# Multi-Hazard Risk Assessment Using Open-Source Data and Tools for Understanding Climate and Disaster Risks

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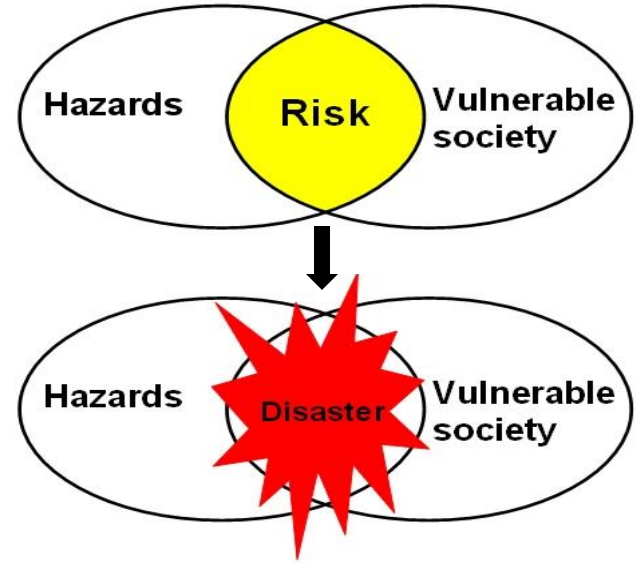
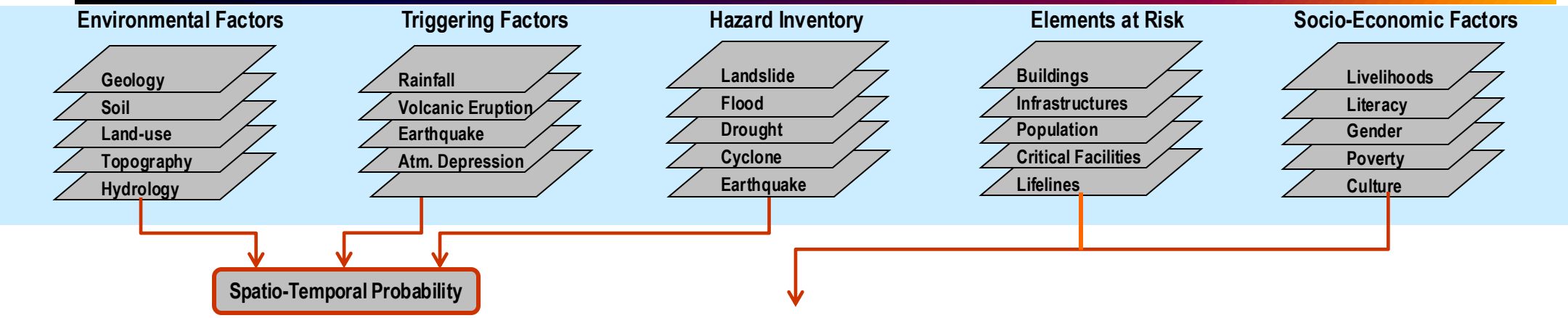
# Defining the ‘Disaster Risk’

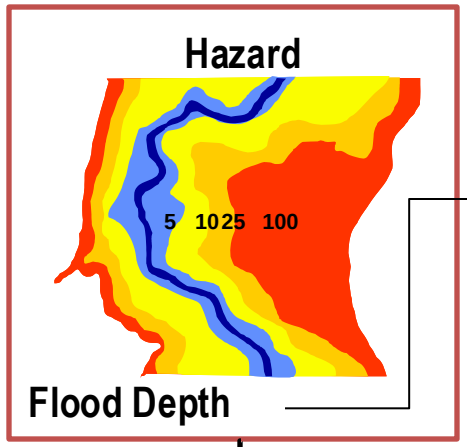


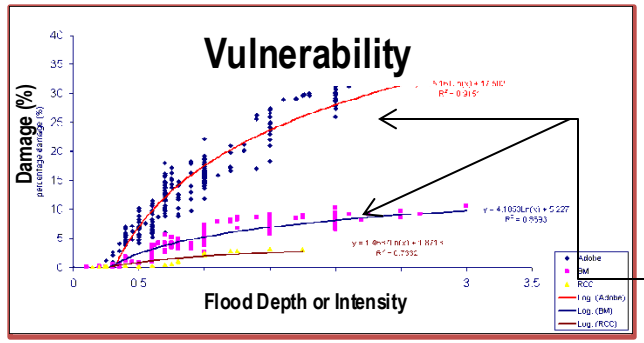
# Spatial Representation of Disaster Risk

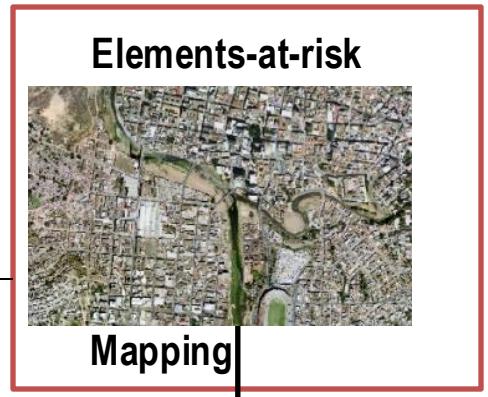


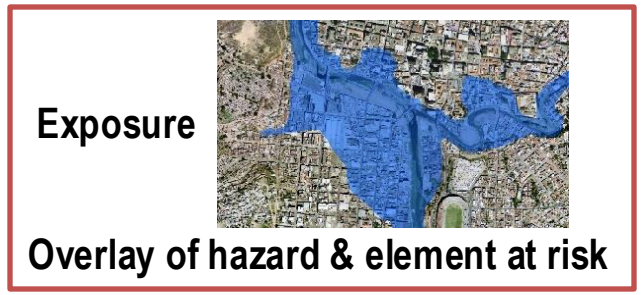

**Risk** = **Hazard** x **Vulnerability** x **Amount/Number**

(**Probability** of occurrence) (**Degree of losses** to elements-at-risk) (Quantification of **exposed** elements)



