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Great Lakes Coastal Mapping Summit
Summary – April 4-6, 2017

The Great Lakes Coastal Mapping Summit was held at the USACE Chicago District in Chicago, IL, April 4-6. The intention of the Summit was for governmental partners, regional/local authorities, academia, the private sector, non-governmental groups, and others to share data needs and explore opportunities for collaboration on coastal mapping data acquisitions and applications in the Great Lakes region. The geographic area of interest for the Summit ranged from terrestrial near coast to offshore. Participants at this Summit included representatives from Federal agencies, Illinois, Indiana, Michigan, Minnesota, Wisconsin, Pennsylvania, New York, and Ohio state agencies, non-governmental groups, academia, and private sector stakeholders. See attachments for a full list of attendees.

The items listed below outline key points and concerns raised at this Summit. This is not a detailed report of all Great Lakes Coastal Mapping Summit activities rather, it is intended to highlight key issues and commonly raised interests. Input received at this Summit and subsequently will help catalog source data for a future topobathymetric elevation model, identify mutual science applications of interests, and improve the coordination of data acquisition efforts and funding strategies.

Tuesday, April 4

Setting the Stage- Status of Key Federal Mapping Programs: Six speakers addressed the current state of coastal mapping programs in the Great Lakes region for the National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), and U.S. Army Corps of Engineers (USACE). This included federal interagency working group discussion from the Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM) and the 3D Elevation Program (3DEP). Speakers and presentations included in these sessions:

1. Ashley Chappell, NOAA/IWG-OCM – Introduction to the IWG-OCM and the National Coastal Mapping Strategy
2. Chris Macon, USACE - Joint Airborne Lidar Bathymetry Technical Center of Expertise: Great Lakes
3. John Brock, USGS, and Harvey Thorleifson, Minnesota Geological Survey - National Cooperative Geologic Mapping Program
4. Jeff Danielson, USGS - CoNED Applications Project: Topobathy Model Requirements and Plans for the Great Lakes
5. Mike Aslaksen, NOAA – NOAA Coastal Mapping Program

Key points and questions:

- Integrated Ocean and Coastal Mapping (IOCM) – three main components focused on coordination of data acquisition, data stewardship, and unique/novel use of datasets.
    - Focus on both coordinating across NOAA and with other Federal agencies. The interagency arm is managed through the Integrated Working Group on Ocean and Coastal Mapping (IWG-OCM). This is a White House Subcommittee on Ocean Science and Technology working group. See Chappell presentation for list of IWG-OCM participants.
    - Key product of the IWG-OCM over the past several years has been the National Coastal Mapping Strategy. One of the components of this Strategy calls for focused coordination on coastal mapping data acquisition, and is a driver for this Great Lakes Coastal Summit. Regionally focused Summits provide focus on geographic areas and are a successful model for heightened awareness of local to federal mapping and related activities. As a mechanism to facilitate collaboration regional Summits are planned to continue into the foreseeable future.
- USACE Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX).
    - Covered JALBTCX mission and planned areas of data collection for next several years. Talked about specific projects such as wetland habitat mapping/protection, invasive species mapping, water quality monitoring, etc.
    - As part of the data collection hyperspectral imagery is also captured and used with the lidar data to create fusion products.
    - Planned topobathy mapping of the Great Lakes region in 2018 and 2019 – see presentation for specific collection details. Hold planning meetings at USACE District offices, can contact Chris Macon (christopher.l.macon@usace.army.mil). Can collaborate with states for funding projects but this takes 6-9 months to secure.
    - **Questions:**
        - (Q) What is the timeframe in which you plan to collect this data? (A) Currently collection is scheduled for early spring.
        - (Q) Any interest in strike-slip fault mapping, example Western California? (A) Yes
        - (Q) Noticed Green Bay wasn't included in the upcoming collect graphic? (A) Currently not a requirement for the Detroit District.
        - (Q) When planning for collects, is turbidity taken into consideration? (A) An effort is made to collect under ideal conditions; however time windows/schedules do not always allow the flexibility needed.
        - (Q) Is there coverage or planned coverage in the connecting channels? For instance, the St Lawrence River? (A) Sometimes you'll see coverage, but all dependent on requirements.

