Caltrans Aviation Weather Information (AWI) from Surface Transportation and Concept to Aviation and Implementation

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Disclaimer

The opinions, findings and conclusions expressed in this presentation are those of the authors and not necessarily those of the California Department of Transportation, Montana State University or Utah State University.

Abstract

Weather significantly affects safety as related to transportation, which includes regional surface transportation (highways and local streets) and aviation (airports, hospital heliports and flight paths). ***Starting in 2008, the Western Transportation Institute (WTI) at Montana State University (MSU) conducted a research and development study of a proof-of-concept system for integrating Automated Weather Observing System (AWOS) with Roadside Weather Information System (RWIS).***

This multi-phase project targets small, underserved rural airfields and hospital heliports. The goal is to provide airport managers, air traffic controllers, pilots, and related operators of air ambulance services with more comprehensive and accurate meteorological data by integrating currently used weather systems with systems used by related agencies, including surface transportation. *Implementing such an integrated system is expected to improve safety and increase efficiency. Caltrans has demonstrated the system to emergency responders and public safety personnel from other agencies in real situations ranging from wildfires, the Napa earthquake, even during the Oroville Dam crisis, and all situations received positive responses for this beneficial tool.*

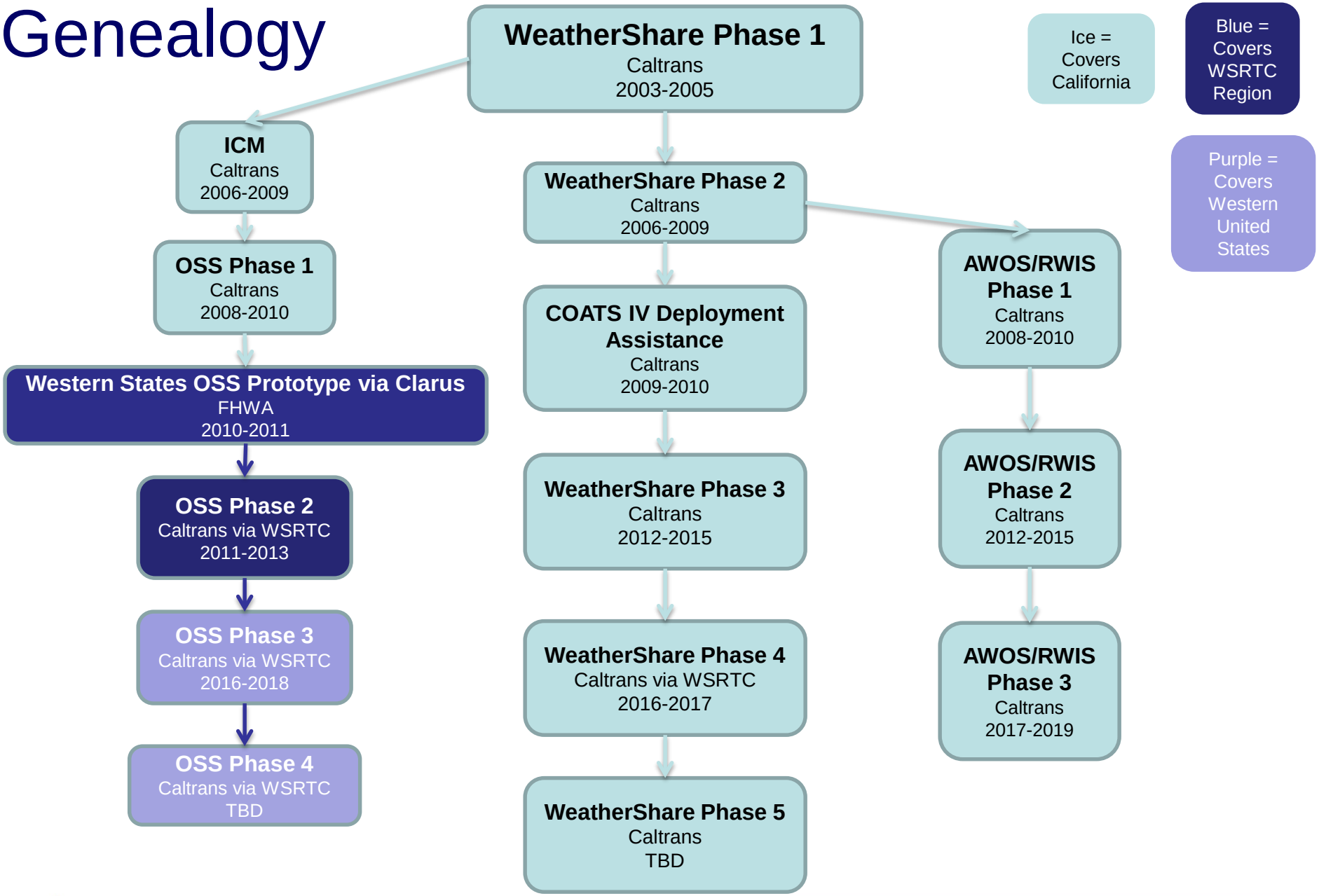
This presentation will summarize work conducted in Phases I, II and III of this research project, which is culminating with the migration from research and development at Montana State University to long-term implementation within Caltrans, demonstrating a successful relationship between aviation and surface transportation to better-serve those in rural areas.

Original Problem Statement

AWOS (Automated Weather Observing Systems), ASOS (Automated Surface Observing Systems) and RWIS (Roadside Weather Information Systems) equipment provide similar meteorological information to support safe and efficient transportation across multiple modes, but are operated independently of each other. Continued deployment and operation of similar but independent systems in close proximity to each other may result in redundancy and increased costs. Linkage consolidation of such systems will provide system managers and users (airport managers, flight departments and pilots) more comprehensive and accurate meteorological data and may reduce cost.

Note that “rural” was not a part of the original problem statement. All involved subsequently recognized that the need for this project was greatest in rural, underserved areas.

Genealogy


WeatherShare Phase 1
Caltrans
2003-2005
Ice = Covers California
Blue = Covers WSRTC Region
Purple = Covers Western United States
ICM
Caltrans
2006-2009
OSS Phase 1
Caltrans
2008-2010
Western States OSS Prototype via Clarus
FHWA
2010-2011
OSS Phase 2
Caltrans via WSRTC
2011-2013
OSS Phase 3
Caltrans via WSRTC
2016-2018
OSS Phase 4
Caltrans via WSRTC
TBD
WeatherShare Phase 2
Caltrans
2006-2009
COATS IV Deployment Assistance
Caltrans
2009-2010
WeatherShare Phase 3
Caltrans
2012-2015
WeatherShare Phase 4
Caltrans via WSRTC
2016-2017
WeatherShare Phase 5
Caltrans
TBD
AWOS/RWIS Phase 1
Caltrans
2008-2010
AWOS/RWIS Phase 2
Caltrans
2012-2015
AWOS/RWIS Phase 3
Caltrans
2017-2019

Phase I

February 1, 2008 – June 30, 2010

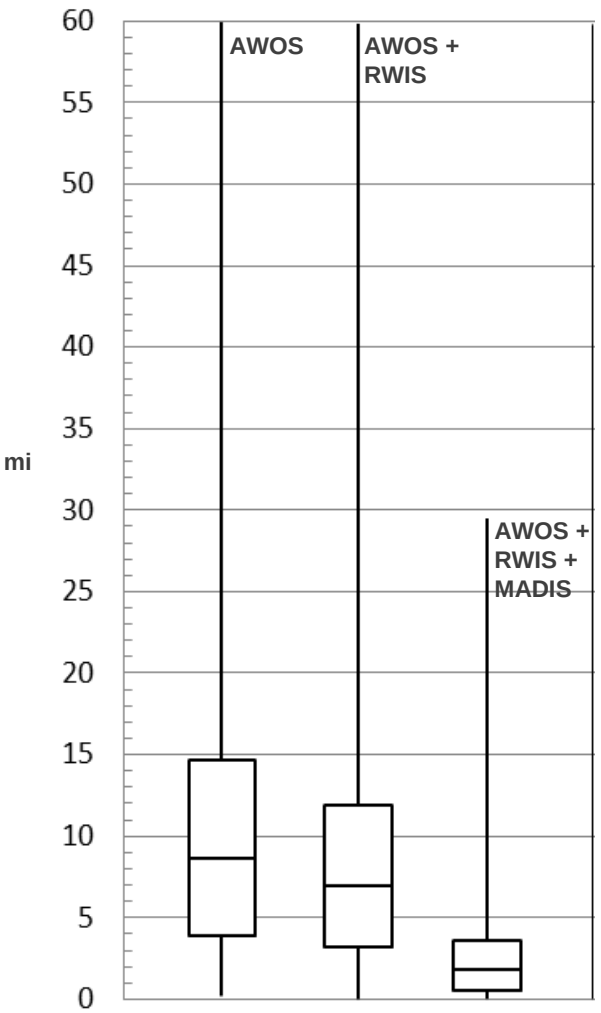
Phase I
Research Outcomes

- Identified aviation industry needs, requirements and benefits, and compare current capabilities, costs, coverage, and operation and maintenance requirements of AWOS / ASOS and RWIS by respective agencies.
- Summarized lessons learned from similar integration projects.
- Conducted a cost-benefit analysis for both an integrated data system and for cooperative maintenance and deployment, and determine related institutional issues.
- Created a controlled field demonstration prototype system.
- Evaluated the controlled field demonstration prototype system.
- Made recommendations based on the cost-benefit analysis and the evaluation of the field demonstration prototype system.

Coverage Analysis

More than 82.8% of the airfields are within 5 miles of a weather station.

More than 97.1% of the airfields are within 10 miles of a weather station.



Distance (mi)	AWOS	AWOS + RWIS	AWOS + RWIS + MADIS
dist < 5	298	366	801
5 ≤ dist < 10	262	288	138
10 ≤ dist < 20	261	219	25
20 ≤ dist < 30	82	63	3
30 ≤ dist < 40	46	22	0
40 ≤ dist < 50	10	5	0
50 ≤ dist	8	4	0
Min	0	0	0
Q1	3.88	3.09	0.69
Median	8.63	6.92	1.83
Q3	14.49	11.83	3.61
Max	59.77	59.77	29.53

Phase 2

July 3, 2012 – December 31, 2015

Phase 2
Research Outcomes

- Conducted a Business Case Analysis.
- Researched Additional Data Sources.
- Developed Detailed System Requirements.
- Developed and Implemented the Phase II Prototype System.
- Evaluated the Phase II Prototype System.
- Conducted an in-depth AWOS/ASOS Gap Analysis.

The Phase 2 Prototype System

Dynamic Data Layers & Sources

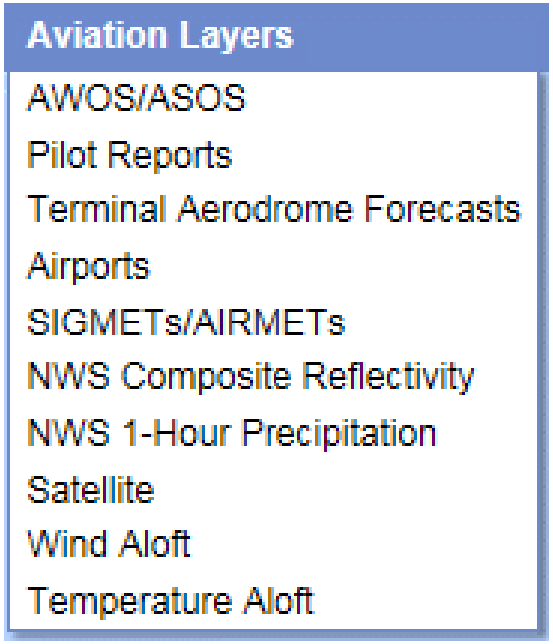
- National Center for Atmospheric Research (NCAR) Aviation Digital Data Service (ADDS):
  - PIREPS
  - TAF
  - SIGMETS
  - METAR
- NOAA's Satellite Service Division of the NESDIS (SSD):
  - Satellite Images
- NOAA's National Weather Service (NWS) National Doppler Radar Sites (NDRS):
  - Radar Images
  - Precipitation Images
- NOAA's National Weather Service NCEP Central Operations (NCO):
  - Wind Aloft
  - Temperature Aloft
- Caltrans CWWP2:
  - Caltrans CCTV
- National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service Public Alerts:
  - NWS Alerts
- National Weather Service National Digital Forecast Database:
  - Surface Forecasts
- Caltrans Scanweb:
  - Caltrans RWIS
- Meteorological Assimilation and Data Ingest System (MADIS):
  - Surface Conditions
- MesoWest:
  - Surface Conditions

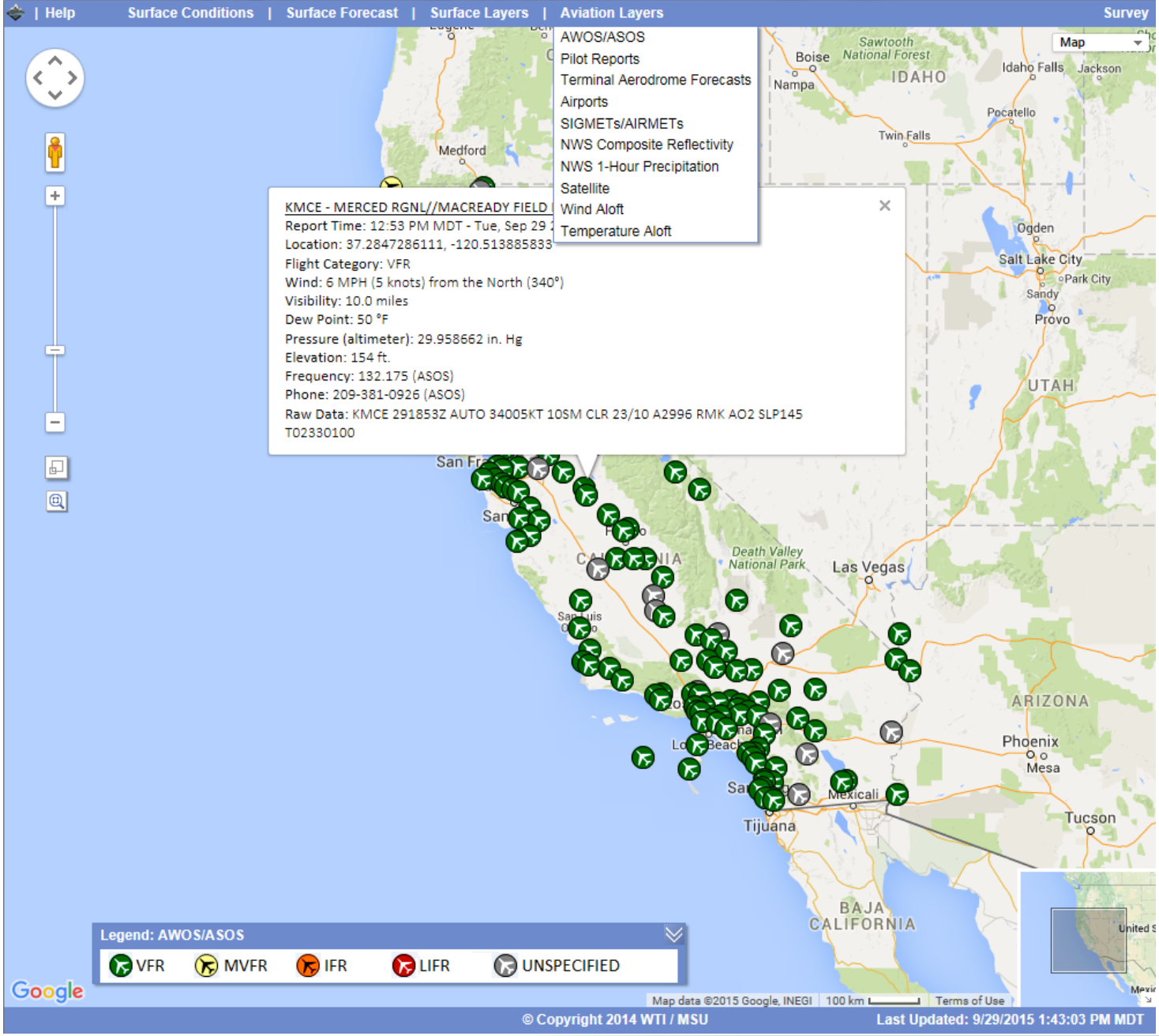
Airport, Heliport and Military Aviation Facilities are presented as a static layer using data provided by Caltrans.