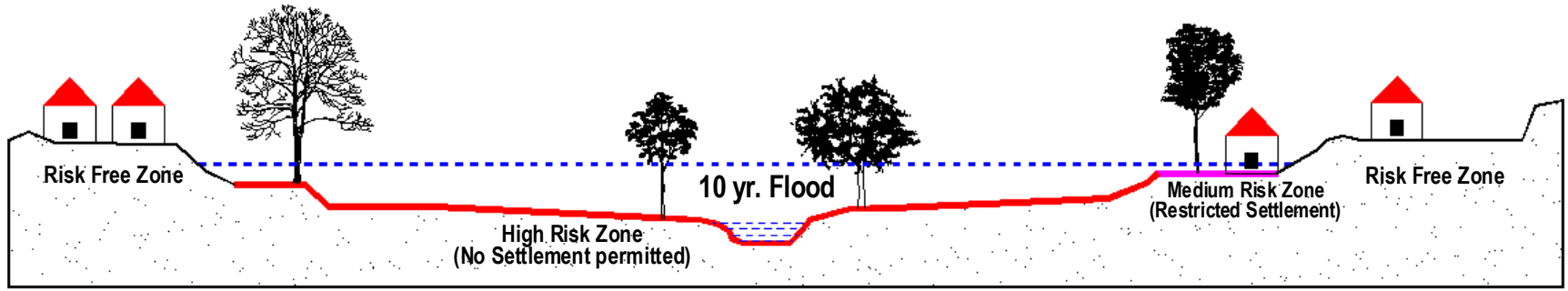

**Modeling + GIS**

**RS + GIS**

# Quantitative (Absolute) Risk Assessment - Asset

**What is the cost for risk zoning and relocation?**

**What is the insurance premium in different risk zones?**



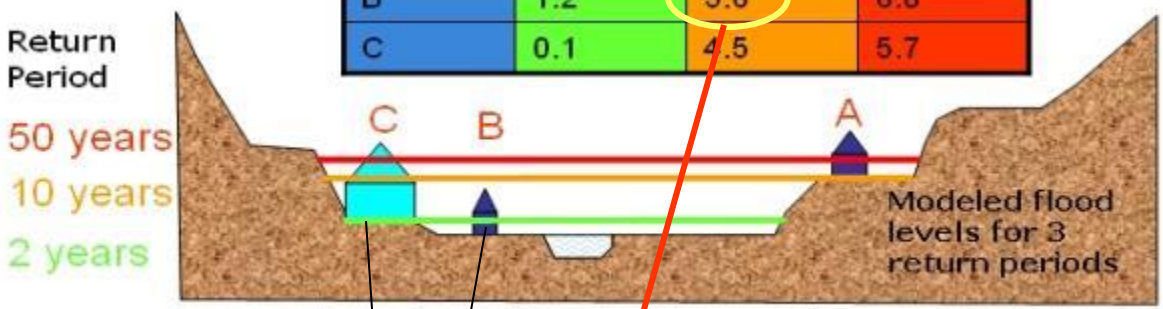

| Risk | = Hazard | x | Vulnerability | x | Amount (Building/Asset) | (Total Risk) |
|---|---|---|---|---|---|---|
| $Risk_{Lt}$ | = 0.1 | | x 0.5 | | x 100,000 | = 5,000 US$ |
| $Risk_{Mid}$ | = 0.1 | | x 1.0 | | x 100,000 | = 10,000 US$ |
| $Risk_{Rt}$ | = 0.1 | | x 0.2 | | x 100,000 | = 2,000 US$ |
| $Risk_{Total}$ | | | | | | = 17,000 US$ |

# Quantitative Risk Assessment - Probabilistic

**Hazard**

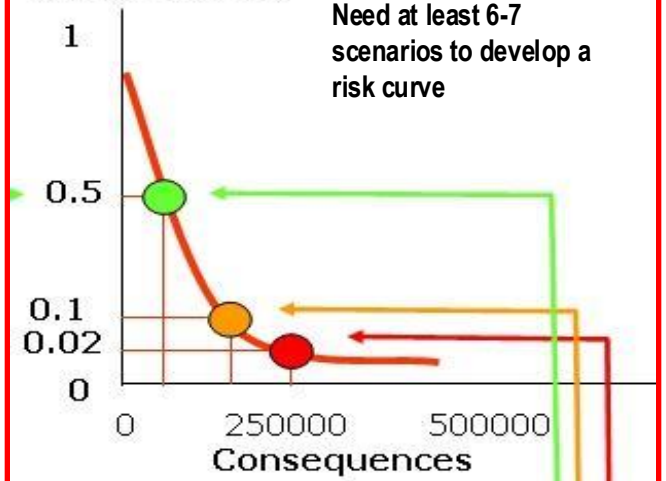
Water depth per return period

| House | 2 years | 10 years | 50 years |
|---|---|---|---|
| A | 0 | 0.8 | 2.0 |
| B | 1.2 | 5.6 | 6.8 |
| C | 0.1 | 4.5 | 5.7 |

