# Integration of Aviation Automated Weather Observation Systems (AWOS) with Roadside Weather Information Systems (RWIS)

## Phase 2: Final Report Presentation

Doug Galarus
Western Transportation Institute
Montana State University

**Wednesday, October 21, 2015**

# 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 or Montana State University.*

# Acknowledgments


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- Caltrans Project Technical Advisory Panel
- Project Focus Group and all who Provided Feedback

# 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), in partnership with the Mineta Transportation Institute (MTI) at San Jose State University, conducted a research and development study of the proof-of-concept system for integrating Automated Weather Observing System (AWOS) with Roadside Weather Information System (RWIS).

The goal of this multi-phase project 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. Implementing such an integrated system is expected to improve safety and increase efficiency.

The project is targeted at small, underserved rural airfields and hospital heliports.

**This document summarizes work conducted in Phase II of the research project, which ends December 31st, 2015.**

# Project Tasks

# Task: Project Management

Deliverables:

- Kickoff Meeting : Thursday, February 28th, 2013 in Sacramento.
- Quarterly Reports
- Other meetings via teleconference and web conference.
- Special meeting : “California Aviation Day at the Capitol” on Wednesday, April 23, 2014. See: http://www.westernstates.org/Projects/Aviation/Updates/2014-04-29.html
- Project web presence for background and updates : http://www.westernstates.org/Projects/Aviation/Default.html

# Task: Business Case Analysis

Deliverable:

- Benefit Analysis of the Aviation WeatherShare System by Wenbin Wei, San Jose State University. Finalized February 2, 2014.

# Task: Research Additional Sources

Deliverable:

- Integration of Aviation Automated Weather Observation Systems (AWOS) with Roadside Weather Information Systems (RWIS) Phase II Data Sources Summary, by Daniell Richter and Douglas Galarus, Western Transportation Institute, Montana State University. Finalized April 27, 2015.

# Task: Detailed System Requirements

Deliverable:

- Integration of Aviation Automated Weather Observation Systems (AWOS) with Roadside Weather Information Systems (RWIS) Phase II Detailed Prototype System Requirements Specification, by Daniell Richter and Douglas Galarus, Western Transportation Institute, Montana State University. Finalized August 13, 2014.

# Task: Develop System

Deliverable:

- Phase II System in Development and Testing Environment

# Task: Implementation

Deliverable:

- Phase II System in Production Hosting Environment: http://aviation.weathershare.org/.

# Task: Evaluation

Deliverable:

- Evaluation Summary (Included in the Project Final Report)
  - SJSU Survey Results
  - Online Survey Results
  - Google Analytics Results

# Task: AWOS/ASOS Gap Analysis

Deliverable:

- Integration of Aviation Automated Weather Observation Systems (AWOS) with Roadside Weather Information Systems (RWIS) Phase II Gap Analysis, by Douglas Galarus and Daniell Richter, Western Transportation Institute, Montana State University. Finalized July 10, 2015.

# Task: Determine Usage Status and Recommendations

Deliverable:

- Disclaimer on the splash screen, shown upon entry to http://aviation.weathershare.org/.

# Task: Final Project Report and Presentation

Deliverable:

- Final Project Report will be finalized prior to the conclusion of the project: December 31st, 2015.
- The Final Project Presentation (this presentation)

# The Prototype System

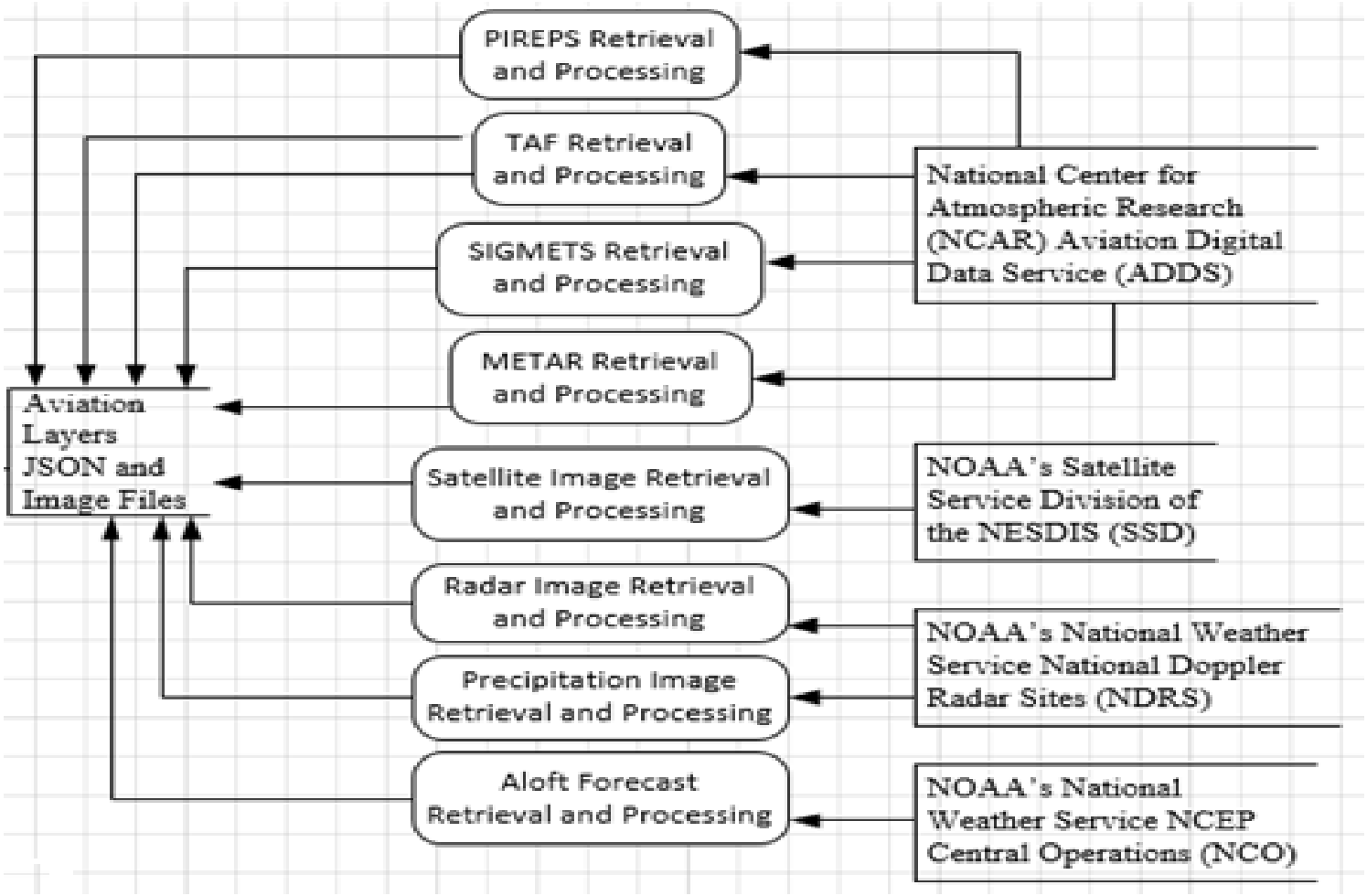
## Data Retrieval and Processing…

# Dynamic Data Layers & Sources

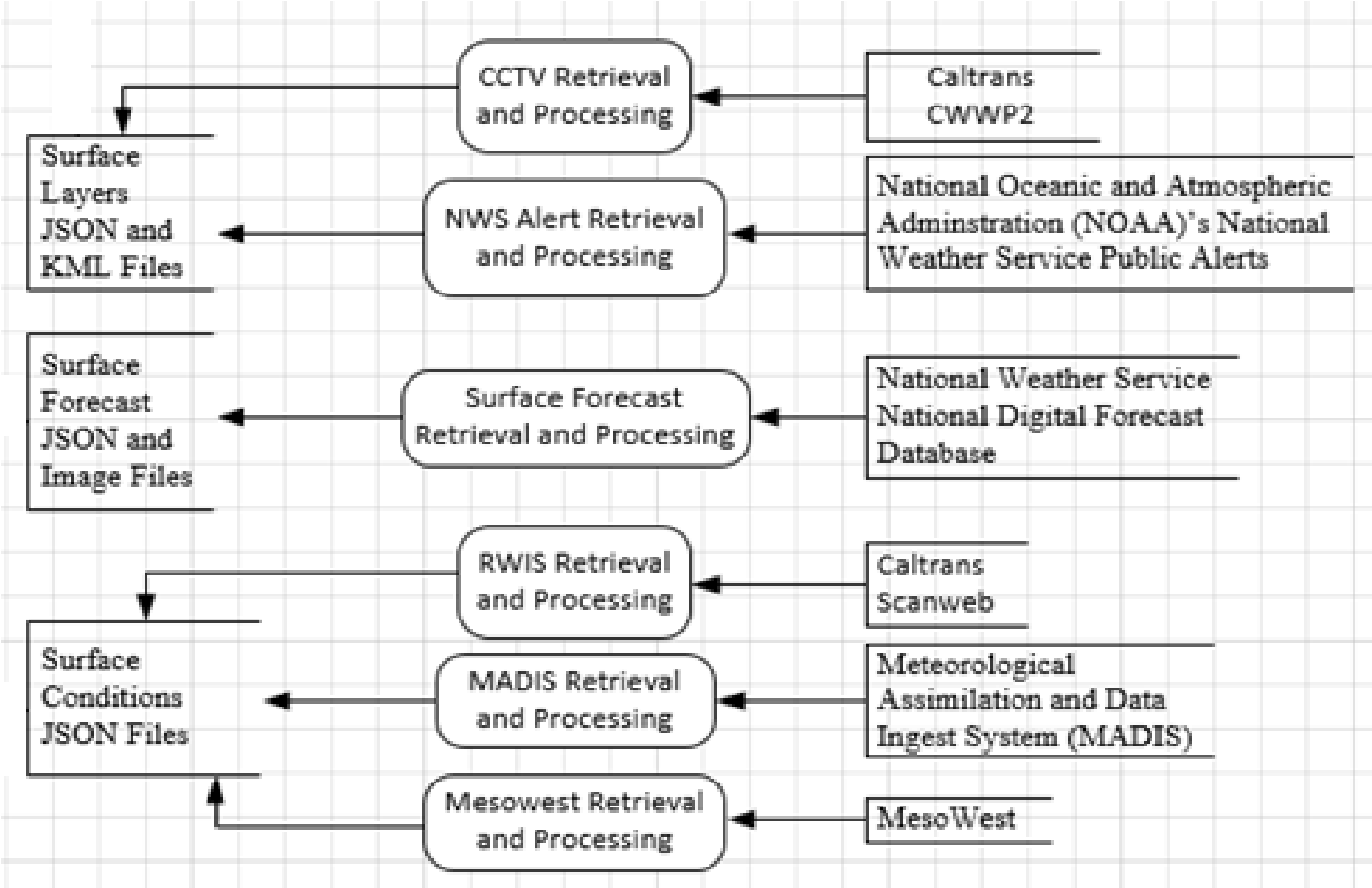
- National Center for Atmospheric Research
- (NCAR) Aviation Digital Data Service (ADDS):
  - PIREPS
  - TAF
  - SIGMETS
  - METAR
- NOAA's Satellite Service Division of the NESDIS (SSD):
  - Satellite Images
- NOAA's National Weather Service National Doppler Radar Sites (NDRS):
  - Radar Images
  - 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.

