CRB TOOLS and FORECASTING

Jacob Wolf
Senior Air Quality Meteorologist

OUTLINE

- Overview of CRB
- CRB Op Guide Parameters
- Forecast Development
- Meteorological Tools

DEQ's Mission

To protect human health and the quality of Idaho's air, land and water.

Purpose of the Program

To Minimize the impact of smoke on public health

- Inhaling smoke worsens the symptoms of heart and respiratory conditions
- Health effects of smoke include:
  - Irritation of the eyes and airways
  - Coughing
  - Scratch throat
  - Irritated sinuses
  - Headaches
  - Stinging eyes
  - Runny nose

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Registration Process

Process approximately 350 registrations annually

- Registration Includes:
  - Applicant and Burn Manager Information
  - Location
  - Crop Type
  - Acreage
  - Fire Safety Measures
  - Requested Burn Date

Burn Decision

DEQ Must Make a Daily Burn Decision by County

Includes:

Number of Acres Burned

Burn Window

Provide an Email Update

Toll-Free Number

Year	Acres Burned
2008	34310
2009	54695
2010	64165
2011	65362
2012	67370
2013	54418
2014	43390
2015	37393
2016	39579
2017	36737
2018	40536
2019	34123
Average:	47673
Min:	34123
Max:	67370

Burn Decision Factors

- Air Quality (Current and Forecast)
- Emissions (DEQ and other potential emission sources)
- Acreage
- Crop Type
- Fuel Characteristics
  - Fuel/Soil Moisture
- Meteorological Conditions
  - Wind (Surface and Transport)
  - Ventilation
  - Inversion Breakout
  - RH
  - Mixing Heights
- Proximity to ISPs
- Proximity to Roadways

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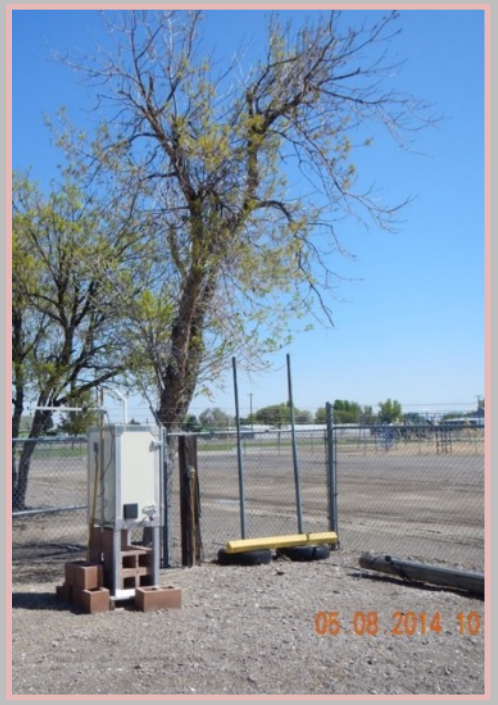
Air Quality

CRB program concentration thresholds - RULE

- 90 % of ozone and 75% of any other NAAQS
  - 26 $\mu g/m^3$ for $PM_{2.5}$ (24-hour average)
  - 63 ppb for Ozone (8-hour average)

- 80% of action criteria for particulate matter =
  - 64 $\mu g/m^3$ for $PM_{2.5}$ (1-hour average)



Pre-Burn/Post Burn Thresholds

- **Pre-Burn**
  - 24 Hour $PM_{2.5}$: > 16 $\mu g/m^3$
  - 4 Hour $PM_{2.5}$: > 22 $\mu g/m^3$
- **Post Burn**
  - 1 Hour $PM_{2.5}$: > 64 $\mu g/m^3$
  - 1 Hour $PM_{2.5}$: > 26.25 $\mu g/m^3$
    - 1 Hour $PM_{2.5}$: 20 to 26.25 $\mu g/m^3$
  - 4 Hour $PM_{2.5}$: >32 $\mu g/m^3$
  - 24 Hour $PM_{2.5}$: > 26 $\mu g/m^3$
  - 8 Hour Ozone: > 63ppb

CRB Op Guide Parameters

Table 1. Burn decision meteorological parameters.

Parameter	Burn Day	Conditional Burn Day	No-Burn Day
Ventilation	"Good" to "Excellent" ventilation is preferred; however, if ventilation is "Good" or "Excellent," check to make sure surface wind speeds are <12 miles per hour (mph).	• "Good" to "Excellent" ventilation may be unacceptable if surface winds are >12 mph • Burning under "Marginal" ventilation may be acceptable only if other criteria are met and burning proceeds with caution. • "Poor" ventilation should be avoided unless there is good vertical convection with enough fuel and/or wind to carry the fire and good transport winds aloft.	"Very Poor" ventilation should be avoided.
Cloud cover	Mostly sunny to partly cloudy is typically best.	• Clear bright skies may indicate a high-pressure system with stagnant conditions. Make sure other criteria are met if this is the case. • Cloudy conditions may be acceptable if clouds are high and all other criteria are met.	Mostly cloudy conditions with low clouds should be avoided.
Surface wind speed (sustained)	Moderate winds, 3 to 8 mph are preferred.	• Calm or near calm winds should be avoided. Light winds <3 mph generally are insufficient to carry the fire. However, sunshine and abundant/dry fuel, especially on a hill, may result in good rise for lighter winds <3 mph. • Winds 8–12 mph may be ok if there is strong sunshine to maximize vertical convection, but proceed with caution.	• Burning is not allowed at fields located within 3 miles of an ISP when wind speeds exceed 12 mph. • Winds >12 mph should be avoided even in remote areas for fire safety reasons.
Surface wind direction	• Avoid institutions with sensitive populations, populated areas, and nearby public roadways, etc. • If possible, also avoid large bodies of water and large canyons/valleys. • Be aware of typical wind shifting patterns in an area and atypical forecast wind shifts.	N/A	It is critical to avoid cities and institutions with sensitive populations.

CRB Op Guide Parameters

Parameter	Burn Day	Conditional Burn Day	No-Burn Day
Transport wind speed (at 850 millibar level or about 5,000 feet AGL)	7–20 mph is preferred.	Use caution with transport winds that are <7 mph or >20 mph.	Upwind of cities and institutions with sensitive populations, transport winds >20 mph should be avoided.
Transport wind direction	Avoid institutions with sensitive populations, populated areas, and nearby public roadways, airports, etc.	Avoid transport winds taking smoke towards cities and institutions with sensitive populations unless ventilation is "Good" to "Excellent."	It is most critical to avoid cities and institutions with sensitive populations at all times.
Mixing height	Greater than 5,000 feet above ground level is desired.	With mixing heights of 2,000–5,000 feet, caution should be used. If transport winds will transport smoke over large bodies of water and large canyons/valleys, avoid burning if mixing height is less than 5,000 feet.	Avoid burning if the mixing height is <2,000 feet above ground level.
Relative humidity	15–45% relative humidity is the ideal range.	• Relative humidity <15% is acceptable if fire control/safety concerns with surrounding fuels are low. • Relative humidity between 45% and 60% may inhibit plume rise and smoke dispersion. • For bluegrass, relative humidity >30% may inhibit plume rise and smoke dispersion.	Relative humidity >60% should be avoided as it may inhibit smoke dispersion and may leave unburned materials.
Inversion conditions There are two types of inversions (radiation and subsidence) and they should both generally be avoided.	Preferably, burns should occur after 10 a.m. and be extinguished before 5 p.m. to avoid trapping the smoke in mountain valleys by radiation inversions.	Radiation Inversion—This is a surface-based inversion that exists on most mornings and evenings, particularly when daytime heating is strong. • Burning should not be permitted before the inversion has mixed out unless transport conditions after breakup would best protect population centers and burning during an inversion does not cause adverse impacts. • A sufficient amount of time should be allowed at the end of the burn day for any residual smoke to disperse before a radiation inversion returns.	Subsidence Inversion—When a strong high-pressure system is present with clear skies, hot air subsides, causing stable air and poor dispersion. This condition is easy to forecast and a no-burn day should be called when a strong high-pressure system is over the region.

With that in mind…

Forecast Product-General Weather

CRD DISPERSION FORECAST: 05/03 AM
SMOKE DISPERSION FORECAST for SOUTHERN IDAHO

Forecast Prepared by: IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY
Forecast Time Prepared: 8:00 AM MDT – Wednesday May 03, 2017
Forecast for: Wednesday–May 03, 2017

GENERAL WEATHER DISCUSSION:
WEDNESDAY:
Today, an upper level ridge will continue to amplify. This will bring warm temperatures, mostly sunny skies, and light winds. Surface wind speeds will range between 2-8 mph. Surface wind direction will be from the west-northwest but variable at lighter speeds. Skies will be mostly sunny to sunny. Mixing heights will range from 1,000-4,000 feet AGL. Transport wind speed will be between 2-8 mph and be from the west-northwest and again, variable at lighter wind speeds. Ventilation is forecast to be POOR in the morning and GOOD in the afternoon while improving to MARGINAL across the entire Snake River Plain. Inversions are expected to break between 11am-12noon.

Forecast Product-Airshed Specific

FORECASTS BY AIRSHED:
SOUTHWEST IDAHO Air Shed:
Forecast for WEDNESDAY:
SKY/WEATHER: Mostly sunny skies all day.
TEMPERATURE: High temperatures ranging from 73-75 degrees.
HUMIDITY: Minimum RH between 25-30 percent.
WIND – SURFACE: Northwest at 2-8 mph.
TRANSPORT: Northwest at 2-8 mph.
INVERSIONS: Inversion breaking around 11am at a temperature of 60-62 degrees.
MIXING HEIGHT: Air mass will become unstable to 3,000 feet AGL.
VENTILATION: POOR in the morning becoming MARGINAL to locally GOOD in the afternoon.

Forecast Product-Ventilation and Recommendation

VENTILATION RECOMMENDATIONS by Air Shed:											
		08	09	10	11	12	13	14	15	16	17
Southwest Idaho		P	P	P	M	M	M	M	M	M	M
N. Magic Valley		P	P	P	M	M	M	M	M	M	M
S. Magic Valley		P	P	P	M	M	M	M	M	M	M
Southeast Idaho		P	P	P	M	M	M	M	M	M	M
Eastern Idaho		P	P	P	M	M	M	M	M	M	M
Central ID Mtns		P	P	P	M	M	G	G	G	G	G
Key: VP=VERY POOR P = POOR M= MARGINAL G= GOOD											

SOUTHERN IDAHO Air Shed Recommendations (by County): Conditional due to ventilation.

Forecast Product-Extended Forecast

EXTENDED WEATHER OUTLOOK: Thursday May 4, 2017

On Thursday, the upper level ridge will begin to track eastward, but will still be the primary influence upon our airsheds. Expect consistent southerly flow with hot temperatures in the mid 70's to mid 80's. Surface wind speeds will range between 5-10 mph. Surface wind direction will be from the southeast to east. Skies will be sunny. Mixing heights will range from 2,000-5,000 feet AGL. Transport wind speed will be between 5-10 mph and be from the southeast-east. Ventilation is forecast to be POOR in the morning and GOOD in the afternoon while improving to MARGINAL across much of the Eastern and Southeast SMA's. Inversions are expected to break between 11am-12noon.

END…Jacob Wolf, AQ Meteorologist

Forecast Product-County Recommendation

Ada	Conditional
Adams	Burn
Bannock	Conditional
Bear Lake	Burn
Bingham	Conditional
Blaine	Conditional
Boise	Burn
Bonneville	Conditional
Butte	Conditional
Camas	Burn
Canyon	Conditional
Caribou	Conditional
Cassia	Burn
Clark	Conditional
Custer	Burn

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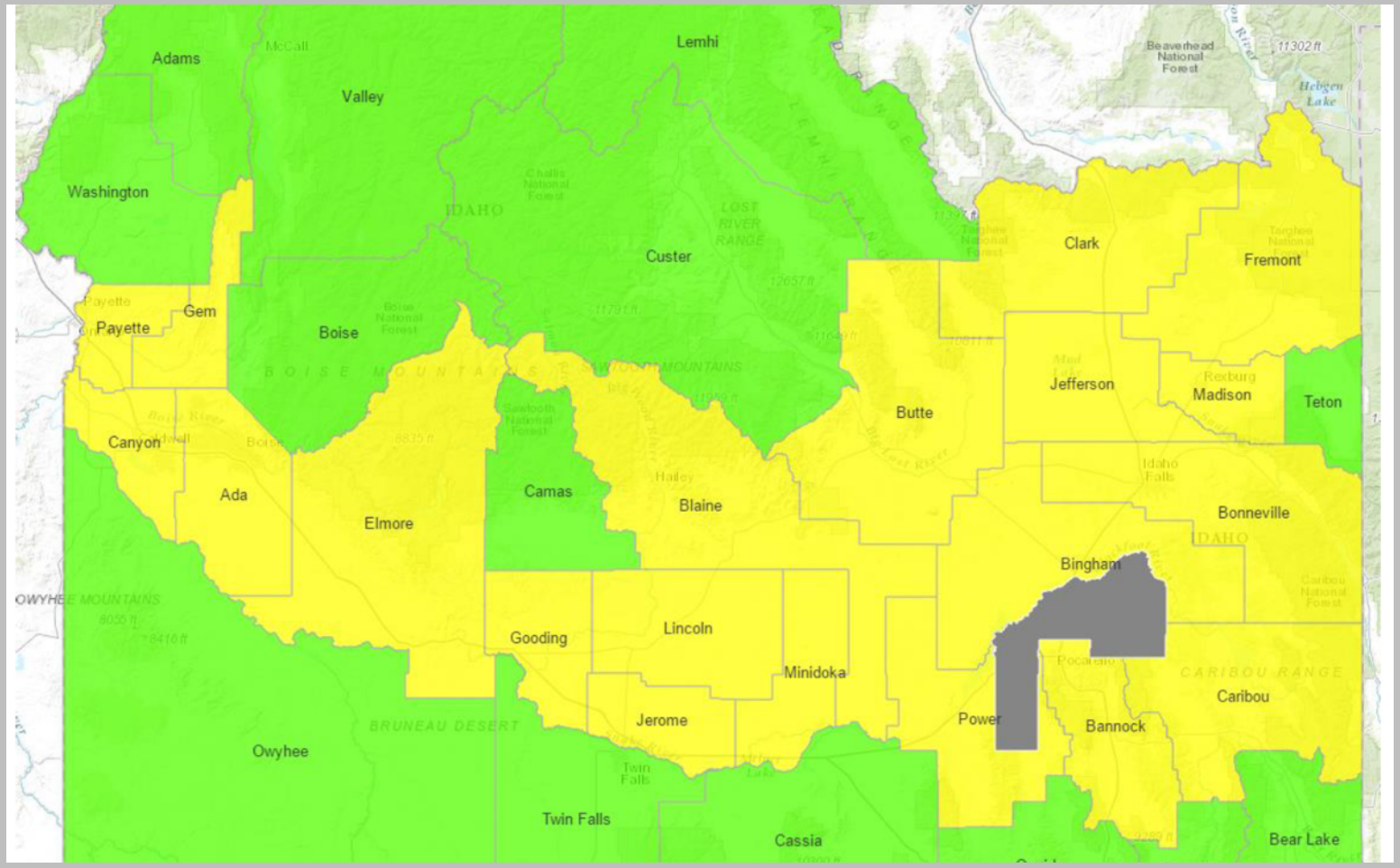
Forecast Product-County Recommendation Map



…How do we get there?

Smoke Mgmt Forecasting Tools

Staff Contact

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NWS Tools
Idaho Graphical Forecast
FirePoker
Spot Weather Requests

Area Forecast Discussion					
BOI	PIH	MSO	OTX	PDT	SLC

Fire Weather Forecast					
BOI	PIH	MSO	OTX	PDT	SLC

FireDay Graphical Forecast					
BOI	PIH	MSO	OTX	PDT	SLC

Local Climate					
BOI	PIH	MSO	OTX	PDT	SLC

NOAA HPC/SPC		
Model Diagnostic Discussion	SPC Mesoanalysis	HPC Surface Analysis

AirFire Tools			
HYSPLIT Trajectories	Monitoring	BlueSky Playground	Bluesky Daily Runs

NWP Models			
UW-WRF	UW-WRF Extended	UW-WRF Air Quality	UW-WRF Extended Air Quality
Tropical Tidbits	College of DuPage-Models	Windy	SimuAWIPS

Observations
Weather and Hazards Viewer College of DuPage-Satellite
MesoWest
Montana-Idaho Airshed Group Proposed Burn Map

[Graphical Forecast]
[BOI NWS AFD]
[Model Diagnostic Disc.]
[UW WRF AQ]
[SimuAWIPS]
[NWS Weather and Hazards]

Home » Program Resources » AQI Forecast Tools

AQI Forecast Tools

This page helps forecasters make decisions regarding air quality in Idaho. View current conditions, satellite imagery, alerts, watches, and warnings issued by the National Weather Service, as well as the WRF GFS model output for future weather conditions. Forecasters should also utilize previous observational data by accessing the Envista database.