The Phase 2 Prototype System

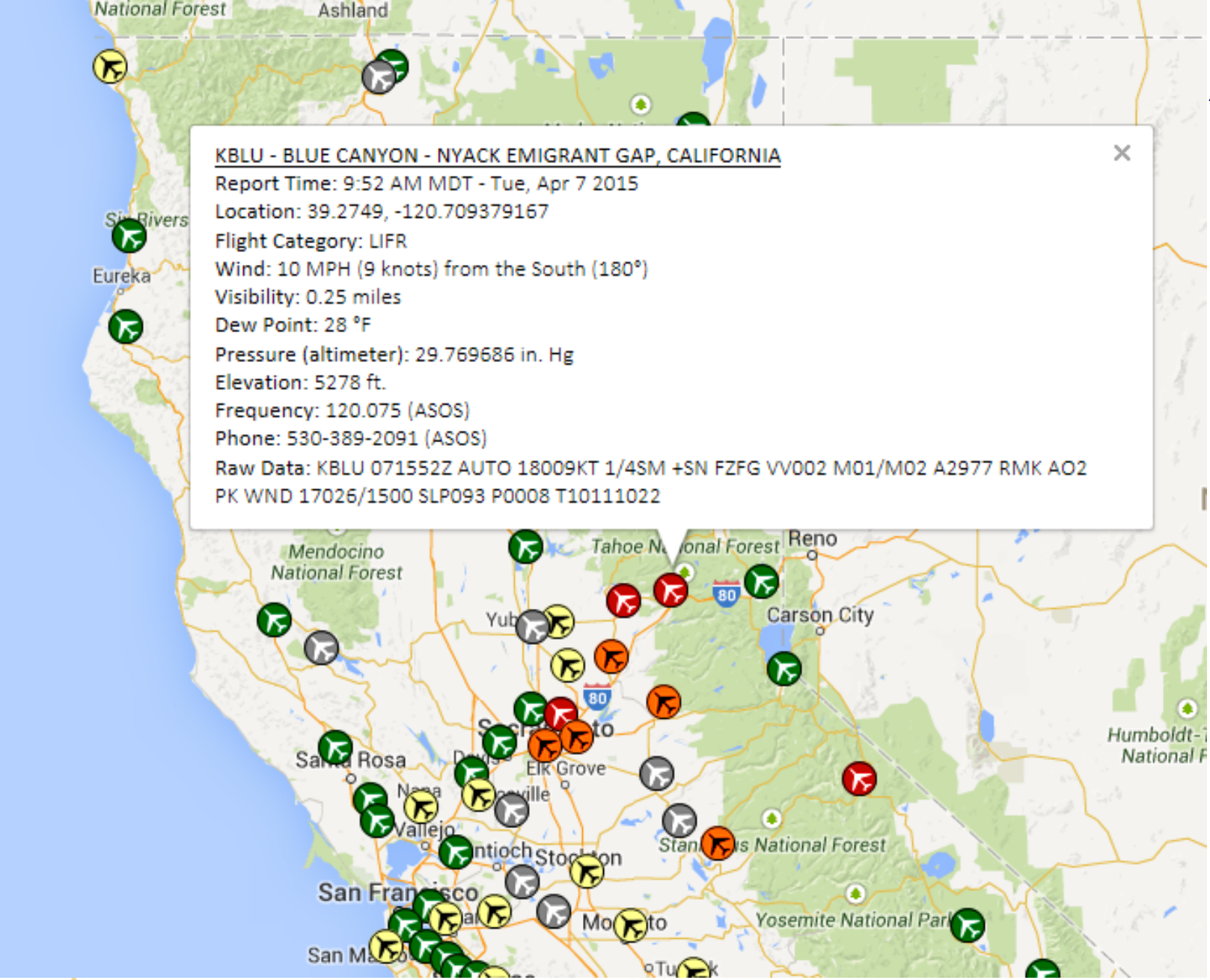
A Pictorial Overview …

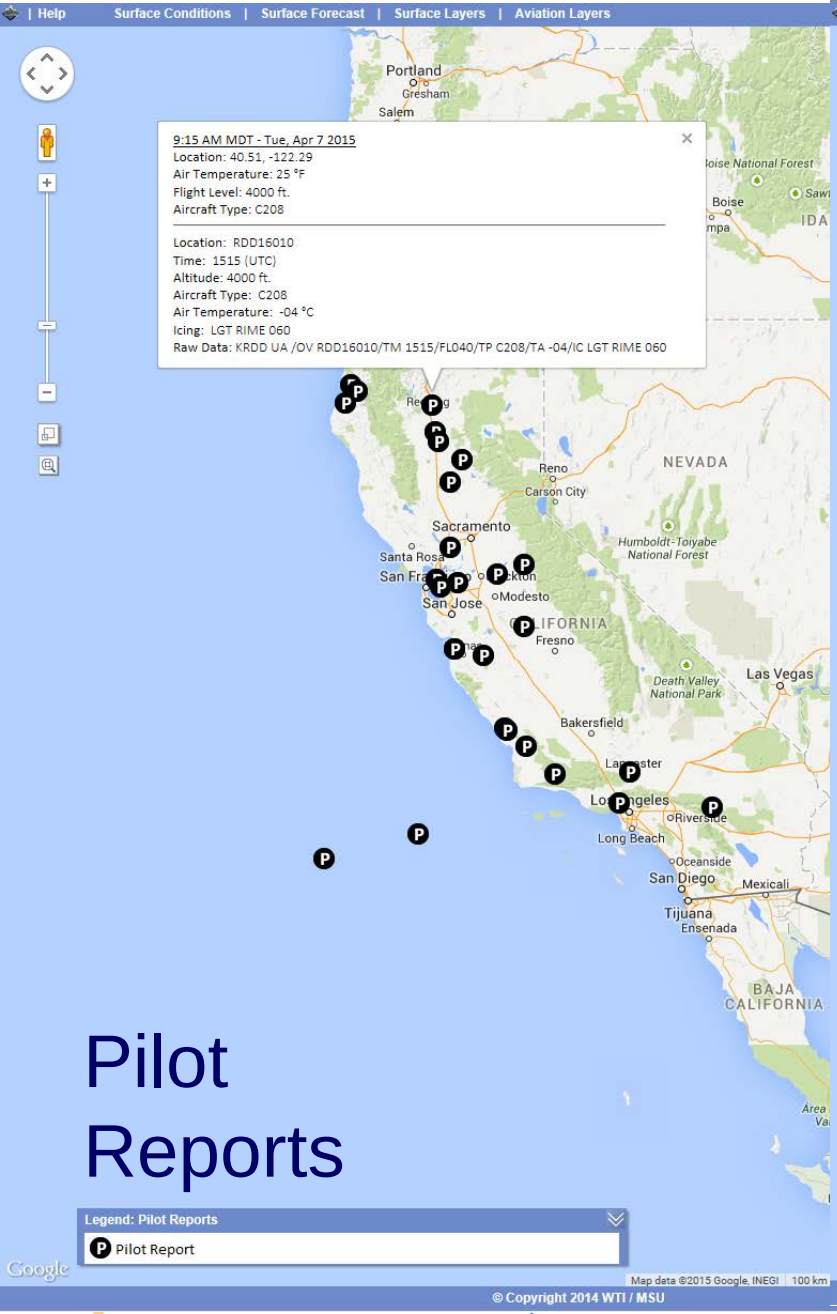
Aviation Layers



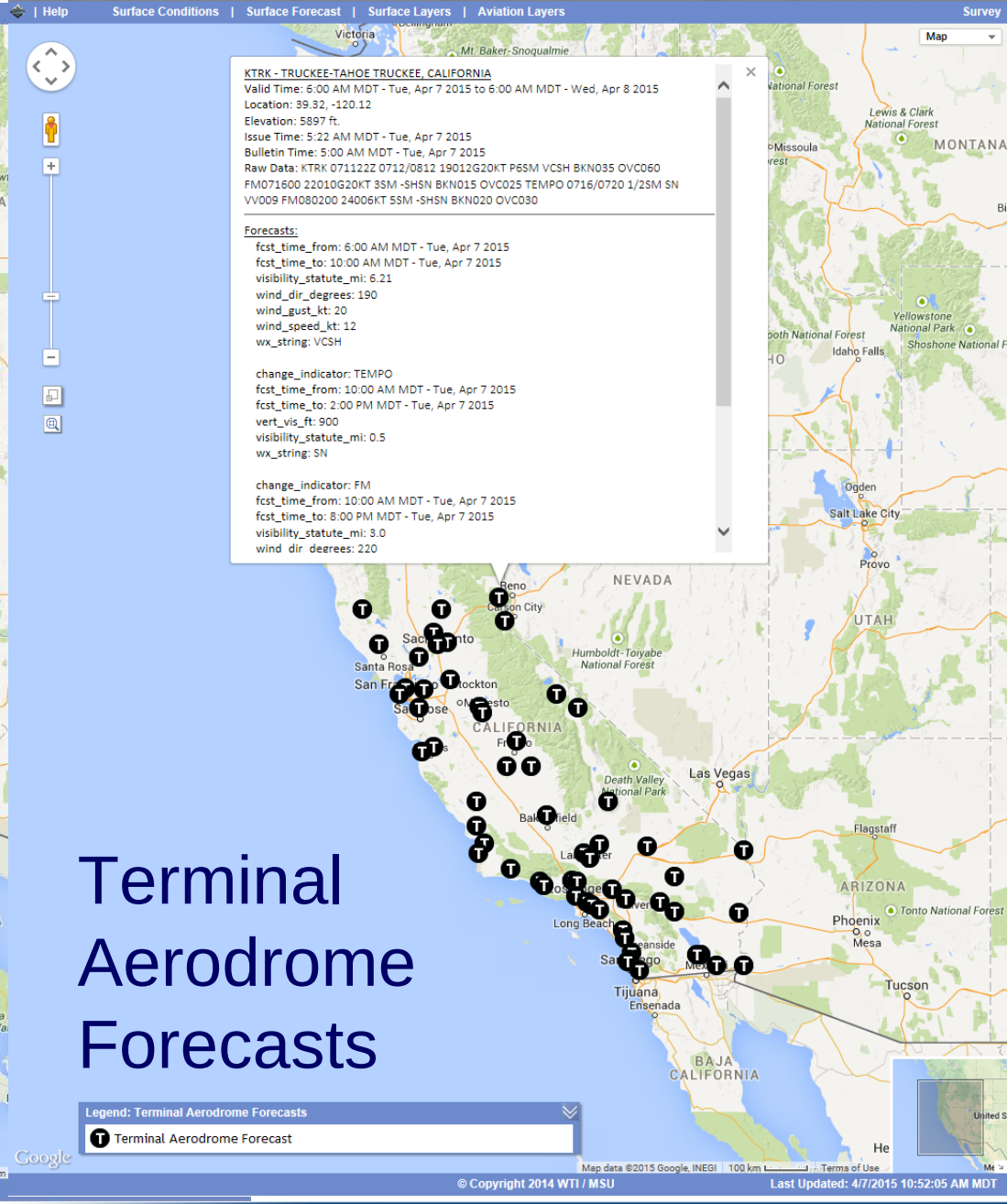

Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
Survey
AWOS/ASOS
Pilot Reports
Terminal Aerodrome Forecasts
Airports
SIGMETs/AIRMETs
NWS Composite Reflectivity
NWS 1-Hour Precipitation
Satellite
Wind Aloft
Temperature Aloft
Map
KMCE - MERCED RGNL//MACREADY FIELD
Report Time: 12:53 PM MDT - Tue, Sep 29
Location: 37.2847286111, -120.513885833
Flight Category: VFR
Wind: 6 MPH (5 knots) from the North (340°)
Visibility: 10.0 miles
Dew Point: 50 °F
Pressure (altimeter): 29.958662 in. Hg
Elevation: 154 ft.
Frequency: 132.175 (ASOS)
Phone: 209-381-0926 (ASOS)
Raw Data: KMCE 291853Z AUTO 34005KT 10SM CLR 23/10 A2996 RMK AO2 SLP145 T02330100
Boise
Nampa
Sawtooth National Forest
IDAHO
Idaho Falls
Jackson
Pocatello
Twin Falls
Medford
Ogden
Salt Lake City
Park City
Sandy
Provo
UTAH
Death Valley National Park
Las Vegas
ARIZONA
Phoenix
Mesa
Tucson
Mexicali
Tijuana
BAJA CALIFORNIA
Legend: AWOS/ASOS
VFR
MVFR
IFR
LIFR
UNSPECIFIED
Google
Map data ©2015 Google, INEGI
100 km
Terms of Use
© Copyright 2014 WTI / MSU
Last Updated: 9/29/2015 1:43:03 PM MDT

AWOS / ASOS

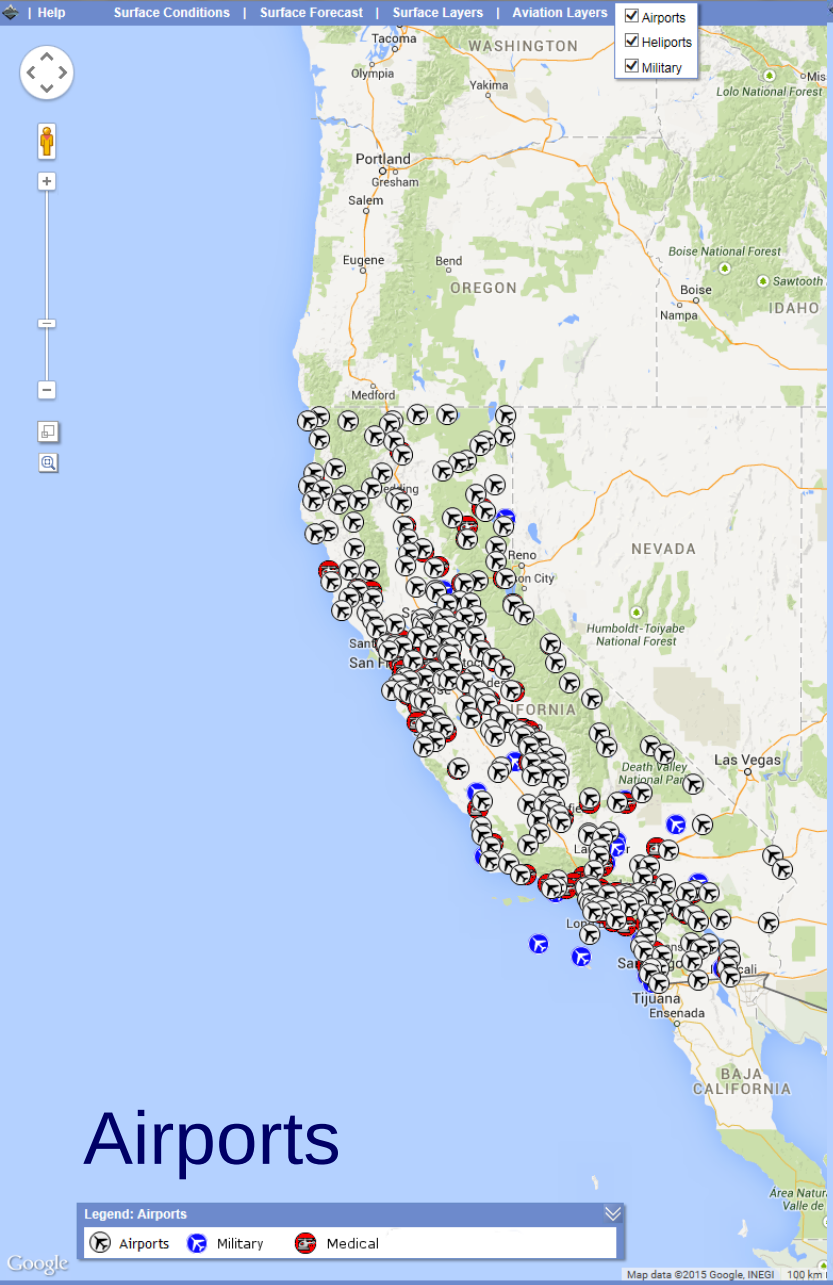

KBLU - BLUE CANYON - NYACK EMIGRANT GAP, CALIFORNIA
Report Time: 9:52 AM MDT - Tue, Apr 7 2015
Location: 39.2749, -120.709379167
Flight Category: LIFR
Wind: 10 MPH (9 knots) from the South (180°)
Visibility: 0.25 miles
Dew Point: 28 °F
Pressure (altimeter): 29.769686 in. Hg
Elevation: 5278 ft.
Frequency: 120.075 (ASOS)
Phone: 530-389-2091 (ASOS)
Raw Data: KBLU 071552Z AUTO 18009KT 1/4SM +SN FZFG VV002 M01/M02 A2977 RMK AO2
PK WND 17026/1500 SLP093 P0008 T10111022
Eureka
Mendocino National Forest
Reno
Carson City
80
Santa Rosa
Elk Grove
Vallejo
Stockton
San Francisco
Yosemite National Park
Humboldt-Toiyabe National Forest



