University at Buffalo
Department of Civil, Structural and Environmental Engineering
School of Engineering and Applied Sciences

Environmental and Water Resources Engineering Seminar

Lake Erie's Storms, Seiches and Hydrokinetic Renewable Energy

Abstract

Coastal storms can initiate periodic low-frequency fluctuations of water level particularly in enclosed water bodies. Such oscillations, known as seiches, can potentially result in unexpected rises of water level leading to coastal flooding and potentially contributing to long-term erosions of coasts. Lake Erie is the fourth largest in surface area, smallest in volume and shallowest lake among the Great Lakes. Due to its shallow depth and because predominant wind direction in the area is along the lake's longitudinal axis, the eastern and western Lake Erie experience significant storm surge usually followed by seiches. According to the History of Buffalo, the seiche of 1844 was "One of the greatest disasters in the city's recorded history occurred at 11 p.m. October 18, when a wall of water quickly inundated the commercial and residential districts along the waterfront. The disaster occurred without warning, breaching the 14-foot seawall and flooding the waterfront. Newspaper accounts of the time indicate that at least 78 people drowned". ***First,*** an overview of the Lake Erie characteristics will be presented. It will be discussed that because of its shallow depth, Lake Erie quickly freezes over in winter when the lake surface typically develops extensive surface ice. The surface ice would, in turn, alter wind setup and waves and even hinder wave propagation in areas where the surface ice is densely concentrated. The storm-induced low frequency motions of the Lake Erie water levels, i.e. seiches, studied analytically for long-term and seasonal, and numerically for short-term time-scales under ice-free and ice-covered lake conditions will be discussed. The frequencies of the lake's seiching modes, the spatial variations of the energy corresponding to the low frequency fluctuations and the impacts of the surface ice on the process will be presented. ***Second,*** Lake Erie's hydrokinetic renewable energy resources including wave, surge and seiche energy will be characterized. It will be argued that there is a significant potential energy in the lake that may be suitable for generating meaningful levels of electricity from seiches and storm surge; for instance, by installation of an artificial 'lagoon', and using the concept of tidal lagoons. The cost of such a lagoon could be partially offset by the potential of such a structure, and the operation of such a lagoon, to help alleviate flooding during extreme events.

Ali Farhadzadeh, Ph.D., P.E.
Assistant Professor
Civil Engineering
Stony Brook University

Dr. Farhadzadeh received his masters' and Ph.D, degrees in Coastal and Ocean Engineering from University of Delaware in 2009 and 2011, respectively. He also earned a bachelor degree in Civil Engineering from University of Tabriz, and a masters' degree in Hydraulic Structures Engineering from TMU, both in Iran. After graduating from University of Delaware, he began working as Coastal Engineer and Technical Lead at Dewberry Inc. on various coastal flood modeling projects including the FEMA's Great Lakes Coastal Flood Study. Farhadzadeh later joined Bechtel Corporation as Senior Engineer leading US nuclear power plant coastal flooding hazard reevaluation activities. In fall 2014, Farhadzadeh joined Stony Brook University as Assistant Professor jointly in the Department of Civil Engineering and School of Marine and Atmospheric Sciences (SoMAS). His main research covers modeling of coastal morphdynamics and interactions of waves and currents with built and natural environments. Farhadzadeh is a registered professional engineer (PE) and a certified floodplain manager (CFM).

Date: April 7, 2017 Time: 11-12 PM
Location: 223 Jarvis Hall, North Campus, University at Buffalo