USE OF SEVERE WEATHER OUTLOOKS FOR DAMAGE PREVENTION AND CIVIL PROTECTION IN FINLAND

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I. INTRODUCTION

A severe weather forecasting program was established in 2005 at the Finnish Meteorological Institute (FMI). One of the goals of this program is to offer authorities detailed information on coming severe weather events and enhance society's resilience to these situations. Therefore, since the beginning of the program the FMI has issued severe weather outlooks for rescue authorities and government organizations. Currently, the outlook is delivered to tens of different organizations, including Emergency Response Centers, Rescue departments, Railroad Transport Company, Centers for Economic Development, Transport and Environment, Finnish border guard, Vessel traffic centers, Finnish road administration, and also to several ministries.

In order to develop severe weather outlooks further by better understanding their use, a user survey was performed in March 2010. A questionnaire was sent to all outlook users, of which 172 individuals from about 30 organizations responded.

The purpose of this paper is to report results of this questionnaire by identifying user needs. Emphasis is put on severe weather preparedness measures and understanding how different authorities operate before and during severe weather event. This may provide ideas how to develop co-operation between meteorological services and civil protection also elsewhere.

II. SEVERE WEATHER OUTLOOKS

Each severe weather outlook consists of two parts. First, the outlook subscribers receive "an alert e-mail" which contains a short outlook with the most essential information on the forecasted severe weather event such as expected time, risk area, expected weather, severity of weather situation (four levels) and a short description of the event and its' possible impacts. Second, the e-mail includes a link to an extended outlook on a webpage (Fig. 1) which has more detailed description of the event, information on uncertainties of the forecast and changes compared to the earlier outlook(s). The outlook webpage may also include images defining the risk area and a warning map.

During the five-year period 2005–2009, a yearly average of 76 outlooks was issued for 38 different weather situations (Fig. 2). The frequency of outlooks has been the highest during late summer, early fall and early winter.

Severe weather outlooks are issued for severe synoptic-scale winds (gusts ≥20 m/s), heavy snowfall (≥15 cm/day), thunderstorm wind gusts (≥20 m/s), heavy rainfall, large hail (≥2 cm), quick snowdrift on roads, heavy snowloads, high forest fire risk, bad air quality, very low temperature and freezing rain. An outlook may be issued also in other weather caused situations if it is expected to have a large impact on society.

FIG. 1: Layout of the extended outlook (in Finnish). The extended outlook may include images that can be viewed separately.

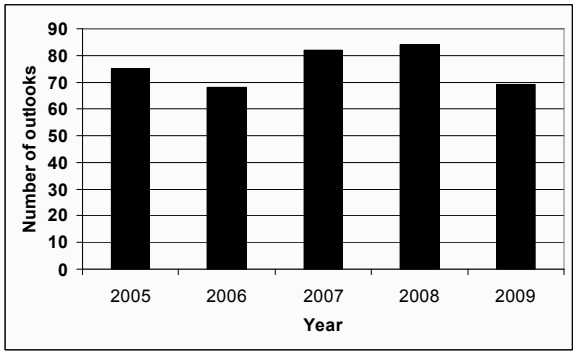

FIG. 2: Number of severe weather outlooks during 2005–2009.

III. OUTLOOK USER NEEDS

Most (74%) outlook users read outlooks with a computer which has a broad-band internet connection. However, the use of cell phones in this matter has clearly increased since the earlier user survey in 2007, as currently about 20% of the users read outlooks via cell phone. Surprisingly, large fraction of the users (69%) usually read only the short outlook received by e-mail. This fact highlights the importance of the well-constructed and informative alert e-mail message.

The most desired time of day to receive an outlook

is from morning to noon (60% of the respondents). However, for a third of the respondents time of day does not matter. It is obvious that in most organizations preparedness level is higher during office hours than during other times of day.

Despite the relatively short thunderstorm season in Finland, convective weather is well represented in the ranking of the most significant weather phenomena (Table 1). High forest fire risk, thunderstorm wind gusts, heavy rain and severe synoptic-scale winds are the most significant phenomena for fire brigades whereas road maintenance authorities are more interested in phenomena which have a direct effect on the state of the road surface (hail, heavy snowfall, quick snow drift). Railroad maintenance authorities closely monitor heavy snowfall and quick snow drift that affect the function of railroad switches. They are also interested in frequent lightning because it occasionally breaks down train tracking and guidance systems.

So far, no outlooks have been issued due to tornadoes. However, the survey results clearly indicate the need of "tornado outlooks" and encourage to further develop severe weather outlook service.