        - (Q) Lake Erie experiences algal blooms…will the collection window account for this? (A) Currently targeting early spring for the western side and largely depends on wind direction; eastern wind is better.
- National Cooperative Geologic Mapping Program (NCGMP). "Great Lakes could become a bellwether region for taking geologic mapping to the next level." (John Brock)
    - The National Geologic Mapping Act mandated the National Cooperative Geologic Mapping Program, consisting of geological mapping by federal, state, and university partners, made consistent and available as the National Geologic Map Database.
    - Principal forum for developing geologic map standards is the annual DMT workshop to be held in Minneapolis MN May 21-24, 2017.
    - Primer provided on history of geologic mapping – see Brock/Thorleifson presentation for details.
    - Zoomable, seamless, 3D, queryable compilations the way of the future.
    - Discussion about geologic, bathymetric, and elevation mapping included a reference to a special issue of the Journal of Coastal Research Special Issue 76) titled "Advances in Topobathymetric Mapping, Models, and Applications".
    - Geologic mapping requires topographic data, so including offshore geologic mapping in the FEDMAP, STATEMAP, and EDMAP components of NCGMP also requires high resolution bathymetric data.
    - **Questions:**
        - (Q) Was the Digital Mapping Techniques workshop coordinated with Canada? (A) Canada actively participates in the Great Lakes Geologic Mapping Coalition; arrangements are in place to expand collaboration. Added: "The Digital Mapping Techniques workshop series ("DMT") brings together scientists, cartographers, and GIS specialists, from State and Federal agencies, as well as Universities, the private sector, and international colleagues. This annual series of workshops began in 1997. It is a highly regarded venue that has contributed to the development and evolution of digital mapping techniques, standards, and guidelines both in the United States and internationally." https://ngmdb.usgs.gov/Info/dmt/
- Coastal National Elevation Database (CoNED) – 3D Elevation Program in the coastal zone. Focused on assimilation of data across coastal zone. Key product is Topobathymetric Elevation Models, which are a merged rendering of topography (land elevation) and bathymetry (water depth) to produce an integrated seamless elevation product.
    - National Enhanced Elevation Assessment 2.0 – USGS working with NOAA to produce a follow-on study to the initial NEEA taking a fresh look at what requirements and benefits of topo and topobathy lidar are today.

    - FY17 Broad Area Announcement. Matching funds program run by USGS, there are some projects in the Great Lakes region. Would be great to see this number grow in the future to increase data collection footprint.
    - Overview of plans for CoNED DEM in Great Lakes region. Provided Great Lakes requirements/specifications, see slides for technical details. Work to start tentatively in Fiscal Year 2020 through 2022
    - **Questions:**
        - (Q) Why no smaller lakes included? (A) Not included in scope, room to modify. Collection of bathymetric data for small lakes also includes challenges related to water clarity for data acquisition, and planning related to geographic distribution of inland, but near-coastal, water bodies.
- NOAA Coastal Mapping Program – defines the National Shoreline and provides nearshore elevation data, NOAA nautical chart updates, and several other important applications such as benthic habitat mapping, coastal resource management, etc.
    - Utilize both NOAA and contract aircraft to collect lidar data. Produces several products including shoreline, ortho mosaic imagery, lidar point cloud and DEMs, DTMs, and photo data .
    - If you are looking for vector shoreline data see www.ngs.noaa.gov/NSDE/; for the shoreline data explorer, see https://www.ngs.noaa.gov/CUSP/.
    - Covered recent and upcoming topobathy work in Florida and Caribbean. All NGS data is available at NOAA Digital Coast

Flash Talk Session 1 – Data Collection:
This session focused on past, current and planned efforts to collect data in the Great Lakes region. Speakers included:

1. Jayme Stone, USGS
2. Jim Giglierano, Wisconsin GIO
3. Brandon Krumwiede, NOAA
4. Tom Loeper, NOAA
5. Ryan Jackson, USGS

Key points and questions:

- Jayme Stone (USGS) – Upper Mississippi River System Topobathy. Topobathy lidar datasets key to understanding ecology of river for habitat mapping. Managing multiple datasets is a big challenge, bathymetry to elevation datum transformation. Have mitigated this in-house. Finished processing dataset in fall 2016 (acoustic bathy from 1989-2010 with terrestrial lidar from 2008-2011). Looking to add high-res bathy next, update with new lidar and potentially topobathy lidar. Also exploring applications for Topobathy. Provided link to Topobathy fact sheet

