Introduction to Probabilistic Risk Assessment

Risk Definition

RISK

HAZARD

X

EXPOSURE

X

VULNERABILITY
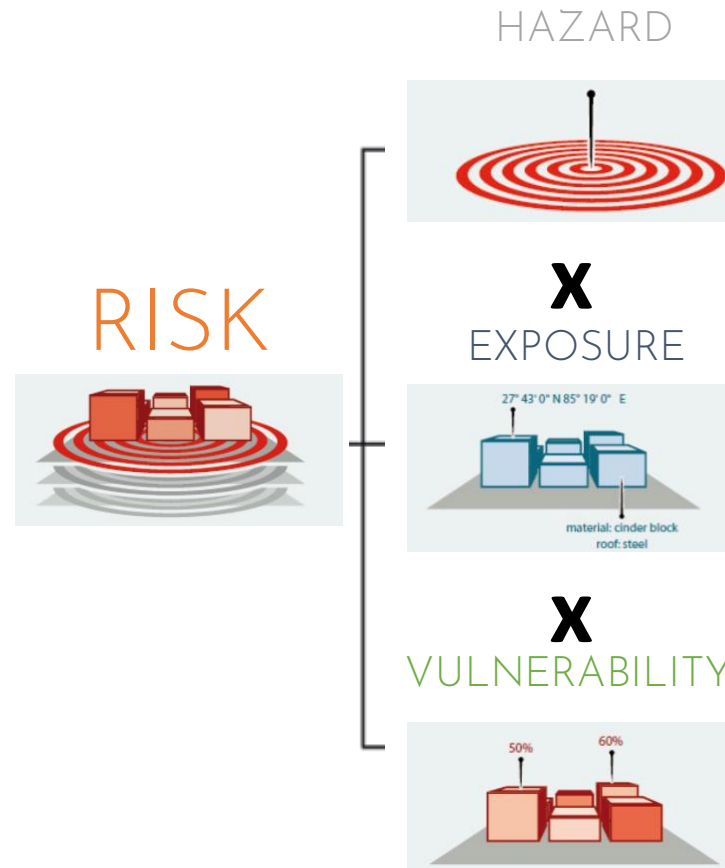
Risk Assessment methodologies

1. Historical analysis

2. Scenario analysis (The exercise of session 1)

   - geographical distribution of the severity of loss due to the occurrence of a postulated event (i.e., Scenario)

3. Probabilistic analysis

   - Risk is defined as the likelihood (i.e., probability) of sustaining a certain level of loss during a given time period.

   - Risk = Probability of an event occurring x impact of the event

Volta Flood and Drought Management
WORLD METEOROLOGICAL ORGANIZATION
A B V A
Global Water Partnership West Africa
cima RESEARCH FOUNDATION
ADAPTATION FUND

