

Evaluation of UDOT's Weather Operations/RWIS Program

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Overview

- Why integrate weather forecasts?
- Past Research
- UDOT's Weather Operations Program
- Preliminary Research Findings
- Final Evaluation
- Concluding Remarks

Why integrate localized, area specific weather forecasts?

- Improve traffic management during adverse weather
- Improve planning/allocation of materials and labor
 - Winter Maintenance
 - Construction
- Improve incident prevention and response



Past Research Focus

- Weather Information for Surface Transportation
 - Clarus Initiative
 - Aurora
 - CASA
 - FORETELL
- TMCs integrating weather information (Cluett, C., 2005)
 - 38 TMCs screened
 - Strong urban focus
 - Improve traffic operations with aid of a trained weather professional



Surveyed TMCs (map courtesy of Chris Cluett)

Differences in Forecasting

- Traditional Weather Forecast:
 - Tonight...Mostly cloudy with a 20 percent chance of light snow. Breezy. Lows near 8 above. North winds 15 to 25 MPH. (Osborne, L. F., 2002)
- Localized, Area Specific Forecast: (Courtesy of UDOT)
 - “Quick $\frac{3}{4}$ ” to 1” snow over the next 1 hour.”
 - “Alerted for road concerns developing by 1400, sloppy onset. Up to 1-2” road snow for the commute tonight.”
 - “Snow band stalling again over your routes areas. Big thing will be dropping temps W-E late afternoon Park Valley, I-15 areas around 1800. General tapering trend west desert areas after temp drop, snow I-15 corridor through 0000.”

Overview of Utah's Program

- 1994: Began using Northwest WeatherNet for Region 2
- 2002: State-of-the-art TOC deployed in preparation for the Winter Olympics
 - Statewide use of Northwest WeatherNet services
 - Staffed meteorologists with local knowledge
 - Real-time inputs
- Salt Lake City found that they saved \$16.70 for every \$1.00 spent on ATMS



Overview of Utah's Program

- Weather Report Schedule:
 - Text forecast 2x per day, and when conditions change (worsen)
 - Morning: 36 hour
 - Evening: 24 hour
- Call backs
 - Meteorologist will call area supervisor for *blown* forecast
 - Supervisors can call office to receive *nowcast*
 - Avg: 25 calls, Max: 75 calls

UDOT Traffic operations Center, weather Desk
REGION 1

Date: 01/18/05
Time: 1200
Meteorologist: Merrill

Region 1 Discussion:

Forecast still on track and beginning to sound like a broken record. Building inversion conditions will continue to increase fog/smog in the Cache and Bear Lake Valley areas with building hazy/patchy fog conditions along the I-15/84 corridors west of the Wasatch Crest. High clouds will continue to ripple through with off chance for a few wet flurries this evening Logan Summit, but no road concerns anticipated due to this. Extended looks dry long-term, and expect no new storm systems through the weekend.

1) 1431 snowville/Park valley

.TUE NIGHT .. Dry with a few high clouds. Patchy fog. Low lower 20s.

.WED .. Mixed high overcast and continued dry. Highs in the upper 30s.



Evaluation of UDOT's Weather Operations Program

- Study Objectives:
 - Assess effectiveness and benefits of the Weather Operations Program
 - Does the Program deliver quality road and weather information to UDOT users?
 - What is the added value of the Program?
 - Determine current practices in other States
 - Suggest study objectives for future research

Current Practices: Survey Questions

- North American Agencies (State-of-the-Practice)
 - Do you utilize weather forecasts to aid you in your winter road maintenance activities?
 - Do you pay for customized weather forecasts?
 - What benefits have you experienced from customized forecasts?
 - Have you experienced cost savings with customized forecasts?
 - Are you satisfied with your customized weather service?