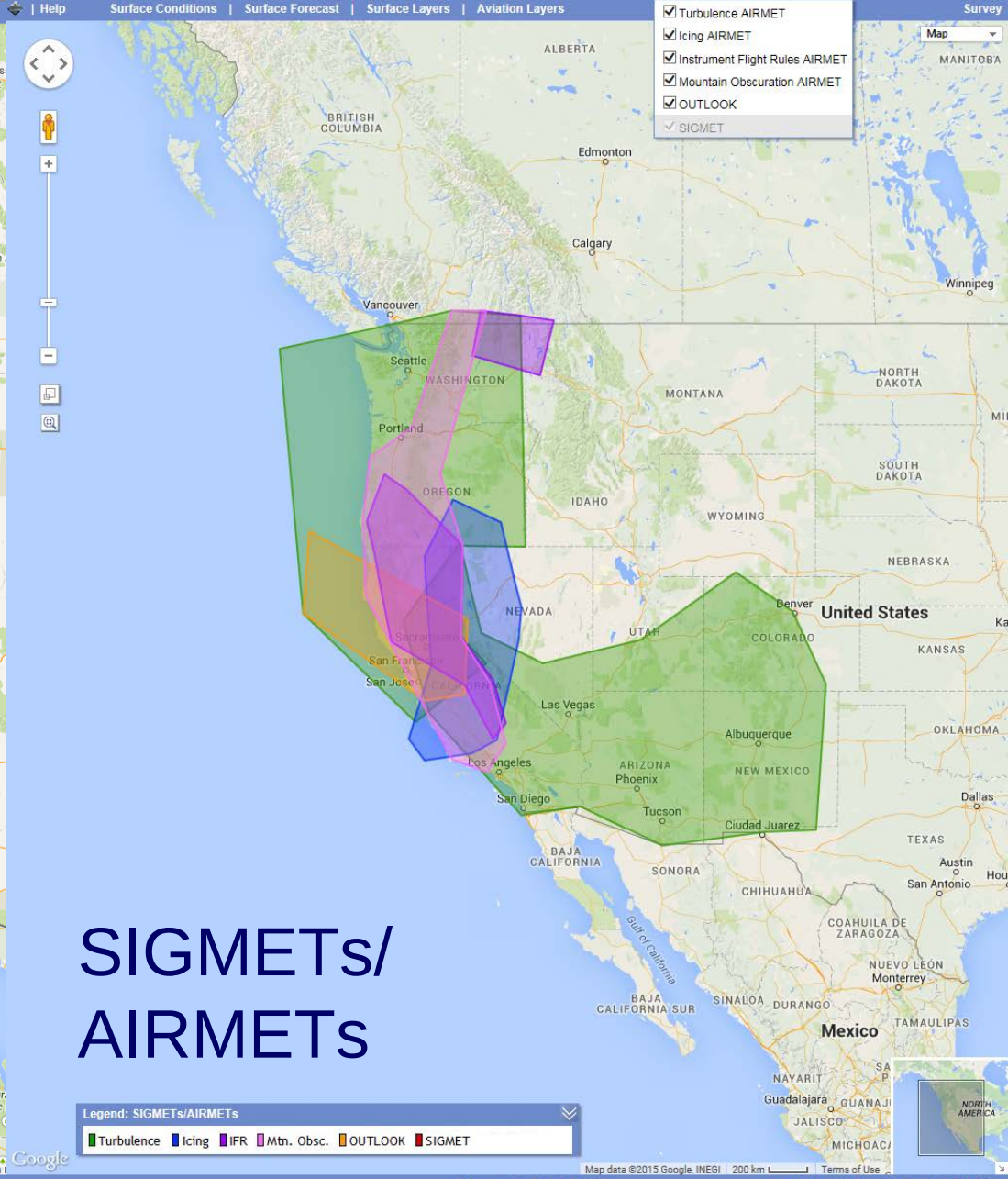
Pilot Reports



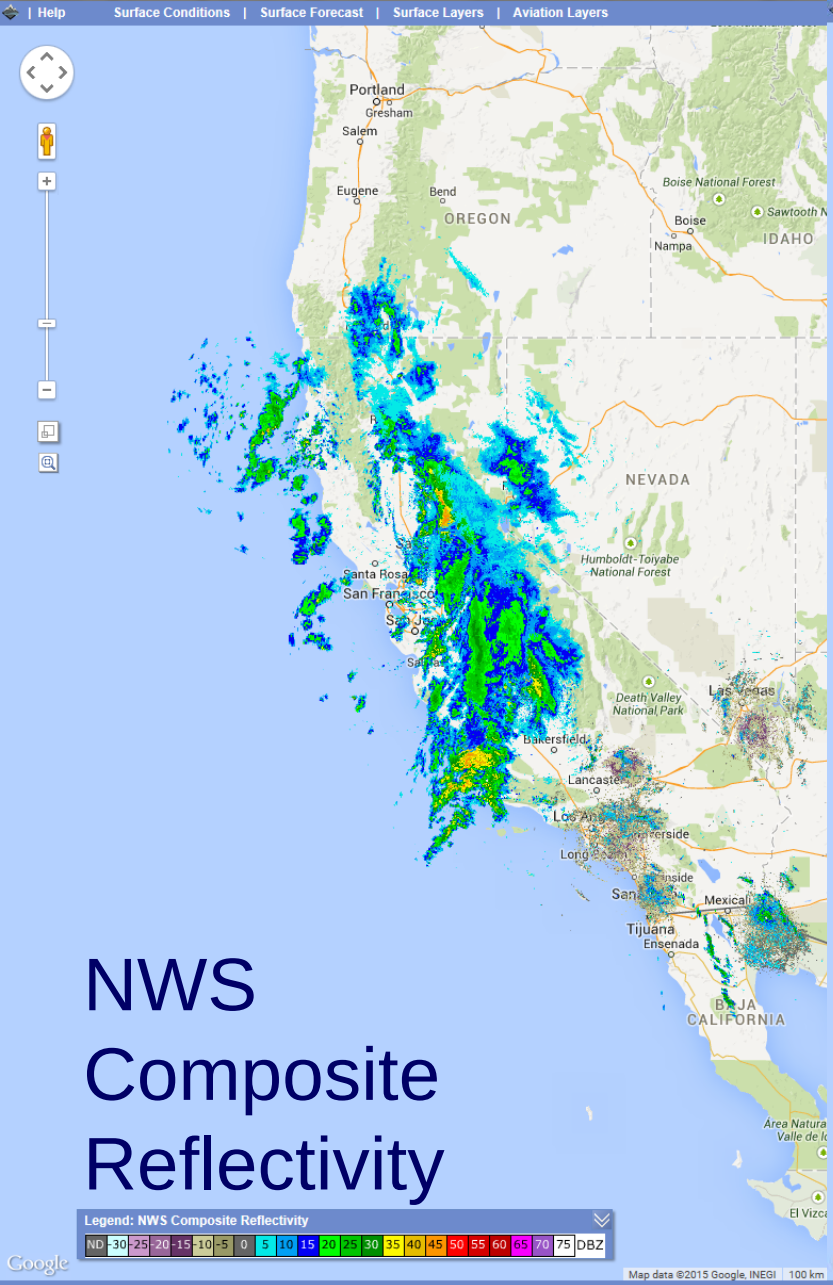
Terminal Aerodrome Forecasts



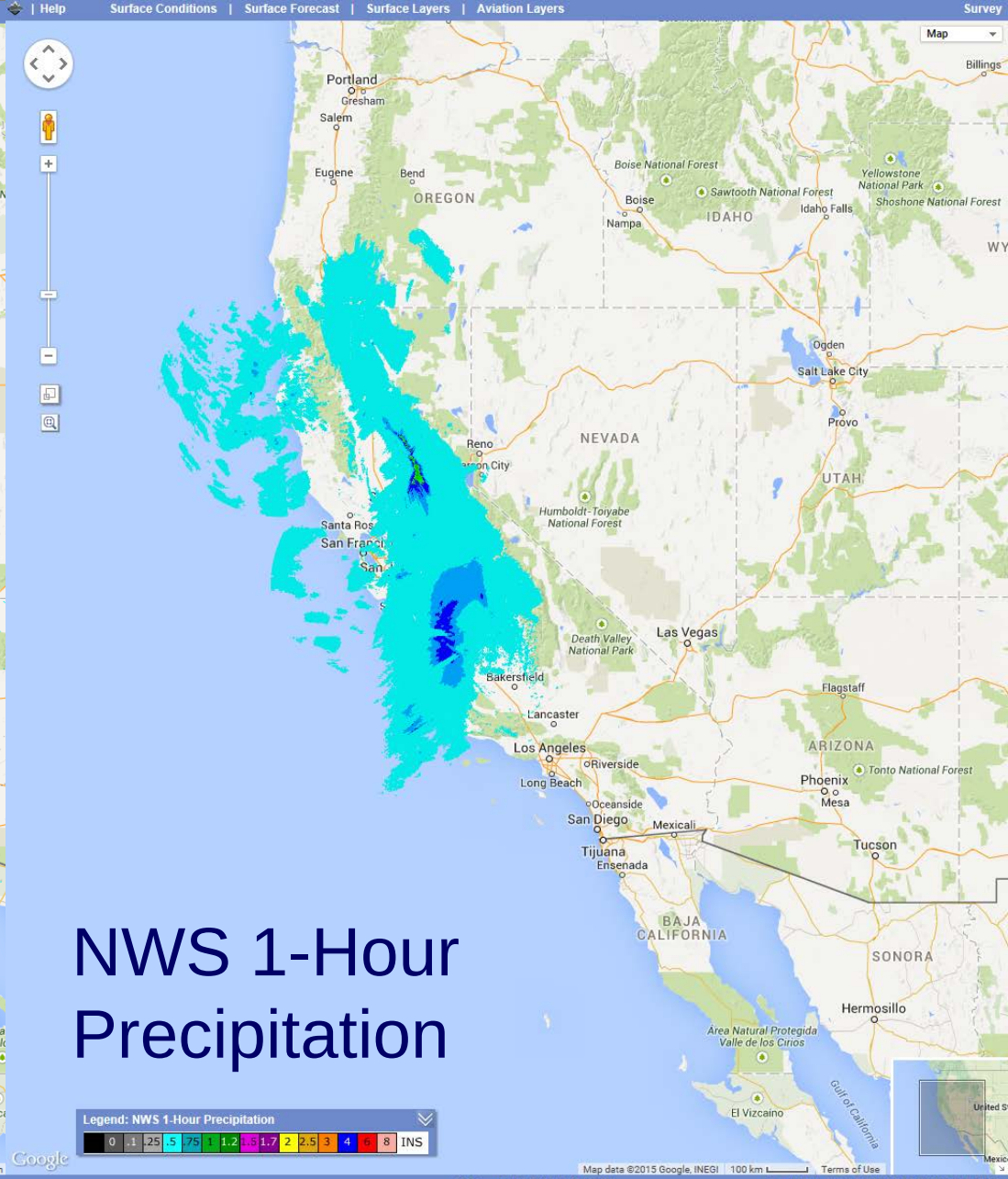
Airports



SIGMETs/
AIRMETs

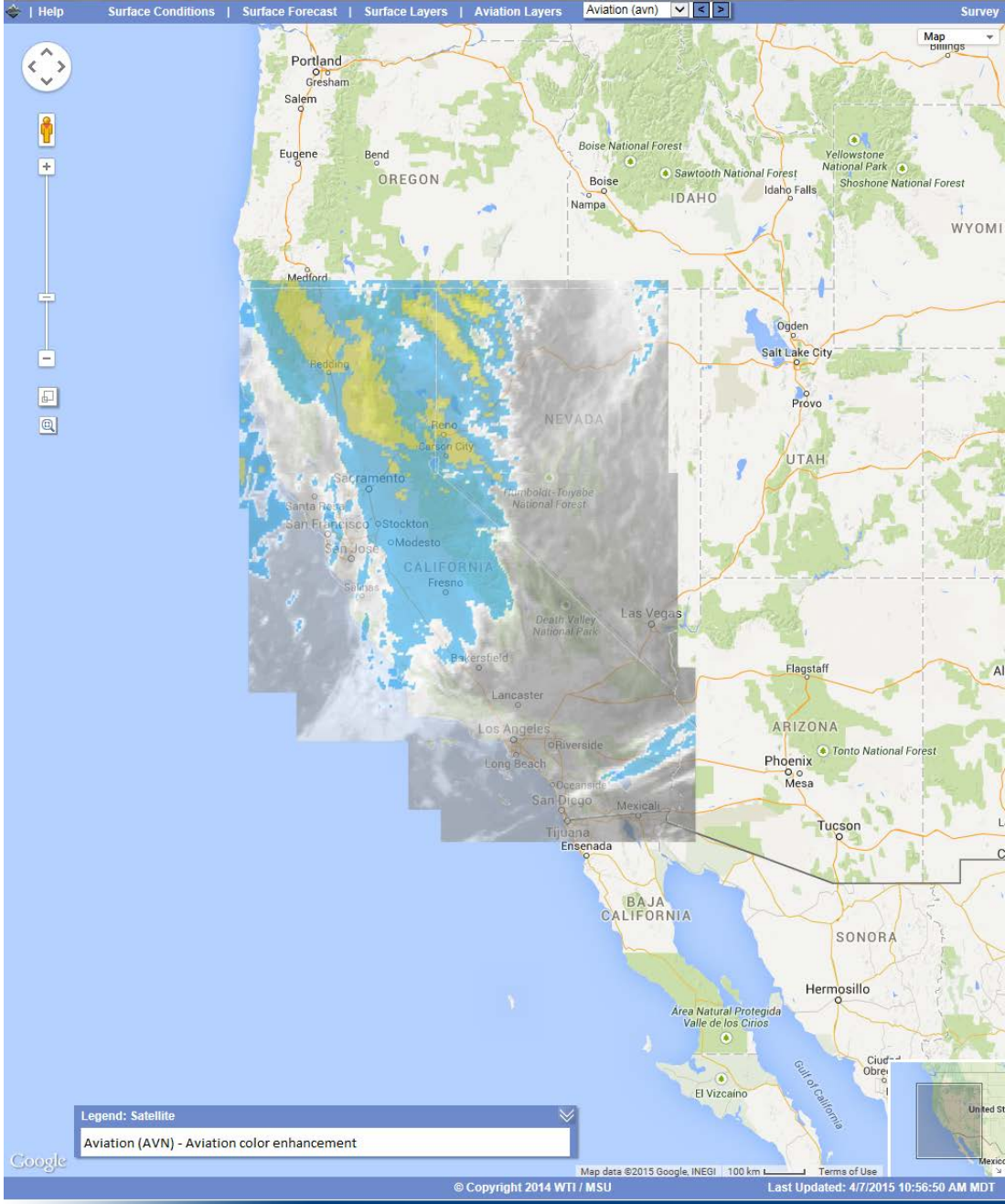


NWS Composite Reflectivity



NWS 1-Hour Precipitation

Satellite


Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
Aviation (avn)
Survey
Map
Portland
Gresham
Salem
Eugene
Bend
OREGON
Boise National Forest
Boise
Sawtooth National Forest
Nampa
IDAHO
Idaho Falls
Yellowstone National Park
Shoshone National Forest
WYOMI
Medford
Redding
Ogden
Salt Lake City
Provo
NEVADA
Reno
Carson City
UTAH
Sacramento
Santa Rosa
San Francisco
Stockton
Modesto
San Jose
Humboldt-Toiyabe National Forest
CALIFORNIA
Fresno
Salinas
Death Valley National Park
Las Vegas
Bakersfield
Flagstaff
Lancaster
Los Angeles
Riverside
Long Beach
ARIZONA
Tonto National Forest
Phoenix
Mesa
Oceanside
San Diego
Mexicali
Tijuana
Ensenada
Tucson
BAJA CALIFORNIA
SONORA