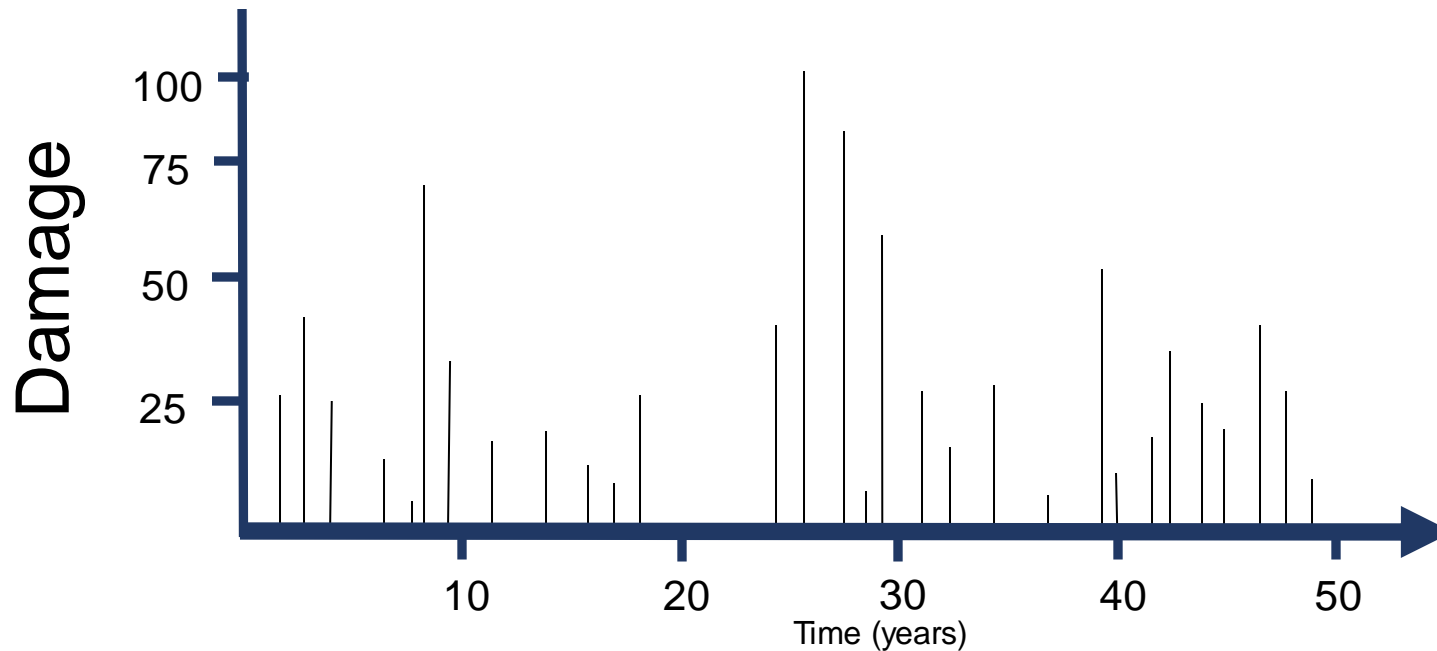# Probabilistic Flood Risk Assessment

Considers a large number of possible scenarios, their likelihood and associated impacts

Risk Metrics

- **Average Annual Loss (AAL)** is the expected loss per year, averaged over many years.

- **Probable Maximum Loss (PML)** describes the loss that could be expected corresponding to a given likelihood, expressed in terms of annual probability of exceedance or its reciprocal, the return period.
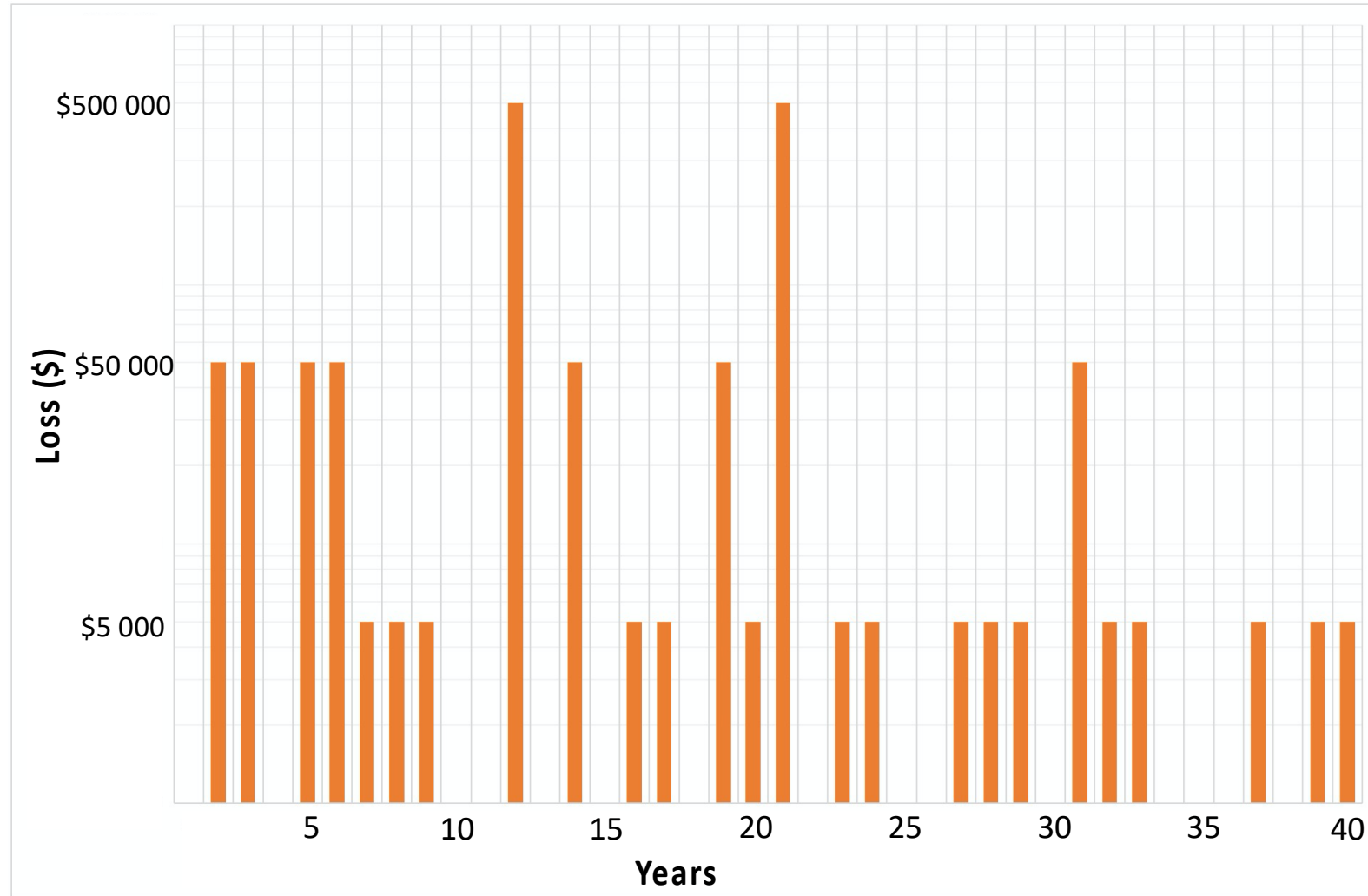
Task 1:

