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Environmental Disasters Data Management Workshop Report

Coastal Response Research Center

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Coastal Response Research Center
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This workshop was facilitated by Dr. Nancy Kinner, Coastal Response Research Center (CRRC) at the University of New Hampshire (UNH). CRRC focuses on issues related to hydrocarbon spills. The Center is known for its independence and excellence in the areas of environmental engineering, marine science, and ocean engineering as they relate to spills. CRRC has conducted numerous workshops bringing together researchers, practitioners, and scientists of diverse backgrounds (including from government, academia, industry, and NGOs) to address issues in spill response, restoration and recovery.

We wish to thank all presenters for their participation in the workshop:
Charles Henry, NOAA Gulf of Mexico Disaster Response Center
Robert Haddad, NOAA Office of Response & Restoration, ARD
Jonathan Henderson, Gulf Restoration Network
Tracy Collier, Puget Sound Partnership
Aubrey Miller, National Institute of Environmental Health Sciences
Stephen Del Greco, NOAA National Climatic Data Center
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1.0 Introduction

In the wake of the Deepwater Horizon (DWH) oil spill, a flood of information and new research has highlighted the need for improved coordination of data management for environmental applications (Figure 1). It is common for multiple entities (NGOs, academic institutions, responsible parties, federal and state agencies) to collect data that vary significantly in quality, collection methods, access, and other factors that affect use by others. These differences result in limitations for use of the data including comparing results or making inferences.

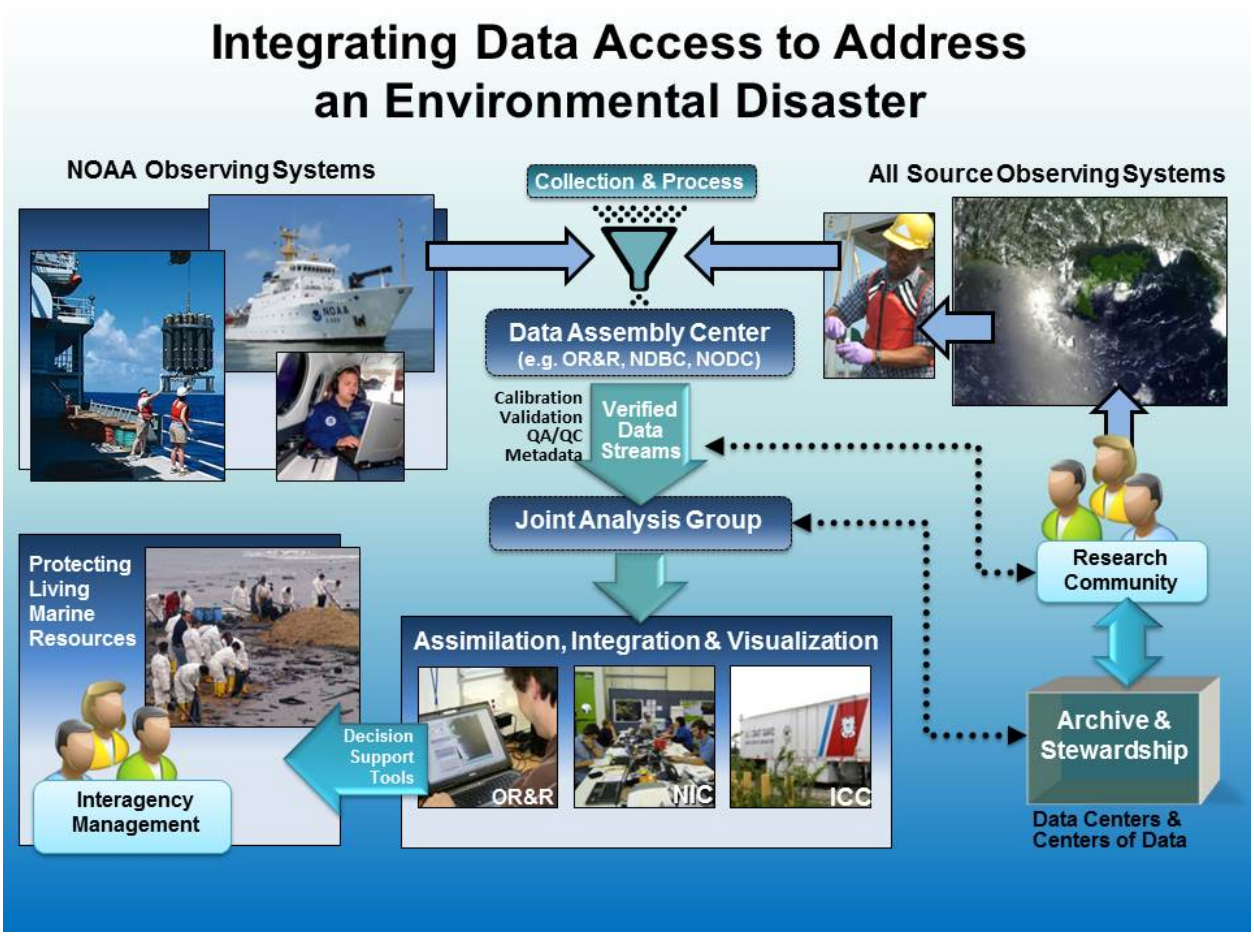

Figure 1. Courtesy of Russ Beard, NOAA, National Coastal Data Development Center

The Environmental Disasters Data Management (EDDM) project seeks to foster communication between collectors, managers, and users of data within the scientific research community, industry, NGOs, and government agencies, with a goal to identify and establish best practices for orderly collection, storage, and retrieval. The Coastal Response Research Center (CRRC) is assisting NOAA's Office of Response and Restoration (ORR) with this effort.

The objectives of the EDDM project are to:

- Engage the community of data users, data managers, and data collectors to foster a culture of applying consistent terms and concepts, data flow, and quality assurance and control;
- Provide oversight in the establishment and integration of foundational, baseline data collected prior to an environmental event, based on user requirements;
- Provide best-practice guidance for data and metadata management;

- Suggest infrastructure design elements to facilitate quick and efficient search, discovery, and retrieval of data;
- Define the characteristics of a "gold standard" data management plan for appropriate data sampling, formatting, reliability, and retrievability; and
- Deliver workshop conclusions to end users in order to promote the use of the protocols, practices, or recommendations identified by participants.

An EDDM workshop was held on September 16-17, 2014 at the U.S. Fish and Wildlife National Conservation Training Center in Shepherdstown, WV. Participants at the workshop included individuals representing industry, government, NGOs, and academia on regional, national, and international levels who have a variety of experience related to data management during disasters (Participants in Appendix A). For the purposes of this workshop, environmental disasters are defined as floods, earthquakes, hurricanes, tornados, and discrete pollution events (e.g., oil spills).

The workshop consisted of plenary presentations and group breakout discussions (Agenda in Appendix B). It commenced with initial introductions and presentations on (1) how data are used for environmental disasters and (2) types of data management systems for these disasters.

The participants were split into breakout groups based on their expertise:

- Breakout Group A: Field Sample Collection (Data Collection/Sampling Protocols),
- Breakout Group B: Data Formatting/Entry (Data Consistency and Comparability),
- Breakout Group C: Data Reliability/Tracking (Accurate Transmission to Databases and QA/QC, Data Validation), and
- Breakout Group D: Discovery and Accessibility (Data to Users).

During the breakout sessions on Day 1, each group addressed questions that had been developed by the Organizing Committee (Breakout Group Questions in Appendix C). The discussions/answers from each breakout group were summarized and presented to all participants during a subsequent plenary session.

In the breakout session on Day 2, the groups discussed EDDM-related issues and challenges, the difficulty and priority to address them, and potential steps for a path forward. Each group presented the main points of its discussion in a final plenary session, which was followed by all participants discussing synthesis and next steps. Participants were given the opportunity to serve on the Organizing Committee as EDDM efforts move forward, or one of several topic-specific working groups that will be convened as a result of the discussions.

The following definitions are useful for the subsequent sections:

Discovery: User knowing that the data exists and then being able to find the specific data desired.

Accessibility: User accessing the data (by browser, mobile app, or other) and the level of access available (completely public or with restrictions).

Data Model: Rubric that documents and organizes data, defines how it is stored and accessed, and establishes the relationships among different types of structured and non-structured data.

2.0 Plenary Sessions

A summary of each presentation from the workshop is provided below. Slides for the presentations are available in Appendix E.

2.1 Use of data for environmental disasters

2.1.a Response – Charles Henry, NOAA, Office of Response & Restoration, Gulf of Mexico Disaster Response Center

Charles Henry provided an overview of how data are used for spill response during environmental disasters and discussed related data needs. He outlined the five key questions to be answered during a disaster: (1) What was spilled? (2) Where is it going? (3) What is at risk? (4) How will it hurt? and (5) What can be done to mitigate the hurt? Data are needed during environmental disasters to provide situational awareness and answer each of the five questions. To characterize the situation quickly, it is helpful if available data fit into a Common Operational Picture (COP) (a common available, easily displayed/used environment, such as the Environmental Response Management Application (ERMA®) used by NOAA). Both the quality of data, as well as how those data are processed and used, can critically affect decisions made in response to a disaster. Trajectories of spills are one critical component for monitoring and planning response efforts. To accurately predict trajectories, many types of data must be combined quickly. If the data are not accurate, or are processed or interpreted incorrectly, a poor trajectory can result. This could be disastrous because assets may be deployed inefficiently. Knowing the confidence in the available data is also important. Often at the beginning of a disaster, available information may be incorrect or sparse, but response decisions must still be made. It is important to update and correct this information/data as new information becomes available. The nature of disasters can add additional challenges to response (e.g., when levees broke in New Orleans after Hurricane Katrina, a road map was useless for planning response because many of the roads were flooded). Another challenge was the limited resources available, and resource use needs to be as effective as possible.

2.1.b Assessment – Robert Haddad, NOAA, Office of Response & Restoration, Assessment and Restoration Division (ARD)

The primary objectives of a Natural Resource Damage Assessment (NRDA) are to: (1) determine the extent and magnitude of injuries to the natural resources as a result of the release/spill and any injuries caused by the response activities, and (2) develop and implement appropriate restoration. The ability to integrate considerable amounts of different types of high quality data (and access related QA/QC information and metadata associated with them) and then see the results is critical to identifying and quantifying injury successfully. Assessment considers not only information derived during and after the spill, but also historical baseline data and material from various agencies. From a NRDA perspective, the term “data” includes: field and laboratory data, in situ measurements, climactic/meteorological data, photos, remote sensing, field observations and determinations, telemetry, model results, and metadata.

NRDA is a scientific and legal process – these both drive how data management is performed. With the potential for litigation, the data collected may be subject to the highest level of scrutiny. Each side in the case will search for inconsistencies that might preclude use of the data in court. The methods of data collection, analysis, and interpretation must be explained and defensible. If data management is not done properly, the data can be rendered useless and significant resources spent on data collection and management wasted.

Data management at NOAA ARD has evolved over the years. ERMA®, which is currently used by NOAA, enhanced the ability to see many types of data (including live feeds) and rapidly share them with stakeholders. Data Integration Visualization Exporting and Reporting (DIVER) is a collection of tools and processes that represent the most current evolution of data management at ARD. It standardizes and makes available to principal investigators/scientists the range of available data. DIVER enables data mining across diverse data types and spatially-explicit queries.

With more advanced instruments, the amount of information and data collected today far exceeds the amount that was collected historically. Much of the data collected 5 years ago or longer cannot be used, as those data need to be validated and managed so that they can be compared to current data. Funding is always limited, and each piece of data collected can be incredibly expensive, so the amount of data collected has to be balanced with the amount of available funding. The DWH case is an outlier because of its size (~200 million gallons of oil spilled) and scope. Education and communication among groups are needed to ensure data managers and users are not segregated. Ideally, everyone involved knows all the data and understands the analytical quality and all the steps that have occurred from collection to final interpretation.

2.1.c NGOs and the Public – Jonathan Henderson, Gulf Restoration Network, Coastal Resiliency Organizer

Jonathan Henderson provided an overview of the Gulf Restoration Network and the Gulf Monitoring Consortium (GMC). The Gulf Restoration Network (www.healthygulf.org), based in New Orleans, is a 20 year old member supported nonprofit environmental conservation organization. Its mission is to unite and empower people to protect and restore the natural resources of the Gulf region. The GMC is a rapid response alliance of various member organizations dedicated to monitoring and reporting pollution across the Gulf of Mexico. GMC uses satellite images and analysis of pollution detection trends to identify targets for monitoring. Airplane flights detect and verify pollution events using photos and GPS data. GMC has volunteers on land and water collecting samples and documenting impacts.

The GMC reports incidents to the National Response Center (NRC), and findings are publicly available. Websites such as the NRC should be able to withstand cyber-attacks. The biggest issue currently with the NRC system is transparency when a report is filed. Unless a Freedom of Information Act request is filed, the entity filing the report does not receive subsequent information about what happens after the report is filed except which agencies were notified of the spill/event. The EPA has better transparency than NRC. Because of the current lack of transparency with the NRC system, GMC cannot keep stakeholders informed about events. Often communities do not trust the agencies responding to disasters, and a clear and direct line of communication between scientists, government, NGOs, and industry is important to engendering trust. Data sharing among all parties also is important.

There is a critical need to respond and prepare the tools necessary for efficient data management. Members of the workshop highlighted two important points resulting from his talk: (1) More individuals need information in a disaster - how can they get it? (2) How do we use data generated by other sources (e.g., NGOs) to help inform additional research or other actions?

2.1.d Research: Ecological Health – Tracy Collier, Puget Sound Partnership

There are five types of data useful for determining ecological effects of oil spills: (1) water chemistry, (2) air chemistry, (3) chemicals in biota, (4) biological measures in individuals, and (5) population metrics.

The last three types of data are the hardest to get, but may be the most important. Pressing needs exist in the following areas: seafood safety, human health, dispersant use, and threatened and endangered species. These are interconnected, so "cross-walking" can occur between them in developing response strategies and sharing data. There are some 30,000 chemicals used in commerce, with only 4% routinely analyzed, and 75% unstudied. Many are designed to be toxic (pesticides) and 400 are estimated to be persistent. Some have unanticipated side effect (e.g. flame retardants). Petroleum contains thousands of unstudied chemicals.

Baseline data are critical information to have in the region of concern. Data must be quickly identified and captured. For Hurricane Katrina, there were no baseline data to compare with post storm conditions. Puget Sound has a long-standing monitoring program, but there is a lack of archived data in other areas. There are episodic attempts to establish this in some places, but it is not systematic or continuous sampling.

2.1.e Research: Human Health – Aubrey Miller, National Institute of Environmental Health Sciences (NIEHS)

Environmental disasters come in all shapes and sizes, and human health is a component of most of them. Typically, health research in response to disasters has been quite limited and suffers from a number of problems including:

- Ad-hoc, convenience-based sampling,
- Non-systematic collection of health information,
- Late Data: Missing baseline & longitudinal health data,
- Exposures not measured,
- High risk groups not included: pregnant, elderly, pre-existing conditions,
- Lack of toxicity / health effect information for exposures, and
- Need for increased community engagement.

It is important to recognize that there are important human health questions associated with disasters that need to be addressed in order to prevent injuries and illnesses and promote recovery and future preparedness. Such questions include:

- What are the acute and long-term health implications (including mental health) of the exposures and stressors, especially among those most vulnerable?
- Are the impacted areas safe for people to live and work there?
- What must be known to help protect the public, address community concerns, and prepare for the future?

In order to address these questions we need to develop tools and processes to enable us to collect useful and timely information. Also, data and their management systems should be developed accordingly to support disaster response and research efforts.

With respect to the Gulf Oil Spill, the NIEHS and the Centers for Disease Control and Prevention (CDC) came together quickly to help coordinate and facilitate an assessment of data gaps and research needs related to spills and exposures. Subsequently, an Institute of Medicine (IOM) workshop held in New Orleans in June 2010 assessed the research needs related to the human health effects of the DWH spill. There are limited human health studies that have been performed for oil spills. Of 38 supertanker oil spills in the past 50 years, only eight have been studied for health effects, and all but one of those studies were short term. Only one study had estimates of exposure (using surrogate measures e.g.,

distance from spill). Exposures of concern during oil spills include: components of the crude oil, dispersants, mixtures of crude and dispersants, and chemicals resulting from burning.

Based on these and other considerations the IOM made the following recommendations:

- Longitudinal human health research is clearly indicated,
- Health studies should begin as soon as possible,
- Mental health & psychosocial impacts must be considered,
- Sensitive populations must be monitored,
- External stakeholders must be part of the process, and
- Data and data systems should be developed to support wider research efforts.

Subsequently, the NIEHS developed a number of intramural and extramural research efforts to respond to the IOM recommendations. The NIEHS GuLF STUDY (Gulf Long-term Follow-up Study) is an intramural health study of 32,762 oil spill clean-up volunteers and workers. The study follows participants for 10+ years and includes some combination of telephone interviews, in-home clinical assessments and biospecimen collection, comprehensive clinical exams, mental health and resiliency assessments, and a linkage to vital records and cancer registries. NIEHS also leads a NIH funded extramural DWH Research Consortia between four academic centers and community organizations focusing on research issues of concern to the coastal communities. The studies being performed by these groups will be looking at distinct populations (women, children, pregnant women, cultural/ethnic minorities) and will also cover seafood safety and community resiliency.

Additional lessons learned from oil spill research include the importance of rapid and ongoing communication with stakeholders, and the need for better capabilities to rapidly evaluate exposures and the resulting toxicity. Also, it is important to characterize the spill exposures to workers and the community to help understand any associated health effects. Such characterization and investigations include:

- Identify chemical profiles of different crude oils,
- Characterize changes in exposure impact due to oil weathering and degradation,
- Conduct research on chemical mixtures, and
- Document background ambient exposures as a baseline to evaluate impacts of future spills.

As part of the Gulf Oil Spill response, as well as responses to other disasters, a number of challenges for performing timely health research in response to disaster situations have been identified including: lack of baseline data (health and environmental), timeliness of funding awards and initiation of studies, study development (including getting approvals from Institutional Review Board (IRB), Office of Management and Budget (OMB), and obtaining Certificates of Confidentiality), identifying and enrolling study populations, and exposure reconstruction.

In response, the National Institutes of Health (NIH) have started a new Disaster Research Response (DR2) Project. This pilot project has been developed to help galvanize and accelerate the necessary infrastructure to mobilize quickly to perform needed health research in response to disasters. The DR2 will improve researchers access to data collection tools and create new platforms and networks to help facilitate engagement by federal, state, local, and community organizations in health data collection efforts. Objectives include the following:

- Development of a central repository for data collection tools and research protocols,
- Development of Rapid Data Collection Capability: baseline, clinical, and biospecimens; and new processes to hasten IRB and OMB approvals and address ethical issues,

- Timely collection of environmental data to accompany health data (including exploring roles of new technologies, social media, and "citizen science" in research),
- Training of intra/extramural disaster researchers,
- Development of Environmental Health Research Response Networks, and
- Development of a public website: "Disaster Research Responder".

Next steps for the DR2 Project include efforts to facilitate the collection of exposure and environmental data by other agencies in support of the human health research studies and to increase our capabilities to perform toxicology research to further our understanding of various exposures of concern.

2.2 Existing data management systems, potential overlaps, shortfalls, opportunities for improvements, evolution of systems going forward

2.2.a Atmospheric Data – Stephen Del Greco, NOAA, National Climatic Data Center (NCDC)

NOAA's National Climatic Data Center (NCDC) is the world's largest archive of climate and weather data. NCDC is responsible for preserving, monitoring, assessing, and providing public access to the Nation's climate and historical weather data and information. There is a rising demand for climate information, and the amount of climate data has increased tremendously in recent years. NCDC offers numerous climate products and services to a large variety of users on the local, regional, and national/global level, on weekly to decadal timescales. The Products and Services Guide available on the NCDC website (www.ncdc.noaa.gov) provides an overview of the offering. Services are delivered online, or via CD-ROM, DVD, computer tabulations, maps, and/or print. Data are accessed from disk (Storage Area Network) and tape (robotics system). NCDC does not store data in all formats, but instead data are formatted on demand to suit a specific need/format. Google Analytics is used to provide usage statistics and patterns. Drupal Content Management System provides the content infrastructure.

There are three data access portals: the Climate.gov portal, the Drought Portal, and the Model Portal. Many partners are involved in the portals, across NOAA, other agencies, and at the regional and state levels. The Climate.gov portal is designed to reach a wide segment of users – scientists, businesses, decision/policy-makers, news media, public, etc. The Drought Portal is geared toward providing critical information to decision-makers. The Model Portal provides access to reanalyses and numerical model output. NCDC also provides access to model data via the Climate Forecast System Reanalyses which is available online via NOMADS. NCDC also hosts international data - the Global Observing Systems Information Center (GOSIC) and the World Data Centers for Meteorology and Paleoclimatology. The GOSIC Portal provides one-stop access to data and information identified by the Global Climate Observing System, the Global Ocean Observing System, the Global Terrestrial Observing System, and their partner programs. The World Data Centers are a component of a global network of sub-centers that acquire, catalog, archive, and facilitate international exchange of scientific data without restriction.

The Climate Data Online (CDO) system and GIS Map Services provide centralized access to numerous US and global datasets and products. Data users are provided access to the data and metadata and allowed direct machine-to-machine access. Data visualization tools (e.g., Multigraph) provide graphical display of various parameters. For CDO, a "Batch" process allows users to submit orders for data and receive a link via email to the data. The underlying structure of CDO includes Oracle databases with tiered server infrastructure. These services continue to be built out to accommodate additional datasets and products. NCDC also has a weather and climate toolkit, which is based on community developed tools and standards. It is a desktop application providing simple visualization and data export to various formats. It supports 22 data formats (Model, Satellite and Radar), and provides interoperability with

diverse user communities. It is interoperable with Google Earth - exporting 3D radar sweeps and isosurfaces for Google Earth visualization. The Comprehensive Large Array-Data Stewardship System (CLASS) website (www.class.noaa.gov) provides users with access to CLASS information holdings and receives the users' requests for information. CLASS manages data user's logins, contact information, preferences, shopping cart, etc.

2.2.b Oceanographic Data – Russ Beard, NOAA, National Coastal Data Development Center (NCDDC)

The National Oceanographic Data Center (NODC) at NOAA manages the world's largest collection of publicly available *in situ* and remotely sensed physical, chemical, and biological oceanographic data. It includes data taken from sources such as ships, CTD/Niskin casts, buoys, plankton tows, laboratory experiments, models, satellites, gliders, ocean currents, instrumented animals, and Expendable Bathythermograph (XBT). The NODC website (Nodc.noaa.gov) provides a list of all the available products. NODC's data are being used for aquaculture, policy, ocean sciences, hazards response, national defense, industry, and climate-related work. Data management should be judged by its usefulness to current and future users.

The National Coastal Data Development Center (NCDDC), a Division of NODC, provides comprehensive end-to-end data management for the coastal environment. It has a regional approach, with a wide constituent base and liaison officers for customer service and user outreach. It provides metadata development (semantic search and ontologies), data discovery, mining, access, transport, archive, entry tools, collaborative web tools, data integration and fusion, geospatial enablement and visualization (e.g., ARC GIS and Google map), and biological data considerations.

NODC hosts global data sets of satellite and *in situ* data. The NODC Advanced Very High Resolution Radiometer (AVHRR) Pathfinder Version 5.2 sea surface temperature (SST) Climate Data Record provides the longest (1982 – 2012), most accurate, and highest resolution, consistently-reprocessed SST climate data record from the AVHRR sensor series. The World Ocean Database (WOD) and World Ocean Atlas (WOA) provide quality controlled comprehensive data collection and global *in situ* climatologies of temperature, salinity, oxygen, and nutrient measurements. The WOA is created from the WOD, and is a set of objectively analyzed climatological fields and associated statistical fields of observed oceanographic profile data interpolated to standard depth levels.

The NOAA Gulf of Mexico Data Atlas (gulfatlas.noaa.gov) provides digital discovery and access to Gulf data. Based on the traditional atlas format, it allows a wide range of users to browse a growing collection of datasets seen as map plates. The goal of the Atlas is to provide access to datasets that characterize baseline conditions of Gulf of Mexico ecosystems in order to assist long-term research, monitoring, and restoration programs. It includes metadata, web mapping services, and data download and access links, as well as access to Representational State Transfer (REST) services. The Atlas benefits from over 30 federal, state, non-governmental, and academic partnerships.

NCDDC's OceanNOMADS (National Operational Model Archive and Distribution System for Oceans) is a web portal providing access to output from data-assimilating ocean-models from NOAA and Navy. It supports NOAA research on marine ecosystems and can be a backup (*note: not primary*) data source during events. Data from operational, data-assimilating ocean models provide 4-D ocean state estimates, and web tools simplify the task of accessing model data in useful formats. OceanNOMADS staff have worked with NOAA and academic scientists on oceanographic input for whole-ecosystem models as well as marine habitat, larval transport, and marine mammal ecology studies. OceanNOMADS is a data source for OR&R's GNOME Online Oceanographic Data Server (GOODS), however

OceanNOMADS is operated primarily as an aid to retrospective analysis, and so does not guarantee reliable real-time data delivery during an event.

The National Centers of Coastal Ocean Science (NCCOS) provides coastal managers the information and tools they need to balance society's environmental, social, and economic goals. NCDDC is working with NCCOS to create a geoportal-based application to enhance easy discovery of and access to the NCCOS data inventory.

A common data model should be platform and format independent. It should stretch across different users, with a consistent vocabulary and glossary. Multiple formats can be used and integrated, as opposed to needing a standard format. If everyone can agree on the metadata (suggests the nine parameters of metadata), then anyone can search for, locate, and discover the data. DIVER is an example of a model that contains different types of data and uses best practices to provide transparency, discoverability, and accessibility.

2.2.c Chemistry Data – Benjamin Shorr, NOAA, Office of Response & Restoration (ORR), Spatial Data Branch/ARD

A data warehouse integrates and makes information and data available from one location. Standard tools are generally used to collect and manage the information. The recommended approach is flexible and scalable. A data management effort in the midst of an emergency will default to existing tools and processes. The sooner field collected and lab processed data streams are integrated, the better the connections and management of the data. Ideally, data are combined beyond high level metadata. One of the ultimate goals is to provide environmental intelligence (using an online query to make an informed decision) and make information available in a useful format. Often in disasters, data have to be managed with an agile development approach (i.e., not all necessary information is known in the moment, but data management must move forward regardless and evolve along the way to meet ever changing needs). This agile approach was implemented during the DWH damage assessment, and frequent brief video conferences enhanced accountability, minimized silos, and helped to facilitate communication and create a team approach.

Common data model(s) (which refers to schemas or structures of data organization) should be flexible and scalable, with the ability to query across types of information. Data delivery and query requirements should drive how the information is managed. Data should be collected digitally if possible, and contain structured information (records with a field such as analytical data) and unstructured information (no records or columns to query such as reports or scanned field sheets). Data are connected by core fields at a high level across data sets/models. The first step in a common data model is to collate source data. The next step is extraction, transformation, and loading (ETL). ETL extracts data from homogeneous or heterogeneous data sources. Steps include defining the common model, accommodating additional data, and standardizing it. Source data and queries should be audited. Data are then brought into the data warehouse and integrated. Then data can be explored, visualized, and reported. Information collected can include: chemical and biological samples; oceanographic data; observations of shoreline, marsh, and species; animal telemetry; photography; and restoration data (potential and implemented, budget and activities). There are data specific information (e.g., results, methodology, units) and related information (field information, source data packages, reports, graphs). Existing standards and nomenclature can be used, and expanded and standardized, when necessary. Metadata is an important component. Existing contaminant chemistry source databases include: Historical Contaminant Chemistry (Query Manager), DWH Response collected (EPA ETL → NOAA QA/QC), and British Petroleum (BP) Natural Resource Damage Assessment (NRDA).

DIVER is an explorer data management and query tool developed and used by NOAA. It has a flexible query providing guided or custom searches, which can be saved for later use. DIVER provides export of data packages (including from NRDA and external datasets) which can then be used for analysis, visualization, and processing. Data tables showing query results are integrated with a mapping function. Information can be displayed as points, lines, and/or polygons and exported into GIS formats. Charts provide a summary of query results and are interactive, showing filtered data when clicked. Information is linked to source data files, and related data and information (e.g., documents, photographs, study notes). Metadata is a critical component, containing information such as query details (e.g., fields and data chosen), data details (e.g., when datasets were updated), data caveats (notes about the data), and field definitions. Metadata meets Federal Geographic Data Committee (FGDC) compliant (Extensible Markup Language (XML) and Hypertext Markup Language (HTML)) specifications; moving to International Organization for Standardization (ISO) geospatial metadata standards. DIVER is interoperable with ERMA® - query results can be shown in the ERMA® application. DIVER staff are currently working on enhanced data search functionality, and more widely available DIVER tools for the Gulf of Mexico, the Great Lakes, and nationally. NOAA is creating a flexible and scalable national approach with the goal of using DIVER as part of NOAA's approach to data collection and management for the next environmental disaster. NOAA is also trying to address Internet data security needs and concerns of federal organizations, while also broadening the community accessibility and usability.

2.2.d Sensors – Mike McCann, Monterey Bay Aquarium Research Institute (MBARI)

Oceanographic research involves using a wide variety of surface and subsurface observation and sampling platforms (e.g., gliders, drifters, moorings, shipboard systems). For example, an autonomous underwater vehicle (AUV) is a mobile platform that measures properties (e.g., dissolved oxygen, nitrate, genetics, fluorescence, chlorophyll) while moving through the water. Data can be received from the AUV in real-time or delayed mode. A long-range AUV can be at sea for two weeks with continuous communication to shore. Examples of instruments placed on these platforms include the Seabird CTD, Wetlabs ECO Puck, ISUS Nitrate analyzer, Oxygen optode, and the Environmental Sample Processor.

Mike McCann discussed managing, visualizing, and understanding *in situ* oceanographic measurement data using the Spatial Temporal Oceanographic Query System (STOQS). STOQS is an open source geospatial database package that provides efficient access to these kind of data. Data ingest depends on using CF-NetCDF 1.6 discrete sampling geometry format for archiving information from the instruments. After loading into STOQS all of the data and metadata are viewable in a web-based user interface, which enables interactive exploration and analysis of large collections of data. The STOQS user interface provides these specific features:

- Spatial and temporal overview of all the data,
- Selection of data by platform, parameter, time, depth, and data value,
- Plotting of selected measured parameter along time-depth sections,
- Plotting of selected measured parameter on the map,
- Plotting any parameter against any other parameter, e.g. T-S plots,
- Visualizing the data in 3D, and
- Export to other formats, e.g.: CSV, JSON, KML.

The STOQS software is under continual development at MBARI. Current efforts include incorporating more laboratory analyses from physical samples and developing machine-learning algorithms to aid in decision making.

2.2.e Biological Data – Felimon Gayanilo, Harte Research Institute for Gulf of Mexico Studies

Biological data are commonly stored or archived in: (1) desktop computer or stand-alone system not accessible or shared with others, (2) databases developed by short-term funded projects that in many cases becomes inaccessible after the project funds are exhausted, (3) institution-wide information systems with institutional support and long-term initiatives, (4) federal, regional, and state programs that are generally accessible to the public, and (5) information systems from multi-national programs and efforts.

The type and structure of biological data are very much dependent on the objective of the study. Although the data management life cycle (which includes planning, collecting/generating, processing/analyzing, archiving, and discovering/re-using) is fairly standard, there are no community-wide encoding standards or vocabulary for biological data. These are just some of major issues that inhibit the re-use/repurposing of biological datasets from data centers. Instances of there being insufficient information to establish data provenance (metadata), absence of data review process (quality control), limited temporal and spatial coverages, and insufficient efforts to allow the interoperability of disparate information systems are the other issues with the management of biological datasets.

2.2.f Human Health Data – Steven Ramsey, Social & Scientific Systems Inc.; NIEHS GuLF STUDY

Objectives of disaster epidemiology include:

- Prevent or reduce the number of deaths, illnesses, and injuries caused by disasters,
- Provide timely and accurate health information for decision-makers, and
- Improve prevention and mitigation strategies for future disasters by collecting information for future response preparation.

Related surveillance work includes assessment of mortality (deaths) and morbidity (disease). A wide variety of resources, data/information, and data collection tools are used to assess these early in disaster situations and some examples were provided. Understanding the short and long-term health effects of disasters requires research that should be another component of the response to disasters. It is being done, but it takes too long to get into the field. Working with human subjects presents unique challenges and complications that are not associated with the study of animals and ecosystems. Human research protections require “Rules of engagement” for interacting with human subjects and strict study protocol must be followed, requiring much time and coordination. In addition, it can be difficult to get people to respond to and participate in research over long periods of time. Certain approaches work better than others depending on the population of interest. A workshop participant mentioned the idea of involving community organizations as one method that resulted in improved response. More work is needed to integrate data from sources such as weather satellites, monitors, sensors, and models with human specimens and questionnaire data to better understand exposures and related sequela. The nature of disasters can also present challenges to the logistical feasibility of conducting research, such as lack of power for refrigeration of samples, and closure of shipping as a means to send samples for analysis. Several examples of research study data management systems were discussed and some pros

and cons of each were presented.

3.0 Breakout Sessions

Based on their expertise, each workshop participant was assigned to one of the breakout groups:

- Field Sample Collection (Data Collection/Sampling Protocols),
- Data Formatting/Entry (Data Consistency and Comparability),
- Data Reliability/Tracking (Accurate Transmission to Databases and QA/QC, Data Validation), or
- Discovery and Accessibility (Data to Users).

The following is a summary of the discussions and conclusions for each of the breakout groups.

3.1 Breakout Group – Field Sample Collection (Data Collection/Sampling Protocols)

The Field Sample Collection Group answered the following questions during the workshop.

Is there a common data model that can be shared across entities?
No. A good place to start would be to create a performance-based conceptual model that unifies data types and variables.

What are the essential core parameters to be collected and recorded for any field collection (e.g., sample ID, date/time, lat/long)?
Essential core parameters should include media being sampled, as well as spatial and temporal components. At the detailed level, there is a long list of parameters, which can become a challenge between different groups. The goal should be to collect parameters that allow an evaluation of data quality and determination of utility with other data resources in order to evaluate exposure and effects.

What are the essential core parameters to be included in the metadata record?
Essential core parameters should be in compliance with Open Data Policy and standard-specific metadata guidelines. Additionally, information regarding how and why data were generated in a particular way (e.g., protocols, SOPs, strategies) and data use and access documentation should be included. A unique identifier and data contact/custodian should also be included. Mandatory and mandatory if applicable fields and their corresponding fields in a variety of metadata standards are available from the Open Data Project website at https://project-open-data.cio.gov/metadata-resources/.

What are the standard data types and protocols for emergency response?
There are numerous protocols for sampling particular agents in a particular matrix. Tiered protocols as needed for emergencies should follow a performance-based approach. This needs to be developed before the emergency because it can take too long once the disaster occurs.

What are best practices for reducing transcription errors?
Electronic field data entry reduces copying and transcription errors. An investment in this technology and the training to use it can substantially reduce data entry costs and errors and provide more rapid access to the results.

What are the roadblocks for getting data from field collection into an electronic format?
Electronic field data entry is preferred for reducing copying and transcription errors and eliminates later transfer to an electronic format. However, electricity (for charging) and Internet (for transmitting) are not always available on-site. Planning is needed to assure adequate storage capacity on-site, until data can be transmitted at a later time.

How is field collection designed to maintain Personally Identifiable Information (PII) (personal identification, human health etc.)?

Personal information should be maintained on a separate computer, with a linking identifier to the files of field data.

How is field collection designed to ensure accuracy of data?

Different collection plans have different criteria to ensure accuracy. Protocols can also depend on who is collecting the data. Ensuring accuracy of the data should be performance-based.

How is field collection designed to maintain data security?

This varies between agencies.

What are requirements for field data collection in order to ensure good data?

- Use of standard sampling protocol,
- Trained data collectors, particularly related to emergency response (protocol for preparedness),
- Coordination of sampling efforts,
- Performance-based,
- Standard Operating Procedures,
- Accurate and thorough metadata documentation, and
- Pre-plan for anticipated emergency response scenario needs, and incorporate into Sampling and Analysis Plan.

What are the types of media that should be sampled for an environmental disaster with respect to human and ecological health?

Both human and ecological health:

- Air,
- Soil/sediment,
- Water,
- Biological samples (e.g., urine, blood, fish bile),
- Characterization of toxicity of hazard (e.g., what chemicals present? e.g., oil, dispersant), and
- Archive a variety of samples that can be analyzed with high sensitivity later (for other analytes that are not known at time of incident). This can be done for background conditions too, prior to incidents. However, that can be expensive. If background sampling is cost limited, an alternative is to collect these samples outside of the disaster area during the event.

Note: Leveraging existing reference sites, as well as existing citizen science and NGO networks, should be considered to increase the data resource.

Human health specific (in addition to above):

- Dermal,
- Time, location, and activity (changes by day),
- Biological sampling (urine, blood, other human health information), and
- Mold, mildew.

Note: Focus initially on characterizing the exposure of the public and emergency responders.

The Field Sample Collection Breakout Group also developed the following table regarding issues and challenges, and a path forward. The group felt that all of these items were high priority.

	Issues and Challenges	**Difficulty**	**Path Forward**

Common data model(s)	Flexibility to adapt	high	Develop interdisciplinary focus. Group/workshop to address.
Core parameters recorded during field collection	Protocols, training, quality assurance, best tools available	medium	Include in funding plan.
Core parameters for metadata	Integrations of citizen and NGO groups collecting core parameters. Using local knowledge/samplers.	medium	Include in preparedness planning. Preparedness and training in advance. Set expectations early about coordination and communication.
Reducing transcription errors	Completeness and accuracy difficult in field conditions	easy	Use electronic entry, when possible. Make it as easy as possible. Do not proceed without filling in all fields. Have automatic data field checks.
			Have appropriate review at appropriate times. Accountability. Real time quality control. Timely review.
			Identify and implement best practices (such as data intake team concept used by NOAA).
			Investigate automated processes, sensors, etc.
	Fatigue	medium	Enhance intake team capacity.
Getting field data into electronic formats	Location Resources: time, money, people	easy	Adopt existing software. Include in drills, plans, and funding.
Maintaining PII	Security, trust, safety, confidentiality	high	Continually upgrade system. Work with security experts. Understand and implement requirements. Follow existing prescribed security processes. Train recorders/collectors.
	Institutional Review Board (IRB) - slows process	high	Have IRB come up with plan for disasters. Blanket IRB that can be implemented during disasters, with pre-approval.
Ensuring accuracy of data	Appropriate QA/QC methods implemented in disasters	medium	Provide training, ensure preparedness
Maintaining chain of custody	Disaster field conditions complicate this	medium	Provide training and supplies, implement procedures
Maintaining data security	Loss or failure of electronic sampling equipment (data integrity), also see PII issues	medium	Implement redundant and robust systems, develop/use best practices for data backup, encryption, training
	Transmission security -integrity	high	Have appropriate systems, encryption
	Transmission security -confidentiality	medium	Have appropriate systems, encryption

3.2 Breakout Group – Data Formatting/Entry (For Consistency and Comparability)

The Data Formatting/Entry Group answered the following questions during the workshop.

Is there a common data model that can be shared across entities?

No, there is not a common data model across all disciplines. What is considered the "best" data model depends on why data are being collected. Best practices and models exist, but there is nothing universal. However, there are many commonalities across disciplines. Many of the data models needed for disaster data management have a spatial component. Census Data, ISO191, and GIS are popular encompassing ones. Data models can have a similar structure, but within the models, there needs to be a glossary/index/dictionary that defines similar terms (e.g., variables, units) and clarifies them for comparison between models. An overarching model is not necessary, as long as there are standards. Crosswalk methods can allow existing data models to connect to each other. Adaptive management can be used as models are adopted and linkages are established.

What are the essential core parameters to be collected and recorded for any data collection (e.g., sample ID, date/time, lat/long)?

- Unique identifier,
- 4-D locations (time, X, Y, Z),
- Parameter measured or observed,
- Actual values,
- Units, and
- Metadata.

What are the essential core parameters to be included in the metadata record?

It is difficult to draw a clear line between data and metadata – they go "hand-in-hand". Metadata is an essential part of data. Some of the core parameters listed for data collection apply to metadata (e.g., unique identifier). Other information for metadata includes:

- Information on what the dataset is, who collected it, what its purpose was?,
- Spatial reference (coordinate system and datum),
- Collection methodology,
- Instruments used,
- Limits of detection by methodology,
- Review status and what type of quality control was done,
- User restrictions, and
- Shareability (How can this be used or shared? Federal data?, Proprietary?, Contains PII?).

What are best practices for reducing transcription errors?

- Electronic data capture, when possible/practical,
- Transcription verification/dual data entry,
- Multiple people review, if possible/practical, and
- Safeguards in the system (unable to enter unrealistic data (e.g., that a person is 16ft tall)).

What are the rate limiting steps for getting data from field collection into an electronic format?

- Time,
- Office of Management and Budget (OMB) requirements (any federal data collection needs their clearance and it is a slow process),
- Data sharing and ownership issues, data sharing agreements,
- Difficulty reading handwriting on paper and finding the original data recorder to clarify,
- Non-standardized data (e.g., personal notes or a small sketch may end up in text fields),
- Platform dependency (Android vs. iOS, PC vs. Mac),
- No access to Internet,

- Running out of battery with electronic devices, and
- Procedural differences among agencies. No clear protocol or process established for data transfer. Adjusting the data into different digital formats for multiple stakeholders.

How are data formatting/entry designed to maintain PII (e.g., personal identification, human health, SSN, birth date)?

The focus should be on how much information is needed to identify a specific individual from a pool – this is different at each scale. Data are needed to make sure that the same person is not surveyed twice and to make sure people with the same name get surveyed individually. Only collect components of PII that are needed. Do not collect PII that is not needed. Perhaps PII may not be needed at all. If PII is available already, do not collect it again. Only use PII that has been collected when it is needed. PII does not have to be put into the electronic record – it can be kept archived. Encrypt the data.

How are data formatting/entry designed to maintain data security?

There needs to be safety and protection from collection to archiving. Data should have a "sharing status" providing information about who it can be shared with and how. For example, approval may be needed before data are shared, and/or there may be a part of the data that cannot be shared prior to public release. Once data are shared, they still have to be protected.

The Data Formatting/Entry Breakout Group also developed the following table regarding issues and challenges, and a path forward.

	Issues and Challenges	Difficulty	Priority	Path Forward
Common data model(s)	Common language (controlled vocabulary)	high	high	Each discipline develops its common data model. Have workshops among groups to develop common data model. If individual models are interoperable that may be sufficient.
	Data structure	medium	high	Create pre-defined forms (e.g., have key tracking terms like keys, ID). Constraint lists (drop down menu - must choose).
	Extensibility & useability	high	high	Engage data and field practitioners in data model development and end user verification/testing. Run drills. Integrate organizations to keep everyone regularly informed of how data is being used. At conferences, each organization talk about their data. Frequent virtual meetings to check progress and discuss. Charter for each working group says what they do, frequency of meetings, etc. Have a representative held accountable and hold working groups accountable.
	Data sharing & ownership	highest	high	Draft memoranda of data sharing agreements so they can be executed at time of disaster. (Group agrees important item, uncertain of best solutions)
Core parameters recorded during data collection	Unique identifier quality: not unique, lengthy, complex	easy	high	Use barcodes to replace long IDs. Use meaningful/logical/sequential IDs so know if something went wrong (alphanumerical order).
-	4-D locations quality	easy	high	Agreement on time zone/reference time and encoding of time. Standardization and training on coordinate system, precision & accuracy, significant figures, calibration, and crossing time zones. Standard operating procedures. Report inconsistencies immediately.
	Parameter measured or observed quality	easy	high	Document the method used.
	Actual values	easy	high	Calibrating equipment, agreement on flag values, significant figures. Checks to make sure the data 'make sense' in the big picture.
	Units	easy	high	Standardize and be explicit.

	Metadata	medium	high	Document instrument used. Zip metadata with data, so it is a core component.
Core parameters for metadata	Confusion regarding definition of metadata	medium	medium	Transformation tools from machine generated nonstandard metadata to standard metadata. One-page clear guidance on what standards are. Make sure metadata gets filled out completely and it is provided by the person collecting the data.
Reducing transcription errors during data formatting/entry	Missing data	easy	high	Validate input. Require all fields.
	Invalid data	easy	high	Inputting techniques (null vs. 0)
	Illogical data (e.g., a male can't be pregnant)	medium	high	Track consistency between fields.
	Typos or inversions	easy	high	Dual entry with cross validation, transcription verify, collect in electronic format, QC after entry (perhaps by field lead or originator)
	Illegible data	easy	high	Have selectable drop down boxes.
	Version control	medium	medium	Gold standard with rules and goals; standard methodologies, routines, and checklists. Training and regular communications (pre-departure meetings, morning assemblies, etc.). People confirm version using and turn old versions in. Project Lead takes ownership.
Getting field data into electronic formats	Resources limitations: equipment & people (analysis takes time)	medium	low	Get more equipment ($) or hire labs with more people and equipment (although can create inconsistencies). Prescreen and certify contractors.
	Time delay between collection and processing, and then loss of information that is needed for a complete record	easy	high	Gold standard with time requirements. Only use electronic. Systems that upload instantly to a cloud. Consider data security.
	Inconsistency in questionnaires, unable to compare groups	easy	high	Have questionnaires available digitally for download.
	Operating equipment in hazardous areas	high	high	Ensure limitations are considered.
	Untrained teams that have different focuses	easy	high	Standardize data entry - ensure team understands forms and variable tested. Field exercises for practice. Data manager accompanies team.

Maintaining data security, PII, and chain of custody	Functionality for user authentication on actual mobile device	high	high	Industry develops necessary technology.
	Inoperability for application within the device (digital signatures)	high	varies per situation	Industry develops necessary technology.
	Something that happens for security adds friction in the field	medium	high	Involve field practitioners in decisions. Minimize security impact. Explain what is required and how to meet it.

3.3 Breakout Group – Data Reliability/Tracking (accurate transmission to database & QA/QC, data validation)

The Data Reliability/Tracking Group answered the following questions during the workshop.

Is there a common data model that can be shared across entities?
A metadata standard is needed. We can generate flexible and extensible usage of existing standards (models). QA/QC and metadata come in different levels. There need to be agreements in place between stakeholders, and active relationships, for data management before incidents occur.

What are the essential core parameters needed for tracking the reliability of data?
A set of core parameters should be developed and used. There should be a process that is known and followed by all; as part of the incident planning process. There should be transcription verification and subject matter expert validation. Having an "authoritative source" and verifying this is a big challenge.

What are the system requirements for data reliability and tracking?
There needs to be flexibility across platforms. Users should be accessing data through loosely coupled web services. IT issues will include security (need data backup), and archiving and maintaining the original. There needs to be security of data while in transit, and security of data at rest. There will always be a hybrid data system using both paper and electronic (need to track both) - the issue is the dynamic of the system.

How are data reliability/tracking designed to maintain data security?
Checksums can be used to detect errors that may have occurred during data transmission or storage. When applied, a checksum function or algorithm calculates a number based on the data. If the checksums calculated before and after storage or transmission are the same, it is a good indicator that the data has not been corrupted or altered. Data should be encrypted in transit and at rest. Version control can be employed regarding version information for devices that are collecting and processing data.

What are the QA/QC processes used and are they community and/or scientifically accepted standards?
Peer review is not practical at the incident. Third party validation of data should be considered.

What is important for data reliability, QA/QC and validation when moving data from field collection into an electronic format?

The physical object and electronic object should be tracked together along with their characteristics (i.e., disposal, location, sample id, sample expiration date, other information to allow the sample to be identified). A robust, flexible system and processes is needed to move data from the field into electronic form. Inconsistencies in nomenclature can present a challenge to proper interpretation. A common vocabulary must be established and consistently used.

What is the process for informing data generators/users about the status of data from collection to archives?

If this is not done well, the system may be viewed as not being transparent. There can be a notification process to inform people that their data has been received and for what it is being used. A reverse Chain of Custody communication should be implemented.

The Data Reliability/Tracking Breakout Group also developed the following table regarding issues and challenges, and a path forward. The group felt that all of these items were high priority.

