B T E A M

Optimal Terminology and Information Content for Weather Warnings and Daily Public Forecasts

by

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and

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Note: The views and opinions expressed in this report are those of the authors, and do not necessarily reflect the policies of the Atmospheric Environment Service, Environment Canada, or the opinions of their representatives.

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INTRODUCTION

In December 1984, Behavioural Team was contracted by the Atmospheric Environment Service (AES) of Environment Canada to conduct a study to determine the optimal terminology and format for public weather forecasts and weather warnings. This study is part of ongoing efforts by AES to improve the quality and usefulness of the weather information they provide. Mr. A. H. Campbell, Chief, Weather Services Division, directed the project for AES and provided much assistance along the way.

In 1980, Behavioural Team had conducted a similar study dealing specifically with the use and understanding of weather information by recreational boaters in Ontario. In the meantime, AES has conducted other studies on the **forecasters'** understanding of various terms used to describe cloud cover and precipitation, and on the various sources of weather information used by the public.

The present study was designed to collect information from a representative sample of the **public** from across Canada. We looked at their understanding of weather terms and concepts, and several other features of the information that people think would be most useful. This report presents the results of our national survey, and our recommendations for improvements to public forecasts and weather warnings.

The project involved two main stages. First we conducted an intensive study of 100 persons in Toronto and Vancouver. These people completed a preliminary survey, took a recall test based on a recorded radio weather forecast, and were interviewed. Results from this stage were used to design the questions asked in the next phase.

The second phase of the study was a national survey. It was completed by 570 persons from Atlantic Canada, Ontario, the Prairies, and British Columbia.

The results were analyzed using Behavioural Team's own computers and survey analysis software.

The Survey

This nationwide survey was pre-tested in an intensive preliminary study. Respondents were solicited using several different techniques to ensure a broadly representative sample. They were paid a small honourarium for their participation.

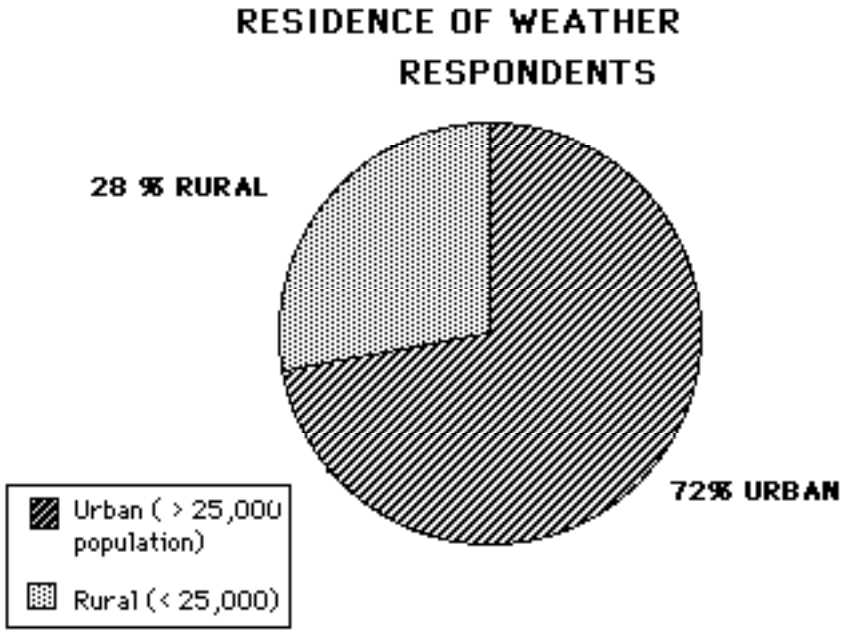
The survey was personally conducted by trained administrators, who answered any questions and encouraged subjects to complete all of the items.

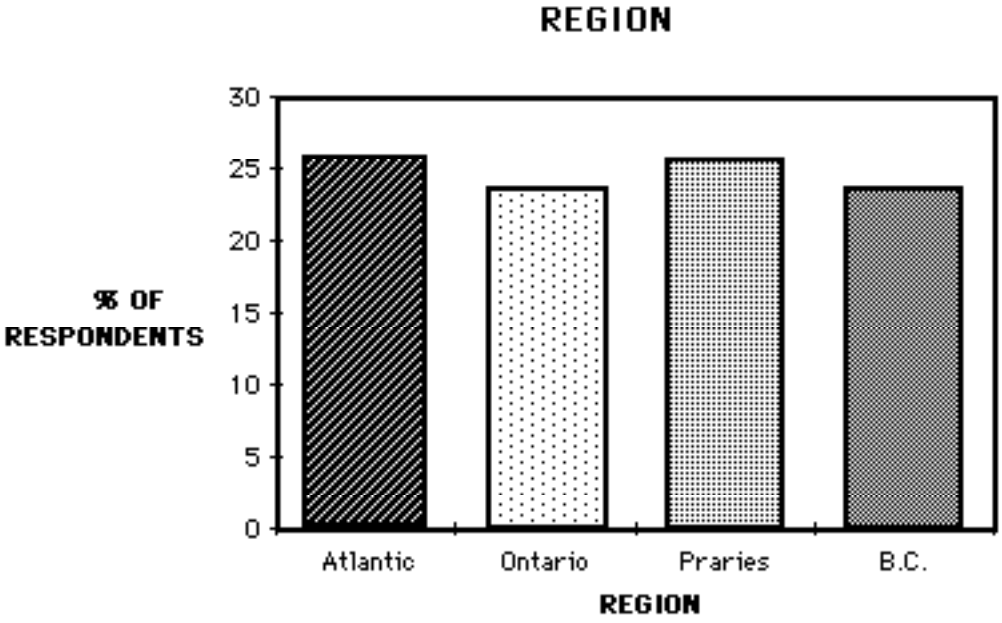
A copy of the survey and the scoring keys used in analyzing the data are included in the Appendix.

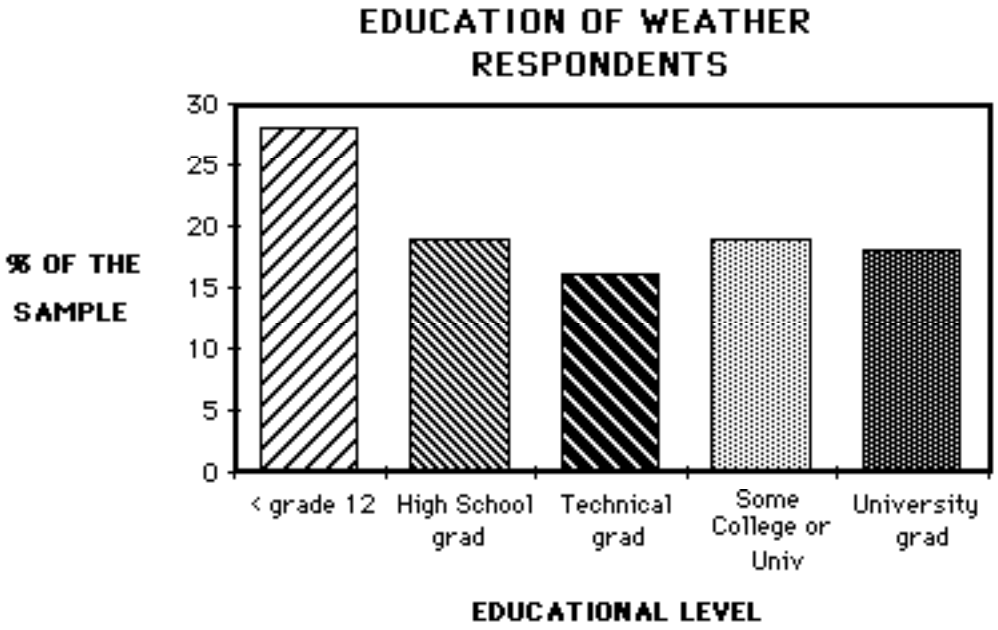
A brief description of the respondents is presented next, followed by details of the results, and Behavioural Team's recommendations.

