Estimating Future Hurricane Wind Losses
Case Study at Eglin Air Force Base

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Contribution

We introduce a method for estimating future wind losses from hurricanes and apply it to Eglin Air Force Base along the northern coast of Florida. The methods combines models of the statistical distributions for extreme wind speed and sea-surface temperature over the Gulf of Mexico with dynamical models for tropical cyclone wind fields and damage losses. Results show that the 1-in-100 year hurricane from the twentieth century picked at random to occur in the year 2100 would result in 36% [(13%, 76%) 90% CI] greater wind damage solely as a consequence of the projected warmer waters in the Gulf of Mexico.

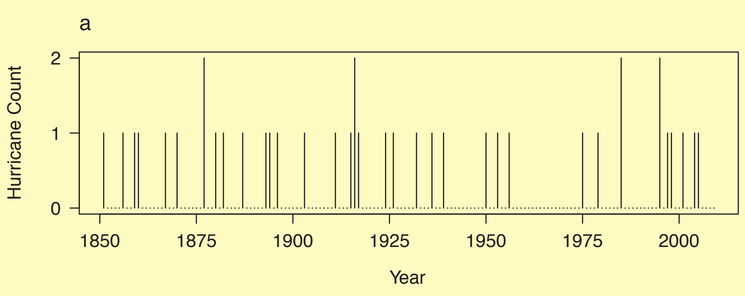
Motivation

Hurricanes and tropical storms pose a serious natural threat to coastal military infrastructure. Since 2005, the United States has experienced devastating impacts from strong hurricanes including Katrina, Rita, and Wilma, and Ike. Research indicates that as ocean temperatures have risen the strongest hurricanes have gotten stronger (Elsner et al. 2008). These increases are likely to continue with rising global temperature (Bender et al. 2010).

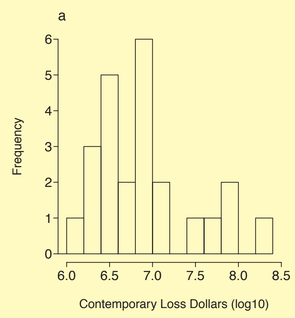
Hurricane hazard models are valuable for estimating contemporary wind damage losses to buildings and infrastructure, and they are widely used for insurance rate adjustments in government and private industry. However at present, the models do not incorporate the potential effects of climate variability and climate change.

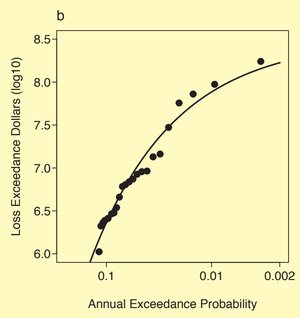
Eglin Air Force Base (EAFB), located in the panhandle of Florida, is used by the U.S. military as a development and testing ground for air-delivered weaponry. The military has invested millions of dollars in infrastructure on the base ranging from roads and air fields to personnel housing and radar installations. Given its proximity to the Gulf of Mexico, much of this built environment is exposed to hurricane winds. In particular, military planners are concerned with the potential increasing risk of wind-damage and surge losses under future climate scenarios.

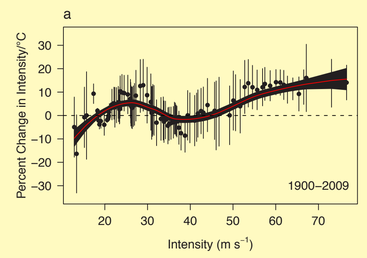
Data

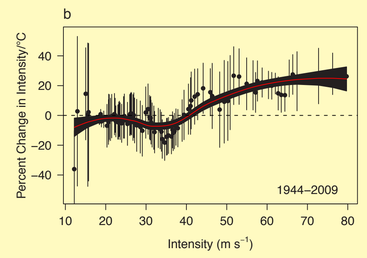


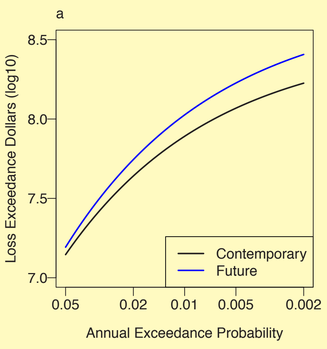
Results

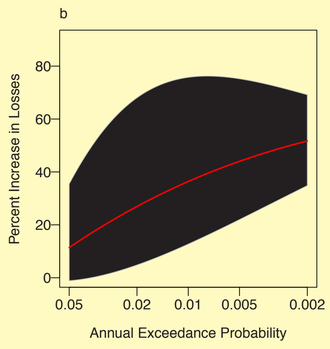


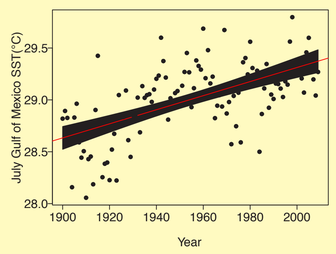












So What?

Results show that if future projections of hurricane intensity are realized, coastal losses will increase for the strongest hurricanes by 36% [(13%, 76%) 90% CI] relative to today's losses making EAFB progressively more vulnerable to hurricanes (Elsner et al. 2011). The approach is important to the EAFB in terms of quantifying the possible risk in the coming years in light of potentially warmer SSTs and stronger tropical cyclone winds. Contemporary damage estimates are based on the record of past hurricanes. While relying only on the relatively few historical events might lead to larger biases in assessing short-term risk (1–10 years) when compared with the simulation methodology widely employed in the insurance business, it allows us to condition the long-term risk (greater than 50 years) on a changing climate.

Improvements

Estimated future losses depend on a number of assumptions. While a linear trend is reasonable fit for the historical data, it might not be the case over the next 90 years. Also, the rate of change, although consistent with global estimates and projections of SST, may be lower (or higher) than what is used here. Our method is conservative with respect to the uncertainty estimates since the change in SST is based on 90 years, but the historical storms all occur before 2010. We could instead use the prediction error for each storm and adjust the change in SST based on the actual storm year. Moreover, the local regression smoother removes noise from the analysis, so our confidence intervals are too small. A bootstrap over the entire model process would be a better way to estimate confidence bands.

References

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