DHS/FEMA

Modeling and Data Working Group

Phase II Report

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Executive Summary

The Modeling and Data Working Group (MDWG) was established in August of 2012 by the Emergency Support Function Leadership Group (ESFLG) to identify and assess the data and modeling resources that are used across the interagency during emergency management. The membership was chosen by the ESFLG and is chaired by the Director of FEMA's Planning Division, Response Directorate. The working group is supported by Gryphon Scientific, whose role is to collect and analyze the information required to identify the data and modeling resources available and determine when and how those resources are used in the context of emergency management. This information has been and will continue to be gathered during extensive interviews with the MDWG members and the subject matter experts they recommend. The scenarios addressed by the MDWG during the first iteration of the project are limited to earthquakes and hurricanes with additional scenarios to be addressed by exception during future iterations of the project.

This project is divided into four phases as follows:

- **Phase I:** determine what decisions are made using data and models during emergency management, with a focus on the questions data and modeling are used to answer;
- **Phase II:** determine what data and information sources inform those decisions;
- **Phase III:** identify and characterize the models and data processing tools required to produce operationally-relevant decision-support information;
- **Phase IV:** identify what resources are the most empirically useful based on the known user communities and produce an interactive library of available models and decision-support tools accessed via a GUI that will facilitate an understanding of the flow of information during emergency management. This product will identify both the producers and consumers of the resources.

In this report, we describe the findings from phases I and II of the project. A framework describing the flow of information through iterative steps of data collection and data processing outlines how data and modeling resources are used to produce information to support decision-making—from the scientific models that forecast the weather to the calculations that drive hiring decisions for surge personnel who provide support to survivors after the event. This framework is mapped onto the timeline of an event to provide context for the temporal aspects of the flow of information during a disaster. The primary findings of this project include:

- Data and/or modeling are used across the interagency and by those involved at all levels of emergency management;
- Producing operationally-relevant information requires iterative steps of data collection and processing;

- The information required to support operational decision-making is phase-specific and diverge by mission areas as the event progresses;
- Different types of data and methods of data collection are necessary to inform each specific mission; however, event characterization data for hurricanes and earthquakes are primarily provided by a select group of agencies with clearly defined mission-spaces.

We have completed an initial assessment of the data and information sources currently being used at an operational level to support decision-making related to hurricane and earthquake scenarios. A complete inventory of these datasets (as identified by the members of the MDWG) is included in Appendix 7.

Due to the ongoing nature of the research and analysis informing this report, this document will be updated and expanded at each phase of the project. This method will allow us to capture the feedback of the members of the MDWG in an ongoing fashion to generate a report that accurately and meaningfully reflects the resources, stakeholders, and capabilities used to support emergency management across the interagency. Resources, networks, and processes will be added, defined, and incorporated throughout the project; the report will be expanded as necessary to reflect additional findings that have not been included in previous phases of the report.

A set of bullet points outlining the primary findings can be found in the blue boxes at the beginning of each section of the document.

Introduction

Introduction Overview

- The amount of information available to emergency managers has dramatically increased in recent years as new data resources and modeling tools have become available.
- The Modeling and Data Working Group (MDWG) was established in August of 2012 to engage interagency stakeholders to collaborate more effectively on issues related to the use of data and models for emergency management.
- The MDWG will identify and catalog the authoritative data and modeling resources required to support operationally-relevant decision making.

Informed decision-making is key to successful emergency management. New data resources and modeling tools, as well as ready access to these resources, have led to a rapid expansion in the amount of information available to decision-makers across the interagency during emergency management. However, the information produced is not always available to those who need it when they need it, is often not in a form that best facilitates operational decision-making, or has not been sufficiently verified and validated to inspire the confidence of decision-makers. Furthermore, a lack of coordination of efforts has led to situations in which conflicting results have been presented and in which the available data or information could not be effectively leveraged to support effective decision-making.

In August of 2012, the Emergency Support Function Leadership Group (ESFLG) established the Modeling and Data Working Group (MDWG) to identify and catalog the authoritative data and modeling resources required to support high-level, operationally-relevant decision making, particularly during the time-sensitive response period, but across all phases of emergency management from preparedness and planning, to response, recovery, and mitigation. The working group was designed to engage stakeholders from across the interagency to collaborate more effectively on issues related to the data and models used to support all phases of emergency management by identifying and characterizing existing resources based on their utility. The goal of the working group, as defined by the charter, is to establish an authoritative list of the most useful and effective resources available to support decision makers across the interagency during emergency management.

The charter and project plan can be found in Appendices 1 and 2.

Project Overview

Overview

- Through interviews with high-level decision makers, program managers, and subject matter experts, the MDWG is identifying the data and modeling resources currently being used to support emergency management.
- The project will characterize not only which data and modeling resources are in use, but also when, how, and by whom those resources are accessed, and what questions they are used to address.
- The project has four phases, the descriptions of which can be found in Figure 1.

The project has been divided into four phases (see Figure 1). The goal of phase I was to identify how, when, and for what data and modeling are used during planning and operational decision-making during emergency management, with a focus on the questions those resources are used to address. The goal of phase II was to identify the information required to support this decision-making and to catalog the data resources that provide that information. The goal of phase III is to identify, characterize, and evaluate the existing data processing tools, including predictive models and assessment tools, that are used to process data collected prior to, during, and after an event to produce the operationally-relevant information. During phase IV, the analytical framework will be completed and an interactive catalog of the data and modeling resources identified and characterized during earlier phases of the project will be built. A gap analysis will inform a series of recommended Courses of Action to address the gaps identified, build an interactive inventory providing access to and information about the resources identified, and outline paths forward to best leverage the strengths, collaborations, and resources already in place across the interagency. A more detailed description of the final product is included in the next section.

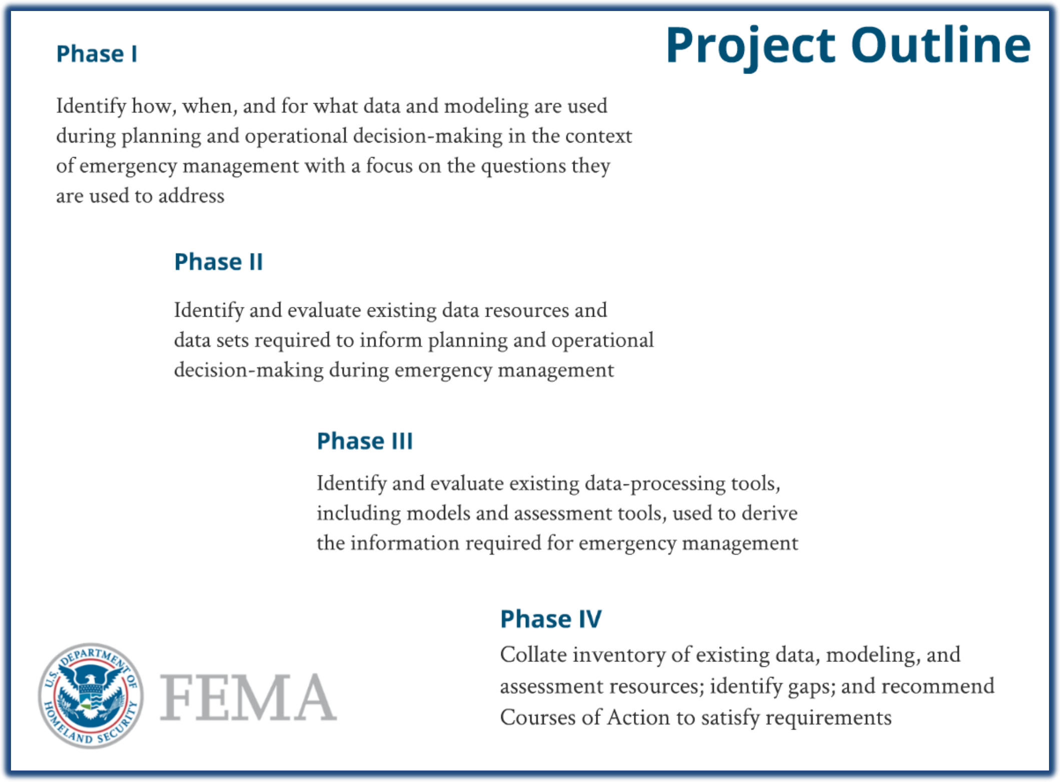


Figure 1. Project overview with a brief description of each phase

Description of the Final Product

Overview Description of the Final Product

- The final product of the project will be an interactive inventory of the data resources, models, and decision-support tools currently in use across the interagency.
- More specifically, the product will be a database, accessed via a user-interface, that will facilitate an understanding of the flow of information during emergency management and identify the producers and consumers of those resources.

The MDWG has been tasked with identifying and characterizing the authoritative data and models used to support operational decision-making during emergency management across the interagency. The resulting information will be collated into an interactive inventory of the data sets, models, and decision-support tools available, accessed via a user-interface that will facilitate an understanding of the flow of information during emergency management, and allow the rapid identification of the producers and consumers of those models/tools. The product will provide a description of each resource and its operationally-relevant characteristics. The database component will be exportable for use during planning activities and to provide a comprehensive list of available resources. In order to make this database accessible and useful during an event, a user-interface will be designed that will facilitate user inputs and queries to identify the resources available relevant to the question, mission, or organization requiring the information. The details of this product will be defined and refined over the course of this project to ensure that the information collected will be available in a useable format, specifically designed to support operational decision-making.

The contact information associated with each resource will include that of the owner or producer of the resource who can address questions relevant outside of an event and the contact information for the person or group responsible for providing access to the resource or its outputs during an event. In some cases, these contacts will overlap; in others, they will diverge. The contact information for each resource will be verified with those contacts before the final product is released.

Importantly, the final product of this effort will be specifically designed for use and maintenance by the user community, as is expected to be defined over the course of this project.

Use Cases: Hurricanes and Earthquakes

Overview of Use Cases: Hurricanes and Earthquakes

- The MDWG chose to focus initially on hurricane and earthquake disaster scenarios, as they are well-practiced and relatively well-understood.
- A comprehensive framework describing the flow of information used for emergency management during these scenarios can later be applied to additional scenarios or use cases.

The need for a comprehensive understanding of the data and modeling requirements for planning and operational-decision making is consistent across all emergency scenarios. The MDWG chose to focus on the large-scale hurricane and earthquake natural disaster scenarios typified by Hurricane Ono and the New Madrid Earthquake scenarios, which were used as the basis for recent national level exercises. While many efforts have previously focused on these types of scenarios, they provide a useful starting point to assess the data and modeling requirements, develop methodology, build a framework, and define authoritative resources for decision-making based on the utility of the resources identified. Precisely because the requirements for these scenarios are relatively well-understood and the necessary resources are generally available, this initial effort can be focused on organizing the available resources so they can be more efficiently and effectively shared, enhancing collaboration and resource-sharing across the interagency. Because these scenarios are well-understood and frequently practiced, decision-makers are better able to articulate their information requirements and clearly define their needs. As we build a framework that describes the flow of information and the time-dependent aspects that define the utility of this information, the analysis can be verified because the users of the tools can ensure that all the resources available can be captured within the framework. This understanding will allow us to build a comprehensive inventory that captures all requirements and their corresponding resources. Furthermore, because the gaps are likely to be limited, they can be clearly defined, and the Courses of Action developed to fill those gaps are more likely to be of a scope that can be readily addressed. The resulting framework will then be in place and tested as the effort is expanded to less frequent types of events for which there are likely to be larger gaps and increased uncertainty. Analysis of these additional scenarios will benefit from an already-established framework that can be used to identify and characterize gaps in the data and modeling resources available for management of those scenarios. The use of a pre-defined framework will also increase the efficiency with which the necessary information about those new scenarios can be collected and analyzed.

Membership

Overview of MDWG Membership

- The MDWG membership was appointed by the Emergency Support Function Leadership Group (ESFLG) and includes subject matter experts, program managers, and program directors.
- Each of the federal Emergency Support Functions is represented by members who sit on the MDWG.

The membership of the working group was chosen by the ESFLG and includes a wide range of emergency managers and subject matter experts from across the interagency, including members from each of the federal Emergency Support Functions as identified by PPD-8. Membership is continually expanded upon request by current ESFLG or MDWG members. Current membership and the agency each member represents can be found in Appendix 3.

Methods

Methods

- During phase I of the project, information was collected through interviews with high-level decision makers, program managers, and users of data and modeling outputs.
- During phase II of the project, additional, targeted interviews were completed with subject matter experts who use, develop, or maintain data resources.
- Select state and local emergency managers were interviewed upon recommendation to ensure that the results of the project adequately reflect their resources, needs, and limitations.

The information required for this analysis of data and modeling resources has been collected through a series of in-person and phone interviews with the members of the MDWG and the subject matter experts they recommend. During these interviews, the users and producers of each resource identify and characterize the ways in which each resource is used to support planning and operational decision-making. In most cases, the MDWG members are interviewed initially. Interviews with additional subject matter experts or leadership are scheduled upon recommendation to provide further breadth or depth of information depending on the size of the agency or division represented and the expertise of each interviewee. In phase I, there was an emphasis on interviews with the high-level decision-makers, program managers, and users of the data and modeling outputs. During phase II, emphasis was placed on targeted interviews with subject matter experts who use, develop, or maintain data resources. The emphasis during phase III will shift toward the subject matter experts who use and develop analysis tools and quantitative models. Phase I was focused on how data and models are used to support operational decision making; phases II and III are more targeted efforts, informed by the results of phase I, during which the technical characteristics of each resource will be captured and characterized. During phase IV, interviews will be, again, focused on the users of the analytical framework and interactive library, with follow-up interviews with subject matter experts to ensure accuracy.

In addition to federal officials, a number of state and local emergency managers were interviewed to assess their use of data and models in their respective agencies. Directors of state emergency management departments and other key personnel in their departments were interviewed based on the recommendations of MDWG members. The presidents of major associations of emergency managers (IAEM and NEMA) were also interviewed. Interview questions for state and local entities were similar to those for federal officials, with added emphasis on interaction with federal agencies.

Interviews are opened with an introduction to the project. For each phase of the project, a questionnaire (see Appendices 4 and 5) was developed to outline the topics to be addressed during the interviews. These questionnaires are used as a general guide for the discussions. For phase I of the project, conversations focused on the role of each agency, division, or group during each phase of emergency management and the questions they use data and modeling to address during that work. During phase II, interviews were more targeted and were used to capture and categorize the technical details about an agency, division, or group's information requirements. Throughout the project, interviewees have included those who are providers of data or are tool engineers; those who are analysts and users of those data and tools; those who make operational decisions informed by data and modeling resources; and those who have roles that include a combination of tool-development, analysis, and decision-making. Interviews are designed to capture an overview of the roles and responsibilities of each group and the ways in which data and data processing tools, including modeling, support those roles. The flow of the conversation varies widely based on the expertise of the interviewee and attempts to capture both the general and specific information requirements from each interviewee across the spectrum of emergency management missions and the phases of an emergency.

During phase I, 62 interviews were completed with 116 people. In phase II, 52 additional interviews were completed with 67 people, for a total of 114 interviews with 149 people representing 54 agencies, divisions, or groups. In addition, ten interviews were completed with fifteen individuals representing six states. A comprehensive list of the interviews completed during phases I and II can be found in Appendix 6.

