

Harnessing Satellite Data and AI to Address Climate Hazards for Children

Protecting the most vulnerable through the lens of Earth Observation and GeoAI

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Climate and Environment Data Unit

The three main objectives of the unit are:



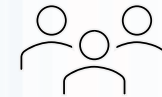
1. Establish Global Child Hazard Database

Standardize database covering all countries and regions, providing a global perspective on climate and environmental hazards that can be uniformly used across diverse projects and initiatives



2. Measure Children's Climate Risk

Understand and measure likelihood of climate and environmental shocks and stresses affecting vulnerable children including the publication of the next version of Children Climate Risk Index (CCRI)



3. Improve Climate Data Literacy

Enhance data-driven decision making through improved user accessibility by employing advanced geoAI solutions, geospatial visualization platform and capacity development

Children's Climate Risk Index (CCRI)

The Core Concept: Risk is not just the presence of a hazard; it is the intersection of exposure and vulnerability.

Pillar 1: Climate & Environmental Hazards (The "Where"): * Measuring the intensity and frequency of shocks like coastal flooding, heatwaves, water scarcity, and cyclones.

Key Focus: Where are these events happening, and how many children are in the "splash zone"?

Pillar 2: Child Vulnerability (The "Who"):

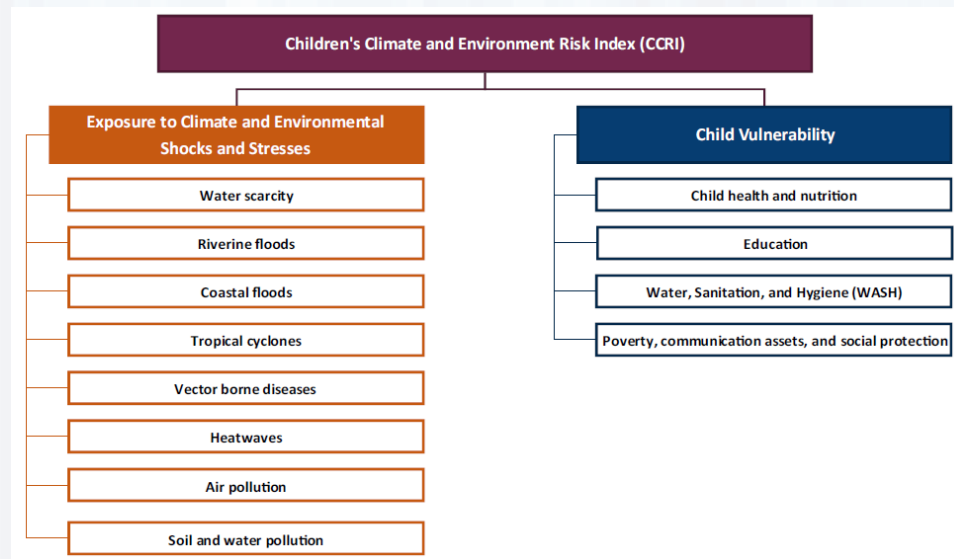
Measuring the internal factors that make a child more likely to suffer from a hazard.

Key Focus: Health, nutrition, education, and access to water/sanitation (WASH). A child with poor nutrition is far less resilient to a flood than a healthy one.

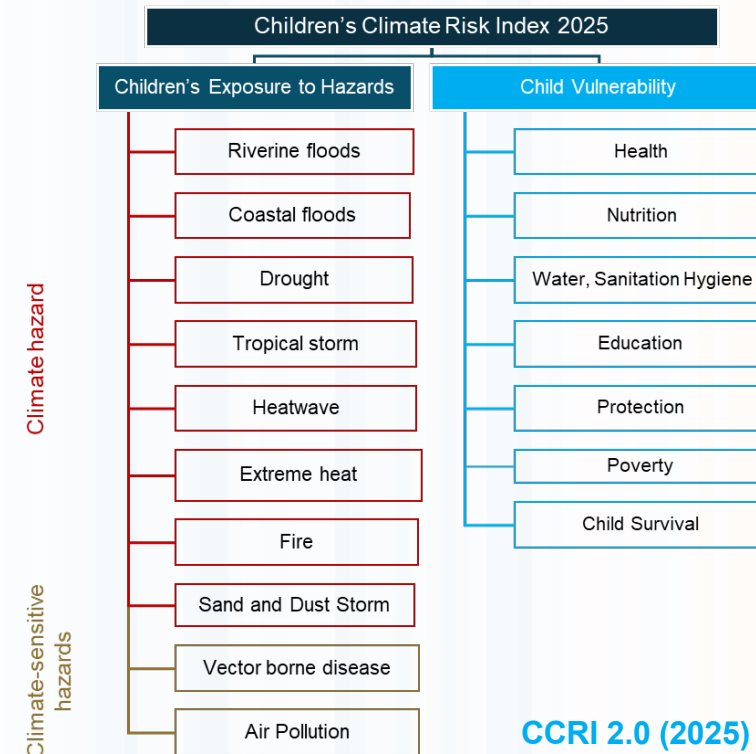
The Intersection: CCRI is the multi-hazard composite that identifies where these two pillars overlap to create a "perfect storm" for children.

CCRI 2021 vs CCRI 2025

- CCRI 2025 focuses more on [climate and climate-sensitive indicators](#), whereas CCRI 2021 focused on a range of different climate and environmental indicators
- CCRI 2025 has [updated data and models](#) for all hazards and vulnerability indicators and includes most countries/territories including the [Small Island Developing states](#)
- CCRI 2025 also includes [pixel-based multi-hazard analysis](#), giving a higher resolution risk index at a gridded level in addition to the country-level ranking.
- CCRI 2025 also uses [high resolution child population raster](#) from World pop



CCRI 1.0 (2021)



CCRI 2.0 (2025)

Global Child Hazard Database

A comprehensive resource on children's exposure to single and multiple hazards at high resolution



Global Coverage and Standardization

Covers **all countries and regions** and include children's exposure to hazards* aggregated at **sub-national, national, regional and global levels** and derived from open-source providers



Comprehensive high-resolution data

Includes a range of standard hazards at **high resolution** (from 100m grid) – predominantly climate and environmental indicators but also geophysical hazards and conflicts at the highest resolution available



Improved Access

Easy accessibility for country and regional offices, host governments and all stakeholders to support informed decision-making in **diverse data formats** (excel, geospatial formats, GeoAI chatbot).

