Understanding Hurricanes: Past, Present and Future

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Friday, November 12th, 2021
12:30 PM
Bowen Hall, Room 222
MAE Seminar Series

Tropical cyclones are one of the most destructive natural hazards, and an energetic element of the tropical climate system. The extent to which the character of tropical cyclones will change over the coming decades and centuries is therefore of substantial scientific significance and societal interest, as are the character of and causes behind historical changes in tropical cyclones. Has tropical cyclone activity increased? Are historical changes in tropical cyclones random perturbations, driven by natural fluctuations of the climate system, or influenced by radiative forcing changes (e.g., greenhouse gas increases)? In what ways do we expect tropical cyclones to change and why? These questions will be explored through analyses of observational records, theoretical arguments, and high-resolution global and regional model experiments. Evidence that the recorded increase in Atlantic hurricane activity since the late-19th century is largely due to changes in observing practices will be presented - along with efforts to understand changes in hurricane activity over the past millennium and connect them to historic and projected future changes in activity. The mechanisms behind these fluctuations and changes will be discussed. The influence of greenhouse gases on past and projected future tropical cyclone changes will be described, along with discussions of crucial sources of uncertainty in interpreting the past and projecting the future.

Gabriel Vecchi is a Professor in the Department of Geosciences and the High Meadows Environmental Institute. Since July 2021 he has been Director of the High Meadows Environmental Institute. He is also the Deputy Director of the Cooperative Institute for Modeling the Earth System (CIMES), a joint institute between Princeton University and NOAA, and from July 2019 to July 2021 was its Director. Prior to coming to Princeton University in 2017, he was a Research Oceanographer and the Head of the Climate Variations and Predictability Group at the NOAA Geophysical Fluid Dynamics Laboratory (GFDL) in Princeton, New Jersey, where he was since 2003. His research focuses on understanding short- and long-term changes to the oceans and atmosphere, including the monsoons, El Niño, and the impact of climate on tropical cyclones, weather extremes, and global patterns of rainfall and drought. Gabriel has received a number of awards including the U.S. Presidential Early Career Award for Scientists and Engineers (PECASE), the American Meteorological Society's Clarence Leroy Meisinger Award, the Ascent Award from the Atmospheric Sciences Section of the American Geophysical Union, the Daniel L. Albritton Outstanding Science Communicator Award, and the U.S. Department of Commerce Gold Medal. Gabriel's Ph.D. in Oceanography is from the University of Washington. His undergraduate degree in Mathematics is from Rutgers University. Gabriel is a member of NOAA's Climate Observing Systems Council, the National Center for Atmospheric Research Community Earth System Model Scientific Steering Committee and U.S. National Committee for Geodesy and Geophysics at the National Academy of Sciences. Gabriel was a co-Chair of the US-CLIVAR Working Group on Hurricanes and Climate, and a Lead Author in Working Group I of the IPCC Fifth Assessment Report. He has authored or co-authored of over 200 peer-reviewed publications.

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