



Baselining Current Road Weather Information

Road Weather Management Stakeholder Meeting
September 9, 2011

Project Background

- FHWA Road Weather Management Program
 - Contract: DTFH61-06-D00006, Task Order 2
 - Initial study conducted from August 2007 - June 2009
 - Report: FHWA-JPO-09-055, June 2009
 - Follow-up study conducted from August 2009 – January 2011
 - Report: FHWA-JPO-11-018, January 2011
 - COTM: Dr. Roemer Alfelor

Project Objectives

- To characterize the availability and quality of road weather information focusing on the information content and usefulness.
- To serve as a baseline for future comparisons of enhanced road weather information enabled by the *Clarus* system and other advanced road weather management technologies.
- To recommend a strategy for future monitoring of road weather information quality

Methodology

- Characterize Available Road Weather Information
 - Scan Road Weather Information Sources
 - Characterize Road Weather Information
- Develop Baseline and Comparison Procedures
- 2008 Survey
 - Design survey
 - Survey DOT transportation managers (Advisory, Control, Treatment)
 - Analyze and report results
- 2009 Survey
 - Refine survey
 - Survey DOT transportation managers (Advisory, Control, Treatment)
 - Analyze and report results

Road Weather Products




PRODUCT	SOURCE	SPATIAL FORMAT		TIME FRAME		
		SINGLE	MAP	HISTORY	CURRENT	FORECAST
Weather Summary	NWS	◆			◆	
Weather History	NWS	◆		◆		
ESS Current Conditions	DOT	◆			◆	
ESS History	DOT	◆		◆		
Regional Weather Map	STWSP		◆		◆	
Regional Forecast (Zone Forecast)	NWS	◆				◆
Pavement Forecast (511 Forecast)	STWSP	◆				◆
Road Weather Alert	STWSP	◆				◆
Watches and Warnings	NWS		◆			◆
MDSS	STWSP	◆				◆
Road Condition Report	DOT	◆			◆	
Flood Warning	NWS	◆			◆	
Camera Images	DOT	◆			◆	
Radar	NWS & WSP		◆		◆	

Road Weather Elements



ELEMENT	
Air temperature	Visibility
Dew point temperature	Pavement temperature
Relative humidity	Pavement condition
Wind direction	Chemical concentration
Wind speed	Freeze point temperature
Wind gust	Frost probability
Precipitation type	Treatment recommendation
Precipitation rate	Road closure
Precipitation accumulation	Severe weather advisory
Snow rate	Wind advisory
Snow accumulation	Winter weather advisory
Weather type	Dense fog advisory
Precipitation start time	Flood advisory
Precipitation end time	Flood stage
Precipitation probability	Camera – road conditions
Probability of precipitation type	Camera – weather conditions
Maximum temperature	Camera – traffic
Minimum temperature	Radar images
Cloud cover	

NWS Current Weather



National Weather Service
Telecommunication Operations Center

[Site Map](#) [News](#) [Organization](#)

Current Weather Conditions: WASHINGTON NATIONAL AIRPORT , VA, United States

(KDCA) 38-51N 077-02W 18M

Conditions at
2011.01.18 0103 UTC

Wind from the NNE (030 degrees) at 10 MPH (9 KT)
Visibility 7 mile(s)
Sky conditions overcast
Weather Light freezing rain, snow
Precipitation last hour A trace
Temperature 30 F (-1 C)
Windchill 21 F (-6 C)
Dew Point 23 F (-5 C)
Relative Humidity 74%
Pressure (altimeter) 30.23 in. Hg (1023 hPa)

ob KDCA 180103Z 03009KT 7SM -FZRASN BKN020 OVC031 M01/M05 A3023 RMK AO2 FZRAB0058 P0000

■ Elements

- Air Temp
- Dew Point
- RH
- Wind Dir & Speed
- Weather
- Precipitation type & amount

ESS Current Weather



District 2 Sites
TH 1 @ MP 146.3 (330017)
Site Status

Current Time: 01/17/2011 19:50 CST

Data Time: 01/17/2011 19:45 CST

Air Data						Wind Data				
Temp	RH	Dew	WtBlb	Min	Max	BaroPs	SpdAvg	SpdGst	DirAvg	DirGst
5F	84%	1F	4F	5F	13F	28.2 in	9 mph	18 mph	N	N

