fog; black dots- estimate of depth of aerosol layer when no fog

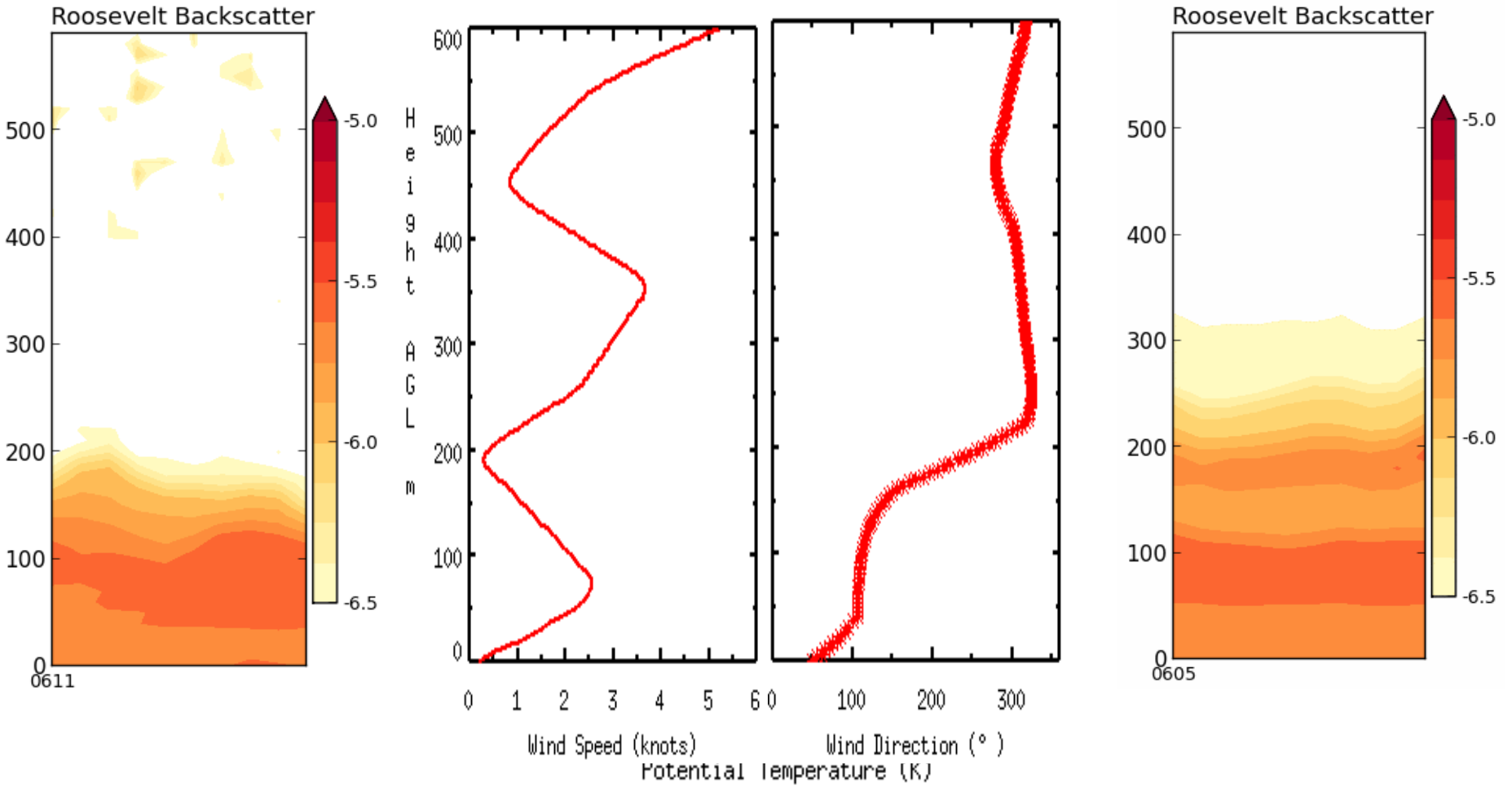


Estimated Depth/Relative Intensity of Aerosol Layer

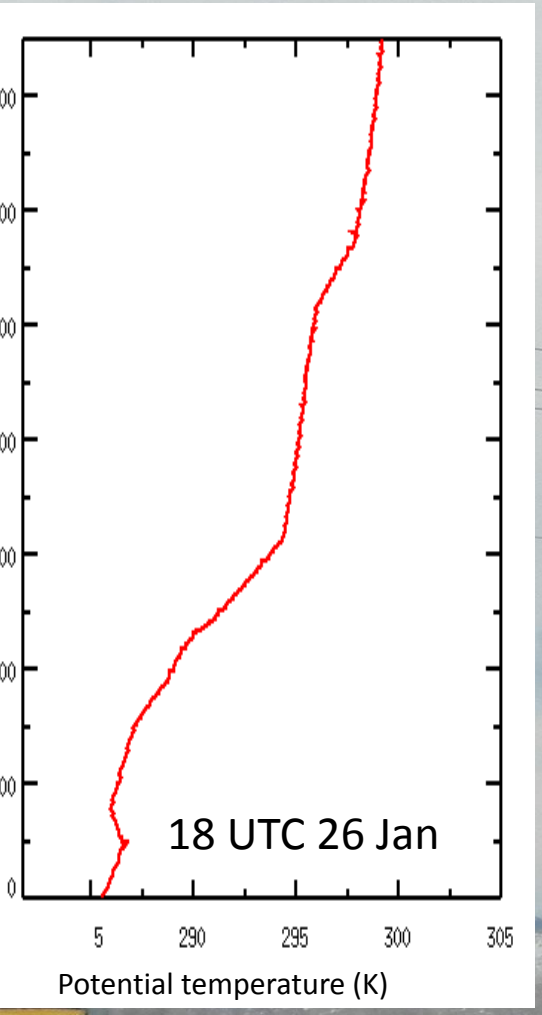


Roosevelt Ceilometer Aerosol Backscatter & 6 Feb Sounding

Darker shades indicate higher aerosol concentrations



Speed and directional shear above near-surface isolated layer



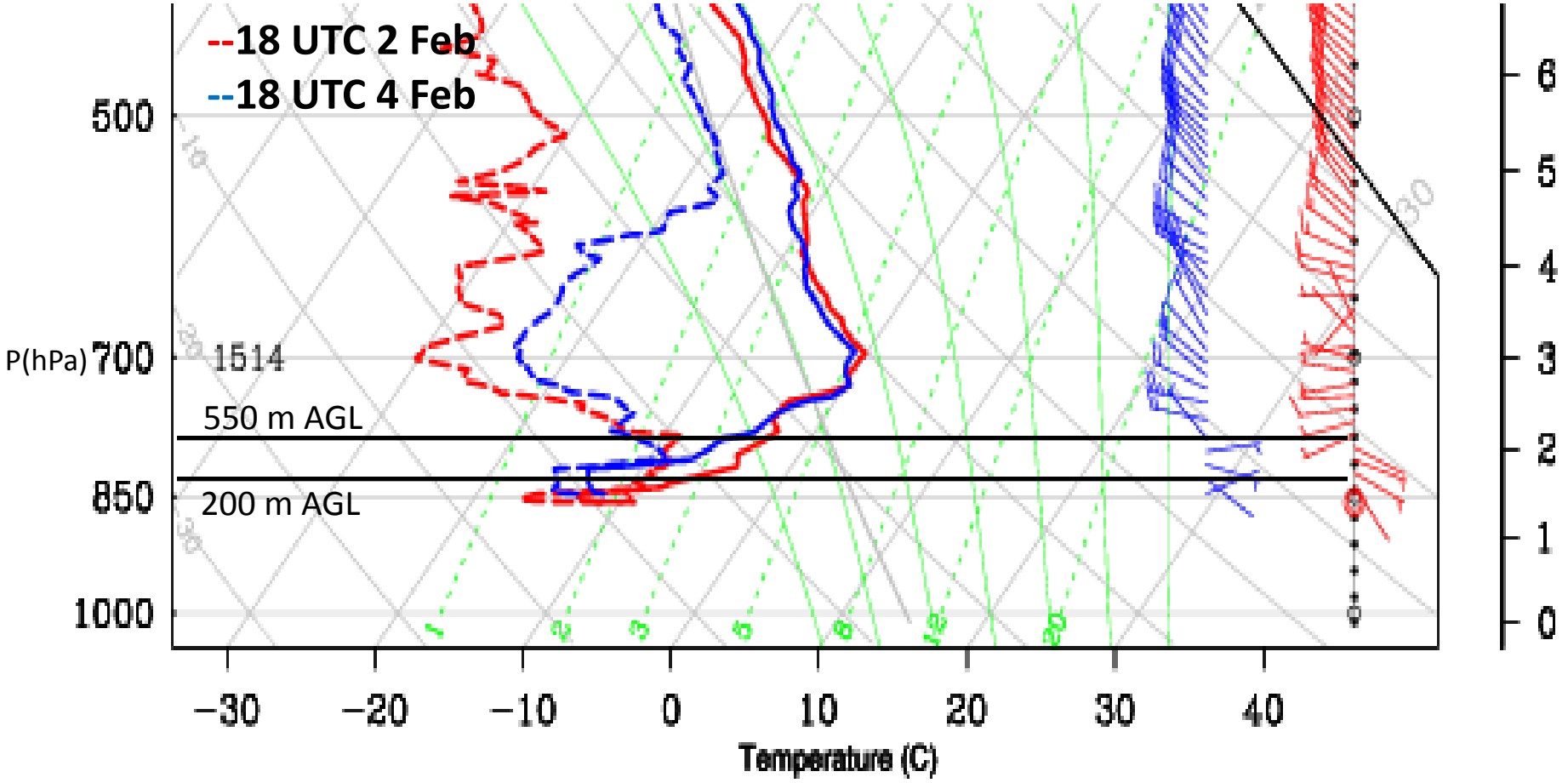
westerly flow above strong stable layer

Easterly flow ***within*** strong stable layer

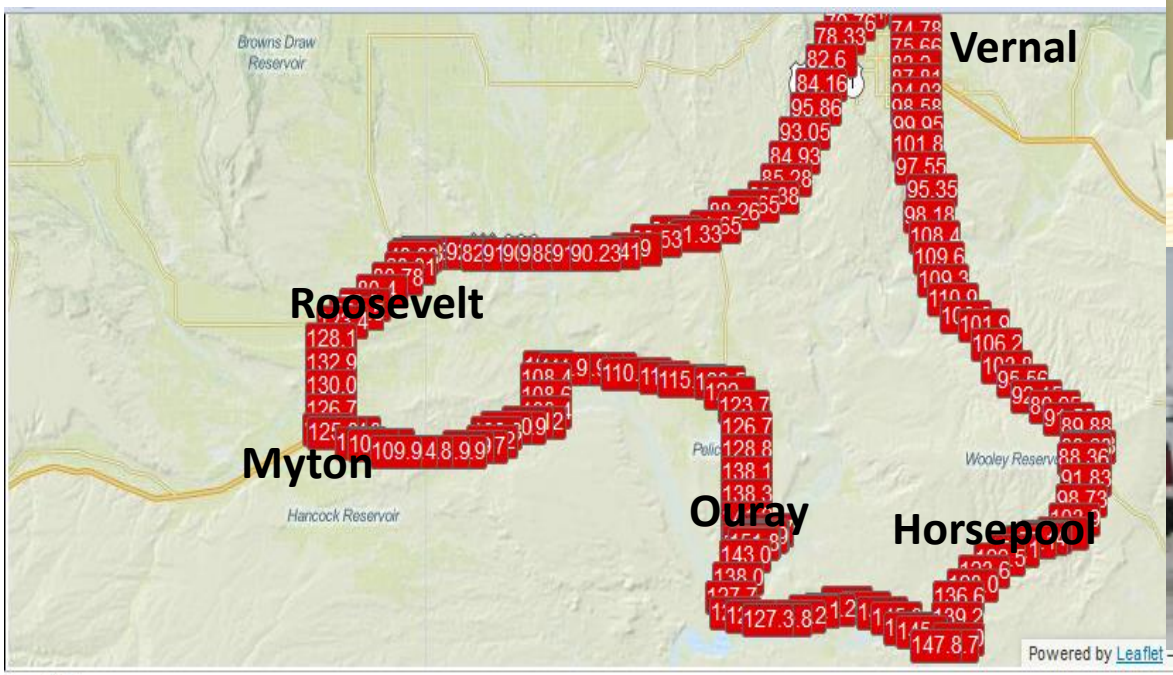
Weak thermally driven flows near surface

