J4.5 MAKING AN IMPACT - THE FUTURE OF NWS FORECASTS

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1. INTRODUCTION

From the dawn of mankind, individuals have observed the weather, and many have attempted to forecast it. While specific reasons differ from one person to the next, the recurring motive for wanting to know what is going to happen with the weather is to answer the question, "How is it going to affect me?" Golfers want to know if they will be able to keep their tee times; pilots want to know if they will be able to fly VFR (visual flight rules) or will have to fly IFR (instrument flight rules); school administrators wonder if they will have to cancel classes due to heat or cold or snow.

While modern electronic media has allowed meteorologists to provide non meteorologists more detailed and up-to-date observed and forecast weather information in both visual and audible formats, too often the layman is still left asking the question, "How is it going to affect me?"

In these instances, the problem is not necessarily the amount or level of detail of forecast information, but the manner in which the information is communicated. Simply put, often the person asking the question doesn't want to know all the details; he or she just wants a simple answer as to what kind of impact they can expect from a change in the weather. Because the impacts of a given change in the sensible weather elements on an individual are as unique as the person himself, there is no simple answer to this question. This, however, does not mean that no attempt should be made to better communicate how a given change in the weather may impact the residents of a particular location.

The primary mission of the National Weather Service (NWS) is to provide weather, water, and climate forecasts "for the protection of life and property and the enhancement of the national economy." Helping non-meteorologists determine how the weather may impact them is a crucial component to meeting this mission.

2. BACKGROUND

An October 24-25, 1997 snow storm dropped more than a foot of snow on parts of southeast Wyoming and the Nebraska Panhandle. The forecasters at the NWS Weather Forecast Office (WFO) in Cheyenne had forecast the situation quite well, and had relayed important information on the expected snowfall, winds, and drifting to the media, emergency managers, and general public through numerous alphanumeric forecasts, warnings, and statements. However, a post-storm product and service assessment by the Warning Coordination Meteorologist (WCM) at WFO Cheyenne showed that opinions of the office's performance by external customers varied greatly.

Among the two main groups of customers contacted - emergency managers and the media - the more weather-savvy emergency managers gave the NWS high marks. The less weather-experienced media, however, were less than satisfied. Upon further investigation, it was revealed that, while the emergency managers were reading the NWS products thoroughly, taking note of snowfall amounts, wind speeds, and temperatures, the media focused more on what the NWS was "calling" the storm (i.e., Winter Storm Warning, Blowing Snow Advisory, etc) . This was admittedly confusing, as forecasters made several adjustments throughout the event, based upon radar information, ground truth reports, and updated model forecasts, then attempted to "pigeon-hole" the storm into the various Advisories and Warnings whose definitions best fit the observed and forecast conditions.

Unlike the emergency managers, the media and general public were not as concerned with the details of this event; they just wanted the NWS to answer the question "How bad is the storm going to be?"

3. A FIRST ATTEMPT AT IMPACT FORECASTING

As a result of the product and service assessment of the October 1997 winter storm, the Cheyenne WCM and Meteorologist in Charge (MIC) set out to develop a more efficient way to communicate to non-meteorologists "just how bad the storm is going to be." What evolved after considerable brain-storming and discussions with state, county, and local officials was the "Winter Weather Severity Index" (WWSI), a 5-category ranking system that subjectively placed winter events into impact-based categories ranging from WX1 - "Minor Inconvenience" to WX5 - "Life-Threatening" (see Table 1).

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Table 1. WWSI categories

WWSI Category	WWSI "code" used in forecast	Descriptive terminology
Category 1	WX1	Minor Inconvenience
Category 2	WX2	Inconvenience
Category 3	WX3	Significant Inconvenience
Category 4	WX4	Potentially Life-Threatening, Unless Well Prepared
Category 5	WX5	Life-Threatening

The WWSI was tested in the Cheyenne County Warning and Forecast Area during the 1998-1999 winter season with limited success. Critics, including most meteorologists, challenged the subjectivity of the system, while proponents applauded its simplicity. Overall, however, surveys of area residents showed that 66% of the respondents felt winter weather forecasts were "more understandable" using the WWSI. Only 22% thought they were "less understandable," with the remainder indicating that understandability was about the same. This fact, in addition to the unprecedented national attention given to the test (four national television networks sent camera and reporting crews out to interview the Cheyenne MIC and WCM about the test), convinced the authors that, while the project needed refinement, a simple impact-based ranking systems was needed to better convey to the layman the anticipated impacts of not only winter weather, but *all* significant hydrometeorological events.

It should be noted that, while this was not the first attempt to assign a numerical classification to winter storms - Dovico (1985) and Hahn and Schumacher (1987) also developed methodologies to numerically rank storms - it *was* the first time an impact-based ranking system was used operationally in NWS forecast products.