Results Overview

Results Overview

- Data and data processing tools are widely used across the interagency to support decision making during all phases of emergency management.
- The use of data and modeling in disaster management is an iterative process, and there is no single resource or tool that can be used to address all questions or requirements.
- Data can be collected through instrumentation, reporting, or the use of social media and crowdsourcing. Each of these data collection methods is associated with varying degrees of uncertainty and time-delays.
- For hurricanes and earthquakes, raw data and situational awareness data produced by a small number of authoritative agencies are used across the interagency to answer a relatively small set of related questions; the use of impact estimates and information regarding mission-specific requirements vary widely based on the specific mission.

Data and data processing tools (including predictive models) have been used to support operational decision making during emergency management for many years. However, with the advent of readily accessible and mobile computing capacity in the last decade, data and models have become increasingly available to support decision making in real-time and in the field. The data and modeling resources available have expanded accordingly, but effectively coordinating these resources and using the information they produce is still a challenge. This challenge is evidenced by widespread interest in Big Data, and has been addressed by a wide variety of efforts across the interagency, including the GeoCONOPS effort and other work specifically focused on improving access to operationally relevant information during emergency management.

The Modeling and Data Working Group (MDWG) was initiated not to supplant these previous efforts, but to incorporate and expand upon them. The strength of this effort lies in the breadth of the membership and the inclusion of all phases of emergency management. In addition, while there are many efforts that have compiled lists of all available resources, the goal of this effort is to identify the authoritative resources, as defined by their interagency utility, and to build an interactive inventory of these tools that can be used as a resource during an emergency regardless of the level of sophistication of the user or the level of detail they need.

This project is divided into four phases, the first and second of which are covered in this report. The interviews and analysis in phase I addressed how data and modeling are used to support operational decision making during emergency management, specifically in hurricane and earthquake scenarios. Phase II focused on the technical details related to specific data resources, including their access requirements, update frequencies, and how they are used. The results are based on the information gathered during interviews with the MDWG members and subject matter experts they have recommended. The analysis resulting from phases I and II of the project is presented below.

Flow of Information

Flow of Information Summary

- The use of data and modeling in disaster management is an iterative process.
- Types of data include raw data, situational awareness data, impact estimates, and mission-specific requirements.
- Types of models and tools include event characterization models and analysis, consequence models, and decision support tools.
- Event characterization and consequence models are shared widely across the interagency, while decision support tools and mission-specific requirements are specific to an agency's mission.

Data and models are used extensively in emergency management across the interagency and throughout each phase of the event. Notably, these data and models are not monolithic, and there is a cascade of information that flows through iterative steps of data collection and data processing. At each step, raw observational data and outputs from earlier iterations of modeling are aggregated. These data are then processed using analysis tools of varying sophistication, ranging from computationally intensive predictive weather forecast models, to simple, computationally-conservative tools that produce the information required to inform more narrowly-defined mission-specific decisions. A broad overview of this framework is shown in Figure 2.

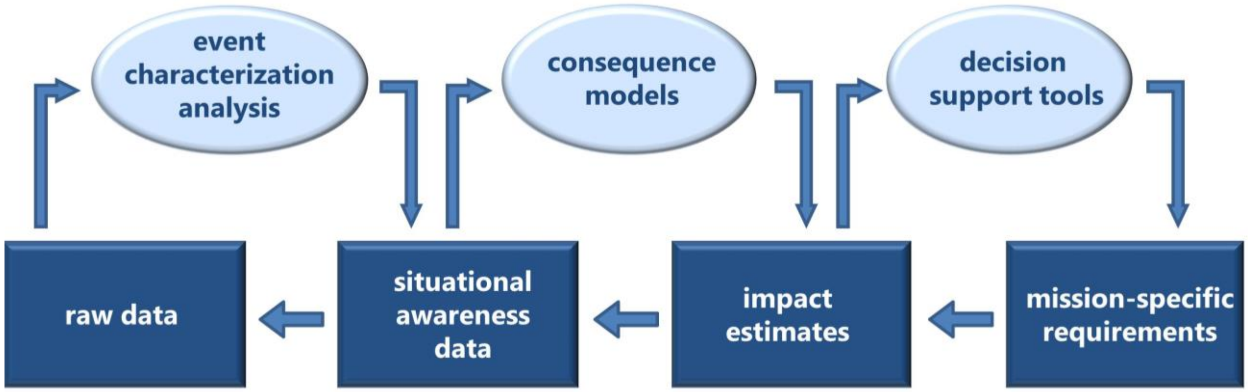


Figure 2. Framework describing the flow of information through iterative rounds of data and modeling. Data sources are shown in dark blue; models and data processing tools are in light blue. Arrows indicate the flow of information. Note: Additional resources provide data and are incorporated into each step but are not shown for simplicity. Examples are described in the text.

In brief, raw data describe the current state of the world: the real-time weather, the location of fault lines, or the amount of seismic activity. These data feed event characterization models and analysis tools that characterize the size and scope of the event (e.g. weather forecasts, flood predictions, identifying when and where an earthquake has occurred). These models produce situational awareness data that characterize the location, timing, and severity of the threat (e.g. when a hurricane will make landfall or which regions were affected by an earthquake). Situational awareness data then feed consequence models, which are used to estimate impacts and help characterize the affected population and infrastructure. These consequence models, such as HAZUS, are used across the interagency to estimate economic impacts, health effects, and infrastructure damage. The outputs of these models are, in turn, used as inputs for mission-specific decision-support models, such as those used to inform decisions about the timing of evacuation, the purchase and allocation of disaster relief supplies, or where to deploy search and rescue teams. The resulting mission-specific information can also be used to define hiring or staffing requirements or to provide information about patient flow in the context of the public health response.

Importantly, this flow of information is not unidirectional. In some cases, and often optimally, as information about the event is collected in real time, these data can be fed back into the predictive models to refine the outputs and improve the fidelity of the results. This process can be particularly important for those models whose outputs are continually used to feed mission-specific tools that define response requirements. For example, as high water marks or surge data are collected during or after a hurricane, the inundation models can be re-run with these inputs, and the resulting outputs can be used to guide evacuation decisions further up the coast.

The flow of information is not a closed loop. Steady-state data describing infrastructure or road maintenance do not inform event-characterization models, but are important data feeds underlying many of the consequence and mission-specific decision-support tools. These data, though not shown in the overview image in Figure 2, are incorporated from additional sources at each iterative step of modeling. These types of data sources are described in more detail below.

This information framework is delineated in more detail below with examples specific to hurricanes and earthquakes. These examples are not intended to be all inclusive and are used here for the purpose of illustration. A comprehensive inventory of the data resources identified thus far is included in the Data Resource Catalog (Appendix 7). This inventory will continue to be updated throughout phases III and IV of the project. The data analysis and modeling resources will be collected during of phase III and will be published in the phase III report. Data generated as the outputs of models are not explicitly included in Data Resource Catalog, but the models that generate them will be included in the Model Resource Catalog informed by the phase III interviews.

Raw Data

Raw data are defined here as those data that define the physical characteristics of a specific hazard or steady-state data that characterize the environment prior to and during an event. The majority of the modeling performed for the purposes of emergency management relies heavily on raw data produced by a small number of specialized agencies.

Across the interagency, raw data are collected in a variety of ways, ranging from the use of pre-deployed instrumentation assets to phone calls over which proprietary and privileged information is exchanged. The majority of these data sets are open source and available online. All social media or crowd-sourced data are collected as raw data. While many types of raw data are collected at the event-specific level before, during, or immediately after an event, steady-state raw data, such as the Quaternary Fault and Fold Database produced by USGS, are also used regularly in support of emergency management. Notably, in order to be used in support of decision-making, raw data must first be processed by models or data analysis tools.

Although raw data, once processed, provide support for nearly all the decisions made by emergency managers across the interagency, they are rarely accessed directly. In the case of hurricane and earthquake scenarios, raw data generally produced and accessed by similar communities, as the agencies and divisions which collect and provide raw data are also heavily involved in the development and dissemination of event characterization modeling resources.

It is worth noting that many of these data sources are useful beyond their most obvious applications. For example, precipitation data are important not only for predicting the path of a hurricane, but also for estimating the severity of an earthquake, as the degree of ground saturation changes ground shaking dynamics. Additionally, temperature is critical for informing the response to any emergency in which homes are lost or survivors require housing: housing requirements vary dramatically if temperatures are expected to be near freezing or to fluctuate significantly between daytime and nighttime.

Examples of raw data for both hurricane and earthquake scenarios are included below as Table 1. These examples are not intended to be all inclusive, and are used here for the purpose of illustration. A complete inventory of the raw data sources is included as the Data Resource Catalog in Appendix 7.

Table 1. Raw Data. Examples specific to hurricane and earthquake scenarios.

Data Class	Type of Data	Resource Provider	Specific Resource Example(s)
Geography	sea height (surge data)	NOAA, USGS	NOAA Tides Online; USGS Inland Storm-Tide Mapping
	fault line mapping	USGS	Quaternary Fault and Fold Database
	seismic data	USGS	USGS Earthquake Feeds & Data
Weather	precipitation	NOAA	Observational weather data (including climatological data from NOAA National Climatic Data Center)
	wind speed	NOAA	
	temperature, pressure	NOAA	
Population	special populations	HHS	Internal HHS data shared through partnerships with states and locals
	Demographics	Census	Census survey data
	population size	Census	
Infrastructure	power (electric and natural gas)	DHS IP; DOE	Proprietary petroleum and natural gas data; Proprietary Data from private power companies
	hospitals	HHS, DHS IP	Internal HHS data shared through partnerships with states and locals
	roads	Regional DOT Offices, private digital map companies	Locally-maintained road network data through Regional DOT Offices, Navteq Road Network Data

Event Characterization Models and Analysis

Event characterization models and analysis tools predict the location, time, and severity of an event. These models are used to consider specific characteristics of potential or impending hazards and compile raw data to identify patterns that define an event or identify the characteristics of a developing event. The major questions underlying emergency response rely on the outputs of these models, as they define which regions are impacted, in what specific locations, and to what degree. These data drive high-level decisions: whether or not an event requires an emergency response; as well as concrete decisions: which patients in which hospitals will need to be relocated because the power is down and the generators flooded. Event characterization models include weather forecast models such as those produced by NOAA, but also include models such as SLOSH (Sea, Lake, and Overland Surges from Hurricanes), which incorporates observational weather data to estimate which areas are going to be inundated with flood waters, when, and with how much water. These forecasts are required to guide the vast majority of downstream decisions, regardless of the specific mission.

Table 2. Event Characterization Models. Examples specific to hurricane and earthquake scenarios

Model	Application	Resource Provider
GFS	Atmospheric Forecast	NOAA
NAM	Atmospheric Forecast	NOAA
SLOSH	Inundation Prediction	NOAA
ShakeMap	Ground Shaking	USGS

Situational Awareness Data

Situational awareness data are used during or after an event to characterize the location, time, or severity of an event. They provide answers to who, what, when, and where for a specific event. While many types of situational awareness data are event specific, such as the National Hurricane Center's Hurricane Forecasts or the output of USGS's ShakeMap model, situational awareness data also include resources such as OnTheMap for Emergency Management and HSIP, which are used to characterize the environment, population, or infrastructure impacted by a specific event.

These data can be collected either by instrumentation, reporting, or social media, or can be the outputs of event characterization models. For example, both the weather forecast and inundation maps that show predictions of the location and scope of flooding ahead of a hurricane would be considered situational awareness data. For events without advance notice such as earthquakes, these data would include information about the size of an earthquake, as collected by seismometers and by social media tools such as "Did You Feel It?", a tool developed by USGS to provide additional data from which to estimate the size and scope of an earthquake, particularly in regions where seismometers are far apart. Notably, these data can also be generated using ground-shaking models that calculate the likely magnitude of the event in the regions where no instruments are deployed based on extrapolations from existing seismometer data. Such models would be defined as event characterization models and produce situational awareness data.

Situational awareness data, then, are used to identify the physical characteristics of a hazard in a meaningful way. While ground-shaking observations from a single seismometer cannot be used to inform operational decisions, once processed, data from seismographic instrumentation networks can be processed to produce ground-shaking maps that illustrate the geographic extent and severity of ground shaking data. Similarly, while temperature, pressure, and wind-speed point observations from a single weather station cannot be used to inform decisions regarding hurricanes, these data serve as the inputs for weather forecast models, which produce weather forecasts that can be used to forecast the location, time, and severity of a hurricane. The instances outlined above are both examples of raw data (seismographic instrumentation and observational weather data) which are processed by event characterization models and analysis to produce situational awareness data (ground-shaking maps and weather forecasts).

Unlike raw data, situational awareness data can be used support decision-making, although it is often processed further through the use of consequence models. Examples of situational awareness data are included below as Table 3. These examples are not intended to be all inclusive, and are used here for the purpose of illustration. A complete inventory of the raw data sources is included as the Data Resource Catalog in Appendix 7.

Table 3. Situational Awareness Data. Examples specific to hurricane and earthquake scenarios.			
Data Class	**Type of Data**	**Resource Provider**	**Specific Resource Example(s)**
Geography	event magnitude	NOAA, USGS	National Hurricane Forecast, ShakeMap output
	impacted areas	NOAA, USGS	National Hurricane Forecast, ShakeMap output
	storm surge	NOAA, USGS	SLOSH output, SHAKEMAP output
	ground shaking	USGS	ShakeMap output
Weather	forecasts	NOAA	National Hurricane Forecast, Local NWS Forecasts
	regions affected	NOAA	
Population	population density and spatial distribution	Census, DHS IP	US Census Data (American Fact Finder), HSIP/LandScan
	demographics	Census,	US Census Data (American Fact Finder)
	worker characteristics	Census	OnTheMap, OnTheMap for Emergency Management
Infrastructure	locations of critical facilities	FEMA, DHS IP, agency-specific assets	Internal HAZUS data (pre-modeling), HSIP and agency-specific data (e.g. Department of State's SIMON)
	infrastructure stability	FEMA, DHS IP, agency-specific assets	Building codes and historical data

Consequence Models

Consequence models are those used to predict the impacts of a potential or impending hazard, including, but not limited to, economic consequences, infrastructure damage, health effects, or impacts to the supply chain. These models, such as HAZUS, make estimates regarding economic loss and infrastructure damage and help characterize the affected populations. These models are scenario-specific, though some include predictions for multiple hazards. HAZUS, Hazards US, for example, is a loss estimation tool that provides economic consequence estimates for earthquakes, floods, and hurricanes. Through a platform called SimSuite, the US Army Corps of Engineer's consequence models similarly provide planning support for earthquakes, floods, and hurricanes, with the goal of expanding to a wide array of terror scenarios. Both HAZUS and SimSuite are designed to be flexible platforms that accept a wide variety of data feeds to be incorporated into a single resource.By contrast, PAGER, a USGS product, is specific to earthquakes.