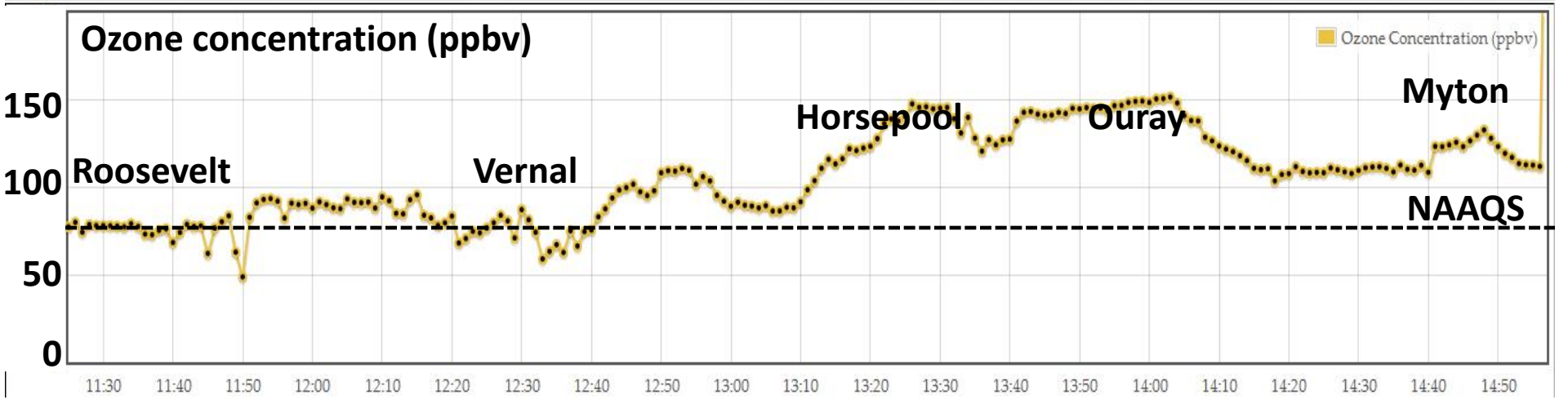
Oil well fire plume 25 January 2013

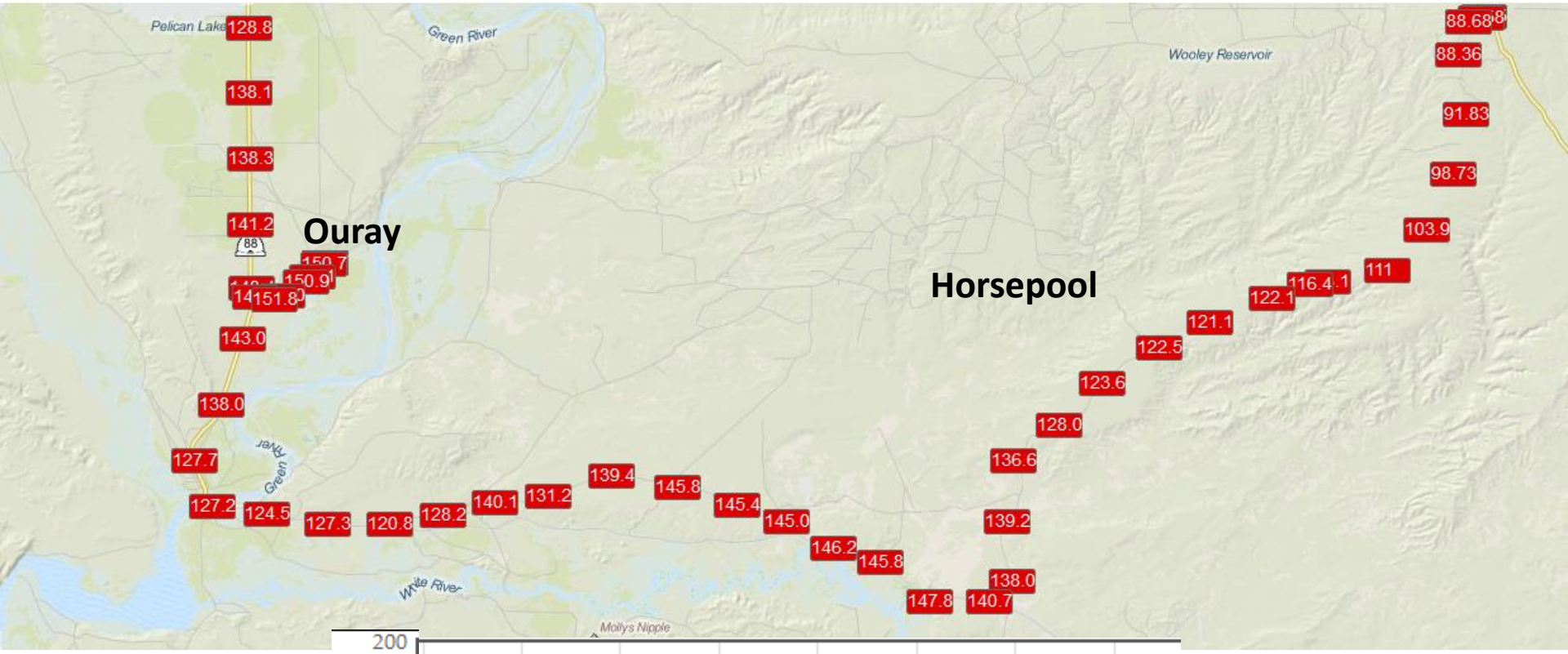
Roosevelt Soundings with Easterly Flow Within Stable Layer

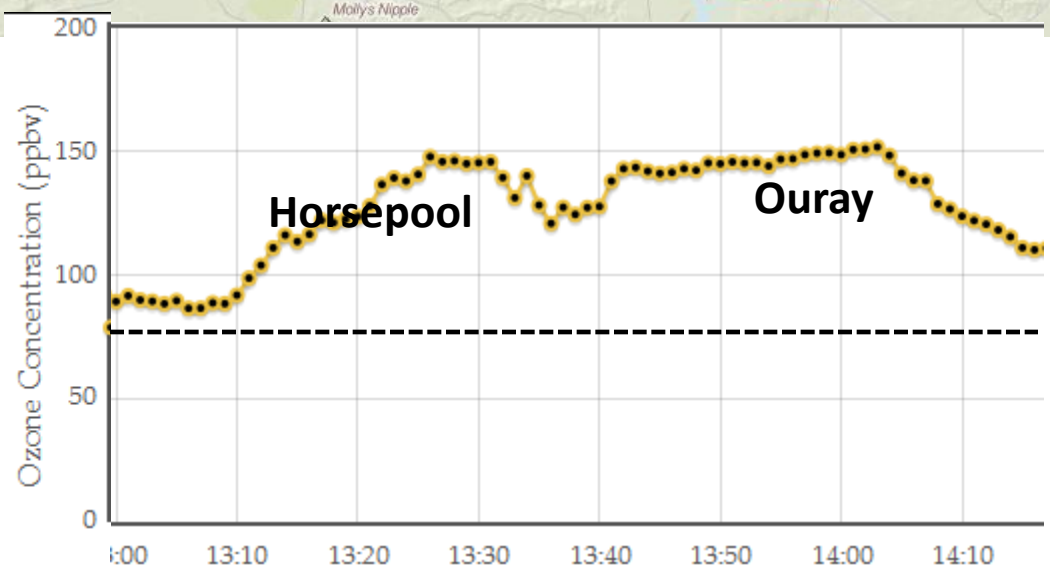


6 February Afternoon 0_3 Transect

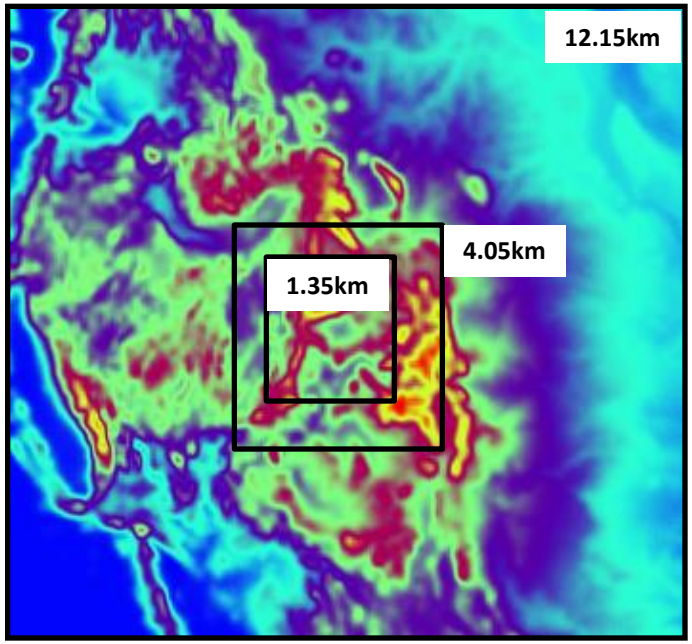





Pelican Lake
Green River
Wooley Reservoir
Ouray
Horsepool
White River
Molly's Nipple
128.8
138.1
138.3
141.2
150.7
150.9
151.8
143.0
138.0
127.7
127.2
124.5
127.3
120.8
128.2
140.1
131.2
139.4
145.8
145.4
145.0
146.2
145.8
147.8
140.7
138.0
139.2
136.6
128.0
123.6
122.5
121.1
122.1
116.4
111
103.9
98.73
91.83
88.36
88.68


Ozone Concentration (ppbv)
200
150
100
50
0
13:10
13:20
13:30
13:40
13:50
14:00
14:10
Horsepool
Ouray
NAAQS

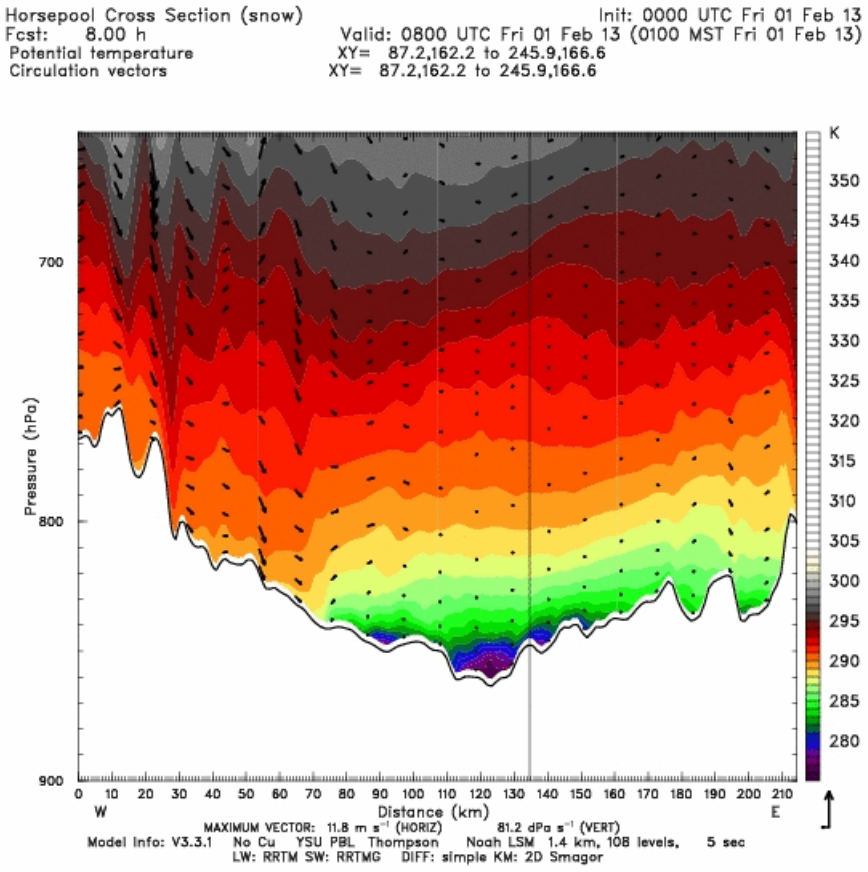
Erik Neemann's WRF Modeling of 1-7 Feb Cold Pool