Model Output Statistics (MOS) for GFS, NAM, and Extended GFS from NOAA

Note: This product is raw model output and has not been adjusted for antecedent conditions or analyzed by a forecaster. Use at own discretion.

» How to Decode the MOS Guidance

Southwest Idaho	Southeast Idaho	North Idaho
Boise	Twin Falls	Coeur d'Alene
Ontario	Idaho Falls	Spokane
Mountain Home	Burley	Pullman
McCall	Pocatello	Lewiston
Caldwell	Rexburg	

Boise Regional Office

» Boise National Weather Service Area Forecast Discussion
» Idaho National Weather Service Graphical Forecasts
» Soundings
» WRF-GFS 12km-850mb Temps

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Quick Links

» National Weather Service Ra
» Infrared Satellite
» Water Vapor Satellite
» Surface Analysis
» AirNow-Tech Log-in
» DEQ AQI Log-in
» AIRPACT
» National Weather Service
» UW WRF-ARW
» University of Wyoming Sound
Select PDF:Skew-T in plot ty
down.
» DEQ Daily Air Quality Report
Forecasts
» DEQ Real-Time Air Quality M
» On the Fly Sounding Generat
» MesoWest Surface Weather M
» Canadian GEM GDPS
» RUC Soundings
» SJSU Model Graphics

Home » Program Resources » Smoke Mgmt Forecasting Tools

Smoke Mgmt Forecasting Tools

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NWS Tools

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FirePoker
Spot Weather Requests

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Fire Weather Forecast

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Tropical Tidbits | College of DuPage-Models | Windy | SimuAWIPS

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Weather and Hazards Viewer
College of DuPage-Satellite
MesoWest
Montana-Idaho Airshed Group Proposed Burn Map

BUFKIT

BUFKIT

Warning Decision Training Division
Office of Chief Learning Officer

Weather.gov > Chief Learning Officer Training Portal > Warning Decision Training Division > Tools > BUFKIT

Introduction

BUFKIT is a forecast profile visualization and analysis tool kit. It is targeted as a training and forecast tool for the decision makers of the National Weather Service. It is also available to anyone that would like to explore very high vertical and temporal resolution model output for specific point locations.

Bufkit 19 (Released February 12, 2019)

Installation

Windows:

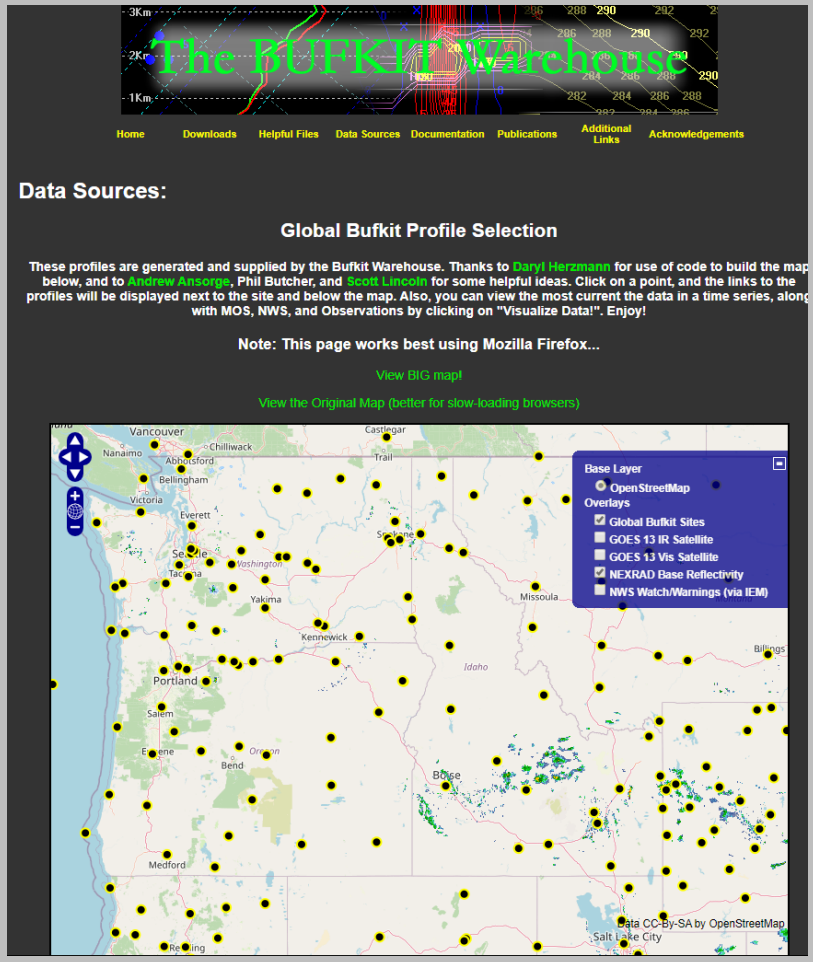
1. Uninstall any earlier version of Bufkit. (Good news if this earlier version was one of the Bufkit 18 releases).
2. Download the Bufkit19.zip file by clicking on this link right below:

   bufkit19.zip download

3. Unzip this file and place the resulting three files in the same directory.
4. Double click on the SetUp.exe to set up Bufkit 19.
5. If there was a previous version of Bufkit 18 that you uninstalled, Bufkit 19 will retain all your data and configuration files. If this is a first time Bufkit installation or the previous version of Bufkit was prior to Bufkit 18, you'll have to configure Bufkit again.

BUFKIT Sites

- Many locations across the PNW.
- Multiple models available.
- Easy updating at a click of a button!



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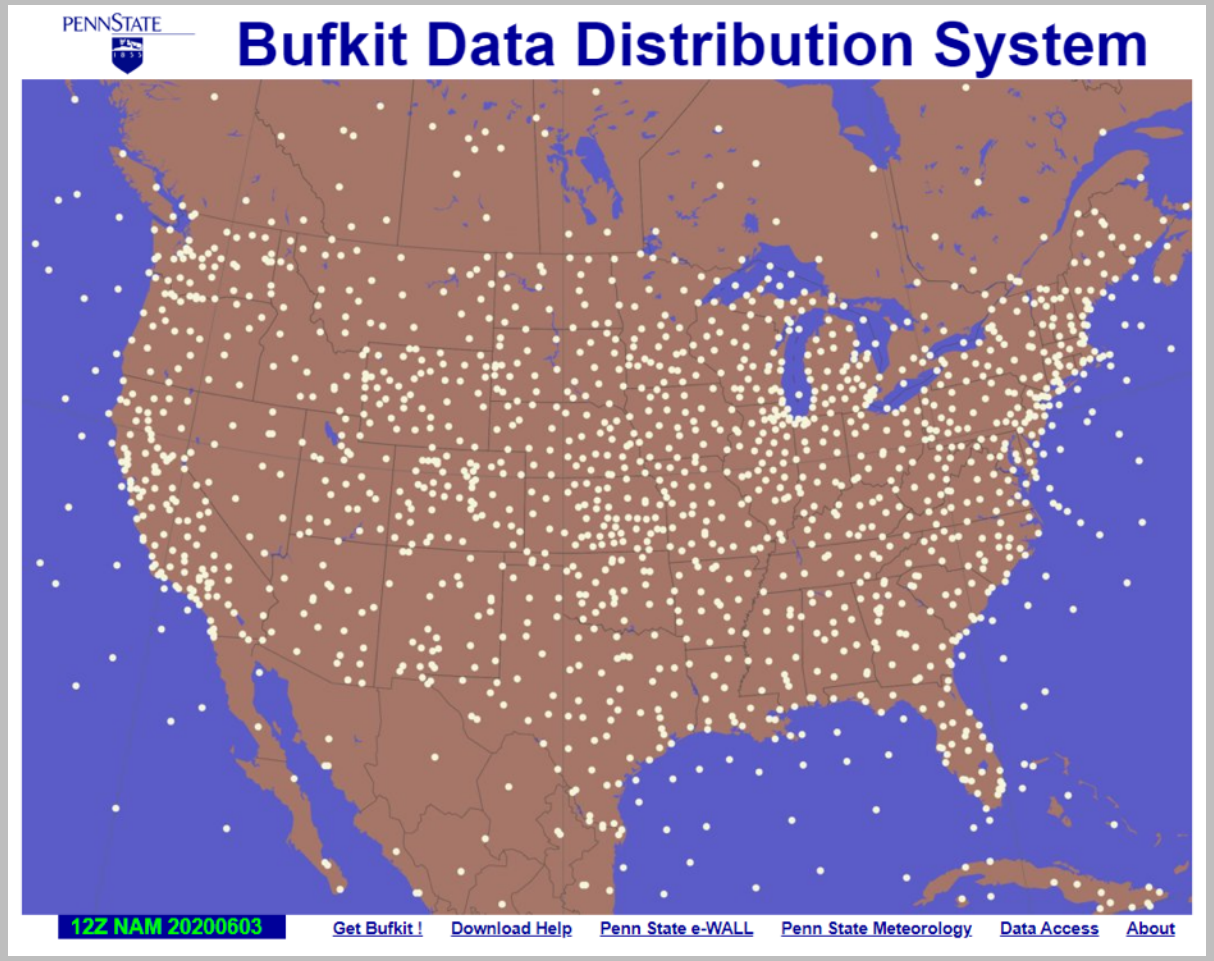
BUFKIT Sites continued…



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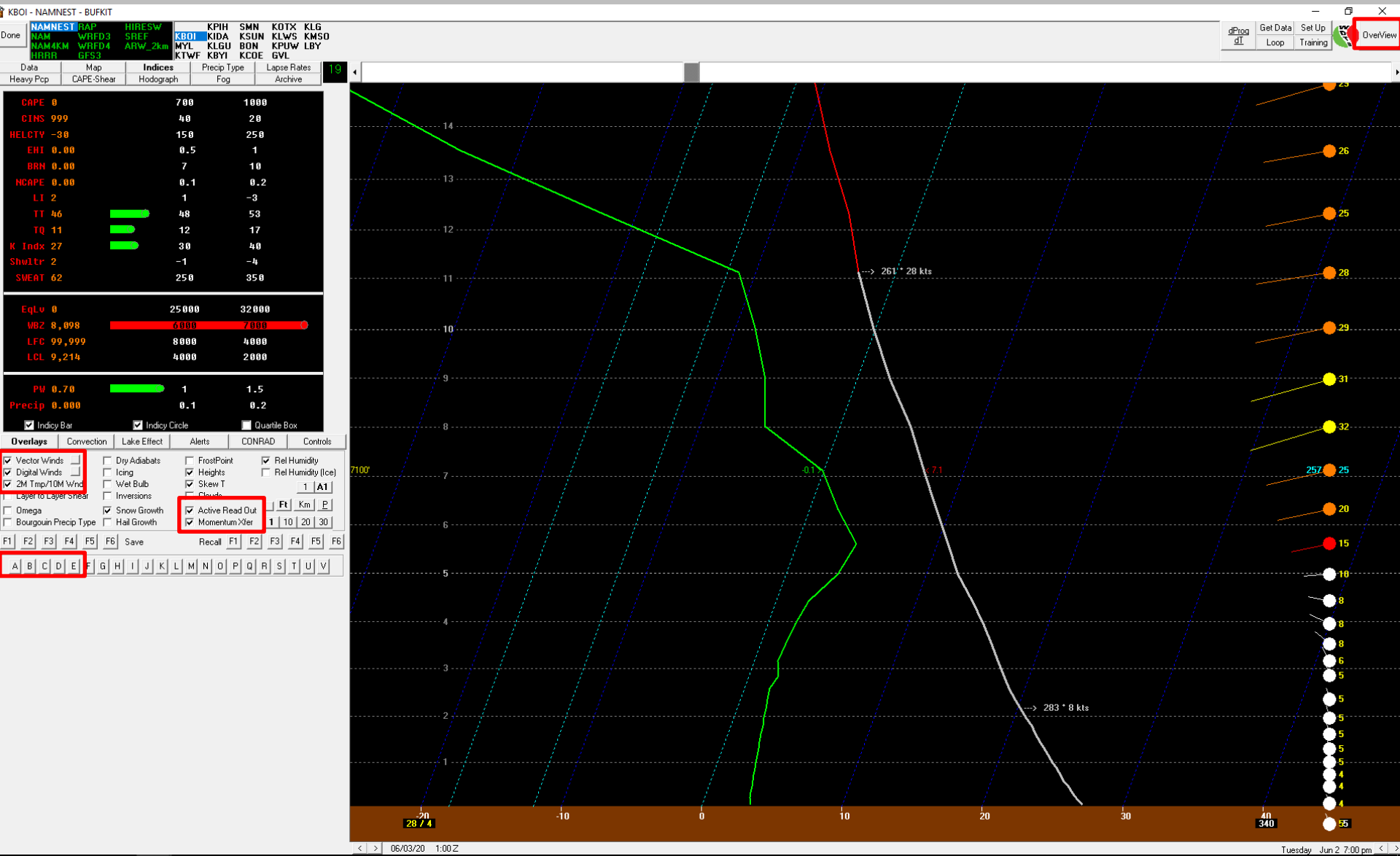
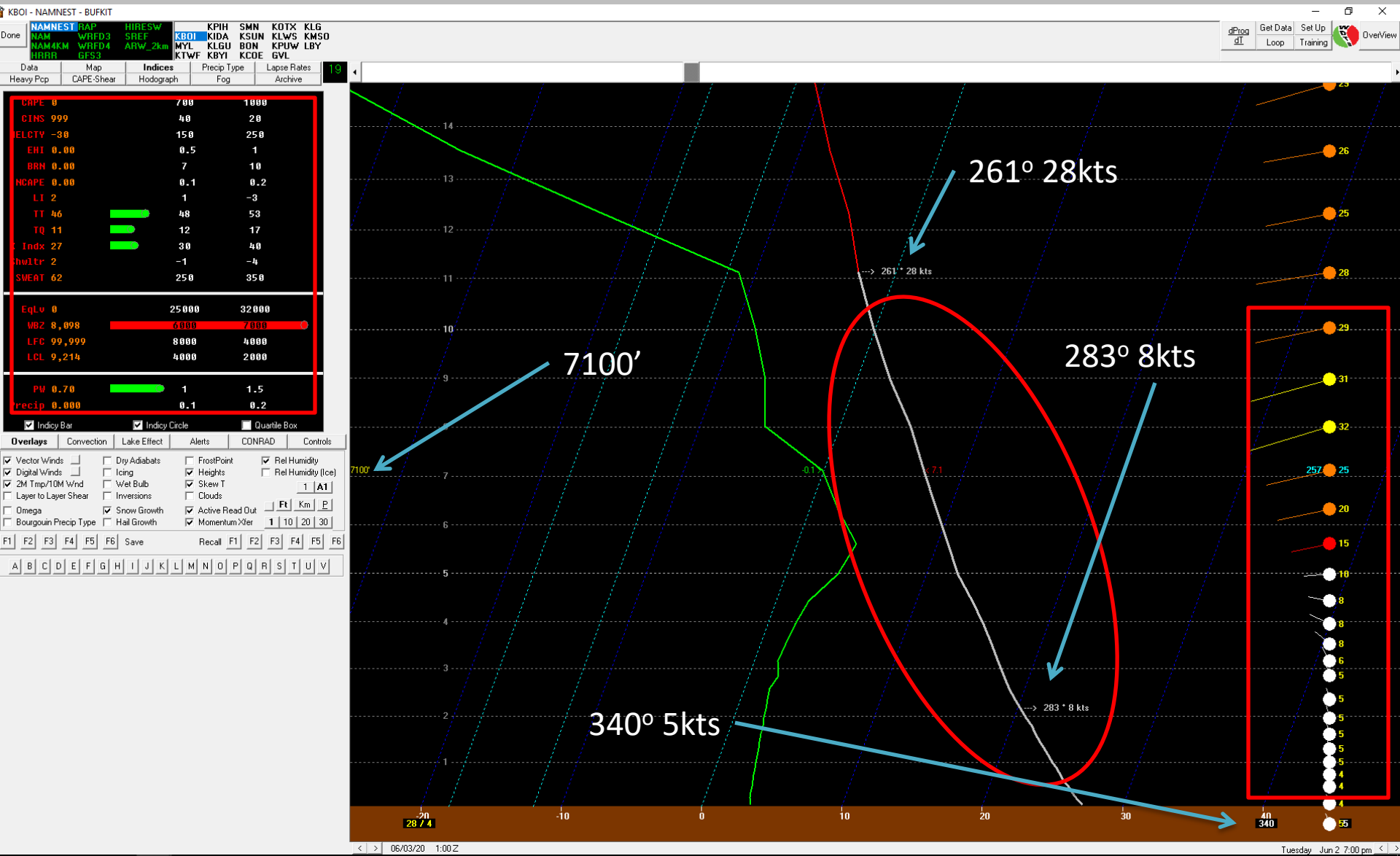
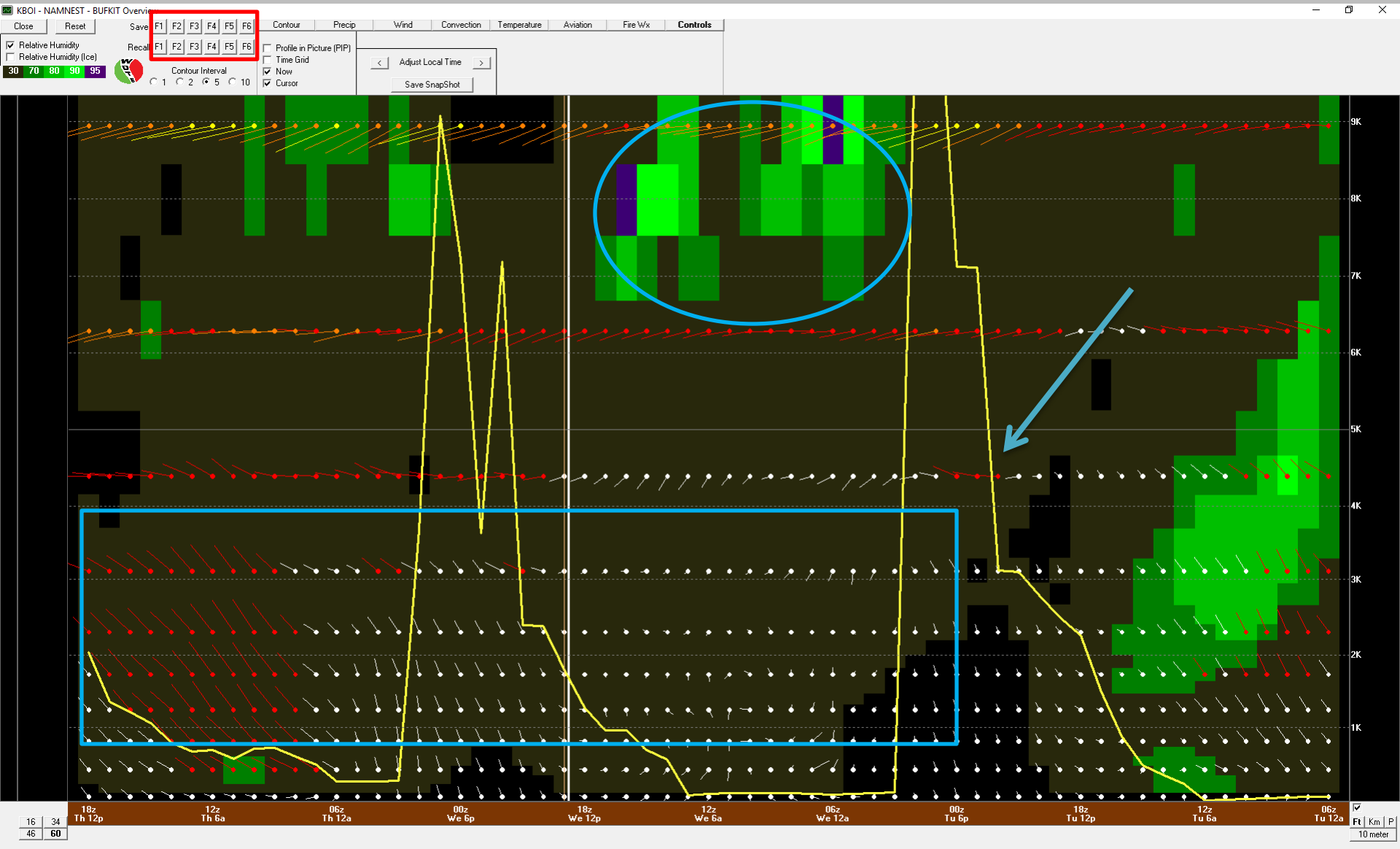
BUFKIT-Profile



