Surveillance of Extreme Urban Heat Events Using Satellite Imagery and Geographical Information Systems

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Objective

This paper describes a method of determining areas at risk during extreme urban heat events using remote sensing technologies, geographical information systems and artificial neural networks.

Background

Heat related illness is the number one cause of human death in relation to extreme weather events in the United States, resulting in an average of 400 deaths per year over the past few decades [1]. It is also expected that both the duration and intensity of these events will increase [2]. The temperature of the surface is measurable from a number of space borne satellites and can be derived using a number of available algorithms [3]. This type of data can be compared to census collected variables to determine the number of persons at risk for heat related morbidity and mortality within urban environments.

Methods

Death certificate data was retrieved from the Pennsylvania Health Department for the 1993 Philadelphia heat event. Satellite imagery was collected for dates corresponding to this event and was processed to reveal surface temperatures. The mortality data was then geocoded to correspond to the address of the decedent and aggregated to the census tract level. Census variables were then examined for a relationship with the areas where mortality occurred. The thermal characteristics, the census variables and the mortality data were then examined via an artificial neural network to develop disease and risk maps.

Results

There were 21 recorded deaths with hyperthermia as the leading cause and 118 deaths with hyperthermia as a contributing cause. The majority of these deaths occurred in areas of higher surface thermal temperature; however inconsistencies were presented in the exact relationship with temperature variation itself. Census variables, which are typical of lower socioeconomic status, consistently identified areas of risk from the models developed with the artificial neural network.

Conclusions

Socioeconomic status and the surface thermal characteristics provide a likely clue which is beneficial for the surveillance of environmental hyperthermia in large urban areas. A surveillance system using a full range of satellite imagery, census variables and the current system in place by the National Weather Service could provide a much more robust alert system during these events.

References

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