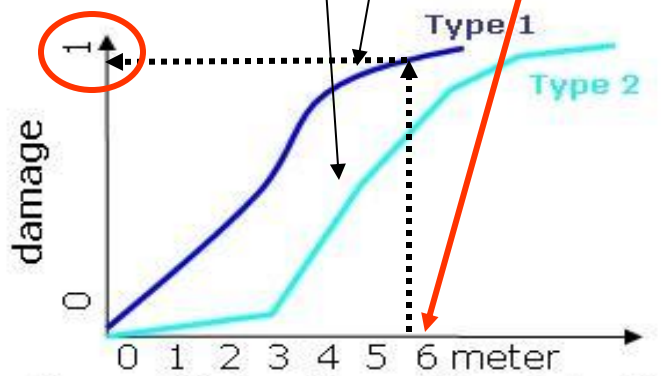



**Risk curve**

Need at least 6-7 scenarios to develop a risk curve




**Vulnerability curve**

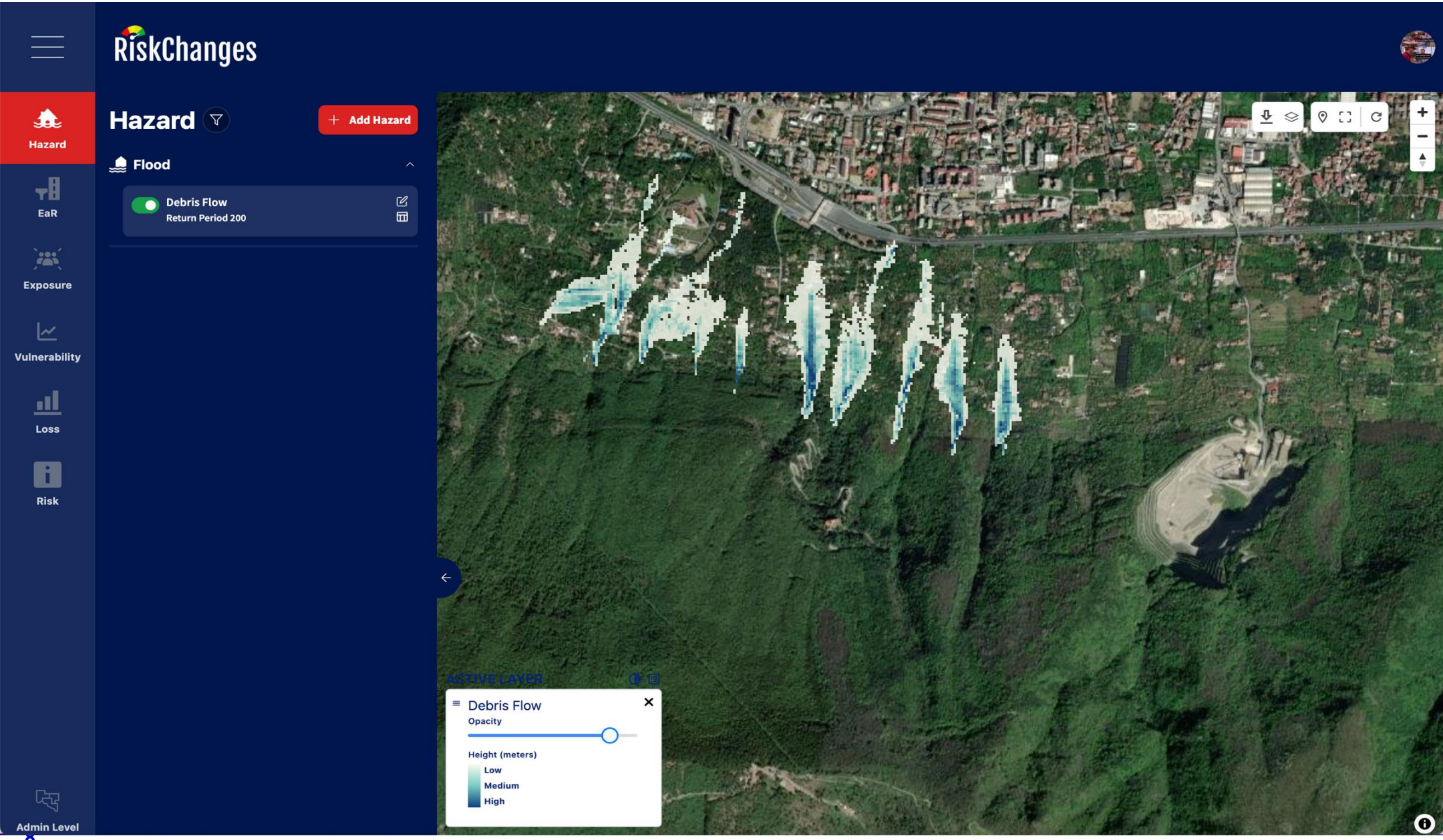



| | RP | PT | A | V | V*A | ΣV*A |
|---|---|---|---|---|---|---|
| A | 2 | 0.5 | 100000 | 0 | 0 | 20000 |
| B | 2 | 0.5 | 50000 | 0.2 | 10000 | |
| C | 2 | 0.5 | 200000 | 0.05 | 10000 | |
| A | 10 | 0.1 | 100000 | 0.1 | 10000 | 160000 |
| B | 10 | 0.1 | 50000 | 1 | 50000 | |
| C | 10 | 0.1 | 200000 | 0.5 | 100000 | |
| A | 50 | 0.02 | 100000 | 0.4 | 40000 | 250000 |
| B | 50 | 0.02 | 50000 | 1 | 50000 | |
| C | 50 | 0.02 | 200000 | 0.8 | 160000 | |



Courtesy: ITC

# RiskChanges: www.riskchanges.org - A Case Study on Debris Flow, Flood and Landslide



# Risk Reduction Alternative 3 – Relocation

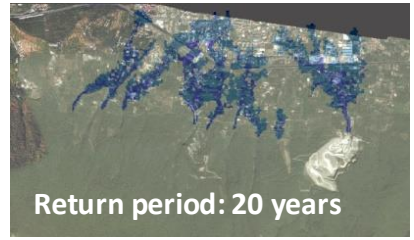
**Debrisflow (DF) hazard**
**Impact pressure (IP)**


DF_IP_20_A0

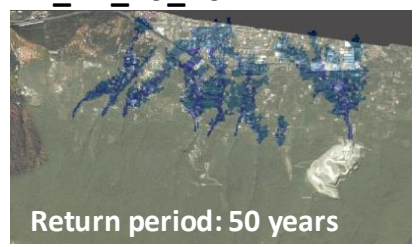

DF_IP_50_A0


DF_IP_100_A0

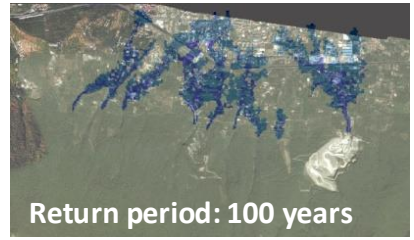
**Flashflood (FL) hazard**
**Water depth (DE)**




FL_DE_20_A0




FL_DE_50_A0

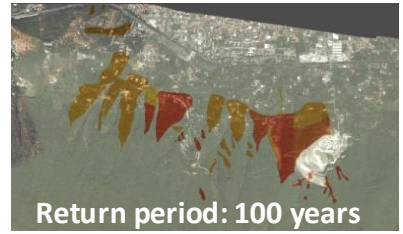



FL_DE_100_A0

**Landslide (LS) hazard**
**Spatial probability (SP)**


LS_SP_20_A0


LS_SP_50_A0




LS

**Since relocation doesn't affect the hazard the same hazard maps for the current situation are used for alternative 3: Relation**