- Wisconsin Coastal Management and Lands Information Program. Joe Dwyer, a NOAA Coastal Management Fellow, is working on comprehensive public access guide for Wisconsin shoreline. Adam Bechle is currently revising the Coastal Processes Manual that was last updated in 1998. Third presenter was Jim Giglierano, who serves as Wisconsin GIO for the Land Information Program. Talked about the Wisconsin Lidar Program, mentioned that he was able to leverage 3DEP BAA to accelerate work, have covered 21 counties thus far. Have four counties without lidar that they look to tackle in 2018. Beyond this project, they are working to create a data repository with Wisconsin View and are focused on development of lidar derivative products and web services.
- Brandon Krumwiede - Beaver Islands Archipelago and South Manitou Island. Just completed this summer, data now publically available at NOAA Digital Coast. There was no prior data for the selected geography. Contracted with Dewberry and Leading Edge Geomatics to collect topobathy lidar for this region. From this data collect produced a LAS point cloud and seamless digital elevation model.
- Tom Loeper – NOAA Navigation Manager for Great Lakes region.
    - Should have entire Great Lakes region covered with Electronic Navigational Charts (ENCs) by mid-late summer 2017.
    - Mentioned strong interest in recommended shipping lane routes by commercial carriers. NOAA working to update these currently utilizing Lake Carriers Association recommended courses. Doing this for all 5 lakes.
    - River level big concern for Chicago mariners. Significant air gap issues with bridges.
- Ryan Jackson, USGS. USACE Great Lakes Coastal Resiliency Study. Building a coastal resiliency project management plan to examine the resiliency of the Great Lakes coastline. Similar to the North Atlantic Coast Comprehensive Study following Hurricane Sandy. USGS and NOAA will work to compile existing data and perform a gap analysis in FY18 pending funding.

Flash Talk Session 2 – Data Collection/Application:

This session focused on current and planned efforts to collect data in the Great Lakes region as well as highlighting innovative approaches to data modeling. Speakers included:

1. Robert Schuchman, Michigan Technological University
2. Larry Robinson, USGS
3. Dennis Hall/Russ Faux, Quantum Spatial
4. Tim Calappi, USACE
5. David Mickelson, Geo-Professional Consultants, LLC
6. John Yellich, Michigan Geological Survey

Key points:

- Guy Meadows for Bob Schuchman – Michigan Tech University: Extent of submerged aquatic vegetation in the nearshore zones of the lower four Great Lakes. Use of remote sensing to analyze impacts of mining stamp sands; action: dredge to try to prevent transport of stamp sands to Buffalo Reef. Looking at cladophora and need to update mapping.
- Larry Robinson – Upper Midwest Environmental Sciences Center. Started aerial analog floodplain mapping work in early 90s. Focus in recent times has been on digital imagery. Acquiring 3DR solo drones in 2017.
- Russ Faux, Quantum Spatial – Full Service Geospatial firm with a focus on topobathy lidar collection. Over 4,000 square miles surveyed in 25 states and 3 Canadian provinces. Did a project in St Marys River in 2015, included approx. 4,800 shoreline miles in Lake Superior for USACE Detroit District. Talked about recent use of Riegl 880, displayed some high-quality images from this system. Stated that water clarity in the Great Lakes region is conductive to bathymetric lidar. QSI has deployed Riegl 880 in a wide range of riverine and coastal environments.
- Tim Calappi, USACE 2015 St Marys River nearshore topobathy lidar collection. Complementary to Russ Faux/QSI presentation, user side of this survey. Survey driver was USACE interest in capturing the transitional slopes of the nearshore region along St Mary's river with a priority area at the rapids to coordinate gate openings for low flow. Previous survey was from mid-80s, not bad quality but needed better resolution to optimize timing of gate openings. Accurate water depths are important for fish habitats; ensure applicability for spawning environments.
- Dave Mickelson, Geo-Professional Consultants, LLC – Effects of structures, bluff, and nearshore profiles and mapping along Lake Michigan shoreline. Technical talk on surveys conducted by Geo-Professional Consultants in GL region from mid-70s to 2012; profiles added to Wisconsin Shoreline Inventory & Oblique Photo Viewer. Bluffs have become more stable during this time period (compared to 2012 USACE lidar data) as the amount of protected shoreline has increased and water levels are lower.
- John Yellich, Michigan Geologic Survey - Mitigation of coastal bluff erosion by removal of ground water 1996-2008. Technical talk on research conducted on MI coastal bluffs since mid-90s to determine reason for erosion. Human use significant cause of erosion.
- **Questions:**
    - (Q) Are land owners ok with holding tanks instead of septic systems? (A) There is a meeting next week, where reception is expected to be good because the drinking water supply is better even though cost is higher.
    - Comment: Talks 5 & 6 prove need for 3D geologic info so the International Joint Commission can look at the amount of discharge into the Great Lakes
    - (Q) Is there any evidence of fracture network in St Mary's data? (A) Have not looked; can provide LAS.

