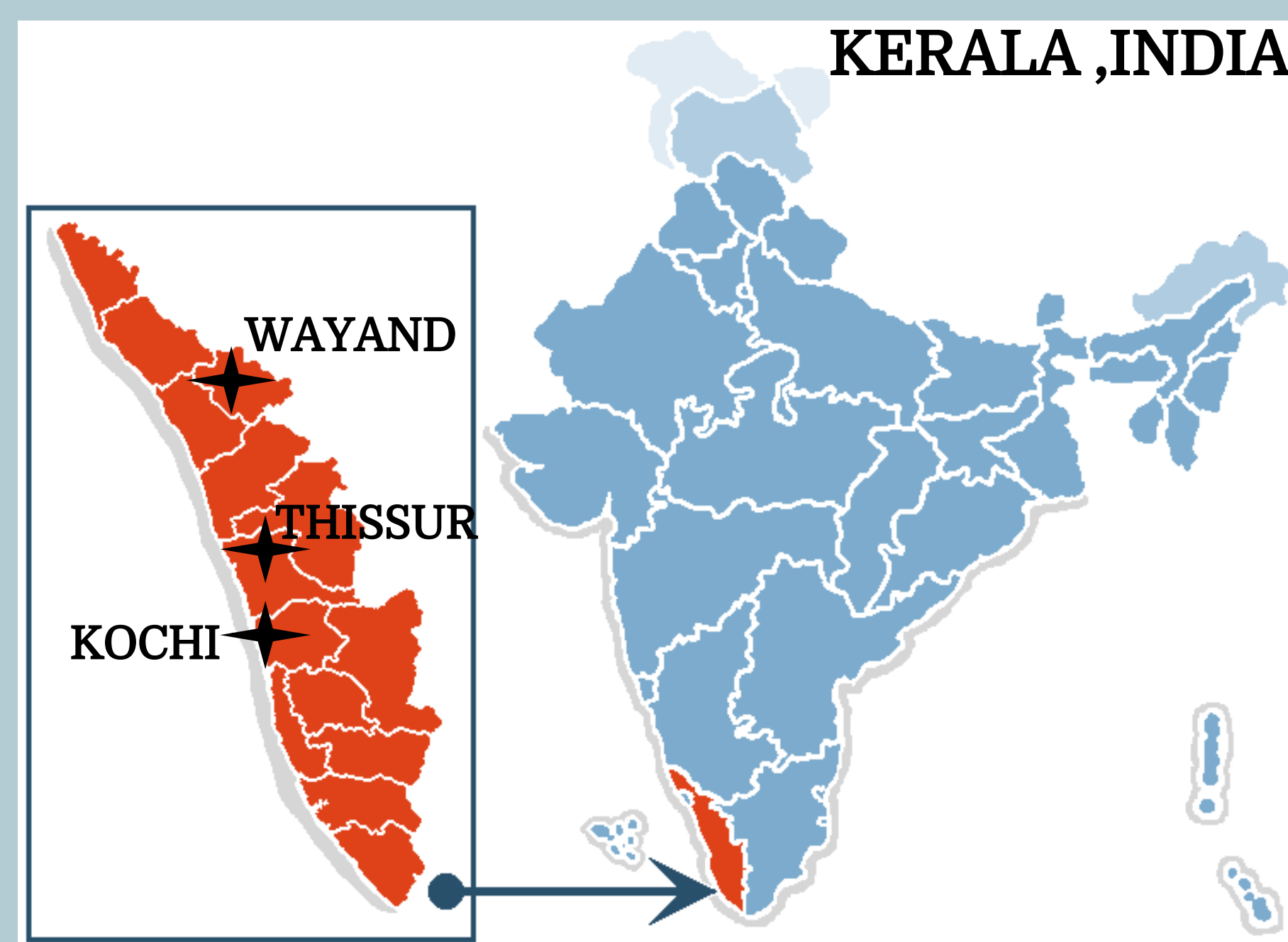


# Examining the Nature of Complex Urban Flooding through a Mixed Method Approach: A Case from Kerala, India

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## Study Area



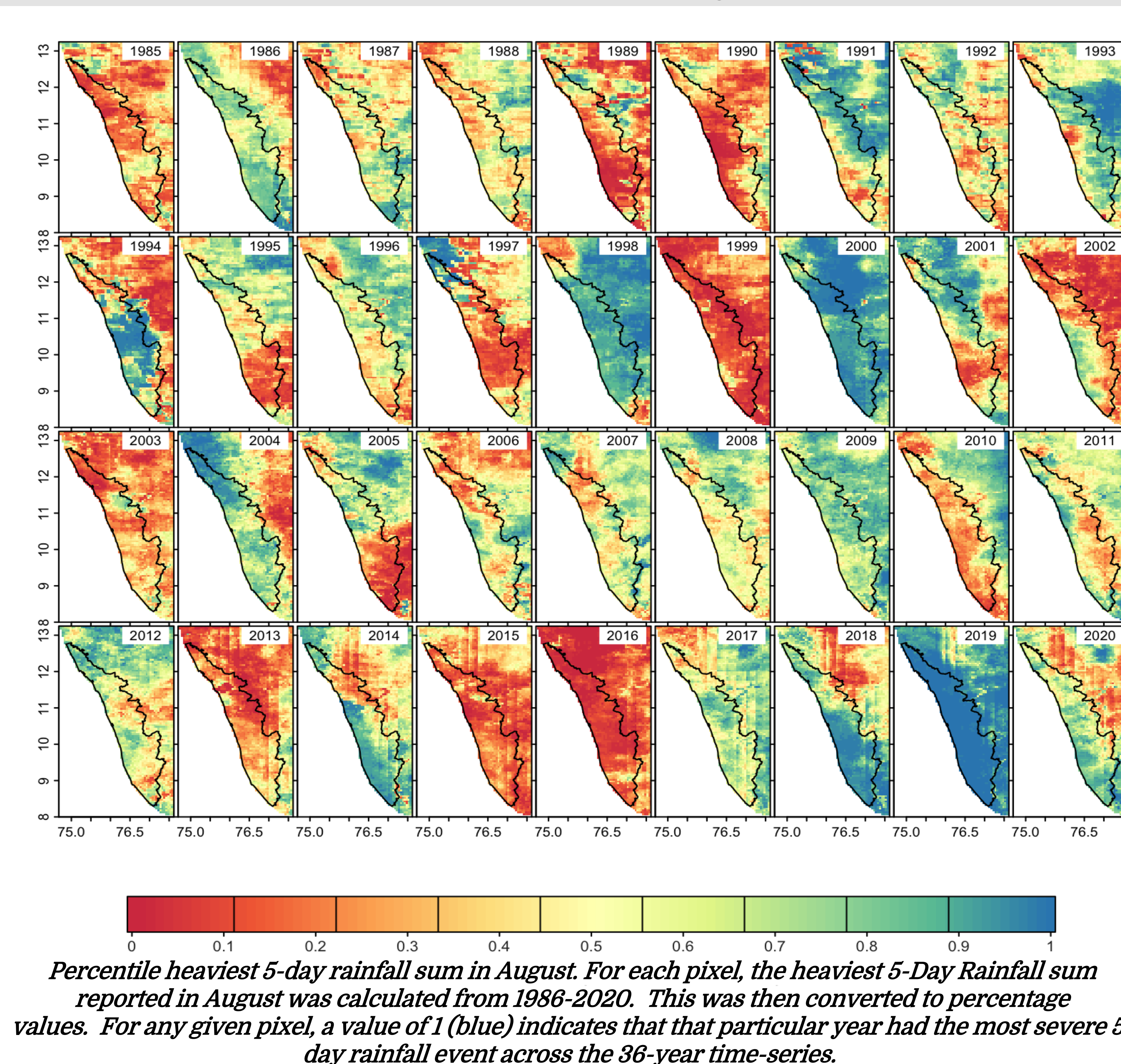
## Research Set-Up

**Problem.** Flash floods are multifaceted and complicated hazards that claim the lives of thousands globally every year. In 2021 alone, appx. 1800 flood events have occurred. Our study aims to assess whether a convergent parallel mixed-methods study design can capture the physical and human complexity of a flash flood event, focusing on a case study in Kerala, India. It is projected that both extreme climate events and urbanization will continue to influence flooding in the region.

**Questions.** 1) What factors cause impactful floods in Kerala; 2) What are the government and public's perceptions of such events; and 3) What spatial-temporal rainfall statistic captures impactful complex urban flood events?

**Methods.** A **convergent parallel design** was chosen for this study to concurrently collect satellite and interview data to enable comparison among sources, compensation for weaknesses among different methods, and expansion of knowledge. Satellite rainfall data was collected from the Climate Hazards Group's Infrared Precipitation with Stations (CHIRPS) between 1986 and 2020. Results from the interviews were used to guide the analysis and to suggest avenues for further qualitative research.

## Satellite Analysis



## Interview Analysis

**Government Official:** "So, the 2-first flood happened within the span of 3 days of intermittent rain. We have been facing this kind of monsoon-like for the past-like all the monsoons are like this. But the intensity of this monsoon happened with the built-up area. The rain happened 3-4 days exactly in the catchments areas and the dams become full in 1 or 2 days."

