New forecasting method: Predicting extreme floods in the Andes mountains

October 14 2014

This might allow for improved disaster preparedness. As the complex systems technique builds upon a mathematical comparison that can be utilised for any time series data, the approach could be applied to extreme events in all sorts of complex systems.

"Current weather forecast models cannot capture the intensity of the most extreme rainfall events, yet these events are of course the most dangerous, and can have severe impacts for the local population, for example major floods or even landslides," says lead author Niklas Boers of the Potsdam Institute for Climate Impact Research (PIK). "Using complex networks analysis, we now found a way to predict such events in the South American Andes."

When the monsoon hits South America from December to February, it brings moist warm air masses from the tropical Atlantic. Travelling westwards, these winds are blocked by the steep Andes mountains, several thousand metres high, and turn southwards. Under specific air pressure conditions, the warm air masses, loaded with moisture, meet cold and dry winds approaching from the south. This leads to abundant rainfall at high elevations, resulting in floods in the densely populated foothills of the Bolivian and Argentinian Andes. "Surprisingly, and in contrast to widespread understanding so far, these events propagate against the southward wind direction," says Boers.

'Big Data' analysis of observational time series from

satellites

The international team of scientists performed a 'Big Data' analysis of close to 50,000 high-resolution weather data time series dating from the 15 years since high quality satellite data became available, generated by NASA together with the Japan Aerospace Exploration Agency. "We found that these huge rainfall clusters start off in the area around Buenos Aires, but then wander northwestward towards the Andes, where after two days they cause extreme rainfall events", says Boers. The new method makes it possible to correctly predict 90 percent of extreme rainfall events in the Central Andes occurring during conditions of the El Niño weather phenomenon when floods are generally more frequent, and 60 percent of those occurring under any other conditions.

"While the findings were hard to derive, local institutions can now apply them quite easily by using readily available data, which helps a lot," says co-author José A. Marengo of the National Institute for Space Research in Sao Paulo, Brazil. "Major rainfall events can result in floods which for instance in early 2007 alone produced estimated costs of more than 400 million US dollars in the region. It is now up to the affected countries to adapt their disaster preparation planning."

Method can be applied to the climate, but also to financial markets

"Comparing weather data sounds simple enough, but it actually took the new mathematical tool that we developed to detect the intricate connections that lead to the extremes," says co-author Jürgen Kurths, co-chair of PIK's research domain Transdisciplinary Concepts and Methods. "The data was there, but nobody joined the dots like this before. The method provides a general framework that could now be applied to forecast extreme changes in time series of other complex

systems," says Kurths. "In fact, this could be financial markets, brain activity, or even earthquakes."

Provided by Potsdam Institute for Climate Impact Research

Citation: New forecasting method: Predicting extreme floods in the Andes mountains (2014, October 14) retrieved 29 April 2024 from https://phys.org/news/2014-10-method-extreme-andes-mountains.html