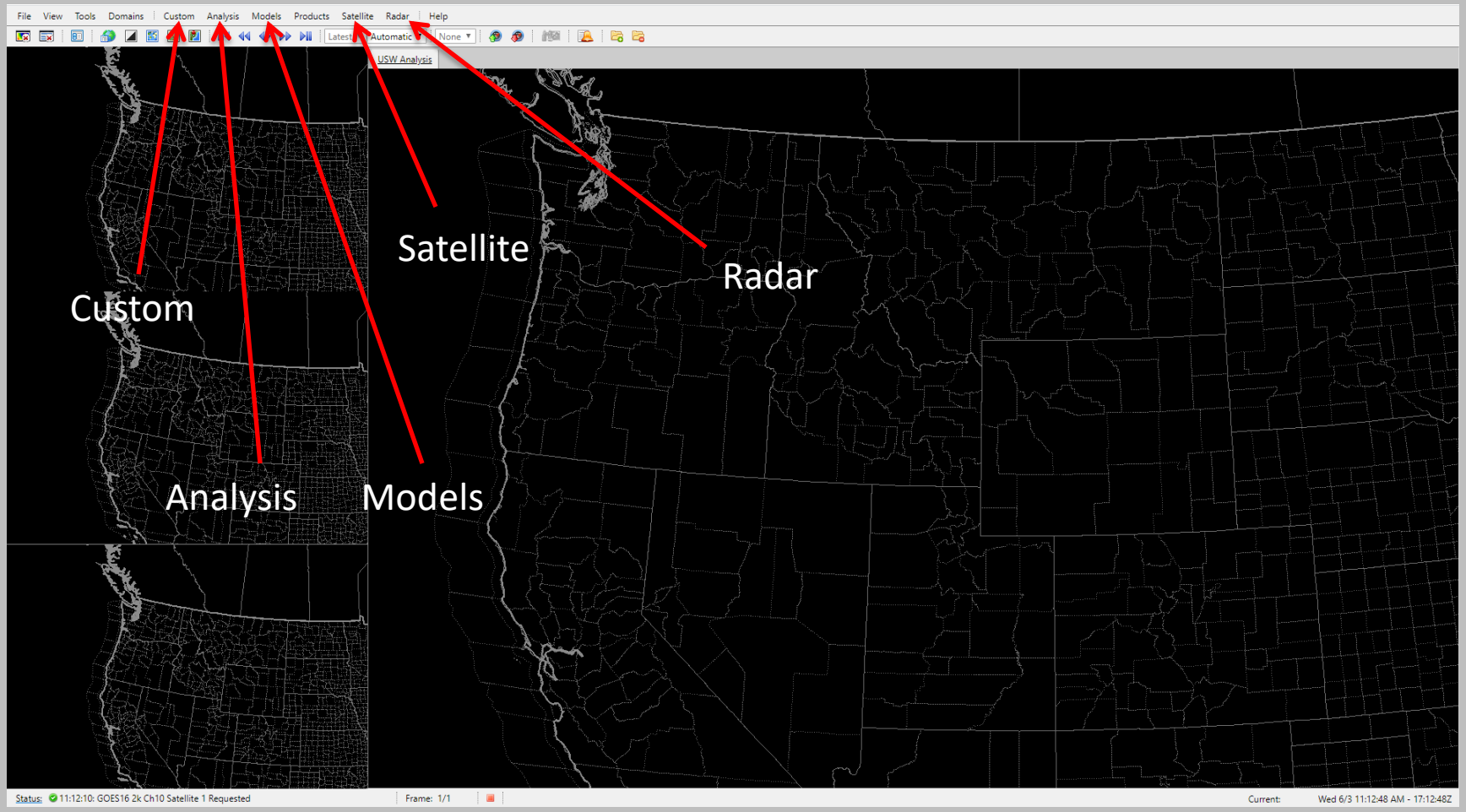
BUFKIT-Profile Cont'd.



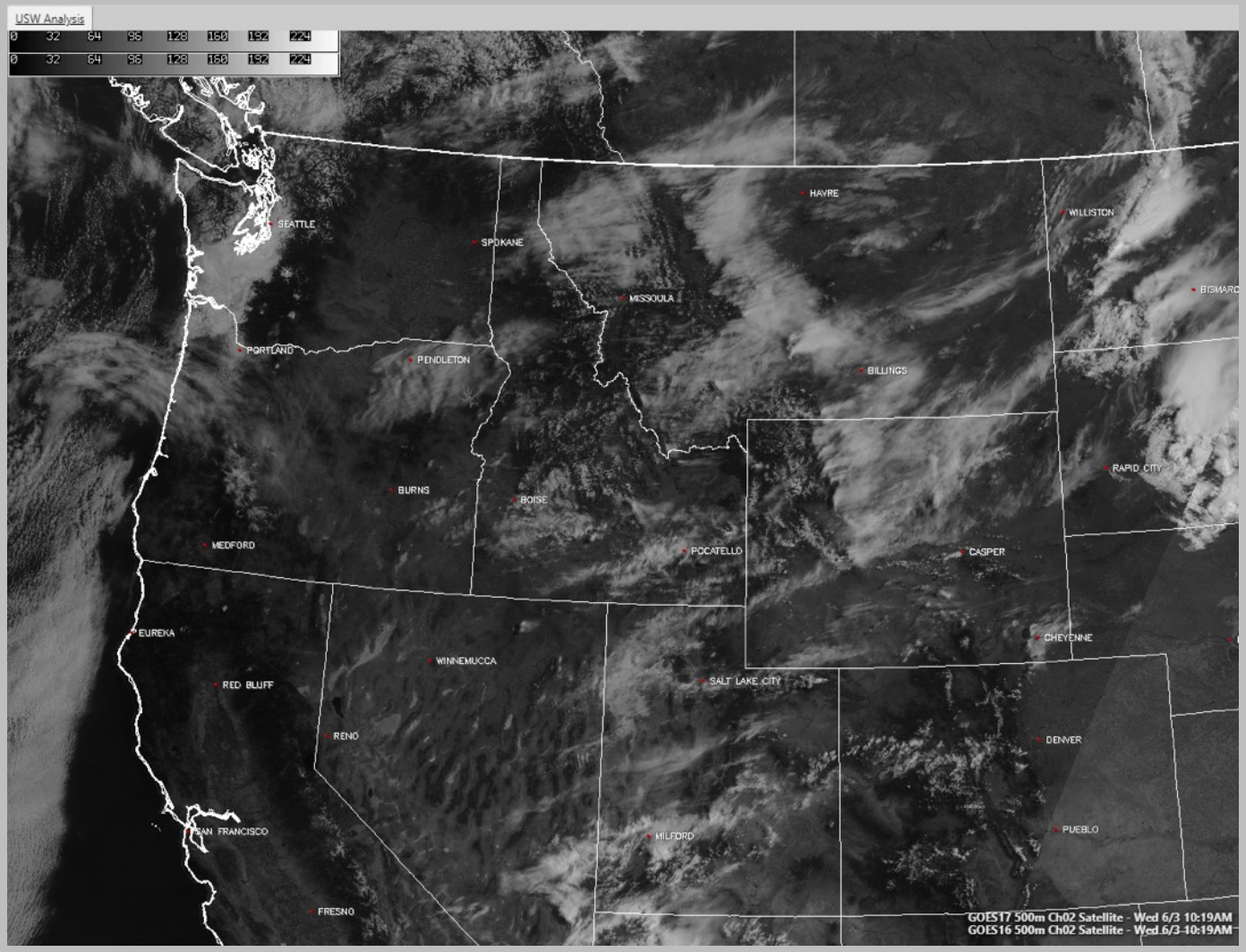
BUFKIT-Overview



SimuAWIPS (subscription based)



SimuAWIPS-
Visible Observations-GOES 16/17



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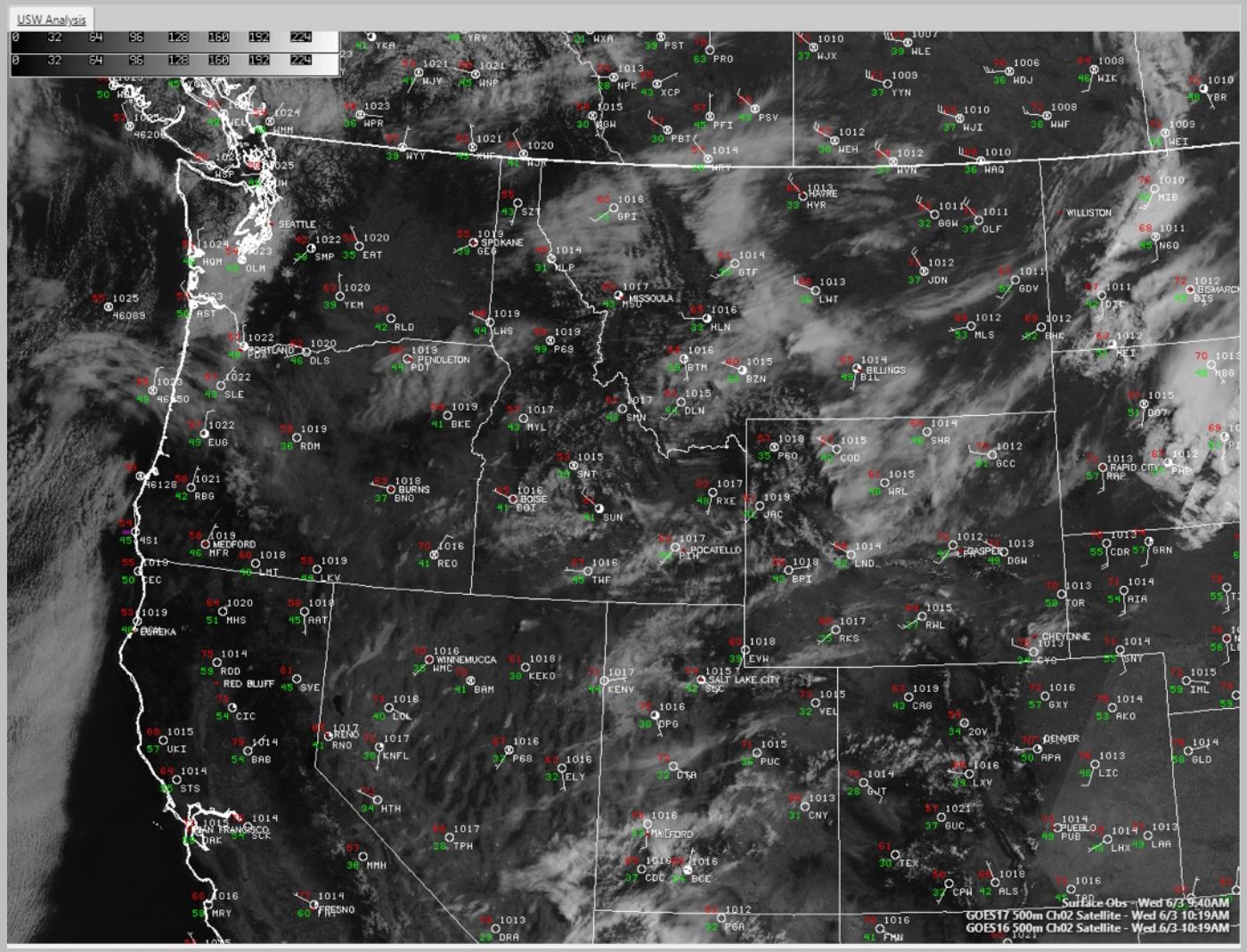
Visible Observations-GOES 16/17

