A01. **3D Nation: The Interagency Working Group on Ocean and Coastal Mapping: Update on the National Coastal Mapping Strategy**

Sasha Pryborowski and Ashley Chappell, NOAA Office of Coast Survey; Jennifer Wozencraft, U.S. Army Corps of Engineers

The federal IWG-OCM has completed this first iteration of a National Coastal Mapping Strategy (NCMS) in August 2016. This first version focuses on that portion of the U.S. coastal zone (including Great Lakes) that can be successfully mapped by a mix of lidar techniques for accurate elevation data as part of a 3D Nation effort. Future iterations will include ocean mapping in the offshore and Outer Continental Shelf regions using other mapping technologies to continue to build out the U.S. elevation dataset and meet other mapping needs (e.g. nautical charting, habitat assessment, tsunami models, etc.). The presentation will provide a brief refresher on the IWG-OCM, followed by an update on the final Strategy and preview what will be included in Version 2, which will focus more on ocean mapping and other remote sensing technologies. A description and demonstration of the U.S. Federal Mapping Coordination Site will be included to illustrate how the IWG-OCM agencies, state, local, academic and private sector partners are able to coordinate on mapping data needs and acquisition.

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A02. 3D Nation: The 3D Elevation Program (3DEP) – A National Program for the Acquisition of Terrestrial Lidar Data

Cindy Thatcher, Diane Eldridge, and Allyson Jason, U.S. Geological Survey National Geospatial Program

The Federal Geographic Data Committee (FGDC) NGDA Elevation Theme Community has adopted a vision of the U.S. as a 3D nation, where the elevation community contributes to making our nation more resilient and the U.S. economy more competitive by working to build a modern, accurate elevation foundation from our highest mountains to our deepest oceans. 3D Nation unites terrestrial and coastal/ocean mapping agencies in common purpose to achieve an authoritative national geospatial foundation in support of national mapping needs. For terrestrial elevation, the 3D Elevation Program (3DEP) fills the primary leadership role for data acquisition, interagency coordination and partnership development. 3DEP is accelerating the rate and quality of 3D elevation data collection to address a wide range of critical needs. 3DEP is managed by the USGS and includes many partners who work together to build on existing programs with the goal to complete national coverage of 3D elevation data in 8 years. 3DEP distributes lidar point cloud data (ifsar in Alaska) and derivative elevation products and services through The National Map. The presentation will provide a status of the program and overview the process by which attendees can apply for partnership funding to support the acquisition of lidar data over specific geographic areas in the pursuit of national coverage.

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A03. USACE National Coastal Mapping Program: Advanced Lidar Products to Support Storm Damage Risk Reduction

Charlene Sylvester, U.S. Army Corps of Engineers Joint Airborne Lidar Bathymetry Technical Center of Expertise

Engineers and scientists across government, academia and industry require high-accuracy, high-resolution elevation, imagery and derivative data products to address emerging environmental, socio-economic, and emergency response matters aimed at reducing storm risks for people and property, monitoring habitat for benthic, threatened and endangered species, and improving coastal resilience. USACE, NAVO, NOAA and USGS partner to meet these requirements through the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX). Formed in 1998, and re-established in 2012 with a new Memorandum of Agreement, the partners execute operational elevation and imagery data collection programs in the U.S. and overseas. They also advance research and development in airborne lidar bathymetry and complementary technologies through partnerships with industry and academia. USACE operations are conducted under a National Coastal Mapping Program (NCMP), which is funded by Headquarters to provide these data along sandy shorelines of the U.S. on a recurring basis. NCMP efforts are coordinated with Federal mapping partners and stakeholders via the U.S. Federal Mapping Coordination SeaSketch site. This presentation will provide a brief introduction to the NCMP. It will highlight basic and advanced data products developed from the 2014/2015 field campaign along the U.S. West Coast. Basic data products include lidar point clouds, digital surface and elevation models, elevation contours, and imagery mosaics. JALBTCX first piloted an advanced lidar data product to assess coastal change during the Superstorm Sandy emergency response effort of 2012. Since then, JALBTCX has standardized the methodology and data product with a software toolbox implemented in a GIS. With two evolutions of NCMP data products along the West Coast, JALBTCX will operationalize the coastal change product and distribute it alongside its standard NCMP data product suite. They will serve as critical baseline layers for understanding the impacts of the 2015 U.S. West Coast El Nino.

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A04. The USGS Coastal National Elevation Database (CoNED): Integrated Topobathymetric Models for the U.S. Coastal Zone

Jeffrey Danielson, U.S. Geological Survey

Lidar enables the rapid collection of very accurate elevation data over large areas, and during the last decade, airborne laser altimetry has been widely applied to map coastal geomorphology, leading to improved knowledge of coastal geomorphic processes. Accurate high-resolution topobathymetric data are required to establish building set-backs, inventory wetland land resources, identify flood inundation hazard zones, and develop hydrodynamic, sediment-transport, and storm surge models. The Coastal National Elevation Database (CoNED) is an integrated multi-temporal and multi-resolution database aligned both vertically and horizontally to common reference systems that extends the framework of the 3-D Elevation Program (3DEP) offshore into the littoral zone and the inner continental shelf. CoNED topobathymetric models are referenced to the North American Vertical Datum of 1988 (NAVD 88) vertical datum and, the vertical accuracy of the input topography data varies depending on the input data source. Since the input topographic data sources are primarily based on lidar, the vertical accuracy ranges in Root Mean Square Error (RMSE) roughly between 10 cm to 15 cm. CoNED topobathymetric models have been constructed for the San Francisco Bay Region, the Northern Gulf of Mexico, and the Hurricane-Sandy Region. Improved geospatial techniques to mask, interpolate, store multi-temporal terrain data, and to fuse elevation data from multiple point cloud sources will be presented along with an overview of the CoNED topobathymetric model development work flow. Future plans to be presented include expanding CoNED topobathymetric activities to the Hawaiian Islands and the Pacific Northwest with a specific focus on Puget Sound.

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A05. Deep-Sea Coral Habitat Protection over Time and by Depth in U.S. Regions

Heather Coleman, Thomas Hourigan, and Renee King, NOAA Office of Habitat Conservation

Over the last decade, the United States has begun to take a systematic approach to protecting deep-sea coral habitats from fishing impacts. This presentation reviews the coordinated steps that the U.S. Fishery Management Councils and the National Oceanic and Atmospheric Administration (NOAA) have taken to advance conservation of vulnerable deep-sea habitats. In 2009, NOAA's Deep Sea Coral Research and Technology Program began a series of multiyear, regional research programs to collect information that can be directly translated into conservation action. Research priorities were developed in collaboration with fishing and management communities. Compilation of both new and historic data, and a systematic application of species distribution modeling has allowed extrapolation from study sites to larger areas relevant to management. Examples from the northwest Atlantic and northeast Pacific illustrate how this new, finer-scale information is being applied to understand and manage fisheries impacts, and point to areas where additional progress is needed. The Deep Sea Coral Research and Technology Program's database maintains these data, and makes them broadly available. Maps shown in this presentation display the amount of habitat that has been protected from various types of fishing impacts across the Fishery Management Council regions over time and according to depth, overlaid with known areas of deep-sea coral.

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A06. An Alternatives Analysis Tool for the West Coast Groundfish Essential Fish Habitat Review

Allison Bailey, Sound GIS

The Pacific Fishery Management Council (Council) is currently reviewing Groundfish Essential Fish Habitat Conservation Areas (EFHCA) off the West Coast of the United States. The Council is evaluating proposals that include additional areas to be closed to commercial trawl fishing, as well as re-opening areas that are currently closed. During this review, they will consider the importance of the habitat to groundfish (i.e., rockfish, flatfish) and other ecosystem components, as well as the economic impact or benefit to the fishing community. The Council has identified two public proposals to be evaluated in their entirety as stand-alone alternatives. In addition, they would like information about each of the individual polygons for all of the proposals, so they can evaluate the potential benefits and impacts of a custom combination of the areas. The full proposals and individual polygons will be evaluated based on a list of proposed metrics. Some of the key information for the metrics includes seafloor habitat type, both physical and biological, and existing trawl fishing effort and revenue. To facilitate the Council's review of the EFH alternatives, I developed a web-based decision support tool, using JavaScript, to query and access the analytical information visually and interactively. With this tool, one can select a custom set of polygons on a map and immediately view the summarized metrics for the selected polygons. The user can also view and download a list of selected polygons and their associated individual metrics. The tool will provide access to the information in a way that is more accessible, and allows the Council to review a range of what-if combinations of potential closures and openings to see the trade-offs between different options. Ideally, this tool will support better decision-making about fisheries management and habitat conservation.

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A07. NOAA's National Database of Deep Sea Corals and Sponges: A Resource to Inform Conservation and Management, Highlighting Work in the Gulf of Mexico

Robert McGuinn and Enrique Salgado, Jardon and Howard Technologies, Inc. at NOAA National Centers for Coastal Ocean Science; Matt Dornback and David Sallis, General Dynamics Information Technology at NOAA National Centers for Environmental Information; Scott Cross, NOAA National Centers for Environmental Information; Matt Poti, CSS-Dynamac, Inc. at NOAA National Centers for Coastal Ocean Science; Brian Kinlan, NOAA National Centers for Coastal Ocean Science; Thomas Hourigan, NOAA Fisheries Service Office of Habitat Conservation; Peter Etnoyer, NOAA National Centers for Coastal Ocean Science

The United States National Oceanic and Atmospheric Administration (NOAA) Deep Sea Coral Research and Technology Program has developed a comprehensive geo-database for deep-sea corals and sponges (deeper than 50 m) as a resource for both scientists and resource managers. The database currently integrates more than 250,000 deep-sea coral records and more than 70,000 deep-sea sponge records, most from U.S. waters. Records were compiled from museums, bycatch from fisheries and fisheries surveys, scientific literature, and in situ observations collected by NOAA and other research institutions. The database schema accommodates both linear (trawls, transects) and point (samples, observations) data types, along with images and additional data related to biology, environment, provenance and accuracy. The database structure can accommodate information on size, abundance, density, condition, and associated habitat characteristics. The database structure and taxonomy are based on international standards (Darwin Core, World Register of Marine Species).

A case study showing the use of the database to support establishment of new marine protected areas is presented for the Gulf of Mexico. The Gulf of Mexico is an example of an ocean environment under heavy human impact, such as oil and gas development, fishing, and land-based pollution. Two conservation initiatives using these data to propose new MPAs are the Flower Garden Banks National Marine Sanctuary and the Gulf of Mexico Regional Fishery Management Council. With 15,000 records within the Gulf of Mexico, the database and portal provides managers and researchers access to location-based data and associated reports. Depth distribution, condition, and habitat composition data across 215 Gulf coral and sponge genera provide a baseline for predicting ecosystem impacts from oil spills, climate change, and commercial fishing. We summarize the process by which the database is used to support the design of conservation areas and fisheries closures.

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A08. A Spatially Explicit, Multi-Criteria Decision Support Tool for Loggerhead Sea Turtle Nesting Habitat Suitability

Molly Reif and Lauren Dunkin, U.S. Army Corps of Engineers

In 2014, over 700 miles of Atlantic and Gulf of Mexico coastlines were designated as critical habitat for the federally endangered loggerhead sea turtle (Caretta caretta). While site specific approaches are typically employed, identifying nesting suitability over such a large and dynamic coastal environment requires a regional scale model that utilizes high resolution, yet expansive geospatial data. Morphological parameters (e.g., beach width, slope and dune elevation) extracted from remotely sensed data (e.g., detailed coastal lidar) provide critical inputs into a spatially explicit, multi-criteria decision support tool to determine nesting habitat suitability. The model was applied to a 200 kilometer stretch of coast along southeast Florida and illustrates a regionally scaled approach with an optimized model producing sensitivity and detection prevalence values great than 80% and a detection rate greater than 70%. Furthermore, the model is used as the basis for a newly developed geospatial application within the ArcGIS toolbox to assist users with assessing relative nesting habitat suitability. As such, a user can extract morphological parameters and analyze different weighting schemas for a flexible, yet streamlined approach to evaluate model results in a given region of interest. Spatially explicit tools such as this provide critical decision support assistance to evaluate the impacts of coastal projects, while likewise improving opportunities for integrated resource management concepts. In addition, they assist with coastal monitoring and evaluating priorities to enhance our coasts as well as nesting habitat suitability through beneficially managing sediment and other resources.

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A09. Performance of the Riegl VQ-880-G Lidar Sensor in Mapping Coastal Near-Shore Bathymetry

Colin Cooper, Russell Faux, and Nick Kules, Quantum Spatial

Topographic-bathymetric (topo-bathy) LiDAR continues to develop as a unique tool for mapping shallow near-shore and intertidal zones. These data provide extremely valuable information for inundation modeling, habitat mapping, and other coastal zone management applications. Over the past two years a new generation of topo-bathy LiDAR sensors has entered the commercial market that offers increased functionality and expanded performance capabilities. Tasked by NOAA's National Geodetic Survey to collect high resolution topo-bathy LiDAR data, QSI recently deployed one such sensor – the Riegl VQ-880-G - to map over 200 miles of South Carolina coastline. In this presentation, we will provide an overview of the sensor's performance in capturing detailed elevation data in coastal near-shore and estuarine environments, as well as lessons learned from deploying this sensor for this and similar mapping projects. Updated processing methodologies and QA/QC measures will be discussed regarding data creation with focus on the upcoming National Coastal Mapping Strategy 1.0: Coastal LiDAR Elevation for a 3D Nation.

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A10. Fusion Processing for Puerto Rico Regional Sediment Management

Heath Harwood, Joint Airborne Lidar Bathymetry Technical Center of Expertise

The Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) has been performing bathymetric lidar surveys along coastlines in the United States for the Army Corps of Engineers' (USACE) Regional Sediment Management (RSM) since the early 2000's. In 2005, JALBTCX began incorporating an Itres Compact Airborne Spectrographic Imager (CASI) 1500 for not only land classification but for use in benthic classification mapping with a focus on providing physical and environmental fusion products. From 2005-2012, JALBTCX with Teledyne-Optech, developed an in-house field-to-finish software and data-fusion product suite to compliment the Coastal Zone Mapping and Imaging Lidar (CZMIL) system, a new high resolution, bathymetric lidar system designed to perform in shallow, deep, and turbid water environments. From late January to early February of 2016, JALBTCX's National Coastal Mapping Program (NCMP) collected high resolution lidar, hyperspectral and true-color RGB imagery of the entire north shore of Puerto Rico in an effort to map and characterize volume changes since an earlier USACE bathymetric lidar survey in 2001, shoreline condition, coastal structures, and benthic habitat. This presentation will discuss:

- an overview of JALBTCX and the NCMP, CZMIL and CASI collection specifications
- processing examples and workflows for data-fusion with emphasis on hyperspectral processing in coastal environments as well as bottom reflectance, bottom type and inherent optical property derivation

  comparisons to ground-truth data and previously acquired classification data used for benthic habitat mapping.

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A11. Estimating Bank Heights from Lidar Data in Chesapeake Bay

Julie Herman, Robert Isdell, and Karinna Nunez, Virginia Institute of Marine Science

Having accurate banks heights are critical for studying sediment processes in nearshore coastal environments, including sediment input from shoreline erosion, shallow water sediment transport, and estuarine sediment budgets. With newer technologies, bank heights can be measured using ground-based lidar or structure from motion. However, with research projects encompassing huge areal extents, such as the Chesapeake Bay (>18,000km of tidal shoreline), estimating bank heights from remotely sensed data are necessary. Previous studies in stream channels have used multiple cross sections to identify bank heights (e.g. Claggett and others, 2015). Others have extracted breaklines from digital terrain models (e.g. Rutzinger and others, 2012). While lidar data typically have high vertical accuracy, along estuarine shorelines it can be difficult to determine what constitutes the bank. For example, many banks along the Bay have small beaches in front of them, so deciding how far back from the shoreline to delineate the bank is challenging. Using geographic information systems we have developed a methodology to estimate bank heights using lidar data in a raster format and focal statistics. This technique allows large areas to be processed in reasonable amounts of time and solves the problem of identifying the bank remotely. Results can be verified using imagery and field checking. In addition, this protocol is transferable to other areas, and the data are easily imported into ongoing sediment transport and marsh modeling efforts.

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A12. Acquiring Lidar Data in Western Alaska

John Gerhard, Woolpert

In 2016 Woolpert was tasked to acquire lidar data covering the Yukon and Kuskokwim River Deltas in Western Alaska, one of the flattest and most vulnerable regions in the state. The resulting elevation data is to provide multiple government agencies valuable information to support research, mitigation, and resilience activities related to coastal inundation. This project area poses significant challenges when compared to a typical lidar project, due to the isolated, remote nature of the project area and the extreme complexity of the hydrologic feature network. This presentation will provide an overview of the project background, acquisition and processing challenges, planned uses of the data, and expected benefits to the region.

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A13. Innovations in Planning and Public Engagement for Community Resilience

James Schwab, American Planning Association

Planners' increased knowledge of post-disaster recovery processes, and the ongoing development of technological tools to facilitate analysis, visualization, and public engagement in the planning process, have made it clear that recovery and resilience planning is undergoing significant and positive changes that will continue well into the future. These changes can significantly improve the preparedness and resilience of communities that undertake this process; however, much will depend on the communities' capacity to use the tools and processes that become available to them, and to apply the resulting information. Therefore, developing sound, knowledgeable, and forward-looking guidance for the planners and allied professionals most likely to employ such tools and processes in advancing the recovery process is essential to helping the Federal Emergency Management Agency (FEMA), states, and communities fulfill the whole community vision of resilience in the face of future disasters. Over the past year, the American Planning Association and its partners (University of California, San Diego; Placeways LLC; and National Charrette Institute) have completed the first phase of a project to llay out an overall approach for constructing and using a community resilience scenario planning model (CRSPM) that will allow planners to map and analyze existing and projected future flooding hazards in urban neighborhoods, and to develop community resilience strategies that can mitigate these flooding and floodplain-related hazards. One result was to complete and publish a scenario planning model report that is now available on the APA website. In September 2016, FEMA provided funding for a two-year second phase of the project in which the project partners will work with at least one demonstration site community to conduct a public engagement workshop demonstrating such tools after they have been refined using CommunityViz software as the underlying platform. This presentation will describe this project at its point of progress in February 2017.

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A14. Integrating Coastal Resilience into Local Plans and Policies

Benjamin McFarlane, Hampton Roads Planning District Commission

Rising sea levels and land subsidence make Hampton Roads one of the most vulnerable regions in the United States to flooding and storm surge. Counties and independent cities in Virginia have primary responsibility for planning for coastal hazards. Localities in the Hampton Roads region are required to incorporate strategies to address flooding and sea level rise into their comprehensive plans. While many localities have begun working on strategies to address sea level rise and other coastal hazards, considerable room for improvement exists, particularly in regards to incorporating vulnerability assessments and other GIS products into local plans and policies. As part of its mission to provide technical assistance to its local government members, the Hampton Roads Planning District Commission, in partnership with the Virginia Coastal Zone Management Program, has developed a number of data layers which its localities can use to inform their local planning efforts. These data layers include sea level rise and storm surge scenarios and baseline vulnerability assessments. The HRPDC has also produced technical reports which local governments can use to inform their own individual analyses. In addition to its own technical work, the HRPDC has also produced guidance for localities that documents best practices for more in depth analysis. In conjunction with this work, the HRPDC has also worked with its Coastal Resiliency Committee to identify existing data and information gaps, such as the need for first-floor elevations and flood frequency analysis. This work directly informs the HRPDC's work program and regional priorities, and many of the HRPDC's member localities also rely on these data and information products to inform their local planning efforts.

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A15. High Stress Risk Communications

Chris Mack and Emily Dhingra, AECOM

We live in a world today where communication travels immediately and can significantly impact the outcome of a situation, goal, or common interest positively or negatively. People process information differently especially during low-stress or high-stress situations or when they feel they are being supported or threatened. Choice of words, delivery, tone, body language, gestures, competence, memory, and messaging all interact dynamically and can alter the outcome of an intended message especially when the topic involves risk communication. Risk communication matures and is ongoing. This presentation explores research and techniques developed by the Center for Risk Communication with several case studies involving flood plain management and climate change. This presentation will provide a discussion of the following elements: 1. Stress Response & Information - how people process information; what areas of the brain are activated in low stress versus high stress situations; how is information retained in low versus high stress situations (i.e., rational thinking response, emotional response, and fear response). 2. Risk Communication Templates - overview of three popular risk communication templates developed by the Center for Risk Communication including R3 (i.e., the rule of threes), CCO (i.e., compassion-conviction-optimism), and 27/9/3 (i.e., 27 words / 9 seconds / 3 messages). 3. Application of the High Risk Communication to Sea Level Rise Scenarios - an example of risk communication templates and messaging (i.e., Covello's communication templates) applied to sea level rise scenarios impacting a developed coastal community such as Charleston, SC. 4. Tips/guidelines for preparing risk communication presentations and briefs for climate change.