Hazard Category	Available Data	No Global Data
Climate	<ul style="list-style-type: none"> Riverine Flood Coastal Flood Tropical Storm Agricultural Drought Meteorological Drought Heatwaves (frequency, duration, severity) Fires (frequency, severity) Sand and Dust Storm 	<ul style="list-style-type: none"> Pluvial Flood Rainfall induced Landslides
Climate-sensitive	<ul style="list-style-type: none"> Vector borne disease (Malaria) Air Pollution 	<ul style="list-style-type: none"> Vector borne: Zika, Dengue,... Water borne: Cholera, ...
Environment		<ul style="list-style-type: none"> Water Pollution Land Pollution
Geophysical	<ul style="list-style-type: none"> Earthquakes Volcanoes Landslides 	<ul style="list-style-type: none"> Earthquake induced landslides
Other	<ul style="list-style-type: none"> Conflict 	

*The database includes only probabilistic modelled hazard data and not forecast/impact/projection data

Child Hazard Exposure

Children exposure to each hazard is estimated by overlaying the hazard layers with a new high resolution global U18 children population data from Worldpop (100m x 100m)

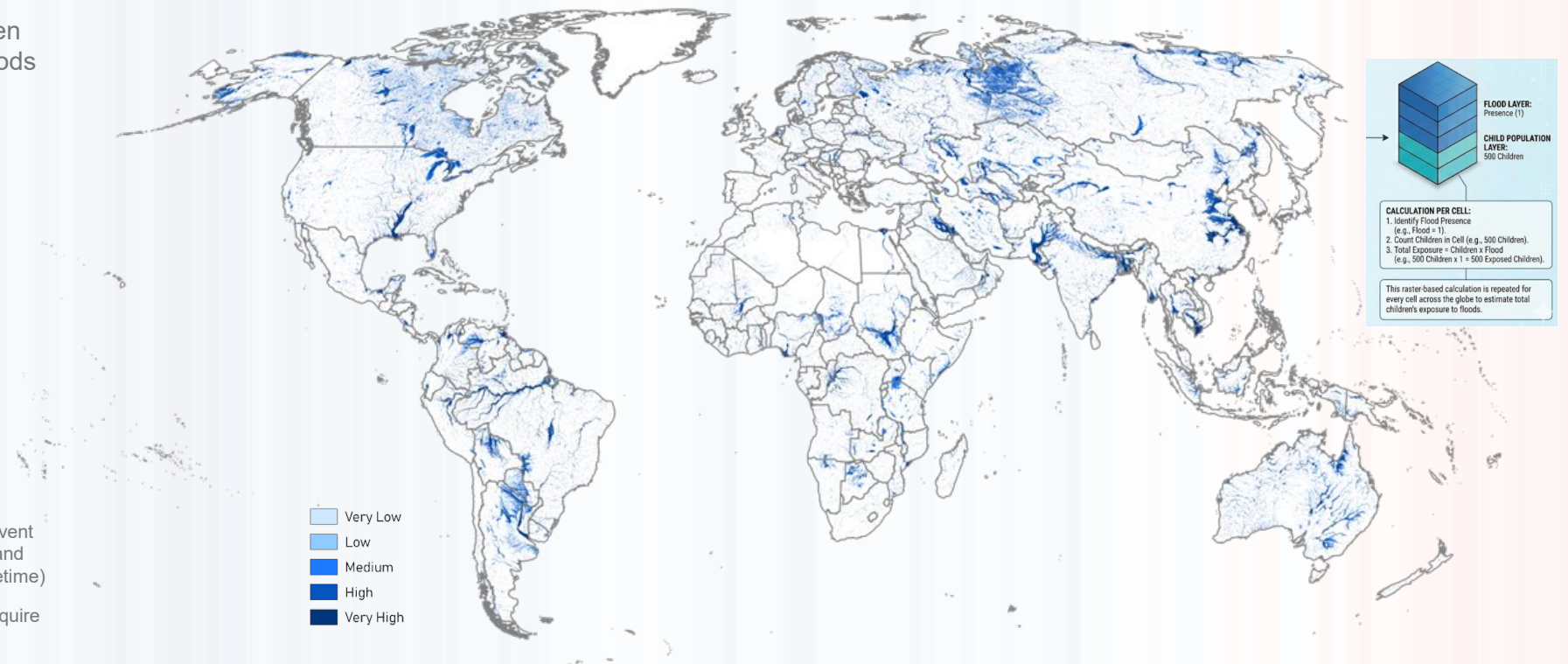
Riverine flood hazard exposure:

Absolute and relative number of children estimated to be exposed to riverine floods globally

Available formats:

- Excel/CSV
- SDMX
- Shapefiles, geojson (vector)
- Geotiff (raster)

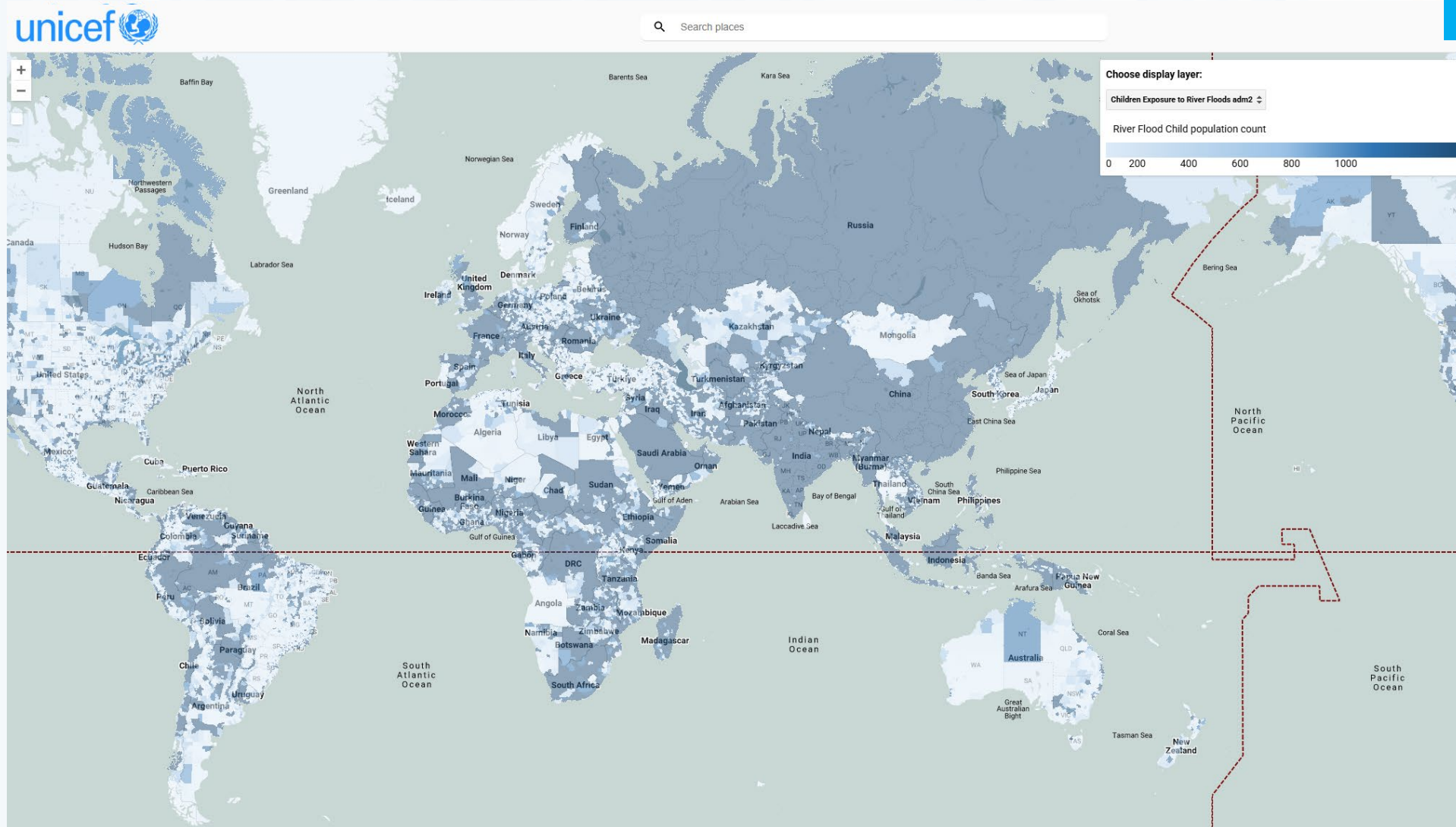
Data Source	EU Joint Research Center
Release Year	2024
Resolution	90m
Threshold	All (> 1 cm depth)
Return Period	100 year (1% chance of the event happening in any given year and highly likely within a child's lifetime)
Update Frequency	Probabilistic models do not require frequent update, but higher resolution expected in 2027
Limitations	Global models could under-represent flooding along small river streams



