



# Preparing Coastal Communities for Climate Change



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**Abstract:** Sectors involved in the construction of and planning for coastal infrastructure - such as ports, marinas, stormwater managers and community planners - need to be aware of the long-term forecasts for climate change impacts as they make decisions today that will shape this infrastructure for the next 50-100 years. We report the results of a two year effort by Sea Grant Extension to address the obstacles inherent in preparing for climate change, particularly as they are faced by ports, marinas, stormwater managers and community planners. Activities related to communication of scientific uncertainties have included a compilation of journal articles related to sources of climate science uncertainty, tools for addressing these uncertainties, climate forecasting and communication of climate change uncertainty to lay audiences. Focus groups were assembled representing shipping and marinas & stormwater managers and community planners, in both Toledo and Duluth, to better understand how members viewed their vulnerability, planning time frames and investments related to climate change. A matrix tool for assessing economic impacts of climate change to coastal infrastructure was developed. Integration of climate change thinking into Sea Grant programming has grown dramatically over the course of this project.



**Communicating Uncertainty:** Conveying an understanding of scientific uncertainty inherent in modeling, forecasting and planning for scenarios of increased variability (as opposed to directional change), and generating a will to act and a plan for action in a paradigm of uncertainty and variability are among the key obstacles in communicating about climate change to stakeholders. To address these obstacles, team members conducted a comprehensive review of communications literature to assess potential communication strategies. This review was used as a starting point to distill key messages and communication strategies which can be used in communicating the concepts of uncertainty and variability to lay audiences.  
**Products:** (Available at <http://www.miseagrant.umich.edu/greatlakes/climate/products.html>)  
•Communicating Uncertainty Bibliography  
•52-slide series on "Global Climate Change and Uncertainty."

**Strategic Planning:** Through a series of meetings, the GLSGN has developed a set of logic model for working on climate change extension in the Great Lakes region. This model has buy-in from all 7 Sea Grant programs in the region. The model is divided into four segments corresponding to major thematic areas:

- Climate Resilient Communities
- Risk Assessment Support
- Stormwater Runoff and Watersheds
- Climate Literacy



**Focus Groups:** Focus groups were held in Duluth and Toledo to engage with port, marina and stormwater infrastructure managers to better understand their needs in preparing for climate change and to build a foundation for continuing to communicate.

**Key Findings:**

- There is a clear need for more specific science-base information at the regional and local levels.
- More specific information on climate change impacts is needed.
- Great Lakes maritime commerce, both in transit and in port, is dependent on water level.
- The most dramatic threats come from compound climate variables that impact water levels.
- Most respondents looked at short term planning windows.
- Watershed management is important, as well as stormwater issues.
- Respondents felt that economics may overshadow climate issues.
- Models of what other communities were doing in the Great Lake region would be helpful.

**Products:** "Preparing Coastal Communities and Businesses for Climate Change: Duluth, MN and Toledo, OH Focus Group Results" by Dale Bergeron, Gene Clark, Frank Lichtkoppler and Joe Lucente.

**Visualizations:**

Integrated topography/bathymetry digital terrain models have been developed for sections of the Ports of Toledo and Duluth/Superior. Multiple sources of spatial data were used to develop the topo/bathy models, including terrestrial and bathymetric LIDAR, multibeam sidescan sonar, and nautical charts. Reports were prepared documenting the methods used to create the models, as well as issues faced during their creation. Visualizations of shorelines associated with historic high and low water levels have been prepared for both the Toledo and Duluth/Superior case studies utilizing ArcScene within the ArcGIS software suite. The visualizations will be enhanced to reflect lake level scenarios related to climate change. We hope that the visualizations will result in increased understanding of potential impacts of changing water levels, flood patterns, and storm events in Great Lakes coastal communities.



**Economic Products:**  
•Great Lakes Ports & Harbor Infrastructure Cost Matrix & Dredging Cost Estimate Evaluation Tool (Great Lakes Ports & Harbor Infrastructure Cost Range Estimates 2010 costs) Gene Clark at [gclark1@uwsuper.edu](mailto:gclark1@uwsuper.edu)  
•Bergeron, Dale and Clark, Gene. 2010. "Port asset values and economic impacts". Great Lakes Seaway Review. Vol 39, #1, July-Sept 2010 pp 31-35.

**Economic Impact Analyses:**

We examined several of the potential impacts of climate variation on a key element of the region's important, yet poorly recognized resources: Great Lakes coastal infrastructure and aids to navigation, typically channels and turning basins. These man-made elements of the marine/coastal interface serve critical roles in protecting numerous resources and aiding maritime commerce; they're also extremely vulnerable to projected climate change scenarios.