	All	Fire	Road	Rail
Thunderstorm wind gusts	**4,06**	**4,33**	**3,63**	**3,81**
Heavy snowfall (> 15 cm/day)	4,02	3,73	5,00	4,81
Severe synoptic-scale winds	3,89	4,07	3,88	3,50
Heavy rain	**3,84**	**4,30**	**4,38**	**3,50**
Tornadoes	**3,73**	**4,00**	**3,63**	**3,31**
Lightning	**3,72**	**4,02**	**2,75**	**4,19**
Drought / high forest fire risk	3,53	4,70	2,25	1,63
Quick snow drift on roads	3,53	3,16	4,75	4,56
Large hail (> 2 cm)	**3,51**	**3,73**	**4,88**	**3,00**
Very bad road conditions	3,5	3,88	5,00	2,69

TABLE 1: The most significant weather phenomena (top 10 out of 24) in Finland defined by outlook users (5 = very significant, 1 = insignificant). Fire stands for fire brigades, road for road maintenance and rail for railroad maintenance.

IV. PREPAREDNESS MEASURES

The most common preparedness measures based on the outlook information were checking the state of equipment, rescheduling work shifts and calling in extra personnel (Fig. 3).

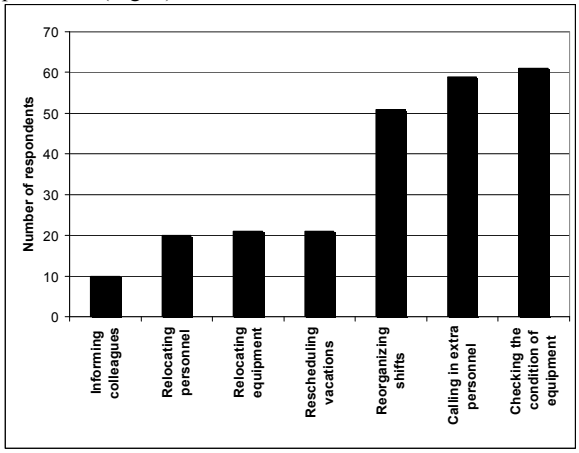

FIG. 3: Frequency of certain preparedness measures taken based on severe weather outlooks among respondents.

The frequency of different preparedness actions greatly varies from organization to another (Fig. 4). For example, Emergency Response Centers call in extra personnel and reorganize work shifts but do not relocate personnel or reschedule vacations. Moreover, among traffic authorities all preparedness action alternatives are used by some extent. It is also obvious that all organizations do not use special equipment in difficult weather situations.

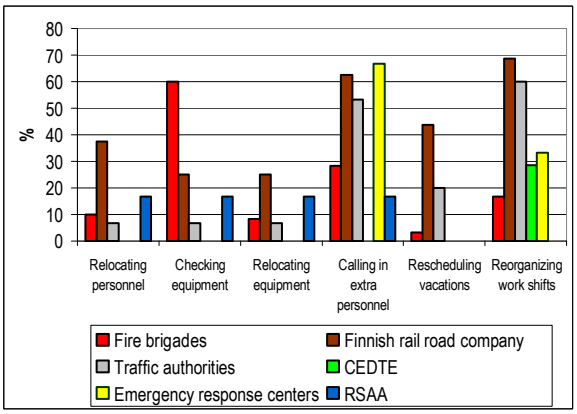

FIG. 4: Frequency of most common preparedness actions in different organizations. CEDTE stands for Centers for Economic Development, Transport and the Environment and RSAA for Regional State Administrative Agencies.

Capability to prepare is naturally dependent on the available lead time. During 2005-2009, the first outlook gave on average 16 hours time to prepare for the weather situation (difference between the issuing time and forecasted beginning of the event). Most of the outlook users are able to react to the outlooks within a few hours and for three fourths of the respondents even a one-hour lead time is enough for implementing certain measures. With a 12-hour lead time 95% of the respondents are able to take at least some preparedness actions. The majority (74%) of the outlook users were satisfied with the outlook lead times.

The chosen preparedness actions strongly depend on the lead time (Fig. 5 and 6). Short lead times allow calling in extra personnel, checking the equipment and forwarding severe weather information. With a 24h and longer lead times reorganizing work shifts and relocating equipment become more common. Differences between organizations and even within the same organization are still significant. For example, with a 1-hour lead time fire brigades call in extra personnel more frequently than traffic authorities. The variation of replies within the same organization is probably due to the different practices between organization's units.

V. DISCUSSION

A clear majority (75%) of the respondents assessed that the outlooks have eased to cope with difficult weather situations. The main reason for this improvement was the longer preparation time, which offered the possibility to rearrange work shifts and allowed better scheduling of the work tasks and internal communication within rescue organizations. Many respondents said that just becoming aware of severe weather risk makes easier to cope with the situation.

Two thirds of the respondents estimated that the outlooks improved the quality of their services (Fig. 7). This is also assumed to have a general positive effect on society's

ability to recover from harsh weather conditions. Many respondents believe that severe weather outlooks have shortened disruption times in electricity supply and traffic and decreased the amount of material damage and injuries (Fig. 8). Some of the respondents also mentioned that the outlooks improve severe weather communication and thus, have positive effect on how people act under severe weather threat. With the aid of improved communication people probably drive more carefully and reschedule their outdoor activities.

