Geophysical Research Abstracts
Vol. 19, EGU2017-1119, 2017
EGU General Assembly 2017

Assessing extreme sea levels due to tropical cyclones in the Atlantic basin

Sanne Muis (1), Ning Lin (2), Martin Verlaan (3,4), Hessel Winsemius (3), Deepak Vatvani (3), Philip Ward (2), and Jeroen Aerts (2)

(1) Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam, Amsterdam, the Netherlands, (2) 1Department of Civil and Environmental Engineering, Princeton University, Princeton, New Jersey, USA, (3) Deltares, Delft, the Netherlands, (4) Technical University Delft, Delft, the Netherlands

Tropical cyclones (TCs), including hurricanes and typhoons, are characterised by high wind speeds and low pressure and cause dangerous storm surges in coastal areas. Over the last 50 years, storm surge incidents in the Atlantic accounted for more than 1,000 deaths in the United Stated. Recent flooding disasters, such as Hurricane Katrina in New Orleans in 2005 and, Hurricane Sandy in New York in 2012, exemplify the significant TC surge risk in the United States. In this contribution, we build on Muis et al. (2016), and present a new modelling framework to simulate TC storm surges and estimate their probabilities for the Atlantic basin.

In our framework we simulate the surge levels by forcing the Global Tide and Surge Model (GTSM) with wind and pressure fields from TC events. To test the method, we apply it to historical storms that occurred between 1988 and 2015 in the Atlantic Basin. We obtain high-resolution meteorological forcing by applying a parametric hurricane model (Holland 1980; Lin and Chavas 2012) to the TC extended track data set (Demuth et al. 2006; updated), which describes the position, intensity and size of the historical TCs. Preliminary results show that this framework is capable of accurately reproducing the main surge characteristics during past events, including Sandy and Katrina. While the resolution of GTSM is limited for local areas with a complex bathymetry, the overall performance of the model is satisfactory for the basin-scale application.

For an accurate assessment of risk to coastal flooding in the Atlantic basin it is essential to provide reliable estimates of surge probabilities. However, the length of observed TC tracks is too short to accurately estimate the probabilities of extreme TC events. So next steps are to statistically extend the observed record to many thousands of years (e.g., Emanuel et al. 2006), in order to force GTSM with a large number of synthetic storms. Based on these synthetic simulations, we would be able to provide reliable probabilities of surge levels for the entire Atlantic basin.

References

Demuth, J., DeMaria, M., and Knaff, J.A. (2006). Improvement of advanced microwave sounder unit tropical cyclone intensity and size estimation algorithms. Journal of Applied Meteorology., 45, pp. 1573-1581.

Emanuel, K., Ravela, S., Vivant, E. and Risi, C. (2006). A statistical deterministic approach to hurricane risk assessment. Bulletin of the American Meteorological Society, 87(3), pp.299-314.

Holland, G.J. (1980). An analytic model of the wind and pressure profiles in hurricanes. Monthly Weather Review, 108(8), pp.1212-1218.

Lin, N. and D. Chavas (2012). On hurricane parametric wind and applications in storm surge modeling. Journal of Geophysical Research - Atmospheres. 117. doi:10.1029/2011jd017126.

Muis, S., Verlaan, M., Winsemius, H. C., Aerts, J. C. J. H., & Ward, P. J. (2016). A global reanalysis of storm surge and extreme sea levels. Nature Communications, 7(7:11969), 1–11.