# Aviation Layers



# Surface, Surface Forecast & Surface Conditions Layers



# The Prototype System

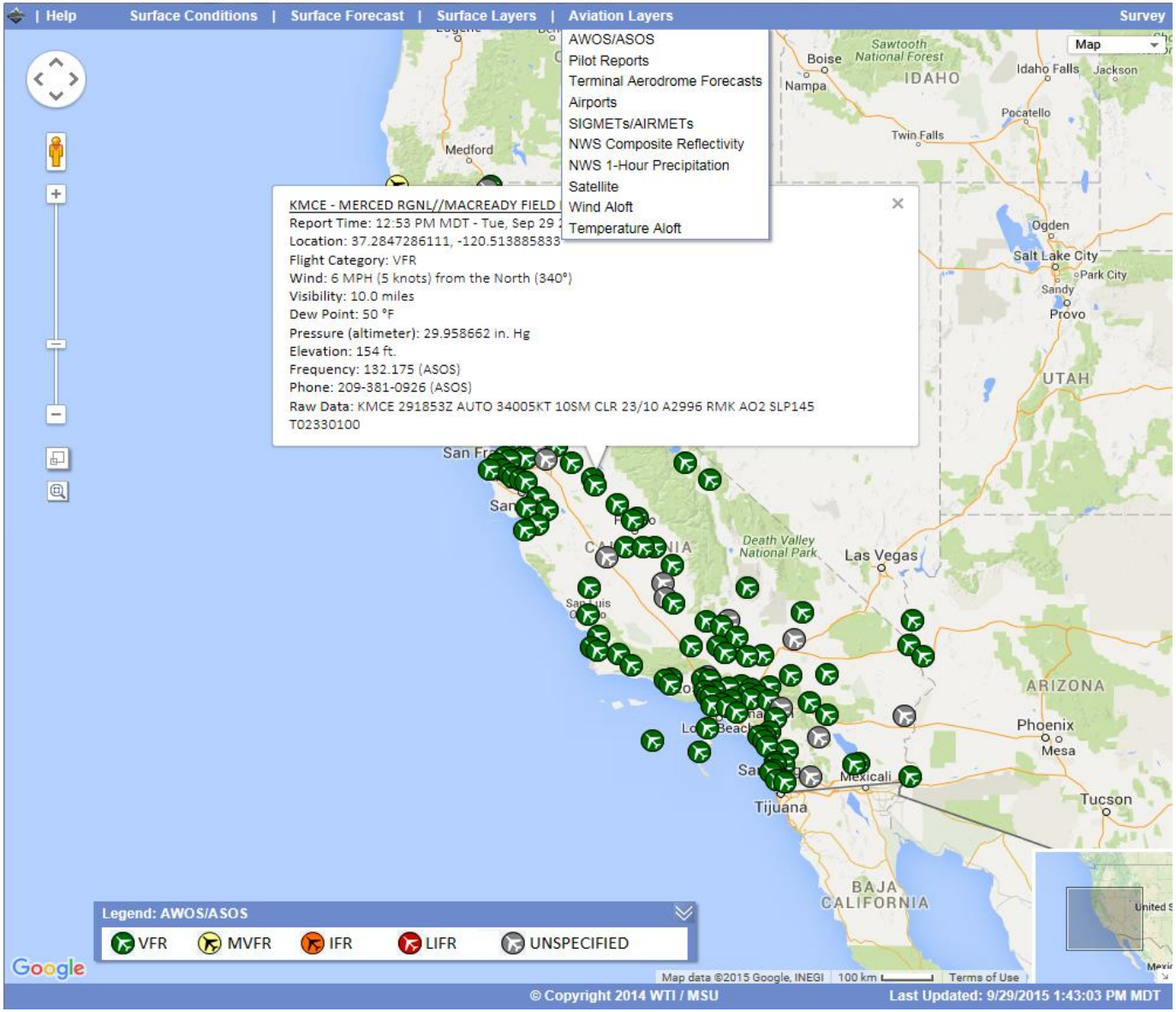
A Pictorial Overview …

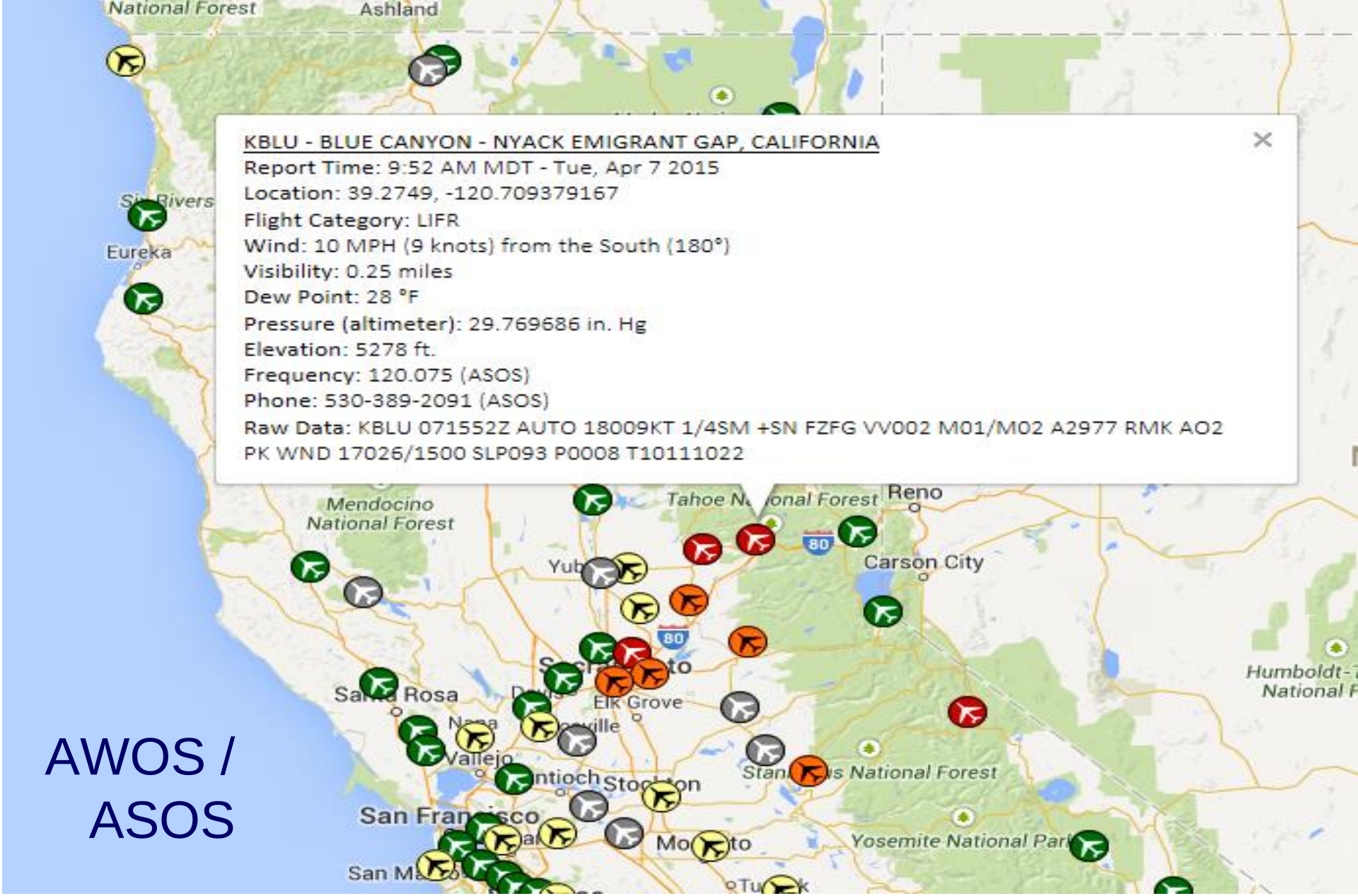
# Aviation Layers

**Aviation Layers**

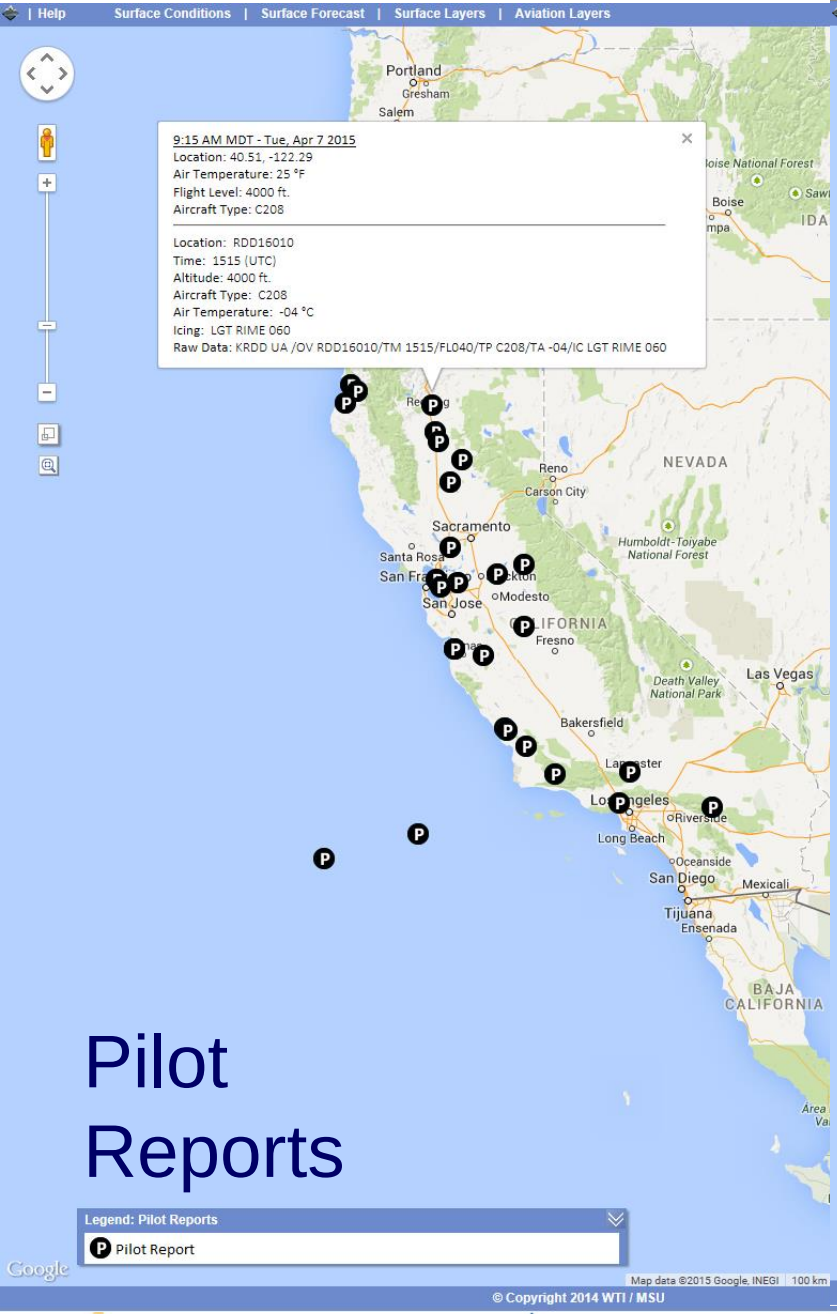
- AWOS/ASOS
- Pilot Reports
- Terminal Aerodrome Forecasts
- Airports
- SIGMETs/AIRMETs
- NWS Composite Reflectivity
- NWS 1-Hour Precipitation
- Satellite
- Wind Aloft
- Temperature Aloft

http://aviation.weathershare.org/

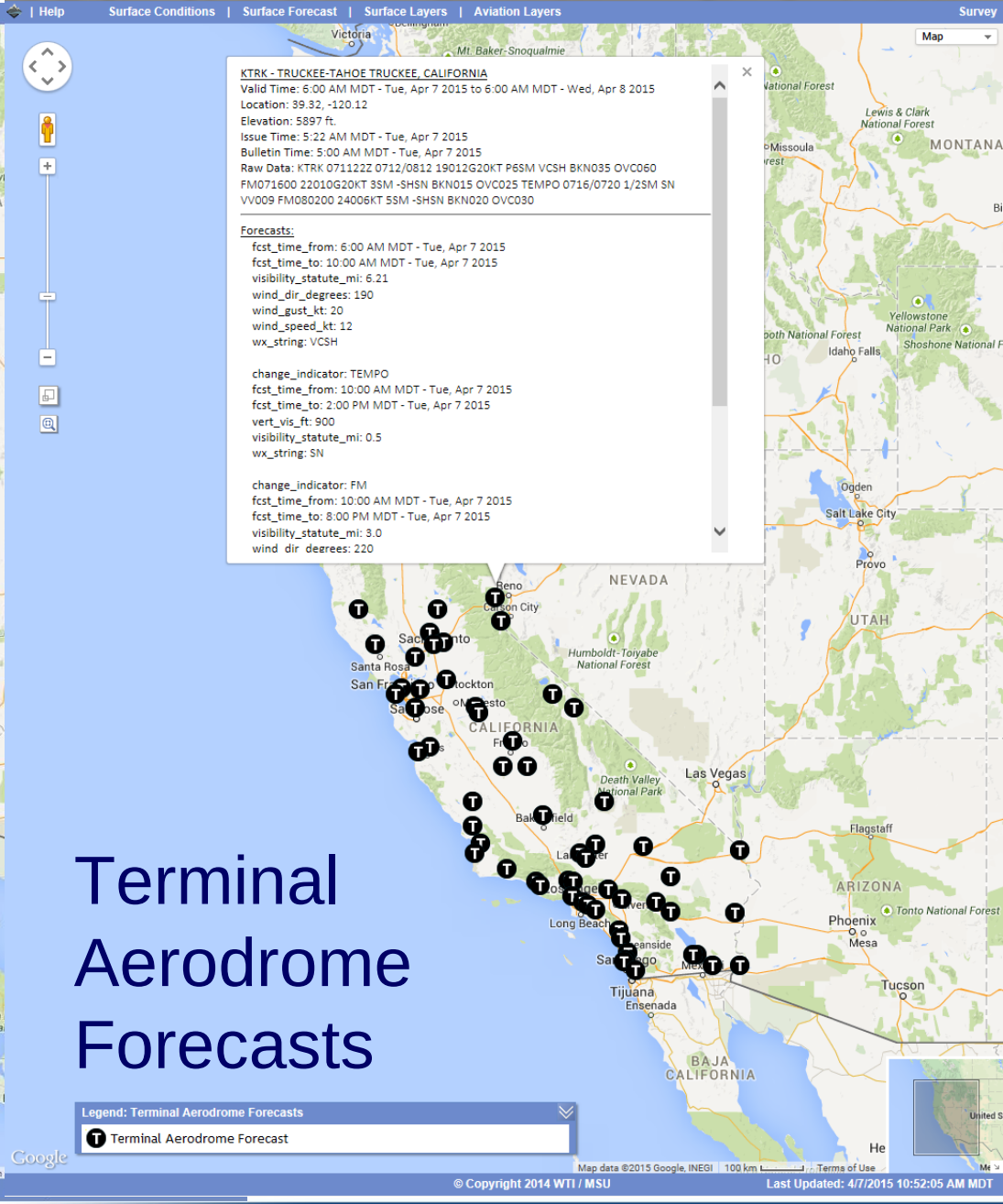



KBLU - BLUE CANYON - NYACK EMIGRANT GAP, CALIFORNIA
Report Time: 9:52 AM MDT - Tue, Apr 7 2015
Location: 39.2749, -120.709379167
Flight Category: LIFR
Wind: 10 MPH (9 knots) from the South (180°)
Visibility: 0.25 miles
Dew Point: 28 °F
Pressure (altimeter): 29.769686 in. Hg
Elevation: 5278 ft.
Frequency: 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
National Forest
Ashland
Eureka
Mendocino National Forest
Reno
Carson City
Elk Grove
Vallejo
Stockton
San Francisco
Yosemite National Park
Humboldt-
National F

