(GSP) Management of Public Utilities / (IMFS) Mechanical Institute of Fluids and Solids
Ecole Nationale de l'Eau et de l'Environnement de Strasbourg / Cemagref / CNRS / UdS

Automating the evaluation of flood damages

-Methodology and potential gains-

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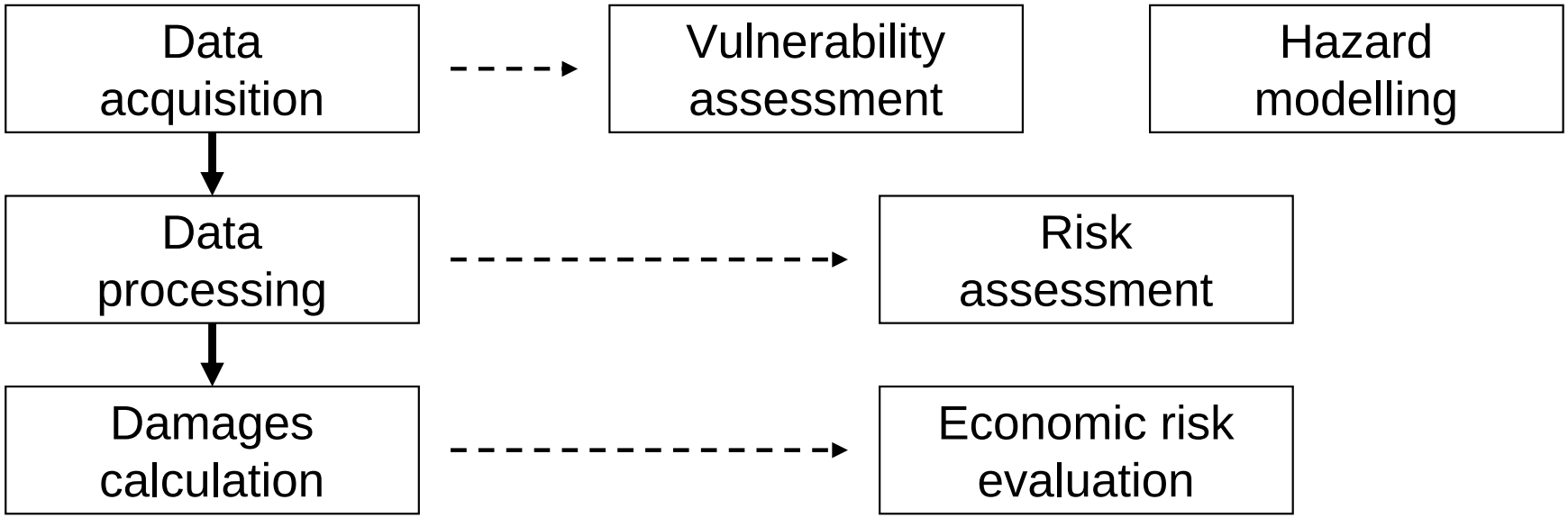
- Context
- Objectives
- Methods
- Results
- Perspectives

- Evaluation of flood damages

  - Risk analyses: loss potential of flood events
  - Risk management: benefits of flood alleviation projects
  - Economic criteria in decision making process