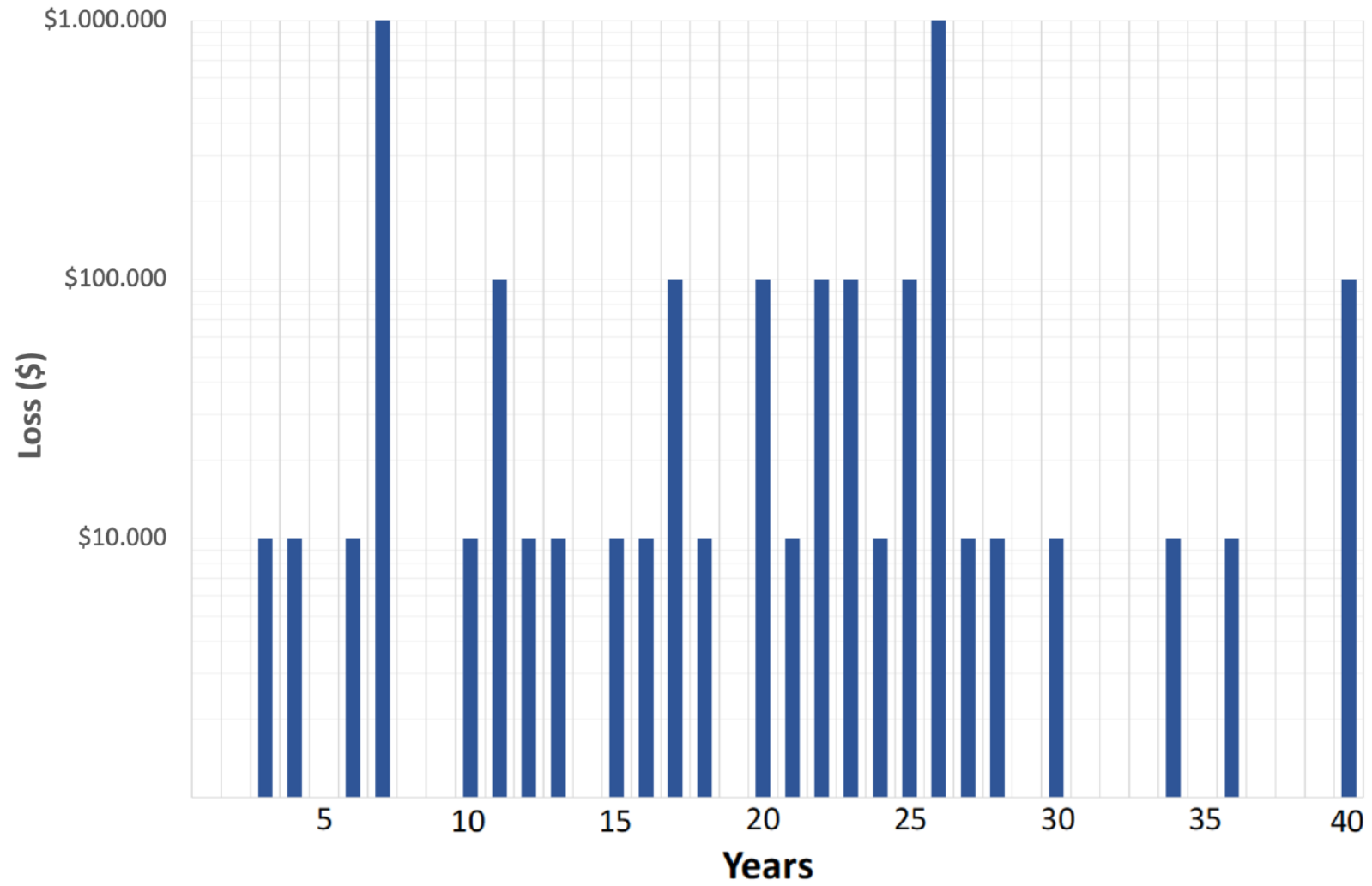> AAL= is the expected loss per year, averaged over many years.

Suppose to have the time-series of the damages in two Region of the country

- Compute the Average Annual Loss, very likely events, medium likely and unlikely for the two time-series
- Derive 3 key messages and compare the results, what difference do you notice among the two time- series?