Consequence models are often well beyond the uses for which they were originally intended. For example, HAZUS, the loss estimation tool produced by the Mitigation division of FEMA, was originally designed to provide first-pass damage estimates for the purpose of gauging the scope of the financial burden of a specific event. However, HAZUS is being used throughout the interagency as a tool to estimate general event impacts for those with a wide array of mission areas. Its outputs, either without further analysis or after processing by downstream tools, are used to guide estimates of the volume of temporary housing resources that will be required, the populations affected, and even the number of loan officers required to field the applications that are expected to be filed with the Small Business Administration. Understanding this expansion in utility is important, as it suggests that the product serves as an important backbone for operational decision-making during emergency management, increasing the value of keeping the product updated, maintained, and, potentially, suggesting that its original intended audience should not be the only drivers of its future expansions. These findings may, in fact, support the formation of an interagency process by which to support the development and maintenance of products of such broad utility.

Table 4. Consequence Models. Examples specific to hurricane and earthquake scenarios

Model	Application	Resource Provider
HAZUS	Economic; General	FEMA
PAGER	Economic; Health Effects	USGS
CNIMS	General	DTRA
SimStorm	General	USACE

Impact Estimates

Impact estimates are the data that define consequences post-event. This information can either be derived from post-event assessment data or as the outputs of consequence models that predict impacts including economic loss, infrastructure damage, health effects, or disruptions to the supply chain. These data directly inform the response and recovery phases of an emergency and are collected, processed, and used broadly across the interagency.

Impact estimates are used to support nearly all mission-areas and can range from the identification of the states most likely to request federal assistance, the regions most likely to be out of power based on critical infrastructure impacts, the populations specifically impacted, or the cascading effects of greatest concern (e.g. nuclear power plants most likely to have sustained damage from an earthquake). Each agency, and often each division, may collect, process, and use these data differently. While many of those interviewed described success in having access to the outputs of predictive consequence modeling and many appear to use these data streams effectively, assessment data was a point of concern for many individuals across the interagency.

Assessment data are those data that define the actual impacts of an event and, by definition, can only be collected during or after the event. In the best case scenario, these data should be made available to those making response and recovery decisions as soon as possible to facilitate the verification of the outputs of the predictive modeling and to continually re-assess response and recovery activities over the course of the event. Assessment data can include neighborhoods or individuals in distress, as identified by local emergency responders, schools on high ground that can be used as temporary shelters, or aerial imagery data upon which rescue operations can be planned for those stranded by flood waters. Critically, these data must be processed, formatted, and presented in ways that facilitate analysis and subsequent decision making. Based on the interview results, reporting delays, a lack of standard operating systems for data collection, or a lack of analysis (for example, of geocoding or time stamping of aerial photographs) have previously prevented the use of these data. In other examples, some assessment data such as real-time surge data can be collected only if the equipment necessary to collect the information is pre-deployed in anticipation of the event. Such data collection requires pre-event funding and coordination efforts that do not yet appear to be fully in place.

It is of note that the incorporation of assessment data into iterative model runs is particularly critical for the verification, validation, and continuous use of event characterization and consequence models. For example, SLOSH is a widely-used and validated flood inundation model, but a combination of high water marks or, better, surge gauge data must be incorporated after each event to improve the fidelity of the model with each storm. Similarly, earthquake damage assessment data should be used to validate the outputs from models such as PAGER, providing robust and data-driven verification and validation of modeling outputs to ensure that the tools improve with each new event and the availability of new data.

The use of assessment data is challenging, partially due to difficulties in defining standardized methods for data collection, centralization, and organization to facilitate data-mining or analysis. This lack of standardization and the subsequent lack of effective use of assessment data prevents the incorporation and adjustment of response or recovery activities based on those data and also prevents effective verification and validation of the models.

Examples of impact estimate data are included below as Table 5. These examples are not intended to be all inclusive, and are used here for the purpose of illustration. A complete inventory of the raw data sources is included as the Data Resource Catalog in Appendix 7.

Table 5. Impact Estimates Examples specific to hurricane and earthquake scenarios.

Type of Data	**Resource Provider**	**Specific Resource Example(s)**
event severity and scale	USGS, FEMA	PAGER output, HAZUS output
time-specific impacts	FEMA	HAZUS output (rerun every 6 hours based on NHC Forecast releases)
location-specific impacts	USGS, FEMA, DHS IP, DoE, EPA, Red Cross	PAGER output, Hazards Data Distribution System, HAZUS output, CIPDSS output, EAGLE-I, assessment data
population-specific impacts	FEMA, HHS, Red Cross	HAZUS output, data from local medical services, assessment data

Decision Support Tools

Decision support tools are models and data processing tools that are typically mission-specific, and developed by divisions or agencies with relatively narrowly defined scopes. Most often, these tools use impact estimates or assessment data to determine specific actions required during response and/or recovery. For example, HURREVAC, a decision-support tool developed through a partnership between FEMA, NOAA, and USACE, calculates when specific regions will need to be evacuated based on a forecast of the storm path, severity, and time of arrival. In addition, the Army Corps of Engineers has developed a tool that predicts the amount of debris likely to be left in public roadways in regions impacted by flooding; this tool additionally helps calculate the number of dump trucks and other equipment required to remove that debris.

Table 6. Decision-Support Tools. Examples specific to hurricane and earthquake scenarios		
Tool	**Application**	**Resource User**
Debris-Estimating Model	Debris	USACE
HURREVAC	Evacuation	FEMA
ShakeCast	Infrastructure	USGS, agency-specific infrastructure data
ODA Scalability Model	Surge Personnel	SBA

Mission-Specific Requirements

As indicated by the name, mission-specific requirements are just that: mission-specific. These data quantify the impact of an event by informing specific agencies about the resources required to support each mission, from personnel, to equipment or to temporary housing or shelter. Every interviewee described some aspect of their work or questions they use data or models to address that are specific to their agency, their division, and/or their role. Most often, mission-specific tools incorporate data collected during post-event assessments or from outputs of predictive models and are used to analyze those data to inform specific decisions.

Most state and local use of data and modeling outputs falls in this category. As discussed in more detail below, the primary role of state and local governments during emergencies, whether small or catastrophic, is to directly provide the resources necessary to protect and care for the affected population. Their information requirements are focused on region-specific and population-specific impacts and the concrete resources required to restore normalcy for their constituents.

Examples of mission specific requirements are included below as Table 7. These examples are not intended to be all inclusive, and are used here for the purpose of illustration. A complete inventory of the raw data sources is included as the Data Resource Catalog in Appendix 7.

Table 7. Mission-Specific Requirements. Examples specific to hurricane and earthquake scenarios.		
Application	**Resource User**	**Specific Resource(s)**
equipment requirements	FEMA, USACE, HHS, Red Cross	Ice/Water Commodities Model output, Debris Estimating Model output, Temporary Housing Model output, HAvBED, DSARS
personnel requirements	FEMA, USACE, SBA	Automated Deployment Database, Debris Estimating Model output, ODA Scalability Model output

Time-dependent Information Requirements

Summary of Time-dependent Information Requirements

- Information requirements change and develop over the course of an emergency.
- There is significant overlap between the questions addressed in the course of work associated with a wide range of mission-areas.
- The iterative steps of data collection and modeling described in previous sections can be mapped to an event timeline.
- The flow of information is independent of the event type, with the exception that advance-notice events allow for a period of event-specific planning before the event occurs.
- While emergency management during hurricanes and earthquakes requires the use of unique event characterization and consequence models, the same decision support and mission-specific resources inform the majority of the post-event efforts for both types of natural disasters.

Questions Associated with an Emergency

The critical informational requirements filled by data and modeling during large-scale emergencies vary by mission and by the timeline of the event more than by the event type. During normal operations, data and modeling are used to help emergency managers and those agencies involved position themselves to be more effective once the event occurs. During this phase, the questions that will need to be addressed during future events are defined, and the specific information resources available are identified, and the personnel who will need to use them are trained. As the event is identified, whether advance-notice (e.g. hurricanes) or no-notice (e.g. earthquakes), the data and models identified previously are used to address questions about a specific, impending threat. Following the event, these questions become continually more specific and refined, addressing mission-specific, actionable requirements. As the response to the event progresses, accurate situational awareness data become increasingly important, preferably at the highest resolution available. After the acute emergency has passed, there is an opportunity to reflect on lessons-learned, as well as a chance to use assessment data to verify, validate, and evaluate the models, data assessment tools, and specific actions taken during the event to improve the efficiency and effectiveness of emergency management efforts for future events.

An overview of the time-specific questions that data and models are used to address across the interagency for emergency management are shown below. These questions are presented to serve as examples and are not intended to provide a comprehensive outline of every question asked at the federal level during emergency management. However, by considering specific questions and their relationship with the timeline of emergency response, it is possible to develop a more holistic understanding of the ways that information requirements change and develop over the course of an emergency.

Normal Operations

- How can resources be best allocated to minimize risk?
- How can we most effectively develop systems, programs, and infrastructure to support all phases of emergency management?

Immediate Response

- What is the current threat and how severe will the threatening event be?
- When and where will the event occur?
- Who and what will be affected by the event and at what time?

Deployment

- What needs to be done?
- What and who were *actually* impacted, and how severely?
- What resources are available for response?
- How should we allocate existing resources and set priorities for response?

Sustained Response and Recovery

- What resources are still needed to allow those impacted to recover from the event?
- When is our mission complete and withdrawal appropriate?

Verification, Validation, and Evaluation

- What went well?
- What could have been improved?
- How can we improve our existing systems, programs, and infrastructure to address future emergencies?

Time-dependent Information Requirements

The flow of information during emergency management can be mapped onto an event timeline to highlight how information requirements change as the event unfolds (Figure 3). The timeline is a cycle and is usually depicted as a circle; it has been linearized here to simplify the correlation of data and model use during each time period. The timeline shown is for a no-notice event, such as an earthquake.

The raw data required to characterize an event, to inform pre-event planning, and to guide the early post-event response are similar across event types. These data and the event characterization models used to process the data are typically collected, generated, and run by a small number of agencies who have the most event-specific expertise. For example, NOAA and the National Hurricane Center are the widely acknowledged experts who collect weather data and produce hurricane forecasts. The USGS plays a similar role in the characterization of earthquakes. As the response to the event progresses, the modeling and data resources used become less event-specific and increasingly mission-specific. For example, it is largely irrelevant why someone was displaced from their home: whether due to a hurricane, earthquake, or other event, their needs for food and shelter are the same. Thus, the information required to perform missions associated with filling these needs are generally independent of the type of event and are, instead, determined by the task.

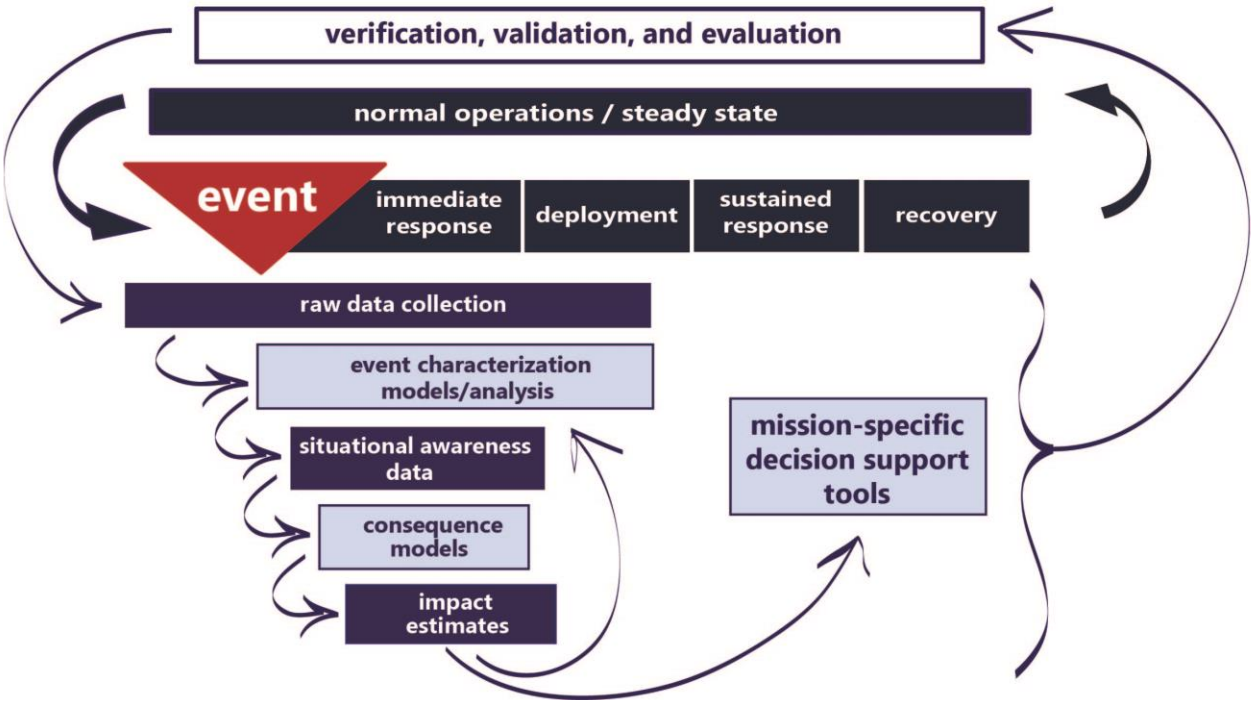


Figure 3. Flow of information required during emergency management organized along the timeline of an event. The timeline of the event is shown in black with the event indicated by the red arrow head. The organization of the timeline is based on that described in the Response Federal Interagency Operational Plan. Data sources and phases of the event are shown in dark blue; models and data processing tools are in light blue. Arrows indicate the flow of information and the feedback loops inherent in that flow of information.

Example Scenario: Hurricanes

With the approach of a hurricane, planning relies heavily on the raw weather data collected by NOAA. These data are processed by weather models to produce accurate forecasts of the storm track, size, forward speed, and intensity. The outputs from these models are used as inputs for inundation models such as SLOSH to predict the scope of the event. In turn, the predictions generated by SLOSH are used as inputs to the models required to inform specific decisions that have to be made before landfall. For example, pre-landfall evacuation is informed by decision support tools such as HURREVAC and the pre-deployment of resources can be informed by the outputs of consequence models such as HAZUS. During the event itself and during the early response to the event, raw data are rapidly gathered to provide real-time situational awareness. The consequence models are re-run based on this updated information. Incoming assessment data are used as inputs for decision support tools that define mission-specific requirements such as the numbers of temporary housing shelters required each day or the number of dump trucks required to remove debris from specific areas. These efforts continue throughout the sustained response and recovery periods during which assessment data that provide information about the ongoing status of post-event activities, such as data about power outages and fuel availability, are continually collected and analyzed. Some of this analysis is performed with the aid of data analysis tools; much of it is performed on the ground by the emergency managers and disaster relief effort specialists who are leading the response and recovery efforts themselves.

The dissemination of information to decision makers at the senior level and involved directly in operations occurs through a wide variety of avenues. In some cases, data are input directly into fillable PDF documents or uploaded to websites that are hosted and curated by the agency (e.g. the Environmental Protection Agency.) In other cases, data are transmitted to the Emergency Operations Center, NRCC, JFO, or other coordinating facility by phone. Information sharing platforms such as WebEOC are used by many at the state and local level, though these systems tend not to be well-integrated with their counterparts in the federal government. There appear to be a number of these types of systems available, but only a few interviewees described using them during recent storms.