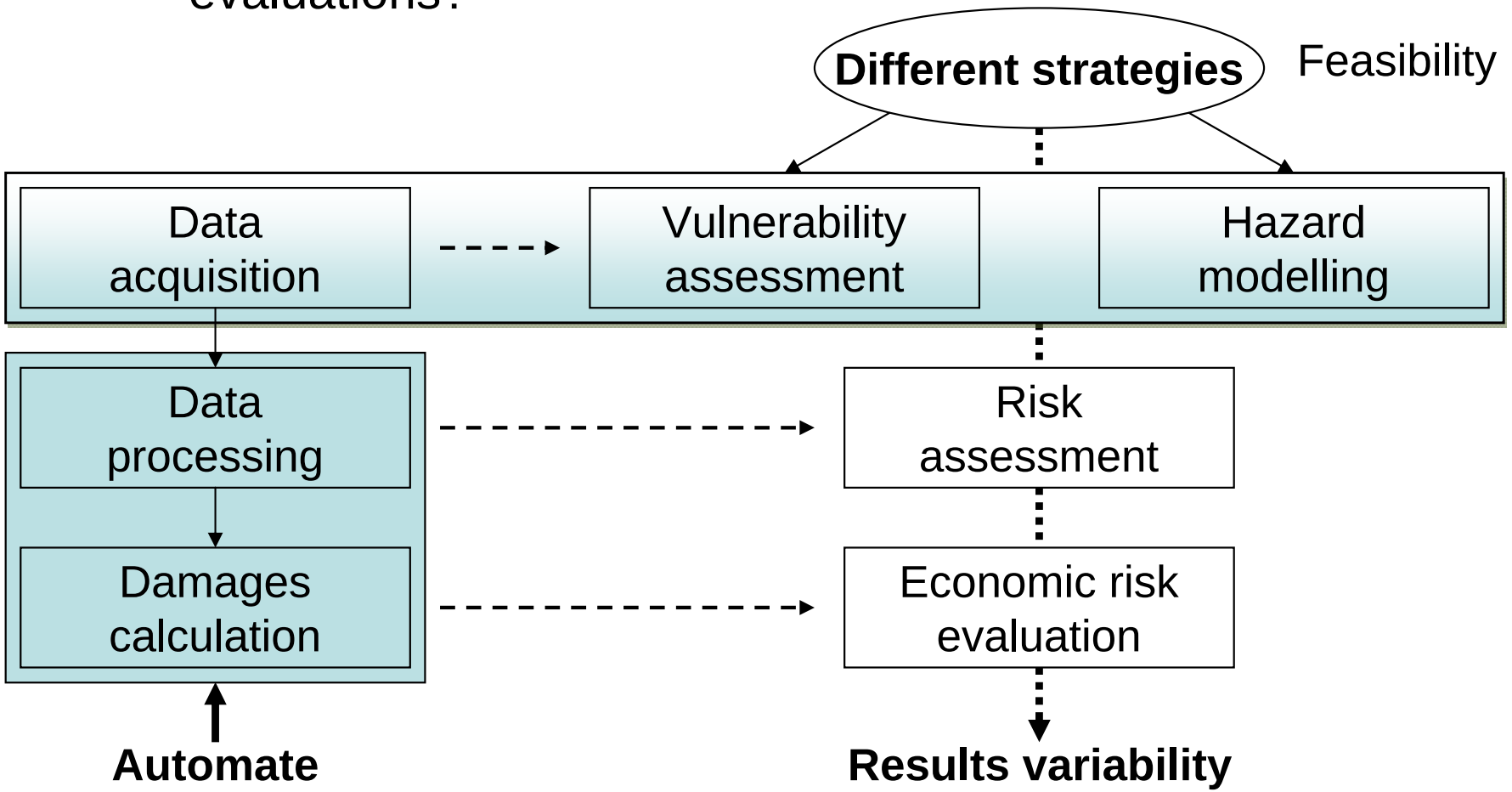
  - Method:



  - Results: reports, risk maps, consequence maps, models

- Thesis project

  - What is the impact of the strategies used to model hazard and assess vulnerability in the results of economic flood risk evaluations?