- Time: 15 min

Disaster Loss time series n. 1

Disaster Loss time series n. 2

TASK 1

Question 1: Extract the following information from the graph:

AAL: is the expected loss per year, averaged over many years

	Series 1	Series 2
AAL		
Most frequent/Very likely damage (once every 2-3 years)		
Frequent/Medium likely damage (once every 5-10 years)		
Less frequent/unlikely damage (once every 20-30 years)		

Question 2: Observe the damage time series and derive 3 key messages and comment on the comparison between AAL of series 1 and series 2

1. Key message 1

   _____
   _____
   _____

2. Key message 2

   _____
   _____
   _____

3. Key message 3

   _____
   _____
   _____

Volta Flood and Drought Management

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ABV VOLTA BASIN AUTHORITY

Global Water Partnership West Africa

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$$AAL\ series\ 1 = 35{,}750\ \$$$

$$AAL\ series\ 2 = 71{,}500\ \$$$

Disaster Loss time series n. 1
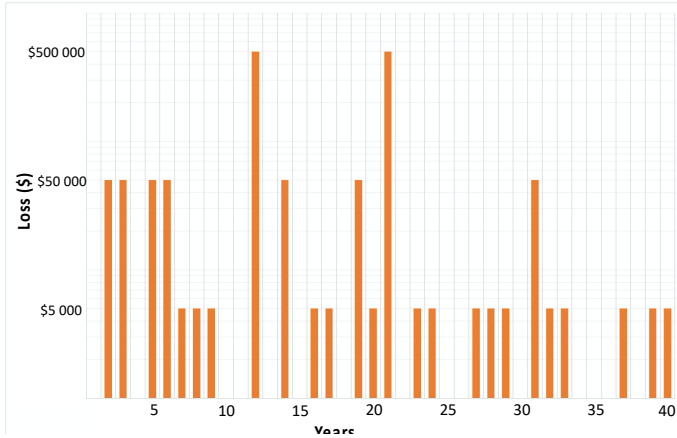
Disaster Loss time series n. 2
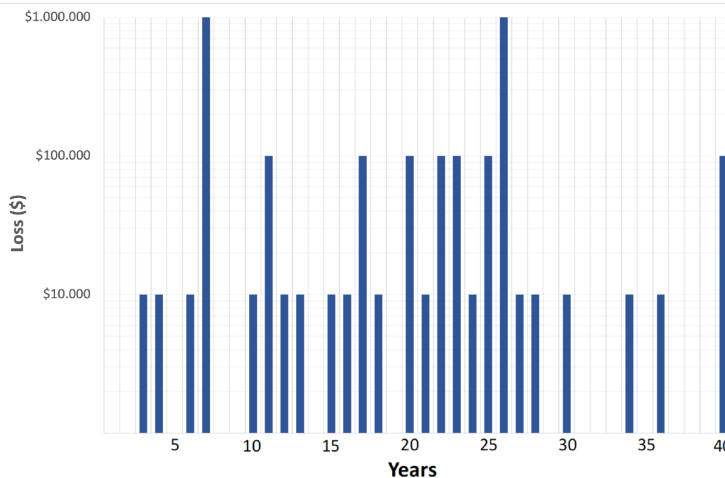
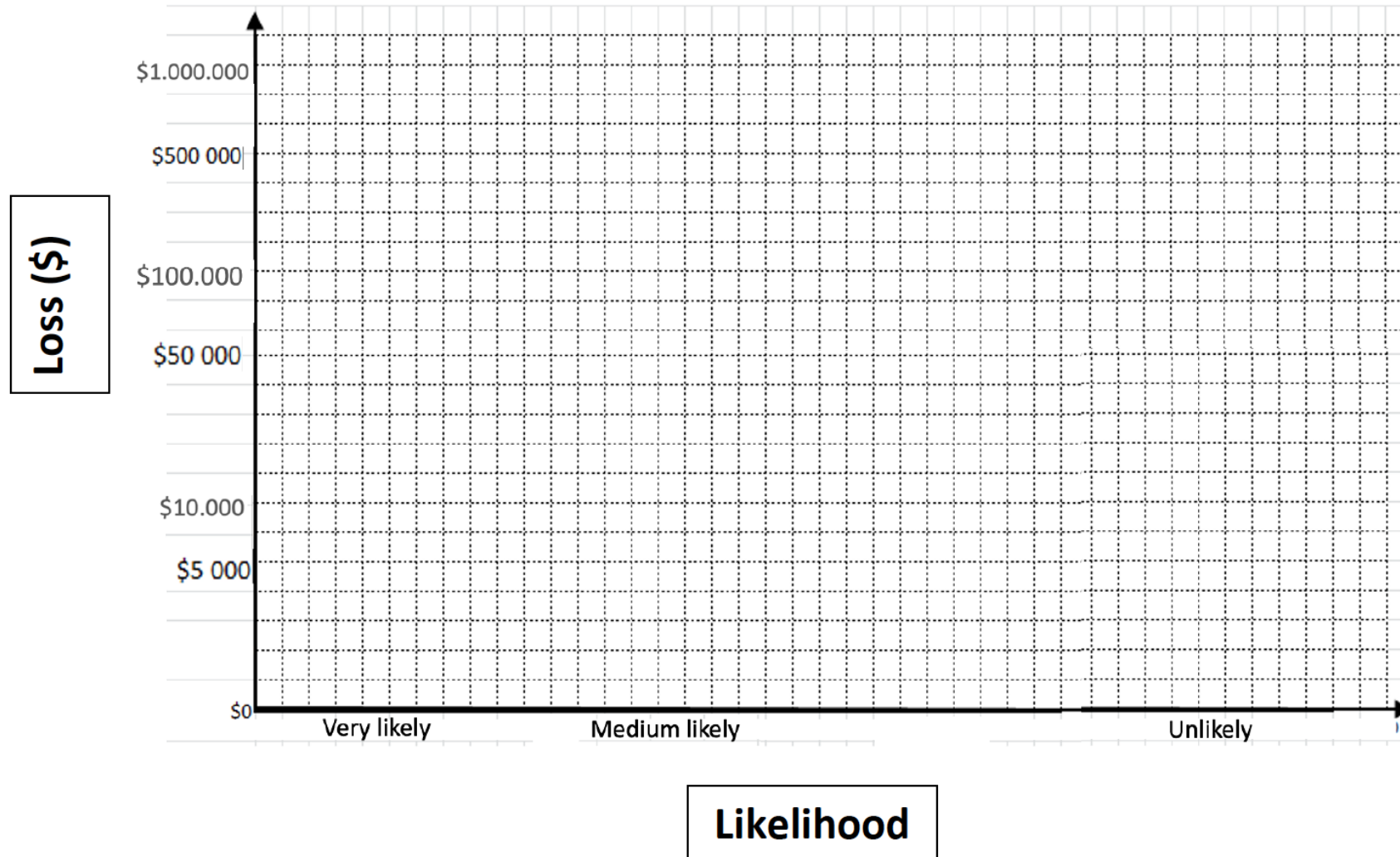|	Loss	
	Series 1	**Series 2**
Very likely	$ 5,000	$ 10,000
Likely	$ 50,000	$ 100,000
Unlikely	$ 500,000	$ 1,000,000

