Mapping High Stakes Coastal Zones: An Interactive Dashboard for Improved Coastal Decision-Making

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Introduction

Climate change is one of the most pressing environmental challenges today, with coastal regions among the most vulnerable. Sea level rise, shifting fish populations, and marine ecosystem degradation threaten the livelihoods, food security, and resilience of coastal communities. Due to limited resources, these areas often lack the data necessary for policymakers to make equitable and informed decisions. To help bridge these knowledge gaps, our team developed a high-resolution, interactive dashboard that synthesizes key climate and socioeconomic indicators for policymakers and localized decision-making.
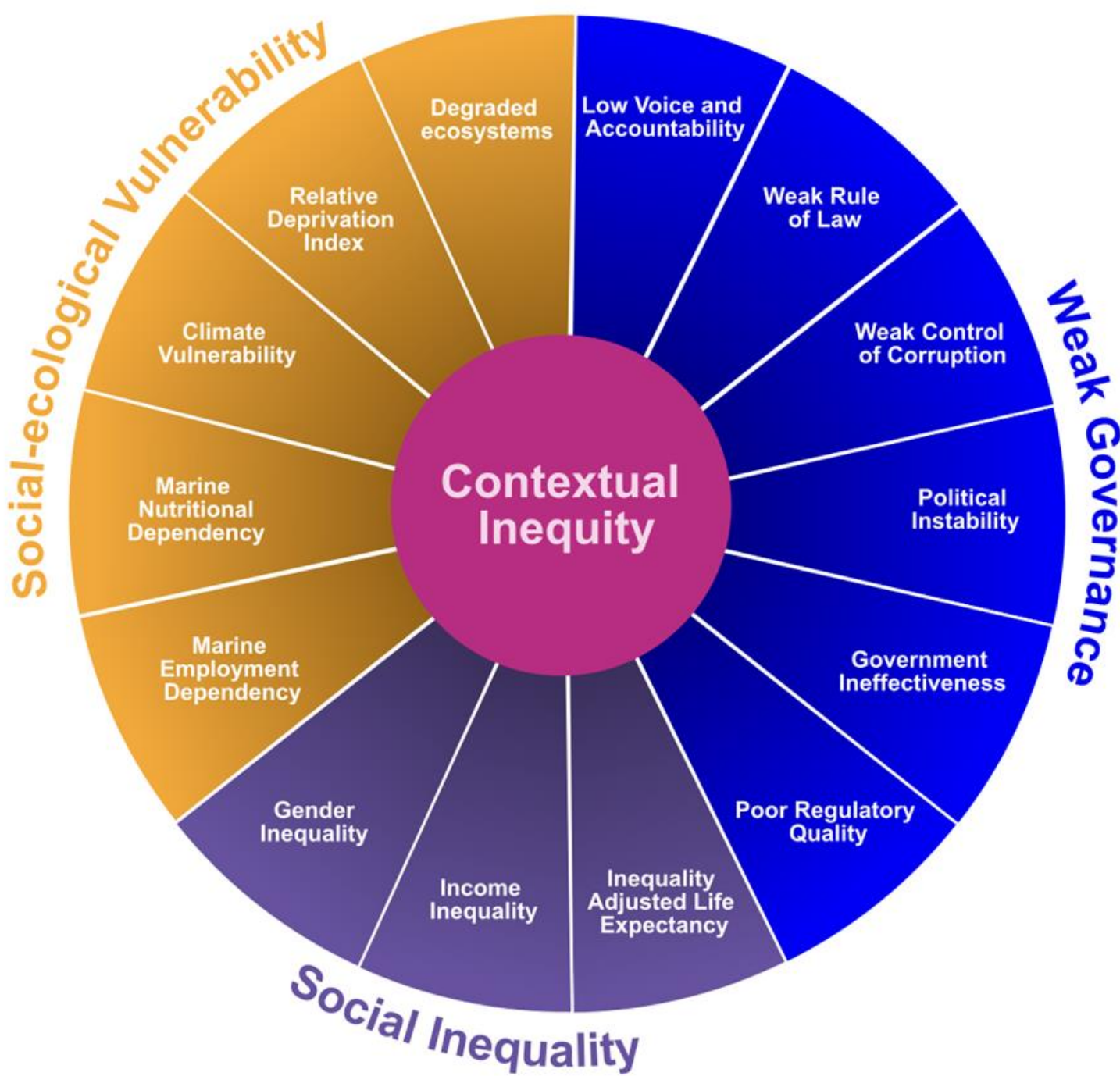
Datasets

Figure 1: Breakdown of three composite scores that comprise the main Contextual Inequity dataset, with 14 indicators for 1.3 million global data points (regional level).