Snow and Ice List Serve Survey

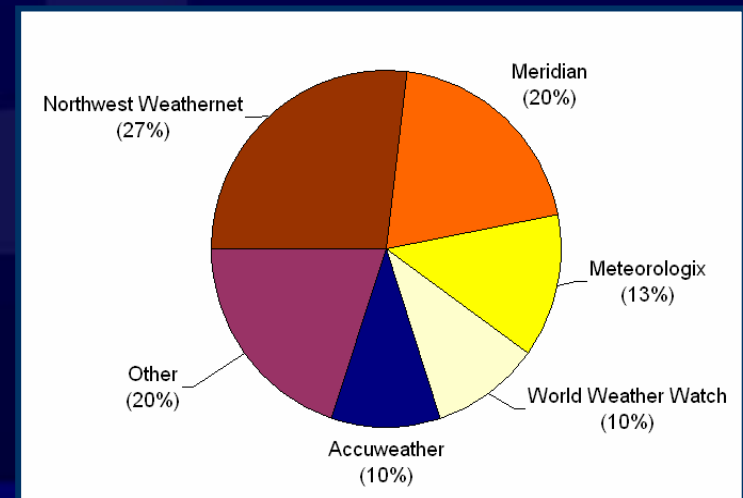
- Focus:
 - Weather forecasts aiding winter maintenance in North America
 - Use of localized, area specific forecasts (benefits and experience)
- Contacts included:
 - Maintenance Managers, Directors, Superintendents, Engineers, Area Supervisors and Technologists
- Total of 31 contacts from 19 states and 4 provinces
 - 68% U.S. State DOT
 - 13% U.S. City Agency
 - 9% Canadian Provincial or Regional Agency
 - 10% Canadian City Agency

States and Provinces Contacted



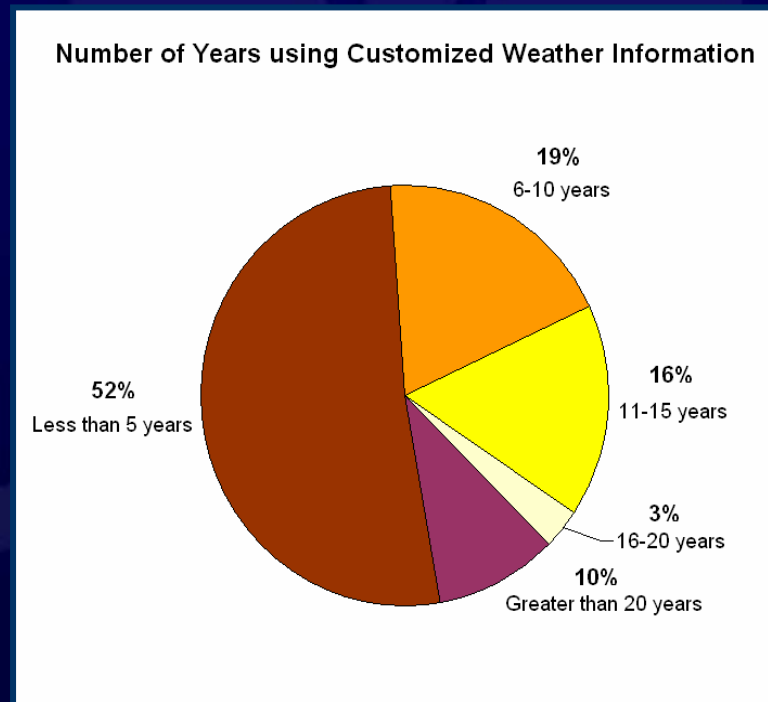
Preliminary Research Findings: State of the Practice

- All use forecasting for winter maintenance operations
 - Including localized, area-specific forecasts
 - Some respondents felt RWIS services counted as localized, area-specific forecasts
- Most common service providers:
 - Northwest WeatherNet (27%)
 - Meridian (20%)
 - Meteorologix (13%)
 - World Weatherwatch (10%)
 - Accuweather (10%)



Preliminary Research Findings: State of the Practice

- Most agencies (52%) have been receiving customized forecasts for less than 5 years



Preliminary Research Findings: Survey Summary

- Benefits of localized, area specific forecasts:
 - More accurate forecasts (microclimate knowledge)
 - Advanced warning of storm conditions
 - Better response time, planning, and scheduling of staff
 - Knowledge of pavement temperatures
 - Knowledge of precipitation type and amount expected
 - Better use of chemical product (deciding when to use)
 - Timely forecast and access to forecaster
 - Cost effective

Evaluation: UDOT Questionnaire

- UDOT Employees
 - Maintenance and Construction
 - Do you use weather forecasts for you maintenance operations?
 - What services do you use from UDOT's Program?
 - How often do you use these services?
 - Do you feel UDOT is efficient in relaying forecast information?
 - How satisfied are you with the service of UDOT's Program?
 - How reliable and how usable are these forecasts?
 - Has UDOT's weather operations changed your approach to maintenance?