Results are not final, included only for illustrative purposes and under embargo for external sharing until CCRR release

Global Child Hazard Exposure

Estimates can be aggregated at different levels: sub-national, national, regional and global levels



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Global Child Hazard Database



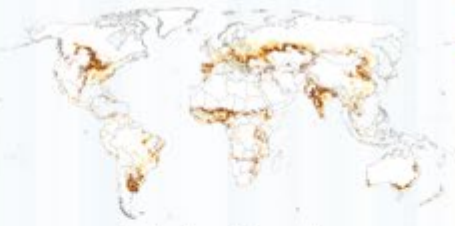
Riverine Flood



Coastal Flood



Tropical Storm



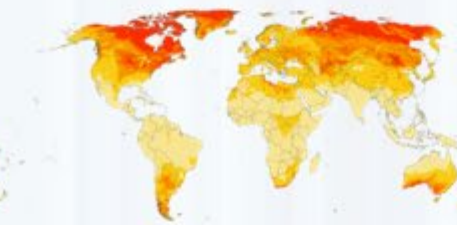
Agricultural Drought



Meteorological Drought



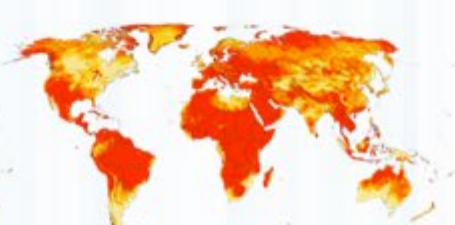
Extreme Heat



Heatwave Severity



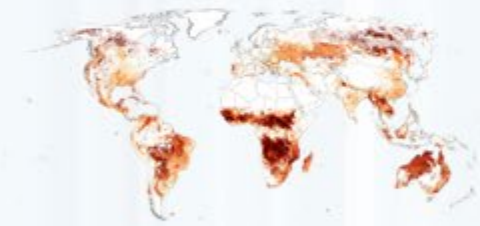
Heatwave Frequency



Heatwave Duration



Sand and Dust Storm



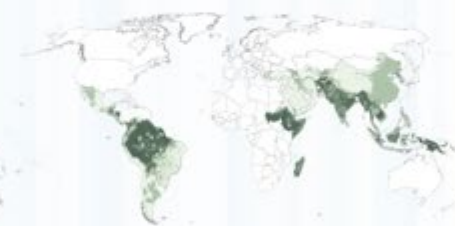
Fire Frequency



Fire Intensity



Malaria (P.Falciparum)

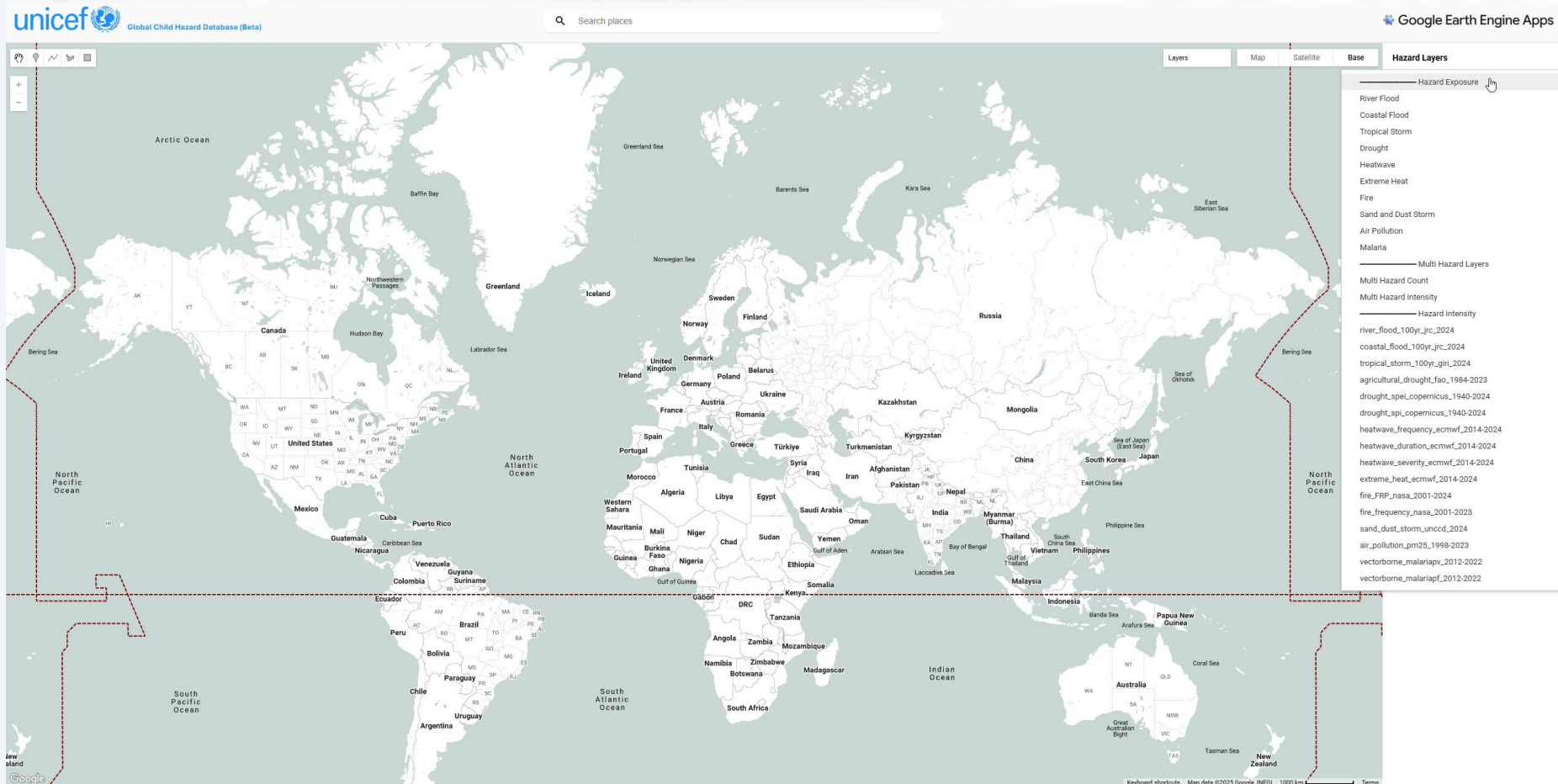


Malaria (P.Vivax)



Air Pollution

Global Child Hazard Database (internal/sub-national)



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The Bottlenecks

Data Coverage, Quality, and Availability

- **The "Monitoring Gap":** Lack of ground-based air quality stations in LMICs leads to reliance on modeled satellite data.
- **The "Invisible Child":** Current drought and flood models often miss children in specific rural or "small river" environments.