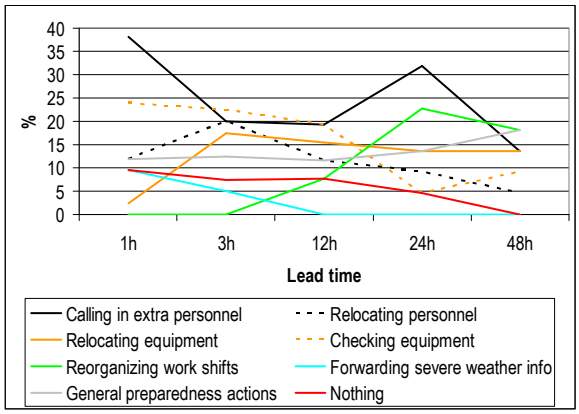

FIG. 5: Frequency of preparedness actions with different lead times among fire brigades (60 respondents from several offices and positions).

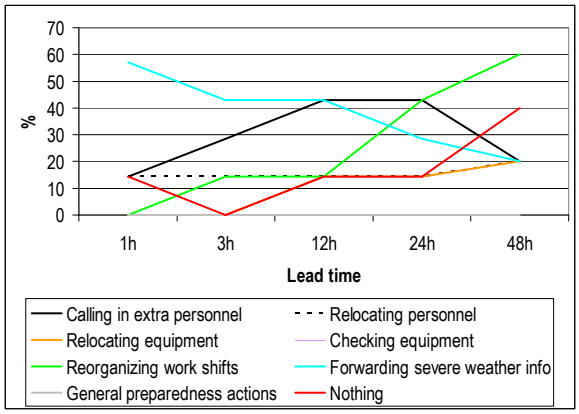

FIG. 6: Frequency of preparedness actions with different lead times among traffic authorities (15 respondents).

A half of the respondents were unable to assess the cost effects of the severe weather outlooks for their organizations. A third estimated that there have not been significant changes in the costs. Moreover, 5% said that the costs have increased due to the outlooks. This is mainly due to calling in extra personnel in advance before the onset of the event or in false alarm situations. On the other hand, optimizing the needed resources was seen by some respondents as mean to reduce expenses. Several respondents recognized that right timing and fast response actually decreased their organizations' costs.

In general, respondents are very satisfied with the severe weather outlooks and the user survey results clearly show the importance of this kind of service. With the aid of outlooks, rescue and civil protection authorities gain time and are better prepared for severe weather in most cases. Higher level of preparedness in rescue services and meteorological institutes may cause them extra costs. Nevertheless, these expenses are easily compensated by the benefits of better response to severe weather caused interruptions and society's faster recovery from these situations.

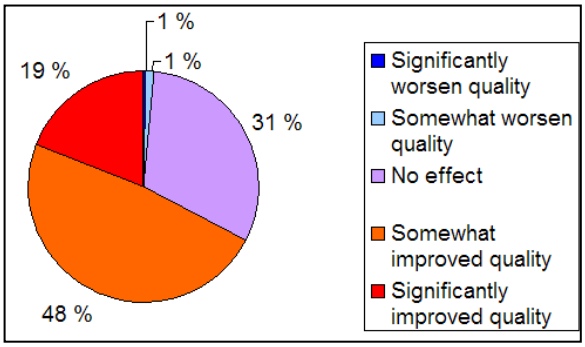

FIG. 7: The effect of the severe weather outlooks on the quality of service provided by respondents' organizations.

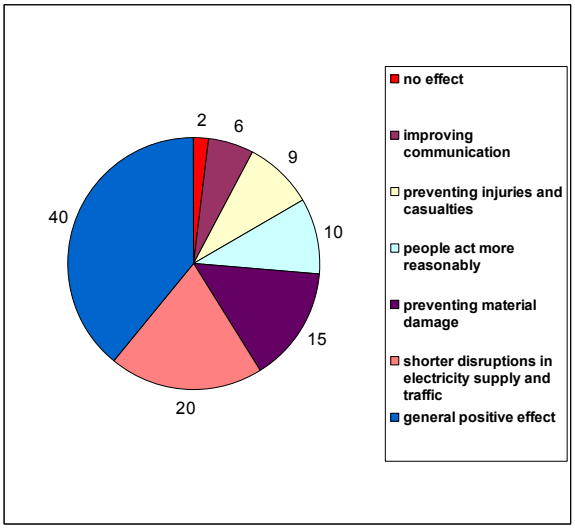

FIG. 8: The effect of the severe weather outlooks on society's ability to cope with difficult weather situations (pointed out by respondents).