SeaSketch Tour:

Ashley Chappell, co-chair of the Interagency Working Group on Ocean and Coastal Mapping, provided an overview on the Federal Mapping Coordination SeaSketch website. SeaSketch was developed by the McClintock Lab at the University of California Santa Barbara as a simple, easy to use tool to facilitate discussion and coordination of marine spatial planning, monitoring and enforcement in our shared coastal and ocean spaces. The IWG-OCM, in conjunction with the 3D Elevation Program, utilizes SeaSketch to coordinate on mapping plans and requirements across Federal and state agencies, academia, coastal managers, private sector stakeholders, etc. The types of activities included in the Federal Mapping Coordination site include acoustic surveys (side scan/single/multibeam), topographic, bathymetric, topobathy lidar, digital imagery, hyperspectral imagery, and more. In addition to data layers the Federal Mapping Coordination site hold Forums, included under the Participate tab, to enable tailored discussions on specific topics.

- Federal Mapping Coordination website URL: fedmap.seasketch.org
- Great Lakes Region Forum: http://www.seasketch.org/#projecthomepage/5272840f6ec5f42d210016e4/forum/568a9cf824dfab24667f380b

Questions:

- (Q) Can you add KML files to submission options? (A) Not currently but we will follow up with UCSB to see if this is feasible. However, providing information through a REST service does work. (In response to this question the ISGS created a REST service for the ongoing HTEM data collection and had the project flight lines available in SeaSketch within minutes during the session.)
- (P) John Brock mentioned interest in creating forum for NCGMP, to follow up with Ashley Chappell offline regarding best path forward.
- (Q) Once an AOI has been entered, how does it become viewable on SeaSketch? (A) There are two ways in which it can be added: to the Forum, where it will be harvested, or to "My Plans" and then send an email that it is ready to be added.

Flash Talk Session 3 – Data Application:

This session focused on innovative approaches to data application and modeling. Speakers included:

1. Byron Stone, USGS
2. J. Elmo Rawling III, Wisconsin Geological and Natural History Survey
3. G. William Monaghan, IGS
4. Molly Reif, USACE
5. Russ Green, NOAA

Key points and questions:

- Byron Stone, USGS - Geologic maps and models in the Great Lakes coastal zone. Technical talk on models created by USGS for analyzing moraines/glacial deltas and other geologic structures. Talked about current project at Manistee, MI, determining age of sand layers. Needs for this project include complete CoNED lidar set, cooperation with offshore science, drillhole support and others (see presentation for details).
- Elmo Rawling, WGNHS - Wisconsin geological and natural history survey. Talked through recent and current survey work using GPR and hand augers with optical dating, including bluff stability and value of LiDAR data for bluff failure investigations.
- Bill Monaghan, Indiana Geologic Survey - Lake Michigan coastal dunes, paleo environment, and shoreline processes. Technical talk on historical dune research and surveys. We should look to use lidar and other survey processes to study environmental changes and other processes.
- Molly Reif, USACE – Classifying coastal benthic habitats in the Great Lakes. Covered current efforts to develop a streamlined approach to use existing and new geospatial technologies for classifying bottom types in shallow, aquatic, and marine habitats using the Great Lakes as a case study. Starting a project at Illinois Beach State Park that overlaps with other surveys and work with the Illinois Coastal Management Program and ISGS.
- Jenny Hanson, USGS – Mapping and monitoring aquatic vegetation in Lake Erie for Grass Carp risk assessment. Recent project to ID the distribution and community composition of SAV within western Lake Erie to establish baseline data in the early stages of Grass Carp invasion.

