UNIVERSITY OF TWENTE.

RISK ASSESSMENT OF HYDRO-METEOROLOGICAL HAZARDS IN A CHANGING CLIMATE (CHANGES)

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NANETTE KINGSMA, VICTOR JETTEN

CHANGES
Risk=HVA

SEVENTH FRAMEWORK PROGRAMME

MARIE CURIE ACTIONS

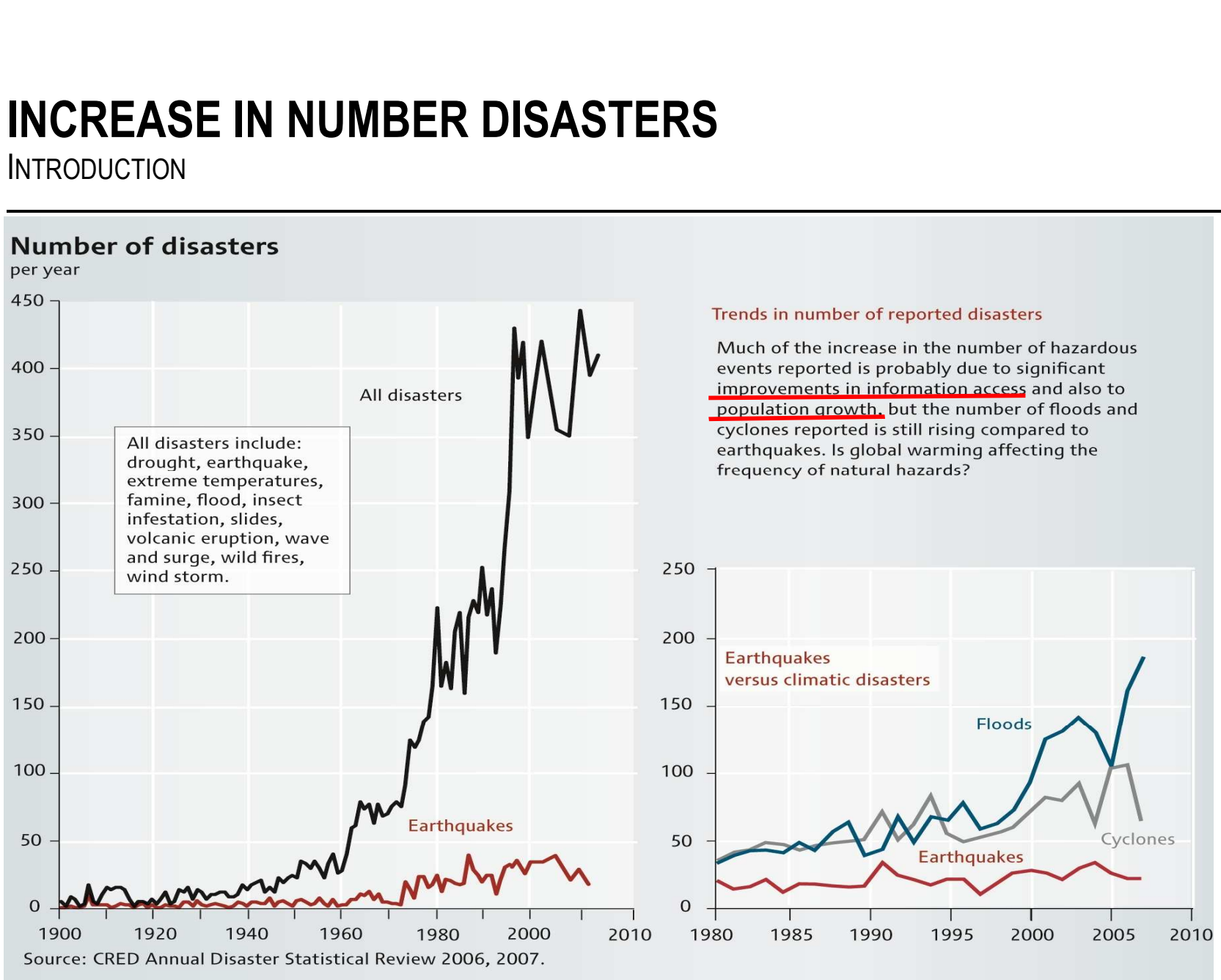
ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

LAY-OUT

- Framework of multi-hazard risk assessment
  - Examples:
    - Catchment Barcelonnette, France
    - Catchment Naga city, the Phillipines
    - River Rhine, the Netherlands
- Introduction to new project CHANGES

INCREASE IN NUMBER DISASTERS

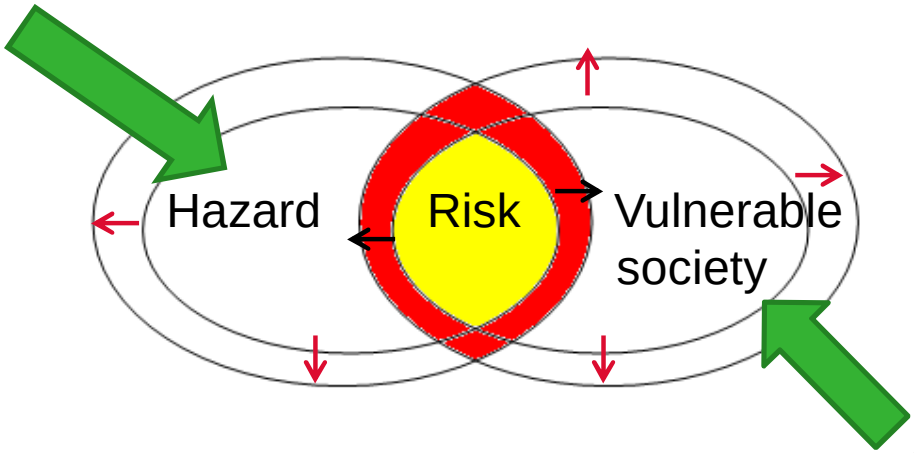
INTRODUCTION



CLIMATE CHANGE INCREASES RISK AND VULNERABILITIES

INTRODUCTION

Climatic Change:
Temperature rise, sea level rise and more extreme events in the field of hydro-meteorologic disasters



RISK REDUCTION

Population growth; urbanization; bad planning; complex societies

WHAT IS RISK?

INTRODUCTION

- The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between (natural, human-induced or man-made) hazards and vulnerable conditions.
- How can we assess risk?

Risk = Probability of losses occurring

Risk = Hazard * Vulnerability * Amount

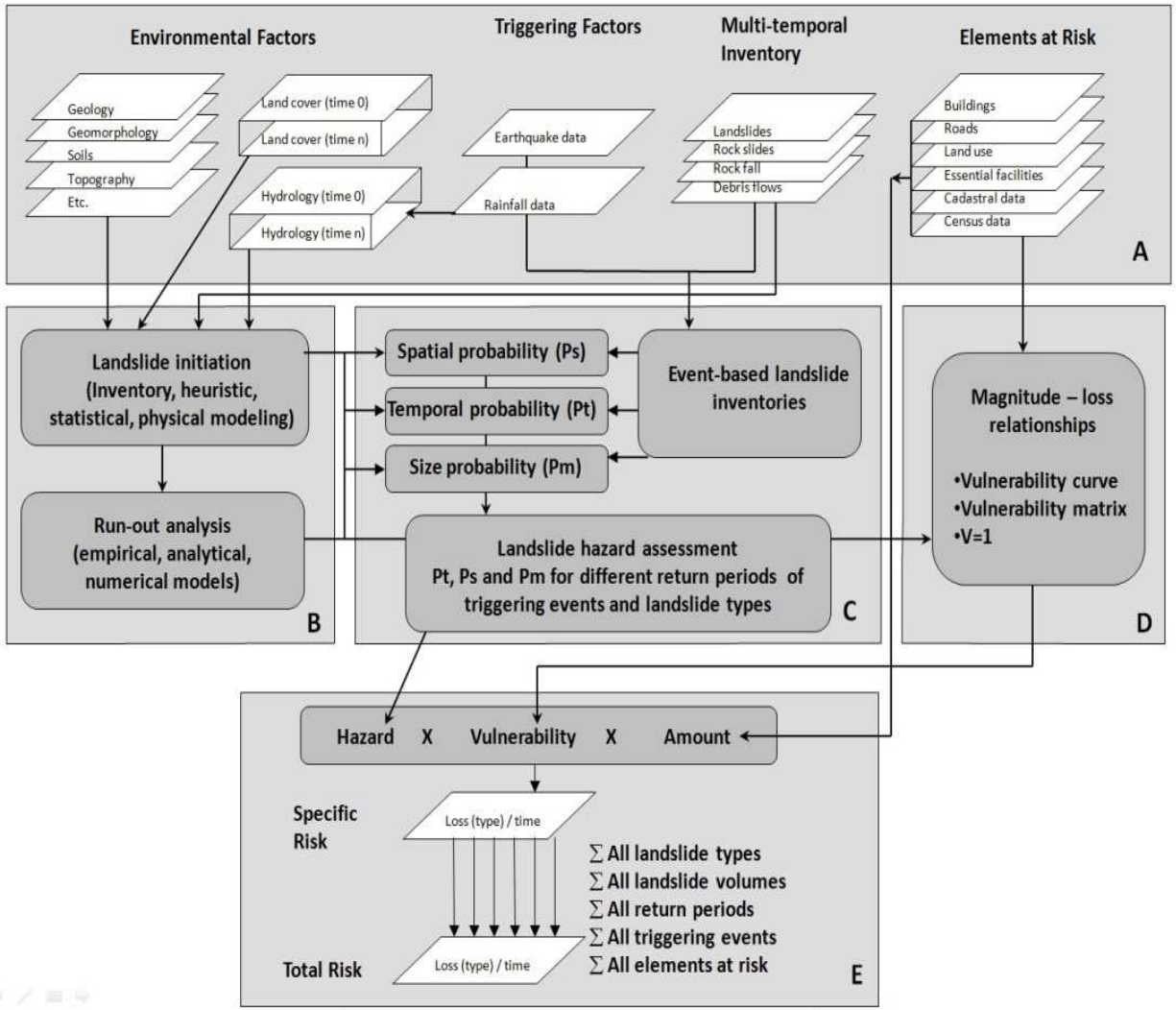
= Temporal probability * Consequences or losses

= Temporal probability * Degree of loss to Elements at risk * Quantification of Elements at risk