Precipitation			Last Precipitation Period		Accumulation				
Type	Intensity	Rate	Start Time	End Time	10 min.	1 hr.	3 hr.	6 hr.	12 hr.
Snow	Slight	0.0 iph	01/17/2011 19:38	-	0.00 in	0.00 in	0.02 in	0.30 in	0.38 in

Surface Data											
Sensor	Status	Sfc	Sub	Frz	CF	Chem	Dpth	Ioe	Cond	Salin	Hist
TH 1 East Bound (0)	Ice Warning	9.7F	20F	32F	20	0%	-	99%	0 mhos	52	History

Subsurface Data		
Sensor	Temp	History
Subsurface Sensor (0)	20F	History

Elements

- Air Temp
- Dew Point
- RH
- Wind Dir, Speed, & Gust
- Precipitation type
- Pavement Temperature
- Pavement Condition
- Chemical Concentration
- Freeze Point Temp

Product Components

PRODUCT	COMPONENTS
Weather Summary	Air temperature
	Dew point
	Relative humidity
	Wind direction
	Wind speed
	Weather
	Precipitation type
	Precipitation amount
	Snow amount
Weather History	Air temperature
	Dew point
	Relative humidity
	Wind direction
	Wind speed
	Precipitation amount
	Snow amount
ESS Current Conditions	Air temperature
	Dew point
	Relative humidity
	Wind direction
	Wind speed
	Wind gust
	Precipitation type
	Pavement temperature
	Pavement condition
	Chemical concentration
	Freeze point temperature

Product Components

- 14 Products (2008 survey)
- 37 Elements (2008 survey)

- 92 Product Components (2010 survey)

Quality Assessment

- Quality Attributes
 - Accuracy
 - Completeness
 - Relevance
 - Latency
 - Reliability
 - Ease of use

 - Composite average of six attributes

- Importance

Quality Attribute Question

Product: Current Weather

Source: National Weather Service
Spatial Format: Single Site Report
Time Frame: Current

1. In your opinion, please indicate the level of Accuracy/Precision for the following Road Weather Components within Current Weather products.

Accuracy/Precision - How close is the observed or forecasted condition to the actual condition?

	Very High	High	Moderate	Low	Very Low	Not Applicable
Air Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dew Point	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relative Humidity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wind Direction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wind Speed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Weather	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Precipitation Type	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Precipitation Amount	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Snow Amount	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