	Issues and Challenges	Difficulty	Path Forward
Common data model(s) & core parameters for tracking reliability of data (combined)	Defining metadata standards	easy	Clarify the concept to enable a coalition to develop a project-based approach; leverage existing systems and how they can be adapted; design an easy-reading training/internal outreach strategy
	Adopting metadata standards	high	Engage NOAA and metadata experts to establish a training plan/path forward.
	Implementing metadata standards	high	See above
	Building comprehensive QC plan (validation levels, useability, methodologies, versioning, links to publications, historical and baseline data, links to source, study plan, QAP)	high	Scan, analyze, adapt/adopt; review existing large-scale plans
	Need agreement and active relationships for data before incidents	medium	See above
	Easy translation and communication to public - common language/public outreach on understanding data quality and importance of metadata	medium	Make this a priority and work with incident command structure; forms, job aids, info inserts for incident management handbook & work flows
Maintaining data security	Defining data security - what is necessary (checksums, digital signatures, chain of custody)	medium	Policy recommendation; creating a plan; having a panel of experts from different domains to verify/validate protocols to validate authenticity
	Defining who should have access, levels of access (system level, local admin rights, not requiring an IT person in the field)	high	See above
Developing community and scientifically accepted standard QA/QC processes	Need for a coalition of government, public, scientific, academia, stakeholders	high	Identify, organize, and deal with the low-hanging fruit; implement plans noted above

Data reliability, QA/QC, and validation when moving data from field to electronic format	Scanning original source data to store alongside electronic data file; transcription verification and validation	easy	Develop best practices for capturing and submitting data types; supply tools and training to enable field personnel
	Physical and electronic objects to be tracked together along with their characteristics (e.g., disposal, location, ID, expiration date, sample identifying information)	medium	Determine importance of sample to set time to be kept; identify potential for legal ramifications
	Robust, flexible, system and processes to move data from field to electronic form	high	Very important for QA/QC, see group A
Informing data generators/users about the status of their data & tracking disparate data sets as they are processed	Designing and implementing flexible infrastructure to provide multiple types of access. Clearly defined roles and responsibilities. Should have point of contact for feedback from data providers.	high	Have provisional pathway built in to data flow
			Status on "push-pull" basis
			Need subject matter expert
			A system to keep generators and users engaged/informed on where the data is in the process.
			Information at a granular level to be able to communicate where things are in the process; and be able to track it
			Require a data source and a contact mechanism; whoever receives the data is now an "informer"
			To provide data, must provide contact – chain of custody

3.4 Breakout Group – Discovery and Accessibility (getting data to the users)

The Discovery and Accessibility Group answered the following questions during the workshop.

Is there a common data model that can be shared across entities?

- No there is not a common data model, and there may never be one. However, the ability for multiple ones to work together (interoperability) is critical.
- Data sharing agreements need to be developed before events happen. The agreements would establish things like a common ontology, a standard file format for data exchange (including standardized metadata), and requirements that everything is platform independent (works with everything else).

What are the essential core parameters needed for discovery and accessibility?

- Essential core parameters are: spatial, temporal, and keywords.
- Ontologies are important for searching the data. Ontology is a classification, while vocabulary is a definition. Ontology can be used to show links between concepts (e.g., shrimp to chemistry).

What are the system requirements for discovery and accessibility?

- Robust infrastructure to host during emergency situation (lots of bandwidth)
- Online access
- Publicly accessible
- Platform independent
- Accessibility controls
- Vocabulary/ontology built into the system by software (i.e., user-centered design).
- Every sample accompanied by certain necessary parameters. Need to use common vocabulary.
- Metadata automatically generated as data is collected
- Valid links to metadata, data, contacts
- System has to be dynamic modified for access

The Office of Science and Technology Policy (OSTP) has an Open Data Policy that could be a good model/example. It provides guidelines on discoverability and access. Any data generator with federal funding will be required to follow it.

What are the best practices for data visualization, discovery, and accessibility?

- Consider what questions the end user is trying to answer when deciding how to structure information gathered. It should be a user-centered design.
- Develop an inventory of existing best practices that can be shared (there are a lot of them).
- Do not conflict with existing statutes, regulations, and guidance.
- Have a quality statement go along with the data, to tell how it can be used.
- Have good metadata, and provide good metadata training.

What are the best practices for maintaining PII (e.g., personal identification, human health, SSN, birth date) and Chain of Custody in discovery and accessibility?

- Follow guidance of Open Data Policy – there is a section on PII and controlled access.
- Use best practices of metadata (e.g., instead of name, use a position title).
- The National Coastal Data Development Center (NCDDC) has documented best practice for chain of custody during the Deepwater Horizon spill.
- Share best practices widely.

How is access to data granted to users given that PII data are available and need to be protected? The group expanded on this question and included any controlled data (e.g., preliminary data during a response, marine archeology, budgeting data).

- Security is an important consideration in maintaining data quality, as well as data accessibility.
- See Open Data Policy guidance. Training is needed.
- Make a list of restricted data types that could be shared and put in metadata records.
- Data can still be discoverable, even if it is not accessible, for transparency. If the user does not have the required credentials, they will see the data exists, but will not be able to access it.

The Discovery and Accessibility Breakout Group also developed the following table regarding issues and challenges, and a path forward.

	Issues and Challenges	Difficulty	Priority	Path Forward
Common data model(s)	Many	medium	high (essential)	Ensure interoperability between the models through training, awareness, consistency of the existing systems, and core elements. Required by Open Data Policy for federal entities to move in this direction.
Core parameters for discovery and accessibility	Limited awareness of core parameters/elements	easy	high	Nine core elements plus nine if-applicable elements from Open Data Policy. See "Common Core" elements. Make this information more commonly known through evangelizing, training, publications.
System requirements for discovery and accessibility	Infrastructure (hardware) exists for sharing data across entities.	easy - technical, industry, internally medium - process high - security	high	Develop data sharing agreements and have discussions before incidents.
	Storage and archiving the data long term so it can be accessible	easy - storage medium - archive	high	Data centers already exist for archiving issues, but there are issues that go beyond that. Recognize that data centers are underfunded. Register data with, and make it known to, use Data.gov and HAZUS.gov.
	Sharing process and policy information	easy	high	Develop a two pager from federal perspective to list/explain all policies affecting data access; share broadly.
Developing best practices for data visualization, discovery, and accessibility	Information officer when incident occurs to coordinate data accessibility	high	high	Adjust incident management handbooks to include this, which is a high level decision.
	Need metadata training	easy	high	Online metadata training is currently available. Different levels of metadata training for different roles. Determine which entities need to take it.

	Implementation of keywords and ontologies used by data generators	high	high	Find out what vocabulary industry uses; across full range of data generators.
Developing best practices for maintaining Chain of Custody during discovery & accessibility	Lack of accountability and ownership	medium	medium	Use electronic submission. Understand litigation hold: General counsel defines minimum requirements for litigation hold.
	Multiple processes for chain of custody, per collector	easy	medium	Need for synthesis. Need to identify the different processes.
Granting users access to data while maintaining PII and controlled access data	Transparency of users knowing the data exists even if they cannot get access to the actual data	medium	high	Raise awareness of the Open Data Policy, which gives policy guidance on this issue. Make users aware of why data is being restricted.
	When request comes for multiple data sets, uploader does not always have enough information about data and if it contains sensitive information.	medium	low during incident as everything is sensitive, high long term	Raise awareness of the Open Data Policy, which gives policy guidance on this issue. Responsibility falls upon authoritative source, who should know laws and policy. Flagged in the metadata.

It was noted during the question period that data management should be budgeted at the beginning of a project (15-25%). When it is not done until later it becomes more expensive. Every time budgets are renewed (for O&M etc.), the data management cost should be included.

The Discovery and Accessibility Breakout Group developed Figure 2 as a conceptual model.

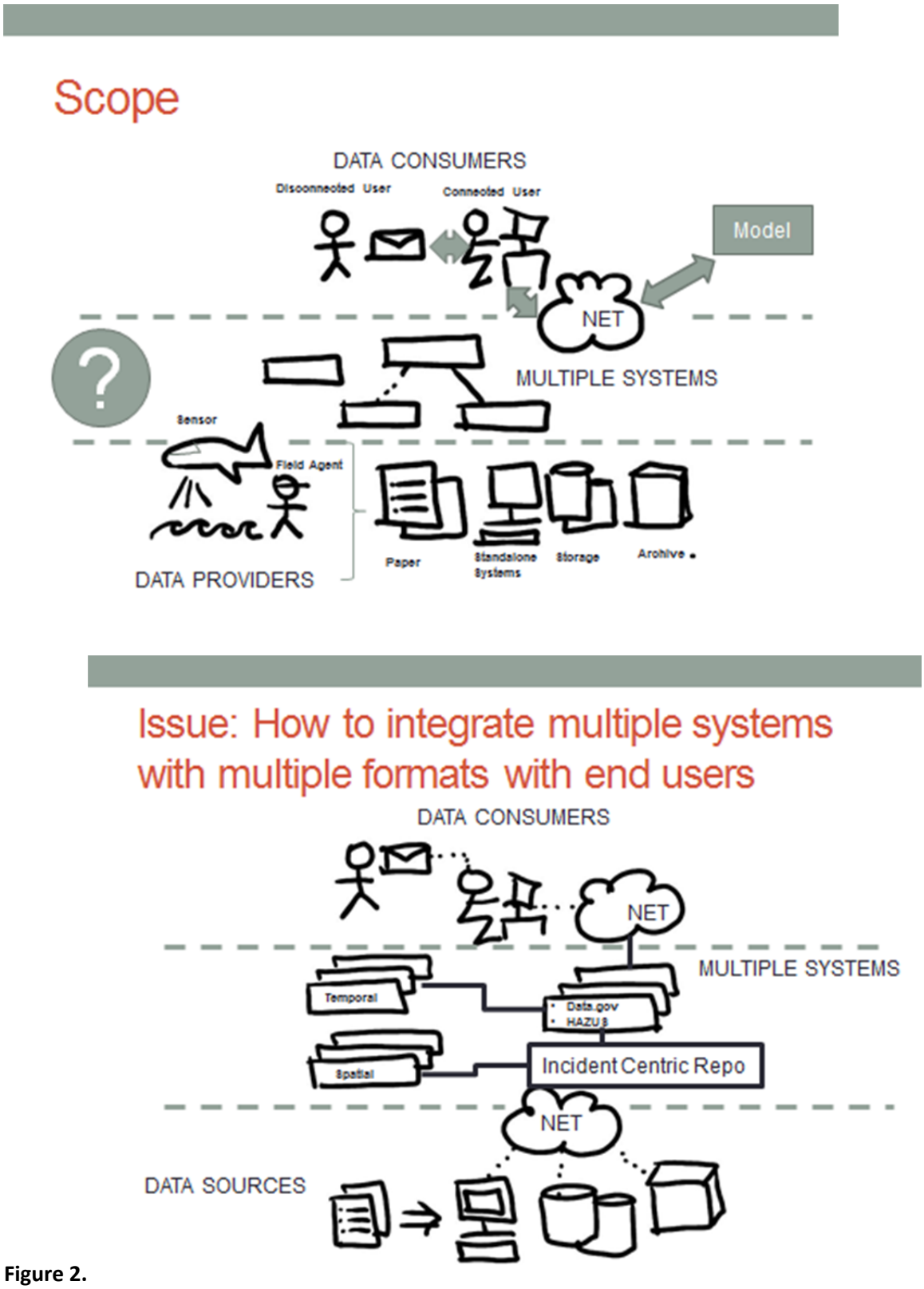

Figure 2.

4.0 Recommendations for the Path Forward

The presentations and subsequent discussions resulted in a number of conclusions and "next steps" which should be part of the path forward and continued dialogue regarding data management during environmental disasters.

- **Use Existing Resources.** Mine existing resources (e.g., information, policies, data management plans) to ensure EDDM's efforts do not overlap or contradict existing guidelines, and that established best practices are used where appropriate to avoid "reinventing the wheel". Check the Open Data Policy, Ocean Exploration Research best practices, and others.

- **Review Open Data Policy.** Form a small working group (WG) to examine the Open Data Policy to determine if it can be the guiding principle for EDDM's efforts. Include a representative from each type of organization (e.g., Federal, State, industry, NGO) on the WG.

- **Employ Existing Tools.** Enable the reuse of existing tools for new processes. Employ existing tools at all levels, rather than developing new tools/processes. Inventory existing tools at each step of the data process. Start at the field collection level – identify what information is collected in the field and how. List any existing tools currently used. See the Open Data Policy as a starting list. Identify gaps in tools.

- **Compile Background Data.** Develop, manage, and maintain a disaster data package for background data that refers to historical baseline data in specific regions, in order to understand changes post-disaster. This data package would mine existing baseline data and/or data currently being collected across all disciplines and identify any data gaps. This work must be done before disaster events occur. It is easier to do this before an emergency. It provides a dry run in preparation for an emergency. This effort could be the focus of a working group and would help drive the interconnectivity goal of EDDM.

- **Work Toward a Common Data Model and Interoperability.** Create a WG to document what specific common data models people are using across different disciplines and compile details regarding each one. Crosswalk existing common data models (i.e., translate between data models) to see if there are similar elements (perhaps under different names). Incorporate data dictionaries. At all levels (field collection, synthesis, analysis) inventory/identify existing ways to be interoperable. Find and build connections to create something that is more extensive and broad. Unify models that exist. Create a virtual infrastructure connecting the nodes. Demonstrate interoperability of the databases.

Figure 3 provides a conceptual model that incorporates these recommendations.

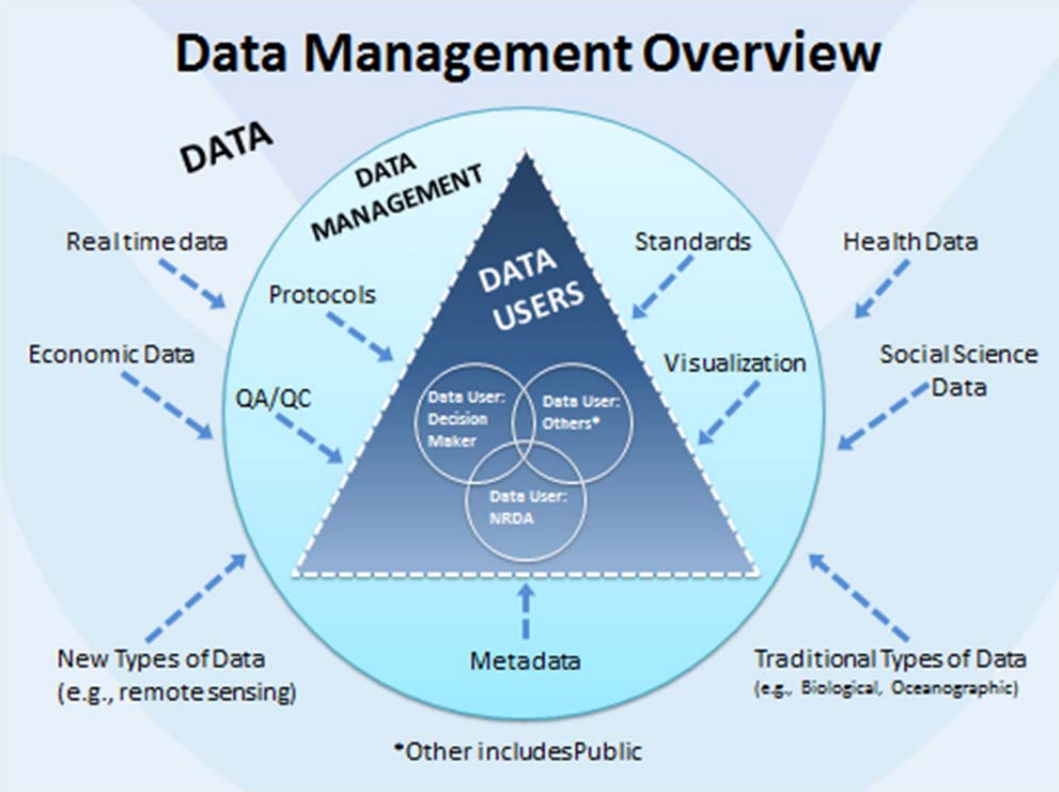

Figure 3.

- **Identify and Answer Fundamental Questions - User Centered Design.** Work with smaller working groups or society meetings to identify the mission and fundamental questions that need to be answered during a disaster response by domain/discipline. Questions would include: (1) What is their recommendation for a common data model? (2) What are their data requirements? (3) What data are collected? (4) What quality is required? These questions determine how/what data should be collected, which can feed into the model(s). A common data model and the related procedure/approach need to be flexible and adaptable.

- **Identify Data Dictionaries.** Identify data dictionaries, common language across disciplines, and have a clearinghouse of terminology. This can be included in data sharing agreements to help ensure consistent terminology.

- **Include NGO and Academic Data.** Consider how to incorporate NGO and academic data that feeds into decision making during a disaster. The data may have been collected with different objectives and timeframes, but the information is still important. Determine how the data can be incorporated into a common data model and decision making?

- **Incorporate Data Management Plans.** Data Management Plans must be incorporated into the Concept of Operations (CONOPS).

- **Include Data Managers in Response.** Data managers should be incorporated into the incident response plan and Unified Command.

- **Address Planning and Training.** Planning and training are essential, and there is a large need for

them. Create a WG to address what planning and training needs to be done. One thing missing currently is cross-training and collaboration across different sectors. Provide specific recommendations on cross-training (e.g., citizen science, human health). Make training available to producers and users of data, perhaps online. The National Response Team (NRT) might be a venue to move forward with this work.

- **Work Across Disciplines.** Pair different disciplines within working groups (e.g., pair environmental toxicology people with meteorological people to share experience with natural hazards). Weather and climate data are critical components, but data managers may lack experience with this kind of data.

- **Prepare Outreach Materials.** Prepare a one-page document (and slides) for all target audience organizations, with a consistent message regarding what EDDM is doing and why.

- **Perform Outreach.** Have an "inside champion" for each discipline, who is a member of appropriate organizations, to lead the outreach effort (e.g., a chemist within the EDDM group to take the message to the American Chemical Society). Consider sending someone to the organization's meeting and/or plan a roundtable for the meeting. Pair people from different disciplines to go to these meetings as a team (i.e., one within society and one outside society) to share experiences. There is value in obtaining the perspective of various stakeholders. Mini working groups held at society meetings could gather their core data requirements.

5.0 Appendices

Appendix A: Agenda
Appendix B: Breakout Group Questions
Appendix C: Breakout Group Members
Appendix D: Participants
Appendix E: Presentations
Appendix F: Group A: Field Sample Collection Breakout Groups Notes
Appendix G: Group B: Data Formatting/Entry Breakout Groups Notes
Appendix H: Group C: Data Reliability/Tracking Breakout Groups Notes
Appendix I: Group D: Discovery/Accessibility Breakout Groups Notes

Appendix A

Environmental Disasters Data Management Workshop
September 16 - 17, 2014
National Conservation Training Center
Shepherdstown, WV

AGENDA

Day 1: Tuesday, September 16

8:00 am Registration

8:15 am Welcome & Overview of Meeting

Nancy E. Kinner, *UNH Coastal Response Research Center*
Amy Merten, *NOAA Office of Response & Restoration, Spatial Data Branch/ARD*
Russ Beard, *NOAA National Coastal Data Development Center*

8:45 am Participant Introductions

Presentations: How are data used for environmental disasters?

9:10 am ➢ Response: *Charlie Henry, NOAA Gulf of Mexico Disaster Response Center*

9:35 am ➢ Assessment: *Robert Haddad, NOAA Office of Response & Restoration, ARD*

10:00 am *BREAK*

10:15 am ➢ NGOs and the Public: *Jonathan Henderson, Gulf Restoration Network*

10:40 am ➢ Research – Ecological Health: *Tracy Collier, Puget Sound Partnership*

11:05 am ➢ Research – Human Health: *Aubrey Miller, National Institutes of Health*

Presentations: Data Management Systems

Existing data management systems, potential overlaps, shortfalls, opportunities for improvements, evolution of systems going forward

11:30 am ➢ Atmospheric data: *Stephen Del Greco, NOAA National Climatic Data Center*

11:45 am ➢ Oceanographic data: *Russ Beard, NOAA, National Coastal Data Development Center*

12:00 pm *LUNCH*

1:00 pm ➢ Chemistry data: *Benjamin Shorr, NOAA, Office of Response & Restoration, Spatial Data Branch/ARD*

1:15 pm ➢ Sensors (e.g., ROV, AUV): *Mike McCann, MBARI*

1:30 pm ➢ Biological Data: *Felimon Gayanilo, Harte Research Institute for Gulf of Mexico Studies*

[*] For the purposes of this workshop environmental disasters is defined as floods, earthquakes, hurricanes, tornados, and discrete pollution events.

1:45 pm
- Human Health Data: *Steven Ramsey, Social & Scientific Systems; NIEH GuLF STUDY)*

2:00 pm Instructions for Breakout Group: *Nancy Kinner*

2:15 pm *BREAK*

2:30 pm Breakout Groups - Session I

Breakout Group A: Field Sample Collection (Data Collection/Sampling Protocols)
Breakout Group B: Data Formatting/Entry (for consistency and comparability)
Breakout Group C: Data Reliability/Tracking (accurate transmission to database & QA/QC, data validation)
Breakout Group D: Discovery and Accessibility (getting data to the users)

4:00 pm Plenary Report Out

5:00 pm *ADJOURN*

6:15 pm Dinner & Social Hour

Day 2: Wednesday, September 17

8:30 am Recap and Recalibrate

8:45 am Breakout Groups: Session II
How do you overcome the challenges and move forward?
Breakout Group A: Field Sample Collection (Data Collection/Sampling Protocols)
Breakout Group B: Data Formatting/Entry (for consistency and comparability)
Breakout Group C: Data Reliability/Tracking (accurate transmission to database & QA/QC, data validation)
Breakout Group D: Discovery and Accessibility (getting data to the users)

12:15 pm *LUNCH*

1:30 pm Plenary Report Outs

2:30 pm *BREAK*

2:45 pm Plenary Discussion of Path Forward

3:45 pm Closing Remarks

4:00 pm *ADJOURN*

Appendix B

BREAKOUT GROUP QUESTIONS

Breakout Group A: Field Sample Collection (Data Collection/Sampling Protocols)

- Is there a common data model that can be shared across entities?
- What are the essential core parameters to be collected and recorded for any field collection (e.g., sample ID, date/time, lat/long, etc.)?
- What are the essential core parameters to be included in metadata record?
- What are the standard data types and protocols for emergency response?
    - Shoreline and/or soils
    - Watercolumn
    - Air
    - Human Health
    - Other
- What are best practices for reducing transcription errors?
- What are the roadblocks for getting data from field collection into an electronic format?
- How is field collection designed to maintain PII (personal identification, human health etc.)?
- How is field collection designed to ensure accuracy of data?
- How is field collection designed to maintain Chain of Custody?
- How is field collection designed to maintain data security?

Breakout Group B: Data Formatting/Entry (for consistency and comparability)

- Is there a common data model that can be shared across entities?
- What are the essential core parameters to be collected and recorded for any data collection (i.e., sample ID, date/time, lat/long, etc.)?
- What are the essential core parameters to be included in metadata record?
- What are the standard data types and protocols for emergency response?
    - Shoreline and/or soils
    - Water column
    - Air
    - Human Health
    - Other
- What are best practices for reducing transcription errors?
- What are the rate limiting steps for getting data from field collection into an electronic format?
- How are data formatting/entry designed to maintain PII (personal identification, human health, SSN, birth date, etc.)?
- How are data formatting/entry designed to maintain Chain of Custody?
- How are data formatting/entry designed to maintain data security?

Breakout Group C: Data Reliability/Tracking (accurate transmission to database & QA/QC, data validation)

- Is there a common data model that can be shared across entities?
- What are the essential core parameters needed for tracking the reliability of data?
- What are the system requirements for data reliability and tracking?
- How are data reliability/tracking designed to maintain data security?
- What are the QA/QC processes used and are they community and/or scientifically accepted standards?
- What is important for data reliability, QA/QC and validation when moving data from field collection into an electronic format?
- What is the process for informing data generators/users about the status of data from collection to archives?
    - What are the software and techniques for tracking disparate data sets for structured and unstructured data; where are they in process (at what lab, have they been analyzed? Have they been validated?)
- Optional: What are the standard data types and protocols for emergency response?
    - Shoreline and/or soils
    - Water column
    - Air
    - Human Health
    - Other

Breakout Group D: Discovery and Accessibility (getting data to the users)

- Is there a common data model that can be shared across entities?
- What are the essential core parameters needed for discovery and accessibility?
- What are the system requirements for discovery and accessibility?
- What are the best practices for data visualization, discovery, and accessibility?
- What are the best practices for maintaining PII (personal identification, human health, SSN, birth date, etc.) and Chain of Custody in discovery and accessibility? Human subjects data protections?
- How is access to data granted to users given that PII data are available and need to be protected?

Appendix C

EDDM WORKSHOP BREAKOUT GROUPS

Breakout Group A: Field Sample Collection (Data Collection/Sampling Protocols)

Lead: Carol Rice
Recorder: Laura Belden

Kim Anderson
Courtney Arthur
Tracy Collier
Shawn Fisher
Jim Gibeaut
Jonathan Henderson
Sairah Malkin
Amy Merten
David Mica
Aubrey Miller
Geoff Scott
Patricia Stewart
Kent Thomas

Breakout Group B: Data Formatting/Entry (for consistency and comparability)

Lead: Henry Norris
Recorder: Ian Gaudreau

Matthew Foster
Amna Greaves
Kevin Hobbie
Matt Howard
Dan Hudgens
Stephane Leblanc
Lewis Leinenweber
Zach Nixon
John Parker
Steven Ramsey
Kari Sheets
Stephanie Sneyd
Laura Weems

Breakout Group C: Data Reliability/Tracking (accurate transmission to database & QA/QC, data validation)

Lead: Kim Jenkins
Recorder: StefanieTetreault

Steve Delgreco
Chander Ganesan
Felimon Gayanilo
Charlie Henry
Ann Jones
Anthony Lloyd
Wendy McDowell
Greg Minnery
Ben Shorr
Jason Weick
Kyle Wilcox

Breakout Group D: Discovery and Accessibility (getting data to the users)

Lead: Mark Miller
Recorder: Angela Sallis

Russ Beard
Dennis Beckmann
Brandon Brewer
Derek Eggert
Bob Haddad
Michele Jacobi
Hugh Johnson
Mike McCann
Jaci Mize
Peter Murphy
Mark Stenzel
Evonne Tang

Appendix D

EDDM WORKSHOP PARTICIPANT LIST

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Appendix E

WELCOME

Environmental Disasters Data Management Workshop

September 16 – 17, 2014

EDDM

September 16 & 17, 2014

Nancy E. Kinner
Coastal Response Research Center
University of New Hampshire

Logistics

- Fire Exits
- Restrooms at each end of hallway
- Coffee, tea, water available all day
- Dining: breakfasts (onsite in dining hall), lunches & snacks (all), welcome to bring food in meeting rooms
  - Breakfast 6:30 – 9:00
  - Morning snack (in hallway): 9:30 – 10:00
  - Lunch: As scheduled on agenda
  - Afternoon snack (in hallway): 2 – 3:30
  - Dinner: Tonight as scheduled; Tomorrow: 5:30 – 7:30

Logistics

- Dining: Tuesday night dinner (all)
  - Cash bar is located lower level in social area
  - 5:30 – 11:00
  - Welcome to bring drinks upstairs to dining area
- All meals – please sit in designated area behind dividers reserved for EDDM
- Logistical questions see Kathy Mandsager or me

Thank You

- Thank you to National Oceanic and Atmospheric Administration (NOAA)
  - Amy Merten – Office of Response & Restoration, Spatial Data Branch
  - Russ Beard – National Coastal Data Development Center

THANK YOU Participants!

Coastal Response Research Center (CRRC)

- Partnership between NOAA's Office of Response and Restoration and the University of New Hampshire
- Since 2004
  - UNH Co-Director - Nancy Kinner
  - NOAA Co-Director - Amy Merten

Overall CRRC Mission

- Conduct and oversee basic and applied research and outreach on spill response and restoration
- Transform research results into practice
- Serve as hub for oil spill R&D
- Facilitate workshops bringing together ALL STAKEHOLDERS to discuss spill issues and concerns

Workshop Objectives

- Engage community to apply consistent terms and concepts, data flow, and QA/QC.
- Provide oversight for foundational, baseline data collected prior to environmental event, based on user requirements.
- Provide best-practice guidance for data and metadata management.

Workshop Objectives

- Suggest infrastructure design elements to facilitate quick and efficient search, discovery, and retrieval of data.
- Define characteristics of "gold standard" data management plan for appropriate data sampling, formatting, reliability, and retrievability.
- Promote use of workshop protocols, practices, and recommendations.

Environmental Disasters Data Management Workshop
September 16 - 17, 2014
National Conservation Training Center
Shepherdstown, WV

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11:45 am ➢ Oceanographic data: *Russ Beard, NOAA, National Coastal Data Development Center*

12:00 pm *LUNCH*

1:00 pm ➢ Chemistry data: *Benjamin Shorr, NOAA, Office of Response & Restoration, Spatial Data Branch/ARD*

1:15 pm ➢ Sensors (e.g., ROV, AUV): *Mike McCann, MBARI*

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*For the purposes of this workshop environmental disasters is defined as floods, earthquakes, hurricanes, tornados, and discrete pollution events.

Coastal Response Research Center www.crrc.unh.edu/workshops

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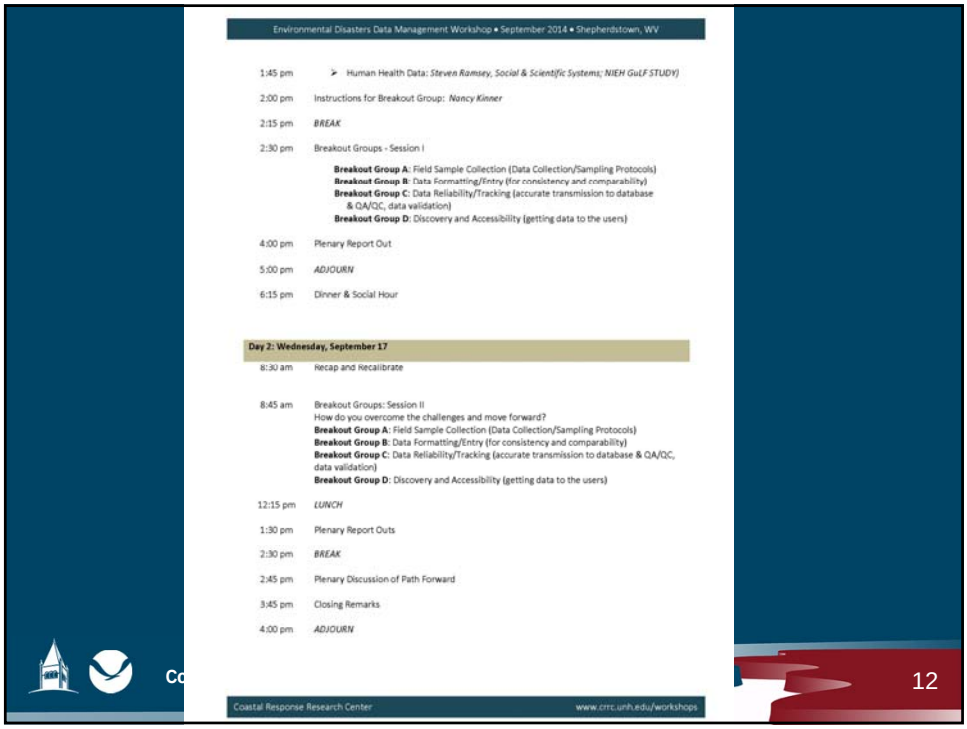

Environmental Disasters Data Management Workshop • September 2014 • Shepherdstown, WV

1:45 pm ➢ Human Health Data: *Steven Ramsey, Social & Scientific Systems; NIEH GuLF STUDY)*

2:00 pm Instructions for Breakout Group: *Nancy Kinner*

2:15 pm *BREAK*

2:30 pm Breakout Groups - Session I

Breakout Group A: Field Sample Collection (Data Collection/Sampling Protocols)
Breakout Group B: Data Formatting/Entry (for consistency and comparability)
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Breakout Group D: Discovery and Accessibility (getting data to the users)

4:00 pm Plenary Report Out

5:00 pm *ADJOURN*

6:15 pm Dinner & Social Hour

Day 2: Wednesday, September 17

8:30 am Recap and Recalibrate

8:45 am Breakout Groups: Session II
How do you overcome the challenges and move forward?
Breakout Group A: Field Sample Collection (Data Collection/Sampling Protocols)
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12:15 pm *LUNCH*

1:30 pm Plenary Report Outs

2:30 pm *BREAK*

2:45 pm Plenary Discussion of Path Forward

3:45 pm Closing Remarks

4:00 pm *ADJOURN*

Coastal Response Research Center www.crrc.unh.edu/workshops

Co

12

After Workshop

- Website:
  - Presentations
- Report distributed
- Working Group meetings
- EDDM "Evangelism"

Facilitation Pledge

- I will recognize and encourage everyone to speak
- I will discourage side conversations
- I commit to:
  - Being engaged in meeting
  - Keeping us on task and time
- Stop me if I am not doing this!

Participant Pledge

- Be Engaged
  - Turn off cell phones and computers, except at breaks
- Listen to others
- Contribute
- Speak clearly: Use microphones in plenary
- Learn from others
- Avoid side conversations
- Avoid using acronyms

Participant Introductions

- Name
- Affiliation
- Community/organization representation
- What is your interest for this workshop?

Environmental Disasters Data Management Workshop

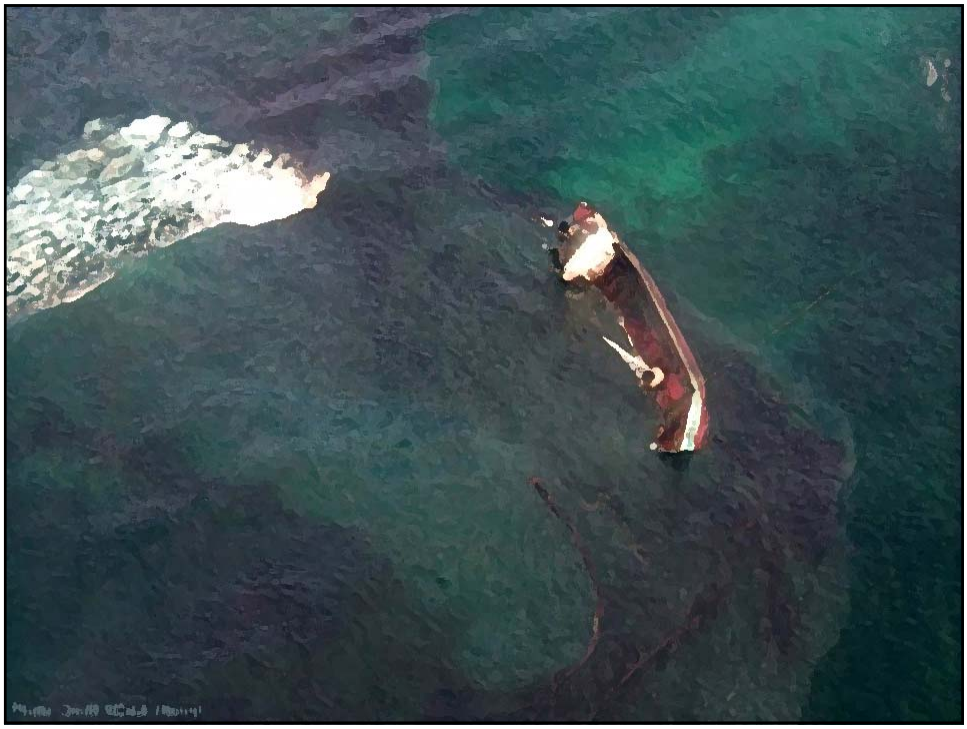
Response Data Needs

Charlie Henry
Director, NOAA's GOM Disaster Response Center
Office of Response and Restoration

16 Sept. 2014

Disclaimer:

The information presented reflects only the views of the presenter, and does not necessarily reflect the official positions or policies of NOAA or the Department of Commerce.



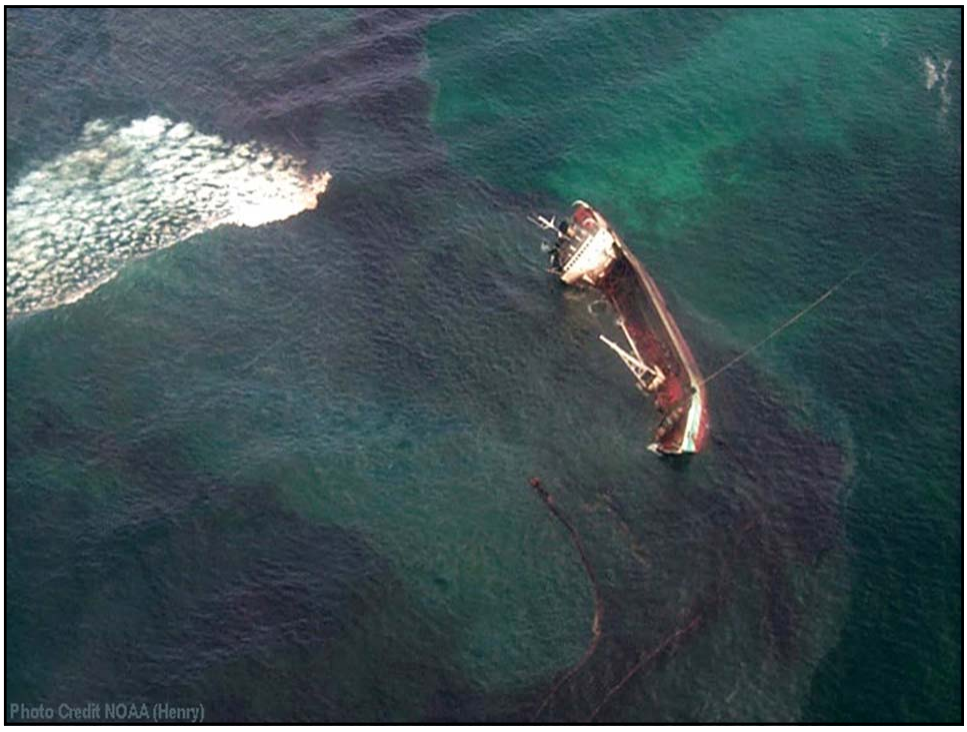


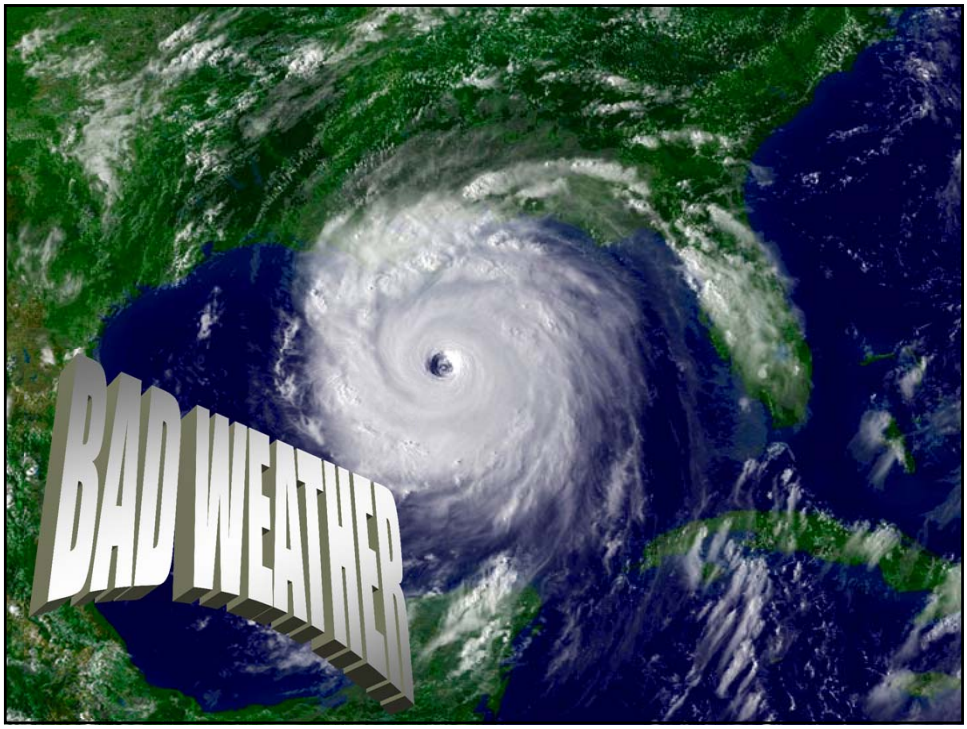
Photo Credit NOAA (Henry)


Photo Credit NOAA (Henry)


Photo Credit USCG

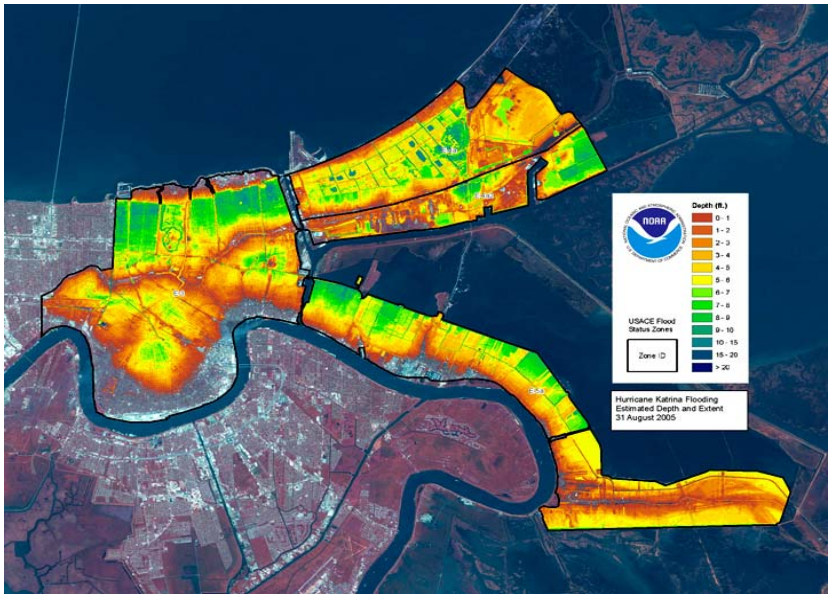

Oil Spills
TORM MARY
KØBENHAVN
8/2/2004
Photo Credit NOAA (Whitmore)


Chemical Spills


BAD WEATHER

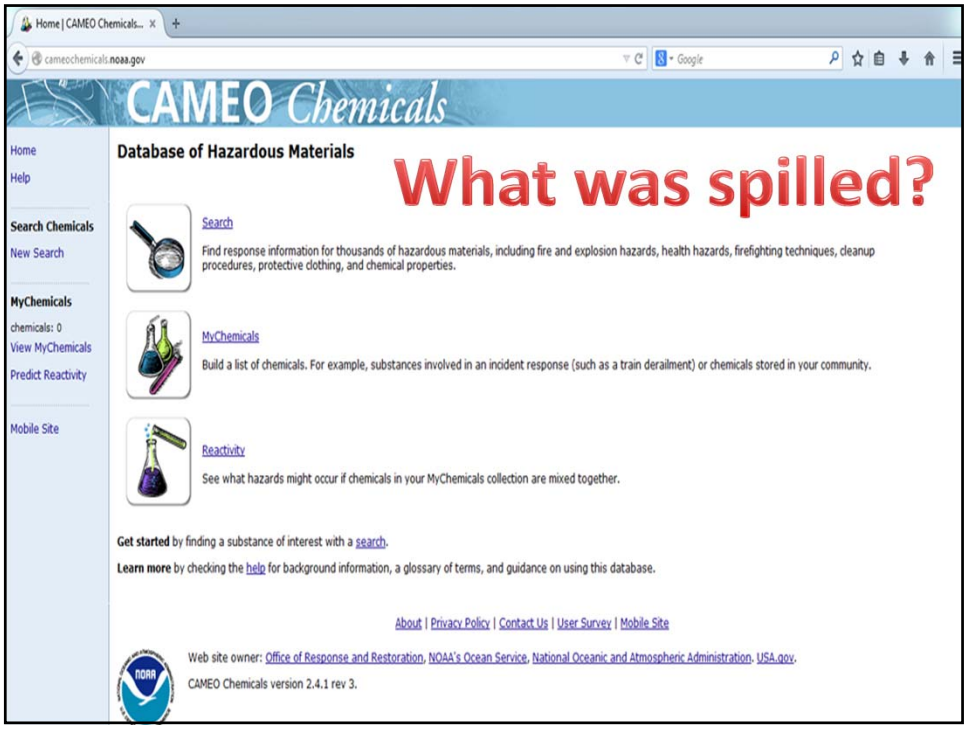

U.S.
COAST GUA

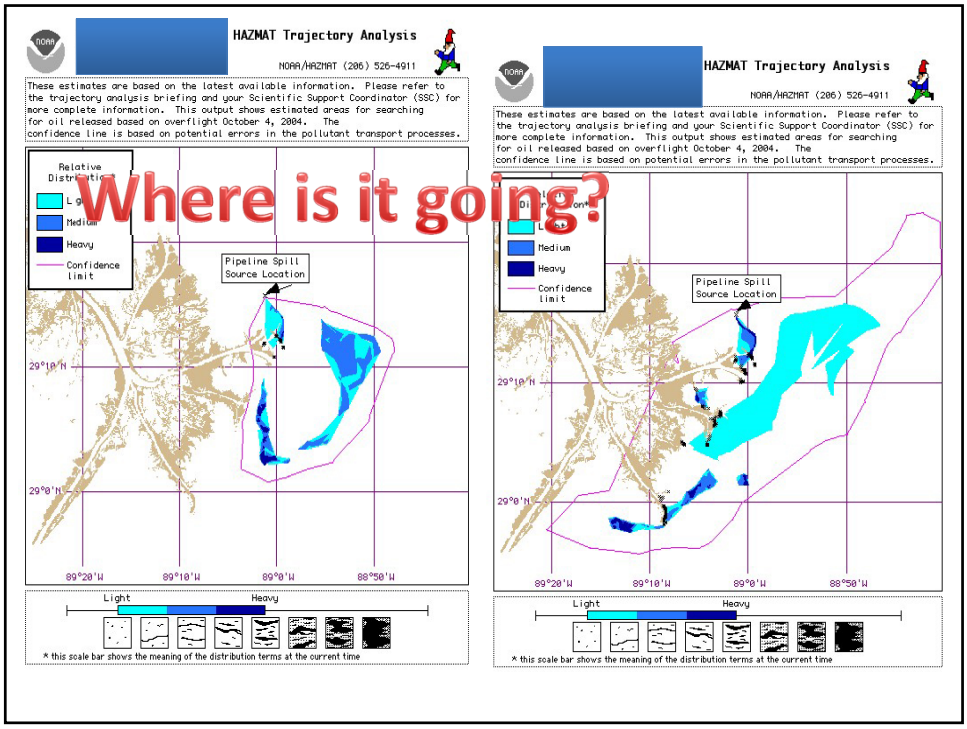
NOAA Estimation of Floodwater Depth



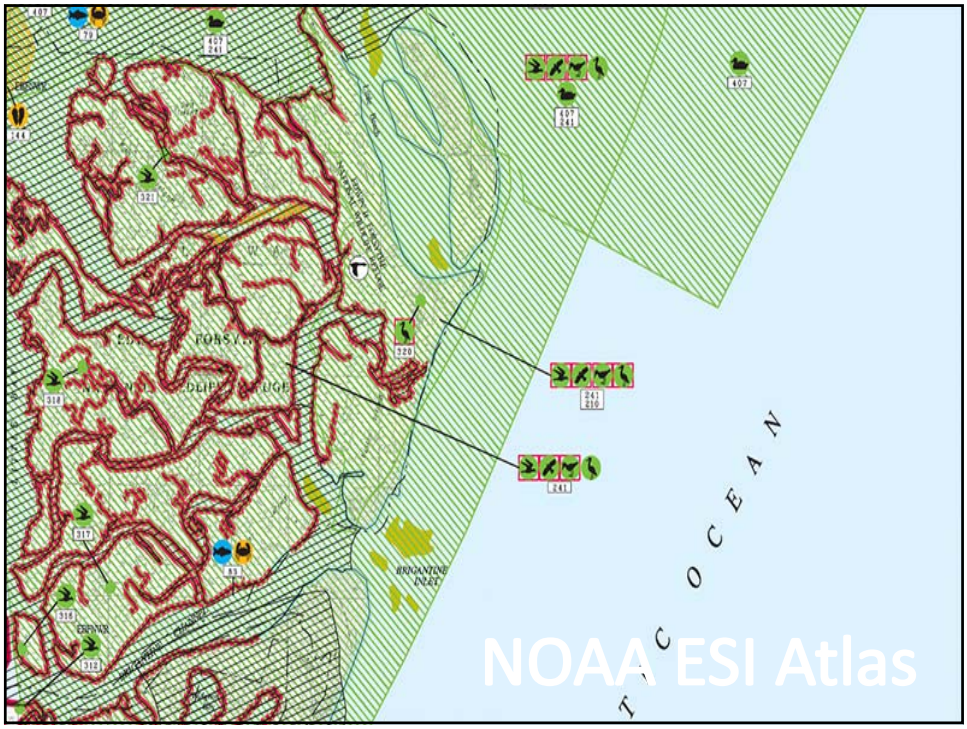
The Five Response Questions?