Example Scenario: Earthquakes

The data and modeling used to support operational decision making following a large-scale earthquake are incorporated in the same basic framework that describes the flow of information for hurricane scenarios. The greatest differences between the specific data and modeling resources used during earthquakes and hurricanes are the raw data and event characterization models. These data sets and models reside almost entirely with the US Geological Survey (USGS), which, like NOAA, makes all their data publicly accessible on the web. The raw data, much like those collected by both NOAA and the USGS in support of hurricane preparedness, are collected ahead of time: mapping of fault lines, analysis of historical earthquakes to anticipate scope and magnitude of future events, and mapping of building codes associated with infrastructure across the US and abroad to help model the potential impacts of events. Seismometers collect the real-time earth shaking data that determine when an earthquake has occurred and a series of models calculates the magnitude and scope of the event based on those real-time data. This information about magnitude and scope are incorporated as inputs for a number of earthquake-specific consequence models, including PAGER (USGS) and HAZUS (FEMA). Once the impact of the event has been estimated, the vast majority of decision support tools and mission-specific requirements used are the same as those used by decision makers regardless of the event type. The focus of post-event efforts are on ensuring that lifelines are secured for those affected, that critical infrastructure is secured to prevent or limit the scope of cascading effects (e.g. preventing chemical releases from industrial sites or securing nuclear reactors in the affected area), and that debris is cleared from the roadways, electricity restored, and transportation infrastructure repaired. The data and modeling required to support these missions are as varied as the missions themselves.

Types of Data Collection Methods

Types of Data Collection Methods Overview

- The data collected and used for emergency management are primarily collected by instrumentation, reporting, or through the use of crowdsourcing and social media.
- Each data collection method generates data with resolution, uncertainty, delays, and personnel requirements characteristic of the method.

Data can either be generated through the use of models (as model outputs are, themselves, data) or collected in their raw form to later be aggregated and analyzed. There are three primary methods of data collection: instrumentation, reporting, and social media. This distinction is significant in that each method of data collection generates observations with varying resolution, uncertainty, delays, and personnel commitments.

Instrumentation Data

Instrumentation data, as its name suggests, are obtained through the use of instruments that are capable of recording repeated observations. Often, but not always, data collected by instrumentation is raw and requires processing by event characterization models or analysis before it can be used in support of decision-making.

Successful collection and aggregation of instrumentation data requires investment in a data collection infrastructure which must be developed and deployed before an event occurs to collect and transmit the data in real time. The collection of instrumentation data, then, requires significant pre-event investments. Observational weather data, seismograph data, and storm-surge data are all examples of instrumentation data. Failure to pre-position assets — for instance, temporary storm surge sensors that are used to collect the information shared through USGS's Storm Tide Mapper — can result in an incomplete network through which to collect, access, and process instrumentation data.

Examples of instrumentation data are included below as Table 8. These examples are not intended to be all inclusive, and are used here for the purpose of illustration. A complete inventory of the raw data sources is included as the Data Resource Catalog in Appendix 7.

Table 8. Instrumentation Data. Examples specific to hurricane and earthquake scenarios			
Data Resource	**Owner**	**Hazard**	**Data Collection Method**
USGS Earthquake Feeds & Data	USGS Earthquake Hazards Program	Earthquake	Instrumentation (also social media and crowdsourcing)
NOAA Tides Online	NOAA National Ocean Service	Hurricane	instrumentation
Storm Tide Mapper	USGS Office of Surface Water	Hurricane	instrumentation
Hazards Data Distribution System	USGS EROS	Earthquake; Hurricane	instrumentation
Post-event aerial imagery	Multiple agencies, coordinated by FEMA	Earthquake; Hurricane	instrumentation

Reporting Data

Data that require human observation or non-automated data entry are considered reporting data. These data include damage assessments, hospital records, or critical infrastructure locations. While many types of instrumentation data can be collected in an ongoing fashion without large numbers of personnel during an event, reporting data generally take longer to collect and aggregate, and require large investments in personnel. Thus, reporting data are typically available at a different resolution and with longer associated delays than instrumentation data.

Examples of reporting data are included below as Table 9. These examples are not intended to be all inclusive, and are used here for the purpose of illustration. A complete inventory of the raw data sources is included as the Data Resource Catalog in Appendix 7.

Table 9. Reporting Data. Examples specific to hurricane and earthquake scenarios			
Data Resource	**Owner**	**Hazard**	**Data Collection Method**
Proprietary petroleum and natural gas data	USCG Regional Offices, DoE	Earthquake; Hurricane	reporting
OnTheMap	Census Bureau LEHD	Earthquake; Hurricane	reporting
HSIP	NGA	Earthquake; Hurricane	reporting
Scribe.NET	EPA OSC	Earthquake; Hurricane	reporting (also instrumentation)

Social Media and Crowd-sourced Data

There is considerable interest from across the interagency in developing methods to use social media data to support decision-making in a way that accounts for the inherent uncertainty associated with this type of crowd-sourced data. Particularly in instances where traditional data feeds are unable to address a specific question, social media has the potential to serve as a valuable resource.

Crowd-sourced data are also being used to inform and validate operational models and decision-support tools. For example, during Hurricane Sandy, when many citizens and disaster relief workers in the Northeast struggled to identify sources of fuel, several FEMA employees reported using Gas Buddy, a crowd-sourced mobile application that allows users to identify gas stations that are up and running. The Department of Energy's EAGLE-I tool is fed in part by data obtained through the Twitter accounts and webpages of private electric power companies. As much of the data regarding electric power outages is proprietary, the use of social media allows the Department of Energy to gather open-source data that otherwise may not be readily available. Similarly, USGS operates the "Did You See It?" and "Did You Feel It?" programs to gather observations from the public about landslides and earthquakes, respectively. In the case of the "Did You Feel It" program, these crowd-sourced ground shaking observations are then used as a means of further assessing and validating the results of ShakeMap.

The National Operations Center, or NOC, run by the Department of Homeland Security, uses social media as an ongoing way to monitor current events. In the case of the April 15th Boston Marathon Bombings, the NOC Media Monitoring Center was able to provide situational awareness data regarding the bombings several minutes before major media outlets broke the story. In the case of the NOC Media Monitoring center, Twitter feeds and other forms of social media serve as sources of raw data that can be aggregated and processed to provide rapid, first-pass situational awareness data.

The concern expressed most frequently about crowd-sourced and social media data the difficulty in quantifying the error associated with these data sources. Although there is ongoing research to develop new ways of quantifying the error associated with social media data, these data are still used primarily as an additional source of information and are not expected or intended to replace traditional, authoritative data resources.

Examples of social media and crowd-sourced data are included below as Table 10. These examples are not intended to be all inclusive, and are used here for the purpose of illustration. A complete inventory of the raw data sources is included as the Data Resource Catalog in Appendix 7.

Table 10. Social Media and Crowd-sourced Data. Examples specific to hurricane and earthquake scenarios.

Data Resource	Owner	Hazard	Data Collection Method
Did You Feel It?	USGS Earthquake Hazards Program	Earthquake	social media
Tweet Earthquake Dispatch	USGS Earthquake Hazards Program	Earthquake	social media
Did You See It?	USGS Landslides Hazards Program	Earthquake; Hurricane	social media
Facebook	Facebook	Earthquake; Hurricane	social media

Metadata and Resource Categorization

Metadata and Resource Categorization Overview

- For the purpose of categorizing the resources identified during this project, metadata is required to characterize and organize the resources in a meaningful way.
- Metadata should reflect both data categories and data collection methods (as outlined above), as well as the owners and users of the resource, how the resource can be accessed, and whether or not the resource incorporates real-time data.

While the framework described above is a meaningful way to consider the functional, temporal, and mission-specific variation between resources across the federal interagency, it is not intended to capture the associated metadata of each of the resources identified. It is necessary, then, to define additional metadata requirements that are necessary to access, use, and update data resources in a meaningful way in support of emergency management. These metadata are described below and are those to be used in the interactive inventory.

Hazard

Data resources are characterized based on the hazards for which they can be used to inform operational decision-making. For this iteration of the project, data can be tagged by hurricane, earthquake, or both hurricane and earthquake. In future iterations or related efforts, resources would be tagged by the hazard or hazards for which they most directly inform decision-making.

Primary vs. Cascading Scenarios

For natural disaster scenarios such as hurricanes and earthquakes, there exist a variety of downstream impacts, decisions, and information streams that are unique to a given event (not event type) and that may not be accessed regularly or with any predictable structure. Distinguishing specific resources as most directly associated with primary or cascading effects of each use case is a method to capture whether or not the resource is used to address decisions that are most common following a given event type.

For the purpose of this project, primary scenarios are defined as decisions and processes that can be expected to regularly occur as the result of a hurricane or earthquake. Primary scenarios, then, would include pre-event evacuation before a hurricane or post-event critical infrastructure damage due to an earthquake. Damage to the electric grid, mass care requirements, or damage due to inundation would also be examples of primary scenarios associated with the hurricane and earthquake use cases.

Cascading scenarios are defined herein as decisions and processes that *are not* expected to regularly occur as the result of a given hazard, but are possible given compounding events. Examples of cascading scenarios include fires that occur as the result of earthquake-related damages (such as the 1906 fires which devastated the City of San Francisco after an earthquake along the San Andreas Fault), the release of radioactive material following the earthquake and tsunami affecting Fukushima, or an accidental chemical release from a chemical plant following a hurricane.

For any use case, whether hurricane, earthquake, public health related, fire or cyber, the decisions, processes, and resources defined as primary and cascading will differ. Thus, it is useful to develop a comprehensive inventory of the data and modeling resources that can be used throughout emergency management and to use the identification of primary and cascading scenarios to highlight resources that are particularly relevant to a given scenario. In this way, it is possible to develop an information infrastructure for all hazards.

For the purpose of this project, data and modeling resources used to inform decisions related to cascading scenarios are included only upon specific mention by members of the MDWG or the subject matter experts they recommend. Hurricanes and earthquakes remain the primary focus of this iteration of the project; however, all data described as relevant, useful, or applicable to the membership of the MDWG is included.

Data Category

Data resources are characterized based on the ways in which they can be used to inform operational decision-making. As outlined earlier in this report, data will be categorized as raw data, situational awareness data, impact estimates, or mission-specific requirements.

Data Collection Method

There are three primary methods of data collection: instrumentation, reporting, and the use of social media and crowd-sourced data. Data that are collected, aggregated, and processed directly (and not generated as the output of models) fall into one of these three categories. It is useful to define the method used to collect the data incorporated into a specific information resource, as the method of data collection influences the availability, accessibility, and error associated with a given source of information.

Owner

The agency, division, or group responsible for updating, maintaining, and validating a given data resource is identified for each resource. As specific contact information and organizational structures may change in an ongoing fashion throughout the interagency, identifying the agency and division responsible for maintaining a given resource will hopefully help to ensure that the resource continues to be accessible in an ongoing fashion, regardless of personnel changes or reorganization efforts within a given agency.

Users

Data resources are identified based on their known user community. Although there are many data and modeling resources available across the federal interagency, as well as the public, private, and academic sectors and communities, the same set of core resources are accessed most frequently across the interagency for hurricane and earthquake scenarios. This tag allows the utility of a given data resource to be considered as a function of its user community.

It is necessary to note that, while it is useful and informative to identify data resources based on their known users, this is not the only way to consider the utility or reliability of a given information source. New or recently updated datasets may be underrepresented based on a lack of familiarity within the emergency management community. Similarly, it is also useful to consider the quality control methods used to verify and validate a given data resource. However, identifying the existing user communities who regularly use specific data resources in support of decision-making allows both users and producers of this information to work together in a process of ongoing development, evaluation, and maintenance.

Input Compatibility

Based on the understanding that data collection, analysis, and modeling is an iterative process, the data and models that lie downstream of a given resource (i.e. the data and modeling resources that serve as inputs for any given data and model) are defined. This is particularly important as the validity of upstream models relies heavily on the accuracy of their inputs. If the inputs and parameters that define a model are incorrect or are based on flawed assumptions, the outputs of that model are far less applicable or useful.

Output Compatibility

Complementary to the input compatibility category, output compatibility defines the data and models that lie upstream of a given resource. This information indicates the datasets and models that use a given resource as an input. For the same reasons described above, it is important to identify the data and modeling resources that are interdependent, as validity of any model relies heavily on the accuracy of its inputs.

Access to Resources

The access requirements necessary to view, use, or update the data resource are also defined. Data can either be open-source (available to anyone who is interested in accessing the resource) or limited access (which can include proprietary data, classified data, or data that requires registration before the user is able to access the resource). If possible, specific information on how to access the resource will be included in the resource description.

Update Frequency and Incorporation of real time data

During all phases of emergency management, frequently updated datasets are necessary to inform all levels of decision-making. Data should be identified based on whether or not they incorporate real time data in an ongoing fashion during pre-event planning, response, and recovery. These datasets should be further characterized by their operational update frequencies by an order of seconds, minutes, hours, or days during pre-event planning, response, and recovery.

It is important to note that not all data used to support decision-making during emergency management can or should incorporate real time data. While ground-shaking data and observational weather data must be updated every few minutes to provide meaningful situational awareness data, data regarding the locations of critical infrastructure or residential building codes do not require the same level of update frequency in order to be operationally useful. For datasets that do not incorporate real time data, the update frequency is indicated to help users determine the operational relevance of the resource. If a given resource is not updated with any regular frequency, the most recent updated is listed.

Contact Information

The contact information for the group or individual responsible for updating, maintaining, or granting access to a specific data resource should be identified. When possible, this contact information should be attached to a division or group instead of to a specific individual, with the understanding that specific contact information and organizational structures change in an ongoing way throughout the interagency.

Coordination with State and Local Partners

Summary of Information Requirements for State and Local Governments

- The flow of information and phases of disaster management affecting state and local emergency managers correspond to those at the federal level.
- Efficient allocation of resources is the primary concern for state and local emergency management.
- State and local emergency managers often require a higher resolution of information than what is currently available for the federal level, specific to their region.

Emergency management is largely driven by those at the state and local level. To ensure that the results of this project incorporated their requirements and information resources, a number of stakeholders at the local, state, and regional levels have been interviewed. These interviews have focused on conversations with state emergency managers and a small number of additional contacts who have provided an overview of how data and modeling are used to support decision making during emergencies at the state and local level. Table 8 lists those interviewed thus far.

Because each state has its own emergency management structure, the findings may not capture the entirety of the methods used by each state and likely oversimplify the differences between states and localities. The adage that "every emergency is a local emergency" applies, and the ways in which emergencies are managed differ widely. For example, this analysis compiles information collected from states with either centralized or home-rule emergency management and with widely varied emergency management capabilities. Furthermore, these interviews are on-going; this discussion serves solely as an initial assessment and generalization of the ways in which data and modeling resources are used and how state and local governments fit into the larger framework of national-level emergency management.

Based on the phase I interviews, the mission of greatest concern to those at the state and local levels involved in emergency management is to efficiently and effectively allocate resources during response and recovery. These groups focus their efforts on collecting information regarding what assistance is needed and what resources are available. Some of this information may be collected in the planning phase, when outputs from federal models are used to predict the level and type of resources likely to be needed. Some states have developed their own tools to analyze the model outputs and provide these estimates. Once the event occurs, however, the majority of data-related efforts from the state and local agencies are in collecting assessment data to monitor and direct response activities.