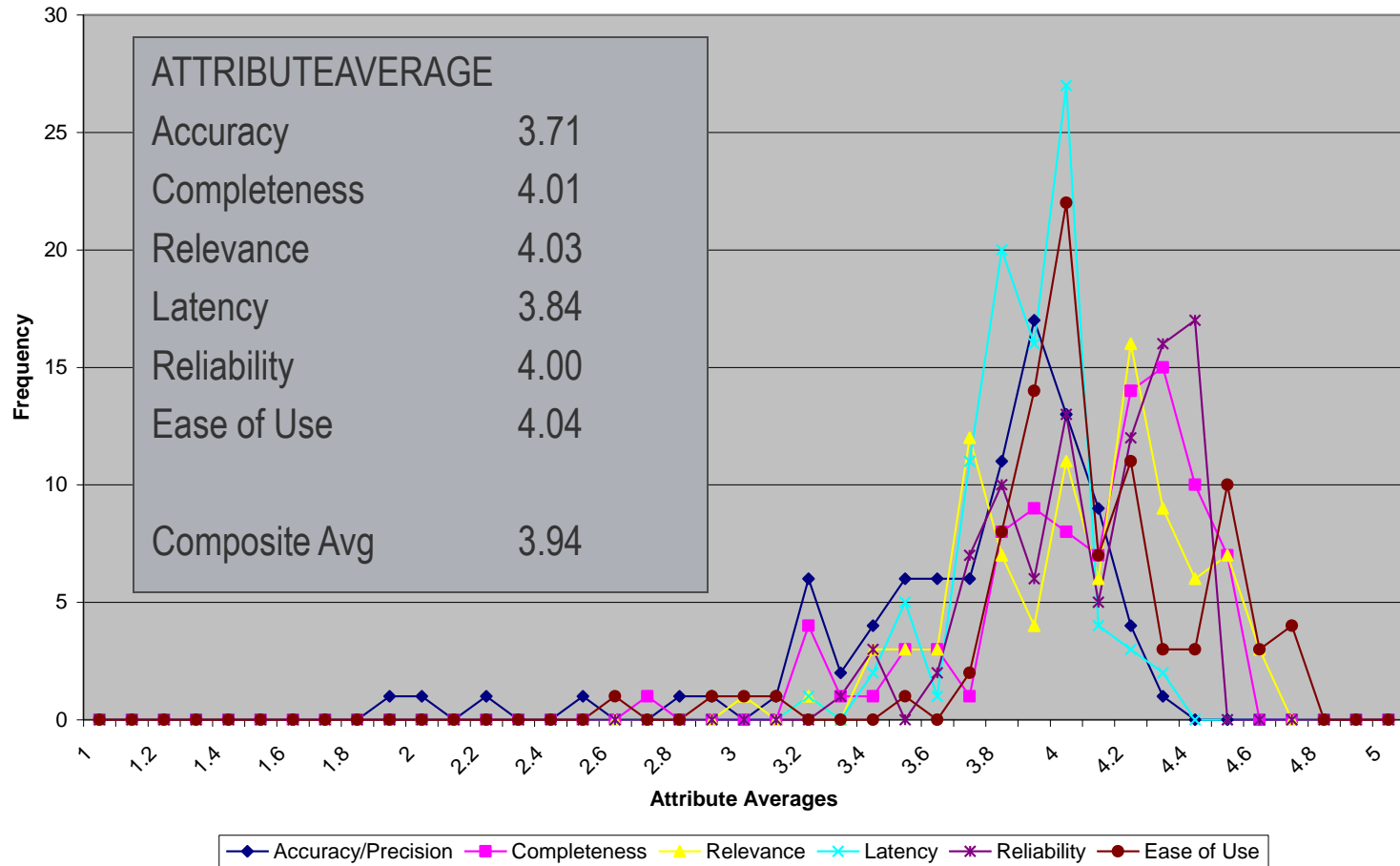
Comment on this question?

Computation of Results

STEPS

- List Likert scores for each Product Component by Attribute
- Calculate statistics
 - Number of responses
 - Average (mean)
 - Median
 - Standard deviation
 - Range

Distribution of Product Component Attribute Averages



Interpreting Results - Averages

PC ID	PRODUCT COMPONENT	Accuracy / Precision	Completeness	Relevance	Currency / Latency	Timeliness / Reliability	Ease of Use	Average Composite Attribute Score	Importance
38	ESS Histories - Chemical Concentration	1.83	3.17	3.00	3.33	4.20	2.57	2.97	3.50
39	ESS Histories - Freeze Point Temperature	2.00	3.17	3.33	3.60	4.25	2.83	3.16	3.50
40	Map - Air Temperature	3.91	4.23	3.95	3.75	4.19	4.19	4.04	4.10
41	Map - Dew Point	3.65	4.20	3.95	3.75	4.10	4.15	4.00	4.00
42	Map - Relative Humidity	3.81	4.24	3.86	3.75	4.10	4.20	3.99	3.70
43	Map - Wind Direction	3.95	4.23	4.18	3.75	4.14	4.24	4.09	4.00
44	Map - Wind Speed	3.95	4.23	4.18	3.75	4.14	4.19	4.08	4.19
45	Map - Precip Type	3.67	4.05	4.29	3.85	4.05	3.95	3.99	4.29

- List of Attribute Averages by Product Component
 - Averages are difficult to organize or sort
 - A few patterns appear in the data
 - Inconsistency in number patterns make assessment difficult

