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Severe Thunderstorm Warning Services: Responsibilities to the Public

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1. INTRODUCTION

The system by which severe thunderstorm hazards in Australia are brought to public awareness has undergone substantial changes beginning in the late 1980s. My invited participation in a forecasting experiment at Sydney in 1989 was a reflection of the commitment of the Bureau of Meteorology to a new course. This conference is in part a chance to reflect on what has been done, perhaps with an eye toward improving on those beginnings, based on that early experience.

The Severe Thunderstorm Warning Services (STS) have as their operating principles the following:

Statement of objectives: To minimise the loss of life and property and community disruption from severe thunderstorms through the provision of accurate advices/warnings of severe meteorological phenomena (such as destructive wind squalls, damaging hail, tornadoes and flash flooding) and timely receipt of these advices/warnings by threatened communities and their emergency service managers

Parallel objective: to ensure that the community is aware of:

- **the severe thunderstorm threat;**
- **the available advice/warning service; and**
- **the appropriate action(s) to take.**

This is to be accomplished via:

- **ADVICES, with validity up to 6 hours, cover all areas of Australia except the tropical north, and**
- **WARNINGS, with validity up to 3 hours, cover capital cities and surrounding areas under weather watch radar surveillance.**

There are sufficient parallels with the system in the USA in these statements and methods that I believe I can offer some perspective on the problem, based mostly on my experiences with that system in the USA.[1]

I am going to be offering some perspectives that appear to be somewhat off the track, simply because I want to draw attention to the lack of a substantive distinction between weather hazard warnings and ordinary weather forecasting information in the notions that are to follow. Some of this

[1] I hasten to add the standard **disclaimer**: This essay reflects only my personal opinions and does not represent the view of the National Severe Storms, Laboratory, ERL, NOAA, the Depart-ment of Commerce, or the office of the President of the United States. In other words, if you don't like what you see and/or hear, please don't write anyone in these agencies to complain; they'll wash their hands of any responsibility and rightly so. And trying to make trouble for me is a waste of your time: I'm better at it than you are!

material is also contained in an essay that can be accessed on the World Wide Web at the following URL:

<http://www.nssl.uoknor.edu/~doswell/users.html/>

2. COMMENTS ON THE SYSTEM

When I was here in 1989, I was offered the opportunity to comment upon and make suggestions about what was to become the STS system. It is always intriguing when asked for an opinion, because if the opinion rendered is in conflict with that of the *seeker* of the opinion, what is to be done? In this case, perhaps for many good reasons, most of my comments and suggestions were ignored; politely, of course. Given another chance to render opinions, I am going to reiterate two of those I offered earlier because I continue to believe the reasons for them are valid, without regard to mitigating circumstances.

First, I continue to believe that an effective system of "warning" (and, for the sake of brevity, I am going to use this generic term in lieu of the actual names of the services provided) must be a 24 h, seven days per week operation. A 40 h per week operation leaves [(1-40/168) = 0.7619] about 3/4 of the week uncovered. The simple odds are that a substantial amount of hazardous weather will strike during that time when the "experts" are not on duty. The devastating Sydney hailstorm of 1990 is an example. Since the weather does not know anything about the clock, the calendar, or climatology, the only way to be prepared is to have a continuous operation. Anything less is going to have repercussions when the weather hits at an "inopportune" time.

Second, the dispersion of the "experts" to the widely-scattered Regional Offices is a mistake, in my opinion. Severe weather is sufficiently infrequent in any given geographical area that it is difficult to develop an adequate experience base. Although I am quite committed to a scientific approach to weather forecasting, I must confess to my own inadequate understanding. And I will take this chance to confess on behalf of my colleagues as well: we simply do not understand severe weather well enough for a *purely* scientific approach to be satisfactory. Experience and empiricism are still important factors, in spite of my wishes to have the process be as science-based as possible.