# Risk Reduction Alternative 2 – Nature Based Solutions

**Debrisflow (DF) hazard**
**Impact pressure (IP)**


DF_IP_20_A0


DF_IP_50_A0


DF_IP_100_A0

**Flashflood (FL) hazard**
**Water depth (DE)**


FL_DE_20_A0


FL_DE_50_A0


FL_DE_100_A0

**Landslide (LS) hazard**
**Spatial probability (SP)**


LS_SP_20_A0


LS_SP_50_A0


LS_SP_100_A0

# Risk Reduction Alternative 1 – Engineering Measures

**Debrisflow (DF) hazard**
**Impact pressure (IP)**


**DF_IP_20_A0**


**DF_IP_50_A0**


**DF_IP_100_A0**

**Flashflood (FL) hazard**
**Water depth (DE)**


**FL_DE_20_A0**


**FL_DE_50_A0**


**FL_DE_100_A0**

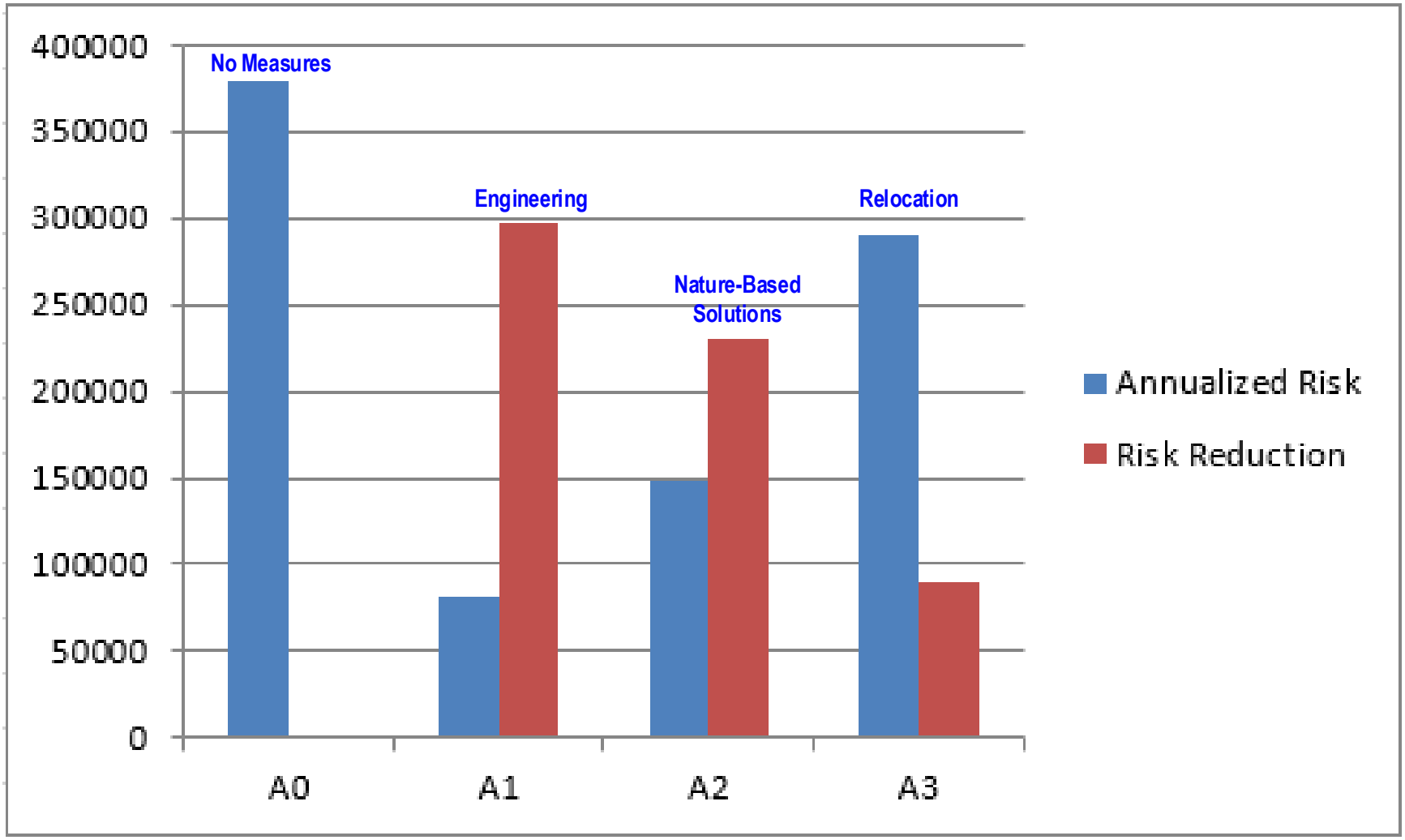
**Landslide (LS) hazard**
**Spatial probability (SP)**