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A16. Tying It All Together: Improving Community Resilience by Integrating Risk Modeling and Community Planning

Mike Robinson, AECOM; Joshua Murphy, NOAA Office for Coastal Management

The U.S. Department of Housing and Urban Development (HUD), in partnership with the NOAA Office for Coastal Management, American Planning Association (APA), Association of State Floodplain Managers (ASFPM), National Association of Counties (NACo) and AECOM, is exploring strategies to more effectively integrate risk assessment and mitigation planning resources into the larger array of local community planning processes. Phase I includes the creation of an inventory of GIS-based models, tools, datasets, methodologies and other resources for flood risk reduction, based in part on direct input from APA, ASFPM and NACo members. This inventory documents each resource's relevance to local planning processes, including "points of intervention" where each resource can be used at the local level. One example of the type of resource included is NOAA's Digital Coast. Phase II will be to develop a workshop showcasing resources from the inventory for delivery to two pilot communities where opportunities have been identified to integrate resources into their local planning processes (for example, as part of updates to a comprehensive plan, hazard mitigation plan or consolidated plan). Efforts will be documented in a report highlighting successes and lessons learned. Phase III will consist of outreach to other communities on how they can replicate the process in their own planning area. Recommendations will also be provided to model and tool developers to help enhance their resources for the purposes of community resilience. Findings of the project will also be channeled back to APA, ASFPM and NACo members. This 20-minute presentation will cover the information above and will be engaging and relevant to participants, particularly local officials. With the explosion of online data in recent years, especially with regard to risk modeling, it is crucial to provide leadership and guidance in identifying, understanding and integrating resources effectively in local planning processes for better decision making.

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B01. Paper vs. Projector: A Mixed Approach to Participatory Mapping of Reef Fisheries in the Mariana Islands

Rebecca Skeele Jordan and Robert Greene, Pacific Coastal Research and Planning

The Pacific Islands are home to a wealth of spatially-explicit, local ecological knowledge. Due to the strong cultural ties that Pacific Island communities have to their coastal environments, and the fine scales at which resource use occurs, this information can greatly enhance efforts toward culturally appropriate, area-based management at high-resolutions. Fisheries-related data in the Mariana Islands exists for pelagic species at coarse resolutions (in offshore waters), while reef fisheries data in nearshore environments exists in the form of creel data, referenced to rectangular survey zones (not representative of actual fishing effort boundaries). This project aimed to supplement and enhance the latter focus area (reef fisheries) by engaging the local fishing communities in the mapping of near-shore/coral reef fishing grounds, thus creating a more accurate portrayal of spatial variation in fishing effort for management and planning. In an effort to gather and visualize this type of geographic information, a participatory mapping project was implemented, leveraging multiple methods of spatial data capture. Due to mixed technical capacities within the local fishing community and varying levels of participation, participatory mapping was conducted using (1) a printed base-map approach, (2) NOAA's Guidance on participatory mapping of ocean uses leveraging digital whiteboard technology, and (3) in-field data capture using GPS tracking of 3 months of fishing trips. This presentation highlights the benefits and challenges of each approach, provides a glimpse into project results, and offers lessons learned. Given the range of ages, technological literacy, and cultural sensitivity of the subject matter, this particular project benefited from multiple methods of mapping, as the mixed approach allowed for diverse means of participation. The mixing of mapping methods requires additional time and some creativity in project design to ensure results are compatible, but may be extensible to other scenarios in which the target participants have such diversity.

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B02. Crowdsourced Bathymetry

Adam Reed, NOAA Office of Coast Survey; Evan Robertson, NOAA National Centers for Environmental Information

Over the past few decades, interest has grown in crowdsourcing for geospatial data. However, significant contributions from crowdsourcing of scientific data in the marine environment for maritime uses has only recently become feasible. In 2016, the International Hydrographic Organization's (IHO) Data Centre for Digital Bathymetry (DCDB) and National Oceanic and Atmospheric Administration (NOAA) collaborated to expand the DCDB to include a crowdsourced database. This database is one of the first publicly available sources to collect and provide crowdsourced bathymetry data. In this presentation, we will discuss the current crowdsourced methods in use, the data available, and several use cases, including by NOAA's Integrated Ocean and Coastal Mapping (IOCM) program. Our goal is to introduce the community to crowdsourced data as an available resource for future use by ocean and coastal interests and to encourage participation from users to contribute.

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B03. Visualizing Sea Level Rise with Citizen Science

Randy Dana, Oregon Coastal Management Program

Two projects of the Oregon Coastal Management Program are brought together to help us see what sea level rise might mean to Oregon coastal communities. One project, mapping projected future shorelines, relies on models of land and water surfaces. These models show that rare events today may become common events in the future. The other project relies on volunteers photographing predicted tidal high water events. These images were compared to aerial images and digital elevation models to estimate water levels in areas where direct measurement is lacking. Together, this information shows where rare inundation events may become common and what they will look like.

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B04. What We Learned (so far) while Trying to Save the World with Citizen Science

Wes Shaw, Blue Urchin, LLC

In this presentation, we'll share some of what we've learned over the past nine years of building technology for crowd-sourcing reporting of coastal events including storm damage, nuisance flooding, king tides, abandoned boats, and beach cleanups. We've worked our way from paper-based forms to dedicated mobile apps built on a cloud platform, all gathering data to: 1) Inform better short and long-term decisions (from emergency response to planning); 2) Help with coastal hazard and sea level rise outreach and engagement efforts; and 3) Provide hard data for ground-truthing oceanographic and meteorological models. We'll focus our talk on our experience with the MyCoast platform (mycoast.org), the successor to the Massachusetts StormReporter system we built with the Massachusetts Office of Coastal Zone Management and then expanded while working with the South Carolina Department of Health and Environmental Control, the Northeast Regional Ocean Council, the Gulf of Mexico Alliance, and others. MyCoast allows users to quickly submit photos from the field via our mobile apps. Our servers augment reports with meteorological and tidal data, and then present the information in various formats based on users needs. For storm damage reports, users include emergency management professionals who use the live-stream view of the reports to help target response efforts, and coastal decision makers who use our maps when making planning, mitigation, and adaptation decisions. The process is designed to minimize the required effort to add the data and maximize the data's utility. The low barrier to participation has led to wide adoption: as of September 2016 more than 1,100 users have contributed 3,750 reports. Participation engages the general public in the issues of coastal hazards. We'll discuss building a crowd-source system: what worked and what didn't, with the goal of helping others avoid some pits we stumbled blindly into. We'll also share stories about the complexities of dealing with untrained citizen-scientists using their own multifarious personal mobile devices.

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B05. A National OCS Sand/Sediment Inventory

Lora Turner, Marine Minerals Branch, Bureau of Ocean and Energy Management; Alexa Ramirez, Quantum Spatial, Inc.

BOEM is developing a GIS to track sand resources on the OCS to support resource decisions. The system is designed to integrate BOEM's state partner's historical and new geospatial data into a uniform data model. Data includes: sediment samples, bathymetry, seismic, and side scan sonar surveys; NEPA, dredged, and sand resource data. An analysis tool has been developed to identify ocean core samples within user defined variables, and then query and process the datasets to create potential sand resource areas.

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B06. Using GIS for Regional Sediment Management: A BCDC Exploration

Alex Braud, San Francisco Bay Conservation and Development Commission

The San Francisco Bay Conservation and Development Commission (BCDC) is a state agency charged with administration of the Coastal Zone Management Act in the San Francisco Bay and authorizes activities including dredging, aquatic sand mining, habitat restoration, flood control and development activities among others. San Francisco Bay is facing two convergent significant changes to the estuarine system, decreasing sediment supply from the Delta and rising seas due to climate change. As a result, BCDC is developing a regional sediment management plan that incorporates sediment management issues from flood control to habitat development, dredging and aggregate mining. As part of this effort, BCDC is exploring several ways it can better understand the internal and external factors influencing the sediment dynamics and management options within the San Francisco Bay system, along with efficiently administering BCDC policies. One important concept to regional sediment management in San Francisco Bay is the best use of dredged sediment, an increasingly valuable resource. It is of high interest to BCDC that dredged sediment is used for beneficial reuse - marsh restoration or other habitat enhancement, levee maintenance, or construction projects rather than being disposed as a waste product. By understanding the costs and benefits of different beneficial reuse sites and the location of dredging sites, and comparing them to sediment supply, a water-based bay-wide network can be created to analyze best use and service areas. Some other efforts include creating a time-aware web app visually depicting the environmental work windows for dredging permits, an enhanced sediment characteristics map for the Bay, and a suitability of sediments for potential beneficial reuse sites.

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B07. Watershed Erosion Potential Mapping Using AHP Modeling and GIS

John Cartwright, Mississippi State University

Many hydrologic systems have impairments from an overabundance of sediment due to instream and upland erosion. Geospatial technologies are effective and often the foundation for decision support systems that can address such problems. The assessment of erosion potential based on watershed landscape characterizations can improve decision making efforts related to erosion in a (coastal) watershed and the associated estuary. The purpose of this research is to utilize geospatial technologies to improve decision making efforts and to better understand soil erosion potential in Gulf of Mexico coastal watersheds (estuarine drainage areas). The current effort involves developing a conceptual model of coastal watershed erosion potential based on landscape characteristics. These characteristics will include slope, stream density, soil erodability, land-use/practice, and precipitation. The model uses the analytical hierarchy process (AHP) and methods coupled with geospatial technologies to look at interactions between the selected characteristics. The conceptual model is executed with three phases or steps for the AHP method. The first step is data layer standardization or classification based on erosion potential. The second step is criterion weight assignment for each of the layers based on scores using Saaty's method of a continuous rating scale for pairwise comparison (Saaty, 1980). The third step is the weighted combinations of the classified data layers with map algebra. This process will define the erosion potential as it looks at each layer based on its' relative importance to the other layers for selected estuarine drainage areas of the northern Gulf of Mexico. The results are summarized, providing a zonal analysis at the sub-basin level with NOAA Coastal Assessment Framework (CAF).

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B08. Coastal Monitoring and Research to Inform a Regional Sand Management Strategy along the Illinois Lake Michigan Coast

Ethan Theuerkauf, Steven Brown, Andrew Phillips, Andrew Anderson, and Kisa Mwakanyamale, Illinois State Geological Survey

Sand management is a priority along the Illinois coast given the high degree of urbanization combined with the need to protect remaining natural ecosystems. Erosion threatens ecologically and economically important landscapes, while accretion creates hazards for maintaining navigable waterways. Decades of geologic research along the Illinois coast have resulted in numerous management recommendations; yet sand management issues remain unresolved. In addition to political and financial constraints, a major barrier to developing a long-term sand management solution for Illinois is a limited scientific understanding of the physical drivers of coastal change as well as regional sediment transport processes. The Illinois Coastal Management Program is addressing these data and knowledge gaps through the development of a research-based sand management program. One of the primary data needs along the Illinois coast is an isopach map of modern sediment distribution to identify borrow sites for beach nourishment and to measure rates and magnitudes of changes to the nearshore substrate. Helicopter time-domain electromagnetic (HTEM) surveys will be conducted in FY2017 to map regional sand resources. Continuous monitoring of beach and bluff morphologic change has not been conducted along the Illinois coast, however, these data are requisite for mapping the extent of erosion and accretion as well as for process geomorphic studies of the dynamics of fluctuating lake level, storms, and nearshore ice. Biannual and event-specific monitoring has begun on beach profiles that tie in with past projects, however, the long-term goal of this monitoring program is to employ unmanned aerial vehicles (UAVs) and frequent regional LIDAR data collection. An improved understanding of littoral transport is also needed for proper sand management. Novel remote sensing techniques to measure hydrodynamics and littoral transport will be combined with beach and nearshore mapping to parameterize a predictive model of coastal evolution that informs a regional sand management strategy.

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B09. The Coastal and Marine Ecological Classification Standard Geoform Component to Buzzards Bay, Massachusetts

Dan Sampson, Massachusetts Office of Coastal Zone Management

The CMECS Geoform Component describes the major geomorphic and structural characteristics of the coast and seafloor by identifying and mapping the tectonic and physiographic setting, geoform origin, geoform, and geoform type. The Massachusetts Office of Coastal Zone Management, in conjunction with partner USGS Woods Hole Science Center, applied the classification to Buzzards Bay, a 28 miles (45 kilometers) long by 8 miles (12 kilometers) wide embayment created during the latter portion of the Pleistocene epoch through the interplay of glacial and oceanic processes. Today, the Bay is heavily utilized by fishing, boating, tourism, and commercial interests; shoreside the Bay is characterized by increasing development and land-use changes. These characteristics make Buzzards Bay an ideal, and challenging, location to apply the CMECS Geoform Component. Massachusetts and USGS first identified pertinent geological, biogenic, and anthropogenic classification units, located or created the necessary spatial data, and mapped the units at an appropriate scale. Where beneficial, we added modifiers to either clarify or further refine the unit. Many federal datasets were used including NOAA NOS charts, bathymetry, and U.S. Fish and Wildlife Service National Wetlands Inventory (NWI). The resulting classification compliments existing Massachusetts CMECS Substrate and Biotic Component mapping and serves as a baseline against which future change can be measured.

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B10. Ecological Marine Units

Keith VanGraafeiland and Drew Stephens, Esri

Given the general availability of remotely sensed or in situ-derived information describing the earth's surface, several regionalizations of the global ocean have been developed which divide the sea surface into environmentally or biologically distinct areas. These two dimensional characterizations are limited to describing sea-surface and/or benthic properties, and there is no synthesized or mapped information which describes the entire water column in three-dimensions. Fortunately, however, globally comprehensive pelagic environmental data do exist, and advances in three dimensional analytical and visualization technologies now permit the mapping of the physical and chemical structure of the entire global water column. We constructed a regularly spaced ocean point mesh grid from sea surface to sea floor, and attributed these points with 50 year average values for six physical and chemical environment parameters (temperature, salinity, dissolved oxygen, nitrate, phosphate, and silicate). Over 52 million points were used to tessellate the global ocean in x, y, and z dimensions, and these were statistically clustered into 37 distinct volumetric regions. The 37 clusters, termed ecological marine units (EMUs), represent physically and chemically distinct regions based on spatial variation in key marine environmental characteristics. Twenty two of the 37 clusters are globally or regionally extensive, and account for 99% of the ocean volume, while the remaining 15 are smaller and shallower, and occur around local environmental gradients. EMU distributions by depth were characterized against traditional oceanographic notions of ocean zonation. We found support for the existence of different numbers and sizes of distinct marine regions varying with depth, and a general zonation pattern by top, middle, and lower water column. The EMU distributions were compared with a map of biogeographic realms constructed from an analysis of species distribution data from the Ocean Biogeographic Information System (OBIS) dataset, and considerable spatial congruence is apparent for several EMUs.

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B11. Chesapeake Bay: Tools for Analyzing Three Decades of SAV Monitoring Data

David Wilcox, Robert Orth, and Jonathan Lefcheck, Virginia Institute of Marine Science

Chesapeake Bay, one of the most researched, monitored, managed, and iconic estuaries in the world, has been undergoing profound changes over the last half century. Increases in population, both human and animal, changes in land use, increases in nutrient loadings and shoreline changes have altered the Bay. Annual assessments of Chesapeake Bay health using 7 key indicators have shown improvements in regions with reduced nutrient loadings but degradations in other regions. Submersed aquatic vegetation are one of the key indicators that provide explanations of these trends because of their sensitivity to water quality, shoreline development and land use. More than 30 years of annual SAV GIS monitoring data provides detailed spatial information and insight into how aquatic grasses are responding to changes in the Bay. Spatial and statistical analysis of this dataset is helping to explain SAV trends that are pointing to shifting baselines that are being driven by water quality, shoreline modifications, invasive species, and climate change. The changes in these sentinels will have a significant influence on the numerous ecosystem services they provide to the Chesapeake Bay ecosystem, such as carbon sequestration, nutrient filters and habitat for numerous species.

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B12. Indian River Lagoon Florida Seagrass Mapping

Keith Patterson, Dewberry

Dewberry has completed three contracts with the St. Johns River Water Management District (SJRWMD) for seagrass mapping within Indian River Lagoon and adjacent estuaries in Florida. The intent of these projects was to prepare seagrass maps for an ongoing trend analysis aimed at documenting seagrass distribution over time. Approximately every two years, aerial imagery is acquired and mapping is completed within the estuaries. The projects included the acquisition of time-sensitive digital aerial photography of the Indian River Lagoon (IRL), ground-truthing fieldwork aimed at documenting seagrass habitats, time-series change analysis and photo interpretation, and the creation of lagoon-wide seagrass ArcGIS maps from the aerial photography. The resultant data provides an overall picture of the seagrass resource within the Indian River Lagoon and serves as an important management tool for assessing distribution trends. The mapping and trend analysis performed under these projects provides quantifiable data vital to the assessment of water quality and the general health of the estuarine system.

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B13. The Impact of Flood Frequency on Land Cover Change Type

Francois Smith and Mary Latiolais, MDA Information Systems LLC

Flooding is a threat to much of the coastal United States and they directly impact the landscape on which they occur. It is difficult to measure or characterize this impact on the ground over a large area. But it can be quantified if you have access to satellite imagery at regular intervals. This study explores how often a study area floods, and what impact the frequency of flood events has on that landscape using multi-date Landsat imagery and C-CAP land cover data for the same area. The area around the Texas/Louisiana border are highly prone to flooding. The past couple of decades have seen numerous flood events in this area, and this year has been particularly devastating. In our study, approximately 10 years of Landsat imagery (ranging from 2000 to 2010) have been compiled for the study area composed of a single scene area. This is used to calculate a 10-year flood frequency layer. NOAA OCM's C-CAP land cover data is then obtained for the same area for the two dates, 2000 and 2010. These land cover datasets are used to generate from-to bivariate land cover change classes. These classes are then used as zonal boundaries within which statistical variables are generated based on the flood frequency layer. By analyzing this information we characterize what classes changed to what other classes given different frequencies of flooding. Also we look at other statistics such as flood variability to see the impact of that on land cover change. Finally we list the frequency of flooding for each of the C-CAP categories in the study area.

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B14. Cyclones, Casinos, and C-CAP: Responding to Rapid Land Cover Change in the Mariana Islands with Novel Data Development Efforts

Robbie Greene and Katie Graziano, Northern Mariana Islands, Bureau of Environmental and Coastal Quality

Between 2014 and 2016 the U.S. Commonwealth of the Northern Mariana Islands (CNMI) experienced unprecedented changes to its biophysical environment. Significant shifts in land-use composition by large-scale tourism developments were compounded by a direct hit by Super-Typhoon Soudelor and the strongest El Nino episode in twenty years. This pairing of natural and anthropogenic disturbances has effectively reconfigured portions of the CNMI's landscape, and continues to have profound implications on the relevancy of the Islands' geospatial data and models. In particular, existing land cover and land use data from NOAA's Coastal Change Analysis Program (C-CAP) has served as an important foundation for resource management in the CNMI; however, future updates to the 2005 CNMI data products may not occur on a frequency that matches the current rate of landscape transformation in the Marianas. To ensure environmental management is informed by the most accurate and timely data, the CNMI Bureau of Environmental & Coastal Quality has embarked on a two year project to develop high resolution land cover/land-use data products using quarterly deployments of unmanned aerial vehicles (UAVs). With support from an NRCS Conservation Innovation Grant, our team is seeking enhanced output from existing watershed and water quality models through the use of UAV imagery and structure-from-motion technology. Our presentation highlights some of the more conspicuous land cover changes resulting from both natural and human disturbances since 2015, and associated flight paths for the collection of new imagery and land cover data in threatened CNMI watersheds. Our discussion then turns to the anticipated output from watershed modelling efforts that leverage this new data. We expect these products to provide a basis for delineating high-priority management and restoration efforts in the CNMI, while demonstrating a crucial tool for data enhancement throughout the Pacific Islands.

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B15. High Resolution Land Cover Mapping for the Coasts

Nate Herold, NOAA Office for Coastal Management

Understanding current conditions and past change is essential to improving natural resource management in the future, and through its Coastal Change Analysis Program (C-CAP) NOAA's Office for Coastal Management (OCM) has produced highly accurate, well respected land cover information in the coastal areas of the U.S. for decades. Current products include both regionally focused (30 meter resolution) monitoring data that is updated every 5 years and high resolution (1 to 2.4 meter resolution) maps, produced over smaller geographies, that can support applications at a more local level. This presentation will be focused on OCM's decision to move towards monitoring all coastal areas at a 1 meter resolution. We will discuss the phases to this transition, classes that will be mapped and their applicability to local applications, and the potential for states to leverage NOAA funds and cost models in order to obtain high resolution land cover in their states at a drastically reduced cost.

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B16. High Resolution Change Detection and the Puget Sound Change Map

Kenneth B. Pierce Jr., Washington Department of Fish and Wildlife

The Puget Sound Change Map is an ongoing project of the Washington State Dept. of Fish & Wildlife to map land cover changes throughout the 35,000 sq. km of Puget Sound with an emphasis on canopy loss and impervious surface increase. Using 1-m NAIP aerial imagery, the project has mapped over 140,000 individual change locations for the three time intervals of 2006-2009, 2009-2011 and 2011-2013 including 23,000 hectares of non-forestry related canopy loss and over 5,000 hectares of new impervious surface. This comprehensive map of Puget Sound change is designed to help understand dynamic watershed conditions and provide a means for monitoring land cover and land management effectiveness. Each location mapped has been attributed visually by an analyst. This results in the removal of commission error and provides change estimates for multiple quantities and an expert-provided change agent. Change polygons are developed through segmentation and random forests modeling and attribution is performed on polygons having a high probability of change. A skilled analyst can review and attribute about 200 change events per hour adding the following 6 attributes: initial land-cover, change agent, percent change, percent canopy loss, percent impervious increase and percent semi pervious increase. WDFW and other agencies and local jurisdictions have a need for highly spatially accurate change data in order to assess riparian and shoreline change. These often very thin linear features require a high degree of precision to accurately reflect change events within 50-100 foot margins. This presentation will summarize some of the major trends and provide information on data distribution, future plans and potential methods for scaling to larger areas.