RISK ASSESSMENT FRAMEWORK

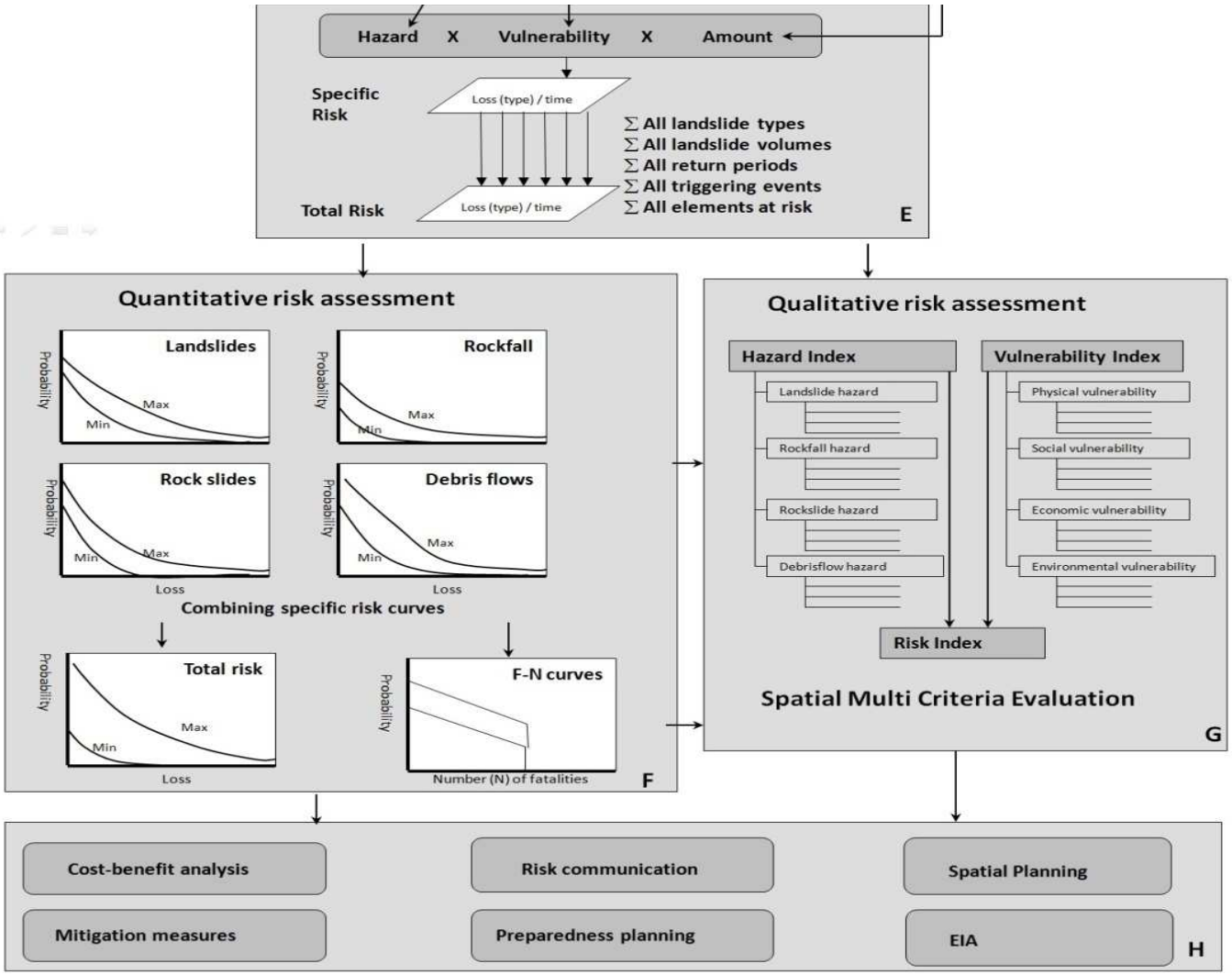
EXAMPLE LANDSLIDES

- A: Basic data sets
  - Static
  - Dynamic
- B: Susceptibility & hazard modelling
- C: Hazard assessment
- D: Vulnerability assessment
- E: Total risk



RISK ASSESSMENT

EXAMPLE LANDSLIDES



- E: total risk
- Risk assessment
  - F: Quantitative
  - G: Qualitative
- H: Risk evaluation

RISK ASSESSMENT

SPATIAL AND MULTI-DISCIPLINARY

Hazard assessment: earth scientists, hydrologists, volcanologists, seismologists, meteorologists

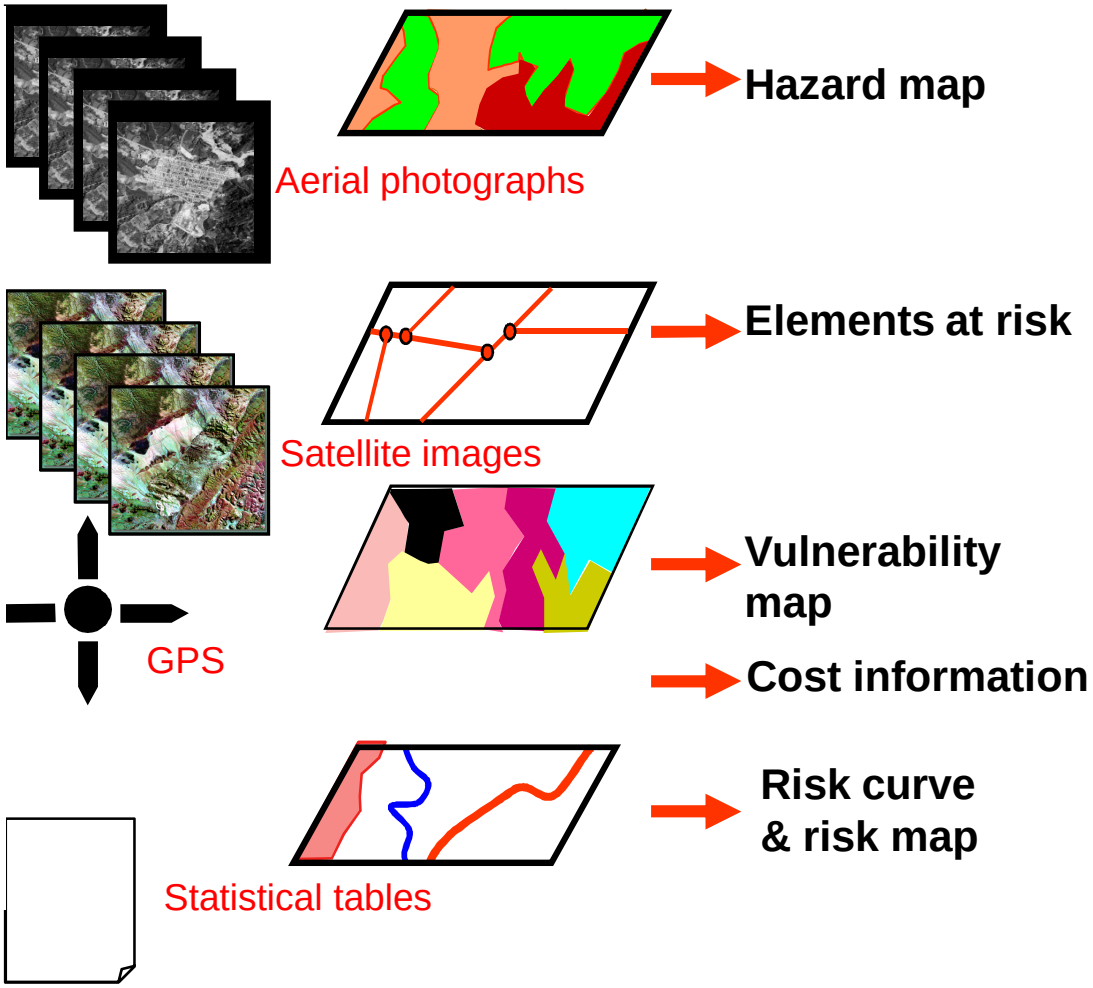
Elements at risk: geographers, urban planners, civil engineers

Vulnerability: depending on type of vulnerability by different scientists from: structural engineers, civil engineers to geographers , social scientists, ecologists

Cost estimation: economists

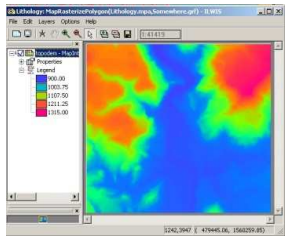
Risk assessment: GIS experts

Risk management & reduction: Decision making: Polititians.