In our experience, weather events that are notably unusual tend to create a sort of "paralysis" in local weather forecasters. They simply can't believe that today is not going to be a day like any other, that significant events well beyond the "2σ" limit of normality are actually going to happen. They often don't recognize what is imminent and don't act until it is already happening. The guidance they receive is critical in being prepared to deal with unusual weather, whether or not they actually respond properly to that guidance. I contend this is primarily a consequence of a lack of experience. Given the relative rarity of severe weather events, even in the USA, the cadre of forecasters in what will soon be well-known as the Storm Prediction Center (SPC) are able to provide excellent guidance for much of the severe weather that happens simply because they are used to dealing with it, virtually every day. Certainly, a centralized severe weather forecasting office is going to accumulate more experience in less time under a broader range of weather circumstance than any Regional Office can hope to gain. On how many days per year is severe weather actually happening in any particular region? On how many days per year is severe weather actually happening in the whole Australian nation? Do the arithmetic for yourself. This is a non-trivial component of the problem, that in my opinion transcends any personal, political, or economic constraints. If you want your people to become "experts" they must have adequate experience.

Please do not take this as a denigration of the fine efforts expended by the severe weather teams so far. What I have seen suggests that a really excellent program is evolving, but it is always going to be handicapped by the two issues I have just raised.

3. REALISM AND HONESTY

I am taking a position that the "contract" (unwritten) among public-sector forecasters, private-sector forecasters, and the public (worldwide) is in drastic need of renegotiation. For the sake of brevity, I am only going to touch on some of the reasons why I feel this way. Weather forecasts (for the "ordinary" weather) as issued by public-sector forecasters are naturally and properly "one size fits all" products. That is, with a few notable exceptions, their purpose is a general one, without regard to the specific needs of the users. They are a service provided to the citizens by the government. The exceptions to this rule include: agricultural, aviation, and marine forecasts, which are additional duties imposed on the public-sector forecasters that purport to serve specific user needs.

My contention is that this structure is not doing a good job of serving *anyone's* needs, simply because it stretches the capabilities of poorly-funded, undertrained, and understaffed public-sector forecast offices to accomplish this multidimensional, exceedingly challenging job. For the sake of keeping this essay within bounds, I cannot go into all the arguments on behalf of this position. The essential notion is that in "interesting" weather situations (i.e., those where forecasters readily can add value beyond that of objective forecasting systems), this plethora of responsibilities does not allow forecasters the chance to do their jobs effectively. There are too many competing responsibilities relative to the staffing and resources, and some of the specialized forecasts require some things that are very difficult (if not impossible) with today's science and technology, such as detailed forecasts of ceiling height and runway visibility.

Moreover, the public generally considers our forecasts to be laughably bad, and full of "hedging." They say things like "Don't feed us that probability rubbish! Just tell us whether or not it's going to rain!" Asking for a categorical forecast is tantamount to asking *forecasters* to make the decision: if my choices depend on the occurrence of rain, and you tell me it is or is not going to rain, that decision becomes trivial for me; *provided* I believe the forecast.

Unfortunately, we are not quite that good, and the users know it! If we accede to this demand, we produce categorical forecasts that fail to satisfy most of our users some substantial percentage of the time. We are in the position of the 2nd Lieutenant being ordered to "Take that hill!" which is heavily defended by a battalion of dug-in troops, with a squad of sick and wounded soldiers having no ammunition. The lieutenant, facing the general, thinks he must salute crisply and say "Can do, sir!" even though the odds are overwhelmingly against him. We are asked to do the impossible (make perfect categorical weather forecasts) and then are derided when we fail. It's as if our mythical lieutenant somehow survives the ill-fated attempt up the hill, and then is ridiculed by everyone for his failure. It's *this* "contract" with the public that I want to renegotiate.

This essay cannot contain a proper argument in favor of probabilistic forecasts, but *uncertainty is inevitable* in our job and *probability is the language of uncertainty*. If a forecast is made without including information about uncertainty along with that forecast, then substantially less is provided about the situation than what our capabilities permit. Useful and reliable forecast uncertainty assessment in probabilistic terms is already a demonstrated capability in many public-sector weather services. Properly educated and nurtured users can use this uncertainty information to help them make decisions much more effectively than they can use categorical forecasts. A very well-developed science of decision-making in the face of uncertainty is available to users (Clement 1991; Winkler and Murphy 1985). This is *not* an arguable point.