Presentation on NOAA Crowdsource Bathymetry policy - Adam Reed, NOAA

- NOAA is developing a methodology for accepting hydrographic data from non-NOAA and NOAA contract sources. Crowdsourcing refers to the current development of other stakeholders collecting data (in this case bathymetry) that could be used for recon or even application to nautical charts. See presentation for hardware and software specifics. NOAA's office of coast survey is looking to use this data specifically for examining vessel traffic, determining survey priorities, and determining nautical chart adequacy. Data to be part of international public archive at NOAA's National Center for Environmental Information, which hosts the International Hydrographic Office crowdsource bathymetry database. Provided current workflow being utilized to ingest this type of data.
- **Questions:**
    - (Q) Can you correct for water level variations? (A) Yes, as part of the raw measurements, the time stamp is collected, so a tide correction can be applied.

Day 1 Closing Session – Geologic Mapping in the Coastal Zone:

Todd Thompson, Indiana Geological Survey, presented on the history and current status of geologic mapping in the Great Lakes coastal zone in preparation for Wednesday site visits.

Wednesday, April 7

Great Lakes Bottom Mapping Working Group Breakout Sessions:

Attendees split into three subgroups to discuss and determine which coastal and bottom mapping priorities resonate among the Great Lakes community.

3 Themes:

1. Technology and Standards
    a. Top 3 priorities:
        i. Coordination on equipment and standards
        ii. Data portal
            1. Who could create?
            2. Cost?
        iii. Data awareness
            1. How do we increase awareness?
            2. ICAN
    b. Additional needs:
        i. Contact list
        ii. GLIN.net still in existence?
        iii. Collaboration with Great Lakes Regional Planning Body
2. Data Users
    a. Data management, location, discovery. Also looking at modeling techniques in addition to data acquisition needs and types.
    b. What do we need? 1) Forecast/prediction tools (geol/ecol/climate tied together, user friendly). 2) Regional systematic surveys vs postage stamp surveys. 3) Set priorities for mapping – agree upon base components (Annex 7, GLMC, with Canada)
3. Data Managers
    a. Questions:
        i. How do we facilitate what's out there? Digital Coast may not be comprehensive; we may need to create a new portal.
        ii. Where do you go to get the data? Some go to national level, some go to state level, some go to counties or municipal level to obtain data
        iii. Who has the ability to collect data? Need to ID data stewards, track data standards. One size doesn't always fit all. Identifying which standards work best is a good start.
        iv. Developing standard file formats: better coordination needed here.

v. Understanding user workflows and derivatives. Derived data sets just as critical.
vi. Metadata, Metadata, Metadata

b. 3 top priorities
i. Funding and dissemination
ii. Collection & collaboration
iii. Operational standards: archival, stewardship, metadata

Afternoon site visits: The group traveled to three sites along the Indiana coast for an overview of Great Lakes coastal processes, such as shoreline erosion and beach ridge development, harbor and facility maintenance, and geologic hazards in a public jurisdiction. A local government guest speaker discussed challenges of managing public spaces adjacent to parcels under private ownership under changing shoreline and lake conditions.

Thursday, April 8

Great Lakes Mapping Projects Discovery (Part 1): What is your biggest challenge and how are you working to overcome it? Moderated by Brandon Krumwiede, NOAA. Speakers included:

1. Jay Glase, NPS – NPS Benthic Mapping
2. Brian Huberty, FWS – GLRI Remote Sensing of Coastal Wetlands
3. Kaitlyn McClain, LMCP – Indiana Shoreline and Wetlands Mapping
4. Ethan Theuerkauf, ISGS – Illinois Coastal Mapping

Key points and questions:

- Jay Glase and Lara Bender provided overview of NPS Great Lakes restoration program survey work. Coverage area includes lakes Superior and Huron. Provided snapshots of recent work in Isle Royal, Apostle Islands, Pictured Rocks, Sand Point, and Sleeping Bear Dunes. Future work is targeted at continued collaboration with other agencies in the Great Lakes (coregonid and other fish restoration efforts with USGS, USFWS, etc.), incorporating data into larger Great Lakes research efforts and continuation of benthic mapping to collect foundational data for restoration and research.
    - Key challenge is making data available
    - (Q) Is the data that you've collected publically available? (A) This is a big challenge for us, we are working with NOAA/Brandon K. to make our data available on the NOAA lake level viewer or Digital Coast
    - (Q) What are your plans for next year? (A) Unclear because of funding uncertainties.
- Brian Huberty (FWS/GLRI) provided an overview on interstate, interprovincial, and inter-federal coastal wetlands remote sensing work recently done and ongoing in the Great Lakes region. Also discussed Blue Waters of the National Center for