Task 2:

(PML) describes the loss that could be expected corresponding to a given likelihood

Suppose to have the time-series of the damages in two Regions of the country
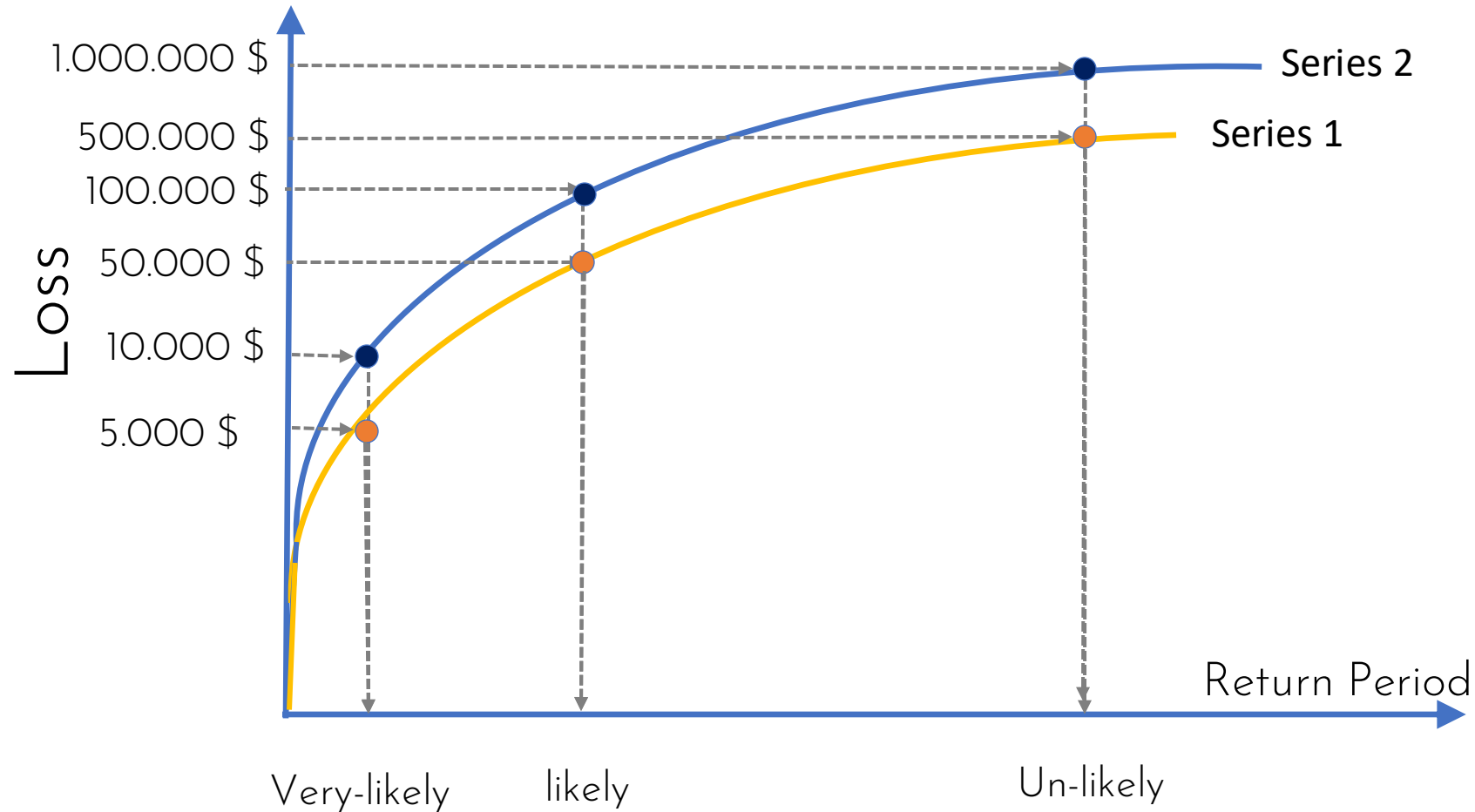
- Plot over the curve the expected losses and the likelihood for the two time-series

