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Using discovery algorithms to forecast seasonal tropical cyclone genesis in the Atlantic

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Tropical cyclones (TC) are among the most damaging extreme weather events, regularly displacing millions of people. Global warming is expected to intensify tropical cyclones and the damages they cause. Although adaptation options are limited, forecasting the impact of single tropical cyclones or the intensity of a whole tropical cyclone season is of great interest. While the skill of dynamical forecast models of lead times up to a week has steadily improved, forecasts with longer lead times remain challenging due to the uncertainty in tropical cyclone genesis events.

Warm sea surface temperatures (SST) and low vertical wind shear (VWS) are well established as favorable conditions for TC formation. Using causal discovery algorithms, we confirm that relationship and identify suitable precursor regions for seasonal TC genesis prediction for the Atlantic basin. Our predictive model exhibits high skill with two months lead time before the Atlantic hurricane season. In line with previous findings, our approach reveals the established factors: Atlantic multidecadal oscillation (AMO) favoring TC genesis through warm SST conditions and El Niño southern oscillation (ENSO) influencing VWS. Although TC formation is to some extend a probabilistic phenomenon, we find that basic climate variables as mean sea level pressure over the Pacific and Atlantic SSTs can help to estimate the total amount of such events.