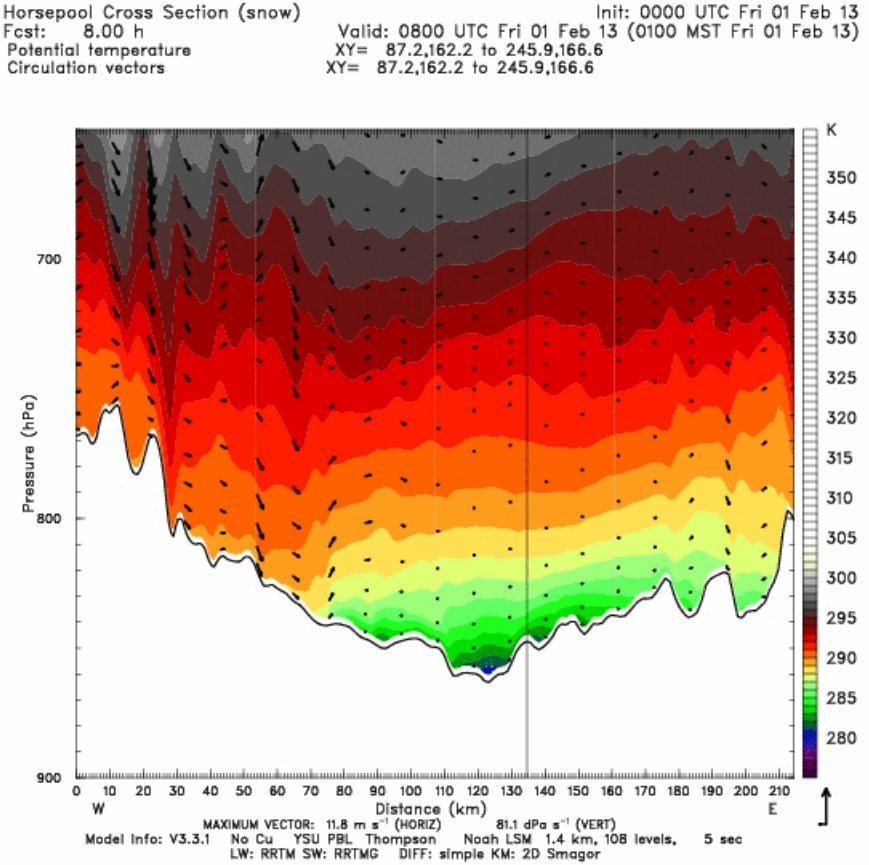
- Start 00 UTC 1 February 2013, end 00 UTC 7 February 2013
- Nested domains (12.15,4.05,1.35 km)
- Initialization and boundary conditions from NAM analyses
- Idealized snow cover based on elevation
- Number of vertical levels = 109
- Time step = 45 seconds (15, 5 s for inner 2 grids)
- Microphysics: Thompson scheme
- Radiation: RRTM longwave, RRTMG shortwave
- Surface layer: Monin-Obukov
- NOAH land-surface option
- YSU PBL Scheme
- Slope effects for radiation, topo shading

Sensitivity to Snowcover

Snow

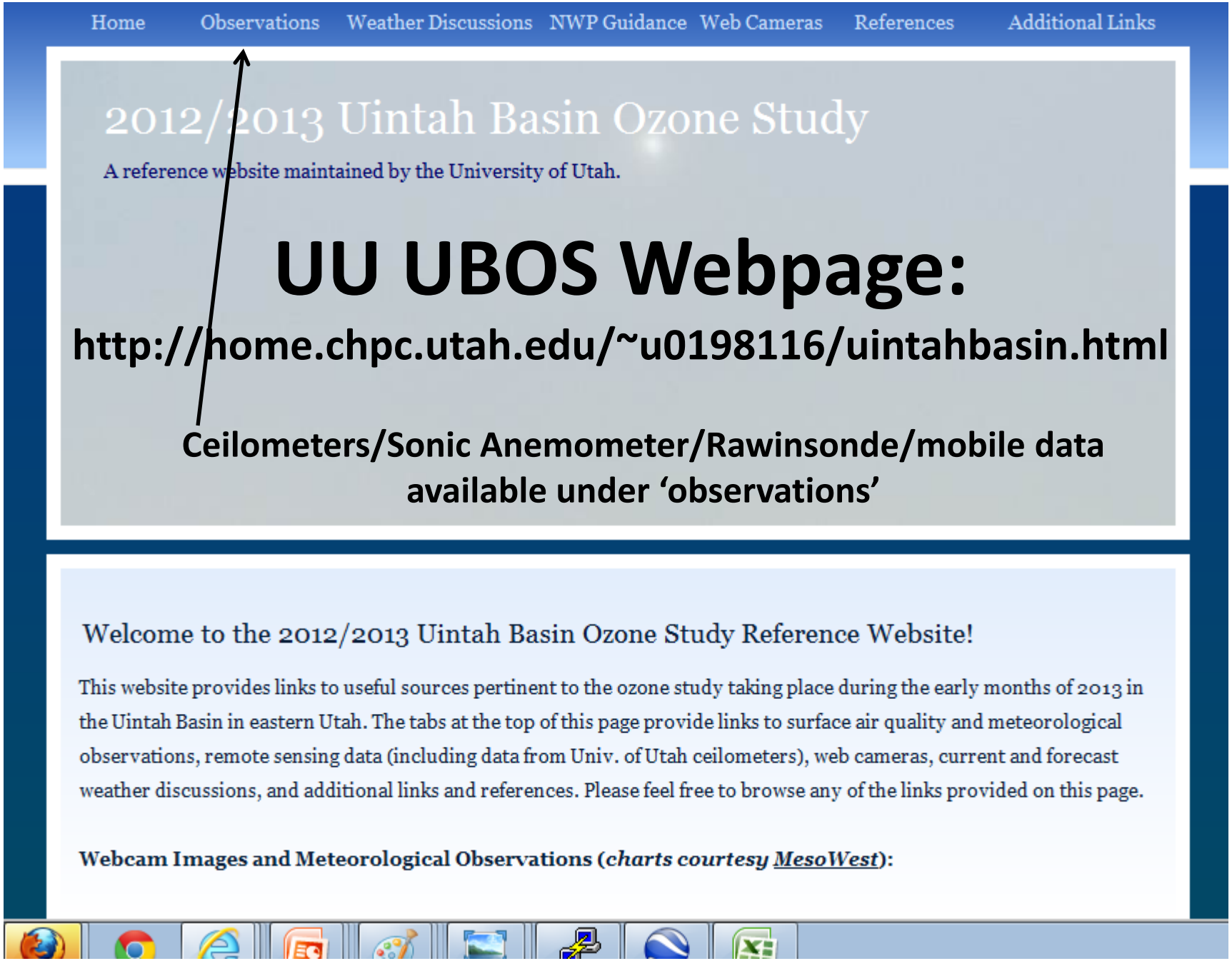


No Snow



Hypotheses about Uintah Cold-Air Pools

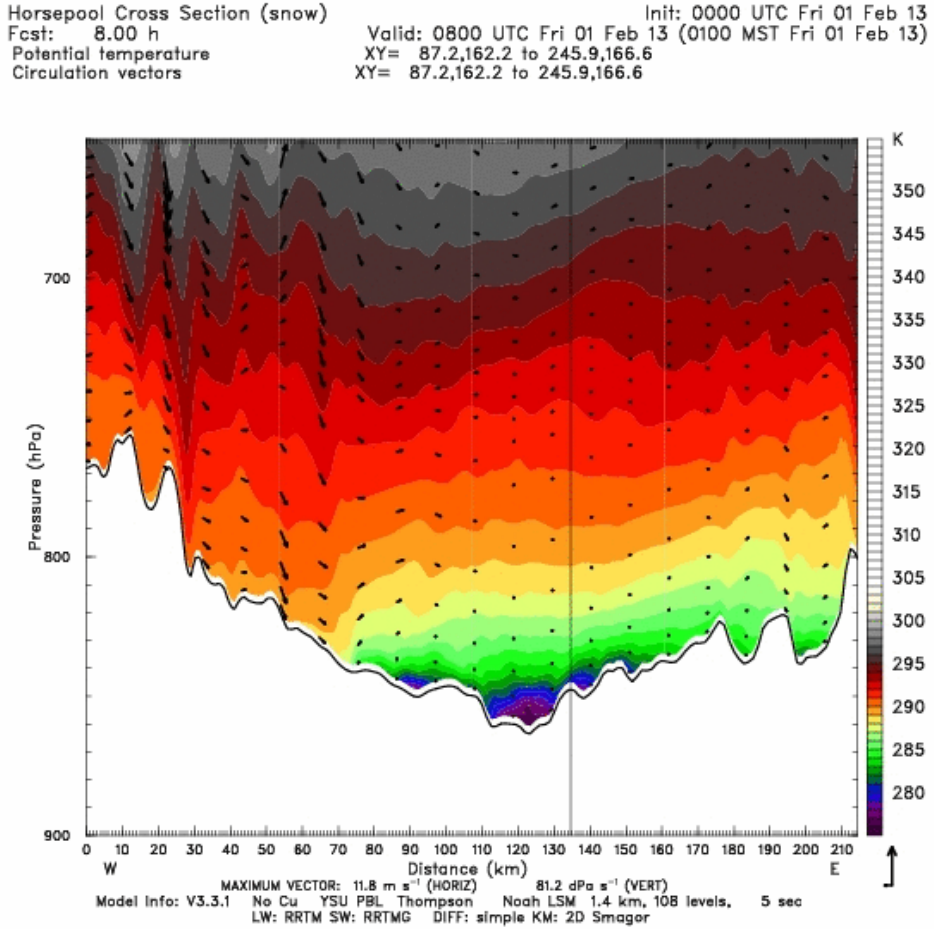
- Ozone concentrations near surface build rapidly and remain high:
  - Emissions into lowest 100-200 m tend to be isolated from basin circulations aloft
  - reduced turbulence in lowest 100-200 m leads to low sublimation rates (and deposition) helping to perpetuate modest snow cover
- Weak thermally driven flows within surface isolated layer
- Terrain-flow interactions lead to jets and directional shear layers above surface isolated layer
  - Alternating layers of high and reduced aerosol concentrations embedded within stable boundary layer
- Model results suggest presence of snow cover affects surface energy balance leading to colder temperatures and enhanced stability in lowest 100-200 m with minimal impact aloft