- Can overlay other analysis data
- Observational station plots



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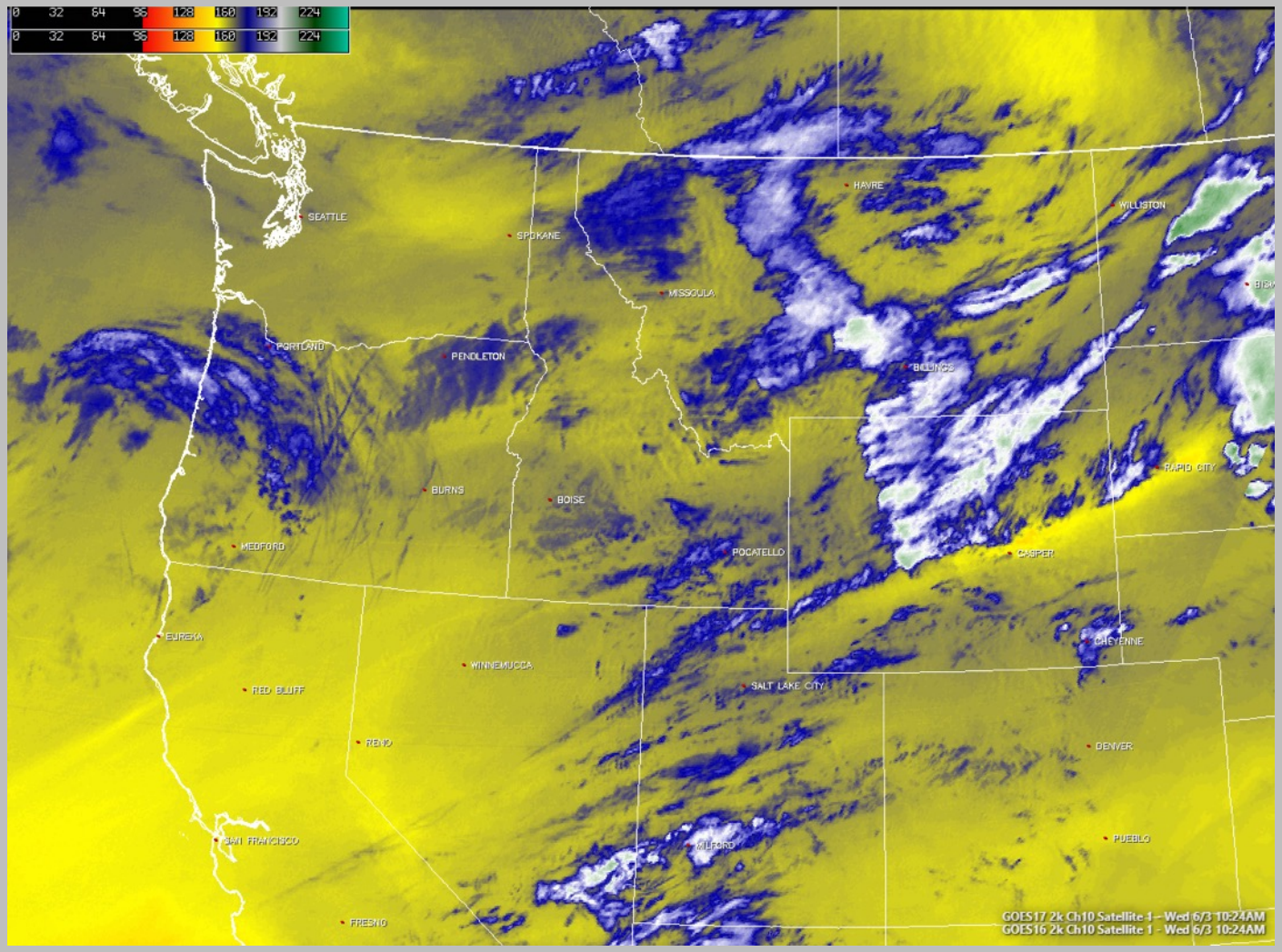
WV Observations-GOES 16/17



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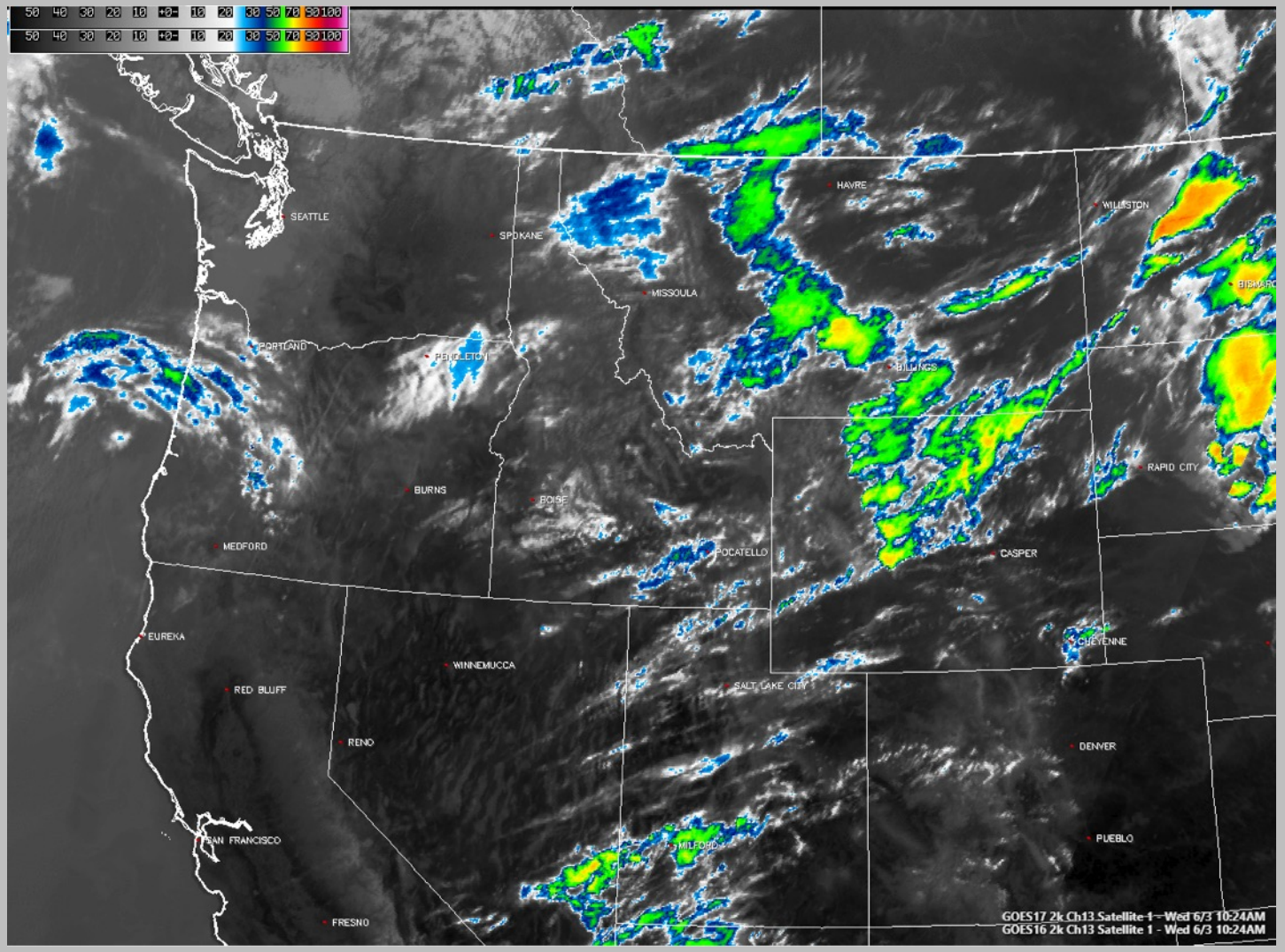
IR Observations-GOES 16/17



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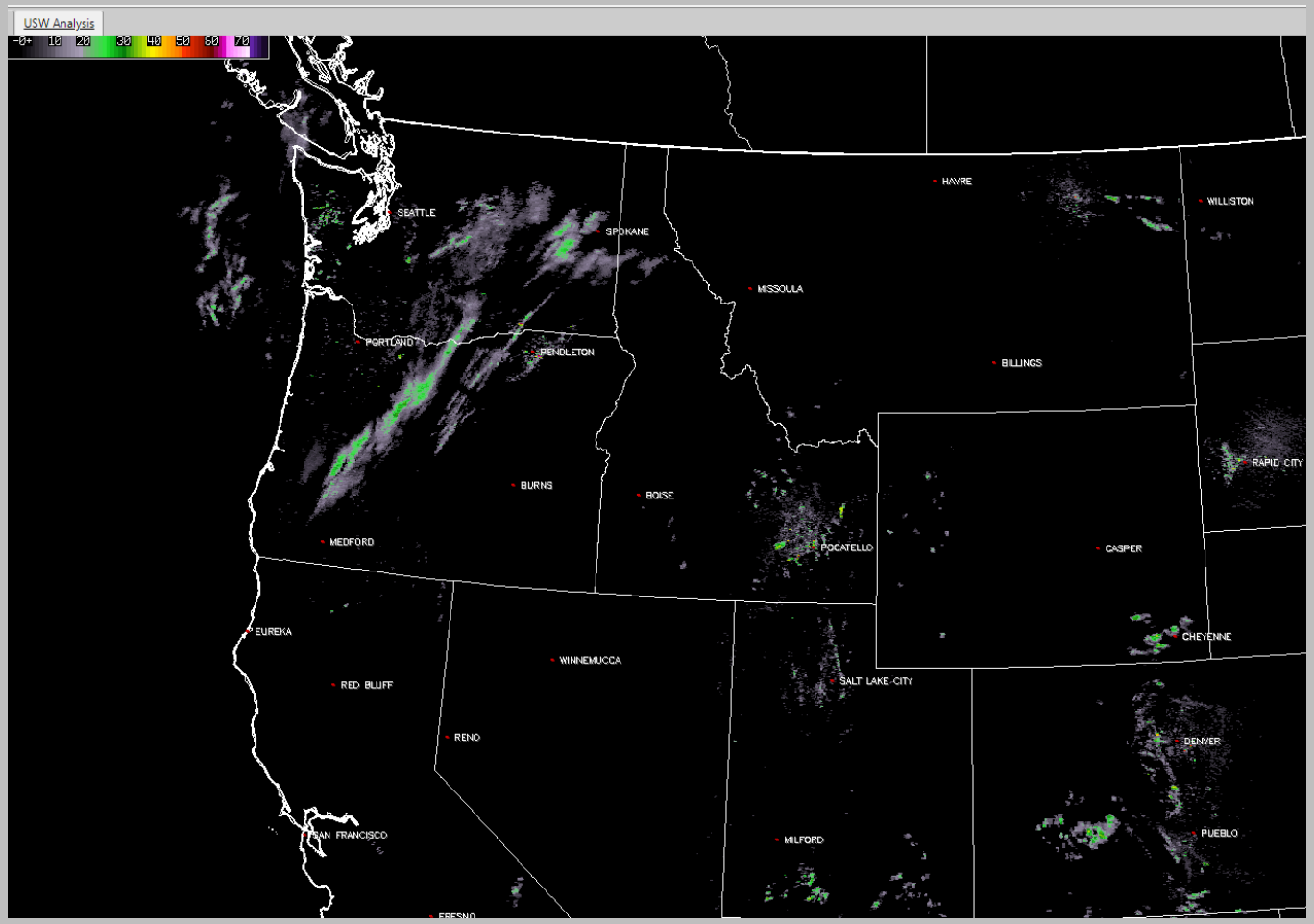
SimuAWIPS-Radar



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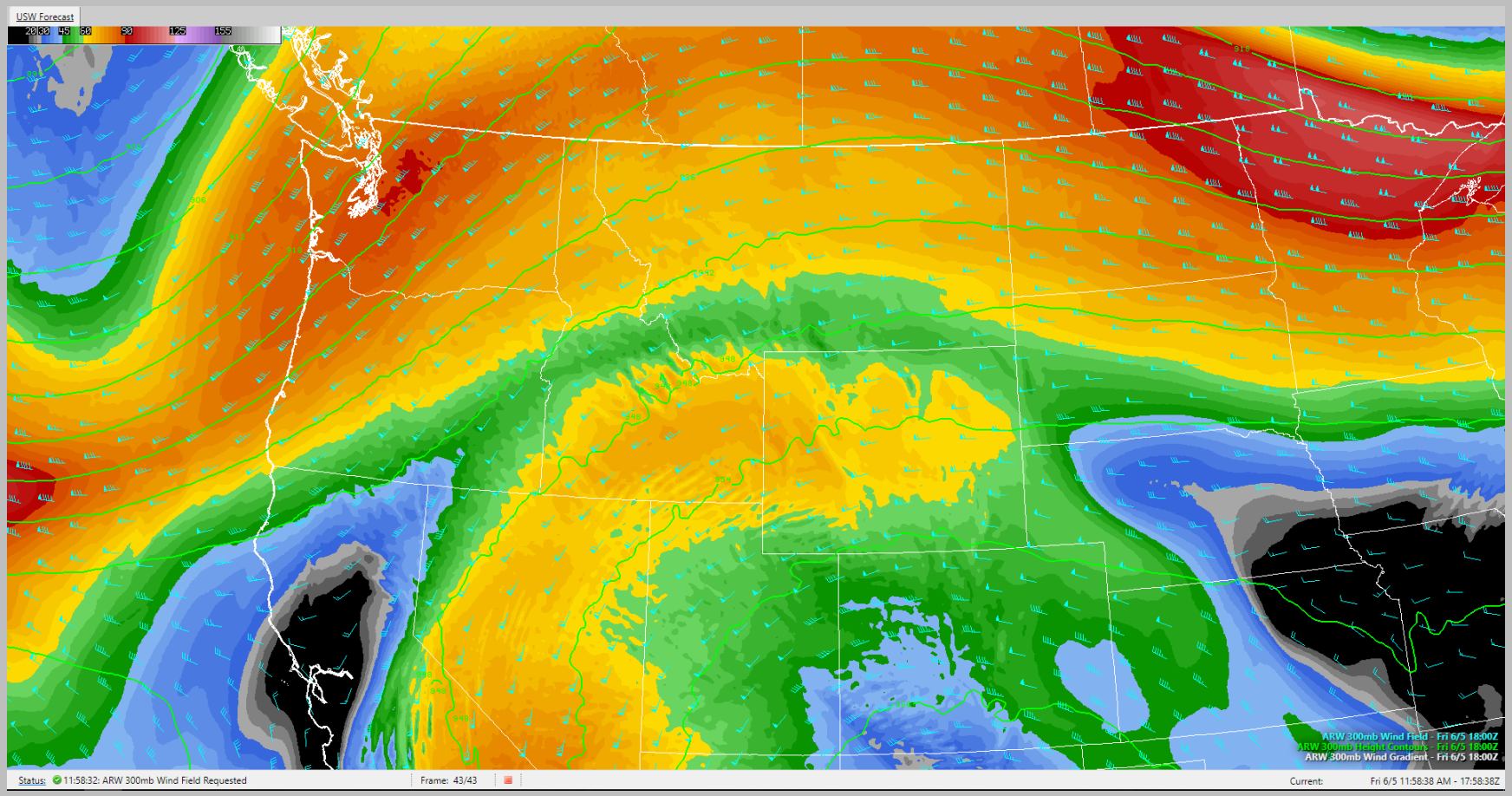
SimuAWIPS-Model Data