**LS_SP_20_A0**

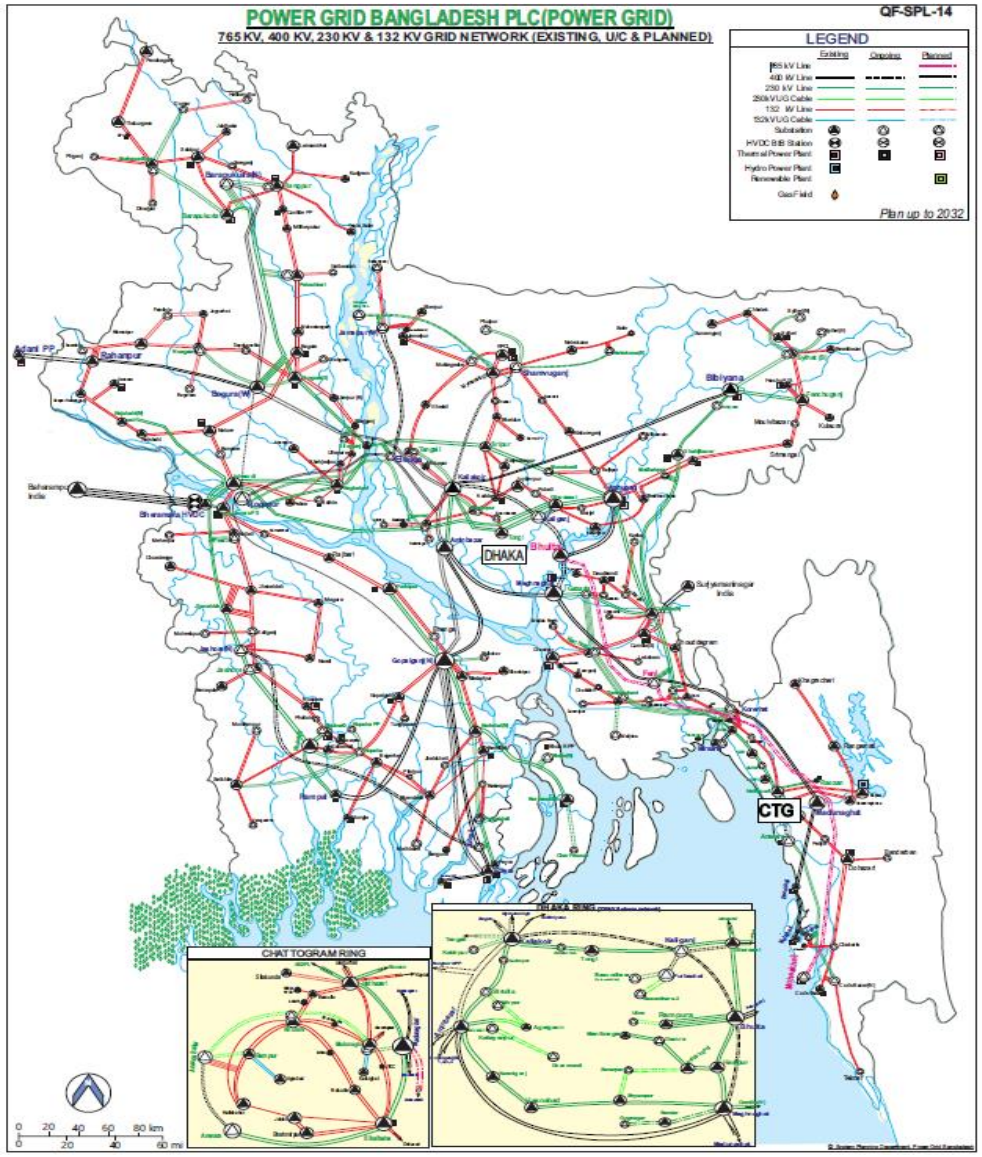

**LS_SP_50_A0**


**LS_SP_100_A0**

# Risk Reduction from the Three Alternatives



# Analysis of Impacts of **Climate Change** in **Power Sector** in Bangladesh




*Source: BPDB*

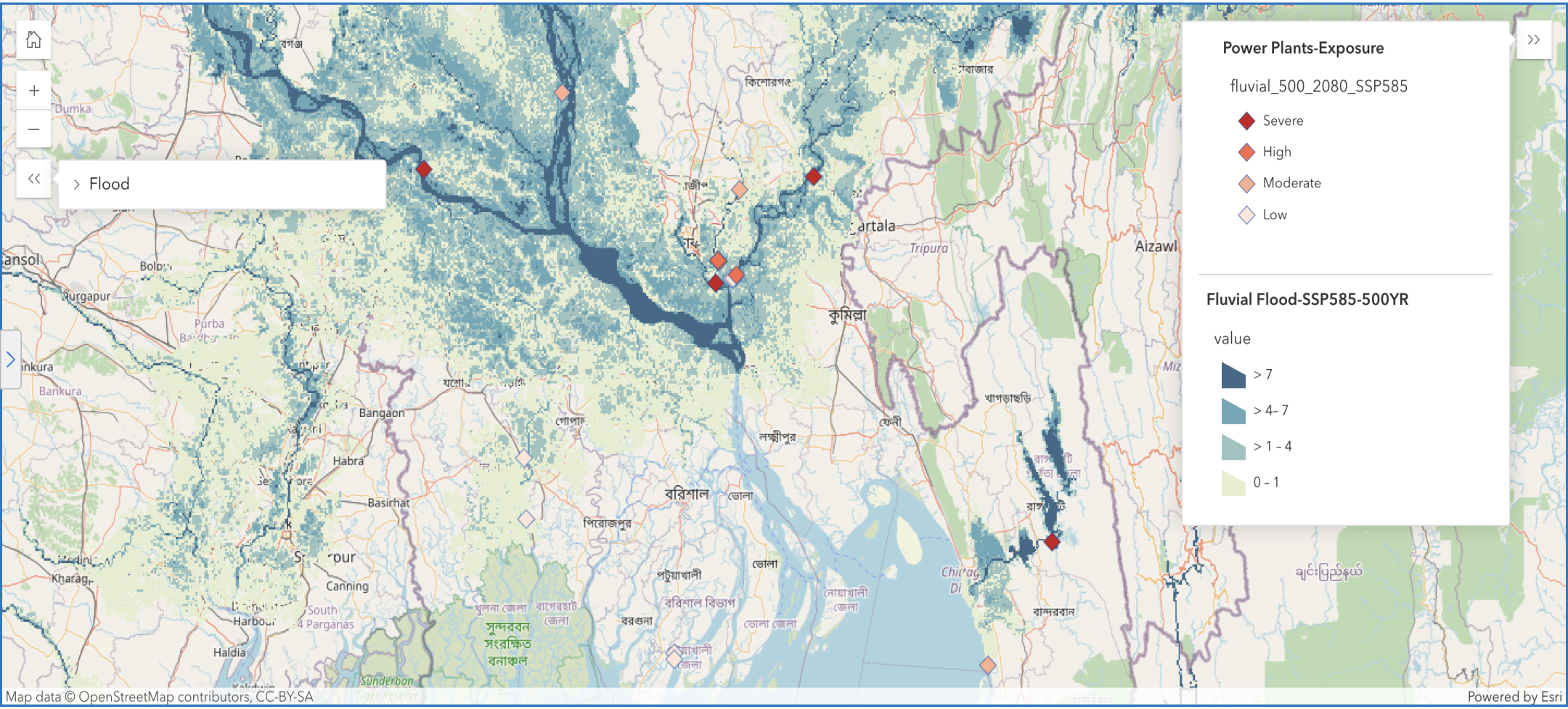
1. Power demand expected to grow by. 5.7% per annum through 2050

2. Generation capacity required to serve the demand 110.8 GW, Existing capacity = 27.7GW

3. Transmission Network - Mostly comprising of 132kV, 230 kV and 400 kV network,

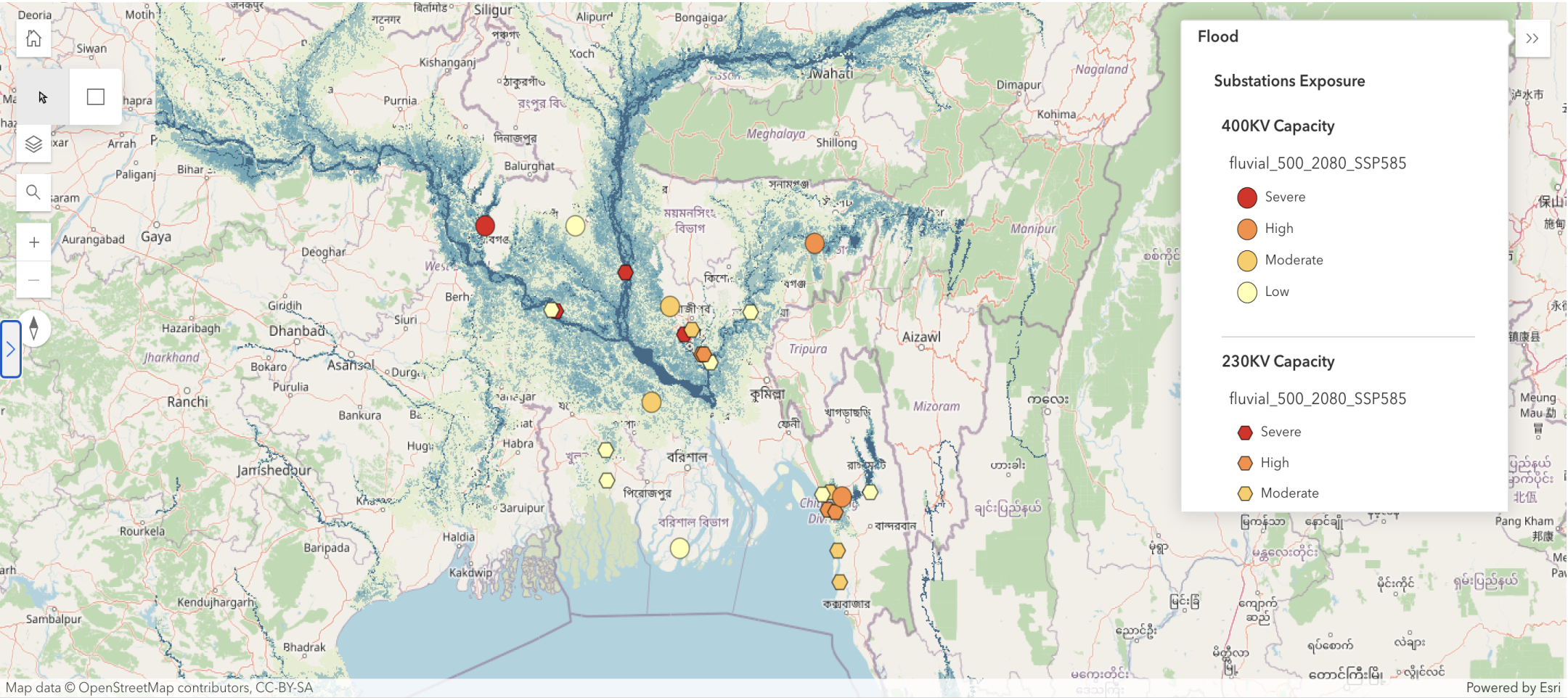
# Exposure of **Power Plants** to 500 yr **Riverine Flood** for SSP 5-8.5