The progression of emergency management activities for state and local emergency managers includes planning and preparedness, response, recovery, and mitigation, as it does at the federal level. Likewise, the flow of information, from ground-truth data through mission-specific requirements, remains the same. The primary difference is in whether the state and local entities are using or producing that information. The upstream data, including outputs from event characterization models and consequence models, primarily come from the federal agencies that produce them. These data are provided by the lead federal agency for the information that produces and publishes official model outputs, from which the state and local consumers of the information either pull the data themselves or receive it, “pushed,” from the federal agency. In this way, states are operating on the basis of the same information that the federal government is. State emergency managers rely heavily on the data and model outputs produced by the federal government, and these data are generally shared effectively and in a timely fashion.

According to the interviewees, while the available data are at sufficient resolution for planning at the federal level, the requirements for accuracy and resolution are much higher for state and local planning and response departments, and those needs are not always met by the resources provided by the federal government. In many cases, these resources are still used, for lack of better alternatives, but others are not. For example, many states use the consequence outputs from HAZUS. Often they use the runs performed and published by FEMA, but these are not well-suited for state and local use because of issues with resolution, accuracy, and timeliness of the data. Other states use HAZUS outputs generated through independent runs of the model using customized datasets. These datasets have been created to provide a more accurate representation of the local conditions (including soil type and facility locations) than what accompanies the standard HAZUS release. Of note, the forecasts generated by the National Hurricane Center were repeatedly described as being heavily used and useful. The predictions of location and severity of a hurricane at landfall are used invariably by state and county emergency response agencies, and the information provided is accurate and timely.

The critical infrastructure data made available through the Homeland Security Infrastructure Program (HSIP) also has several issues that prevent it from being used effectively by state and local emergency managers. Most of these problems arise due to inaccuracies in the geo-tagging of local resources in the federal-level maps. Also, because of the federal bias within the dataset, many of the facilities of importance to local officials are not included. In addition, once the emergency is over, states often lose access to HSIP Gold and cannot use it for planning or mitigation activities. Some states have begun addressing these gaps by compiling more detailed and locally-relevant critical infrastructure data sets of their own, but others are hopeful that this issue can be addressed at the federal level. Should designing a system intended for use by states and localities be undertaken, close collaboration between these entities and federal agencies would be necessary.

State and local entities contribute a larger percentage of the data for mission-specific activities than for event characterization. The primary responsibility of states and localities during response to an emergency is to efficiently and effectively allocate resources, including police, fire, and rescue crews. Tracking the availability of these resources is a major local issue. In order to support these missions, real-time assessment data regarding, for example, the status of critical infrastructure elements, power availability, and traffic flow, are critical. These data, when available, are usually collected by the service providers (e.g. DOT, power companies) and provided through collaboration with emergency management offices. However, access to these data is often lacking for states and localities; in some cases, this information is not available (not collected), and in others, it is collected by a number of entities and not shared effectively, if at all, with emergency officials. These data sets are critical to managing an effective response, but most states are not in a position to use them to their full potential. Structured management systems such as WebEOC generally have not been found useful to state emergency managers, partly because they are not used frequently enough. While efforts are beginning at the federal level to aggregate some of these data (e.g. the Department of Energy's EAGLE-I), it remains a gap, and one that will require cooperation with states, localities, and the private sector to be sufficiently addressed.

Table 8. State and Local Officials Interviewed.		
Name	**Organization**	**Title**
John Madden	National Emergency Managers Association; Alaska Division of Homeland Security and Emergency Management	President, NEMA; Director, Alaska DHS&EM
Jeff Walker	International Assoc. of Emergency Managers; Licking County, OH, Emergency Management Agency	President, IAEM; Director, Licking County EMA
Mark Ghilarducci	California Emergency Management Agency	Secretary
Kathy McKeever	California Emergency Management Agency	Director of Infrastructure Protection
Matthew Hawkins	California Emergency Management Agency	Deputy Commander of the State Threat Assessment Center
Kim Zagaris	State of California Governor's Office of Emergency Services	State Fire and Rescue Chief
James E. Turner III	Delaware Emergency Management Agency	Director
Bryan Koon	Florida Division of Emergency Management	Director
Michael Whitehead	Florida Division of Emergency Management	Florida State Mass Care Coordinator
Richard Butgereit	Florida Division of Emergency Management	Information Management Section Head
John Wilson	Lee County, FL, Emergency Management Agency	Director (retired)
Ken Mallette	Maryland Emergency Management Agency	Executive Director
Jordan Nelms	Maryland Emergency Management Agency	Director of Planning
Michael Fischer	Maryland Emergency Management Agency	Director of Administration

Initial Gap Assessment

On-going Gap Assessment Summary

- Additional storm surge data are necessary to more accurately predict the extent of flooding due to hurricanes.
- Though a great deal of assessment data is collected, it is often not fully incorporated into consequence models and decision-support tools.
- Very few supply chain models are in use at the federal level. Although there are efforts underway to develop this type of resource, they are not yet operational.

This section includes an initial analysis of the questions that the currently available data and modeling resources do not sufficiently address and data or information that are not currently available, as described by the interviewees. This section will be expanded and will include additional research and assessments of additional tools that are available to fill those gaps identified if not currently in use (and, therefore, not included in previous sections).

The gaps identified during the first two phases of this project are described below. These gaps were identified by multiple interviewees as points of concern; addressing them would serve the broader emergency management community.

Gaps in Raw Data

The first gap is characterized by a concern about the inability of current surge models to accurately predict the scope of flooding or inundation ahead of a hurricane or tropical storm. Both Hurricane Isaac and Tropical Storm Debby from the 2012 hurricane season highlight this gap: in both storms, storm surge caused extensive flooding at times and in locations that could not be predicted by the strength of the winds. Because current surge models rely almost entirely on wind speed to identify when and what strength at storm will hit, these models fail to capture rises in sea level either ahead of these winds or in the absence of strong winds, despite other factors such as rainfall. These factors have combined in several cases to prevent decision makers from having access to accurate information predicting the extent of flooding and hinder the ability of emergency managers to make the accurate evacuation decisions necessary to protect the affected population.

Individuals across the interagency have also expressed a desire for high resolution daytime and nighttime population data. Although the LandScan data included in HSIP addresses this issue, several groups have expressed a desire to acquire population data at higher resolution. These data are particularly needed for high-density urban areas where response efforts must be scaled to reflect the population density in a given geographic area. For example, an event that impacts 500 people spread out over 100 square miles requires inherently different response efforts than a similar event that impacts 500 people in a single high-rise building.

Gaps in Situational Awareness Data

For hurricanes and earthquakes, situational awareness data are relatively well defined for the event itself. The National Hurricane Center and the USGS Earthquake Hazards Program are recognized across the interagency as the natural and authoritative resources for the majority of situational awareness data related to hurricanes and earthquakes, respectively. However, in instances in which cascading effects occur as the result of earthquakes or hurricanes, the providers of situational awareness data are not as well-defined. Accidental chemical or biological releases or accidents involving radiation would require event-specific coordination by those providing situational awareness data. Although this process would likely involve IMAAC, the Interagency Modeling and Atmospheric Assessment Center, several groups have expressed concern that the roles and responsibilities for managing the flow of information has not been clearly defined.

Gaps in Impact Estimate Data

While a great deal of assessment data is collected in the aftermath of an event, many agencies and groups have significant challenges collating, analyzing, and using those data to refine their response and recovery activities accordingly. Situation reports tend to describe a small subset of static data and, while useful for those for whom they are intended, this user group is relatively small; these reports often does not fill the needs of those on the ground. The most effective systems available were described as incorporating mobile applications for the ready input of assessment collected by those on the ground in the affected regions, pulled into a centralized database, from which the data must then be analyzed and provided back to those making operationally-relevant decisions. The entirety of this process is only successfully completed by a minority of those with whom we spoke.

Gaps in the Use of Social Media and Crowd-sourced Data

Although there is growing interesting across the interagency in the use of social media and crowd-sourced data, many agencies and divisions are still in the process of developing structures, analysis tools, and processes through which to best consider and communicate the error inherently associated with the use of social media and crowd-sourced data.

Social media and crowd-sourced data are not being used or developed as replacements for traditional data resources. However, across the interagency, there is growing interest in how to best take advantage of these types of data as supplements to existing data streams. The use of social media data, specifically, provides a unique opportunity to generate accelerated situational awareness data once the raw data has been processed and aggregated in a meaningful way. Although this situational awareness data is associated with a relatively high degree of uncertainty, its primary utility lies in its speed, sensitivity, and ability to collect data from geographically and demographically diverse audiences in an ongoing fashion.

Gaps in Access to Data

Many individuals do not feel as if they have access to the data they need when they need it. This can be due to a variety of challenges, including a lack of familiarity with existing or recently developed data resources. Security restrictions also pose a challenge, as some individuals have experienced challenges accessing classified or FOUO information quickly and efficiently during response. Accessing, sharing, and communicating proprietary information, including data regarding private telecommunication resources, electric energy, and natural gas, has also posed a challenge across the interagency. In some instances, this data is shared to a specific, mandated agency which is not authorized to share the data externally. In other cases, the data are simply not available, or are only available at whatever resolution, accuracy, or time private companies decide to share the information.

Modeling Gaps

The primary gaps in the models and data processing tools available, as described to us during interviews, were those focused on predicting, characterizing, and quantifying the effect of supply chain dynamics and the associated cascading effects associated with disruptions in the supply chain. We have found no comprehensive, widely-available tools that link, for example, power outages to critical infrastructure to transportation routes. It is in this area that there is likely to be the greatest benefit of significantly greater interagency coordination and information sharing. By collating the data sets that provide this information into a single resource, a systems model could then be used to assess the connections between these data sets. There are efforts underway to develop this type of resource, though they are not yet operational. These efforts will be one area of further analysis during later stages of this project.

Conclusions

Conclusions

- Data and/or modeling are used across the interagency and by those involved at all levels of emergency management.
- Producing operationally-relevant information requires iterative steps of data collection and processing.
- The information required to support operational decision-making are phase-specific and diverge by mission areas as the event progresses.
- Raw data, situational awareness data, and impact estimates are largely event-specific and used similarly across the interagency, while each agency, division, or group uses their own tools and resources to define mission-specific requirements.
- Geospatial data is critical, but information requirements include quantitative data that are not well-captured by existing geospatial tools.
- Modeling outputs require effective translation for use during operations is needed.

What is modeling?

When asked about what data and modeling they use, many people initially responded that they do not use models for operational decision-making during emergency management. However, nearly all use data, and the vast majority have some type of data processing tool that helps to perform mission-specific analysis of data collected over the course of their work prior to or during an emergency. While agencies such as NOAA and USGS require and use computationally intensive, highly complex models to produce the information they are tasked with providing, the majority of the tools used by the federal government to perform data analysis in support of response and recovery missions require, by necessity, only limited computing power and limited training. This difference suggests that the tools available are, at least in most cases, tailored to the needs of the users.

The Questions

The focus of phase I was on the types of questions that those involved in emergency management across the interagency use data and modeling to address. Despite the breadth of the emergency management community, the questions that data and modeling are used to address during large-scale hurricanes and earthquakes differ more by phase than by mission. The similarity of the questions asked is most marked during the early phases of the emergency when everyone simply needs to know what is going to happen, when, and where. These questions are, for the most part, answered by the work of a few agencies that specialize in event characterization. Similarly, consequence tools that incorporate the situational awareness data produced by the event characterization models are used widely. However, it is of note that these tools are often not used for their intended purpose. Most notably, while HAZUS is a model designed to calculate economic impact, it is used much more broadly; it is used by the vast majority of groups with whom we spoke, and its outputs serve as inputs for a wide array of assessment tools in support of widely varied missions.

The questions that data and modeling are used to address once the event is characterized and the general sense of scope understood are more divergent. However, the data required between missions differ more in resolution than in source. For example, given a single high-rise apartment building, one group may need to know if it has power, another if it has a roof or is structurally sound, and another needs to know the special populations who live there. These data interact closely; even if these data are not available from the same source, sharing of the information between agencies is critical.

Iterative analysis

Data collection and analysis are iterative. There is a flow of information between each step of data collection and analysis as the analysis becomes less abstract and more operationally relevant. As the modeling or data analysis becomes more operationally relevant, it becomes less computationally intensive. This progressive simplification and reduction is what allows those in the field to call up mission-specific data analysis tools or input assessment data directly via their mobile devices and is also what limits the complexity of each single piece of information so that it can be processed by those who are responsible for tremendous breadth (e.g. the Federal Coordinating Officers and state and local emergency managers) as opposed to those responsible for tremendous depth (e.g. the meteorological scientists at NOAA).

This iteration of data collection and analysis has important implications for the tools themselves. While there was originally a perception that there are many overlapping tools, these results suggest that, just as there are critical roles for both the meteorological scientists and the FCOs in emergency management, so too are there for data collection and analysis tools tailored for each. The key is that information can flow directly from one into the other, that everyone who needs information at the same level of resolution or detail is able to share information with each other, and that when any one person needs access to information at a different level of resolution, that they know where to find that information.

Notably, this framework applies to state and locals as well as those in the federal government. Upstream data are very often the same feeds that the federal government is producing. The states' major contribution is in providing decision-support information—in the form of real-time assessment data—and mission specific requirements. Information from all sources (federal, state, and local) is shared in the same data stream. The extent to which the data come from the federal agencies versus the state and local entities will vary by state. No matter the information balance, though, the key element in this relationship is the ability to easily share data in both directions. A standard, consistent mechanism to facilitate the sharing of information resources at the federal level would allow states to design their own systems that would integrate with that system.

Data Translation for Decision-makers

The first large-scale datasets to become widely available in many fields were maps. Mapping and the use of geo-tagging as a method to organize and process data rapidly became a foundational technology and has been successfully leveraged to support emergency management operations. The availability of these resources has driven a large number of efforts to develop platforms to make geospatial technologies readily available to decision-makers across the interagency. GeoCONOPS is a powerful example of the potential of these capabilities. The results of this project confirm the value of those efforts in both demonstrating what is possible and developing best-practices that can be followed by subsequent efforts. However, not all data is geospatial or are best conveyed using mapping technology. Specifically, quantitative data are often more effectively communicated through the use of graphs, trend lines, or tables. These methods of data visualization have not been as well-developed for use in emergency management, and the standard mechanisms of sharing these data result in a loss of resolution and of context.

Particularly with the maturing of geospatial technology and data-sharing mechanisms, there is new potential for the development of systems to support the sharing of quantitative data that are as sophisticated, rapid, and successful at conveying information as geospatial methods. This translation will require both understanding the outputs of the models themselves (the quantitative data and associated error) and understanding the time-sensitive and information-overloaded environment faced by operations leads in the field. Furthermore, methods to convey those data in readily-accessible images that can be used on situation reports, published on WebEOC or other information-sharing platforms as data files, and used to brief senior leadership must be developed and matured.

Next Steps

The next phase of this project will be focused on identifying and characterizing the models or data processing tools used to transform unprocessed or minimally processed data into information upon which operationally relevant decisions can be made. The goal of the project is to produce an interactive library of the models and decision-support tools available accessed via a user-interface that will facilitate user inputs, run queries, to identify the data sets and the tools used as well as the producers and consumers of those resources. The final product will be built in phase IV of the project and will serve to identify the resources that are used most widely or are foundational to other decision-support tools and identify the gaps in the currently available resources. Ultimately, the goal of the project is to ensure that those involved in emergency management across the interagency have access to the information they need when they need it to more effectively accomplish their missions.