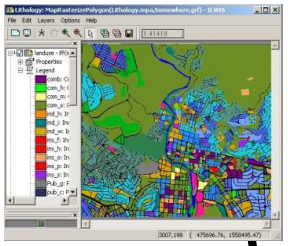
ENVIRONMENTAL FACTORS IMPACTING ON SUSCEPTIBILITY

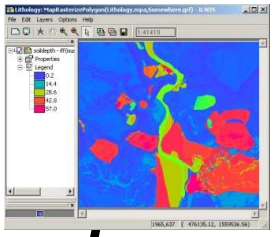
SPATIAL AND MULTI-DISCIPLINARY



Dem

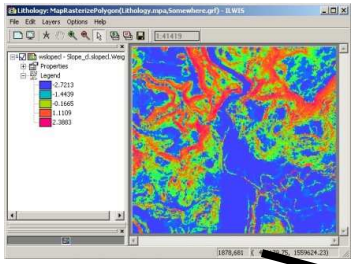
Landuse



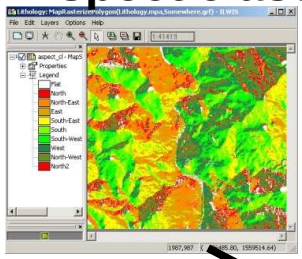


Soil depth

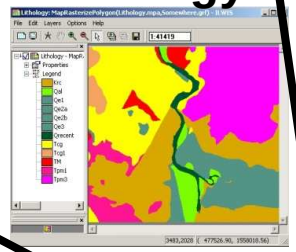
Slope classes



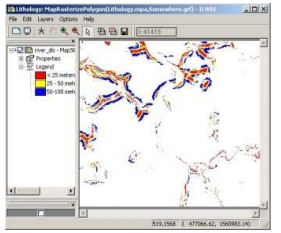
Aspect classes



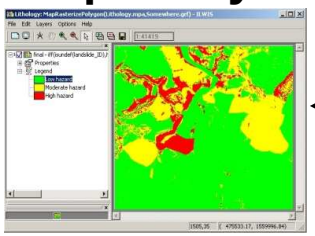
Lithology

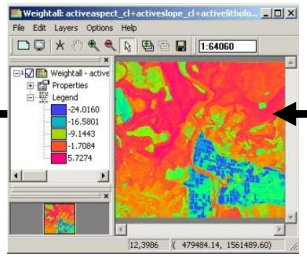


Distance from river

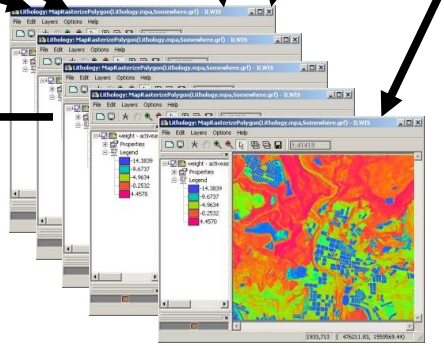


Susceptibility map





Total weight



Weight maps

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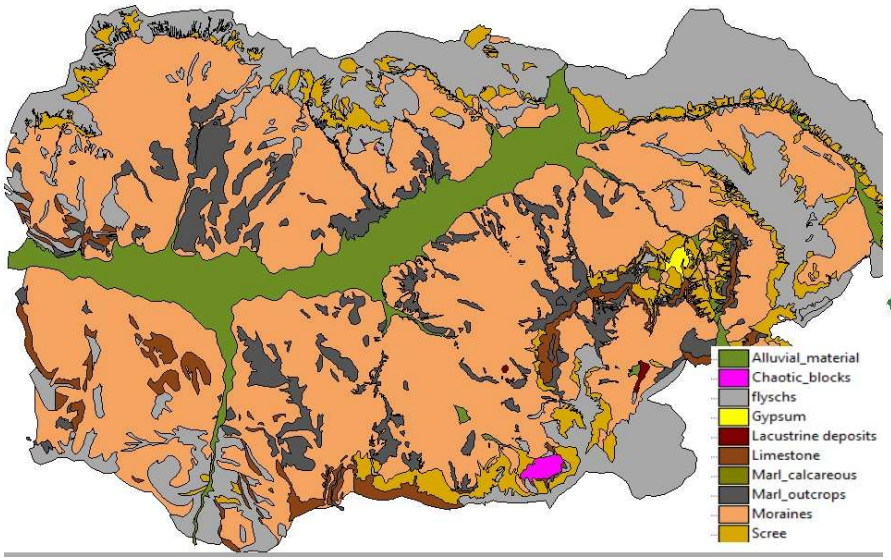
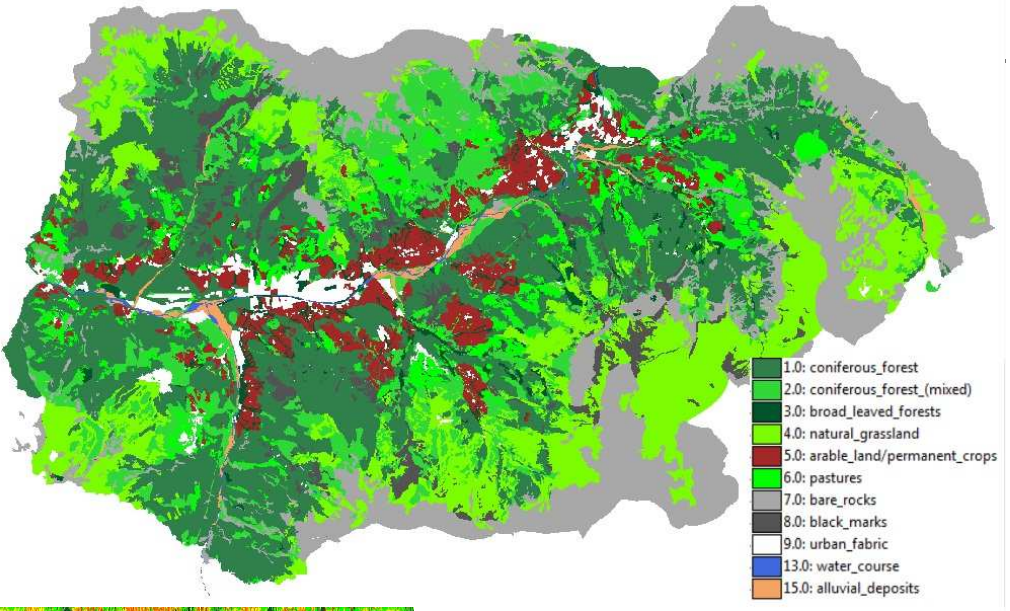
BASIC DATA SETS: ENVIRONMENTAL FACTORS

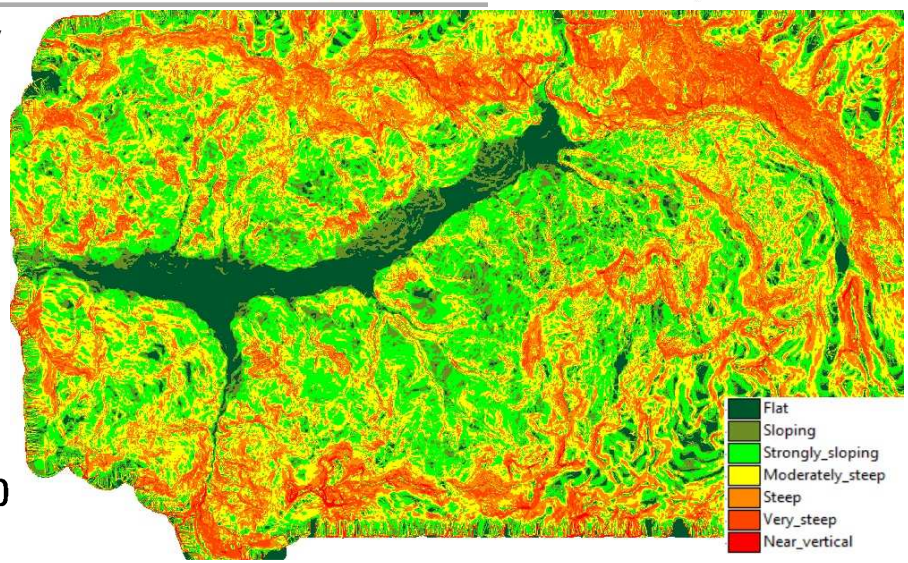
BARCELONNETTE



Geomorphology



Land use



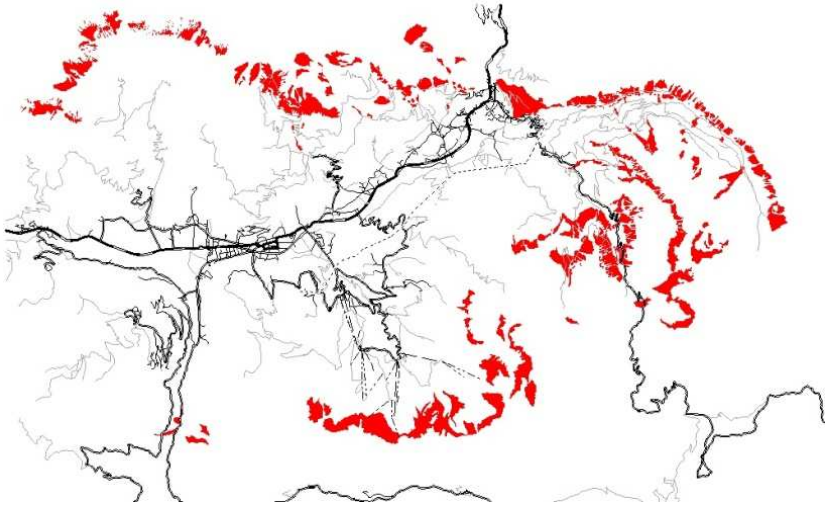
Orography

FROM SUSCEPTIBILITY MAP TO SOURCE AREAS

BARCELONNETTE

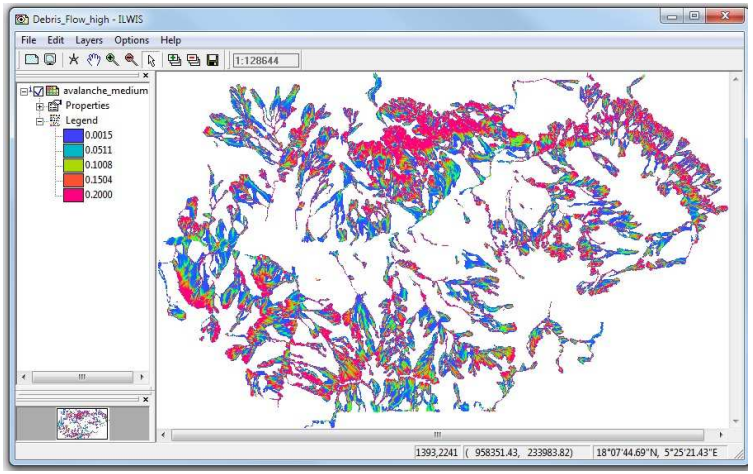
Susceptibility level	Hazard triggering event: source zones		
	Major event	Moderate event	Minor event
High	1	1	1
Moderate	1	1	0
Low	1	0	0
None	0	0	0

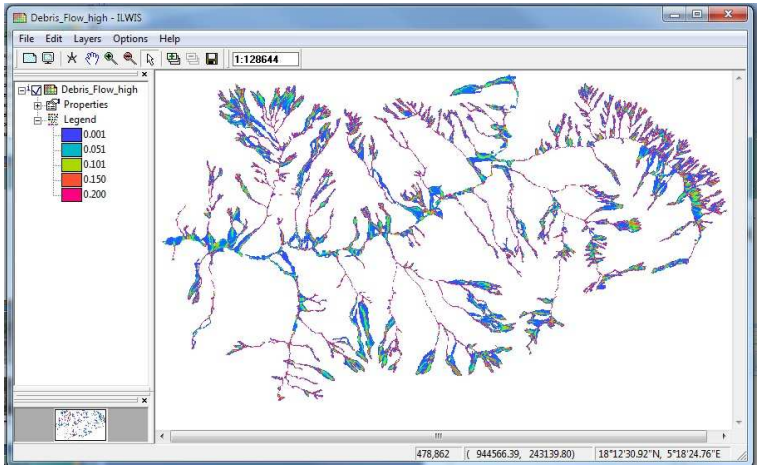
This means that a major triggering event might produce mass movements in the areas designated as High, Moderate and Low susceptible. Small triggering events will only trigger mass movements in the Highly susceptible zones.

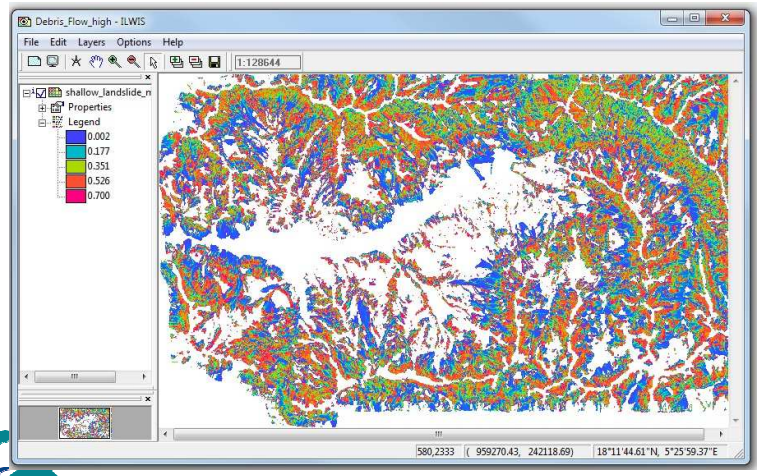


HAZARD ASSESSMENT: RUNOUT MAPS

BARCELONNETTE





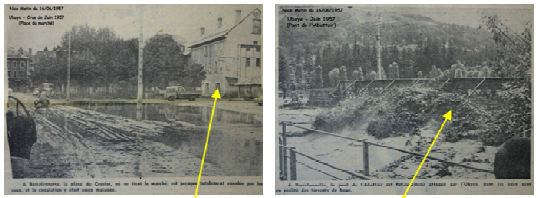


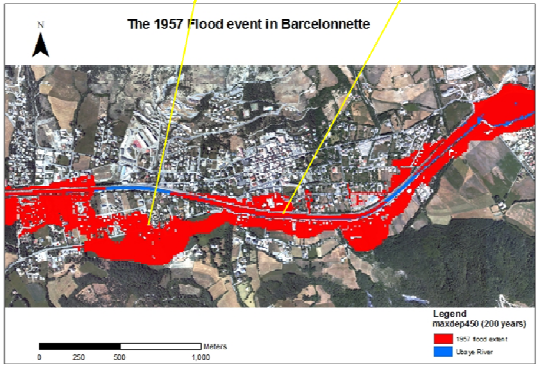
- Run different scenarios (major, moderate, minor events)
- Initiation areas using the output of the source area maps.
- Runout model calculates:
  - Extend of the runout
  - Kinetic energy converted to impact pressure