- What was spilled?
- Where is it going?
- What's at risk?
- How will it hurt?
- What can be done to mitigate the hurt?


Home | CAMEO Chemicals...
cameochemicals.noaa.gov
Google
CAMEO Chemicals
Home
Help
Search Chemicals
New Search
MyChemicals
chemicals: 0
View MyChemicals
Predict Reactivity
Mobile Site
Database of Hazardous Materials
What was spilled?
Search
Find response information for thousands of hazardous materials, including fire and explosion hazards, health hazards, firefighting techniques, cleanup procedures, protective clothing, and chemical properties.
MyChemicals
Build a list of chemicals. For example, substances involved in an incident response (such as a train derailment) or chemicals stored in your community.
Reactivity
See what hazards might occur if chemicals in your MyChemicals collection are mixed together.
Get started by finding a substance of interest with a search.
Learn more by checking the help for background information, a glossary of terms, and guidance on using this database.
About | Privacy Policy | Contact Us | User Survey | Mobile Site
Web site owner: Office of Response and Restoration, NOAA's Ocean Service, National Oceanic and Atmospheric Administration, USA.gov.
CAMEO Chemicals version 2.4.1 rev 3.



Where is it going?


NOAA ESI Atlas

"Information (data) is very critical to providing situational awareness."

How will it hurt? Toxicity Data

What can be done to mitigate?

"Knowing the confidence in the information can be just as critical."

Uncertainty – Spill Responders are OK with uncertainty, if they know the information is uncertain.

Significant Figures – Implied Accuracy

10,000,000

10,000,063

63

60

100

10.345 (ppm)

Types of Emergency Responses - All-Hazards

Types of Data – All Kinds

To "paint a good picture" quickly, it is very helpful if the data fits into what is called a Common Operation Prospective."

common, easily displayed environment

ERMA

Last comment…

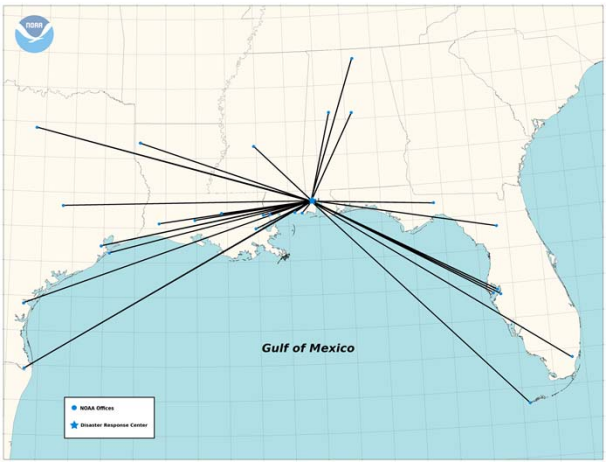
- Much of the early information known during an emergency response is wrong, and response decisions must be made anyway.

  (It is important to update and correct bad information.)

THE NOAA GOM DISASTER RESPONSE CENTER

Mobile, Alabama

Charlie Henry
Director
Disaster Response Center



Core Business Function:

A Hub for NOAA Emergency Preparedness, Response, Recovery, and Resilience…

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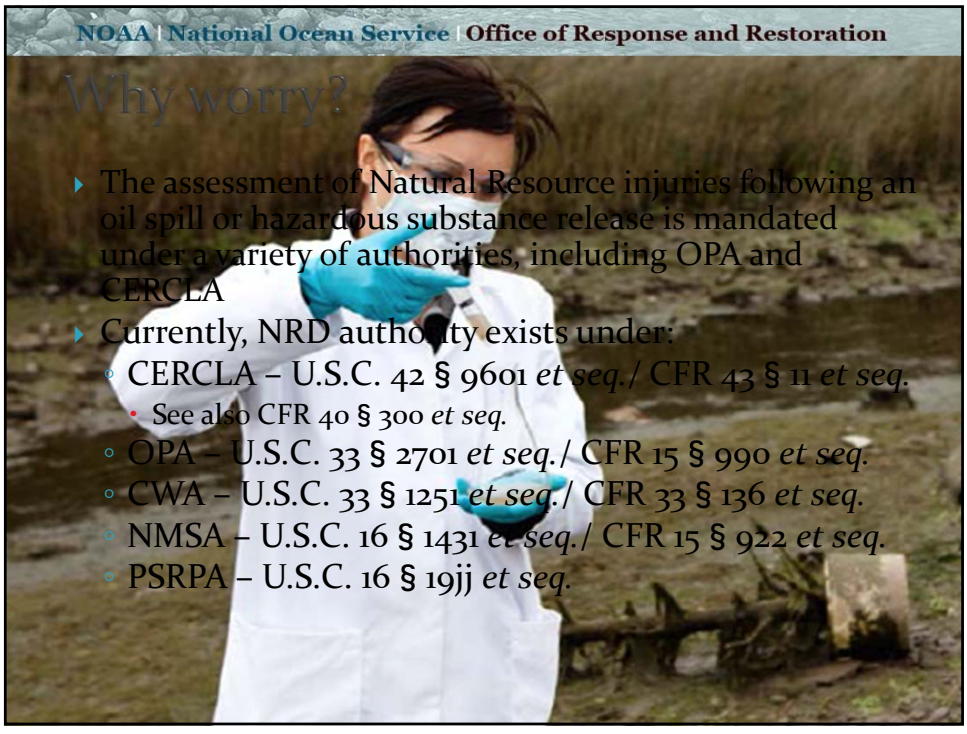
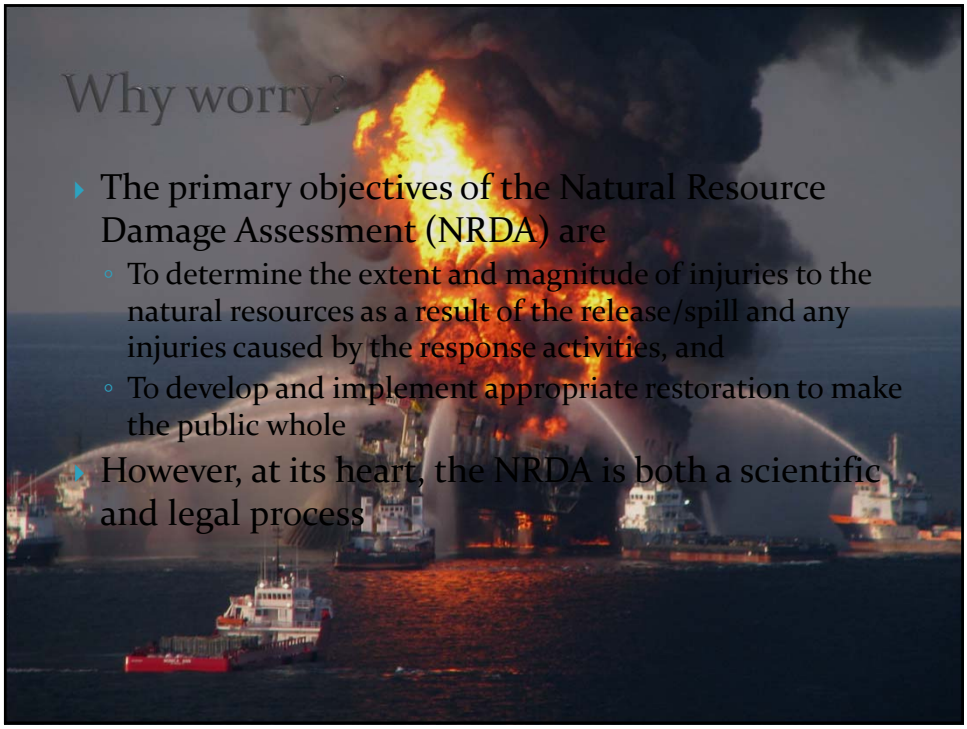
Data and Information Management Needs for Natural Resource Damage Assessments

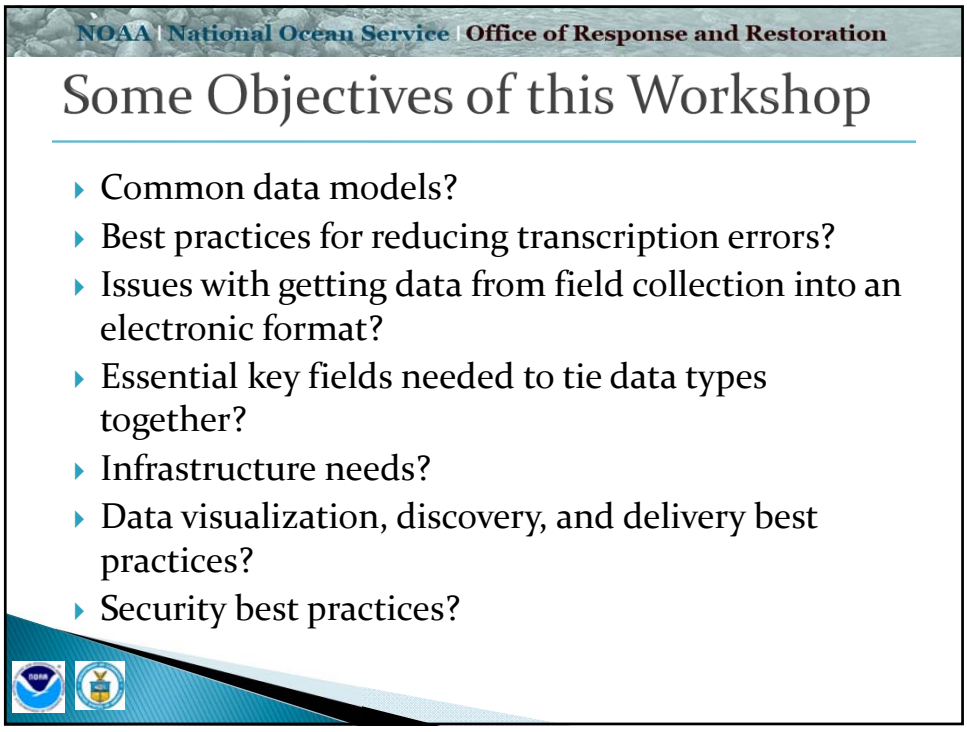
(why this is important to the users and abusers!)

Environmental Disasters Data Management Workshop
Sept 16-17, 2014
National Conservation Training Center

Robert Haddad, PhD
Amy Merten, PhD
NOAA Office of Response & Restoration and
Damage Assessment, Remediation, & Restoration Program




Why worry?
The primary objectives of the Natural Resource Damage Assessment (NRDA) are
To determine the extent and magnitude of injuries to the natural resources as a result of the release/spill and any injuries caused by the response activities, and
To develop and implement appropriate restoration to make the public whole
However, at its heart, the NRDA is both a scientific and legal process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Some Objectives of this Workshop
Common data models?
Best practices for reducing transcription errors?
Issues with getting data from field collection into an electronic format?
Essential key fields needed to tie data types together?
Infrastructure needs?
Data visualization, discovery, and delivery best practices?
Security best practices?

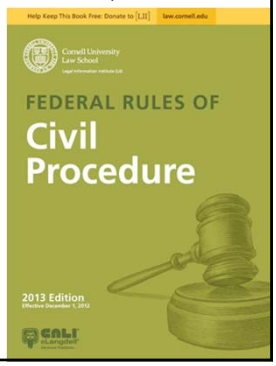
My Drivers… Science

- Science performed in any system, but especially within the complexity of natural ecosystems requires strong hypothesis testing
  - In turn, our ability to test hypotheses and reduce or minimize natural variability inherent in these systems requires a considerable amount of high quality data
  - Access to these data, to the underlying QA/QC information and other metadata is critical for any scientific investigation
  - The ability to integrate all of the different data types and then visualize the results of our analyses are also critical to our success in identifying and quantifying injury

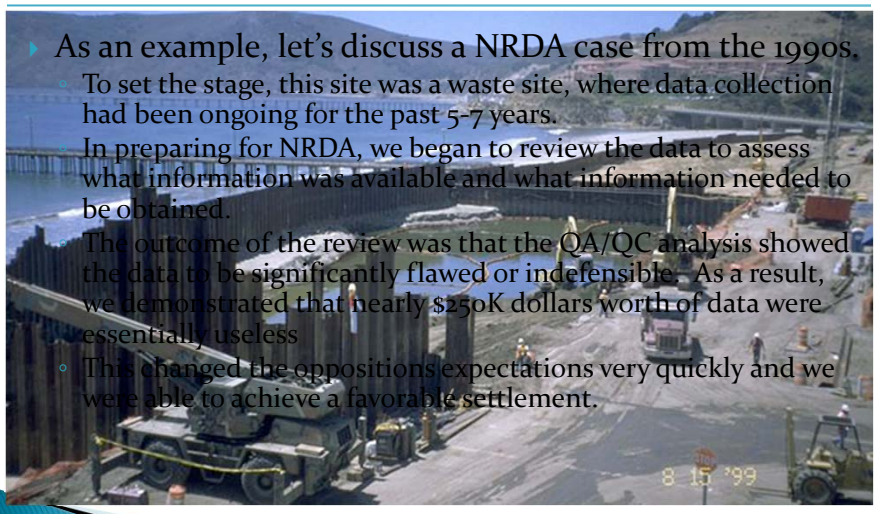
My Drivers…Legal Framework

- Every NRDA is conducted within a legal framework. It is always our desire to settle, but we have to be prepared for litigation
- Within this legal framework, all of the data we collect and use to develop our injury analyses are subject to the highest level of scrutiny

Thus, we must be able to explain and defend the appropriateness of how these data were collected, analyzed, and interpreted in the adversarial arena of the courts



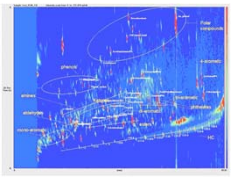
Really??



- As an example, let's discuss a NRDA case from the 1990s.
  - To set the stage, this site was a waste site, where data collection had been ongoing for the past 5-7 years.
  - In preparing for NRDA, we began to review the data to assess what information was available and what information needed to be obtained.
  - The outcome of the review was that the QA/QC analysis showed the data to be significantly flawed or indefensible. As a result, we demonstrated that nearly $250K dollars worth of data were essentially useless
  - This changed the oppositions expectations very quickly and we were able to achieve a favorable settlement.

What does this have to do with DM?

- The amount of information collected today far exceeds that collected historically – in almost every case
  - More laboratory analytical samples
  - More *in situ* instrument-derived results
  - More telemetry information
  - More digital photos
  - More modeling results



- And for assessment purposes, we need to capture data and information not only derived from the assessment
  - We need to be able to access and integrate historical baseline data/information
  - We need to be able to access and integrate much of the data/information developed during the response by the response agencies (think SCAT, dispersant usage, oil trajectory information [models, photos, observations, & remote sensing], etc.)
  - All of these data become pertinent to the NRDA

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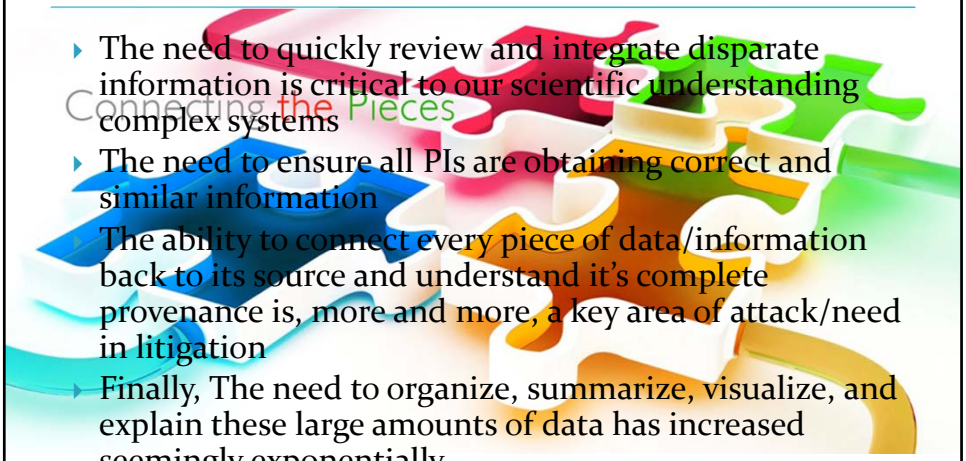
What does this have to do with DM?



- The need to quickly review and integrate disparate information is critical to our scientific understanding complex systems
- The need to ensure all PIs are obtaining correct and similar information
- The ability to connect every piece of data/information back to its source and understand it's complete provenance is, more and more, a key area of attack/need in litigation
- Finally, The need to organize, summarize, visualize, and explain these large amounts of data has increased seemingly exponentially

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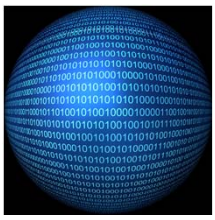
What do we mean when we say Data?

- There are others in the room who will talk about what types of data are important – and Amy touched on this point, earlier
- However, from the NRDA perspective, we see data as an encompassing term – A few broad examples of what we use:
  - Field and laboratory collected analytical data & methodologies (*e.g.*, analytical lab derived chemistry, in situ measurements of DO, etc.),
  - climactic/meteorological data,
  - Photos and data derived from remote sensing
  - field observations (*e.g.*, SCAT observations, species identification),
  - field determinations (*e.g.*, how many critters in a quadrat?),
  - telemetry output,
  - laboratory observations,
  - mathematical model inputs & outputs,
  - QA/QC data,
  - all associated meta data, etc.



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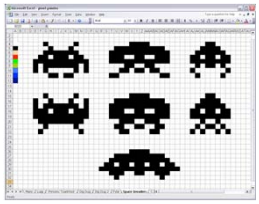
Evolution of ARD Data Management

- In our Division (ARD), we have been evolving along multiple pathways
- Early efforts where focused on what was needed for a specific case and generally involved a number of excel spreadsheets shared between staff



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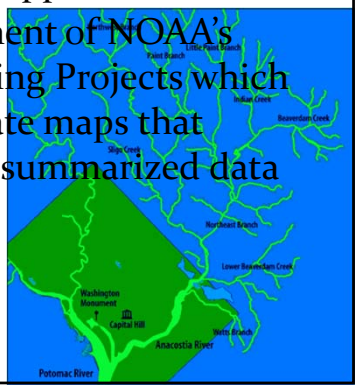
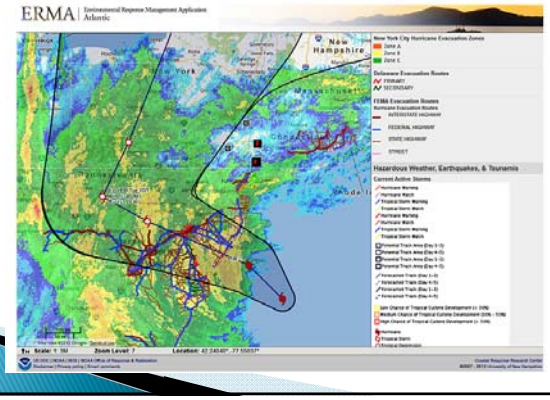
Evolution - continued

- Later evolution (*e.g.*, Query Manager) resulted from a need to better integrate analytical data from multiple sites to draw more universal conclusions and develop widely applicable models
- QM was a foundational component of NOAA's Watershed Database and Mapping Projects which provided a rapid method to create maps that displayed analyzed, sorted, and summarized data on a watershed-wide basis



Evolution - continued

- ERMA – the Environmental Response Management Application enhanced our needs for and ability to visualize many different types of data (including live feeds) and rapidly share these views with stakeholders



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Evolution - continued

- DIVER – Data Integration, Visualization, Exploration, and Reporting – represents our current evolution of data management. This is a collection of tools and processes to standardize and make available to the principle investigators/scientists the vast range of data we have already discussed. This includes the ability for data mining across diverse data types with the ability to ask spatially explicit questions.

DIVER
Data Integration Visualization Exploration and Reporting

What this means to me

- As a scientist, I need to have a high degree of confidence in the data and other information upon which I will base my conclusions
- I also need to have access to the widest base of knowledge available. Many answers will not be simple, and instead will be identified as a probability in a weight of evidence analysis

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What this means to me

- As an NRDA practitioner, I need to know that the data and information I use is scientifically valid and that the interpretations I draw from those data will be scientifically and legally defensible
- As head of NOAA's Damage Assessment group, I need to know that at a programmatic level, our Damage Assessment Claims are scientifically and legally defensible

Data Management Plans – why?

From C.Titus Brown, May 2010 (http://ivory.idyll.org/blog/data-management.html)

"*Now, as to my actual data management plan, here is how I plan to deal with research data in the future.*

I will store all data on at least one, and possibly up to 50, hard drives in my lab. The directory structure will be custom, not self-explanatory, and in no way documented or described. Students working with the data will be encouraged to make their own copies and modify them as they please, in order to ensure that no one can ever figure out what the actual real raw data is.

Backups will rarely, if ever, be done.

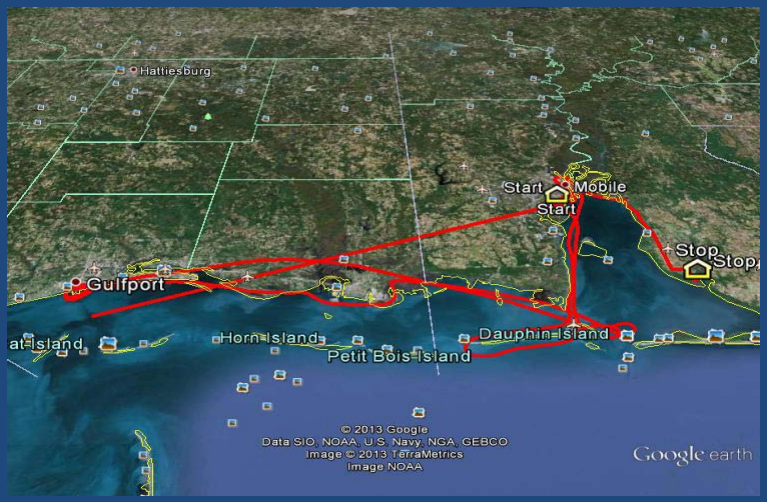
When required to make the data available by my program manager, my collaborators, and ultimately by law, I will grudgingly do so by placing the raw data on an FTP site, named with UUIDs like 4e283d36-61c4-11df-9a26-edddf420622d. I will under no circumstances make any attempt to provide analysis source code, documentation for formats, or any metadata with the raw data. When requested (and ONLY when requested), I will provide an Excel spreadsheet linking the names to data sets with published results. This spreadsheet will likely be wrong -- but since no one will be able to analyze the data, that won't matter."

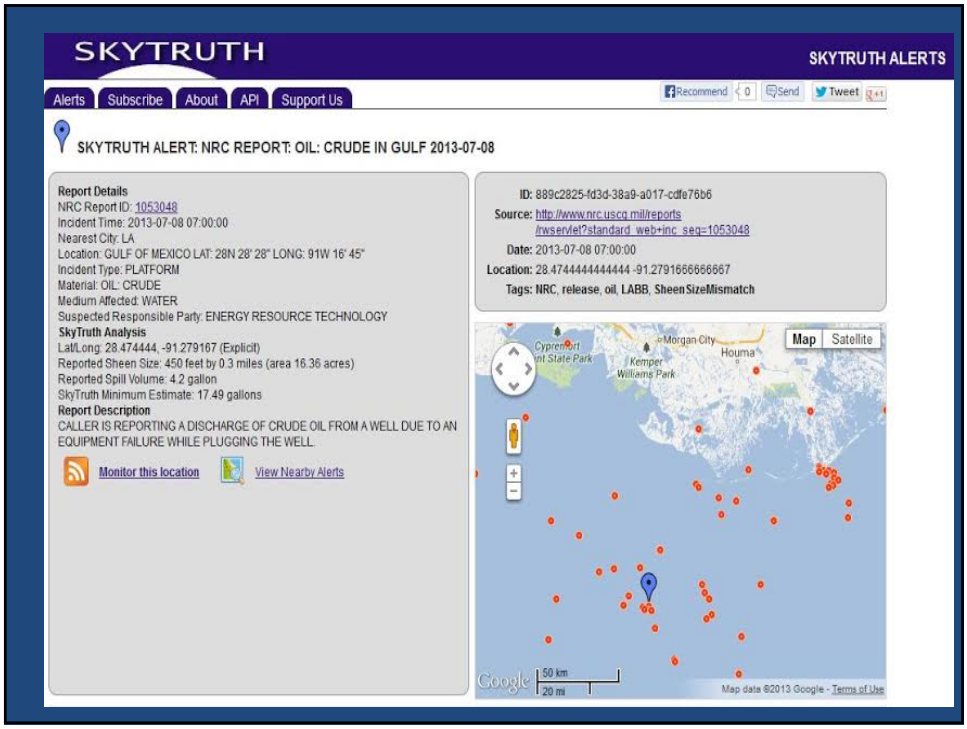
GULF MONITORING CONSORTIUM

What We Do

- Rapid Response Alliance
- Space: Satellite images and analysis of pollution detection trends identify targets for monitoring
- Air: Over flights detect and verify pollution events with photos and GPS data
- Earth & Sea: Volunteers on land and in the water collect samples, document impacts
- Report incidents to National Response Center
- Publish our findings to the Public

GMC Flyover Flight Path—March 24, 2013




SKYTRUTH
SKYTRUTH ALERTS
Alerts
Subscribe
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API
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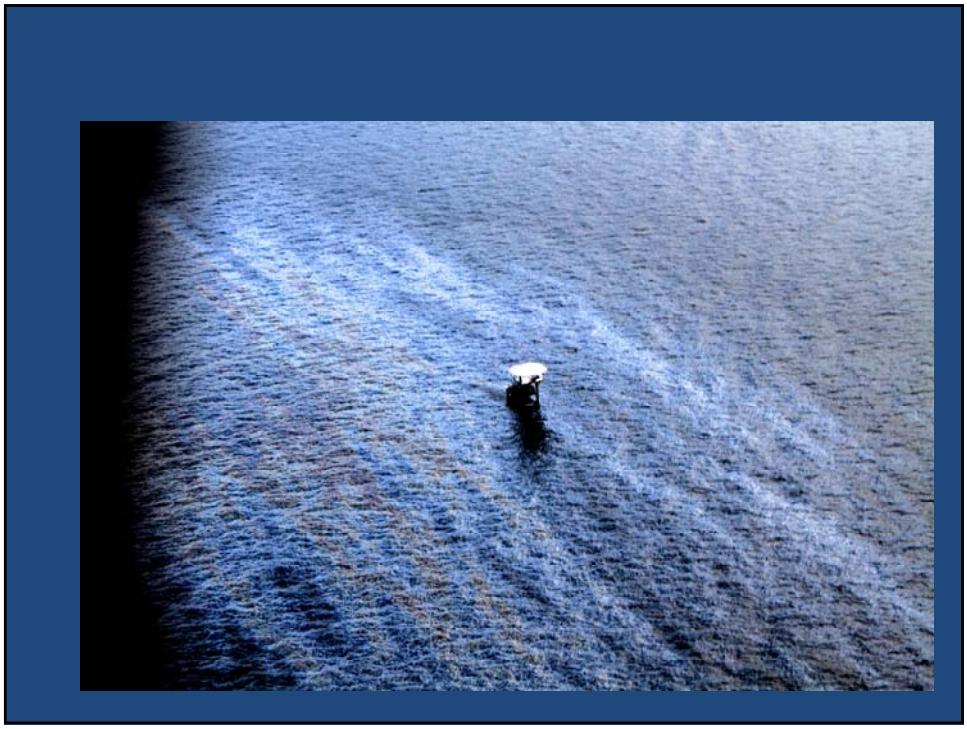
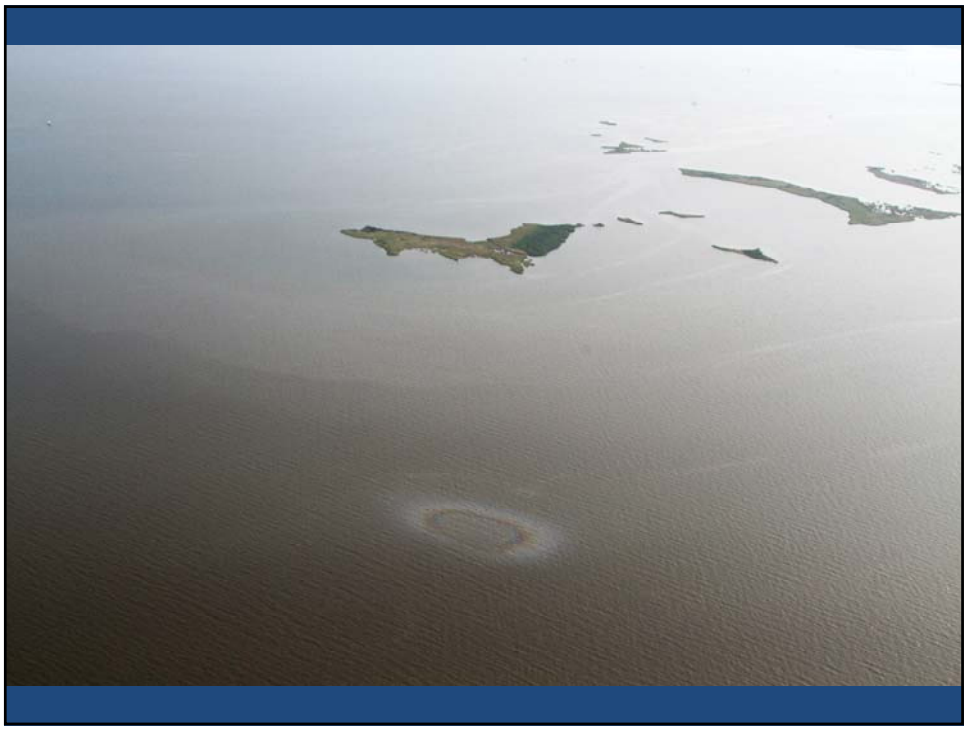
Recommend
Send
Tweet
SKYTRUTH ALERT: NRC REPORT: OIL: CRUDE IN GULF 2013-07-08
Report Details
NRC Report ID: 1053048
Incident Time: 2013-07-08 07:00:00
Nearest City: LA
Location: GULF OF MEXICO LAT: 28N 28' 28" LONG: 91W 16' 45"
Incident Type: PLATFORM
Material: OIL: CRUDE
Medium Affected: WATER
Suspected Responsible Party: ENERGY RESOURCE TECHNOLOGY
SkyTruth Analysis
Lat/Long: 28.474444, -91.279167 (Explicit)
Reported Sheen Size: 450 feet by 0.3 miles (area 16.36 acres)
Reported Spill Volume: 4.2 gallon
SkyTruth Minimum Estimate: 17.49 gallons
Report Description
CALLER IS REPORTING A DISCHARGE OF CRUDE OIL FROM A WELL DUE TO AN EQUIPMENT FAILURE WHILE PLUGGING THE WELL.
Monitor this location
View Nearby Alerts
ID: 889c2825-fd3d-38a9-a017-cdfe76b6
Source: http://www.nrc.uscg.mil/reports
/rwservlet?standard_web+inc_seq=1053048
Date: 2013-07-08 07:00:00
Location: 28.4744444444444 -91.2791666666667
Tags: NRC, release, oil, LABB, SheenSizeMismatch
Map
Satellite
Morgan City
Houma
Kemper
Williams Park
Google
50 km
20 mi
Map data ©2013 Google - Terms of Use





Incident Report # 1042025
McDuffie Coal Terminal, Mobile River
March 24th,2013 10:00am.


GULF
MONITORING
CONSORTIUM
GMC Website:
http://www.gulfmonitor.org/

Assessing ecological effects following environmental disasters, and data needs

Tracy Collier
Science Director (until Thursday)
Puget Sound Partnership
Tacoma, WA USA

Environmental Disasters Data Management Workshop

National Conservation Training Center
Shepherdstown, WV

September 16, 2014

Prior to working for PSP, I worked for 30+ years at NOAA's Northwest Fisheries Science Center, where I managed assessments of several environmental 'disasters':

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EXXON Valdez oil spill (1989-1992) Ecosystem and human health

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EXXON Valdez oil spill	(1989-1992)	Ecosystem and human health
North Cape oil spill	(1996-1998)	Ecosystem health

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Cosco Busan oil spill	(2007-2009)	Ecosystem health

Since 'retiring' from NWFSC in 2010, I've been a science advisor to NOAA's Oceans and Human Health Initiative, a technical advisor to NOAA's marine mammal and sea turtle TWGs for the DWH NRDA, and have been informally liaising with NIEHS on their DWH long-term human health study (GuLF).

Types of data useful for determining ecological effects of oil spills, focused on fish and higher vertebrates

Types of data useful for determining ecological effects of oil spills, focused on fish and higher vertebrates

Water chemistry

Types of data useful for determining ecological effects of oil spills, focused on fish and higher vertebrates

Water chemistry

Air chemistry

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Water chemistry

Air chemistry

Chemicals in biota

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Water chemistry

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Chemicals in biota

Biological measures in individuals

Types of data useful for determining ecological effects of oil spills, focused on fish and higher vertebrates

Water chemistry

Air chemistry

Chemicals in biota

Biological measures in individuals

Population metrics

New research on petroleum in the water column is raising concerns for eggs and larvae

Oil spills and fish health: exposing the heart of the matter

JOHN P. INCARDONA[a], TRACY K. COLLIER[b] AND NATHANIEL L. SCHOLZ[a]
[a]Environmental Conservation Division, Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration, Seattle, Washington, USA
[b]Oceans and Human Health Initiative, National Oceanic and Atmospheric Administration, Silver Spring, Maryland, USA
Address all correspondence to john.incardona@noaa.gov

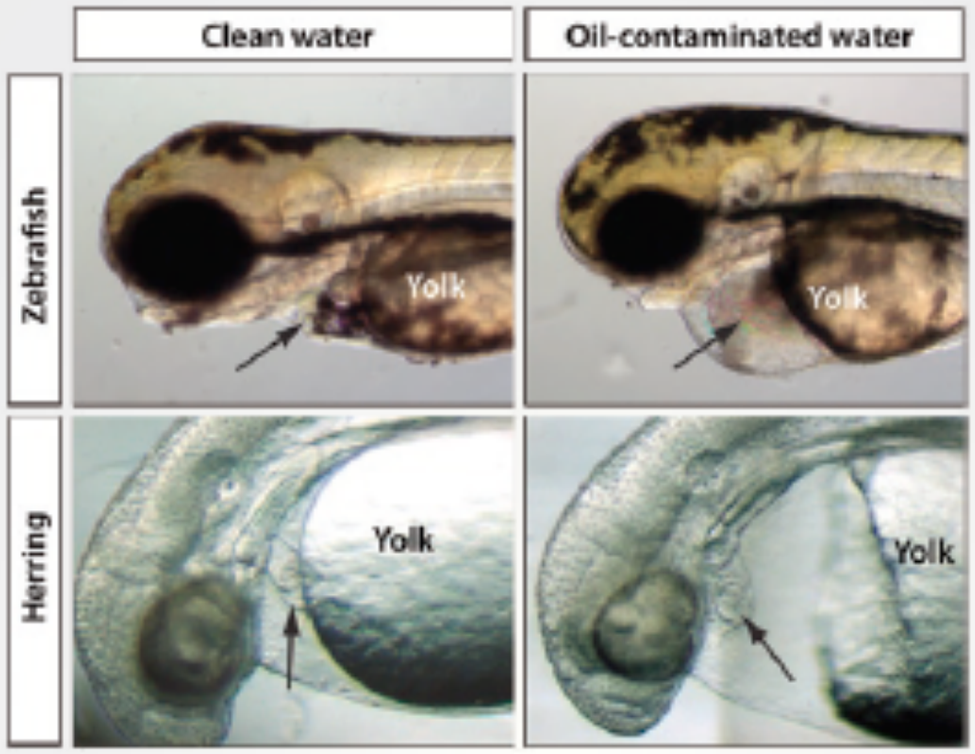
Journal of Exposure Science and Environmental Epidemiology published online 10 November 2010; doi:10.1038/jes.2010.51

Exposure Science Digest

The chemical complexity of crude oil and its fuel products poses many important challenges for exposure science in marine ecosystems that support productive fisheries throughout the world. Meeting these challenges will enable better decisions on approaches to protecting and restoring these ecosystems.

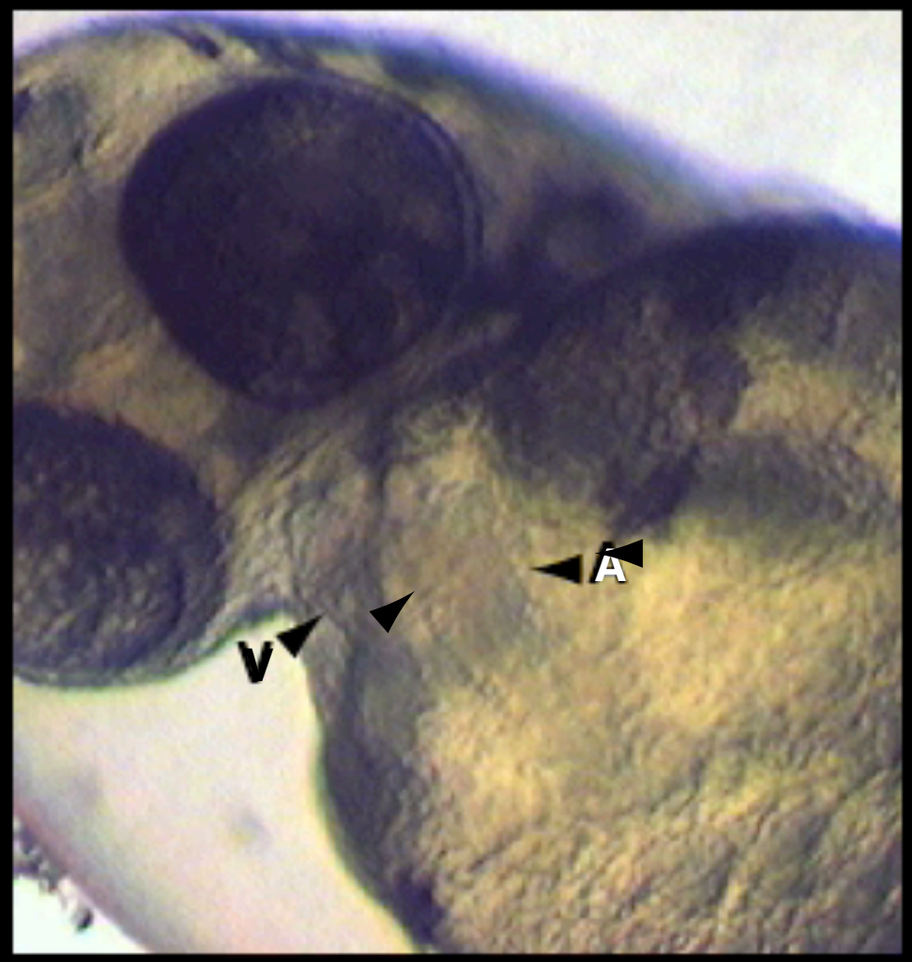
BACKGROUND

Major oil spills typically trigger heightened public concern for highly visible species such as birds and marine mammals. However, because these events do not occur every day and are difficult to study, we know much less about the unseen and more subtle effects of oil exposure in marine ecosystems. Consequently, academic



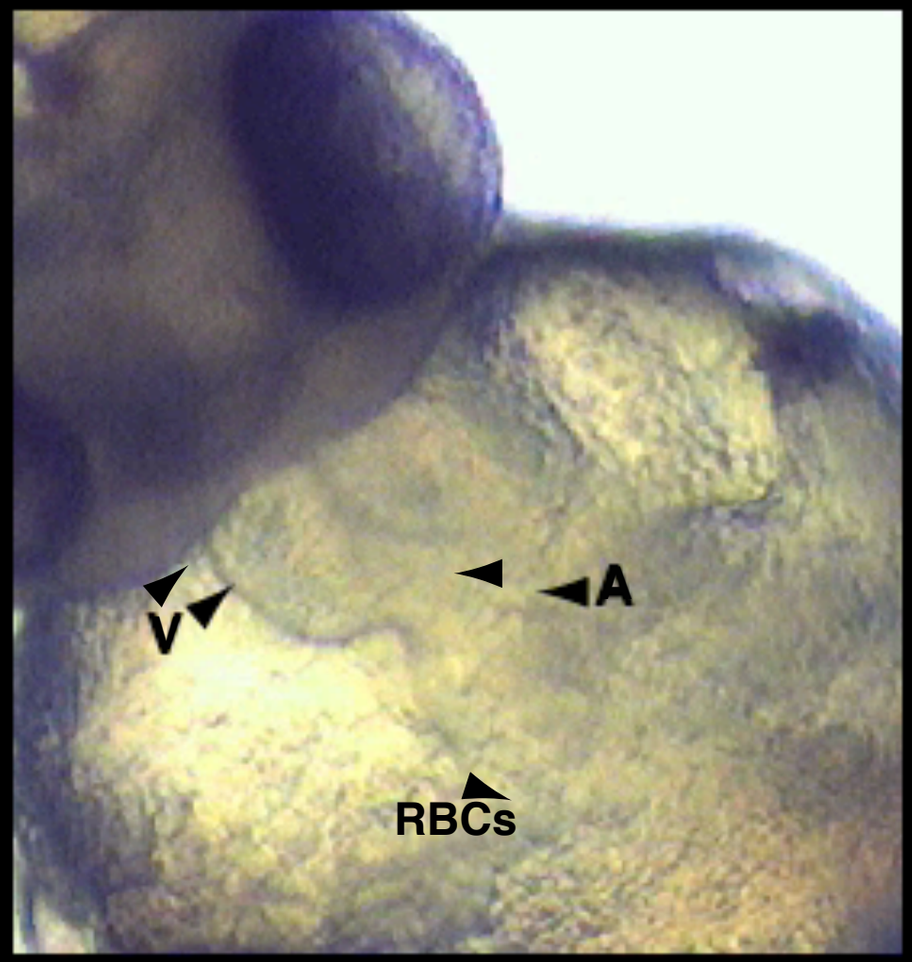
As we learn more about exposure and effects of oil spills, many assumptions are being proven wrong and more unknowns are

Cardiac dysfunction from exposure of fish embryos to very low levels of weathered crude oil



control 39 hpf

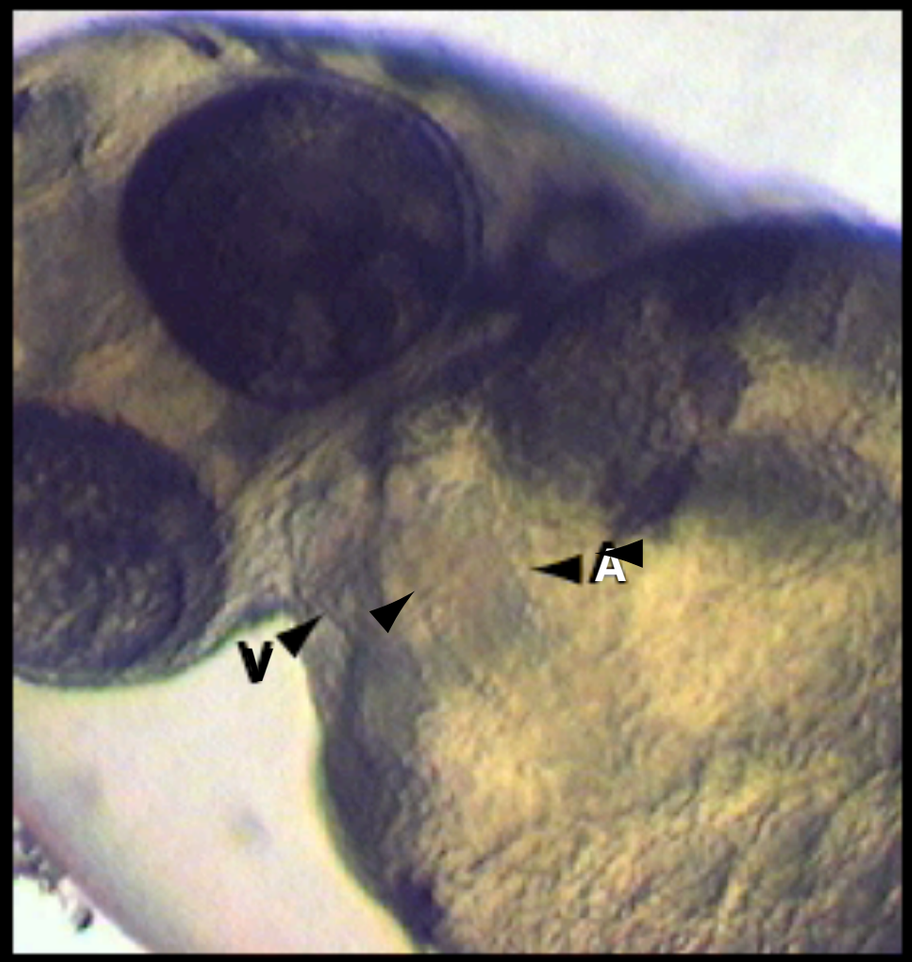
HR @ 56 hpf = 189 ± 8



weathered ANS crude 39 hpf

HR @ 56 hpf = 143 ± 12, $p < 10^{-8}$

Cardiac dysfunction from exposure of fish embryos to very low levels of weathered crude oil



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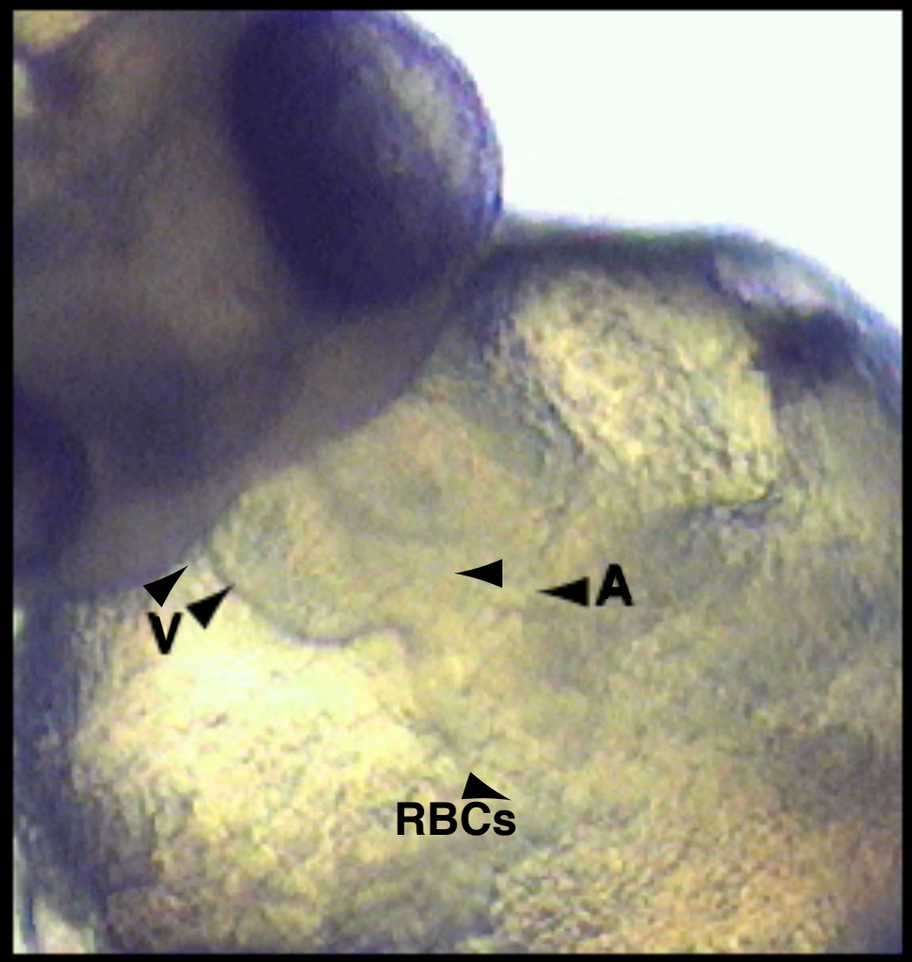


weathered ANS crude 39 hpf

HR @ 56 hpf = 143 ± 12, $p < 10^{-8}$

Air chemistry data is a major need for assessing the effects of oil spills on human health;

The toll free number is 1-855-NIH GULF.
That's 1-855-644-4853.