Point of Contact Information

The points of contact for this report are:

Joshua Dozor
Project Lead
Planning Division; Response Directorate
FEMA Headquarters
500 C St. SW
joshua.dozor@fema.dhs.gov

Report prepared by:
Gryphon Scientific, LLC
Ellie Graeden, PhD
Gryphon Scientific, LLC
6930 Carroll Avenue, Suite 810
Takoma Park, Maryland 20912
ellie@gryphonscientific.com
(301) 270-0645

Appendix 1: The ESFLG Modeling and Data Working Group (MDWG) CHARTER

August 6, 2012

1.0 PURPOSE

This charter provides the framework for the establishment and structure of the Modeling and Data Working Group (MDWG). The MDWG is comprised of Emergency Support Function Leadership Group (ESFLG) members or designees and chaired by the Director of FEMA's Planning Division, Response Directorate. The MDWG will:

- Analyze the catastrophic scenarios to be addressed and prioritized;
- Define and assess information requirements for response planning and operational decision-making;
- Evaluate existing modeling resources to support the range of scenarios and determine modeling input and output requirements;
- Identify gaps and recommend solutions to meet the modeling input and output requirements.

2.0 MISSION

The MDWG mission is to identify consistent, reliable, authoritative models and data sets for response planning and operational decision making for catastrophic events.

3.0 BACKGROUND

Scientific based models and empirical information products and programs are increasingly used to predict the effects of and inform response planning and operations, particularly when faced with complex, cascading "maximum of maximums" threats and incidents. These models and programs enable decision makers with enhanced situational awareness and heightened visualization of the operational environment to prepare and assess the response to catastrophic events. For example, the benefits of prompt and accurate modeling include improved incident warning, reduction of public anxiety through effective risk communications, and delineation of hazard areas. Both real world events and exercises alike have highlighted a need to standardize these processes and products. However, currently no central mechanism exists to address the doctrine, organizational, training, materiel and leadership requirements necessary to exploit the effective use and coordination of such models and products.

The lack of a formal and standardized approach to integrating scientific modeling and coordinating related technical programs is a challenge to information sharing as well as to the development of effective preparedness plans and responses. The need to develop a standardized framework of modeling across the Emergency Support Function Leadership Group (ESFLG) structure is essential to closing core capability gaps, and improving the overall effectiveness of models for both planning and operations. The MDWG will address modeling and analysis requirements and the most effective ways to exploit emerging data generation products, to include scientific modeling and data sets to meet those requirements.

4.0 MEMBERSHIP

The Modeling and Data Working Group (MDWG) members were nominated by the Emergency Support Function Leadership Group (ESFLG) and will meet on a monthly basis. A list of the voting organizations of the MDWG is attached. The MDWG will address the most effective ways to exploit emerging data generation products, to include scientific modeling and data sets. The working group will determine the most effective programs to incorporate into the ESFLG structure as well as to evaluate implementation success.

5.0 ROLES AND RESPONSIBILITIES

- The MDWG voting members will provide primary and alternate representatives to contribute throughout the process.
- Each primary organization of the MDWG will have a voting responsibility when dealing with modeling and data issues that affect the interagency working group.
- The MDWG gathers and assesses modeling and information requirements for catastrophic scenarios and will provide regular updates to the ESFLG for evaluation.
- The ESFLG will then use the information compiled to work with the Office of Science and Technology Policy (OSTP) and the National Security Staff (NSS) to develop and formalize interagency modeling capability governance and coordination.

6.0 DELIVERABLES

The working group will provide an update status to the ESFLG on a monthly basis.

The working group will provide the following deliverables:

1. Identify and analyze the catastrophic scenarios to be addressed and prioritized;
2. Define and assess information requirements for response planning and operational decision-making;
3. Define information requirements for response planning and operational decision making.
4. Develop criteria to evaluate and determine modeling and data source that support requirements
5. Evaluate authoritative modeling and data sources to support catastrophic scenarios; and
6. Identify gaps and recommend solutions to solve the identified modeling and information requirements.
7. Utilize the results from each scenario to inform subsequent scenarios.

7.0 RESOLUTION OF ISSUES AT MDWG MEETINGS

- The working group will utilize the ESFLG structure to resolve interagency coordination issues.
- Any interagency issues that cannot be resolved at the ESFLG level will consult the National Security Staff (NSS) and the Office of Science and Technology Policy (OSTP) for resolution of policy issues.
- Finalize resolution of policy issues will be handled by the Domestic Readiness Group (DRG).

8.0 ESFLG WORKING GROUPS

The MDWG is an ESFLG working group, in accordance with the ESFLG Charter. ESFLG working groups will include appropriate expertise and representation to guide the development of the requisite procedures for response and recovery activities under the National Response Framework (NRF) and National Disaster Recovery Framework (NDRF), as well as Federal Interagency and National planning efforts. Representation on working groups will be open to selected departments and agencies and FEMA Regions as appropriate.

The working group's purpose is to:

- Convene on an ad-hoc basis as designated for specific issues, and disband upon completion of the specific assigned task;
- Address issues that require appropriate department/agency participation for researching and developing procedures to operationalize and execute policy decisions;
- Identify and suggest process improvements to the ESFLG for approval;
- Provide input from subject matter experts; and
- Provide expertise to the Federal response community to address tasks including the research and development of potential options/courses of action and drafting of documents, recommendations, and procedures to improve Federal interagency coordination, integration, and incident response.

9.0 MDWG Primary Voting Organizations

Department of Agriculture

Department of Agriculture/Forest Service

Department of Commerce

National Oceanic and Atmospheric Administration

Department of Defense (OSD, Joint Staff)

Department of Defense/U.S. Army Corps of Engineers

Department of Energy

Department of Energy/National Nuclear Security Administration

Department of Health and Human Services

Department of Homeland Security

Federal Emergency Management Agency
U.S. Coast Guard
Transportation Security Administration
Immigration and Customs Enforcement
Customs and Border Protection
United States Secret Service
Office of Science & Technology
United States Citizenship & Immigration Services

Department of Housing and Urban Development
Department of the Interior
Department of the Interior/National Park Service
Department of Justice
Department of Transportation
Environmental Protection Agency
Small Business Administration

Appendix 2: The ESFLG Modeling and Data Working Group Project Plan

DHS/FEMA

The ESFLG Modeling and Data Working Group (MDWG)

Project Plan

RD-Planning/ESFLG/MDWG/MDWG Project Plan.doc/svc
8/6/2012

Introduction

In July of 2012, both the Department of Homeland Security (DHS) and Federal Emergency Management Agency (FEMA) agreed that FEMA would coordinate the creation and implementation of an interagency Modeling and Scientific Workgroup (MDWG), with the full support and involvement of the Emergency Support Function Leadership Group (ESFLG). At the July 19, 2012 ESFLG meeting, there was concurrence by the ESFLG to form the Modeling and Data Working Group (MDWG) and designate a representative from their department/agency to participate on the MDWG. On July 31, 2012, the MDWG was formed from ESFLG nominations and the August 6th kickoff meeting was announced. The MDWG will assess the current state of modeling systems used, including their owners, requirements, consumers, production processes and means of public messaging. The working group will utilize the ESFLG structure to resolve routine interagency coordination issues. The working group will consult the National Security Staff (NSS) for resolution of policy issues. The purpose of the MDWG will be information gathering – regular updates will be provided to the ESFLG. The ESFLG will then use the information compiled to work with the NSS to develop and formalize interagency modeling capability governance and coordination.

Background

Scientific based models and data generation products and programs are increasingly used to predict the effects of and inform response planning and operations, particularly when faced with complex, cascading "maximum of maximums" threats and incidents. These models and programs enable decision makers with enhanced situational awareness and heightened visualization of the operational environment to prepare and assess the response to catastrophic events. For example, the benefits of prompt and accurate modeling include improved incident warning, reduction of public anxiety through effective risk communications, and delineation of hazard areas. Both real world events and exercises alike have highlighted a need to standardize these products, programs, and processes. A need exists to understand the strengths and constraints of each scientific model and related technical program; enabling the closing of core capability gaps, however, currently no central mechanism exists to address the doctrine, organizational, training, materiel and leadership requirements necessary to exploit the effective use and coordination of such models and products.

The lack of a formal and standardized approach to integrating scientific modeling and coordinating related technical programs is a challenge to information sharing as well as to the development of effective preparedness plans and responses. The need to develop a standardized framework of modeling across the Emergency Support Function Leadership Group (ESFLG) structure is essential to closing core capability gaps, and improving the overall effectiveness of their use in both planning and operations.

Project Plan

The MDWG will address the most effective ways to exploit emerging data generation products, to include scientific modeling, data requirements, and geospatial analysis for catastrophic scenarios. The working group will determine the most effective modeling and data products to incorporate into the

ESFLG structure as well as to evaluate implementation success. Further, Presidential Policy Directive #8 (PPD-8), and specifically the response core capabilities, will inform this process and support this effort.

The MDWG will:

- Analyze catastrophic scenarios to be addressed;
- Assess data requirements for response planning and operational decision-making;
- Evaluate existing resources to support scenarios and address data requirements;
- Identify gaps and recommend solutions to solve the data requirements.

Roles/Responsibilities

- The MDWG voting members will provide primary and alternate representatives to contribute throughout the process.
- Each primary organization of the MDWG will have a voting responsibility when dealing with modeling and data issues that affect the interagency.
- The MDWG gathers and assesses modeling and data requirements for catastrophic scenarios and will provide regular updates to the ESFLG for evaluation.
- The ESFLG will then use the information compiled to work with the OSTP and NSS to develop and formalize interagency modeling capability governance and coordination.

Project Management

1. The membership group will establish a charter.
2. The membership group will establish a work plan.
3. The MDWG will meet monthly to discuss working issues.
4. The MDWG Chair will provide an update to the ESFLG on a monthly basis.
5. The MDWG will provide a formal status update to the ESFLG annually.
6. The MDWG voting members will provide primary and alternate representatives to contribute throughout the process.

Deliverables

The MDWG will provide an update status to the ESFLG on a monthly basis.

The MDWG will provide the following deliverables:

1. Identify and analyze the catastrophic scenarios to be addressed and prioritized
    a. Review the 15 National Planning Scenarios
    b. Review other catastrophic scenarios (i.e. flooding, tsunami, solar storms)
    c. Prioritize scenarios and choose pilot scenarios
    d. Establish process and rating scheme for prioritizing scenarios
2. Define and assess data requirements for response planning and operational decision-making
    a. Map the data requirements for the pilot scenarios

   b. Identify the response organizations for each pilot scenario
   c. Collect input from the response organizations on their current modeling and data requirements supporting these pilot scenarios
3. Evaluate authoritative modeling and data sources to support pilot catastrophic scenarios
   a. Review the modeling and data requirements of each response organization
   b. Define the lead agency responsible for the modeling and data products
   c. Identify the consumers of each modeling and data product
4. Identify gaps and recommend solutions to meet the identified modeling and data requirements
   a. Determine if the existing modeling and data products are meeting the needs of the response organizations and stakeholder groups (e.g. White House, Public, etc.) in assisting them to make informed decisions.
   b. Develop a matrix to determine gaps in modeling and data requirements for each pilot scenario
   c. The MDWG will vote upon solution sets for each gap identified and recommend these solutions to the ESFLG for review and approval
5. Utilize the results from the pilot scenarios to inform subsequent catastrophic scenarios
6. Provide a formal briefing to the ESFLG annually on work accomplished during the fiscal year.

Appendix 3: MDWG Membership

Name (Last, First)	Agency
Alt, Rich	DHS NPPD/IP (HITRAC)
Anderson, Debra	DHS S&T
Applegate, David	US Geological Survey
Artz, Richard	NOAA
Barrett, Todd	USDA Emergency Programs Division
Bausch, Doug	FEMA
Bennett, Gerilee	FEMA
Berman, Eric	FEMA
Billado, William	DHS IMAAC
Blumenthal, Daniel	DOE/NNSA
Blunt, Kenyetta	FEMA
Bonifas, Michelle	FEMA IA
Briggs, Kevin	NCS
Brown, Cliff	FEMA
Carroll, Shenan	FEMA
Chacko, Betsie	DHS IMAAC
Crawford, Sean	FEMA
Daigler, Donald	FEMA
Dial, Patrick	SBA
Dickinson, Tamara, Ph.D.	OSTP
Dozor, Josh	FEMA

Ewing, Melvin	FEMA
Flick, Darrin	DTRA
Franco, Crystal	DHS S&T
Gilmore, Lance	FEMA
Gleason, Joseph J CAPT	USCG
Gorman, Chad	FEMA
Griffith, David	FEMA NHC
Hammond, Steve	USGS
Hernandez, Patrick	FEMA
Hill, Laura	USDA USFS
Hinkson, Tasha	FEMA
Hodge, Craig	FEMA
Irwin, William	USACE
King, Steve	DHS
Knabb, Richard	NOAA
Landry, Mary	USCG
Lant, Tim, Dr.	HHS
Legary, Justin	FEMA
Leong, Timothy CIV	DTRA
Magnuson, Matthew	EPA
Mahrous, Karim	FEMA
Maycock, Brett	FEMA/Medical Liaison
McQueen, Jeff	NOAA

Monarez, Susan Dr.	DHS S&T
Montañez, José M. Gil	FEMA
Moore, Brian	USCG
Morgan, D'arcy	DHS S&T
Mueller, Lora	NOAA
Murray, Michelle	Department of State
Nye, William	USACE
O'Neill, Ed	Department of State
Olsen, Jennifer	HHS
Reeves, Toimu (Troy)	NORTHCOM
Remick, Alan	DOE/NNSA
Rhome, Jamie	NOAA
Roohr, Peter	NOAA
Sanderson, Bill	FEMA
Schilling, David	DOT
Scott, Margaret	DOE
Snead, Kathryn	EPA
Sokich, John	NOAA
Springstein, Thomas	FEMA
Tribble, Ahsha, Ph.D	NSS White House
Tune, Greg	Red Cross
Underwood, Patricia, PHD	DHS NPPD/IP (HITRAC)
ValentineDavis, Victor	DHS IMAAC

Valliere, John	SBA
Vaughan, Chris	FEMA
Villoch, Deborah	NPPD/IP
Wiacek, Chris	DOT