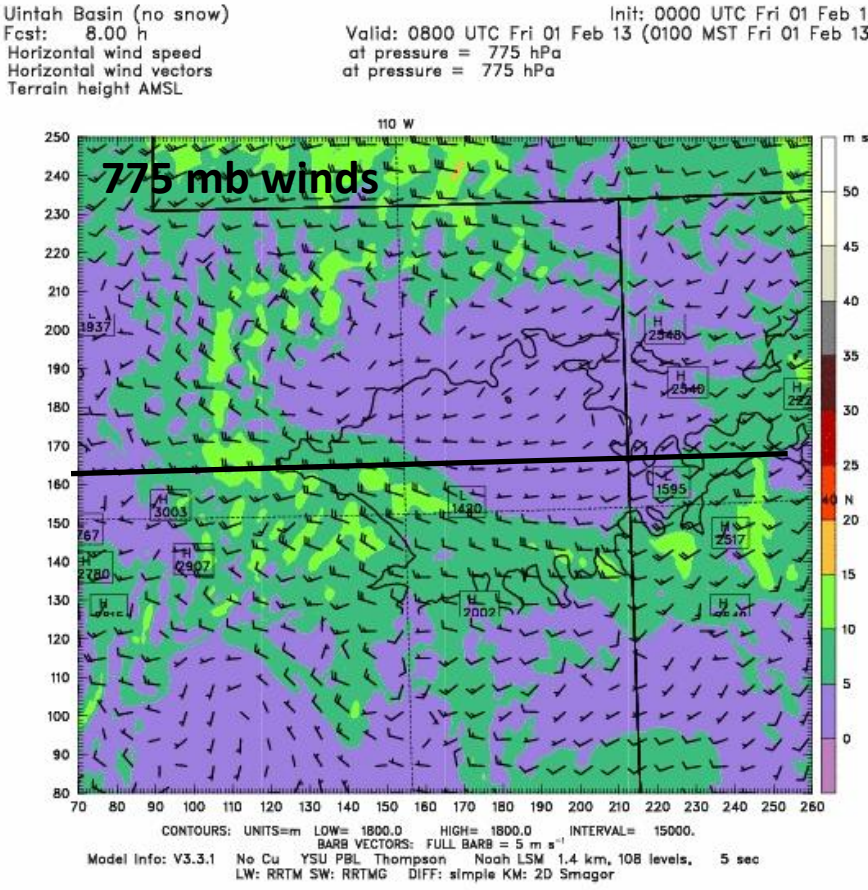

Home
Observations
Weather Discussions
NWP Guidance
Web Cameras
References
Additional Links
2012/2013 Uintah Basin Ozone Study
A reference website maintained by the University of Utah.
UU UBOS Webpage:
http://home.chpc.utah.edu/~u0198116/uintahbasin.html
Ceilometers/Sonic Anemometer/Rawinsonde/mobile data available under 'observations'
Welcome to the 2012/2013 Uintah Basin Ozone Study Reference Website!
This website provides links to useful sources pertinent to the ozone study taking place during the early months of 2013 in the Uintah Basin in eastern Utah. The tabs at the top of this page provide links to surface air quality and meteorological observations, remote sensing data (including data from Univ. of Utah ceilometers), web cameras, current and forecast weather discussions, and additional links and references. Please feel free to browse any of the links provided on this page.
Webcam Images and Meteorological Observations (charts courtesy MesoWest):

U/Utah Operations

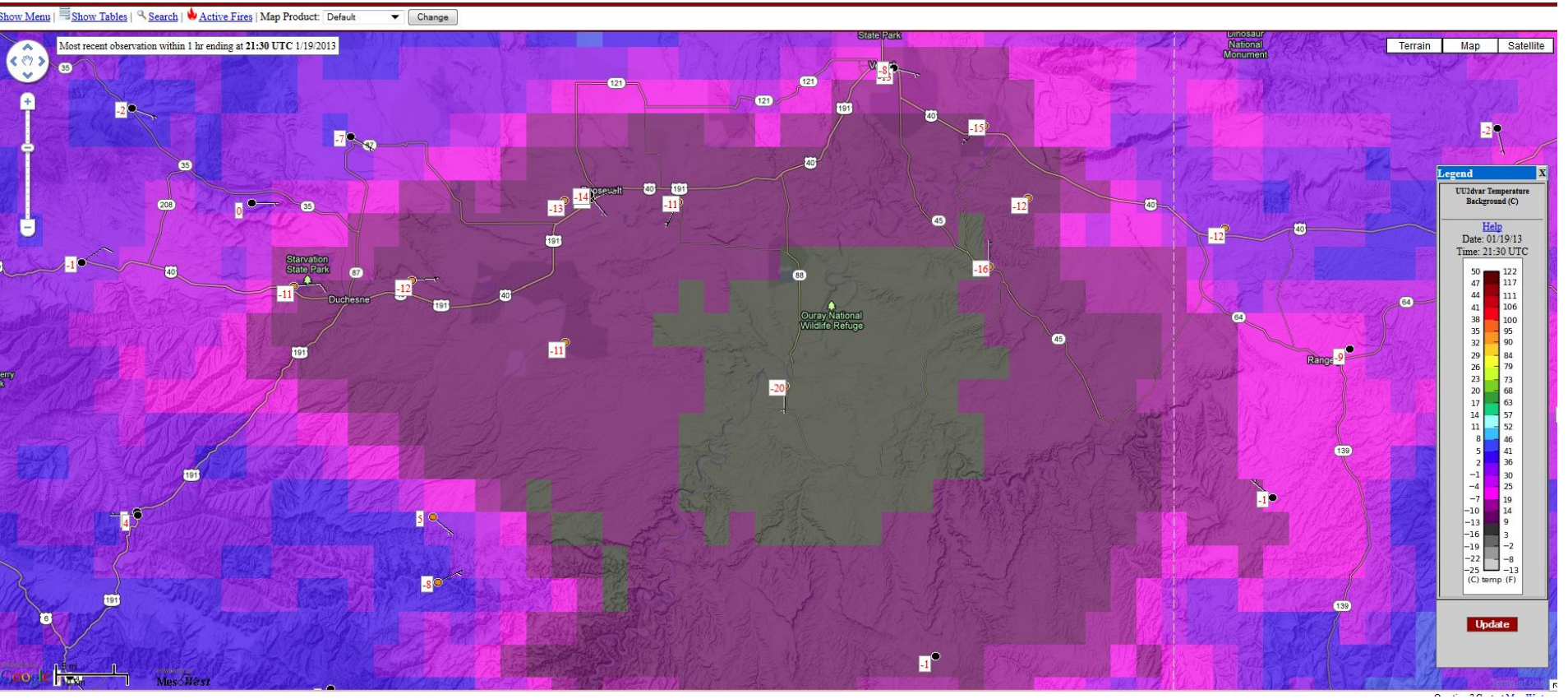
Sun	Mon	Tue	Wed	Thu	Fri	Sat
13	14	15	16 URHS ceil begins	17	18 Roosevelt Ceil begins	19
20	21	22	23 Ozone Transect into basin	24	25 Trailer tower begins Ozone Transect	26 18 UTC Sonde Ozone Transect out
27	28	29	30	31 Ozone Transect Into basin	Feb 1 18 UTC Sonde Ozone Transect	2 18 UTC Sonde Ozone Transect
3 18 UTC Sonde Ozone Transect	4 18 UTC Sonde Ozone Transect	5 18 UTC URHS Sonde Ozone Transect	6 18 UTC Sonde Ozone Transect	7 18 UTC Sonde Ozone Transect	8 16 UTC Sonde Ozone transect out	9
10	11	12	13	14	15	16 18 UTC Sonde Ozone Trans Into, In, Out Roosevelt Ceil & Trailer tower end
17	18	19	20	21	22	23
24	25	26	27	28	Mar 1	2 URHS Ceil cont.

Animation WRF simulations 1-2 Feb Westerly ‘Partial Mix-Out’





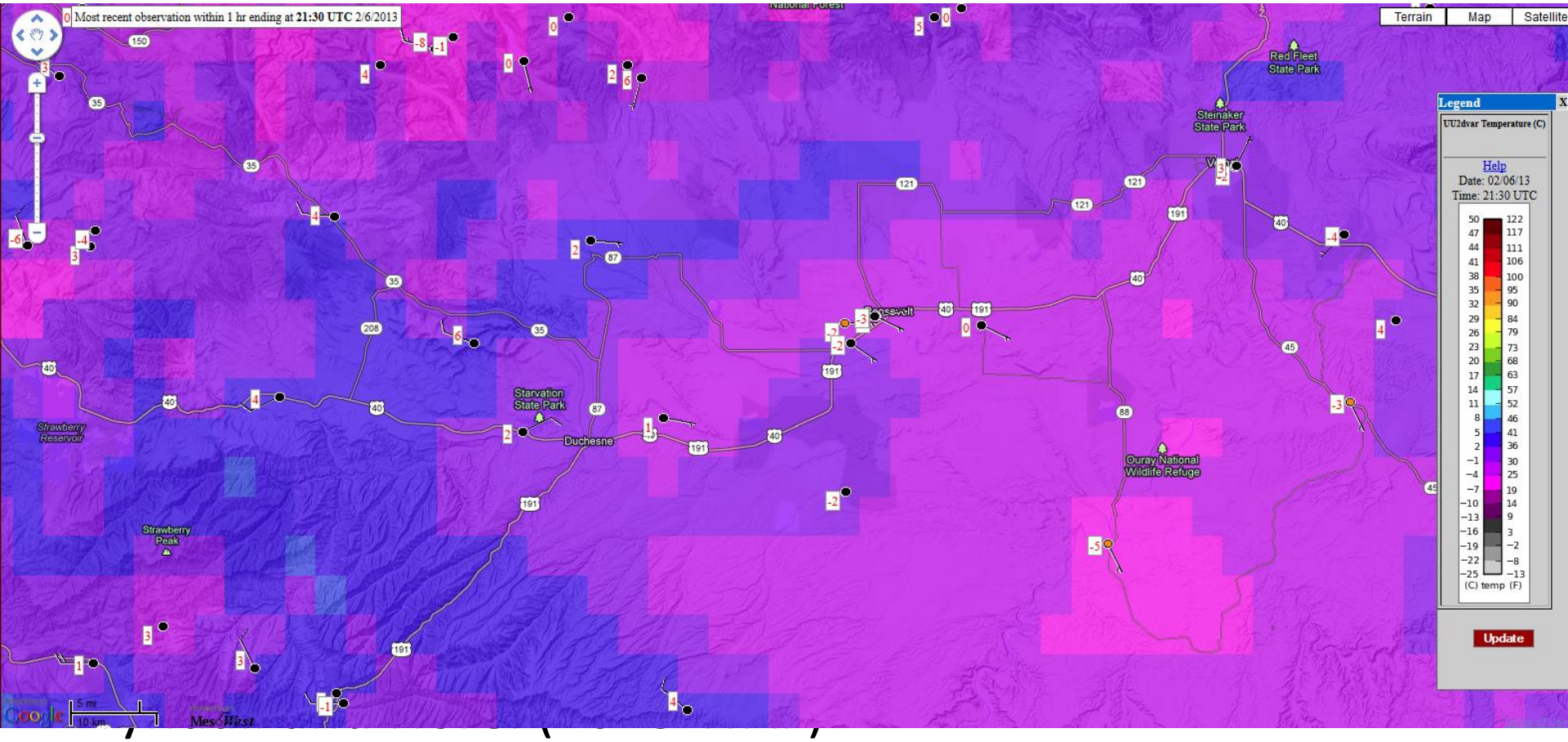
UU2DVAR Variational Surface Temperature Analysis 2 PM MST 19 Jan



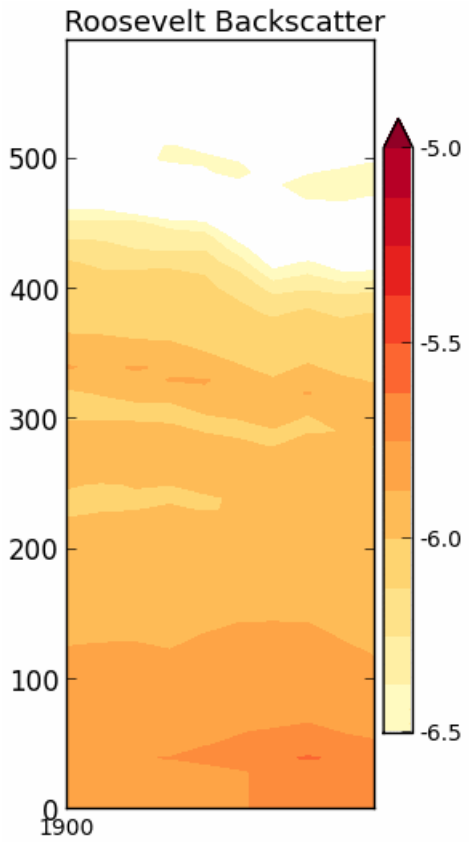
Tyndall and Horel (2013 WAF)