Hermosillo
Area Natural Protegida Valle de los Cirios
El Vizcaino
Gulf of California
Legend: Satellite
Aviation (AVN) - Aviation color enhancement
Google
Map data ©2015 Google, INEGI
100 km
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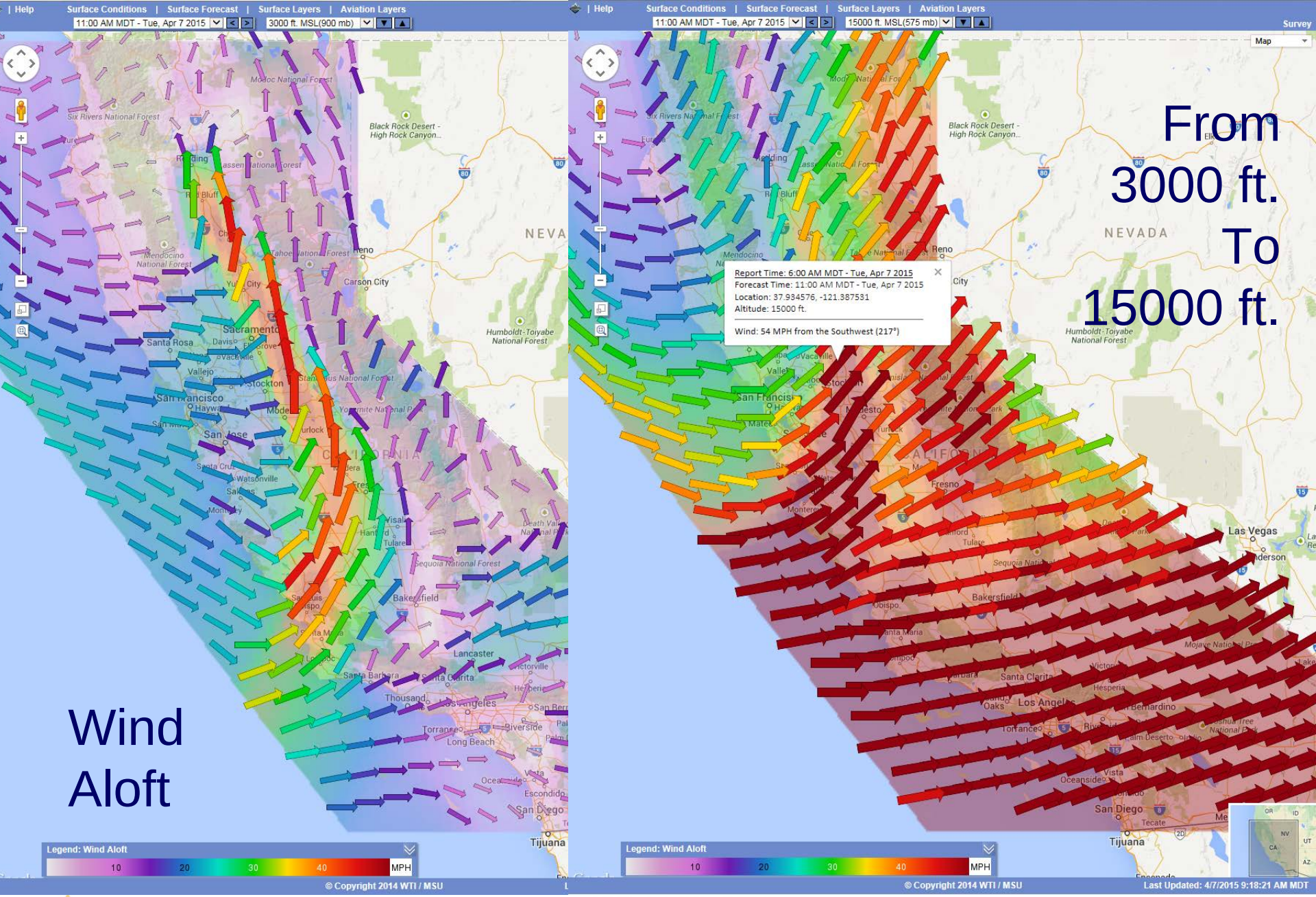
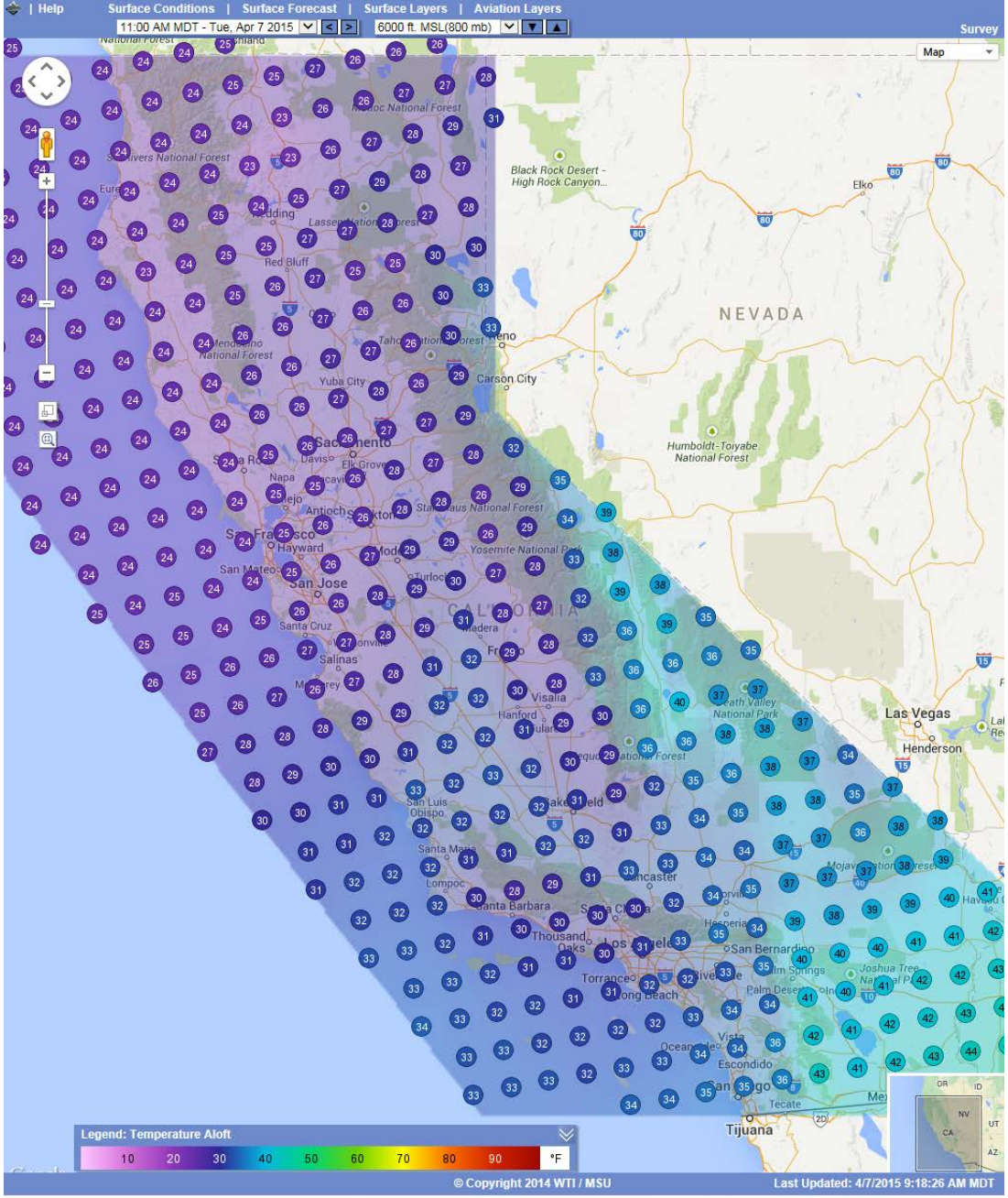
Last Updated: 4/7/2015 10:56:50 AM MDT


Help
Surface Conditions | Surface Forecast | Surface Layers | Aviation Layers
11:00 AM MDT - Tue, Apr 7 2015
3000 ft. MSL(900 mb)
15000 ft. MSL(575 mb)
Survey
Map
From 3000 ft. To 15000 ft.
Wind Aloft
Report Time: 6:00 AM MDT - Tue, Apr 7 2015
Forecast Time: 11:00 AM MDT - Tue, Apr 7 2015
Location: 37.934576, -121.387531
Altitude: 15000 ft.
Wind: 54 MPH from the Southwest (217°)
Legend: Wind Aloft
10 20 30 40 MPH
© Copyright 2014 WTI / MSU
Last Updated: 4/7/2015 9:18:21 AM MDT

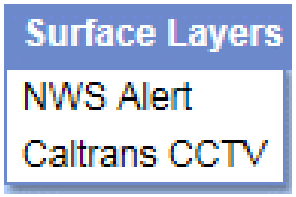


Temperature Aloft

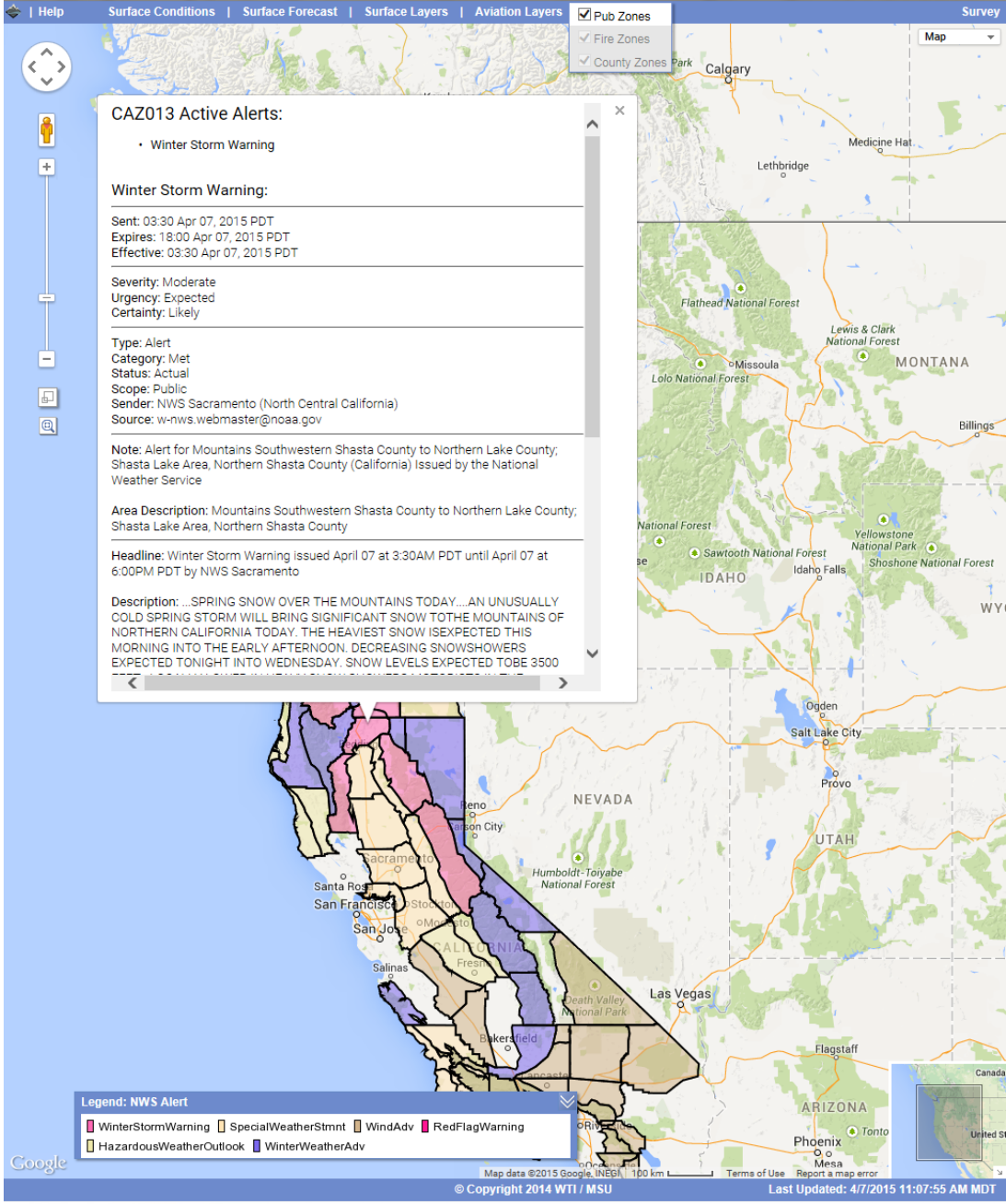
From
3000 ft.

To
15000 ft.