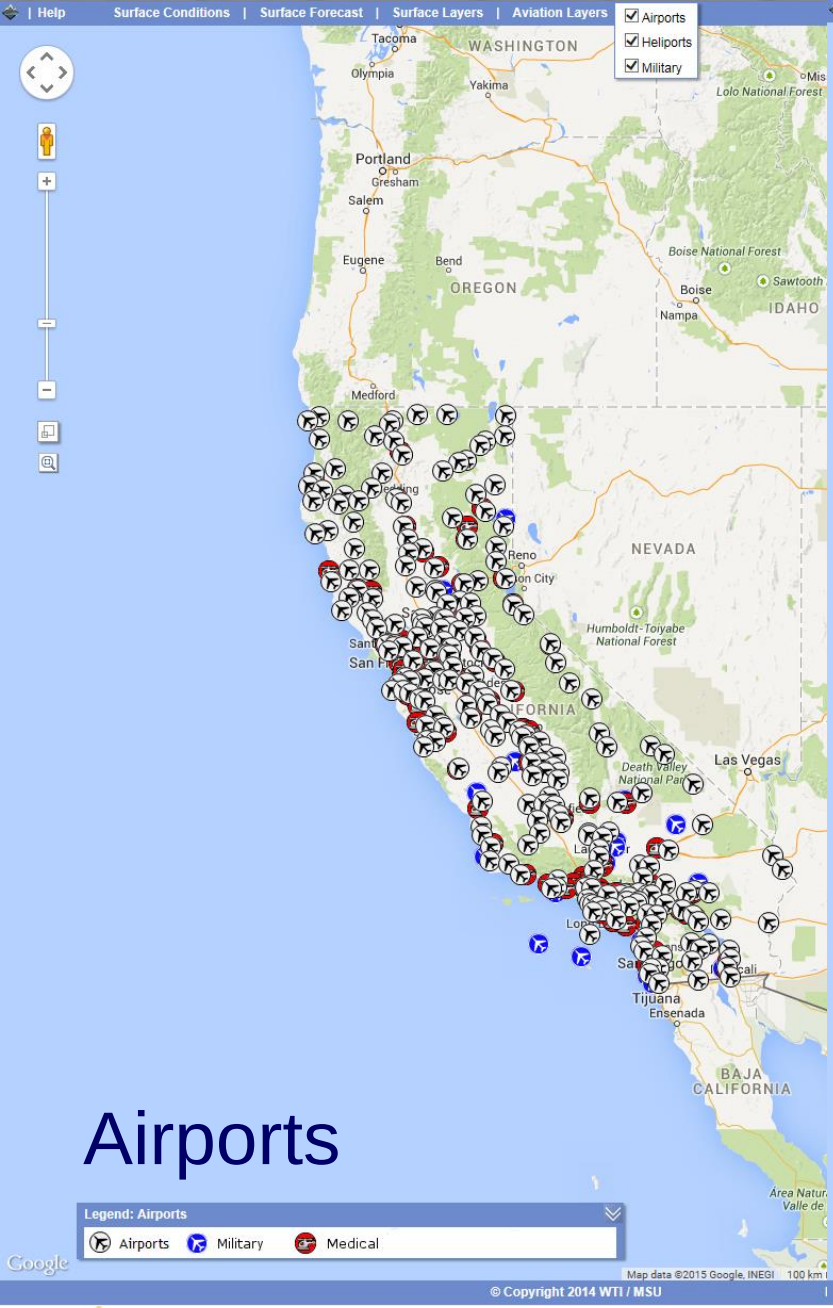
AWOS / ASOS



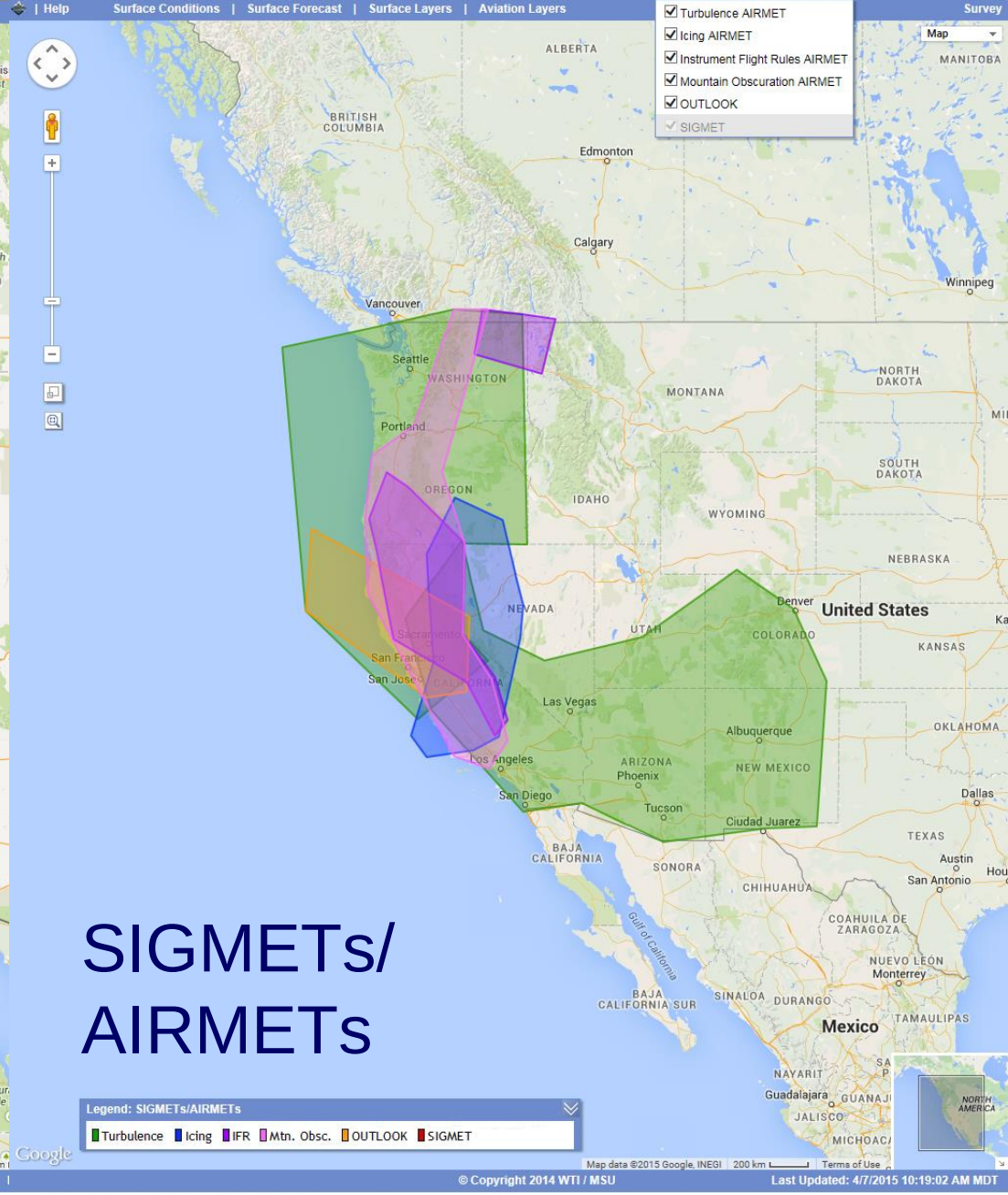

# Pilot Reports



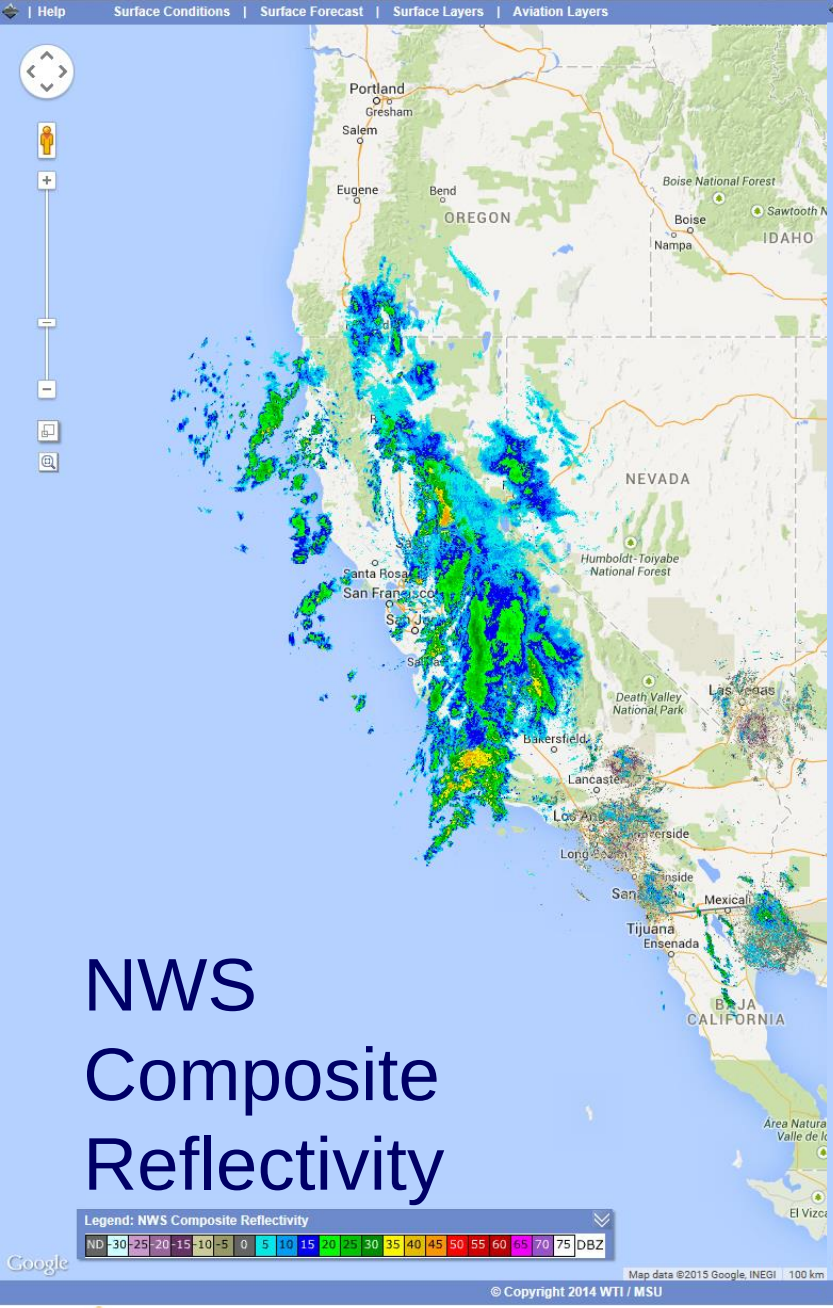

# Terminal Aerodrome Forecasts



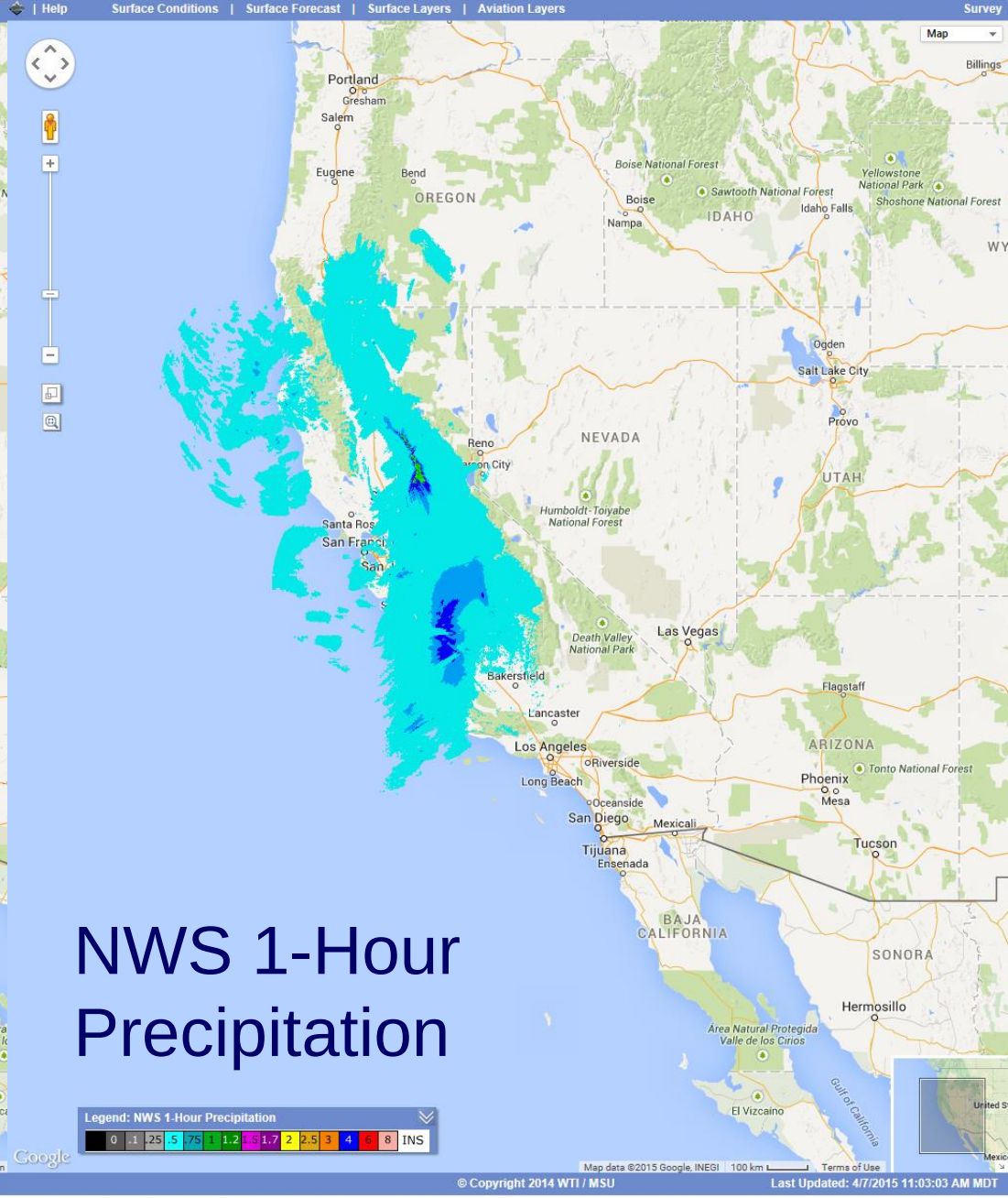

Airports




SIGMETs/ AIRMETs

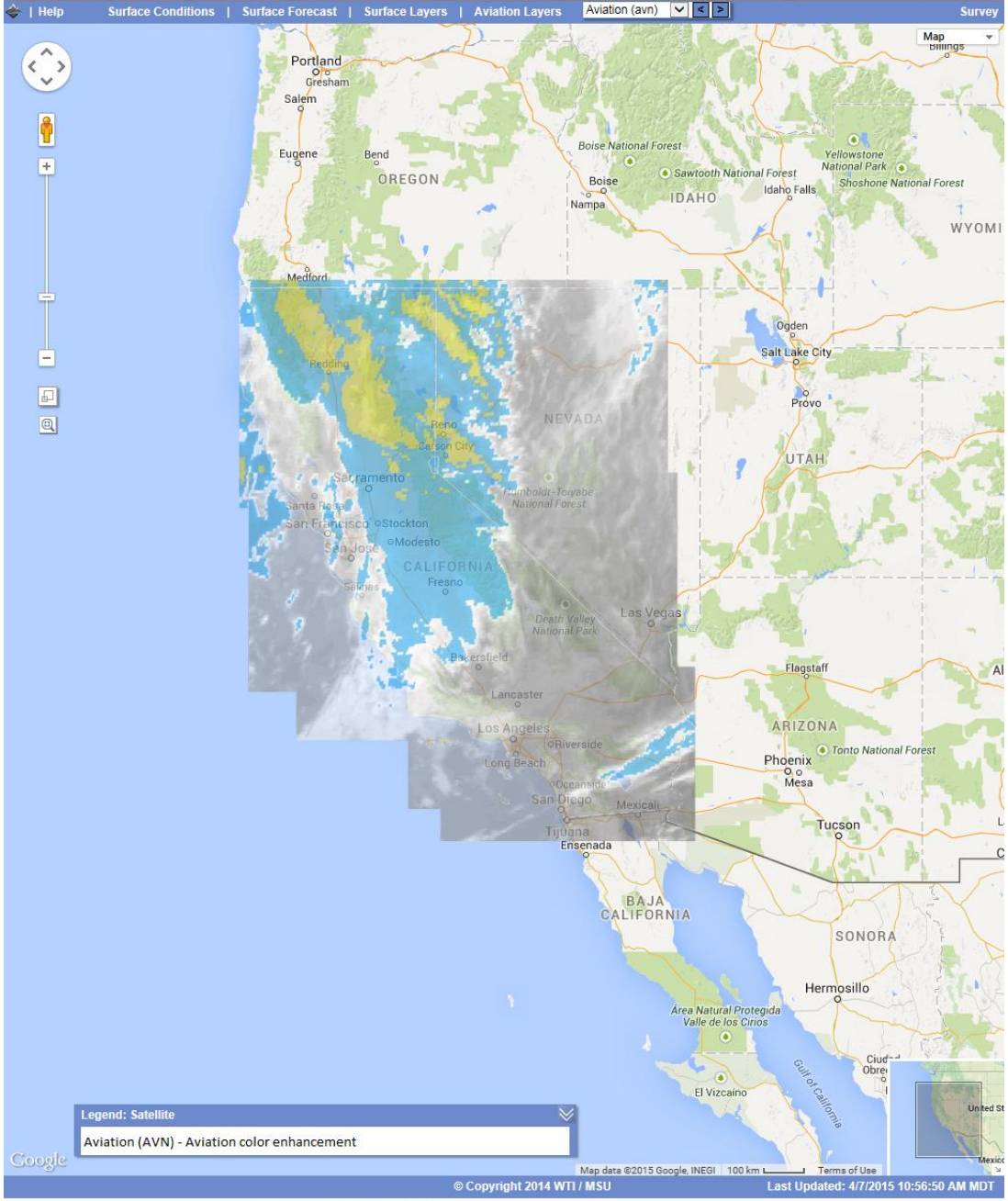



NWS Composite Reflectivity




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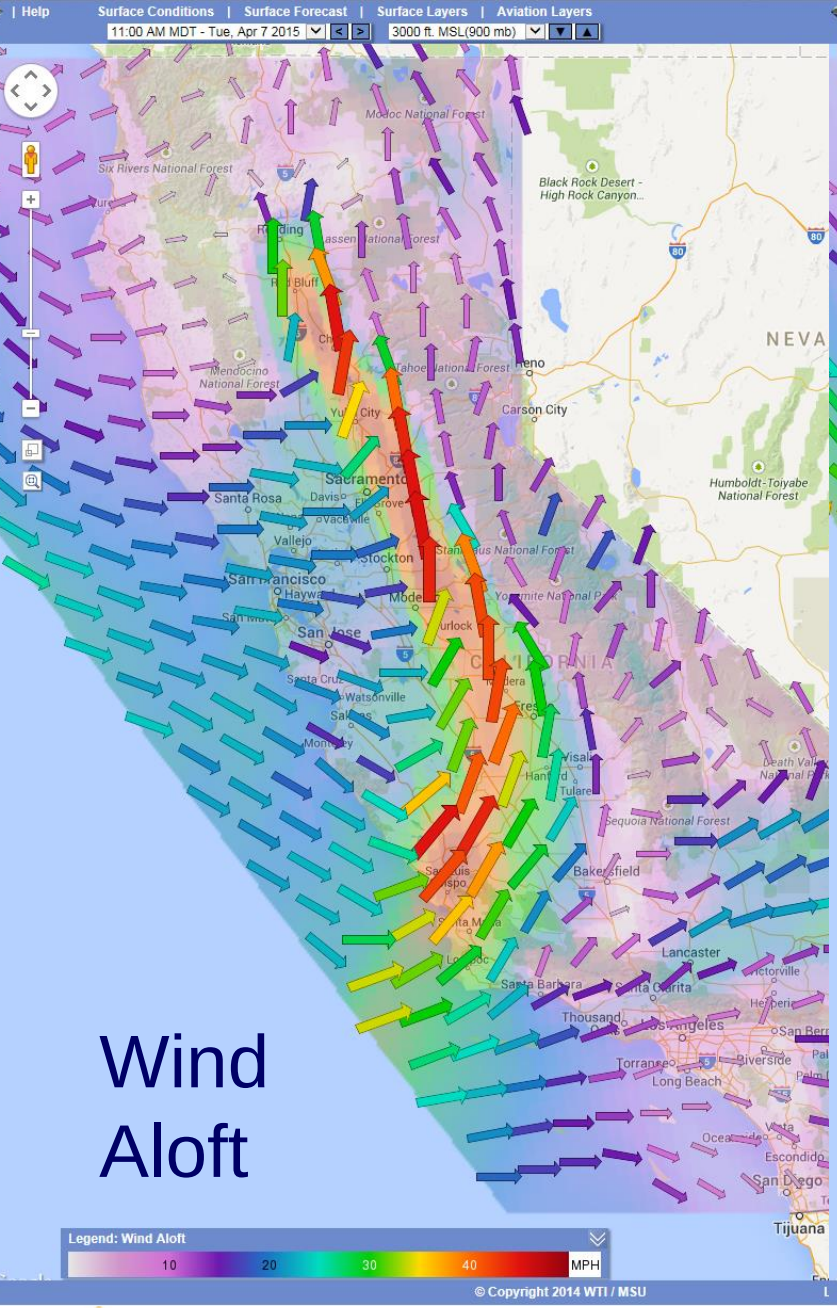
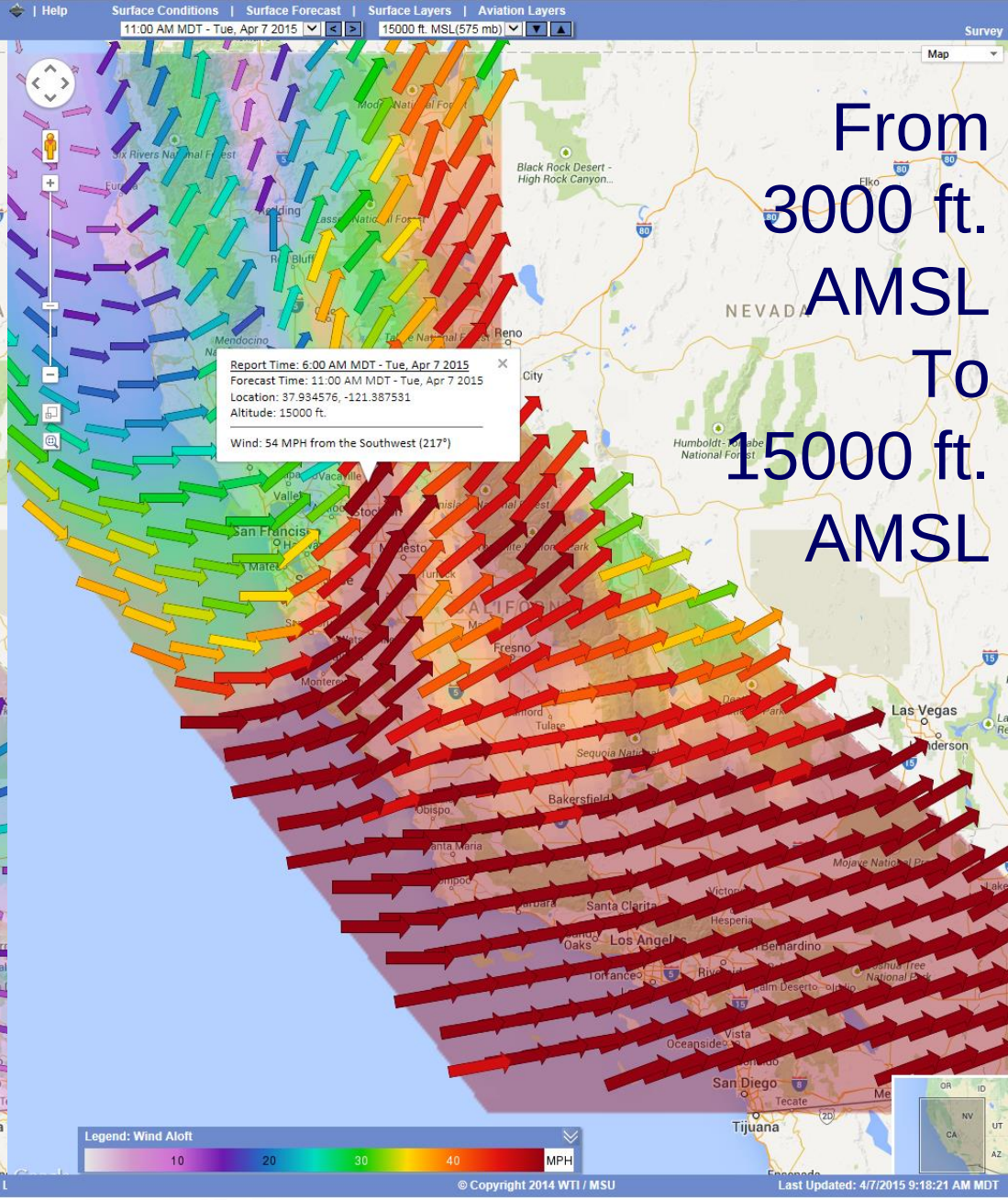
Last Updated: 4/7/2015 10:56:50 AM MDT