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T01. USGS-CMGP Video and Photograph Portal: Accessing Sea Floor and Coastal Video and Photographs from the USGS Coastal and Marine Geology Program

Seth Ackerman, Nadine Golden, Evan Dailey, and Fran Lightsom, U.S. Geological Survey

The U.S. Geological Survey's Coastal and Marine Geology Program (USGS-CMGP) has a vast collection of video and photographs from sea floor and aerial surveys along coastal shorelines. Until 2013, only a small amount of these data sets were available publically. Since then, a new geospatial web-portal was developed to provide a single point of access for CMGP video and photograph data. The portal workflow streamlines the processing and publication of imagery datasets enabling the USGS-CMGP to share the data quickly in a meaningful and interactive geospatial format. Video and photograph data originally collected for a single use are now being easily shared with our own science teams, research partners, the greater scientific community and the general public. As of September 2016, the USGS-CMGP Video and Photo Portal contains over 160,000 still images, more than 1000 hours of video and covers approximately 48,000 kilometers of US coastline and sea floor. The Portal is updated with new imagery as they are collected during new USGS field activities and older data from the USGS-CMGP archives are also being processed and uploaded to the portal. Future goals of the project are: 1) to continue adding additional functionality to the portal interface; 2) enhance user interface for ease of use and new technologies; 3) provide easy access to this rich USGS dataset of fine-scale imagery in an interactive web-format; and 4) meet the needs of USGS scientists, USGS research partners, ocean planning experts and the public.

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T02. Assessing Community Exposure to Coastal Flooding

David Betenbaugh, The Baldwin Group at the NOAA Office for Coastal Management

The Coastal Flood Exposure Mapper allows users to select a location and explore maps that show people, places, and natural resources exposed to coastal flood hazards. Maps in this tool provide a starting point for users undertaking a community-based approach to assessing coastal hazard risks and vulnerabilities. With the choice of overlaying a variety of flood hazard data sets, the user can create a collection of maps that can be saved or shared online. All map layers are available for use as map services for other mapping applications. Also included with the tool are tips for using these maps in a community workshop, several relevant case studies, and resources for continuing risk and vulnerability conversations. Currently, the tool is available for coastal counties along the Gulf of Mexico and Atlantic shorelines, with plans to expand to the West Coast and beyond.

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T03. Sea Level Rise Viewer and Data: Adding Local Scenarios

William Brooks, Rebecca Mataosky, and Matt Pendleton, The Baldwin Group at the NOAA Office for Coastal Management

Tool users gain a powerful teaching and planning aid when they can visualize potential impacts from sea level rise and coastal nuisance flooding, and the Sea Level Rise and Coastal Flooding Impacts Viewer brings this capability to coastal communities. The tool was developed by the National Oceanic and Atmospheric Administration Office for Coastal Management. Many partners and customers are successful in addressing a variety of coastal management issues—public education, resilience planning, and ecosystem restoration, to name a few—when they use the viewer and leverage its underlying data for spatial analysis. Partners and customers value the tool's ability to communicate the potential impacts of various sea level rise and coastal nuisance flooding scenarios. They also value how the spatial data can inform climate-related planning activities. Many options are available for accessing these resources, and this demonstration will focus on some options, including the addition of local sea level rise scenarios.

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T04. Planning and Coordinating Field Work with Esri's Dashboard, Collector, and Workforce Apps

Ken Buja, NOAA National Centers for Coastal Ocean Science

Large-scale, large-participant sampling efforts require substantial coordination, orchestrating the deployment of multiple small boat carrying dive teams to meet the goals and objectives of the field mission and the overall project. Each mission's objective is to successfully survey a pre-determined number of sites distributed by strata based on regional and habitat classifications. It is then the responsibility of the field coordinator to deploy boats with dive teams (combination of fish and benthic divers) to the targeted site. A combination of the Dashboard and Workforce apps used by the field coordinator and Collector apps on the boats will streamline the planning and coordination of the field work.

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T05. Maryland Coastal Atlas and Resiliency Tools

Nicole Carlozo, Maryland Department of Natural Resources

To prepare for future climate impacts, the Maryland Department of Natural Resources has evaluated marsh migration potential and assessed where habitats reduce exposure to coastal hazards. This hands-on session will introduce the recently updated Coastal Atlas mapping platform and showcase datasets that support climate smart conservation and restoration planning. Participants will learn about the development of Maryland's Coastal Resiliency Assessment and how ESRI's Query Tool is being applied to query resiliency data based on program-by-program goals. ESRI's story map platform will also be showcased as a simple way to communicate how data is accessed and used in decision-making.

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T06. CO-OPS' Coastal Inundation Dashboard

Paul Fanelli and Alison Carisio, NOAA Center for Operational Oceanographic Products and Services

The Center for Operational Oceanographic Products and Services (CO-OPS) within NOAA's National Ocean Service (NOS) maintains a network of sensors measuring water level, water velocity, and physical oceanographic and meteorological observations along the nation's coast and throughout the Great Lakes, Caribbean and Pacific islands. CO-OPS is also responsible for maintaining a national network of hydrodynamic operational oceanographic modeling systems. This information supports safe and efficient maritime commerce, coastal resilience, and recreation. Given this wealth of data, CO-OPS has invested resources in building a GIS infrastructure to better integrate our products and services. Customers now have the ability to access CO-OPS' geospatial data using our new GIS Data Portal, which provides formal Open Geospatial Consortium (OGC)-compliant GIS web services. To foster better product integration, CO-OPS is developing a robust new tool to incorporate real-time and historic coastal inundation information: The Coastal Inundation Dashboard. This product will initially be released for three regions (New York City, Chesapeake Bay, and coastal North Carolina) in 2017 and will highlight locations where flooding may be occurring, or is forecast to occur, based on water level gauge observations and model forecasts from hydrodynamic models. Real-time and forecast data are compared against minor flood thresholds established by the National Weather Service (NWS) in order to trigger alerts, which are displayed on the map. For long-term stations, sea level trend and exceedance probabilities are highlighted, and an analysis of historic water level data has yielded the yearly number of flood days throughout the period of record. Finally, the date and height of peak historic water levels are shown with the associated meteorological event listed for reference. CO-OPS intends to work with internal and external stakeholders to expand the product on a regional basis until nationwide coverage is achieved.

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T07. The NOAA Shoreline Data Explorer Application: Including the Continually Updated Shoreline Product

Doug Graham and David Ermisch, NOAA National Geodetic Survey

The NOAA Shoreline Data Explorer provides the Continually Updated Shoreline Product (CUSP), National Shoreline, historical raster T-Sheets, and geospatially displays areas we are planning to provide new shoreline products. This presentation will focus primarily on CUSP and the NOAA Shoreline Explorer application. CUSP provides the most current shoreline representation of the United States and its territories. Shoreline data supports coastal mapping applications and to assist decision makers in developing coastal community plans, managing resources, mitigating hazard events, and conducting environmental analyses to meet our nation's economic, social, and environmental needs. Over the years, several continuous shorelines have been developed, but many have not been maintained and therefore no longer adequately represent current conditions. CUSP has been designed to deliver continuous shoreline with frequent updates. Where applicable, CUSP will reference a mean high water shoreline based on vertical modeling, images acquired near mean high water, or image interpretation using water level stations and shoreline indicators. CUSP makes use of NOAA and non-NOAA contemporary sources to update our nation's dynamic shorelines.

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T08. New York's Geographic Information Gateway

Jeffrey Herter and Alex Kuttesch, New York Department of State, Office of Planning and Development

The New York Department of State's Office of Planning and Development (OPD), responsible for overseeing the State's Coastal Management Program, developed the Geographic Information Gateway (Gateway), and made it publicly accessible the end of September 2015. The Gateway is an award-winning site that makes OPD's geographic data available to the public and decision-makers, supports planning activities of OPD staff and local governments, and serves as a public communication tool. This demonstration provides a brief overview of the Gateway's continuing development process and focuses on the suite of tools the Gateway offers, with an emphasis on interactive stories and a story editor, and application of the Gateway's tools to advance OPD's coastal and offshore planning activities. The Gateway vision was developed using an iterative design process, which provided an adaptive framework allowing incremental updates, structured feedback, and systematic testing of functionality and design concepts. While the initial release of the Gateway focused on the OPD's Atlantic Ocean and resilience planning activities, subsequent additions have been made focusing on Waterfront Revitalization, the Great Lakes, Long Island's South Shore and Long Island Sound. OPD continues to expand the Gateway's content and functionality to ensure its utility as an office-wide resource and public communication tool. The Gateway includes an interactive map viewer, which ingests and publishes map services, a data search and download page, a Latest Conditions page, Focus Area pages, and interactive stories. Focus Area pages allow users to explore program-specific activities, data, and resources in depth. Interactive stories provide an illustrated, user-friendly interface to describe a diversity of topics, from OPD's offshore wind planning activities to the application of living shorelines as a community resilience planning strategy.

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T10. The Digital Coast Data Access Viewer

Erik Hund and Kirk Waters, NOAA Office for Coastal Management

The Data Access Viewer is the NOAA Office for Coastal Management's primary data distribution system for lidar, imagery and land cover products. The interface makes it easy to search for data and allows users to download data with a number of custom output options. Users also have the capability to view image services of individual data sets in the viewer without having to download the data. Come to this session to learn more about the Data Access Viewer and let us know what you think.

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T11. The Northeast Ocean Data Portal: A Web-Based Ocean Planning Tool

Kelly Knee, RPS ASA; Nick Napoli, Northeast Regional Ocean Council; Jenna DuCharme, RPS ASA; Emily Shumchenia, Northeast Regional Ocean Council; Kate Longley-Wood, Seaplan

The Northeast Ocean Data Portal is an information resource and decision support tool for ocean planning from the Gulf of Maine to Long Island Sound. First launched in 2010, the website, norteastoceandata.org, provides user-friendly access to maps, data, tools, and information needed for regional ocean planning. It is used by a broad range of government entities, non-government organizations, and ocean stakeholders. Users can launch interactive thematic maps, download data, and browse a directory of selected information products on other websites. The easy-to-use interactive map interface provides data and information related to the ocean's human dimensions, marine life, and environmental characteristics. The Portal Working Group (PWG) collaborates with many organizations to identify data needs, obtain new datasets, enhance existing datasets, and determine the best ways to map ocean features. Based on that information, the PWG has developed a variety of datasets and maps, which were released on a rolling basis leading since the site was launched. Before the release of the draft Northeast Ocean Plan in May 2016, the Portal underwent a number of updates to habitat, marine life, economic, and national security data. An updated version of the Portal that addressed issues raised during the public comment period, was released prior to the final Northeast Ocean Plan in October 2016. The PWG will continue to add data, maps, and website enhancements on a rolling basis. We prioritize and develop products primarily to support the regional planning process being led by the Northeast Regional Planning Body (RPB) in collaboration with many public and private sector partners. Generally, our development process includes (1) defining specifications based on user needs, (2) compiling, analyzing, and integrating existing datasets, (3) creating a new interactive map and/or incorporating the data into our existing maps, (4) adding the data to our downloadable databases, (5) publicly releasing the map and downloadable data on northeastoceandata.org, and (6) updating and revising the product over time.

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T12. SeaSketch: A Software Service for Collaborative Planning

Will McClintock and Grace Goldberg, University of California Santa Barbara, Marine Science Institute

SeaSketch (www.seasketch.org) is a software service that may be quickly launched and configured to support a wide variety of collaborative planning efforts. Currently, SeaSketch is being used to support marine spatial planning and coordinated research planning in over a dozen countries including the US, Canada, New Zealand, United Kingdom, Montserrat, Curaçao, Indonesia and Australia. Essential features include (1) viewing & querying map layers, (2) gathering spatial data via surveys, (3) sketching and analyzing zones, (4) discussing map-related data and plans in forums, and (5) a rich set of administrative features to configure and analyze project usage. In this demonstration, we will briefly review these features and configure a new SeaSketch project for a participant on-the-fly. We will show how existing mapping resources, such as Esri and OGC-compliant map services, may be leveraged to create a very low cost yet feature rich decision support system.

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T13. How to Use Land Cover Data as a Water Quality Indicator

Jamie Carter, The Baldwin Group at the NOAA Office for Coastal Management; Nate Herold, NOAA Office for Coastal Management

Land cover data provide a useful perspective to help land use decision makers understand what is actually on the ground as opposed to what might have been planned or permitted. Come explore this step-by-step guide that describes how land cover data can be analyzed to assess several water quality indicators. From identifying potential impacts from impervious surfaces to exploring the state of an area's riparian buffer, we'll walk you through the steps and a story map that highlights the land cover information and analysis that are key.

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T14. Expanding Coastal Community Planning Opportunities in Western Lake Erie Using the Natural Solutions Toolkit

Douglas Pearsall, Katie Kahl, Gust Annis, Morgan Chow, and Zach Ferdaña, The Nature Conservancy

The western Lake Erie basin (WLEB) is the warmest, shallowest, and most biologically productive region in the Laurentian Great Lakes. It provides world-renowned fishing and migratory bird-watching opportunities, which contribute important economic revenues to the region. Despite these natural assets, the WLEB has been severely degraded due to increasing human population densities, intensive agriculture, and significant shoreline hardening. Today only 5% of the original 307,000 acres of coastal wetland remains. The Western Lake Erie Coastal Conservation Vision (WLECCV) mapping effort incorporates an expert-driven goal to increase the current acreage of coastal wetlands by 10% and provides the first Great Lakes example of a spatially-explicit conservation plan advancing shared ecological and human well-being goals. Unlike sea levels, water levels in the Great Lakes aren't predicted to rise in response to climate change. However, the magnitude of natural lake-level fluctuations is predicted to increase and extreme high lake levels could exacerbate storm and flood damage to ecological systems and human infrastructure, especially in communities located at river mouths. Using the Natural Solutions Toolkit, we will develop a stakeholder-driven, web-based geospatial platform to put science-based information into the hands of community decision makers and conservation practitioners. To achieve buy-in for on-the-ground projects and achieve conservation goals, these stakeholders will be involved in tool development from the conceptual interface mock up to beta testing. These steps will familiarize community members with the tool, generate feedback on usability, and build trust in the value of these tools for informing decisions. This process will allow planners to envision potential risk scenarios and plan for hazard mitigation through restoration, policy and planning actions that complement economic development, place making and other competing priorities.

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T15. Land Use Web Portal

Junior Sauni, Joseph Meredith, and Grace Felise, American Samoa Coastal Management Program

The Land Use Web Portal (gis.dos.as) is an online tool created and used by the Coastal Management Program and the public. It's a compilation of data relating to land use from the Department of Commerce (DOC), Environmental Protection Agency (ASEPA), and the American Samoa Power Authority (ASPA). Board members on the Project Notification and Review System (PNRS) provided all data for this portal to help with permitting. Users are encouraged to use this data to visually verify existing setbacks and hazard zones when looking into possible development locations by clicking on different data layers. This data is used in conjuncture with the PNRS review process. This is the best available data, but it may not represent all recent changes. The development of the Land Use Permitting Portal was completed by the American Samoa Department of Commerce in partnership with the National Oceanic and Atmospheric Administration (NOAA) Pacific Services Center.

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T16. Shades of Grey: New Techniques to Mosaic Acoustic Intensity Surfaces

Will Sautter and Timothy Battista, NOAA National Centers for Coastal Ocean Science

The NOAA National Centers for Coastal Ocean Science (NCCOS) with support from CSS-Dynamac conducts many benthic habitat mapping projects using bathymetric surveys that contain acoustic intensity from multibeam backscatter and sidescan data. Acoustic intensity data is an invaluable resource for analyzing the geomorphology and sedimentary structures of the seafloor that cannot be detected from the bathymetry alone. Backscatter and sidescan data can be used to identify hard versus soft bottom areas, measure changes in sediment composition and grain size, and even detect marine vegetation cover. The biggest challenge with using this type of data is that the decibel values of the acoustic intensity are relative to the different systems, the time of survey, and even the orientation of the survey lines due to the dynamics of the underwater environment. These issues can create offsets in the dynamic range between different backscatter or sidescan datasets even with calibrated systems, rendering intensity mosaics inadequate for analysts to accurately classify or predict different bottom types. NCCOS has developed a new workflow to integrate intensity products from different sensors, ships, and surveys by rendering the datasets into 8-bit (0-255 value) surfaces and mosaicking them together using PCI Geomatica. PCI Geomatica is generally used for analyzing aerial orthophotos and satellite imagery, but NCCOS has successfully used this software to merge acoustic backscatter and sidescan data into intensity mosaics for the Long Island Sound Benthic Habitat Mapping Project and for the ongoing Seafloor Mapping of the US Caribbean project. NCCOS is able demonstrate how this intuitive new method can be utilized to turn a patchwork of backscatter and sidescan surveys into a vivid seamless surface that can then be used for mapping, monitoring, and modeling benthic habitats.

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T17. MarineCadastre.gov: Ocean Reporting Tool

Dave Stein, NOAA Office for Coastal Management; Christine Taylor, Bureau of Ocean Energy Management

The Ocean Reporting Tool is a component of MarineCadastre.gov, a partnership between the National Oceanic and Atmospheric Administration and the Bureau of Ocean Energy Management. The Ocean Reporting Tool extends the capability of MarineCadastre.gov by delivering marine geographic data in a report-based format using summary statistics, info-graphics, and interpretive analyses. Users can select pre-defined areas or use the custom draw tool to generate reports on general site characteristics, energy and minerals, natural resources and conservation, transportation and infrastructure, and economics and commerce. The new tool is envisioned to be used by ocean planners, policy analysts, and the general public.

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T18. Estuary Data Mapper: A Coastal Information System to Propel Emerging Science and Inform Environmental Management Decisions

Daniel Torre, Naomi Detenbeck, and Todd Plessel, U.S. Environmental Protection Agency

The Estuary Data Mapper (EDM) is a free, interactive virtual gateway to coastal data aimed to promote research and aid in environmental management. The graphical user interface allows users to custom select and subset data based on their spatial and temporal interests giving them easy access to visualize, retrieve, and save data for further analysis. Data are accessible across estuarine systems of the Atlantic, Gulf of Mexico and Pacific regions of the United States and includes: (1) time series data including tidal, hydrologic, and weather, (2) water and sediment quality, (3) atmospheric deposition, (4) habitat, (5) coastal exposure indices, (6) historic and projected land-use and population, (7) historic and projected nitrogen and phosphorous sources and load summaries. EDM issues Web Coverage Service Interface Standard queries (WCS; simple, standard one-line text strings) to a public web service to quickly obtain data subsets by variable, for a date-time range and area selected by user. EDM is continuously being enhanced with updated data and new options. Recent additions include a comprehensive suite of nitrogen source and loading data, and inputs for supporting a modeling approach of seagrass habitat. Additions planned for the near future include 1) support for Integrated Water Resources Management cost-benefit analysis, specifically the Watershed Management Optimization Support Tool and 2) visualization of the combined effects of climate change, land-use and green infrastructure on habitat and biotic integrity for a series of pilot projects across the United States. EDM is an efficient tool for visualizing and obtaining large volumes of coastal data imperative to management, planning and research. Online tutorials are available to showcase the tool and cover basic needs such as visualizing, retrieving and saving data.

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C01. Projects in Varying Environments: Lessons Learned during Acquisition and Processing

Elise MacPherson, Dewberry

In the past year, NOAA has worked with Dewberry on projects in unique environmental conditions throughout the United States and Puerto Rico. Dewberry has been tasked with some challenging lidar and other technology projects where unique approaches, techniques and tools needed to be used. From Central Florida, to Northern Virginia, to the complete western coastline of the United States, unique environmental conditions and events in these areas, such as the effect of El Nino, allowed us to use exclusive techniques for data collection and processing for the most efficient data delivery to NOAA. In Puerto Rico, topographic linear-mode lidar, was combined and merged with data from topobathy lidar sensors on land and underwater at the coastline. In Florida, lidar was collected over a vast flat area in a very wet winter season where pools of standing water had to be avoided. To study the west coast effects of El Nino, a lidar sensor was mounted in a helicopter to fly a single 500 meter swath covering the complete 1,700 line mile coastline within 6 weeks, making sure collection was within a 4 hour low tide window, to produce a QL1 lidar product. This presentation will provide an overview of Dewberry's recent interesting lidar projects, completed in various environments. Unique acquisition and processing techniques, challenges encountered, along with lessons learned will be discussed.

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C02. Constructing Regional Topobathymetric Elevation Models Using Custom ArcGIS Tools

Dean Tyler, U.S. Geological Survey

The Coastal National Elevation Database (CoNED) Applications Project of the U.S. Geological Survey Coastal and Marine Geology Program leads efforts to partner with a number of federal agencies including the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, and a number of non-governmental organizations. As a component of the National Coastal Mapping Strategy, CoNED's role is integrating coordinated light detection and ranging (lidar) data across the shoreline and the littoral zone with topographic (land elevation) and bathymetric (water depth) information. Accurate seamless cross-shore integrated topobathymetric data developed from multi-source information are needed to establish building set-backs, inventory wetland and agricultural land resources, identify flood inundation hazard zones, and to develop hydrodynamic, sediment-transport, and storm surge models. While much of the processing to create topobathymetric models is accomplished with built-in ArcGIS tools, there are some tasks that have either been automated or made more efficient with custom scripting. This presentation will highlight a number of the custom geospatial tools and describe their use. Some of the generic and topobathymetric-centric tools that will be discussed include: 1) Filling spatial gaps in vector and raster data, highlighting the ArcGIS Elevation Void Fill Function for Digital Elevation Model data; 2) Tools for systematically parsing metadata; 3) Transforming Bathymetric Attributed Grid and hydrographic data; 4) Methods to chronologically sort a list of spatial boundaries representing topographic lidar surfaces; and 5) Techniques to perform successive spatial overlays on identified shorelines derived from overlapping topographic data in order to maintain current shoreline position in topobathymetric elevation models. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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C03. Towards an Accurate and Consistent National Coastal Digital Elevation Dataset

Michael Sutherland, Christopher Amante, and Kelly Stroker, CIRES at NOAA National Centers for Environmental Information

Towards an accurate and consistent national coastal digital elevation dataset Accurate depictions of coastal topography and bathymetry are critical for a variety of purposes, including inundation modeling, habitat research, and ocean planning. The importance and need for improved coastal elevation data is specifically mentioned in the National Ocean Policy of 2013. In this context, the NOAA National Centers for Environmental Information (NCEI) is currently developing digital elevation models (DEMs) for various coastal locations in the United States, extending a data development paradigm initially created in response to Hurricane Sandy. Using this framework, NOAA NCEI are able to meet the needs of specific user groups (e.g. tsunami and storm surge inundation modelers), while simultaneously improving the larger national coastal DEM database being developed in conjunction with the U.S. Geological Survey. Of particular importance to the NCEI approach is the overall reduction of the DEM update interval to enable the incorporation of the most recent high-resolution survey data. The free, open access to the completed DEMs allows users to seamlessly integrate NCEI DEMs with those built by other agencies. DEM development best practices and access will be discussed, as well as future directions in improving the product suite.

