Understanding of extreme temperature events by environmental health stakeholders in South Africa

J John[1,1], RM Garland[1,2], WA Landman[1,3]

[1]CSIR Climate Studies, Modelling and Environmental Health Research Group, Pretoria, South Africa; [2]Climatology Research Group, Unit for Environmental Sciences and Management, North West University, Potchefstroom, South Africa; [3]Department of Geography, Geoinformatics and Meteorology, University of Pretoria, South Africa

Abstract

The purpose of the work is to understand the potential need and use of extreme temperature forecasting products in the environmental health sector in South Africa by using an online questionnaire.

Seven of 19 respondents currently receive hot weather warnings. Most agreed that industries and government currently do not have adequate heat-health action plans, with only one indicating that they had policies/plans in their work environment in the event of high temperature forecasts. However, 16 respondents would regard such a plan as useful.

Respondents did identify a need for a forecasting system but seem unsure about the range of capabilities that it can provide.

Keywords: Environmental Health, Climate, Weather Forecast, Practitioners

Introduction

A changing climate can potentially have a large and negative impact on human health, especially in Africa where there are a large number of vulnerable people and an over-burdened healthcare sector (Confalonieri, 2007). In addition, the interior regions of southern Africa are projected to experience increases in temperature as great as 4-6˚C under the A2 emission scenario, by the end of the century (Engelbrecht and Bopape, 2011). The warming atmosphere is expected to contribute to an increase in storms, floods, and other extreme weather events; thus scientists and meteorologists will need to rely more on advanced computing power (models) to develop medium-range forecasts that are accurate enough to save lives and property (Katz, 2015*).* Exposure to high ambient temperatures and heat waves can have large negative impacts on human health ranging from discomfort and fatigue, to heat stroke and death. Thus, the projected large increases in temperatures in Africa may lead to large negative health impacts. Also, temperature is also the easiest weather variable to predict*;* 'being more than 80% accurate if predicted 3-5 days in advance, moderately accurate (> than 60%) accurate , 5-10 days ahead, and a low degree of accuracy (40-60%) if predicted more than 10 days in advance' (Hughes et al., 2004).

In order to mitigate the impacts of high temperatures on human health, many countries utilize early warning systems and heat-health plans. The National Climate Change Response Plan has in fact highlighted the need for the creation of such plans. A key component of these plans includes weather forecasts, a tool that can be easily utilized by the health sector. Although under-utilised within public health, there is a growing recognition of the ability of weather forecasting to predict threats to health. (Hughes et al., 2004) The usefulness of these forecasts as a public health tool relies on the availability of accurate and timely information that is easily understood by the health sector and that is actionable. When developing forecasting products for early warning systems and heat-health plans, it is important to balance what metrics (i.e. maximum temperature) can be forecasted with certainty and what metrics are needed by the health sector.

In South Africa, the uptake and use of forecasts, at weather and a seasonal scale is not well-understood by the health sector. This project surveyed environmental health researchers and practitioners about their potential need and use of extreme temperature forecasting products.

Methods

[1] Tel 012 841 4189
Email: jjohn@csir.co.za

An online questionnaire with 49 questions, developed through Google docs, was tailored to investigate and understand the potential current use and need of extreme temperature forecasting products in the environmental health sector in South Africa. Table 1 below highlights the topics that were covered in the questionnaire. The survey contained non-identifying questions on the respondents.

Open-ended (5) and multiple choice (44) questions were used, of which 22 utilized a five-level Likert scale, ranking responses from strongly agree, agree, neither agree nor disagree, disagree to strongly disagree. Table 1 gives an overview of the types of questions and key variables, including the explored traits related to the perceptions of environmental health practitioners to the topics. The questionnaire was piloted before circulation. Ethics approval was granted by the CSIR Research Ethics Committee (Certificate Number: 71/2013).

Members of the Environmental Health Researchers Network (EHRN) were selected as study subjects, using a convenience sampling technique. The EHRN, developed in 2009, is a community of practice for those interested in environmental health research. The network includes researchers, Environmental Health Practitioners (EHPs) and government officials across South Africa. As participants in the group are working on and are interested in how the environment can impact human health in South Africa, it was deemed that they represent the main health stakeholders in the country that would be interested in using heat forecasts for health-planning purposes which could include the task of developing and implementing a heat-health plan or health early warning system. They were thus deemed to be appropriate subjects for the survey.

