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Serial clustering of US hurricane landfalls

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A number of hurricane modeling applications, such as statistical seasonal forecasting and natural catastrophe modeling for the insurance industry require knowledge of the underlying probability distribution function of hurricane landfall counts. It is often assumed that yearly hurricane landfalls follow a random Poisson process. Statistical hypothesis testing is applied to test this assumption. We provide evidence that when the North Atlantic Oscillation at the beginning of the hurricane season (May-June average) is in the negative phase hurricanes tend to arrive in clusters. This is found to be the case when landfalls are examined for the U.S. as a whole and for three US coastal regions separately: the state of Florida, the East Coast north of Florida and the Gulf coast west of Florida. For instance, the conditional probability of having a second hurricane landfall in the U.S. during the same season if one landfall has occurred is 47 % if the North Atlantic Oscillation index is positive and 64 % if it is negative. It is subsequently shown that hurricane landfall counts for seasons in a negative North Atlantic Oscillation phase can be modeled more accurately using a probability distribution that can reproduce clustering, such as the negative binomial distribution. A physical explanation is provided to explain the possible influence of the North Atlantic Oscillation on hurricane motion.