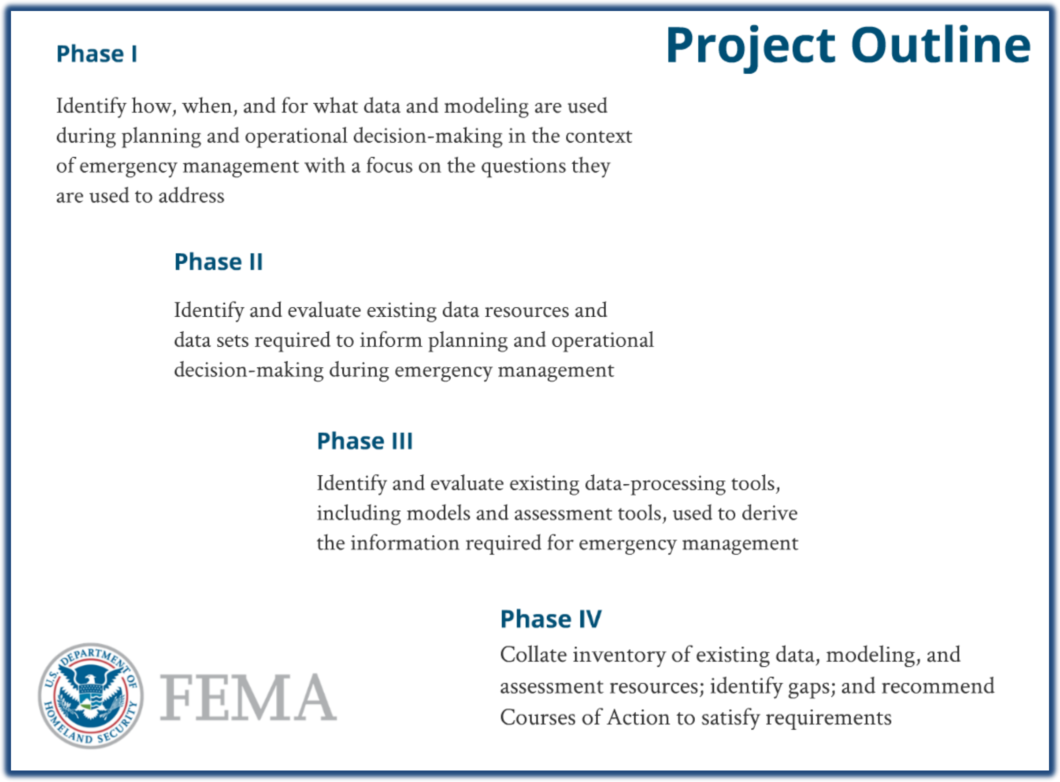
Appendix 4: Phase I Questionnaire

ESFLG Modeling and Data Working Group Phase I Questionnaire

The MDWG Charter recognizes the need to "develop a standardized framework of modeling across the… [ESF] structure…" Informed by national preparedness goals and the associated core capabilities, this effort will produce an expansive list of modeling and data resources used during all stages of emergency activities. Based on the list generated through informed interviews with experts in each department, the MDWG will ultimately determine the most effective modeling and data products to incorporate into the ESFLG structure and evaluate implementation success. In addition to unifying modeling and data resources in use, this process will identify gaps in currently available modeling and data resources.
The MDWG will:

- **Analyze catastrophic scenarios to be addressed;**
- **Assess data requirements for emergency planning and operational decision-making;**
- **Evaluate existing resources to support scenarios and address data requirements;**
- **Identify gaps and recommend solutions to satisfy the data requirements.**

The project will be separated into three phases. This questionnaire is phase I of the MDWG requirements analysis, designed to elicit both general and specific data requirements to inform phases II and III. It is intended for high-level Emergency Managers and Interagency Policy/Planners (Current MDWG group). This questionnaire focuses on two notional "use cases", the Hurricane Ono scenario and the New Madrid Earthquake scenario; other scenarios will be added by exception. Collection of this information is focused on all hazards; notional disasters are used to elicit specific information where appropriate. Phases II and III will involve additional detail and levels of complexity by engaging SMEs with the goal of assessing the volume, velocity, and variety of modeling and data efforts for disaster preparedness, response, recovery, and mitigation. Data will be collated and provided in a report at the conclusion of each phase.


Project Outline
Phase I
Identify how, when, and for what data and modeling are used during planning and operational decision-making in the context of emergency management with a focus on the questions they are used to address
Phase II
Identify and evaluate existing data resources and data sets required to inform planning and operational decision-making during emergency management
Phase III
Identify and evaluate existing data-processing tools, including models and assessment tools, used to derive the information required for emergency management
Phase IV
Collate inventory of existing data, modeling, and assessment resources; identify gaps; and recommend Courses of Action to satisfy requirements
FEMA

SECTION 1: PARTICIPANT AND AGENCY PROFILE

Last Name: **First Name:**

Phone Number (primary): **Phone Number (alternate):**

Fax: **Email Address:**

Work Address:

Home Organization:

Department, Division or Office Name:

Position Title:

1. **Are you considered a program manager, SME or both?**
2. **For which of the following Emergency Support Functions (ESF) does your division support and what is your role (Coordinator, Primary, Secondary)? Select all that apply**

___ ESF #1 – Transportation ___C ___ P ___ S

___ ESF #2 – Communications ___C ___ P ___ S

___ ESF #3 – Public Works and Engineering ___C ___ P ___ S

___ ESF #4 – Firefighting ___C ___ P ___ S

___ ESF #5 – Emergency Management ___C ___ P ___ S

___ ESF #6 – Mass Care, Housing and Human Services ___C ___ P ___ S

___ ESF #7 – Resource Support ___C ___ P ___ S

___ ESF #8 – Public Health and Medical Services ___C ___ P ___ S

___ ESF #9 – Urban Search and Rescue ___C ___ P ___ S

___ ESF #10 – Oil and Hazardous Materials Response ___C ___ P ___ S

___ ESF #11 – Agriculture and Natural Resources ___C ___ P ___ S

___ ESF #12 – Energy ___C ___ P ___ S

___ ESF #13 – Public Safety and Security ___C ___ P ___ S

___ ESF #14 – Long-term Community Recovery and Mitigation ___C ___ P ___ S

___ ESF #15 – External Affairs ___C ___ P ___ S

3. **For which of the following Recovery Support Functions (RSF) does your division support and what is your role (Coordinator, Primary, Secondary)? Select all that apply.**

___ Community Planning and Capacity Building ___C ___ P ___ S

___ Economic ___C ___ P ___ S

___ Health and Social Services ___C ___ P ___ S

___ Housing ___C ___ P ___ S

___ Infrastructure Systems ___C ___ P ___ S

___ Natural and Cultural Resources ___C ___ P ___ S

4. **For which of the following Mitigation Core Capabilities does your division support? Select all that apply.**

___ Threats and Hazard Identification

___ Long-term Vulnerability Assessment

___ Risk and Disaster Resilience Assessment

___ Community Resilience

5. **Please provide contact information for the lead modeling point of contact for your function so we can follow-up with them.**

6. **How does the use of modeling and empirical data add to your division's mission?**

7. **How does your division generally use modeling and the associated data sets required to support pre- and post-emergency activities?**

   a) **event preparedness?** *(e.g. risk assessments and threat hazard identification; estimating available capabilities and determining required capabilities)*

   b) **event mitigation?** *(e.g. identifying characteristics and potential consequences of hazards; identifying the benefit of risk reduction efforts)*

   c) **event response?** *(e.g. improving Situational Awareness; establishing response priorities)*

   d) **event recovery?** *(e.g. determining resource requirements; guiding restoration efforts)*

SECTION 2 - DATA REQUIREMENTS

1. **In a scenario such as Hurricane Ono:**

   a) **What data sets do you use to support your modeling efforts? On what types of data are your modeling parameters typically based?**

   b) **From what sources do you obtain the information and data required to support your division's responsibilities? Check all that apply**

   ___ Commercial database provider

   ___ Public Internet

   ___ Informal social network

   ___ In-house library/archive

   ___ Local Government (SPECIFY):

   ___ State Government (SPECIFY):

   ___ National Agency (SPECIFY):

   ___ Other (SPECIFY):

   c) **With whom do you collaborate in defining your data requirements and/or sources?**

2. **In a scenario such as the New Madrid Earthquake:**

   a) **What data sets do you use to support your modeling efforts? On what types of data are your modeling parameters typically based?**

   b) **From what sources do you obtain the information and data required to support your division's responsibilities? Check all that apply**

   ___ Commercial database provider

___ Public Internet

___ Informal social network

___ In-house library/archive

___ Local Government (SPECIFY):

___ State Government (SPECIFY):

___ National Agency (SPECIFY):

___ Other (SPECIFY):

c) With whom do you collaborate in defining your data requirements and/or sources?

SECTION 3 – MODELING APPLICATIONS

1. **How would modeling be used within your division specifically to support pre- and post-emergency activities in the event of a scenario such as Hurricane Ono?** *(e.g. aid in making pre-landfall evacuation decisions; determining required core capabilities and supporting resources)*

   a) **What specific models would you use?**

   b) **Which questions would these models be used to address?**

   c) **Is there an alternate model available that could be used to address these same questions?**

2. **How would modeling be used within your division to specifically to support pre- and post-emergency activities in the event of a scenario such the New Madrid earthquake?** *(e.g. aid in making post-event evacuation decisions; determining required core capabilities and supporting resources)*

   a) **What specific models would you use?**

   b) **Which questions would these models be used to address?**

   c) **Is there an alternate model available that could be used to address these same questions?**

Appendix 5: Phase II Questionaire

SECTION 1 - PARTICIPANT AND AGENCY PROFILE

Last Name:

First Name:

Phone Number (primary):

Phone Number (alternate):

Fax:

Email Address:

Work Address:

Home Organization:

Department, Division or Office Name:

Position Title:

SECTION 2 – INFORMATION REQUIREMENTS

What information is required for you to make the decisions you need to make during disaster management?

How do these information requirements differ between stages of disaster management (planning, preparedness, response, recovery, and mitigation)?

At what level of resolution do you need that information?

SECTION 3 - DATA SOURCES

From what sources do you primarily obtain the information and data required to support your agency's responsibilities? Check all that apply.

- ☐ Commercial database provider
- ☐ Public Internet
- ☐ In-house database
- ☐ Local Government (SPECIFY):
- ☐ State Government (SPECIFY):
- ☐ Federal Agency (SPECIFY):
- ☐ Other (SPECIFY)

SECTION 4 – SPECIFIC DATA RESOURCES

What data sources does your department, division, or agency own, maintain, and/or fund?

For each of these data sources, please identify:

GENERAL INFORMATION

A. Specific (or potential) use cases for the data in the context of Emergency Management

B. For which phases of Emergency Management is the data most useful?

C. How the data are collected (Survey? Instrumentation? Observation? Regulatory data?)

D. The owner of the data or database

E. The individual or group responsible for updating and maintaining the data

F. Contact information for the database manager or IT specialist (if applicable)

G. Any relevant security restrictions (Who has access to the data? How?)

MAINTENANCE AND UPDATE INFORMATION

H. Are the data updated in real-time for event response and recovery?

IF YES:

1. How are the data uploaded from the field to the database?

2. What are the delays associated with updating the real-time data?

IF NO:

1. How frequently is the data updated?

2. Who is responsible for updating the data?

I. What, if any, QA/QC practices are in place?

DATA COMPATIBILITY INFORMATION

J. Resolution of the data (Census tract? 1 km? Threat or event-specific characteristics?)

K. Exported data formats

USER INFORMATION

L. Do you know of any specific models that use the data as inputs?

1. If so, do you have any relevant contact information for the individuals responsible for running or maintaining that model?

M. Which agencies or divisions use these data to support their decision-making process?

N. Which types of decisions could be made using these data?

ADDITIONAL INFORMATION

O. What are the specific strengths of this source of data?

P. What are the weaknesses of this source of data?

Q. How could the data or database be improved?

SECTION 5 - GAP IDENTIFICATION

What sources of data do not have access to when you need them, and why?

What resources or policies would be most helpful to improve the quality of the data you are already using or maintaining?

Which agencies or organizations would you like to collaborate with more effectively to address your data and information requirements?

What agencies, organizations, or individuals would you recommend as excellent providers of data or information? Are there specific best-practices you have found to be particularly useful?

Appendix 6: Interview Participants (Phases I and II)

NAME Last, First	AGENCY	PHASE
Langhelm, Ron	BAH	II
Gunn, Julia	BPHC	II
Jernigan, Dan	CDC	II
Meltzer, Martin	CDC	II
Swerdlow, David	CDC	II
Dowell, Earlene	Census Bureau	II
Alexander, David	DHS	II
Cole, Ray	DHS	II
Cotter, Daniel	DHS	II
Epstein, Gerald	DHS	II
Billado, William	DHS IMAAC	I, II
Chacko, Betsie (A)	DHS IMAAC	I, II
ValentineDavis, Victor (P)	DHS IMAAC	I, II
Chatfield, Catherine	DHS IP	I
Danielson, Glenn	DHS IP	I, II
Norman, Mike	DHS IP	I
Franco, Crystal	DHS S&T	I
Klucking, Sara	DHS S&T	II
Mapar, Jalal	DHS S&T	I

Moe, Matthew	DHS S&T	I
Monarez, Susan Coller	DHS S&T	I
Shephard, Dave	DHS S&T	I
Cedres, Stewart	DOE	I, II
Clark, Jamie	DOE	I
Hsu, Simon	DOE	II
Lippert, Alice	DOE	I
Lucas, Anthony	DOE	I
Rollison, Eric	DOE	I
Scott, Margaret (P)	DOE	I, II
Willging, Patrick	DOE	II
Blumenthal, Daniel (P)	DOE NNSA	I, II
Greenberg, Jeremy	DOT	I
Schilling, David	DOT	I, II
Stuckey, Bill	DOT	II
Vanness, Jeffrey	DOT	I
Wiacek, Chris	DOT	I
Aeschelman, Jeremiah	DTRA	I
Basiaga, Dariusz	DTRA	I
Cooper, Charles "Jeff"	DTRA	II
Grouse, Andy	DTRA	II
Leong, Timothy	DTRA	I
Lowenstein, Eric	DTRA	I

Phillips, Michael	DTRA	II
Gattuso, Peter	EPA	II
Irizarry, Gilberto "Tito"	EPA	I, II
Magnuson, Matthew	EPA	I
Snead, Kathryn	EPA	I
Woodyard, Josh	EPA	II
Almonor, Niclaos	FEMA	I
Anderson, Lindsey	FEMA	I
Bausch, Doug	FEMA	I
Bennett, Gerilee	FEMA	II
Berman, Eric	FEMA	I, II
Bonifas, Michelle	FEMA	II
Boyce, Carla	FEMA	I
Brown, Cliff	FEMA	I
Byrne, Mike	FEMA	I
Daigler, Donald	FEMA	I
Decker, KC	FEMA	I, II
Demorat, David "Mo"	FEMA	I
Faison, Kendrick	FEMA	I
Farmer, Bob	FEMA	II
Gilmore, Lance	FEMA	I
Gorman, Chad	FEMA	I
Griffith, David	FEMA	I

Hall, Mike	FEMA	I
Harned, Rebecca	FEMA	I
Hewgley, Carter	FEMA	I
Hinkson, Tasha	FEMA	I
Hodge, Craig	FEMA	I
Ingram, Deborah	FEMA	I
Jackson, Liz	FEMA	II
Juskie, John	FEMA	I
Lawson, David	FEMA	II
Legary, Justin	FEMA	I, II
Longenecker, Gene	FEMA	I
Lumpkins, Donald	FEMA	I
Mahrous, Karim	FEMA	I
McDonald, Blair	FEMA	I
Rabin, John	FEMA	I
Roberts, Nikki	FEMA	I
Rogers, James	FEMA	I
Rozelle, Jessee	FEMA	I
Sanderson, Bill	FEMA	I, II
Stanfill, Derek	FEMA	I
Vaughan, Chris	FEMA	I, II
Woodhams, Katrina	FEMA	I
Wycoff, Kristen	FEMA	II