PowerPlants Exposure to Riverine Flood



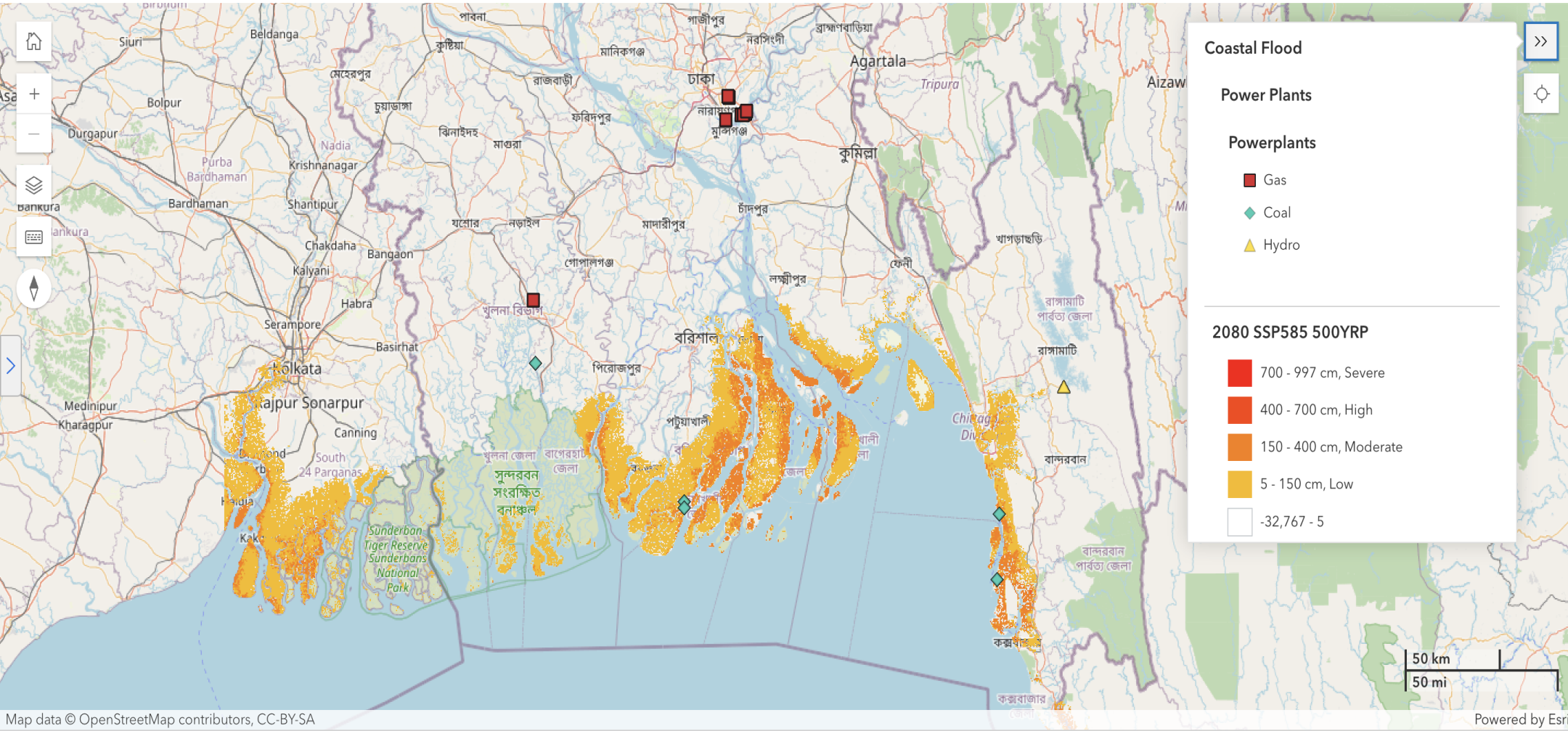
# Exposure of **Sub-Stations** to 500 yr **Riverine Flood** for SSP 5-8.5

