Abstract: We explore recent efforts aimed towards predicting and projecting tropical storm and hurricane activity changes using dynamical and statistical models. We outline strategies for regional climate change prediction as applied to hurricanes, and discuss aspects of the hurricane prediction problem that make it particularly challenging. In order to predict changes in hurricane activity, one must: i) define a measure of activity, ii) test prediction methods on historical cases (making efforts to correct historical estimates of this change in activity for data problems), iii) develop comprehensive dynamical models and theoretical understanding to connect changes in activity to large-scale environmental parameters.

Dynamical models and simple statistical models exhibit skill in year-to-year predictions of Atlantic and East Pacific hurricane counts. Building on these methodologies we develop methodologies for multi-year to decadal prediction, in an effort to extend the forecast horizon. The results of 50 years of retrospective forecasts of multi-year to decadal hurricane frequency are encouraging, but confidence in the future reliability of the forecast system is limited by the small effective sample size.

Efforts to glean the course of multi-decadal to centennial changes in hurricane activity with dynamical models are found to be critically sensitive to details in the horizontal structure of sea surface temperature (SST) changes and the vertical structure of atmospheric temperature changes - rather than the overall temperature change. The pattern of SST change provides a unifying statistical framework for seemingly divergent hurricane projections using dynamical models. The sensitivity of hurricane activity to details in the response of the climate system limits their predictability.