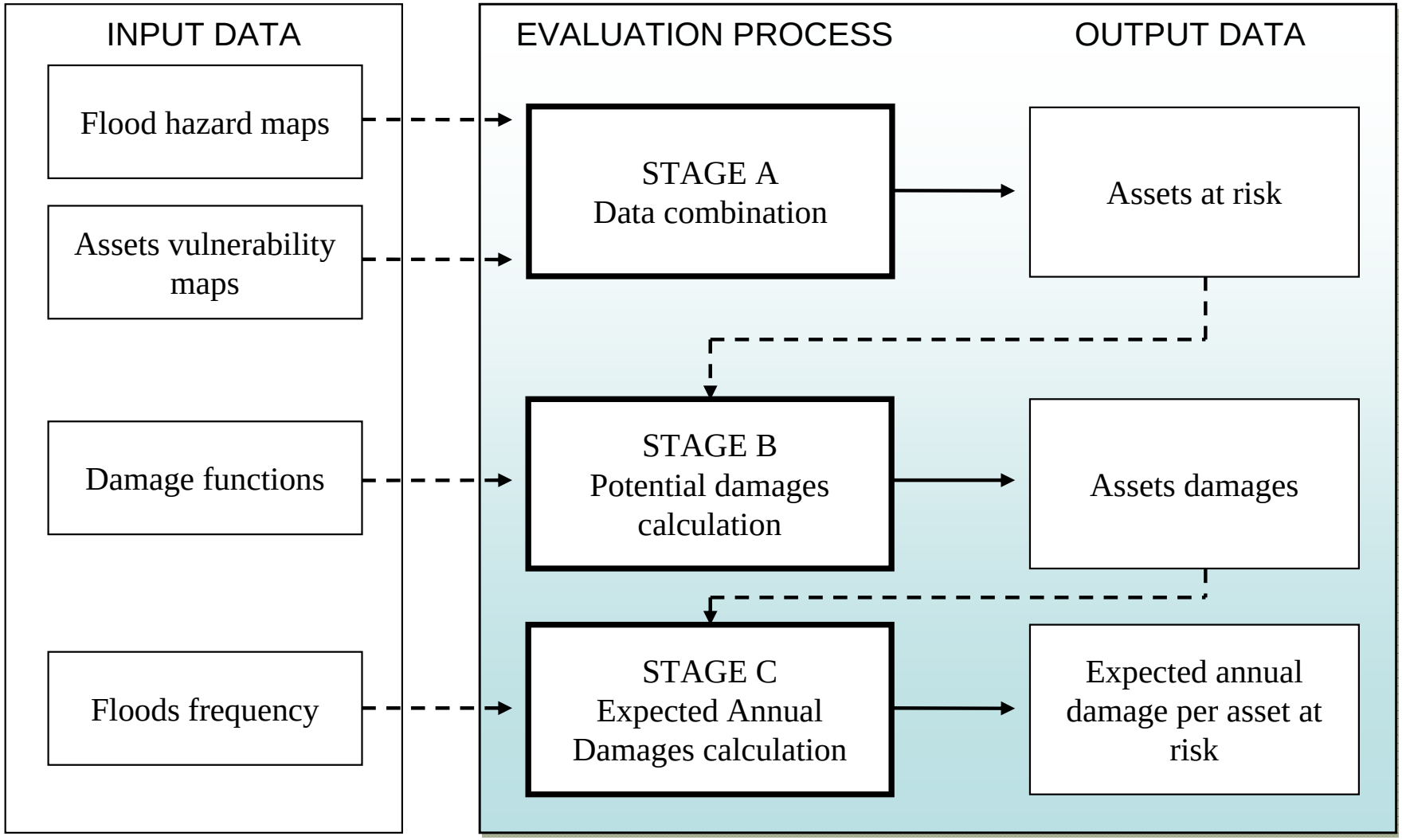


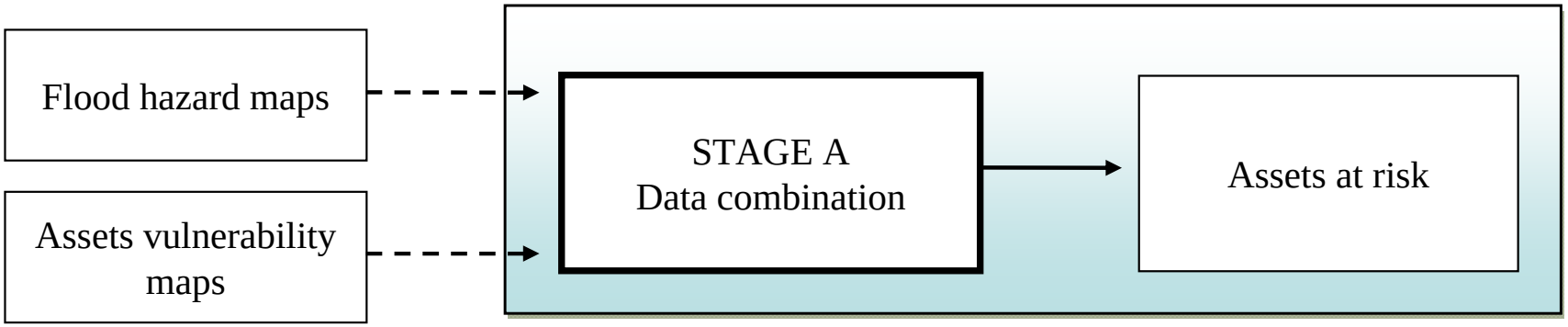
- Develop a general methodology to automate the evaluation of flood damages