Dynamic Risks: Rapidly changing climate patterns outpace traditional decadal data updates.

Hazard Name	Number of countries with no available data
river_flood	33
agricultural_drought	17
pruvial_flood	10
drought_spei	8
drought_spi	8
fire_frequency	5
fire_FRP	5
air_pollution	2

Methodological & Literacy Challenges

Bridging the Gap Between Data and Action

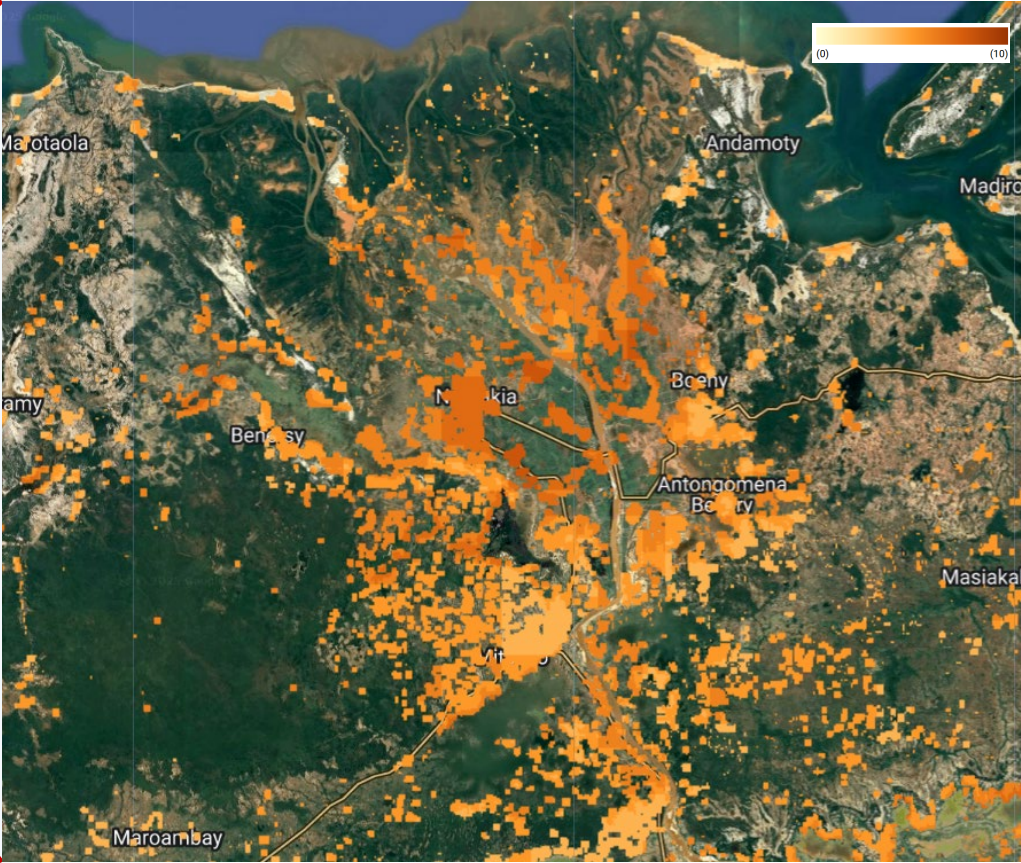
- **Index Building:** Moving beyond simple weighted averages to capture compounding risks.
- **Beyond Exposure Analysis:** more detailed and specific focus on impact/damage assessment.
- **The Literacy Barrier:** Geospatial complexity often excludes non-technical policymakers.

Solution: We need tools/models that translate "pixels" into "policy."

Pixel based approach

High Resolution Multi-Hazard Count

Children are exposed to multiple, overlapping hazards – which could further exacerbate their existing vulnerabilities. The new database provides **hazard count** at **10 sq km grid** level and can be aggregated at **sub-national, national, regional** and **global** levels.




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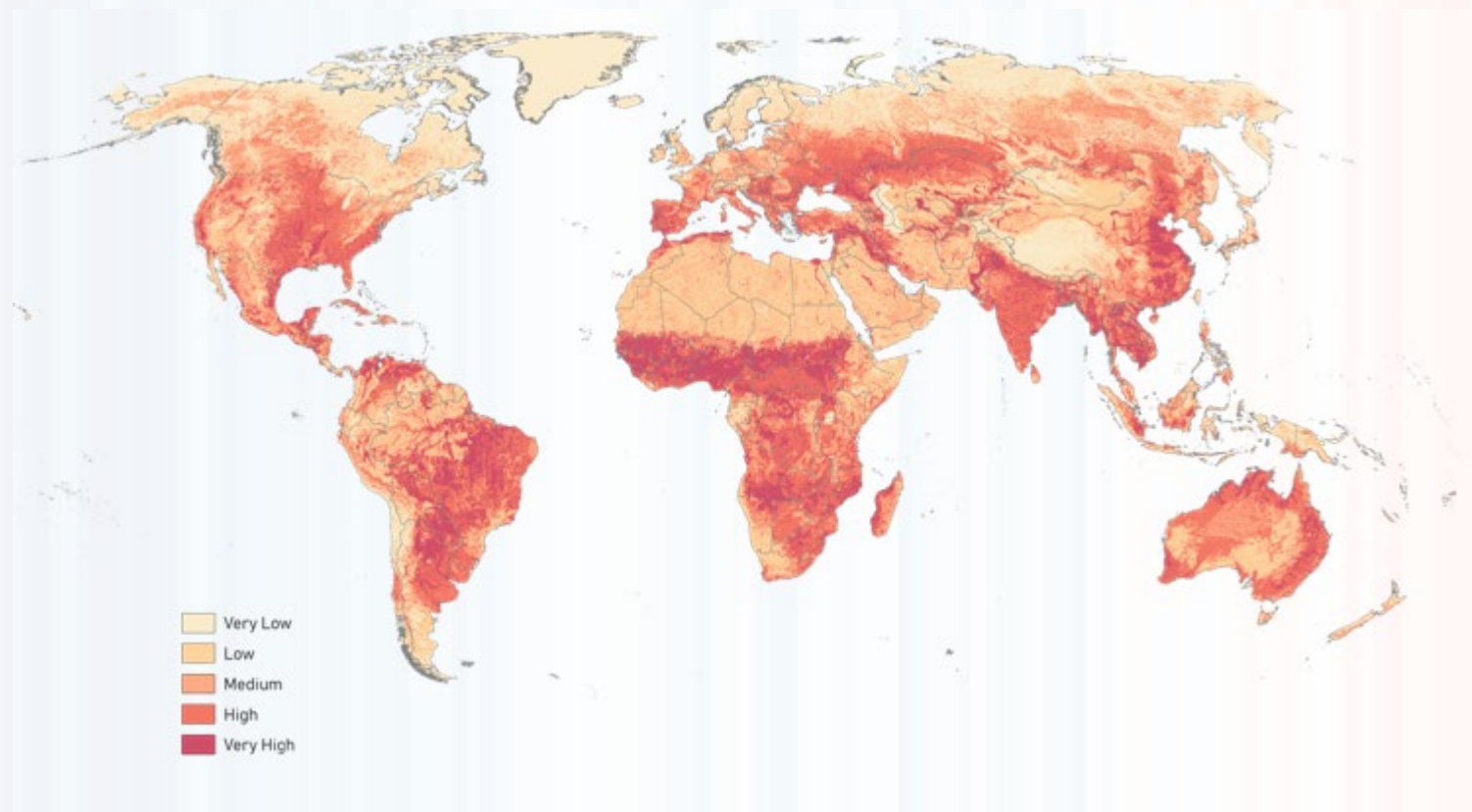
Pixel based approach Multi-Hazard Intensity Score