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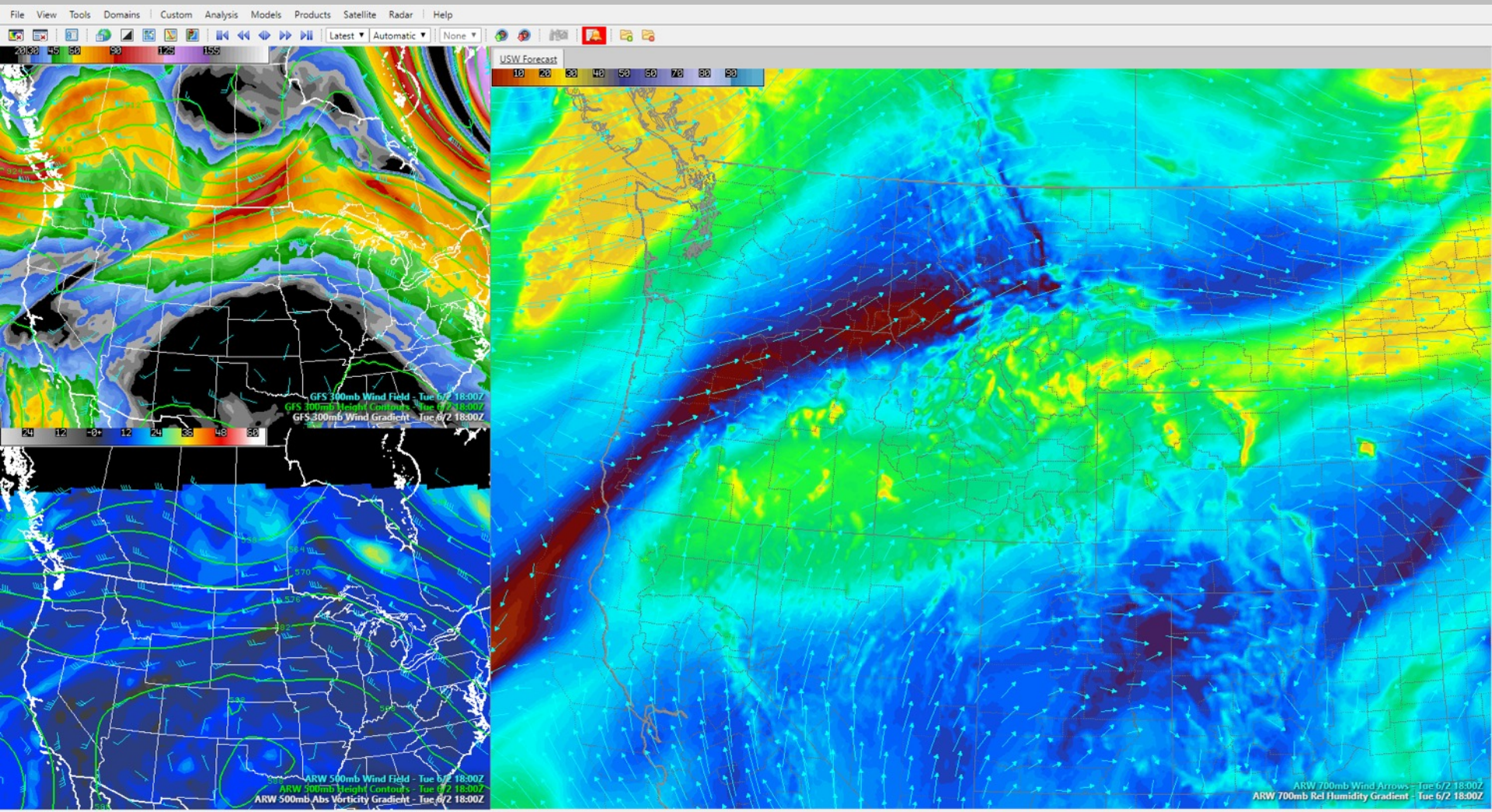
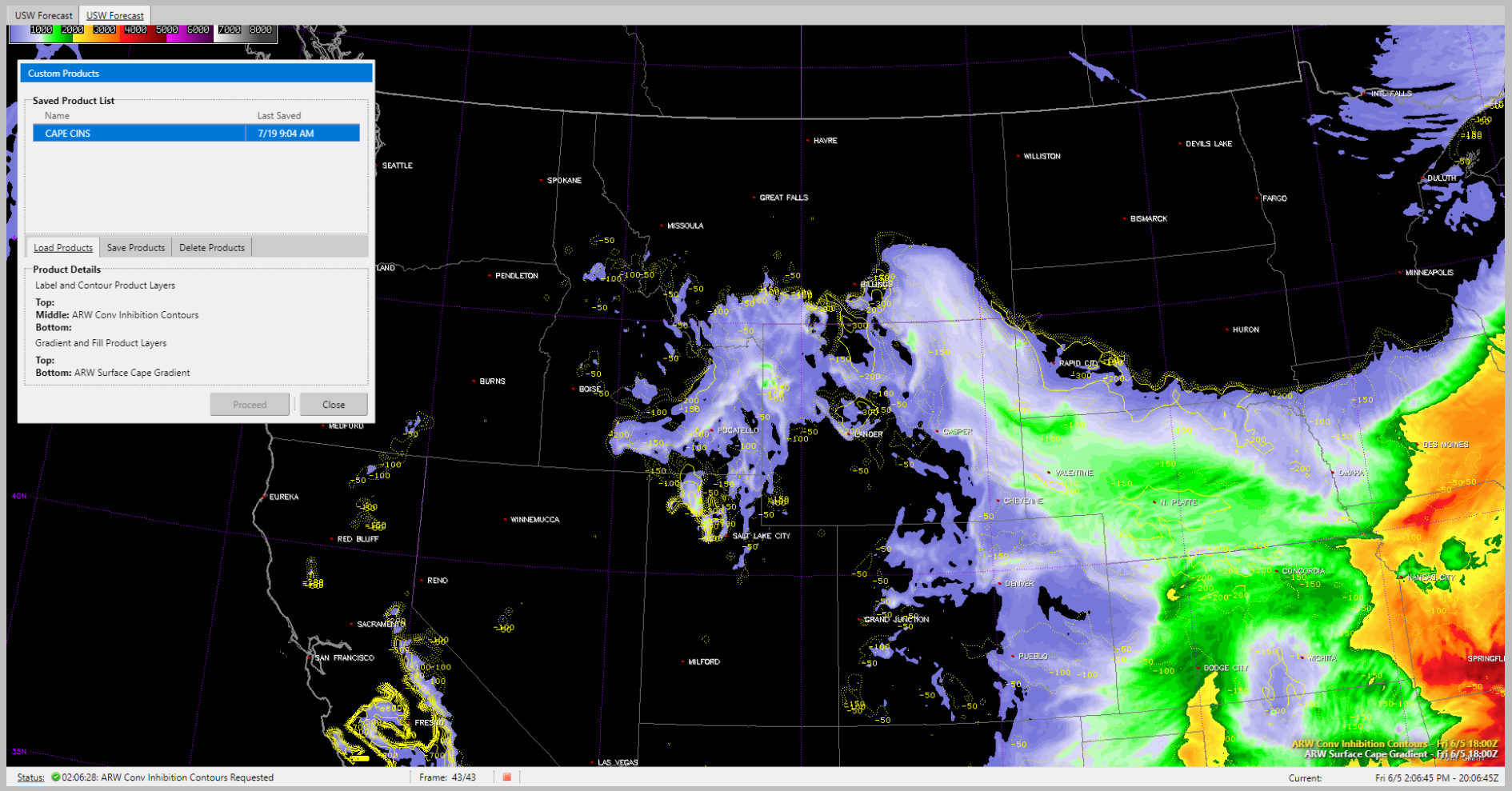
SimuAWIPS-Model Data Cont'd.



SimuAWIPS-Custom



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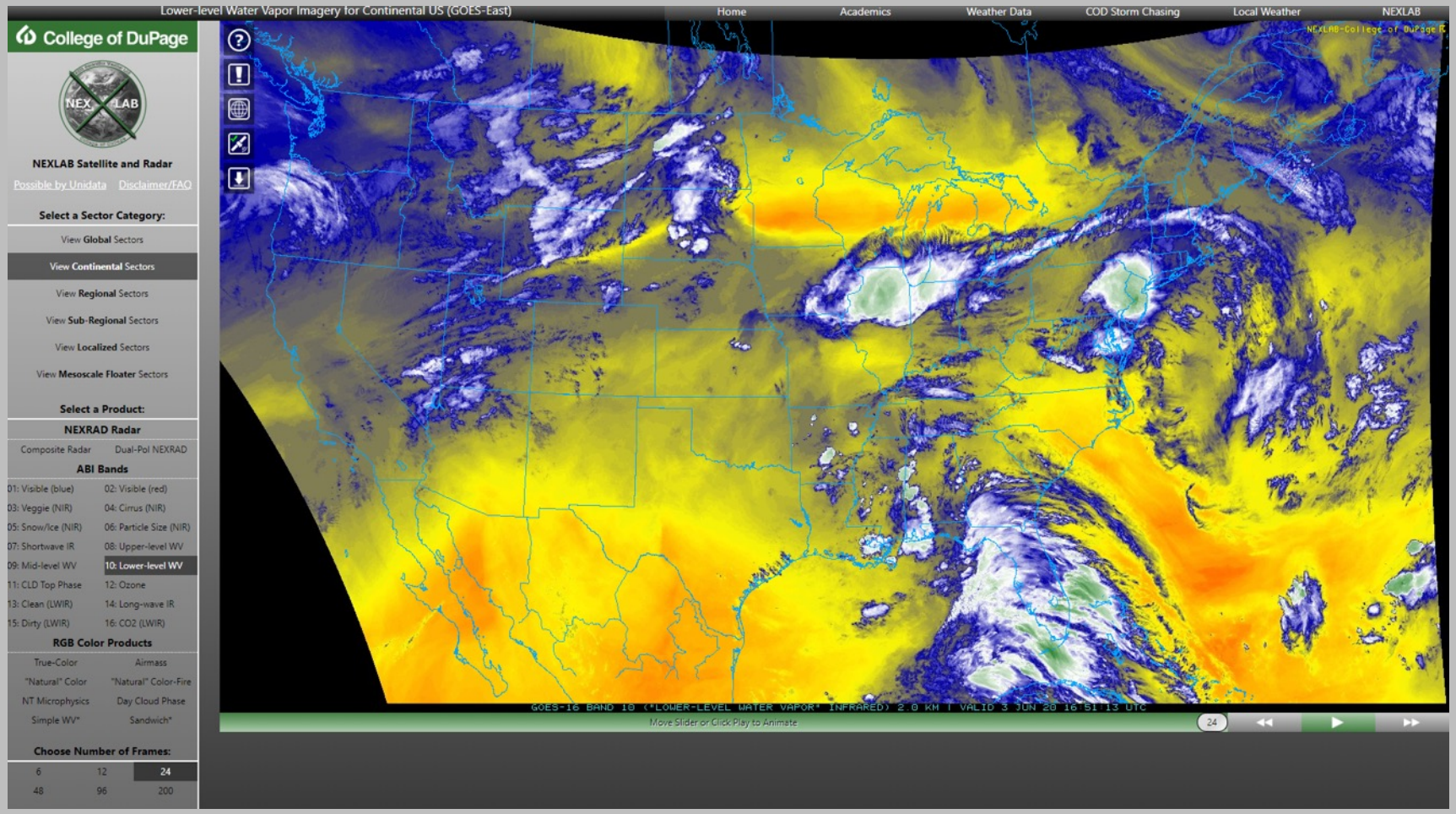
College of DuPage-Satellite Data



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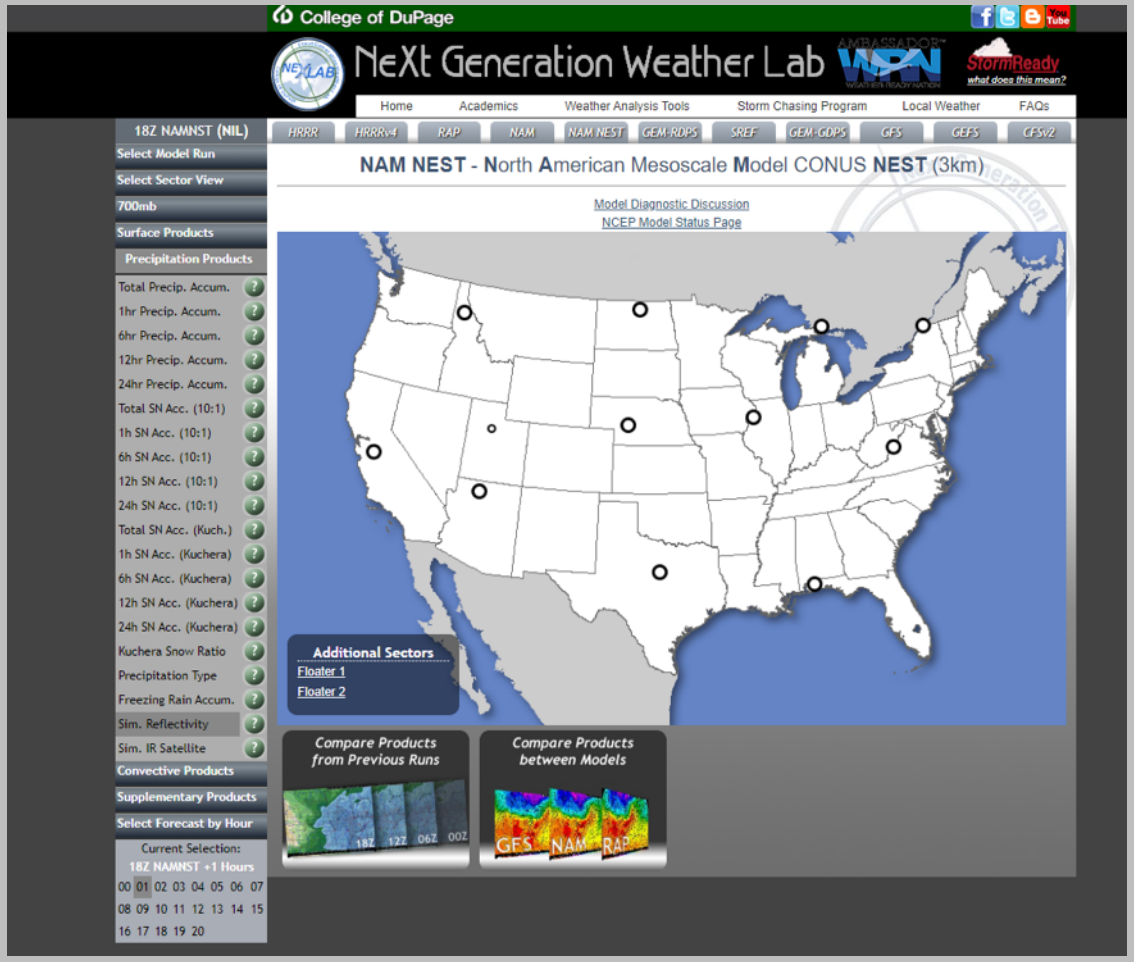
College of DuPage-Model Data