Hourly Analyses of T, Td and Wind at 2.5 km resolution

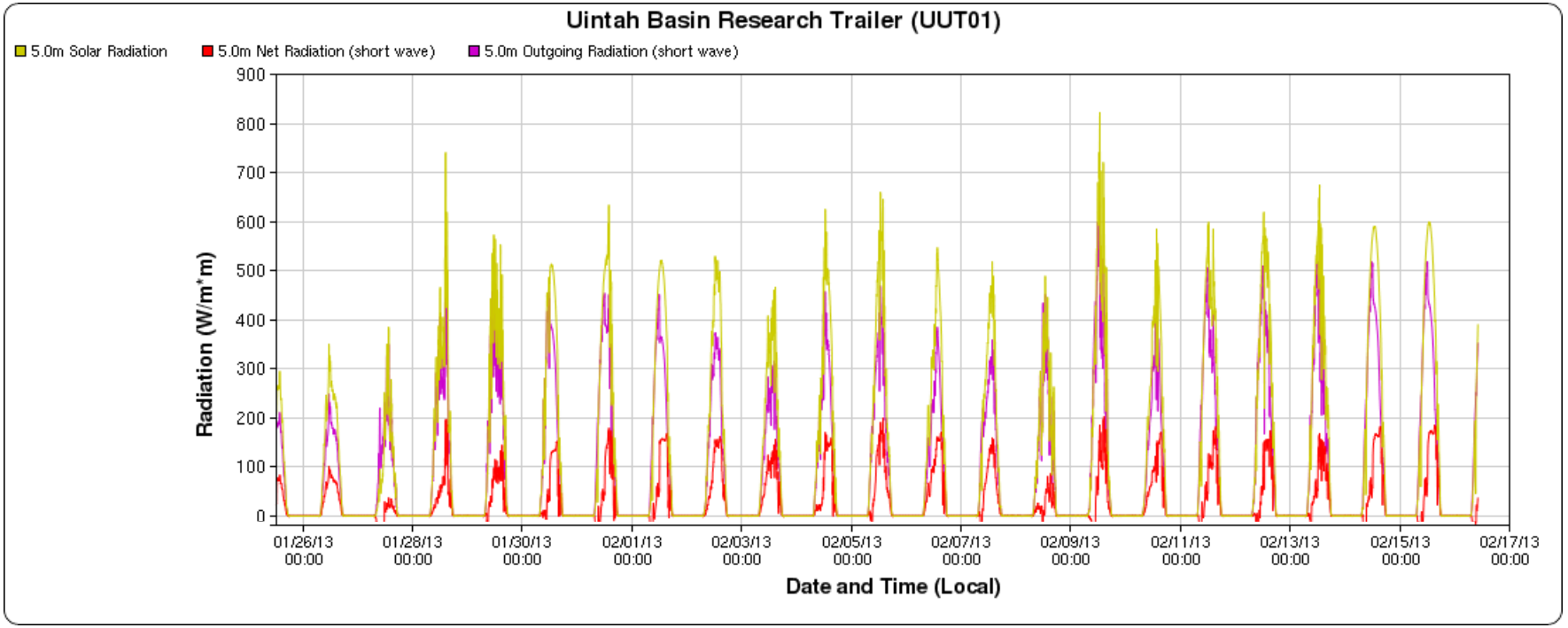
UU2DVAR Variational Surface Temperature Analysis 2 PM MST 6 Feb

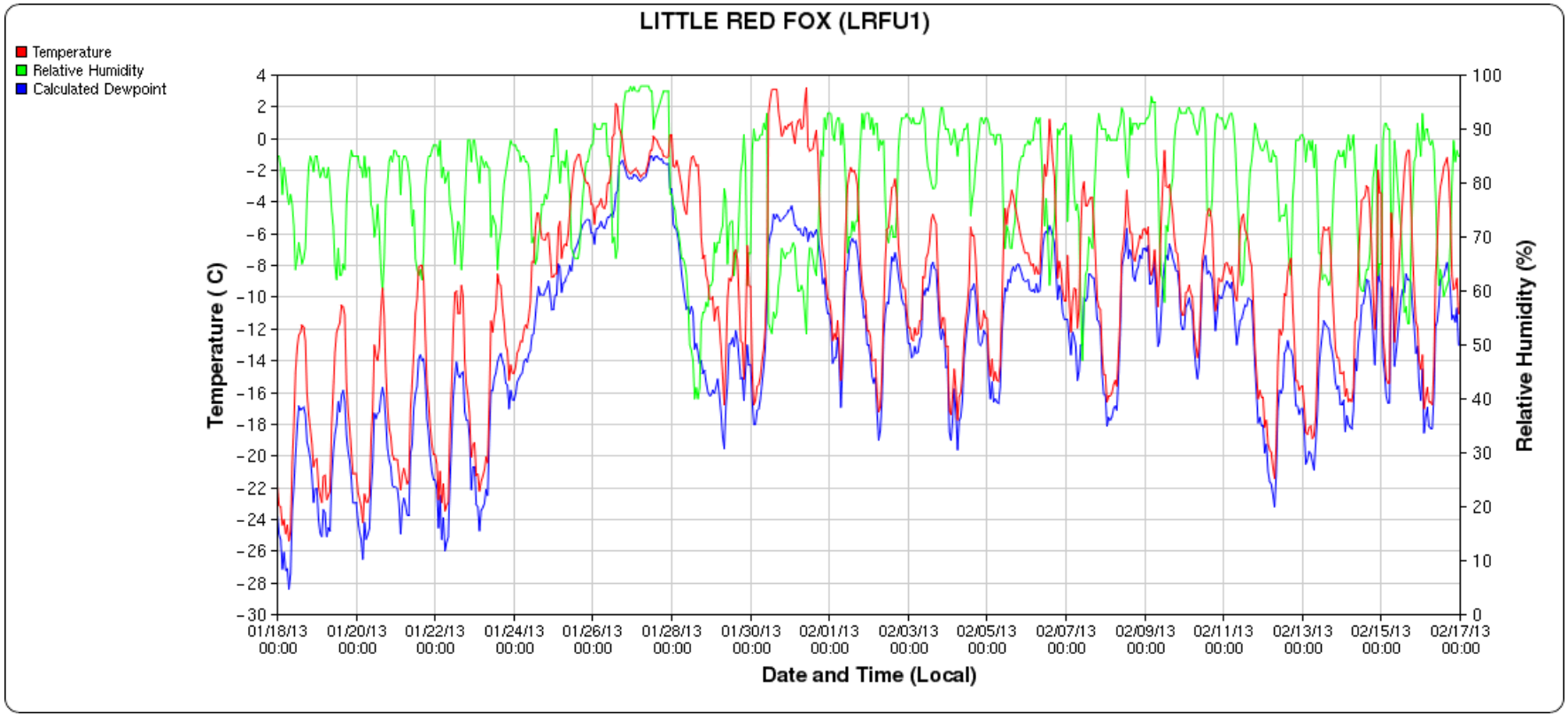


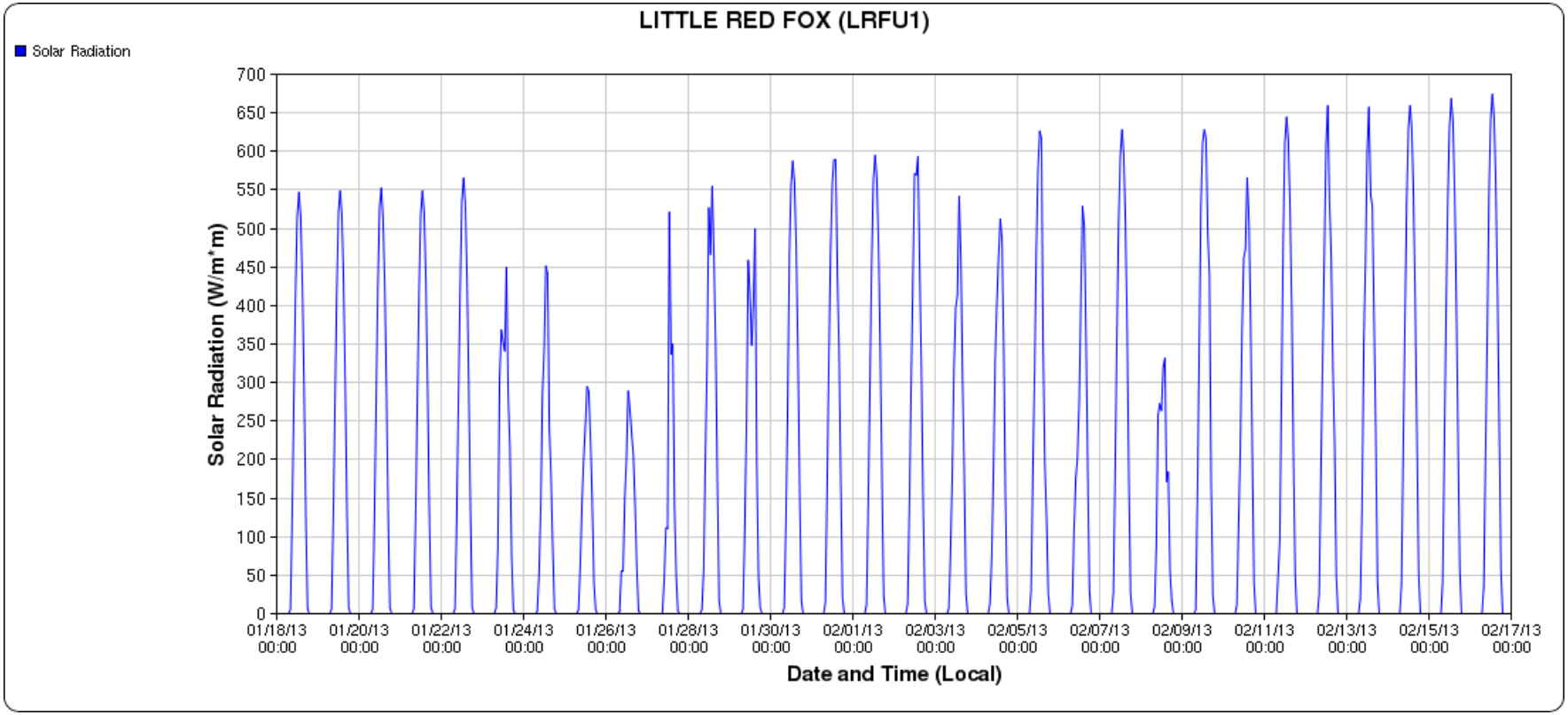
Hourly Analyses of T, Td and Wind at 2.5 km resolution