Contextual Inequity: Comprises 14 variables within 3 main components: Social-Ecological Vulnerability, Weak Governance, and Social Inequality.

ND GAIN: Notre Dame Global Adaptation Initiative Country Index that assesses 182 UN countries' climate vulnerability and readiness, with 40 scores between 1995 to 2022.

IPCC: Intergovernmental Panel on Climate Change's WGI Atlas CMIP6 SSP5-8.5 model for climate risk projections (pH, sea level rise, heating degree days) across near-term, medium-term, and long-term time horizons.

NOAA: National Oceanic and Atmospheric Administration's daily Degree Heating Weeks data for coral reefs during the month of April.
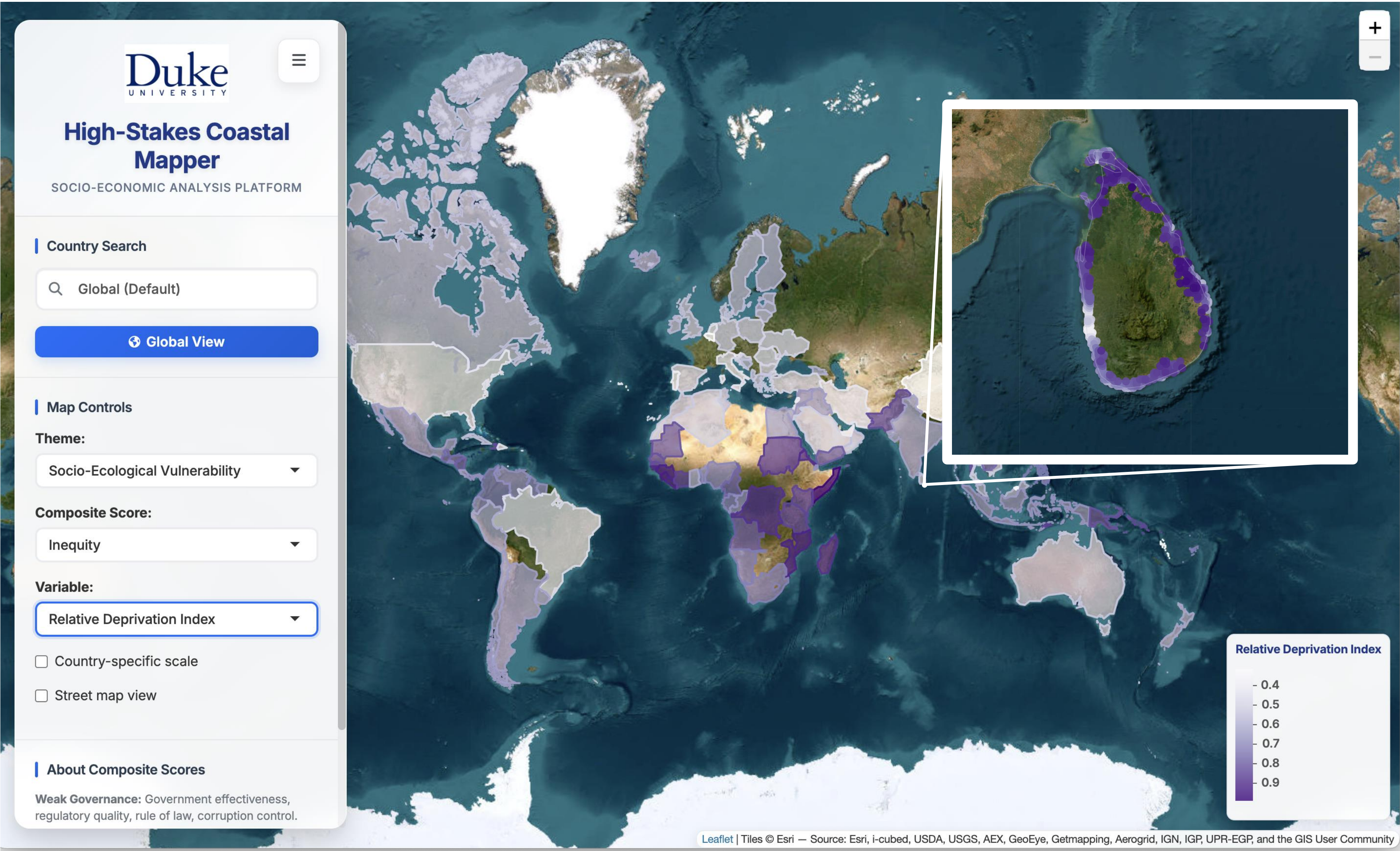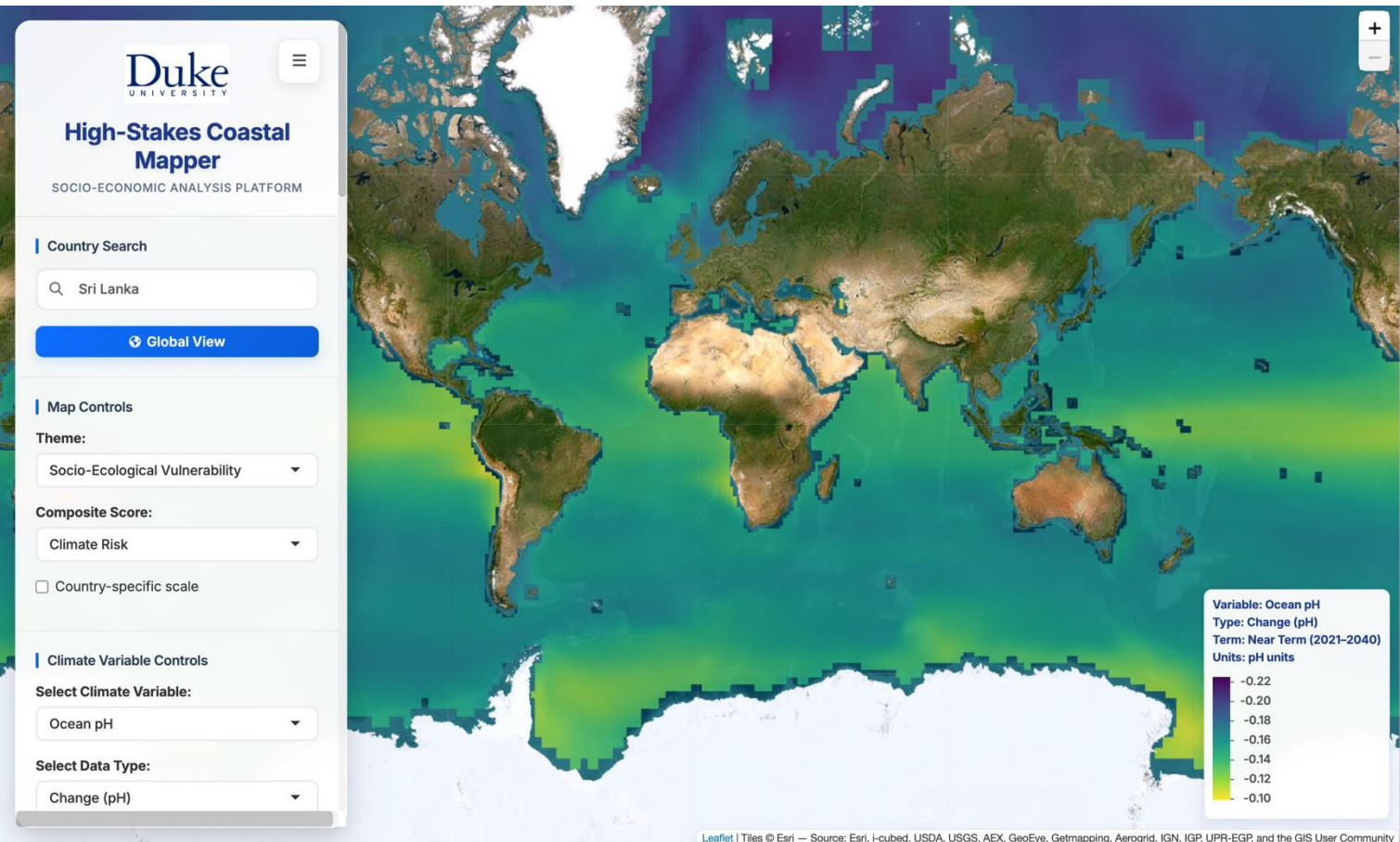
Dashboard