Preliminary Research Findings: UDOT Evaluation

- Winter 2004-2005 Data (Oct. 31, 2004 to Mar. 30, 2005)
- Key Factors in Determining Value Added:
 - # Calls/Shed,
 - Level-of-Maintenance (LOM) normalized,
 - Winter maintenance strategies (pro-active),
 - Winter severity index (WI),
 - Average seasonal daily traffic volume/shed,
 - Material usage

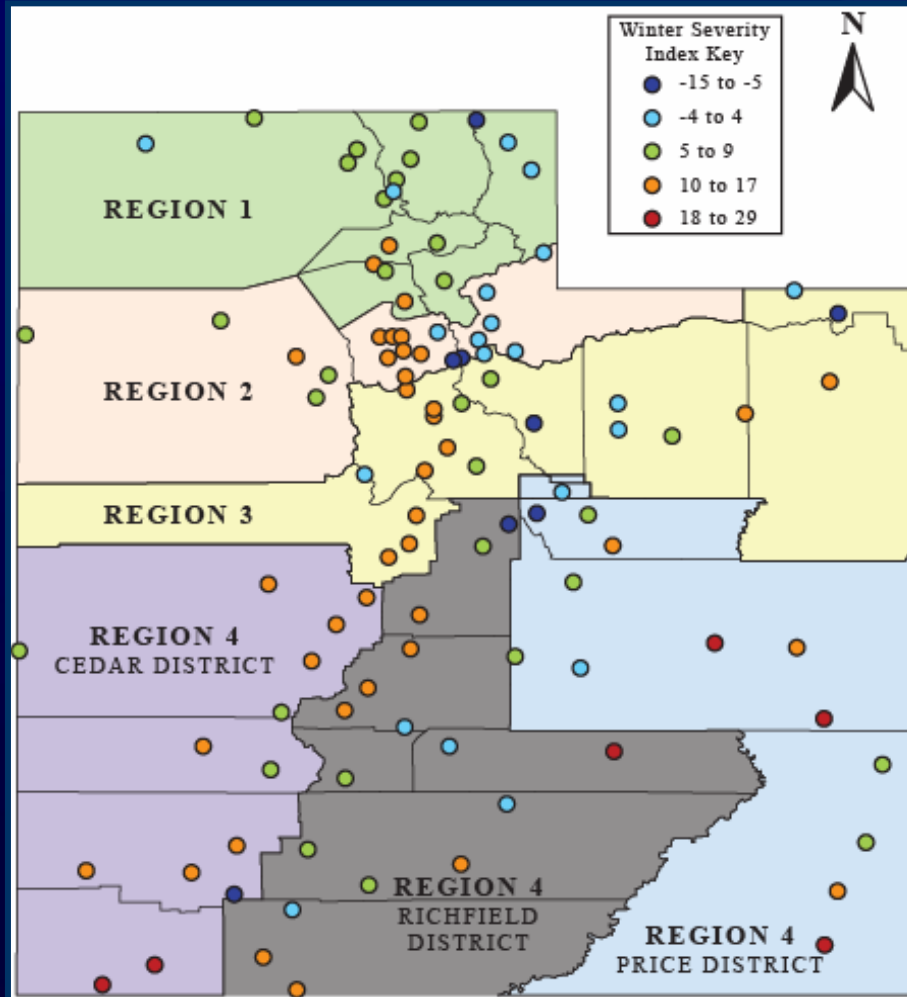
Preliminary Research Findings: UDOT Evaluation

- **LOM codes**

- **Condition 1:** Bare pavement conditions.
- **Condition 2:** Snow build-up encountered occasionally. Patches of black ice, slush or packed snow.
- **Condition 3:** Snow build-up encountered regularly. Black ice or packed snow with only wheel track bare.
- **Condition 4:** Compact snow build-up encountered regularly.
- **Condition 5:** Road closed. Not seasonal road. Temporary closure of route due to significant amounts of snow - unpassable.