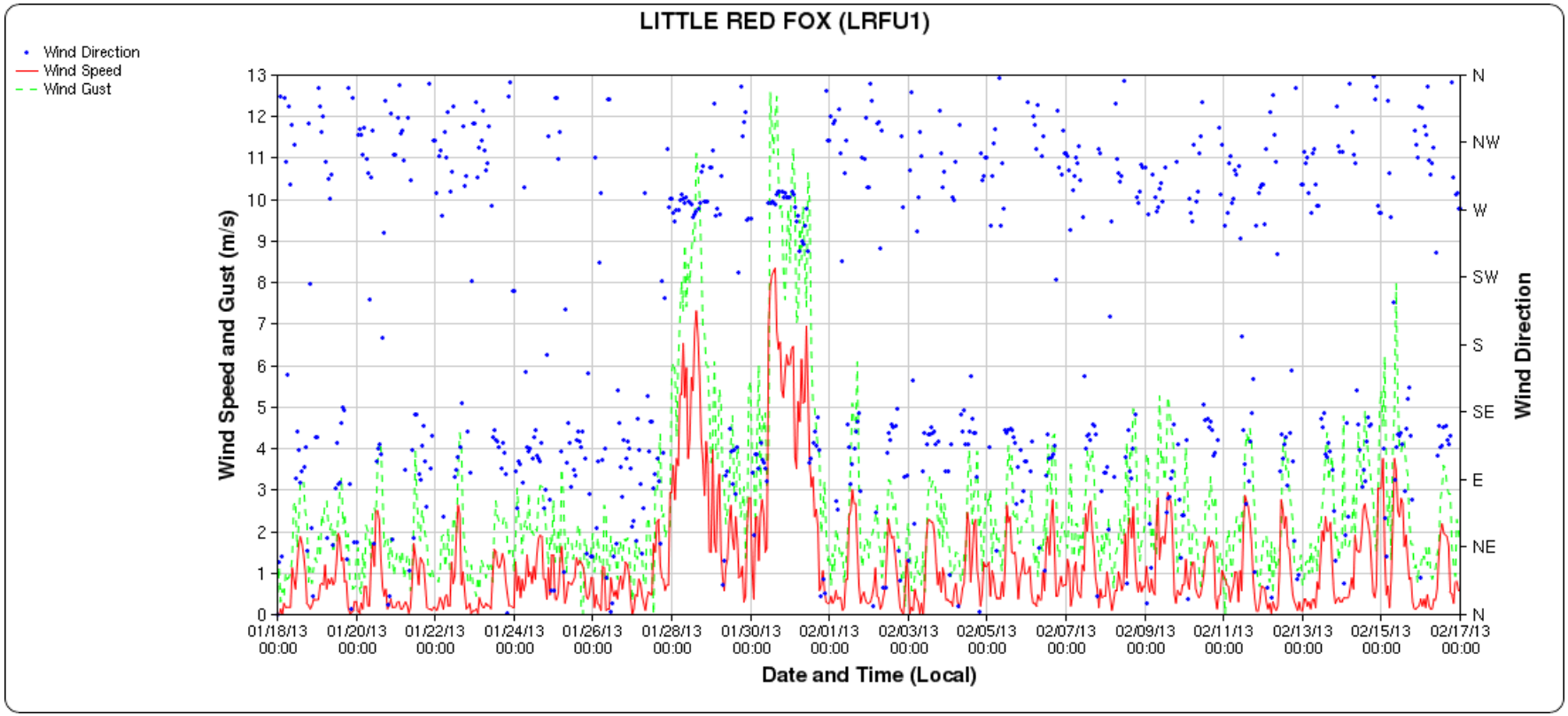


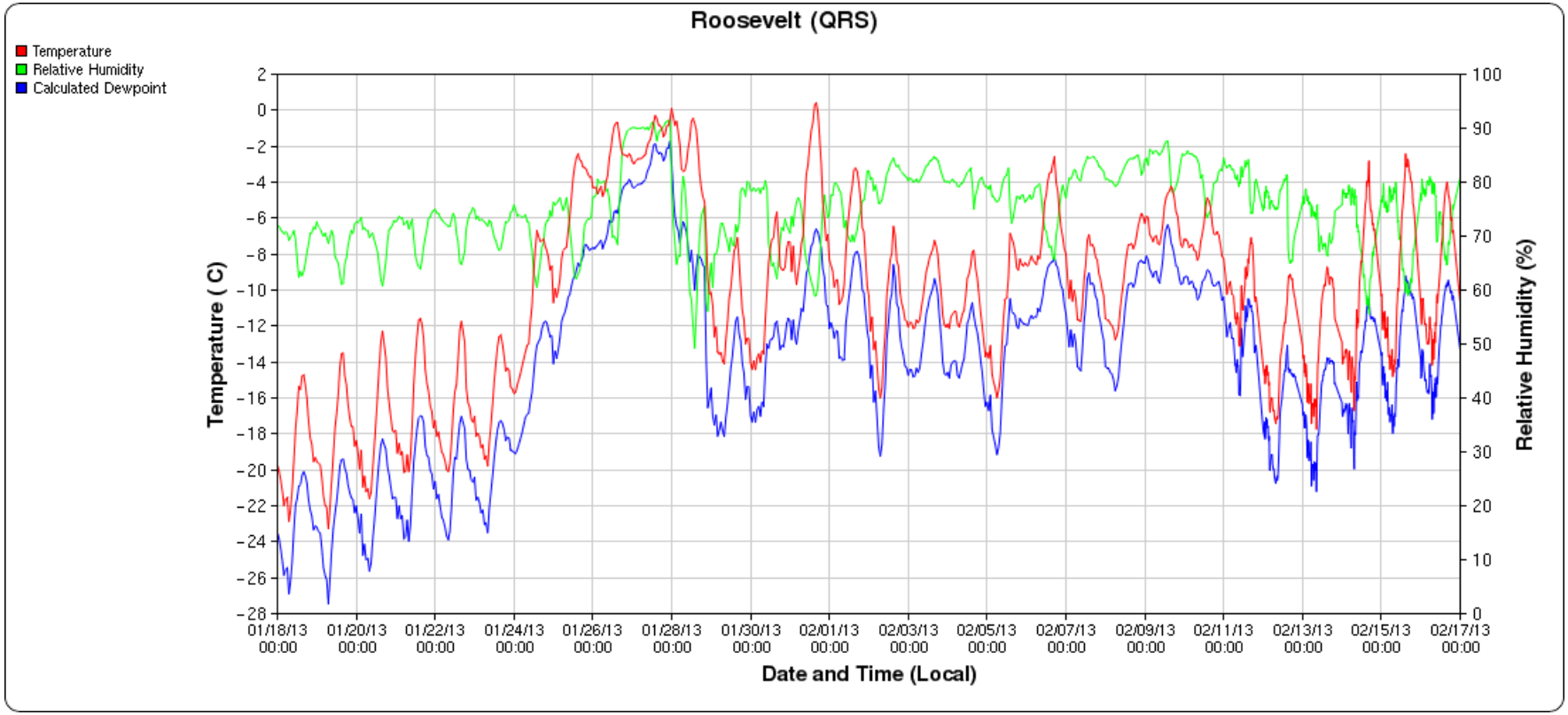
Aerosol Backscatter at Roosevelt:
January 19, 2013
Darker shades indicate higher aerosol concentrations
10 minute window

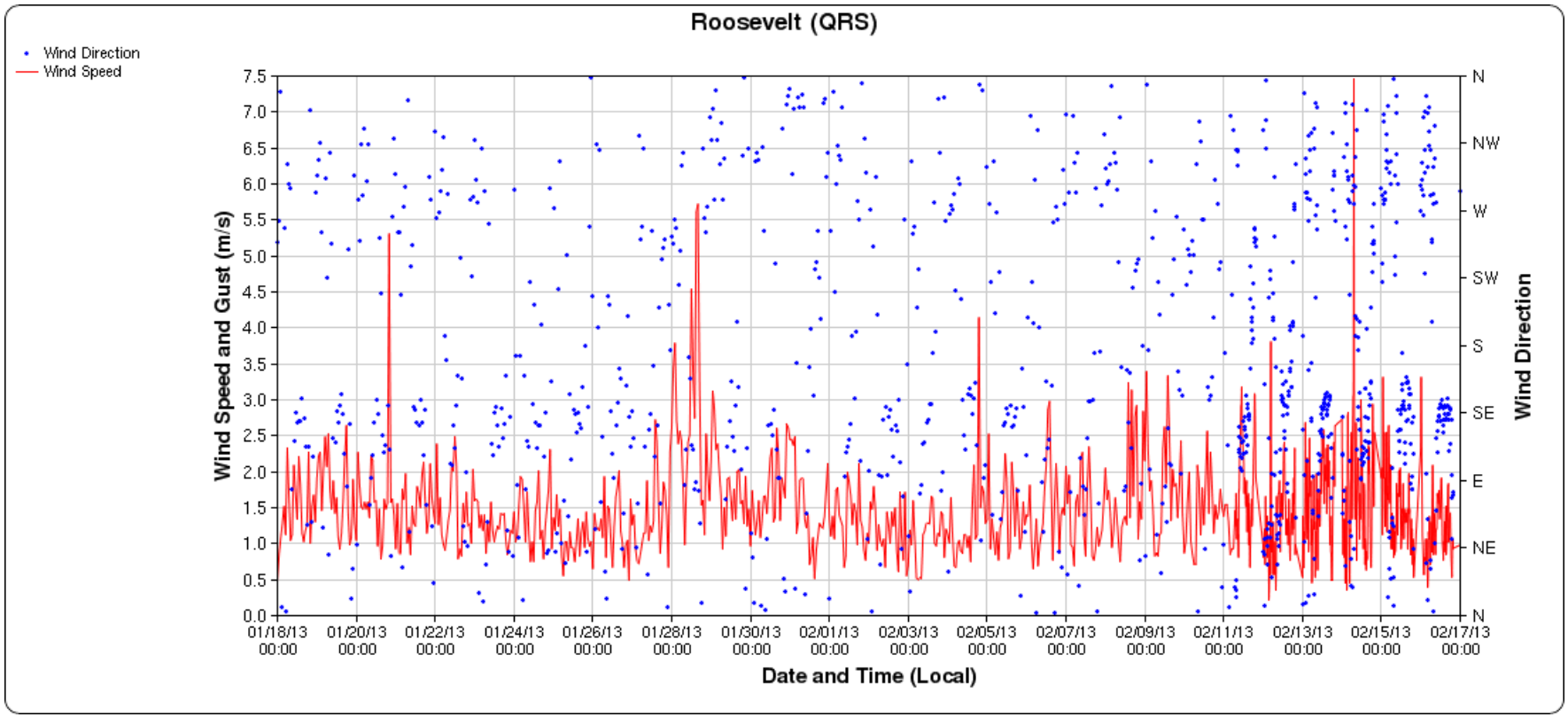

Uintah Basin Research Trailer (UUT01)
5.0m Solar Radiation
5.0m Net Radiation (short wave)
5.0m Outgoing Radiation (short wave)
Radiation (W/m*m)
900
800
700
600
500
400
300
200
100
0
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00
Date and Time (Local)

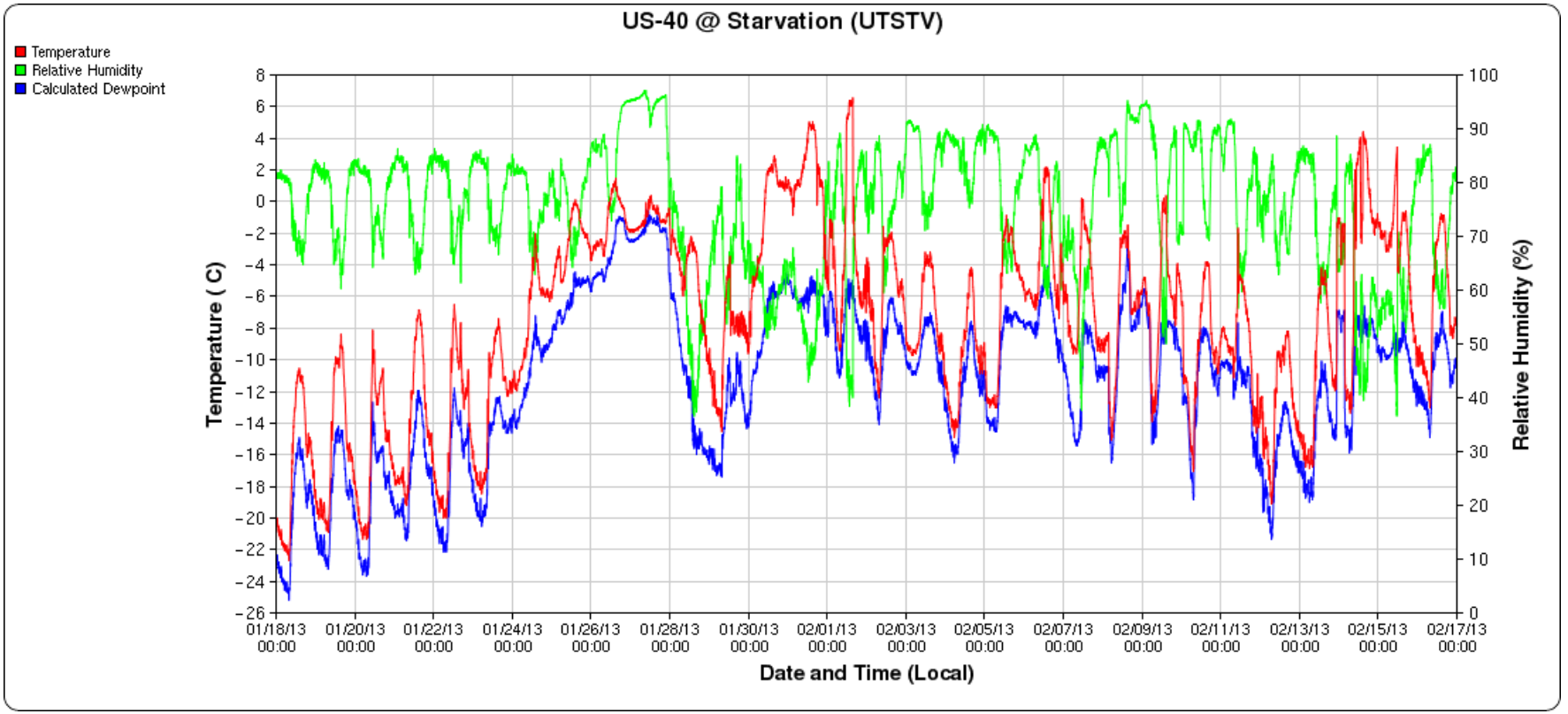

LITTLE RED FOX (LRFU1)
Temperature
Relative Humidity
Calculated Dewpoint
Temperature (C)
Relative Humidity (%)
Date and Time (Local)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
100
90
80
70
60
50
40
30
20
10
0
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00