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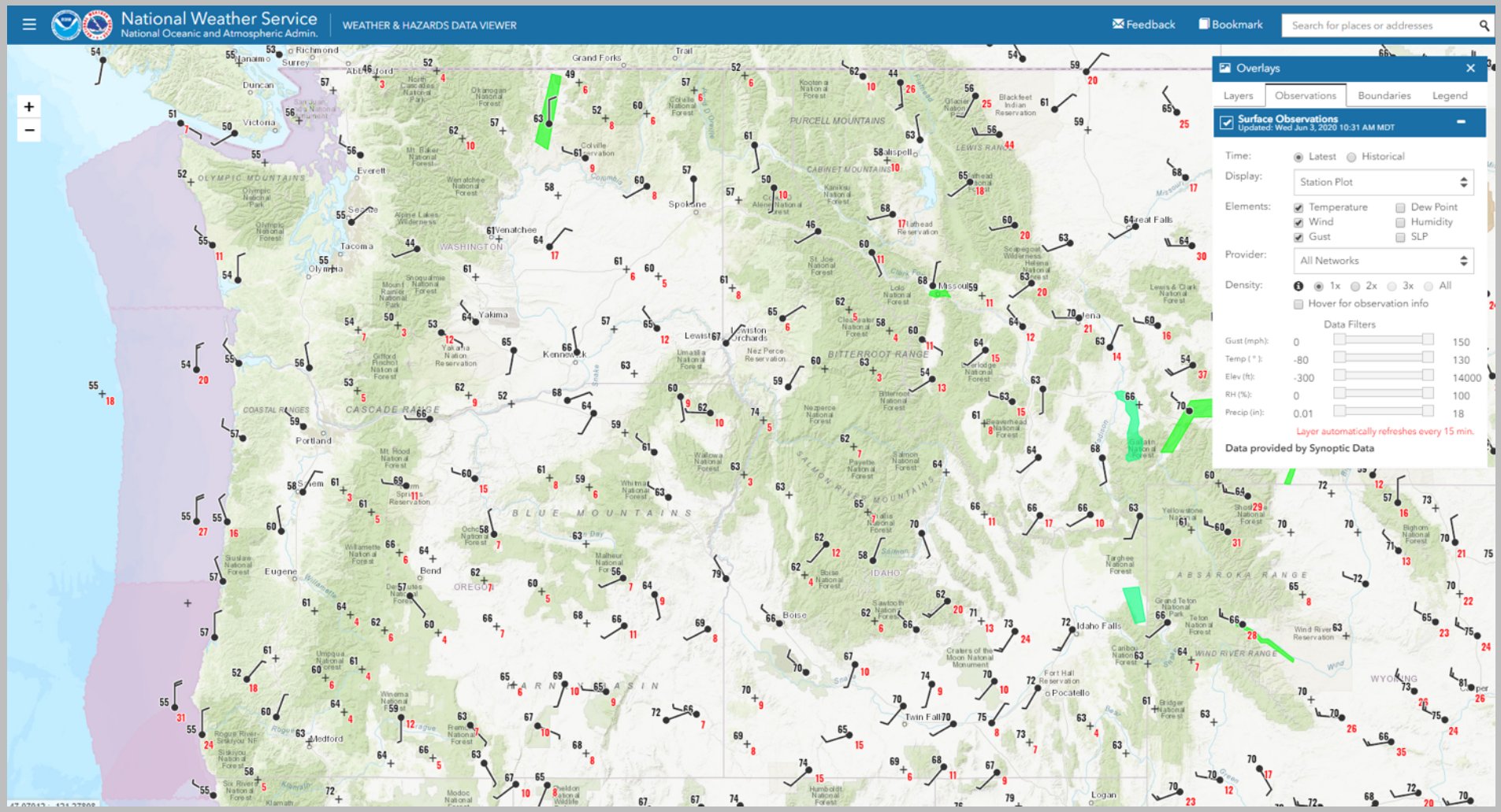
NWS Weather and Hazards Data Viewer



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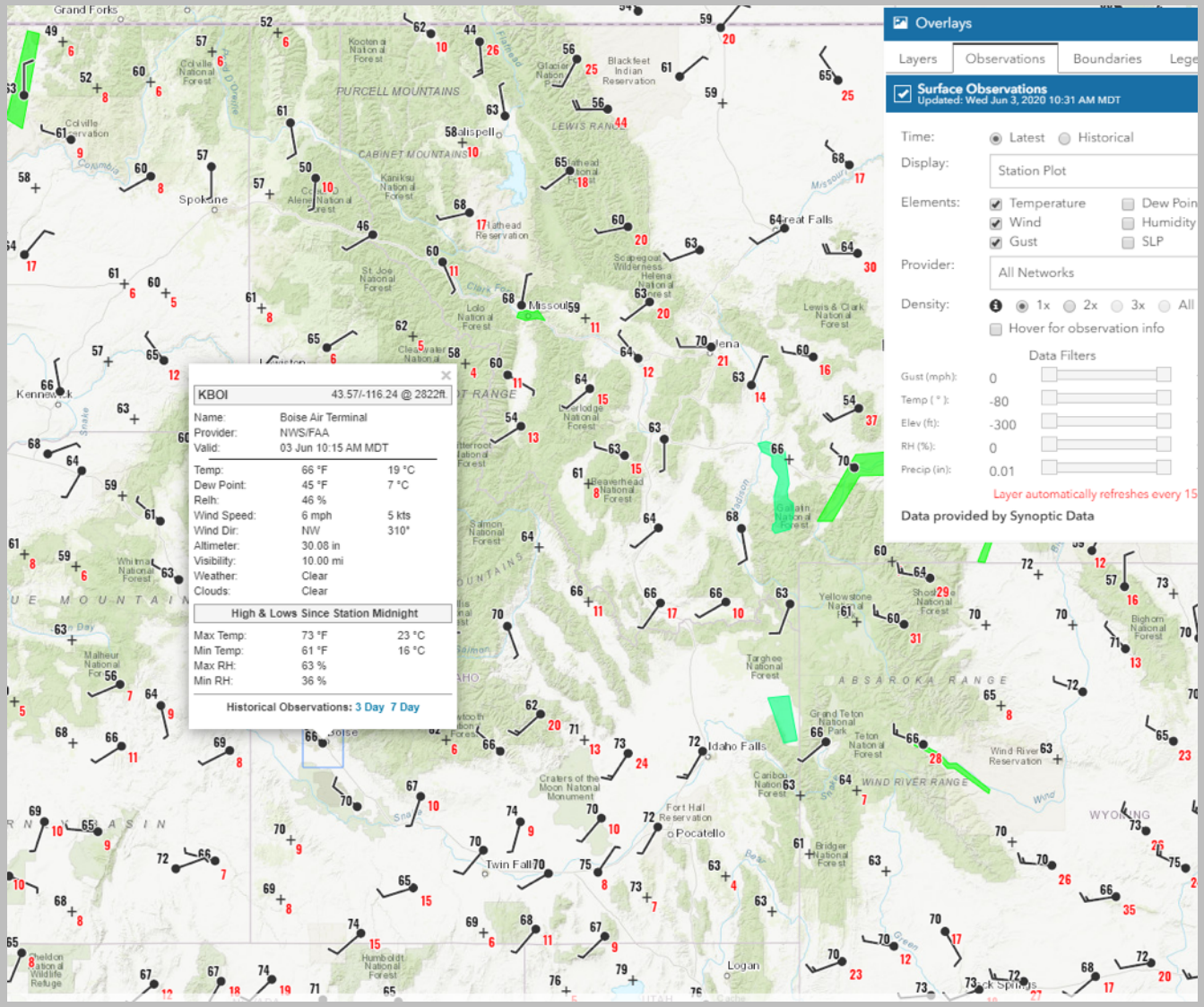

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Model Diagnostic Discussion

- Good resource to aid in evaluating model performance.
- Updated multiple times per day.

Model Diagnostic Discussion
NWS Weather Prediction Center College Park MD
311 PM EDT Wed Jun 03 2020

Valid Jun 03/1200 UTC thru Jun 07/0000 UTC

...See NOUS42 KWNO (ADMSDM) for the status of the upper air ingest...

12Z Model Evaluation Including Final Preferences and Confidence

...Frontal wave moving from the mid MS Valley Fri across the midwest and Great Lakes to Ontario Friday and northern New England Sat...

Preference: Blend of 12z ECMWF/12z GFS
Confidence: Normal

The models indicate a front boundary moving slowly east from the central Plains and upper MS Valley with low pressure developing along the front in the midwest and then moving across the Great lakes into Ontario. The 00-12z UKMET have both developed stronger low pressure but the 12z Fri positions were off by about 180 nm (12z run further east in IL with low pressure location). With the deeper low and lack of run to run continuity, confidence is low in either the 00-12z runs of the UKMET. Given better agreement among the 12z GFS/12z ECMWF/00z ECMWF Ensemble mean, I recommend blending the better clustered solutions.

Cut-off low moving from offshore southern California moving onshore Friday and into Great Basin Saturday

Preference: Blend of the 12z ECMWF/12z UKMET/12z GFS
Confidence: Slightly above normal

A cut off upper low will move slowly northeast Friday and move onshore into southern California Friday.
The system opens up as it moves inland in confluent flow, with slight timing differences. Given the 12z UKMET timing was close to the 00z-12z ECMWF and the EC mean, so good clustering of solutions lends itself to a consensus-based approach.

...Closed low drifting south off British Columbia through Friday night and then off Washington/Oregon Saturday, wave moving into northern high Plains Saturday...

Preference: Blend of 12z UKMET/12z ECMWF/12z GFS
Confidence: Slightly above normal

An upper level low is expected to drop south, west of the British Columbia coast, and be situated west of the Washington coast by Saturday morning.
The low may approach the Pacific northwest coast Sat night. The 12z NAM was a bit deeper than the other models, with good agreement among the 12z UKMET/12z GFS/12z ECMWF. At 700 mb, the models show a wavy warm front crossing the northern Rockies Saturday and then onto the northern Plains. The 12z NAM had stronger low pressure near the SD/NE border than other models, and the 12z CMC global had different timing/phasing at 500 mb.
The good agreement among the 12z ECMWF/12z UKMET/12z GFS supports a consensus of those 3 models.

Boise NWS AFD

- Expert evaluation of current model performance
- Forecast information to your local area

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FXUS65 KBOI 031525
AFDBOI

Area Forecast Discussion
National Weather Service Boise ID
925 AM MDT Wed Jun 3 2020

.DISCUSSION...Skies are partly cloudy this morning, and should
become less cloudy as the day progresses. We will remain dry today
with temperatures climbing 5 to 10 degrees above normal. No
changes are planned at this time.

&&

.AVIATION...VFR. Surface winds, west to northwest 5-10kts with
afternoon gusts of 20-25kts. Winds aloft to 10k feet MSL,
southwest 25-30kts.

&&
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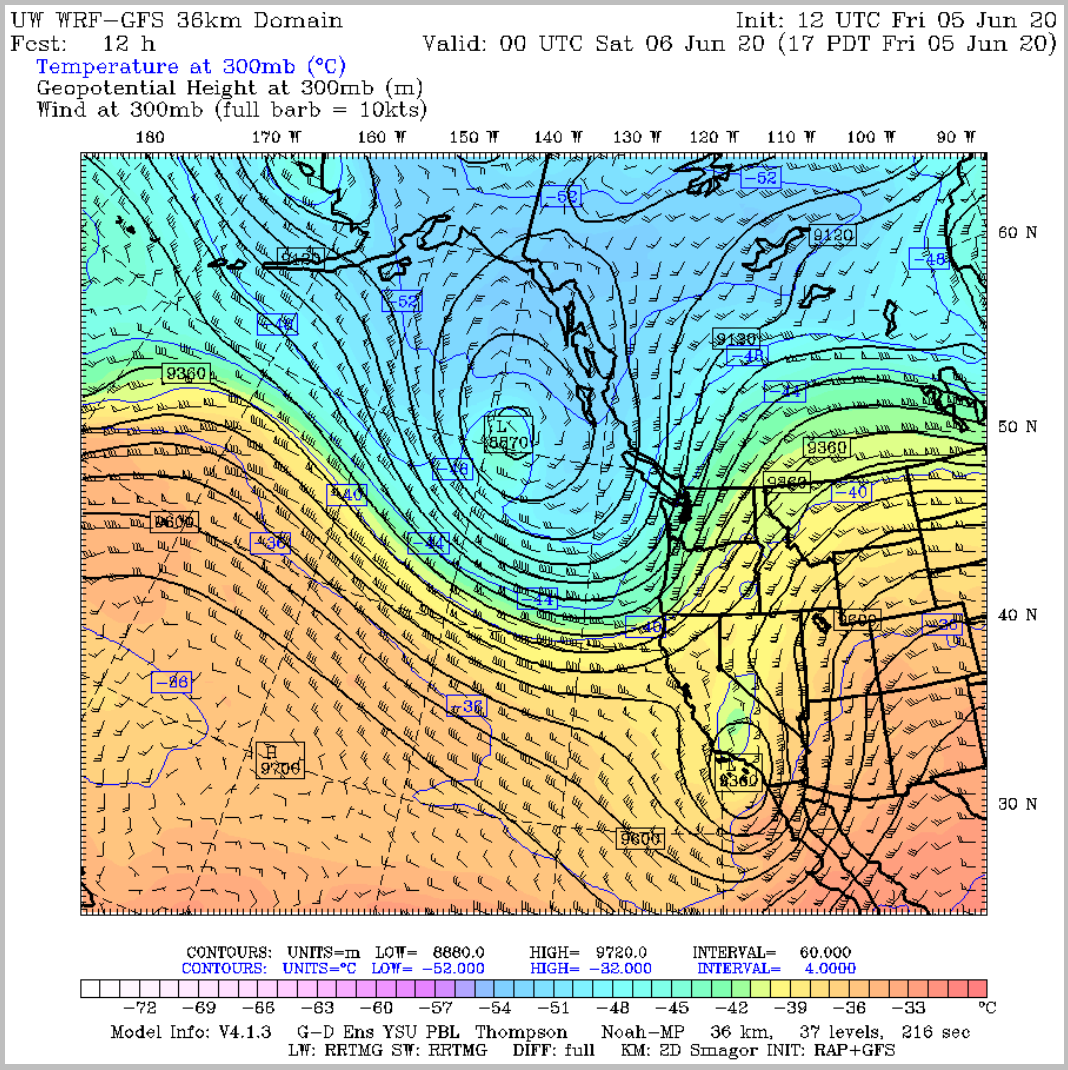
- Detailed information for the short and long term

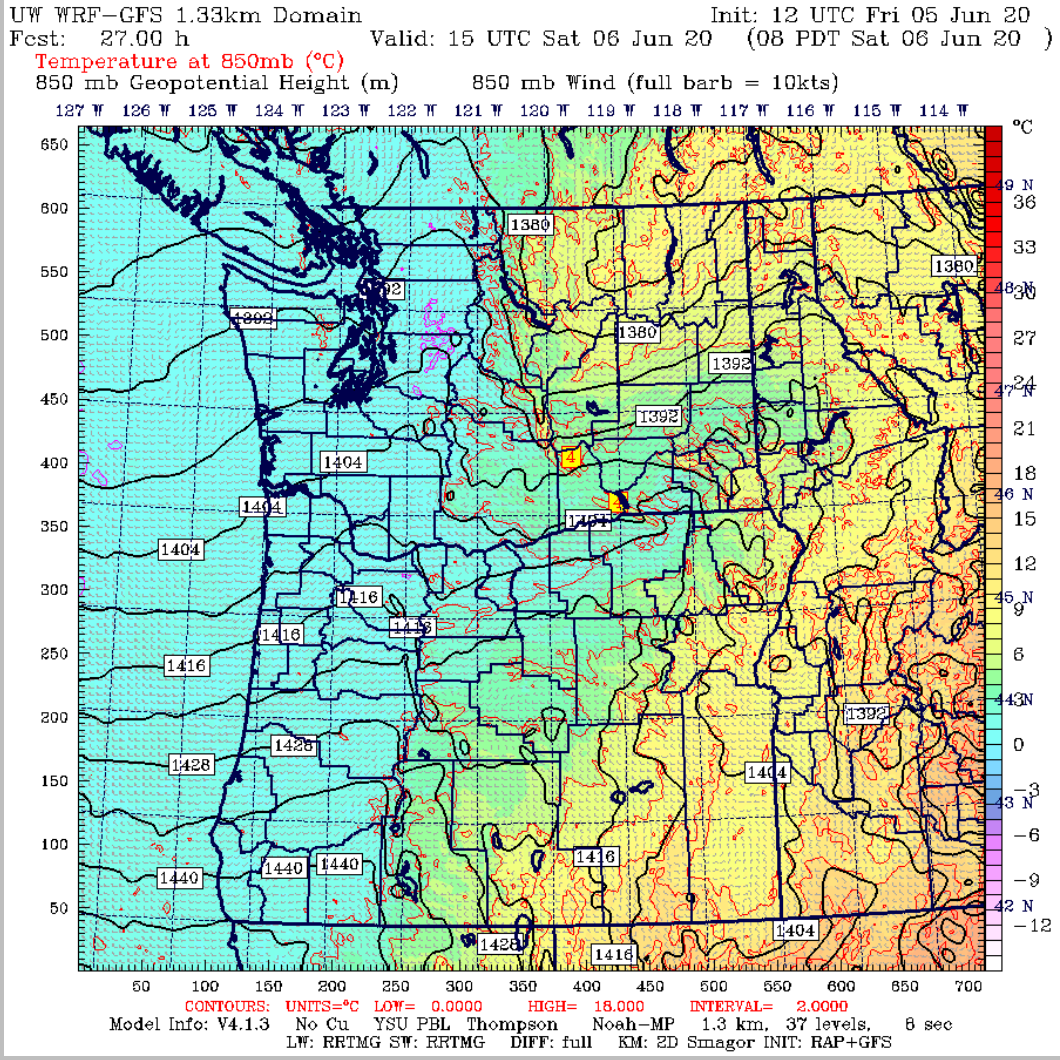
University of Washington WRF-GFS



We can get big picture synoptic weather information…

University of Washington WRF-GFS

…And down to localized influences that affect our forecasts and burn recommendation