**Social Worker:** "Even the dam management is basically done by IMD (Indian Meteorological Department) and we depend on IMD data. IMD prediction in 2018 was that rainfall in 2018 will be almost similar to what happened in 2017 the previous. Actually, why IMD failed in predicting intense rainfall? Because we believe in IMD data."

**Researcher and Native :** "Landlock cities for them not proper drainage system and at the same time it is hard for them to flush out the water. Yeah, I mean not just cleaning but to re-work they have to extend the drainage system. Even if cities might [have them], they might be having a one side drainage system [in one part of the city]."

## Results

The results from our studies of both interviews and satellite data show that complex urban flooding is an influential and reoccurring phenomenon that disrupts states such as Kerala socially and economically. We have identified that a triangulation approach through a convergent parallel mixed method enabled us to explore some of the complexities associated with flash flooding. This approach concluded that five-day maximum rainfall sum percentiles, despite being a relatively simple rainfall statistics successfully captured most historical flood events discussed by interviewees and provided a novel way to validate the perceptions themselves.

In general, our results suggest that a complex combination of extreme weather, urbanization, dam management, and infrastructure (e.g., drainage systems) are the drivers of flooding in Kerala. The flash flooding events captured through CHIRPS analysis are comparable to the years in people's perceptions. These instances were independently confirmed across all methods.

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The map of Kerala was retrieved from <https://indianceo.in/news/kerala-startup-mission-establish-50-labs/>