At the time during which the survey was circulated, the total membership of the network was ~143. As this number was tabulated in December 2013 and the survey was circulated in January 2014, it was assumed that the membership did not change significantly. The survey was circulated as an email through the EHRN listserv with the invitation to participate and the link to the survey. Participants who were not able to complete the online survey were sent an excel copy of the survey to complete. The survey was available online for one month and a reminder email was sent to the participants five working days before the closure of the survey.

Table 1: Overview of survey topics and key variables

Overall topic	Variables	Question method
General information on respondent	Type of organization; Field of work; Years working in field; Location of work (by Province); Level of education	Categories
Perceived importance of heat on health currently and into the future	Currently receive weather warnings of extremely hot temp/ heat waves.	Binary (yes/no)
	Public/occupational health impacts from exposure to high temperatures currently not a problem[1].	Likert scale
	Public/occupational health impacts not projected to be problem into the future[1]	
	Knowing likelihood of above average temperatures occurring 1 wk-3 months ahead would aid to plan for preventing negative health impacts.	
Current use of heat-health action plans	Industries/government currently have adequate heat-health action plans to protect workers/public.	Likert scale
	Set policies or plans in work environment to follow If high temp forecasted?	Binary (Yes/No)
Perceived need for heat-health action plans and early warning system	If none, would a set plan that would be tailored to your needs be useful in your opinion?	Binary (Yes/No)
	How do you find out if high temperatures or heat waves are forecasted?	Categories (multiple responses)
Current use and perceived future needs for forecasting products	How far in advance would you like to know if high temperatures or heat waves are forecasted?	
	What sort of forecasted information related to heat-health would be most useful?	
	What format would be most useful to display the forecasted information?	Categories (single response)
Feedback on example forecasting product	- helpful to show both "Observed" and "Forecasted" data as a comparison.	Likert scale
	- product would be useful in my work if it were tailored for my area.	

Overall topic	Variables	Question method
	- figure is confusing. - not helpful to see the historical data. - easy to understand main message of the figure.	

[1] Used to derive Likert score "perceived heat-health score"

Results and Discussion

The results were captured into Excel and subsequently imported into Stata 13, a biostatistics package, for analysis. Tabulations, frequencies and contingency tables were used to analyse the data.

A total of 19 responses were received; 16 of which were submitted electronically and three through an Excel version via email, corresponding to a 13% response rate. Demographics of the participants indicated the predominant field of work as environmental health, with most of the respondents (12) from government, with their place of work representing five provinces. The years in the field varied between 1 and 34 years, with 21% having 7 years or less experience. Almost half of the respondents (8) had post-graduate training.

Perceptions of heat and health and impact

Only seven respondents indicated that they currently receive weather warnings of extremely hot temperatures and heat waves. However, 11 respondents indicated that they know someone whose health had been affected by high temperature. Most respondents disagreed that public and occupational health impacts from exposure to high temperatures are not or will not be a problem in future (Table 3). As the combination of these four questions measured the underlying characteristic regarding the perception of heat-health impacts, the scales were combined into a Likert score (or 'heat-health perception score'). This score (see Table 3) indicated that more than half of the respondents believed that health impacts from exposure to high temperature are currently and will be a problem in future.

Table 2: Responses to statements on health impacts from exposure to high temperatures.