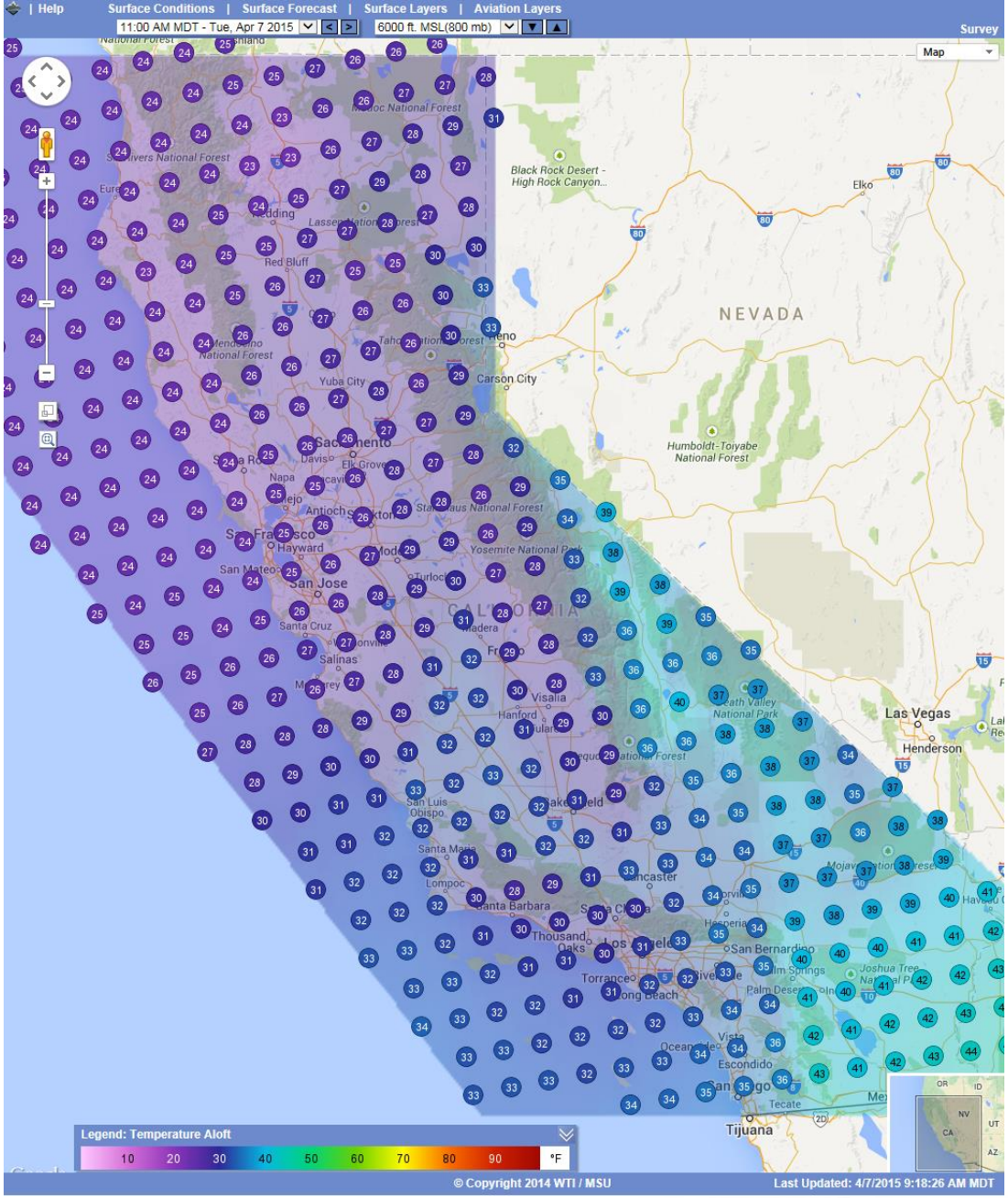



Wind Aloft

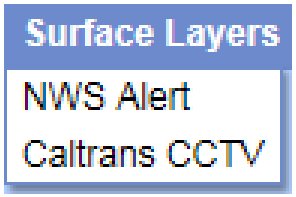



From 3000 ft. AMSL To 15000 ft. AMSL

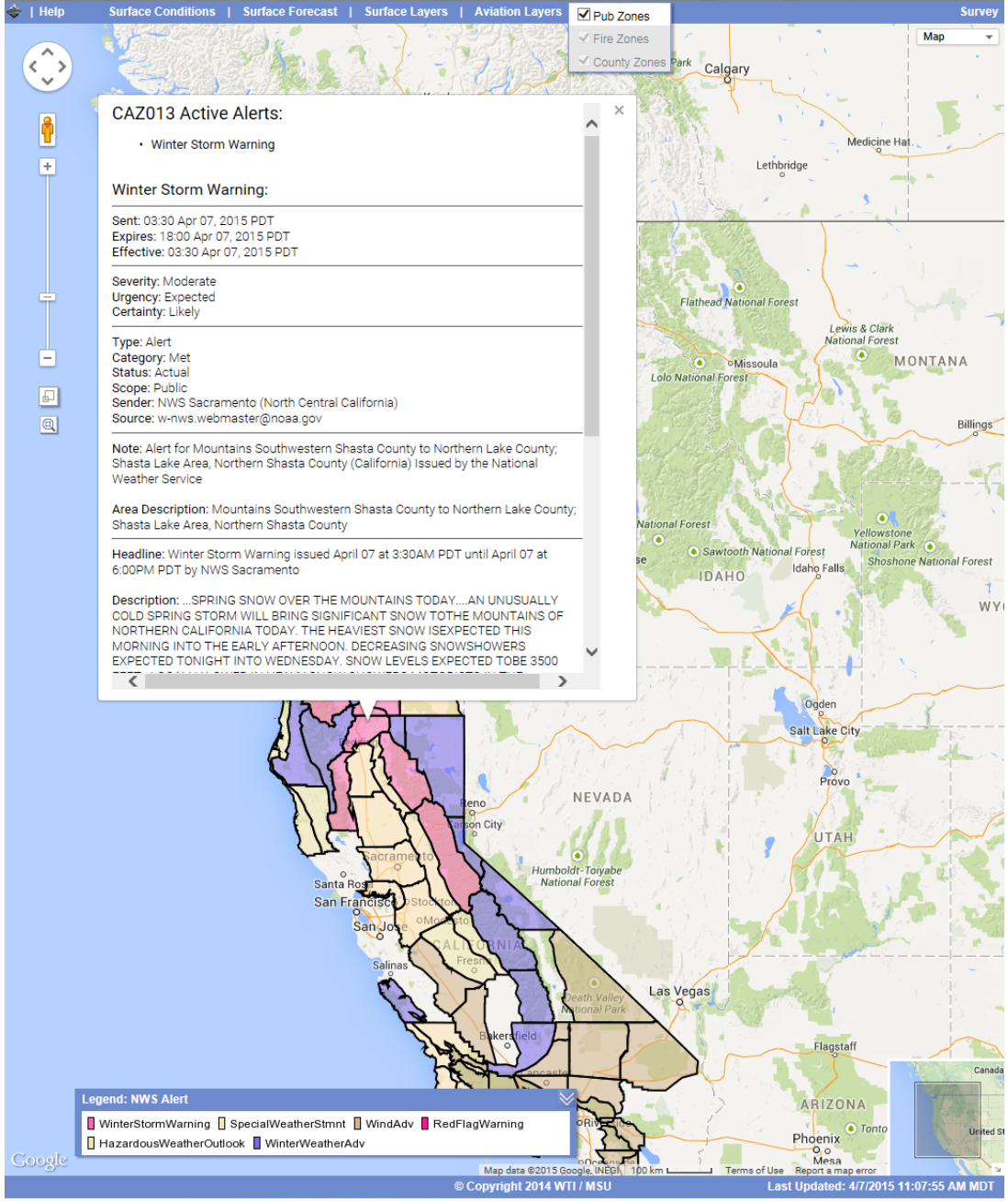
# Temperature Aloft



# 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
Sawtooth National Forest
Shoshone National Forest
IDAHO
Idaho Falls
Ogden
Salt Lake City
Provo
NEVADA
UTAH
Reno
Carson City
Sacramento
Humboldt-Toiyabe National Forest
Santa Rosa
San Francisco
San Jose
Salinas
Las Vegas
Death Valley National Park
Bakersfield
Flagstaff
ARIZONA
Phoenix
Mesa
Legend: NWS Alert
WinterStormWarning
SpecialWeatherStmnt
WindAdv
RedFlagWarning
HazardousWeatherOutlook
WinterWeatherAdv
Google
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Report a map error