- Comment the results

- Time: 10 min

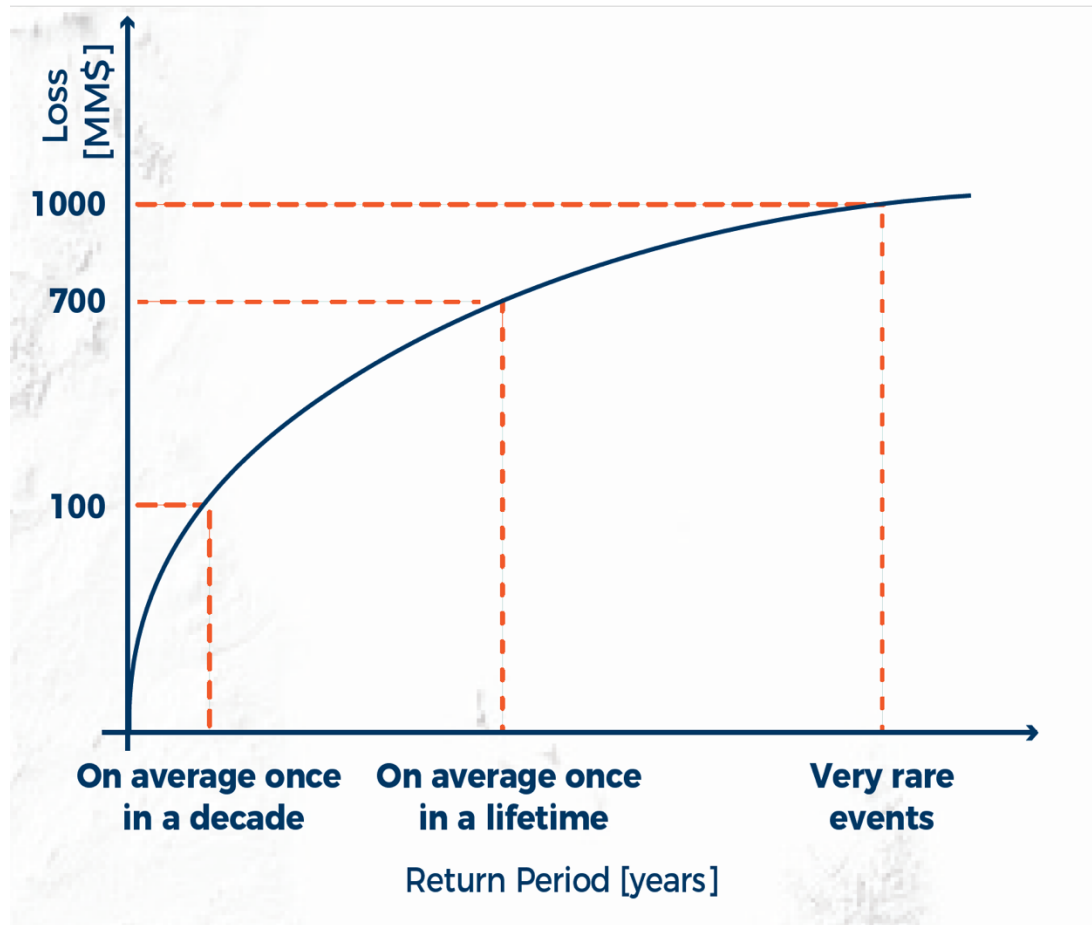|	Series 1	Series 2
AAL		
Most frequent/Very likely damage (once every 2-3 years)		
Frequent/Medium likely damage (once every 5-10 years)		
Less frequent/unlikely damage (once every 20-30 years)		

TASK 2: PML: describes the loss which could be expected corresponding to a given likelihood for the 2 loss time series.