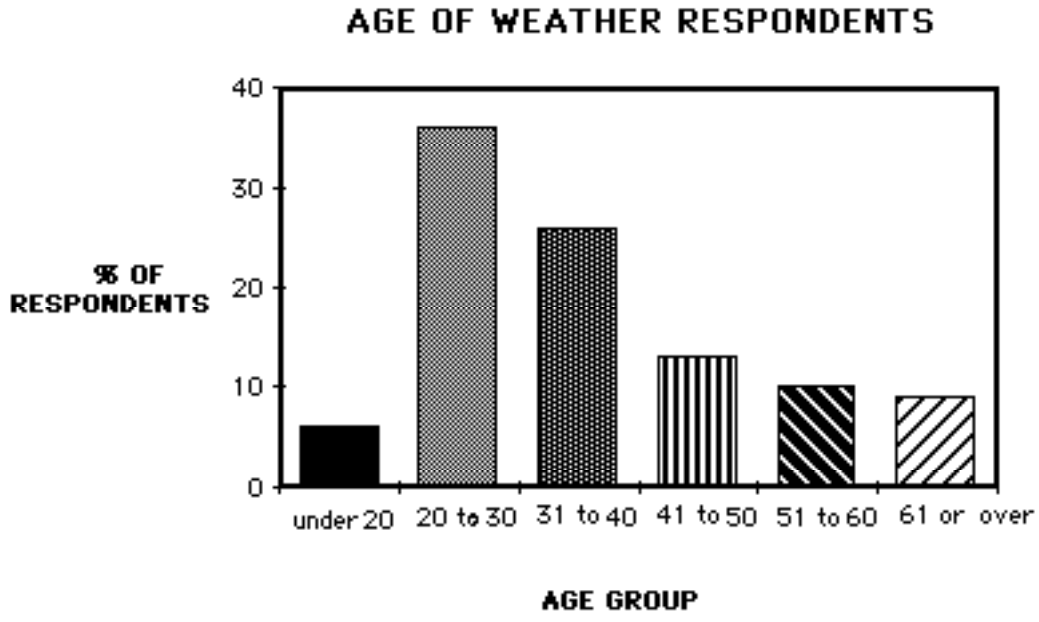
The Respondents

The 570 people who answered our survey came about equally from Atlantic Canada, Ontario, the Prairies, and B.C. They ranged in age from late teens to mid 70's with an average age of 37. Both urban and rural people were represented in all of the regions sampled. The demographic features of the sample are shown in the following figures.


RESIDENCE OF WEATHER RESPONDENTS
28 % RURAL
72% URBAN
Urban (> 25,000 population)
Rural (< 25,000)


REGION
% OF RESPONDENTS
30
25
20
15
10
5
0
Atlantic
Ontario
Praries
B.C.
REGION





1. Where do people get weather information?

Looking outside is the most popular method for getting information about the weather, followed by radio and television. The table below shows how often people get weather information from different sources..

Table 1. Use of weather information sources

	once per day or more	once a week or rarely	never
look outside	97%	3%	1%
radio	91%	9%	1%
weather on TV news	76%	21%	3%
newspaper	37%	50%	14%
cable TV weather *	32%	32%	36%
Weather Radio Canada *	16%	25%	60%
Weather Office phone record *	3%	37%	59%
Weather Office "live" *	1%	17%	81%

* These estimates of use are slightly inflated since 82 to 85% responded to these items compared to the 90 to 98% response rate for the more commonly used sources.

Several other sources were mentioned by some people. These included such things as almanacs, pains in body joints, other phone-in weather information, observing animals' behaviour, and looking at weather beacons, weather vanes, electronic news displays, etc. 12% of the respondents said they frequently get weather information from other people.

2. How important are the different weather features?

People ranked temperature as the most important feature, with precipitation a close second. The average rank for each weather feature is shown in Table 2. Further questions about the specific weather features are addressed in later sections of the report.

Table 2. The importance of six weather features

	Weather Feature	Average Rank
MOST IMPORTANT	temperature	2.0
	precipitation	2.2
	wind	3.6
	fog, blowing snow	3.6
	cloud cover	4.4
LEAST IMPORTANT	humidity	5.0

The Canadian public feels that wind and visibility at ground level are clearly more important than cloud cover (sky conditions.) Weather events affecting visibility are slightly more important to rural respondents (avg. rank 3.1) than to urban respondents (avg. rank 3.8.)

Rural respondents are more likely to be affected by the weather because they work outside (about 1 out of 3 rural people versus 1 out of 7 urbanites.) People in urban communities are more likely to see the effects of weather on their mood as its most important effect on their work (1 out of 7 versus 1 out of 20 for rural respondents.) Many of the respondents in both groups felt either that weather had no great effects on their work (36%), or that its main effect on work was due to traveling conditions (32%.)

3. Hazardous weather

Most of the respondents wanted something more from the announcements about hazardous weather.

-- Only 30% found them adequate and in no need of change,
-- 39% thought the hazardous weather information should be updated and repeated more often,
-- 19% wanted more detail about the times and places where severe weather is expected,
-- 12% wanted more information about what people should do to avoid danger, and
-- less than 1% thought that the warnings and advisories should have fewer details.

There were similar trends indicated in the subjects' preferences between different versions of specific weather warnings. Those with more details or more advice on avoiding danger were preferred to the warnings with fewer details.

There is some clear agreement on what names should be used to call attention to hazardous weather conditions. The term "weather warning" is slightly preferred to "weather alert" but they are applied to similar situations where dangerous weather is expected in the next several hours.

"Weather advisory" is preferred for situations when the weather may cause inconvenience but will not be dangerous.

"Weather watch" is chosen more frequently for situations involving lower probability of occurrence or more than 24 hours advance notice of dangerous weather.

4. Temperature

In forecasts of the temperature most people (57%) want comparisons to be made to the previous day's temperature. However a large minority (the other 43%) would rather have the comparison made to seasonal norms.

If the forecast calls for "continuing very hot" on a Summer day, people from all regions surveyed expect a temperature range of 27 to 31° C. But their expectations for a "very mild" Winter day depend on the region.

On a "very mild" Winter day -

- people in Atlantic provinces would expect temperatures of 5° to 9° C,
- a similar range - 5° to 8° - would be expected in Ontario,
- those in Manitoba and Saskatchewan think that -3° to +1° is very mild,
- Albertans expect 1° to 4°,
- while those in B.C. expect temperatures of 8° to 11°.

Although people consistently list the lower temperature first when specifying temperature ranges above zero, they are not so consistent for the negative temperatures. The tendency to give the higher temperature (lower absolute value of the number) first is greater for more negative values.

Two other questions that relate to temperature involve:

a) the effects of humidity on the perception of warm temperatures, and
b) the effects of wind on perception (and danger) of cold temperatures.

If the weather forecast gave only one expected high "temperature" for a hot day, 44% of the respondents said they would prefer the higher "subjective temperature number" suggested by the Humidex Scale. Although this is not the "real" temperature, it more closely reflects human comfort under conditions of high temperature and high humidity.

5. Wind chill

Because it has broader and more serious implications, Winter wind chill information is more important than Summer Humidex values. The three most commonly desired pieces of information are:

the actual temperature,
the "equivalent temperature" that takes wind into account,
and a worded description of the degree of wind chill.

Information concerning the time limits for avoiding frostbite was also widely endorsed, especially in Alberta where this information has been provided in past wind chill warnings.

Cooling rates (in watts/ m^2 or a unitless value) were much less likely to get a high endorsement. But familiarity plays a role here, too. The watts/m^2 measure was most likely to be endorsed in Manitoba and Saskatchewan where it has been more widely used.

Depending on the sort of information given about wind chill conditions, many of the people asked could not identify the ones that would be dangerous. One out of 7 (14%) failed to associate a 30 km/hr wind at minus 30^{o} C with frostbite or exposure danger. Two out of 3 (66%) didn't know that a wind chill factor of 2000 watts/m^2 is hazardous.