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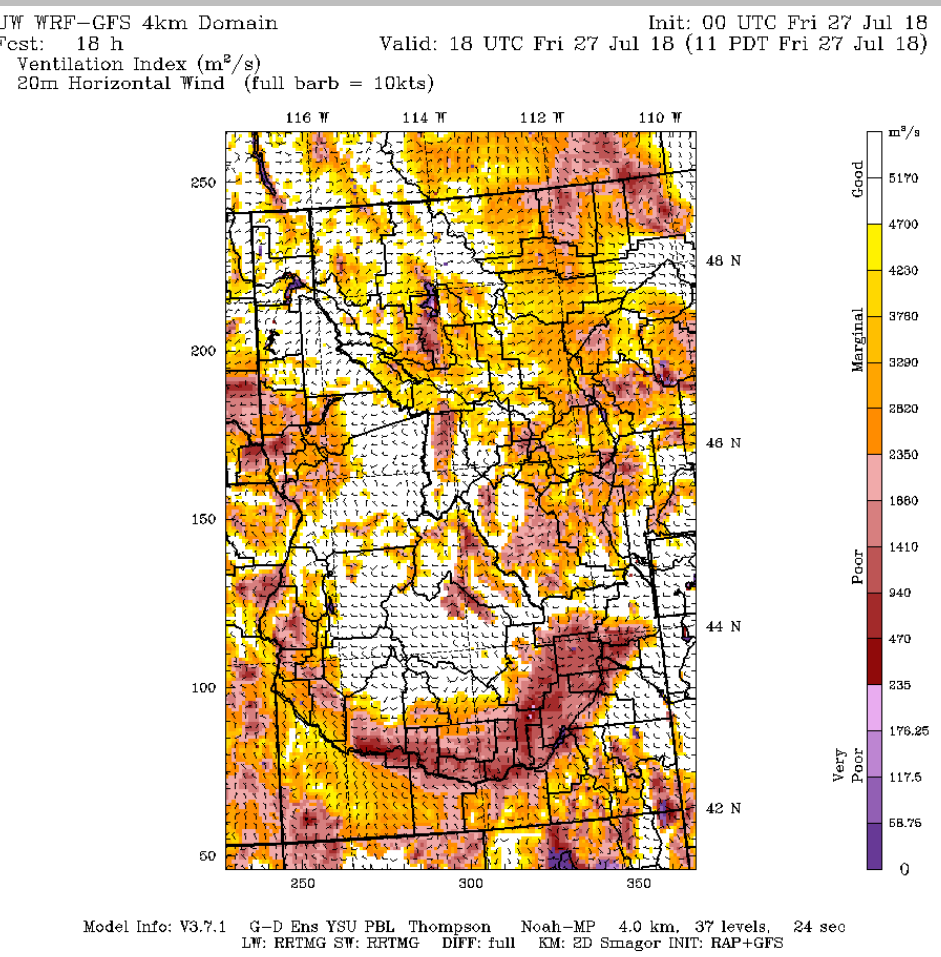
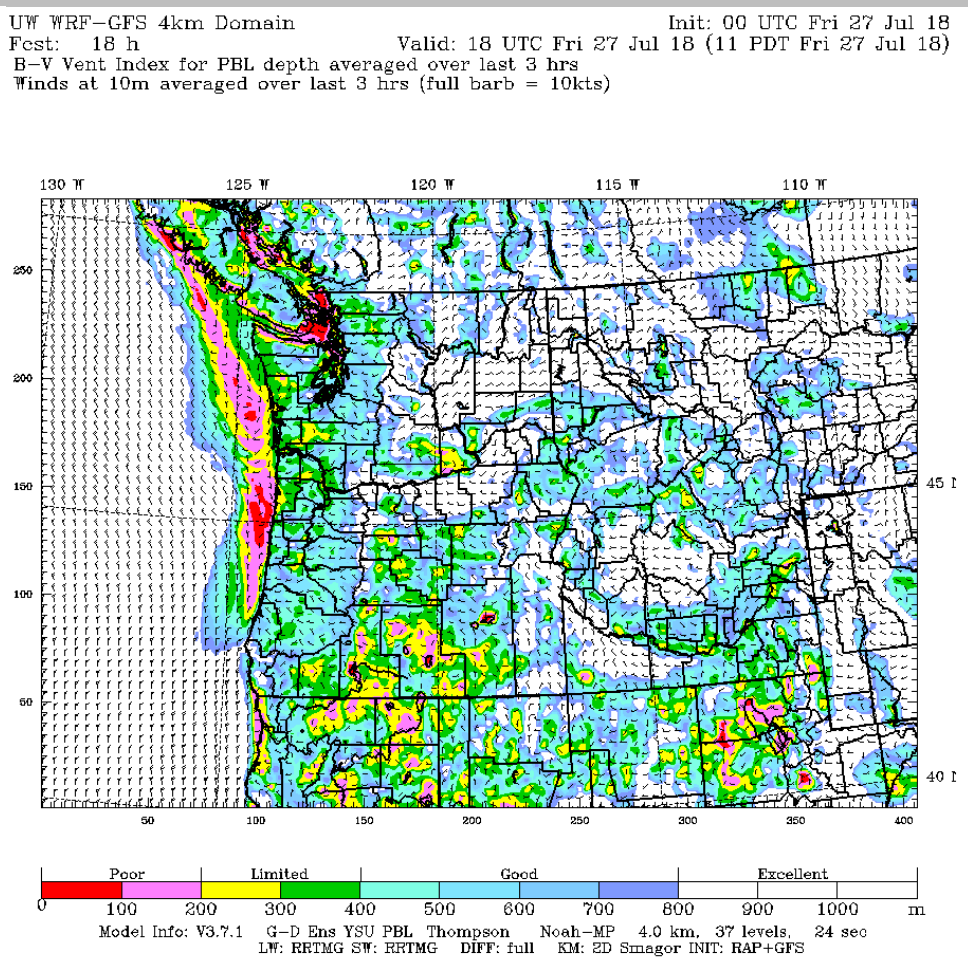
Ventilation- University of Washington





Model Output Statistics

MOS FORECASTS

GFS MOS (MAV)

```
 KBOI   GFS MOS GUIDANCE    6/03/2020  1200 UTC
 DT /JUNE  3/JUNE  4               /JUNE  5               /JUNE  6
 HR   18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 06 12
 N/X                 57          81          58          93    60
 TMP  76 82 83 80 71 64 59 64 73 78 79 76 66 62 59 69 83 90 88 71 62
 DPT  42 41 40 41 43 43 43 44 42 39 38 38 41 42 43 43 41 37 40 51 52
 CLD  FW FW BK BK BK BK SC CL CL CL CL FW FW SC BK SC FW SC OV OV OV
 WDR  31 32 34 34 16 28 29 31 31 33 32 33 15 17 15 14 13 11 13 24 31
 WSP  07 10 10 05 04 05 04 08 13 12 11 07 04 06 09 07 09 06 09 17 04
 P06         2     0     1     0     0     0     1     0     2 20 36
 P12                     1           0           1           2    38
 Q06         0     0     0     0     0     0     0     0     0  0  1
 Q12                     0           0           0           0     1
 T06     10/ 6  0/ 6  0/ 1  1/ 2  0/ 1  1/ 2  0/ 3  7/12 12/ 2
 T12           12/ 6        0/ 6        1/ 9        2/ 4    22/15
 CIG   8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  7  7
 VIS   7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
 OBV   N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N
```

NAM MOS (MET)

```
 KBOI   NAM MOS GUIDANCE    6/03/2020  1200 UTC
 DT /JUNE  3/JUNE  4               /JUNE  5               /JUNE  6
 HR   18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 06 12
 N/X                 57          84          58          93    58
 TMP  74 80 82 79 69 62 58 64 74 80 82 77 67 63 60 69 81 89 91 72 61
 DPT  45 43 40 39 42 43 42 42 39 34 31 32 35 36 37 40 41 39 38 42 45
 CLD  FW FW FW BK BK BK CL CL CL CL FW FW FW FW SC SC CL FW BK OV BK
 WDR  32 33 34 34 25 28 28 31 31 32 33 33 15 16 15 14 13 14 34 23 25
 WSP  06 08 08 04 04 04 03 06 08 08 09 04 04 05 08 05 07 08 08 11 04
 P06         0     0     1     1     0     0     1     1     1  5  6
 P12                     3           1           1           2    8
 Q06         0     0     0     0     0     0     0     0     0  0  0
 Q12                     0           0           0           0    0
 T06      5/ 5  1/ 3  0/ 3  0/ 1  1/ 6  2/ 5  2/ 3  0/ 5  8/11  5/ 3
 T12           6/ 5        0/ 3        2/ 8        2/ 5    14/12
 CIG   8  8  8  8  8  1  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
 VIS   7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7
 OBV   N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N
```

GFSX MOS (MEX)

```
 KBOI   GFSX MOS GUIDANCE   6/03/2020  1200 UTC
 FHR  24  36| 48  60| 72  84| 96 108|120 132|144 156|168 180|192
      THU 04| FRI 05| SAT 06| SUN 07| MON 08| TUE 09| WED 10|THU CLIMO
 N/X  57  81| 58  93| 60  66| 43  59| 38  62| 44  67| 50  77| 58 51 79
 TMP  59  79| 59  88| 62  61| 45  56| 38  60| 45  65| 52  75| 59
 DPT  43  38| 43  40| 52  45| 45  36| 37  28| 36  34| 44  39| 48
 CLD  PC  CL| PC  PC| OV  OV| OV  OV| OV  PC| CL  PC| OV  PC| CL
 WND  10  13| 11   9| 17  13| 10  17| 19  22| 13  10| 14  11| 11
 P12   1   0|  1   2| 38  75| 58  46| 37  13|  8  10| 27  21| 18 12 11
 P24       1|      2|     75|     72|     39|     14|     28|       18
 Q12   0   0|  0   0|  1   3|  2   1|  1   0|  0   0|       |
 Q24       0|      0|      2|      2|      1|      0|       |
 T12   0   1|  2   9| 22  23| 23  14| 11   5|  3   4|  5   7|  6
 T24        |  2    | 34    | 47    | 19    |  5    |  5    |  9
```

MOS FORECASTS

GFS MOS (MAV)

```
 KCOE   GFS MOS GUIDANCE    6/03/2020  1200 UTC
 DT /JUNE  3/JUNE  4               /JUNE  5               /JUNE  6
 HR   18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 06 12
 N/X                 50          70          47          73    53
 TMP  63 67 68 63 56 54 52 56 63 68 69 64 54 50 48 56 67 71 70 58 55
 DPT  40 39 38 42 43 43 42 42 40 39 38 41 42 41 41 43 44 45 46 51 48
 CLD  FW CL FW BK OV OV BK FW CL CL CL CL CL CL CL BK BK OV OV OV OV
 WDR  20 23 23 20 14 14 15 18 21 24 24 19 11 06 05 04 03 02 01 25 20
 WSP  07 08 09 04 04 05 06 07 07 09 08 05 04 05 08 13 14 07 08 10 06
 P06         0     0     4     2     2     0     0     0     6 62 50
 P12                     4           4           0           6    74
 Q06         0     0     0     0     0     0     0     0     0  2  2
 Q12                     0           0           0           0    3
 T06      0/ 2  0/ 3  0/ 1  0/ 0  0/ 2  0/ 1  0/ 0  0/ 2  4/ 7  7/ 2
 T12           0/ 3        0/ 3        0/ 6        0/ 2    12/11
 CIG   8  8  8  8  8  8  7  8  8  8  8  8  8  8  8  8  8  7  5  4
 VIS   7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  4
 OBV   N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N BR
```

NAM MOS (MET)

```
 KCOE   NAM MOS GUIDANCE    6/03/2020  1200 UTC
 DT /JUNE  3/JUNE  4               /JUNE  5               /JUNE  6
 HR   18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 06 12
 N/X                 46          71          45          69    49
 TMP  63 67 68 63 54 50 48 57 64 68 70 64 54 49 47 56 63 66 66 54 50
 DPT  41 41 39 42 42 40 40 44 43 41 40 42 42 41 40 47 48 48 49 47 47
 CLD  CL FW SC BK OV OV BK SC FW SC SC FW CL CL FW BK OV OV OV OV OV
 WDR  22 24 24 20 17 16 19 18 22 24 23 20 12 07 06 04 04 02 01 10 24
 WSP  06 09 09 05 04 04 05 07 07 08 08 05 03 05 06 09 09 09 05 05
 P06         0     0     2     1     0     0     1     5    18 62 55
 P12                     3           1           1           18    77
 Q06         0     0     0     0     0     0     0     0     0  3  3
 Q12                     0           0           0           0    3
 T06      0/ 5  0/ 4  0/ 0  0/ 3  0/ 3  1/ 3  0/ 0  0/ 4  2/ 8  5/ 2
 T12           0/ 5        0/ 3        1/ 3        0/ 4     9/10
 CIG   8  8  8  8  8  1  8  8  8  8  8  8  8  8  8  8  8  7  4  4
 VIS   7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  7  5  5
 OBV   N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N HZ BR
```