- Analyse the gains of the automation in terms of time and expertise needs

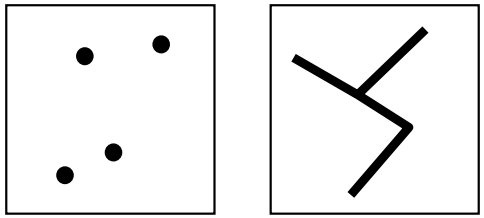
- Automate the evaluation of flood damages
  - GIS platform : ArcGis 9.2
  - Programming language: VBA

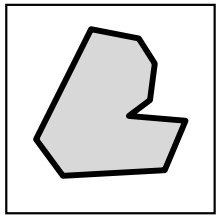
- Measure the gains enhanced by the automation
  - Develop a hypothetical example of flood damages evaluation


INPUT DATA
EVALUATION PROCESS
OUTPUT DATA
Flood hazard maps
Assets vulnerability maps
Damage functions
Floods frequency
STAGE A
Data combination
STAGE B
Potential damages calculation
STAGE C
Expected Annual Damages calculation
Assets at risk
Assets damages
Expected annual damage per asset at risk

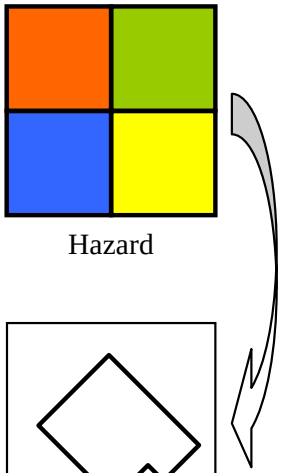


INPUT

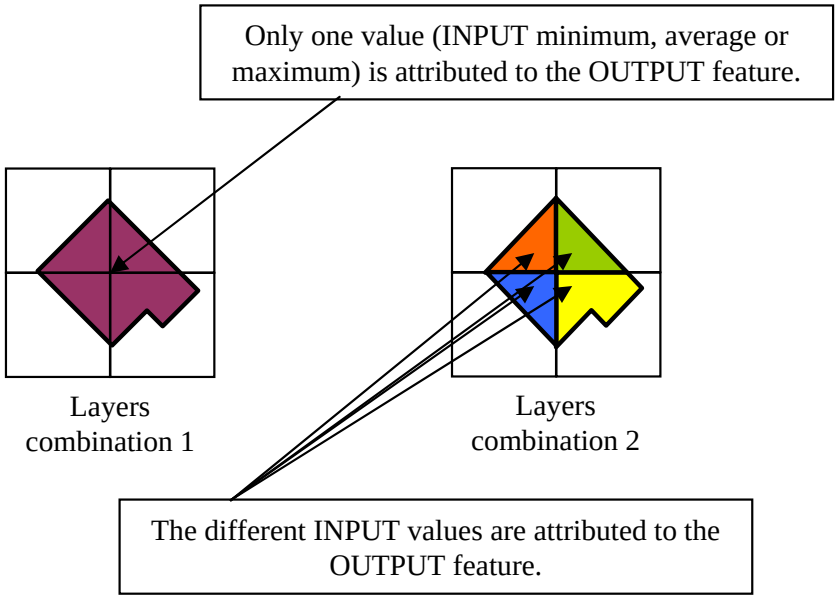


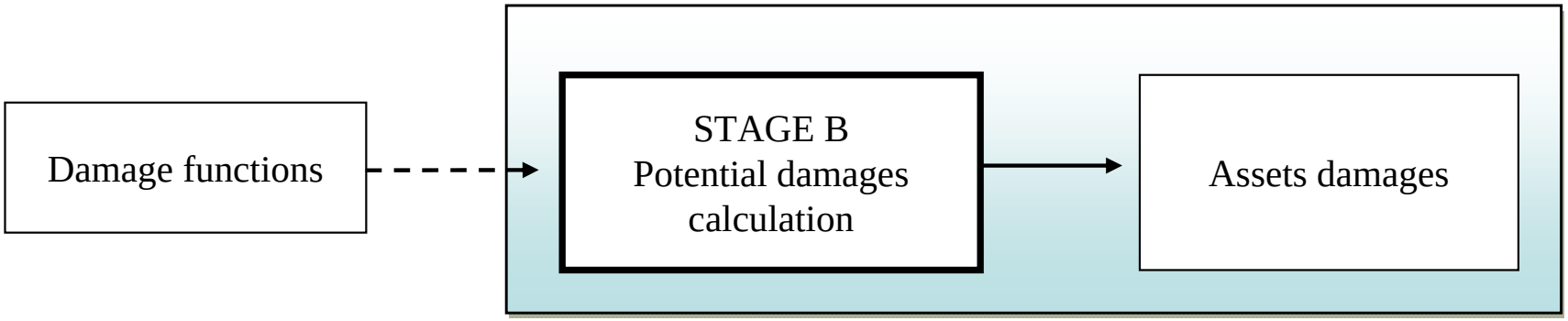


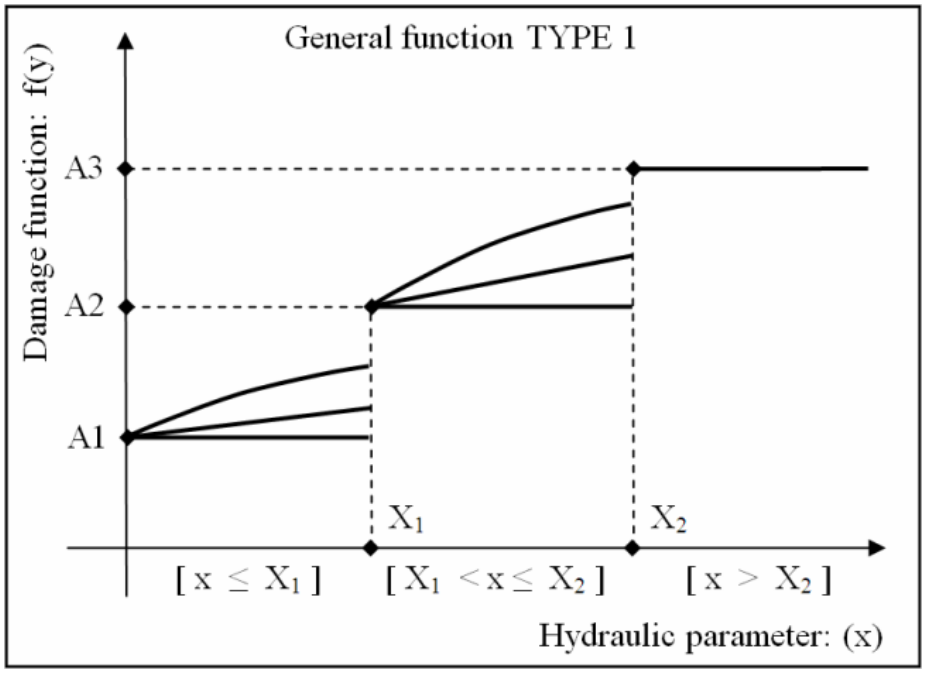
COMBINATION

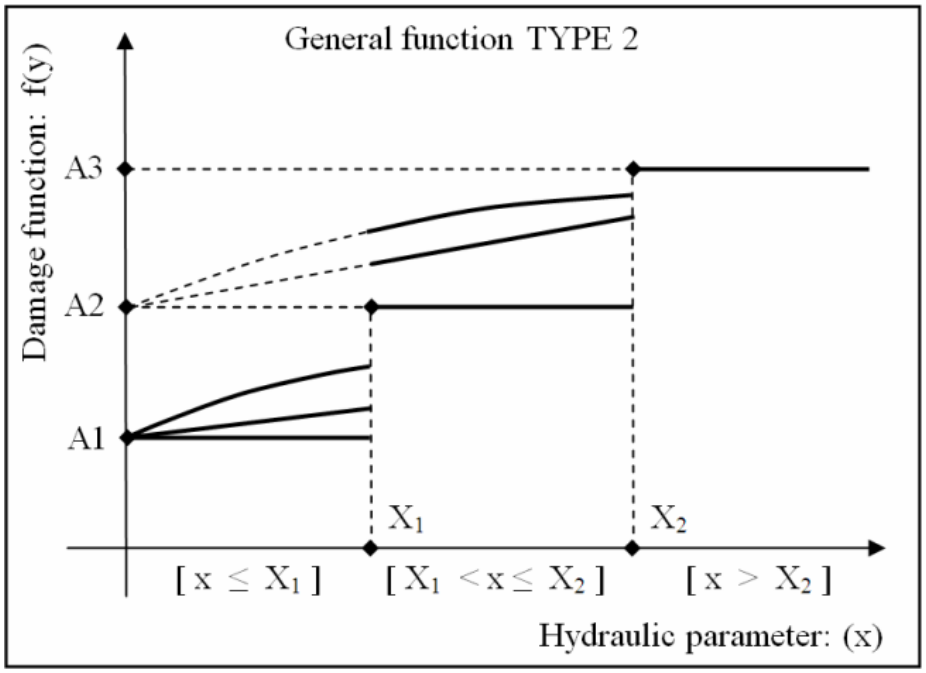


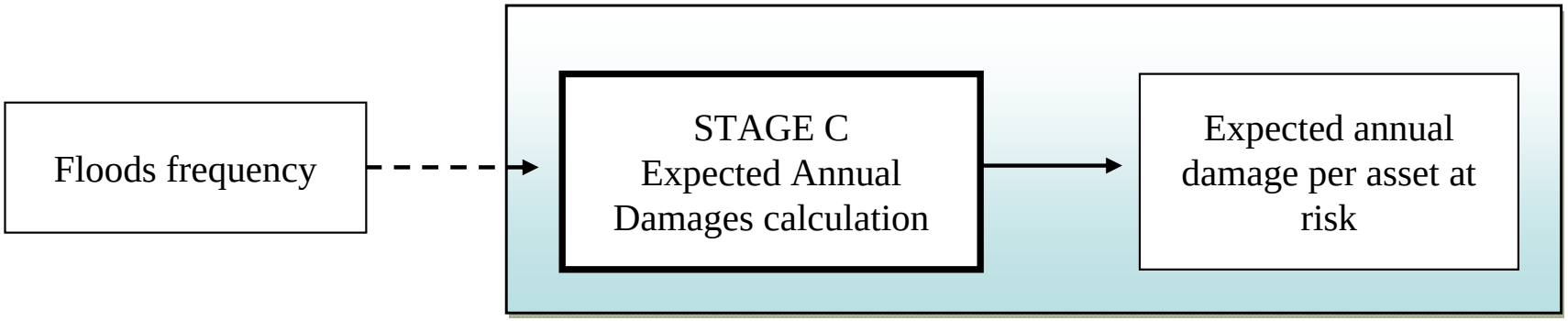
OUTPUT




Damage functions
STAGE B
Potential damages
calculation
Assets damages


General function TYPE 1
Damage function: f(y)
A3
A2
A1
X1
X2
[x ≤ X1]
[X1 < x ≤ X2]
[x > X2]
Hydraulic parameter: (x)


General function TYPE 2
Damage function: f(y)
A3
A2
A1
X1
X2
[x ≤ X1]
[X1 < x ≤ X2]
[x > X2]
Hydraulic parameter: (x)



$$EAD = \int_0^{\infty} D(q) \times f(q)dq$$

$$EAD = \sum_{i=0}^{10} \left[\left(f(i) - f(i+1) \right) x \left(\frac{Dq(i) + Dq(i+1)}{2} \right) \right]$$

Where: *i vary from 0 to 10*

f(i):	*Flood's frequency = 1 / return period (q)*
Dq(i):	*Damages caused by floods*
f(0):	*Frequency of the first flood we observe damages*
f(11):	*Frequency of theoretical infinity return period flood = 0*
Dq(0):	*Damages for the null return period = 0*
Dq(11):	*Theoretical damages for the infinity return period flood*

- Automate the evaluation of flood damages
  - GIS platform : ArcGis 9.2
  - Programming language: VBA

