GeoCollaborative Crisis Management (GCCM)

Building better systems through advanced technology and deep understanding of technology-enabled group work

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The need to develop information science and technology to support crisis management has never been more apparent. Federal, state, and local government agencies must develop coordinated strategies and adopt advanced and usable technologies to prepare for and cope with crises in contexts ranging from natural disasters to homeland security.

Crisis management is considered here to include both strategic assessment (work to prepare for and avert crises) and emergency response (activities designed to minimize loss of life and property). G*eospatial information* plays a key role in both activities, providing context and details about the event itself, its causes, the people and infrastructure affected, and resources available to respond. Crisis management also requires close coordination among individuals and groups of individuals who need to collaboratively derive information from geospatial data and use that information in coordinated ways. *Current geospatial information technologies, however, fail to support group work and have typically been designed without scientific understanding of how groups (or groups of groups) work in crisis management to collect, process, and use geospatial information*.

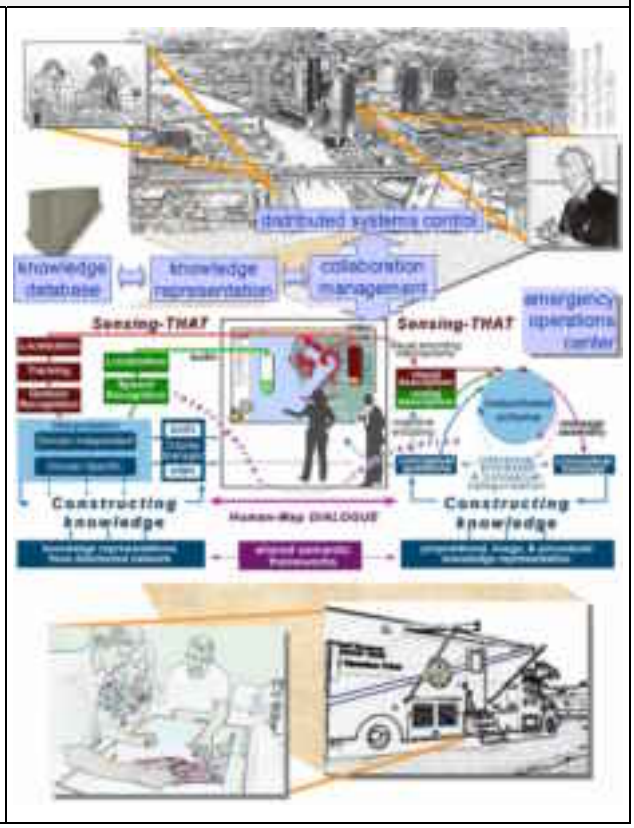
Our research addresses both of these problems in an integrated way, within the context of real world crisis management activities. The research is focused on parallel, integrated advances for two fundamental components of *GeoCollaborative Crisis Management* (GCCM): (1) developing a deep understanding of group work with geospatial information and technology and (2) developing advanced geospatial technology to support both same-place and distributed, dialogue-enabled, collaborative crisis management activities. The research is advancing both theory and technological practice required to make geospatial information technology more effective for command and control, situation assessment, and crisis response activities.

Agency collaborators include units focused directly on crisis management for natural hazards (chemical, biological, meteorological) and on homeland security as well as units that supply the geospatial information to meet their needs. Federal partners include the EPA (four units), HHS-Agency for Toxic Substances and Disease Registry, NIMA, USGS, NASA (Earth Science Applications Division), Air Force Research Laboratory, Wright Patterson Air Force Base, and the Federal Geographic Data Committee. State partners are the PA-DEP, the Port Authority of NY & NJ, Operations & Emergency Management, and the Florida Emergency Management Agency. Our industry partner, *Advanced Interface Technologies, Inc.* (AIT) will collaborate on technology implementation portions of the research.

Our research is addressing collaborative geoinformation use and technologies to enable all stages of crisis management (mitigation, preparedness, response, and recovery, with an emphasis on preparedness and response. The approach we take is a human-centered one that builds on theories of distributed cognition, emphasizes development of intelligent adaptive systems, applies robust Cognitive Systems Engineering (CSE) methods, and takes a Living Laboratory perspective. Our vision for next generation distributed GCCM is characterized in the Scenario and figure below.

A Scenario: Imagine a crisis management center with Center Director Jill White and chief logistics manager Jim Smith, in front of the large-screen display provided by the agency's *GeoCollaborative Crisis Management (GCCM) system*.

The Crystal River nuclear power plant has notified officials that an accident occurred, resulting in a potential radioactive particulate release within 9 hours. Response professionals with a range of expertise, work to determine the impact area, order and carry out evacuations, and deploy RAD health teams to identify 'hot zones' in residential and agricultural areas. Based on available information, immediate decisions must be made about where and how to evacuate or quarantine residents, establishing decontamination checkpoints, deploying rescue and RAD health teams, ordering in-place sheltering, and prioritizing situations. As field personnel deploy, the command Center focuses on coordination of the distributed activity among many participants who are using a range of devices and who have a wide range of geospatial information needs. At right, we represent the multimodal, dialogue-enabled *GeoCollaborative Crisis Management* methods and technologies we envision, and to which our research is targeted. The central portion of the figure depicts models of the complementary system/human knowledge construction processes and components of the proposed dialogue-enabled links between them.



The research is focusing on two problem domains relevant to achieving the above vision:

- Group work in Emergency Operations Centers (EOCs) around large screen, GIS-enabled displays using multimodal, gesture-speech interfaces.
- Distributed teams – some of whom use mobile devices in the field linked to others using desktop or large-screen displays in the EOC or in mobile field stations.

Specific research questions being addressed include:

- **Distributed cognition**: How can we facilitate distributed cognition in GCCM? What role can external, visual, manipulable representations play in distributed cognition for teams?
- **Visually-enabled group work**: What are the impacts of visual-mediation tools on group work with geospatial information and how can these tools be enhanced?
- **Multimodal interfaces**: What role can multimodal interfaces play in GCCM command centers? How can multimodal interfaces support work of distributed, mobile teams?
- **Dialogue management**: How can technology enable human-computer-human mixed initiative dialogues for GCCM activities?
- **Intelligent adaptive systems**: How can intelligent geo-appliances enable user-computational power in the real world? How can we support robust, human—agent, shared mental models providing context for mutual adaptation in a changing environment?
- **Time-critical decision support**: How should geocollaborative devices be designed to facilitate user-centric, distributed team use in stressful crisis management environments?