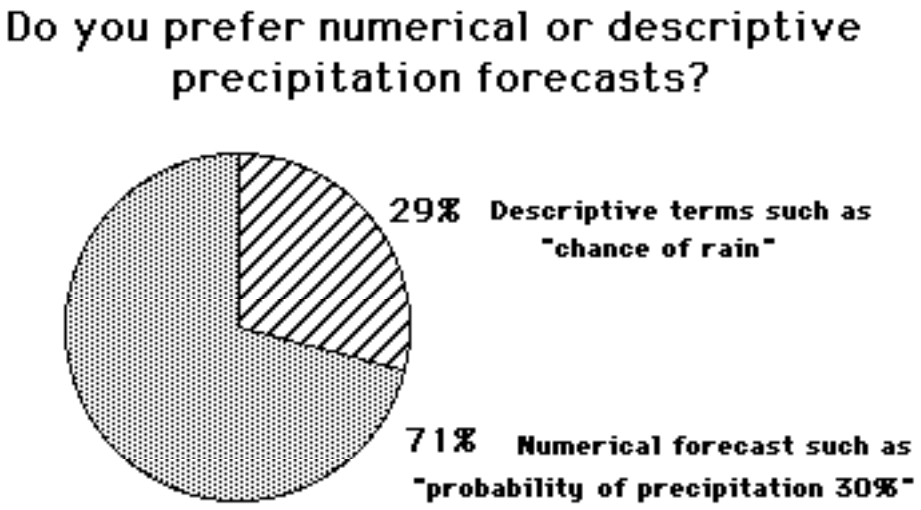
Although many reported that they would like a descriptive term for the wind chill factor, respondents failed to differentiate between "bitterly cold" and "extremely cold" wind chill. The conditions presently defined as "extremely cold wind chill" were correctly identified as the most dangerous on the list by only 10% of the people!!

6. Precipitation

Respondents were asked several kinds of questions about the part of weather forecasts dealing with precipitation. The following figures show what people want and expect from forecasts about the likelihood of precipitation. They show that most people prefer PoP! That is, forecasts in terms of numerical statements about the probability of precipitation, rather than descriptive terms.

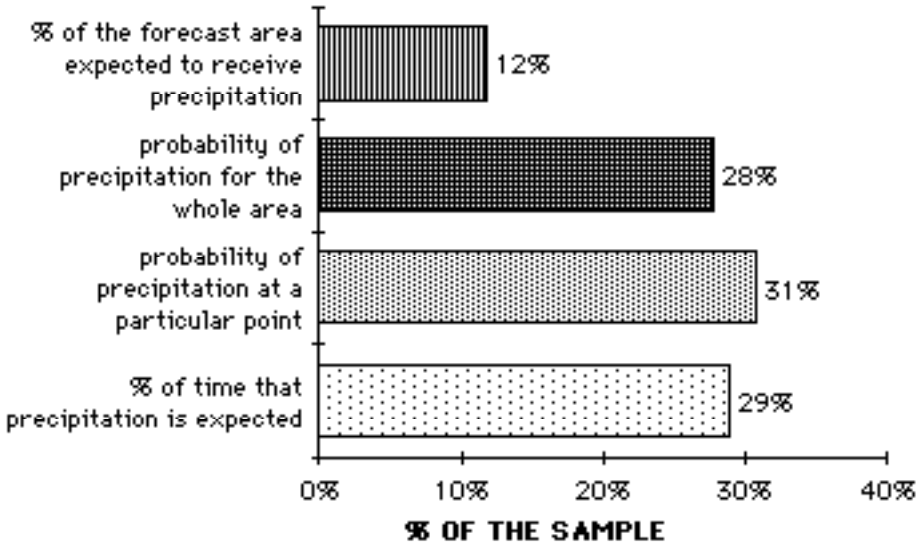
However, 70% of them misinterpret the presently used probability of precipitation as applying to *the area as a whole*. Only 10% correctly indicated that it is meant as *a point forecast.*

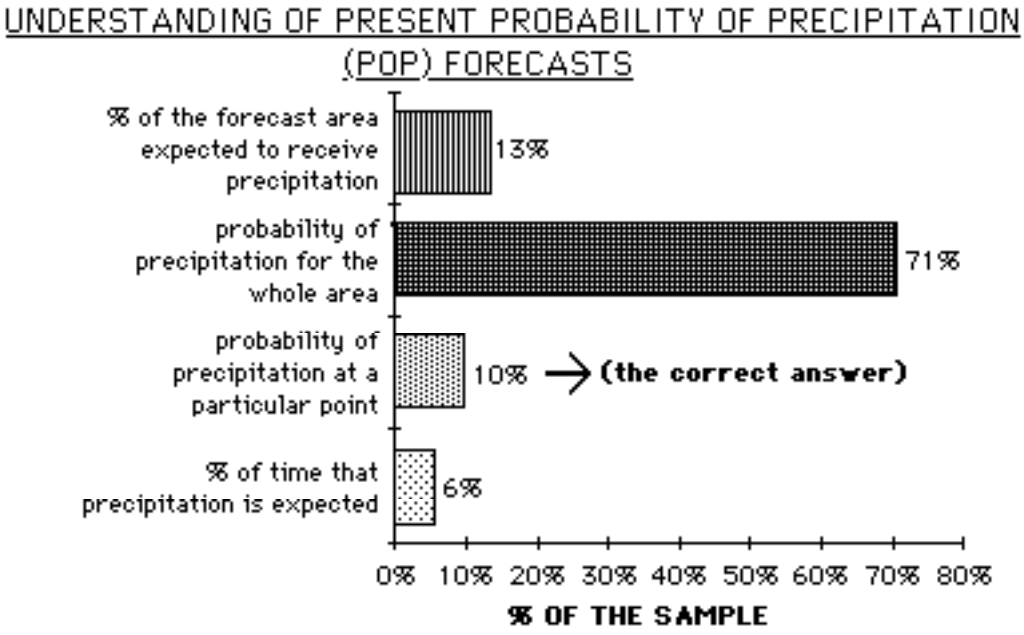
There was a slight preference for point forecasts for precipitation. This preference was greater among the rural respondents. Forecasts for the whole area and forecasts for the percentage of time that precipitation is expected were nearly as popular.



B T E A M

What information do people want in precipitation forecasts?





We asked the survey respondents about several different terms describing precipitation and its probability of occurrence. First, we asked whether particular words or phrases meant "steady" or "off and on" precipitation, and whether they indicated that precipitation was expected in "some places" or "all over" the forecast area. Good agreement among people exists here. At least 70% of the respondents agreed on the meaning of the terms in Table 3.

Table 3. Characteristics associated with different precipitation terms
(scores indicating % of subjects are given in [brackets])

Words for "steady" precipitation

heavy snowfall [95%] **blizzard** [90%]
rain [87%] **hurricane** [78%]

Words for "off and on" precipitation

periods of snow [98%] **occasional rain** [98%]

intermittent rain [96%] **isolated showers** [95%]
showers [88%] **snow flurries** [87%]
snow squall [84%] **ice pellets** [84%]
hail [76%]

Words for precipitation "all over the forecast area"

heavy snowfall [87%] **blizzard** [83%]
rain [80%]

Words for precipitation in only "some places" in the forecast area

isolated showers [86%] **snow squall** [76%]
ice pellets [77%] **hail** [755]
occasional rain [73%] **intermittent rain**[73%]
showers [70%]

There was a clear tendency to associate continuous precipitation with being widespread, and to link intermittent precipitation with being more localized. Persons who first learned another language besides English showed similar patterns but they did not differentiate as much between the different terms. However "isolated showers" and "periods of snow" were interpreted similarly by both groups.

There were 17 terms in the section describing precipitation. The remaining terms, such as "drizzle," "freezing rain," and "thunderstorm," were not consistently associated with either continuous or intermittent precipitation.