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C04. Open Heat Vulnerability Mapper

Bev Wilson and Arnab Chakraborty, University of Illinois at Urbana-Champaign

Heat waves that are more intense and occur more frequently are among the expected impacts of global climate change and therefore, measuring and visualizing vulnerability to extreme heat in cities is an important aspect of climate adaptation planning. Our presentation and the tool development effort it documents explores three questions: (1) how should we measure vulnerability to extreme heat, (2) how has the spatial distribution of vulnerability to extreme heat changed over time in the Chicago area, and (3) are the most vulnerable areas of the region and city also the warmest? We package the findings of our analysis into a web-based tool, called Open Heat Vulnerability Mapper, which also has the capability to project outcomes of past trends into the future and explore scenarios that diverge from past trends. To measure vulnerability to heat, we adapted Cutter et al.'s social vulnerability index to those factors which contribute specifically to heat related illnesses and mortality. We rely on census tract level data and maximum likelihood factor analysis at the national scale to isolate the primary variables that affect heat vulnerability and employ the Daymet dataset to capture heat exposure. We developed the tool using open data and open source software so that it could be replicated easily while providing a more robust and transparent foundation for data-driven decision-making. Using the open source software environment R, we develop a web application that makes existing data from a variety of government and local sources available in one place for visualization and analysis. We also incorporate downscaled climate model projections and scenario analysis techniques to explore what the intersection of vulnerability and exposure to extreme heat might look like in the future in the Chicago region.

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C05. Using a Web-Based Decision Support System and Facilitation Process to Assist Great Lake Communities in Creating Watershed Action Plans

Lydia Utley, Kara Salazar, and Daniel Walker, Illinois-Indiana Sea Grant, Purdue University; Jarrod Doucette, Purdue University; Brian Miller, Illinois-Indiana Sea Grant College Program

In the face of environmental degradation, communities need action plans to balance human impact on natural systems in their watersheds. Tipping Points and Indicators is a research and extension program for the Great Lakes states comprised of a web-based decision support system (tippingpointplanner.org) and a facilitated community visioning and action planning process. Tipping Points and Indicators is not simply a web-based library of data layers, but an interactive program that leverages tools and data to support science-based decision making. Communities explore information on land use, natural resources, and environmental concerns to identify watershed tipping points, which are thresholds of human-induced ecological stress that can indicate watershed health. After communities explore and identify information in their watersheds, the program facilitates strategy development and prioritization with land use planners, natural resources managers, and other stakeholder groups. The final product is a high quality action plan focused on a more sustainable future for Great Lakes communities.

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C06. Developing a Web-Based Decision Support Tool for Coastal Permitting in the CNMI

Rachel Bouchillon, CNMI Bureau of Environmental and Coastal Quality

In the Commonwealth of the Northern Mariana Islands (CNMI), spatially-explicit information related to coastal permitting is often scattered throughout many different data repositories, both digital and print. For this reason, the permit application review process for coastal development is often cumbersome and potentially less thorough than it could be. The creation of a map-based decision support tool that incorporates social, ecological, and climate-related considerations promises to help centralize relevant geospatial data and streamline the permitting process. This tool is in the form of an Esri web application that allows permitting staff to query parcels of land and generate a descriptive report on factors that may influence permitting decisions, such as flood zone boundaries and wetland buffers. Such an interactive coastal planning tool is a relatively new concept in the Pacific islands, especially since much of the region is generally slow to adopt new technology, and could set a precedent for coastal permitting in other island nations in Oceania. The tool is currently in a piloting phase with in-house testing among local government staff, and an official launch is expected early next year.

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C07. Sea Level Rise Associated Vulnerability Assessment to Support Planning along Cape Hatteras National Seashore

Michael Flynn, East Carolina University; Tom Allen, Old Dominion University; Tom Crawford, Saint Louis University

Vulnerability assessments of coastal development to multiple hazards are a crucial component of effective hazard mitigation planning. Flood Insurance Rate Maps (FIRMs) are the primary regulatory product that participating communities of the National Flood Insurance Program (NFIP) use to identify development that is vulnerable to storm surge. However, it can take up to a decade or more for FIRMs to be updated, with priority given to more densely populated areas. Therefore the level of flood risk can become inaccurate as time passes beyond the effective date of a FIRM; especially if significant geomorphic changes have occurred, or significant rates of sea level rise/land subsidence exist in the area since the most recent coastal flood risk study was completed. A GIS-based multi-hazard vulnerability assessment was conducted to evaluate the vulnerability of coastal development located along Cape Hatteras National Seashore to coastal erosion, storm surge, and sea level rise. The storm surge vulnerability assessment incorporated coastal change forecast data from the USGS and identified the properties that have the potential to be inundated by storm surge modeling data from the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) display program. The results revealed that the percentage of properties in the study area that have the potential to be inundated by category 1 – 5 hurricanes is 11%, 42%, 53%, 60%, and 67% respectively. Sea level rise scenarios were also added to the storm surge inundation layers to visualize the effect of sea level rise and demonstrate that lower magnitude storm events may inundate greater extents of land as sea level rises.

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C08. Adequacy of Current and Planned Coastal Elevation Data for High Confidence Assessments of Sea-Level Rise Vulnerability

Dean Gesch, U.S. Geological Survey

Coastal elevation data are a critical input for assessments of sea-level rise (SLR) vulnerability. Previous research has demonstrated that the quality of data used for elevation-based assessments must be well understood and applied to properly model potential impacts. The vertical uncertainty of the input elevation data controls to a large extent the increments of SLR and planning horizons that can be effectively used in an assessment. Because recent lidar elevation data along the coast generally exhibit high vertical accuracy, these data have become indispensable for SLR assessments, whether a simple inundation model is used or a more sophisticated process-based or probabilistic model is employed. When properly characterized, the vertical accuracy of the lidar elevation data can be used to report assessment results with the uncertainty stated in terms of a specific confidence level. An evaluation has been conducted of the adequacy of current conterminous U.S. coastal elevation data for quantitative SLR assessments. Vertical accuracy information for available lidar elevation data has been obtained from the U.S. Interagency Elevation Inventory and has been analyzed along with spatially explicit SLR projections and estimates of vertical land movement to calculate the minimum SLR intervals and minimum planning timelines that should be used for assessments in U.S. coastal counties. Statistics accumulated for all the subject counties show the proportion of the U.S. that can be properly assessed using the various SLR rates and time intervals (at specific confidence levels). Some counties do not yet have lidar elevation data that meet 3DEP accuracy standards, but the proportion of the U.S. that can be assessed at fine increments of SLR and at shorter planning horizons will increase when 3DEP-quality data are fully available for the entire coast, thus fulfilling a critical need of coastal managers and planners for accurate, detailed projections of potential impact zones.

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C09. Visualizing Sea Level Rise to Examine the Nexus of Climate Change and Socio-Economic Security

Jory Fleming, University of South Carolina and NOAA Office for Coastal Management; Nicholas Schmidt and Lori Cary-Kothera, NOAA Office for Coastal Management

Studies estimate a sea level rise range of 0.5 to greater than 2 meters by the year 2100. A rise of this magnitude will significantly impact the socio-economic dimensions of coastal communities, which contain approximately 40 percent of the U.S. population and account for close to 50 percent of the U.S. gross domestic product. Data visualizations represent a useful tool for communities preparing for this environmental change. The singular capabilities of GIS for assimilating data allow users to link science to society in a geographic context. The results provide valuable insight for community planning efforts. Increasing the data visualizations from two dimensional (2D) to three dimensional (3D) will help communities better understand the impacts of sea level rise. Charleston, South Carolina is uniquely situated for a case study of this approach due to its location at the confluence of environmental change and cultural, historic, and economic influence. Predicted levels of sea level rise will disrupt this community and result in wide ranging impacts to the region's economic, employment, and infrastructure sectors. In this study data visualizations and 3D mapping are used to get a holistic understanding of the nexus of a changing climate and its effect on Charleston. The lessons learned here are transferable to other coastal cities and to government officials and planners interested in using exploratory visualizations to address sea level rise impacts. The results of this case study indicate that despite limitations in display and analysis, visualizations and 3D mapping are an engaging medium for shaping interdisciplinary spatial planning and revealing important connections between the environment and the community.

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C10. Online Mapping Interface to Link Nature-Based Science and Policy Solutions for Climate Adaptation

Lisa Wedding, Center for Ocean Solutions, Stanford University; Gregg Verutes, Natural Capital Project, Stanford University; Jessica Williams, Jesse Reiblich, and Eric Hartge, Center for Ocean Solutions, Stanford University

To support decision-makers in their efforts to manage coastal resources in a changing climate the Natural Capital Project, Center for Ocean Solutions and Stanford Law School are engaging in, informing, and helping to shape climate adaptation planning across the coastal counties of California. Decision-makers are considering engineered solutions (e.g. seawalls), natural solutions (e.g. dune or marsh restoration), and combinations of the two. Bridging the knowledge-to-action gap in applying nature-based adaptation strategies will help decision makers identify and quantify where coastal ecosystems are most likely to protect people and property from rising seas and more damaging storms. Our interdisciplinary team of scientists, analysts, and legal scholars is working with California coastal decision makers to co-produce an online decision-support tool that will highlight where natural habitats in coastal California play the greatest role protecting people, property, and other coastal assets. In addition, the tool will inform restoration projects that meet the least legal and political resistance, explore any legal impediments to using nature-based strategies, and provide examples of where such strategies have been successfully implemented.

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C11. The "Community Rating System Explorer": A Tool to Support Floodplain Management and Improve Coastal Resilience

Morgan Chow, Lora Eddy, Laura Flessner, and Zach Ferdaña, The Nature Conservancy

Coastal Resilience is an approach and online mapping platform developed to guide management decisions to reduce the ecological and socioeconomic impacts of increasingly frequent and intense coastal hazards and other effects of climate change. Low lying coastal communities experience the most direct impacts from increased storms and sea level rise. In an effort to help these communities address their risk, FEMA's CRS is a voluntary program that encourages a more comprehensive approach to floodplain management and provides opportunities for communities to lower their flood insurance premiums by participating in activities that reduce flood damage to insurable property. Unfortunately, some communities do not have the capacity to take full advantage of the CRS program. To help address this gap, TNC worked with local planners from seven pilot communities in North Carolina to develop The Community Rating System (CRS) Explorer application. This web app helps planners identify areas that are eligible for Open Space Preservation credits, calculates potential CRS points, provides exportable information to support their CRS review process, and helps prioritize future OSP areas. This presentation will demonstrate how the CRS Explorer saves time for the planner administrating the program, allows for more in depth analysis which may help reduce NFIP rates for the greater community, and can serve as flood risk outreach to citizens.

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C12. Maryland Coastal Resiliency Assessment: Mapping Natural Solutions for More Resilient Communities

Nicole Carlozo, Maryland Department of Natural Resources; Michelle Canick, The Nature Conservancy

Natural features can enhance the ability of coastal communities to prepare for and respond to coastal hazard events. Recognizing the risk-reduction benefits of coastal habitats, the Maryland Department of Natural Resources partnered with The Nature Conservancy to evaluate how the state's existing coastal forests, marshes, dunes, underwater grasses, and oyster reefs work together to protect coastal communities. This study adapted and applied the Natural Capital Project's InVEST Coastal Vulnerability Model, The Nature Conservancy's Marsh Protection Potential Index, and The U.S. Army Corps of Engineers' North Atlantic Coast Comprehensive Study. A landscape-level GIS analysis was completed to evaluate coastal exposure to erosion and inundation, and assess how habitats can reduce relative exposure along Bay and Ocean shorelines. Census and floodplain data were applied to identify socially vulnerable communities at risk to coastal flooding. The results of this modeling effort were used to prioritize shoreline and marsh areas where conservation, enhancement, and restoration activities will enhance the resiliency of adjacent vulnerable communities. This presentation will highlight how cross-agency collaboration led to multiple resiliency datasets that are being integrated into local and state conservation, restoration, and hazard mitigation planning.

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D01. Improving the Quality of Lidar Data for Coastal Terrain Modeling and Analysis

David McKittrick, Blue Marble Geographics

As LiDAR data permeates the mainstream, its use and utility is becoming much more widespread and diverse. As a spatial commodity, LiDAR is the raw material from which a wide variety of 3D datasets are generated. Technology improvements over recent years have seen the cost of data acquisition decrease and consequently the coverage and availability of LiDAR data expand dramatically. Concurrently, software developers have been creating increasingly more powerful and affordable tools to allow the full utilization of LiDAR data, making it accessible to everyone. As with any data processing and analysis procedure, the quality of the source data has a direct bearing on the quality of coastal terrain analysis. In this presentation, we will demonstrate various procedures for improving the quality of raw LiDAR data including the removal of noise points and the identification and reclassification of unclassified points that are likely to be ground points. We will also demonstrate the process for filtering points based on elevation, intensity, return number or any other variables, and for manually editing or deleting points from a 2D, 3D, or cross-sectional perspective. Subsequently we will follow the process whereby ground points are isolated and gridded to form an accurate terrain model as the basis for various analytical procedures. From this model, we will generate a flood intrusion model to visualize and analyze the extent of catastrophic flooding events or ongoing changes in sea level. We will perform a change detection process as an illustration of temporal changes in coastal morphology and we will use the high-resolution DTM derived from LiDAR data to conduct accurate volumetric calculations.

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D02. Integrated Bathymetric-Topographic Digital Elevation Model (DEM) Uncertainty

Christopher Amante, Mike Sutherland, and Sharon Mesick, NOAA National Centers for Environmental Information

Integrated bathymetric-topographic digital elevation models (DEMs) are representations of the Earth's solid surface and are the framework for modeling coastal processes including tsunami, storm surge, and sea-level rise inundation. Deviations in elevation values from the actual seabed or land surface constitute errors in DEMs, which originate from numerous sources, including: (i) the source elevation measurements (e.g., multibeam sonar, lidar), (ii) the interpolative gridding technique (e.g., spline, kriging) used to estimate elevations in areas unconstrained by source measurements, and (iii) the datum transformation used to transform bathymetric and topographic data to common vertical reference systems. The magnitude and spatial distribution of the errors from these sources are typically unknown, and the lack of knowledge regarding these errors represents the uncertainty in the DEM. The National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) has developed integrated bathymetric-topographic DEMs for more than 200 coastal communities. NOAA NCEI is currently developing a method for creating accompanying uncertainty surfaces that estimate the DEM errors at the individual pixel-level. The development of high-resolution (1/9th arc-second), integrated bathymetric-topographic DEMs along the southwest coast of Florida are serving as the case study for deriving uncertainty surfaces. The integrated bathymetric-topographic DEMs and the derived uncertainty surfaces will be incorporated into flood risk assessments and subsequent mitigation strategies to support resilient communities.

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D03. Bathymetric Lidar Quality Level Measurements

Nicholas Johnson, USACE - SAM - OPJ - Joint Airborne Lidar Bathymetry Center of Expertise

The Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM) has produced the first iteration of a National Coastal Mapping Strategy (NCMS), up for public review, to focus on that portion of the U.S. coastal zone that can be successfully mapped by a mix of lidar techniques for accurate elevation data. The NCMS outlines four components ranging from agency organization of mapping and research activities to the definition and outline of bathymetric accuracy quality levels. Introduction of the bathymetric accuracy quality levels and challenges the community faces in carrying over topographic measurement practices will be presented. Cost, uncertainty and frequency of 'truth data', dynamic coastal environments, and environmental pulse interactions are a few of the challenges to consider. As a co-share of the IWG-OCM, USACE's Joint Airborne Lidar Bathymetry Center of Expertise works in developing best practices, QA/QC guidance, and tools to such challenges.

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D04. Bringing Research Results to Life with Story Maps

Cary Chadwick and Emily Wilson, University of Connecticut

If there's one thing that a good map does well is tell a story. Gone are the days of paper maps, but while digital maps have become increasingly sophisticated, it's arguable whether they have advanced the art of storytelling. Enter the Story Map. Story Maps are interactive, web-based applications that combine geographic information with text and multimedia content including photographs, charts, graphs and video. They allow content to be accessed on web browsers, tablets and smartphones. And now, more than ever before, Story Maps are easy to create and can be built by just about anyone. Educators at the University of Connecticut's Center for Land use Education and Research (CLEAR) have been busy doing just that. This presentation will introduce several exciting, award winning Story Maps that the Center has recently developed, showcasing everything from wildlife and stormwater regulations to tracking trends in land cover and landscape change. We will tour the Story Maps and provide insight on the technology and techniques used to create them, demonstrating how this medium can be an engaging way to bring research data to life -- hopefully leaving you inspired to go home and create your very own Story Map.

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D05. Story Map Describing the Ocean Economies of Puerto Rico and the U.S. Virgin Islands

Jennifer Zhuang and Camille Martineau, The Baldwin Group at the NOAA Office for Coastal Management

A new report on NOAA's Digital Coast, Describing the Ocean Economies of the U.S. Virgin Islands and Puerto Rico, notes that more than 19 percent of the U.S. Virgin Islands workforce are in ocean-related jobs, as are 7 percent of Puerto Rico's workforce. To visualize how the ocean contributes to the economies of the U.S. Virgin Islands and Puerto Rico, an ArcGIS story map was created based on the report findings. The story map will use interactive maps, images, and graphics to guide local managers through the unique economic environments of largely ocean dependent places. Economic reports on ocean-dependent employment often do not include informal economic activity. Therefore, non-traditional data sources were also accounted to develop the results. The story map delves into some of these local stories, such as the contribution of informal markets as when subsistence fishermen who routinely sell part of their catch by the roadside. This presentation will demonstrate a way of sharing socioeconomic data and analysis through maps and graphics. The report reveals the true dependence of U.S. Caribbean economies on the ocean and the management of ocean resources.The story map will make it more straightforward for local managers to understand economic analysis and easier for them to communicate with stakeholders.

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D06. Exploring 83 Years of Coastal Change with the Story Map "Connecticut's Coast: Then and Now"

Emily Wilson, University of Connecticut, Center for Land Use Education and Research

In these days of climate change and sea level rise it's especially important for coastal managers and researchers to be able to convey and show how the coastline has changed to any audience. Using the Esri "story map" format, the University of Connecticut Center for Land Use Education and Research (CLEAR) did just that with the award-winning story map Connecticut's Coast: Then and Now. In 1934, a statewide aerial imagery survey was conducted for the state of Connecticut. The photos show a landscape frozen in time and very different from today. CLEAR researcher Joel Stocker carefully georeferenced each scanned tile along the coast to enable accurate comparison with other imagery. The comparisons reveal stunning visuals of the dynamic nature of undisturbed areas are as well as the impact of human activities. The interactive story map format was ideal for showing and explaining the imagery and its comparisons. The Connecticut's Coast story map focuses on three main coastal changes. The first is marsh loss due to erosion, development and dredging. The second is dynamic beaches including erosion, accretion and sand spit migration. The third is new land where marsh and water were filled. For each type of change, the story map includes explanation and "swipe" where the past and current can be compared. It goes on to highlight ten areas in greater detail that include imagery or maps as far back as 1880 with twelve dates in-between before reaching 2012. Someone recently asked how we measure "if the coast is eroding." Sometimes a picture is the best answer. Visit the story map at http://s.uconn.edu/coast1934.

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D07. STORMTOOLS Coastal Environmental Risk Index: A GIS Based Tool to Assess Coastal Flooding Damage to Structures and Infrastructure

Malcolm Spaulding, Chris Damon, Teresa Crean, and Annette Grilli, University of Rhode Island; Grover Fugate, Rhode Island Coastal Resources Management Council

An important challenge facing coastal zone managers and municipal planners is the development of a tool to provide a quantitative, objective assessment of the risk that structures and infrastructure face from storm surge in the presence of changing climatic conditions, particularly sea level rise and coastal erosion. In this presentation, an overview of STORMTOOLS Coastal Environmental Risk Index (CERI), designed to meet this need, is provided. CERI provides predictions of the percent damage to each structure in the flood impacted area for selected return periods (e.g. 100 yr), with and without sea level rise. State of the art hydrodynamic and wave models are used to predict storm surge and wave. The location and characteristics of individual structures are obtained from state emergency data base (E-911). Wave and inundation damage curves are derived from the US Army Corp of Engineers, North Atlantic Comprehensive Coastal Study(NACCS). CERI has been designed as an on line Geographic Information System (GIS) based tool, is fully compatible with current flooding maps and can be readily applied to any coastal area. The approach can be used by local and state planners to objectively evaluate different policy options for effectiveness and cost/benefit. Application of CERI to several coastal areas in Rhode Island are provided to highlight the differences between communities located along the exposed southern RI coastal line versus those in more protected waters bordering Narragansett Bay.