Substations Exposed to River Flood



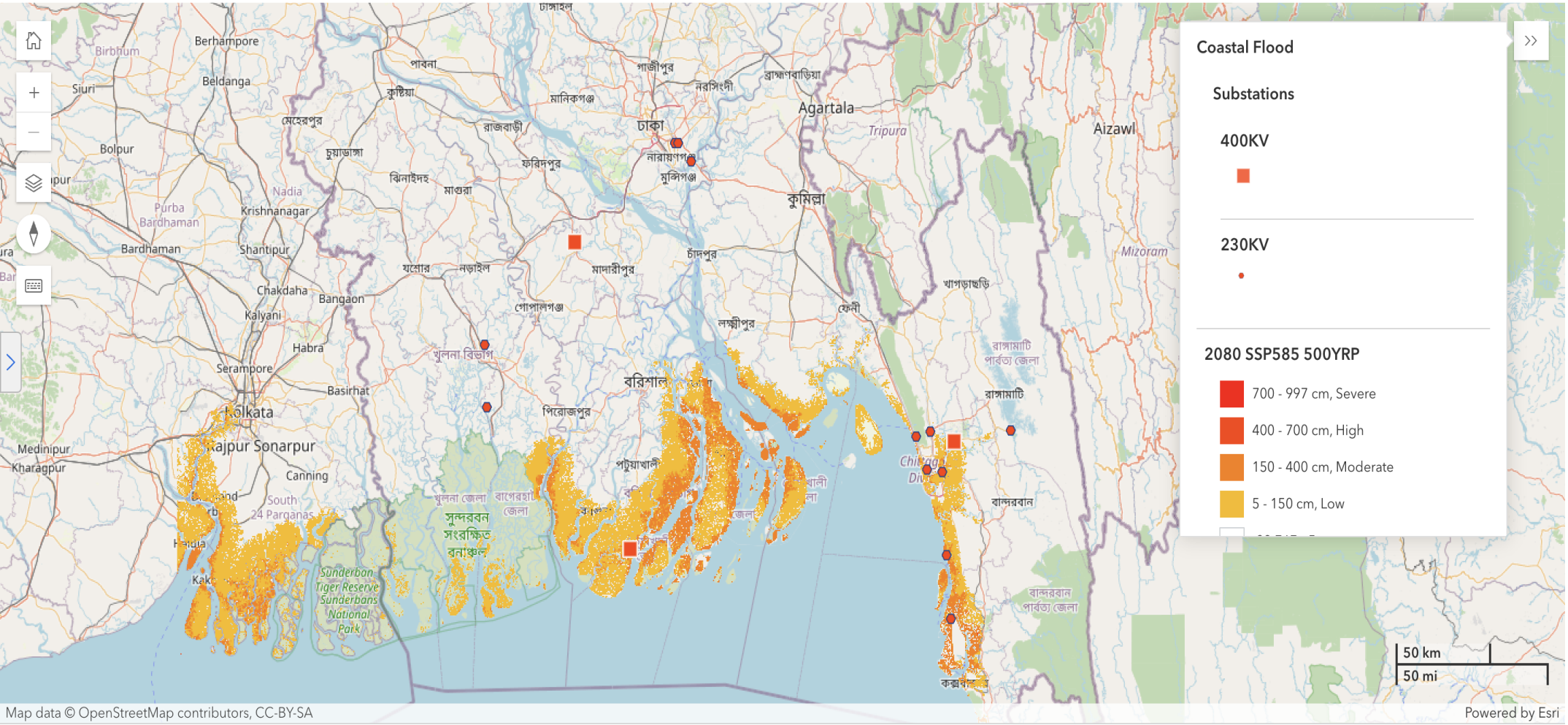
# Exposure of **Power Plants** to 500 yr **Coastal Flood** for SSP 5-8.5

Powerplants Coastal Flood Exposure



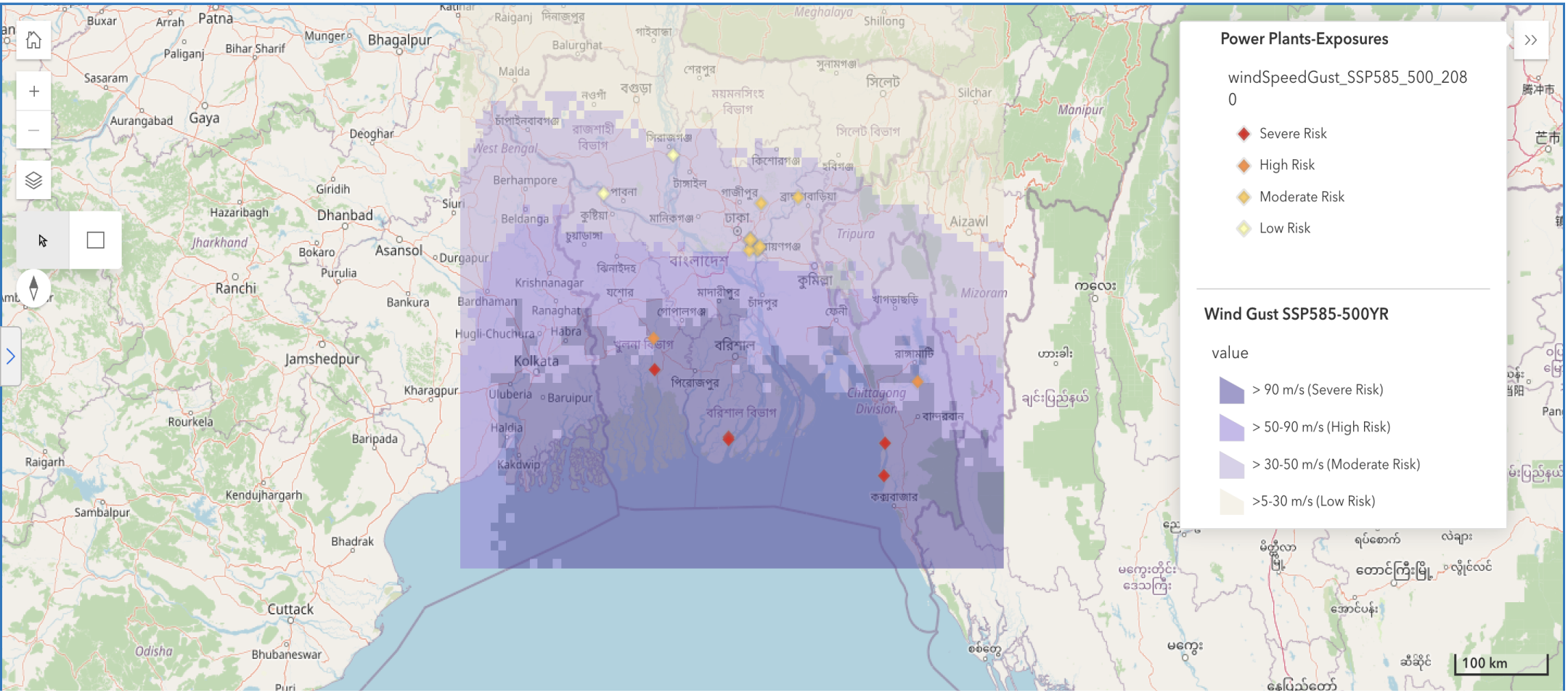
# Exposure of **Sub-Stations** to 500 yr **Coastal Flood** for SSP 5-8.5