4. ROUND TWO - REFINEMENTS AND IMPROVEMENTS

One of the primary arguments against the development and use of a simplified winter weather ranking system is the fact that, as Hahn and Schumacher (1987) stated, when it comes to winter weather, "what is severe in Arkansas is not severe in the Dakotas." With this in mind, plans were made to conduct additional testing in other geographic locations in the wake of the original Cheyenne test. Seven NWS offices serving five states in the central U.S. agreed to participate in a wider test. Due to shifting personnel and program priorities, however, the second round of formal testing over the expanded area never commenced.

Despite the lapse in formal testing, forecasters at WFO Milwaukee, Wisconsin informally experimented with the impact-based 5-category concept, inserting a "coded" WWSI forecast at the end of their Area Forecast Discussions, but not in any public forecast products. After starting out slow, the Milwaukee forecasters showed improvement over the course of the winter season in their ability to forecast the events according to WWSI ranking. Their experience with the concept also led to the office modifying their philosophy on issuing some winter advisories, taking into consideration the varying impacts of snowfall in urban vs. rural areas.

In addition to the Milwaukee testing, refinement of the WWSI concept continued at WFO Cheyenne, with several major modifications to the process being made. Among the most significant:

1) Expansion of the impact-based categorization concept from winter weather to all weather events

2) Reduction of the number of impact categories from five to four

3) Elimination of the numerical classification in favor of a descriptive word format - Extreme, High, Moderate, and Limited Impacts (the absence of significant weather implies a "No Impact" forecast)
4) Inclusion of local officials in the identification of critical thresholds of various weather elements that determine the impact classification for a given forecast zone

Perhaps the key modification made was the inclusion of local partners in the development of the Impact thresholds. This is significant in that it not only gave them ownership in the product, but tapped into their local climatological, sociological, and infrastructure expertise as well. Such interaction is very time- and labor-intensive, requiring NWS meetings with state, county, and local public and private partners, including (but not limited to) emergency managers, transportation, school, and health officials, commercial broadcasters, and locally-based private meteorologists. In theory, this would result in an impact-based "expert system," that taps into the collective expertise of all participating parties.

5. THE FUTURE OF IMPACT FORECASTING

With 121 WFOs nationwide, the NWS is uniquely structured to develop an impact-based expert system as described above, incorporating highly localized information into a product designed to alert non-meteorologists of anticipated weather impacts to the general populace in a given area. This "Impact Forecast" could be disseminated in both graphical and alphanumeric format.

Such a product would not be designed to be stand-alone. Rather, it is intended that it would be used to direct interested parties to the standard suite of NWS forecasts, warnings and statements for detailed

information on the forecast weather conditions.

As mentioned earlier, involving local public and private partners in the determination of the weather element thresholds defining the impact categories is a time and labor-intensive process. Because of variations in such factors as population, infrastructure, and terrain (to name a few), unique thresholds would need to be developed for each NWS forecast zone. Since the WCM is the primary liaison with the local community, he or she would logically lead the effort to coordinate with all interested local partners toward the determination of thresholds in each zone. It is anticipated that this would take several months initially, and may require periodic reassessment and adjustments to account for changes in the profile of the zone (e.g., population influx, change in infrastructure, etc.).

Given past NWS forecast procedures and equipment, such an undertaking would have been nearly impossible. Forecasters would have had to cross-check each zone forecast to the myriad combination of elements that were used to determine the impact category for each location. However, with the introduction of the NWS' Advanced Weather Interactive Processing System (AWIPS), and more importantly, the upcoming deployment of the Interactive Forecast Processing System (IFPS) software, the NWS will soon have in each WFO the tools needed to incorporate micro-climatological information into the forecast database.

Utilizing the "smart tools" feature of IFPS, each WFO could incorporate the partner-established thresholds into an "Impact Tool" that would ingest the corresponding forecast weather elements (e.g., snowfall, wind speed, temperature, etc.) for a given forecast zone, compare it with the threshold values obtained from the partnered "expert system," and assign an Impact Forecast value of "Extreme," "High," "Moderate," "Limited," or none. This allows the meteorologist to do what he/she does best - forecast the weather - while at the same time allowing the computer to handle the herculean task of incorporating localized information into the forecast process and developing a simple product that provides useful information for area residents to make meaningful decisions that can protect their lives and property, as well as enhance the national economy.

6. ACKNOWLEDGMENTS

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WFO Minneapolis, Minnesota
WFO Riverton, Wyoming

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7. REFERENCES

Dovico, W. W., 1985: Classification and Prediction of Snowstorm Severity. *Natl. Wea. Dig.*, **10:2**, 31-38.

Dovico, W. W., 1985: Snowstorm Severity Index Nomogram. *Natl. Wea. Dig.,* **10:4**, 45.

Hahn, B., and Schumacher, M., 1987: Winter Storm Severity Index. *Central Region Technical Attachment* **87-1**, NWS Central Region HQ, NOAA, U.S. Department of Commerce, 4 pp.

Parker, W.T. 1999: Final Report - Winter Weather Severity Index, Report to NWS Central Region Headquarters, 13 pp.