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D08. Planning for Future Flooding, Building a Sea-level Rise Exposure Inventory for Oregon's Estuaries

Julie Sepanik, Andy Lanier, and Randy Dana, Oregon Coastal Management Program

Oregon's statewide land use planning program requires local governments to plan for and make decisions that account for hazards known to be present. Currently, sea-level rise is not a hazard that is planned for due to a lack of relevant local data. In 2010, the state of Oregon released the "Oregon Climate Change Adaptation Framework" (Oregon Adaptation Framework Work Group, 2010) identifying sea-level rise as an expected climate risk for Oregon with effects expected to ecosystems, built and developed systems, economy, and public health and safety. The framework specifies that it will be necessary to continue to develop adaptation strategies and plans, in particular at the regional and local level. Responding to these needs, a sea-level rise exposure inventory within estuary shorelands is being developed. The exposure inventory will fill significant gaps in the knowledge base of partners working on sea level rise adaptation planning and related coastal resilience issues. The goals of the exposure inventory are to initiate a discussion among coastal communities about sea-level rise, provide asset exposure details to communities for vulnerability assessments and adaptation planning, and identify priority areas for further study. Inundation scenarios for the exposure inventory were created from LiDAR based DEMs and estuarine water levels derived from NOAA tide-gauge high water analysis. The assets of interest were determined through existing needs assessments, and discussion with stakeholders from various state agencies. The inundation scenarios and asset inventories are being provided to local planners and the greater public via an online map viewer. A final report will include results of the inventory by geography and asset category, and an index of exposure across the estuaries to compare relative risk. The resulting products will support state and local efforts to better understand and plan for climate-related ocean hazards as required by Oregon's statewide planning goals.

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D09. Determination and Mapping of Future Sea-Level Rise Planning Scenarios for Delaware

John Callahan, Delaware Geological Survey, University of Delaware

Sea-Level Rise (SLR) is one of the most significant impacts of climate change. It is felt worldwide, across political and geographic boundaries, and impacts a wide range of public and private interests through shoreline erosion, inundation of wetlands and uplands, changes to natural habitat, and damage to infrastructure. For at least the past 4,000 years, we have experienced only modest changes to sea levels, driven primarily by geologic land subsidence. During the past century, however, much higher rates have been observed, mostly due to ocean thermal expansion and glacier mass loss from increased temperatures. Linear trends of global SLR since 1900 are approximately 1.7 ± 0.2 mm/yr, with more recent trends (1993 – present) approximately 3.2 ± 0.4 mm/yr from both tide gauges and satellite altimetry missions. The Delaware Sea-Level Rise Technical Workgroup, coordinated by the Department of Natural Resources and Environmental Control (DNREC) Delaware Coastal Programs, in 2009 identified three SLR planning scenarios of 0.5, 1.0, and 1.5 meters by the year 2100, for DNREC to consider in "all future efforts." However, since that time, new national and international assessments, academic research articles, and technical reports regarding climate change and sea-level rise have been released. Recently, the Delaware Geological Survey is working with DNREC Delaware Coastal Programs to coordinate activities of a new 2016 SLR technical workgroup to review the current scientific literature and update the 2009 SLR scenarios as needed. The 2016 SLR workgroup is comprised of scientists representing both academia and state government, in Delaware and regionally, with knowledge and experience in coastal issues and data analysis relating to sea-level rise. Additionally, a set of inundations maps were generated to accompany the new SLR planning scenarios. Maps were produced statewide at 1-foot increments from mean higher-high water (MHHW) to MHHW + 7 ft and were based on recent, high-resolution lidar acquisition from 2014. This presentation will summarize the findings of the 2016 SLR workgroup regarding the new SLR planning scenarios for Delaware and discuss the methodology used to develop the SLR inundation maps.

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D10. Ground Truthing Flood Inundation during Hurricane Matthew in North Carolina

Maribel Marquez, ESP Associates, P.A.

This presentation will provide an assessment of ground truthing exercises that occurred during and after the flooding caused by Hurricane Matthew in October 2016. This exercise compared the accuracy of North Carolina's Flood Inundation Mapping and Alert Network (FIMAN) to real high water marks and other technologies such as post-event imagery and drone flights. This presentation will also provide an overview of the FIMAN system and the historic flood impacts and damages to eastern North Carolina.

Initial estimates project that Hurricane Matthew may have caused damage in over 100,000 homes in NC alone and some stream gages recorded flood elevations higher than any previous records. Other gages recorded elevations over the 1% annual chance flood event. This event allowed NC test FIMAN in real time to gain the following insights: improving confidence in the estimated flooding from FIMAN, IT solutions, pre-event activities such as evacuations and moving contents to higher elevations, swift water boat rescue planning, and other various lessons learned.

The State of North Carolina developed its FIMAN over 10 years ago to provide real-time flood inundation and alerts for gaged stream locations across the state. These updates provide real time inundation polygons for discrete locations and extend approximately 1 mile upstream and downstream of stream gages. In 2015, NC Floodplain Mapping initiated a pilot study to evaluate the use of new geospatial datasets for real-time, seamless flood inundation mapping for entire river systems (*not just in the vicinity of the gaging station*). The technology and mapping algorithms leverages the State's vast investment in 100% digital flood hazard/modeling information, real time telemetry at stream gage sites and enhanced probabilistic GIS datasets to allow for "connecting the dots" and real time mapping of actual flood events for *entire river systems*.

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D11. The Utilization of Flood Hazard Risk Data and Real-Time Alerting during Hurricane Matthew

John Dorman, North Carolina Department of Public Safety, North Carolina Emergency Management

This will be a discussion on the improvements made in North Carolina with hazard risk data and real-time altering capability following Hurricane Floyd, and how it was utilized during Hurricane Matthew. The discussion will provide quantitative and/or anecdotal evaluation of how that played out during the preparation, operations, and response to Matthew, with a focus on the GIS/mapping/elevation data component and dynamic, digital display delivery.

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D12. New Geospatial Storm Surge Risk Products from the National Hurricane Center

Jamie R. Rhome, Brian Zachry, William Booth, NOAA National Hurricane Center; Doug Marcy, NOAA Office for Coastal Management; David Betenbaugh, The Baldwin Group at the NOAA Office for Coastal Management

Nearly half of the deaths associated with land falling tropical cyclones in the United States over the past 50 years are attributable to storm surge. In order to help mitigate the impacts of storm surge from tropical cyclones, emergency managers and decision-makers stress the need for actionable information in GIS-ready formats. NOAA has responded to these challenges by leading the development of new operational storm surge products, warnings, and risk analysis tools. NOAA's Office for Coast Management and National Hurricane Center launched a new storm surge risk map highlighting storm surge vulnerability from Texas to Maine in 2015. This product serves as a key data layer in OCM's Coastal Flood Exposure Mapper. In 2017, this new product will be updated to include Puerto Rico and provide GIS-ready datasets. During the 2016 hurricane season the NHC introduced a real-time high-resolution storm surge inundation graphic and associated map services via NOAA's NowCoast. This product was well received by Emergency Managers during recent Hurricane Matthew. This new graphic, and associated GIS data, was the culmination of extensive social science research and emergency management and broadcast meteorologist input. In 2017, the National Weather Service will introduce a Storm Surge watch/warning. This presentation provides an overview of these new products and services and describes the expected applications and benefits.

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E01. Modernizing the National Spatial Reference System

Dru Smith, NOAA National Geodetic Survey

The mission of the National Geodetic Survey (NGS) is to define, maintain and provide access to the National Spatial Reference System (NSRS). The NSRS is the collective name for the system of geodetic coordinates, official shoreline, and surveying standards and specifications in use by all non-military federal geospatial agencies, but frequently adopted and used by state and local agencies as well. This system includes, among other things, the North American Datum of Datum of 1983 (NAD 83), the North American Vertical Datum of 1988 (NAVD 88) and the International Great Lakes Datum of 1985 (IGLD 85). These three datums were established using predominantly terrestrial, pre-space-geodesy, line-of-sight observations, and rely heavily upon fragile, unmonitored passive control marks set into Earth's crust. Decades of space geodetic observations have led to the conclusion that these datums contain systematic errors at a scale that is significantly large relative to today's accuracy capabilities. Furthermore, while passive control was the primary method of defining and realizing datums of the past, it has certain inherent weaknesses, such as susceptibility to destruction and untracked motions. These issues make it less desirable as the primary method of defining and realizing a datum in the future. All of these conclusions have led NGS to plan for the modernizing of the NSRS. Planned for 2022 are the simultaneous replacement of NAD 83, NAVD 88 and IGLD 85 with one single integrated datum, defined through a mathematical relationship to the International GNSS Service (IGS) reference frame at CORS (Continuously Operating Reference Stations). Any geodetic quantity should be accessed in the new datum via GNSS (Global Navigation Satellite Service) receivers as well as a model of Earth's geopotential (including a gravimetric geoid model). Prior to 2022, NGS is working both internally as well as externally to prepare for the transition. Internally, an entire new spatial database, capable of storing and understanding both spatial and temporal relationship is being created. Externally, NGS is exchanging information with NSRS users. This information is being used both to educate users as well as temper NGS plans for new tools and services. This talk will focus on the current plans for 2022 and seek to continue the exchange of information with users of the NSRS.

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E02. New 3rd edition of "Digital Elevation Model Technologies and Applications: The DEM Users Manual"

David Maune, Dewberry Consultants LLC

In the decade since ASPRS' publication of the 2nd edition of the DEM Users Manual, there have been major changes to geospatial standards, specifications and technologies relevant to coastal management. The 3rd edition, to be published in 2017, includes near-total rewrites of a number of chapters.

Several chapters result from the National Enhanced Elevation Assessment (NEEA) prepared by Dewberry in 2012. The NEEA fathered the 3DEP which standardizes on QL2 topographic lidar nationwide, except for QL5 IFSAR of Alaska, and NOAA is funding a follow-on to the NEEA study that includes five potential bathymetric lidar Quality Levels. Chapters 3 and 14 explain the new ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014) and the USGS Lidar Base Specification V1.2 (2014). Chapters 8 and 9 explain linear mode, Geiger mode and single photon lidar and lidar data processing. Chapter 10 explains the various new bathymetric and topobathymetric lidar sensors and datasets. Chapter 15 is a thorough tutorial on how to quality control lidar data to be included in the 3DEP. The DVD that goes with Chapter 16 has new samples of elevation data from most of the technologies explained in the 3rd edition. Chapter 1 (Introduction to Digital Elevation Models), Chapter 2 (Vertical Datums), Chapter 4 (National Elevation Dataset), Chapter 6 (Photogrammetry), Chapter 7 (IFSAR), Chapter 11 (Sonar) and Chapter 12 (Enabling Technologies) are all updated also, but not totally rewritten as are the nine chapters listed.

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E03. Online Tidal Datum Computations

Nathan Wardwell, JOA Surveys, LLC

Water level data is collected on every coast and waterway of the United States following different procedures and using sensors with different accuracies. The water levels may support a myriad of projects and purposes from mapping to research. The NOAA requirements for precise tidal datum determination are rigorous because of the high level of accuracy required by their users, from producing nautical charts to the reference datums for the coastal United States. The NOAA datum computation software is necessarily limited to certain users and demands a high level of experience and interpretation. This poses a barrier to casual or exploratory tidal datum determination using the many water level datasets collected for other purposes. In early 2016, JOA Surveys LLC developed an online tool that automates the computation of National Tidal Datum Epoch equivalent tidal datums from water level records less than 19 years. The computations are based on NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) Computational Techniques for Tidal Datums Handbook. The tool was modeled after the simplicity of the National Geodetic Survey's Online Positioning User Service (OPUS) for GPS processing, which requires raw data and limited user input. Like OPUS, the Online Tidal Datum Computation tool is not designed to perform comprehensive quality checks on the user data or procedures. This tool has been tested using 41 water level datasets from 30 locations and the results were compared against datums published by CO-OPS. The locations were distributed from the Arctic to the Caribbean and represent a comprehensive array of tide types. The length of the data series ranged from 1 week to 4 years with sample intervals from 1 minute to 1 hour. The root mean square of the differences between the datums derived using the online tool and the CO-OPS published values is 4 cm.

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E04. Time-Animated Data: Acoustic Telemetry off the South Carolina and Georgia Coast

Tanner Arrington, Erin Koch, and Mike Arendt, South Carolina Department of Natural Resources

A web application was developed to display animations of acoustically-tagged marine species off the coast of South Carolina and Georgia. Animations help researchers and the public recognize and visualize spatiotemporal patterns in large time-series datasets. In 2013, multiple arrays of acoustic receivers were added to coastal waters off South Carolina and Georgia to complement inshore data collection for sturgeon, as well as to benefit other telemetry studies conducted by wildlife management agencies in both states. The ArcGIS JavaScript API was used to animate species detected at specific receiver locations, aggregated by month, from December 2013 to May 2016. The data are visualized with proportional symbols based on the number of days the species were detected during each month. A control on the web application lets users pause the animation or modify the time increments to visualize data at custom intervals. Challenges in data preparation and application design are also discussed.

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E05. Analyzing Environmental Influences on the Spatial Distribution of Fish Species along the South Atlantic Bight and Projecting Future Distributions Using Different Climate Scenarios

Sarah Roberts, Duke University Nicholas School of the Environment

This project analyzes how environmental variables influence the distribution of 7 commercially regulated fish species in the South Atlantic Bight using the Marine Geospatial Ecology Toolbox (MGET) for ArcGIS. By analyzing the relationship between environmental variables such as sea surface temperature, chlorophyll, habitat and climate indices, we can better understand the vulnerability of commercially important species to environmental changes. Finally, this project projects future species distributions using high resolution statistically downscaled climate models. This project highlights applications of the MGET toolbox, uses fisheries independent data collected by the Southeast Area Monitoring and Assessment Program (SEAMAP) and habitat data developed by the Nature Conservancy, and projects future distributions using climate models that were statistically downscaled with a high resolution (7-by-7 km) Regional Ocean Modeling System simulation of the Western Atlantic.

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E06. Elevation, Vegetation, and Water Levels: In Coastal Wetlands There's No Substitute for On-the-Ground Measurements

Andrew Neil, Scott Rasmussen, Michael Bradley, Charles LaBash, and Peter August, University of Rhode Island, Environmental Data Center

The University of Rhode Island Environmental Data Center (URI EDC) and the Northeast Coastal and Barrier Network of the National Park Service (NCBN NPS) have collaborated to collect detailed elevation, vegetation, and water level data for salt marsh environments at three coastal national parks; Assateague Island National Seashore (ASIS), Fire Island National Seashore (FIIS), and Gateway National Recreational Area (GATE). The data collected will serve as the baseline for future marsh modeling and vulnerability assessments. It is critical in understanding how coastal wetlands will respond to changes in sea level. RTK GPS elevations and detailed vegetation information (i.e. species type and abundance) were collected at a 20 meter grid spacing throughout marsh units. Water level loggers were deployed locally near each marsh unit to capture on-site tidal dynamics. These intense on-the-ground measurements have shown inaccuracies in large scale datasets such as LiDAR, lack of detail in vegetation cover maps derived from imagery, and differences in tidal dynamics with distance from NOAA tide gages. As management decisions are driven by scientific data it is crucial to deliver the most accurate data possible. Put simply there is no substitute for on-the-ground measurements. In this session we will share our work from the past two years, discuss our methods of collecting these data, highlight differences between our data and large scale datasets, and showcase future applications of our data.

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E07. Recent Topobathymetric Lidar Surveys in Various Coastal, Riverine, and Lacustrine Environments

Amar Nayegandhi, Dewberry

Since 2015, Dewberry has performed numerous topobathymetric lidar projects for various federal, state, and local agencies. Sensor selection is typically based on project requirements and intended application, but cost is often a factor. The cost of bathymetric Lidar acquisition and processing can vary significantly depending on the type of aircraft and sensor used for each project. Dewberry's sensor agnostic / vendor neutral approach enables us to select the most appropriate sensor for each job, thereby providing our client with the best solution based on their individual needs. In this presentation, we discuss 8 projects that we have recently conducted for various clients including NOAA, USGS, and Southwest Florida Water Management District that used various sensor technologies – including Teledyne-Optech CZMIL and Titan sensors, Riegl VQ820G and VQ880G sensors, and Leica-AHAB Chiroptera sensor, for topobathymetric projects in various geographical locations and differing water conditions including Beaver Islands in Upper Lake Michigan, the Gulf of Mexico bays and estuaries, Florida reef tract, and Puerto Rico. Sample products and results from these projects will be discussed.

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E08. Coastal/Nearshore and Offshore Bathymetry Requirements and Benefits Study

Ashley Chappell, NOAA Office of Coast Survey; Allyson Jason, U.S. Geological Survey; Sue Hoegberg, Dewberry

NOAA and USGS are sponsoring a study to design a follow-on to the National Enhanced Elevation Assessment (NEEA) that will update the NEEA study and collect requirements and benefits from users of coastal/nearshore and offshore bathymetry. This paper will present an overview of the plan for updating the NEEA for the years beyond the initial 3DEP acquisition period. The NEEA update will take into account new technologies for elevation data collection as well as new uses of the elevation data. It will also take into account the refresh requirements for different activities and geographies, to include coastal areas. This paper will also present an overview of the plan for collecting coastal/nearshore and offshore bathymetry requirements and benefits. Considerations will include target study participants, coastal/nearshore and offshore business uses and activities, data requirements, technologies, the spatial extent out to which information will be collected, and benefits categories. Once the study has been designed, it is envisioned that study participants will be selected and asked to provide input on what activities they are currently engaged in, how they currently collect and use coastal and offshore bathymetric data, their geographic area of interest, their data requirements for an integrated national bathymetric dataset, the benefits they currently realize from the bathymetric data they collect and use, and the future benefits they could expect to realize if their stated requirements for bathymetric data were met.

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E09. Shoreline Mapping in the Aftermath of Superstorm Sandy: A Topobathymetric Lidar-Based Approach to Updating the National Shoreline

Ray Miller, Dewberry; David Jennings and Stephen White, NOAA National Geodetic Survey

NOAA's National Geodetic Survey (NGS) produces the national shoreline which provides critical baseline data for updating nautical charts; defining our nation's territorial limits, including the Exclusive Economic Zone; and managing our coastal resources. This shoreline is applied to nautical charts and is considered authoritative when determining the official shoreline for the United States. Historically, the national shoreline has been produced using traditional stereographic compilation from tide-coordinated aerial imagery. However, NGS recently has begun using topobathymetric lidar data to derive consistent, highly-accurate shoreline contours (MHW, MLLW) that serve as the basis for updating the national shoreline. In the aftermath of Superstorm Sandy, NGS identified the need to update the national shoreline from Long Island, New York to Myrtle Beach, South Carolina. To carry out this monumental effort, NGS tasked Dewberry to acquire and process over 3,000 square miles of topobathymetric lidar data. This lidar data were then used to delineate over 3,500 statute miles of the national shoreline along with various coastal and navigational features. This presentation will provide an overview of topobathymetric lidar data, the shoreline mapping process, challenges encountered, along with the benefits of this approach.

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E10. Post-Storm Analysis and Visualization of Surge and Wave Time Series

Greg Petrochenkov and Harry Jenter, U.S. Geological Survey

The USGS has developed and demonstrated the capability to deploy hundreds of self-recording water and air pressure sensors simultaneously in order to monitor coastal water levels during large storms. The sensors collect continuous high-frequency (4 Hz) measurements for up to 10 days and are deployed safely before a storm and collected afterward. The analyses and visualizations of the storm surge and storm wave data resulting from these deployments provide insight into the physical forces impinging upon infrastructure and natural shorelines as well as the risk to coastal communities. When the time series are displayed in a geospatial context, the juxtaposition of data from proximal sites and the supplementary data collected nearby provides additional information. A dashboard with a geospatial graphical user interface will be demonstrated to illustrate the utility of viewing time series in a spatial context and to show a variety of analytical products derived from the USGS data including storm surge, significant wave height, significant wave period, and wave spectra. Additionally, the underlying technical specifications of the data will be described briefly in order to explain USGS efforts to conform with national oceanographic and meteorological standards, and thereby, ensure the data are accessible to numerous other standard analysis and visualization utilities.

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E11. Event-Based Flood Data Collection and Dissemination: The USGS Flood Event Viewer and Short-Term Network Database

Blake Draper, U.S. Geological Survey, WiM Group; Todd Koenig, U.S. Geological Survey

The U.S. Geological Survey plays an important role in flood data collection and delivery. USGS streamflow data is vitally important for the National Weather Service to forecast flood magnitude and timing, the USACE to operate flood control systems, and for support of emergency response at all levels of government. In addition to the constant monitoring of streamflow through its network of long-term, permanent streamgages, the USGS has established a robust network of coastal sites for the measurement of surge, wave, and tide hydrodynamics with small sensors in advance of an event. The data collected from those sensors, along with surveyed high water mark elevations, are recorded in the Short-Term Network (STN) database.

The USGS WiM group has developed the STN database and a set of tools around it to facilitate the collection and dissemination of event-based flood data to make to easily accessible to partner agencies and the public alike. Internal and public applications work in concert via a web service layer to make data available in real time, also leveraging National Water Information System (NWIS) data to provide a complete picture of flood conditions. Data can be viewed by the public in the Flood Event Viewer, a map-centric data portal which allows users to explore and download sensor data and high-water mark records for any event in the STN database, including historic high-water events dating back more than 40 years.

The development of the STN database and suite of products has been instrumental in expanding the USGS response to flooding events, such as Hurrican Matthew, providing increased efficiency and improved data dissemination.This presentation will illustrate how these tools support the USGS and partner agencies in their efforts to build resilient coastal communities.

