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Predictors of extreme hurricane intensities over the North Atlantic

O. Mestre (1), S. Hallegatte (1,2)

(1) Ecole Nationale de la Météorologie, Météo-France, Toulouse, France, (2) Centre International de Recherche sur l'Environnement et le Développement, Nogent-sur-Marne, France

We investigate the predictors of the most extreme hurricanes over the North Atlantic between 1880 and 2005. To do so, we calculate the Emanuel's Power Dissipation Index (PDI) for all hurricanes over this period and relate the largest PDI of each hurricane season to several potential drivers: global surface air temperature (T), detrended Sea Surface Temperature (SST) over the North Atlantic, Atlantic Multi-decadal Oscillation (AMO) index, South Oscillation Index (SOI), and North Atlantic Oscillation (NAO) index.

Preliminary analysis of annual extremes of PDI is performed by means of Vector Generalized Additive Modelling of the Generalized Extreme Values Distribution. This method, introduced by Yee (1996), allows modelling the position and scale parameters of the GEV as smooth functions of the potential predictors. Detrended SST and SOI are found to have a significant influence on extremes of PDI, while the extra information brought by the other predictors is insignificant. In particular, no climate change signal can be detected in this series. The additive modelling of the position parameters reveals a quasi-linear dependency on reduced SST and SOI. Concerning the scale parameter, the response is still linear on reduced SST, but SOI exhibits a more complex behaviour: linear for low values (El Niño conditions), and rather constant for larger values (from neutral to La Niña conditions).

Final model is computed by means of the Vector Generalized Linear Models (Yee & Hastie, 2003), taking into account the features revealed by the preliminary analysis : linear in SOI and reduced SST for position, and using a linear model (SST) and a change-point model (SOI) for scale. Concerning the shape parameter, we find that the

Gumbel approximation is valid for those data. Reliability diagrams confirm the good fit of the computed return levels.

Consistently with previous studies, we find that warmer SSTs led to stronger storms, and that El Niño conditions inhibit intense hurricanes. We find that these properties translate into historical records of the most extreme hurricanes. Those results can be used to forecast the PDI of the most intense storm of a hurricane season and to assess the probability of exceeding a given intensity threshold, as a function of the large scale climate conditions.