The new database also includes [multi-hazard intensity scores](#) at 10km x 10km grid level which can be used to estimate the number of [children exposed to multiple hazards at the highest intensities](#).

Example: Tropical Storm Intensity

Any exposure: > 63 km/hr ([WMO](#))

	Category 1 Winds 74-95 mph (119-153 km/h) Some damage and power cuts
	Category 2 Winds 96-110 mph (154-177 km/h) Extensive damage
	Category 3 Winds 111-129 mph (178-208 km/h) Well-built homes suffer major damage
	Category 4 Winds 130-156 mph (209-251 km/h) Severe damage to well-built homes
	Category 5 Winds 157+ mph (252+ km/h) Many buildings destroyed, major roads cut off

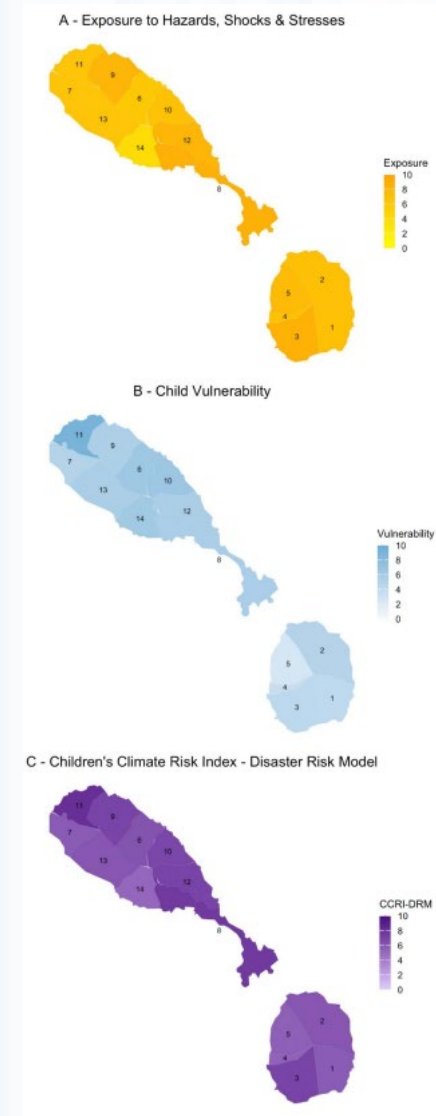


Sub-national vulnerability data

Vulnerability data are only available at country scale

Gap filling : Using Machine Learning to build proxies for hazards where ground data is absent.

Downscaling : Using Machine Learning and other proxies to overcome the spatial limitation

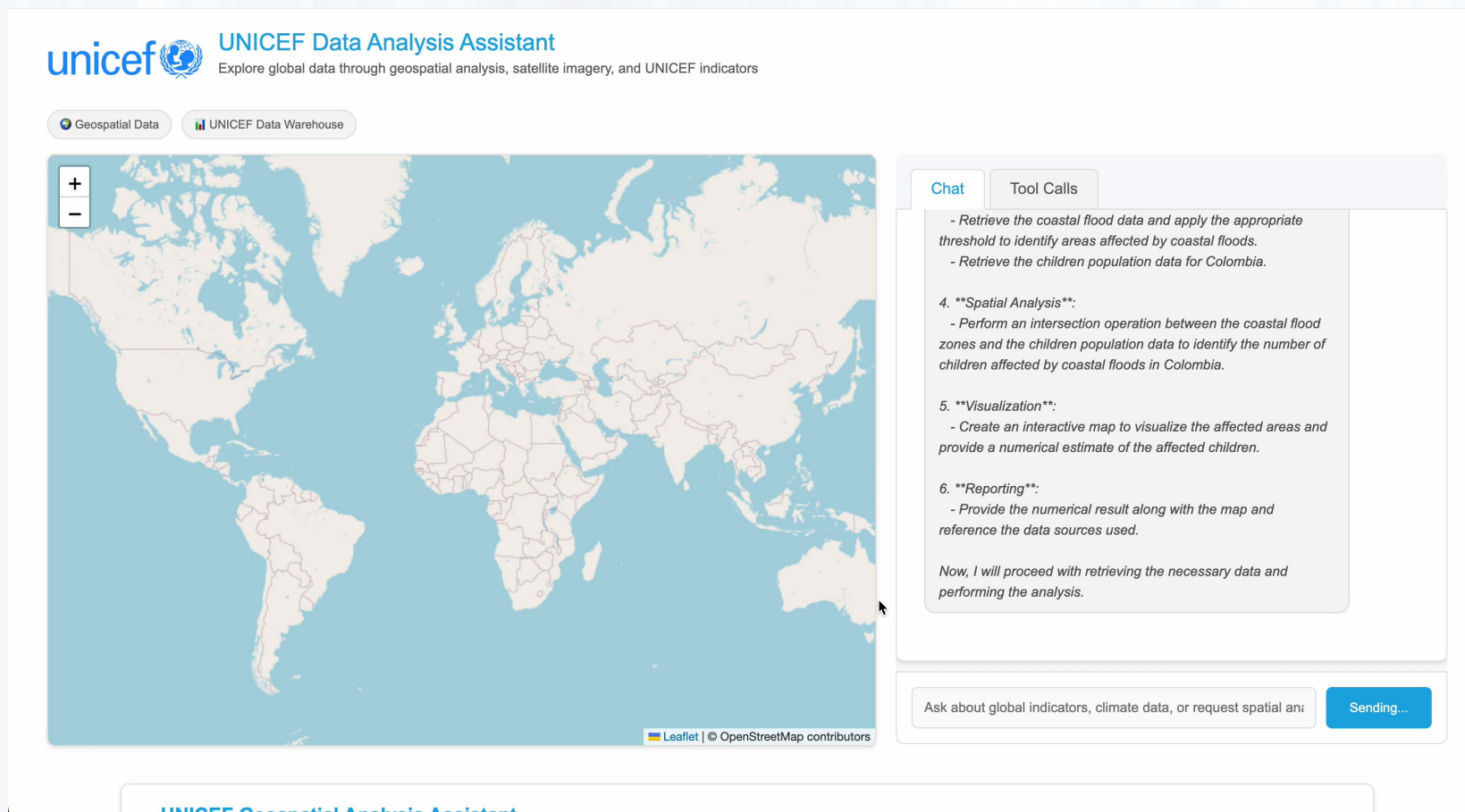


Subnational CCRI-DRM results for Saint Kitts and Nevis,
Ashorn et al., 2025

Introducing Geosphere – Interactive AI tool

A [Geo-AI tool](#) is currently being tested to enable easy access to query the underlying database using natural language, especially [for non-technical users](#)

Prompt: How many children are exposed to coastal flooding in Colombia?