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E12. Hurricane Hermine: Rapid Response for Evaluation of Structure Flooding Impacts in Florida

Jeff Gangai, Catherine Bohn, Brian Batten, and Kevin Slover, Dewberry

Hurricane Hermine was the first major tropical storm to make landfall in Florida in many years. A quick assessment after landfall was needed to determine the level of impacts to structures from flooding. GIS processes and data aided in making this rapid assessment possible. The first step was to determine how high the storm surge from Hermine got. A detailed modeled surge hincast of Hermine was needed. The SLOSH model was run with the National Hurricane Center advisories before and after landfall as input. GIS was used to create a digital elevation surface of the resulting surge elevations from the SLOSH model. The second step was to determine the height of the surge above the ground or the depth of flooding and the flooding extent. Using GIS processes the Hermine surge surface was subtracted from a seamless topo/bathy DEM to get the depth of flooding from Hermine across the Big Bend region. The surge surface was also intersected with the seamless topo/bathy DEM to obtain the flooded area and extent. Once the flooded area was finalized the Hermine depth grid was clipped to the flooded area. The last step was to determine the flooded depth on structures. GIS Land parcels data was used to approximate structure locations. At each parcel centroid the depth of flooding was obtained. Available tax assessment data was joined with the parcel data and used to eliminate parcels without structures and to determine other building characteristics if available. The severity of flooding was categorized into three levels based on the depth of flooding predicted on the structure as affected, minor, and major flooding. This information was used to determine the number of structures impacted, where the storm surge flooding from Hermine had the greatest impacts, and the areas most likely to have the greatest damages.

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T19. New Jersey Waterway Linear Referencing System

Daniel Barone, Michael Baker International; Genevieve Clifton and Scott Douglas, New Jersey Department of Transportation, Office of Maritime Resources

The New Jersey Department of Transportation-Office of Maritime Resources (NJDOT-OMR) is the state agency responsible for maintaining the State Marine Transportation System, which is comprised of over 200 navigation channels totaling over 225 miles of New Jersey's coastal waters. Since its inception, NJDOT-OMR has consistently implemented maintenance dredging efforts to manage safe navigation. However, funding issues and high sedimentation rates have made maintaining navigability in all state channels a difficult task. To address this issue, in the mid-2000s NJDOT-OMR coordinated with various stakeholders from federal and state agencies as well as academia to pilot a waterway linear referencing asset management development project analogous to a highway transportation system's linear referencing system. It wasn't until October 2012, when Hurricane Sandy's storm surge and waves dramatically decreased the navigability of New Jersey's coastal by depositing millions of cubic yards of suspended land-based and in-situ bayfloor sediments into state navigation channels that NJDOT-OMR determined implementing the use of a statewide asset management tool was necessary to efficiently maintain safe navigation. As such, NJDOT-OMR funded the development of the Waterway Linear Referencing System (WLS). Based on the methodologies developed during the original pilot study, the WLS development included a logical system architecture and data model for acquisition, consolidation, and integration of synoptic, statewide channel bathymetric survey data using custom geospatial desktop tools and the development of spatially-enabled WLS State Channel Web Viewer application. Through coordination with maritime stakeholder groups such as the NJDEP, Stockton University Coastal Research Center, the USACE New York and Philadelphia Districts, and NOAA's National Ocean Service Office of Coast Survey, the project team has developed intuitive desktop and web-based asset management tools for NJDOT-OMR staff to effectively manage dredging schedules, budgets, and sediment quantities and placement options associated with dredging activities within the state's 215 navigation channels.

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T20. Gateway to the Nation's Existing Lidar Datasets: The U.S. Interagency Elevation Inventory

Lindy Betzhold, The Baldwin Group at the NOAA Office for Coastal Management; Allyson Jason, U.S. Geological Survey

Ever wonder how to find out if publicly available, high-accuracy elevation data is available for your area? The answer can be found by accessing the U.S. Interagency Elevation Inventory (USIEI), which is an online tool providing a nationwide index of known high accuracy topographic and bathymetric elevation data. The USIEI includes information on data types such as topographic lidar, IfSAR, multibeam sonar, and bathymetric lidar. The topographic portion of the inventory is built and maintained through a collaborative effort among seven federal agencies (USGS, NOAA, USDA-NRCS, USDA-FS, USACE, FEMA and NPS). Maintenance includes two updates per year for federal, state, and locally held datasets. The bathymetric datasets are continuously updated via map services. For each dataset, the inventory provides many attributes such as vertical accuracy, point spacing, date of collection and, where possible, a direct link to the data for download. The USIEI provides an important central location for information about elevation datasets, decreases duplication of effort from unnecessary data collections, and raises awareness of and increases access to existing elevation data. The USIEI is critical to the operations of the 3D Elevation Program (3DEP) which is is accelerating the rate and quality of 3D elevation data collection across the nation. 3DEP uses the inventory for collection prioritization and to track progress toward achieving national coverage.

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T21. Beach Profiling Monitoring Web Application

Jessica Boynton, South Carolina Department of Health and Environmental Control, Ocean and Coastal Resource Management

The South Carolina Department of Health and Environmental Control, Ocean and Coastal Resource Management (DHEC-OCRM) office has released a web application to aid stakeholders in understanding coastal dynamics. Employing ESRI's ArcGIS API for Javascript and ArcGIS for Server, the app allows users to visualize and download data associated with DHEC-OCRM's Beach Erosion Research and Monitoring (B.E.R.M.) program. DHEC-OCRM maintains a statewide network of over 400 beachfront monuments. These serve as the starting point for annual beach profiles, where both topographic and bathymetric data are collected. These monument locations and profiles can be viewed through the B.E.R.M. Explorer application. Analysis of this data informs the annual characterization of beachfront areas and identifies areas that experience chronic sand deficits, erosion, accretion and/or variability. This application, along with several other related viewers, will ultimately comprise DHEC-OCRM's State of the Beaches web application. The State of the Beaches application will serve as a one-stop shop for DHEC-OCRM's coastal datasets, including jurisdictional line positions, beach access locations, renourishment projects, and nearshore alterations.

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T22. Evolving Ocean Mapping: Developing a Seamless Workflow for Acquisition, Processing, Visualization, and Sharing of Hydrographic-based Data

Samantha Bruce and Chris Malzone, QPS Inc.

Since the installation of the first sonar system, Hydrographers have consistently adjusted their workflows to provide detailed and accurate information in an efficient manner. Human error within these workflows have led to inaccuracies or poor decisions with undesirable consequences. Advancements in the Hydrographic workflow by researchers and engineers at Quality Positioning Systems are moving toward the automation of mundane, human-error prone tasks while guiding users through processing & analysis. This is accomplished by removing redundancy, capitalizing on computing technological advances and providing a dynamic multidimensional user interface that allows those even with a low knowledge threshold to make good decisions that lead to high-end final products. This paper will outline the evolution of this Hydrographic workflow with case studies presented.

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T23. GANDALF: A Decision Support System for AUV Operators in the GOM

Robert Currier, Matthew Howard, and Barbara Kirkpatrick, Texas A&M University

GANDALF, the Gulf AUV Network and Data Archiving Long-term Storage Facility (http://gcoos2.tamu.edu/gandalf) was conceived as an aid to AUV pilots operating in the Gulf of Mexico. GANDALF provides real-time vehicle positioning information via a maps-based interface with dashboard display, plots of flight and science sensors, Google Earth KMZ file generation and access to processed data files. GANDALF is equipped with numerous layers that can be individually displayed on the base map. Each layer's transparency can be individually adjusted allowing for 'mash-ups' of layers. Provided layers include CONUS NEXRAD, GOES visible and GOES infrared satellite images, sea surface temperature and chlorophyll images from the University of South Florida, sea surface heights from CCAR and NOAA raster navigational charts. In addition to the observational layers several model outputs are provided including the Naval Research Lab's ensemble of sea surface velocity, sea surface temperature and sea surface elevation. During a deployment NetCDF files are created from uploaded glider data files and uploaded to the IOOS Glider DAC. In addition to the real-time features offered by GANDALF, post-processing of mission data is provided to operators. Binary data files and text log files are downloaded from operator's servers and publication quality plots are generated. Mission files are permanently archived on the GANDALF server. In this tool demonstration we will display both the real-time and post-processing features of GANDALF. Ideally, several AUVs will be deployed at the time of the presentation and the demonstration will be conducted using live data streams. If no vehicles are deployed we will use historical data to simulate a deployment. GANDALF provides a valuable service for AUV operators and is particularly useful to glider operators that have little or no IT support. GANDALF services are provided at no cost to users: all that is needed is access to glider data files.

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T24. OpenNSPECT: A Tool for Examining Impacts of Climate and Land-use Change on Runoff, Non-Point Pollution, and Erosion

Dave Eslinger, NOAA Office for Coastal Management; Shan Burkhalter, The Baldwin Group at the NOAA Office for Coastal Management

OpenNSPECT, the open-source version of the Nonpoint Source Pollution and Erosion Comparison Tool, is a water quality screening tool that evaluates spatial variables to identify potential sources of pollution and erosion and predict the effect of land cover or climate changes. The tool uses elevation, precipitation, soil characteristics, and land cover to estimate runoff volume, pollutant loads, and sediment yield. OpenNSPECT provides watershed managers with a way to visualize and compare the impacts of proposed land use changes or to examine the possible effects of different climate scenarios. The tool is free and runs on the free, open source MapWindow GIS platform. In this Tool Showcase presentation, we will offer hands-on demonstrations of the capabilities of OpenNSPECT to address both of these issues.

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T25. Developing End-User Tools for Response Plan Management in ERMA

Chander Ganesan, NOAA Office of Response and Restoration

The Environmental Response Management Application (ERMA) is a tool designed to aggregate data from a wide range of sources for the purpose of coordinating disaster response and restoration. One recent addition to ERMA is the ability leverage the knowledge of in-the-field personnel to build data sources “on the fly”, using spatial drawing tools to generate plans, as well as to intelligently select related data to dynamically populate new data layers. The end result allows users to create new layers, with new data and geometries, that are partially derived from data in other layers. This leads to enhanced decision making capabilities, and data sharing opportunities. It also allows administrators to control workflows to ensure consistency of data within ERMA. This functionality is currently used by agencies such as USCG, NOAA HSPO to develop and maintain response plans and coordinate search and rescue. In this presentation we’ll talk about some of the use cases, as well as the technology that drives the tool.

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T26. GCAMP: Georgia Coastal and Marine Planner

Tony Giarrusso, Georgia Tech Center for GIS

The Georgia Coastal and Marine Planner (GCAMP) is a revolutionary geospatial gateway to Georgia-specific maps, data, and resources relevant to coastal and marine planning. Built using ESRI App Builder, GCAMP contains one base application and four customized, content specific applications (Fisheries, Shipping, Habitat, Energy). Each application has customized queries, charts, and other tools to explore designed the make exploring the data and creating maps easier than ever. Additionally, several Story Maps are found on GCAMP, providing users with GCAMP tutorials, coastal Georgia resources, a daily, four-year AIS shipping animation, and a hypothetical wind farm example, which walks users through the proposed process of establishing an offshore development in Georgia. This tool demonstration will allow users to interact with and explore GCAMP while discussing the pros and cons of using ESRI software for this project with the GCAMP developer.

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T27. Online Map-based Surveys with SeaSketch

Grace Goldberg, SeaSketch, University of California Santa Barbara

For both formal research and informal outreach, the spatial survey tools within the SeaSketch platform (http://www.seasketch.org) allow for easy collection of map-based information. For administrators, the survey builder allows you to design your survey with spatial and non-spatial questions, send out invites to potential respondents, link directly to social media, and track and export responses. Respondents receive a direct link, which can also be configured to set a specific map view alongside the survey. At our tool table, we will demonstrate existing uses of the survey tool, originally developed for use by the New Zealand Department of Conservation in a crowdsourced survey of the general public to map use and values of ocean and coastal spaces. Ongoing in the Blue Halo Initiative in the Caribbean, the survey tool is used in a stakeholder interview process to develop maps of fishing and dive value in coastal water to inform community-based zoning. Participatory mapping, crowdsourcing and general coordination projects all make use of the SeaSketch survey features with unique configuration for their process context.

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T28. The Sea Level Scenario Sketch Planning Tool: Assessing Vulnerable Transportation Infrastructure and More

Crystal Goodison, Barbara Kirkpatrick, Alexis Thomas, and Reginald Pierre-Jean, University of Florida GeoPlan Center

Many Florida transportation facilities are low-lying and vulnerable to flooding, storm surge, and inundation from sea level rise (SLR). Because Florida's economy is dependent on the transportation system's ability to move people and freight, considering the effects of SLR is important to protecting the State's infrastructure investments and economic stability. While some effects could be decades away, the time is now for developing adequate data and tools to inform the planning process. This presentation will demonstrate features, data, and tools available in the Sea Level Scenario (SLS) Sketch Planning Tool. The University of Florida GeoPlan Center, with funding from the Florida Department of Transportation, developed the SLS Sketch Planning Tool to assist in the identification of transportation infrastructure potentially vulnerable to inundation from SLR. The tool uses the U.S. Army Corps of Engineers (USACE) sea level change methodology and National Oceanic and Atmospheric Administration (NOAA) tide gauge data to project future sea level rise. The benefits of this methodology include the use of local data to project relative SLR, projections for multiple SLR scenarios, and the ability to revise calculations based on the latest available data and trends. The Sketch Planning Tool includes three publicly available components: (1) Web accessible map viewer for visualization of where, when, and how much inundation and affected transportation facilities occur under various SLR scenarios. (2) GIS Data Layers: Regional and statewide data layers depicting SLR inundation and affected transportation infrastructure layers; and (3) SLR Inundation Surface Calculator: ArcMap Add-in Tool that facilitates creation of GIS inundation layers using USACE methods and NOAA tide gauge data.

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T29. NOAA's Land Cover Atlas

Nate Herold, NOAA Office for Coastal Management; John McCombs, The Baldwin Group at the NOAA Office for Coastal Management

Through its Coastal Change Analysis Program (C-CAP) NOAA's Office for Coastal Management (OCM) has produced highly accurate, well respected land cover information in the coastal areas of the U.S. for decades. Current products include both regionally focused (30 meter resolution) monitoring data that is updated every 5 years and high resolution (1 to 2.4 meter resolution) maps, produced over smaller geographies, that can support applications at a more local level. This information is accessible through the Digital Coast's online Land Cover Atlas. Come see a demonstration of the Land Cover Atlas and the types of land cover change information that is available through it. Development and impervious cover, forestry and regrowth, as well as wetland changes and trends are all displayed through a series of easy to understand maps and graphics. Get the big picture view without breaking a sweat. No GIS expertise or software required.

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T30. The USACE Field Research Facility Data Integration Framework Portal: A Modular and Scalable Approach to Web-based Data Visualization and Analysis

Kelly Knee, RPS ASA; Michael Forte, U.S. Army Corps of Engineers Coastal and Hydraulics Laboratory Field Research Facility; Andrew Bird, RPS ASA; Kent Hathaway, U.S. Army Corps of Engineers Coastal and Hydraulics Laboratory Field Research Facility; Robert Fratantonio, RPS ASA

The U.S. Army Engineer Research and Development Center's (USACE ERDC) Coastal and Hydraulics Laboratory Coastal Observations and Analysis Branch Measurements Program has a 35-year record of coastal observations. These datasets include oceanographic, meteorological, survey, and remote sensing data. Together these datasets provide a comprehensive record of winds, waves, currents, CTD profiles, water levels, surf zone imagery, and beach and bar morphology at the Field Research Facility (FRF) in Duck, NC. The data has been used to support a variety of USACE mission areas, including coastal wave model development, beach and bar response, coastal project design, coastal storm surge, and other coastal hazard investigations and have been widely used by a number of federal and state agencies, academic institutions, and private industries. In 2013 the FDIF project was launched to facilitate the rapid, reliable access and publicly available metadata for each data type, by adding web tools for data exploration and visualization, providing publically available web services for data access, and including well-documented, web-accessible and searchable metadata. A front-end data portal connects the user to the framework that integrates both oceanographic observation and geomorphology measurements using a combination of ESRI and open-source technology while providing a seamless data discovery, access, and analysis experience to the user. The user interface was built using RPS ASA's OceansMap framework and all project metadata is managed using Geoportal. The geomorphology data is made available through ArcGIS Server, while the oceanographic data sets have been formatted to netCDF4 and made available through a THREDDS server. Additional web tools run alongside the THREDDS server to provide rapid statistical calculations and plotting, allowing for user defined data access and visualization. Since the projects inception, new datasets types, such as sediment samples, have been added and analysis tools are continually being added to the modular data portal. The entire data portal will be demonstrated during the tools showcase, including a tour of available data and demonstrations of available tools.

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T31. ENOW Explorer

Gabe Sataloff, The Baldwin Group at the NOAA Office for Coastal Management

How reliant is your county or state on the six sectors of the maritime economy? How many people are involved in the living resources sector, and what is the average wage for a person working in marine transportation? Come answer these questions and more through maps and graphs in the ENOW Explorer developed by NOAA's Office of Coastal Management.

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T32. NOAA's Lake Level Viewer: United States Great Lakes

Brandon Krumwiede, The Baldwin Group at the NOAA Office for Coastal Management; Doug Marcy, NOAA Office for Coastal Management; Lindy Betzhold and William Brooks, The Baldwin Group at the NOAA Office for Coastal Management

The Lake Level Viewer: United States Great Lakes is a tool from NOAA's Office for Coastal Management that helps users visualize and understand the impacts of lake level fluctuations along the coastal areas of the Great Lakes in a two-dimensional web mapping interface. The easy-to-use web map viewer allows users to display lake level variations (from +6 feet to -6 feet) in relation to long-term water level averages taken from the Great Lakes Water Level Dashboard. The data in the viewer covers over 6,300 square miles of Great Lakes shoreline, and the interface was scoped, designed, and tested using regional and topic-area input from Great Lakes stakeholders. The viewer helps communities make well-informed planning decisions, such as augmenting zoning restrictions, encouraging sustainability, restoring or conserving habitat, and planning the details of marinas, intake pipes, and other types of infrastructure. Users of the tool are also able to download the data and access services for more in-depth analysis. The tools showcase will provide a live demo of this tool, including how to change water levels, examine map confidence, compare data with socioeconomic data, and access data and services. Development of the viewer was funded by the Obama Administration's Great Lakes Restoration Initiative.

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T33. Coastal Oblique Imagery

Maryellen Sault, Jason Woolard, Jon Sellars, Mike Aslaksen, NOAA National Geodetic Survey

NOAA' National Geodetic Survey (NGS) is acquiring oblique imagery in the coastal zone to support the Coastal Imagery Viewer and Emergency Response efforts. The Coastal Imagery Viewer contains 2015 and 2016 georeferenced oblique imagery of the U.S. coastline. Images are acquired with a Trimble Digital Sensor System (DSS) at a 37.5 degree look angle from altitudes between 1,500 to 7,500 feet. The Coastal Imagery Viewer allows users to view, pan, zoom and download georeferenced oblique images. There are three methods for downloading imagery. Users can either download individual images and associated virtual raster files, use the bulk data download option, or select groups of images for download with the QGIS download tool. This imagery can be viewed in most GIS software packages. It was acquired to satisfy a wide range of Integrated Ocean and Coastal Mapping (IOCM) requirements, such as coastal zone management. Additionally, in 2014, NGS added oblique imagery to its suite of emergency response datasets to support NOAA's home security and emergency response requirements. These datasets are typically made available to federal, state, and local government agencies, as well as to the general public through an interactive viewer within 12 hours of acquisition. The emergency response viewer is similar to the coastal oblique imagery viewer but includes links to access image map services. To date, oblique imagery was acquired and made available for the Hurricane Arthur (2014) response efforts, the Midwest U.S. Flooding (2015) response efforts, and the response for the Louisiana flooding event (2016). Imagery from the Coastal Oblique Viewer and the Emergency Response website are not intended for mapping, charting nor navigation. The functionality, improvements and future enhancements of these two interactive viewers will be demonstrated and discussed.

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T34. Extracting Actionable Information from Big Data in Support of Disaster Response

Jeff Van de Vaarst, Intergraph Government Solutions

NOAA and the Coastal Community regularly deal with large quantities of data in various formats. In addition to vast amounts of geospatial data in the form of imagery, LiDAR, and mapping data there is a host of other business and systems data, including real-time data feeds. In times of crisis, it can be very challenging to quickly identify the most relevant data necessary to support critical decisions. This challenge is further compounded by the need to fuse information from disparate sources together in order to clearly understand the current state of the area of interest, perform necessary analysis, and rapidly share results with a wide range of individuals. Intergraph Government Solution (IGS) will highlight and demonstrate a collection of technologies that are designed to address these challenges and enable organizations to effectively and efficiently tap into the vast array of data resources available in order to create a common operating picture, improve overall decision making and coordinate resources. These technologies include ERDAS IMAGINE-based open web services operating on a cloud architecture which provide instant access across the enterprise to powerful analytical functions such as change detection, elevation processing, and point-cloud analysis. An additional technology, EdgeFrontier, is a powerful "super switchboard" that reads many real-time sensor feeds such as flood gauge readings and AIS feeds from ships, parses and normalizes the data, and then takes immediate action based on policy-driven business logic, including sending alerts and reporting. This highly-configurable solution also directly integrates with the geospatial web services to further automate the information fusion and analysis workflows, thereby reducing workload and timeframe required to develop a clear and meaningful real-time common operating picture. By attending learn how these technologies from IGS can enable the Coastal Community to effectively extract actionable information from vast amounts of disparate data sources and information feeds.