Supercomputing Applications at the University of Illinois, the NSF sustained petascale computing supercomputer facility being used to process data.
    - Key challenges include communications and funding. Additionally, we are now getting to a time where we may be inundated with too much data and need to work on methods to pull relevant information from the data in a timely manner.
    - (Q) Have you tried masking out the veg to go from DSM to DTM? (A) That's on the list, however plan to tackle Blue Waters challenge first.
- Kaitlyn McClain (LMCP) talked about GIS mapping of Indiana's Lake Michigan shoreline. Specifically a project to create a single GIS shoreline inventory database for the coastal region completed in 2013. She covered the data providers/sources and steps involved in processing the data. Next project on deck is focused on wetlands mapping and protection.
    - Challenges include GIS expertise and funding. Their data is publically available but have resource constraints to host data.
    - (Q) Any strategies or successes educating land owners, when land ownership is usually shorter than the water cycle? (A) Developed model ordinances because of increased redevelopment; currently working on education factors to help awareness.
- Ethan Theuerkauf (ISGS) Mapping and research along Illinois Lake Michigan coastline. Talked in detail on recent and current sand mapping efforts that include beach and dune topographic mapping. Future work includes structure from motion mapping with drones.
    - Challenges include lack of comprehensive coastal database and need of further observations and models to support work including observations of the hydrodynamics along shore.
    - (Q) What happened on sandy shorelines as bluffs stabilized? (A) Period of stability in '90s and '00s; still erosion happening near marina.
    - (Q) Is the USACE sediment budget work available now? (A) It's almost complete.
    - (Q) What is the status of geologic mapping (1:24,000) along the coastline? (A) Lake County is completed right to the shoreline, Chicago is up next, then moving up NW Indiana, perhaps next 2 years? 1:100,000 might be best.
    - Comment: USGS has coastal monitoring stations, will share data
    - Comment: Structure from Motion (SfM) being used to research sand thickness.

<u>Great Lakes Mapping Projects Discovery (Part 2)</u>: Moderated by Brandon Krumwiede, NOAA. Speakers included:

1. Kisa Mwakanyamale, ISGS – Onshore and Offshore Geological Mapping with the Helicopter Borne Transient Electromagnetic (HTEM) Method
2. Charles Menza, NOAA – National Centers for Coastal and Ocean Science Lakebed Mapping

3. Hans Van Sumeren, NMC – Marine Technology Educational Training Programs
4. Guy Meadows, MTU – ASV Technology & Application in the Great Lakes
5. Walter Barnhardt, USGS – Hurricane Sandy – Geologic Mapping and Processes of Coastal Evolution Great Lakes Mapping Projects Discussion.

Key points and questions:

- Kisa Mwakanyamale (ISGS) presented on geophysical imagine of southwestern Lake Michigan sediment. The purpose of this research was to create accurate, high-res maps and cross sections of the distribution of sand along the coast; estimate the thickness of the beach sand layer and; to map the shoreline using low-resolution bathymetry. They conducted this work with helicopters (helicopter transient electromagnetic method, or HTEM). To supplement this data collection they used ground based geophysics and ERT. There are several applications for this data including shoreline erosion management, identification of coastal hazards, and defining the rate of sediment budget and transport.
    - Biggest challenges are accessibility limitations and urbanization and therefore inability to collect HTEM data on the beach and/or very close to the shore. This is due to presence of buildings and infrastructures close to the shore, which pose safety risk, and are a source of noise to the HTEM data. Also bad weather, windy conditions and heavy clouds delayed the data collection efforts.
    - (Q) Have you looked at lidar for nearshore substrate info? (A) Not yet because we're looking subsurface, so lidar wouldn't be applicable.
    - (Q) What is the minimum thickness of discernable sediment? (A) 2m resolution for thickness in areas underlain by materials with less contrast in electrical properties and perhaps 1 meter vertical resolution for high contrast, such as sand over clay. Horizontal sounding is every 15m for this particular data collection.
    - (Q) Are you acquiring any imagery during flight? (A) Helicopter has camera and the field crew manager has reported that the photos are not high quality but willing to share.
- Charlie Menza (NOAA) presented on a lakebed mapping project for the proposed WI Lake Michigan National Marine Sanctuary. This area was nominated to be a NMS in 2014 to preserve shipwrecks and serve as a research area. It is currently working through the designation process, no anticipated date for designation at this time. As part of this designation process NOAA is conducting MBES and side scan mapping (2017-18) in the proposal area to identify shipwrecks and benthic habitats. Complimentary research includes a socioeconomic study of residents in the proposed sanctuary area.
    - Biggest challenge is data discovery (would be great to have single repository)
    - (Q) Do you plan to crowdsource any bathymetry data? (A) No current plans but will look into it.
    - (P) Request to share bathy data for groundtruthing data

