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.
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.

<table>
<thead>
<tr>
<th>Distance (mi)</th>
<th>AWOS</th>
<th>AWOS + RWIS</th>
<th>AWOS + RWIS + MADIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>dist &lt; 5</td>
<td>298</td>
<td>366</td>
<td>801</td>
</tr>
<tr>
<td>5 ≤ dist &lt; 10</td>
<td>262</td>
<td>288</td>
<td>138</td>
</tr>
<tr>
<td>10 ≤ dist &lt; 20</td>
<td>261</td>
<td>219</td>
<td>25</td>
</tr>
<tr>
<td>20 ≤ dist &lt; 30</td>
<td>82</td>
<td>63</td>
<td>3</td>
</tr>
<tr>
<td>30 ≤ dist &lt; 40</td>
<td>46</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>40 ≤ dist &lt; 50</td>
<td>10</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>50 ≤ dist</td>
<td>8</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Min</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q1</td>
<td>3.88</td>
<td>3.09</td>
<td>0.69</td>
</tr>
<tr>
<td>Median</td>
<td>8.63</td>
<td>6.92</td>
<td>1.83</td>
</tr>
<tr>
<td>Q3</td>
<td>14.49</td>
<td>11.83</td>
<td>3.61</td>
</tr>
<tr>
<td>Max</td>
<td>59.77</td>
<td>59.77</td>
<td>29.53</td>
</tr>
</tbody>
</table>
Phase 2

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
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

- AWOS/ASOS
- Pilot Reports
- Terminal Aerodrome Forecasts
- Airports
- SIGMETs/ARMETs
- NWS Composite Reflectivity
- NWS 1-Hour Precipitation
- Satellite
- Wind Aloft
- Temperature Aloft
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 0715522 AUTO 18009KT 1/4SM +SN FZFG VV002 M01/M02 A2977 RMK AO2
PK WND 17026/1500 SLP093 P0008 T10111022
Airports

SIGMETs/AIRMETs
NWS Composite Reflectivity

NWS 1-Hour Precipitation
Satellite
Wind Aloft

From 3000 ft. To 15000 ft.
Temperature Aloft

From 3000 ft.
To 15000 ft.
Surface Layers

- NWS Alert
- Caltrans CCTV
NWS Alerts
Surface Forecast Layers

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

Station ID: PIEC1
Updated: 11:15 AM MDT - Tue, Sep 29 2015
Location: 40.24011, -120.6422
Elevation: 5809.54 ft.
Provider: MADIS
Source: RAWS

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Value</th>
<th>Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>66°F</td>
<td>11:15 AM MDT - Tue, Sep 29 2015</td>
</tr>
<tr>
<td>Wind Speed</td>
<td>8 mph</td>
<td>11:15 AM MDT - Tue, Sep 29 2015</td>
</tr>
<tr>
<td>Wind Direction</td>
<td>133°</td>
<td>11:15 AM MDT - Tue, Sep 29 2015</td>
</tr>
<tr>
<td>1 Hour Precipitation</td>
<td>0.00 in</td>
<td>11:15 AM MDT - Tue, Sep 29 2015</td>
</tr>
<tr>
<td>24 Hour Precipitation</td>
<td>0.00 in</td>
<td>11:15 AM MDT - Tue, Sep 29 2015</td>
</tr>
<tr>
<td>Humidity</td>
<td>37%</td>
<td>11:15 AM MDT - Tue, Sep 29 2015</td>
</tr>
</tbody>
</table>
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.
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.
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For Further Information see:

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

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