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T35. NACCS Viewer Based on OceansMap Framework

Nathan Vinhateiro, Brian McKenna, Jeremy Fontenault, and Kelly Knee, RPS ASA; Dani Carter, Northeast Regional Ocean Council

The US Army Corps of Engineers (USACE) recently completed the North Atlantic Comprehensive Coastal Study (NACCS), a $20M initiative to address the flood risk for coastal areas affected by Hurricane Sandy. The study included state of the art atmospheric, wave and storm surge modeling for the North Atlantic region using the coupled ADCIRC (Advanced Circulation Model) and STWAVE (Steady State Spectral Wave) models. One major result of this effort is a large catalog of storm surge, wave heights, and extremal statistics derived from thousands of model runs and stored at high resolution stations ("save points") along the coast. These data are distributed via the USACE Coastal Hazards System. The NACCS Viewer is a web portal developed by RPS ASA to provide rapid and reliable access to a subset of NACCS modeling products that are of interest to the coastal planning and management communities. The portal features a map-based interface that allows users to easily pan and zoom to areas of interest within the model domain, explore results from individual simulations and summary statistics (e.g. wave and water level return periods and associated confidence intervals) at each save point, and visualize the storm tracks and associated model parameters used as forcing. For users that wish to explore the data further, the portal also offers an option to directly download model output. The NACCS Viewer is implemented using RPS ASA's OceansMap framework - a web-based metocean data visualization and analysis platform that aggregates a broad range environmental data including both real-time observation and model data.

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T36. St. Louis River Area of Concern Data Visualization

Clinton Little, Minnesota Department of Natural Resources, Minnesota's Lake Superior Coastal Program; Norman Will, Richard Axler, Elaine Ruzycki, and George Host, University of Minnesota-Duluth, Natural Resources Research Institute

As we enhance our ability to assess nearshore environmental conditions and consolidate real-time, historical, and modeled data on central web sites, it is critical that we get the resulting data into the hands of citizens and decision-makers in a format that is truly accessible, easily interpretable, timely, and relevant. Management decisions affecting nearshore health are made at the community and local government level as well as at the state and federal level, but data and resources that might improve decision-making are scattered among a number of widely-distributed, and often difficult to integrate sources. This tool provides access to environmental data collected for the St. Louis River Area of Concern in a user-friendly interface ensuring that these resources are institutionalized and implemented at the local and watershed level for improved environmental planning and management.

This project was founded in part under the Coastal Zone Management Act of 1972, as amended by NOAA's Office of Ocean and Coastal Resource Management, in conjunction with Minnesota's Lake Superior Coastal Program. Additional 50% matching support came from the Natural Resources Research Institute at the University of Minnesota-Duluth

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F01. Coastal Hazards: Defining Inlet Hazard Areas Using a 30-Year Risk Line

Ken Richardson, North Carolina Division of Coastal Management

Inlets and the areas influenced by them are the most dynamic, unpredictable, and rapidly changing portions of a barrier island system. They are affected not only by erosion, overwash and on-shore/off-shore processes affecting the ocean shorelines, but also tidal flows, channel migration/relocation (back and forth, or unidirectional, or both) which can be dramatic even during normal conditions, but potentially catastrophic during large storms. In addition to their unpredictability, inlet areas can also present many challenges to coastal development policy- and decision-makers in their delicate attempt to balance protection of life, property and natural resources. North Carolina's Ocean Hazard Area (OHA) of Environmental Concern (AEC) is comprised of lands adjacent to the oceanfront and inlets. Within NC's OHA there are two AEC subcategories: 1) Ocean Erodible AEC, and; 2) Inlet Hazard AEC. The nature of the hazard in each AEC is managed using varied siting and development standards designed to address a reasonable degree of hazard protection for oceanfront development based on the actual nature of the hazard. North Carolina is currently updating its Inlet Hazard Areas using statistical methods to define the point along the oceanfront shoreline where inlet processes no longer dominate over oceanfront processes, in addition to also utilizing a "30- and 90-Year Risk Line" approach to delineate the landward extent of areas vulnerable to shoreline changes due to inlet processes over a period of 30 and 90 years. The methodologies used in delineating the areas of inlet influence take into account the effects of past dredging and beach fill projects, as well as the influence of existing structures along the shoreline.

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F03. Coastal Enhancements to the National Hydrography Dataset (NHD)

Susan Phelps and Zsolt Nagy, AECOM

As NOAA Digital Coast resources such as lidar, bathymetry and local geospatial data become more readily available across the nation, the demand for enhanced local-resolution (i.e. parcel level) NHD has, in turn, also greatly increased. This presentation will focus on coastal NHD enhancements AECOM has completed in the Great Lakes region (Indiana) and along the Gulf Coast (Mississippi), and potential applications for this NHD data including flood modeling, water quality, navigation, etc. AECOM will provide an overview of the technical approach used to identify and extract NHD hydrography features from hydro-corrected, lidar-based terrain sources, as well as the role that NOAA's shoreline and other local data such as storm water pipes, dams and levees have played in the development of these coastal NHD products. Also included will be a brief discussion on "ele-hydro" (the collection of hydrography data at the time lidar data is flown and processed), and how future ele-hydro initiatives may enhance the creation of local-resolution hydrography data in coastal areas. We will also touch on some of the coastal requirements for hydrography, as reported in the recently completed USGS Hydro Requirements and Benefits Study (HRBS).

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F04. Drainage Analysis for Lake Erie

Eric Cole, Woolpert

Utilizing remote sensing technology along with the base mapping layers of high resolution ortho-imagery and LiDAR, the Pennsylvania Lake Erie Watershed Team has implemented a process that efficiently and effectively delineated impervious surfaces, calculated the Lake Erie Bluff-Line, created a connected hydrology dataset (3D streams, rivers, lakes, ponds) and watershed boundaries. All the data layers in combination are being used to analyze runoff from existing developed areas and the surrounding undeveloped terrain, how that runoff is entering the bodies of water and where those bodies of water are transporting drainage throughout the watershed. The technologies and datasets used in the drainage analysis are cutting edge and evolutionary in their application.

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F05. Inundation Modeling of Buildings for National Parks in the Northeast U.S. Using SLOSH and On-the-Ground Survey Data

Michael Bradley and Aimee Mandeville, University of Rhode Island Environmental Data Center; Nate Vinhateiro and Lisa McStay, RPS Applied Science Associates

The National Park Service manages several iconic cultural and natural resources along the Northeast coast, including the Statute of Liberty and Ellis Island in New York Harbor, and numerous sites within Gateway National Recreation Area (GATE), Fire Island National Seashore (FIIS), and Assateague Island National Seashore (ASIS). Because many of these locations experienced flooding and damages associated with the landfall of Superstorm Sandy, the NPS has partnered with the University of Rhode Island, and RPS- Applied Science Associates on an initiative to assess the vulnerability of these properties to future storm impacts. Dual frequency, survey-grade GPS equipment and total stations were used to collect first floor elevations (FFE) relative to NAVD88 for buildings and structures at ASIS, FIIS, and GATE. NOAA's SLOSH (Sea lakes and Overland Surge from Hurricanes) model was used to simulate storm surge from an ensemble of synthetic hurricanes and future (higher) sea levels. More than 55,000 projections of storm surge were modeled to represent various combinations of sea level change and hurricane parameters at time horizons of 15- and 35-years from 2015. The model results were aggregated into 16 inundation grids, each representing the worst case flooding for a particular hurricane category (1-4) and SLR scenario. Each inundation grid was exported to GIS and interpolated across the study area to create a water surface raster. The FFE points were then intersected and compared against each water surface raster. Each point was coded as Wet/Dry/Uncertain based on a comparison of water surface elevation and FFE after taking into account the uncertainty of the SLOSH predictions. We then developed web applications (tools) utilizing ArcGIS Online so that park staff and managers will be able to query and assess buildings with respect to future sea level and hurricane surge conditions to aid in future planning decisions.

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F06. Assessment of Infrastructure Risk from SLR to Support Joint Land Use Studies; Beaufort County, SC

Keil Schmid, Geoscience Consultants LLC

The Lowcountry Council of Governments administered two Joint Land Use Studies (JLUS) focusing on Marine Corps Air Station Beaufort and Marine Corps Recruit Depot Parris Island. One of the JLUS recommendations was to investigate potential effects of SLR. These bases, which have been highlighted for their potential for land loss from SLR, are major factors in the local economy of Beaufort County. This study examines the risks to targeted infrastructure (e.g., roads, sewer, water) from SLR and the costs associated with maintaining essential service to the bases. This study is 'scenario agnostic'. Rather than a set scenario, the envelope of SLR curves, adopted from the USACE, are used to map relative risk from SLR for several different time thresholds, which were developed from potential SLR impacts to the bases. In addition to the risk envelope, this study includes uncertainty in elevation (lidar) and tidal (VDatum) data. The mapping datum, 2.7 m above MLLW, was chosen based on an assessment of the inundation frequency; this level has a 50% of occurring at least once each month. Impacts of climate variability on the various infrastructure are time dependent; planning for future work toward solutions necessitates a level of priority. Prioritization can either help bring various groups together or divide them. To achieve the former it was deemed important to have a flexible, non-single scenario approach to the natural risks (SLR in this case); and a shared understanding of the importance of the existing or planned infrastructure components. Targeted infrastructure was assigned a risk score for each time period and assessed for its function in movement of services off and on the DoD bases. The results and techniques of this resiliency project will be shared along with the hurdles and their working solutions.

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F07. Quantifying Increased Flood Risk to Transportation Infrastructure Due to Sea-Level Rise

Jared Dorvinen and Brian Batten, Dewberry

Florida's low-lying topography, developed coast and growing population result in the state having one of the greatest needs in the nation to promote and execute sea level rise adaptation planning. In response, the Florida Coastal Management Program Section 309 strategy included a five-year initiative titled "Community Resiliency: Planning for Sea Level Rise" to examine the statewide planning framework and establish best practices for integrating adaptation and coordinating efforts across Florida. Through this initiative, the Florida Department of Economic Opportunity (DEO), in partnership with the National Oceanic Atmospheric Administration, Department of Environmental Protection, the Florida Coastal Management Office, and the Florida Division of Emergency Management, are working together to integrate coastal adaptation measures into existing local planning, policy and budgeting mechanisms. As part of the Community Resiliency Initiative, DEO has initiated pilot studies in three communities across the state including the City of St. Augustine. Instead of a "one-size-fits-all" approach, each case study was meant to explore risk informed adaptation planning that reflects the unique exposure, characteristics and goals of the individual community. In the city of St. Augustine, a novel method was developed using the NOAA Inundation Analysis Tool to assess the vulnerability of the community's road network to increases in periodic flooding due to sea-level rise. First, a table of total annual inundation times corresponding to discrete vertical elevations was developed for each community. Next, the entire road network was discretized into short segments and each attributed with an elevation. By cross referencing the elevation of each road segment with the annual inundation time for that elevation from the previously developed table, the vulnerability of the entire road network to periodic flooding was quantified. This approach provides a unique way of communicating the risks associated with sea-level rise on critical transportation infrastructure.

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F08. Decision-Support System to Assess the Impact of Sea Level Rise on Critical Infrastructure

Scott Samson and John VanderZwaag, Geosystems Research Institute, Mississippi State University

State and local decision-makers need to be pro-active in evaluating the impact of sea level rise on the critical infrastructure. The effect of rising sea levels is already evident in many coastal communities, as witnessed in Miami Beach during a king tide in 2015. The cost of remediation following a flooding event is considerably higher than the preparations to avert or limit the impact of sea level rise on coastal communities. The Geosystems Research Institute at Mississippi State University has developed an interactive, web-based tool to allow decision-makers to simulate sea level rise along the Mississippi coast. GeoCoast is a publicly accessible website allowing users to select a potential elevation above current sea level and evaluate the effect on traffic routing over the local road network as well as its impact on critical infrastructure, such as government and medical facilities. Users of GeoCoast identify an origin and destination on the coastal road network and witness the model's rerouting of traffic around the inundated landscape. A graphic overlay is also displayed depicting the depth of flooded areas. The user is also able to identify critical infrastructure either flooded or isolated due to inundated conditions around the facilities. The inundation model employed in the current application is based on the relatively simplistic "bathtub" or linear superposition approach, using QL2 lidar data collected in 2015. Efforts are currently underway to develop a more robust sea level rise model utilizing readily accessible data inputs while maintaining a user interface suitable for non-technical state and local decision-makers.

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F09. Passive and Active: Remote Survey Solutions for the Nearshore, an Integrated Approach

Don Ventura, Fugro Pelagos Incorporated

Emphasis on nearshore, shallow water surveys and the immediate coastal hinterland has increased over the past few years. This has been generated by concerns over various issues, including: sea level rise due to climate change and directly-attributable man-made issues such as land subsidence through extraction of valuable mineral and water resources; growth of, and reliance on, a seaborne Blue Economy delivering goods as efficiently as possible; concerns over erosion or damage to nearshore ecosystems necessitating additional focus on habitat mapping and environmental surveys in general; and an increasing percentage of the world's human population residing in close proximity to the coast which places extra emphasis on baselining and monitoring of this specific margin. At the same time, economic pressures on a great many of the world's advanced and developing nations alike bring the need for cost-effective methods of garnering geospatial data in the nearshore into sharp focus. Clearly, mapping of the land-sea interface requires the adoption of a broader approach to hydrographic surveying techniques and technologies to augment that already well surveyed with traditional methodology. This presentation will illustrate an integrated solution to this survey paradigm through the pragmatic use of satellite derived bathymetry and airborne topo- and bathymetric techniques.

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F10. Climate Change Tools for Resiliency Planning

Chris Mack, AECOM

This presentation will provide an overview of the impacts of climate change including sea level rise, increased storm intensity and frequency, and precipitation changes. Impacts analysis, modeling, and geospatial visualization tools from NOAA, USACE, and USAG will be highlighted. These tools include: 1) NOAA Sea Level Rise and Coastal Flooding Impacts Viewer, 2) USACE Sea Level Change Calculator Tool, and 3) USGS Coastal Vulnerability Index. Climate change resiliency planning will be reviewed by showcasing representative projects involving climate change assessments, prioritization of strategies, and methods to protect facilities, assets, and operations. Methods highlighted will include structural, non-structural, and natural systems.

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F11. The DESIS Hyperspectral Instrument – A New Space-Based Tool for Coastal Zone Monitoring

Ray Perkins, Teledyne Brown Engineering / Commercial Space Imaging; Rupert Mueller and Emiliano Carmona, DLR Earth Observation Center

The Teledyne Technologies Multi-User System for Earth Sensing (MUSES) platform will launch in 2017. MUSES will attach to the International Space Station (ISS) and is designed to host up to four robotically-installed Earth-observing instruments to return data for commercial, scientific, and humanitarian uses. The inertially stabilized pointing platform features a two-axis gimbal and provides a 50° field of regard in both along-track and cross-track directions. The platform agility and the ISS orbit enable studies of diurnal variations, and provide varying target aspect angles to support investigation of bidirectional reflectance distribution function effects. The MUSES system acquires ISS-provided time and ephemeris, adds data from the on-platform Star Tracker and Miniature Inertial Measurement Unit, and then processes this data through a real-time Pointing and Control System (PCS). The PCS has been validated to support the pointing accuracy and pointing knowledge required for both in-flight operations and post-flight ground processing of earth imaging instruments. The DLR Earth Sensing Imaging Spectrometer (DESIS), operated from the Teledyne MUSES, will provide space-based Visible to Near InfraRed hyperspectral data to support scientific, humanitarian, and commercial objectives. The DESIS instrument will be the first commercially available, production-class, space-based imaging spectrometer capable of delivering near-global coverage with long-term, high quality, high spectral resolution data. This will enable significant new research, expand the dimensions of humanitarian crisis response, and provide improved large-scale commercial spectral analytic applications. Research conducted over the last two decades has established that hyperspectral data can improve the quality and accuracy of vegetation classification, health assessments, and stress indications. Recent research has validated the use of space-based hyperspectral imagery for estuary and inland water monitoring. Fusing the DESIS spectral content with panchromatic, multi-spectral, and radar imagery will enable enhanced analyses across multiple domains within aquaculture, environmental management, agriculture, and forestry.

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F12. Urthecast Video Imaging from Earth Orbit: A New Tool for Mapping Coastal Bathymetry

Ron Abileah, jOmegak; Christos Koulas, Urthecast

Video methods for near coast phenomena have been used for decades, but so far only from airborne, balloons, or fixed tower platforms. Urthecast now provides 3-fps 1-m pixel resolution full-color video from the space station Iris camera. The 2 km x 4 km image footprint tracks the AOI for 60 seconds. The images are stabilized and orthorectified, ready to process into coastal products with minimal effort. Urthecast plans deployment of a constellation of 8 video capable satellites as part of their planned Opti-SAR constellation. The paper discusses use of such video for mapping bathymetry in the surf zone (depth range of 0-2m), and beyond the surf zone (2–10m).

Video in the surf zone was pioneered by Holland, Lippmanm, and Holman with a tower-based video at Duck, NC around 1980. That work eventually evolved into the permanent “Argus” system operated by Oregon State University at Agate Beach, OR. There are now thirty Argus installations world-wide. The basic algorithm is inverting the shoreward progressing breaking wave front into depth. Time averaging the video also reveals submerged topography. We present similar analysis with the space-based Iris video.

Video beyond the surf zone was pioneered by Dutch and German teams starting in the 1980s, imaging ocean waves from a tower mounted radar, and later with airborne video by USA researchers. Depth is determined by fitting the shallow depth wave dispersion equation to the wave temporal spectrum. (The algorithm also provides currents.) We propose using this method for periodic inspection of dredged channels by remote sensing.

Videos from satellites can access remote coastal areas and can be cost effective relative to airborne deployments or fixed towers.

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F13. MarineCadastre.gov – Ocean Reporting Tool

Christine Taylor, Bureau of Ocean Energy Mangement; Alexa Ramirez, Quantum Spatial

Marine Spatial Planning efforts often incorporate many data layers in order to make informed decisions for our state and federal waters and their use. In most cases the general public and effected stakeholders want to understand the background data that is or could be used, to make decisions in a quick and easily understood report format. The MarineCadastre.gov project is trying to fill that need with a new prototype application. The Ocean Reporting Tool is “coming soon” and will be a component of MarineCadastre.gov, a partnership between the National Oceanic and Atmospheric Administration and the Bureau of Ocean Energy Management. The new tool will extend the capability of MarineCadastre.gov by delivering marine geographic data in a report-based format using summary statistics, info-graphics, and interpretive analyses. Users can select pre-defined areas or use the custom draw tool to generate reports on general site characteristics, energy and minerals, natural resources and conservation, transportation and infrastructure, and economics and commerce. The new tool is envisioned to be used by ocean planners, policy analysts, the press, and the general public. At present the tool is being developed to cover offshore East Coast waters from Virginia to Florida. User interest will determine if and where the tool will be expanded. Data will be kept up to date so that infographic results will change as more and newer data is included in the pilot project. The MarineCadastre.gov team along with QSI will present this project and invite feedback from the GeoTools audience .

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F14. Aquamapper: A Decision-Support Tool for Regulating Offshore Aquaculture in the Gulf of Mexico

Lisa Wickliffe, NOAA National Centers for Coastal Ocean Science; Kenneth Riley, NOAA National Marine Fisheries Service; James Morris, Jr., NOAA National Centers for Coastal Ocean Science

In 2016, NOAA's National Marine Fisheries Service released the Gulf Aquaculture Plan (GAP) to manage the development of environmentally sound and economically sustainable open ocean finfish aquaculture in the Gulf of Mexico (inside the U.S. Exclusive Economic Zone [EEZ]). The GAP provides the first regulatory framework for aquaculture in federal waters with estimated production of 64 million pounds of finfish, and an estimated economic impact of $264 million annually. Through a highly collaborative, multi-agency effort a mock permitting exercise was conducted to illustrate a phased, regulatory process for the Gulf. Using the Gulf Aquamapper, spatial planning efforts allowed for identification of preliminary suitable siting areas for establishing finfish aquaculture using authoritative federal and state data housed in a centralized geodatabase. Initial siting efforts are aimed to guide coastal managers in developing regulatory guidelines and avoiding user conflicts, considering a multitude of biological, navigational, military, social, economic, physical and chemical parameters over space and time. Further analyses were conducted during the simulated secondary permitting phase using in situ conditional parameters (e.g., dissolved oxygen, persistence of HABs) for one mock site off of Matagorda, TX.

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F15. Putting Together a SeaSketch Project: Case Study from the Channel Islands National Marine Sanctuary

Grace Goldberg and Will McClintock, University of California Santa Barbara, Marine Science Institute

Effective interagency and cross-sector coordination is essential to ecosystem based management which depends on processes characterized by collaboration and science-based information. Many technological barriers that exist in the development of science-based management plans are closely tied to process challenges, such as the sharing of data and information or the inclusion of parties with varied levels of technical experience. In 2015-2016, the Channel Islands National Marine Sanctuary Advisory Council convened a diverse working group to develop recommendations for the management of marine shipping in and around the Santa Barbara Channel, as well as recommendations regarding research needs and outreach strategies. In addition to support from the Sanctuary and professional facilitators, the group used a decision-support platform, SeaSketch (http://safepassage.seasketch.org). SeaSketch is a web-based GIS that supports collaborative science-based marine spatial planning (MSP). Each feature supports a step of the MSP process, from data gathering, identification of data needs, the design of spatial plans, evaluation of those plans with analytics, and map-based forums that facilitate data-driven discussions. Working group members are able to access these tools to explore management options and collaborate remotely, in addition to using the platform during in-person meetings and webinars. Empowering diverse audiences to engage in the design of science-based plans is of key importance to developing ecosystem-based management plans where multi-sector participation and inter-agency coordination are critical.