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Last Updated: 4/7/2015 11:07:55 AM MDT

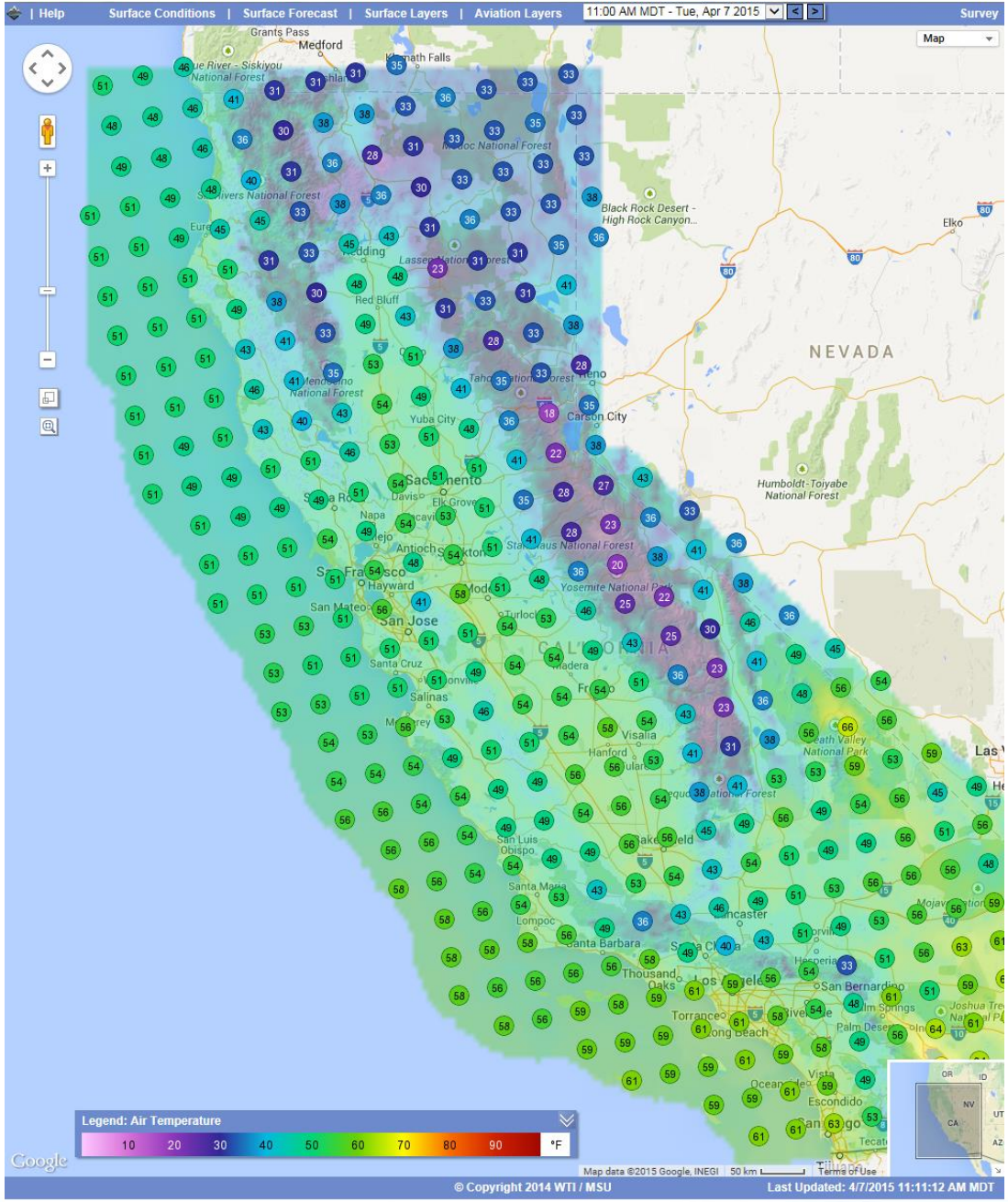
# Caltrans CCTV

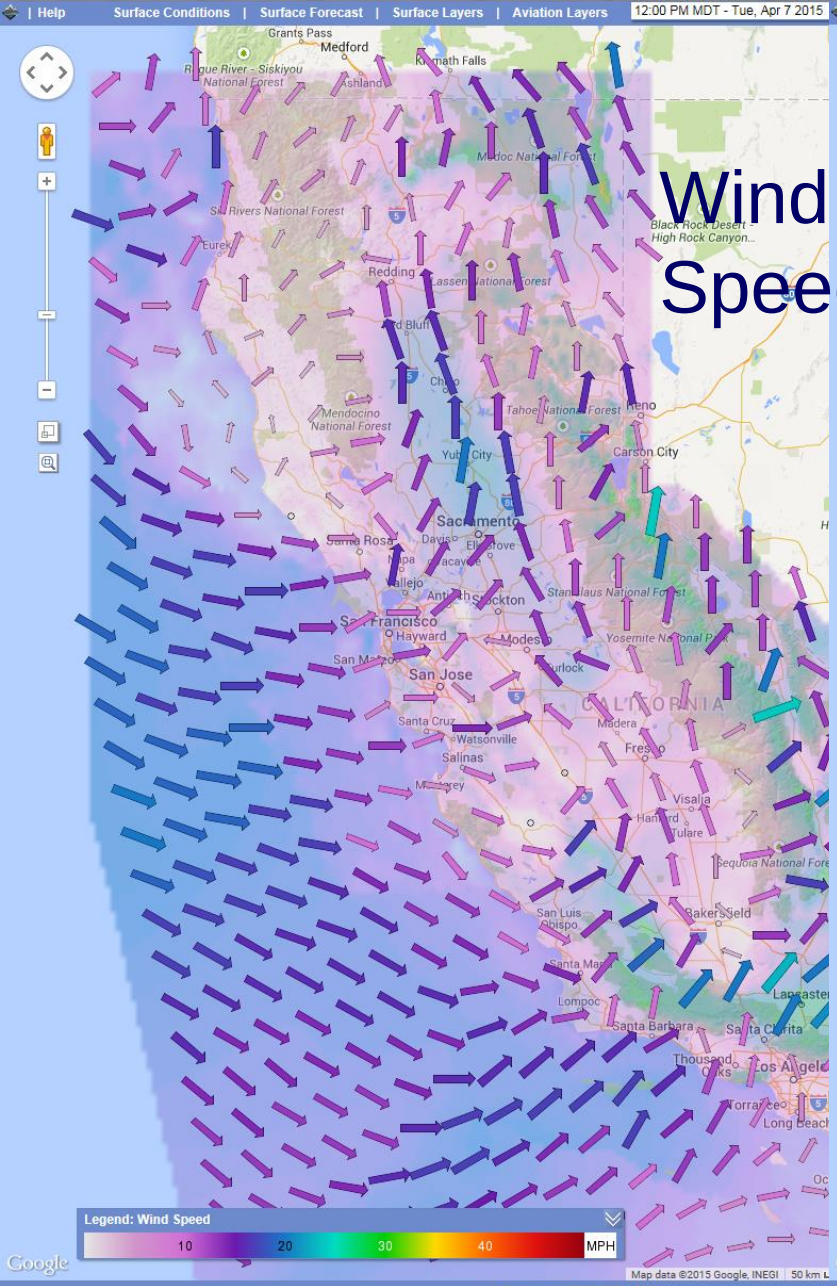
# Surface Forecast Layers

**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
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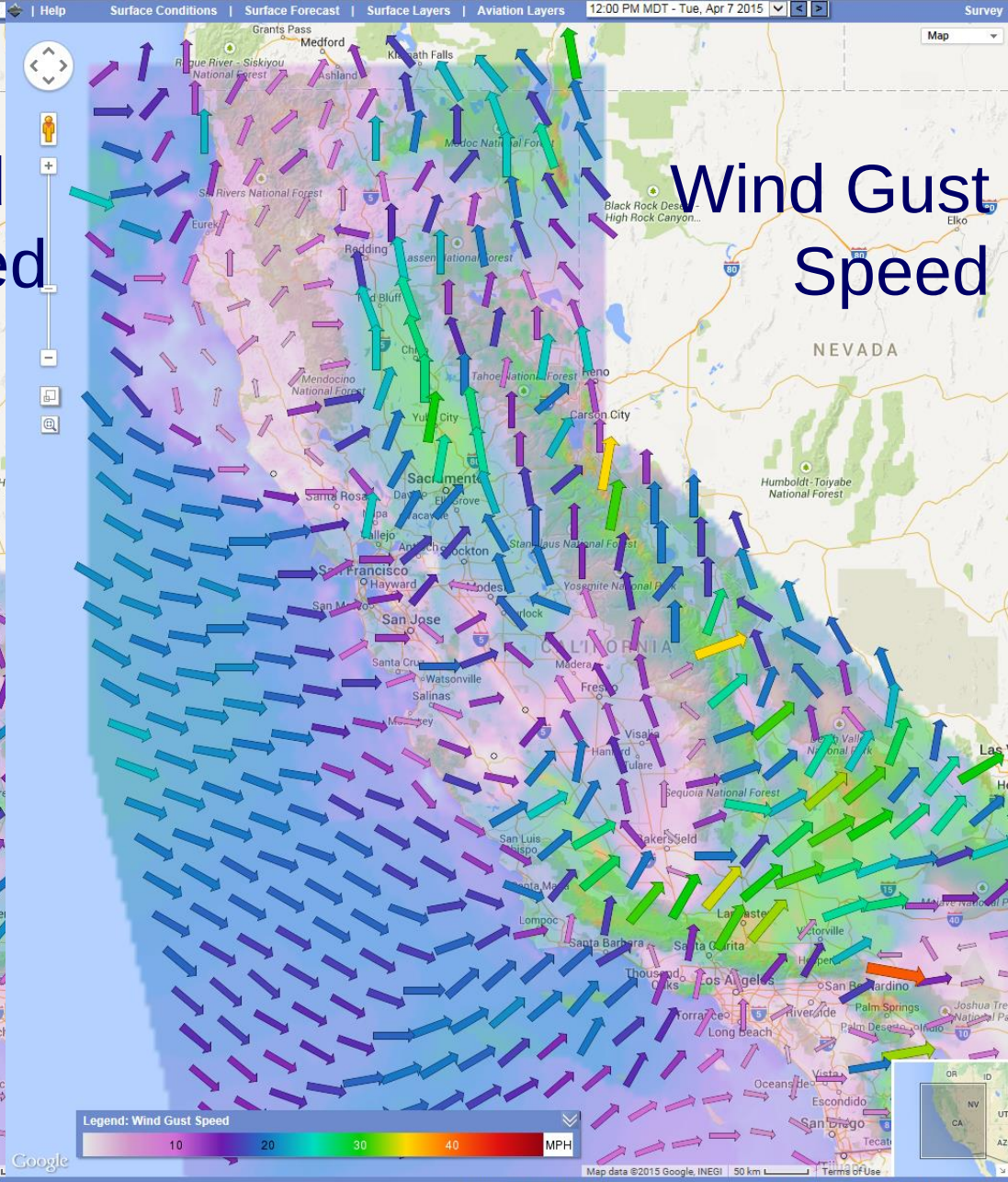
Help
Surface Conditions
Surface Forecast
Surface Layers
Aviation Layers
12:00 PM MDT - Tue, Apr 7 2015
Survey
Map
Wind Gust Speed
NEVADA
Legend: Wind Gust Speed
10
20
30
40
MPH
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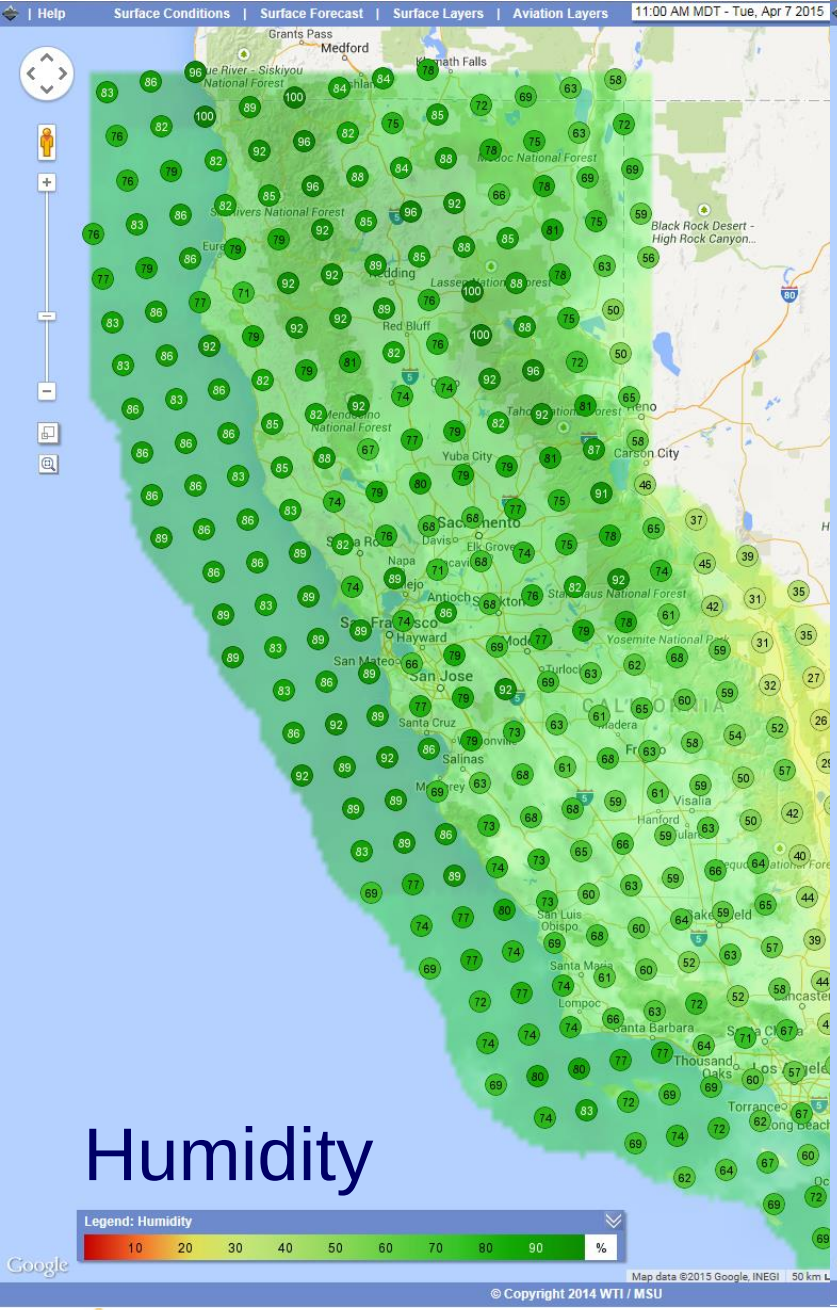
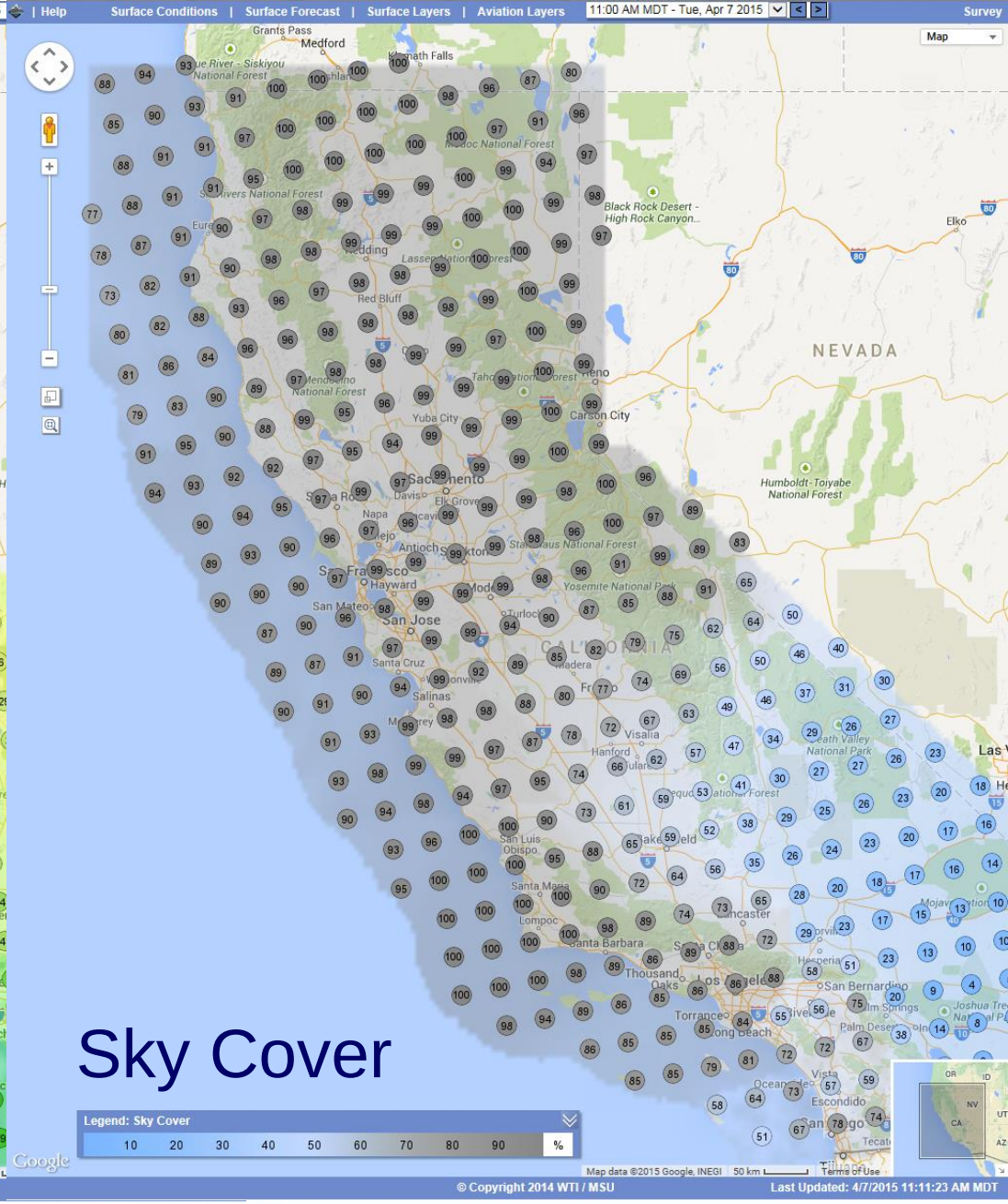
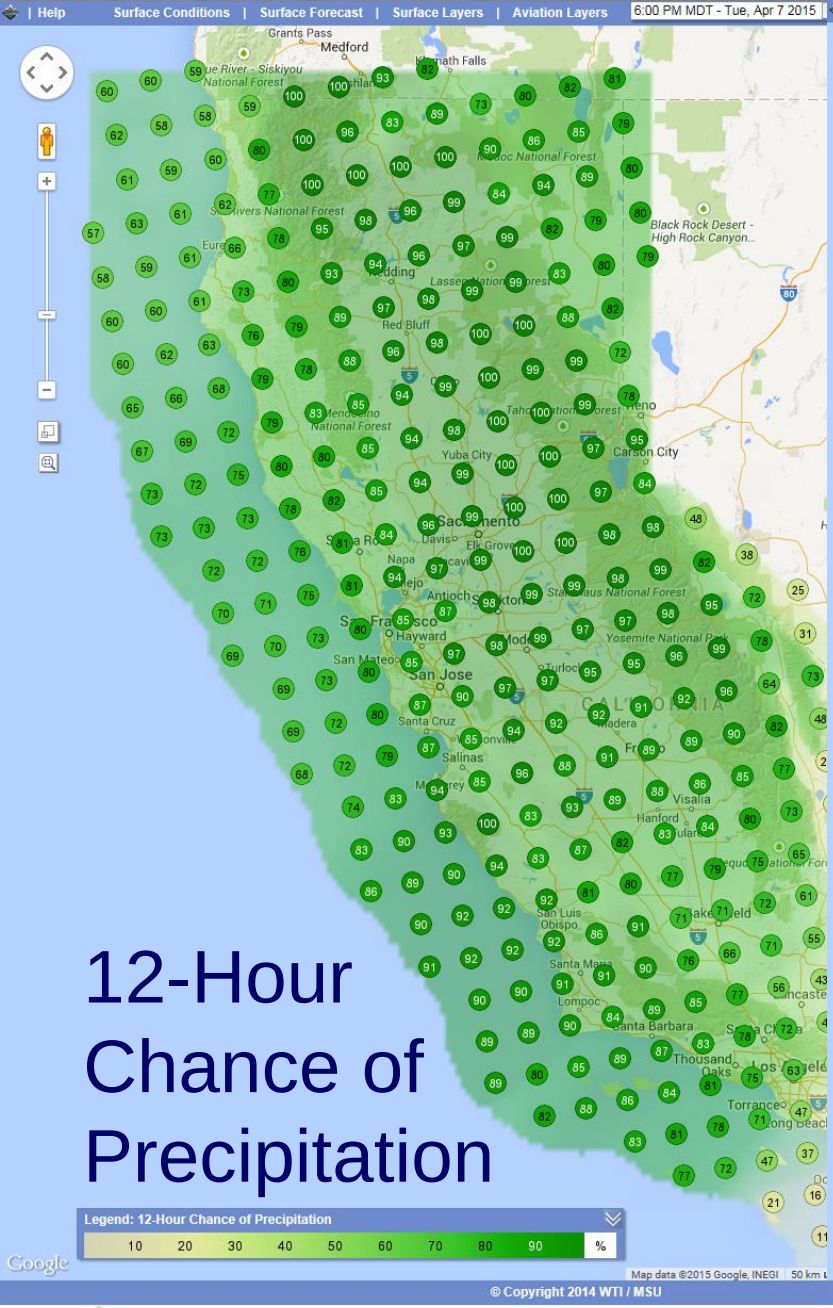
Last Updated: 4/7/2015 11:11:38 AM MDT



