



Evaluating the effectiveness of impact-based, extreme weather warnings and behavioural recommendations

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Extreme weather warnings are only as valuable as the degree of appropriate behavioural change that they induce. There is evidence of suboptimal response to today's standard warnings (SWs), primarily due to too little behavioural change. In response, National Meteorological and Hydrological Services (NMHSs) have started to put greater emphasis on impact-based warnings (IBWs). Compared to standard warnings, which are based on the weather regardless of the potential effects of the event, IBWs are designed to provide people with more information about the hazard and its impacts on specific infrastructure and actions. In this study, we compared how the general public reacts to IBWs vs SWs, with vs. without behavioural recommendations. Indeed, standard warnings in a lot of European countries such as Switzerland, and unlike in the USA, do not include precautionary or preparedness actions. Therefore, we also considered the possible effects of behavioural recommendations in this study (e.g. avoid mountain ridges, exposed trees, groups of trees, masts and towers, all of which are at risk of lightning strikes). In November 2017, we conducted an online experiment (N=1121) that investigated the public's response to warning communication about a severe thunderstorm event in a hypothetical scenario. We randomly assigned respondents to one of four warnings types (SW; SW with behavioural recommendations; IBW; IBW with behavioural recommendations) and asked them to make decisions about their prospective behaviours. These included to not alter their plans, to adapt them, to interrupt them or to seek more information. We also asked respondents to evaluate the quality of the warning information in terms of clarity, understanding, credibility, as well as concern and threat evoked by the warnings. We observed both types – with or without behavioural recommendations - of IBWs to result in a higher likelihood to take immediate protective action compared to the two both types of SWs. At the same time, we also observed IBWs with recommendations to result in an even higher likelihood to engage in protective behaviour compared to IBWs without such recommendations. Moreover, recipients of warnings that included information about behavioural recommendations reported finding the warning clearer, easier to understand, and more credible, than recipients of warnings without these recommendations. They were also more concerned about their safety, and understood better the threat and behaviours to engage in. Finally, perceptions of credibility, concern and threat influence taking protective actions, as do general risk perception and warning experience. Overall, the results support the conclusion that impact information coupled with behavioural recommendations in warning messages, promote more effective decisions than standard warnings.