The screenshot displays the UNICEF Data Analysis Assistant interface. At the top left, the UNICEF logo is followed by the text "UNICEF Data Analysis Assistant" and the tagline "Explore global data through geospatial analysis, satellite imagery, and UNICEF indicators". Below this, there are two tabs: "Geospatial Data" (selected) and "UNICEF Data Warehouse". The main area features a world map with a zoom control on the left. On the right side, there is a chat window with two tabs: "Chat" (selected) and "Tool Calls". The chat window contains a detailed AI response to the prompt "How many children are exposed to coastal flooding in Colombia?". The response is structured as follows:

- Retrieve the coastal flood data and apply the appropriate threshold to identify areas affected by coastal floods.
- Retrieve the children population data for Colombia.

4. **Spatial Analysis**:

- Perform an intersection operation between the coastal flood zones and the children population data to identify the number of children affected by coastal floods in Colombia.

5. **Visualization**:

- Create an interactive map to visualize the affected areas and provide a numerical estimate of the affected children.

6. **Reporting**:

- Provide the numerical result along with the map and reference the data sources used.

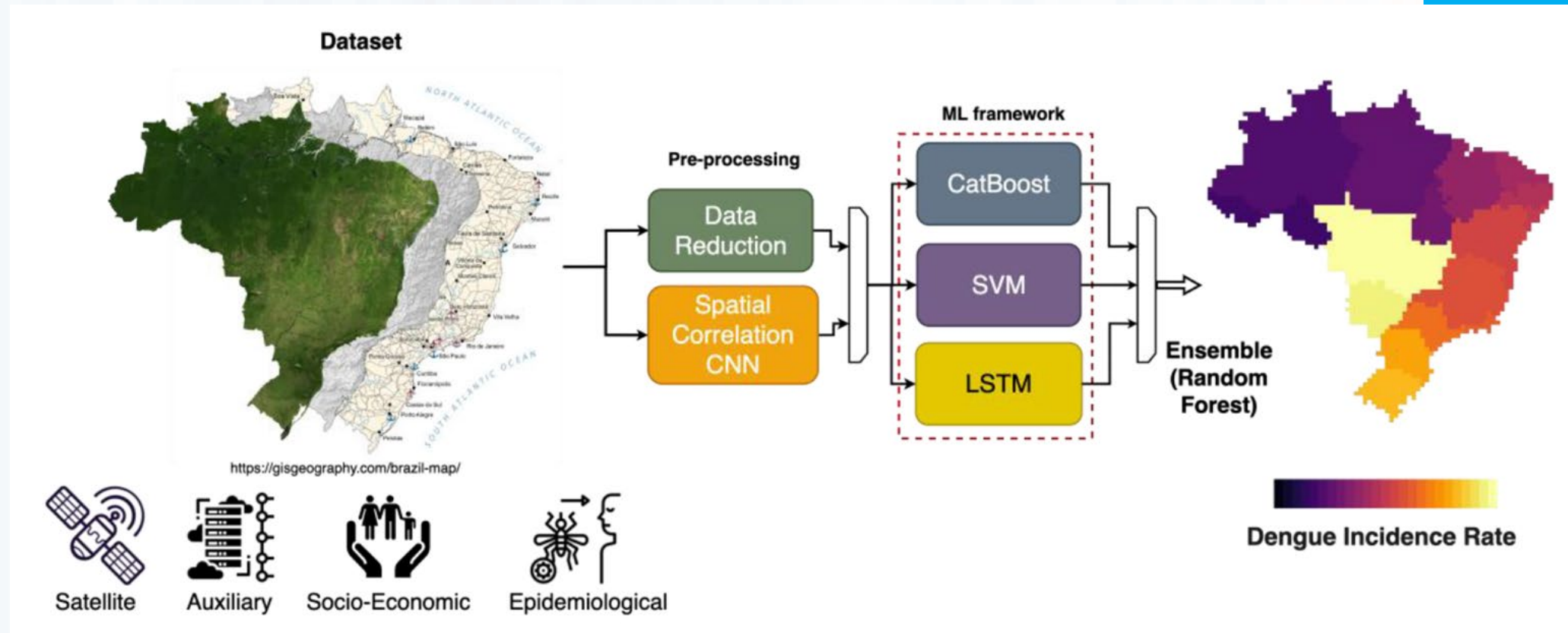
Now, I will proceed with retrieving the necessary data and performing the analysis.

At the bottom of the chat window, there is a text input field with the placeholder text "Ask about global indicators, climate data, or request spatial an:" and a blue "Sending..." button.

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Case study: Disease monitoring