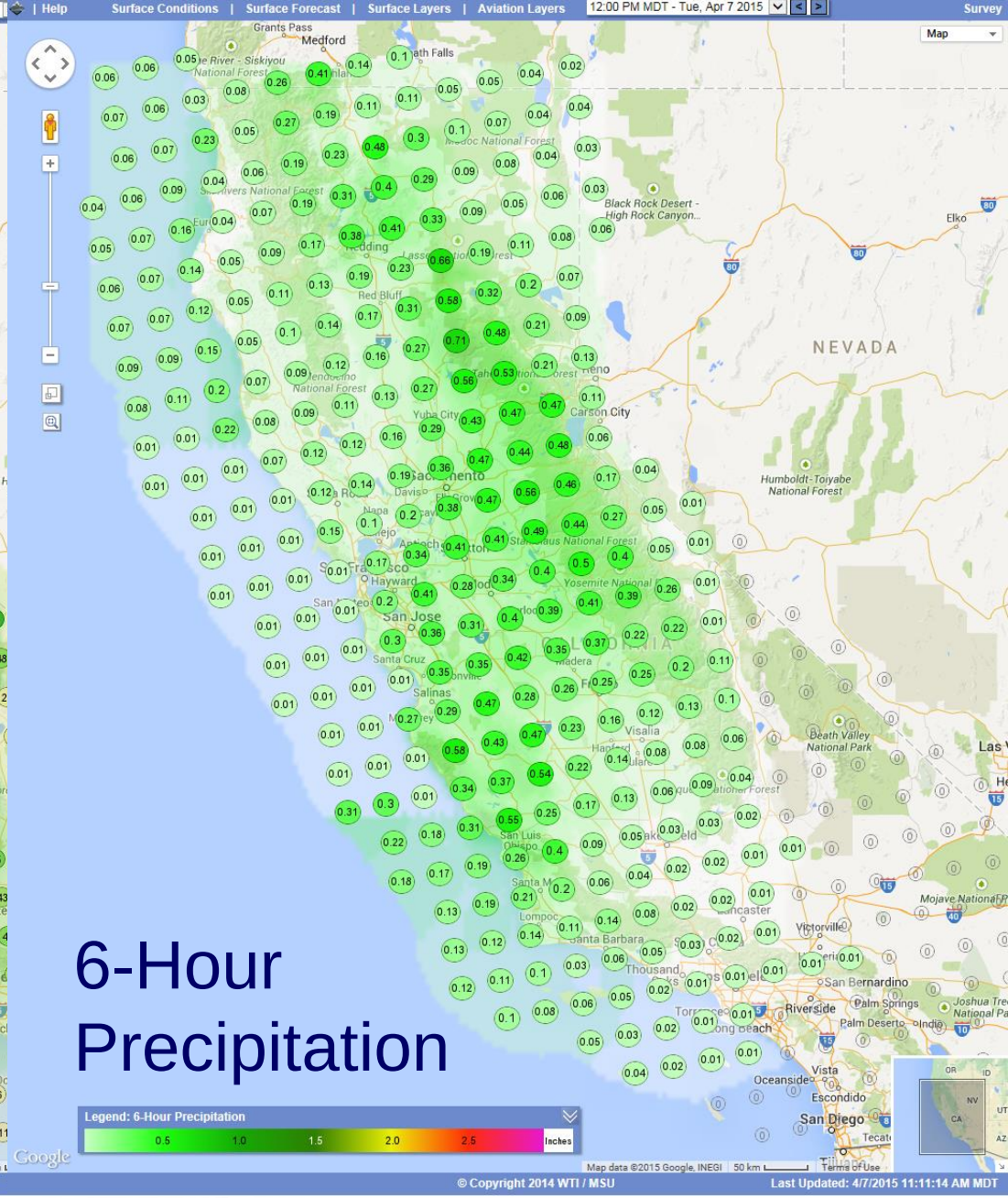

Humidity



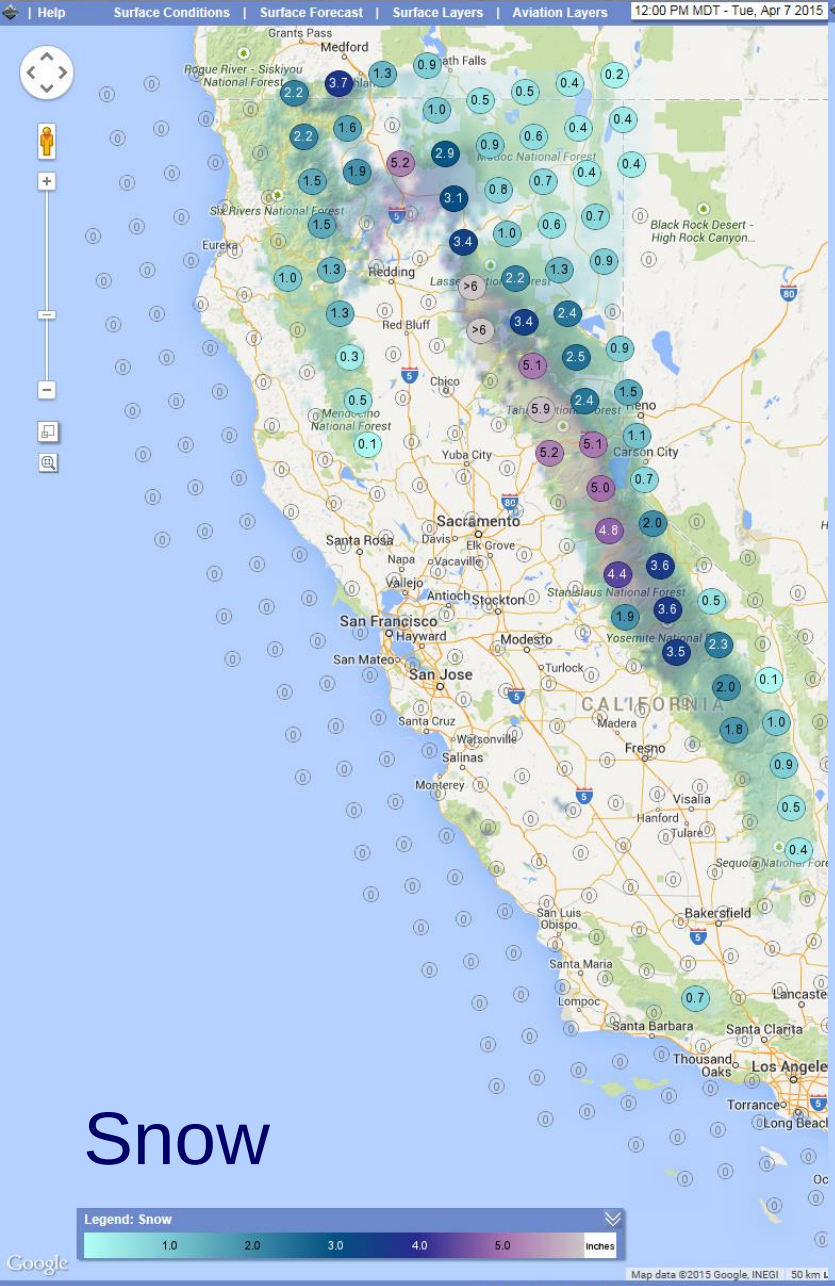

Sky Cover



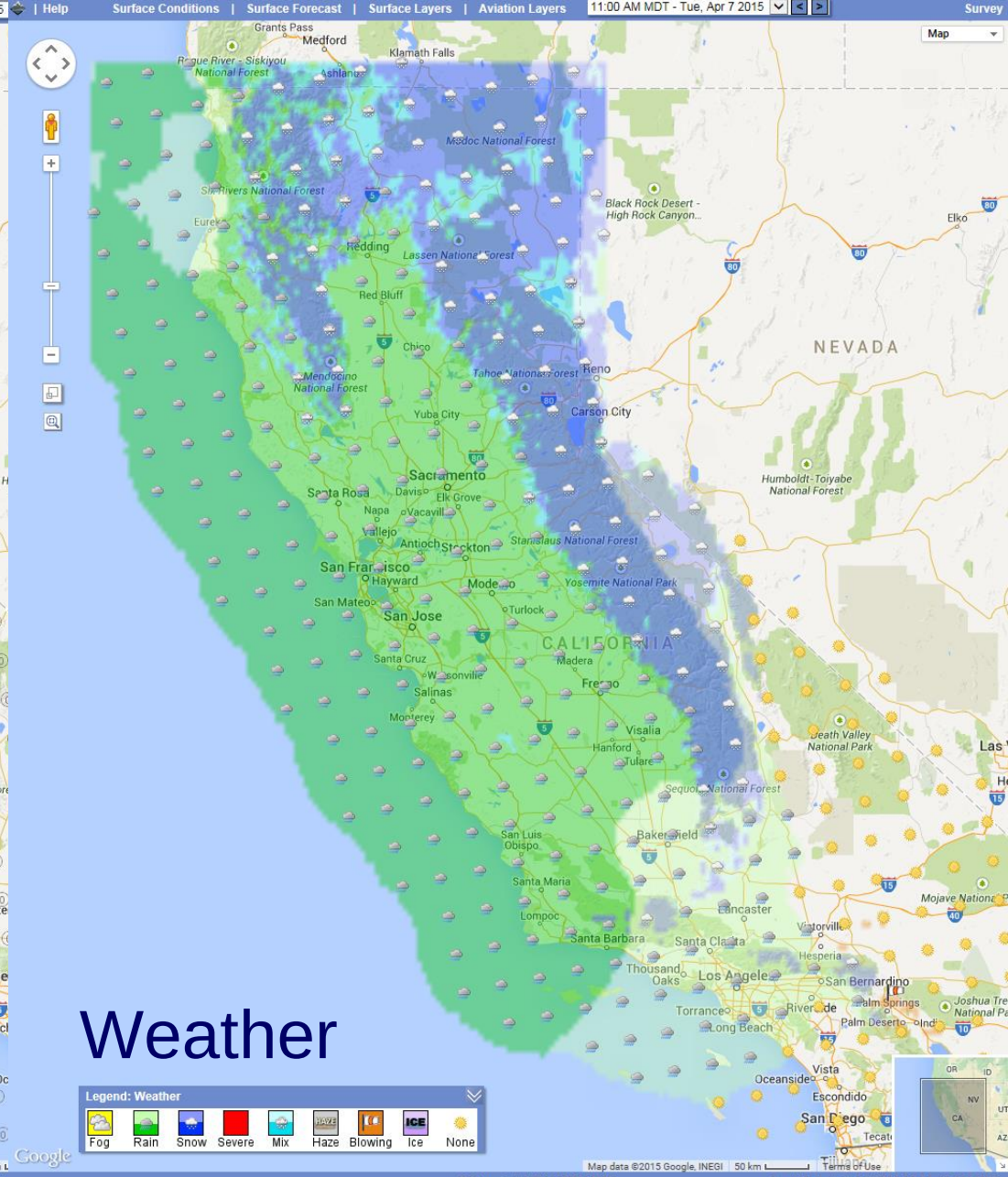

12-Hour Chance of Precipitation




6-Hour Precipitation




Snow



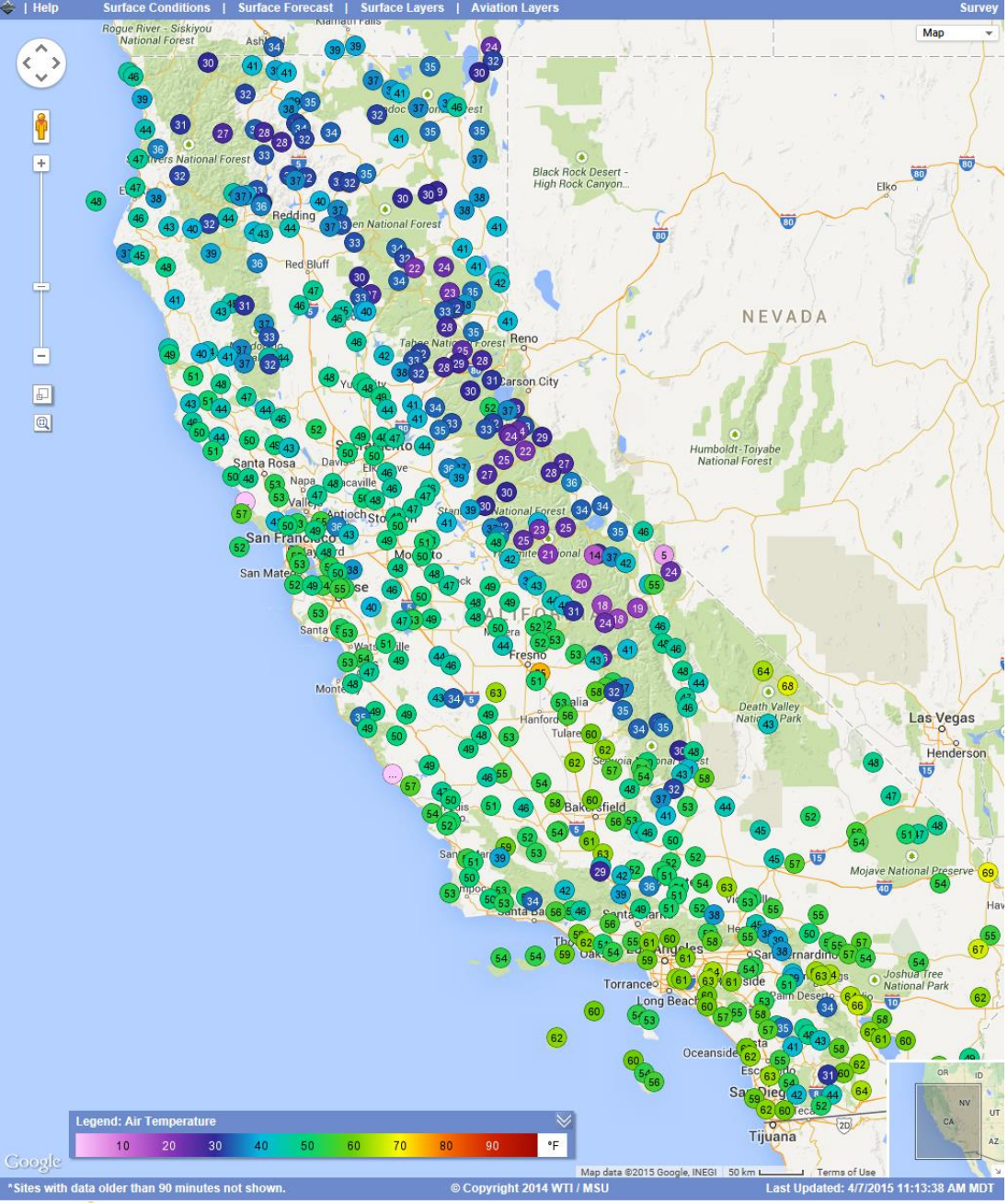

Weather

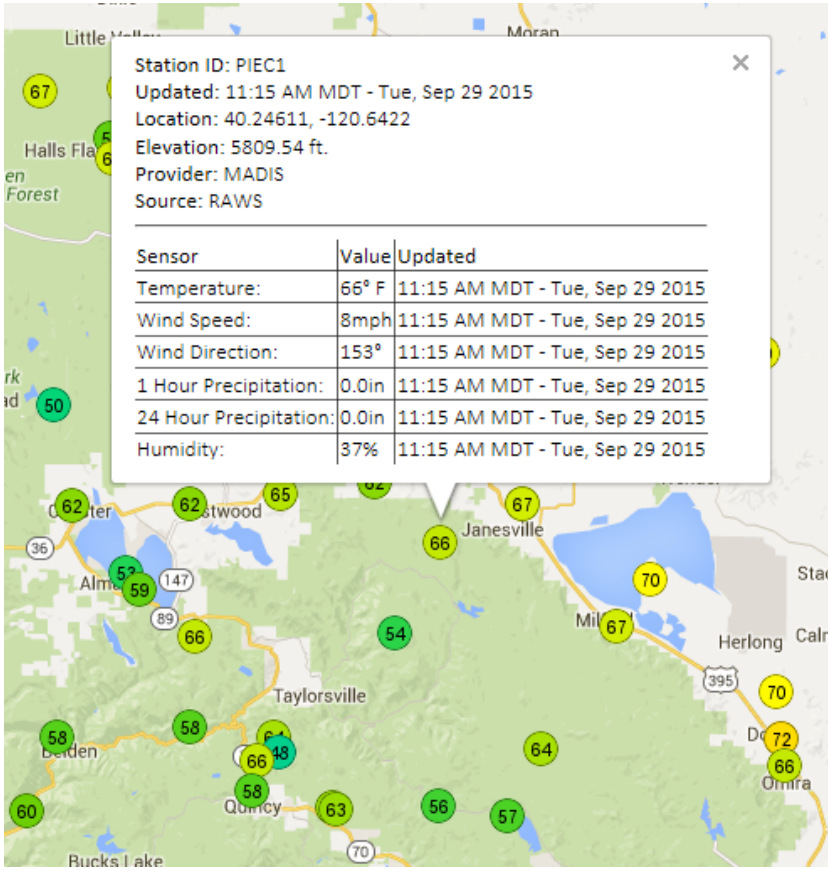
# Surface Conditions Layers

**Surface Conditions**

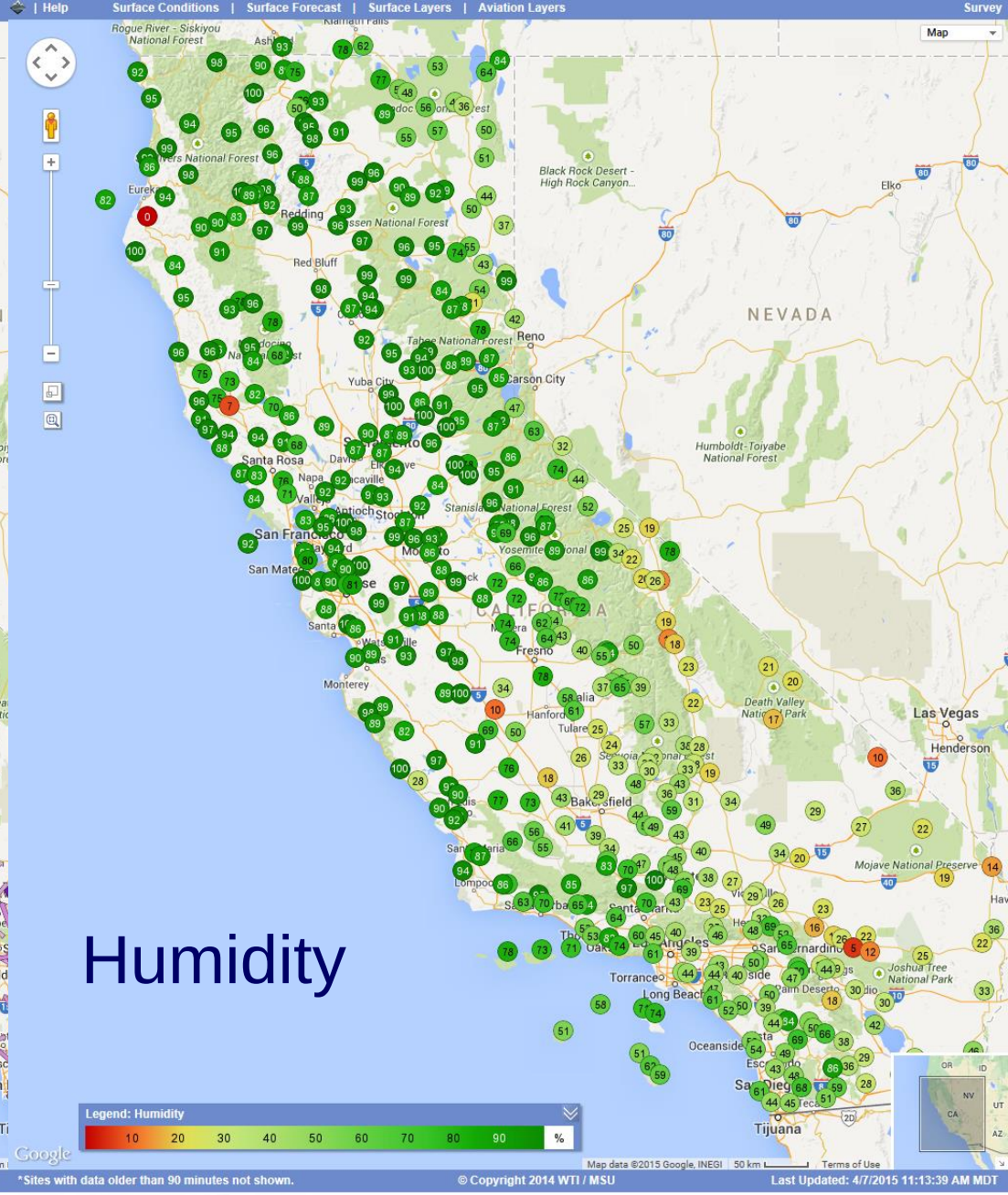
- Air Temperature
- Wind Speed
- Hourly Precipitation
- 24-Hour Precipitation
- Humidity
- RWIS Stations

# Air Temperature

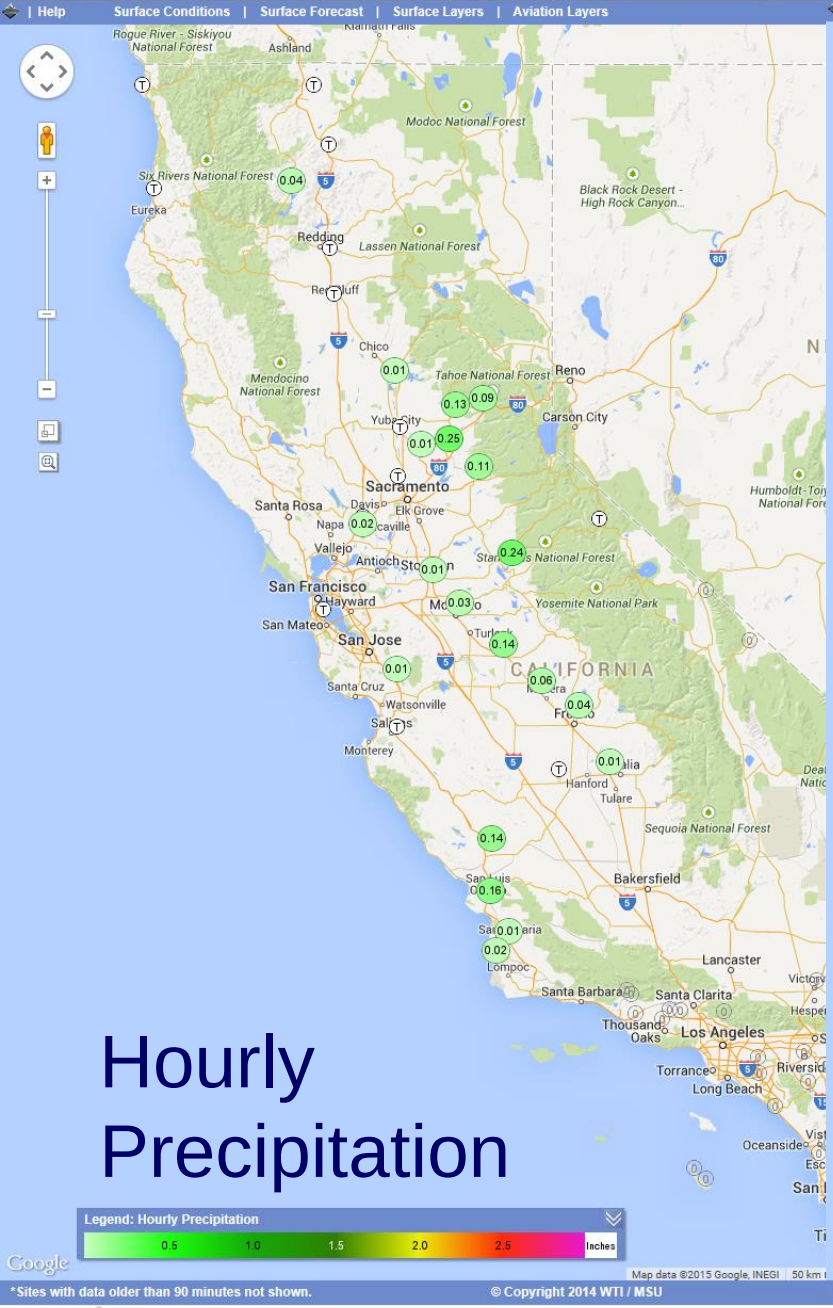


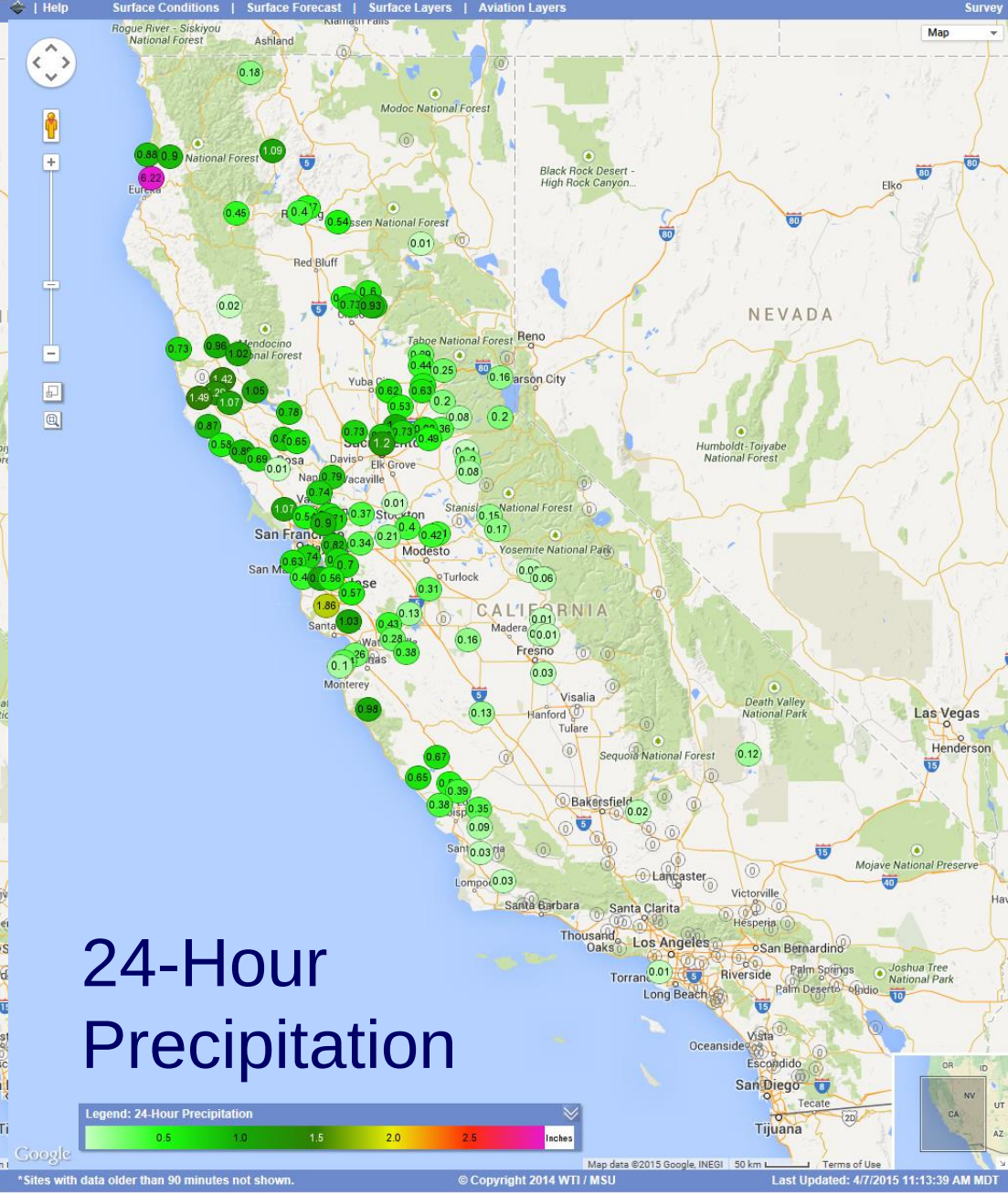



Wind Speed




Humidity


Hourly Precipitation
Legend: Hourly Precipitation
0.5
1.0
1.5
2.0
2.5
Inches
*Sites with data older than 90 minutes not shown.
© Copyright 2014 WTI / MSU