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F16. Estimating Terrestrial Sediment and Nutrient Delivery to Coral Reefs around Puerto Rico Using a Free GIS Tool

David Gibbs, ORISE Fellow, U.S. Environmental Protection Agency, Office of Research and Development; Leah Oliver, U.S. Environmental Protection Agency, Office of Research and Development

One of the many stressors threatening coral reefs is land-based pollution, including sediment and nutrients. Unfortunately, estimating pollutant loads in watersheds and potential delivery to reefs is challenging, partially because many reef systems lack long-term watershed and coastal pollutant monitoring. In this project, we estimated relative levels of land-based sediment, nitrogen, and phosphorus in Puerto Rico's coastal waters and compared those values with island-wide reef survey data. There were two main steps. First, we modeled annual flow, sediment, nitrogen, and phosphorus loads in every HUC10 watershed in Puerto Rico with a free, open-source, GIS-based tool called OpenNSPECT. This produced approximate runoff volumes and land-based pollutant loads at over 200 river and stream mouths. Inputs for this step were: a DEM, a precipitation raster, a shapefile of hydrologic soil groups, a rainfall factor raster, a land use raster, and the number of raining days per year in each HUC10. We compared the modeled values to observed flow and pollutant values wherever possible. Second, we used a series of geoprocessing tools to estimate dispersion of sediment and nutrients from river and stream mouths. Ultimately, we combined sediment, nitrogen, and phosphorus into a single composite index raster of relative pollutant concentration and overlaid that with reef survey data. This process will help Puerto Rico's coastal resource managers assess the relative threat from land-based pollutants to reefs and other benthic communities. It can be replicated with local modifications for other reef systems where land-based pollutants are stressors but spatially explicit data are lacking.

DISCLAIMER: The views expressed in this abstract are those of the author and do not necessarily reflect the views or policies of the U.S. EPA.

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G01. Office of Coast Survey Latest GIS Applications

Kurt Nelson, NOAA Office of Coast Survey

The Office of Coast Survey continues to look for initiative means to provide nautical charting information to the mariner. Over the past year Coast Survey's Marine Chart Division has launched the "Chart Tile Service" that provides up-to-date charts in a mobile friendly raster tiling service. We have also developed two new GIS web portals that geographically represents changes to navigational charting products. One displays weekly critical and non-critical updates applied to affected charts, while the second provides an historical record of all critical updates applied to those same products. Lastly, to improve how bathymetric information is disseminated to navigational products, the Coast Survey Development Laboratory is developing a Navigational Gridded Bathymetric Database that will utilize many different sources of bathymetric information, such as historical smooth sheets, modern multibeam surveys, and satellite bathymetry, to provide enhanced depth contours to feed into precision navigation products. These are just few examples of how Coast Survey is using geospatial applications to meet the emerging requirements of the maritime community.

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G02. NGS' Capabilities that Support the Geospatial Community

Mike Aslaksen, Gretchen Imahori, Chris Sloan, Stephen White, and Jamie Kum, NOAA National Geodetic Survey

NOAA's National Geodetic Survey (NGS) maps the National Shoreline of the United States using topographic bathymetric (topobathy) lidar and photogrammetry techniques in support of NOAA's nautical charting mission. Through NGS' IOCM approach to "map once, use many times", NGS has been able to support the geospatial community with high resolution nearshore bathymetry and aerial imagery to help update the nation's shoreline and nearshore bathymetry on NOAA nautical charts, update the continually updated shoreline (CUSP), fill in the gaps in habitat maps, aid emergency response efforts and support a variety of other GIS user needs. Bathymetric lidar and Aerial imagery capabilities will be discussed.

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G03. Continued Evolution of NOAA's Environmental Shoreline Mapping Program (ESI)

Jill Petersen, NOAA Office of Response and Restoration; David Moe Nelson, NOAA National Centers for Coastal Ocean Science

Over the past 3 years, NOAA's ESI shoreline resource mapping has seen many changes. December 2016 marked the culmination of a multi-year project to remap the Atlantic coast. This effort was driven by the coastal impacts of Hurricane Sandy, and afforded an unprecedented opportunity to improve and enhance the ESI content and data structure. Increased areal coverage and the addition of multiple human-use features were part of the effort to broaden the ESI user base. Traditionally focused on oil spill response and planning, the new maps and data should be useful during planning and response to other natural and man-made hazards. These enhancements will be incorporated in all future ESI data projects. This session will focus on a review of the data content in its entirety, new features and uses, ESI specific data tools and ESI plans for the future.

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G04. Standardizing Coastal Geographic Response Plans at a National Level

Jill Bodnar, Genwest Systems, Inc. at at the NOAA Office for Response and Restoration;
Jay Coady, I.M. Systems Group at the NOAA Office for Response and Restoration

Geographic Response Plans (GRPs) are detailed response strategies that aim to protect sensitive coastal environments and resources in the event of an oil spill or other hazardous event. They identify potential resources at risk and the equipment necessary for protecting these assets and adjacent coastline. They are an essential mechanism used by federal and state agencies to ensure that all responders have access to pre-approved plans that will improve the effectiveness of a response. GRPs are an important product managed by 13 U.S. Regional Response Teams, consisting of representatives from state, local, and federal agencies. Although there are general U.S. Coast Guard guidelines to develop GRPs, this is done differently in each region without consistency in the amount of information they provide, their format, or how they are displayed spatially.

Over the past two years, NOAA's Office of Response and Restoration (OR&R), the Bureau of Safety and Environmental Enforcement (BSEE), and the U.S. Coast Guard have partnered to standardize GRPs in the United States and its territories. The focus has been on developing a consistent Geographic Information System (GIS) format, including attributes and symbology, and providing a centralized location for easy access to the GRP data and associated planning documents. NOAA's Environmental Response Management Application (ERMA) Web-mapping application was leveraged as the visualization and distribution platform for regional partners to access the data and planning documents. Additionally, ERMA provides the user a broad scope of spatial data, such as key infrastructure, weather, and natural resource data, to use with the GRPs for planning and decision making. U.S Coast Guard Sectors in the Great Lakes and Guam are actively using ERMA and its simple map feature drawing tools to develop and maintain their GRPs.

This presentation will cover the challenges, methods, and outcome of creating a national standard and repository for Geographic Response Plans.

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G05. A Baseline Ecological Assessment of the Tidal Choptank River: Digital Atlas, Web Mapping Portal, and Baseline Status Report

David Moe Nelson, NOAA National Centers for Coastal Ocean Science; Dan Dorfman, Ayman Mabrouk, and Laurie Bauer, CSS-Dynamac at NOAA National Centers for Coastal Ocean Science; Ken Buja, NOAA National Centers for Coastal Ocean Science

The Choptank River Complex, including the tidal Choptank and Little Choptank Rivers on Maryland's Eastern Shore and watershed extending into Delaware, has been selected as a Habitat Focus Area under NOAA's Habitat Blueprint Program. To support the management, conservation, and restoration objectives, NOAA's National Centers for Coastal Ocean Science (NCCOS) has developed a Digital Atlas of the Choptank Habitat Focus Area The Digital Atlas can be used as a tool for conservation planning, resource analysis, data exploration, and other purposes. The Digital Atlas consists of three components:

- Geodatabase of existing relevant data sets from NOAA and partner organizations
- Interactive web portal for mapping and displaying relevant data sets
- Summary report published as a NOAA Technical Memorandum.

The information presented in all three components are organized into seven themes: Land Cover, Shoreline Composition, Water Quality, Benthic Index of Biotic Integrity, Submerged Aquatic Vegetation, Fish, and Oysters. For each theme, pertinent data sets from partner organizations have been processed, summarized, and scaled to be used in the web mapping portal.

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G07. Mapping Habitat Quality for Listed Beach Species: An Index to Inform Mitigation Planning for the Florida Beaches Habitat Conservation Plan (FBHCP)

Amy Knight, Florida Natural Areas Inventory

The goal of the FBHCP is to offset impacts to federally listed species due to state-authorized construction and land use activities in coastal beach and dune habitats and to maintain and improve the quality, quantity and function of this habitat over the 25-year plan period. In addition to avoidance and minimization, a primary strategy is to offset any remaining impacts through mitigation for a net conservation benefit. Statewide occurrence-based habitat was mapped for sea turtles, shorebirds/seabirds, and beach mice as a component of the mitigation plan to inform area-based incidental take projections. Wildlife biologists with expertise in each species group provided input on both the geographical extent and physical and biological features of occupied habitat. Significant investment was made in consolidating species occurrence data from many sources, and habitat polygons were delineated using a combination of land cover, mean-high water shoreline, elevation, and aerial photo interpretation. Relative habitat quality was mapped per species group to enable assessment of mitigation costs and potential for habitat improvement through mitigation. A deductive modeling approach was used to overlay habitat quality factors into a 1 – 5 index for each species group. Species experts provided input into the weighting of habitat factors and review of the resulting index maps. The species groups differed substantially, not only in habitat requirements, but also in the robustness of occurrence data and existence of empirical data to support decisions related to habitat factors. Thus, the GIS techniques used were highly customized for each species group. Updates are planned at intervals throughout the life of the HCP to address the challenges of a dynamic coastal system and continual improvements in species knowledge. The habitat maps were used in SPLASH, a new decision support system for habitat conservation planning, and are also expected to inform other coastal conservation planning.

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G08. SPLASH: A Decision Support System for Habitat Conservation Plan Development

Michael Flaxman, Geodesign Technologies Inc.

The Florida Beaches Habitat Conservation Plan (FBHCP) is one of the most complex projects of its kind, covering dozens of development and mitigation activities, 16 species and approximately 400 miles of coastline. The development of a plan of this scope and scale requires a new generation of decision support technologies. We have created cloud-based system known as SPLASH (for scenario planning, analysis and sharing). SPLASH uses a "robust decision-making" approach to accommodate the views of multiple participants, as well as scientific uncertainty. Drivers of uncertainty beyond the immediate control of the plan are organized into 'contextual scenarios.' These include varying amounts of sea level rise and coastal erosion, future development patterns, and the effectiveness of particular mitigation practices. Meanwhile, sets of rules and measures which are within the HCP's regulatory purview are treated as 'plan scenarios.' Many such scenarios exist, each with varying program costs and risks to each species. The process of robust decision-making involves wide consultation in developing scenarios, followed by simulation of each plan scenario against each contextual scenario. In this formulation, a 'robust' plan is one which meets its legal requirements at low socioeconomic cost, across a wide range of context scenarios. Managing such complexity is computationally as well as architecturally-challenging. SPLASH uses two techniques in order to remain largely interactive, even with terrabytes of geospatial data. First, it performs scale-sensitive geocomputation. Operations which cannot be run in near real-time at full level of detail are approximated using aggregated data and progressively refined. Second, scenario, geographic and species calculations without dependencies on each other are run in parallel. We have found this combination of process and computing architecture to be valuable in delivering the Florida Beaches HCP on time and on budget. We look forward to applying such methods to other coastal management challenges.

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G09. Small UAS-based LiDAR Acquisition and Processing Considerations for Natural Resource Management

Russ Faux, Steve Raber, and Nick Kules, Quantum Spatial, Inc.

High resolution LIDAR data collected from a small unmanned aerial system (sUAS) has the potential to revolutionize our approach to environmental conservation. We now have the unprecedented ability to locally collect detailed elevation data at temporal frequency that would be cost prohibitive using traditional manned flights. However, the successful deployment of these technologies often requires applying best practices that were developed for the traditional airborne LiDAR market. This presentation will discuss the sUAS LiDAR processing workflow, the challenges with efficient acquisition and processing, and an optimized approach. Examples will be demonstrated, with potential pitfalls, and critical success factors for projects with high quality expectations. The project includes the acquisition and processing of high density LiDAR for three diverse coastal sites within the National Estuarine Research Reserve System (NERRS), specifically in California, New Jersey, and Mississippi.

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G10. Unmanned Aerial Systems for Coastal Mapping and Change Detection

David Day, Keystone Aerial Surveys, Inc.; Renee Walmsley, Tetra Tech

Imaging and laser scanning of coastlines have long been used to determine the effects of erosion and human development, for planning and disaster response. However, due to tidal windows, weather restraints and the physical size of sensors, the costs to perform these activities is often prohibitive and certainly does not allow for the frequent recapture of data. This presentation will document the current state of UAS data acquisition under the FAA Part 107 rules – highlighting what types of work are possible and which of the commercially available aircraft and sensors are to meet the needs of mapping professionals. Secondly, real-world examples from Tetra Tech, Inc. and Keystone Aerial Surveys, Inc.'s experience using UAS for both coastal and inland mapping projects will be displayed and reviewed. This includes accuracy assessments of multiple UAS sensors in comparison to existing manned technology. With horizontal and vertical accuracies in the range of a few centimeters, the current UAS technology can meet the specifications of many projects. Costs can be reduced for frequent revisits or for one time surveys, especially when smaller areas or poor weather areas are targeted.

Outline:

- Introduction to Keystone Aerial Surveys/Tetra Tech
- UAS sensors and aircraft
- Accuracy assessment and comparison of AT and Height Models
- Acquisition examples from coastline project (Pismo Beach)
- Use case for rapid response, change detection and mapping of small to mid-sized sites

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G11. Using Small UAS and USV for Coastal Monitoring and Analysis

Robert Moorhead, Gray Turnage, and Lee Hathcock, Mississippi State University; Lindsay Spurrier, Cypress Environmental Science and Engineering; Mel Landry, NOAA Restoration Center

Small unmanned aerial systems (sUAS) provide unique and highly beneficial capabilities for monitoring and analyzing coastal habitats and landscapes. In this presentation, we will present the results of two projects that exploited sUAS to analyze a coastal habitat. The first project involved one of the Sentinel Sites at the Grand Bay National Estuarine Research Reserve in southeast Mississippi. Historically subsidence and sea level rise have been determined by in-situ measuring within in one meter squares spaced approximately 20 meters apart over a 50 acre site. By using a small UAS, we are able to collect ~1 cm resolution imagery over the entire area in ~20 minutes. Exploiting a classification scheme, we are able to determine from the imagery the species of marsh grasses over the entire area. Compared to in situ measurements, using a UAS eliminates the need to haul heavy equipment over the fragile landscape you are trying to preserve and analyze, and allows analysis of the whole area, not just small sample areas. It is also much faster and cheaper. The second project was an analysis of a marsh reconstruction project in Bayou DuPont, Louisiana. Collecting highly-overlapped high resolution imagery over 1000 acres using a hand-launched UAS, we were able to create a surface elevation representation. Based on the results of these experiments, we will discuss the value of using a small UAS to obtain the topography and a shallow-draft unmanned surface vehicle (USV) to measure the near-shore depths in turbid water. Using the USV enables a more comprehensive analysis of the environment and provides highly useful information for a more cost-effective adjustment of the marsh reconstruction to create a diverse and thus more resilient environment.

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G12. UAS-Based Lidar and Imagery in the NERRS Marshes

Kirk Waters, NOAA Office for Coastal Management; Jamie Carter, The Baldwin Group at the NOAA Office for Coastal Management; Jared Lewis, San Francisco Bay National Estuarine Research Reserve; Susan Bickford, Wells National Estuarine Research Reserve; Andrea Habeck, Jacques Cousteau National Estuarine Research Reserve

There is a near universal need within the National Estuarine Research Reserve System (NERRS) and by other natural resource stakeholders for accurate Digital Elevation Models (DEMs) and habitat maps to support a diversity of applications including: reducing the error of marsh DEMs to support sea level rise research and management and flood forecasts; evaluating the impact of specific vegetation management practices on elevation in marsh micro-environments; assessing beaches after storms for damage assessment and restoration purposes; and identifying high priority invasive and sensitive vegetation. Unmanned Aerial Systems (UAS) are being used to collect high resolution multi-spectral imagery and lidar elevation for three NERRS sites: Jacques Cousteau, NJ; Grand Bay, MS; and San Francisco Bay, CA. The project is assessing the positional accuracy attainable by the PrecisionHawk UAS system and the applicability of the data for use within the NERRS. By collecting data on test plots in three different NERRs, we are examining the advantages of using a UAS across ecosystems, varying from the relatively simple dunes of New Jersey to the Gulf of Mexico salt marsh in Mississippi to the estuarine salt marsh in California. The more complex California site will be overflown in two different seasons to test the multi-season enhancement for habitat mapping and the reproducibility of the lidar data. Issues related to obtaining a Certificate of Authority (COA) from the FAA to fly will be discussed as well as permitting issues at co-managed lands such as the NERRS.

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G13. **Using FEMA's Tools to Better Identify, Communicate, and Mitigate Flood Risk**

Bradley Dean, Michael Baker International

Since 2010, FEMA has made a significant investment in updating the Nation's flood hazard maps in coastal areas as part of its Risk Mapping, Assessment, and Planning (Risk MAP) program. FEMA has funded nearly all the engineering work necessary to update flood hazards along 100% of the populated coastline of the United States. The goal of Risk MAP is to not only map flood hazards, but also to increase awareness of flood risk and encourage communities, property owners, and others to take action to mitigate their risk.

FEMA's new Flood Risk Products provide a set of tools to augment the regulatory FIRM and Flood Insurance Study report produced during a coastal flood risk study. They better convey 1-percent-annual chance flood depths, flood risks from more severe storms, wave hazards, and areas of erosion risk. States, regional entities, communities, and businesses can use these products for climate adaptation & future development planning, risk assessment of critical infrastructure or building and housing stock, and risk mitigation and communication efforts.

FEMA and its community engagement and risk communications (CERC) contractor, Resilience Action Partners, are helping understand community data needs, especially with regards to future conditions and sea level rise. In addition, they are working to address community specific needs, avoid redundancy with other efforts, and to provide useful, easy to comprehend informational resources. FEMA's flood risk products can be valuable for making good decisions for planning and mitigation activities intended to reduce risk and protect communities from future flood events. This presentation will provide discussion of the resources that are provided to communities and will touch on steps FEMA is taking to understand and meet communities' needs for additional information related to sea level rise and future flood risk.

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G14. Multi-Hazard Flooding Risk Maps for Coastal Community Water Infrastructure

Tom Allen, Old Dominion University, Commonwealth Center for Recurrent Flooding Resilience; George Mcleod, Old Dominion University, Geospatial and Visualization Computing; Tom Crawford, St. Louis University

Coastal community water infrastructure is increasingly vulnerable to coastal hazards operating across multiple spatial and temporal scales such as king tides, storm surges, urban flash flooding from extreme precipitation, and salt water intrusion. Using two case studies of Charleston (SC) and Morehead City (NC), this project develops methods for geospatial risk assessment of urban water and wastewater infrastructure vulnerability by integrating physical assets, geospatial hazard characterization, and guidance from planners, public utilities, and health care providers. Risk maps from the GIS models are used to compare and contrast nuisance flooding and king tides, storm surges, and extreme precipitation-related inundation that impact wastewater systems, potable water supply, and provision of emergency health services. Our models includes tidal inundation, downscaled storm surge models and LiDAR DEMs, and spatial rainfall runoff potential exacerbated by climate change and sea level rise. Results highlight the differential patterns of vulnerability, modeling uncertainty, and elevation data quality. Implications for improving integrative public health risk assessments, emergency management, and planning are drawn. Portability and application of the approach is also reviewed with a case study of Hampton Roads, Virginia, where relative sea level rise and urban flooding challenge modeling of disparate inundation processes and impacts.

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G15. Leveraging Available Data Sets in Response to Implementing Federal Flood Risk Management Standards

Brian Caufield and Sarah Braddy, CDM Smith

In June 2013, President Obama issued The President's Climate Action Plan, meant to improve the nation's resilience to flooding and better prepare the nation for climate change. On January 30, 2015, the President signed Executive Order 13690, Establishing Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, which amended Executive Order 11988, Floodplain Management, issued in 1977. The new federal flood risk standard requires all future federal investments in and affecting floodplains to meet the level of resilience set by the Standard. The Standard set one of three approaches by which federal agencies can establish the flood elevation and hazard used in siting, design, and construction to achieve resilience:

- Utilizing best available, actionable data and methods that integrate current and future changes in floodplain based on science,
- Two or three feet of elevation, depending on the criticality of the building, above the 1-percent-annual chance flood elevation, or
- 0.2-percent-annual chance flood elevation In order to meet these standards, one can leverage readily available online data sources.

In order to establish either the 1-percent or 0.2-percent-annual chance flood elevation, data sets such as FEMA's National Flood Hazard Layer or Flood Insurance Rate Maps are needed. Knowledge of the local terrain can be gathered from sources like Digital Coast's coastal LiDAR. And climate based science in the coastal settings would rely on sea level curves, which can be built using USACE online tools. This presentation will discuss EO 13690 and how to leverage available online datasets in order to implement resilience.

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G16. Private Homeowners Using Public Resources to Determine Special Flood Hazard Areas

Sarah Braddy, Diana Rodriguez, and Brian Caufield, CDM Smith, Inc.

The Federal Emergency Management Agency (FEMA) and its partners remain focused on providing up to date and accurate flood maps, mitigation information, and relevant tools to state and local communities in coastal and riverine areas. Their program Risk Mapping, Assessment and Planning's flood hazard mapping is an integral part of the National Flood Insurance Program, forming the basis for regulations and flood insurance requirements. FEMA maintains and updates its data through Flood Insurance Rate Maps (FIRMs) and risk assessments by using the best available technical data to create the flood hazard maps that outline a community's flood risk areas. Resources available to private and public sectors depicting these flood risk areas include (1) FEMA's Flood Map Service Center, an official online repository housing all flood hazard mapping products, and (2) FEMA's Official National Flood Hazard Layer web app viewer, allowing access to and easy creation of printable FIRMettes, showing Special Flood Hazard Areas (SFHAs) across the country in riverine and coastal communities. Though there are available tools and resources, there is a lack of awareness at a homeowner and even community level. Many inquiries reaching the Office of the Flood Insurance Advocate are initiated by private homeowners and related to flood zone discrepancies, proper identification of a SFHAs, and the location of the property in question related to those areas. A simple look at these two resources and how to appropriately utilize them will help private homeowners navigate this process.

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