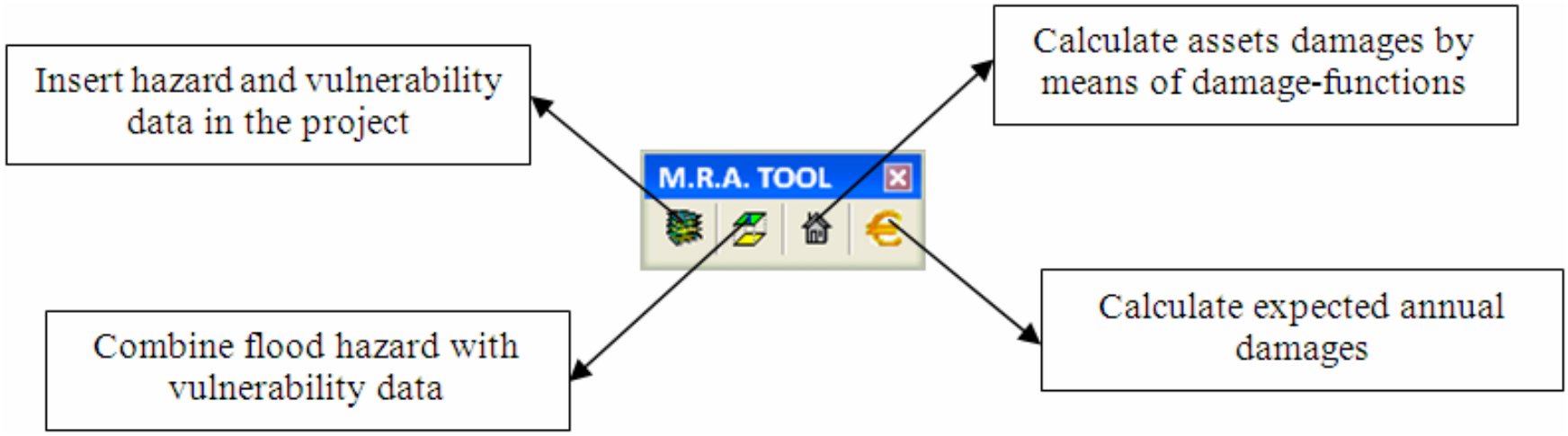
- Measure the gains enhanced by the automation
  - Hypothetical example

Scenarios	Approach	Expertise level
Scenario 1	Semi-automatic	Medium
Scenario 2		High
Scenario 3	Automatic	Irrelevant

- Semi-automatic approach: using simple functions of a GIS software
- Automatic approach: the analyst uses an existing tool to process the data in the GIS software
- Medium expertise level: the analyst is proficient in GIS software and knows exactly which functions and when to use them to achieve the loss evaluation
- High expertise level: the analyst have some knowledge of Visual Basic for Applications (VBA), he or she is proficient in the GIS software and knows exactly which tools and when to use them to achieve the loss evaluation

- General methodology
- Tool
- Analysis of gains

- After processing INPUT data according to the specifications of the Tool.



- General methodology
- Tool
- Analysis of gains enhanced by automation

Scenarios	Approaches	Expertise level	**Evaluation Time**
Scenario 1	Semi-automatic	Medium	**~ 94 min**
Scenario 2		High	**~ 41 min**
Scenario 3	Automatic	Irrelevant	**~ 1 min**

- Relevance of gains in practical applications
  - Sensitivity tests
  - Analysis of uncertainty
  - Comparison of management scenarios
  - Reduction of human error occurrence
- Disadvantages: limits of automated processes

- Improve the tool
- Use the tool to test sensitivity of flood damages evaluation
  - In the Thesis project
  - In future: other scientific studies, public utilities?

THANK YOU

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		Dataset 1					Dataset 2			
Evaluation		Stage A	Stage B	Stage C	**Total**		Stage A	Stage B	Stage C	**Total**
Scenario 1		20 min	41 min	33 min	**94 min**		20 min	41 min	34 min	**95 min**
Scenario 2		20 min	12 min	9 min	**41 min**		20 min	12 min	9 min	**41 min**
Scenario 3		33 sec	9 sec	9 sec	**51 sec**		54 sec	13 sec	13 sec	**80 sec**