Statement	Response		
	Agree[1]	Neutral	Disagree[1]
a. Public health impacts currently not problem.	1	2	16
b. Occupational health impacts currently not problem.	2	1	16
c. Public health impacts not problem in future	4	5	10
d. Occupational health impacts not problem in future.	5	1	13
"Heat-perception score" (comb a-d)	1 (0-10)[2]	7 (11-15)[2]	11 (16-20)[2]

[1] combined strongly and somewhat [2] score sum

Policies and plans on heat-related health

Fourteen respondents agreed that industries in general currently have adequate heat-health action plans to protect their workers from extremely high temperatures and heat waves, while nine respondents agreed that government currently have such plans to protect the public. However, only one respondent indicated that there were in fact set policies or plans in their work environment that must be followed in the event of high temperatures being forecasted with 12 indicating that there were not (six did not know). Nonetheless, 16 respondents were of the opinion that a set plan, tailored to their needs would be useful. Some aspects deemed useful for such a plan include:

- Information on expected symptoms and awareness-creation of health impacts of high temperature.
- Regulation of working conditions to protect employees against the effects of high temperature, including the average time to be spent in a very hot environment, measures to prevent and treat heat-related symptoms, availability of resource for hydration and sun protection.
- Procedures to follow in the case of an event to be aligned to current health and safety plan.
- Short and long-term action points, including reporting of incidents.

Knowledge and use of forecasting products and information: weather and seasonal time-scale

Nine respondents agreed that seasonal forecasts providing information on the likelihood of extremely high temperatures would be helpful. Eight of the 10 respondents who agreed that knowing one week or more ahead would aid in planning to prevent negative health effects, indicated a temperature range as being the most useful forecasted information related to heat-health, followed by temperature scale linked to possible health outcomes at each scale (7). Most respondents who preferred to know one week or more ahead indicated that they would use either tv (8) or radio (7) as means to get forecasts.

Eight respondents indicated that a map will be most useful for presenting forecasted information. An action or piece of advice and a table was the least preferred formats.

An example forecasting product for a South African town were included in the questionnaire (Fig. 1), followed by statements on its usefulness. Responses to these statements are shown in Table 3.

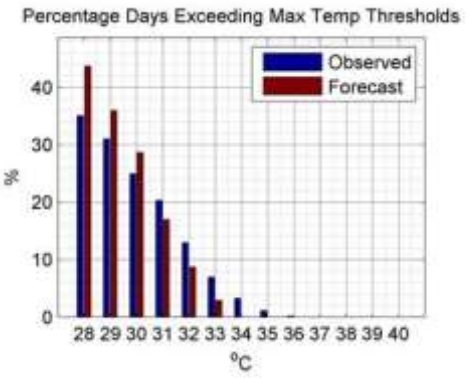

Figure 1: Example forecasting product comparing days "observed" and "forecasted" where the max temperature is expected to exceed different temperature thresholds.

Table 3: Responses to statements on the usefulness of the example forecasting product.

Question	Statements	No of Responses
Feedback on usefulness of example forecasting product (somewhat or strongly agreed)	- Show "Observed" and "Forecast"	13
	- Useful in work if tailored	15
	- Figure not confusing.	10
	- Helpful to see historical data	9
	- Easy to understand message	10

One of the main points from the survey was that people were interested in forecasting material, including on a seasonal scale, but didn't actually understand what was possible – e.g. they want to know on day x three months in future the temp will be Y. It was also indicated that the product should be readily available without subscription or a fee.

Discussion

This survey tested the knowledge of and perceived need in the health sector for forecasting products of extreme temperatures with different lead times that could aid this sector in their development of heat-health action plans and policies. Although the response rate was very low, the results do indicate that, although the perception exists that both government and industry have adequate heat-health plans in place, no set policies or plans are in place in the work environment, should high temperature be forecasted, or if there are, that the level of awareness about them was very low. As most respondents indicated that they would find both a tailor-made set plan, as well as information on the likelihood of extreme temperatures useful, it does point to the need for timeous information that could be applied by professionals in the health sector.

Weather forecasting techniques have the potential to contribute to timely public health information and to the achievement of adequate access and care, and combined, may reduce levels of mortality and health inequalities caused by weather variability. An improved understanding of the relationships between weather and health, together with appropriate transmission tools can assist in predicting and communicating the public health impact of future climate change.

In developing appropriate tools, it should be borne in mind that, even though a global framework for climate services, which contains information to help the health community to make decisions, is in place, the current framework for model development is top-down, beginning with climate and ending with health outcomes. Community mind-sets and existing modelling tools thus need rethinking and transformation to make climate services work (Betts and Sawyer, 2015).

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