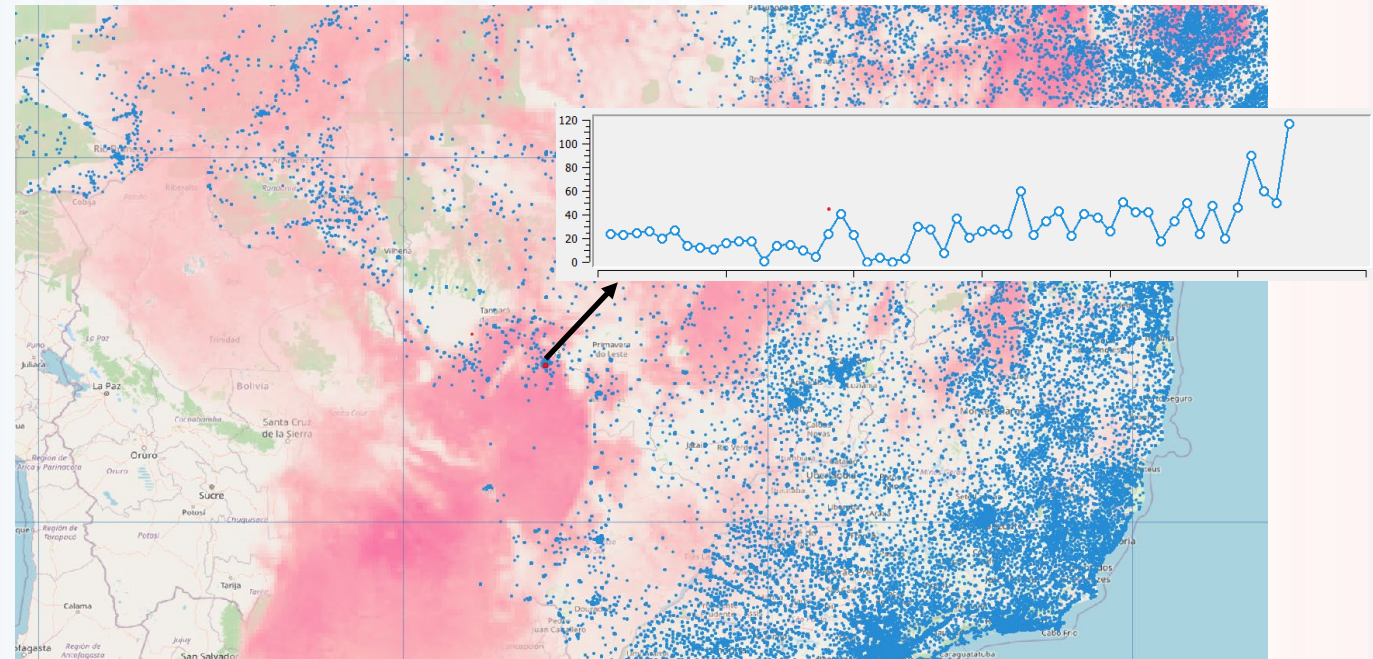
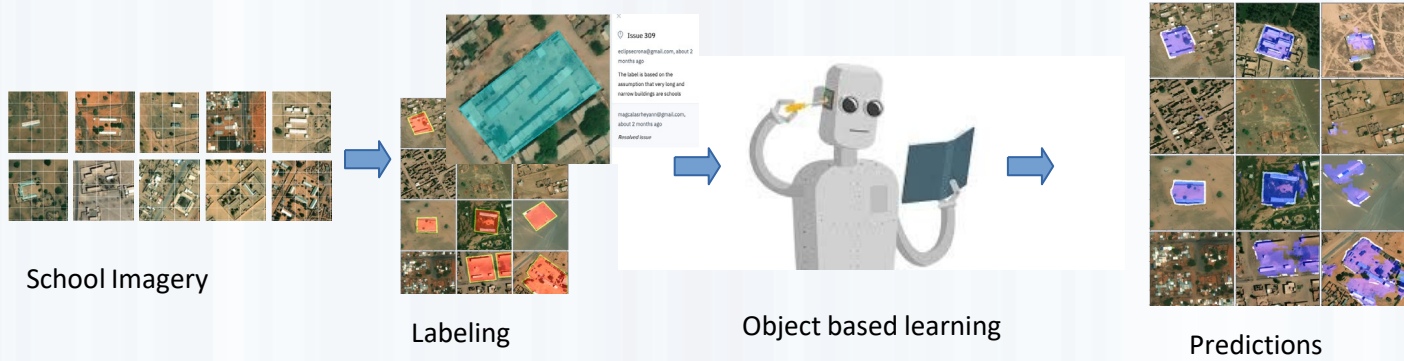
Using Satellite data and ML to monitor Dengue prevalence



Φ-lab

Case study: Infrastructure monitoring

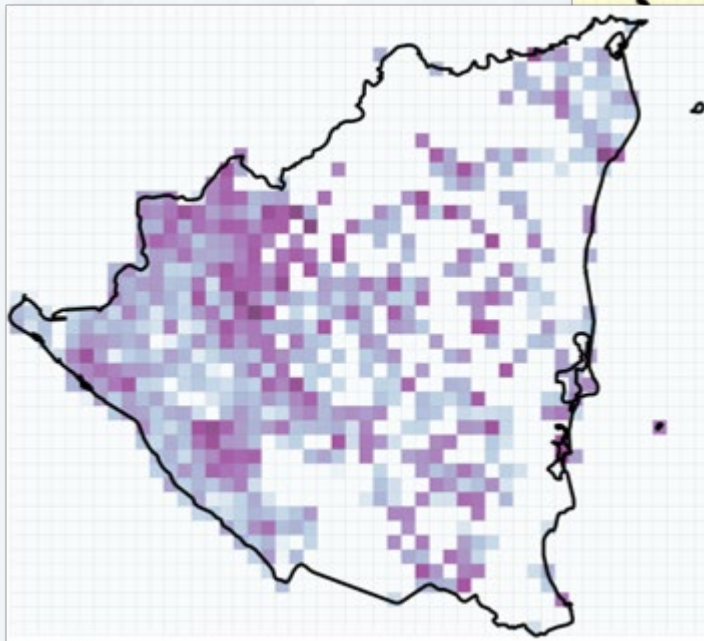
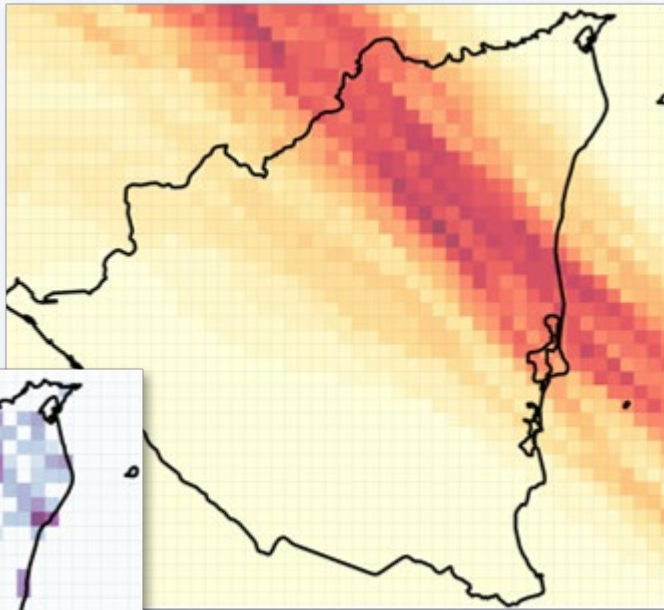
Using Satellite data and ML to detect schools and their status