The scalable Infrastructure & Dredging Cost Estimate Matrix is designed to examine possible impacts on specific types of Great Lakes infrastructure, including dredged channels and slips critical to navigation and port function. The Matrix is designed for use in any port, harbor, or marina within the Great Lakes region. It can also be linked to USAC's "current infrastructure condition ratings" being conducted in Great Lakes ports and harbors to offer a more concise view of potential threats to various infrastructure types.

The Matrix was designed to help communities identify the current "value" of their navigational and port infrastructure, which allows them to extrapolate the potential costs for maintaining these resources in the face of changing water levels and storm conditions due to climate variation. Potential secondary economic impacts, such as those that could be anticipated as the result of the failure of primary support infrastructure, can easily be added to matrix data to expand the scope of economic impacts. Secondary costs could involve: buildings, land-based transportation facilities, commercial and recreational docks and staging areas, grain elevators and storage facilities, water treatment facilities, cultural resources, public access, sensitive wetlands and estuaries, etc.

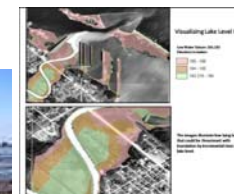
**Research Products:**

The research component of this project was conducted by NOAA GLERL (on parallel funding) and CILER.  
•Lofgren, B. M., T. S. Hunter, and J. Wilbarger, 2010. Interaction of energy and water budgets in hydrologic and coupled models of climate change. *Preprints, Water 2010*. 5<sup>th</sup> International Conference on Water Resources and Environment Research, Québec City, Québec, Canada, 5-7 July 2010.  
•Final Report: NOAA Great Lakes Environmental Research Laboratory's Climate and Hydrologic Modeling Activities Associated with the Project "NOAA Sectoral Applications Research Program (SARP): Coastal Resource Management/Water Resources Management". Brent M. Lofgren and Timothy S. Hunter, NOAA Great Lakes Environmental Research Laboratory, Ann Arbor, Michigan. December, 2010.

**State Funding:**

Seed funding was included for each state to incorporate climate elements into their on-going outreach programming. Here are a few of those products:

- Dorworth, L.E. and R. McCormick, 2009. Sustainable land use: impact on climate change and health. IISG-09-04 (FNR-415-W) (reviewed and edited and available at <http://www.planningwithpower.org/pubs/SustainableLandUse.pdf>)
- Bird, E., L. Dorworth and R. McCormick. 2010. Climate Change: Are you preparing for it? IISG-10-13 (FNR-425-W), pp. 1-7. (reviewed and edited and available at [http://www.iisgpc.org/catalog/climate/climate\\_prepare.html](http://www.iisgpc.org/catalog/climate/climate_prepare.html))
- McCormick, R. and L. Dorworth. 2010. Climate Change: How will you manage stormwater runoff?, IISG-10-14 (FNR-426-W), pp. 1-4. (reviewed and edited and available at [http://www.iisgpc.org/catalog/climate/climate\\_runof.html](http://www.iisgpc.org/catalog/climate/climate_runof.html))
- Dorworth, L. and R. McCormick. 2010. Climate Change: Where does it fit in your future plans? IISG-10-15, pp. 1-4. (reviewed and edited and available at [http://www.iisgpc.org/catalog/climate/climate\\_future.html](http://www.iisgpc.org/catalog/climate/climate_future.html))
- Dorworth, L. and R. McCormick. 2010. Climate Change: How will you manage your water resources? IISG-10-16 (FNR-429-W) (reviewed and edited and available at [http://www.iisgpc.org/topic\\_climate.html](http://www.iisgpc.org/topic_climate.html))
- "Climate Change and Natural Resources in Pennsylvania" may be found at: <http://seagrant.psu.edu/extension/climate/Climatefactsheet.pdf>
- Pennsylvania Sea Grant Climate Change website: <http://seagrant.psu.edu/extension/webinars.htm>
- PA Webinars & Seminars –
  - August 10, 2010 - "Pennsylvania's Changing Climate-Trends and Impacts"
  - September 20, 2010 - "Climate Change Impacts on Public Beach Access, Beach Ownership, and Riparian Erosion"
  - October 26, 2010 - "The Ecological Impacts of Climate Change on North American Forests"
  - December 14, 2010 - "Is Climate Change Precipitating a Biological Meltdown in the Lake Erie Basin"
- "Roadmap: Coastal Hazard and Climate Adaptation" workshop in Philadelphia



**Spin-Off Products:**

- Climate Ready Great Lakes (funded by the NOAA Great Lakes Regional Team) – Expanded the "Communicating Uncertainty Bibliography" into a much larger annotated bibliography for "Assisting Great Lakes Coastal Communities with Climate Change Adaptation" including segments for impact, needs assessments, vulnerability and risk assessment, adaptation and policy.
- Climate Ready Great Lakes (funded by the NOAA Great Lakes Regional Team) – Developed a 300+ slide set in 3 modules for use by Sea Grant and NOAA staff in communicating Great Lakes Climate Change to coastal managers and community planners.

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