Surface Layers



NWS Alerts


Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
Pub Zones
Fire Zones
County Zones
Survey
Map
CAZ013 Active Alerts:
Winter Storm Warning
Winter Storm Warning:
Sent: 03:30 Apr 07, 2015 PDT
Expires: 18:00 Apr 07, 2015 PDT
Effective: 03:30 Apr 07, 2015 PDT
Severity: Moderate
Urgency: Expected
Certainty: Likely
Type: Alert
Category: Met
Status: Actual
Scope: Public
Sender: NWS Sacramento (North Central California)
Source: w-nws.webmaster@noaa.gov
Note: Alert for Mountains Southwestern Shasta County to Northern Lake County; Shasta Lake Area, Northern Shasta County (California) Issued by the National Weather Service
Area Description: Mountains Southwestern Shasta County to Northern Lake County; Shasta Lake Area, Northern Shasta County
Headline: Winter Storm Warning issued April 07 at 3:30AM PDT until April 07 at 6:00PM PDT by NWS Sacramento
Description: ...SPRING SNOW OVER THE MOUNTAINS TODAY....AN UNUSUALLY COLD SPRING STORM WILL BRING SIGNIFICANT SNOW TOTHE MOUNTAINS OF NORTHERN CALIFORNIA TODAY. THE HEAVIEST SNOW ISEXPECTED THIS MORNING INTO THE EARLY AFTERNOON. DECREASING SNOWSHOWERS EXPECTED TONIGHT INTO WEDNESDAY. SNOW LEVELS EXPECTED TOBE 3500
Calgary
Medicine Hat
Lethbridge
Flathead National Forest
Lewis & Clark National Forest
MONTANA
Missoula
Lolo National Forest
Billings
Yellowstone National Park
Shoshone National Forest
Sawtooth National Forest
IDAHO
Idaho Falls
Ogden
Salt Lake City
Provo
NEVADA
Reno
Carson City
UTAH
Humboldt-Toiyabe National Forest
Sacramento
Santa Rosa
San Francisco
San Jose
Salinas
Las Vegas
Death Valley National Park
Flagstaff
ARIZONA
Phoenix
Tonto
Mesa
Legend: NWS Alert
WinterStormWarning
SpecialWeatherStmnt
WindAdv
RedFlagWarning
HazardousWeatherOutlook
WinterWeatherAdv
Google
Map data ©2015 Google, INEGI
100 km
Terms of Use
Report a map error
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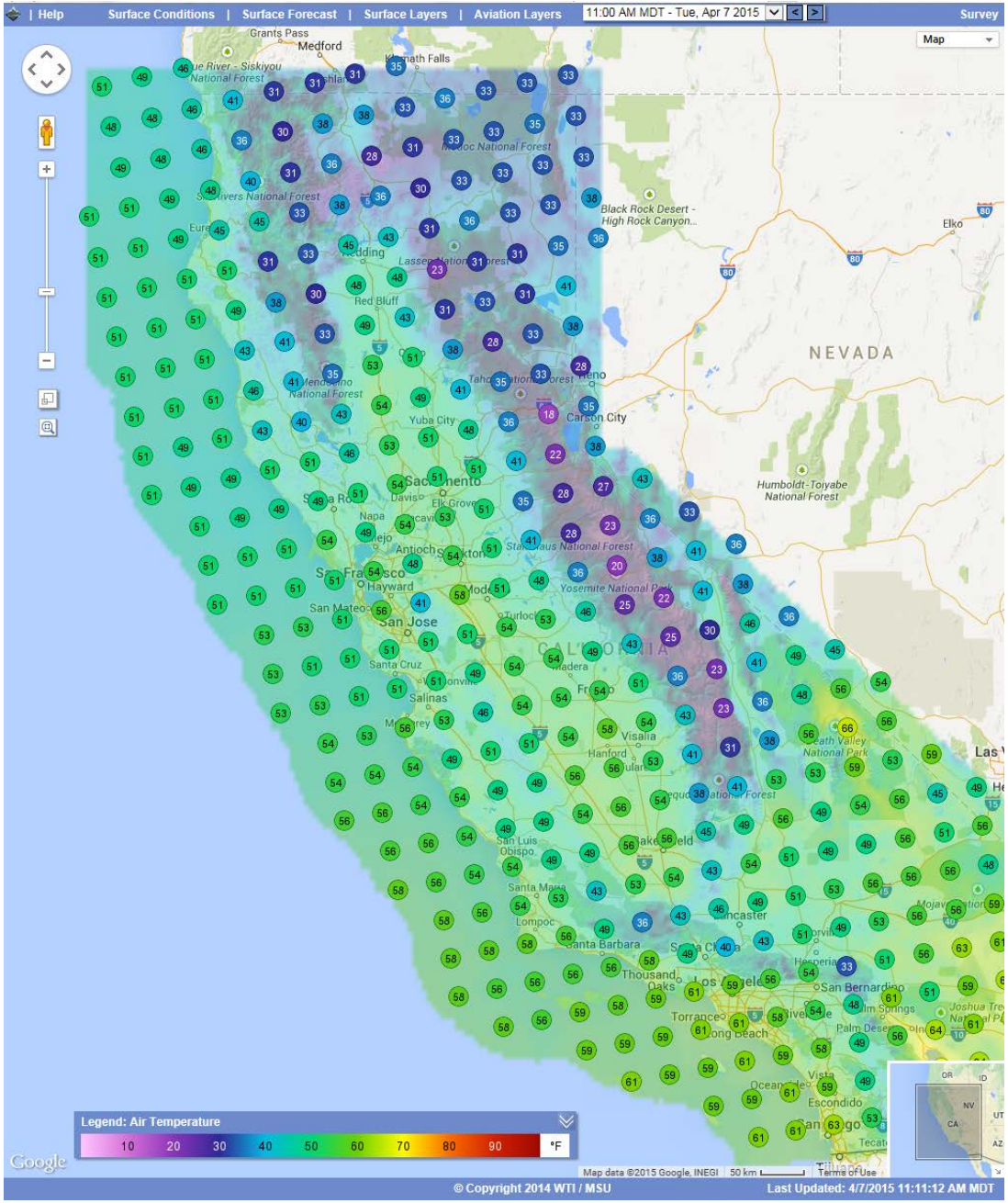
Last Updated: 4/7/2015 11:07:55 AM MDT

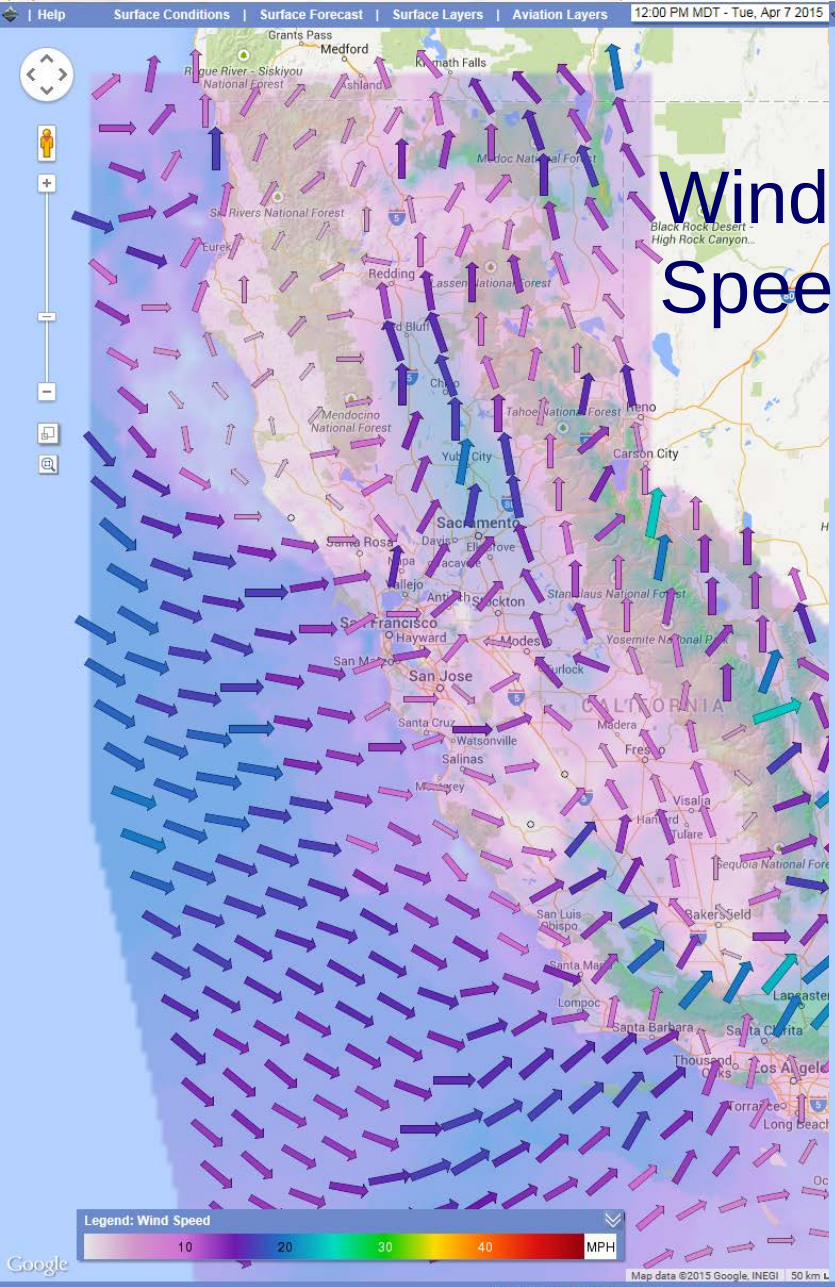

Salt Creek
SALT CREEK PRESET 1
Tuesday, April 07, 2015 09:34:16 PDT
Antlers Bridge
ANTLERS BRIDGE PRESET 3
Tuesday, April 07, 2015 10:10:04 PDT
Lakehead
LAKEHEAD PRESET 3
Tuesday, April 07, 2015 10:11:04 PDT
Vollmers
VOLLMERS PRESET 1
Tuesday, April 07, 2015 10:06:08 PDT
La Moine
LA MOINE PRESET 3
Tuesday, April 07, 2015 10:09:03 PDT
Pollard Flat
POLLARD FLAT PRESET 1
Tuesday, April 07, 2015 09:15:15 PDT
Gibson
GIBSON PRESET 3
Tuesday, April 07, 2015 09:14:45 PDT
Donner Lake
I-80 AT DONNER LAKE INT
2015-04-07 10:13:54
Dunsmuir
DUNSMUIR PRESET 1
Tuesday, April 07, 2015 10:06:25 PDT
Snowman
SNOWMAN PRESET 1
Tuesday, April 07, 2015 09:45:02 PDT
Caltrans CCTV
I5-SR89
I5-SR89
Tuesday, April 07, 2015 09:18:33 PDT
Castle Peak
I-80 AT CASTLE PEAK
2015-04-07 10:13:51
Soda Springs Eastbound
I-80 AT EB SODA SPRINGS
2015-04-07 10:13:51
Kingvale Westbound
I-80 AT WB KINGVALE LOW PRESSURE
2015-04-07 09:14:13
Kingvale Eastbound
I-80 AT EB KINGVALE PRESET 1
2015-04-07 10:09:34
Whitmore Grade
I-80 WHITMORE GRADE
2015-04-07 10:05:53
I-80 AT CRYSTAL SPRINGS
2015-04-07 10:13:50
ADJUST C38 TO BALANCE
2015-04-07 09:18:21
BOGARD PRESET 2
Tuesday, April 07, 2015 10:02:30 PDT
OBRIEN PRESET 1
Tuesday, April 07, 2015 10:12:02 PDT

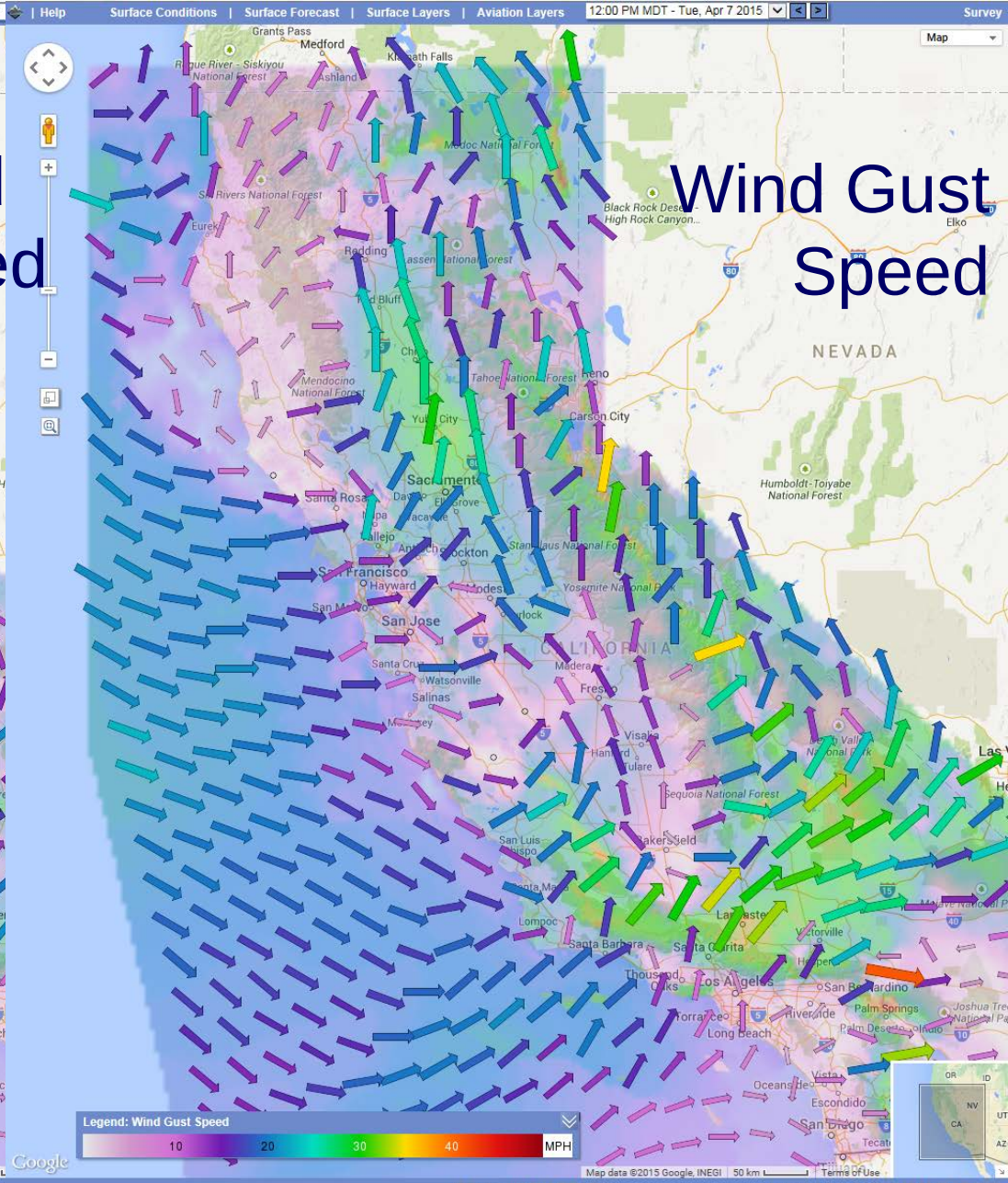
Surface Forecast Layers

Surface Forecast
Air Temperature
Wind Speed
Wind Gust Speed
Humidity
Sky Cover
12-Hour Chance of Precipitation
6-Hour Precipitation
Snow
Weather



Air Temperature


Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
12:00 PM MDT - Tue, Apr 7 2015
Wind Speed
Legend: Wind Speed
10
20
30
40
MPH
Google
Map data ©2015 Google, INEGI
50 km
© Copyright 2014 WTI / MSU


Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
12:00 PM MDT - Tue, Apr 7 2015
Survey
Map
Wind Gust Speed
NEVADA
Legend: Wind Gust Speed
10
20
30
40
MPH
Google
Map data ©2015 Google, INEGI
50 km
Terms of Use
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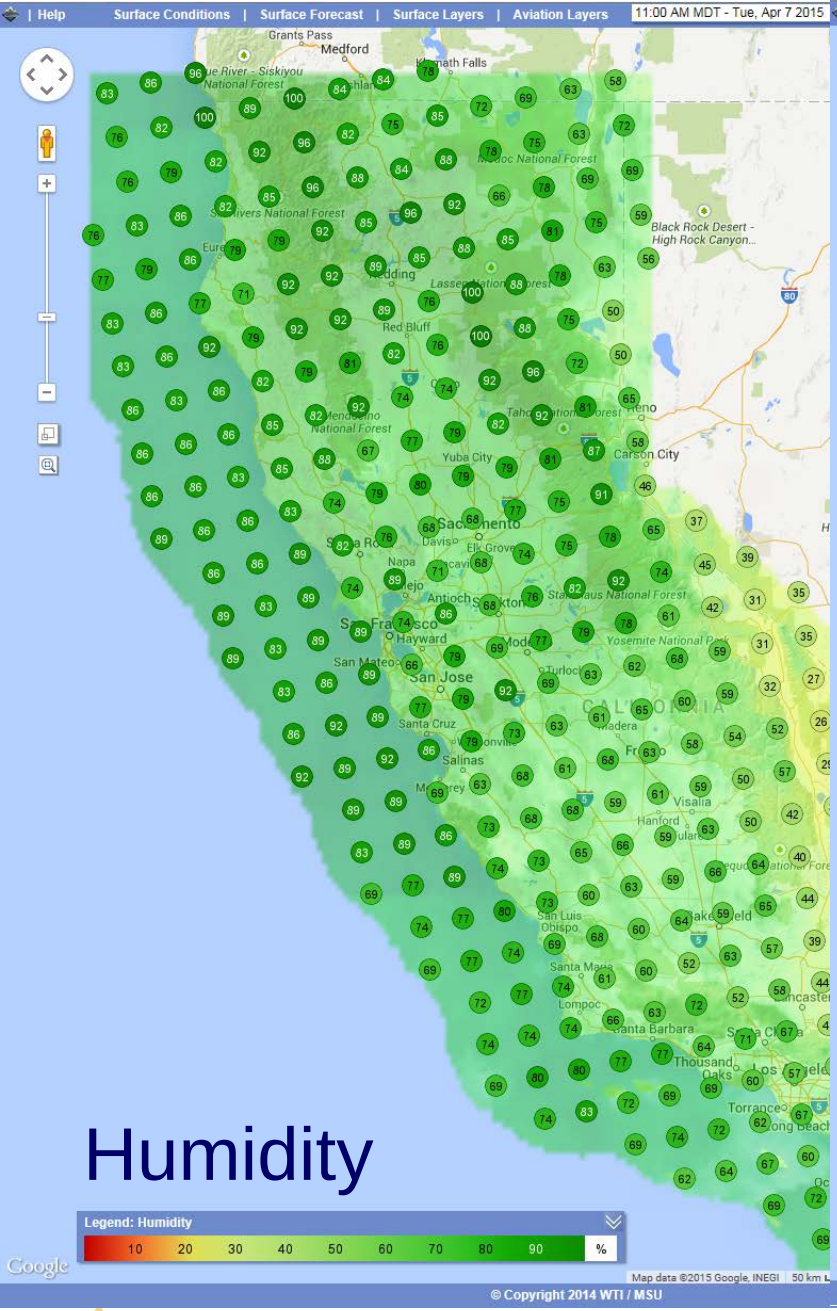
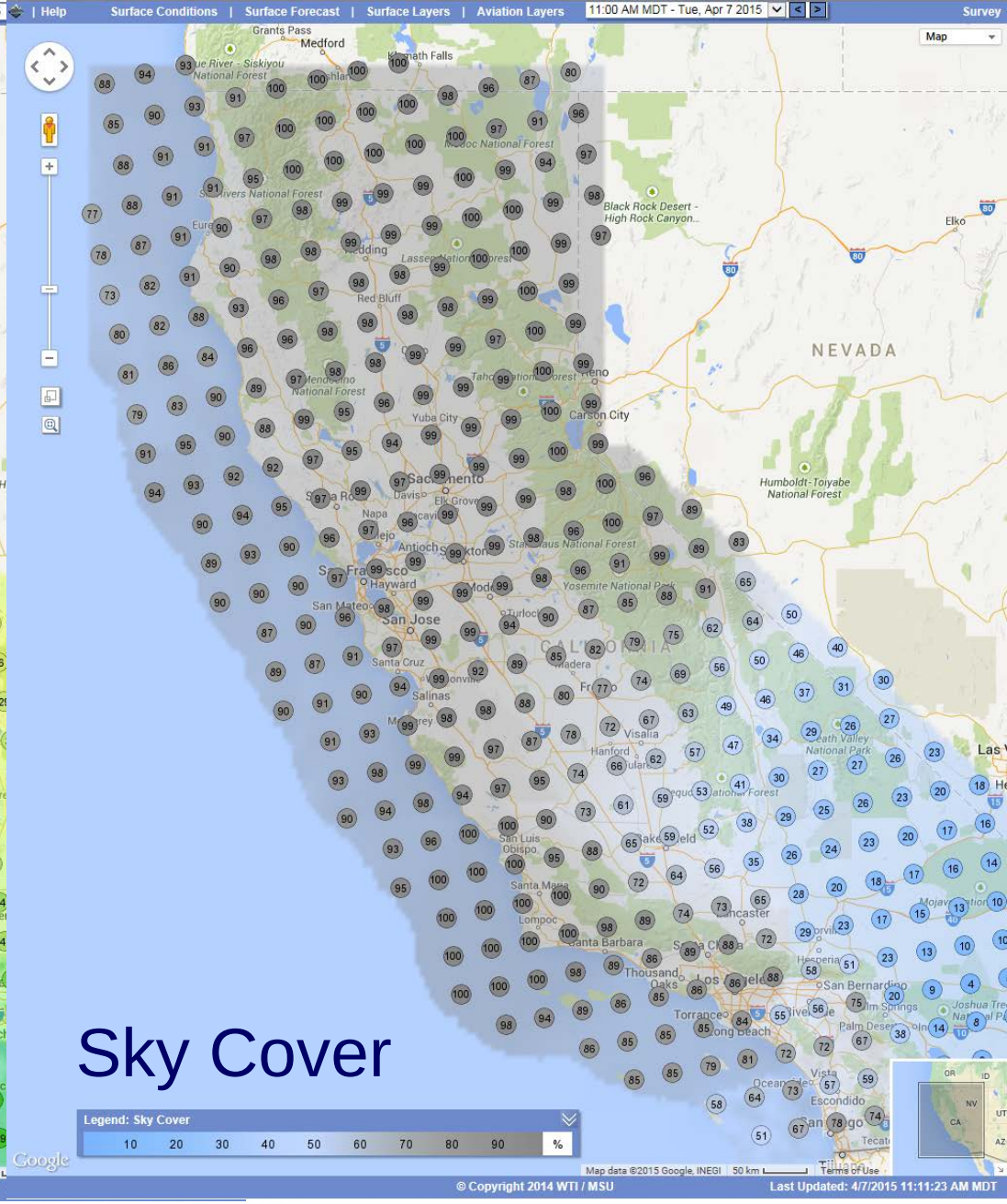
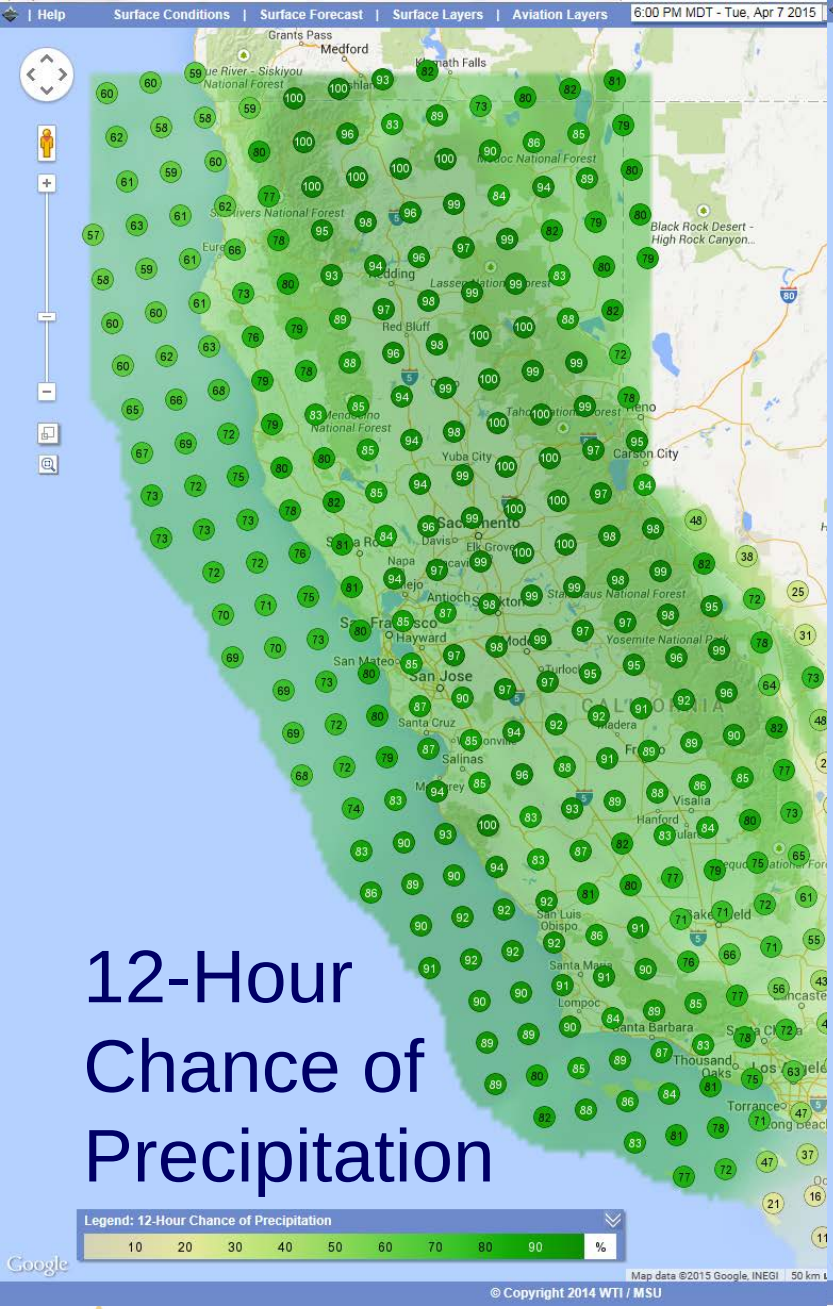
Last Updated: 4/7/2015 11:11:38 AM MDT