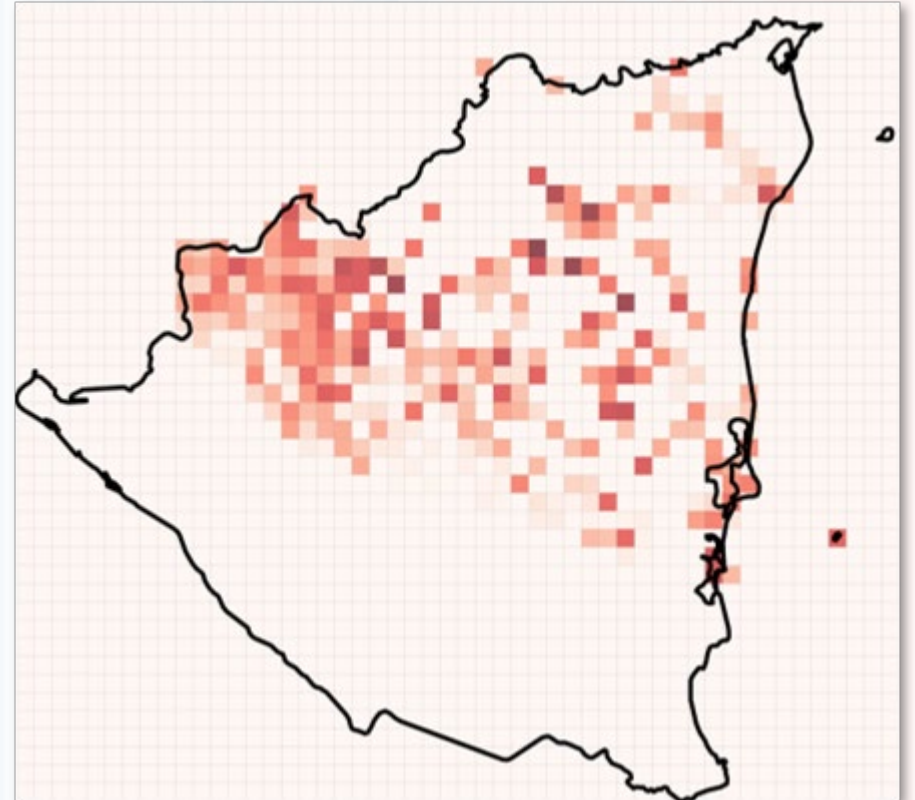
Case study: Emergency monitoring

Using Satellite data and ML for emergency monitoring

Exposure:
Probability of
forecasted
hurricane



Vulnerability:
Concentration of
children in poverty



**27,000 children
in poverty at risk**

Global Use Cases

The new, high-resolution, grid-level data in the database along with % and # of children exposed to individual and/or multi-hazards enables multiple use cases with both external and internal UNICEF stakeholders

UNICEF Strategic Plan

- To provide [baseline estimates](#) for number of children exposed to multiple hazards
- To guide [resource allocation](#) for climate, environment and DRR

Government support and UNICEF Country Programme Planning

- To provide tailored technical support to [national governments](#) for policy development, particularly NDCs
- To support [data-driven targeting](#), sector-specific and hot-spot analysis to support child-sensitive approach to adaptation
- Provide hazard data for CCRI-DRM, CLAC, Equity Analysis and any other sub-national risk analysis

Emergency Preparedness

- To provide [preparedness planning](#) estimates for individual hazards at sub-national level incl

Climate Financing

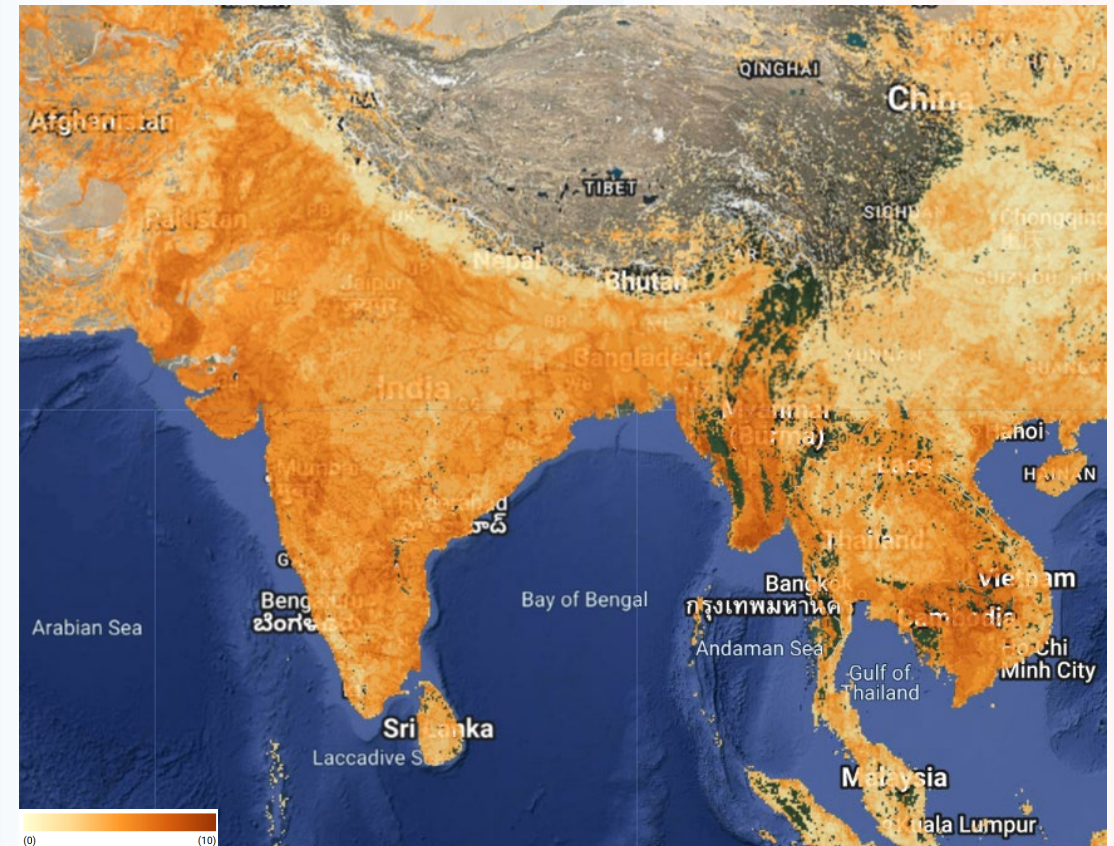
- To support applications for [climate financing](#) such as GCF

Intergovernmental Collaboration

- To influence key UNFCCC workstreams, [embedding data on children](#) into global frameworks and commitments

Global Advocacy on Climate Change and Children

- To update global Child Climate Risk Index (CCRI) with [cross-country analysis of child hazard and vulnerability](#)



Conclusion

The Technical Leap: We have successfully transitioned from national averages to high-resolution, pixel-level multi-hazard analysis. By integrating Earth Observation and WorldPop data, we can pinpoint overlapping risks down to a 100m grid.

Bridging the Data Gap with AI: Where ground data fails, Machine Learning allows us to build critical proxies. Furthermore, tools like Geosphere translate complex geospatial data into natural language, breaking down the literacy barrier for policymakers.

Operationalizing the Data: This high-resolution data empowers both internal and external stakeholders to move from observation to action.

- It forms the baseline for: Embedding child-centric data into National Determined Contributions (NDCs).

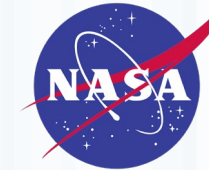
- Automating Emergency Preparedness and rapid "People in Need" estimates.

- Securing targeted Climate Financing (e.g., GCF proposals) for critical infrastructure like schools and health sites.

Data is the fuel, but child safety is the destination. By harnessing satellite data and AI, we ensure that no child remains invisible to the systems meant to protect them.

External Hazard Data Advisory Group

Voluntary external group has been established with experts from various fields, including climate science, data analysis, Earth observation and geospatial technology.



Thank you!
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