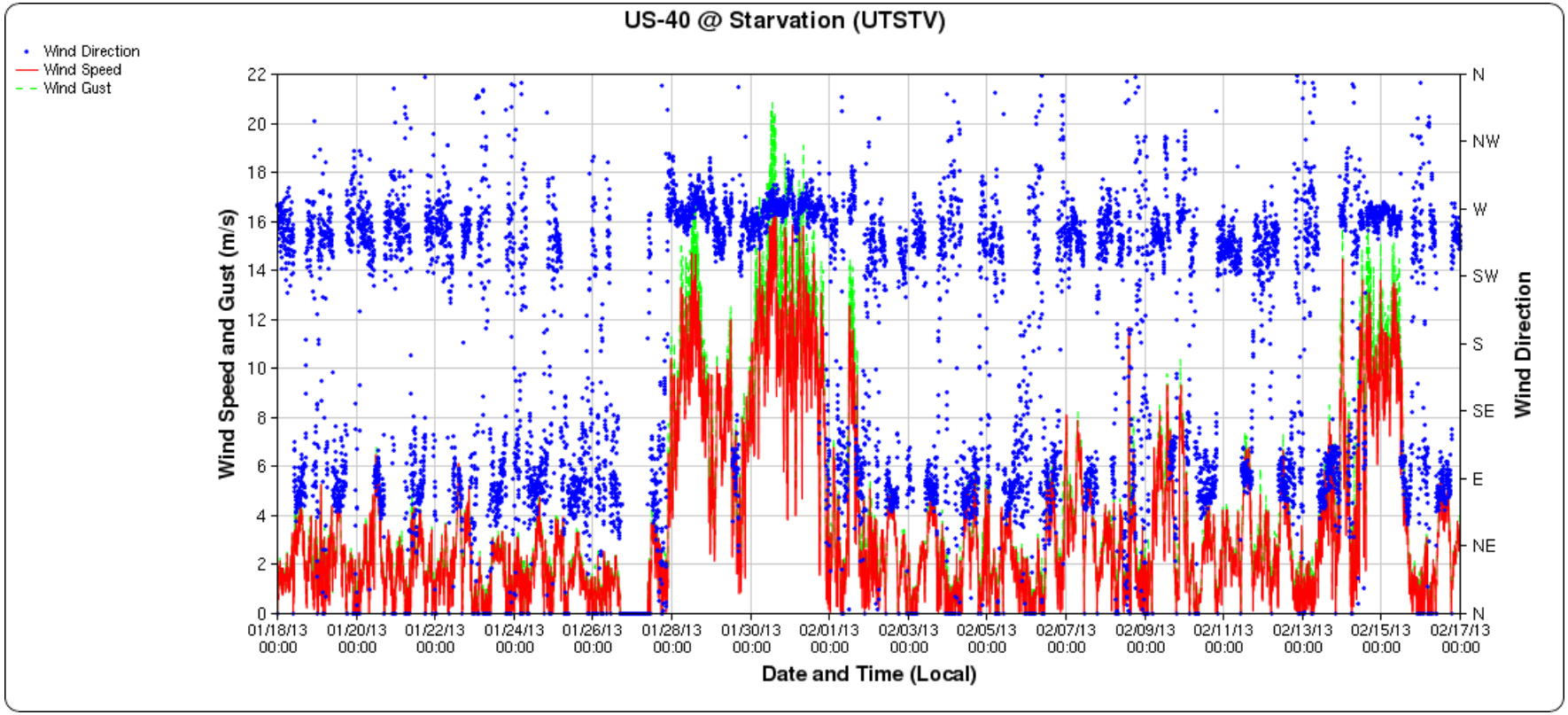

LITTLE RED FOX (LRFU1)
Solar Radiation
Solar Radiation (W/m*m)
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00
Date and Time (Local)

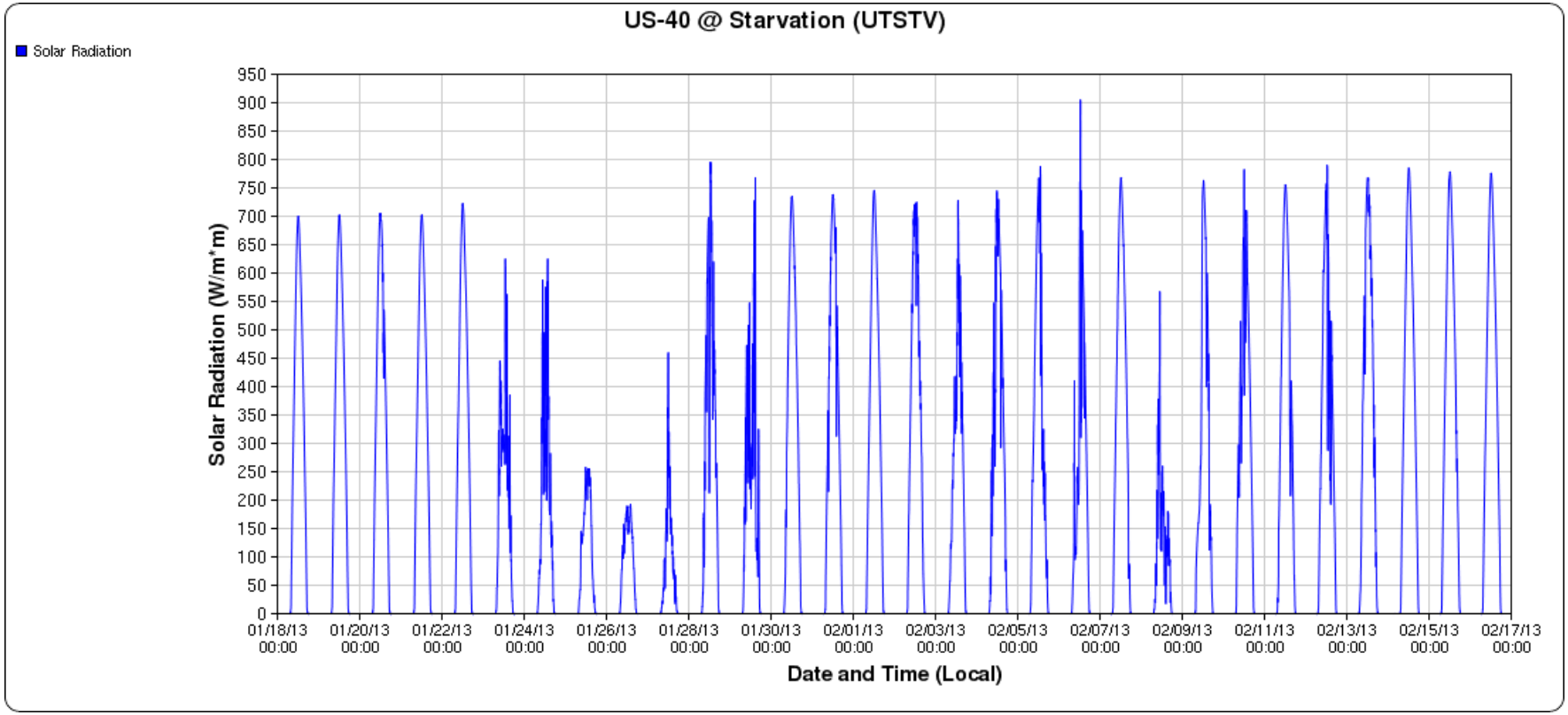

LITTLE RED FOX (LRFU1)
Wind Direction
Wind Speed
Wind Gust
Wind Speed and Gust (m/s)
Wind Direction
N
NW
W
SW
S
SE
E
NE
N
0
1
2
3
4
5
6
7
8
9
10
11
12
13
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00
Date and Time (Local)

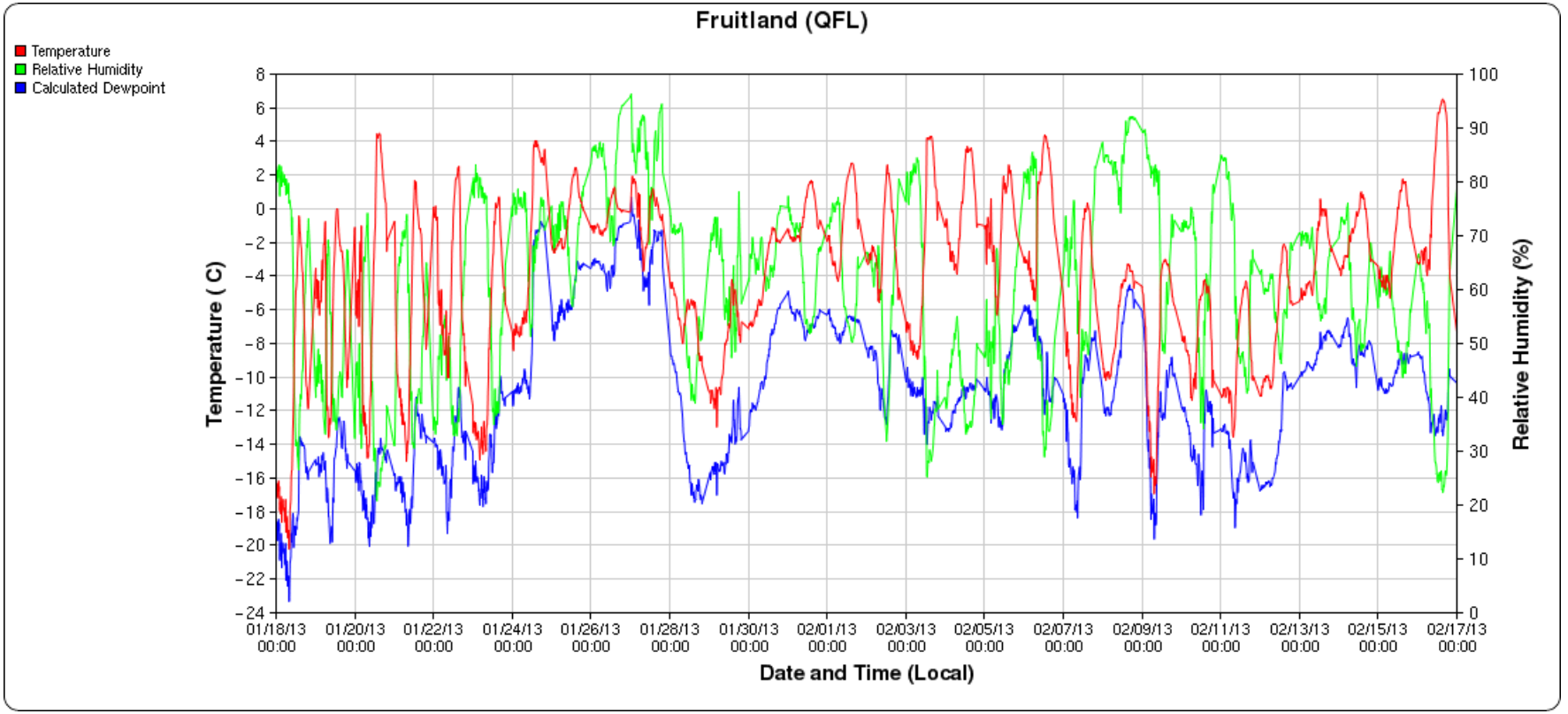

Roosevelt (QRS)
Temperature
Relative Humidity
Calculated Dewpoint
Temperature (C)
Relative Humidity (%)
Date and Time (Local)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
100
90
80
70
60
50
40
30
20
10
0
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00