Interpreting Results - Rankings

Map - Wind Direction	22	30	30	64	38	21	23	70
Map - Wind Speed	23	31	31	65	39	27	29	52
Map - Precip Type	57	52	17	43	49	55	42	44
Map - Pavement Temperature	46	51	20	68	45	34	36	36
Map - Pavement Condition	67	76	55	45	44	40	57	45
Map - Chemical Concentration	83	84	89	79	55	68	82	87
Map - Freeze Point Temperature	71	66	63	66	41	49	63	66
Zone Forecast - Maximum Temperature	58	22	90	46	73	57	69	83
Zone Forecast - Minimum Temperature	66	23	85	47	74	58	68	74
Zone Forecast - Wind Direction	73	24	86	67	68	59	73	54
Zone Forecast - Wind Speed	69	25	82	76	69	60	70	55
Zone Forecast - Weather	76	50	77	48	75	72	74	30
Zone Forecast - Probability of Precipitation	80	59	78	49	76	85	78	37
Pavement Forecast - Air Temperature	5	1	26	27	3	1	4	21

- List of Attribute Ranks by Product Component
 - Ranked from highest average value to lowest
 - Ranks represent position in average scale, NOT QUALITY
 - Ranks color coded by quartiles
 - Patterns are easier to recognize

Interpreting Results - Rankings

PRODUCT COMPONENT	RANK		RANK					RANK	
	1-23	24-46	70-92					47-69	
	Accuracy / Precision	Completeness	Relevance	Currency / Latency	Timeliness / Reliability	Ease of Use	Average Composite Attribute Score	Importance	
ESS Histories - Precip Start	78	77	35	81	23	83	71	60	
ESS Histories - Precip End	79	78	36	82	24	84	72	61	
ESS Histories - Pavement Temperature	68	63	40	41	25	67	52	51	
ESS Histories - Pavement Condition	88	65	76	83	26	90	86	82	
ESS Histories - Chemical Concentration	92	88	92	91	34	92	92	89	
ESS Histories - Freeze Point Temperature	91	89	88	84	29	91	90	90	
Map - Air Temperature	26	29	52	61	35	26	33	62	
Map - Dew Point	40	33	54	62	46	28	38	69	
Map - Relative Humidity	44	26	60	63	47	24	40	86	
Map - Wind Direction	22	30	30	64	38	21	23	70	
Map - Wind Speed	23	31	31	65	39	27	29	52	
Map - Precip Type	57	52	17	43	49	55	42	44	
Map - Pavement Temperature	46	51	20	68	45	34	36	36	
Map - Pavement Condition	67	76	55	45	44	40	57	45	
Map - Chemical Concentration	83	84	89	79	55	68	82	87	

Key Findings

- Pavement Weather Forecasts
 - Highest rated resource
 - Overall quality attribute ratings were high
- Watches and Warnings
 - Second in importance and overall quality rating
- Camera Imagery
 - High in importance
 - High in accuracy and currency
- Radar
 - Timely and reasonably accurate
 - Derived services need improvement

Key Findings

- ESS Observations
 - Lower level of importance
 - Issues with accuracy, timeliness, and reliability
- Road Weather Alerts
 - Important to users
 - Users disappointed with content and timeliness
- Road Condition Reports
 - Average level of importance
 - Issues appear in most quality attributes

2008 – 2010 Results Comparison



ELEMENTS

- Advisory - averages increased by 0.54
- Control – averages increased by 0.54
- Treatment – averages increased by 0.08

PRODUCTS

- Advisory - averages decreased by 0.19
- Control – averages increased by 0.34
- Treatment – averages decreased by 0.08

General Findings

- Perceived quality is “good” – Likert score of 4
- Attributes needing weather support emphasis:
 - Accuracy
 - Ease of Use
- Differences between user expectations and perceived quality are affected by:
 - Sensor performance
 - Forecast accuracy
 - Complexity of ‘abstract’ secondary formats
- Human factors have an important influence on the estimation of quality

Recommendations

- **Sample Size**
 - Increase the number of participants
 - Expand the sampled community
- **Length of Survey**
 - Separate into survey components
 - Perform series of shorter survey components
- **Survey Clarity**
 - Use example of product at beginning of each section
 - Simplify questions

Program Recommendation

- FHWA Road Weather Management Program should...
 - Have oversight of an ongoing quality “monitoring” program
 - Establish a road weather information quality attribute database that is periodically updated
 - Guide an open dialog of the monitoring process at appropriate road weather stakeholder community meetings

Contact Information



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