24-Hour Precipitation
Legend: 24-Hour Precipitation
0.5
1.0
1.5
2.0
2.5
Inches
*Sites with data older than 90 minutes not shown.
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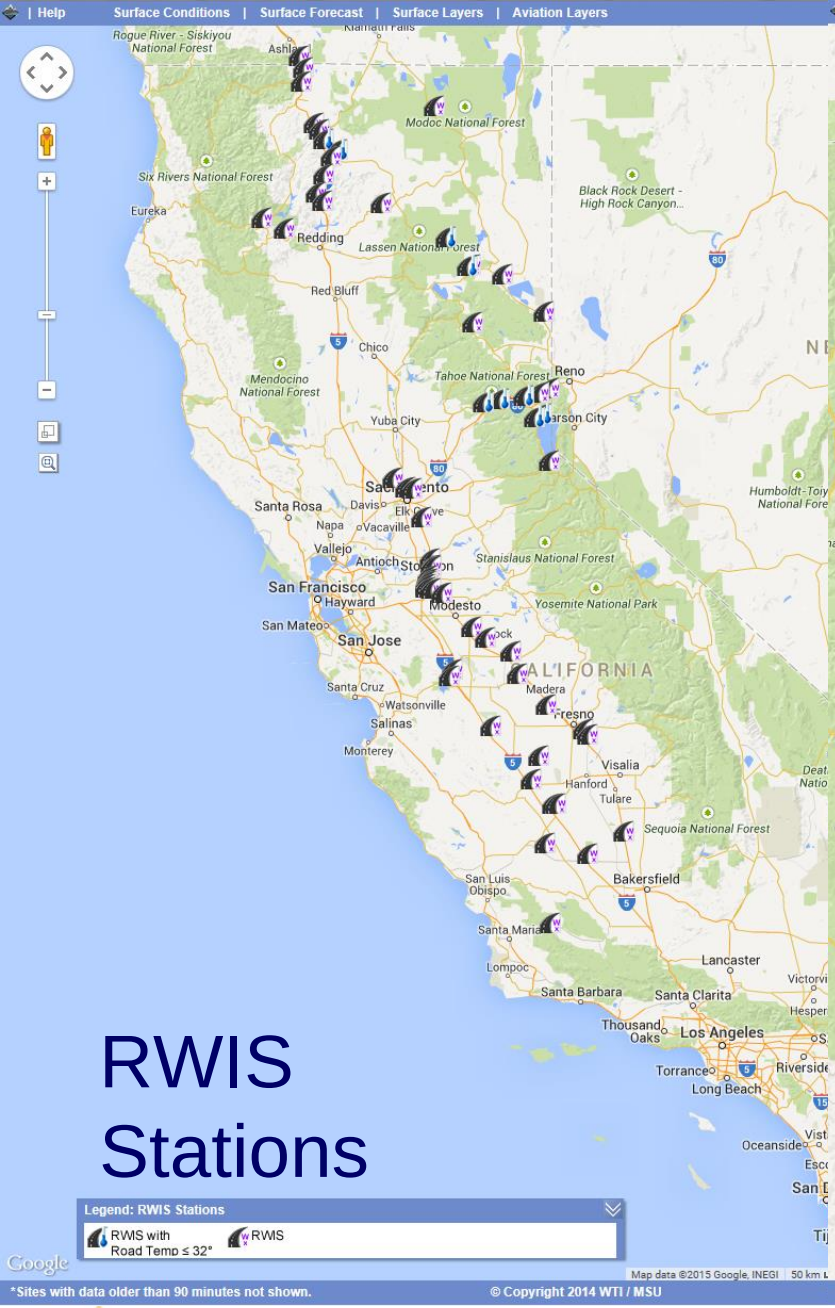
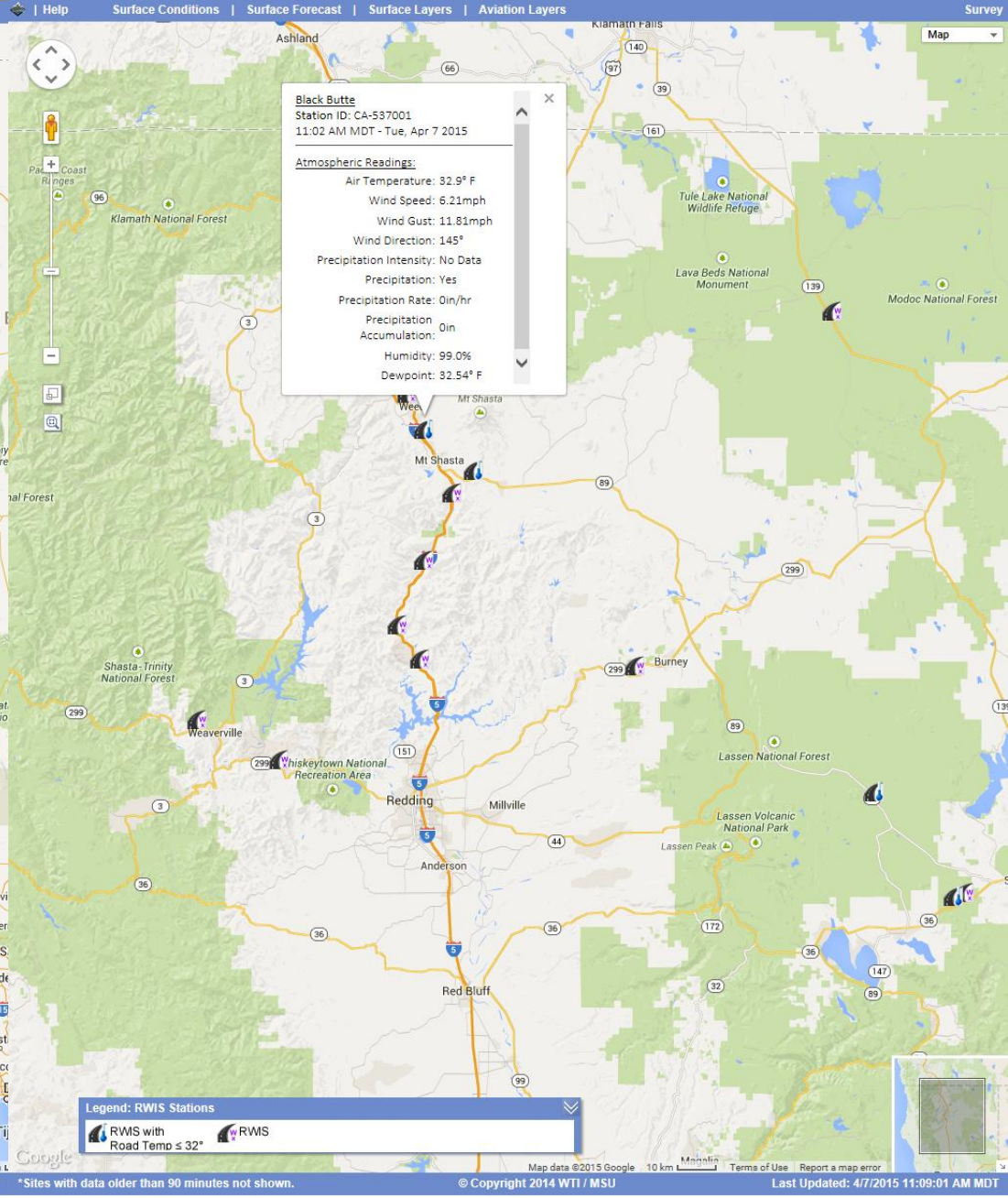
Last Updated: 4/7/2015 11:13:39 AM MDT

# RWIS Stations



# Evaluation

Focus Group Survey (SJSU)

Online Survey

Google Analytics System Usage Statistics

(Gap Analysis)

# Focus Group Survey

- San Jose State University conducted an open-ended survey of a focus group of prospective users once the Phase II prototype was available for use.
- Caltrans provided San Jose State University with a list of nine participants for this survey.
- Some of these participants forwarded the survey to others, resulting in sixteen total participants.
- Eleven of the participants were pilots, four were airport managers or government officials, and one was not specified.
- SJSU sent the survey to the focus group on October 22, 2013

**Question #1. What are the strengths of the prototype integrated weather system? For example, do you find necessary weather information in the system or not?**

- *It is nice to have the AWOS and Cal-Trans info in a single location.*
- *Flying: Found the information I need for local flying. No information for trips leaving or entering California beyond the border. Even for local flying, I would like to see large scale systems such as weather extend far beyond the state's boundaries.*
- *Intuitive operations (don't really need instructions).*
- *after several times on the site I found that each time was better and that I can get real time information from anywhere.*
- *Good job it is a keeper.*
- *like the proposed site...great utility...easy to manipulate...cannot think of any thing lacking....when finished it will become my # 1 WX site for both aviation and surface operations...thanks for the opportunity to "take an early look" .*

**Question #1. What are the strengths of the prototype integrated weather system? For example, do you find necessary weather information in the system or not?**

***(Continued …)***

- *There's a wealth of information available, which may be an obstacle for some people. It might seem overwhelming.*
- *The Caltrans roadcam layer is a good idea, many pilots might not think to check this resource if it hadn't been integrated.*
- *Being able to see all the surface wind vectors on the map could be infinitely useful for low level planning as well as educational to see how the terrain effects wind locally in different weather systems.*
- *As a pilot, I use ADDS because it consolidates so many items. Your graphical navigation of many of those items is very useful for California trips. However, since I live in far northwest California, I would find it useful to see Oregon data as well. Any plans to expand this to the full set of Pacific NW states as well as California?*

**Question #2. In what specific areas do you think that the system should be improved? For example, what additional weather information or features should the system have?**

- *It would be nice if the airport icon colors indicated the current conditions at the field ie: VFR, MVFR, IFR, LIFR.*
- *Having density altitude reporting at airports is important in our area of mountains and short runways. Cloud ceilings I noticed are not reported which is important.*
- *I noticed that the weather for awos and forecast aviation weather is not fully decoded.*
- *Plain English instead of raw data would be helpful.*
- *Cloud ceilings and tops are common needs for pilots*
- *I like the "Flight Path Tool" on the ADDS website*
- *Any way to integrate icing?*
- *It would really be something if this were expanded to other states.*

**Question #3. What other suggestions do you have for the developers of this integrated weather system?**

- *Hopefully have it available as an iPhone app.*
- *In proposing an integrated weather system, make sure you can sustain it over the long haul. If pilots begin to depend on it and then it's not there…….*
- *Add coverage to other states like Oregon, Washington, Nevada and Idaho.*
- *It would be good if you could somehow note the differences between this info and other sources. I think you are using RAW, RWIS etc that most of the other sources do not use. Also having the CT Web cams is great – not available on any other weather info site.*
- *If there are a "Quick Start Guide" or a "Basic Usage Video", they should be findable. Do NOT use a "video"; they use "Flash Player"!! ..see next...*
- *Your site needs a name. "Integrated Weather System" doesn't cut it from a marketing standpoint. Am I going to ask my friends if they use Integrated Weather System or IWS? We don't need another TLA (three-letter acronym). How about if we just call it "WeatherShare"?*

**Question #4. Any other comments?**

- *Hopefully this can catch on in more than California, I'd be a little afraid of getting too dependant on this system and then forget how to read hieroglyphics in DUATS/Aviationweather.gov when flying out of State.*
- *I think that you are on the right track. From both a pilots and aviation safety officer aspect I feel that it is critical to have a centralized and easily manipulated source of weather information to make informed Go / No-Go decision making. The good geographical layout along with cameras to reinforce conditions at particularly remote locations will serve users well in better planning their activities.*
- *The interface has been very well thought out.*
- *Your project is developing an excellent tool. Thank you for your efforts. Think about the marketing point. Many potential users are not necessarily all that tech-savy, and some of the ease-of-use features will need some work.*

# Online Survey

- The Phase II prototype includes a link to an online survey to solicit further input from prospective users.
- To date, seven people have responded to the online survey.
- No effort was made advertise this survey beyond placement of a link in the application.
- An excerpt of survey responses through September 30th, 2015 are presented here.

**Question: Please rate the usefulness of the following surface condition layers:**

| | Very Useful | Somewhat Useful | Not Very Useful | Not Aware of it | Response Count |
|---|---|---|---|---|---|
| **Air Temperature** | 4 | 1 | 1 | 0 | 6 |
| **Wind Speed & Direction** | 4 | 1 | 1 | 0 | 6 |
| **Precipitation Last Hour** | 2 | 3 | 1 | 0 | 6 |
| **Precipitation Last 24 Hours** | 2 | 3 | 1 | 0 | 6 |
| **Relative Humidity** | 3 | 2 | 1 | 0 | 6 |
| **RWIS Stations** | 4 | 0 | 2 | 0 | 6 |

**Question: Please rate the usefulness of the following surface forecast layers:**

| Answer Options | Very Useful | Somewhat Useful | Not Very Useful | Not Aware of it | Response Count |
|---|---|---|---|---|---|
| Air Temperature | 5 | 0 | 1 | 0 | 6 |
| Wind Speed & Direction | 5 | 0 | 1 | 0 | 6 |
| Wind Gust Speed & Direction | 5 | 0 | 1 | 0 | 6 |
| Relative Humidity | 3 | 1 | 1 | 0 | 5 |
| Sky Cover | 2 | 3 | 1 | 0 | 6 |
| 12-hour Chance of Precipitation | 2 | 3 | 1 | 0 | 6 |
| 6-hour Amount of Precipitation | 2 | 3 | 1 | 0 | 6 |
| Snow | 2 | 3 | 1 | 0 | 6 |
| Weather | 3 | 2 | 1 | 0 | 6 |

**Question: Please rate the usefulness of the following surface layers:**

| Answer Options | Very Useful | Somewhat Useful | Not Very Useful | Not Aware of it | Response Count |
|---|---|---|---|---|---|
| NWS Alerts | 4 | 1 | 1 | 0 | 6 |
| Caltrans CCTV Images | 4 | 0 | 1 | 1 | 6 |

## Question: Please rate the usefulness of the following aviation layers:

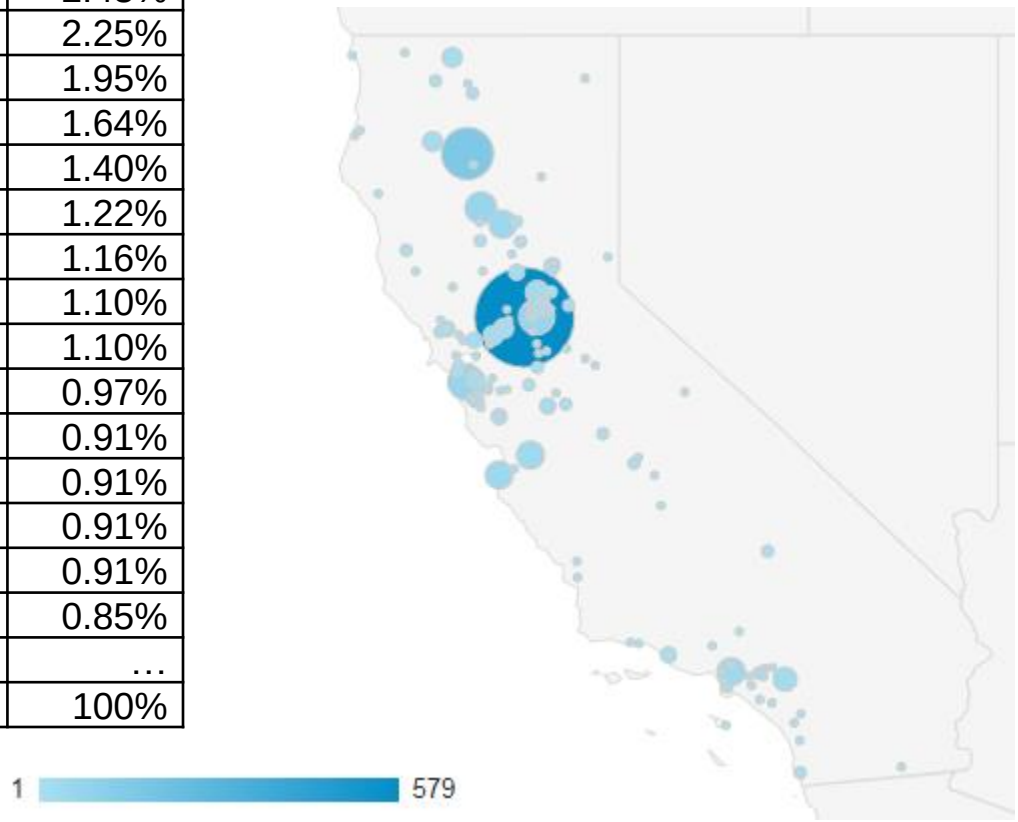
| Answer Options | Very Useful | Somewhat Useful | Not Very Useful | Not Aware of it | Response Count |
|---|---|---|---|---|---|
| AWOS/ASOS (METAR) | 5 | 0 | 1 | 0 | 6 |
| Pilot Reports (PIREPS) | 3 | 2 | 1 | 0 | 6 |
| Terminal Aerodrome Forecasts (TAF) | 2 | 3 | 1 | 0 | 6 |
| Radar: NWS CONUS Merged Reflectivity Composite | 3 | 2 | 1 | 0 | 6 |
| Radar: NWS 1-Hour Precipitation | 3 | 2 | 1 | 0 | 6 |
| Satellite: Visible (vis) | 2 | 3 | 1 | 0 | 6 |
| Satellite: Rainbow (rb) | 2 | 2 | 2 | 0 | 6 |
| Satellite: Visible (rgb) | 2 | 3 | 1 | 0 | 6 |
| Satellite: Shortwave (ir2f) | 1 | 3 | 1 | 1 | 6 |
| Satellite: JSL2 (jsl) | 0 | 3 | 1 | 2 | 6 |
| Satellite: Aviation (avn) | 1 | 2 | 1 | 2 | 6 |
| Wind Aloft | 1 | 2 | 2 | 1 | 6 |
| Temperature Aloft | 1 | 2 | 2 | 1 | 6 |

# Google Analytics System Usage Statistics

- System usage is tracked via Google Analytics.
- The project team has implement tracking mechanisms to record user selection of layers and markers.
- Additionally, Google Analytics provides information about users and user sessions including the locations of users.
- Tracking via Google Analytics started during Phase 1 on June 1st, 2010.
- The Phase 2 prototype system went live on August 13th, 2013, and additional tracking of layers and markers was implemented at that time.
- Google Analytics data from August 13th, 2013 through September 30th, 2015 is presented here.

| | | | |
|---|---|---|---|
| **1** | **Sacramento** | **579** | **35.24%** |
| **2** | Redding | 153 | 9.31% |
| **3** | San Francisco | 74 | 4.50% |
| **4** | Rancho Cordova | 65 | 3.96% |
| **5** | Corning | 61 | 3.71% |
| **6** | Chico | 49 | 2.98% |
| **7** | Monterey | 44 | 2.68% |
| **8** | Los Angeles | 40 | 2.43% |
| **9** | Hollister | 37 | 2.25% |
| **10** | Lincoln | 32 | 1.95% |
| **11** | Riverside | 27 | 1.64% |
| **12** | Oakland | 23 | 1.40% |
| **13** | Weaverville | 20 | 1.22% |
| **14** | Vacaville | 19 | 1.16% |
| **15** | Dixon | 18 | 1.10% |
| **16** | Yreka | 18 | 1.10% |
| **17** | Patterson | 16 | 0.97% |
| **18** | Folsom | 15 | 0.91% |
| **19** | Rocklin | 15 | 0.91% |
| **20** | Santa Rosa | 15 | 0.91% |
| **21** | Yuba City | 15 | 0.91% |
| **22** | Napa | 14 | 0.85% |
| | | … | … |
| | TOTAL | 1643 | 100% |

- 2883 sessions
- 1261 users
- 1643 Sessions from 128 Communities in California



# Surface Condition Events

## Layer and Sublayer Events

| | |
|---|---|
| **Main Menu Select** | **1377** |
| **Wind Speed** | 346 |
| **Air Temperature** | 259 |
| **24-Hour Precipitation** | 160 |
| **RWIS Stations** | 148 |
| **Hourly Precipitation** | 137 |
| **Humidity** | 118 |

## Marker Selection Events

| | |
|---|---|
| **Air Temperature** | **925** |
| **Wind Speed** | 714 |
| **RWIS Stations** | 551 |
| **Humidity** | 124 |
| **Hourly Precipitation** | 100 |
| **24-Hour Precipitation** | 88 |

# Surface Forecast Events

## Layer and Sublayer Events

| | |
|---|---|
| **Main Menu Select** | **1221** |
| **Wind Speed** | 207 |
| **Weather** | 155 |
| **Wind Gust Speed** | 142 |
| **12-Hour Chance of Precipitation** | 117 |
| **SkyCover** | 108 |
| **6-Hour Precipitation** | 87 |
| **Air Temperature** | 67 |
| **Snow** | 62 |
| **Humidity** | 36 |

## Marker Selection Events

| | |
|---|---|
| **Weather** | **158** |
| **Wind Gust Speed** | 74 |
| **Wind Speed** | 41 |
| **Air Temperature** | 38 |
| **12-Hour Chance of Precipitation** | 16 |
| **Sky Cover** | 14 |
| **6-Hour Precipitation** | 12 |
| **Snow** | 6 |
| **Humidity** | 1 |

# Surface Layer Events

## Layer and Sublayer Events

| | |
|---|---|
| **Main Menu Select** | **1243** |
| **Caltrans CCTV** | 294 |
| **NWS Alerts** | 163 |

## Marker Selection Events

| | |
|---|---|
| **Caltrans CCTV** | **2832** |
| **NWS Alerts** | 492 |

# Aviation Layer Events

## Layer and Sublayer Events

| | |
|---|---|
| **Main Menu Select** | **1744** |
| **Wind Aloft** | 441 |
| **AWOS/ASOS** | 312 |
| **SIGMETs/AIRMETs** | 277 |
| **Pilot Reports** | 252 |
| **Terminal Aerodrome Forecasts** | 241 |
| **Satellite** | 239 |
| **NWS Composite Reflectivity** | 181 |
| **NWS 1-Hour Precipitation** | 168 |
| **Airports** | 161 |
| **Temperature Aloft** | 136 |