Probable Maximum Loss Curve

Loss (y-axis): 1.000.000 $, 500.000 $, 100.000 $, 50.000 $, 10.000 $, 5.000 $

Return Period (x-axis): Very-likely, likely, Un-likely
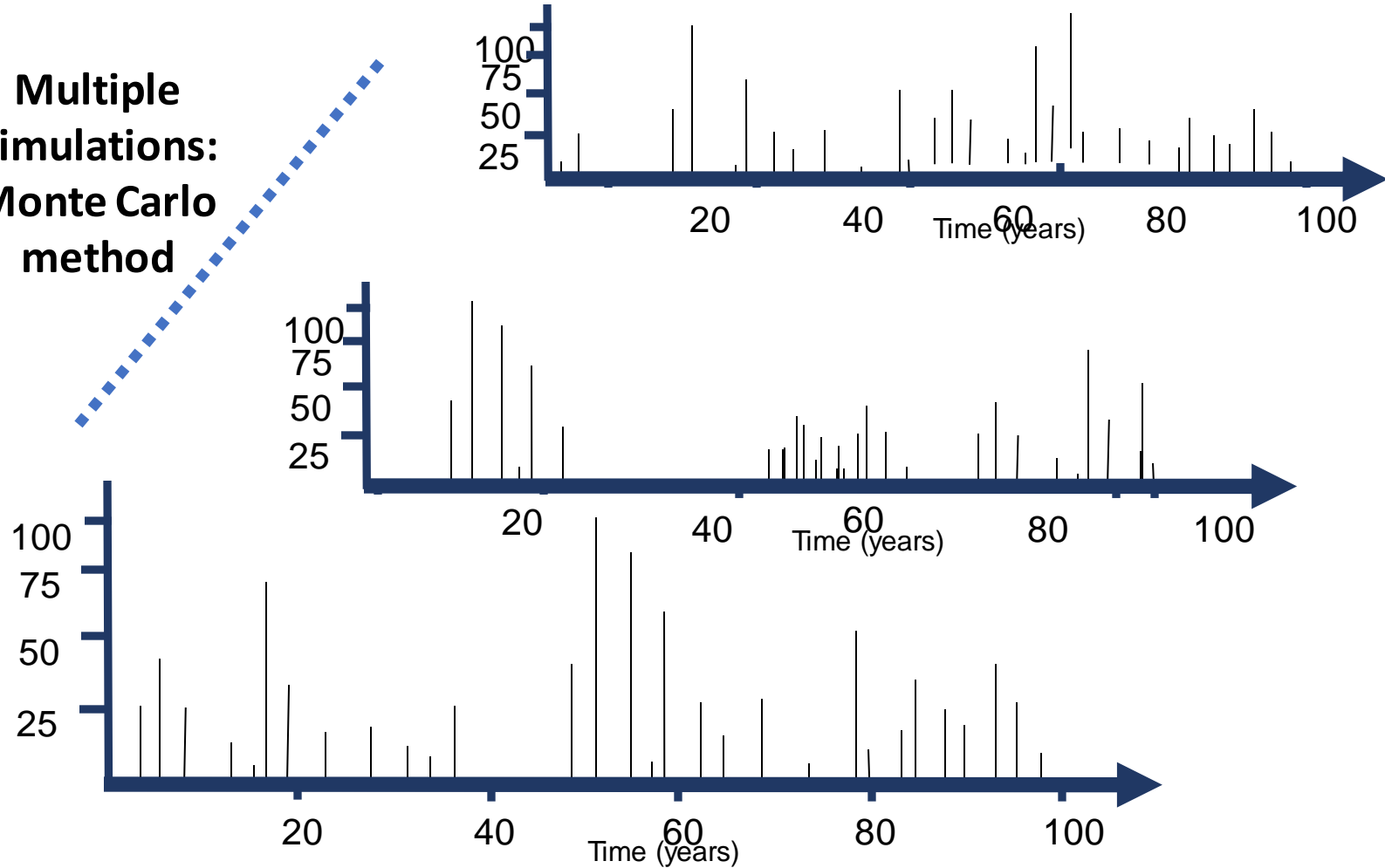
Series 2, Series 1