Figure 2: View of main interactive map, featuring global map controls and point-level resolution displays of composite and indicator scores within countries (zoomed in view of Sri Lanka's Relative Deprivation Index distribution displayed).
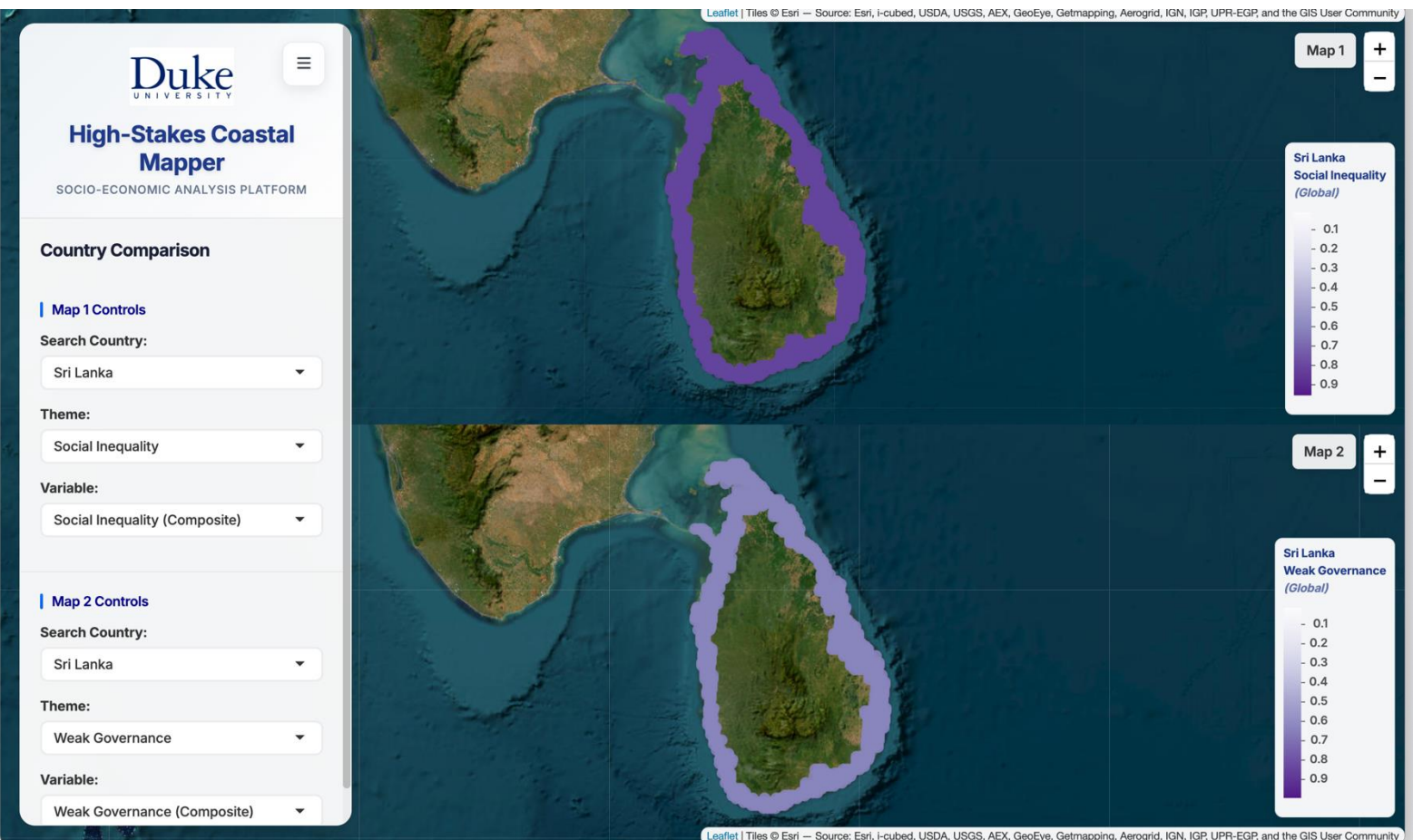
Key Features