Substations Coastal Flood Exposure



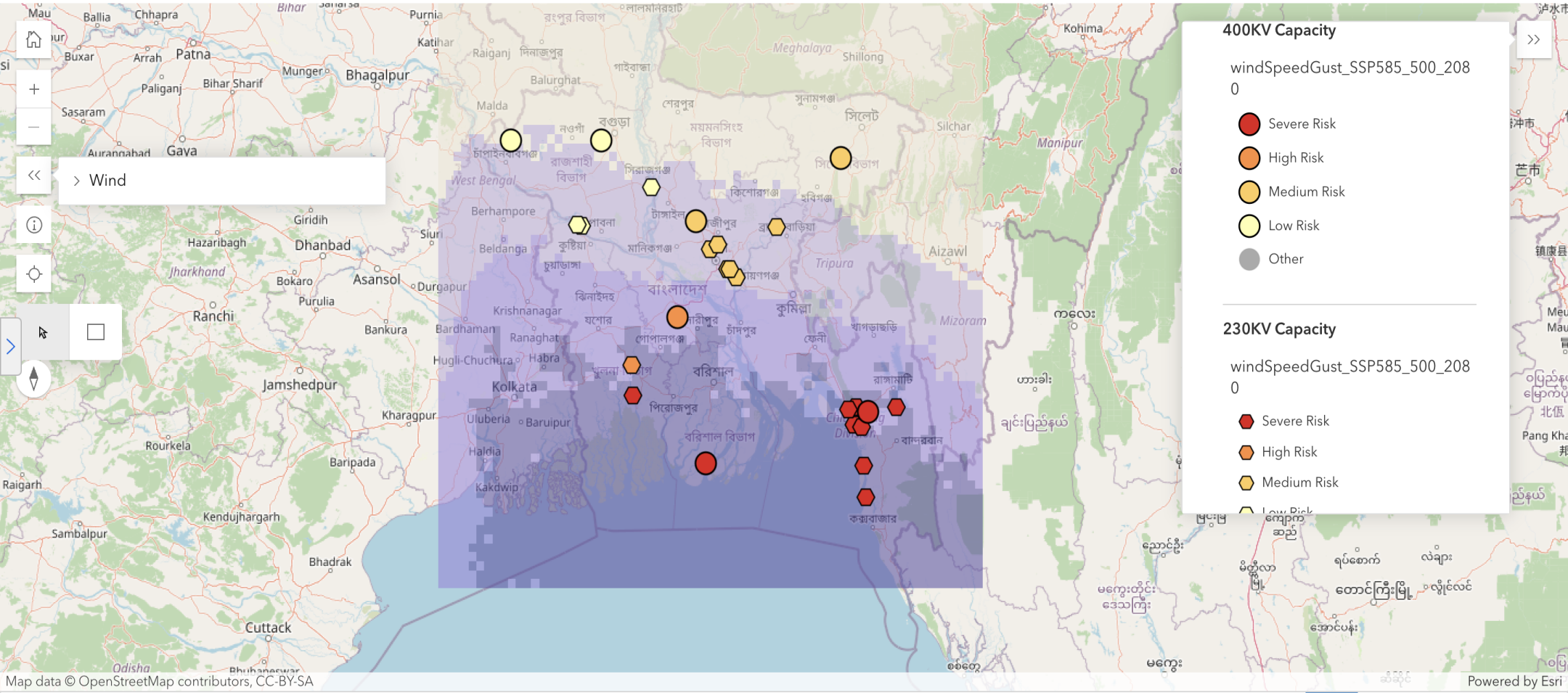
# Exposure of **Power Plants** to 500 yr **Wind Gust** for SSP 5-8.5

Power Plants Exposure to Wind Gust



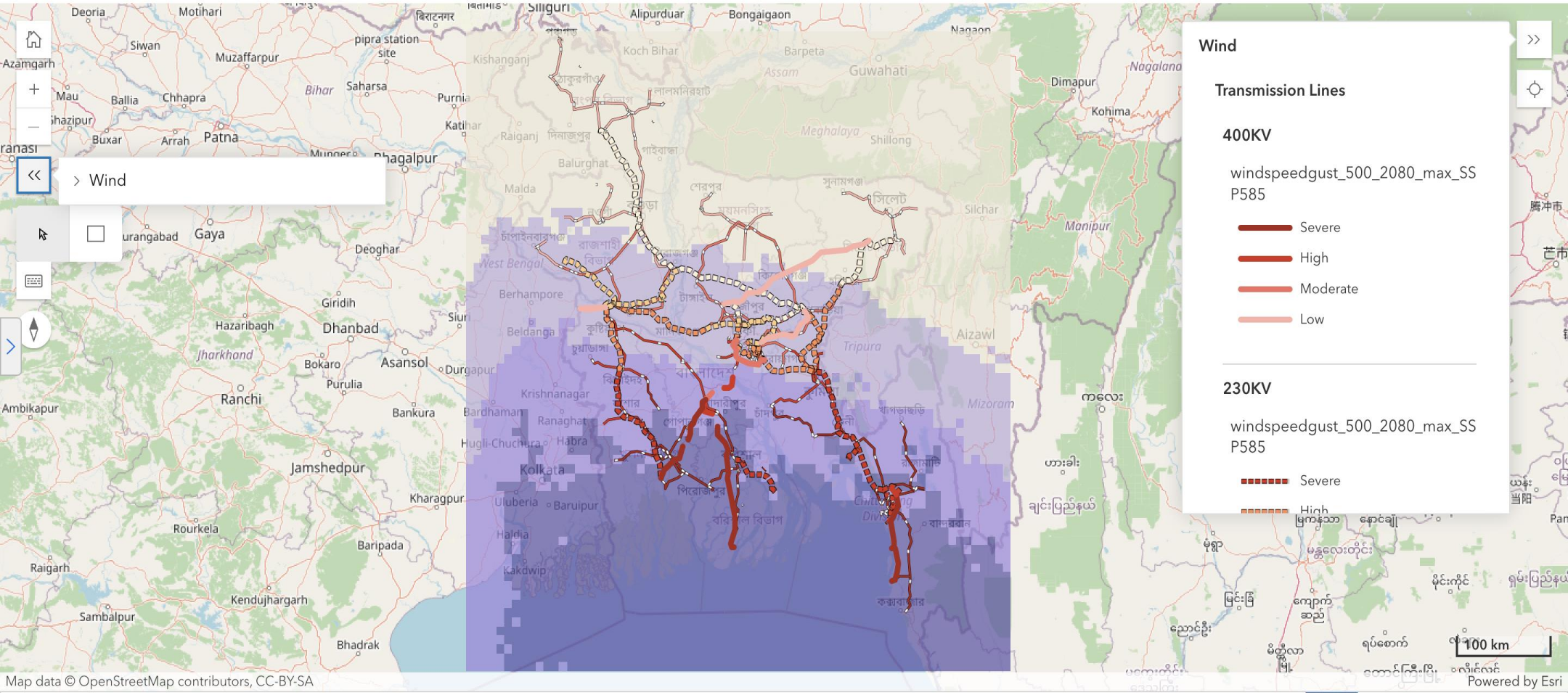
# Exposure of **Sub-Stations** to 500 yr **Wind Gust** for SSP 5-8.5

Substations Exposure to Wind Gust



# Exposure of **Transmission Lines** to 500 yr **Wind Gust** for SSP 5-8.5

Transmission Lines Exposure to Wind Gust



# Thank you for your kind attention