

# Quantification and Visualization of the Human Impacts of Anticipated Extreme Events

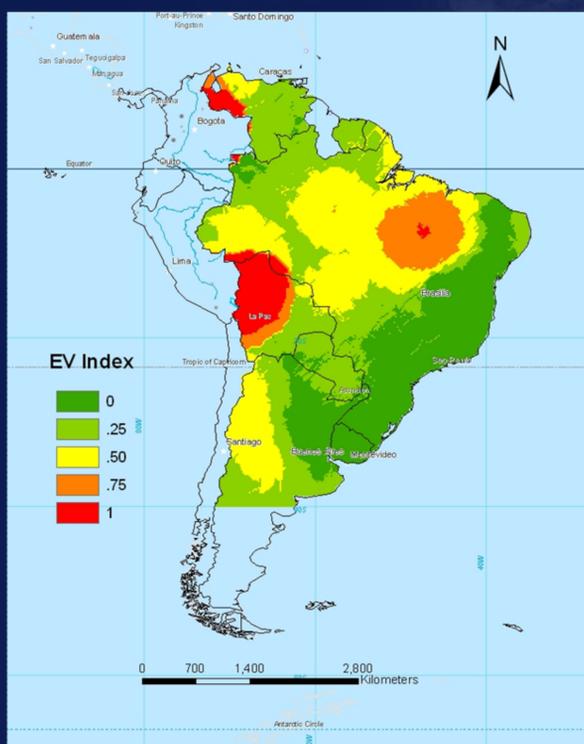
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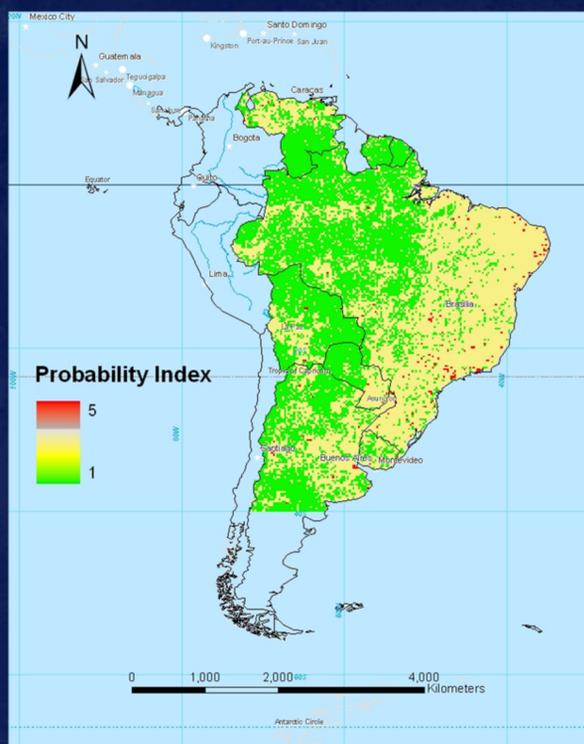
Mentors: Aarthy Sabesan, Shiraj Khan, Gabriel Kuhn and Auroop R. Ganguly  
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## Abstract