Preliminary Research Findings: UDOT Evaluation

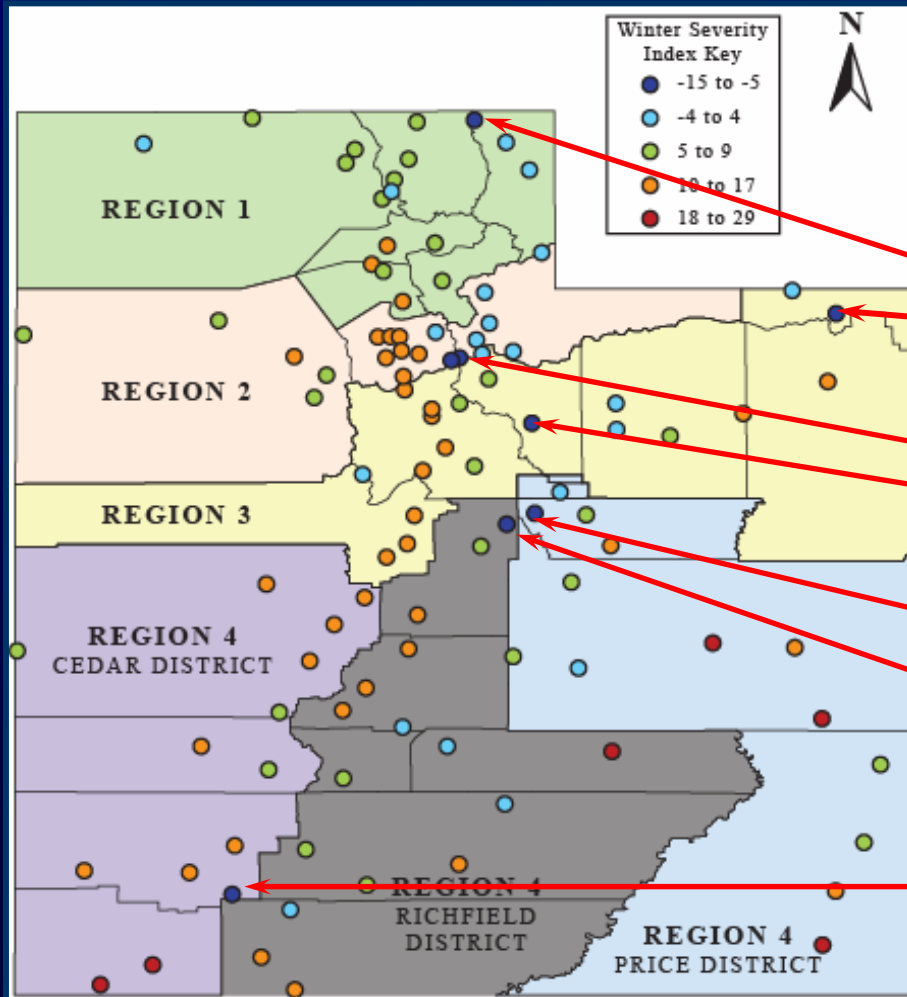


- Winter Severity Index (WI)
 - Possible range: -50 to +50
 - Index from SHRP and previous UDOT work:

$$WI_{Utah} = a\sqrt{t_{seasonindex}} + b\ln\left(\frac{S_{daily}}{10} + 1\right) + c\sqrt{\left(\frac{d_{freeze2}}{T_{range2} + 10}\right)} + d$$

- Historical weather data collected from 252 weather stations
- Mapped to maintenance sheds using latitude, longitude and elevation using a regression model

Preliminary Research Findings: UDOT Evaluation



- Lowest WI's:

1445 Logan Summit
Elevation = 7612 ft
WI = -10

2433A/B Alta/Brighton
Elevation = 9220 ft (A),
8664 (B)
WI = -15 (A), -12 (B)

