Module 1: The Importance of Spatial Thinking to Disaster Management

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The amount of possibility associated with the integration of geographic information systems and emergency management is very high, and increasing. When considering how to best apply the tools and resources available today to both the scholar and the practitioner, we see there are a myriad of ways to approach the work, and there are continuously new updates in technology and advances in application techniques. However, the changes to thinking spatially do not necessarily correlate linearly as technology does. Spatial elements of data include location (xy), time (t) and elevation (z). Points, lines, and polygons may represent these spatial elements. (Country-Day, 2019). The ways in which these representations are portrayed may improve many aspects of preparation, execution, and communication of emergencies and disasters. Thinking about each aspect of GIS with these perspectives of broad application and rapid ongoing technological change in mind is a key factor for emergency managers to consider when choosing how the tools available best fit with local strategies and practices. As emergency managers determine how best to employ GIS in their standard operating procedures and game plans, they must consider why it is important to think spatially, how this thinking is best supported, and what challenges there are to develop effective spatial perspectives.

The earth's climate is changing, with many variables contributing to the processes at work in the associated biological and ecological systems. One of the drivers of climate change is anthropomorphic contribution to greenhouse gasses causing a warming trend. This is important to understand immediately and take action to mitigate wherever possible. Emergency managers must understand how sea level rise will contribute to frequency of local flooding and other hazards such as air quality and local urban heat islands (UHIs). There are two studies that demonstrate how thinking spatially about these problems can improve data synthesis, provide emergency managers with better support for well-reasoned decision making, allow for improved modeling and mapping to demonstrate how changes might affect populations, and improve overall situational awareness.

The first case study (Zhu et al, 2020) was conducted to determine the prevalence of UHIs by determining the deviation within specified zones from a reference rural temperature. Understanding these deviations has been done in the past; this study takes into account the idea that each zone is not a stagnant quadrant of air and soil. There are many variance factors to consider, such as weather, wind, solar heating, seasons, presence of structures and their type, etc. This study used a regression style mathematical approach to determine these variance factor contributions to or limits of heating. When applied data is paired with GIS, the zones are better represented and provide a way for emergency managers and urban planners to move forward smartly with real time data from applied sensors deployed strategically, a potential game changing application of technology to reduce UHIs in urban areas.

The second case study (Fotheringham et al, 2019) acknowledges a massive uptick in air pollution in China's urban areas since the late 1970s. The externalities associated with all of the trappings of modern industry have created a situation that is detrimental to human health and contributes negatively to the climate change trend. The study reviewed current mathematical approaches to mapping these heavily polluted areas and determined a way forward using a new, more detailed approach that includes variables to more finely show a band of variance in pollution, per unit area, as mapped. The importance cannot be overstated of enabling stakeholders by continuously refining techniques to show data in ways that allow for human or artificial intelligence interaction with variables to tailor desired outcomes.

Climate change is already affecting locations all around the world. Even without acknowledging this trend, natural and man-made disasters happen in every location at some periodicity. Emergency managers must develop hazard mitigation plans and emergency response procedures for chronic and acute conditions, respectively. Using GIS to support spatial thinking about sea level rise, warming trends, loss of permafrost, trends in the Jetstream driving weather pattern changes, etc is a critical aspect of every emergency manager's job. The challenges associated with establishing this structure include lack of local knowledge, past practices of taking a less data integrated approach, funding, training and expertise, and poor perspectives on the value of GIS support of typical spatial representations. Additionally, as demonstrated in the two case studies I discussed above, there is a great amount of scholarly work being done that demonstrates there are gains being made in GIS that support better spatial thinking for emergency managers. The problem often becomes how to best integrate the scholarly knowledge gains with the policies and procedures put in place for practitioners in the field. As emergency managers see best practices employed successfully elsewhere these gaps can shrink and GIS will support spatial thinking, allowing mapping to take on a larger role in providing situational awareness, planning, hazard mitigation, and better control of climate changing and human health affecting variables.

References

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