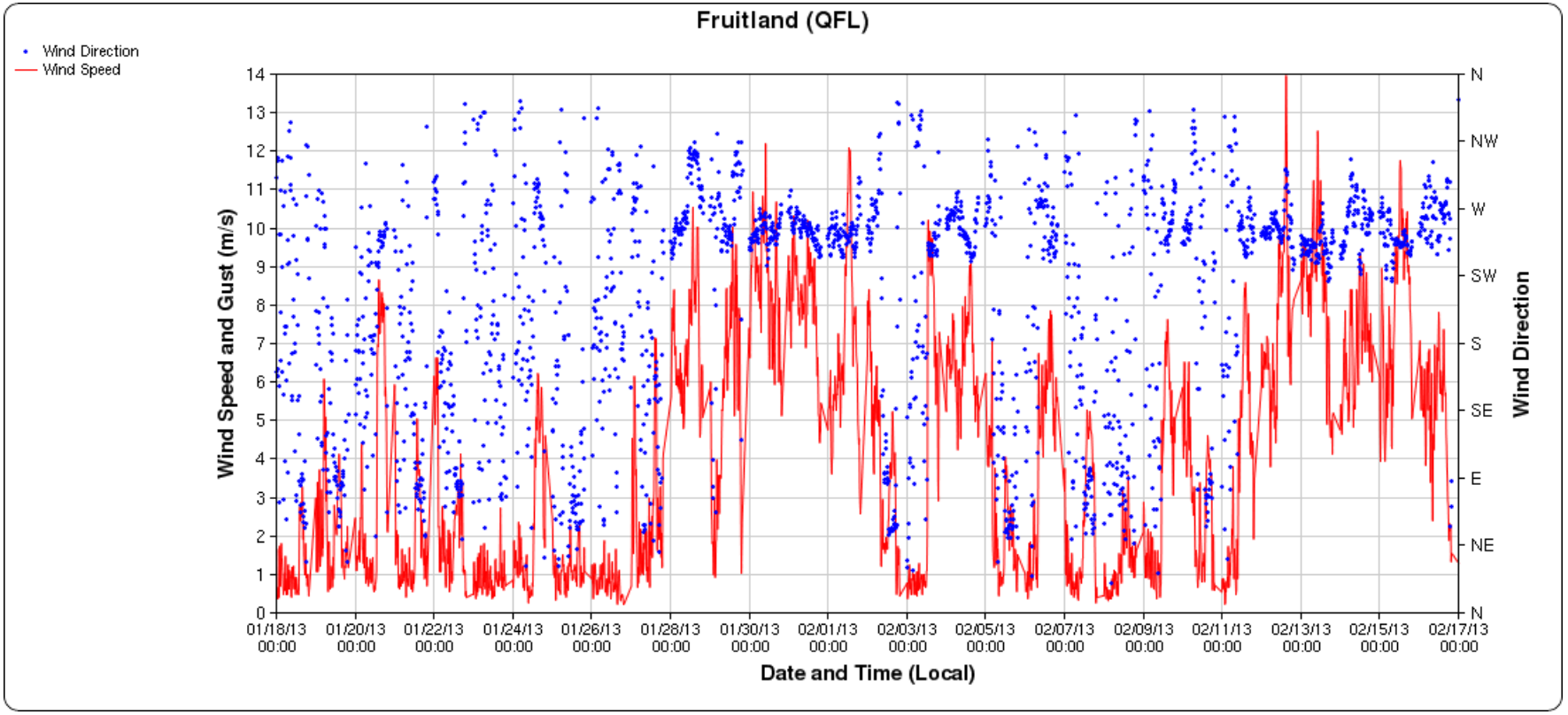

Roosevelt (QRS)
Wind Direction
Wind Speed
Wind Speed and Gust (m/s)
Wind Direction
Date and Time (Local)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
N
NW
W
SW
S
SE
E
NE
N
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00

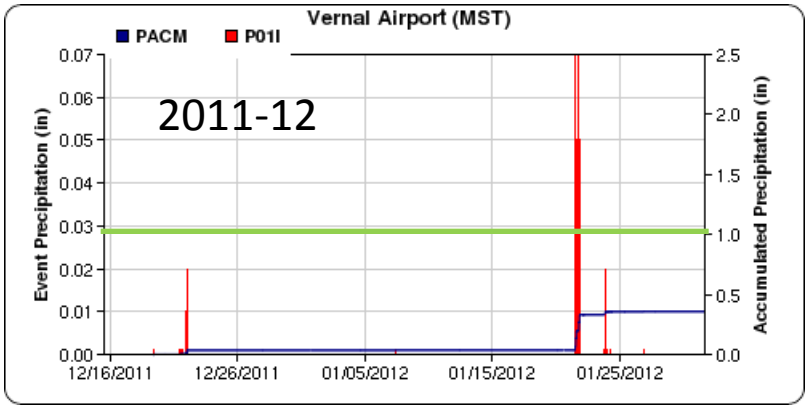

US-40 @ Starvation (UTSTV)
Temperature
Relative Humidity
Calculated Dewpoint
Temperature (C)
Relative Humidity (%)
Date and Time (Local)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
100
90
80
70
60
50
40
30
20
10
0
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00

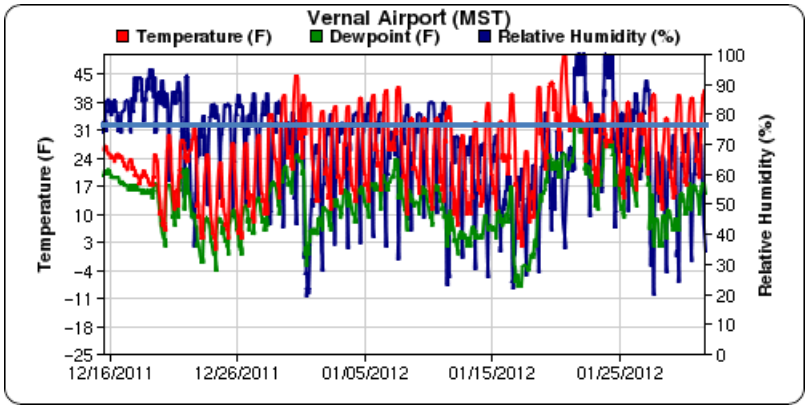

US-40 @ Starvation (UTSTV)
Wind Direction
Wind Speed
Wind Gust
Wind Speed and Gust (m/s)
Wind Direction
Date and Time (Local)
0
2
4
6
8
10
12
14
16
18
20
22
N
NW
W
SW
S
SE
E
NE
N
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00

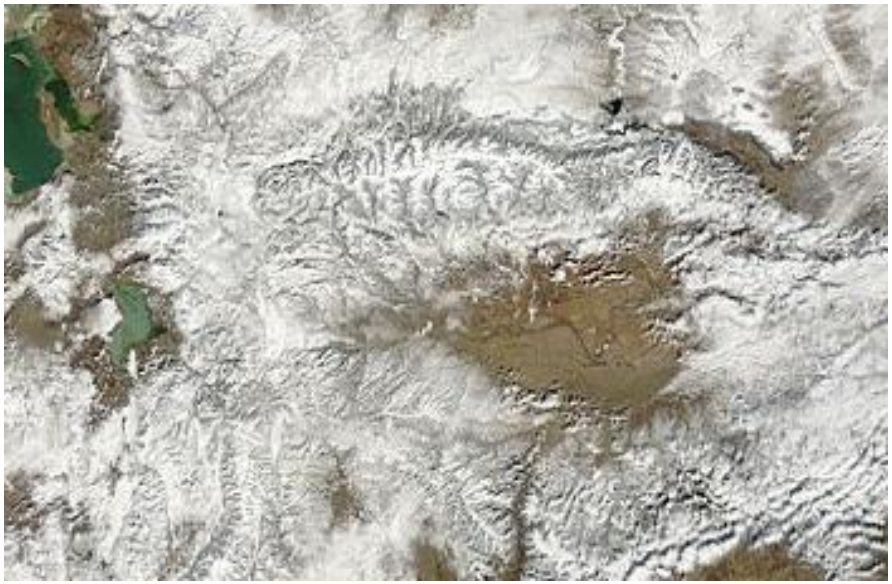

US-40 @ Starvation (UTSTV)
Solar Radiation
Solar Radiation (W/m*m)
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00
Date and Time (Local)


Fruitland (QFL)
Temperature
Relative Humidity
Calculated Dewpoint
Temperature (C)
Relative Humidity (%)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
100
90
80
70
60
50
40
30
20
10
0
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00
Date and Time (Local)


Fruitland (QFL)
Wind Direction
Wind Speed
Wind Speed and Gust (m/s)
Wind Direction
Date and Time (Local)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
N
NW
W
SW
S
SE
E
NE
N
01/18/13 00:00
01/20/13 00:00
01/22/13 00:00
01/24/13 00:00
01/26/13 00:00
01/28/13 00:00
01/30/13 00:00
02/01/13 00:00
02/03/13 00:00
02/05/13 00:00
02/07/13 00:00
02/09/13 00:00
02/11/13 00:00
02/13/13 00:00
02/15/13 00:00
02/17/13 00:00

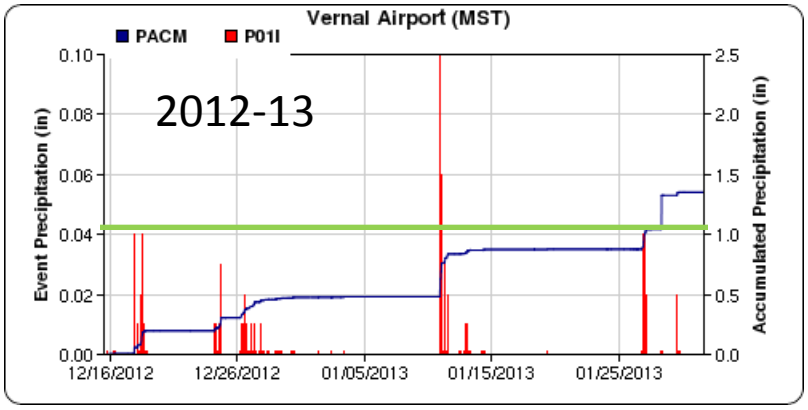


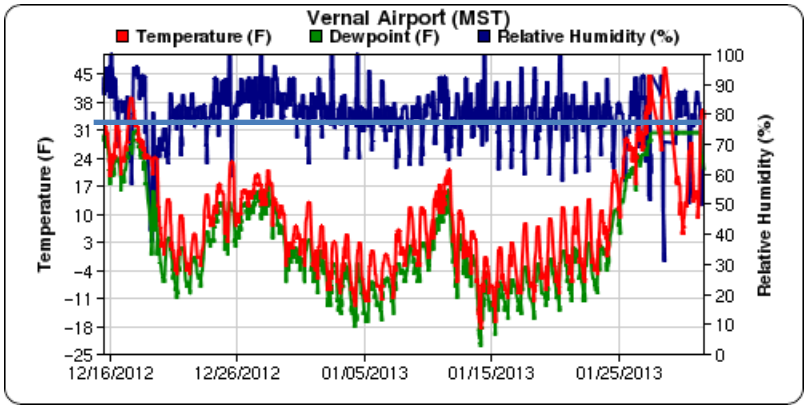




Mid-February 2012.
Vernal -0.5 ^{o}C (**+2.5**)
Salt Lake City 3.0 ^{o}C **(+1.5**)
700 mb (**-1.5**)
Peak ozone **63 ppb**
Feb Snow days **0**

Sensitivity to Timing of Rare Snow Events Leading to Snow Cover





Mid-February 2013.
Vernal -8.5 ^{o}C (**-4.5**)
Salt Lake City -1.7 ^{o}C (**-3.0**)
700 mb (**-2.5**)
Peak ozone **150 ppb**
Feb Snow days **28**

Sensitivity to Timing of Rare Snow Events Leading to Snow Cover