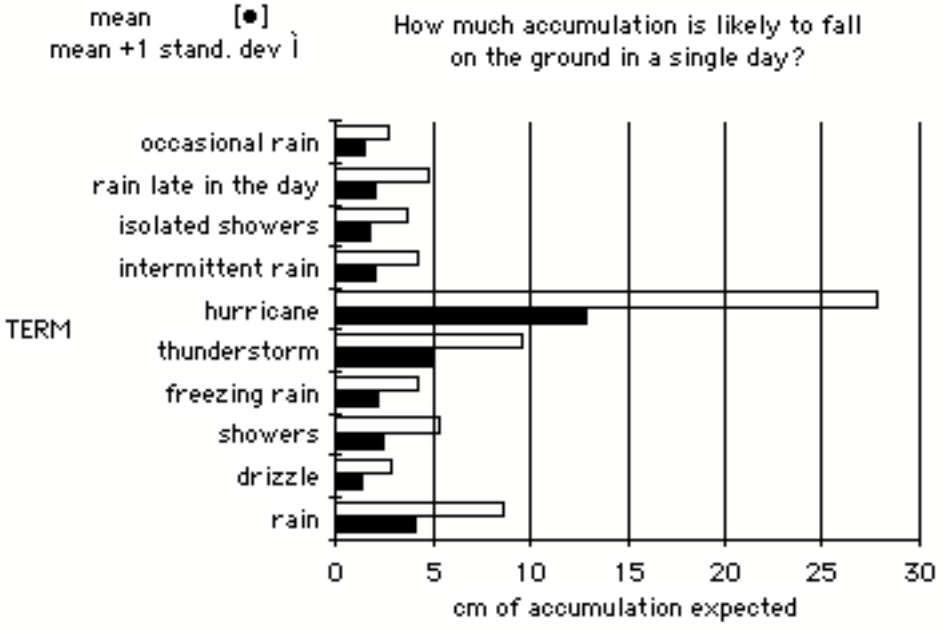
One particularly interesting result is the comparison between the terms "rain" and "rain late in the day."

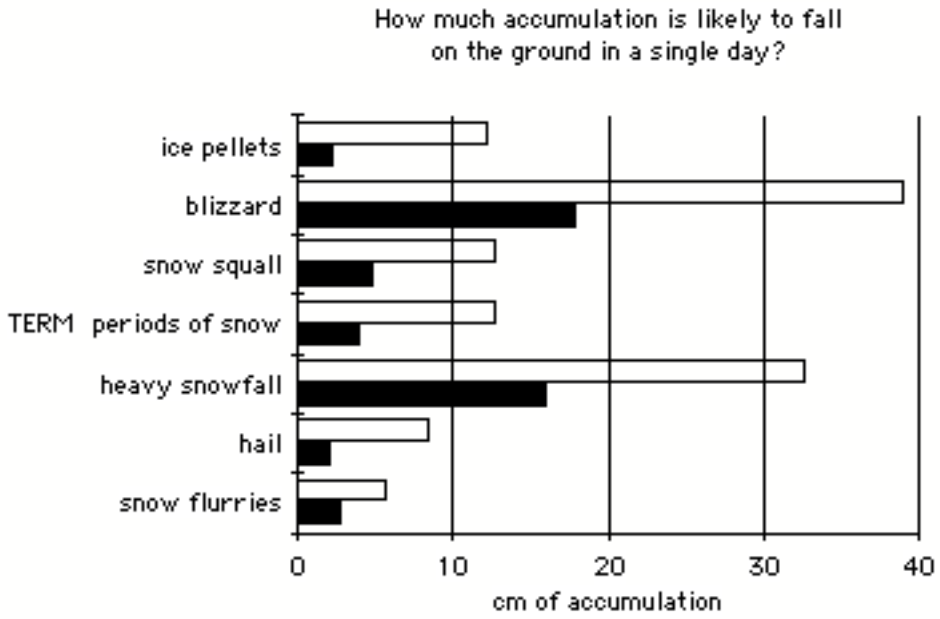
If the forecast calls for

rain	**rain late in the day**	
87%	52%	expect continuous rain, and
80%	57%	expect it to cover the whole forecast area.

The respondents were also asked how much accumulation they would expect over the course of a day or night. Most people (59%) reported these amounts in inches. Centimeters were used by 37%, and other units (mostly millimeters) by 5%. People who first learned English were more likely to use inches.

The following figures show the results for expected accumulation during a day or night covered by the forecast. The black bars indicate the average accumulation expected and the white bars show the variability in people's estimates (average plus one standard deviation.)

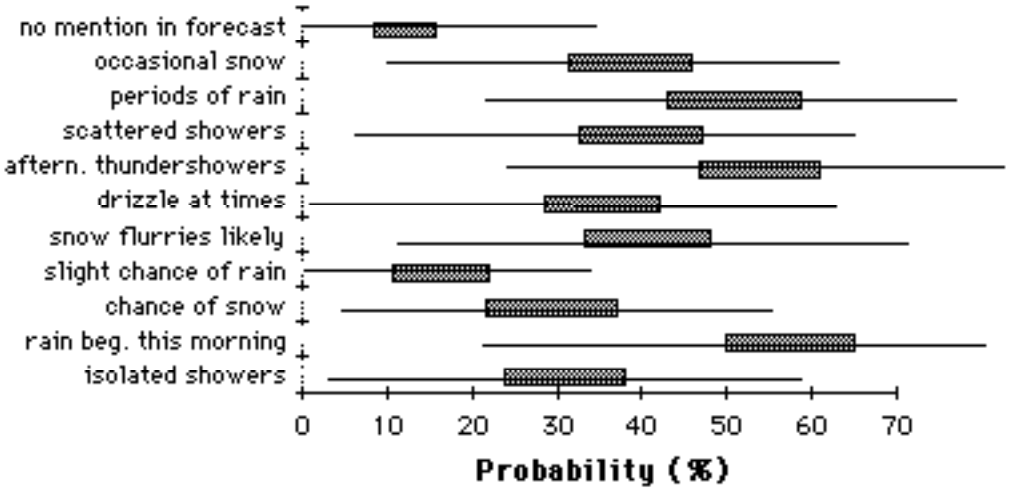




Another section of the survey asked what *likelihood of personally experiencing precipitation* was expected *for specific forecast terms*. The survey respondents were asked to indicate a range of probabilities (both an upper and a lower limit.) The averages and variability (plus and minus one standard deviation) are shown in the next figure.

B T E A M

WHAT IS THE LIKELIHOOD THAT YOU PERSONALLY WILL EXPERIENCE PRECIPITATION GIVEN THE FOLLOWING FORECASTS?



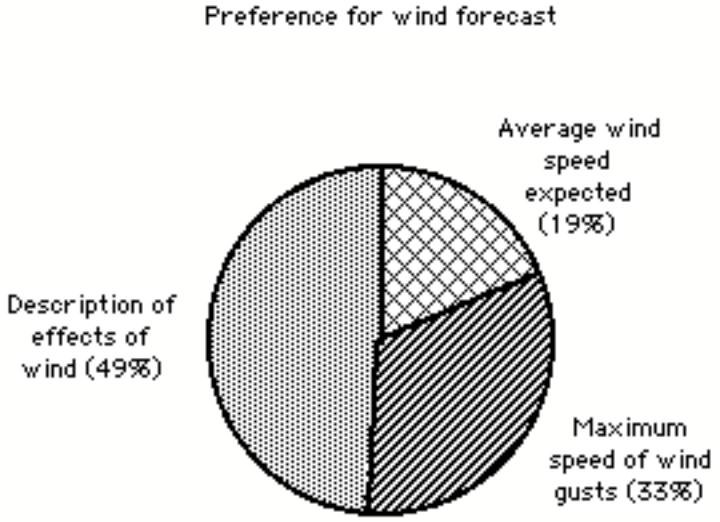
7. Wind

Wind was rated as the third most important factor in weather forecasts. People's responses to specific questions indicate that they want more information about wind conditions in the weather forecasts. When asked:

