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Multidimensional risk in a nonstationary climate: changes in joint probability of extreme conditions in space and time

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As has been made acutely clear in recent years, many natural and human systems are particularly prone to the co-occurrence of extremes like severe heat, heavy rainfall, storm-surge flooding, severe drought, and extreme wildfire conditions. The co-occurrence of these conditions, both simultaneously (or in rapid succession) in a given location or in different parts of the world, is critical for a broad suite of climate-sensitive concerns, including agricultural markets, food security, poverty vulnerability, supply chains, weather-related insurance and reinsurance, and disaster preparedness and recovery - particularly when those conditions are sufficiently extreme to fall outside of historical experience. This seminar will summarize recent work quantifying changes in the frequency of unprecedented events without consideration for joint probability, and then present a framework for quantifying the spatial and temporal co-occurrence of climate stresses in a nonstationary climate. This framework shows that, globally, anthropogenic climate forcing has doubled the joint probability of years that are both warm and dry in the same location (relative to the 1961–1990 baseline). In addition, the joint probability that key crop and pasture regions simultaneously experience severely warm conditions in conjunction with dry years has also increased, including high statistical confidence that human influence has increased the probability of previously unprecedented co-occurring combinations. The potential for this methodology to lend insight for other sectors that are accustomed to deploying resources based on historical probabilities, such as wildfire risk management, will also be discussed.