GFSX MOS (MEX)

```
 KCOE   GFSX MOS GUIDANCE   6/03/2020  1200 UTC
 FHR  24  36| 48  60| 72  84| 96 108|120 132|144 156|168 180|192
      THU 04| FRI 05| SAT 06| SUN 07| MON 08| TUE 09| WED 10|THU CLIMO
 N/X  50  70| 47  73| 53  60| 44  64| 45  57| 42  62| 45  71| 51 48 72
 TMP  52  69| 48  70| 55  57| 46  61| 46  54| 44  60| 46  68| 51
 DPT  42  38| 41  46| 48  48| 40  41| 40  42| 37  41| 41  49| 46
 CLD  PC  PC| CL  OV| OV  OV| OV  OV| OV  OV| PC  OV| OV  OV| OV
 WND   9   9|  8  14| 10  14| 11  12| 12  14|  9  14| 14  13| 16
 P12   4   4|  0   6| 74  71| 22  32| 37  31| 28  18| 35  30| 26999999
 P24       4|      9|     83|     43|     43|     38|     47|      999
 Q12   0   0|  0   0|  3   2|  0   1|  1   1|  0   0|       |
 Q24       0|      0|      3|      1|      1|      1|       |
 T12   0   0|  0   4| 14  15|  9  12| 14   7| 13   3| 11  10|  8
 T24        |  0    | 14    | 16    | 21    | 14    | 11    | 12
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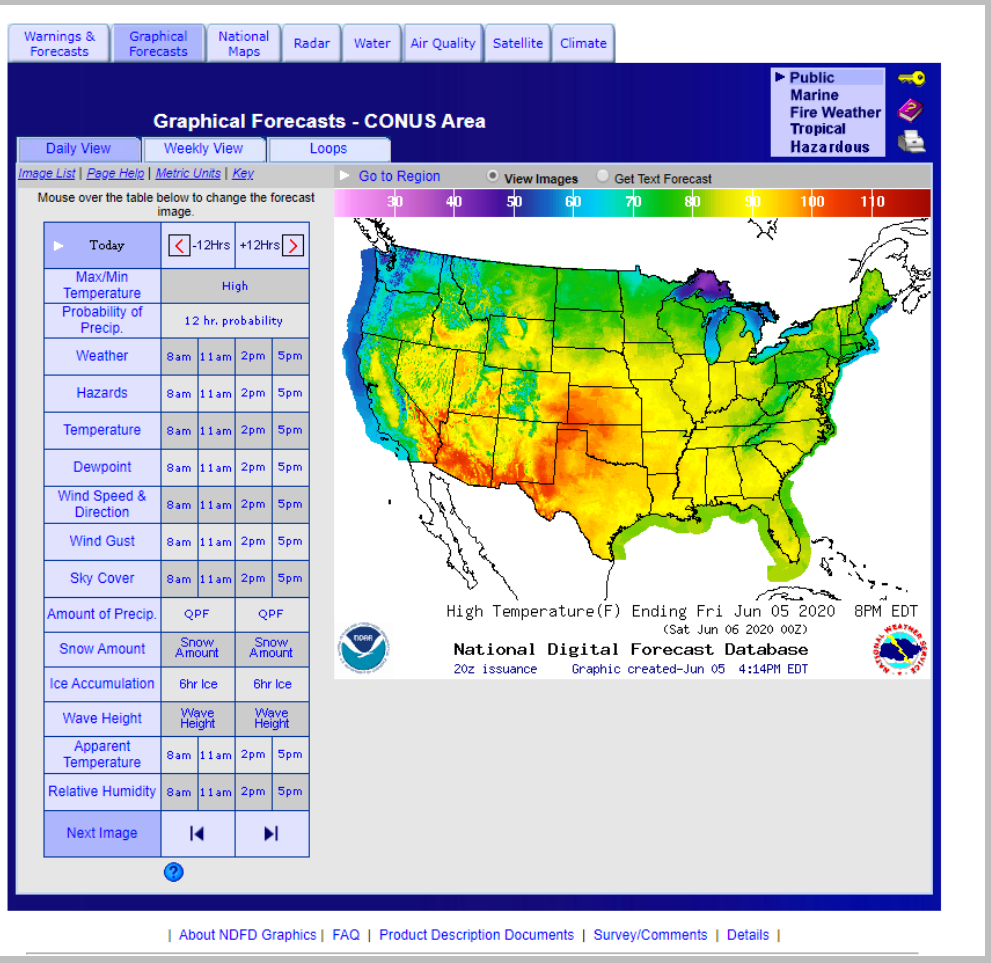
NWS Graphical Forecast (National)



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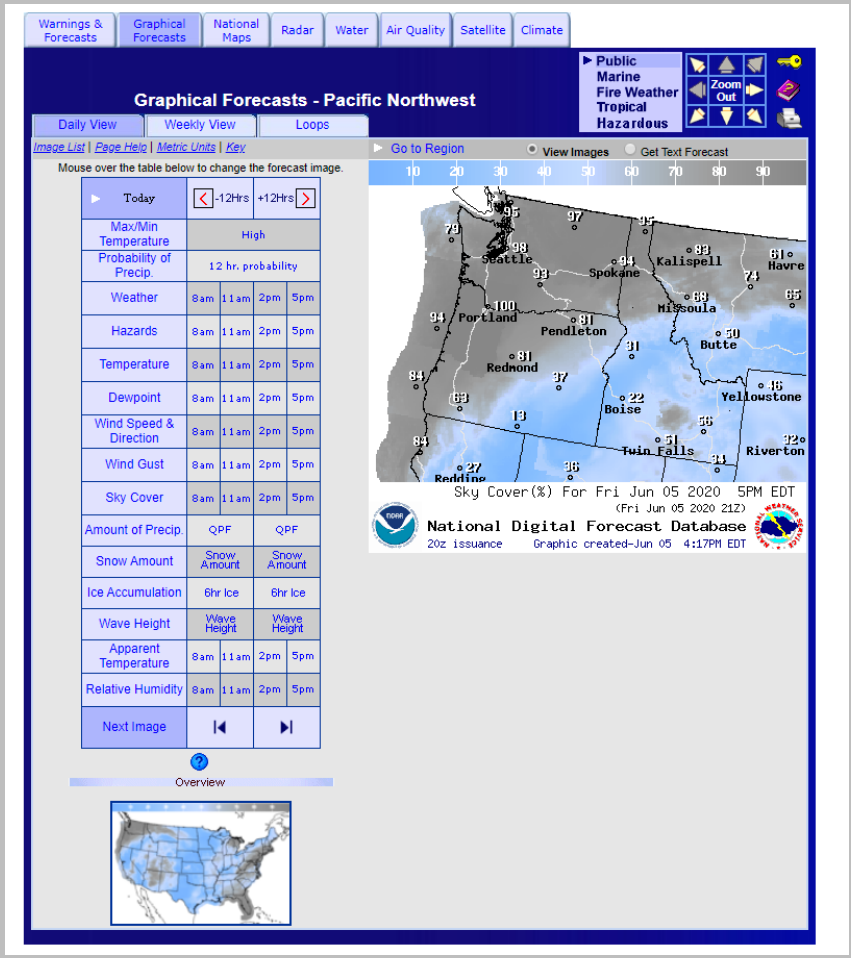
NWS Graphical Forecast (Regional)



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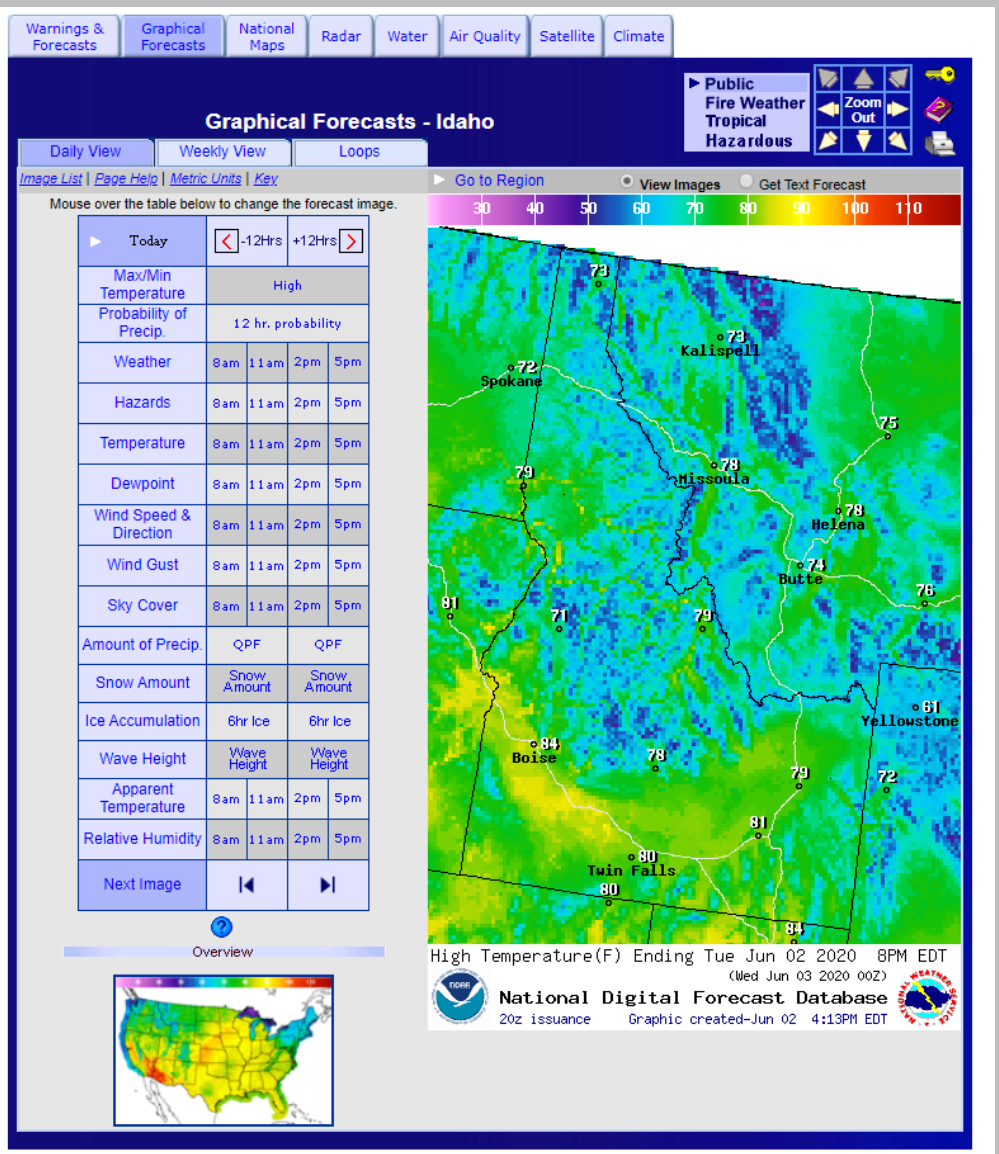
NWS Graphical Forecast



- Temperature
- Probability of Precipitation
- Wind Speed and Direction (Surface)
- Wind Gust
- Sky Cover
- Amount of Precipitation
- Relative Humidity

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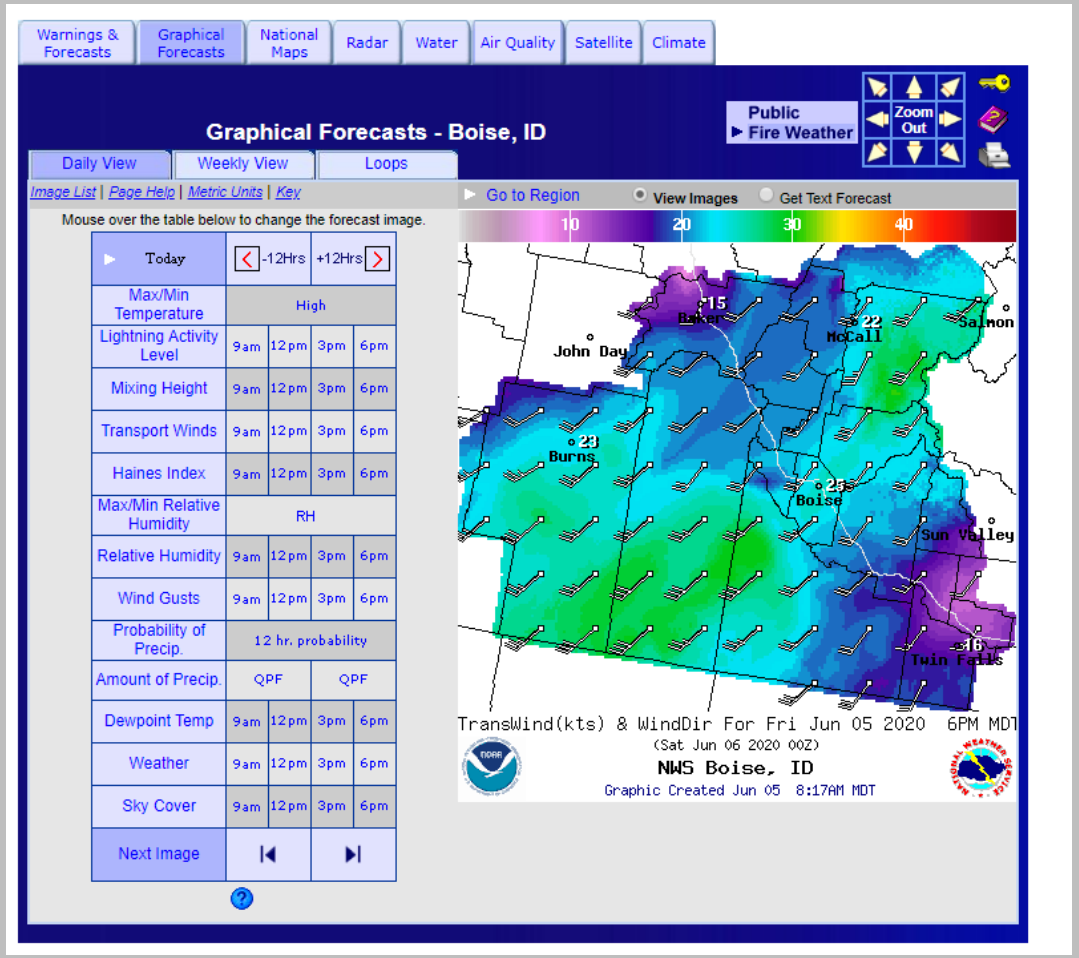
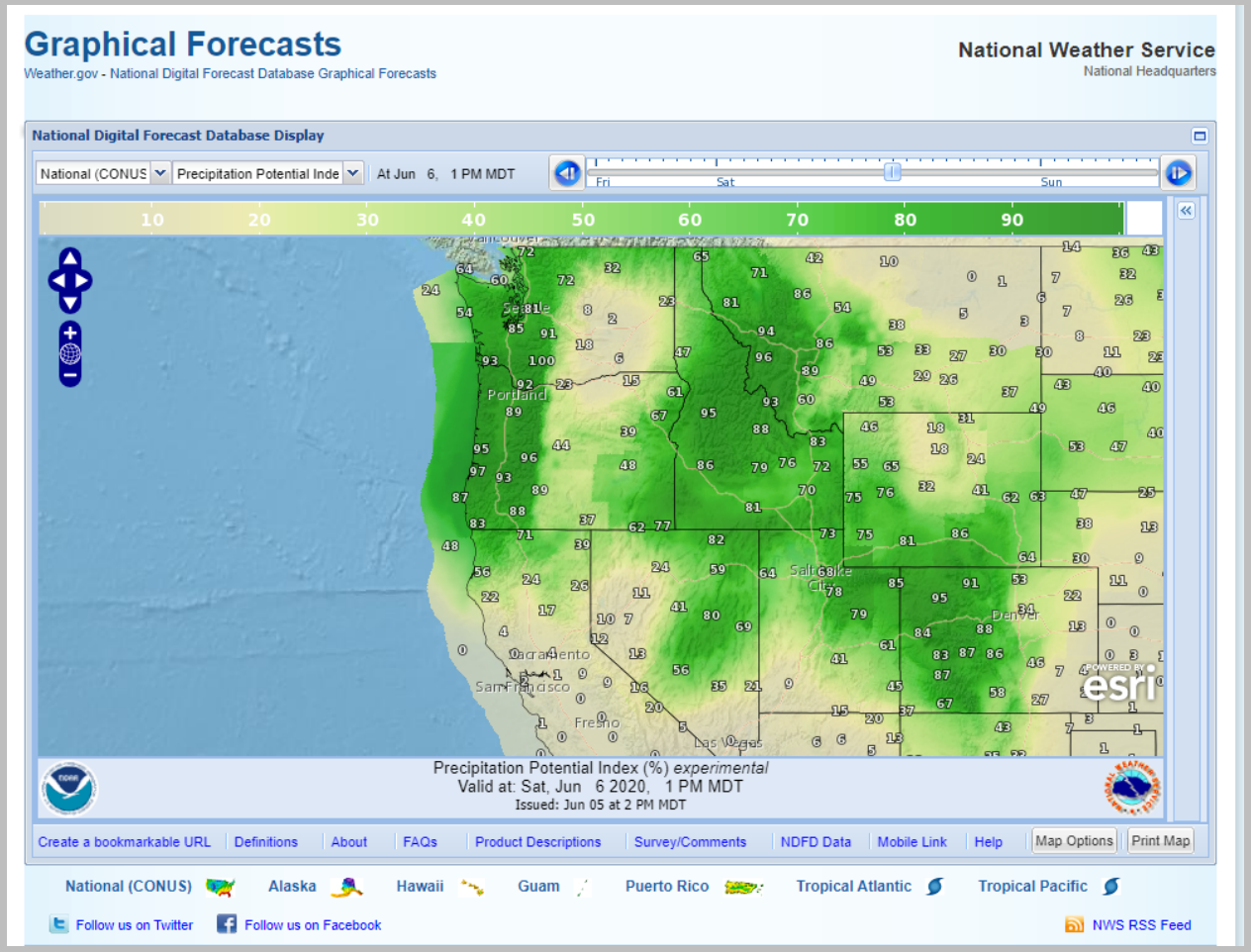
NWS Graphical Forecast (Local)

Fire Weather Information (tab in upper right)

- Mixing Height
- LAL
- Transport wind speed and direction
- Many more!



New(er) NWS Graphical Forecast



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Questions?

This list is not all inclusive. Many other options exist!

- SimuAWIPS (Subscription)
- NWS Graphical Forecast (FREE!)
- University of Washington WRF Model Output (FREE!)
- BUFKIT (FREE!)
- College of DuPage (Satellite and Model Output) (FREE!)
- MOS (FREE!)
- Model Diagnostic Discussion (FREE!)
- NWS Area Forecast Discussion (FREE!)
- NWS Weather and Hazards Viewer (for Observations and NWS Alerts) (FREE!)