4334A Fairview Canyon
Elevation = 8838 ft
WI = -10

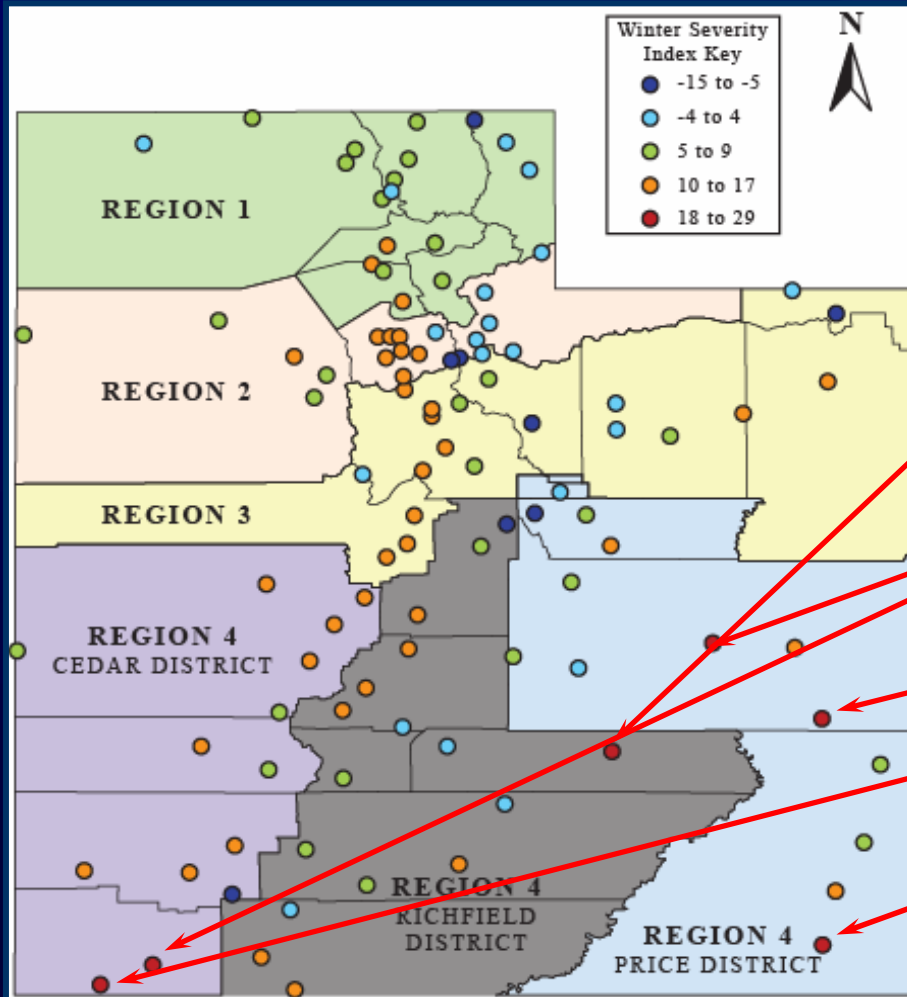
4540 Cedar Mountain
Elevation = 9943 ft
WI = -11

3437A Greendale Jct
Elevation = 7748 ft
WI = -5

3445 Strawberry
Elevation = 7633 ft
WI = -5

4435A Scofield
Elevation = 7944 ft
WI = -5

Preliminary Research Findings: UDOT Evaluation



- Highest WI's:

4332 Hanksville
Elevation = 4321 ft
WI = 20

4432 Cove Fort
Elevation = 4081 ft
WI = 20

4522 Hurricane
Elevation = 3274 ft
WI = 26

4424 Moab
Elevation = 4035 ft
WI = 23

4521 St. George
Elevation = 2710 ft
WI = 29

4421 Bluff
Elevation = 4419 ft
WI = 25



4540 Cedar Mountain
Elevation = 9943 ft
WI = -11

4524 Cedar City
Elevation = 5677 ft
WI = 12

2433A/B Alta/Brighton
Elevation = 9220 ft (A),
8664 (B)
WI = -15 (A), -12 (B)

2433 Cottonwood
Elevation = 4676 ft
WI = 10



Final Evaluation

- Look at hi and low users and run correlations (case studies) before making reasonable assumptions for estimating the benefits provided by the UDOT Weather Operations Program
 - Strong correlation between # calls/shed and self-described usage of the Program ($\alpha=0.05$)
 - Define Material Usage as a function of X_1, X_2, X_3, X_4, X_5
 - Y: Material Usage in Dollars (from MMQA⁺)
 - X_1 : # Calls/Shed (from meteorologists)
 - X_2 : Level-of-Maintenance (from MMQA⁺)
 - X_3 : Changed Approach – Anti-icing (from survey response)
 - X_4 : Winter Severity Index (calculated from historical data - Mesowest)
 - X_5 : Average Seasonal Daily Traffic Volume/Shed** (from UDOT)
- ** Not yet completed **

Concluding Remarks

- Reported Benefits from UDOT Maintenance Supervisors
 - More efficient with budget, labor, and materials
 - Helps control overall costs
 - Provide higher LOS
- Issues to Overcome:
 - Contracting localized, area specific forecasts
 - Examples: Northwest Weathernet, Meridian, Meteorologix, or staffed meteorologist
 - This does not include RWIS service providers
 - End-users not completely confident in forecasts
 - Question Cost/Benefit ratio – Is it beneficial for agencies to pay for customized weather service?

Concluding Remarks

- Timeline:
 - Final data analysis to be completed soon once we obtain the traffic volume data for sheds
 - Final report completed in September
- Future Research:
 - How does the Program benefit travelers, reduce accidents, etc.?
 - Specifically, benefits of providing:
 - Construction Forecasts
 - Forensic Meteorology
 - Increased LOS to traveling public with increased information given to TOC and then added to VMS and 511 systems

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