American Water Resources Association
2015 SUMMER SPECIALTY CONFERENCE
Climate Change Adaptation
June 15 - 17, 2015
New Orleans, LA

Wednesday, June 17
3:30 PM – 5:00 PM
SESSION 23: Climate Vulnerability Assessments

Mapping Future Flood Hazards and Structure Vulnerability Across Lower New York State - Brian Batten, Dewberry, Fairfax, VA (co-author: J. Plummer)

Climate change is projected to increase average global sea levels, which is projected to result in a relative increase in sea level up from 1 to 4.5 ft in the 2080s for coastal areas in New York State connected to the Atlantic Ocean. Future flood events will propagate across these higher water levels and result in increased flooding and damages. Identification and recognition of the future flood exposure can inform planning efforts and facilitate future flood loss reductions through proactive adaptation efforts. Evaluation of the change in flood characteristics due to sea level rise must be undertaken to inform such efforts. Detailed modeling of surge and wave processes can be costly, time-consuming and difficult to justify when considering the range of uncertainty in sea level rise projections. Recent studies funded by the Federal Emergency Management Agency (FEMA) have shown the changes in probabilistic surge elevations used to define the extent of the regulatory floodplain remain nearly linear for lower SLR scenarios. However, changes in wave effects, which are a key component of regulatory Base Flood Elevations (BFEs), do not follow the same linear increase. Separation of these two key flood processes allows for improved calculation of future conditions with a relatively low-level of effort. The Analysis of Future Floodplains in New York State Study, funded by the New York State Energy Research and Development Authority, has developed detailed mapping of the evolution of multi-flood frequencies and wave hazard areas across a range of sea level rise scenarios. Although we applied linear increases to existing flood elevations, mapping processes and extrapolation of existing flood elevations were informed by hydraulic connectivity, knowledge of flood propagation, and FEMA floodplain mapping post-processing methods. Future wave conditions were established by a geospatial classification of existing wave-height to water depth relationships considering fetch environment and land cover types. The product of this approach resulted in reasonably accuracy delineations of wave hazard areas for the future conditions including sea level rise. Our presentation will provide an overview of the project scope, highlight results, and discuss how existing flood hazard information, wave theory, and geospatial modeling techniques were employed to provide a cost-effective solution for informing New York State on potential future flood conditions. Other topics will include how results were broken down to inform stakeholders and decision makers to the potential changes in flood hazard and need for adaptation in their community.

Climate Change Adaptation Planning Strategies for Water Resource Infrastructure - Elizabeth Delaney, First Environment, Inc., Boonton, NJ

According to U.S. Federal Government's Global Climate Change Research Program, climate change has altered the water cycle. Floods, storm surge, storm intensity, high heat, and droughts are likely to become more common. Precipitation and runoff are likely to increase in the Northeast and Midwest in winter and spring, and decrease in the West in spring and summer. "Adaptation"-- or practical steps to protect countries and communities from the likely disruption and damage resulting from effects of climate change--is a valuable approach. Effective adaptation planning involves developing an inventory of assets likely to be vulnerable, ranking their level of vulnerability, monitoring risk, and engineering strategies to reduce or prevent infrastructure damage cost effectively. This presentation will discuss the latest climate change science from the IPCC's 5th Assessment Report and how water resource agencies can begin to consider adaptation strategies to protect their assets. Focusing on the two components of climate change risk--criticality and vulnerability--the speaker will discuss the identification of inputs for assessing criticality, which are highly community dependent, and the use of exposure, sensitivity, and adaptive capacity in assessing vulnerability. Experiences from Hurricane Sandy will be used to illustrate the need for adaption planning and share lessons learned.

Identifying Cisco Refuge Lakes in Minnesota to Develop a Landscape Approach for Climate Change Adaptation - Xing Fang, Auburn University, Auburn, AL (co-authors: P. C. Jacobson, H. G. Stefan, D. L. Pereira)

A process-oriented, dynamic and one-dimensional year-round lake water quality model and an oxythermal fish habitat model were developed and applied to investigate impacts of future climate change on cisco fish habitat in Minnesota lakes. Long-term daily water temperature (T) and dissolved oxygen (DO) profiles were simulated for different types of representative lakes in Minnesota under the past climate conditions (1961-2008) and projected future climate scenarios. Two projected future climate scenarios were based on the output of the third generation Canadian Centre of Climate Modeling and Analysis (CCCma) coupled general circulation model (CCCma CGCM 3.0) and the Model for Interdisciplinary Research on Climate (MIROC 3.2). The climate scenarios lead to a longer period of anoxic hypolimnetic conditions in stratified lakes that will result in various negative environmental and ecological impacts in lakes. The study has identified potential refuge lakes from 620 Minnesota cisco lakes, which are important for sustaining cisco habitat under climate warming scenarios. Cisco Coregonus artedi is the most common cold-water stenothermal fish species in lakes over the several northern states in USA. To project its chances of survival under future warmer climate conditions, using simulated daily T and DO profiles in 30 virtual lake types, an oxythermal habitat variable, TDO3, i.e. water temperature at DO = 3 mg/L, was calculated in each simulation day. The fish habitat model was validated in the 23 Minnesota lakes of which 18 had cisco mortality while 5 had no cisco mortality in the unusually warm summer of 2006. Projected multi- year average TDO3 was used to divide the 620 Minnesota lakes into Tier 1 refuge lakes (most suitable for cisco), Tier 2 refuge lakes (suitable habitat for cisco), and Tier 3 or non-refuge lakes that would support cisco

only at a reduced probability of occurrence or not at all under climate change scenarios. About 208 (one third) and 160 (one fourth) of the 620 cisco lakes are projected to maintain viable cisco habitat under the two projected future climate scenarios using the fixed and variable benchmark periods, respectively. These selective lakes have a Secchi depth greater than 2.3 m (mesotrophic and oligotrophic lakes) and are seasonally stratified (geometry ratio less than 2.7 m- 0.5). Building on fish habitat modeling, a landscape approach was developed to identify important catchments of refuge lakes. These catchments were prioritized based on two components: (1) threat (changes in land use) and (2) investment efficiency. Conservation strategies were implemented for some of the prioritized catchments critical for water quality protection.

Susceptible Zone Identification on Water Resources in Asian Monsoon Region Due to Climate Change - Deg-Hyo Bae, Sejong University, Seoul, South Korea (co-authors: M.H. Lee, J. A. Awan)

Asia monsoon plays an important role on global water circulation and provides substantial precipitations and water resources to the peoples living within the domain. It provides many benefits such as power generation and transportation facilitates, but also causes serious flood and drought problems. Of course, there are various reasons for these water-related disasters, but the current climate change makes much more complicate and difficult to manage them. In this sense, the climate change impact on water resources over the region and the identification of highly susceptible regions due to climate change will be necessary to reduce the damages. The objectives of this study are to investigate the future climate change impacts on temperature, precipitation, and runoff and to delineate the highly susceptible regions under future AR5 climate change in the Asian Monsoon region. Several GCMs representing the better performance in this region were selected and used for climate change projections. The change factor method with bilinear interpolation method was used to project climate change at 0.5 degree horizontal grid resolution. The Variable Infiltration Capacity (VIC) macroscale hydrological model was employed to project runoff using future climate change scenarios. Average temperature, precipitation and runoff were projected to increase by all future periods i.e. 2020s, 2050s, and 2080s. The latitudinal and longitudinal analysis was performed to investigate features of future climate change at different latitudes and longitudes. In addition, spatial distribution of future climate change projections was investigated and the susceptible regions were identified over the Asian monsoon region. These findings can be useful for the better implementation of climate change adaptation strategies in this region.