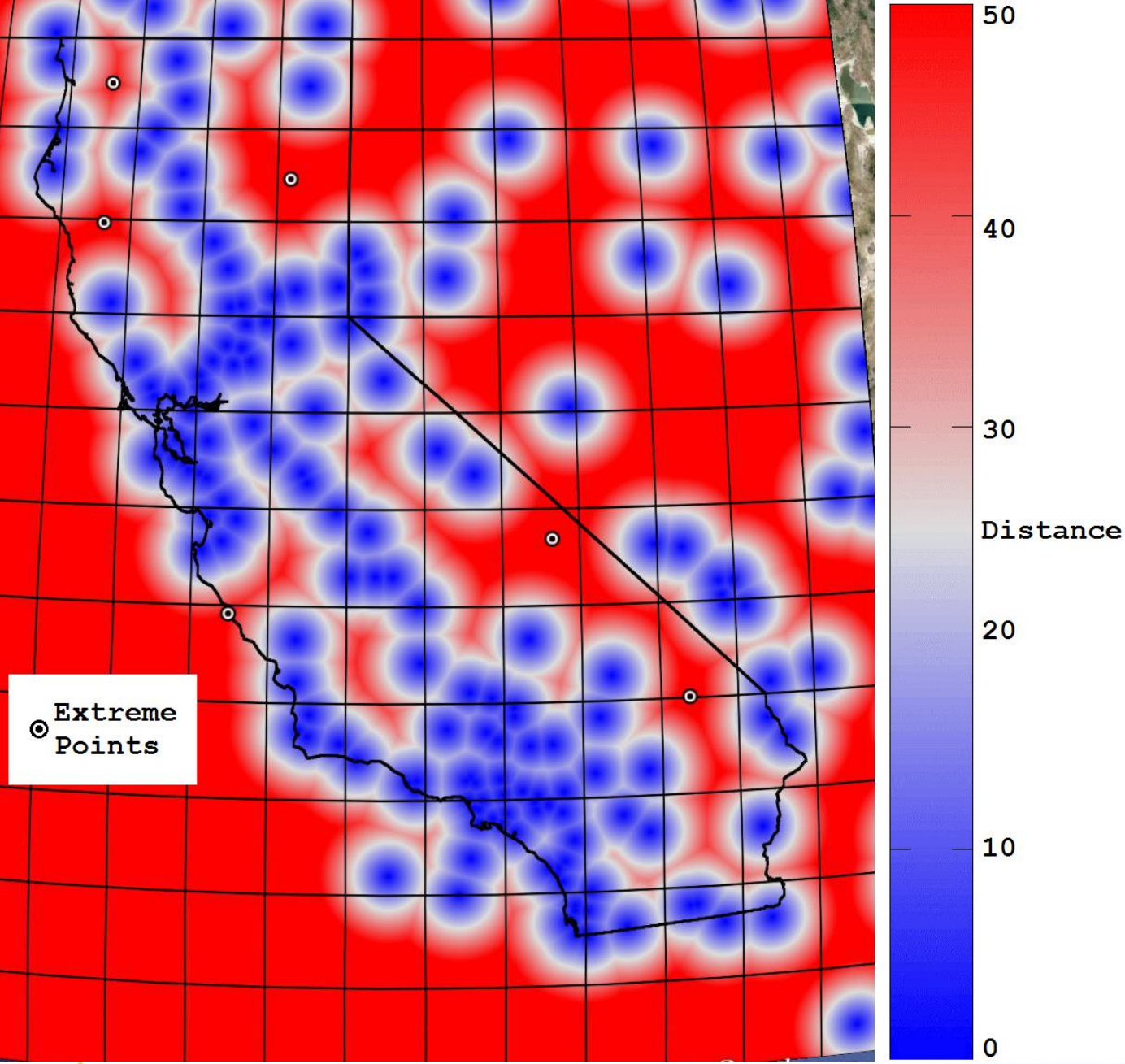
## Marker Selection Events

| | |
|---|---|
| **AWOS/ASOS** | **6845** |
| **Pilot Reports** | 634 |
| **Terminal Aerodrome Forecasts** | 569 |
| **Wind Aloft** | 409 |
| **SIGMETs/AIRMETs** | 188 |
| **Airports** | 192 |
| **Temperature Aloft** | 95 |

# Gap Analysis

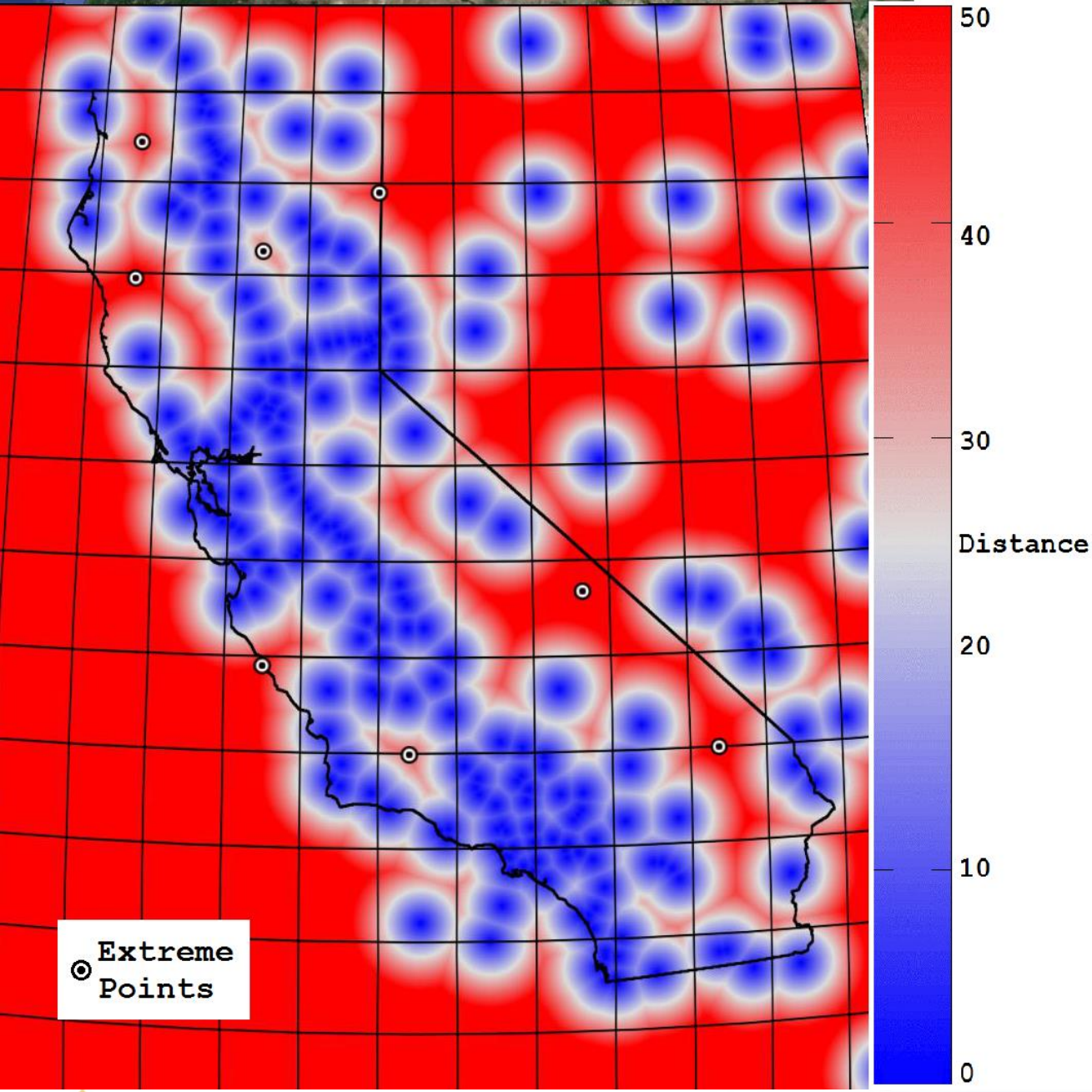
For further information see:

- Integration of Aviation Automated Weather Observation Systems (AWOS) with Roadside Weather Information Systems (RWIS) Phase II Gap Analysis, by Douglas Galarus and Daniell Richter, Western Transportation Institute, Montana State University. Finalized July 10, 2015.



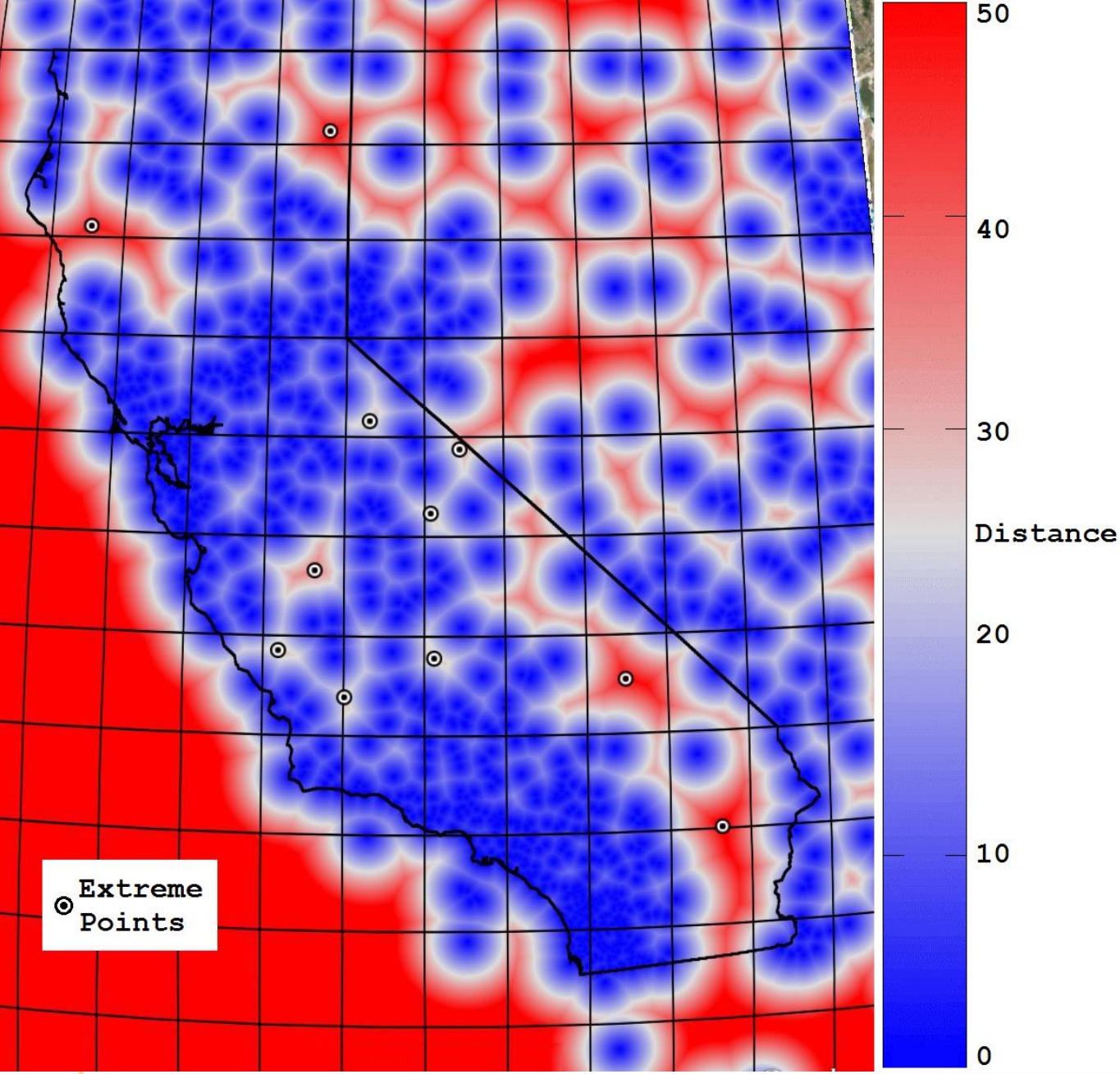

**Heat Map Showing Distances (mi) to the Nearest Reporting AWOS / ASOS Site from All Locations in California and Extreme Points within Areas of Poor Coverage**

**(Blue = less than 25 miles from nearest site, White = 25 miles from nearest site, Red = more than 25 miles to nearest site)**




**Heat Map Showing Distances (mi) to the Nearest Reporting AWOS / ASOS / RWIS Site from All Locations in California and Extreme Points within Areas of Poor Coverage**

**(Blue = less than 25 miles from nearest site, White = 25 miles from nearest site, Red = more than 25 miles to nearest site)**




**Heat Map Showing Distances (mi) to the Nearest Reporting AWOS / ASOS / RWIS / MADIS / MesoWest Site with QC-Passed Observations and Reporting Frequency of 15 Minutes or Better from All Locations in California and Extreme Points within Areas of Poor Coverage**

**(Blue = less than 25 miles from nearest site, White = 25 miles from nearest site, Red = more than 25 miles to nearest site)**

# 40 airports fall more than 25 Miles from the nearest reporting AWOS/ASOS site.

| Name | City | County | Distance to AWOS/ASOS |
|---|---|---|---|
| STOVEPIPE WELLS AIRPORT | Death Valley National Park | Inyo | 62.64 |
| SUSANVILLE MUNICIPAL AIRPORT | Susanville | Lassen | 61.08 |
| SPAULDING AIRPORT | Susanville | Lassen | 58.26 |
| LONE PINE AIRPORT | Lone Pine | Inyo | 56.46 |
| FALL RIVER MILLS AIRPORT | Fall River Mills | Shasta | 50.60 |
| FURNACE CREEK AIRPORT | Death Valley National Park | Inyo | 48.48 |
| RAVENDALE AIRPORT | Ravendale | Lassen | 47.94 |
| GANSNER AIRPORT | Quincy | Plumas | 47.12 |
| SHOSHONE AIRPORT | Shoshone | Inyo | 46.94 |
| ROGERS FIELD | Chester | Plumas | 46.64 |
| ROUND VALLEY AIRPORT | Covelo | Mendocino | 46.45 |
| HAPPY CAMP AIRPORT | Happy Camp | Siskiyou | 42.85 |
| RUTH AIRPORT | Ruth | Trinity | 42.18 |
| KERN VALLEY AIRPORT | Kernville | Kern | 40.98 |
| MESA DEL REY AIRPORT | King City | Monterey | 40.48 |
| INDEPENDENCE AIRPORT | Independence | Inyo | 39.25 |
| LOST HILLS KERN COUNTY AIRPORT | Lost Hills | Kern | 38.19 |
| SOUTHARD FIELD AIRPORT | Bieber | Lassen | 37.14 |
| SHELTER COVE AIRPORT | Shelter Cove | Humboldt | 36.21 |
| GARBERVILLE AIRPORT | Garberville | Humboldt | 36.13 |
| HERLONG AIRPORT | Herlong | Lassen | 36.06 |
| OCOTILLO AIRPORT | Ocotillo Wells | San Diego | 33.39 |
| NEW CUYAMA AIRPORT | New Cuyama | Santa Barbara | 31.83 |
| LITTLE RIVER AIRPORT | Little River | Mendocino | 31.23 |
| BAKER AIRPORT | Baker | San Bernardino | 30.32 |
| HYAMPOM AIRPORT | Hyampom | Trinity | 30.06 |
| MARIPOSA YOSEMITE AIRPORT | Mariposa | Mariposa | 29.78 |
| TAFT AIRPORT | Taft | Kern | 29.75 |
| SALTON SEA AIRPORT | Salton City | Imperial | 29.65 |
| ADIN AIRPORT | Adin | Modoc | 28.38 |
| OCEAN RIDGE AIRPORT | Gualala | Mendocino | 28.28 |
| LEE VINING AIRPORT | Lee Vining | Mono | 28.13 |
| DINSMORE AIRPORT | Dinsmore | Humboldt | 28.13 |
| WILLOWS GLENN COUNTY AIRPORT | Willows | Glenn | 27.51 |
| NERVINO AIRPORT | Beckwourth | Plumas | 27.28 |
| BORREGO VALLEY AIRPORT | Borrego Springs | San Diego | 27.06 |
| CHIRIACO SUMMIT AIRPORT | Chiriaco Summit | Riverside | 26.54 |
| GRAVELLY VALLEY AIRPORT | Upper Lake | Lake | 26.29 |
| TULELAKE AIRPORT | Tulelake | Modoc | 25.91 |
| LOS BANOS MUNICIPAL AIRPORT | Los Banos | Merced | 25.26 |

# 18 airports fall more than 25 Miles from the nearest reporting AWOS/ASOS, RWIS, MADIS or Mesowest site.

| Name | City | County | Distance to Weather Station |
|---|---|---|---|
| BAKER AIRPORT | Baker | San Bernardino | 42.44 |
| RUTH AIRPORT | Ruth | Trinity | 40.11 |
| SHELTER COVE AIRPORT | Shelter Cove | Humboldt | 37.34 |
| GARBERVILLE AIRPORT | Garberville | Humboldt | 37.11 |
| ALTURAS MUNICIPAL AIRPORT | Alturas | Modoc | 34.23 |
| BRAWLEY MUNICIPAL AIRPORT | Brawley | Imperial | 32.26 |
| WILLIAM R. JOHNSTON (MENDOTA) AIRPORT | Mendota | Fresno | 31.83 |
| RAVENDALE AIRPORT | Ravendale | Lassen | 31.79 |
| CALEXICO INTERNATIONAL AIRPORT | Calexico | Imperial | 31.03 |
| CALIFORNIA PINES AIRPORT | Alturas | Modoc | 30.39 |
| DINSMORE AIRPORT | Dinsmore | Humboldt | 28.22 |
| BLYTHE AIRPORT | Blythe | Riverside | 27.64 |
| IMPERIAL COUNTY AIRPORT | Imperial | Imperial | 27.59 |
| CLIFF HATFIELD MEMORIAL AIRPORT | Calipatria | Imperial | 26.99 |
| HYAMPOM AIRPORT | Hyampom | Trinity | 26.81 |
| WILLOWS GLENN COUNTY AIRPORT | Willows | Glenn | 26.49 |
| ROUND VALLEY AIRPORT | Covelo | Mendocino | 26.43 |
| CHIRIACO SUMMIT AIRPORT | Chiriaco Summit | Riverside | 25.47 |

# Conclusions

- Feedback has been generally positive and both the focus group and participants in the online survey have provided useful suggestions.
- The system does appear to be on the right track.
- The Google Analytics data helps to augment the survey data in identifying the most used and useful data layers in the system.
- Not surprisingly, users seem most interested in wind speed data.
- One potential data set identified as missing and beneficial is cloud ceilings. Users also requested additional icing data.

# Conclusions

- The gap analysis identified areas that are underserved by existing weather stations, relative to data that is accessible by the prototype system.
- Not surprisingly 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. EMS flights certainly occur in these areas as well.
- Aside from identifying gaps, the gap analysis helped to demonstrate the utility of the prototype system over AWOS/ASOS alone.
- Otherwise, the gap analysis results may prove helpful in determining locations in which to deploy future AWOS/ASOS or RWIS.

# Contact:

Doug Galarus
Western Transportation Institute
(406) 994-5268
dgalarus@coe.montana.edu

# For Further Information see:

http://aviation.weathershare.org

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