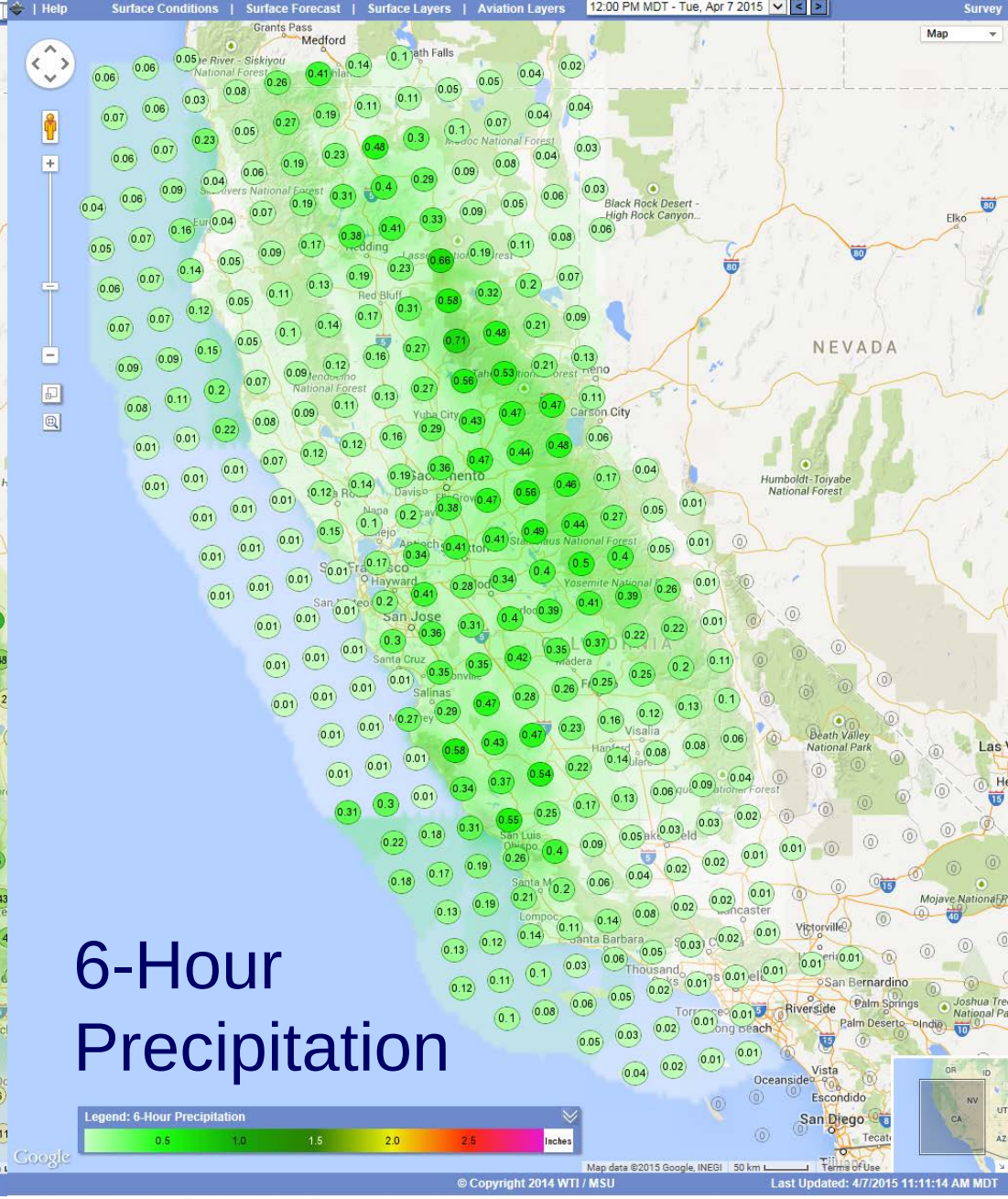
Humidity



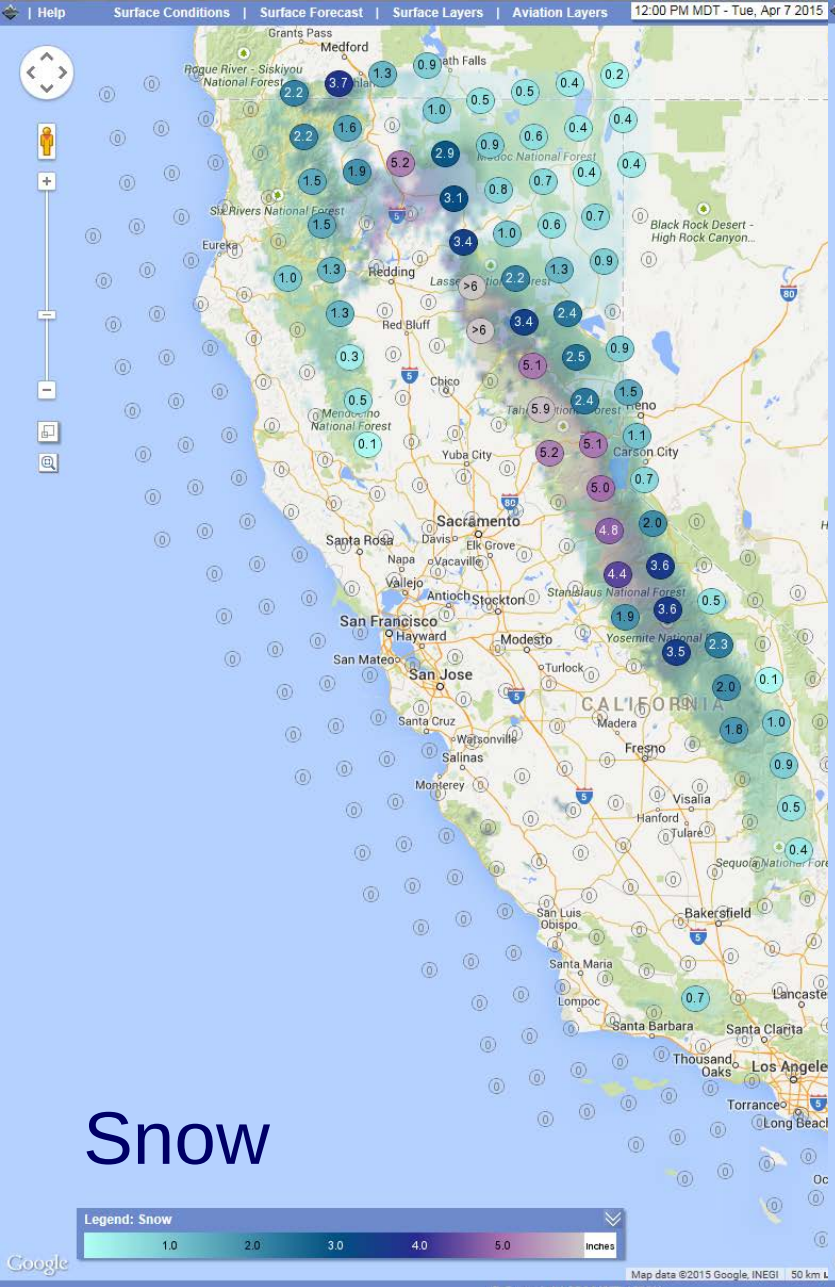
Sky Cover



12-Hour Chance of Precipitation



6-Hour Precipitation


Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
12:00 PM MDT - Tue, Apr 7 2015
Snow
Legend: Snow
1.0
2.0
3.0
4.0
5.0
inches
Map data ©2015 Google, INEGI
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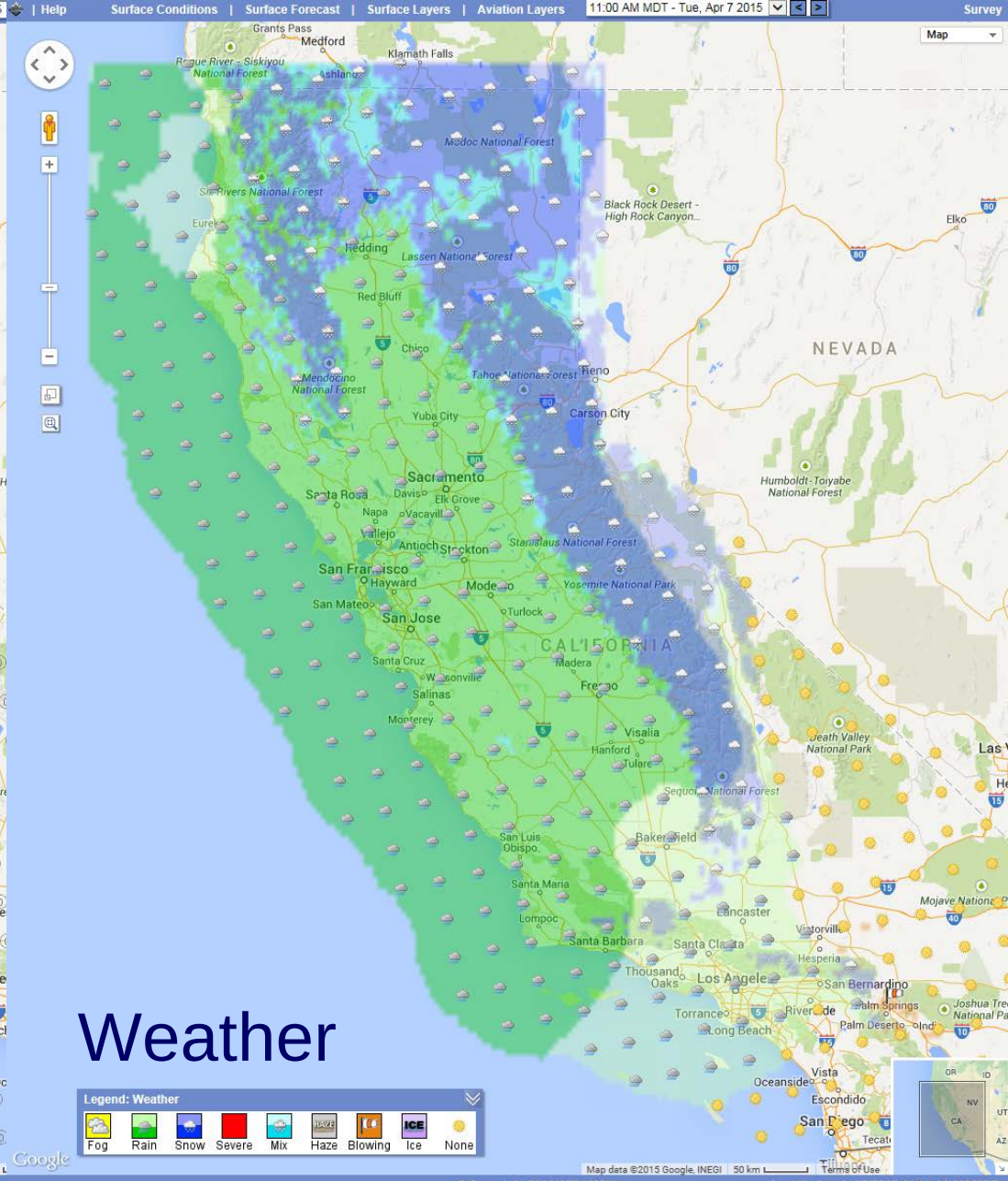
Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
11:00 AM MDT - Tue, Apr 7 2015
Survey
Map
Weather
Legend: Weather
Fog
Rain
Snow
Severe
Mix
Haze
Blowing
Ice
None
NEVADA
CALIFORNIA
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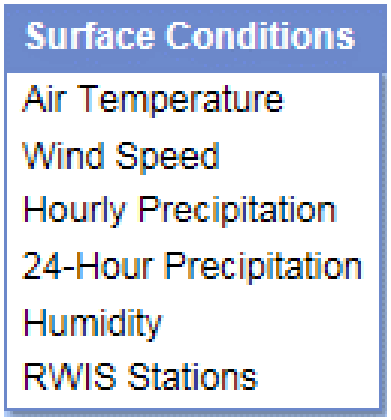
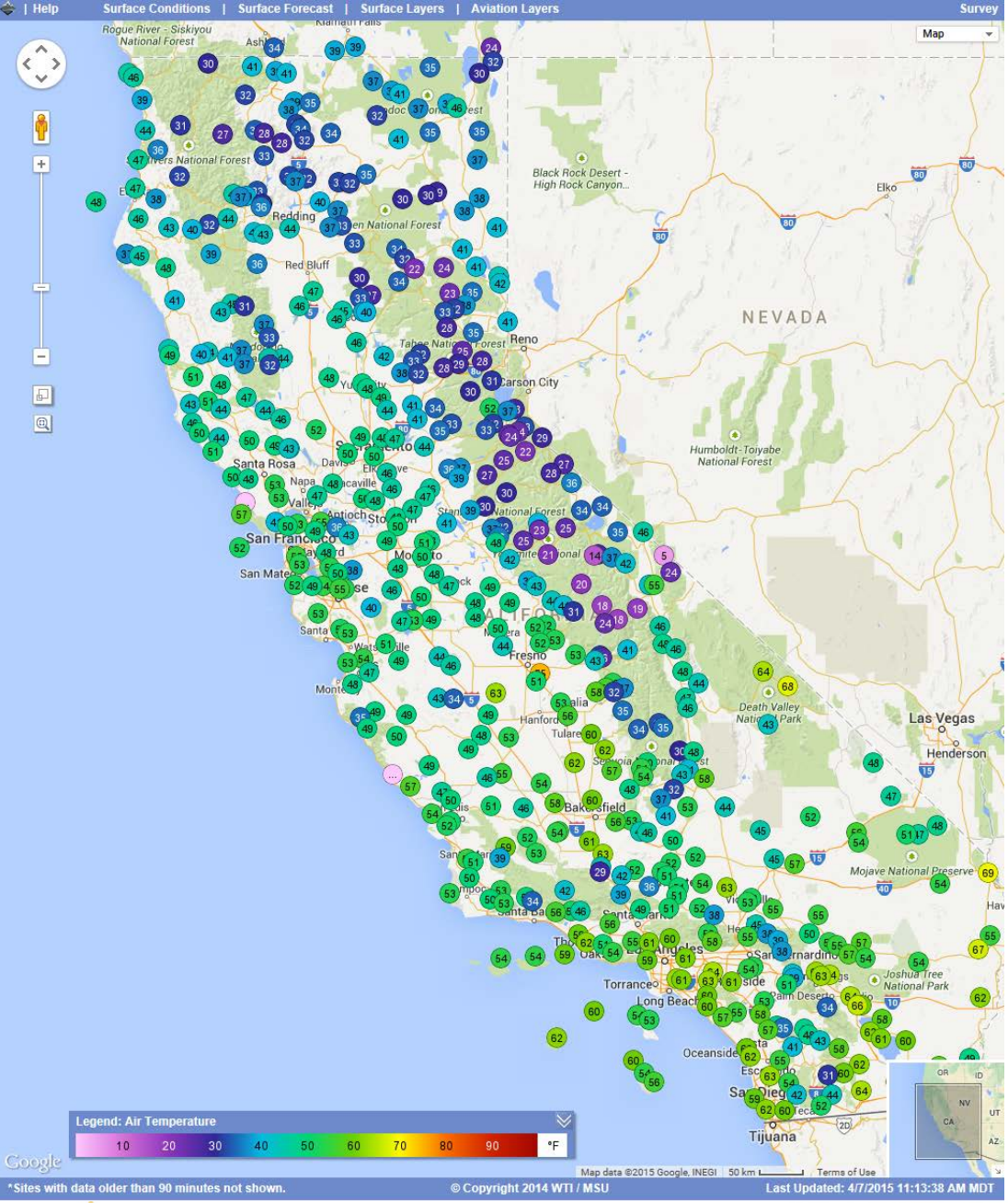
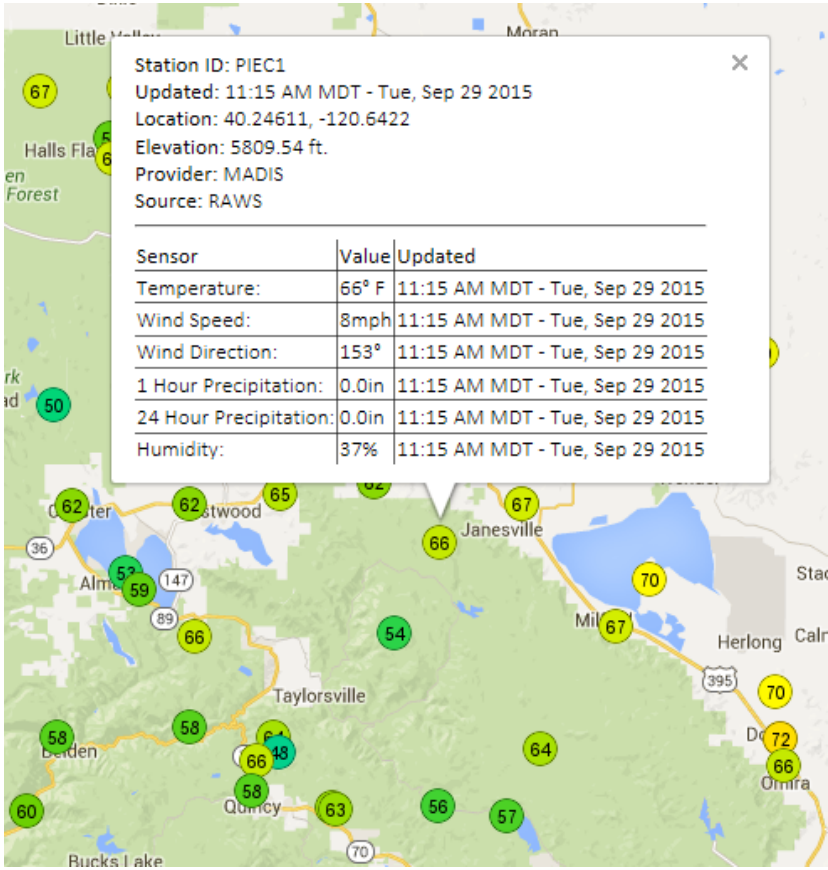
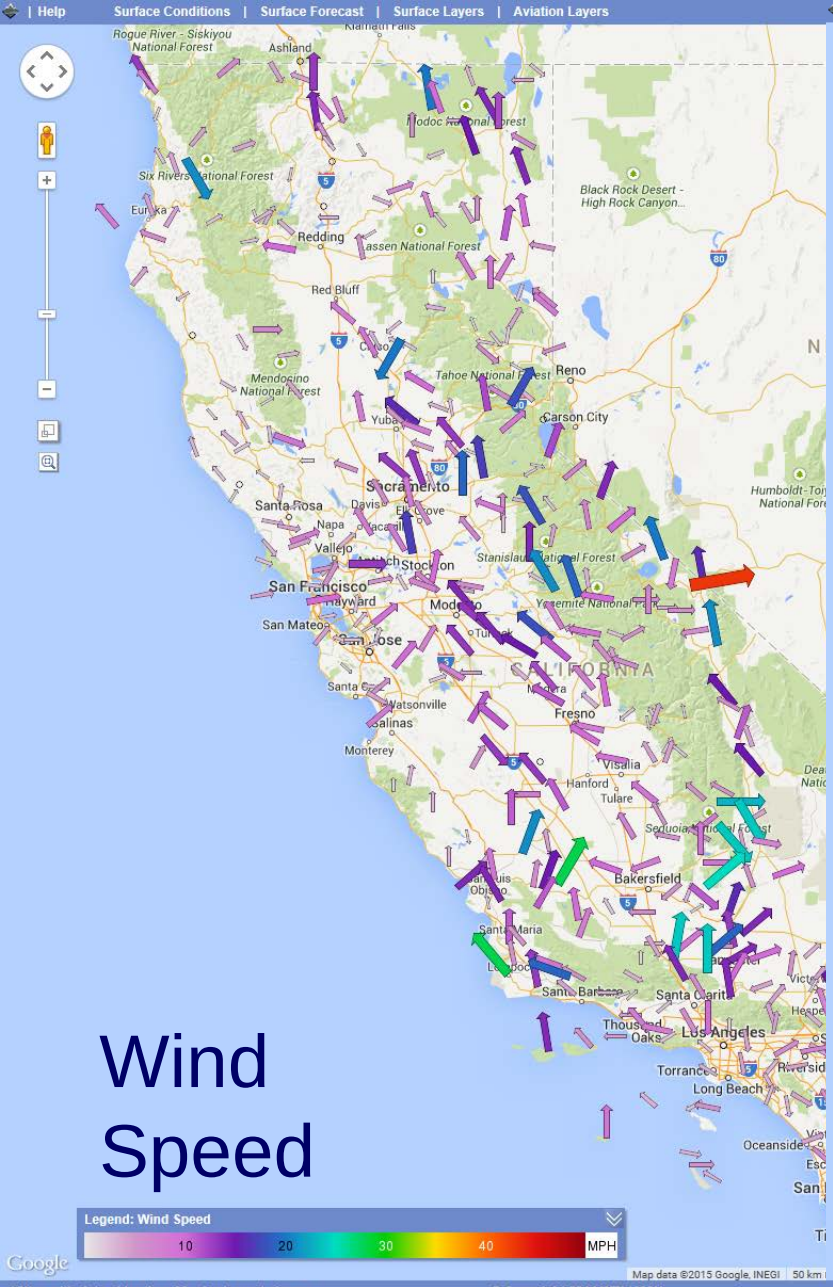
Surface Conditions Layers