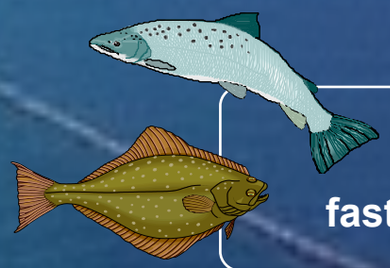
Air chemistry data is a major need for assessing the effects of oil spills on human health;

The fate of chemicals in biota after oil spills

PAHs

Uptake

Uptake



Vertebrates:

fast, efficient metabolism

Invertebrates:

slow, inefficient metabolism

Metabolites

Reactive intermediates

Accumulation in tissues

Released in bile

Little or no PAHs in issues

PAHs in tissues

The fate of chemicals in biota after oil spills

PAHs

Uptake

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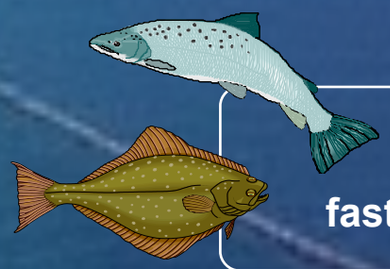
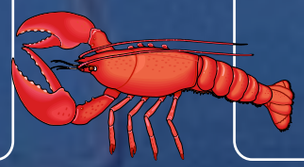


Vertebrates:

fast, efficient metabolism



Invertebrates:

slow, inefficient metabolism

Metabolites

Reactive intermediates

Accumulation in tissues

Released in bile

Little or no PAHs in issues

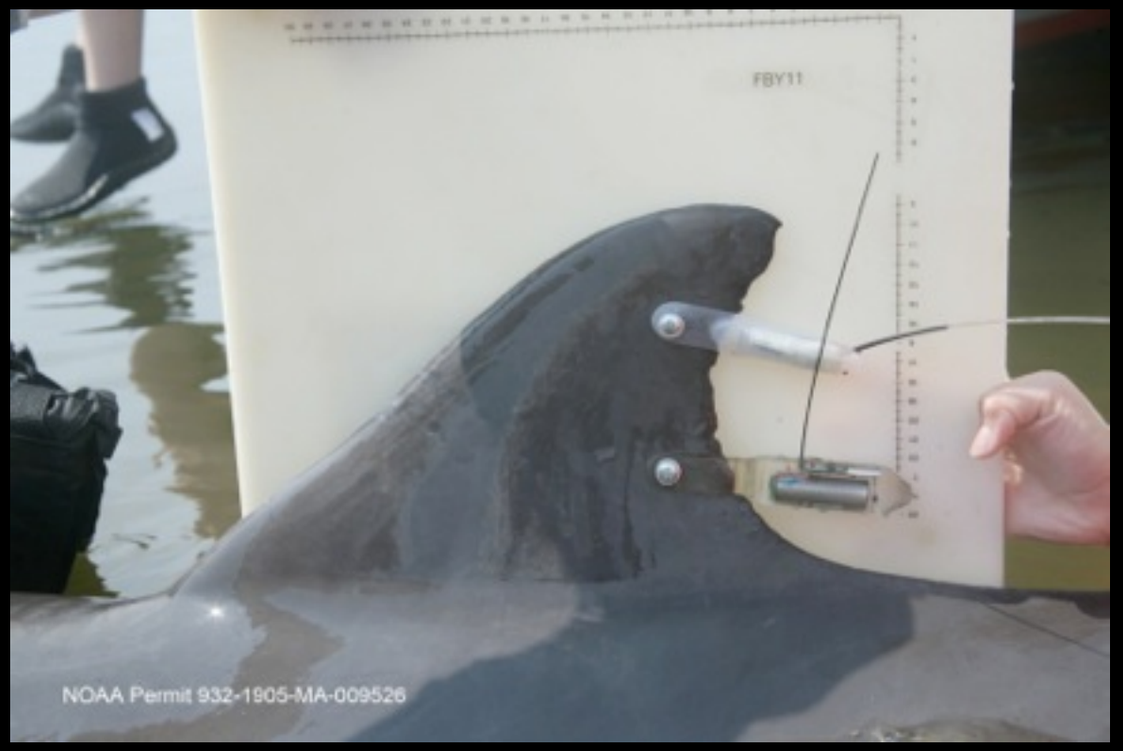
PAHs in tissues


Sampling
bile from
herring
using a
syringe

Biological measures in individuals, taken during dolphin health evaluations

Biological measures in individuals, taken during dolphin health evaluations

- Physical exam & ultrasound
- Blood, urine samples
  - CBC, serum chemistry
  - endocrinology, immunology, serology
  - urinalysis
  - chemical analysis
- Blubber biopsy
- Satellite/VHF tagging



Biological measures in individuals, taken during dolphin health evaluations

Environmental Science & Technology

Article

pubs.acs.org/est

Health of Common Bottlenose Dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, Following the *Deepwater Horizon* Oil Spill

Lori H. Schwacke,[†,*] Cynthia R. Smith,[‡] Forrest I. Townsend,[§] Randall S. Wells,[∥] Leslie B. Hart,[†] Brian C. Balmer,[∥] Tracy K. Collier,[⊥] Sylvain De Guise,[#] Michael M. Fry,[▽] Louis J. Guillette, Jr.,[○] Stephen V. Lamb,[◆] Suzanne M. Lane,[†] Wayne E. McFee,[†] Ned J. Place,[◆] Mandy C. Tumlin,[¶] Gina M. Ylitalo,[+] Eric S. Zolman,[†] and Teresa K. Rowles[★]

[†]National Centers for Coastal Ocean Science, National Oceanic and Atmospheric Administration, 331 Fort Johnson Road, Charleston, South Carolina 29412, United States

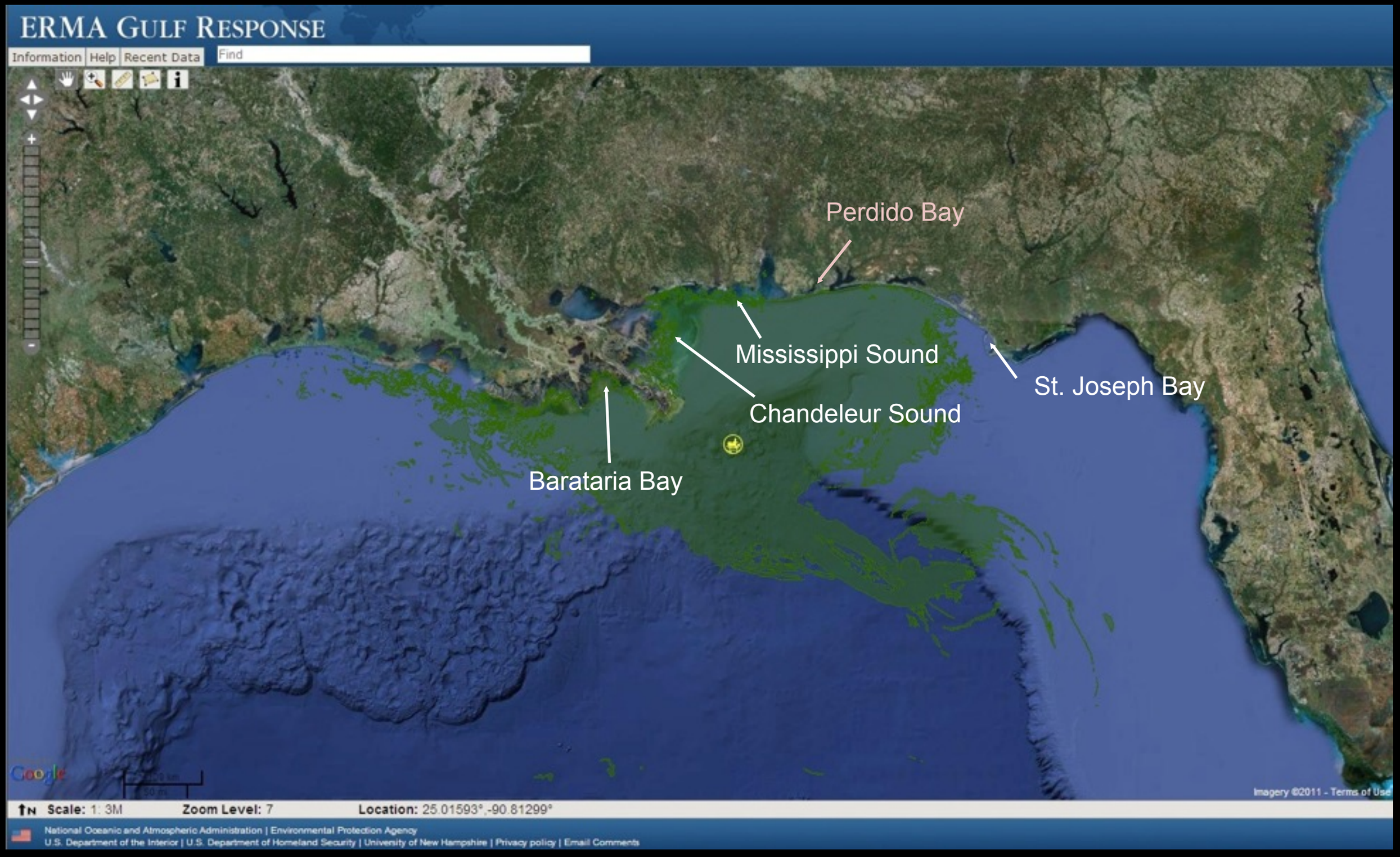
[‡]National Marine Mammal Foundation, 2240 Shelter Island Drive, Suite 200, San Diego, California 92106, United States

[§]Bayside Hospital for Animals, 251 Racetrack Road NE, Fort Walton Beach, Florida 32547, United States

[∥]Chicago Zoological Society, c/o Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, Florida 34236, United States

[⊥]Joint Office for Science Support, University Corporation for Atmospheric Research, 3300 Mitchell Lane, Boulder, Colorado 80301, United States

Focus Sites for *Tursiops* Nearshore Assessments



Longitudinal Vessel-Based Surveys of Dolphin Populations

- Remote biopsy tissue sampling
- Photo-identification for mark-recapture
  - Robust Design
  - Estimate abundance for each primary session
  - Estimate survival rates across primary sessions
  - Document calving events

Photo: NOAA, B. Rone

Poster 32:6 – L. Schwacke et al.
Dolphin Photo-ID, Biopsy, & Capture-Release

Types of data useful for determining ecological effects of oil spills, focused on fish and higher vertebrates

Water chemistry

Air chemistry

Chemicals in biota

Biological measures in individuals

Population metrics

Types of data useful for determining ecological effects of oil spills, focused on fish and higher vertebrates

Water chemistry

Air chemistry

”Other”

Chemicals in biota

Biological measures in individuals

Population metrics

Based on my involvement in and observations of the Deepwater Horizon oil release, and previous experience with EXXON Valdez, North Cape, New Carissa, Prestige, Hurricane Katrina, and Cosco Busan, in 2012 I told a group of European response specialists (PREMIAM—POLLUTION RESPONSE IN EMERGENCIES: MARINE IMPACT ASSESSMENT AND MONITORING) that there are pressing needs in the following areas, regarding pollution emergencies:

Science, Service, Stewardship

NOAA Fisheries' Seafood Safety Response to the Gulf Oil Spill

Aquaculture America 2012
Las Vegas, NV

Calvin C. Walker and Cheryl L. Lassitter
National Seafood Inspection Laboratory
Office of Sustainable Fisheries
Pascagoula, MS

NOAA FISHERIES SERVICE

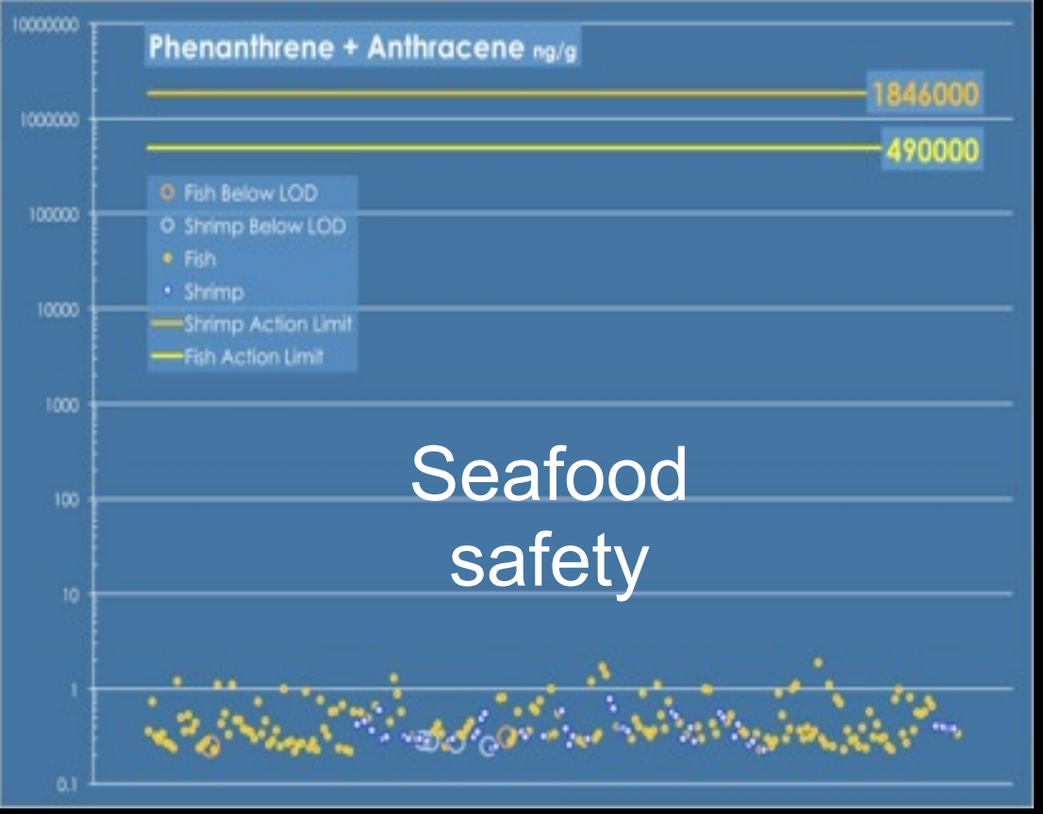
The use of dispersants

EVOS Trustee Council

The effects of oil exposure on human health

The toll free number is 1-855-NIH GULF.
That's 1-855-644-4853.

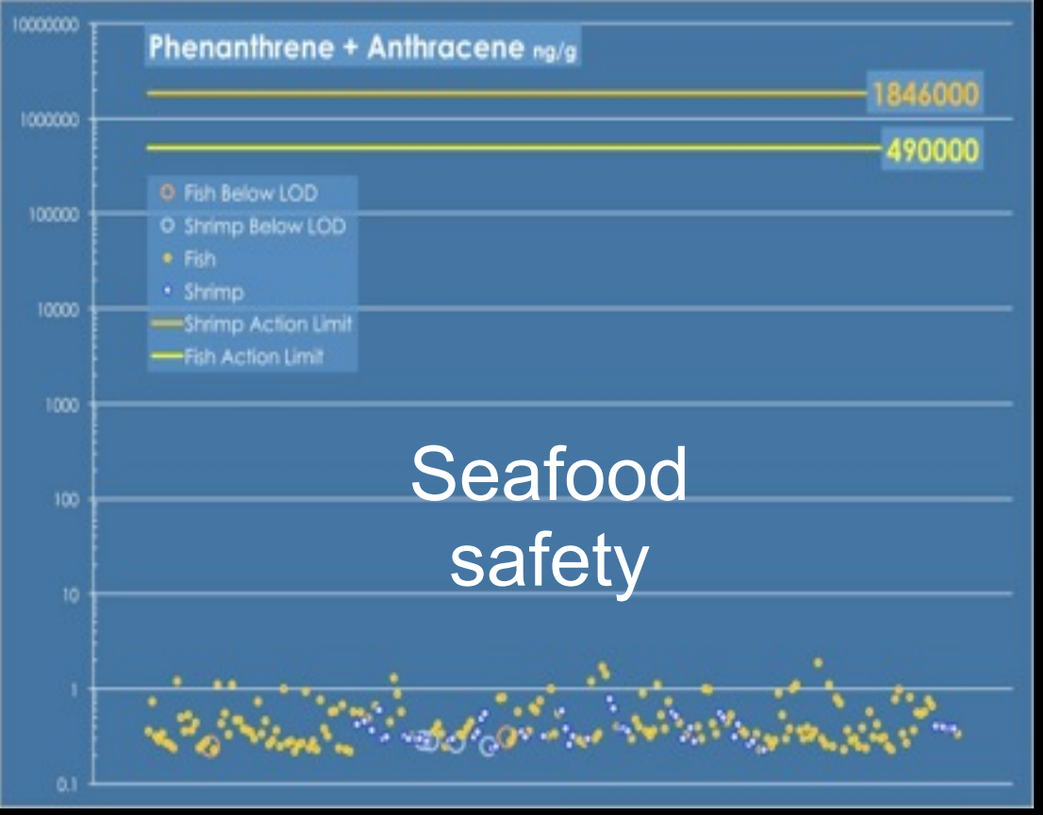
Assessing the effects of oil spills on threatened and endangered species


Phenanthrene + Anthracene ng/g
1846000
490000
Fish Below LOD
Shrimp Below LOD
Fish
Shrimp
Shrimp Action Limit
Fish Action Limit
10000000
1000000
100000
10000
1000
100
10
1
0.1
Seafood safety


GuLF STUDY
1-855 GULF
4853
Human health
The toll free number is 1-855-NIH GULF.
That's 1-855-644-4853.


T&E species


Dispersant use

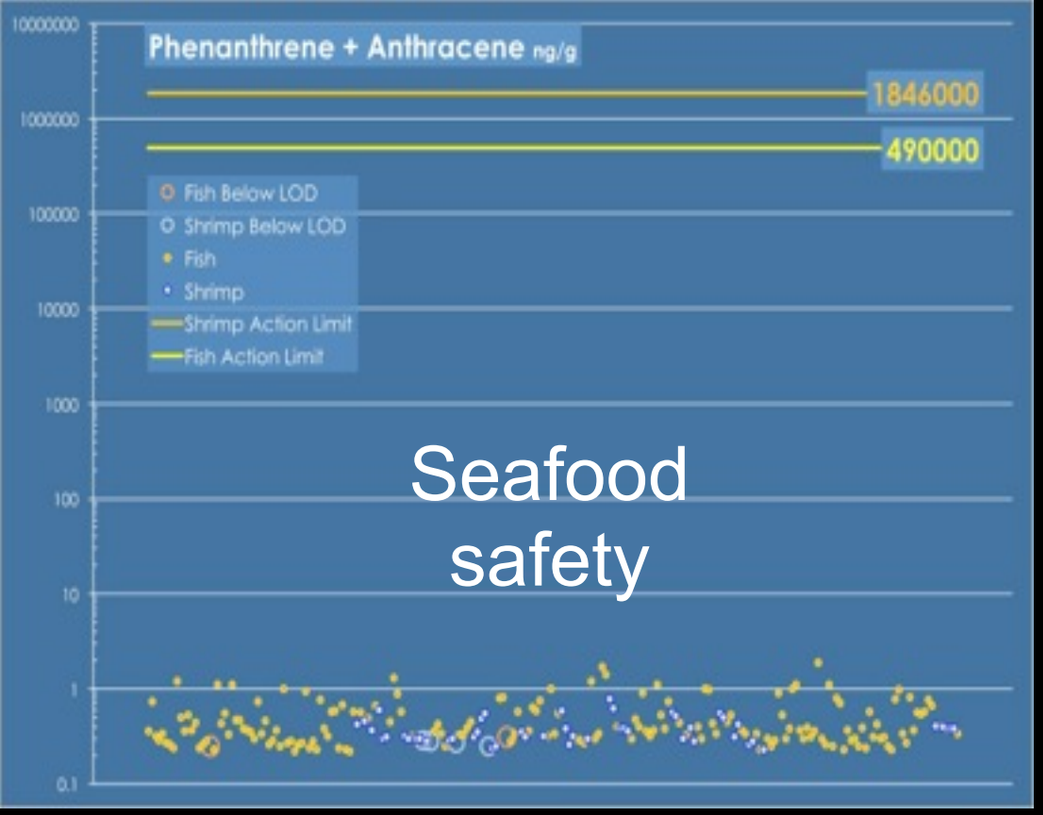


Seafood safety

Human health

T&E species

Dispersant use

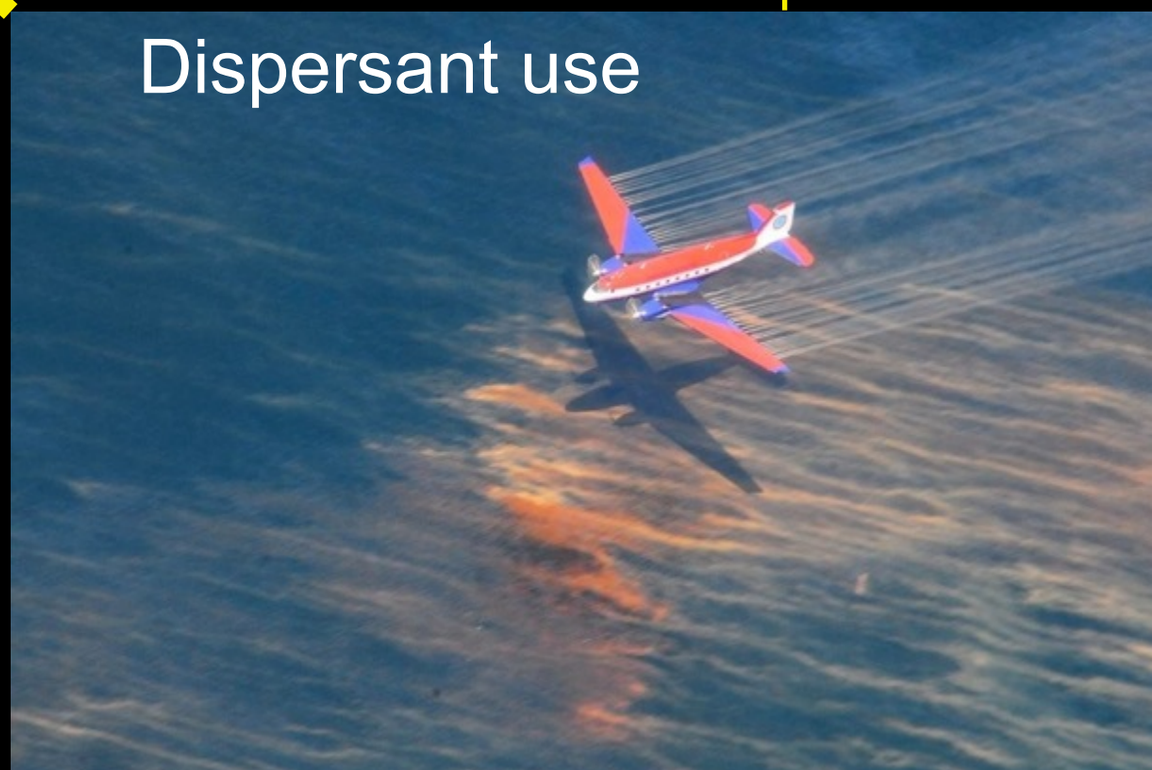


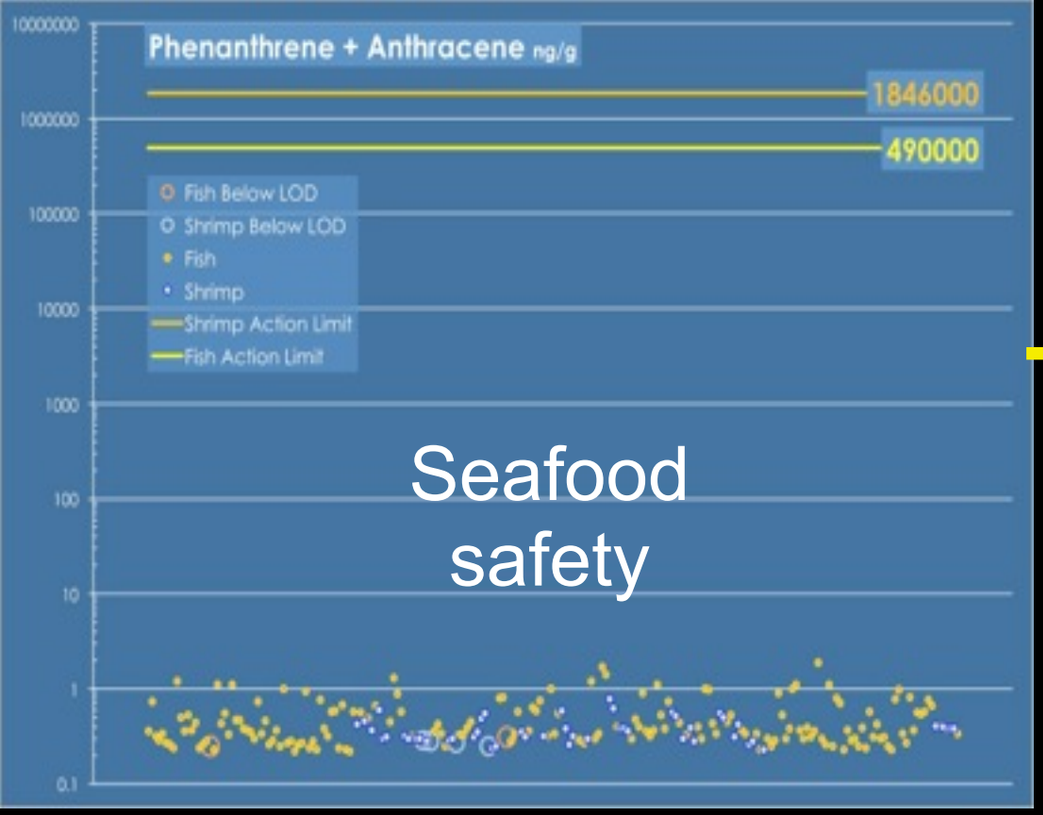
Seafood safety

Human health

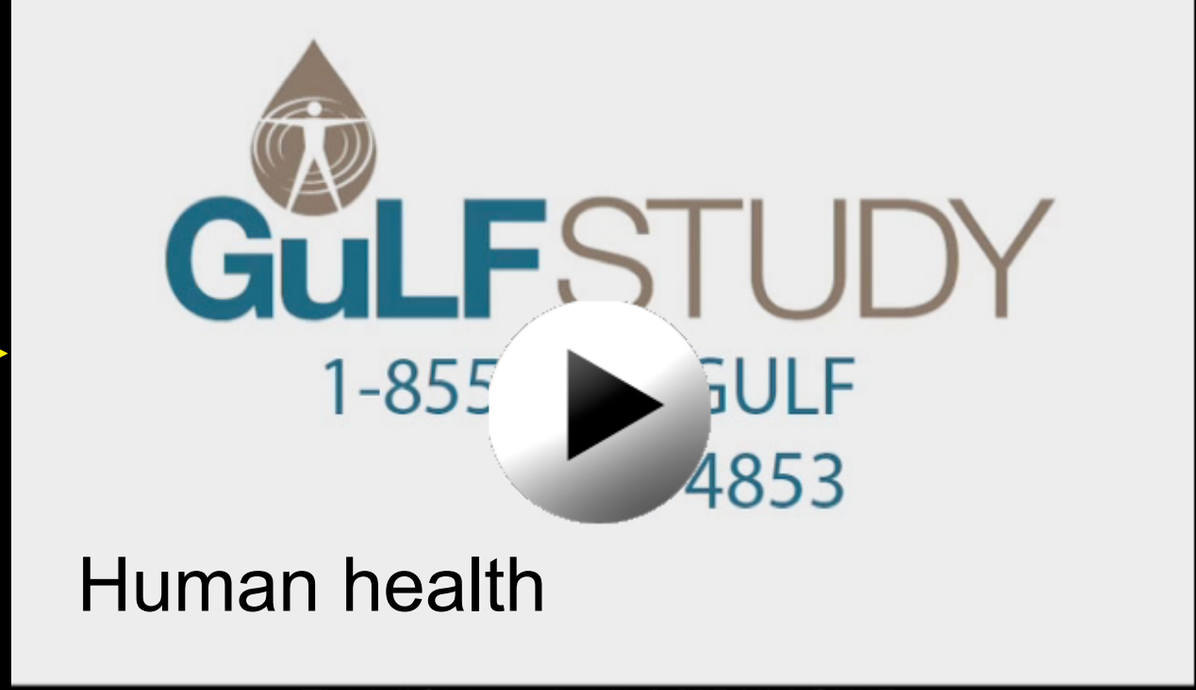
T&E species

Dispersant use





Seafood safety



Human health

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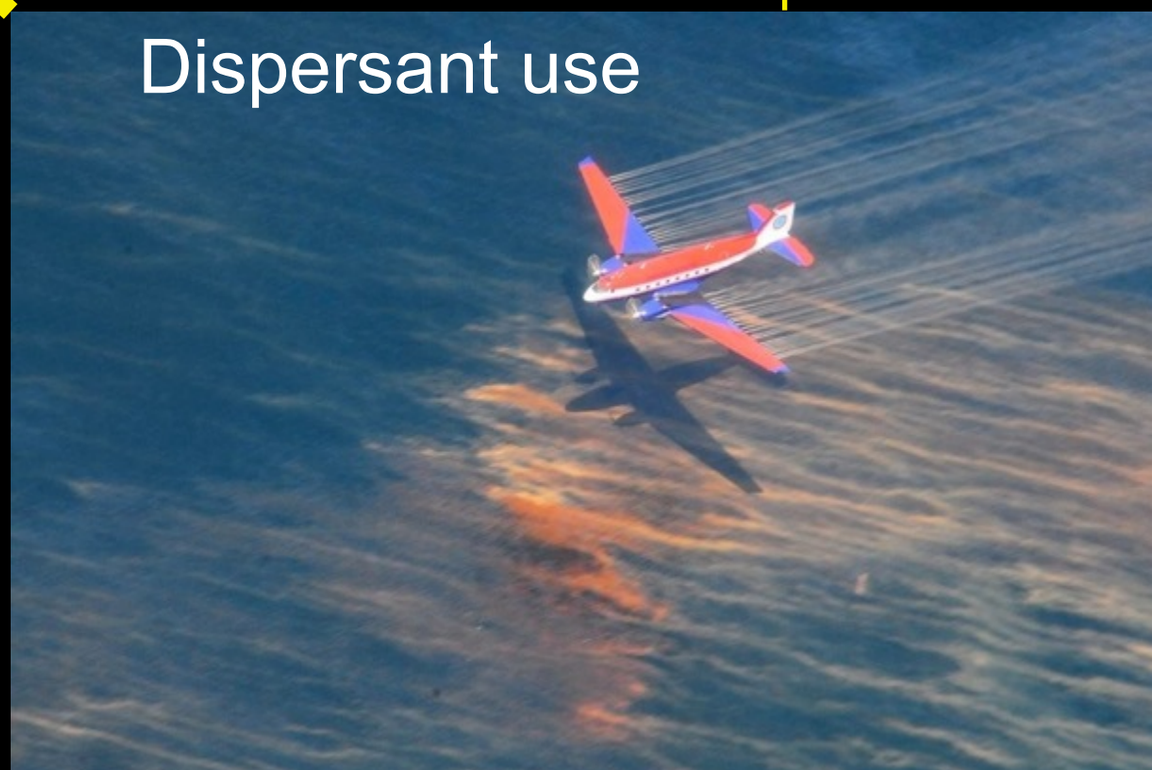
T&E species



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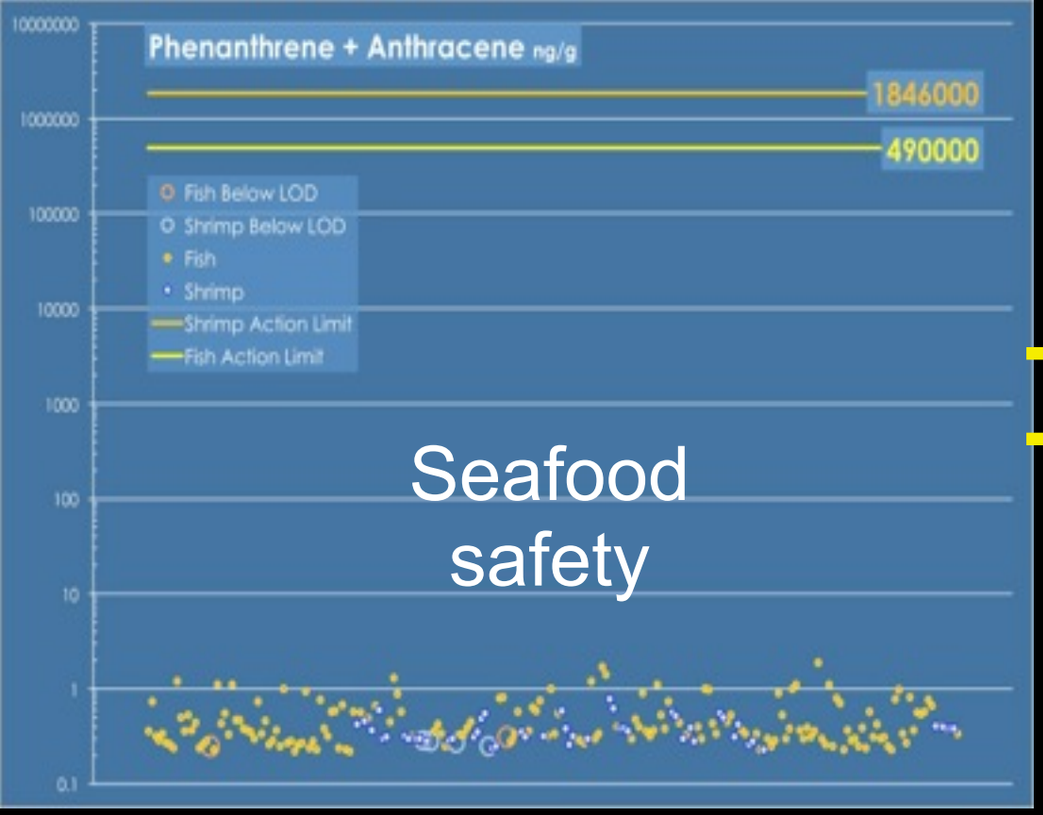
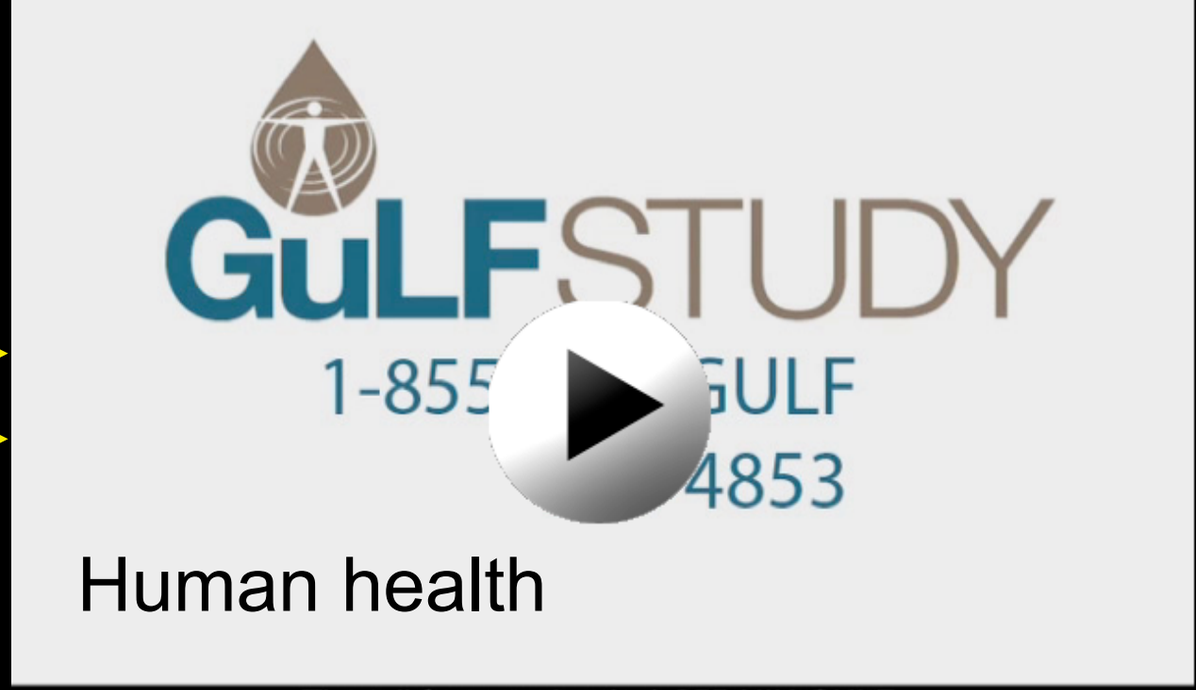
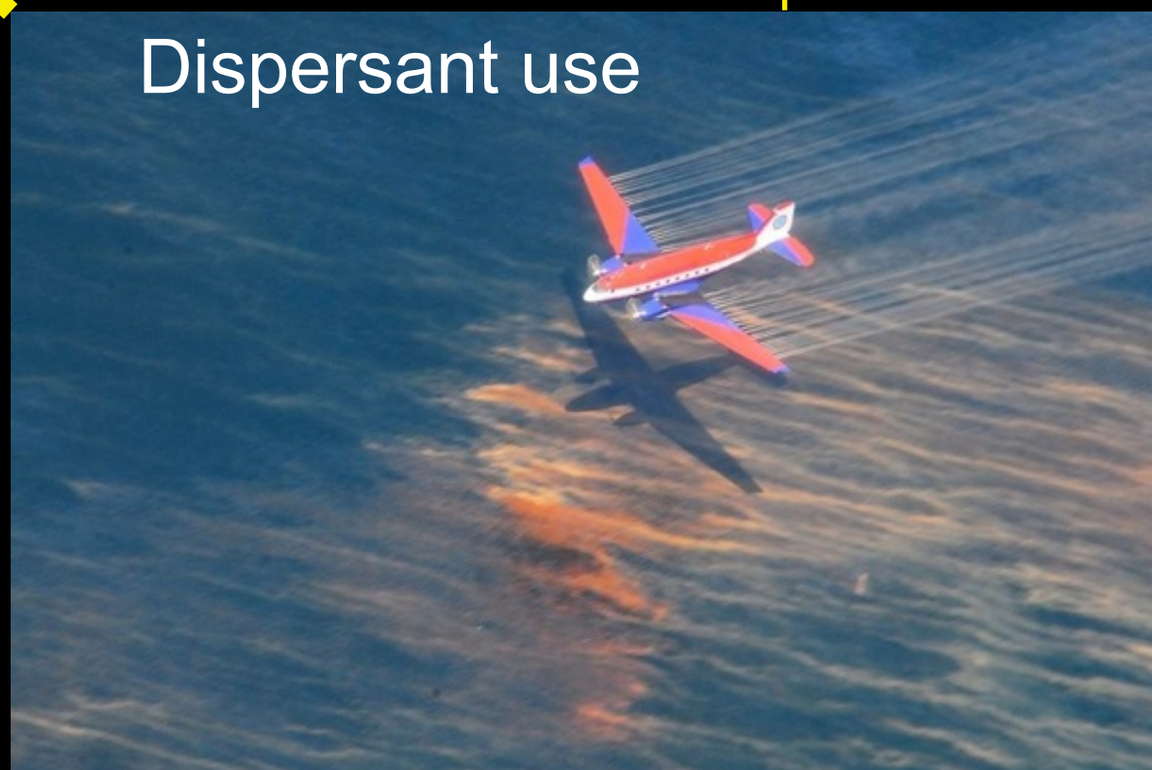


Seafood safety



Human health

T&E species



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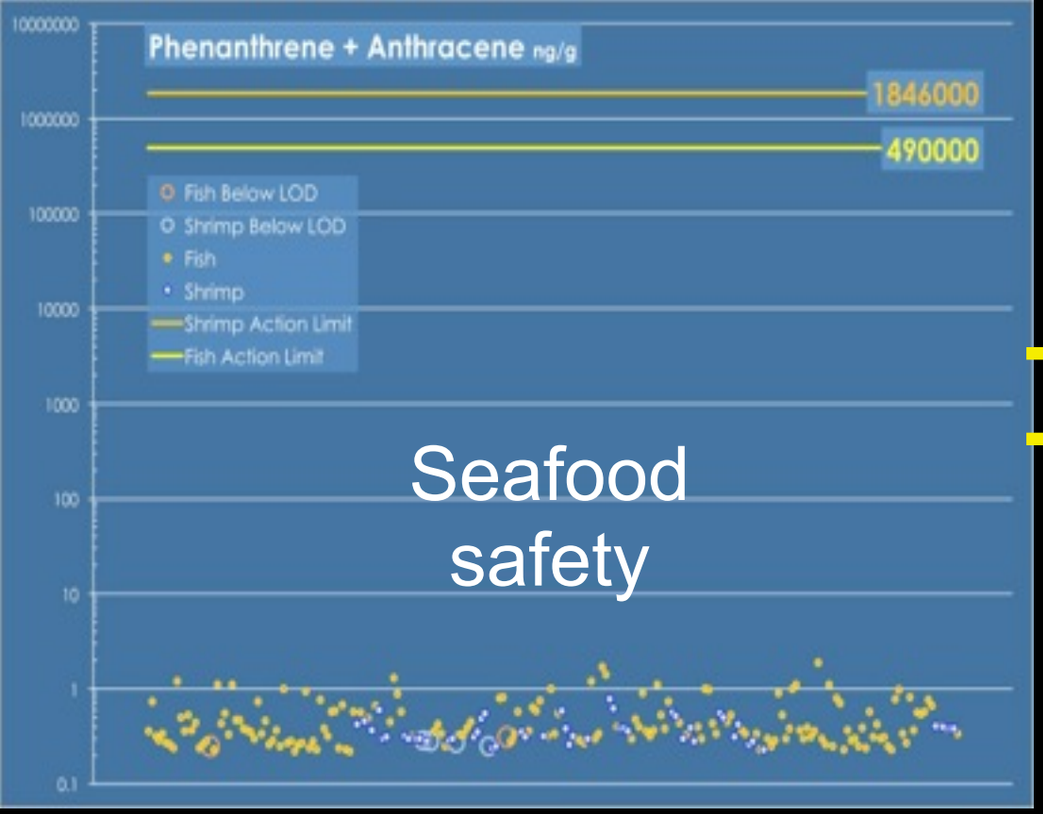
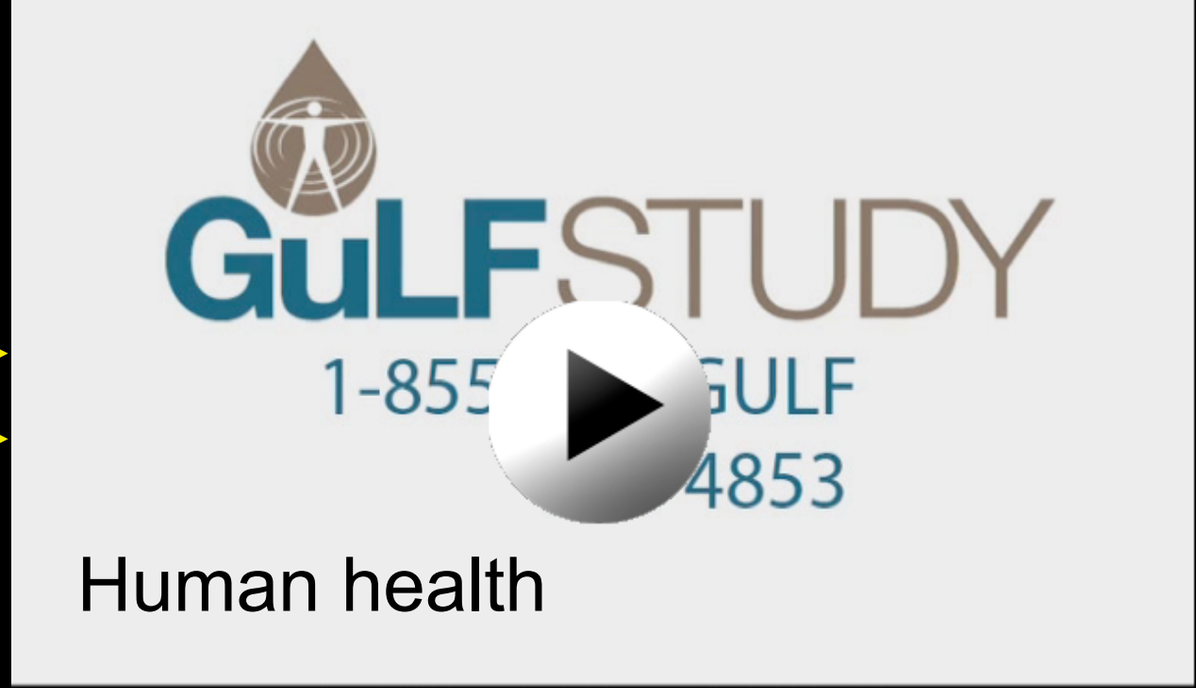


Seafood safety



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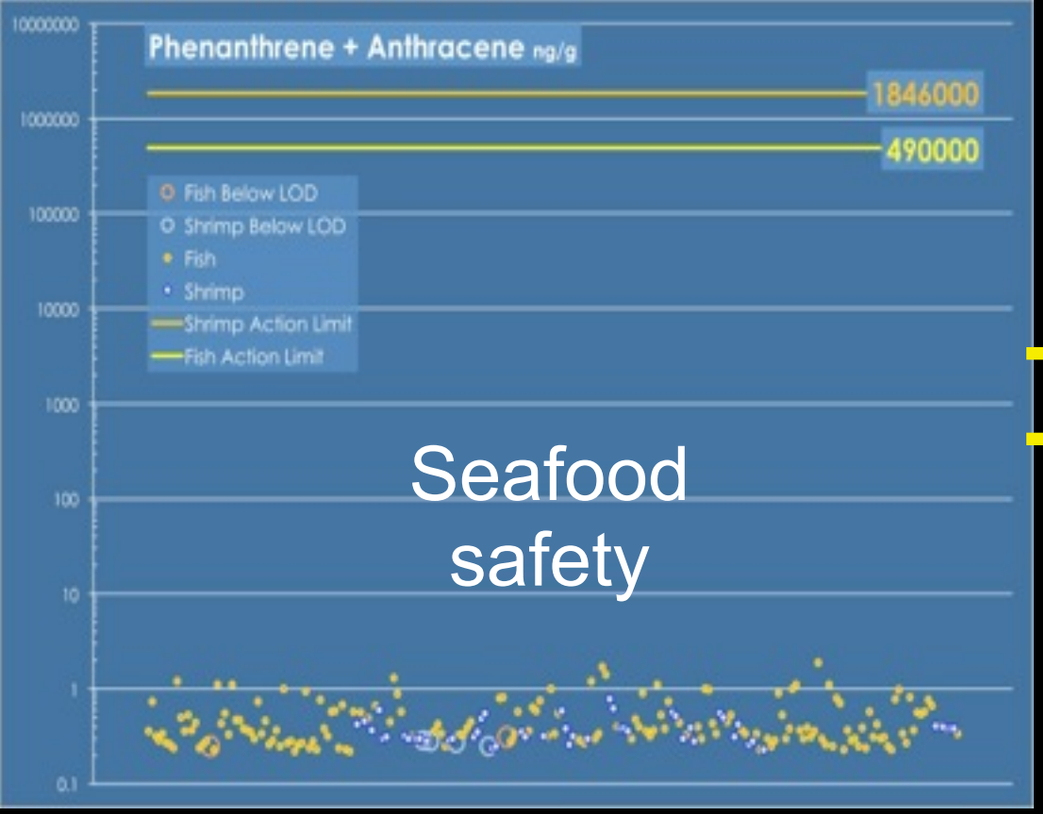
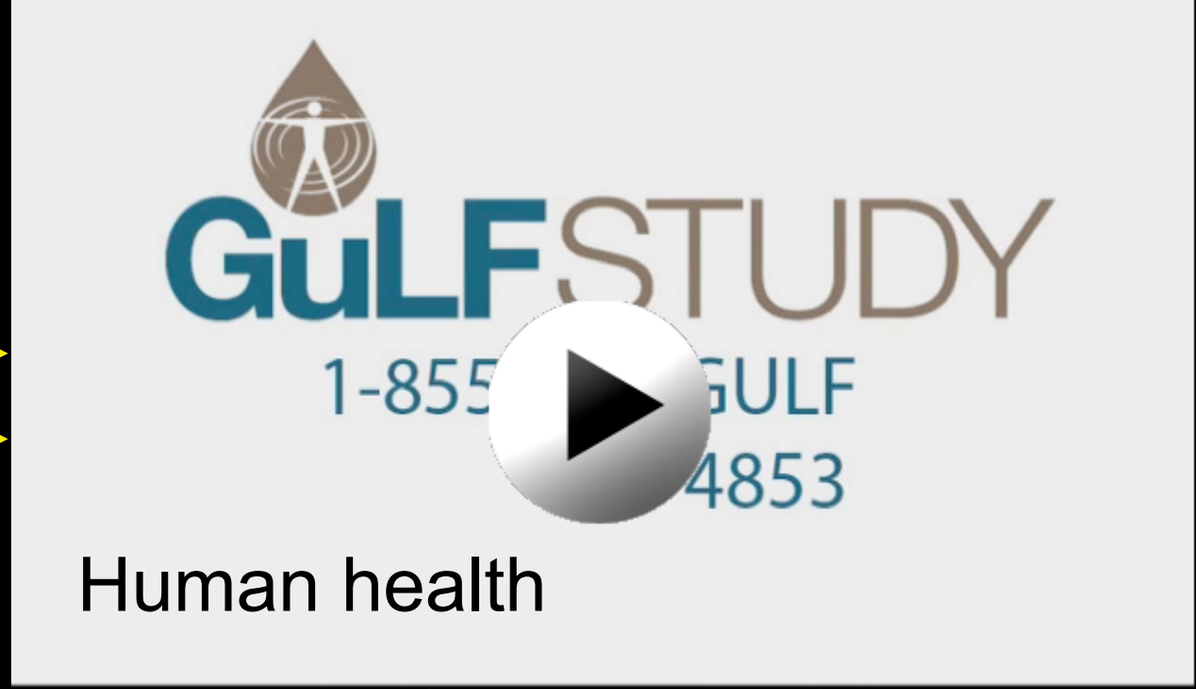


