# Building Capacity for Rapid Financial Response to Natural Hazards: Floods in S. and S. E. Asia

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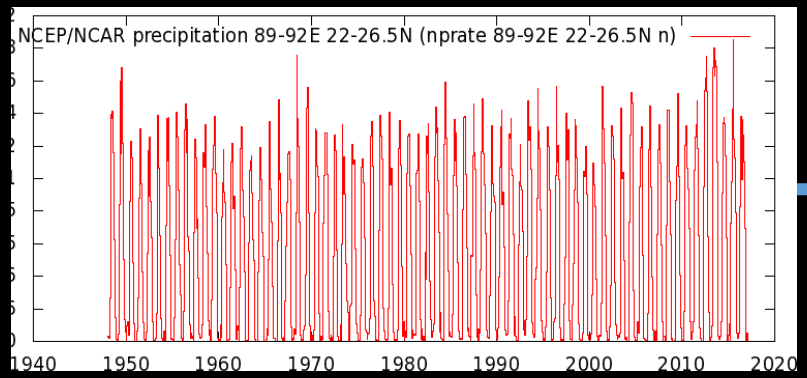
# Research Context

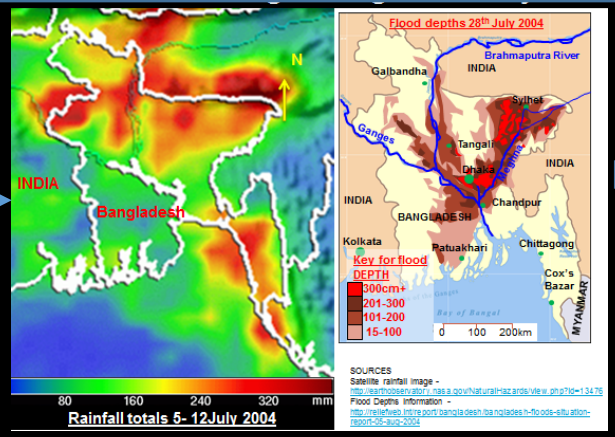
- The limited ability of a government to rapidly allocate funds for effective response immediately after disasters is a potential bottleneck.
- Can  satellite remote sensing data, as well as ground based information be used to do a rapid assessment of the economic implications at a country scale for a catastrophic flooding event?
- Can an estimate of the return period of  such events be made using ancillary hydrometeorological data?
- Can financial instruments for buffering the country from such catastrophic risks be designed using an index tied to the trigger event, and loss estimates linked to it?
- Can such a procedure be tested using Thailand and Bangladesh as context?

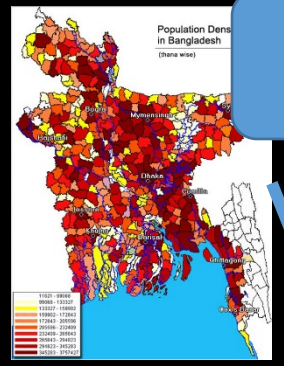
# Multi-Information fusion: Rain to Flood Loss