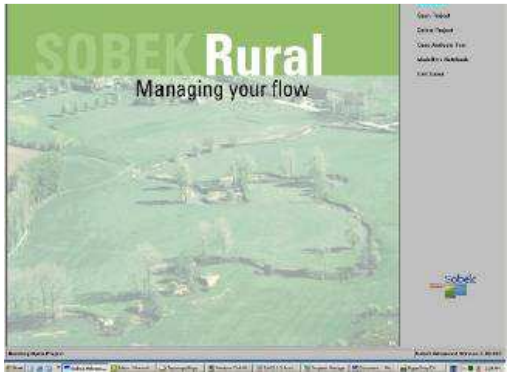
FLOOD HAZARD ASSESSMENT

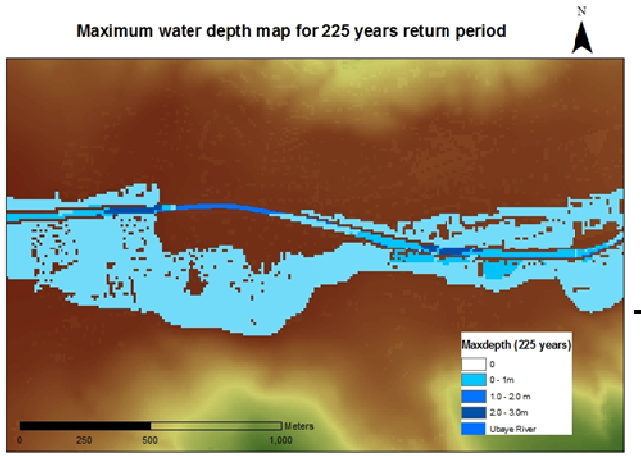
BARCELONNETTE

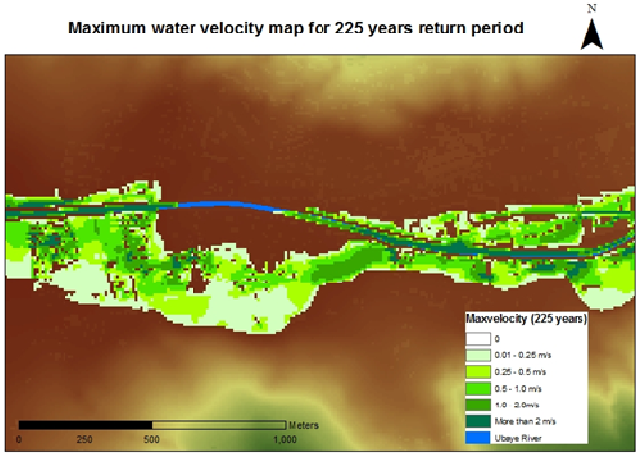
- Flood modeling using 1D-2D hydrodynamic model.
- Input data:
  - DEM (!!)
  - Surface roughness
  - (include buildings)
  - Discharge (return periods)
  - Boundary conditions

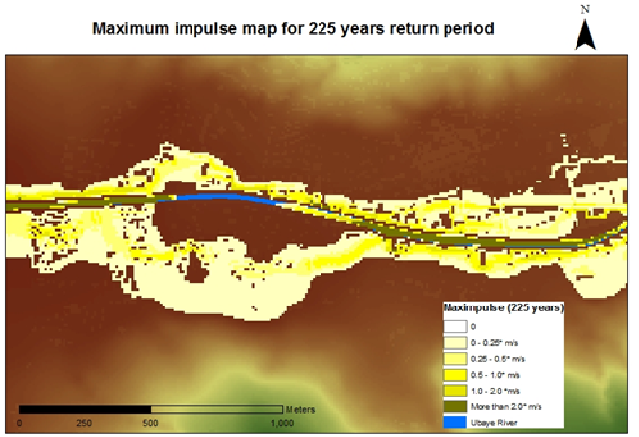






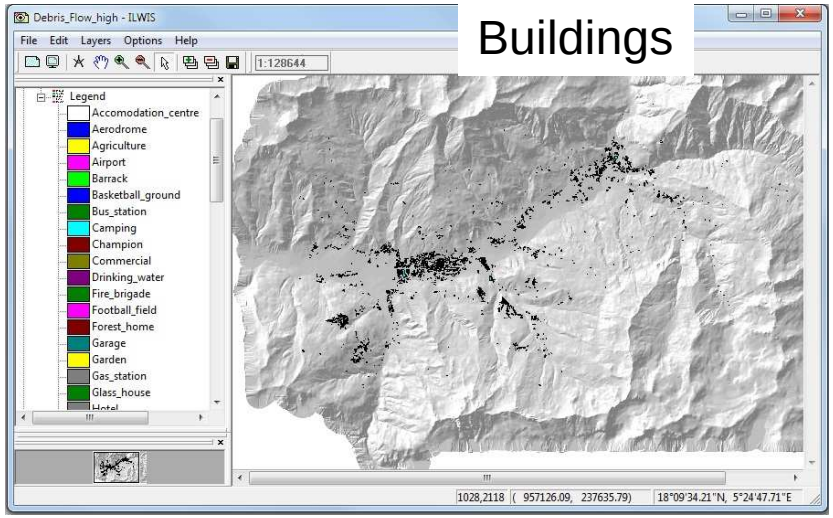


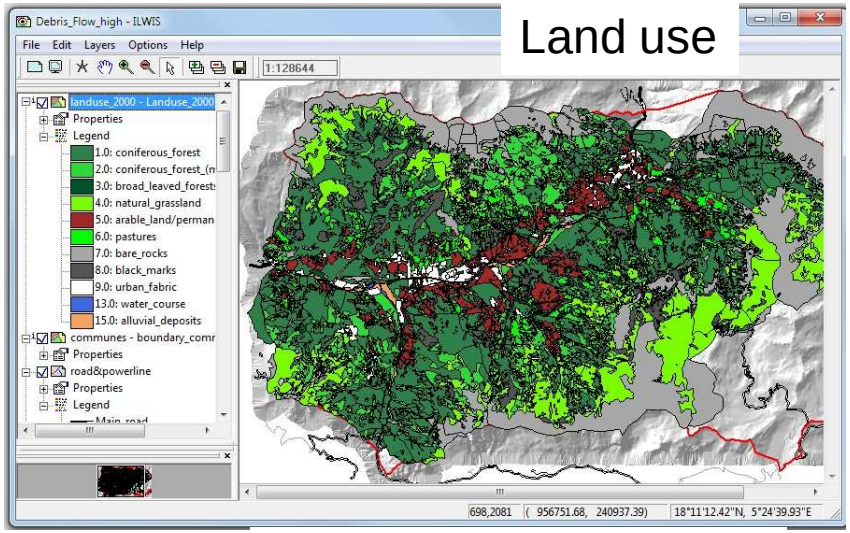


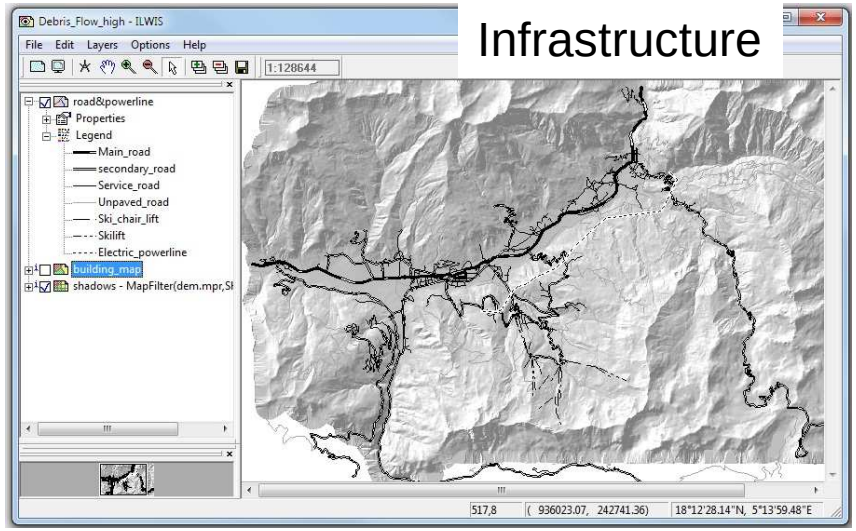


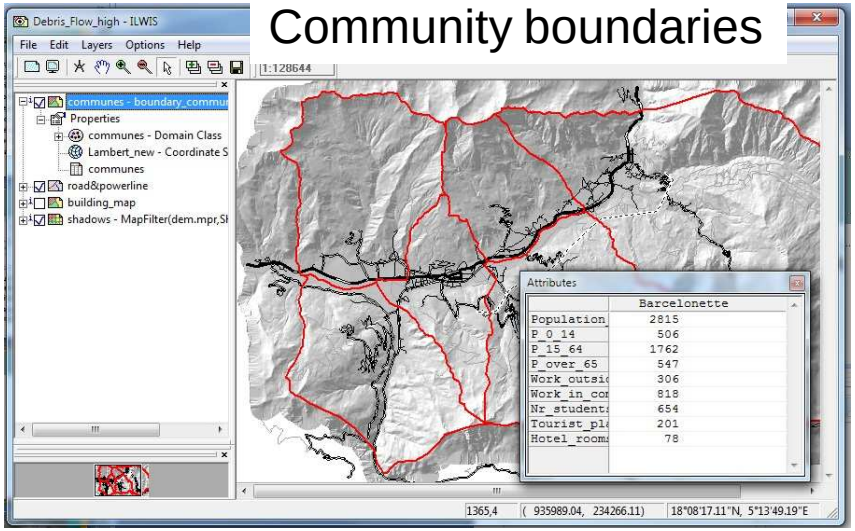
BASIC DATA: ELEMENTS AT RISK

BARCELONNETTE









ITC

RISK MAP

BARCELONNETTE

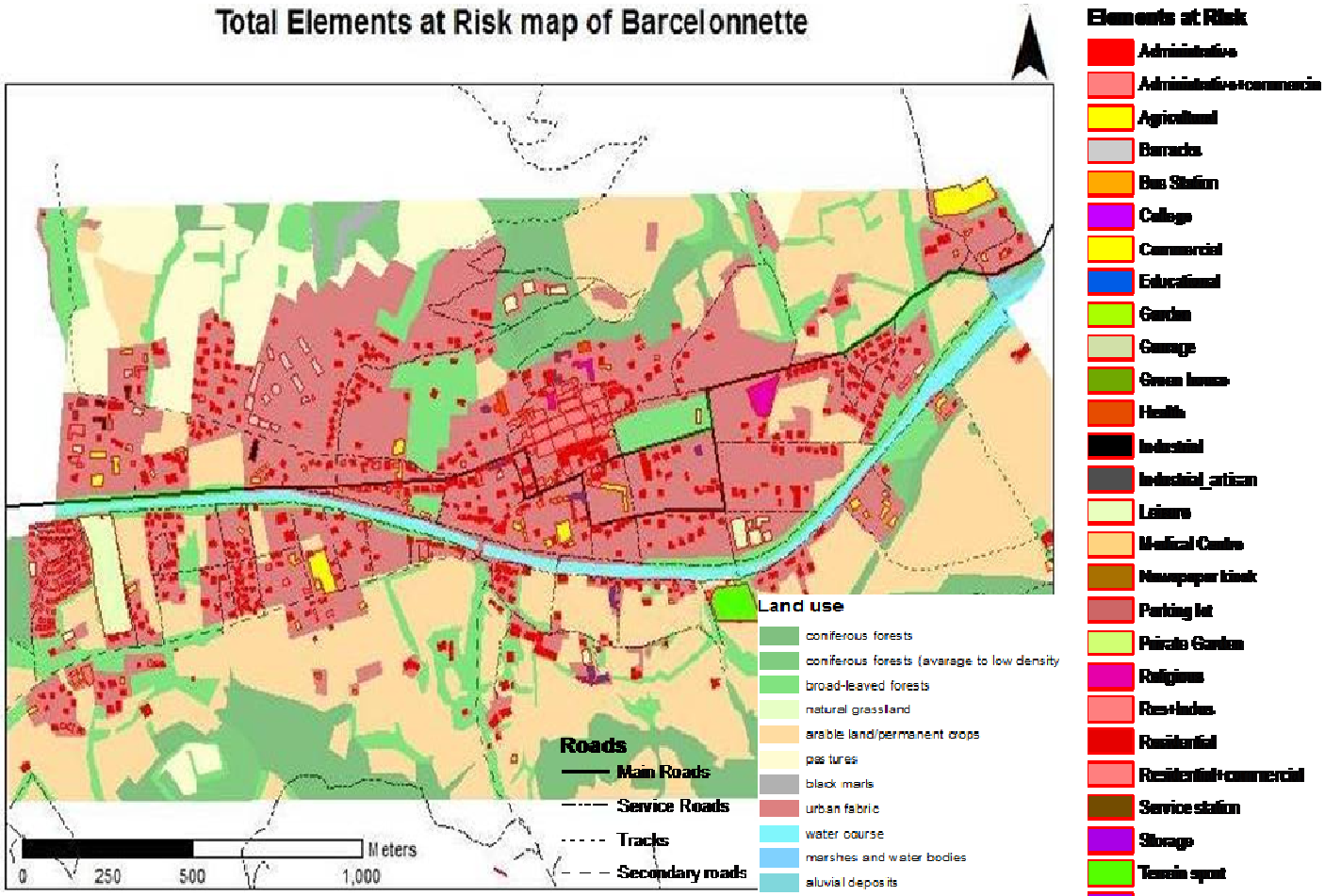
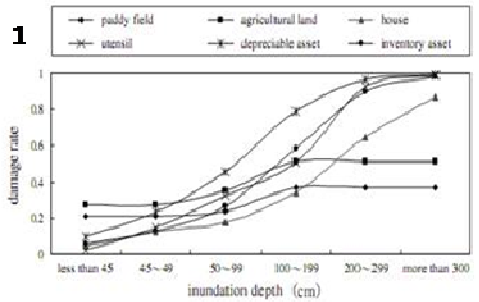