Seafood safety



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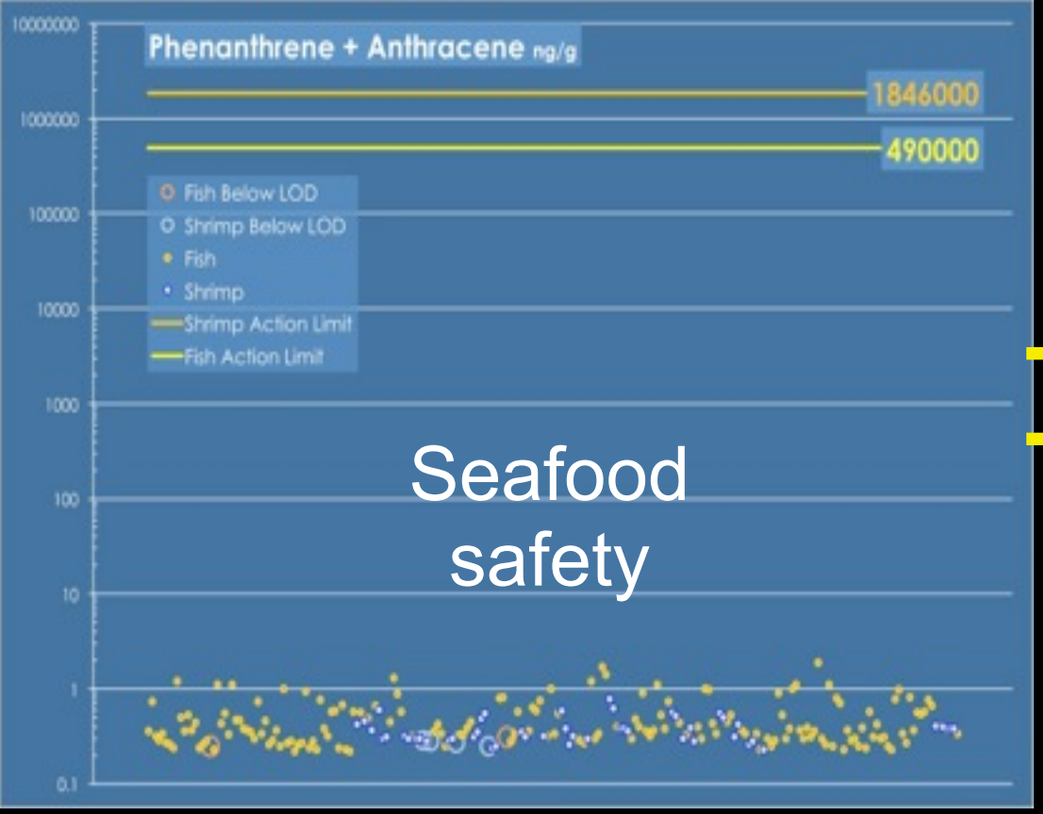

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Human health

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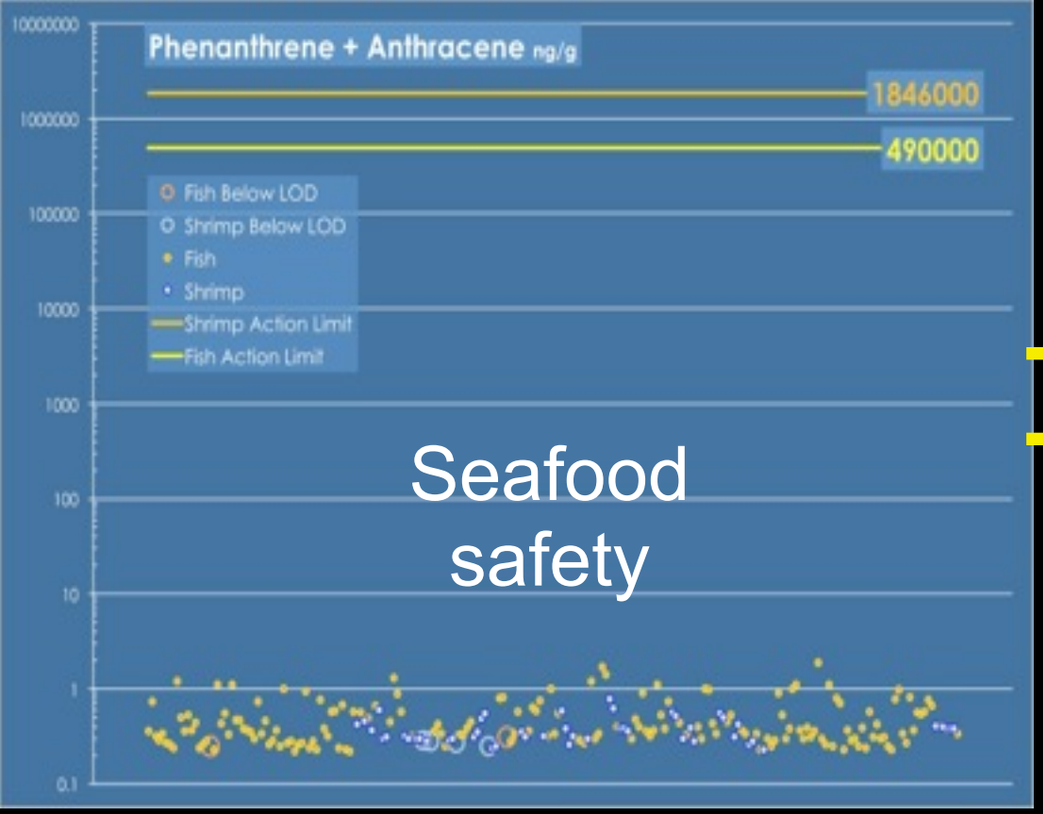


Seafood safety

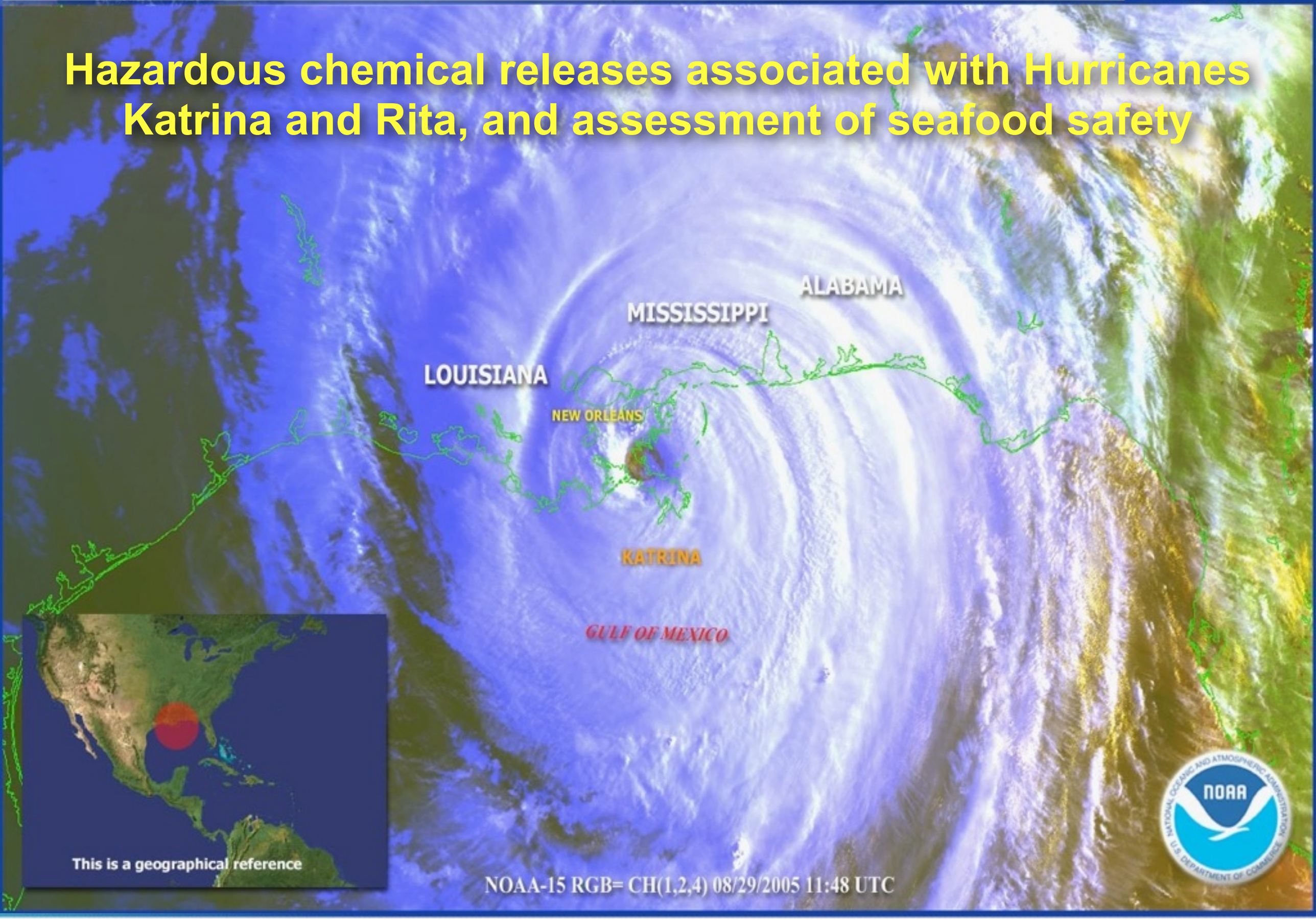
Human health

T&E species

Dispersant use

While each of these areas requires their own advance planning, response, and monitoring capabilities, interconnections mean that we need to crosswalk between them in developing strategies for handling pollution emergencies, and especially for sharing data

Hazardous chemical releases associated with Hurricanes Katrina and Rita, and assessment of seafood safety



30,000 chemicals in commerce

- 400 estimated to be persistent
- 4% routinely analyzed
- 75% unstudied
- Many are designed to kill (pesticides)
- Unanticipated (side) effects (e.g. flame retardants)
- Pharmaceuticals in sewage treatment discharge
- Petroleum = thousands of unstudied chemicals

The research vessel *Nancy Foster* has been sampling the Gulf of Mexico to gauge flood pollution.

NOAA

After Katrina: tracking the toxic flood

BATON ROUGE

Three weeks after Hurricane Katrina ravaged the coasts of Mississippi and Louisiana, marine researchers are starting to assess the safety of fish and shellfish exposed to toxic flood waters in the Gulf of Mexico.

The flood waters are teeming with *Escherichia coli* bacteria and a wide range of chemicals (see *Nature* **437**, 301; 2005). And engineers are pumping the toxic mix out of the city towards the Gulf coast. With its shrimp, oyster, crab and flat-fish stocks valued at around $3.1 billion, the coast is one of the richest fishing grounds in the United States.

Shailer Cummings of the National Oceanic and Atmospheric Administration led a food-safety team into the Gulf last week for a three-day expedition on board the research vessel *Nancy Foster*. Until then the boat was being used to check the safety of the region's major ports, doing soundings to check for obstructions under the water, among other tasks.

Cummings had just two days to organize the expedition — a huge challenge under normal circumstances and more so as personnel were in such short supply. "When you try to get a research team from a distressed area they are hungry, stressed and looking for their family like everyone else," he says. So he recruited a team from the Northwest Fisheries Science Center in Seattle, Washington.

His team of some 15 scientists collected shrimp, oysters and Atlantic croakers — a common ground fish — and sent them to a Seattle laboratory to be tested for bacterial contamination and pollutants. Aware of the risk of a second public-health disaster in the wake of the hurricane, the researchers worked around the clock. "Nobody sleeps," Cummings told *Nature* after three tough days aboard the *Nancy Foster*. "We're doing this to make sure the food supply is safe."

On their tour through the Gulf, the crew took samples from the muddy plume that has spread from the Louisiana coast over hundreds of square kilometres. Katrina muddied the water by washing sediments from the Mississippi into the sea, explains Cummings. And the fresh water is sitting on top of the salty water, spreading "like tea on a tabletop".

"We're making sure the food supply is safe."

So far, the team has seen no evidence of the algal bloom that might result from the fresh-water influx, and the circulation pattern of the water seems normal. But "we don't know what's in the water", says Cummings.

As well as sampling water and sediment for pathogens and chemicals, the researchers dissected, prepared and labelled fish samples for storage until they could be tested back in Seattle. It was close, feverish and smelly work. The liver and bile will be tested for fat-based contaminants such as polyaromatic hydrocarbons. The gut and gill will be tested for pathogens, and the muscle will be tested for mercury and other contaminants.

"It's an unprecedented situation," says Tracy Collier, head of the ship's wet lab and director of Environmental Conservation at the Northwest Fisheries Science Center. "We're trying to sample as broadly as we can," he explains, to detect anything that might harm people.

The results will not be ready until the end of September. But it is unlikely anyone will get ill in the meantime, says Bo Boehringer of the Louisiana Department of Wildlife and Fisheries, because no fishing is likely to take place for many weeks. Katrina has brought the fishing community in the region to a standstill. Boats and piers have been destroyed, ice houses smashed and fish-processing centres damaged. US authorities estimate that about 4,800 fishermen in the area are now out of work.

Although serious attention is being paid to food safety, there is also concern that Katrina has damaged fish and shellfish stocks. Flood water has covered oyster beds along a stretch of inland bays with up to a metre of mud, and the oysters have suffocated.

Some wildlife seems to be bouncing back, however. Biologist Melody Baron was on board the *Nancy Foster* to watch for marine mammals in distress. On her third 12-hour shift she said she had seen turtles and dolphins behaving normally. ■

Adrianne Appel

NATURE 437, 22 Sept. 2005


e toxic flood

for mercury and other contaminants.

"It's an unprecedented situation," says Tracy Collier, head of the ship's wet lab and director of Environmental Conservation at the Northwest Fisheries Science Center. "We're trying to sample as broadly as we can," he explains, to detect anything that might harm people.

Chemicals in Our Waters

fossil fuels **metals** **pesticides** **other commercial chemicals**

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NIEHS Disaster Research Response: Recent Lessons & Future Steps

Environmental Disasters Data Management Workshop

September 16, 2014

National Institutes of Health • U.S. Department of Health and Human Services

Importance of Research

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World Trade Center September 11, 2001

Widespread Contamination

Complex Mixed Exposures

>50,000 Healthy Workers

Study 9 yrs later *

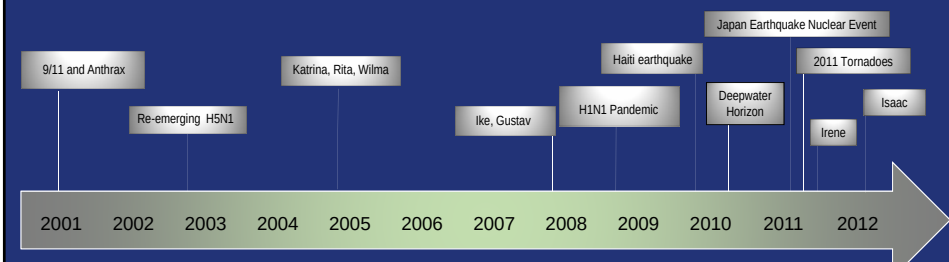
-Asthma	28 %
-Sinusitis	42 %
-Lung Tests	42 %
-PTSD	9 %
-Panic	8 %
-Depression	28 %

Frank J. Dericola / New York Times

*Wisnivesky et al, 2011. Lancet. 378:9794:888-897

Events come in all shapes and sizes
Environmental Health a part of most!

ASPR ASSISTANT SECRETARY FOR PREPAREDNESS AND RESPONSE



4

Common Themes Across Disasters

- **What are the health, including mental health, implications of the exposures & stressors, not just acute but long term ?**
  - Especially among those most vulnerable.
- **Are the impacted areas safe for communities to live and work?**
- **What do we need to know to: help protect the public, address community concerns, and prepare for the future?**

Getting information in a useful & timely way?

Anthrax: Wash DC, 2001

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Deepwater Horizon Oil Spill, April 2010

- **Interagency Research Work Group** (May 2010)

  -NIEHS, NTP, NIOSH, ATSDR, SAMHSA, HHS/ASPR

  - NIEHS & CDC: Coordinated & facilitated assessment of data gaps and research needs related to spill & exposures

- **Seed Funding by NIH Director**
- Dr. Collins: $10M support for research June 2010
- Focus on health effects among those involved in various clean-up activities

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IOM Workshop, New Orleans. June 22-23, 2010

Key Points

-Longitudinal human health research is clearly indicated
-Health studies should begin as soon as possible
-Mental health & psychosocial impacts must not be overlooked
-Sensitive populations need to be monitored
-External stakeholders must be part of the process
-Data and data systems should be developed to support wider research efforts

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U.S. Department of Health and Human Services

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Limited Health Studies on Oil Spills

- **38 supertanker oil spills in past 50 years**
- **Only 8 studied for health effects, all but one cross-sectional or very short term**

	Barrels of Oil (1 B = ~ 40 gallons)
1989 Exxon Valdez, USA	270,000
1993 MV Braer, UK	620,000
1996 Sea Empress, UK	525,000
1997 Nakhodka, Japan	>44,000
1999 Erika, France	146,000
2002 Prestige, Spain	460,000
2003 Tasman Spirit, Pakistan	270,000
2007 Hebei Spirit, South Korea	73,000
2010 Deepwater Horizon, USA	**4,900,000**
- Dispersant Use > 1.8 M gallons	

- Exposure Assessment:
  - only 1 study had estimates of exposure (used surrogate measures e.g. distance from spill)

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U.S. Department of Health and Human Services

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Health Concerns Spill-related Exposures

- **Health Concerns from Previous Studies of Oil Spills**
  - **Acute**
    - Dermal, Eye, Respiratory Irritation
  - **Longer-term health effects**
    - Pulmonary Symptoms and Abnormalities
    - Genotoxicity
    - Generalized Anxiety, Post Traumatic Stress Disorder, Depressive symptoms
- **GOS health findings though August 27th** (NIOSH Report August 13, 2010)
  - **Injuries and Illness through July 27th**
    - N=2130 (1136 injuries (53%) 994 illnesses (47%))
  - **For illnesses about 75% Onshore vs Offshore**
    - 192 Heat stress
    - 171 Multiple Symptoms (more than one organ system with no specific underlying cause)
    - 127 Headache / Dizziness
    - 122 Gastrointestinal
    - 78 Dermatologic
    - 42 General Symptoms (malaise, fatigue, non-specified allergic reactions)
    - 28 Cardiovascular

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Exposures of Concern

- **Crude Oil**
  - Polycyclic Aromatic Hydrocarbons (PAHs)
  - Volatile Organic Compounds (VOCs) (benzene, napthalene, toluene, xylene)
  - Heavy Metals (cadmium, nickel, lead, zinc)
- **Dispersants**
  - Detergents (sulfonic acid salts)
  - Solvents (2-butoxyethanol, propylene glycol)
  - Petroleum Distillates (paraffins, PAHs)

- **Burning**
  - PAHs, respirable particulate, hydrogen sulfide, sulfur dioxide
- **Other:** Heat Stress, Physical Hazards, Mental Health

National Institutes of Health
U.S. Department of Health and Human Services

NIH Funded Gulf Oil Spill Research

GuLF STUDY
A health study for oil spill clean-up workers and volunteers

Intramural Research

National Toxicology Program
U.S. Department of Health and Human Services

Toxicology Research

Worker Training
Oil Spill Cleanup Initiative

Deepwater Horizon Research Consortia:
Health Impacts & Community Resiliency

Extramural Research

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GuLF STUDY (Gulf Long-term Follow-up Study)

GuLF STUDY
A health study for oil spill clean-up workers and volunteers

- **Prospective study of 32,762 adults involved in oil spill clean-up or support**
  - Enrolled Mar 2011 to Mar 2013
    - Baseline telephone interview on clean-up jobs, symptoms, health
    - **In-home clinical assessment and biospecimen collection – 11,210 from Gulf states**
  - Followed 10 or more years
    - Telephone interview every 2-3 years
    - Subgroup with repeated mental health and resiliency assessments
    - Linkage to vital records and cancer registries
  - Comprehensive clinical exam (~4,000 from AL, LA) started 8/14

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U.S. Department of Health and Human Services

Deepwater Horizon Consortium

- **5-year $25.2 M program**
- **Four university/ community partnerships**
  - Tulane
  - LSU
  - Univ. of Florida
  - Univ. of Texas Medical Branch
- **Steering group leadership**
  - Includes GuLF STUDY
  - Input from NTP
- **Distinct populations & foci**
  - Women and children
  - Pregnant women
  - Cultural/ethnic minorities
  - Seafood safety
- **Shared approaches**
  - Seafood
  - Resiliency
  - Population studies
  - Community outreach & dissemination

Funding: NIEHS, NCI, NHLBI, NIMH, NIMHD, NINR, NCATS, OBSSR

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Characterizing Spill Exposures to Understand Health

- Identify chemical profiles of different crude oils
- Better characterize changes in exposure impact due to weathering and degradation
- Conduct research on chemical mixtures
- Characterize background ambient exposures as a baseline to evaluate impact of future spills

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Oil Spill Research Challenges

- **Study Populations: Workers and Volunteers**
  - Use of NIOSH roster & combining multiple lists (BP, national guard)
- **Study Development Process**
  - IRB, OMB, & Certificates of Confidentiality
- **Baseline Data for Comparison**
  - Available only for small fraction of cohort (e.g., Coast Guard)
    - **Health information, biospecimens, relevant tests ?**?
    - Environmental baselines & monitoring (seafood, water, air, etc.)
- **Exposure Reconstruction**
  - Methods, sensitivity/specificity, time/location, area vs. personal samples, etc.
  - Multiple databases that need to be integrated
  - Available data difficult to use to reconstruct exposures
- **Timeliness of Extramural Awards & Initiation of Studies**

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Oil Spill Research: Lessons Learned

- **Atypical workers involved in disaster responses:**
  - fisherman & others who lost jobs, unemployed from other areas
- **Rapid and ongoing communication with stakeholders**
- **Need better capabilities to rapidly understand exposures & evaluate toxicity of exposures**

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Elk River WV Chemical Spill, Jan. 2014
Is it really safe?

- ~10,000 gallons of 4 methylcyclohexane methanol (MCHM) + polyglycol ethers (PPH) leaked into Elk River
- No water for over 300,000 residents, affecting some for more than a week
- About 500 patients seen in response
- Limited toxicology and health data available
- Missed opportunity to assess exposures and health impacts
- **Currently:** CDC looking at surveillance opportunities and NIEHS/NTP developing toxicology studies

NTP Executive Committee examining new role & strategies to support HHS for future incidents

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Disaster Environmental Health Research Issues

- Ad-hoc, convenience based sampling
- Non-systematic collection of health information
- Late Data: Missing baseline & longitudinal health data
- Exposure data not measured to understand effects
- High risk groups: pregnancy, elderly, pre-existing illness
- Lack of toxicity / health data for exposures
- Minimal community engagement

Disaster Research Response (DR2) Project Genesis

- **National Biodefense Safety Board Recommendations (Apr, 2011)**

- **Sep. 2012 NIH/ASPR Federal Partners Meeting:** Identified Areas of Concern

  Funding, IRB/OMB, Data collection tools, trained research workforce, infrastructure support, & community engagement

- **Deployment of research too slow & Data is perishable!**
  - H1N1 Response- treatment research, IRB issues
  - DWH Oil Spill- 9 months to start GuLF Study
  - Hurricane Sandy- 11 months to fund extramural efforts

"Timely research is critical to prevent injury & illness and support recovery"
Lurie, Manolio, Patterson, Collins, Frieden. NEJM Mar 2013:

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NIH Disaster Research Response (DR2) Project

NIEHS & NLM: Project Timeline Aug. 2013 – Sep. 2014

Pilot project to help galvanize and accelerate needed infrastructure as part of a larger HHS Effort

Objectives

1. **Central repository data collection tools & research protocols**
2. **NLM public website**: "Disaster Research Responder"
3. **Rapid Data Collection Capability**: baseline epi., clinical, & biospecimens
4. **Environmental Health Research Response Network (EHS Network)**
5. **Training** intra/extramural disaster researchers
6. **Share & Integrate:** HHS/federal response & recovery frameworks

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Research Responder Training & Education

- **Training & Education**
  1. National response plans & HHS mechanisms
  2. Training on DR2 Project & EHS emerging issues
  3. Health & Safety issues relevant to the disaster/situation

- **Training Exercises** on identified scenarios & issues

4/7 Port of Los Angeles Training Exercise
- USGS Tsunami Scenario
- 140 involved: fed, state, academia & community
- Evaluate DR2 Project concepts & support
- Discussion: integration, issues of concern

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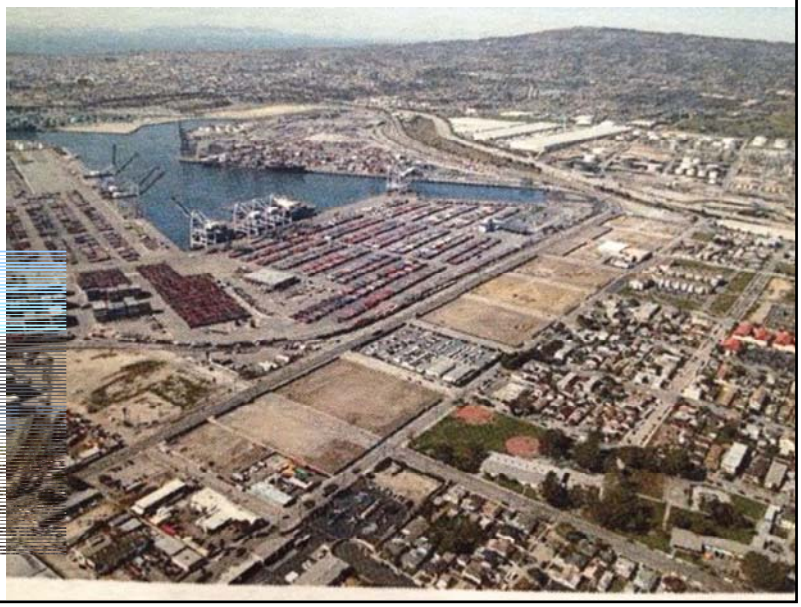
Tour of Area & Tabletop Training Exercise

Port of LA



Day 15

- A storage tank at a local oil refinery has caught fire resulting in a large plume of smoke and leakage into the coastal waters
- Local hospital ED's and poison centers are experiencing increased complaints of respiratory, gastrointestinal, and neurologic symptoms
- Refinery workers and clean-up workers experience similar symptoms

NIH **ASPR** **CDC** **IOM**

Disaster Research Response Workshop: June, 2014*

Enabling Public Health Research During Disasters

- **Build a broader network**
- **Frame a national research agenda & action items**
- **Integrate research into existing response structures**
- **Identify critical research needs & priorities**
- **Identify obstacles & barriers to research**
- **Discuss structures & strategies needed for deployment**
- **Share ideas, innovations, technology to support research**
- **Explore data collection tools & sharing mechanisms**

**IOM Report available by November 2014*

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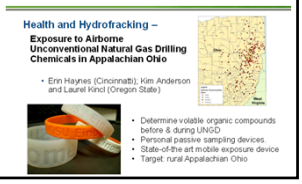
NIEHS Disaster Research Response Looking Forward

1. Build on DR2 Repository & NLM Website, Training, & Integration
2. RAPIDD Protocol for health data collection (IRB & OMB approvals / issues)
3. Expand "EHS Network" & collaborations with federal, state, academia, & communities
4. Exercises to further test research response strategies, protocols, field-implementation, and training.

5. **Rapid collection of environmental data to go with health data!**
   - Explore role of new technologies, social media, & "citizen science" in research



National Institute of Environmental Health Sciences
Your Environment. Your Health.

THANK YOU!
QUESTIONS?

For more information contact: CAPT Aubrey Miller, MD, MPH
miller.aubrey@nih.gov

Or email the DR2 Staff at:
dr2@niehs.nih.gov

Project Webpage
http://disasterinfo.nlm.nih.gov/dimrc/dr2/disasterresearch.html

NOAA's National Climatic Data Center

World's Largest Archive of Climate and Weather Data

Presented to: Coastal Environmental Disasters Data Management Workshop
September 16, 2014

Stephen Del Greco
Deputy Chief, Climate Services and Monitoring Branch

Protecting the past... Revealing the future

NCDC Strategic Vision

MISSION

Steward the Nation's Climate Information

NCDC is responsible for preserving, monitoring, assessing, and providing public access to the Nation's treasure of climate and historical weather data and information.

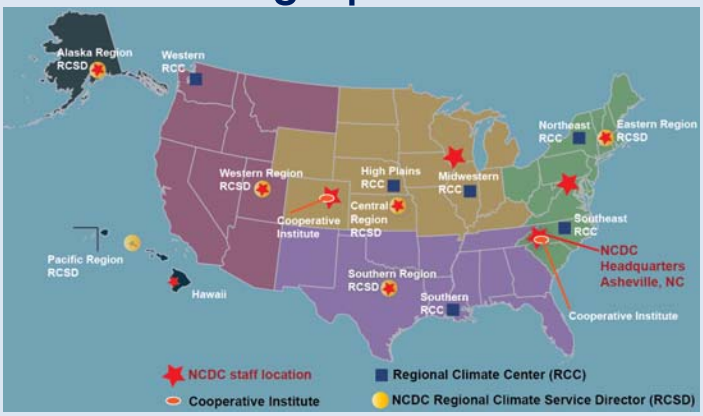
VISION

Be the Nation's Trusted Authority on Climate and Historical Weather Information

NCDC will be the most comprehensive, accessible, and trusted source of state-of-the-art climate and historical weather data, information, and climate monitoring.

2

NCDC Geographic Locations



- **160 Federal Employees**
  - Alaska, Colorado, Hawaii, Maryland, Missouri, New York, North Carolina, Texas, Washington, Wisconsin
- **153 NCDC Headquarter Contractors**
- **6 Regional Climate Centers**
- **2 Cooperative Institutes**

3

Rising Demand for Climate Information

Sustainability of Marine Ecosystems

Coasts and Climate Resilience

Climate Impacts on Water Resources

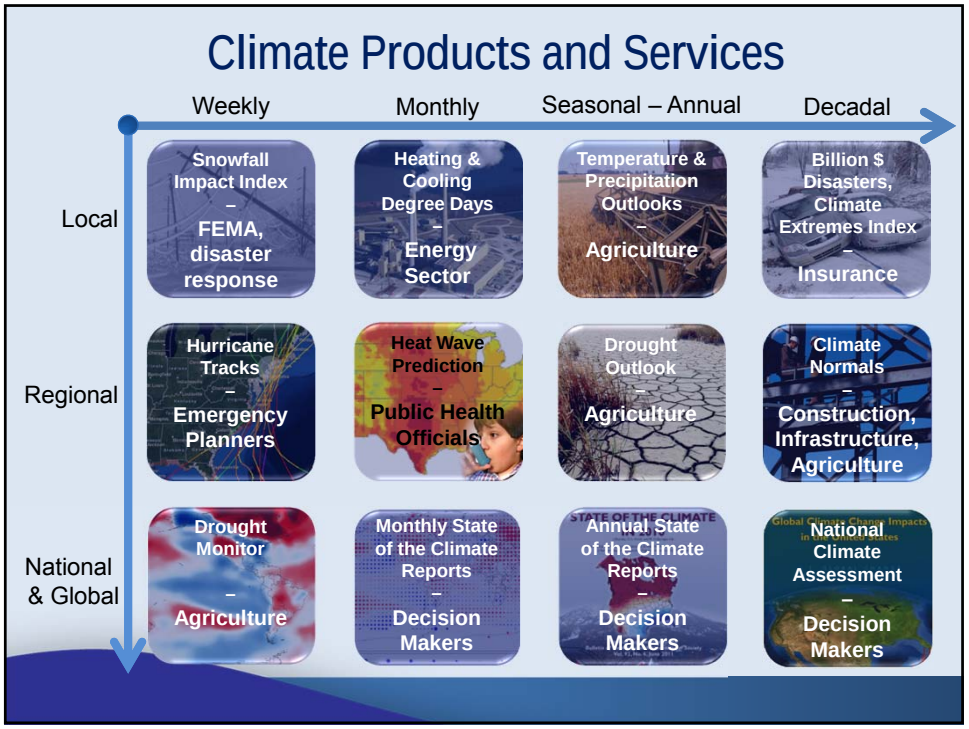
Changes in Extremes of Weather and Climate

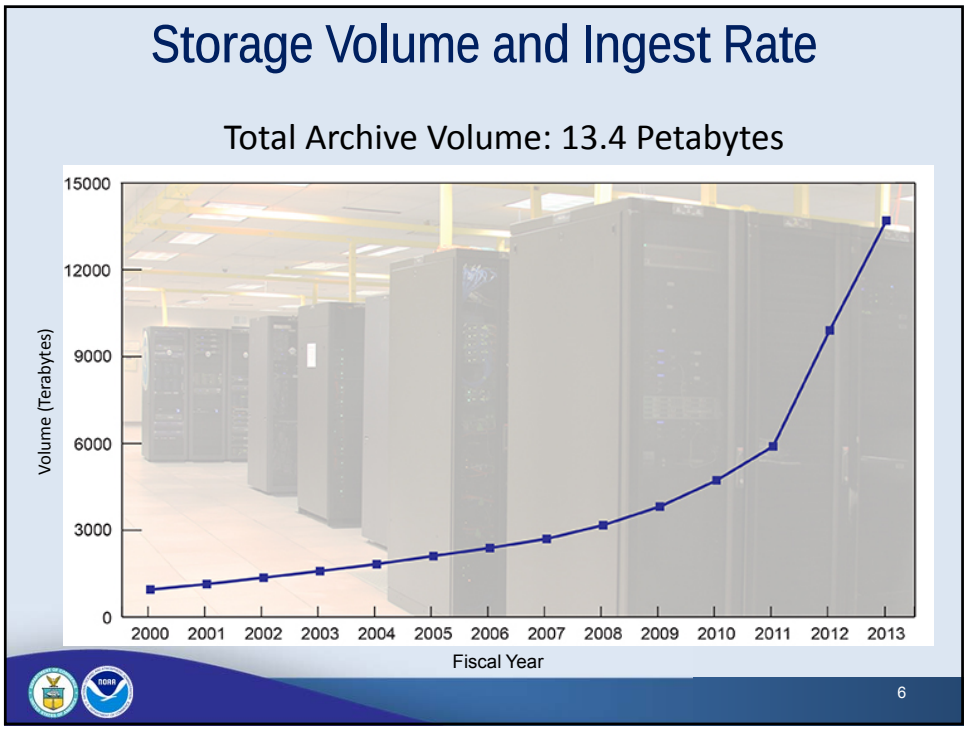
Agriculture

Energy

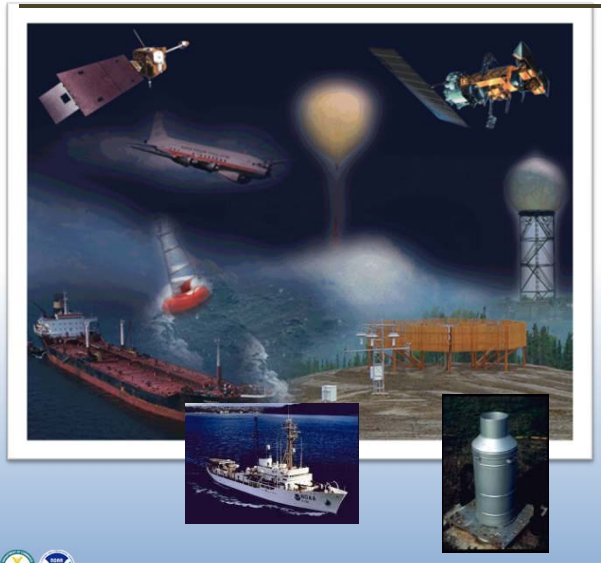
Health

Transportation


Climate Products and Services
Weekly
Monthly
Seasonal – Annual
Decadal
Local
Regional
National & Global
Snowfall Impact Index – FEMA, disaster response
Heating & Cooling Degree Days – Energy Sector
Temperature & Precipitation Outlooks – Agriculture
Billion $ Disasters, Climate Extremes Index – Insurance
Hurricane Tracks – Emergency Planners
Heat Wave Prediction – Public Health Officials
Drought Outlook – Agriculture
Climate Normals – Construction, Infrastructure, Agriculture
Drought Monitor – Agriculture
Monthly State of the Climate Reports – Decision Makers
Annual State of the Climate Reports – Decision Makers
National Climate Assessment – Decision Makers


Storage Volume and Ingest Rate
Total Archive Volume: 13.4 Petabytes
Volume (Terabytes)
15000
12000
9000
6000
3000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Fiscal Year
6

NCDC Access to Data Received from Many Sources



Voluntary U.S. Observers
Global Weather Reports
NCEP Weather Charts & Models
Ship, Buoy Reports
Rocketsonde
Weather Balloons
Storm Data
Doppler Radar
(GOES, POES, NPOESS, and many other Satellites
Aircraft Observations
Wind Profiler
Airport Weather Reports (ASOS)
U.S. Climate Reference Network
Climate Models
Paleoclimate Data

7

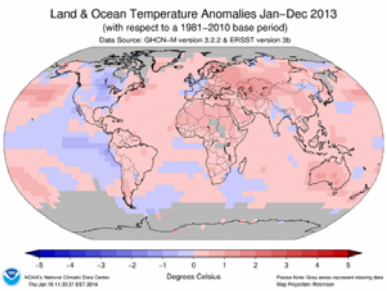
NCDC Homepage/Website

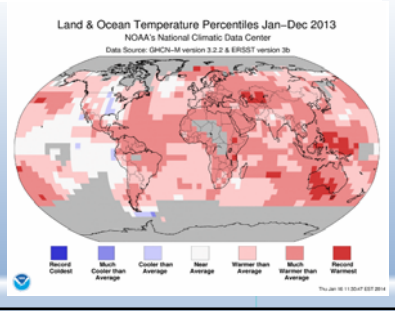
- www.ncdc.noaa.gov
- New site design implemented in 2012 with continued enhancements since then
- Provides access to NCDC datasets, products, and services
- NCDC's regional partners are also featured
- Data are accessed from disk (Storage Area Network) and tape (robotics system)
- Google Analytics used to provide usage statistics and patterns
- Drupal Content Management System provides the website content infrastructure
- Contact information is provided so that customers can call or email as needed

8

Monitor and Describe the Climate

- http://www.ncdc.noaa.gov/climate-information
- Numerous monitoring products at the US and global levels
- Products related to extreme events, hurricanes, tornadoes, etc
- Temperature and precipitation data monitored in detail, regarding climate variability and change





9

Data Access Portals

NOAA Climate.gov Portal, Drought Portal, Model Portal

- www.climate.gov, www.drought.gov, nomads.ncdc.noaa.gov
- Ongoing development and integrated to provide one-stop access to widely distributed datasets, products, services
- Drought Portal geared toward providing critical information to decision-makers
- Climate.gov Portal designed to reach a very wide segment of users – scientists, businesses, decision/policy-makers, news media, public, etc
- Model Portal provides access to reanalyses and numerical model output
- Many partners involved across NOAA, other agencies, and at the regional/state level

10

Data Access – International Partnerships

Global Observing Systems Information Center, World Data Centers for Meteorology and Paleoclimatology

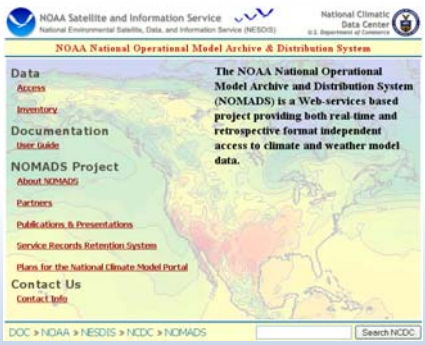
- http://gosic.org/, http://www.ncdc.noaa.gov/customer-support/world-data-centers
- GOSIC Portal and the World Data Centers for Meteorology and Paleoclimatology are hosted by NCDC
- GOSIC Portal provides one-stop access to data and information identified by the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS) and the Global Terrestrial Observing System (GTOS) and their partner programs
- The World Data Centers are a component of a global network of sub-centers that acquire, catalog, archive, and facilitate international exchange of scientific data without restriction

11

Data Access

Access to Model Data
Climate Forecast System Reanalyses (CFSR)

- 350 TBs of CFSR data now accessible online via NOMADS, along with other model data
- 60-80 TBs per month of model data downloaded
- Data volumes continue to grow as data are ingested from NCEP
- Access provided via OPeNDAP/HTTP/FTP/GridFTP
- Accommodates user's most requested data by sub-setting long time series
- Fosters research within geo-science communities (ocean, weather, and climate)



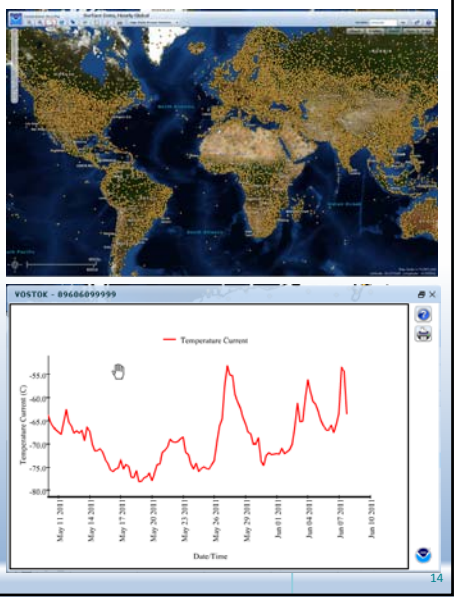
12

Data Access
Climate Data Online (CDO) System

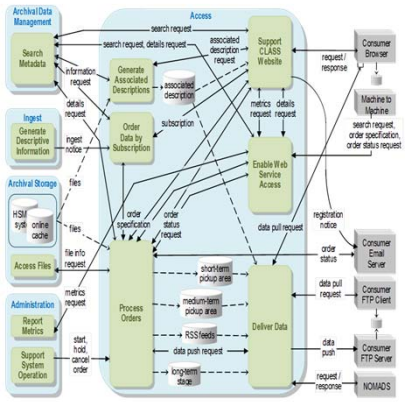
- Centralized access to numerous US and global datasets and products
- Web Services allow users direct machine-to-machine access for use in applications
- "Batch" process allows users to submit orders for data (eg, by station, state, country, etc), then receive email with link to the data
- Underlying structure includes Oracle databases with tiered server infrastructure
- Services continue to be built-out for additional datasets and products

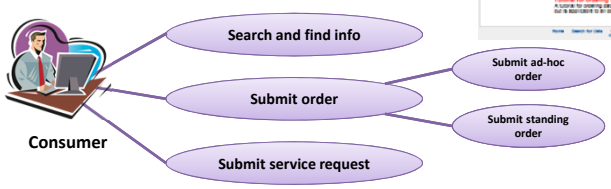
Data Access
Map/Web Services and Data Visualization

- GIS Map Services provide centralized access to numerous US and global datasets and products
- Web Services such as WMS, WFS, KML/KMZ (for Google Earth, etc)
- Access to the data and metadata, including machine to machine access
- Data visualization via tools such as *Multigraph* provide graphical display of various parameters
- Services continue to be built-out for additional datasets and products



CLASS *Data Access*





The CLASS Website

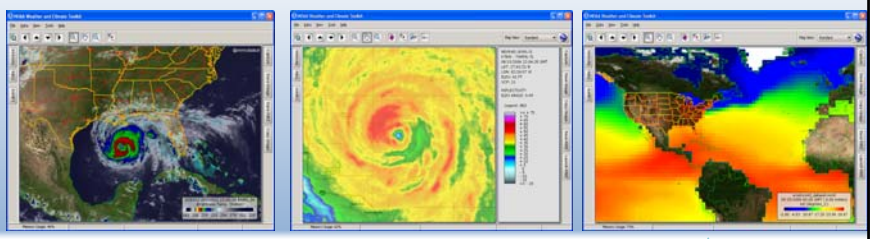
- CLASS Website
  - The CLASS Web Interface provides users with access to CLASS information holdings.
  - Displays the CLASS welcome page and help pages
  - Manages user login
  - Maintains each user's contact information and preferences for searching and ordering
  - Receives users' requests for information
  - Obtains requested information from other functions (e.g. browse images from Generate Associated Descriptions, result sets from the Data Management, metrics reports from Administration)
  - Maintains result sets and shopping carts for users
  - Forwards order specifications to the Process Orders function
  - HTML pages generate requested information, and return responses to users
  - Software components: Cocoon, Tomcat, HTTPD

www.class.noaa.gov

16

Data Access
Weather and Climate Toolkit

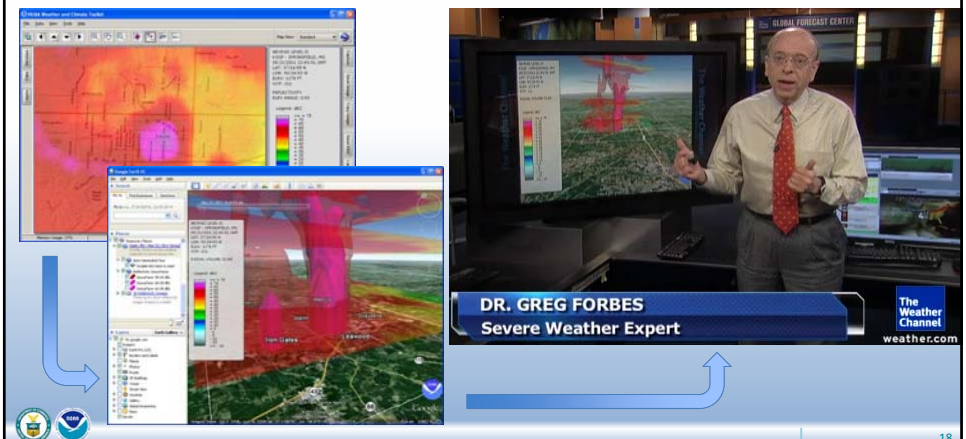
- Desktop application providing simple visualization and data export of weather and climate data
- Supports 22 data formats (Model, Satellite and Radar)
- Based on community developed tools and standards
- Data interoperability with diverse user communities
- Export data to GIS, KMZ, NetCDF and text formats



17

Data Access
Interoperability with Google Earth

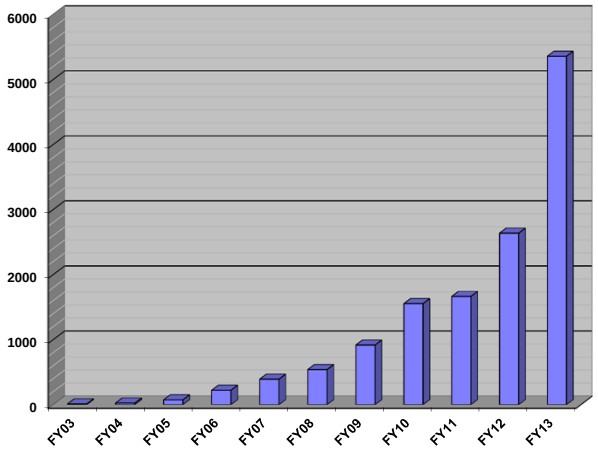
- Weather and Climate Toolkit export of 3D Radar sweeps and isosurfaces for Google Earth visualization



18

Data Access

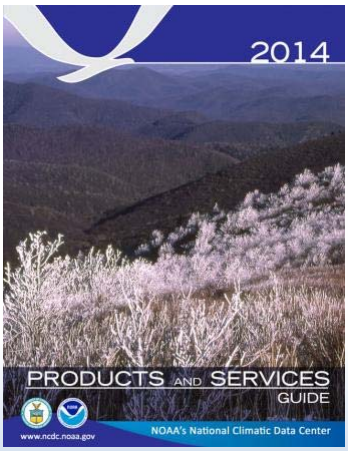
NOAA National Data Centers – Annual Data Downloaded in Terabytes



19

2014 Products and Services Guide Available Online

NCDC offers a wide range of products and services. Our users range from large engineering firms designing the latest in safe energy efficient structures to the attorney documenting a weather event to the individual planning for a retirement move to universities and government agencies engaged in climate research.
Services offered include data resource consultations, publications, copies of original records, certifications, and a wide range of online datasets, products, and reports. Services are delivered on a variety of media including online access, CD-ROM, DVD, computer tabulations, maps, and publications.
The NCDC 2014 Products and Services Guide provides a good overview of everything we have to offer. A free PDF copy of the guide is available on the NCDC website. Free hard copies of the guide are also available for order via the Online Store.