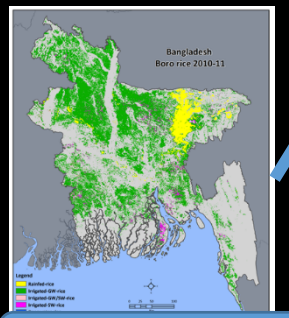

Appropriate Rainfall Statistic → Return Period Analysis

Damaging Events
Rain Statistic, Flooded Area, Duration, Depth

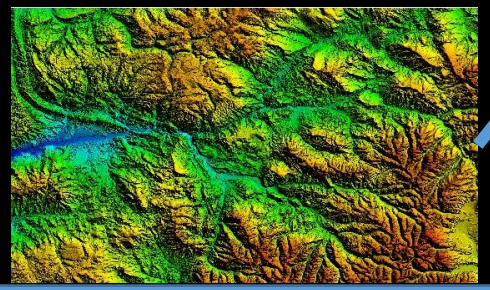



Population, Infrastructure




Crops, NDVI



Digital Elevation Model

**Comparison of Losses Resulting from Recent Floods**

| Item | 1988 | 1998 | 2004 | 2007 |
|---|---|---|---|---|
| Inundated area of Bangladesh (%) | 60 | 68 | 38 | 42 |
| People affected (million) | 45 | 31 | 36 | 14 |
| Total deaths (people) | 2,300 | 1,100 | 750 | 1110 |
| Livestock killed (nos.) | 172,000 | 26,564 | 8,318 | 40,700 |
| Crops fully/partly damaged (million ha) | 2.12 | 1.7 | 1.3 | 2.1 |
| Rice production losses (million tons) | 1.65 | 2.06 | 1.00 | 1.2 |
| Roads damaged (km) | 13,000 | 15,927 | 27,970 | 31,533 |
| Number of homes fully/partly damaged (million) | 7.2 | 0.98 | 4.00 | 1.1 |
| Total losses in Tk (billion) | 83 | 118 | 134 | 78 |
| in US$ (billion) | 1.4 | 2.0 | 2.3 | 1.1 |

*Source: World Bank (2007)*

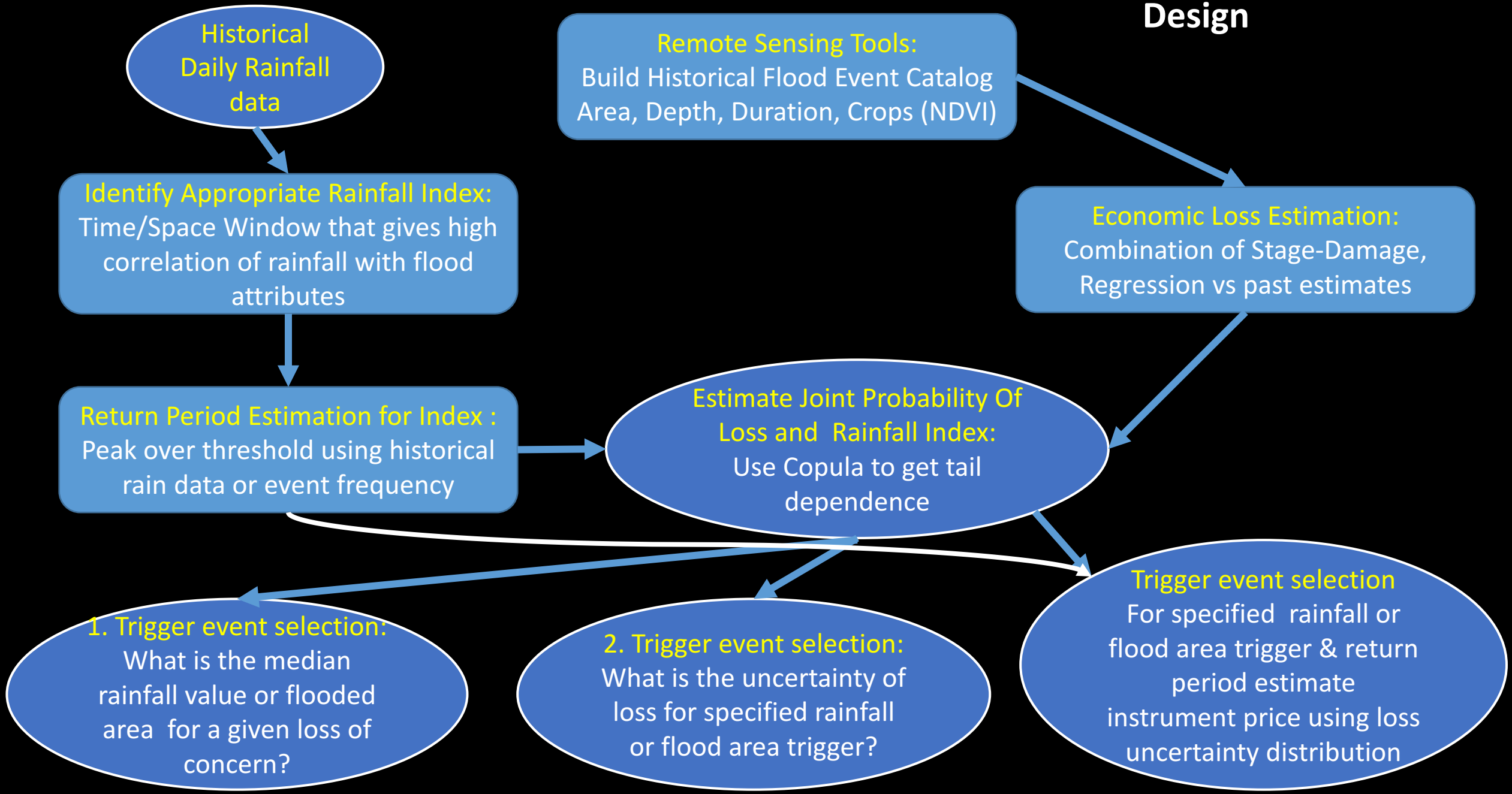
*Damage to infrastructure goes higher even with flood of lower magnitude*