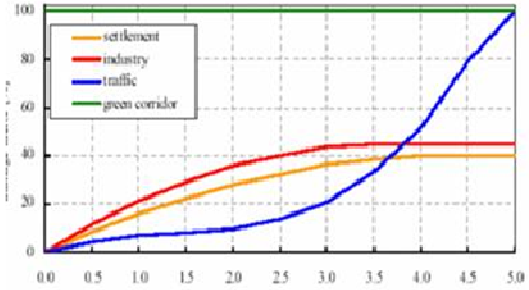
Figure 6. 1.Total elements at risk

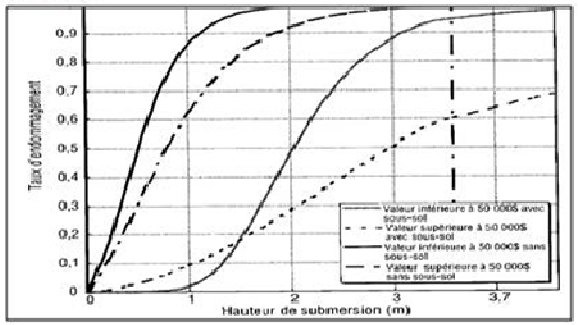
RISK ASSESSMENT

BARCELONNETTE

1

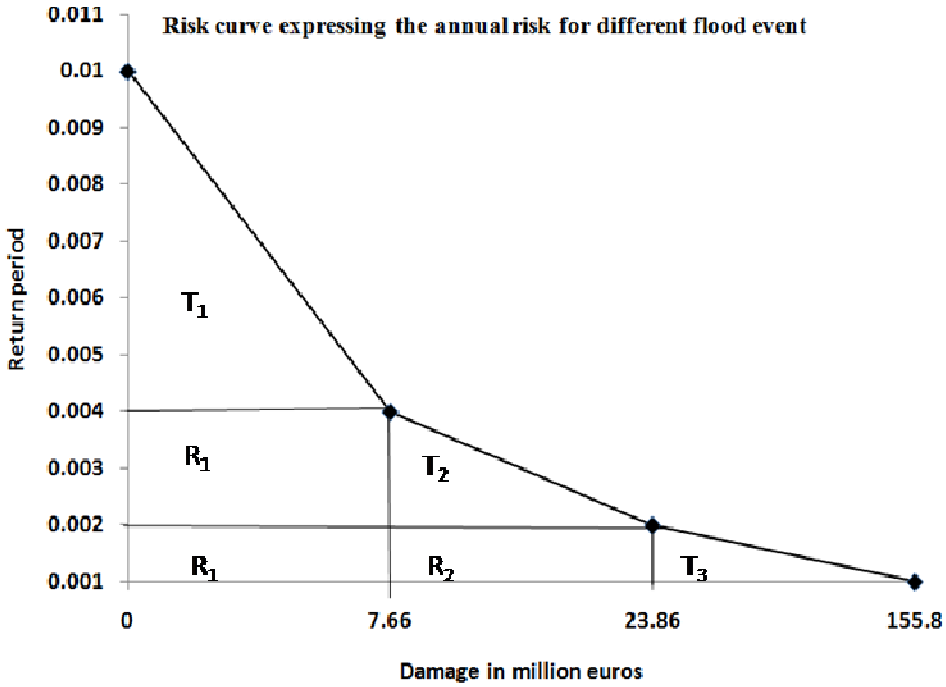






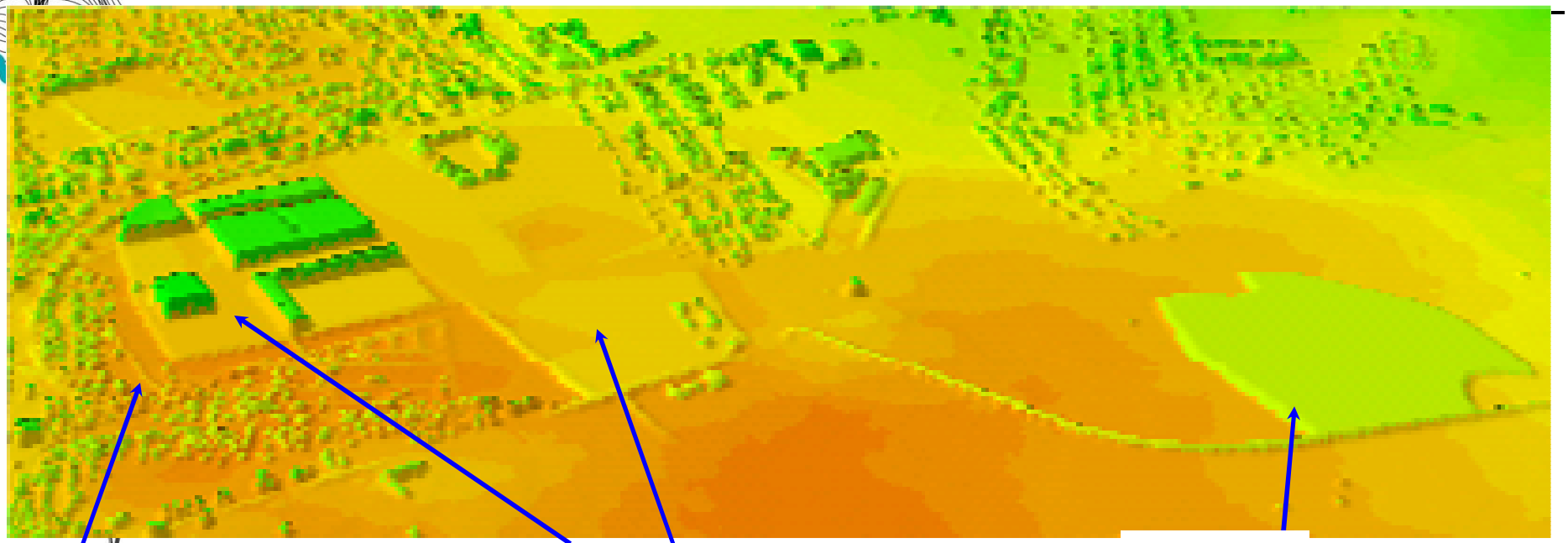
3

2



CHANGE IN ENVIRONMENTAL FACTORS

NAGA CITY, THE PHILIPPINES