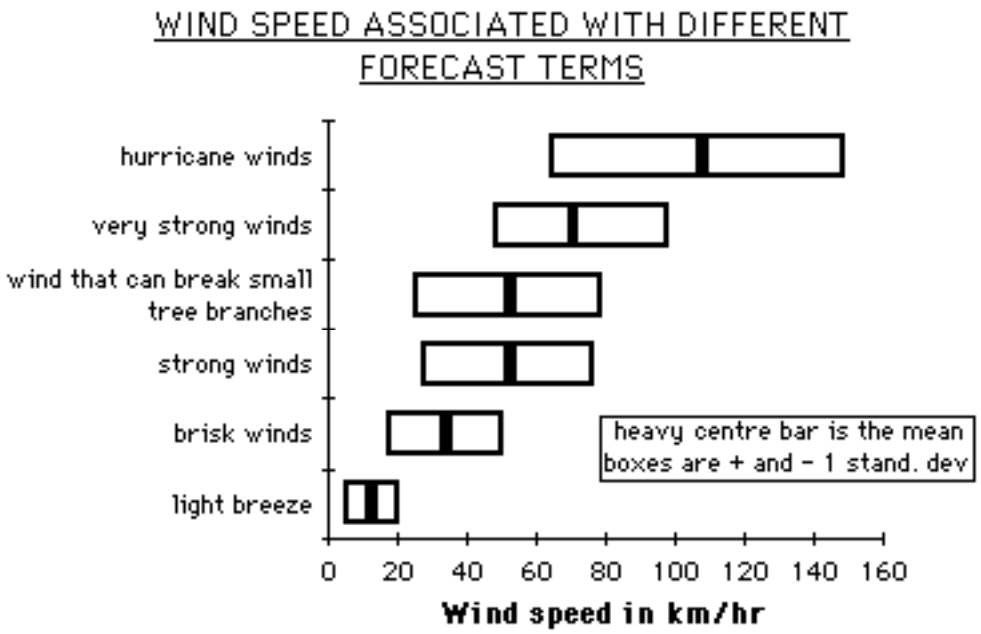
"What is the lowest amount of wind that you would want to hear about in a weather forecast?

40% want the wind conditions in every forecast,
28% want to know about winds of 20 km/hr or more, and
31% don't care unless the wind is strong enough to make walking difficult.

Most people (96%) understood that "Northeast winds" means winds **from** the Northeast. But people don't really have a feel for different wind speeds. About half of the respondents want the forecast to describe the effects of the wind on people and objects rather than giving the average or maximum wind speeds. This is shown in the following figure.



The majority of people (65%) used metric units (e.g. km/hr) to describe what wind speeds are indicated by particular forecast terms. The following figure shows what wind velocity is associated with these different terms (all estimates converted to km/hr.)

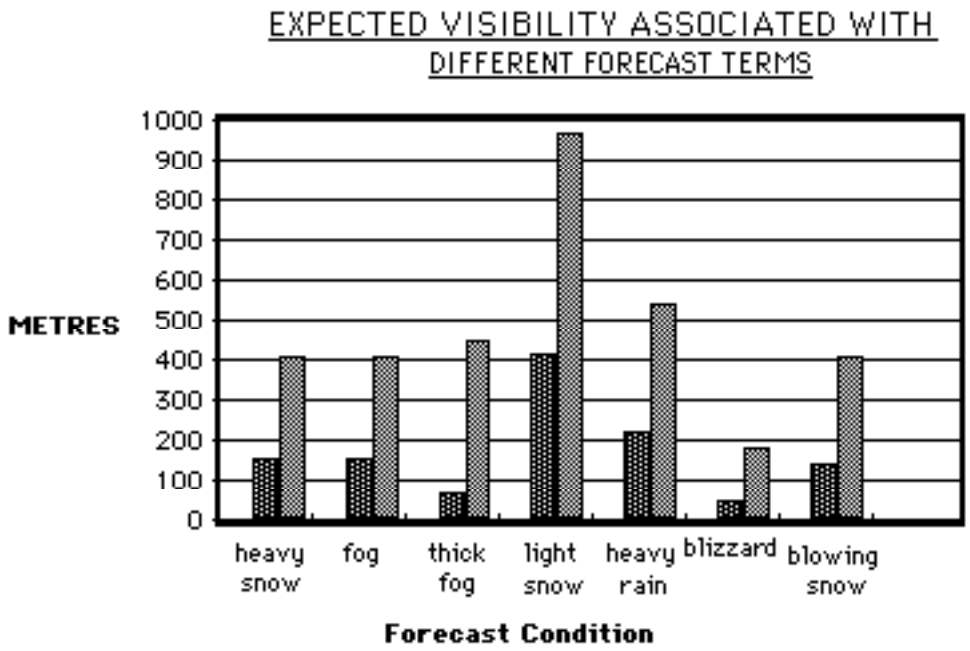


The average estimates for the whole sample are fairly close to the "official" meaning (from MANPUB) for the lower speed wind terms. With the terms for the strongest winds people underestimated the wind speed that can be expected. The variability of responses also indicates that many people don't adequately understand these descriptions.

8. Weather events affecting visibility.

Overall, forecast information on weather events affecting visibility (fog, blowing snow, etc.) were rated about as important as wind conditions, and much more important than cloud cover or humidity.

Respondents were asked how far they would be able to see on a day with different weather conditions. The next figure shows the average estimate for each condition. Most people (64%) used some imperial measure. 33% used metric units, 2% used city blocks, and 1% used other units. All estimates were converted to metres for the figure.



Across Canada, respondents estimated that they have fog in their area that is thick enough to interfere with travel or outside work about once a month (mean = 13.2 times per year, stand. dev. = 22.5.) The reported incidence was highest in the Atlantic regions (18.6 times/yr) and lowest in the Prairies (7.9 times/yr.)

9. Sky conditions (Cloud cover)

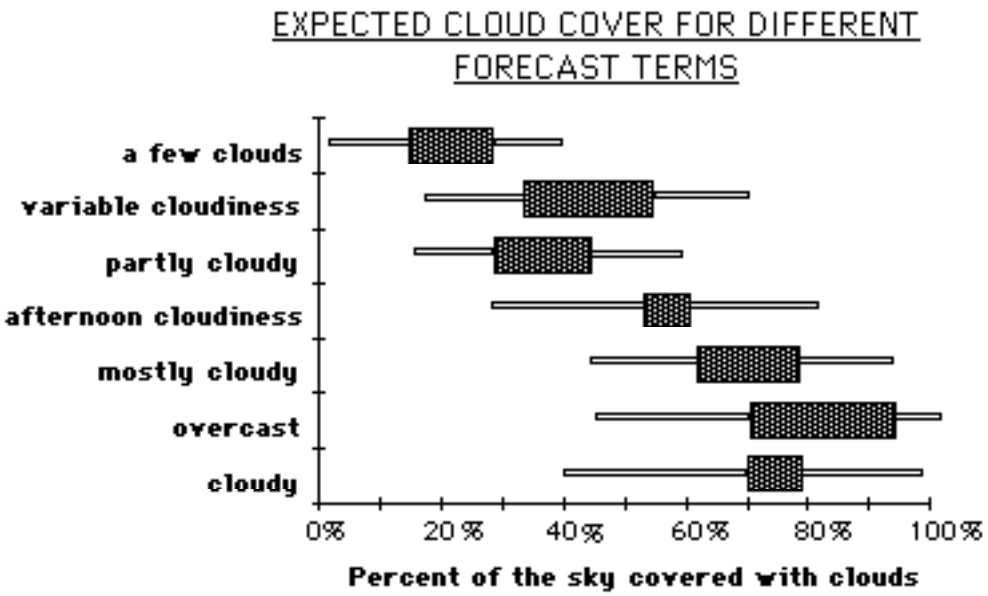
People did not rate information on sky conditions as very important. But, when asked to choose what sort of information on sky conditions the forecast should contain,