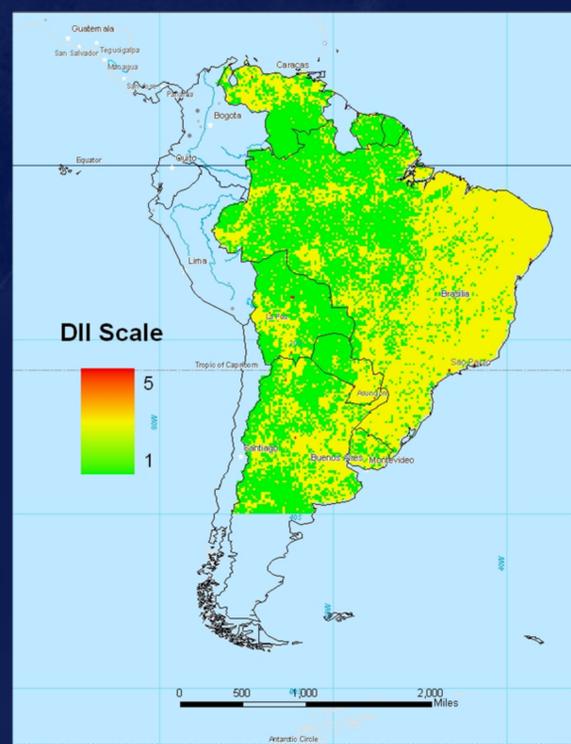
The ability to quantify and visualize the human impacts of anticipated extreme events can enhance disaster readiness levels. This project develops geo-referenced indices and understandable maps for potential disasters caused by precipitation extremes in South America. The project integrates two recent and ongoing lines of research, the first on spatio-temporal extremes with a focus on South American precipitation and the second on uncertainty in high-resolution global population estimates and associated threat metrics. In extreme value theory, a 100-year return level corresponds to the probability that the level will be exceeded once in every 100 years, or a probability of 1/100 in any given year. Thus, the ratio of T-year and t-year return levels, where t relates to extremes for which one is prepared and T corresponds to a lower probability but more significant extremes, measures the degree of “surprise” in anticipated extremes. This quantity has been defined here as the “extremes volatility ratio” (EVR), with t and T assumed to be 50 and 500 respectively. The inverse of EVR, when subtracted from unity, scales from zero to unity, and can be given a probabilistic interpretation in terms of the degree of surprise. This quantity is defined here as the “extremes volatility index” (EVI). The EVR and EVI are plotted at each grid in space for multiple time windows. The product of EVI with a measure of the maximum possible damage yields a risk index. The relevant factors contributing to the potential damage are population at risk and critical infrastructures. This project defines the product of EVI and high-resolution population from LandScan® Global at each grid as the “human risk index” (HRI). The catastrophic impact of a disaster has been defined as the ratio of the anticipated risk and the ability to react to the potential disaster. The latter can be quantified through economic indicators as well as disaster readiness and mitigation strategies. This project utilizes the gross domestic product (GDP) of a nation as a measure of the ability to react. The ratio of the HRI and the GDP is therefore defined as the “disaster impact index” (DII), with higher values indicating greater impact. Maps of geo-referenced indices developed in this project can facilitate anticipatory strategies for disasters caused by precipitation extremes and can be generalized to other types of disasters.



Extremes Volatility Index



Human Risk Index



Disaster Impact Index

**Motivation:** Disaster Readiness

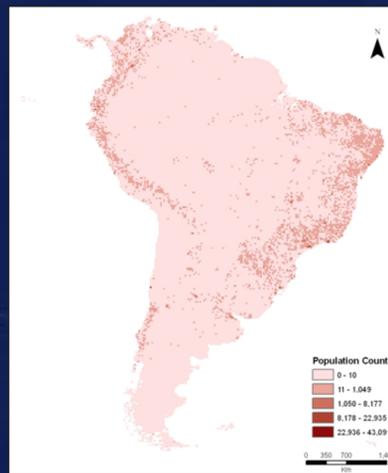
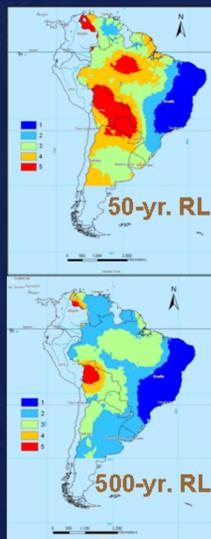
**Application:** Precipitation  
Extremes

**Case Study:** South America

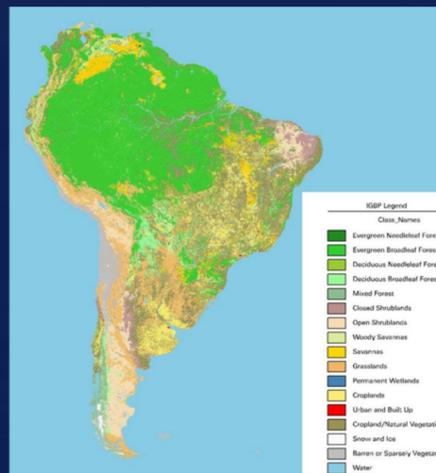
- **Precipitation:** 1940-2004
- **Return Levels (RL):** 50-yr.; 500 yr.
- **Population:** LandScan® Global 2004
- **GDP:** CIA World Factbook
- **Software:** ArcGIS 9.1 (ESRI)

### References

1. Space-Time Extremes for South America Precipitation  
*Khan, Kuhn, Ganguly, Erickson and Ostrouchov (2006)*
2. Uncertainty in Grid-Based Population & Threat  
Metrics *Sabesan, Abercrombie and Ganguly (2006)*



LandScan® Population



Land Cover



GDP

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