Air Temperature






Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
Wind Speed
Legend: Wind Speed
10
20
30
40
MPH
*Sites with data older than 90 minutes not shown.
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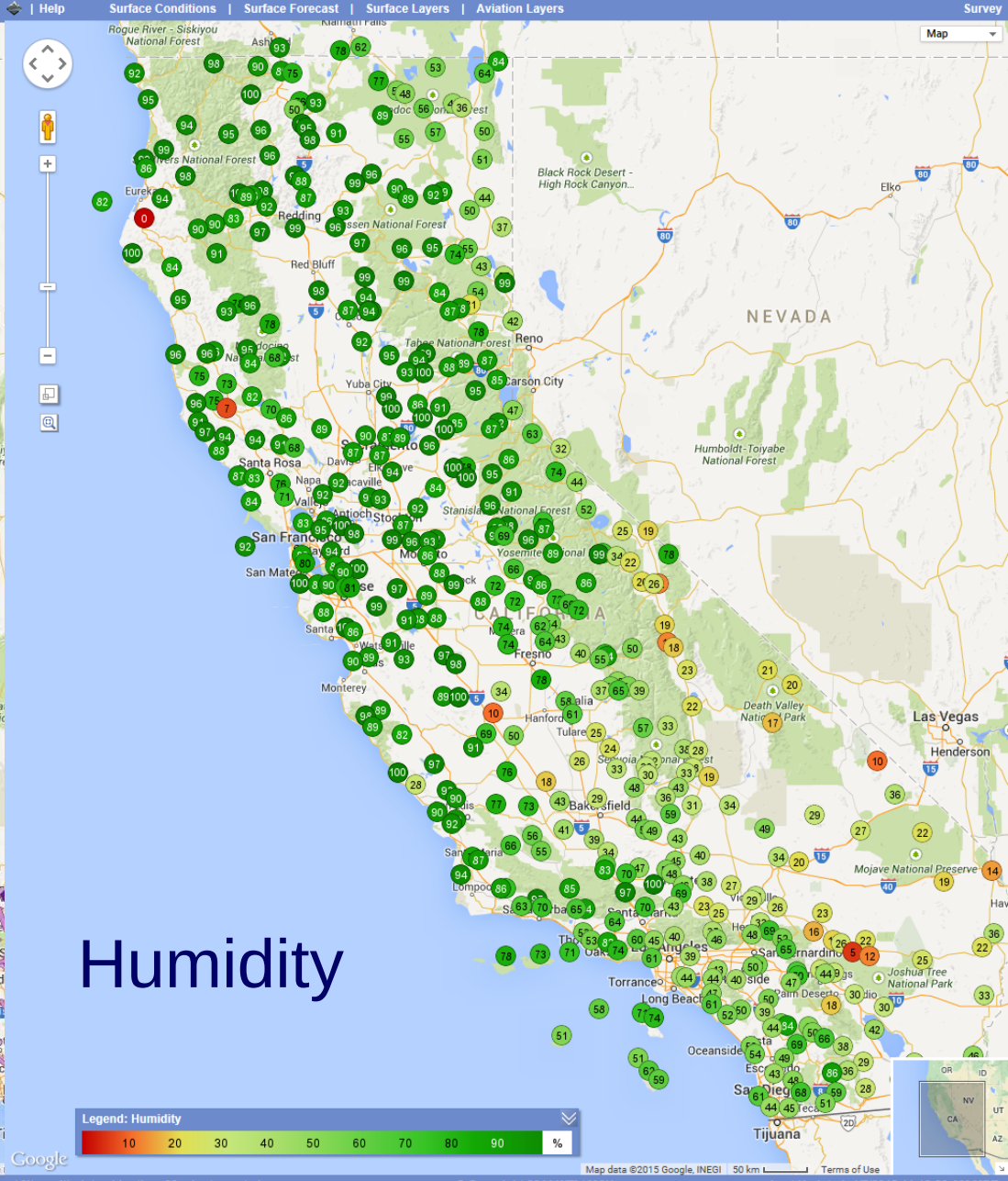
Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
Survey
Map
Humidity
Legend: Humidity
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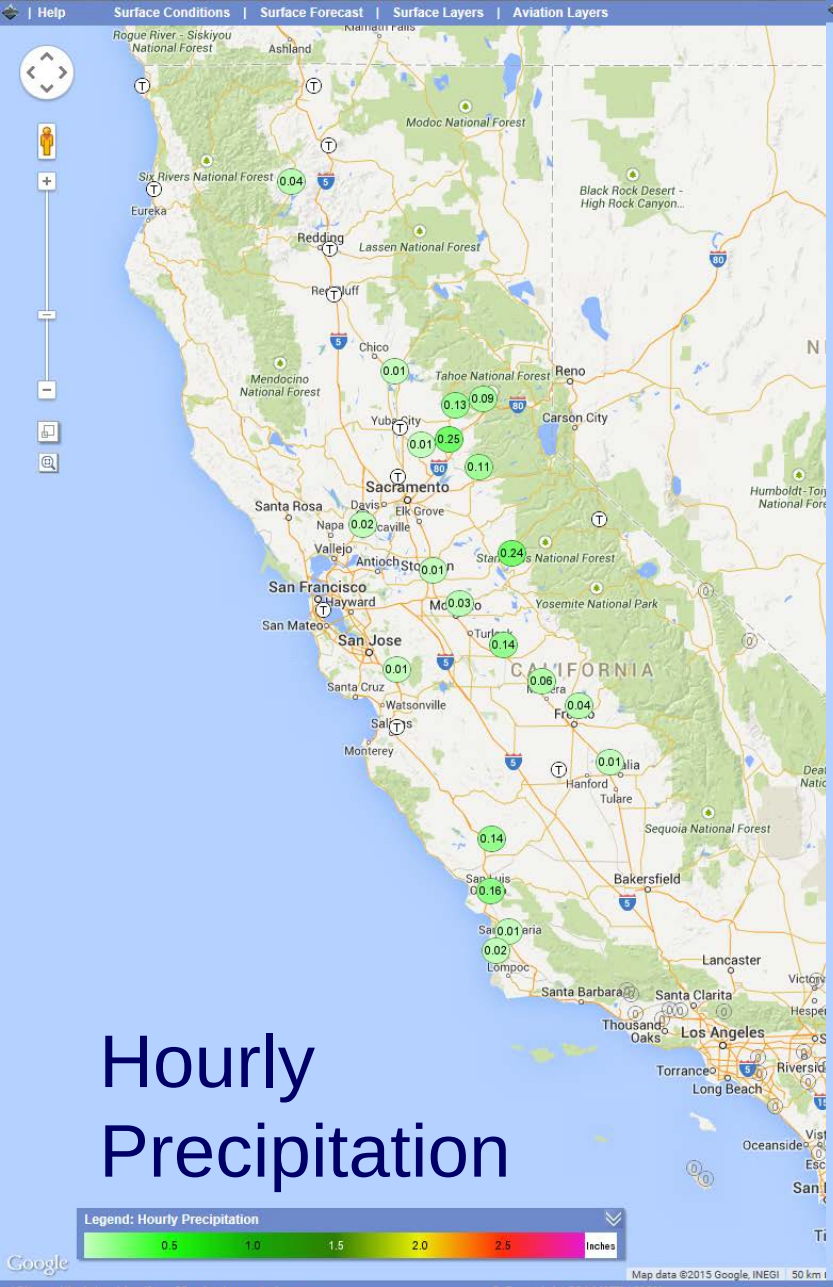
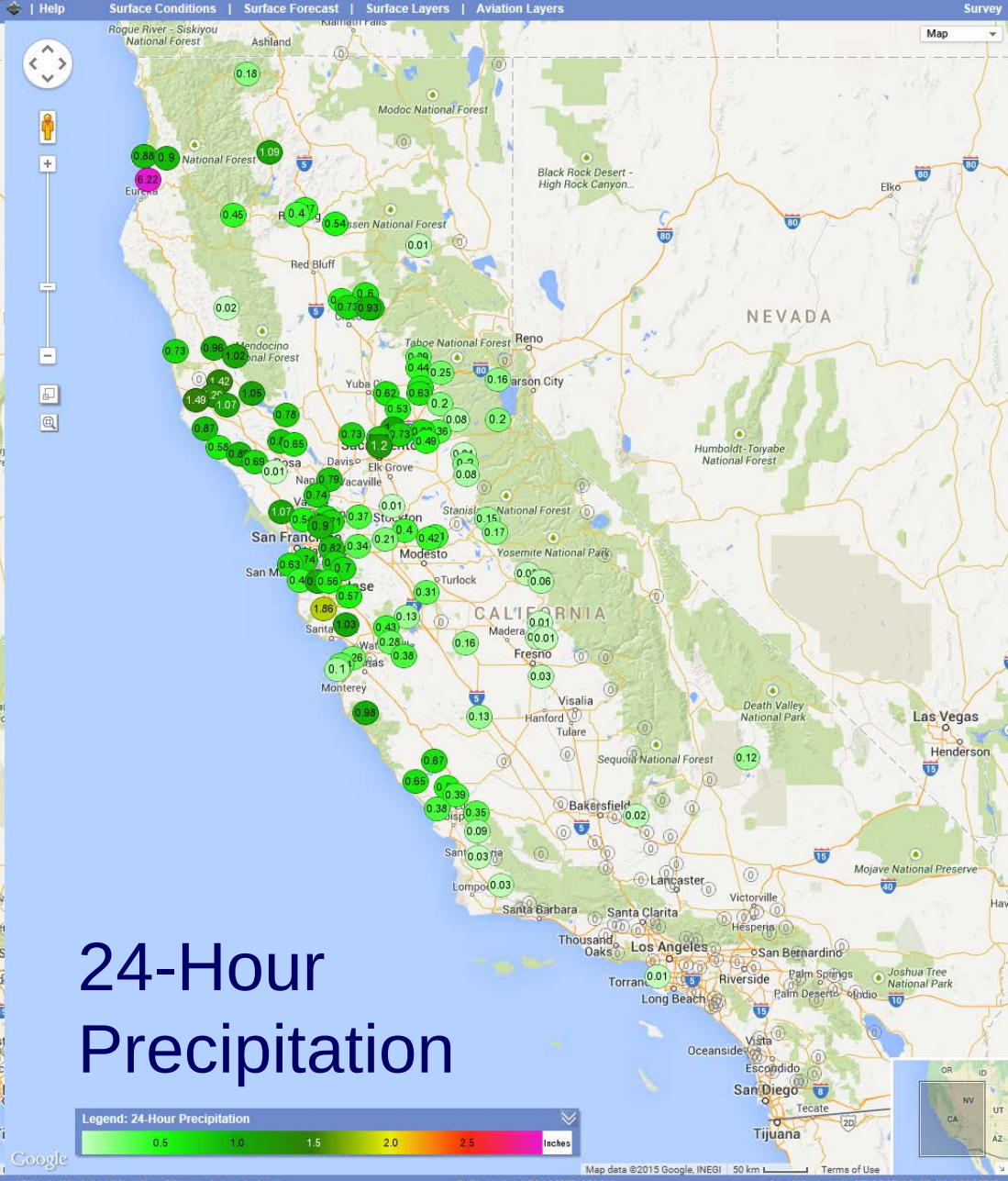
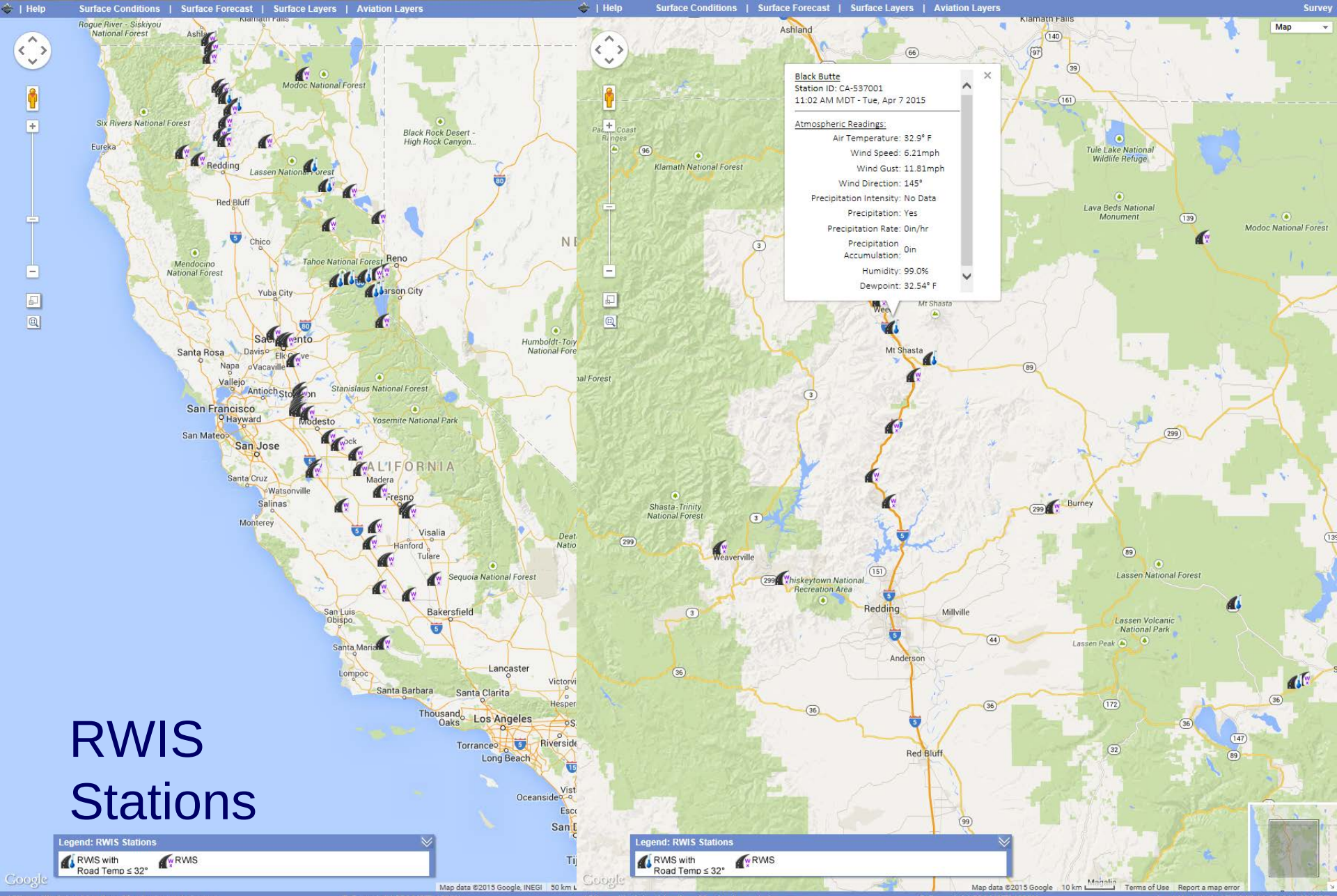


Hourly Precipitation



24-Hour Precipitation



RWIS Stations

Phase 2 Conclusions

- Feedback was positive.
- The focus group and participants in the online survey provided useful suggestions.
- The system appeared to be on the right track.
- Google Analytics data helped to augment the online survey data in identifying the most used and useful data layers in the system.
- Not surprisingly, users were most interested in wind speed data.
- One potential data set identified as missing and beneficial was cloud ceilings. Users also requested additional icing data.

Phase 2 Conclusions

- The gap analysis identified areas that are underserved by existing weather stations, relative to data that is accessible by the prototype system.
- The underserved areas are extremely rural and located in the northeast, northwest, west-central, east-central and southeast portions of the state.
- While rural, there are a number of air fields in these areas that could benefit from having more local weather information. Emergency Medical Service (EMS) flights certainly occur in these areas.
- Aside from identifying gaps, the gap analysis helped to demonstrate the utility of the prototype system over AWOS/ASOS alone.
- The gap analysis results may prove helpful in determining locations in which to deploy future AWOS/ASOS or RWIS.

Phase 3

February 20, 2017 – February 19, 2019
(in progress)

Phase 3
Research Outcomes

- Site Review and Update
- Stand-alone Demonstration CentOS Installation
- System Documentation
- Technical Support

Phase 3
Events to Date

- WTI conducted a site review, update, and stand-alone installation very quickly at the start of the project.
- WTI produced a Data and System Estimated Requirements document for Caltrans IT's reference.
- Code and preliminary documentation was turned over to Caltrans IT early.
- Caltrans IT initiated their install early.
- WTI provided support throughout the install.
- Caltrans went "live" with their system in March 2018.
- Final documentation was produced.
- WTI is providing on-going support and outreach.

Distinction Between Caltrans Aviation Weather Information and WeatherShare

- Initially this project was viewed as “WeatherShare for Aviation”, or “Aviation WeatherShare.”
- It was formally referred to as “Integration of Aviation AWOS/ASOS with RWIS”.
- Ultimately inclusion of “WeatherShare” in the name and URL caused confusion since both projects had gone in their own, separate directions.
- The aviation project was renamed Caltrans Aviation Weather Information to alleviate this confusion.
- WeatherShare now focuses exclusively on being the repository for Caltrans RWIS data, and providing associated functionality.

http://awi.dot.ca.gov/

Outreach

Caltrans has demonstrated the system to emergency responders and public safety personnel from other agencies during real incidents and events including:

- Wildfires and Floods, since 2014;
- Oroville Dam Crisis, February 2017;
- Super Bowl 50, February 2015;
- (South) Napa Earthquake, August 2014;
- California Aviation Day at the State Capitol, April 2014.

In all situations, this beneficial tool has received positive responses.

Acknowledgments

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For Further Information see:

http://awi.dot.ca.gov/

http://www.westernstates.org/Projects/Aviation/