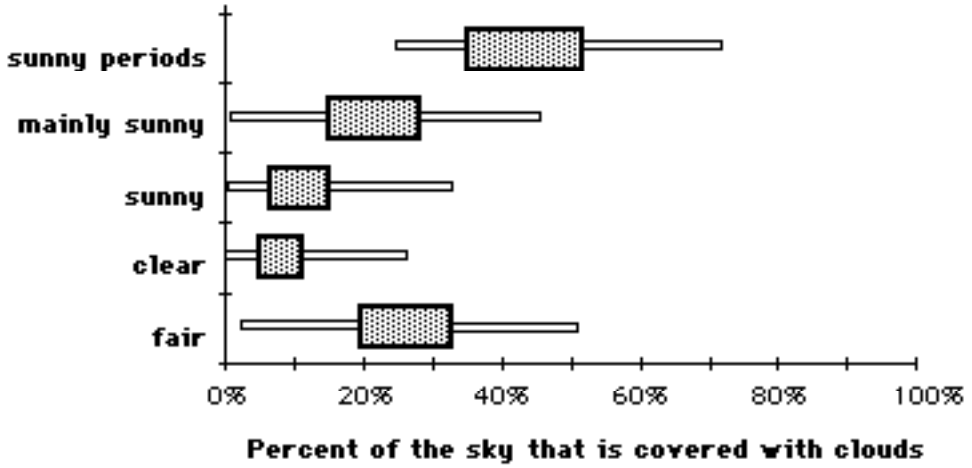
16% want only a descriptive term,
6% want only the numeric percent of cloud cover.
54% said they wanted both descriptive terms and the expected percent cloud cover, and
25% would prefer a forecast containing the number of hours of sunshine expected.

The last alternative may be difficult to forecast and not particularly applicable to far Northern winters. But it was preferred to the present method using descriptive terms for expected cloud cover.

Several of the descriptive terms used for sky conditions were tested. Subjects were asked how much of the sky would be covered with clouds given the different forecast terms. They were requested to give a range of expected cloud cover in tenths (10% divisions.) The figures on the following page indicate what these terms mean to the broad range of Canadians surveyed.

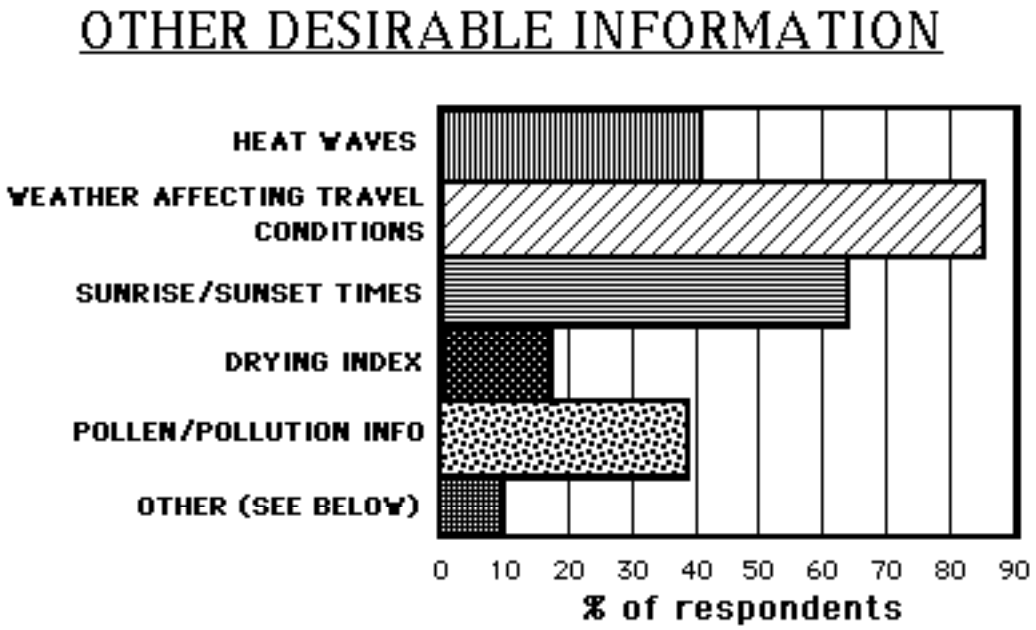
The large, filled boxes show the average low end and high end of the range given by respondents. The smaller, white boxes indicate 1 standard deviation below the low end and one standard deviation above the high end. Put more simply, most respondents (about 70%) think the meaning lies somewhere in the range indicated by the small boxes. The degree of "spread" indicates a lack of precise meaning.


EXPECTED CLOUD COVER FOR DIFFERENT FORECAST TERMS
a few clouds
variable cloudiness
partly cloudy
afternoon cloudiness
mostly cloudy
overcast
cloudy
0%
20%
40%
60%
80%
100%
Percent of the sky covered with clouds


sunny periods
mainly sunny
sunny
clear
fair
0%
20%
40%
60%
80%
100%
Percent of the sky that is covered with clouds

10. Other desirable information for weather forecasts

Respondents mentioned a variety of other environmental information that they would like to see included in weather forecasts or warnings. The following figure shows how common these other interests are.



(The total is more than 100% because people chose more than one option. Other information that was written in by respondents included such things as marine information, small craft warnings, water temperatures at popular beaches, high and low tides, road conditions, and weather conditions in other parts of the world.)

In all regions of the country there were people who wanted each of the different kinds of information. But there were some regional differences in the proportion of people who wanted specific kinds of additional information. People in the Prairies generally chose fewer of all of the options. People in Atlantic regions were slightly more interested in the drying index. And those in Ontario were more interested in pollen and pollution levels.

11. Preferences for different weather forecasts and warnings

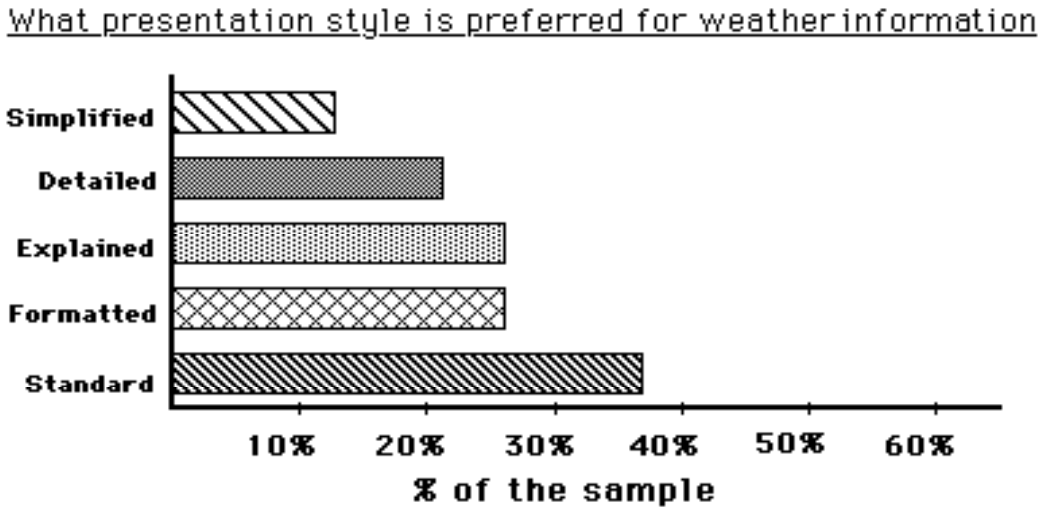
At the end of the survey, respondents were asked to evaluate different versions of 2 warnings and 4 forecasts. For each one of these weather conditions, the information

was presented in four different versions. Specific locality modifiers were not included in the warnings or forecasts because of the nation-wide sample. The people who took the survey indicated which version they preferred.

One version in each comparison (referred to below as the **Standard** version) was based on present AES standards. Other versions either:

* provided more detailed numerical information about the weather (**Detailed** version),
* gave more explanation about possible effects of the weather (**Explained** version),
* presented the information in a different format or order (**Formatted** version), or
* gave a more simplified version of the forecast or warning (**Simplified** version.)

None of the different versions was preferred by more than half of the respondents. The following figure shows the results averaged across the different comparisons.



As the figure shows, the standard style and format was chosen a little more frequently than the re-formatted version, the explained version, or the detailed version. The simplified version was least preferred.