Interactive Map
Users can select a coastal country and explore data at world, country, or regional resolution. Choose from contextual inequity, climate risk, or ND-GAIN data. Apply filters to time-series and numerical raster data. Interactive maps, dynamic graphs and summary stats offer a comprehensive view of coastal conditions.
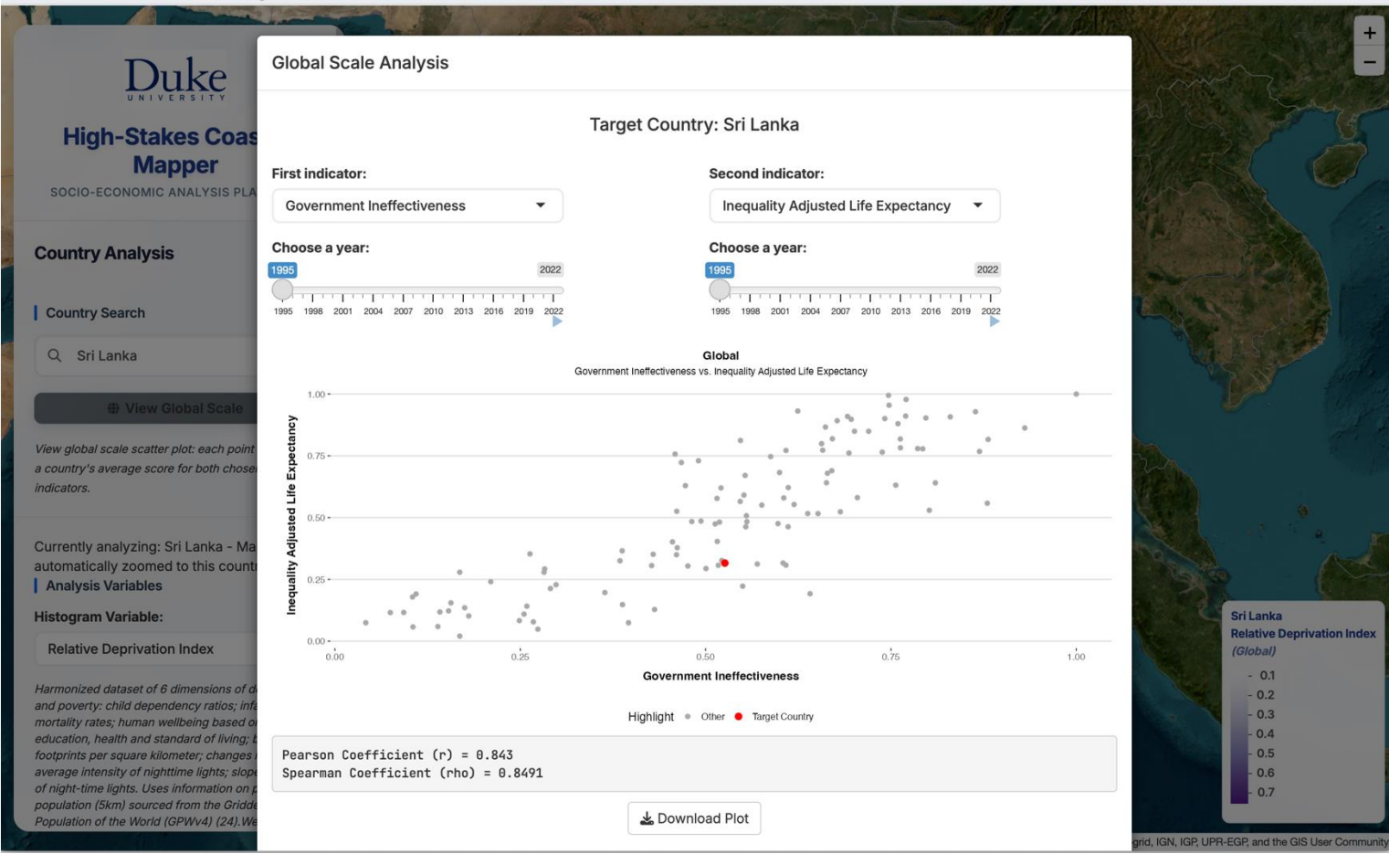
Country Analysis
Users can explore contextual inequity and ND GAIN scores by comparing country-level metrics to global averages or examining regional variation within a country. Supports univariate and bivariate analysis with exportable graphs.

Country Comparison
Users can compare two interactive maps side by side based on different selections of contextual inequity, climate risk, or ND GAIN data. Three levels of resolution used here are world, country, and region.

Approach

Data Preprocessing

Contextual Inequity Data: Filtered to include points located within regions within 5km of the coastline.

IPCC and NOAA Data: Extracted climate variables (GeoTIFF format) and masked to Exclusive Economic Zones (EEZs).

ND-GAIN Data: Subset to coastal countries, selecting variables relevant to coastal vulnerability and readiness.

Dashboard Development

Design: Shiny (front end), Leaflet (mapping), R (logic and visualization)

Conclusion

The final interactive dashboard effectively synthesized large amounts of data and made it easily accessible for relevant decision-makers and researchers. As the world's first coastal socio-ecological database, this dashboard allows for easier analysis of coastal social-ecological vulnerability, which are priority areas for conservation and development.

Next Steps

- Gathering feedback from researchers and NGOs to guide iterative improvements in design and usability.
- Adding subnational data to capture domestic variation in climate risk.
- Reviewing hosting options to ensure the dashboard is scalable and accessible.
- Refactoring code for better readability and maintainability.

References

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