Probable Maximum Loss curve

- the likelihood of a $US 100 million loss occurs, on average, once in a decade
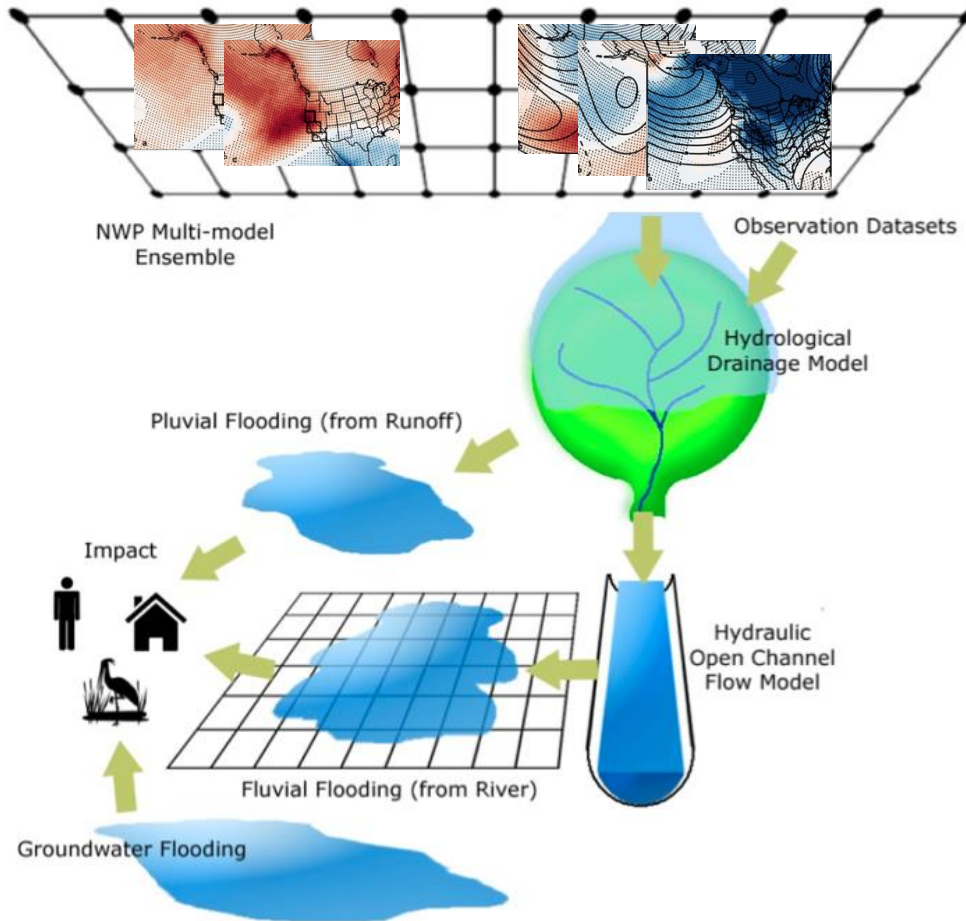- loss of $US 1 billion occurs is a very rare event.

Probabilistic Risk Assessment

Multiple Simulations: Monte Carlo method

Potential Damage

Time (years)

Conceptual Framework: key components

NWP Multi-model Ensemble

Observation Datasets

Hydrological Drainage Model

Pluvial Flooding (from Runoff)

Impact

Hydraulic Open Channel Flow Model

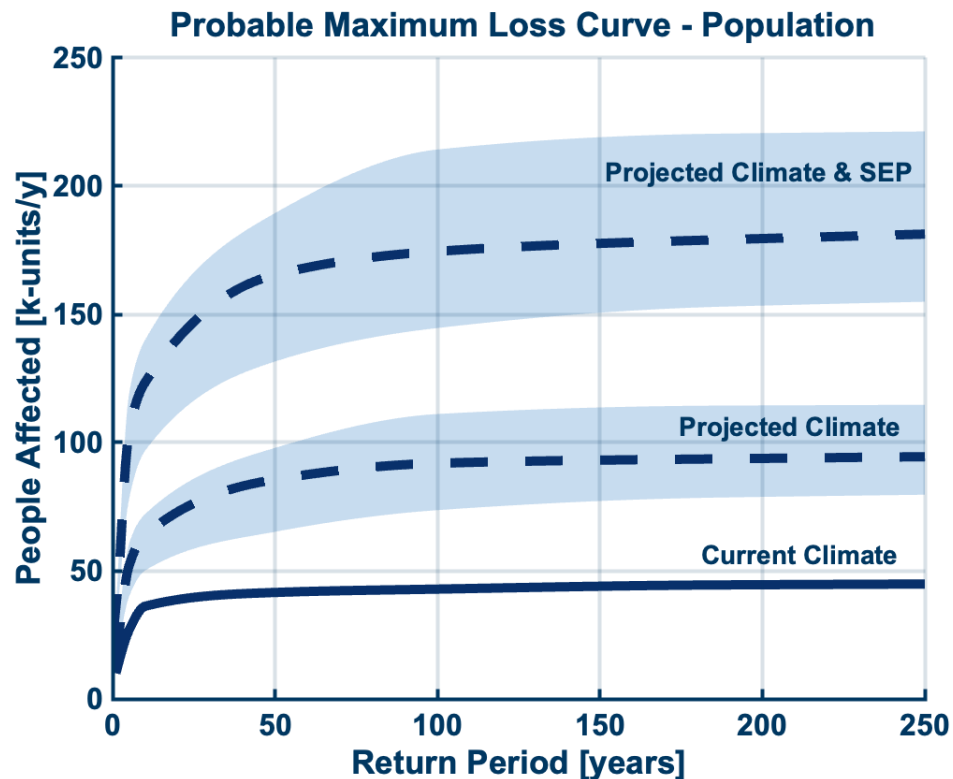Fluvial Flooding (from River)

Groundwater Flooding

1. Weather "Generator"
2. Water Cycle simulation
3. Hazard Mapping
4. Exposure Mapping
5. Impact Assessment

Reading the risk profiles

- AAL for People affected

- PML for People Affected