- Hans Van Sumeren (NMC) presented on the Northwestern Michigan College Great Lakes Water Studies Institute courses and facilities. This school is focused on competency-based training designed for industry. Covered the aspects of the marine technology associates and bachelor's degrees offered at the school. These programs conclude in a multi-faceted degree with training in GIS, marine platforms, hydraulics, electronics, and applied team training. They also offer summer programs and professional training and this summer will offer a teaching program in China through the Yellow Rivers Conservancy Technical Institute.
    - Biggest challenge is exposure for the program and expanding their network.
    - Comment: keep dialogue of equipment sharing going; would support students in learning new technologies.
- Guy Meadows (MTU) presented on autonomous surface and sub-surface coastal mapping. Kicked off talk by providing a summary of the 2015 Autonomous Surface Vehicle workshop held in Solomon's MD. Several stakeholders and agencies attended this meeting. Transitioned into talking about the equipment at Michigan Tech University capable of producing high-res sonar surveys and advanced processing of bottom terrain. Showed imagery of recent survey work including a 3D bathy image of a sunken wooden barge from the late 1800s. Will be acquiring an autonomous wave glider in summer 2017 in partnership with NOAA/GLERL and potentially a fully autonomous ASV global co-worker 5 (pending NSF-MRI funding).
    - Challenge: How to move forward in a declining fiscal environment. Believes the solution to this is increased collaboration.
- Walter Barnhardt (USGS) – Hurricane Sandy geologic mapping and processes of coastal evolution. Talked through the Hurricane Sandy Science Plan developed in 2013, specifically the component focused on understanding coastal change in developing hazard mitigation and response. Two questions his group examined were ability to predict vulnerability of shoreline to erosion and ability to predict response of coastal areas to future sea level rise. To do this they focused on characterizing the regional geologic framework, quantifying sediment-transport processes and developing numerical models from this research to support coastal managers. See presentation for details on equipment and processes used in this research.
    - Biggest challenge is the political landscape. Specifically the will to regard science in policy decisions.
    - (Q) How is coastal hydrology used to quantify storm surge impacts? (A) By looking at back barrier areas with gauges and monitoring stages, as well as monitoring urban flooding to discover correlations.

Flash Talk Session 3 – Data Application:
This session focused on innovative approaches to data application and modeling. Speakers included:

1. Megan Blaskovich, Fugro
2. David Hart, Wisconsin Sea Grant
3. Mark Yacucci, ISGS
4. Lindsay Hunt, USGS LMER
5. Jackie Adams, EPA Chicago
6. Catherine Riseng, University of Michigan

Key points and questions:

- Megan Blaskovich (Fugro) - a contract manager with Fugro, spoke on background/ history of Fugro, contracts with NOAA, USGS, and USACE. Capabilities include high-density lidar and Topobathy, imagery, IfSAR, project tracking and more. Covered PanoramiX oblique imagery platform and high-density lidar capabilities with deliverable imagery. Briefly described BoatMap technology that combines terrestrial LiDAR scanning with vessel-based bottom-data collection. Combined data provides a continuous above water and below water point cloud.
- David Hart (WI Sea Grant) – Presented on components of the Wisconsin Coastal Atlas and encouraged participation in International Coastal Atlas Network (ICAN). Promotes linkages among geospatial data custodians in the Great Lakes Region.
- Mark Yacucci (ISGS) – Geoscience Information Stewardship Section, Illinois State Geological Survey. Talked about new 3DEP Geiger mode lidar acquisition in the Chicago area, plan to add this data to the Illinois Geospatial Data Clearinghouse when it's ready for public consumption. ISGS is the lead on state LiDAR acquisition, working across local, state, and federal agencies to plan, prioritize, and leverage resources. With few exceptions, Illinois LiDAR data is served through the IGDC. Also, as an example of application development, highlighted the development of a web interface that creates a user-defined geologic cross section by inspecting geologic map raster data..
- Lindsay Hunt (USGS LMER) – Spoke on the Great Lakes Coastal Habitat Connectivity Analysis. This project focused on mapping and quantifying the degree of un-urbanized habitat along a 6km buffer of the Great Lakes shoreline. Data used in the analysis included NLCD, GAP National Land Cover Data, PAD-US data, TIGER roads and rails data, and current/historic urban area maps.
- Jackie Adams (EPA) – EPA and GLRI overview of mapping data needs. Spoke on GLRI funding from FY10-17, with amounts from $475M in '10 to $250M in '17. Action plan II focus areas include a focus on toxic substances and areas of concern, invasives, nonpoint source pollution, habitat and species protection and laying the foundation for future restoration actions. Spoke briefly on bottom mapping and data needs. Specifically need updated bathymetry for Lake Superior and bottom mapping in both nearshore and open water.
- Catherine Riseng (University of Michigan) – Great Lakes Aquatic Habitat Framework. A spatial framework linking watersheds and aquatic zones in the Great Lakes region.