20

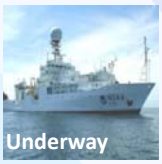
OCEANOGRAPHIC DATA MANAGEMENT

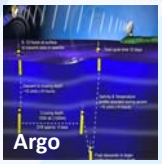
Presented to:

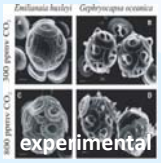
Environmental Disaster Data Management Meeting

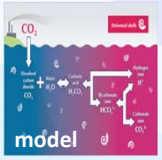
Russ Beard
Director, National Coastal Data Development Center
Interim Science Coordinator, Gulf Restoration Council
September 16, 2014

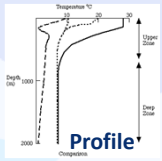
NODC Stewards a Variety of Data











NODC manages the world's largest collection of publicly available *in situ* and remotely sensed physical, chemical, and biological oceanographic data.

How is NODC's Data being used?

Success of data management is judged by its usefulness to current and future users.

Key focus of the National Coastal Data Development Center

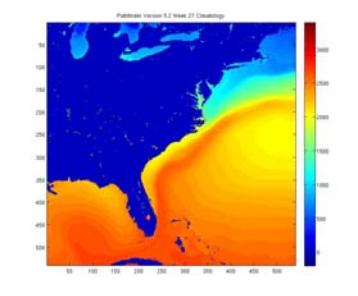
Comprehensive end-to-end data management for the coastal environment

- Gulf of Mexico Data Atlas
- Metadata development (semantic search and ontologies)
- Data discovery, mining, access, transport, archive, entry tools, and collaborative web tools
- Liaison Officers / Regional Approach
- Wide constituent base, customer service and user outreach
- Biological data considerations
- Geospatial enablement and visualization, e.g., ARC GIS and Google map
- Data integration, fusion and partnerships

Global Data Sets: satellite and in situ data

NODC AVHRR Pathfinder Version 5.2 SST Climate Data Record

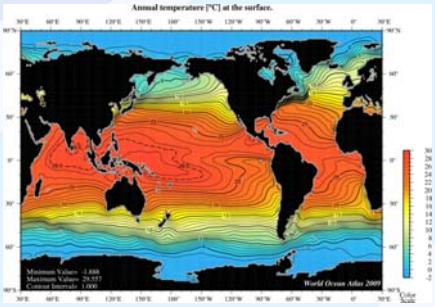
Provides the longest (1981-2012), most accurate, and highest resolution consistently-reprocessed SST *climate data record* from the AVHRR sensor series



World Ocean Database and World Ocean Atlas

New Version

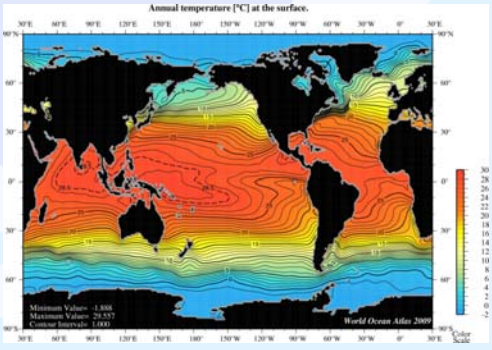
Quality controlled comprehensive data collection and global *in situ* climatologies of temperature, salinity, dissolved oxygen, AOU, nutrients.



World Ocean Atlas 2013

World Ocean Atlas (WOA) is a set of objectively analyzed (1 degree grid) climatological fields at standard depth levels of *in situ*:

- Temperature
- Salinity
- Dissolved Oxygen
- Apparent Oxygen Utilization
- Percent Oxygen Saturation
- Phosphate
- Silicate
- Nitrate

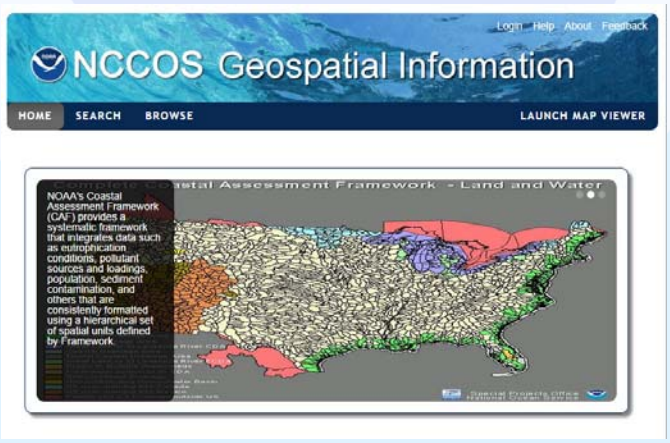


It also includes associated statistical fields of observed oceanographic profile data interpolated to standard depth levels on 5°, 1°, and 0.25° grids.

The **World Ocean Atlas 2013** (WOA) was created from the quality controlled data of the **World Ocean Database 2013** (WOD)

www.nodc.noaa.gov/OC5/woa13/

Data Discovery and Access



The National Centers for Coastal Ocean Science (NCCOS) provides coastal managers the information and tools they need to balance society's environmental, social, and economic goals. This **geoportal** provides an interface in which to discover and access the NCCOS data inventory.

NOAA Gulf of Mexico Data Atlas

Digital Discovery & Access to Gulf Data

gulfatlas.noaa.gov

Over 235 map plates in 70 subject areas, from over 30 federal, state, non-governmental and academic partnerships.

Based on the traditional atlas format, the Gulf of Mexico Data Atlas is a data discovery and data access tool that allows a wide range of users to browse through a growing collection of datasets visualized as map plates. The goal of the Atlas is to provide access to datasets that characterize baseline conditions of Gulf of Mexico ecosystems in order to assist long-term research, monitoring, and restoration programs.

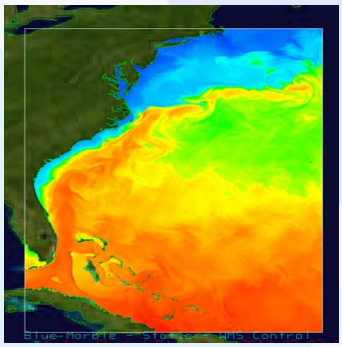
- Metadata, Web Mapping Services and Data Download and Access Links
- Access Representational State Transfer (REST) Services

Additional Federal and State fisheries-independent species

Federal fisheries-dependent catch for shrimp

Hypoxia 10-year frequency of occurrence with animated annual-mean contour maps

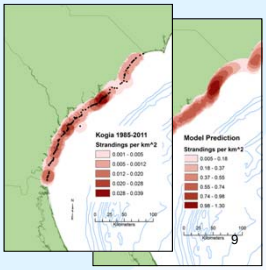
NODC's OceanNOMADS node supports NOAA research on marine ecosystems



- Data from operational, data-assimilating ocean models provides 4-D ocean state estimates
- Web tools simplify task of accessing model data in useful formats
- NODC staff working with NOAA and academic scientists on (FY 12-13):
  - Oceanographic input for whole-ecosystem models
  - Marine habitat models
  - Larval transport
  - Marine mammal ecology

Atlantis ecosystem model for Gulf of Mexico (Univ. of South Florida)

ASA Inc. / NMFS larval tracking application



NCCOC/NCDDC whale stranding study

9

QUESTIONS?

DIVER Data Warehouse and Query Tools: Samples & Contaminant Chemistry Focus

Environmental Disasters Data Workshop

September 16-17

Ben Shorr
NOAA's Office of Response and Restoration

Overview

Discuss "Data Warehouse" approach

Actual framework and processes; flexible and scalable

Common Data Models

Overview of data models and standards; focus on samples and chemistry and related information/data

Data Query and Delivery

Requirements that drive development of data discovery, query, reporting and export tools

Data Warehouse and Business Intelligence

Data Warehousing concept and reality

- **Default** to existing tools and processes; databases and data sources with faults and inefficiencies
- The earlier field collected and lab processed data streams are integrated, the better connections and management. **UP FRONT EFFORT** pays big dividends
- **Data Warehouse and Data Vaulting*** concepts
  - Ideally combine ***data*** beyond high level metadata
- **Business (Environmental) Intelligence**

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Data Warehouse and Business Intelligence

- Use Industry standard tools
  - Collect and manage structured and unstructured information
- DWH Damage Assessment managing data with an Agile development approach
  - Evolve to meet data and development needs
  - Frequent brief video conference enhances accountability; minimizes silos; creates “team”

Data Warehouse and Business Intelligence

- Common Data Models – flexible and scalable
  - Core fields across datasets
  - Collect all digital possible (structured and unstructured) with key connections and hierarchy
  - ETL (Extract, Transform, Load)

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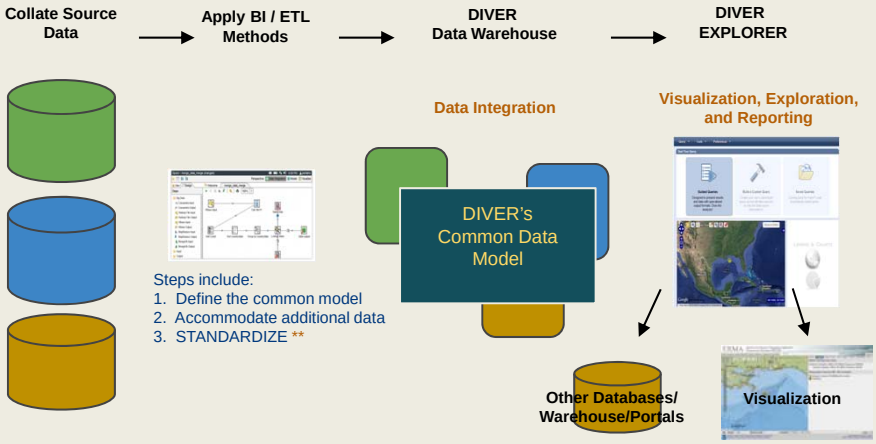
Data Warehouse and Business Intelligence



Our Approach: Promoting Common Data Models

Common Data Model Examples (schemas)

- **Samples:** chemistry, biological+
- **Oceanographic:** cruise-collected sensor data
- **Observations:** shoreline, marsh, birds and mammals
- **Telemetry:** whales, dolphins, turtles, tuna
- **Photography:** keywords
- **Restoration data:** potential and implemented; budget and activities

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Common Data Model Examples (schemas)

- **Core Fields**

  Higher level across data models e.g. Analysis Type, Data Source, Status, Spatial

- **Data Specific**

  Results, Methodology, Units

- **Related Information**

  raw data, field information, source data packages, unstructured documents (reports, graphs, charts etc…)

Common Data Model: Contaminant Chemistry

Samples

- Used existing data standard and data processing (Query Manager) for contaminant chemistry
- Electronic Data Deliverables (lab templates)
- Work with data providers (owners)
- Use existing standards and nomenclature; expand and standardize when necessary
- Metadata, metadata, metadata

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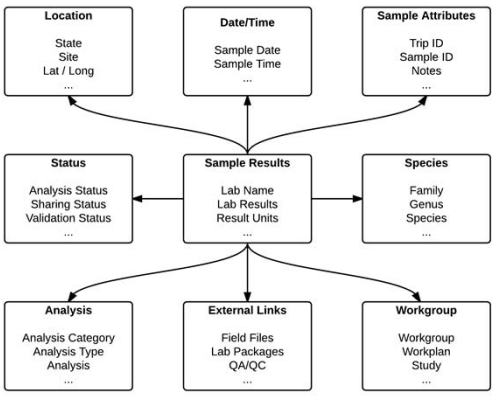
Common Data Model: Contaminant Chemistry

- Ingest into Data Warehouse
  - Contaminant chemistry source databases include:
    - **Historical Contaminant Chemistry** (Query Manager)
    - **DWH Response** collected (EPA ETL → NOAA QA/QC)
    - **BP NRDA** provided
  - Audit source data and queries
  - Integrate with other data streams (e.g. additional field collection information, related field and lab documents and raw packages, "value added" analysis like oil source fingerprinting)

Common Data Model: Samples (Includes Contaminant Chemistry)

Conceptual View



Common Data Model: Samples (Includes Contaminant Chemistry)

Sample Fields			
Age (years)	Cruise Leg	Latin Name: Class	QM Reporting Standard
Analysis	Cruise Name	Latin Name: Family	QM Sample Details
Analysis Category	Data Category	Latin Name: Genus	QM Sample ID
Analysis Detail	Data Classification	Latin Name: Kingdom	QM Site ID
Analysis Method	Data Source	Latin Name: Order	QM Station ID
Analysis Result	Date	Latin Name: Phylum	QM Study ID
Analysis Result Unit	Day or Night Sample	Latin Name: Species	Qualifier Code
Analysis Status	Depth Category	Latin Name: Subphylum	Record ID
Analysis Type	Detection Extent	Length (cm)	Reporting Limit
Analyte Detection Details	Detection Limit	Link to Lab Data Files	Result
Case/Activity	DIVER Dataset	Location_Geom	Result (0.5 DL)
ChemCode	DV Qualifier Reason	LOSDMS Workplan ID	Result (0 DL)
Client ID	DV Qualifier Reason Code	Measurement Basis	Result (-1 * 0.5 DL)
COC ID	DV Qual Reason	MeasuresLevel	Result (-1 * Full ASA)
Collection Form	DV Qual Reason Code	Minutes of Hour	Result (-1 * Full DL)
Collection Matrix	End Latitude	Month	Result (Full DL)
Collection Method	End Longitude	Month (Numerical)	Result Notes
Collection Study Name	File Collection ID	Month Short	Result Type
Collection Workplan	Fingerprint Class	NRDA Grid	Review Status
Common Name: Class	Fingerprint Class Source	Number Below Detection Limit	Sample Delivery Group
Common Name: Family	Gulfspill Workplan Name	Number in Composite	Sample Depth Unit
Common Name: Genus	Habitat Type	Number Measured	Sample ID
Common Name: Kingdom	Hour of day	Oil Presence	Sample Lower Depth
Common Name: Order	Image Id	Oil Presence Screening Class	Sample Notes
Common Name: Phylum	Lab ID	Oil Presence Screening Source	Sample Size
Common Name: Species	Lab Name	Percent Lipid	Sample Size Units
Common Name: Subphylum	Lab Replicate	Photo URL - Midsize	Sample Type
Composite/Part Sample	Lab/Result Matrix	Photo URL - Original	Sample Upper Depth
Composite Sample ID	Lab/Result Matrix Detailed	Photo URL - Thumbnail	Sex
	Last Update Date	QM Matrix	Sharing Status
			Source Type
			Species
			Start Latitude
			Start Longitude
			Station/Site
			Survey Notes
			Tissue Code
			Tissue Type
			Total Organic Carbon (pct)
			Trip End Date
			Trip ID
			Trip Start Date
			Validation Level
			Weight (g)
			Workgroup
			Year

...Just a few favorite fields

DIVER (Data Integration Visualization Exporting and Reporting): Explorer Tool

- Objectives & Requirements
  - Flexible query and export of all data including NRDA collected and external datasets
  - Documented lineage and connections to data holdings
  - Metadata, Metadata, Metadata
  - Export for analysis, visualization and processing

13

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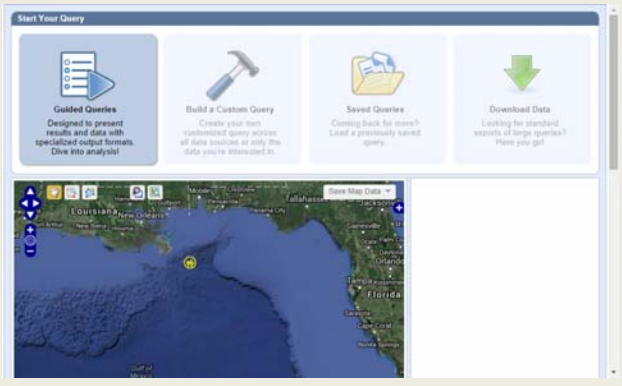
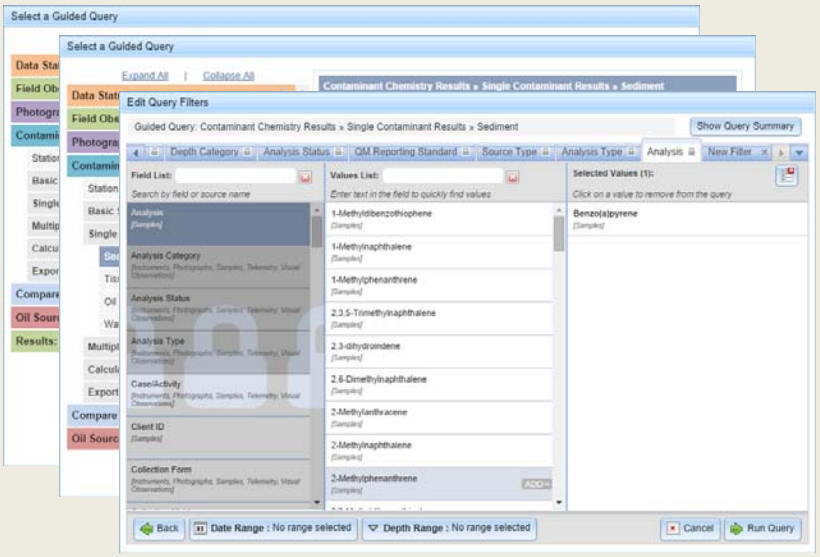
DIVER (Data Integration Visualization Exporting and Reporting): Explorer Tool

- Queries: Guided, Custom & Saved
- Download Data Packages
- Map & Legend
- Charts
- Data Tables
- Photos
- Metadata
- Study Notes
- Export

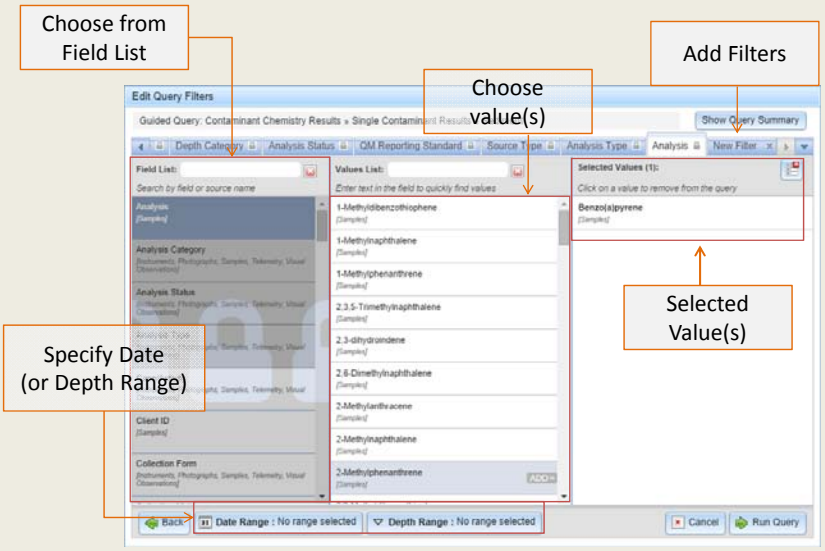


Guided Queries



15

Query Filters



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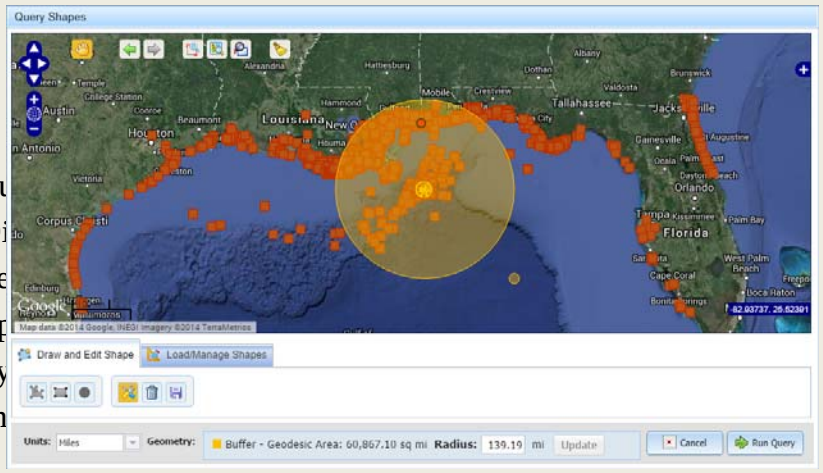

*NOAA's Environmental Response Management Application

17

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Query Results: Summary

18

Query Results (Table)

Requirements and Functionality:

- Present tabular results
- Integrated with map
  - Selected row highlighted in map
  - Select in map creates filtered table
- Link to source data files, related data and information (e.g. documents, photographs)

19

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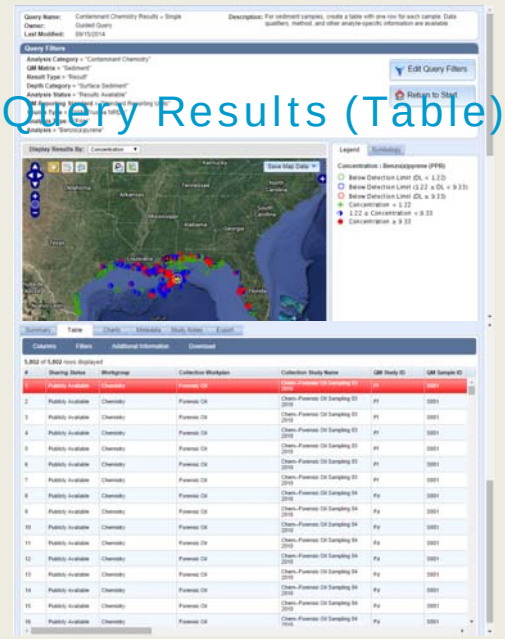
Query Results (Table)



20

Charts

Requirements and Functionality:

- Provide overview summary of query results
- Interactive - click on charts to show filtered data
- Flexible - built to handle new information

21

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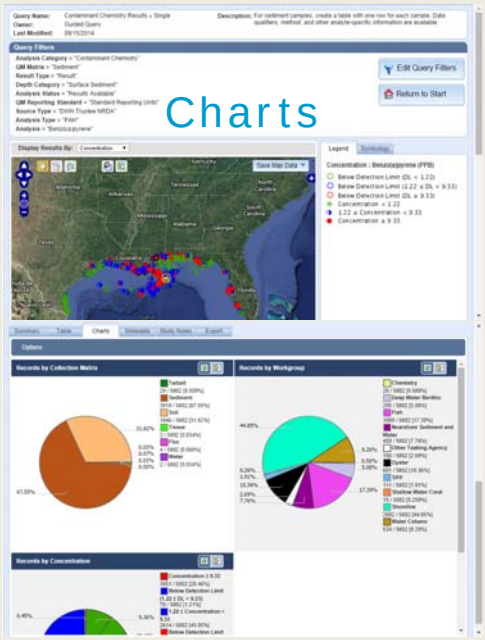
Charts



22

Export

Requirements and Functionality:

- Spreadsheet and GIS formats (CSV, Shapefile, KML)
- Include metadata and related study notes (contaminant chemistry
- Export results
- Export related data (additional fields and collection forms)

23

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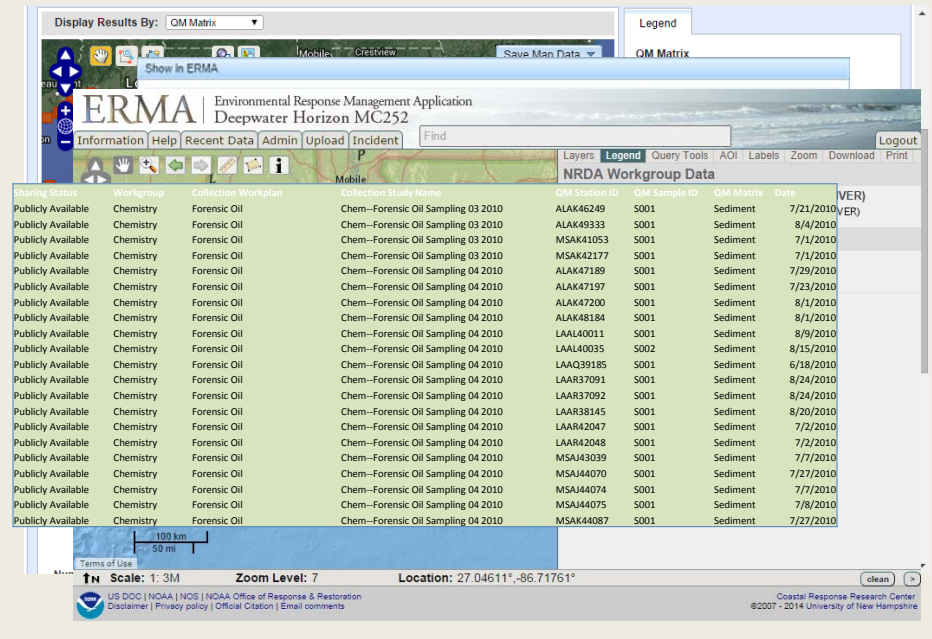

Metadata

Requirements and Functionality:

- "Lite" version with key information (HTML)
- FGDC compliant metadata (XML and HTML)
  - moving to ISO 19115
- Query Details: fields and values chosen
- Data Details: when were datasets updated?
- Data Caveats: notes about data
- Field Definitions

25

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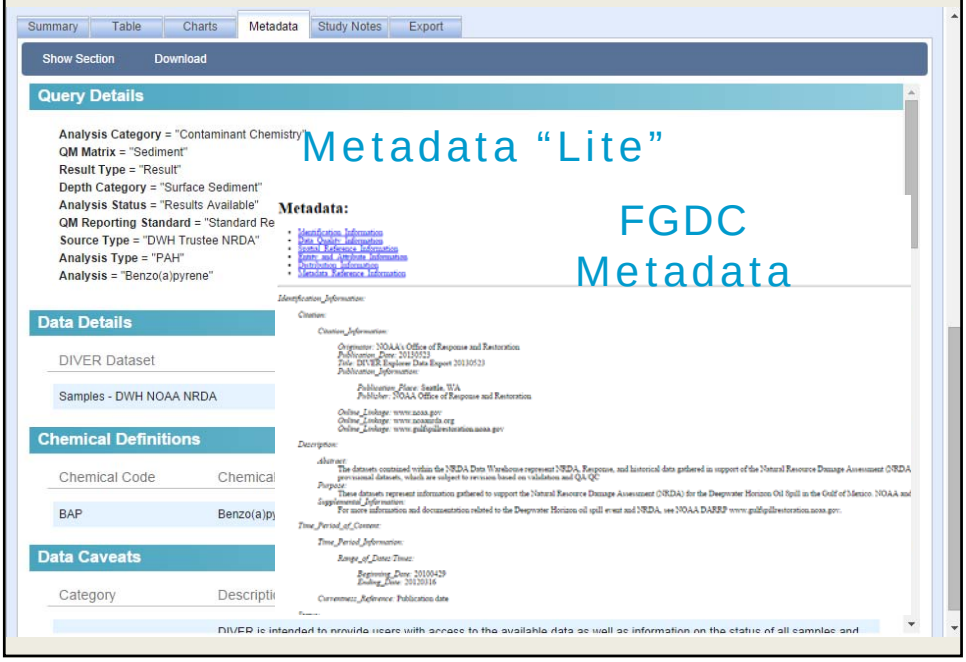
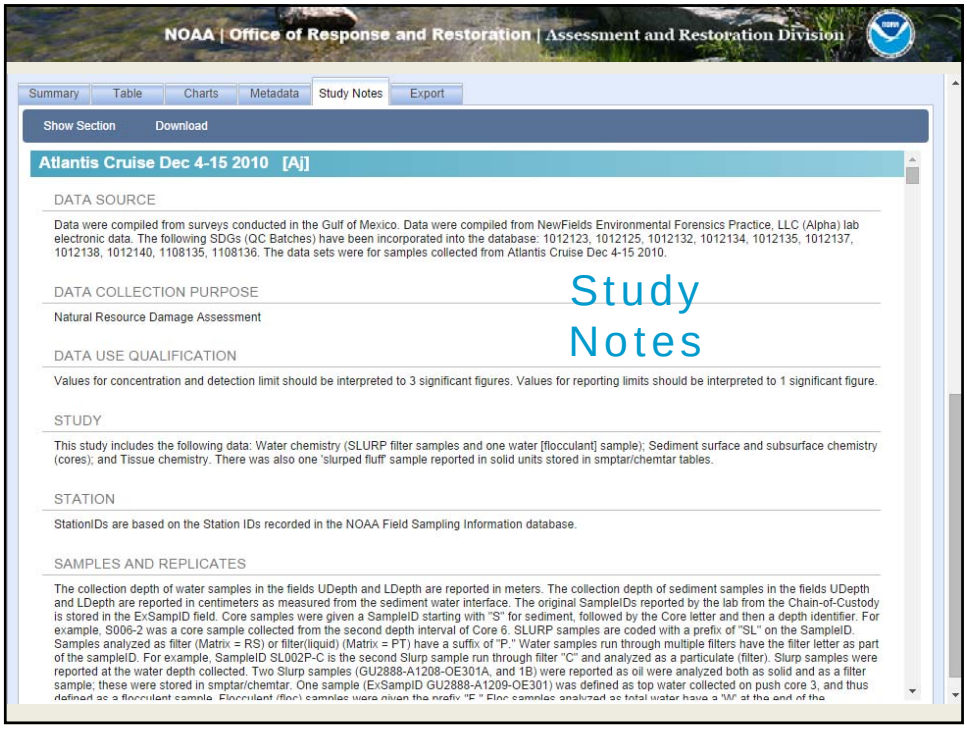
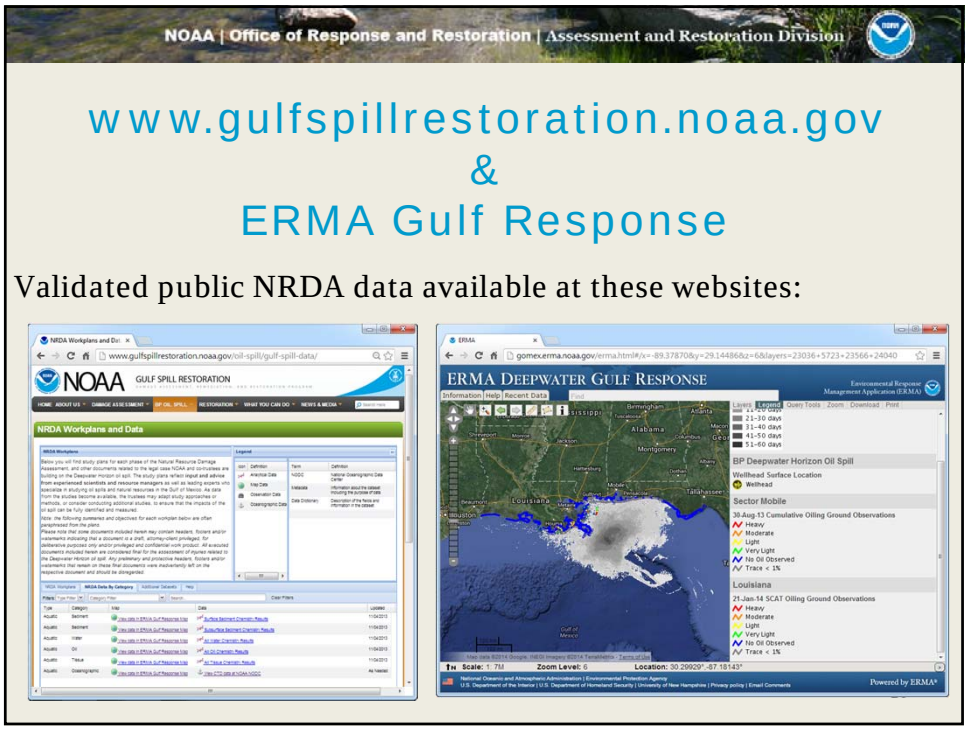


Metadata "Lite"

FGDC Metadata


NOAA | Office of Response and Restoration | Assessment and Restoration Division
Summary
Table
Charts
Metadata
Study Notes
Export
Show Section
Download
Atlantis Cruise Dec 4-15 2010 [Aj]
DATA SOURCE
Data were compiled from surveys conducted in the Gulf of Mexico. Data were compiled from NewFields Environmental Forensics Practice, LLC (Alpha) lab electronic data. The following SDGs (QC Batches) have been incorporated into the database: 1012123, 1012125, 1012132, 1012134, 1012135, 1012137, 1012138, 1012140, 1108135, 1108136. The data sets were for samples collected from Atlantis Cruise Dec 4-15 2010.
DATA COLLECTION PURPOSE
Natural Resource Damage Assessment
DATA USE QUALIFICATION
Values for concentration and detection limit should be interpreted to 3 significant figures. Values for reporting limits should be interpreted to 1 significant figure.
STUDY
This study includes the following data: Water chemistry (SLURP filter samples and one water [flocculant] sample); Sediment surface and subsurface chemistry (cores); and Tissue chemistry. There was also one 'slurped fluff' sample reported in solid units stored in smptar/chemtar tables.
STATION
StationIDs are based on the Station IDs recorded in the NOAA Field Sampling Information database.
SAMPLES AND REPLICATES
The collection depth of water samples in the fields UDepth and LDepth are reported in meters. The collection depth of sediment samples in the fields UDepth and LDepth are reported in centimeters as measured from the sediment water interface. The original SampleIDs reported by the lab from the Chain-of-Custody is stored in the ExSampID field. Core samples were given a SampleID starting with "S" for sediment, followed by the Core letter and then a depth identifier. For example, S006-2 was a core sample collected from the second depth interval of Core 6. SLURP samples are coded with a prefix of "SL" on the SampleID. Samples analyzed as filter (Matrix = RS) or filter(liquid) (Matrix = PT) have a suffix of "P." Water samples run through multiple filters have the filter letter as part of the sampleID. For example, SampleID SL002P-C is the second Slurp sample run through filter "C" and analyzed as a particulate (filter). Slurp samples were reported at the water depth collected. Two Slurp samples (GU2888-A1208-OE301A, and 1B) were reported as oil were analyzed both as solid and as a filter sample; these were stored in smptar/chemtar. One sample (ExSampID GU2888-A1209-OE301) was defined as top water collected on push core 3, and thus
Study Notes


NOAA | Office of Response and Restoration | Assessment and Restoration Division
www.gulfspillrestoration.noaa.gov
&
ERMA Gulf Response
Validated public NRDA data available at these websites:
NOAA GULF SPILL RESTORATION
NRDA Workplans and Data
ERMA DEEPWATER GULF RESPONSE
BP Deepwater Horizon Oil Spill
Wellhead Surface Location
Sector Mobile
Louisiana

Next Steps & Challenges

- More widely available DIVER tools
  - Gulf of Mexico and Great Lakes
- Enhanced data search functionality
- Create flexible & scalable national approach
  - Ability to ingest digital field collected data and unstructured infromation

Internet Security

Discussion? Happy Hour?

29

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Acknowledgements

DIVER Data Management Team: Mike Jackson, Dan Hudgens, Jim Anderton, Ann Jones, Amy Merten, Ben Shorr, Kevin Kirsch

NOAA: Amy Merten, Kevin Kirsch, Jay Coady

IEc: Kate Doiron, Ann Jones, Jess Fydenkevez, Lena Flannery, Neal Etre, Amy Anderton

Sirius Solutions: Vincent Luzzo, Nicole Williams, Brian Thompson

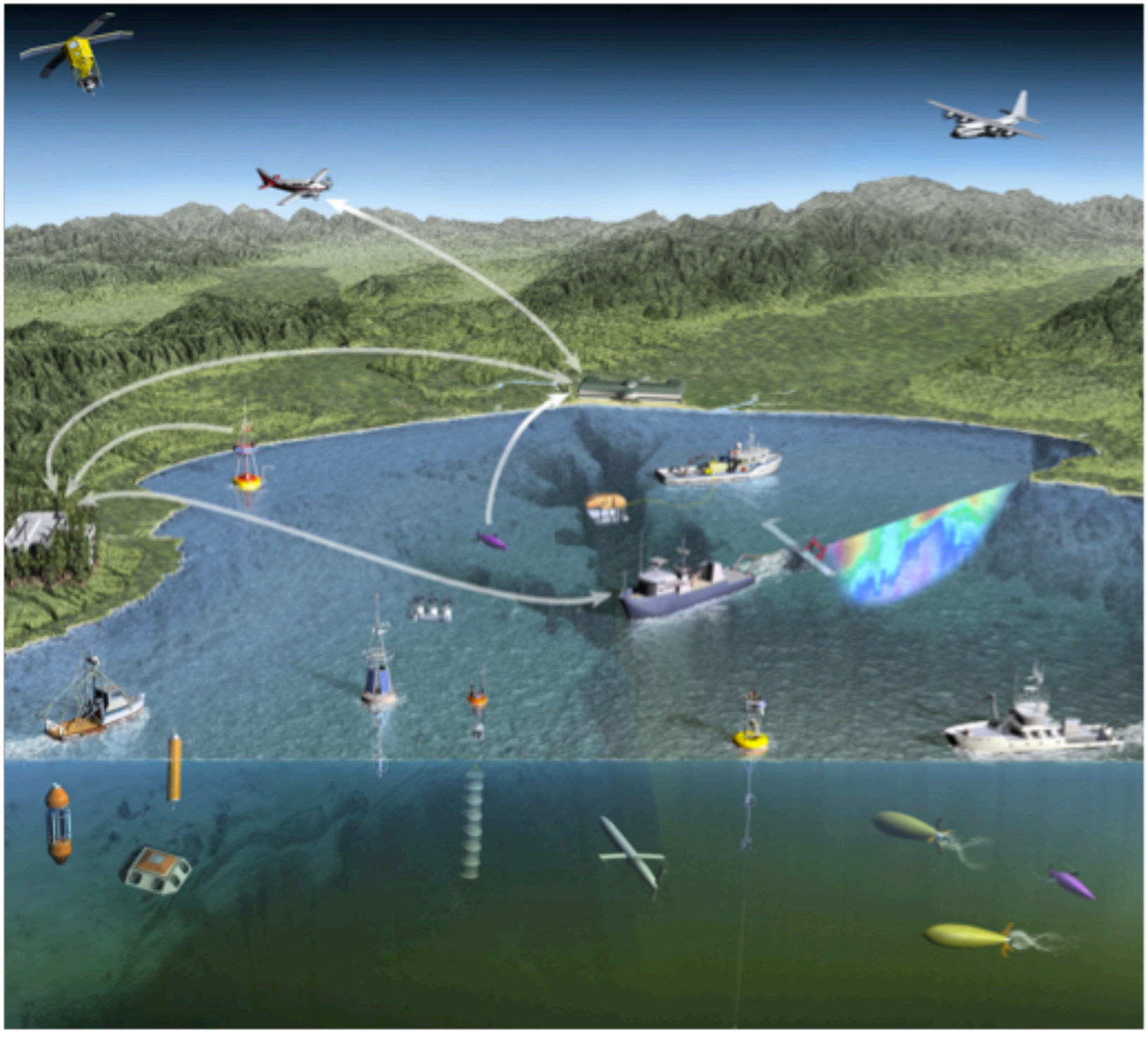
Ocean Sensor Data

Managing, Visualizing, and Understanding data using STOQS

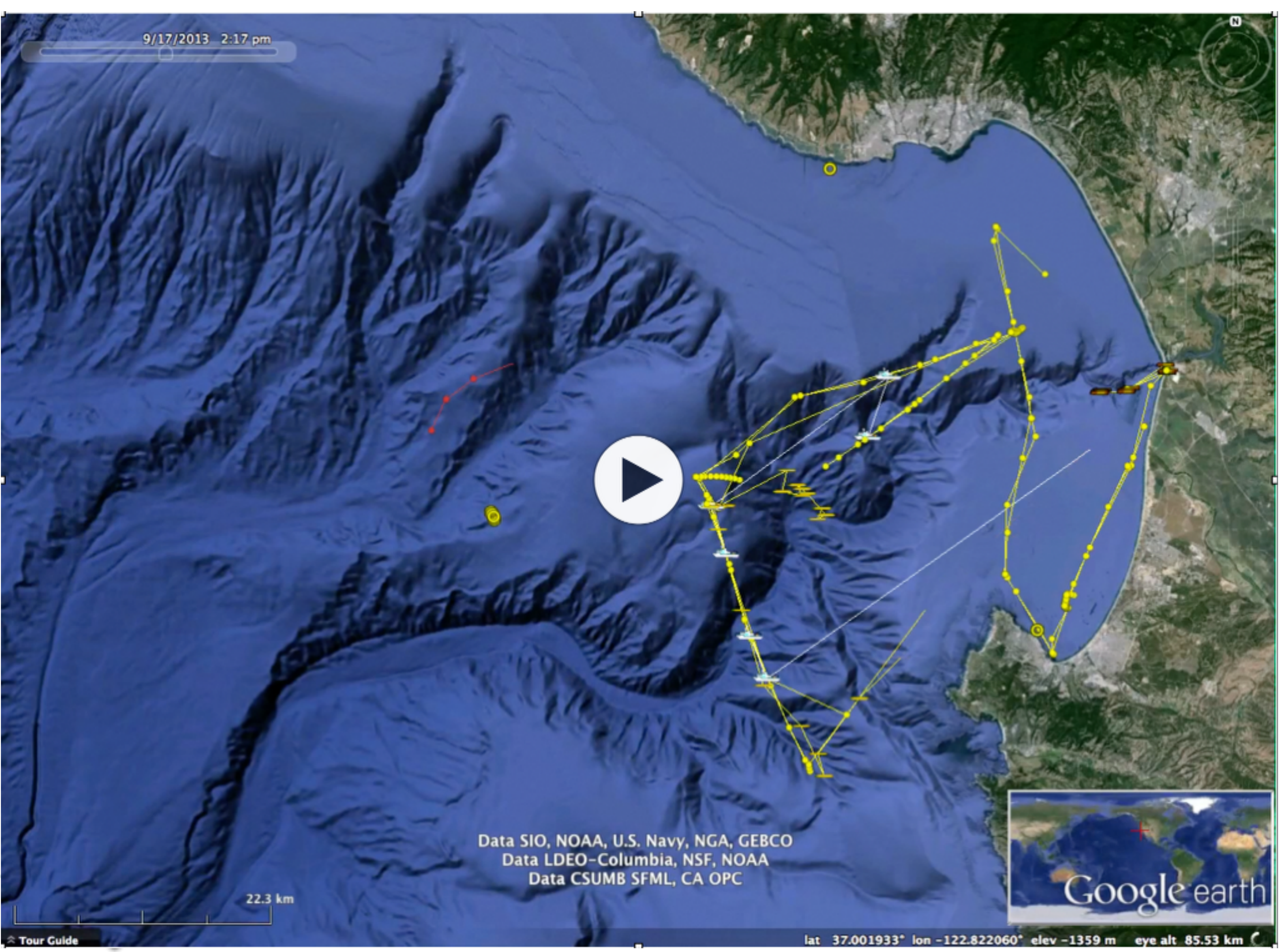
16-17 September 2014
Environmental Disasters Data Management Workshop

Mike McCann
Monterey Bay Aquarium Research Institute

Oceanographic Observations



M B A R I


9/17/2013 2:17 pm
N
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data LDEO-Columbia, NSF, NOAA
Data CSUMB SFML, CA OPC
22.3 km
Google earth
Tour Guide
lat 37.001933° lon -122.822060° elev -1359 m eye alt 85.53 km