When we looked at which subjects preferred which type of forecast or warning the following trends emerged.

The simplified version with fewer details tended to be most popular among the older subjects (especially the 60's and over,) those with less than grade 12 education, and people whose first language was not English.

Males were more likely to prefer the forecast or warning version with more numerical details and females were a little more likely to prefer the version with more explanation.

People in the Prairies were more favourable towards the warnings and forecasts with more numerical details.

In most other regards, the preference for the different messages didn't depend on demographic features such as education, region of the country, or urban/rural residency.

These results clearly indicate that there is no single style or format that will please everyone. Some people prefer a very simplified weather message . But most people all over Canada would prefer more details, more explanation of the effects of weather, or a different format.

12. Other Comments

The survey touched on many aspects of the weather messages used for public forecasts and warnings. After answering the many questions, about 1/3 of the 570 respondents wrote additional comments.

Some positive comment about forecasts was made by 3% of the respondents (17 people.) Six people (about 1%) said they did not like percentages in precipitation forecasts (PoP) and 24 (4%) had some negative comment about metric.

The most common suggestions were:

COMMENT	Number of People	% of Total
improve the accuracy of forecasts	**32**	**6%**
leave out complicated weather factors	**31**	**5%**
more information in warnings	**21**	**4%**
more frequent broadcast/update	**16**	**3%**

Other comments made by 1% to 2% of the sample include improved presentation (e.g. graphics,) more precise information about locations, more public education, more travel/road information, and more extended (future) forecasts. Most of these suggestions would probably be endorsed by many respondents if they had been presented.

13. Regional Questions

Some specific questions were asked in Ontario and Alberta. Ontario respondents were asked how "snow squalls" are different from other kinds of snowfall, and about "snow streamers off the lake". The Alberta respondents were asked how "variable chinook cloudiness" differs from other sorts of clouds, and how "snow showers " are different from other kinds of snowfall.

Ontario

The most common differences between "snow squalls" and other kinds of snowfall were that snow squalls begin suddenly, are intermittent, occur in specific areas, and they are strong bringing heavy downfalls of snow. The results are shown in the following table. The total is more than 100% in the first table since some people gave more than one descriptive term.

	Number of responses	Percent
Intermittent/sudden/specific areas	**58**	**46**
Windy	**57**	**44**
Strong with heavy snow	**48**	**38**
Visibility problems	**13**	**10**
Mild with very little snow	**4**	**3**
Comes in from the lake	**1**	**1**
Other	**2**	**2**
Do not know	**8**	**6**

Of the one 112 respondents to the question on snow streamers, the most common description was that they are snow and wind from the lake.

	Number of responses	Percent
Snow and wind from the lake	**43**	**38**
Narrow bands of precipitation from lake	**17**	**15**
Occurs near lake	**9**	**8**
Blowing snow	**7**	**6**
Other	**4**	**4**
Do not know	**34**	**30**

Thirty percent of the Ontario residents who responded said they could not describe snow streamers off the lake (21% didn't answer this question.)

Alberta

Fifty-four people (78% of the Alberta sample) answered the question on "variable chinook cloudiness". The most common differences mentioned were that chinook cloudiness involves warm temperatures, winds, and the chinook arch.

	Number of responses	Percent
Warm temperature and warm west winds	**15**	**28**
Chinook arch	**14**	**26**
Warm air and cloudiness	**12**	**22**
Cloudy but fair weather	**7**	**13**
Fast moving clouds	**5**	**9**

Different temperature with strong winds	**1**	**2**

Of the 54 responses to the questions on "snow showers", most people indicated that they involve intermittent snow and wind and that they are more moist than other types of snowfall.

	Number of responses	Percent
Intermittent snow and wind	**29**	**54**
More moist	**20**	**37**
No wind	**3**	**6**
Wet snow and bad road conditions	**2**	**4**

RECOMMENDATIONS

The results of Behavioural Team's intensive study and nationwide survey suggest several possible changes to weather forecasts and warnings. They also support several features of the present AES style. Our recommendations about what to change and what to leave the same are summarized below.

I. FORECASTS

A. LENGTH OF THE FORECAST AND AMOUNT OF INFORMATION

1. Canadians say they want more information in forecasts.

Only a small percentage of the respondents preferred the simplified forecasts and wanted descriptive terms instead of numeric details (such as Probability of Precipitation.) Most people want more information in the forecasts and like the numerical descriptions.

2. A 100 word forecast for one area isn't too long.

The exact length of the forecast can depend on the kind of weather events expected and the rate of weather change over the forecast period. But people were very favourable toward some of the longer forecasts in the study. These contained either more explanation of the expected effects of the weather, more details about weather events, or just more "filler" words to put the forecast events into sentences instead of a "telegraphic" style. A good length for the "today, tonight, tomorrow" forecast is 60 to 120 words.

3. People can select the information they need or want out of a long forecast if the information is well presented.

Even those people who preferred the shorter forecasts often said that they don't mind longer forecasts as long as they can get the information they want. This task of information selection can be easier in a longer message than a shorter one if the message is clearly presented. A very concisely worded forecast often presents the information at too fast a rate.

People who had heard the weather forecast presented on the radio in a 1 to 2 minute question and answer format liked it enormously better than a 10 second weather blurb sandwiched between scores and ads. In the intensive study of 100 persons, we played recorded forecasts from local radio stations and afterward asked people to write down whatever details they could remember. Most remembered very little from such short renditions of the forecast.

Of course, it is up to the different commercial media how much of their time or space resources they want to devote to weather forecasts. But there are several reasons why longer forecasts can be better understood and remembered.

Longer versions can permit cues concerning **which** weather feature is about to be described. If these cues always come first they allow the reader or listener to pay attention to the information they want such as temperature or precipitation.

Further explanation or redundancy for critical or noteworthy features of the forecast allows the recipient to **confirm** the message. New information coming in too quickly has the opposite effect. It interferes with understanding and remembering the previous parts of the forecast.

4. People want more details about weather events or their effects but they <u>don't want</u> explanations about the <u>causes</u> of different weather events.

Most people don't care about high pressure systems, low pressure systems, different cloud types, or high altitude winds. These things may be very important to the forecaster in making predictions. But the general public wants to know what weather events to expect, not where the "trough" was three days ago.

In public forecasts from AES details about the "weather systems" that lead to the forecasts are generally contained in the "Synopsis." This part of the forecasts was not specifically addressed in the study. It is our opinion that the synopsis has a place for those who seriously follow the weather. But it should not be broadcast or updated as often as the forecast itself.

5. Some regions of the country have more local variation in the weather. They often require more lengthy forecasts to adequately describe these variations.

In this regard also, people reading or listening to a weather forecast can select the relevant information if given the proper cues.

B. WHAT FEATURES SHOULD BE INCLUDED?

1. Temperature and precipitation forecasts are most important.

In all regions and for all subgroups most people consider this the fundamental forecast data. They are the only features that <u>must</u> be included in <u>every</u> forecast. Temperature and precipitation conditions are just as important overnight as they are during the day.

2. Wind conditions should be included in every forecast.

A large proportion of the public have some special interest in the wind for a variety of reasons. Wind can have many direct effects on people and objects. Wind forecasts fall into the "must include" category only when they are significant to a large portion of the public (e.g. over 20km/hr.) Wind conditions are slightly less important at night for non-threatening wind speeds.

3. Visibility limitations at ground level are important every time they occur.

Fog, blowing snow, and other conditions that limit visibility are also given high importance by the Canadian public. Due to their particular relevance to driving conditions the audience may be smaller at night but the information can be just as important.

4. Cloud cover predictions may not be necessary in every forecast.

Cloud cover was rated as less important than the other weather factors mentioned above. The forecast of precipitation already provides some information about sky conditions. Sky conditions at night are of interest to a particularly limited audience.

The emphasis on sky conditions is rooted in aviation forecasting. It is less important to those of us down here on the ground. In some parts of the country, however, sky conditions assume more importance in the Summer. During hotter weather some individuals want to either maximize or minimize their exposure to the sun.