Comprehensive database includes biological, environmental/chemical, geomorphology, landscape, mechanical energy, rivers/hydrology, temperature energy, and other stressors.

Alan Lulloff from the Association of State Floodplain Managers (ASFPM) – Spoke briefly on the ASFPM and how important it is to check stream gauges before flying a lidar mission. Provided an update on the current activities associated with updated FEMA mapping along the coastal zone to include VE zones, storm induced wave run up, along all of the Great Lakes. There are a series of workshops that are being held across the region and it is encouraged to attend if interested. More information can be found at the following website: http://www.greatlakescoast.org/

Group Discussion – GLCMS Goals: Summary portion of the meeting including the following discussion topics:

Key issues/themes:

- How do we prepare for rising water levels in Lake Michigan?
- How do we increase awareness of existing datasets?
- Joint funding opportunities.
- One-stop shop portal? Catalog of existing portals to start?
- How do we work together to keep current hard resources (vessels, equipment, staff) operational and in use for data collection.

Key points:

- Need to think about user community when we are talking about data. What do they need and how to we best support our stakeholder community? Public input is very important, perhaps solicited via a collaborative research study to determine the best way to serve the data or which datasets would be most useful? Perhaps pick 2 or 3 demo areas and potential datasets would include geology types, bathy, topo, or other features?
- Point made that with lake level rise in Lake Michigan this is a teachable moment to show the community the importance of smart shoreline management and resiliency. Could also report on return on investment, which could be provided to stakeholders and decision makers to support programs.
- Suggestion for an integrated effort for integrated topobathymetric data along the shoreline in the Great Lakes that leverages JALBTCX data, driven by CoNED. CoNED could compile all data along Great Lakes shorelines via a DEM and this gap analysis can be used to reach out to 3DEP and other groups to fill in holes. Leverage the work that has been done already including NOAA Lake Level Viewer DEMs, GLAHF, and other partners that are collecting data (NPS, USACE, USGS, state agencies).
    - CoNED project is a good source of integrated baseline data.

- Suggestion to utilize NOAA lake level viewer as a collaboration point. Lake level viewer data needs a hefty revision with updated data layers. Would be excellent to utilize this group to ensure data is up to date and accurate in the next revision.
- Would be excellent to produce modeling of groundwater and shoreline recession to support decision makers. Given the increase in Lake Michigan water level, further groundwater studies are warranted and a better method for estimating groundwater should be determined so more questions and issues can be addressed concurrently, instead of sequentially.
- Is there a way to pool financial resources and in-kind contributions to leverage projects and maintain or re-deploy hard assets?
- Other areas that should be better planned and monitored: water/water conservation, septic preparation, geologic mapping, and regional coastal geomorphic change.
- Data rescue a big issue – historic data, heritage, preservation, grants?
- 4D: What is the time frequency of data collection to meet needs

Actionable next steps:

- Develop contact list – who does what/has what data?
- Catalog of existing data portals?
- Funding matrix development.
- Data gap analysis for topobathy lidar ahead of USACE JALBTCX data collection planned for 2018.
    - Determining where you don't need to survey/don't need data also important.
- Put your data acquisition plans and requirements on SeaSketch (fedmap.seasketch.org), if you haven't already, and make the effort to keep it up to date.

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