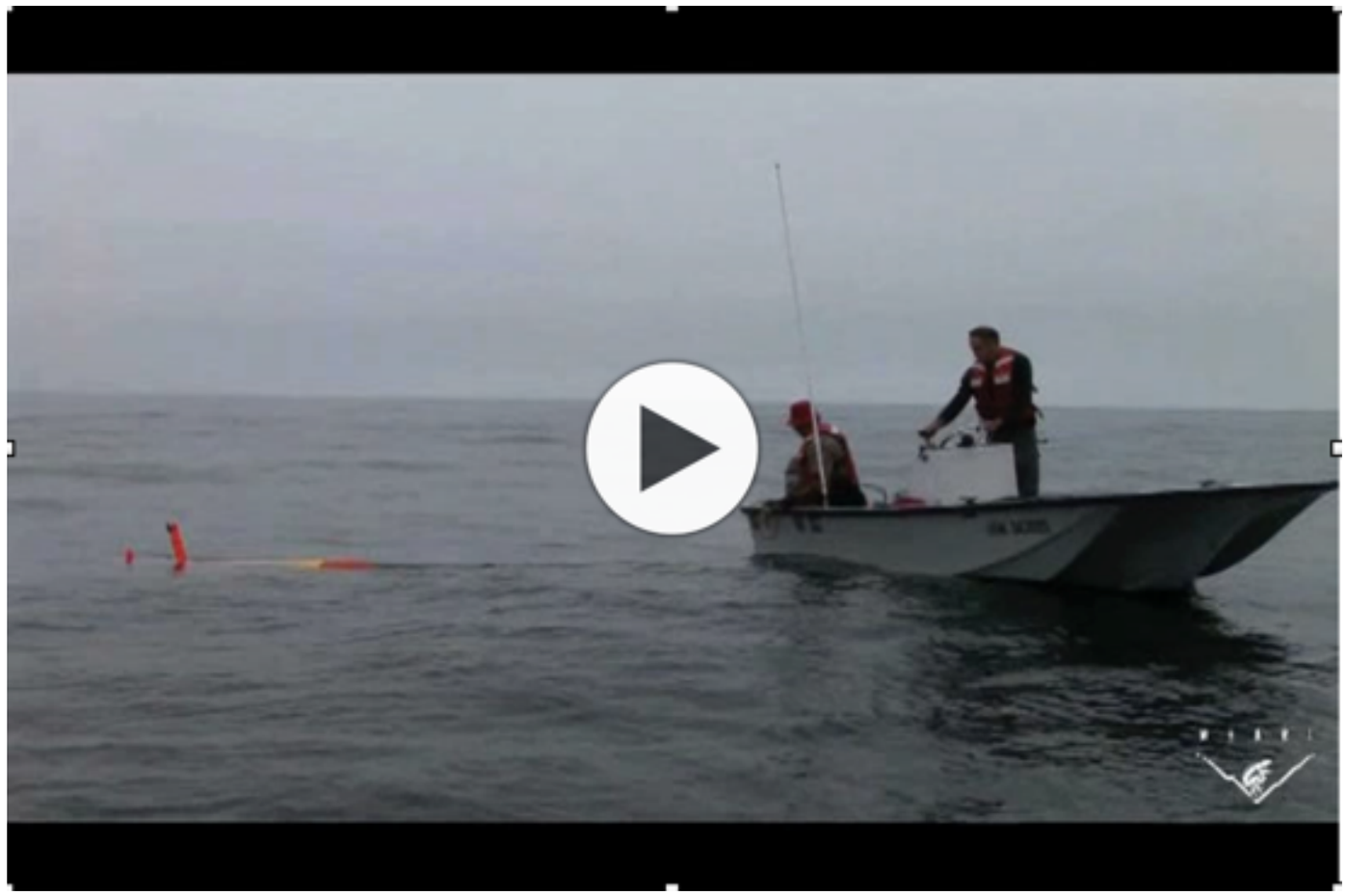
Long Range AUV

- Mobile platform measures properties while moving through the water

- Seabird CTD, Wetlabs ECO, ISUS, Optode, ESP, …

- T, S, optical backscatter, chlorophyll, fluorescence, DO, nitrate, genetics, …

- realtime and delayed mode



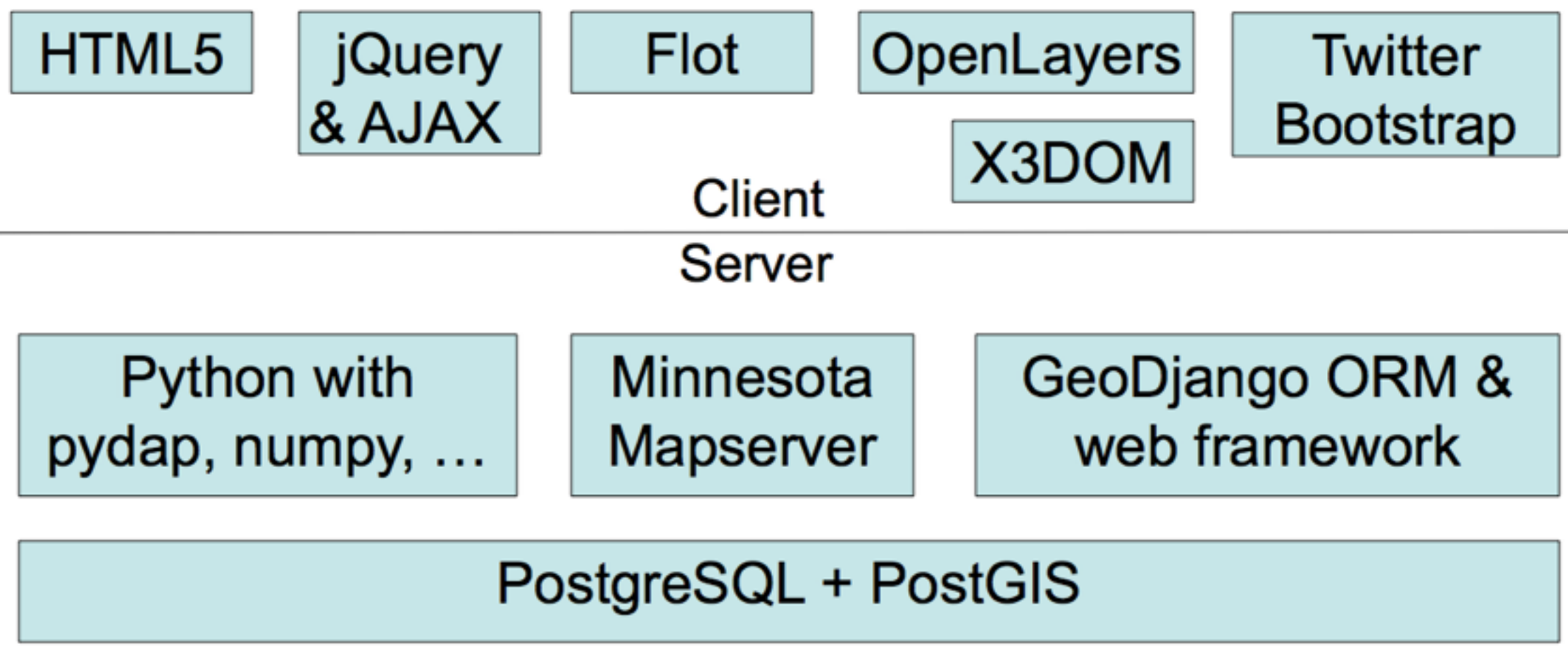
M B A R I

Workflow

1. Install STOQS from stoqs.googlecode.com
2. Conduct missions that collect data
3. Create CF-NetCDF 1.6 files of the data
4. Construct STOQS load script
5. Create PostgeSQL database and run script
6. Explore, visualize, and understand data

STOQS Architecture

All free and open source components



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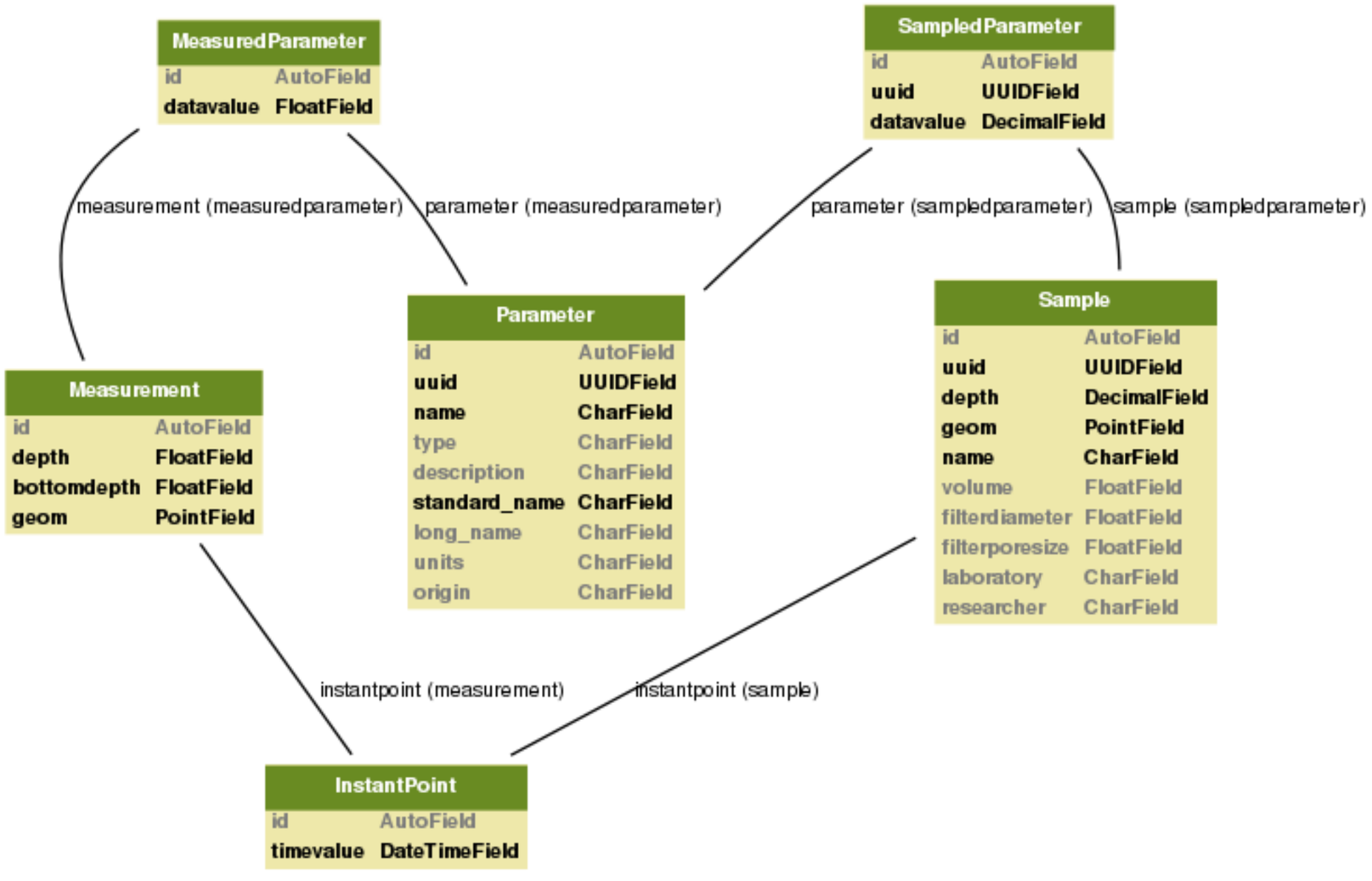
Relational Database



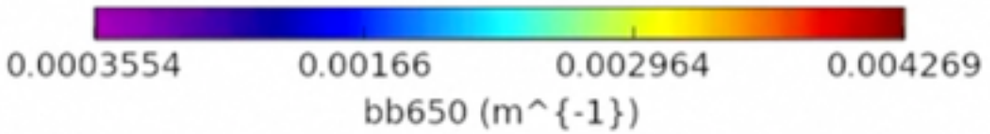
odss.mbari.org/canon/stoqs_september2013_o/query/

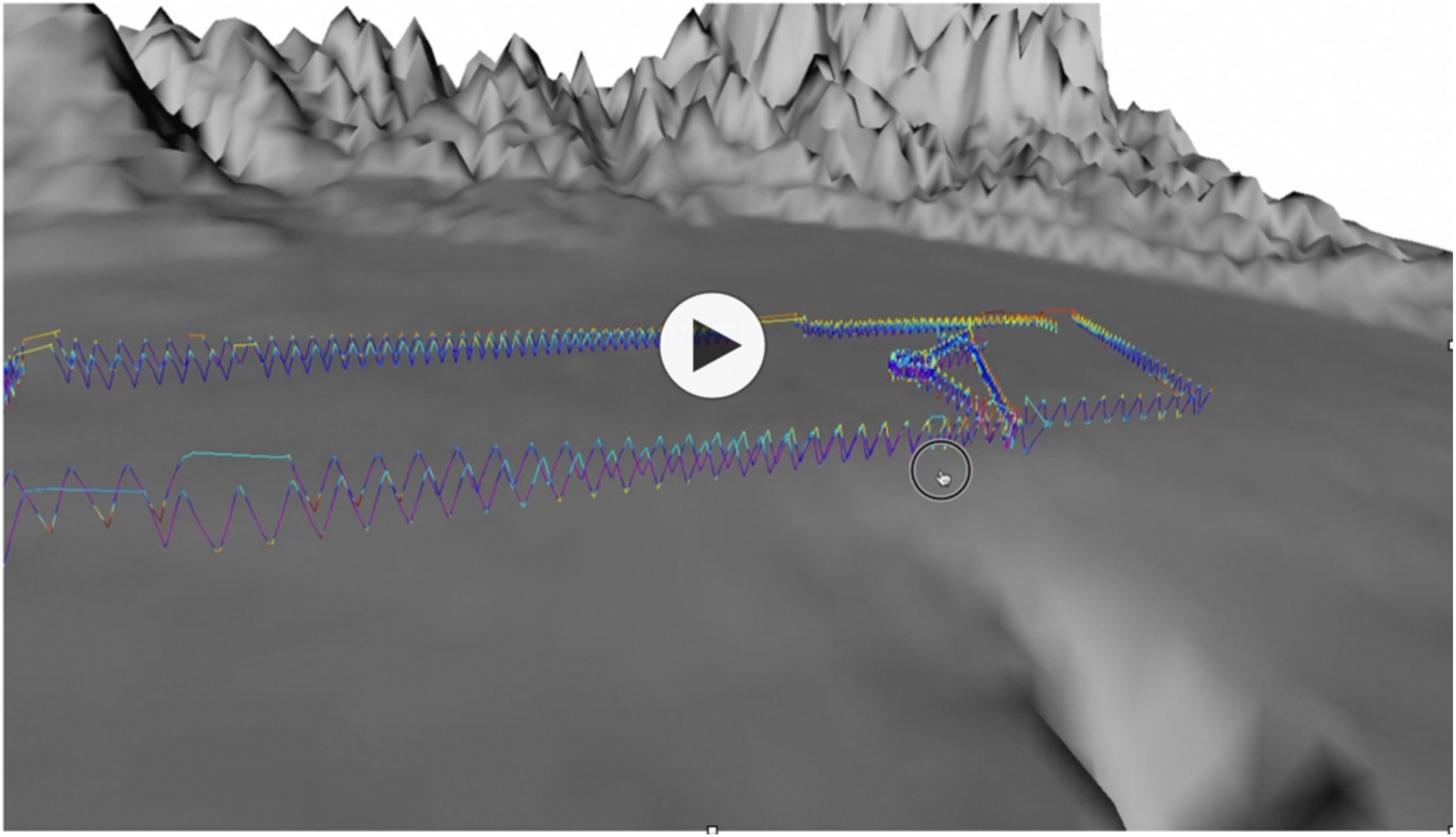
Rotate: Left mouse
Translate: Ctrl + left mouse
Zoom: Alt + left mouse
Recenter rotation: double click

Unzoom display

Reset view

bb650 from tethys





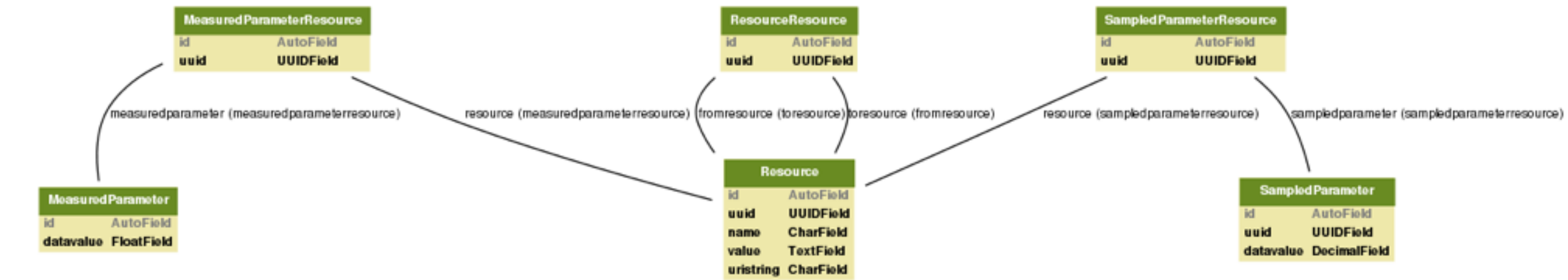
M B A R I

See video at stoqs.googlecode.com

Live Demo

Extra Slides

Tables to support machine learning



M B A R I

172.16.130.158:8000/stoqs_september2013_t/query/

stoqs_september2013_t Campaign list Share this view

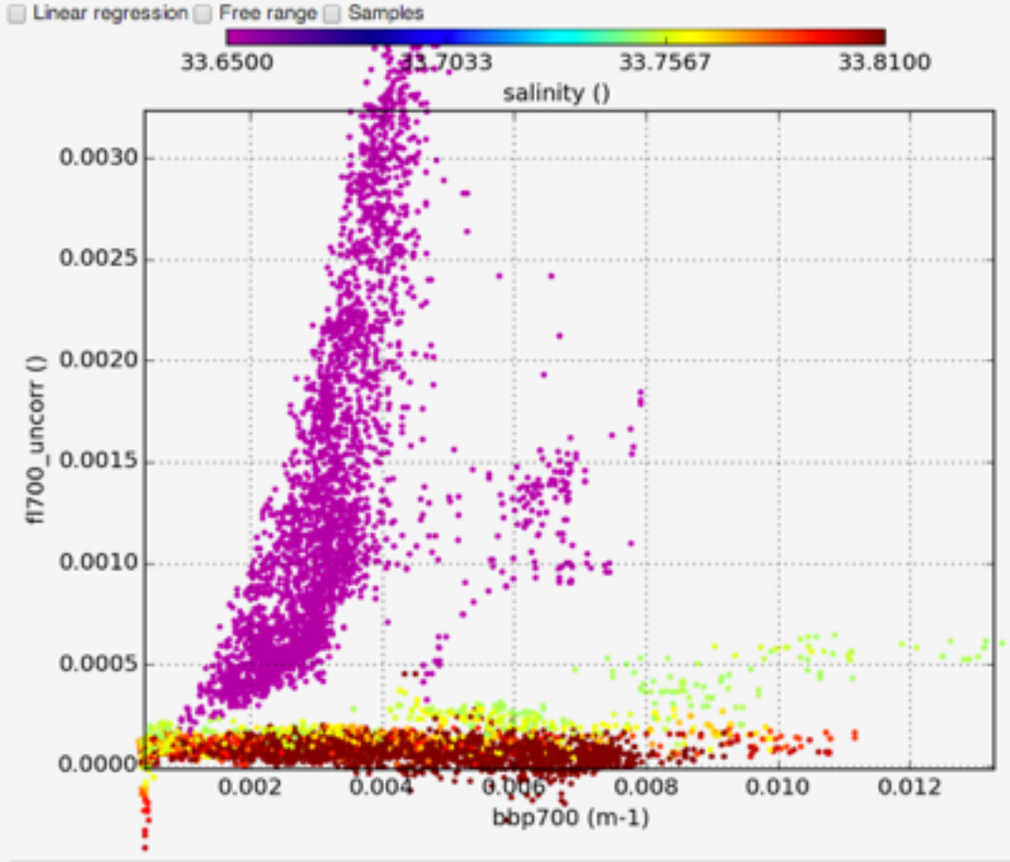
Spatial

Metadata: about 358,086 data values - 24.899 seconds

Parameter-Parameter: x:12 y:13 c:14 Clear Selection

2D 3D sql Data

Linear regression Free range Samples




```
n = 8951
bbp700 ranges: fixed [0.000402, 0.013280], actual [0.000313, 0.013404]
fl700_uncorr ranges: fixed [-0.000018, 0.013280], actual [-0.009190, 0.004648]
```

Measured Parameter Data Access

Temporal: 2013-09-18 17:13:47 to 2013-09-20 04:49:15 Clear Selection

Measured Parameters Clear Selection

Parameter Values Clear Selection

Attributes: 204,210 Clear Selection

Measurement Sample Campaign Platform

Filter by labeled Measured Parameter (co-located measurements remain in selection)

Labeled

diatom	Using Platform dorado, Parameter {'salinity': ('33.33', '33.65')} from 20130916T124035 to 20130919T233905
dino1	Using Platform dorado, Parameter {'salinity': ('33.65', '33.70')} from 20130916T124035 to 20130919T233905
dino2	Using Platform dorado, Parameter {'salinity': ('33.70', '33.75')} from 20130916T124035 to 20130919T233905
sediment	Using Platform dorado, Parameter {'salinity': ('33.75', '33.93')} from 20130916T124035 to 20130919T233905

Platform name: dorado Clear Selection

auv

dorado

mooring

ESP_Mack_Mooring

Labeled Data to suport machine learning

M B A R I

DMS: Biological Data

Environmental Disasters Data Management Workshop (EDDM)
National Conservation Training Center (NCTC) USFWS, Shepherdstown, WV
16-17 September 2014

Felimon Gayanilo

Systems Architect

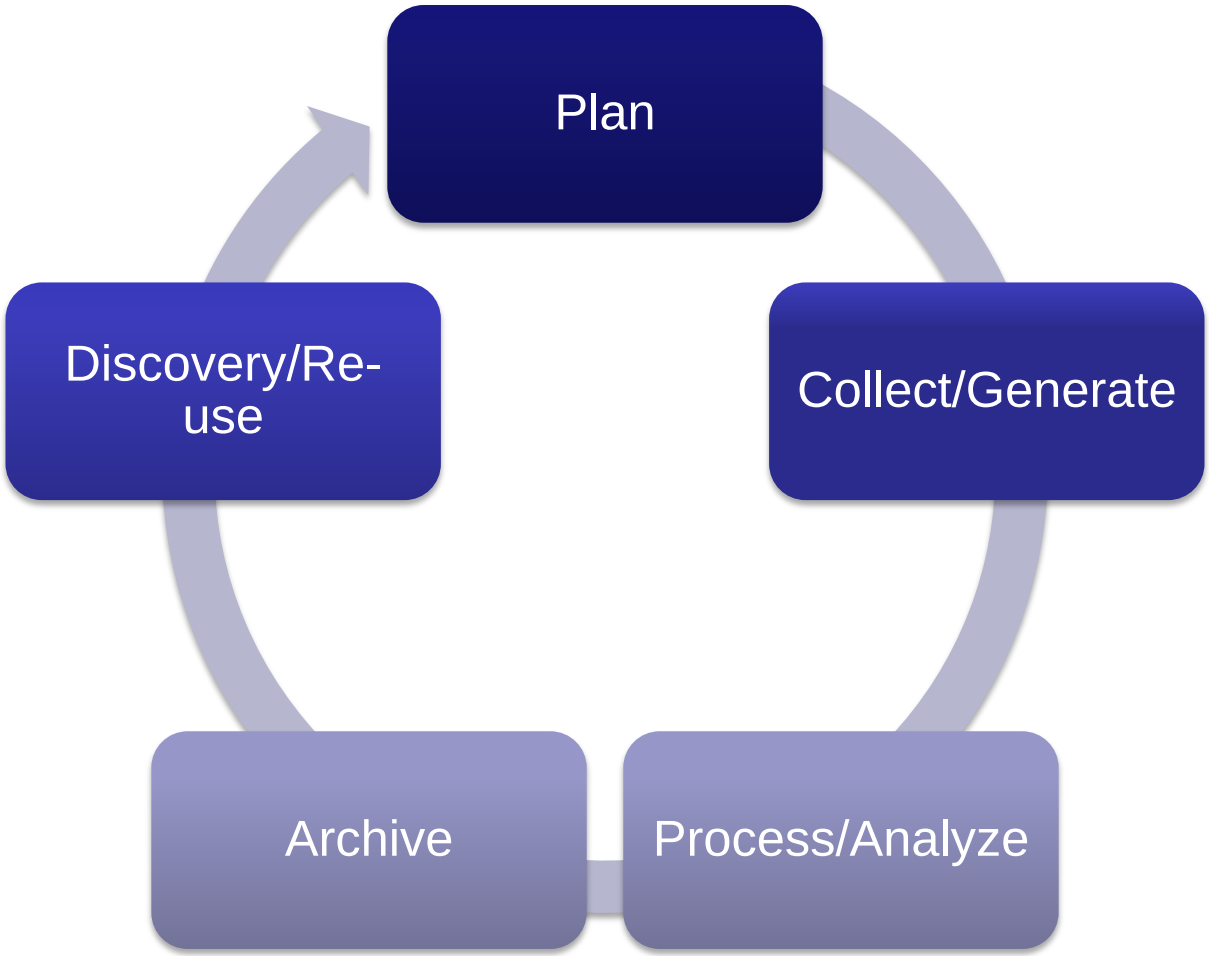
Harte Research Institute, Texas A&M University Corpus Christi

(email: fgayanilo@tamu.edu)

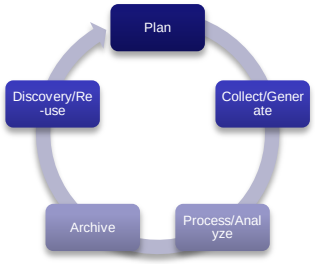
Overview

"…to quickly reach a science-based consensus about the defining characteristics and regulating processes of an ecosystem to address environmental disaster due to natural or anthropogenic causes using best available technology and data."

Data Life Cycle



Data Life Cycle



Data Aggregation/Collection/Archive Centers: Biological Data

Type 1: **Desktop/Stand-alone**
Data is stored on off-line services

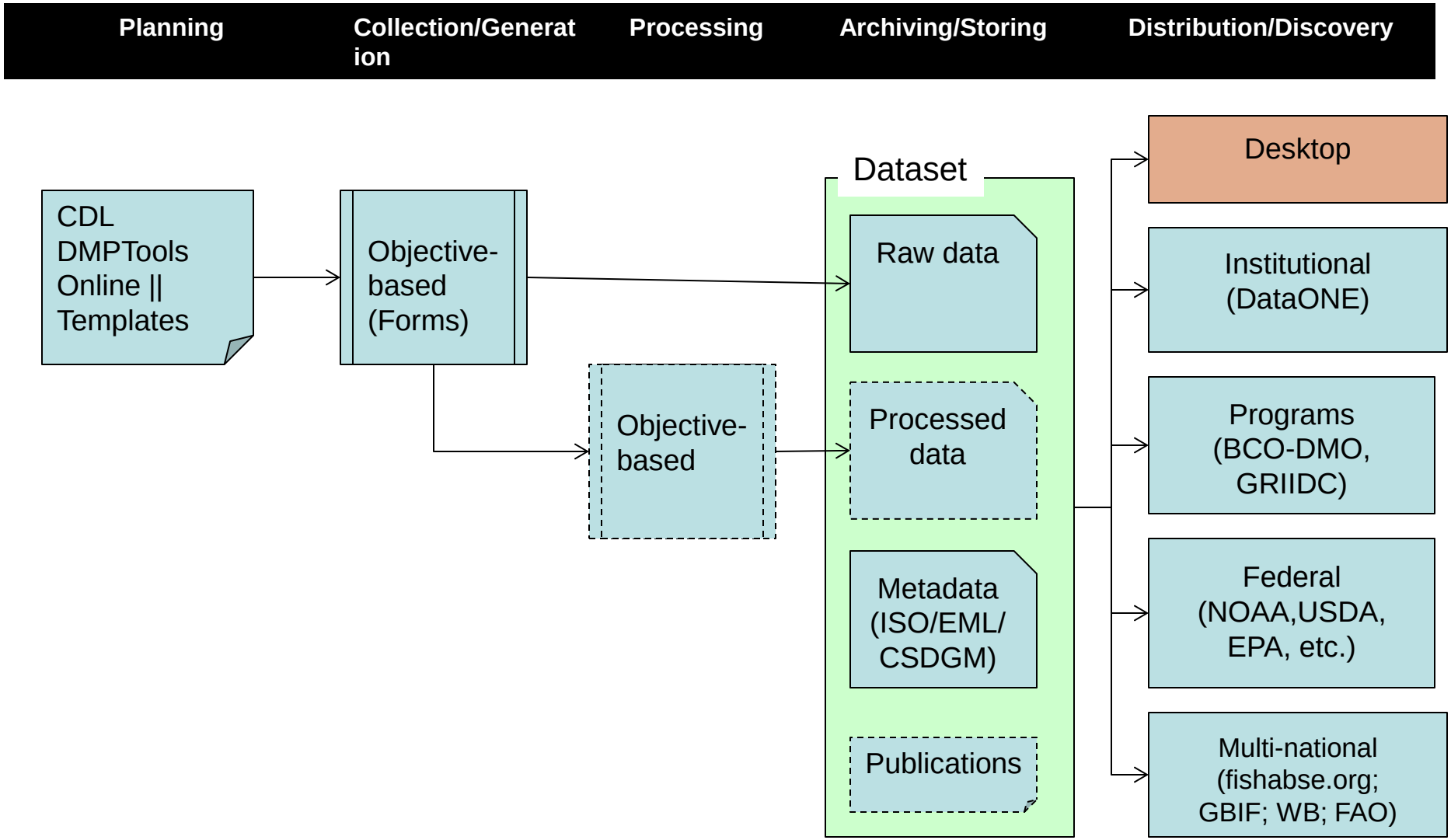
Type 2: **Short-term funded projects**
Objective-based; data encoded offline and sometime served over the Internet

Type 3: **Institutional and Long-term initiatives**
BCO-DMO; GRIIDC; DataONE; eBIRD
Academic/Research Institutes; LTER;
IEDA; ACADIS; fishbase.org; ecosystemresearch.org

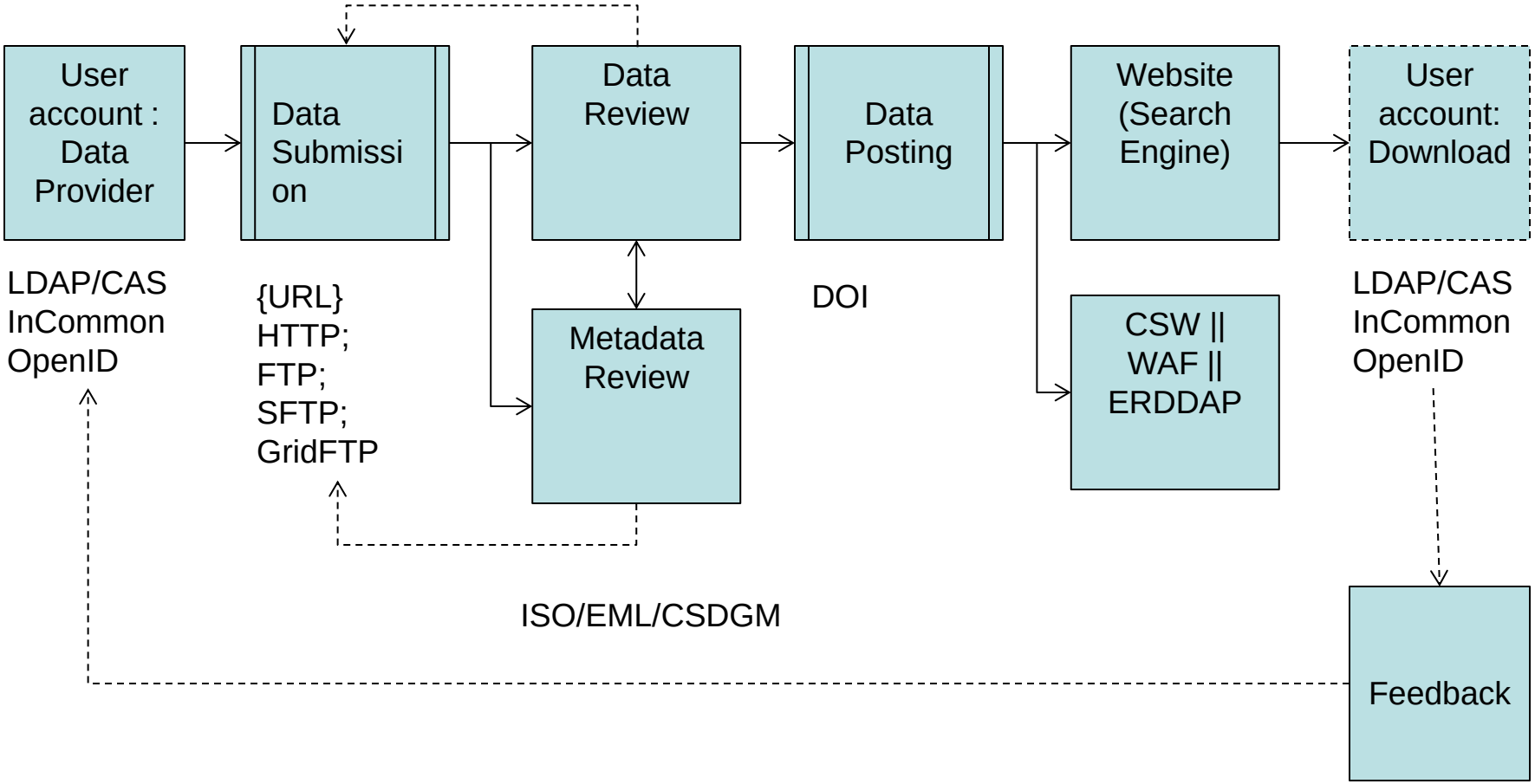
Type 4: **Federal, regional and state programs**
NOAA's NODC/NGDC/NCDC/Fisheries/ESI/DIVERS;
USDA; NIH NCBI; IOOS; GCOOS TOAST; Dept. of Ecology, WA; http://www.ecy.wa.gov/database.html

Type 5: **Multi-national programs**
GBIF/Pangaea/CGIAR/UN Data/ World Bank Environmental Data

Processes: Most Common



Common DMS Elements



Prevailing Issues

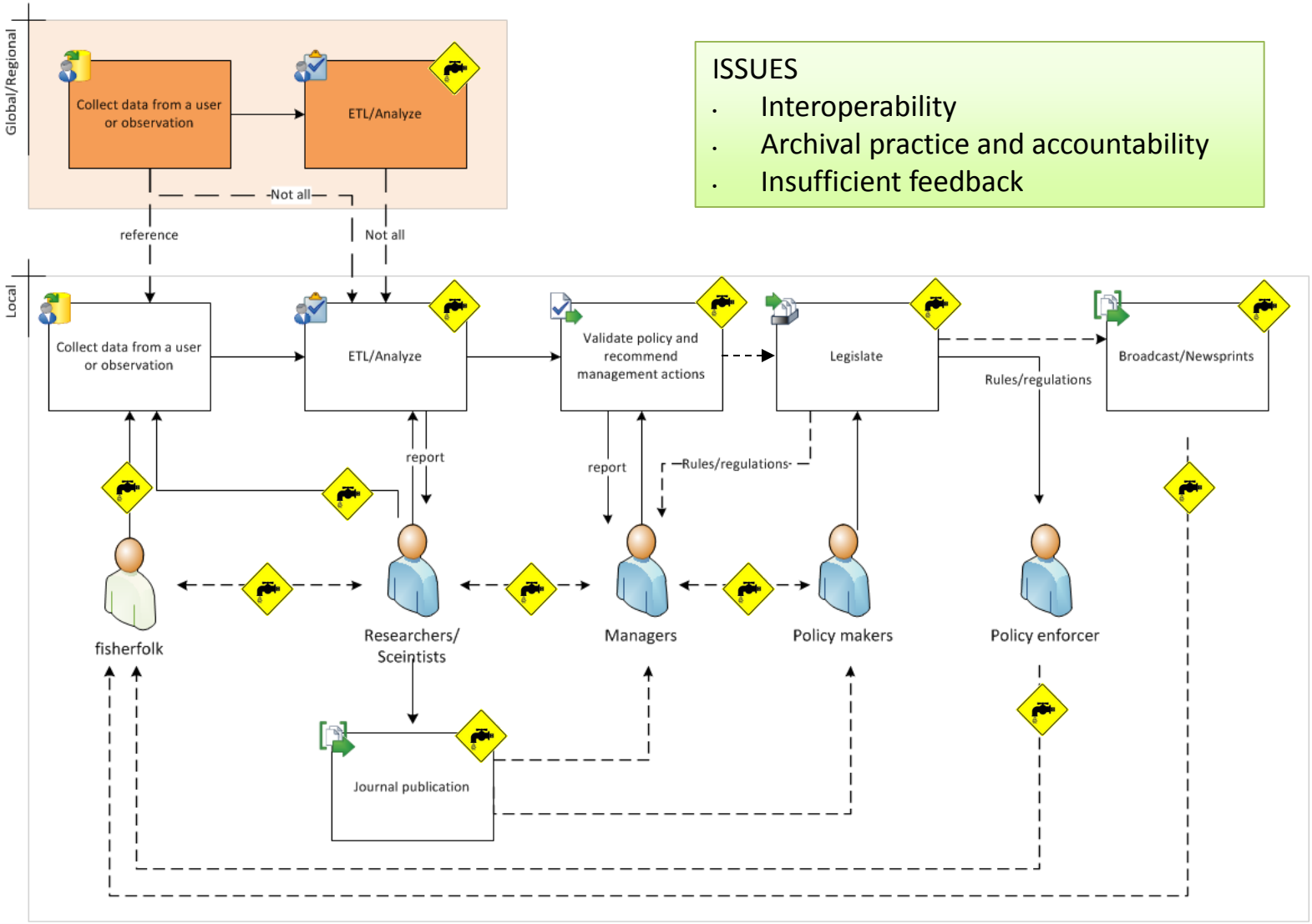
- Insufficient information to establish data provenance (metadata) and data review (quality control)
- Failed to establish a common standard (collection, vocabulary, ontology and structure) throughout inhibiting the re-use/re-purposing of the datasets
- Insufficient interoperability and network capabilities
- Temporal and spatial limited (highly heterogeneous; goal setting)

DMS: Biological Data

Thank you!

Felimon Gayanilo
Systems Architect
Harte Research Institute, Texas A&M University Corpus Christi
(email: fgayanilo@tamu.edu)

Processes: Data Loss



ISSUES

- Interoperability
- Archival practice and accountability
- Insufficient feedback

National Institute of Environmental Health Sciences
Your Environment. Your Health.

Disaster Health Research Data Systems

Steve Ramsey, MPH

National Institute of Environmental Health Sciences
Your Environment. Your Health.

Overview

- Disaster epidemiology
- Types of human health data
- Data systems

Disaster Epidemiology

Objectives

- prevent or reduce the number of deaths, illnesses, and injuries caused by disasters
- provide timely and accurate health information for decision-makers
- improve prevention and mitigation strategies for future disasters by collecting information for future response preparation

National Institute of Environmental Health Sciences
Your Environment. Your Health.

Disaster Epidemiology

Surveillance

- Mortality
  - Vital Records
  - CDC Disaster-related mortality surveillance form
- Morbidity
  - Laboratory
  - Sentinel sites
  - Syndromic surveillance
  - Absenteeism
  - Insurance
  - Pharmacy
  - Shelter
- Response
  - CASPER
  - OEMS Systems

National Institutes of Health
U.S. Department of Health and Human Services

Disaster Epidemiology

Research Data

- Registry/Cohort
- Short and long-term data
  - Medical history, occupational, recreational, residential exposures, mental health, social and behavioral factors
- Anthropometric and physiological measures
  - HT / WT, HC/ WC, HR/ BP, pulse ox, lung function
- Biospecimens
  - Blood, urine, toenails, hair, saliva for DNA
- Environmental measurements
  - Household dust and GPS coordinates

National Institute of Environmental Health Sciences
Your Environment. Your Health.

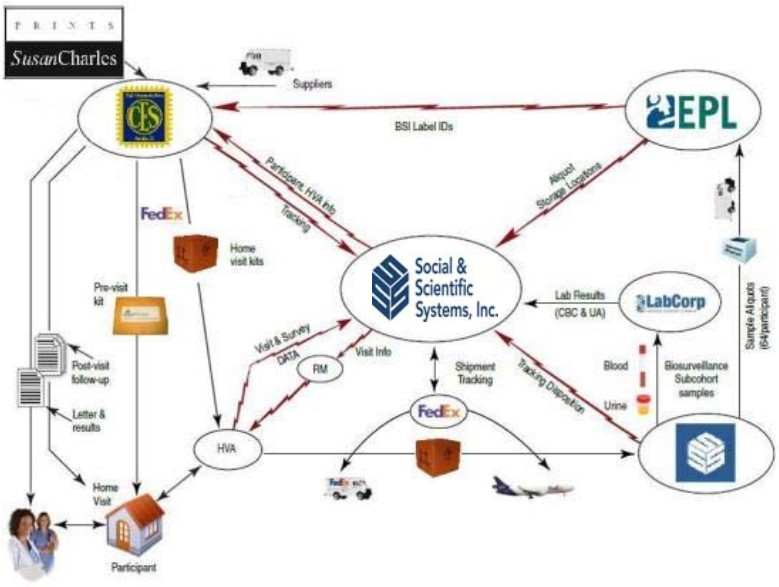
Cohort/Registry

Data Sources

- Training rosters
- Contractor lists
- Shelter manifests
- Evacuee manifests
- FEMA
- Social services
- Public datasets
- Local jurisdictions

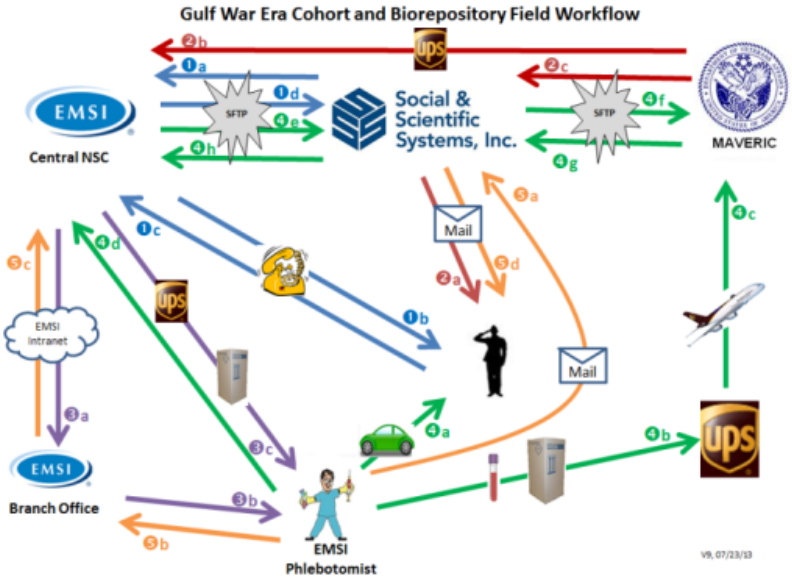
National Institutes of Health
U.S. Department of Health and Human Services

National Institute of Environmental Health Sciences
Your Environment. Your Health.



National Institutes of Health
U.S. Department of Health and Human Services

National Institute of Environmental Health Sciences
Your Environment. Your Health.



National Institutes of Health
U.S. Department of Health and Human Services

National Institute of Environmental Health Sciences
Your Environment. Your Health.

Data Collection Tools

RAPIDD — Registry Basic Core Form

Registry and Contact Information: (Source: ATSDR Rapid Registry Form modified)

Participant Contact Information

The first set of questions will ask you for your contact information and the contact information of a close friend or family member who can be contacted to reach you or in emergency situations. Please answer each question as completely as you can and to the best of your ability.

1. What is your full name?
First: _____
Last: _____
Middle name(s): _____
Suffix (i.e. Jr. Sr. IV, if applicable): _____
☐Don't Know
☐Refused

2. What is your sex? [INTERVIEWER NOTE: ASK ONLY IF NECESSARY OR NOT APPARENT]
☐Male
☐Female
☐Not Determined
☐Refused

3. What is your date of birth?
_____/_____/_____
[DD/MM/YYYY]
☐Don't Know
☐Refused

4. How old are you?
_____
☐Don't Know
☐Refused

5. What is your Social Security Number?
(Your SSN will only be used to match our data to other health registries and will be kept confidential to the extent allowed by the law.)
_____-_____-_____ GO TO QUESTION 7]
☐Don't Know [GO TO QUESTION 7]
☐Refused [GO TO QUESTION 6]

[INTERVIEWER NOTE: IF PARTICIPANT REFUSED OR IS UNWILLING TO PROVIDE FULL SSN ASK THE FOLLOWING]

[PROGRAMMER NOTE: IF "REFUSED" SELECTED, SHOW QUESTION 6, IF "DON'T KNOW" SELECTED, HIDE SSN FOLLOW UP QUESTION 6, GO TO QUESTION 7]

6. Would you be willing to provide the last 4 digits of your social security number instead?
☐Yes --enter last four digits of SSN# _____
☐No
☐Don't Know

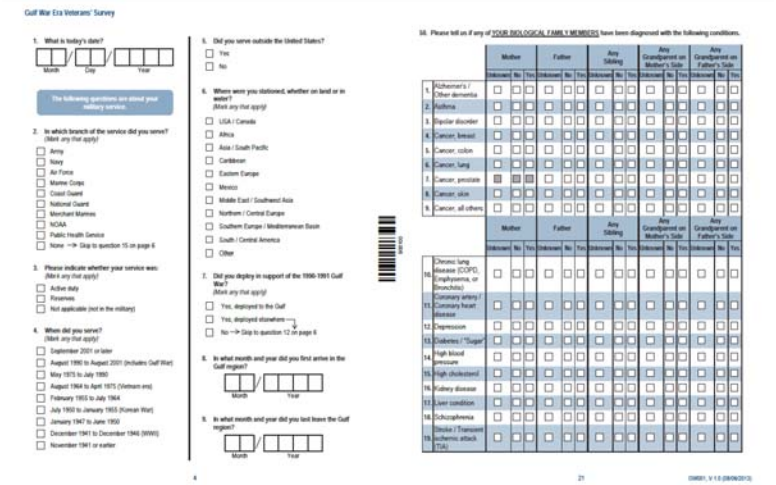
7. What is your home address? [FREE TEXT]
Street: _____
City: _____
State: _____ [Enter state abbreviation]
Zip: _____
☐Don't Know
☐Refused

V0.12.10.26.2014 — Page 3 of 18

National Institutes of Health
U.S. Department of Health and Human Services

National Institute of Environmental Health Sciences
Your Environment. Your Health.

Data Collection Tools



Gulf War Era Veterans' Survey

1. What is today's date?
Month / Day / Year

The following questions are about your military service.

2. In which branch of the service did you serve? (Mark any that apply)
☐Army
☐Navy
☐Air Force
☐Marine Corps
☐Coast Guard
☐National Guard
☐Merchant Marines
☐NOAA
☐Public Health Service
☐None --> Skip to question 15 on page 6

3. Please indicate whether your service was: (Mark any that apply)
☐Active duty
☐Reserves
☐Not applicable (not in the military)

4. When did you serve? (Mark any that apply)
☐September 2001 or later
☐August 1990 to August 2001 (includes Gulf War)
☐May 1975 to July 1990
☐August 1964 to April 1975 (Vietnam era)
☐February 1955 to July 1964
☐July 1950 to January 1955 (Korean War)
☐January 1947 to June 1950
☐December 1941 to December 1946 (WWII)
☐November 1941 or earlier

5. Did you serve outside the United States?
☐Yes
☐No

6. Where were you stationed, whether on land or in water? (Mark any that apply)
☐USA / Canada
☐Africa
☐Asia / South Pacific
☐Caribbean
☐Eastern Europe
☐Mexico
☐Middle East / Southwest Asia
☐Northern / Central Europe
☐Southern Europe / Mediterranean Basin
☐South / Central America
☐Other

7. Did you deploy in support of the 1990-1991 Gulf War? (Mark any that apply)
☐Yes, deployed to the Gulf
☐Yes, deployed elsewhere -->
☐No --> Skip to question 12 on page 6

8. In what month and year did you first arrive in the Gulf region?
Month / Year

9. In what month and year did you last leave the Gulf region?
Month / Year

4

16. Please tell us if any of YOUR BIOLOGICAL FAMILY MEMBERS have been diagnosed with the following conditions.

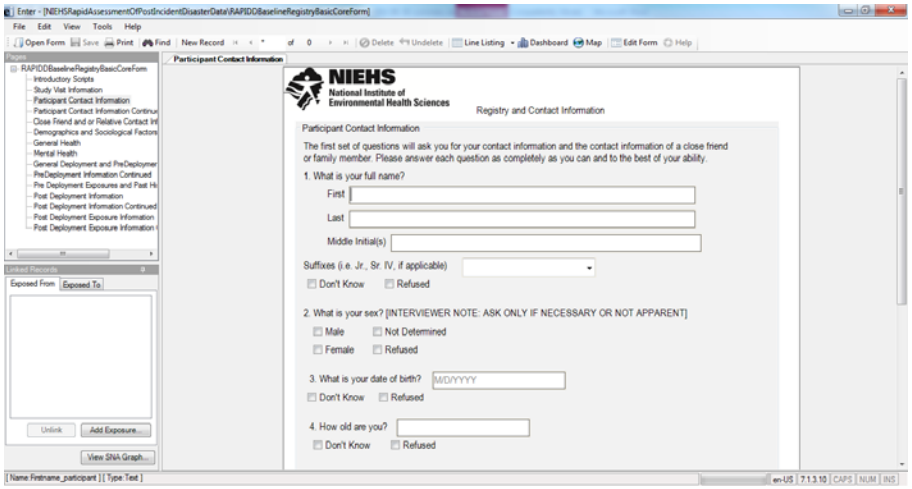
	Mother			Father			Any Sibling			Any Grandparent on Mother's Side			Any Grandparent on Father's Side		
	Unknown	No	Yes	Unknown	No	Yes	Unknown	No	Yes	Unknown	No	Yes	Unknown	No	Yes
1. Alzheimer's / Other dementia	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Asthma	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Bipolar disorder	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Cancer, breast	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Cancer, colon	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Cancer, lung	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Cancer, prostate	■	■	■	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. Cancer, skin	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Cancer, all others	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Mother			Father			Any Sibling			Any Grandparent on Mother's Side			Any Grandparent on Father's Side		
	Unknown	No	Yes	Unknown	No	Yes	Unknown	No	Yes	Unknown	No	Yes	Unknown	No	Yes
10. Chronic lung disease (COPD, Emphysema, or Bronchitis)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. Coronary artery / Coronary heart disease	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Depression	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Diabetes / "Sugar"	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. High blood pressure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. High cholesterol	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Kidney disease	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Liver condition	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Schizophrenia	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Stroke / Transient ischemic attack (TIA)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

21

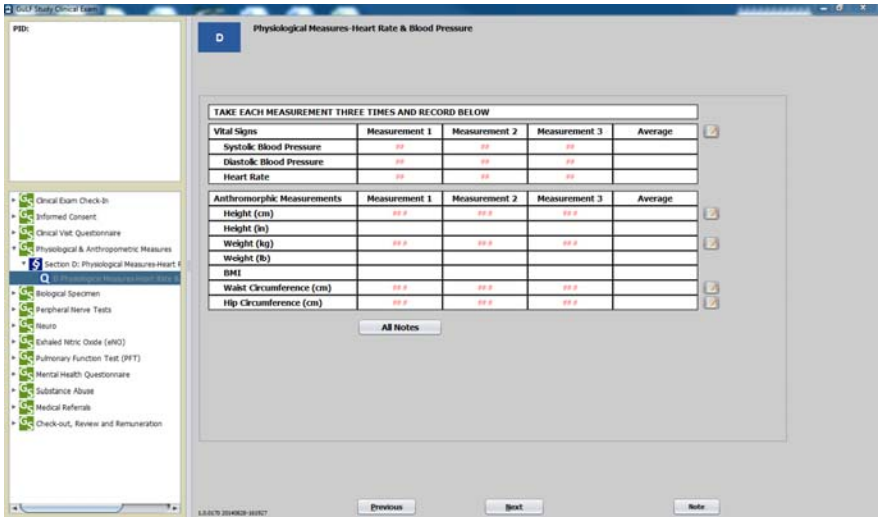
National Institutes of Health
U.S. Department of Health and Human Services

Data Collection Tools

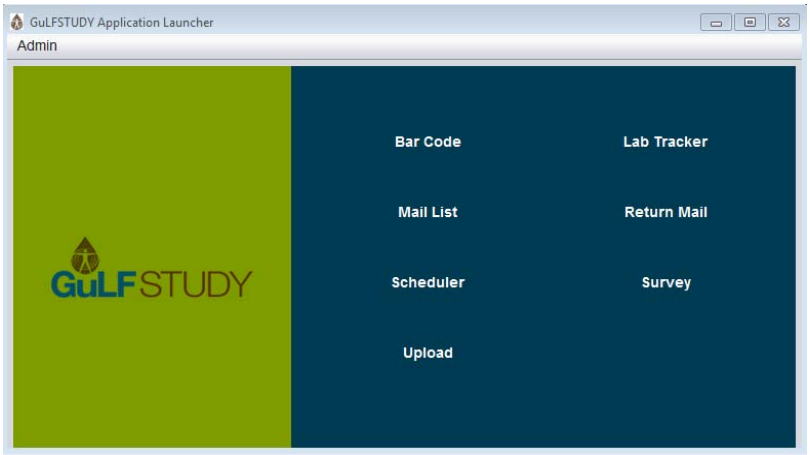


National Institute of Environmental Health Sciences
Your Environment. Your Health.