5. Other information should be provided in other weather messages. It should be included in a forecast and/or warning only when it will affect large numbers of people.

There should be routine messages outside of the forecast to describe sunrise/sunset times, pollution index for affected areas, travel conditions, etc. There should also be special audience forecasts such as marine forecasts giving water conditions and tide times and farm forecasts including a drying index. Much of this special information is already being provided by Environment Canada but it is not presented in the more popular media.

If pollution levels, pollen count, road conditions, etc. are going to seriously affect more than about 10% of the forecast audience, they should be mentioned in the forecast. If they are dangerous for some people a warning message should be used.

C. HOW SHOULD THE INFORMATION BE PRESENTED?

1. Probability of precipitation is good but the public needs more education about its meaning.

Probability of Precipitation (PoP) is widely preferred to descriptive statements about the likelihood of precipitation. The descriptive terms have fairly broad interpretations by the public. The public needs to learn that the PoP is for any point in the forecast area.

The descriptive terms for precipitation that have fairly consistent meaning to most Canadians have already been listed (see Table 3, page 12.) It is important to note that any sort of qualifier about the precipitation (e.g. "rain late in the day") reduces the probability of precipitation that people associate with that term. In such cases the probability should be specifically mentioned (e.g." 80% chance of rain late in the day.")

2. Expected accumulations are more important for snow and ice than for rain.

People have fairly reasonable expectations about rain accumulations. If there is going to be enough rain to cause flooding, or if an especially large amount of rain is expected in a short period of time, specific mention of the amount of rain should be made in the forecast. Otherwise, descriptive terms (such as "heavy rain") are sufficient.

Accumulation predictions for snow and ice have more direct impact on all kinds of decisions, from footwear to driving conditions. The amount of snow, hail, or freezing rain that is expected to accumulate should be described in the relevant forecasts or warnings after the descriptive terms (e.g. "light snow overnight with accumulations of 1 to 3 cm by morning.")

3. Temperature should be presented in a consistent order.

The forecast high should give the lower temperature first, whether the range is above freezing or below (e.g. "the high temperature expected for today is between minus 14 and minus 12".) The forecast low should give the higher temperature first.

Comparative statements about the temperature should be based on the previous one or two days' weather. Statements about large deviations from seasonal averages are interesting to some people. But describing small deviations from the average temperature for that day is misleading to many people. It implies that the temperature is not "normal" when it actually is within the normal range.

4. Wind forecasts should include more information about the effects of the predicted wind speed.

People don't have a good understanding of wind. They underestimate the speed associated with terms such as "very strong wind." And they don't know what the likely effects of different wind speeds are. Additional explanation about the effects of the higher wind speeds would be helpful in the relevant forecasts.

5. When cloud cover forecasts are necessary the number of terms used should be limited.

In terms of desired sky condition information, there are only about 5 different states that would be discriminably important to the public. Our suggestions are as follows:

clear one tenth or less of the sky covered by clouds

mainly sunny two to three tenths cloud cover

partly cloudy four to six tenths of the sky covered

mostly cloudy seven to eight tenths cloud cover

overcast nine tenths to total cloud cover

These are the terms that most clearly separate the different ranges for our respondents. However, people tend to be a little too optimistic in their interpretation of "overcast" (see the figure on page 20.)

Another term such as low, thin clouds can be used to describe situations where the clouds are somewhat transparent and at an unusually low altitude. With some efforts to teach these specific meanings to the public, AES can ensure that most people get all the information they want about sky conditions. People who want more cloud details can phone in for aviation weather.

6. A format organized according to weather features may be more easily remembered than the "today, tonight, tomorrow" format presently in use.

The present style of forecast gives the weather for today followed by the weather for tonight, then the weather for tomorrow. If probability of precipitation forecasts are given they are sometimes worked into this format and sometimes put on at the end.

A forecast organized according to weather features could use the same time format. For example, the forecast could give the temperature forecast for today, tonight,

and tomorrow, the precipitation forecast for the same periods, and then the wind forecasts. This would allow people to select and organize the information more easily.

The present AES format requires too many changes in attention to process the message. As long as the "today, tonight, tomorrow" order is consistently followed within each weather feature, people will be able to keep the forecast days separate in their mind.

II. WEATHER WARNINGS

A. WHAT SHOULD THE DIFFERENT WARNINGS BE CALLED?

1. Weather advisory should be used in situations where the weather may cause inconvenience but will not be dangerous.

2. Weather watch should be used when there is more than 24 hours advance notice of hazardous weather, or when the probability of the hazardous weather is low.

3. Weather warning should be used when dangerous weather is likely to affect the forecast area within the next 24 hours.

B. WHAT INFORMATION SHOULD BE INCLUDED?

1. Weather warnings and weather watches should have more explanations of the likely dangers and how to avoid them.

This is the area where Canadians are most likely to want more details about the expected weather and advice on how to avoid danger or inconvenience.

2. People want more frequent updates and more local details in weather warning messages.

People would be particularly interested in any further information that the forecasters can provide about exactly where and when the hazardous weather is expected.

3. Many people would be interested in hearing about the effects of extreme or hazardous conditions on people, places and property.

This information could be included in the notice terminating the warning, or in a follow-up message. People would also like to know if the dangerous weather never developed.

III. GENERAL RECOMMENDATIONS

A. THE VALUE OF ALTERNATIVES

The "public" for weather forecasts and warnings consists of millions of individuals. They have differing interests and even different understanding of simple weather terms. The different media that use the weather information provided by AES tailor that information

to appeal to different people. Sometimes this tailoring helps people understand the weather, and sometimes it makes the message more difficult to process and remember.

AES should take a more active role in providing different kinds of forecasts to the various "publics."

As a start, two alternatives might be tried. Users could choose between two versions of clear and understandable information if they were presented on separate channels, time schedules, etc. Less "tailoring" would be required and users would have more high quality information to start out with.

The first style would be similar to the present MANPUB style forecast, but with the recommended modifications and word restrictions described above. The second format would be a longer version of the same weather information with some additional details and/or explanations. Examples are provided on the following page.

Format 1. The temperature today will be near 12 degrees, down to around 4 tonight, and between 10 and 14 tomorrow. Winds of up to 30 km/hr today, decreasing tonight, light breeze tomorrow. Probability of precipitation 60 percent today, 20 percent tonight, near 0 percent tomorrow.

Format 2. Today's high temperature is expected to be between 10 and 12 degrees. That is a little warmer than yesterday. The low tonight will be between 5 and 3, and the high tomorrow will be 10 to 14 degrees. Wind speeds of 20 to 30 km/hr today will make it hard to catch up to any papers that blow out of your hands. Less wind is expected tonight, 10 to 20 km/hr., and even less tomorrow. Skies are overcast today. That means 80 to 100 percent covered with clouds. Isolated showers are likely to fall out of those clouds today with a 60 percent probability of precipitation at any one location. The probability of precipitation will decrease to around 20 percent tonight and near 0 percent tomorrow as the skies clear.

High 10 to 12 today, 60 percent chance of showers.

Of course the details would vary with the particular weather conditions. These are meant only as illustrative examples.

B. SUGGESTIONS FOR FURTHER STUDIES

This study has looked at the Canadian public's perception of weather forecasts and weather warnings. The results are generally favourable toward the services that AES provides. Several suggestions have arisen for refining the language, improving the format, and providing more information.

Further work is required to integrate the recommendations within the constraints on forecasting weather and transmitting data.

Sources, delays, and responses to hazardous weather information should also be examined in more detail.

There are many ways that the public can be more educated and involved. These should be explored. For example people could send for PoP kits. These would explain what the weather forecaster means by probability of precipitation. They could also help the individuals organize their own precipitation records and compare them to the forecast value. People could even calculate their own adjustments to the forecast to account for local variations!

The list of possible studies could go on and on. But it would be particularly interesting to us at Behavioural Team to get feedback from our suggestions for different formats to be provided in AES forecasts and warnings. After verbal feedback, some field tests should be in order.