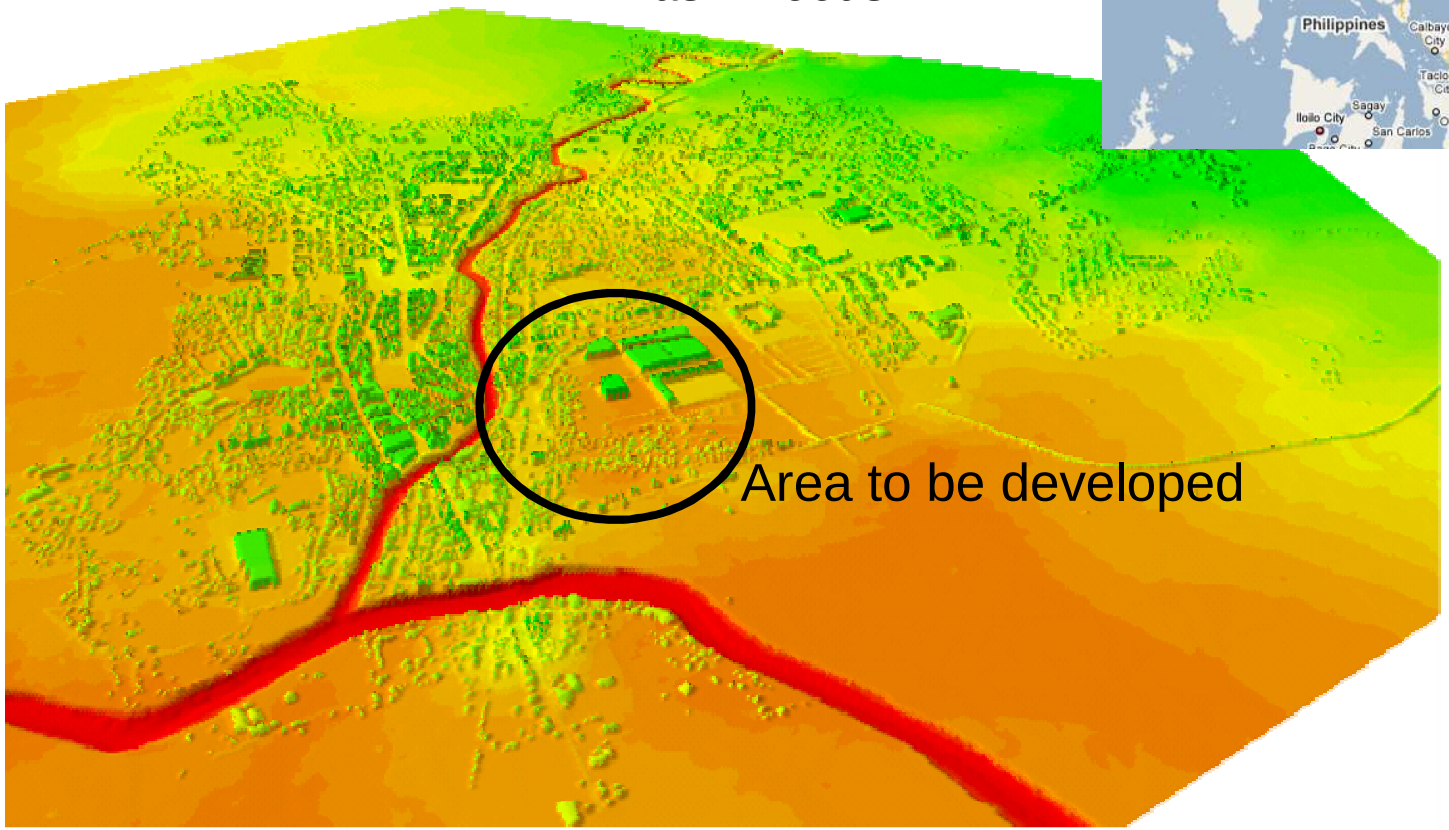
Elevated commercial area

Mall

CHANGE IN ENVIRONMENTAL FACTORS

NAGA CITY, THE PHILIPPINES

Flash Floods

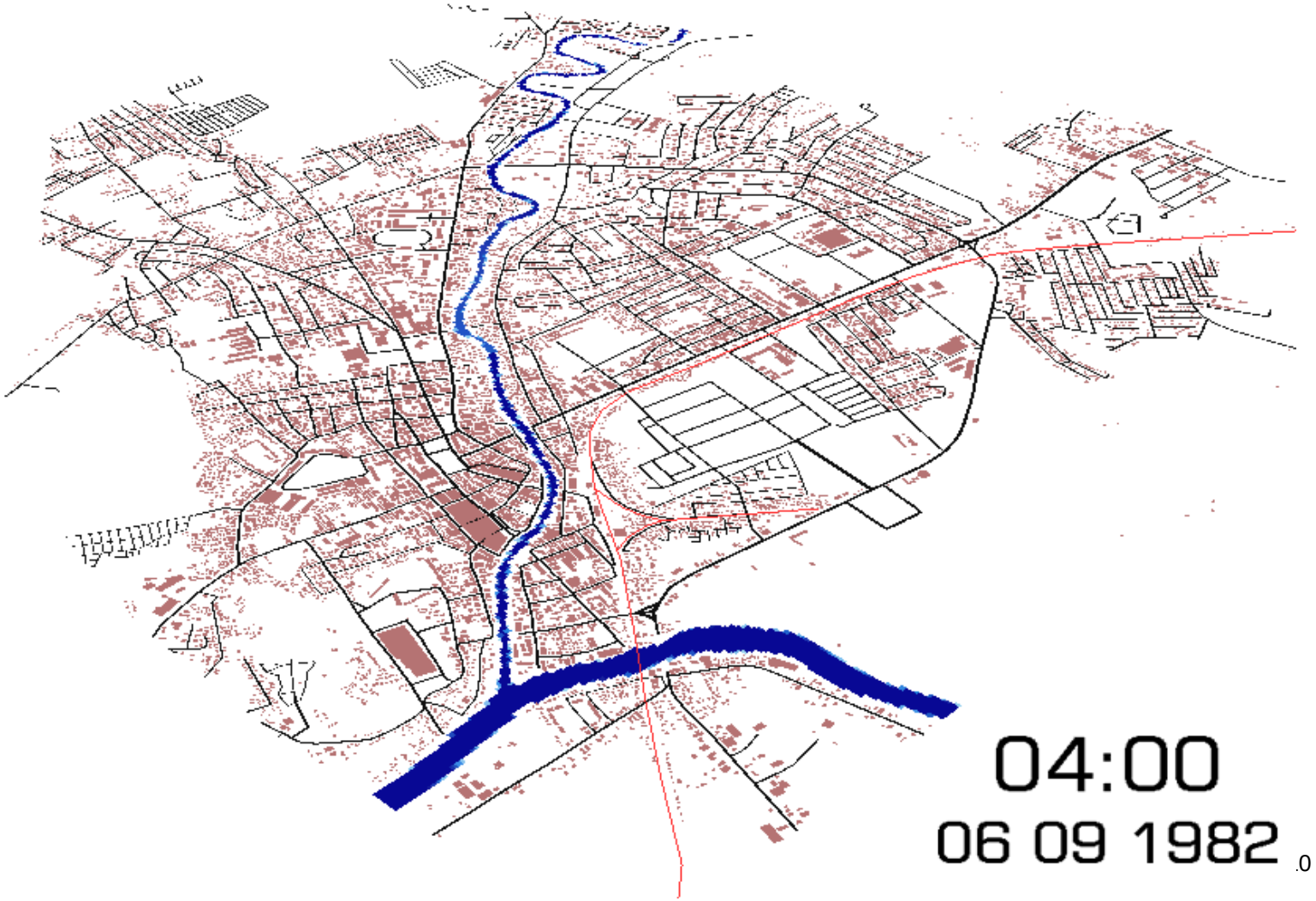


Storm Surges

Alluvial Floods

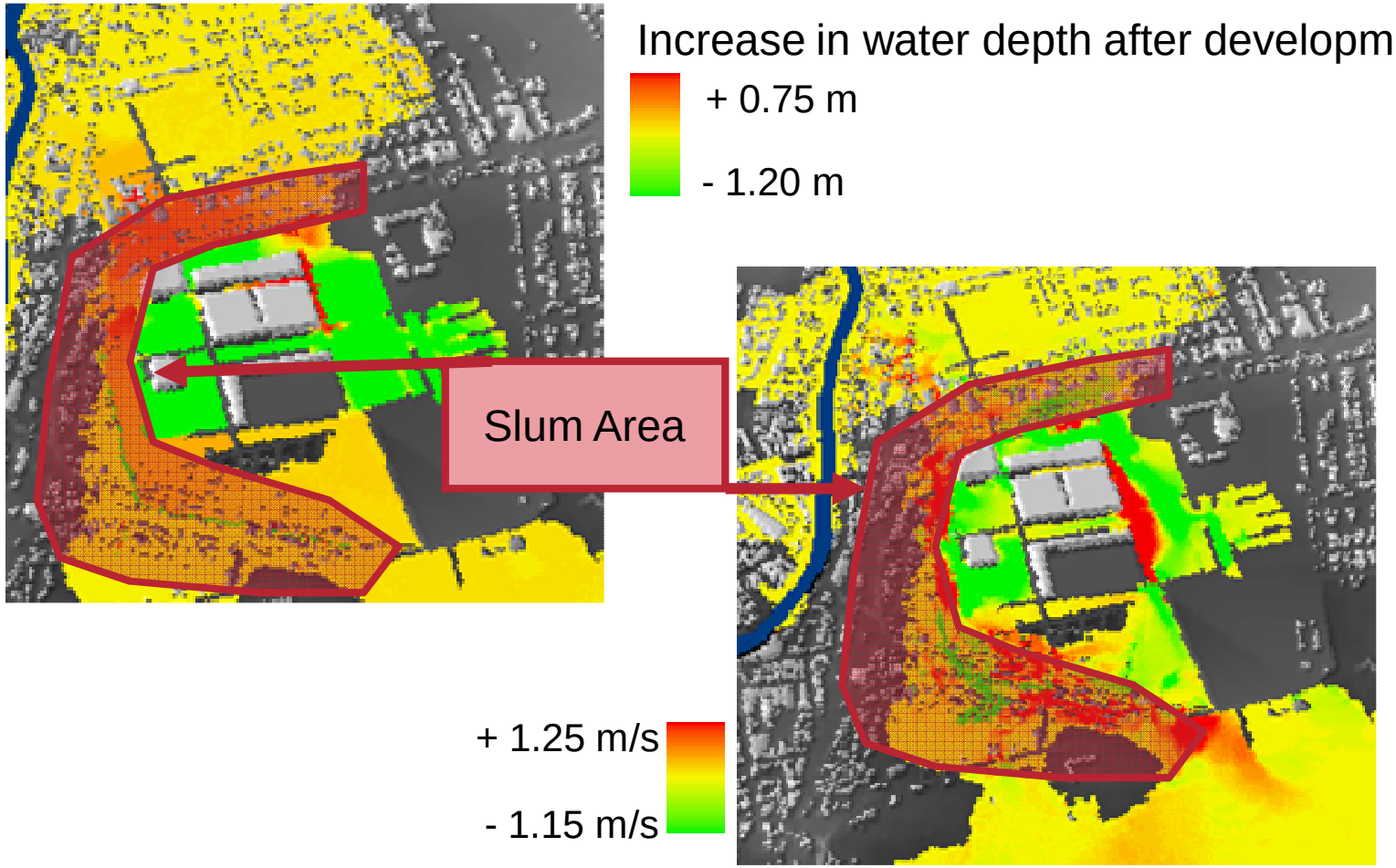
FLOOD PROPAGATION WITH SOBEK(1D-2D)