Data Collection Tools



Research Management Systems



National Institute of Environmental Health Sciences
Your Environment. Your Health.

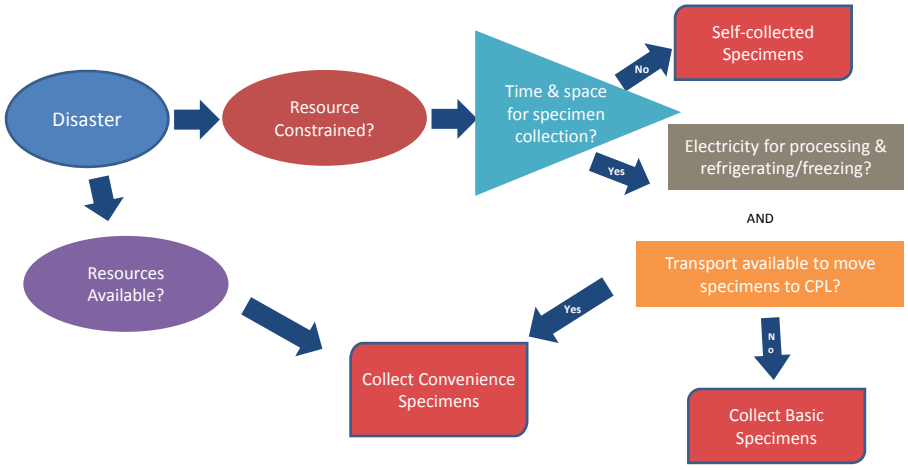
Basic Registry Information

- Contact Information
- Demographic and Sociological Factors
- General Health
- Deployment Information
- Exposure Information
- Medical Records

National Institutes of Health
U.S. Department of Health and Human Services

National Institute of Environmental Health Sciences
Your Environment. Your Health.

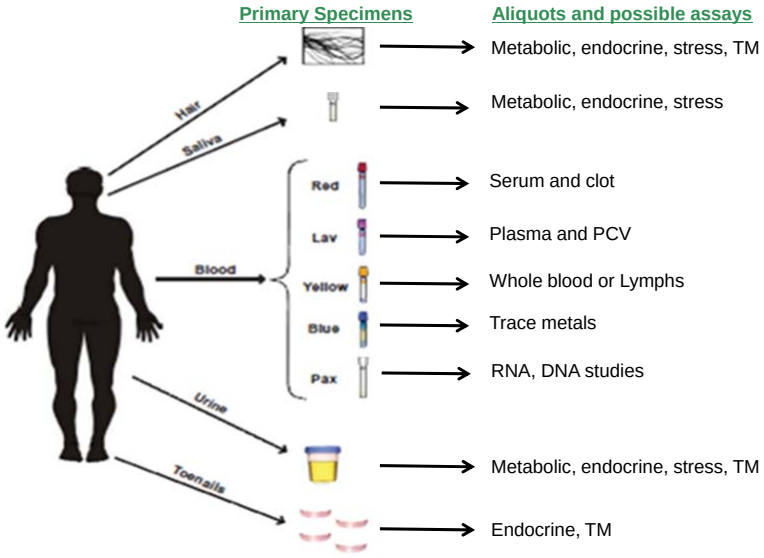
Biospecimen Collection Considerations



National Institutes of Health
U.S. Department of Health and Human Services

National Institute of Environmental Health Sciences
Your Environment. Your Health.

Possible Convenience Specimens



Disaster Epidemiology

Exposure Assessment

- Weather Data
- Monitors
- Sensors
- Models

National Institute of Environmental Health Sciences
Your Environment. Your Health.

Questions?

Social & Scientific Systems, Inc.

National Institutes of Health
U.S. Department of Health and Human Services

Appendix F

BREAKOUT GROUP DAY 1, RECORDER NOTES

Instructions to Recorder: If conversation follows the questions and you can take notes below each question, please do so. If conversation does not closely follow questions you may take notes at the end, below all questions, under "General Discussion". There is also a "Final Decisions/Conclusions/Summary" area at the end. Alternatively, if you have "final decision" items under each question you can highlight them in a certain color to designate. If appropriate, note who says things. There may not be group consensus – if so, please note the differences in opinion and give reasons/examples. At the end of the breakout session, please email me a copy of your notes (laura.belden@unh.edu). Even if they are very rough, it will just be a backup copy so you don't lose your information in case of technology malfunction.

Recorder: Laura Belden

Breakout Group A: Field Sample Collection (Data Collection/Sampling Protocols)

- Is there a common data model that can be shared across entities?
  No
  Ideal data model characteristics:
  Adaptive Management:
  Possible models that can be adapted:
  What data do we really want:
  Creating a conceptual model that is unifying of data types etc would be good place to start

  Some common data models could be described conceptually (tomorrow).

- What are the essential core parameters to be collected and recorded for any field collection (e.g., sample ID, date/time, lat/long, etc.)?
  Media, spatial, temporal
  Time, date, sampling person, result, method, where to find more information,
  Things that get at exposure and effects
  Establishing nomenclature first is important

- What are the essential core parameters to be included in metadata record?
  Unique identifier, data contact/custodian,
  Protocol, SOP, strategy – why and how data were generated this way

- What are the standard data types and protocols for emergency response?
  Consider info that can be taken faster – proxy, representative, indicators
  Include in sampling design long term monitoring sites (certain percentage) then can get error bars etc.
  Sampling plan and protocol may differ from long term sampling one.
  We have lots of protocols for sampling particular things in particular matrix – need tiered one for emergency – need to develop before emergency because otherwise can take too long.
  Need to identify areas where baseline data doesn't exist.

  - Shoreline and/or soils
    Notes

  - Watercolumn
    Notes

  - Air
    Notes

  - Human Health
    Notes

  - Other
    Notes

- What are best practices for reducing transcription errors?
  No 18 hours days for staff
  Ways can value check data
  Making sure it gets implemented can be a challenge
  Electronic field data entry reduces a lot of copying and transcription errors (small investment in this makes big difference). This makes it easier for next level reviewer to review too.
  Electronic tool will generate chain of custody (COC)
  Scribe system. Time stamping. Date stamping.
  GPS, camera, all included
  Automatic geocoding…

- What are the roadblocks for getting data from field collection into an electronic format?
- Electronic field data entry reduces a lot of copying and transcription errors (small investment in this makes big difference). This makes it easier for next level reviewer to review too.
- Electronic tool will generate chain of custody (COC)
- Scribe system. Time stamping. Date stamping.
- GPS, camera, all included
- Automatic geocoding…

  Challenge: internet for transmitting not always available (can transmit later).
  Electronic can generate labels (waterproof) (helps with "room" to write on label)

- How is field collection designed to maintain PII (personal identification, human health etc.)?
  Keep personal info on separate computer from actual data. Or don't put PII on computer (in case lose computer).

- How is field collection designed to ensure accuracy of data?
  Notes

- How is field collection designed to maintain Chain of Custody?
  Notes

- How is field collection designed to maintain data security?
  Notes

General Discussion:

If data is already being taken, how can we optimize it? (to be able to use environmental data for human health etc).

How do we get agencies to buy into this? Get them to collect baseline data etc. (to be discussed tomorrow)

Found a lot of errors in past disasters – transcription errors, missing AM/PM, missing data, etc. Should have been double checked upon entry.

Need to have SOP. Process for how train folks on SOP and documenting this. (But one challenge w/DWH was running out of enough trained people)

Plan to do it right for all disasters – big and small – do it right all the time, not just when White House watching.

Way to harmonize methods is to make it performance based (what is performance of your analytical method etc)

Would be helpful more trainings for NGOs and citizen science – training helpful if free/come to them because of limited resources

How do we start creating platforms that NGOs and citizen science can put their info into and others can start looking at it?

Phytoplankton Monitoring Network (used by NOAA) is model citizen science group.

Citizen Science could be front-line boots on ground where applicable.

Debris program uses a lot of citizen input.

Kent: items not sure addressed with questions here: quality control in emerg field sampling is often nonexistent or poor, developing improved sensor systems (b/c measurements can be cumbersome to collect data), interagency differences in how collect share use data (is National Response Team Science and Technology Committee the right place to bring these things to start address? Aubrey says conversations there more operational so not best place. Amy thinks this could work if we generate synthesis of workshop)

In between major events, work on developing technology, sensors, so that during next emergency can be that much more efficient and effective.

Sensors – have value/advantages, but less accurate than analytical method, define needed precision/accuracy – gets back to performance based. Sensor advantages include greater spatial/temporal data – this can be very valuable. Development of new sensors needed – work with industry. SMIR (small business innovative research programs) one place haven't seen many budget cuts – look at this how can it better serve this All Hazards response – this is how you expedite technology.

We don't have good way of bringing NGO and citizen data into govt system, assimilating it, and putting it back out.

Need data management systems flexible enough to incorporate new technologies.

Focus on what question want to answer, and how do I get that data (as opposed to shotgun approach of data collection – lots of data collected from everywhere). Smart sampling – predictive watershed models (Geoff, one effort doing currently). Ground truth things with local knowledge.

<u>"Final Decisions"/Conclusions/Summary:</u>

BREAKOUT GROUP DAY 2, RECORDER NOTES

Recorder: Laura Belden

Breakout Group A: Field Sample Collection (Data Collection/Sampling Protocols)

1) What are requirements for field data collection in order to assure good data?

- **Sampling Protocol**
- **Trained data collectors, particularly related to emergency response (protocol for preparedness)**
- **Coordination of sampling efforts**
- **Performance based metrics**
- **SOPs**
- **Accurate and thorough metadata collection**
- **Sampling and analysis plan specific to emergency response, anticipated scenarios**

2) What are the types of media that should be sampled for an environmental disaster with respect to:

Human Health

Focus on exposure initially…
Public, responders

- Dermal
- Time, location, and activity (changes by day)
- Biological sampling (urine, blood, other human health information)
- Mold, mildew

Ecological Health

Both Human and Ecological

- Air
- Soil/sediment

- Water
- Characterize Toxicity of hazard (what chemicals present, oil, dispersant, etc)
- Archival variety of samples that can analyzed with high sensitivity later (for other analytes aren't known at time of incident) (done during background conditions too – can be expensive, if cost limited, plan to take these outside of disaster area during event)
- Biological sampling (urine, blood, other human health information, fish bile,)
- Leverage existing reference sites, (NEERS, NEON)
- Leverage existing citizen science and NGO networks

Note: USGS going to collect background data on east coast. Archive sediment samples. In event of hurricane etc, can go back and analyze select ones.

Appendix G

BREAKOUT GROUP DAY 1, RECORDER NOTES

Instructions to Recorder: If conversation follows the questions and you can take notes below each question, please do so. If conversation does not closely follow questions you may take notes at the end, below all questions, under "General Discussion". There is also a "Final Decisions/Conclusions/Summary" area at the end. Alternatively, if you have "final decision" items under each question you can highlight them in a certain color to designate. If appropriate, note who says things. There may not be group consensus – if so, please note the differences in opinion and give reasons/examples. At the end of the breakout session, please email me a copy of your notes (laura.belden@unh.edu). Even if they are very rough, it will just be a backup copy so you don't lose your information in case of technology malfunction.

Recorder: Ian Gaudreau

Breakout Group B: Data Formatting/Entry (for consistency and comparability)

- Is there a common data model that can be shared across entities?

  Depends on who you are.

  Data Model: Field lists, definitions, values, and definition on these values + all key information from all data sets that will be used

  No, there isn't anything across all disciplines. But there are many commonalities that different disciplines use. Best practices and models exist, but nothing universal. If we combine a bunch of things, we might be able to get a universal

  All data models are spatial. ISO191, Census Data, GIS are popular encompassing ones

  Data models can have similar structure, but within the models, there needs to be a glossary/index/dictionary that defines similar terms, variables, units, etc. and clarifies them for when you compare between models

  There doesn't have to be an overarching model as long as their time and place standards.

  Weather: METAR,
  Contaminant chemistry: QUERY Manager Database
  Field observational contaminant chemistry: DIVER & photos
  ESRI GIS Models – Petroleum Engineering

  Adaptive Management

- What are the essential core parameters to be collected and recorded for any data collection (i.e., sample ID, date/time, lat/long, etc.)?

  Summary: Unique identifier, 4-D locations (time, X, Y, Z), parameter measured or observed, actual values, units + the metadata that goes with it

- What are the essential core parameters to be included in metadata record?
  User restrictions. Information that is required for metadata standard. Core standards that go across all metadata record.

  Limits of detection by methodology

  Spatial reference/coordinate system (=coordinate system + datum)

  Also, how you got the data (Instruments have different levels of detection and different parameters), collection methodology

  Unique identifier also applies here

  What is this dataset, who collected it, review status (what type of quality control was done),

  essential core parameters (what was its purpose, spatial reference, who contributed to the data set, what **instruments** did you use?, shareability (proprietary, personal information [business identifiable], is it federal data? How can/cant this be used or shared?),

- What are the standard data types and protocols for emergency response?

  - Shoreline and/or soils

  Notes

  - Water column

  Notes

  - Air

  Notes

  - Human Health

  Notes

  - Other

  Notes

- What are best practices for reducing transcription errors?
  Naming conventions, terminology, domain definitions, safeguards in your system (so you can't say a person is 16ft tall), use electronic data capture (see challenge at bottom), the original data collectors need to sign off saying that anyone else that edits the data has been approved, transcription verification/dual entry, how are you archiving the data capture?,

- What are the rate limiting steps for getting data from field collection into an electronic format?
  Time, inavailabilty of experts to integrate information, does the system have an offline mode, you can't get trained workers (not hazardous waste trained), no access to internet, not able to read handwriting from paper documents and having to find the original data recorder to clarify, Difficulty to transfer from paper to digital, paper documentation requirements, Office & Management of Budget (any federal collection needs clearance by this – slow process), platform dependency (android vs. iOS, PC vs. Mac), running out of battery with electronic devices, lack of clarity for data transfer (no clear protocol or process established – different stakeholders and trying to adjust the data into a digital format for multiple stakeholders), data sharing issues/ownership issues, shifting culture that might only prefer paper documents into using electronic device, different versions of same software program or of documents "version control". Non-standardized data (in the context of personal notes or a small sketch)

- How are data formatting/entry designed to maintain PII (personal identification, human health, SSN, birth date, etc.)?
  How much information is needed to identify a specific individual from a pool – different at each scale

  E-Government Act 2002 – Federal Information Security Management Act

  If it doesn't need to be collected, don't collect it. Only use it as needed. Use IDs

  You need enough data to make sure that you don't survey the same person twice or make sure people with the same name get surveyed individually

  We don't have to put PII information into the electronic record – we can keep it archived

  Encrypt data, enter the data twice to make sure it matches (computer will register the match to make sure there is no spelling error)

- How are data formatting/entry designed to maintain Chain of Custody?
  Referring to the transfer of documents from one person to another, what they did with the documents, how long they had it, etc.

  Electronic System Auditing
  Automatic system clearing to delete personal information, but backs it up in a secure location

- How are data formatting/entry designed to maintain data security?

Sharing status – information is appropriate for sharing with whom. –is there a part of that data that is not allowed to be shared yet before it is released to the public? Needs to be approved before it is shared. But, once it is shared, it still has to be protected. Safety and protection from collection to archiving

General Discussion:

Collecting Raw Data – Information – Knowledge (we are operating in the data, records, data set, collection of data points, etc. that we know a lot about). Even a raw data collection is entered in Excel and is data, but is before QAQC process. Our ideas are a bit more focused quality information. Essentially, the atomic bits that create our information is within these parameters.

We are looking at data that is collected but has not been put into a database and QAed, but is quite far from being discoverable in a database.

Perspective on data/information is the determiner. Data might be considered information to other groups, etc. Instruments that give data can still give QAQC data.

CHALLENGE: is equipment intrinsically safe and usable? Damaged in transport, can't use in cold weather, need for backup systems

"Final Answers"/Conclusions/Summary:

Group B: In regards to Data Formatting/Entry:

	Issues and Challenges	Difficulty in addressing issues (Red/Yellow/Green)	Importance (High/Medium/Low	Path Forward?
Common Data Model(s)	Common Language (Controlled vocabulary)	Red	High	Each subgroup (like oceanography) needs to come up with its own common data model. Have workshops with those groups and have them develop a common data model
	Data structure	Yellow	High	Create pre-defined forms (have key tracking terms like keys, ID, etc.). Constraint lists (like a drop down menu and you have to choose something from the menu)
	Extensibility & Usability	Red	High	Making sure you have data and field practitionors in the creation of the data model and end user verification/testing. Create a hypothetical natural disaster and use data from a bunch of different organization to see where the inconsistencies are/full scale drills to see where our resources are needed and how successful the data is used. "The White House is looking for X data in a few hours. see if you can make it work".Drills will be a good time to make sure all software is up-to-date and people know how to use their equipment/forms. Have a calendar/check-ins to see how progress is being made. Integrate different organizations to keep everyone informed of how data is being usedd by other organizations (a contininued effort between pulses of drills or spikes in data use). At Conferences, add another day for each organization to talk about and explain their data + frequent virtual meetings to regularly check in and talk openly. Have a charter for every group that says what they do, the frequency of how they meet, etc. and have a representative from each group that can be held accountable for not following through with these ideas and letting people know the progress.
	Data Sharing & Ownership	Reddest	High	*Everyone agrees it is important but is not sure how to fix this
Core Parameters recorded during data collection	unique identifier quality: not unique, length, complexity	Green	High	Barcoding to replace lengthy IDs. Meaningful/logical/sequential IDs so you can tell if something has gone wrong (alphanumerical order). Forms don't have all proper IDs listed on them. Link campaign to photo or other data so you can easily distinguish what data it is a part of.
	4-D locations quality	Green	High	Agreement on time zone and reference time. Training with electronic devices as they change across time zones (knowing how to deal with that). Agreement on encoding of time. Standardization and training on coordinate system, precision & accuracy, significant figures. Standard operating procedure (take a point with GPS and take a picture as double check). Calibrate equipment to ensure accuracy. avoid redundant copying. Report inconsistencies immediately in order to clear confusion and find the correct answer.
	parameter measured or observed quality	Green	High	What was the method?
	actual values	Green	High	calibrating equipment, agreement of what a flag value is (for example, if you have missing data, is it 0, blank, -9, etc.), significant figures. Sanity checks to make sure the data 'makes sense' in the big picture
	units	Green	High	standardize and be explicit
	metadata	Yellow	High	What was the instrument used? Zip metadata with data so they are a core component with the data
Core Parameters for metadata	Confusion between what is metadata? Is it international standards or just a scientist opinion of what metadata is	Yellow	Medium	What is reasonable? (we don't have a perfect answer for this), transformation tools from machine generated nonstandard metadata to standard metadata. One-page clear guidance (explain to general audience what standards 'we' are accepting). Make sure metadata gets filled out completely: whatever you ask to provide, make sure it is provided by the person collecting the data
Reducing Transcription Errors during data formatting/entry	Missing data	Green	High	Input Validation (controlling the fields that they can enter data into in both paper and electronic forms), elimination of free text
	Invalid Data	Green	High	Differnet inputting techniques (null vs. 0)
	Illogical Data (parameters that don't support each other - if you are a male you can't be pregnant)	Yellow	High	Logic on the forms to track consistency between fields
	Typos or Inversions	Green	High	have two people enter same data and cross validate, transcription verify, have someone check, collect in electronic format, Field Lead or Originator verifies data after entry
	Illegible Data	Green	High	Have selectable drop down boxes
	Version Control	Yellow	Medium	communication, training (understand the form), make sure your gold standard has rules and defined goals. Incorporate pre-flight checklists and pre-departure meetings to make sure everyone is up-to-date on with versions and equipment. Governance or a Project Lead will help in order to organize this. Standardized methodologies that are communicated to the team. Design a routine to eliminate errors from doing things out of order ("a standard habit"). Have a "morning assembly" to make sure people know what is going on and how to use forms
Getting field data into electronic formats	Resources Limitations: Equipment & People (analysis takes time)	Yellow	Low	Get more equipment (money) or higher other labs that have more people or equipment (but going to other people can create inconsistencies)
	Time delay between collection and processing, and then loss of information that is needed for a complete record	Green	High	Reduce time delay - collect and process data - electronically compatible paper. If you are going to create a gold standard, have a time expectation for when you expect the data to be returned (build timetables into the plan) - delete the paper step from the plan so you are only using electronic. Look at systems that upload information to a cloud instantly. Consider data security
	Inconsistency in questionnaires/surveys so you can compare groups	Green	High	Have a list of available questionnaires pertaining to certain topics
	Operating Equipment in certain environments (constraints on uses of certain technologies in certain environmental conditions) (in a hazardous area like explosive, rain, flood, dark, you can't always use certain technologies)	Red	High	Ensuring that these limitations are conisdered when choosing solutions
	Untrained team that have different focuses	Green	High	Standardize data entry by callibrating team to make sure they understand the forms and variable being tested + do actual field exercises with them to practice - Designate a data manager in the team
Maintaining PII	Defer all to Maintaining Data Security			
Maintaining Chain of Custody	Defer all to Maintaining Data Security			
Maintaining Data Security	Functionality for user authentication on actual mobile device	Red	High	Commercial industry way of addressing the technology challenge to meet that requirement mandated by federal government
	Inoperability for application within the device (digital signatures)	Red	Low-High (varies upon incident or situation)	Commercial industry way of addressing the technology challenge to meet that requirement
	Something that happens for security adds friction in the field	Yellow	High	Have field practioners involved in your decision making, adopt the mimimally sufficient security requirements + reduce the footprint of security to as small as possible. Plain text explanation of what is required and how to meet that requirement.

Appendix H

BREAKOUT GROUP DAY 1, RECORDER NOTES

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Recorder: Stefanie Tetreault

Breakout Group C: Data Reliability/Tracking (accurate transmission to database & QA/QC, data validation)

- Is there a common data model that can be shared across entities?
  Data is so different; could be a common format, metadata standard
  Communities of practice
  Generate flexible and extensible usage of existing standards (model(s) plural)
  As data is processed and validated – multiple levels of QA/QC and validation
  Day-to-day models vs incident models – overlap?
  Common model yet to be built; hazard-based model
  Need agreement and active relationships for data before incidents
  Certain set of data points that need to be common – space, time, who collected it,
  Metadata standard is somewhat of a data model
  But most is collected/organized after-the-fact
  QA/QC and metadata come in different levels – to different people at different points in the process
  Metadata, Harmonized data, Specific data

- What are the essential core parameters needed for tracking the reliability of data?
  Reviewed? By whom? – verify the source
  Not necessary to go across disciplines – use generic parameters to capture enough for a specific discipline to use
  A process that is known by all and followed; incident planning process
  Reliability to access and validity of data
  By discipline, by _, by source

Transcription verification; Subject matter expert validation;
Removal from raw data, transcription verification
"Authoritative source" is a big challenge – how do you verify
Peer review – initiated by the public, questioning
Time scale – incident scenario – not going to get peer review; provisional data

- What are the system requirements for data reliability and tracking?

Metadata
Across platform, flexibility
Cannot be tied; central location
Principles required?
Accessing data through web services, loosely coupled – allows for federated databases
Ability to upload to a pre-established master index
IT issues, security – data backup, archive and maintaining original
Network communication, stability of the comms
Always going to have a hybrid data system – paper and electronic; issue is the dynamic of the system
Validate that the data sent is the data received
Not thinking too big, take a modular approach and scale up
Being able to query
Design methodology to bring all data together
Each domain of knowledge has different rules for QA/QC
Need a checkbox "has QA/QC been performed?"
Data validation and reliability is the responsibility of the owner

- How are data reliability/tracking designed to maintain data security?

Checksums
Not necessarily concerned with the data but that it is not tampered with
What is sent vs what is received
Encryptions in transit and at rest
Crowd-source data
Let people develop a reputation of reliability
Certify archived data – maintain integrity of original copy
Version control; version information for devices that are collecting and processing data

- What are the QA/QC processes used and are they community and/or scientifically accepted standards?

Peer review not practical at incident, third party validation
QA/QC at high level are basic, at domain specific
Work groups; producing derivatives of the data
Record the source of the data
Can't go back after collecting original source data

- What is important for data reliability, QA/QC and validation when moving data from field collection into an electronic format?

Scanning original source data to store alongside electronic data file; transcription verification
Archiving material – holding times to consider
Physical sample to archive
Physical object and electronic object to be tracked together along with characteristics of them (including disposal, location, sample id, sample expiration date, info to allow sample to identified)
Data collection for some final informational product is product-specific
Fed/state/local response plans in place
Robust, flexible, system and processes to move data from field to electronic form
Nomenclature – a challenge to proper interpretation; need a common vocabulary
Overall standardization – vocabulary, units,

- What is the process for informing data generators/users about the status of data from collection to archives?

Should have point of contact for feedback
Posted production schedule
Push-pull
Define the user; how much access allowed
Having provisional pathway built in to data flow –
Status on push-pull basis
Versions
If not done well, may be viewed as not transparent
Not including information because it might be misinterpreted
Need subject matter expert –
A system to keep generators and users engaged/informed on where the data is in the process
"Generators and users" doesn't necessarily capture everyone – information at a granular enough level to be able to communicate where things are in the process; and be able to track it
Require a data source and a contact mechanism; whoever receives the data is now an "informer"
To who is the data meaningful for?
If you want to provide data, must provide contact – chain of custody

- What are the software and techniques for tracking disparate data sets for structured and unstructured data; where are they in process (at what lab, have they been analyzed? Have they been validated?)

Notes

- Optional: What are the standard data types and protocols for emergency response?

Notes

- Shoreline and/or soils

Notes

- Water column

Notes

- Air

Notes

- Human Health

Notes

- Other

Notes

General Discussion:

Crowd sourcing – sometimes it works

"Final Answers"/Conclusions/Summary:

Group C: In regards to Data Reliability/Tracking:				
	Issues and Challenges	Difficulty in addressing issues	Priority in Addressing	Path Forward?
		(Red/Yellow/Green)	(High/Med/Low)	
Common Data Model(s) & Core Parameters for tracking reliability of data (combined)	defining metadata standards	Green	High	clarify the concept to enable a coalition to develop a project-based approach; leveraging estisting systems and how they can be adapted; design an easy-reading training/internal outreach strategy
	adopting metadata standards	Red	High	engage NOAA and metadata subject matter experts to establish a training plan/path forward
	implement metadata standards	Red	High	see above
	version control	Green	Med	
	cryptographic signature	Green	Low	
	checksum	Green	Med	
	building comprehesive QC plan (validation levels, usability, methodologies, versioning, links to publications, historical and baseline data, links to source, study plan, QAP)	Red	High	scan, analyze, adapt/adopt; review existing large-scale plans

	implementing QC plan	yellow	High	see above
	Need agreement and active relationships for data before incidents (preplan)	yellow	high	see above
	easy translation and communication to public - common language/public outreach on understanding data quality and importance of metadata	yellow	high	make this a priority and work with incident command structure; forms, job aids, info inserts for incident management handbook & work flows
System Requirements	support for implementing the common data model/higher level plan	yellow	high	making the decision to follow
	across platform flexibility & within-plan flexibility for emergency response	red	high	take into consideration in the plan above
	each domain of knowledge has different rules for QA/QC	red	high	relying on outside standards; making recommendations of existing standards
	robust volunteer (non-federal, individual, organization) coordination plan	green	med	identify existing example plans, create template; identify volunteer groups in each region for regional response teams

	interaction with community (citizen watch, crowd sourcing, overarching social media)	yellow	high	tie into education and outreach; establish outreach plan; develop sub-template of requirements to ask of these people (informal 'metadata'); flexibility in platform (twitter, etc);
Maintaining Data Security	defining data security - what is necessary (checksums, GPG signatures,chain of custody)	yellow	high	policy recommendation; creating a plan; having a panel of experts from different domains to verify/validate protocols to validate authenticity;
	at rest and in transit encryption (organizational agreements)	green	Med	see above
	adopting security plan	red	high	see above
	defining who should have access, levels of access (system level, local admin rights, not requiring an IT person in the field)	red	high	see above
	defining organizational vs common levels of data security	red	high	see above

Developing community and scientifically accepted standard QA/QC processes	**Need for a coalition of government, public, scientific, academia, stakeholders**	red	high	identify, organize, and deal with the low-hanging fruit; implement the plans noted above
Data reliability, QA/QC, and validation when moving data from field to electronic format	**Scanning original source data to store alongside electronic data file; transcription verification and validation**	green	high	developing best practices for capturing and submitting data types; supply tools and training to enable field personel
	Archiving material, physical samples – holding times to consider	red	high	consider early on, how long to be kept and reasonable limitations
	Physical objects and electronic object to be tracked together along with characteristics of them (including disposal, location, sample id, sample expiration date, info to allow sample to identified)	yellow	high	determine importance of sample to set time to be kept; identify potential for legal ramifications
	Robust, flexible, system and processes to move data from field to electronic form	red	high	very important for QA/QC, see group A

	Nomenclature – a challenge to proper interpretation; need a common vocabulary	yellow	med	identify appropriate standards; invite experts to develop vocabulary across domains
Informing data generators/users about the status of their data & Tracking Disparate Data Sets as they are processed	**designing and implementing flexible infrastructure to provide multiple types of access; clearly defined roles and responsibilities; Should have point of contact for feedback from data providers**	red	high	The following points relate to informing generators/users status of the data:
				Having provisional pathway built in to data flow –
				Status on push-pull basis
				Versions
				If not done well, may be viewed as not transparent
				Not including information because it might be misinterpreted
				Need subject matter expert –
				A system to keep generators and users engaged/informed on where the data is in the process

				“Generators and users” doesn’t necessarily capture everyone – information at a granular enough level to be able to communicate where things are in the process; and be able to track it
				Require a data source and a contact mechanism; whoever receives the data is now an “informer”
				To who is the data meaningful for?
				If you want to provide data, must provide contact – chain of custody
Preliminary Conversation:				
short term vs long term priorities				
the hardest problems yeild greatest gains				
system of preparedness - science/academia information management; data and sample management plans				
what makes data valid and useful - bringing this into the preparedness plan				
QA/QC needs to come from the source of the information; and be				

Appendix I

BREAKOUT GROUP DAY 1, RECORDER NOTES

Instructions to Recorder: If conversation follows the questions and you can take notes below each question, please do so. If conversation does not closely follow questions you may take notes at the end, below all questions, under "General Discussion". There is also a "Final Decisions/Conclusions/Summary" area at the end. Alternatively, if you have "final decision" items under each question you can highlight them in a certain color to designate. If appropriate, note who says things. There may not be group consensus – if so, please note the differences in opinion and give reasons/examples. At the end of the breakout session, please email me a copy of your notes (laura.belden@unh.edu). Even if they are very rough, it will just be a backup copy so you don't lose your information in case of technology malfunction.

Leader: Mark Miller
Recorder: Angela Sallis
Reporter: Mike McCann

Introduction
Nobody is talking about a single place to store data. We have a giant continuum: still involves huge temporal time scale. Decision makers need data immediately, but others have long time frame. Let's not confuse the time scales. Data management has to meet all the needs. Intersecting these requirements: focus on the right problems. Process, hardware, whole range. May be useful to put in the context of use case(s).

Breakout Group D: Discovery and Accessibility (getting data to the users)

- Is there a common data model that can be shared across entities?
  - Definition: a data model documents and organizes data, defines how it is stored and accessed, and establishes the relationships among different types of structured and non-structured data. Data modeling techniques and methodologies are used to manage data in a standard, consistent, predictable manner in order to manage data as a resource.
  - We do not have a common data model now.
  - Multiple parties that come with their own data model to the response and how do they come to have an understanding of, accepts and using the existing administration policies (open data policy) or common data model.
  - Agreement that whatever you bring to the table works with everything else (platform independent)
  - How do we have an ontology for all the different players?
  - Need a data sharing agreement that establishes things like an ontology.

- This includes using machine-readable and open formats, data standards, and common core and extensible metadata for all new information creation and collection efforts.

- What are the essential core parameters needed for discovery and accessibility?
  - Security is important consideration in maintaining the quality of the data as well as the accessibility. Can still be discoverable, even if it isn't accessible, for transparency. See Open Data Policy.
  - How do we make sure that all archives are secure, like universities? This impacts response requirements of 24/7 accessibility. Open Data Policy has access level requirements.
  - Security has other meanings.
  - Important to define why data might be classified inaccessible.
  - How do systems access each other on a system to system basis?
  - How do I find the databases I need? How do I apply for access? How do I download data?
  - How do I search the data? Keywords, ontologies, classifications between multiple ontologies. Including common misspellings. Has to be defined ahead of time.
  - Difference between ontology and vocabulary. Ontology is classification, vocabulary is definition.
  - Ontology can be used to show links between concepts—shrimp to chemistry, DO, boats
  - Use Case: Multiple datasets collected by different groups that have to be linked together in order to answer a specific environmental question. DOI

- What are the system requirements for discovery and accessibility?
  - Vocabulary/ontology-should be built into system by software i.e., user-centered design.
  - There are certain necessary parameters that should go with every sample. Need to use vocabulary.
  - Online access
  - Public accessible
  - Platform independent
  - Accessibility controls
  - Metadata—hopefully automatically generated as data is collected
  - System has to be dynamic modified for access
  - See OER Data Management model-Rolling Deck to Repository (R2R) model
  - Need valid links to metadata, data, contacts
  - Robust infrastructure to host during emergency situation (lots of bandwidth)

- What are the best practices for data visualization, discovery, and accessibility?
  - Broad spectrum of users defines a very complex for data visualization, discovery, and accessibility.
  - We have lots of best practices, some are white papers that haven't been implemented. Should develop an inventory that can be shared. Identify benchmarking best practices by going to the experts.
  - How do I find a best practice? How do I implement it?
  - Want to be careful when you call something a best practice for lawsuit reasons. Maybe community accepted standards or SOP. Still could be problems with these terms.
  - Have to know what questions you are trying to answer-back to user centered design.
  - Create apps that enable people to capture data

- Need quality statement to go along with data so you can tell how you can use the data.
- Computer mining like on Star Trek- where is that data system that can help you make a decision. Machine read the data and give me the answer.
- Best practice: Collect it electronically.
- Do best practices have common elements that can be cross walked? Need training and awareness. Don't know what you don't know. Important for planning.
- Where does it go after you collect it?

- What are the best practices for maintaining PII (personal identification, human health, SSN, birth date, etc.) and Chain of Custody in discovery and accessibility? Human subjects data protections?
  - Follow guidance of OSTP. Best practices of metadata, e.g., instead of name, use a position title.
  - NCDDC documented best practice for chain of custody during DWH – wiring diagram.
  - Best practices should be shared.

- How is access to data granted to users given that PII data are available and need to be protected?
  - If there is sensitive data in your data set, how do you decide who has access to it?
  - Authoritative data collector can decide.
  - Need to see OSTP guidance-need training.
  - Get into problems when you use secondary source data-how does that work?
  - What about when parts of the data are protected but parts aren't?
  - Interpreting PII to be any controlled data, e.g. marine archeology.
  - There is also business data like budgeting data that is under data control (restrictions) that can't be accessed even under FOIA. Should make a single list that could be shared and put in metadata records.

General Discussion:

- Where does analysis fit into the picture?
- How do we link in those things? Whose responsibility is it to link the breadcrumbs back to the original data? In metadata, it is the responsibility of the product creator to link back to the original data. Digital Object Identifiers (DOI) can help with this but need more awareness and training.

"Final Answers"/Conclusions/Summary:

- We don't have a common data model, and we may never have one, but we need the ability for the multiple ones to work together (interoperability).
- Discovering the fact that the database exists, then being able navigate the database.
- Keywords, spatial, temporal

- User-centered design
- Good metadata, good metadata training, staff and support
- Should develop an inventory of best practices for data visualization, discovery, and accessibility that can be shared

Group D: In regards to Discovery and Accessibility:

	Issues and Challenges	Difficulty in addressing issues n)	Priority in Addressing High Medium Low	Path Forward?
	Funding and Staffing (problem across all questions)	R	High	Evangalizing, putting emphasis on data management, bad data means bad decisions that can kill people. Scope the scale of the problem. Write data management into project plans (10-15%). Good data management can save money in the long run. Academic and/or industry investigation of how good data management can save money.
Common Data Model(s)	Many	Y	High (Essential)	Interoperability between the models through training, awareness, consistency of the existing sytems and core elements. Required by Open Data Policy for federal entities to move in this direction.
Core Parameters for discovery and accessibility	Limited awareness of core parameters/elements	G	High	Nine core elements plus nine if-applicable elements from Open Data Policy . See http://project-open-data.github.io/schema/ . See Common Core elements. Make this information more commonly known through evangalizing, training, publications.

	Limited implementation of core parameters/elements	Y	High	Nine core elements plus nine if applicable from Open Data Policy . See http://project-open-data.github.io/schema/ . See Common Core elements. Using this information modify existing and new systems. Metadata requirements are extensible.
System Requirements for discovery and accessibility	Acknowledge that many members of the public do not have access to the Internet	R	Low	Use of traditional media to provide information to public; don't rely on Internet/Social Media
	Bandwidth during an incident to both upload and download data	Y	Medium	Awareness that this is a major problem during an incident. Evaluate alternative communication models such as Wave relay to stand up local infrastructure; UAVs; mesh networks; other technology to address. Communicate what technology and permissions are needed to decision makers. Acknowledge that there is expendiential growth in data.
	Infrastructure (hardware) exists for sharing data across entities	G-Technical, Y-Process, R-Security, G-Industry Internally,	High	Data sharing agreements and discussions before incidents.
	Storage and archiving the data long term so it can be accessible	G-storage; Y-Archive	High	Data centers already exist for archiving issues, but there are issues that exist that go beyond. Recognize that data centers are underfunded. register data with and make it known to use Data.gov and HAZUS.gov
	Sharing process and policy information	G	High	Two pager from federal perspective to list/explain all policies affecting data access; shared broadly as possible.

	Implementation of policy	R	High	Cultural shift for some agencies. Need decision makers to get behind. Need resources.
Developing Best Practices for data visualization, discovery, and accessibility	Information Officer when incident occurs to coordinate data accessibility	R	High	Incident management handbooks have to be adjusted to include this which is a high level decision.
	Lots of command structures in an incident. Need to share data for decision makers timely in common data products/presentations.	Y	Medium	Need a common system like DIVER or GII like Homeland Security's which can visualize many streams of data. Need awareness of all the different options.
	Need for data to be checked for quality assurance/sensitivity prior to accessibilty during an incident prior to release to media/public	Y	Medium	Resource question. Need people who aren't generating data to check it. Joint Information Center if incident is big enough.
	Need metadata training	G	High	Online metadata training is currently available. Different levels of metadata training for different roles. Figure out which entities need to take it.

	How do users know what words to search with?	Y	Medium	Users want it to work like Google, temporal, geospatial. Learn from people with diverse users. Develop smart user centric smart ware that link associated themes. Give user limited number to help guide user --pull down lists.
	No awareness of existing ontologies, common vocabularies	G	High	Link existing ontologies; training
	Implementation of keywords and ontologies for response data by the data generator	R	High	Find out what vocabulary industry uses; dealing with full range of data generators;
	Multiple entities and agencies come to an incident with their own system. How do you connect those information streams?	Y	Medium	Can be done with communication but security may be a problem. Lead agencies in incidents need to come to an agreement about data sharing.
Developing Best Practices for maintaining PII and controlled access data during discovery and accessibility	Lack of awareness of definition of PII and controlled access data	G	Medium	See Open Data Policy https://cio.gov/wp-content/uploads/downloads/2012/12/Standardized_Digital_Privacy_Controls.pdf Make this policy well known. Identify all the issues and policies that deal with controlled-access data

	Implement best practice for developing access to PII and controlled-access data	Y	High	Resources. Decision maker buy in.
Developing Best Practices for maintaining Chain of Custody during discovery and accessibility	Lack of Accountability and Ownership	Y	Medium	Goal is to reach electronic submission. Understanding of litigation hold: General counsel define minimum requirements for litigation hold
	Multiple process for chain of custody depending on collector	G	Medium	Need for synthesis. Need to identify the different processes.
Granting users access to data while maintaining PII and controlled access data	Transparency of users knowing the data exists even if they can't get access to the actual data	Y	High	Awareness of the Open Data Policy which gives policy guidance on this issue. Make users aware of why data is being restricted.
	Who decides which users get access?	G	Medium	Responsibility falls upon authorative source. It is the authorative source's job to know the laws and policy.
	When request come in for multiple data sets, you don't always have enough information about the data and if it contains sensitve information	Y	Low-In heat of incident as all is sensitive High-in long term	Same as above. Authorative source, open data policy, flagged in the metadata.

Breakout Group D: **Discovery and Accessibility (getting data to the users)**

Definitions/Acknowledgements:

Discovery: User (Levels of priority during incident: Incident command, academia, then media/public) knowing that the data or information exists and then being able to find (by search or other method) the specific data desired. Dynamic continuum priority, priorities shift over time. Acknowledge that many members of the public do not have access to the Internet.

Accessibility: Includes how the user accesses the data (by browser, mobile app, or other?) and the level of access (completely public or with credential restrictions). Text messaging can be used after incidents when Internet is down understanding that can't be preserved where appropriate. Bandwidth can be an issue. Acknowledge varied skill levels of users.

Data Model: documents and organizes data, defines how it is stored and accessed, and establishes the relationships among different types of structured and non-structured data. Data modeling techniques and methodologies are used to manage data in a standard, consistent, predictable manner in order to manage data as a resource.

Assumptions:

Large temporal scale – data access in minutes, days, years depending on user and needs

Large user scale – public, Unified Command, NGOs, researchers, media

No common or standard data model

All data system support platform independent, standard file format data exchange (should include standardized metadata). Data sharing agreements where possible, i.e., all parties are aware and agree that interoperability and data access among the entities (see the elements previous).

Access via browser, desk and mobile apps

Integrate security into access and qa/qc
- If user does not have credentials still discoverable but not accessible
- Explain why data/information is
- Understand security of all entities (Universities)

Don't conflict with existing statutes, regulations, guidance
- Open Data Policy (OSTO) – metadata, define user access

Information Quality Act

Inventory existing Best Practices (visualization, discovery, accessibility)
See Ocean Exploration and Research (OER)

User Centered Design (UCD)-who is going to be using system, what questions are they trying to answer, how are they going to access

Storage is different from archive. Archive is version controlled, for posterity, and accessible.

Next Steps:

Use Cases:

1. Multiple datasets collected by different groups that have to be linked together in order to answer a specific environmental question. Digital Object Identifier (DOI) www.datacite.org
2. Amna- conceptual model
3.

Define user ontology and data vocabulary
Would this be different for each user types?

Keywords, spatial, temporal - parameters

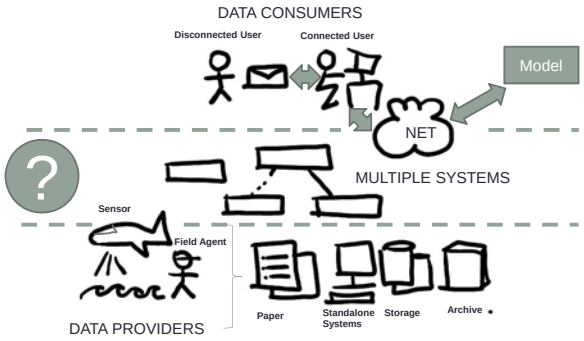
Use case from Amna:

See her diagram photo. Mark took a photo.

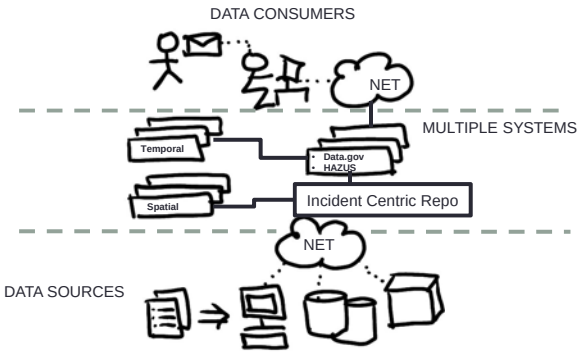
See Russ's DWH Slide. He or I can email.

GROUP D: IN REGARDS TO DISCOVERY AND ACCESSIBILITY

Scope



Issue: How to integrate multiple systems with multiple formats with end users



Assumption

- All data system support platform independent, standard file format data exchange (should include standardized metadata). Data sharing agreements where possible, i.e., all parties are aware and agree that interoperability and data access among the entities

Common Data Model(s)

- Many
- Interoperability between the models through training, awareness, consistency of the existing systems and core elements.
- Required by Open Data Policy for federal entities to move in this direction.

System Requirements for discovery and accessibility

- Limited awareness of core parameters/elements
- Nine core elements plus nine if-applicable elements from Open Data Policy . See http://project-open-data.github.io/schema/.
- See Common Core elements.
- Make this information more commonly known through evangelizing, training, publications.

System Requirements for discovery and accessibility

- Infrastructure (hardware) exists for sharing data across entities
- Sharing process and policy information
- Data sharing agreements and discussions before incidents.
- Two pager from federal perspective to list/explain all policies affecting data access
- Shared information broadly as possible.

System Requirements for discovery and accessibility

- Storage and archiving the data long term so it can be accessible
- Data centers already exist for archiving issues, but there are issues that exist that go beyond.
- Recognize that data centers are underfunded.
- Register data with and make it known to use Data.gov and HAZUS.gov

Developing Best Practices for data visualization, discovery, and accessibility

- Information Officer when incident occurs to coordinate data accessibility
- Incident management handbooks(IMH) need to be adjusted to include this, which is a high level decision.

Developing Best Practices for data visualization, discovery, and accessibility

- Need metadata training
- Online metadata training is currently available.
- Different levels of metadata training for different roles.
- Figure out which entities need to take training.

Developing Best Practices for data visualization, discovery, and accessibility

- Implementation of keywords and ontologies for response data by the data generator
- Find out what vocabulary industry (relevant domain) uses
- Integrate and communicate with full range of data generators

Developing Best Practices for maintaining Chain of Custody during discovery and accessibility

- Lack of Accountability and Ownership
- Goal is to reach electronic submission.
- Need understanding of litigation hold: *General counsel define minimum requirements for litigation hold*

Developing Best Practices for maintaining Chain of Custody during discovery and accessibility

- Multiple process for chain of custody depending on collector
- Need for synthesis of entity policies.
- Need to identify the different processes.

Granting users access to data while maintaining PII and controlled access data

- Transparency of users knowing the data exists even if they can't get access to the actual data
- Awareness of the Open Data Policy which gives policy guidance on this issue.
- Make users aware of why data is being restricted.

Granting users access to data while maintaining PII and controlled access data

- When request come in for multiple data sets, uploaders don't always have enough information about the data or know if it contains sensitive information
- Awareness of the Open Data Policy which gives policy guidance on this issue.
- Responsibility falls upon authoritative source. It is the authoritative source's job to know the laws and policy.
- Flagged in the metadata.