Zohn, Ashley	FEMA	II
Zuzak, Casey	FEMA	I
Macintyre, Anthony	FEMA/Medical Liaison	I
Maycock, Brett	FEMA/Medical Liaison	I
Baker, Jay	FSU	II
Gabriel, Ed	HHS	I
Imbriale, Samuel	HHS	I
Lant, Tim, Dr.	HHS	I
Lurie, Nicole	HHS	I
Nguyen, Ann	HHS	I
Olsen, Jennifer	HHS	I, II
Briggs, Kevin	NCS	I
Artz, Richard	NOAA	I
DiMego, Geoff	NOAA	I
Draxler, Roland	NOAA	II
Feyen, Jesse	NOAA	II
Knabb, Richard	NOAA	II
McQueen, Jeff	NOAA	I
Mongeon, Albert	NOAA	I
Rhome, Jamie	NOAA	II
Roohr, Peter	NOAA	II
Sokich, John (A)	NOAA	I, II
Tune, Greg	Red Cross	I, II

John, Charles	Sandia	II
Mier, Steve	Sandia	II
Teclemariam, Nerayo	Sandia	II
Dial, Patrick	SBA	I
Valliere, John	SBA	I
O'Neill, Ed	State	I, II
Diaz, Steve	USACE	I
Harris, Dewey	USACE	I
Hendricks, Joel	USACE	I
Irwin, Bill	USACE	I
Keown, Patrick	USACE	I
Markin, Chad	USACE	I, II
Nye, William	USACE	I
Schargorodski, Spencer	USACE	I
Schuster, Michael	USACE	II
Town, Patrick	USACE	I
Gleason, Joseph J	USCG	I
Gunning, Jason	USCG	I
Hunt, Michael	USCG	I
Landry, Mary	USCG	I
Lundgren, Scott	USCG	I
McGlynn, Matt	USCG	I
Moore, Brian	USCG	I

Carpenter, Ryan	USDA	II
Li, Yun	USDA	II
Hill, Laura	USFS	I, II
Applegate, David	USGS	I
Blanpied, Michael	USGS	II
Gallagher, Kevin	USGS	II
Haines, John	USGS	II
Hammond, Steve	USGS	I
Ludwig, Kris	USGS	II
Lyttle, Peter	USGS	II
Mandeville, Charles	USGS	II
Mason, Robert	USGS	II
Perry, Sue	USGS	II
Baron, Tom	USNORTHCOM	I
Jackson, Mike	USNORTHCOM	I

Appendix 7: Data Resource Catalog

Full Name	Owner	Users	Brief summary
122 Cities Mortality Data	Morbidity and Mortality Weekly Report, CDC	CDC	Voluntarily reported mortality data identified by place of occurrence, week the death certificate was filed, age category of the deceased individual, and whether or not death occurred as a result of pneumonia and influenza.
Active Fire Mapping Program	USDA Forest Service, Remote Sensing Applications Center	USDA Forest Service	Fire locations are shown online based on data provided by the National Interagency Coordination Center.
Aerial Measuring System	DoE NNSA	DoE NNSA; IMAAC	AMS provides specialized airborne radiation detection systems to provide real-time measurements of low levels of air and ground contamination.
Automated Deployment Database	FEMA	FEMA	FEMA's Automated Deployment Database is used to track the locations and availability of disaster assistance employees after an event.

BioWatch	DHS Health Threats Resilience Division, Detection Branch	DHS OHA	BioWatch is a source of early warning bio-surveillance data. The system is designed to detect specific biological agents through airborne sampling in major metropolitan areas.
Bureau of Labor Statistics Data	Bureau of Labor Statistics	CDC	The Bureau of Labor Statistics releases regular updates on inflation and prices, employment, unemployment, pay and benefits, and workplace injuries.
CAMEO Chemicals	NOAA Office of Response and Restoration	EPA	CAMEO Chemicals contains an online database containing response-related information and recommendations for hazardous materials. The website also maintains a reactivity prediction tool, which can be used to predict potential reactive hazards between chemicals.
CAMEO Facility Database	EPA	EPA	The CAMEO Facility Database is available to select users and is generated through Tier II Chemical Inventory annual reports submitted to the EPA by companies.
Did You Feel It?	USGS Earthquake Hazards Program	USGS	Did You Feel It? allows users to report their experience of an earthquake (location and time). The database takes advantage of high reporting and allows USGS to develop a more complete description of what people experienced, the effects of an earthquake, and the extent of damage.

Did You See It?	US Landslides Hazards Program	USGS	Did You See It? allows users to report their experience of a landslide (location, time, type of landslide, and a description of the damage).
Disaster Services Automated Reporting System	Red Cross	Red Cross	DSARS is used mainly as a look-up table for supply and staffing needs. It categorizes events based on how expensive the event was for the Red Cross (ie a "3" is $50-250 thousand, while a "7" is over $10 million).
Disease BioPortal	University of California, Davis Center for Animal Disease Modeling and Surveillance, FMD Lab	DHS S&T	The Disease BioPortal allows access to, and display of, data for more than 40 animal disease and syndromes reported by a number of agencies and organizations. Specific searches can be performed for serotype, date, location, and other epidemiological parameters.
Emergency Response Safety and Health Database	CDC; NIOSH	CDC; NIOSH	The Emergency Response Safety and Health Database provides information on certain biological, chemical, and radiological agents. Agent characteristics, properties, emergency response information, and decontamination procedures are examples of information included in this database.
Facebook	Facebook	NOC	Facebook is a social media website that media surveillance services pull from to help detect when an event is occurring.

Foodborne Diseases Active Surveillance Network	CDC NCEZID	CDC	FoodNet collects and publishes data on foodborne illness in the United States. They conduct surveillance for certain pathogens and track the burden of foodborne illnesses over time.
Hazards Data Distribution System	USGS EROS	USGS	HDDS is an online collection of imagery and documents intended to assist in response to natural disasters. The database includes both pre-event and post-event imagery for specific events.
Homeland Security Infrastructure Program	NGA	DoE; DHS OEC; DHS S&T; DHS IP; DTRA; EPA; FEMA; HHS BARDA; NORTHCOM; USACE; USCG; State	HSIP contains nationwide, geospatially enabled baseline infrastructure and elevation data.
Hospital Available Beds for Emergencies and Disasters	HHS ASPR	FEMA	HAvBED contains bed availability counts that can be viewed by region or facility. Bed counts are broken down by category: ICU (adult & pediatric), burn, medical/surgical (adult & pediatric), psychiatric, airborne infection isolation, and operating rooms.
Influenza Hospitalization Surveillance Network	CDC NCIRD	CDC	FluSurv-NET contains laboratory-confirmed influenza-related hospitalizations from over 80 participating counties. Data gathered are used to estimate age-specific hospitalization rates on a weekly basis, and describe characteristics of persons hospitalized with severe influenza illness.

Influenza-Associated Pediatric Mortality Data	CDC NCIRD	CDC	Influenza-Associated Pediatric Mortality Data tracks influenza-associated deaths in persons less than 18 years. Any laboratory-confirmed influenza-associated death in a child in the United States is reported through this system, as well as demographic and clinical information for each case.
Landfire Database	USDA Forest Service and DoI Wildfire Management Program	USDA Forest Service; USGS	The Landfire Database contains vegetation, fuel, disturbance, and region-specific fire characteristic data for the United States.
LandScan/LandScan USA	ORNL	DoE; FEMA; USGS; VMASC ODU	LandScan provides 1 km resolution data on global population distribution for both day and night-time populations worldwide. LandScan USA is a higher resolution version available in the United States (90m resolution).
Local NWS Forecasts	NOAA NWS	NOAA NWS	Official weather forecasts for the United States. Includes forecast maps, radar, satellite imagery, and weather alerts
Moreover NewsDesk	Moreover Technologies	NOC	Moreover NewsDesk is a media monitoring service that compiles news items and social media based on the user's search filters. The service covers online, print, and broadcast news, as well as social media.

National Antimicrobial Resistance Monitoring System	FDA; CDC; USDA	FDA; CDC; USDA	NARMS is a public health surveillance system that monitors antimicrobial resistance of pathogens for human, retail meats, and food animals. This data is used to track resistance trends and to guide interventions.
National Data Buoy Center	NOAA NWS National Data Buoy Center	NOAA; USGS; USCG	The National Data Buoy Center collects and maintains data from buoys and coastal stations across the globe. These stations gather both atmospheric and oceanic information.
National Disaster Recovery Program Database	FEMA Individual Assistance Program	FEMA	National Disaster Recovery Program Database (NDRPD) provides data on programs and resources intended to help communities prepare for, respond to, and rebuild after a disaster.
National Elevation Dataset	USGS EROS	USGS; NOAA	The National Elevation Dataset provides 30m resolution elevation data for the United States. The elevation data is produced from high resolution ground truth data including LIDAR data and high-resolution imagery.
National Flood Hazard Layer	FEMA	FEMA	The National Flood Hazard Layer dataset contains GIS data layers of FEMA's Digital Flood Insurance Rate Maps and Letters of Map Revision.
National Hydrography Dataset	USGS	USGS	The National Hydrography Dataset contains maps of lakes, ponds, rivers, canals, dams, and streamgauges, and includes a flow network that allows for tracing water downstream or upstream.

National Shelter System	Red Cross	FEMA; Red Cross	The National Shelter System is an online database that provides the locations of general population shelters, medical shelters, Points of Distribution, as well as the capabilities of each shelter.
National Water Information System	USGS Water Resources	USGS; USACE; NOAA; FEMA	NWIS collects and publishes current and historical water levels and quality conditions for surface and ground water in the United States. Data are processed by USGS before being published on the web.
NAVTEQ road network data	NAVTEQ	VMASC ODU; DOT	NAVTEQ collects road data to create road network maps for GIS systems. NAVTEQ road data also include addresses and locations of exit ramps.
Newsmap	newsmap	NOC	Newsmap is a website that provides links to recent news stories. The news reports are organized by topic, and visually reflect the number of related stories, amount of coverage, and how recent a story is.
Observational Weather Data	variable	DoE NNSA; DTRA; FEMA; IMAAC; NHC; NOAA; USGS	Observational weather data refers to current weather conditions. Different weather parameters are collected via various instruments and collection methods, and are used to feed weather forecast models.
OE-417 Electric Disturbance Events	DoE Office of Electricity Delivery and Energy Reliability	DoE	Form OE-417 is the Electric Emergency Incident and Disturbance Report and is used to collect information on electrical incidents, emergencies, and outages.

Official National Hurricane Center forecast	National Hurricane Center; NOAA	State; DHS IP; DTRA; NHC; FEMA, HHS ASPR; USACE; USCG	The NHC uses multiple weather forecast models to predict a hurricane's intensity and track.
OnTheMap	Census Bureau, LEHD	US Census	OnTheMap is a web-based mapping and reporting tool that shows where workers are employed and where they live. It is also capable of producing reports on age, earnings, industry distributions, ethnicity, educational attainment, and sex.
OnTheMap for Emergency Management	Census Bureau, LEHD	US Census	OnTheMap for Emergency Management is a web-based mapping and reporting tool that shows where workers are employed and where they live. It is also capable of producing reports on age, earnings, industry distributions, ethnicity, educational attainment, and sex. On the Map for Emergency Management is capable of examining these population characteristics specifically for FEMA Disaster Declaration zones and in the geographic vicinity of hurricanes, wildfires, snow, and flooding.
Post-event aerial imagery	Multiple agencies, coordinated by FEMA	FEMA; NOAA; USACE	Aerial imagery is used to help assess the scope of the damage caused by an earthquake or hurricane.
Potential Coastal-Change Impacts	USGS	USGS	USGS determines the chance of coastal erosion due to storm collision, overwash, and inundation. This information is storm-specific.

Proprietary Data from private oil companies	Private Sector	USCG; DoE	Based on relationships built with regional and local Coast Guard representatives, many private oil companies are willing to share data with the Coast Guard. However, this data sharing occurs primarily at the discretion of privately-owned companies.
Proprietary Data from private power companies	Private Sector	DoE; FEMA	DoE has access to some proprietary data related to the current status of the electric grid. However, this data is owned by private companies and can only be shared at limited resolution. To avoid the issues related to sharing of proprietary energy information, DoE has invested in the EAGLE-I program, which scavenges social media outlets and websites to provide electric power information for much of the US.
Proprietary Data from private telecommunication companies	Private Sector	DHS OEC	Based on relationships built with private telecommunication companies, DHS OEC has access to certain proprietary telecommunication information. However, this data sharing occurs primarily at the discretion of privately-owned companies.
PulseNet	CDC	CDC; USDA; FDA	PulseNet is a multistate laboratory-based surveillance network that is used to detect and investigate outbreaks of foodborne illness, and provides pathogen subtype-specific data which allows epidemiologists to link cases and approximate when exposure to contaminated food might have occurred.

Quaternary Fault and Fold Database	USGS Earthquake Hazards Program	USGS	Quaternary Fault and Fold Database contains data on fault lines in the United States. Fault line maps are also available.
RadNet	EPA National Analytical Radiation Environmental Laboratory	IMAAC	The RadNet database contains laboratory analysis results from air monitor filters and samples of precipitation, drinking water, and milk. The air monitoring data occurs in near-real-time.
Scribe	EPA OSC	EPA	Scribe is a software tool that is capable of capturing sampling, observational, and monitoring field data. It is intended for use by EPA on-scene coordinators, their staff, and their partners. The results can be shared online through Scribe.net.
Scribe.net	EPA OSC	EPA; NOAA; USCG	Scribe.net disseminates EPA field data captured by Scribe. It allows for the viewing of Scribe data online and contains four years of archived records.
Storm Tide Mapper	USGS	USGS	Storm Tide Mapper displays storm data collected during a hurricane. This data includes peak tide elevation, wave height, barometric pressure, high-water marks, and storm positions.
Tides Online	NOAA NOS	NOAA NOS	Tides Online provides graphical and tabular water level and meteorological data from NOS stations.

Traditional Media Reports	variable	NOC; DoT	Media surveillance services use traditional media reports as a source of data. Media reports can be online, print, or video reports.
Tweet Earthquake Dispatch	USGS Earthquake Hazards Program	USGS; DOI	USGS uses Twitter to provide alerts on earthquakes worldwide. It provides the earthquake's magnitude, location, and origin time, as well as a link to a USGS webpage with more information about the event.
Twitter	variable	NOC, USGS	Twitter is a social media website that media surveillance services pull from to help detect when an event is occurring.
U.S. Outpatient Influenza-like Illness Surveillance Network	CDC NCIRD	CDC	ILINet contains reports from outpatient healthcare providers in the United States. Reports indicate the total number of patients seen and the number of those patients with influenza-like illness by age group.
US Census Data	US Census Bureau	DHS S&T; EPA; FEMA; DoD; HHS ASPR; HHS BARDA; Red Cross; VMASC ODU; USACE	The US Census includes population information as well as demographic data. This information is available for download on the Census website.
USGS Earthquake Feeds & Data	USGS Earthquake Hazards Program	USGS	USGS provides real-time seismic data in a variety of formats through their Earthquake Hazards Website. Data are updated every minute.

WaterWatch	USGS	USGS	WaterWatch is a USGS website that provides real-time, recent, and past information on streamflow conditions as well as flood and drought locations. Regions are categorized based on long-term conditions.