NAGA CITY, THE PHILIPPINES



CONSEQUENCES ON 10-YEAR FLOOD CHARACTERISTICS

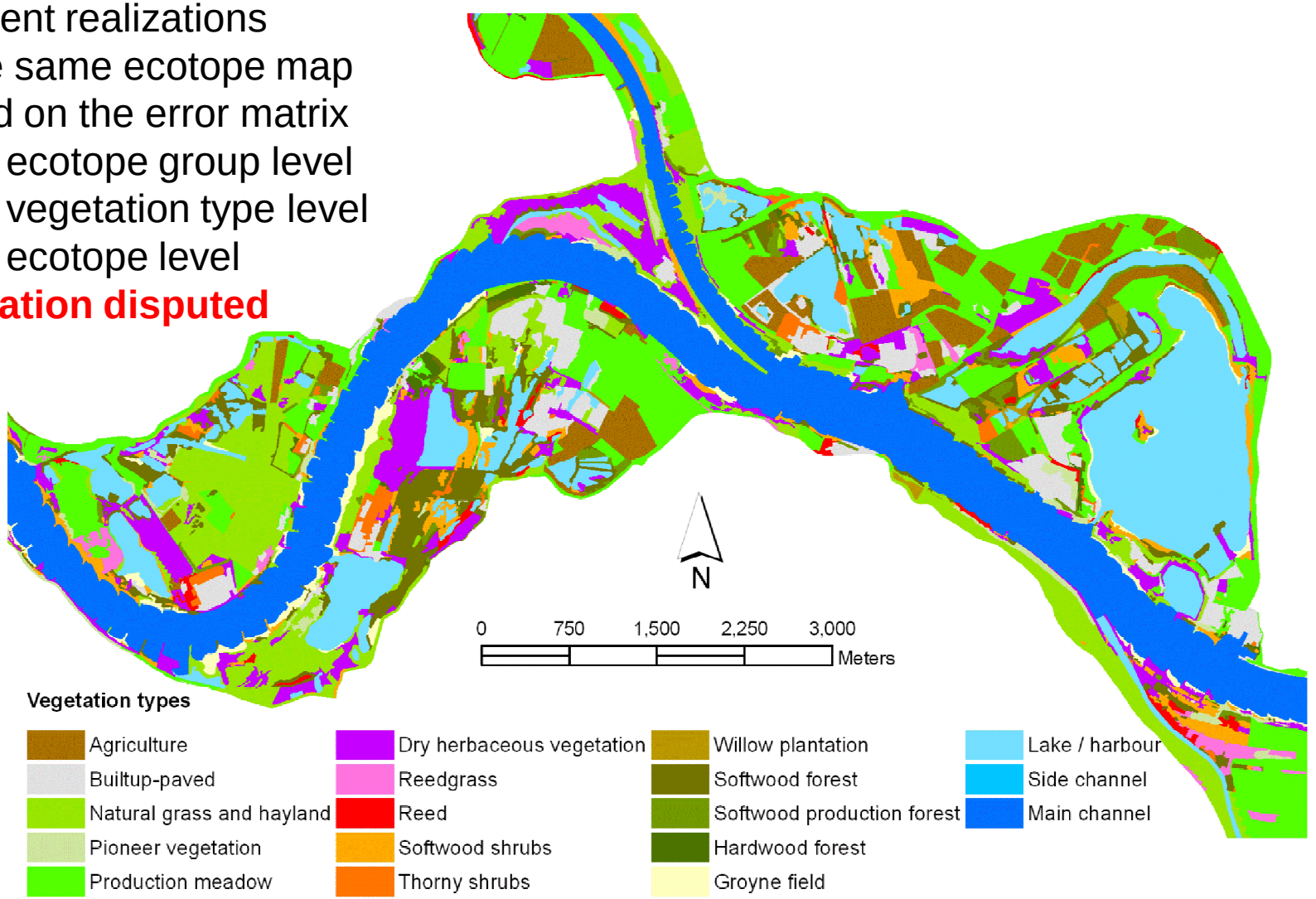
NAGA CITY, THE PHILIPPINES



UNCERTAINTY IN BASIC DATASET: LAND USE

RHINE RIVER, THE NETHERLANDS

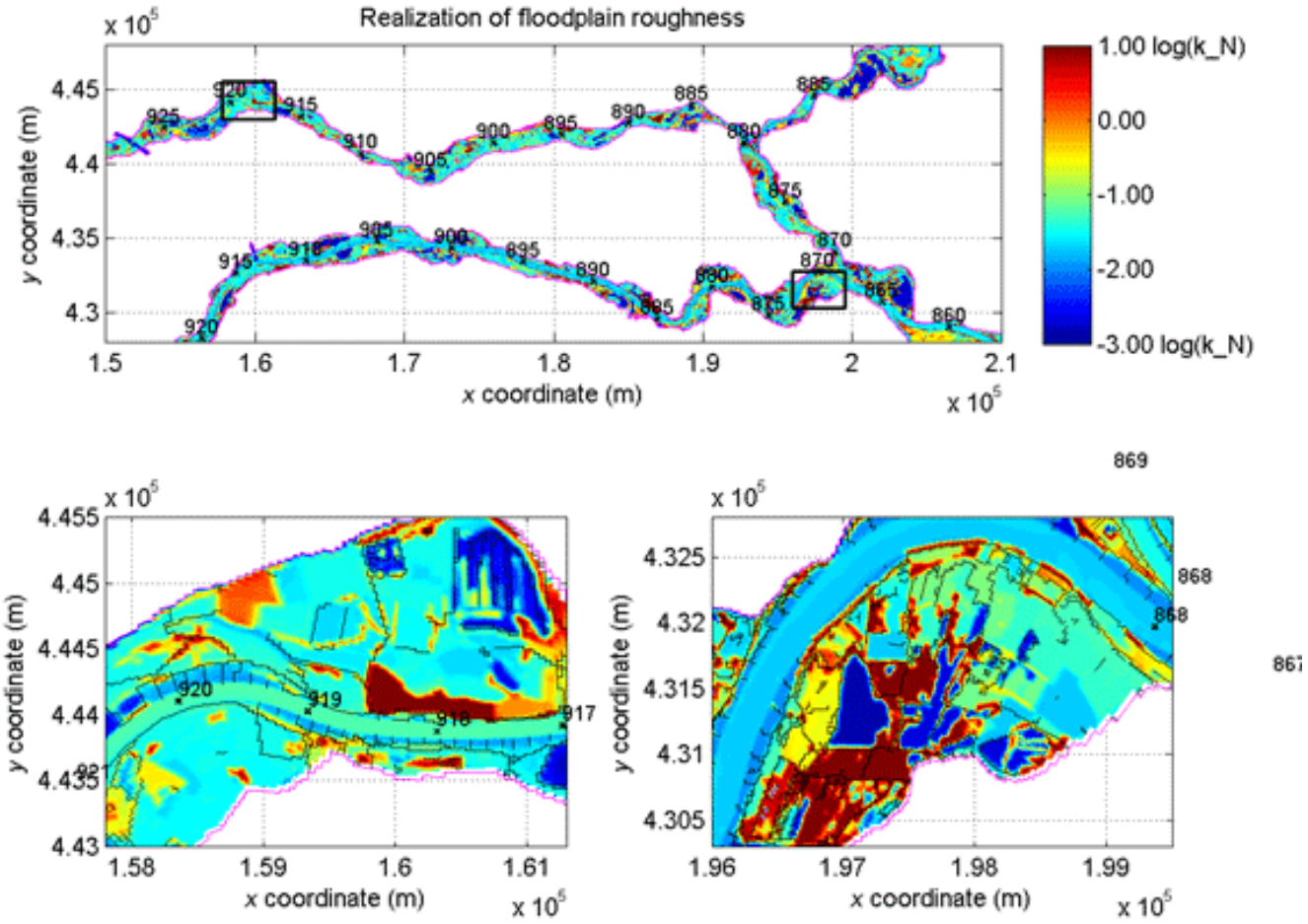
Different realizations
of the same ecotope map
based on the error matrix
69 % ecotope group level
67 % vegetation type level
37 % ecotope level
Validation disputed



ITC

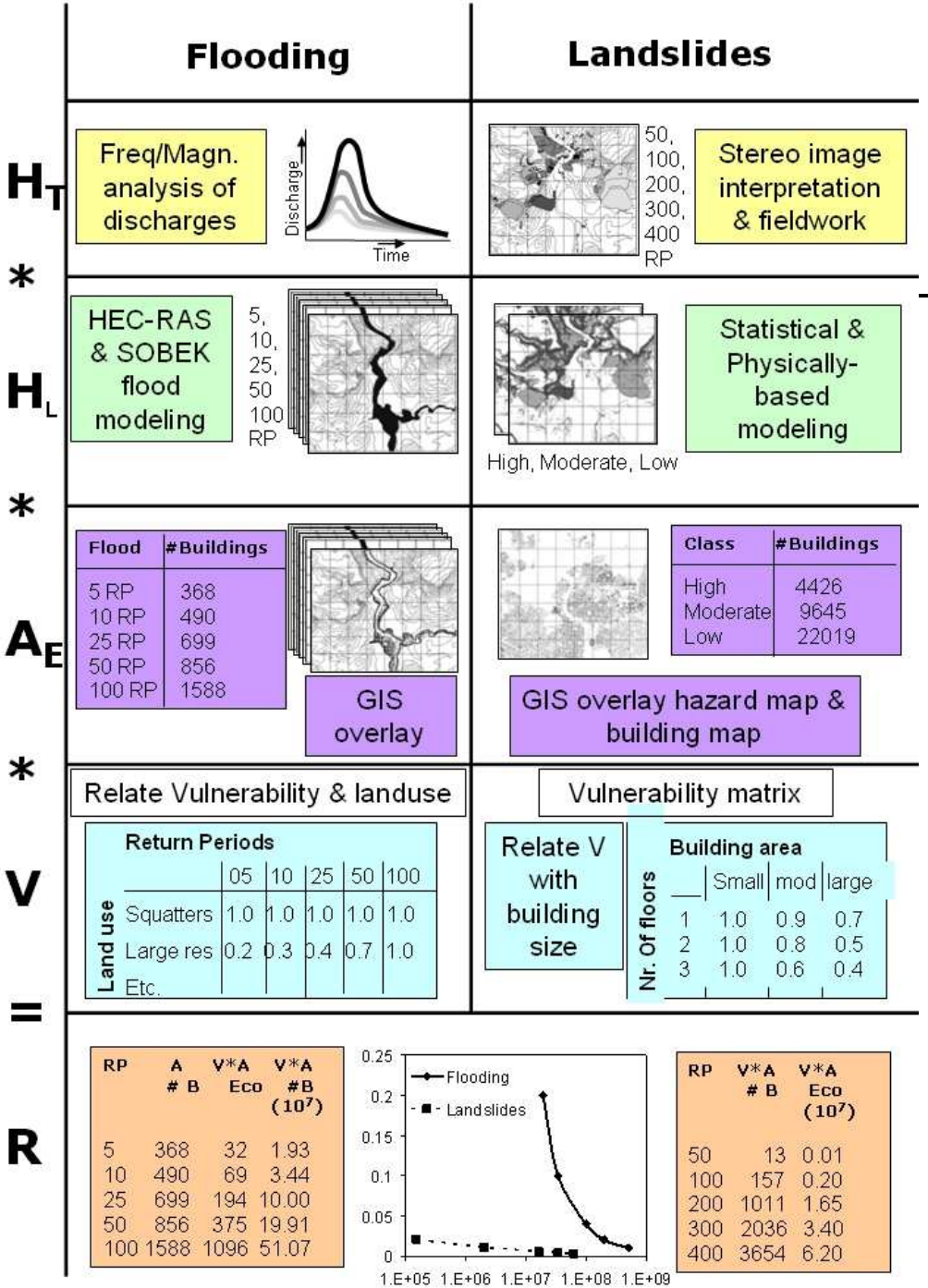
HYDRODYNAMIC EFFECTS

RHINE RIVER, THE NETHERLANDS



RISK ASSESSMENT

- Overview of entire process for flooding & landslides
- Individual GIS operations for each step
- Resulting in risk curves
- Same scheme for meteorological hazards
- Feedback if any condition changes



MARIE CURIE PROJECT: CHANGES

INTEGRATED RISK MANAGEMENT

CHANGES stands for: Changing Hydro-meteorological risks – as Analyzed by a New Generation of European Scientists

To develop an advanced understanding of

- how global changes will affect the temporal and spatial patterns of hydro-meteorological hazards and associated risks in Europe,
- how these changes can be assessed and modeled
- how these can be incorporates in sustainable risk management strategies, focusing on spatial planning, emergency preparedness and risk communication

OBJECTIVES

CHANGES PROJECT

1. Provide high-level training, teaching and research in the field of hazard and risk management in a changing environment context

2. Reduce fragmentation of research on natural processes

3. To develop an innovative methodological framework combined with modeling tools for probabilistic multi-hazard risk assessment taking into account changes in hazard scenarios and exposed elements at risk and for increasing risk awareness

WORK PACKAGES

CHANGES PROJECT

WP1: Modeling changes in hydro-meteorological multi-hazards

WP2: Evaluating changes in exposed elements at risk and their vulnerability

WP3: Development of a probabilistic risk assessment platform

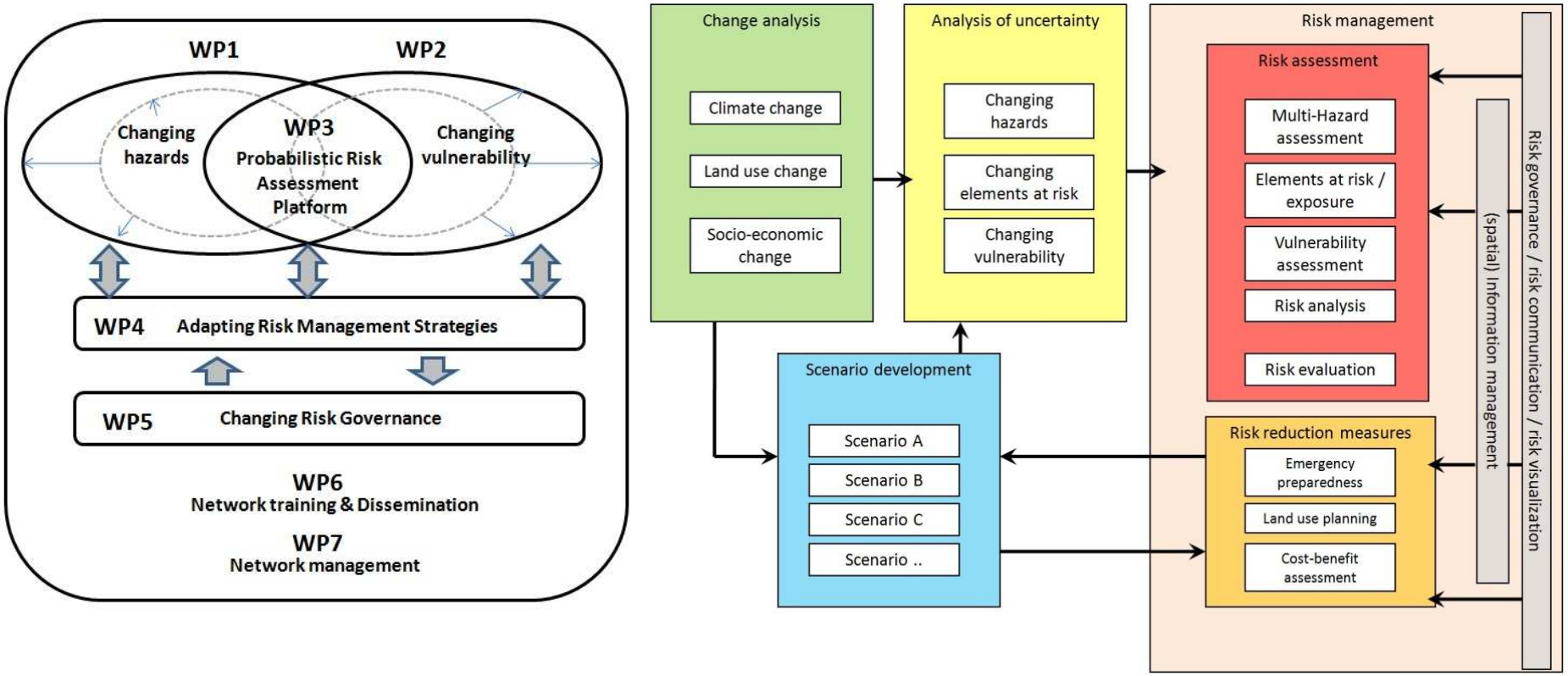
WP4: Adapting risk management strategies to future changes