The only thing arguable is whether or not the public will *accept* such a change in forecast format. I believe it is the only honest thing to do, in spite of the pain such an exercise may create. Giving in to accepting the responsibility for decision-making by our users is one of the primary reasons we are the butt of so many jokes, and are so often blamed when things go badly. Giving in to this demand has *not* assured us of public support, so it has *failed* in the very thing it has attempted to do: satisfy the public that we are doing a good job. Perhaps I am naive, but I think the public is

much more understanding of uncertainty than we seem to be willing to believe; assuming the public to be too stupid to accept new ideas is a self-fulfilling prophecy. Furthermore, I think the public eventually will respond positively to an honest forecast that admits its limitations up front.

4. HAZARDOUS WEATHER

So what does all this have to do with hazardous weather? In the case of hazardous weather, the objectives for the STS are basically spot on, in my view. But can we warn Mr. and Mrs. John Q. Citizen about the flash flood that is going to hit their home this afternoon at 4:23 p.m.? Hardly! We are in the same position re hazardous weather that we are in vis-á-vis the "ordinary" weather. The responsibility for the safety of individual citizens is being downloaded onto public weather forecasters, but we surely should not have to accept that total responsibility. No doubt we have done, and will continue to do, the best we *can*, but the public needs to understand that it is unrealistic to expect their safety to be totally our responsibility. We can provide useful information regarding the weather as it appears to be unfolding, but individuals and the local communities in which they live must shoulder most of the burden for those final "This is it! Take cover!" kinds of warnings.

As weather forecasters, our responsibilities include advising the public about those days when hazardous weather may develop ("advices"). The use of the word "may" here implicitly means such products should be probabilistic, of course. Once hazardous weather actually develops, we can offer information (involving uncertainty) about its current and expected behavior. Is it going to continue on its present course? Is its intensity going to change? These are questions to which can provide answers, albeit *uncertain* ones. But we should not accept the responsibility for telling *individuals* (or even communities) to take appropriate action.

There are three areas wherein we traditionally have done a less-than-adequate job in the USA. Exceptions occur, of course, where individuals in the public weather service have been exceptionally creative and innovative. On the whole, however, we have not been good at:

1. helping the communities understand the limitations on what we can do, and how to deal with those limitations,
2. developing methods for rapid, multi-channel, two-way communication between us and the communities,
3. promoting public awareness of weather hazards, including knowledge of what are appropriate actions to take at all stages of the process (see Redmond 1995).

In the USA, where the threat from tornadoes is the highest anywhere in the world, what we *have* accomplished is nontrivial: we have reduced the annual average tornado death toll from several hundred per year to a few tens of fatalities per year. This clearly has been our most aggressive and successful program, where innovation and community outreach (however imperfect) has been at its best. Our track record with *other* hazardous weather, notably flash floods, has been much less successful than with tornadoes.

Even with tornadoes, we have not been entirely successful, and there are many areas (geographically and subject-wise) wherein our interaction with communities needs work. What we need to foster is a sense of *partnership* with the communities. Our information is for their benefit, and they have a right to expect us to provide that information. They also need to understand *their* role in assuming responsibility for their own safety, given the uncertainties in what we can provide as input for their local decisions.

5. DISCUSSION

Bureaucratic inertia is a potent force, especially where and when it has had a chance to flourish for an extended time. In Australia today, there still is a window of opportunity for change and evolution within the STS; the bureaucracy cannot say with much fervor that "This is the way we've *always* done it!" At least not yet; the system still is young enough to accommodate

new perspectives and to try alternative approaches. If I can succeed in doing anything with this possibly inflammatory essay, I hope it will be to encourage a spirit of *adventure* in the process of dealing with hazardous weather. Yes, times are tight and politicians are notoriously unforgiving of adventures with the public treasury, but we all need to reconsider our current "con-tract" with the public. Let's try something new - **being honest** - and see what hap-pens!

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