Flood Area, Duration, Inundation Depth = Losses

# Strategy

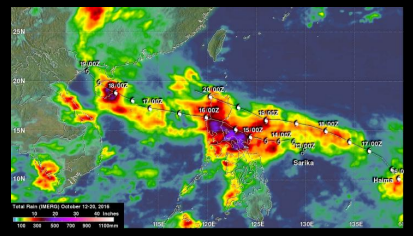
- Explore state of the art Remote Sensing tools for suitability to identify flood area, depth, duration; habitation, and crops. Recommend an approach that leverages older and newer sensors.
  - Build a library of events and develop/demonstrate extraction process
- Develop rapid economic loss estimation to get magnitude right.
- Proxy: Identify space-time windows for rainfall that are best correlated with losses.
- Use resulting rainfall index to estimate event return periods, AND link to potential event loss.
- Uncertainty analysis as far as possible.

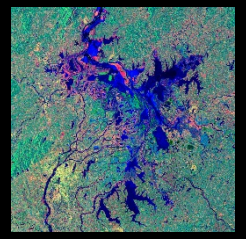
# Parametric Instrument Design



# Rapid Response Application

Event in Progress





| Day | Cumulative Rain Amount (mm) | Flooded Area | Estimated Loss (M$) |
|---|---|---|---|
| 1 | 20 | 0 | 0 |
| 2 | 30 | 0 | 0 |
| 3 | 120 | 20000 | 375 (200 to 450) |
| 4 | 130 | 16000 | 380 (210 to 500) |
| 5 | 220 | 120000 | 750 (300 to 1250) |
| 6 | 225 | 120000 | 750 (320 to 1200) |

Trigger Event 5 day rainfall with 200mm rain, nominal return period = 100 years

Areally averaged rainfall is monitored
Flood area also monitored from remote sensing
Losses should be based on actual sub-area of country flooded

# Results from Examples and Thoughts →

- Remote sensing: Identification of
  - flooded area, flooding depth, crop loss proxy, flood duration
    - Integration of loss estimation directly into Google Earth Engine
    - Use Estimated loss directly as a trigger
- Rainfall proxy based return period and loss estimation
  - Non-unique relation to any specific duration
  - Flood duration, area extremes or loss relation
  - Return period estimates
  - Event based analyses may be needed
  - Streamflow data as an index
  - Estimate return period of loss as trigger using proxies
- Rapid Economic Loss estimation
  - Formula based ~ right order of magnitude
  - Statistical Estimation