WP5: Establishing the risk governance framework

WP6: Network coordination and training (leader: ITC, Cees van Westen)

FRAMEWORK

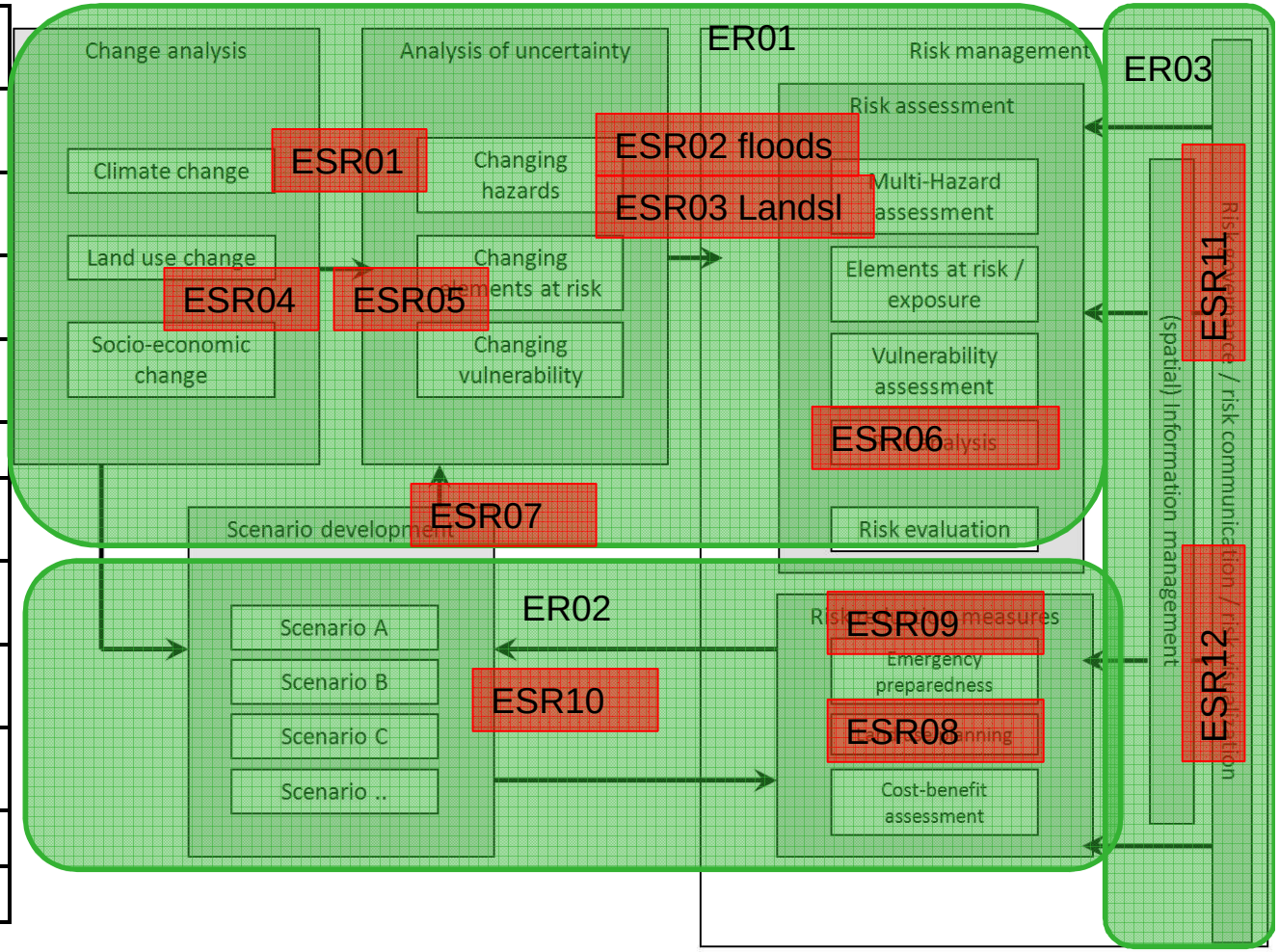
CHANGES PROJECT



LINK WITH ESR / ER POSITIONS

CHANGES PROJECT

ESR-01	Translation of the results of climate change models to expected changes in triggering conditions of hydro-meteorological hazards
ESR-02	Development and application of probabilistic models for flood hazard assessment at regional and local scales.
ESR-03	Development and application of probabilistic models for mass movement hazard assessment at regional and local scales.
ESR-04	Analysis of expected changes in ecosystems and land use patterns in relation to climate change and future economic development.
ESR-05	Expressing uncertainties in vulnerability and value of infrastructure, buildings and land use to hydro-meteorological hazards
ESR-06	Design of a tool for probabilistic risk assessment of hydro-meteorological hazards
ESR-07	Development of a method for constructing risk scenarios and risk maps with associated uncertainties
ESR-08	Use of risk information in Strategic Environmental Assessment and spatial planning
ESR-09	Development of an internet-based Decision Support System for the use of risk information in risk reduction
ESR-10	Emergency preparedness and early warning scenarios based on the outcomes of the probabilistic risk assessment
ESR-11	Comparing risk governance strategies for different EU countries,
ESR-12	Risk communication with a focus on risk visualisation tools.

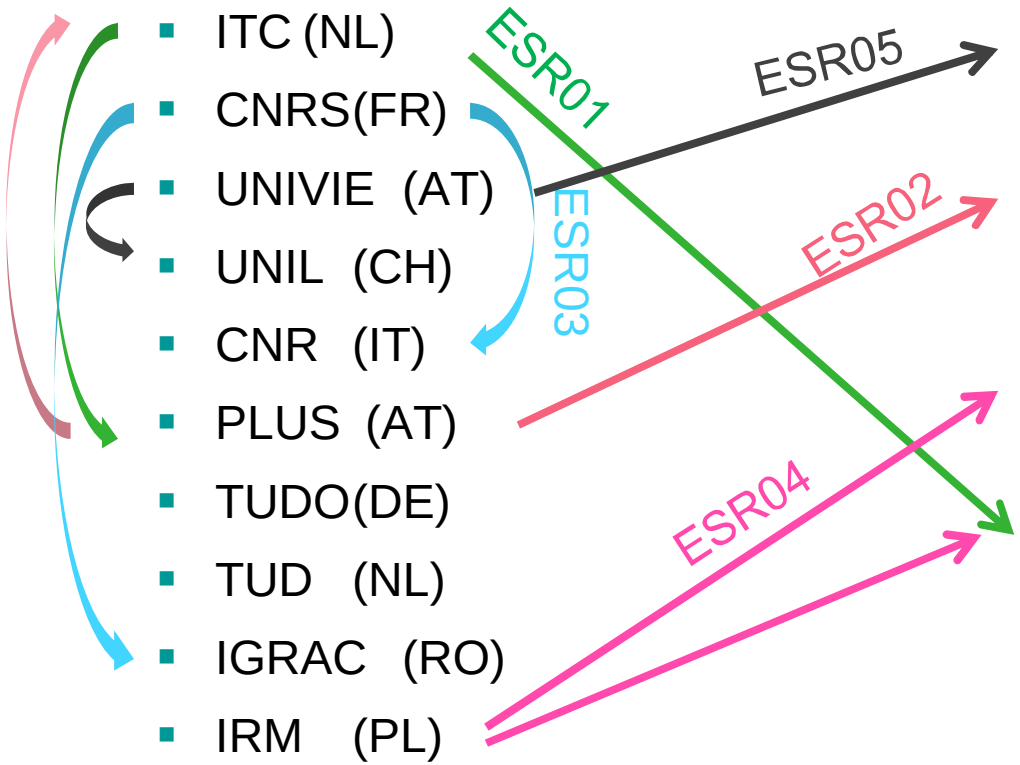


PARTNERS AND EXCHANGES

CHANGES PROJECT

Partners:

- ITC (NL)
- CNRS(FR)
- UNIVIE (AT)
- UNIL (CH)
- CNR (IT)
- PLUS (AT)
- TUDO(DE)
- TUD (NL)
- IGRAC (RO)
- IRM (PL)
- IIASA (AT)

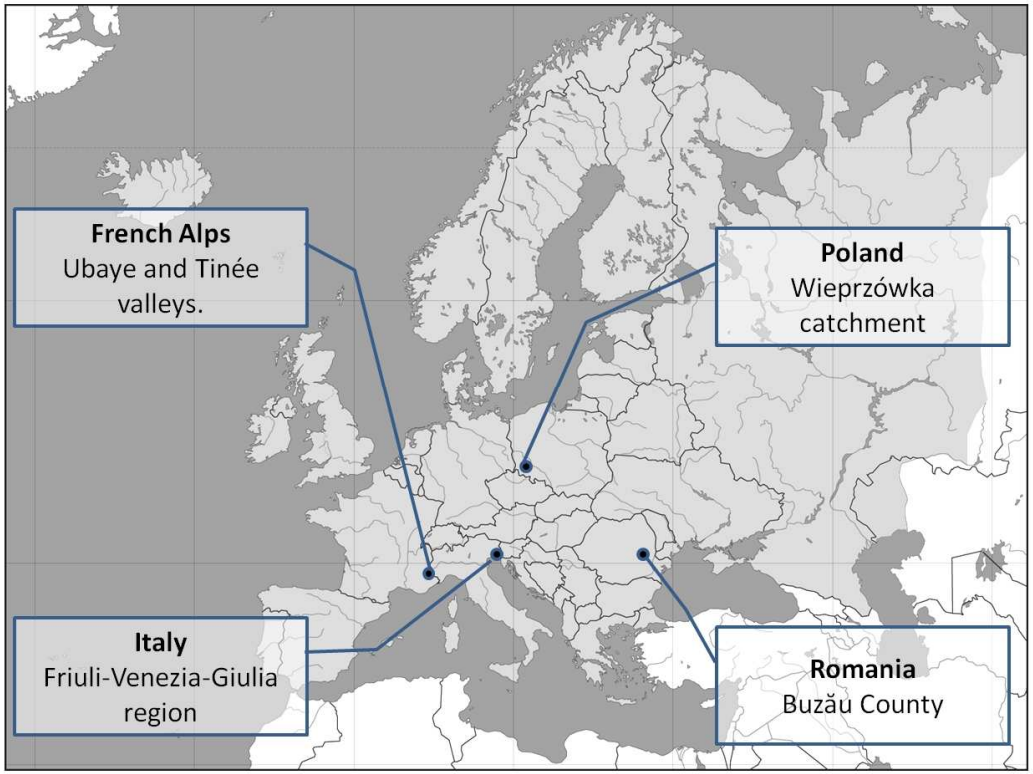


Associated partners:

- Risques & Developpement, (FR)
- Geomer Gmbh (DE)
- Alert Solutions (NL)
- Estudios de Riesgos Naturales (ES)
- Climate Change Risk Management (UK)
- Protezione Civile of Regione Friuli-Venezia-Giulia (IT)

PILOT AREAS

CHANGES PROJECT



- The project is not about study areas but about methodologies and tools
- ESRs should develop methods and apply them into at least two areas
- Interaction between ESRs is very important.
- Medium to small scales
- Open source methods
- ESR should be have appropriate disciplinary background & GIS experience

PRACTICALITIES

CHANGES PROJECT

- Starting date: January first
- Kick-off meeting: 13-14 January at ITC, Enschede, NL. All (associated) partners should be represented & advisory committee
- Project duration: 4 years
- Website coming soon

QUESTIONS?

- Ettema@itc.nl