Outline

1. What is a Digital Twin?

2. SCORE DT-EWS System Architecture
   - SCORE Digital Twin Structure
   - The User Scenario Evaluation (USE) module
   - **Ecosystem-Based Adaptation (EBA) solutions**
   - The Early-Warning Support (EWS) module

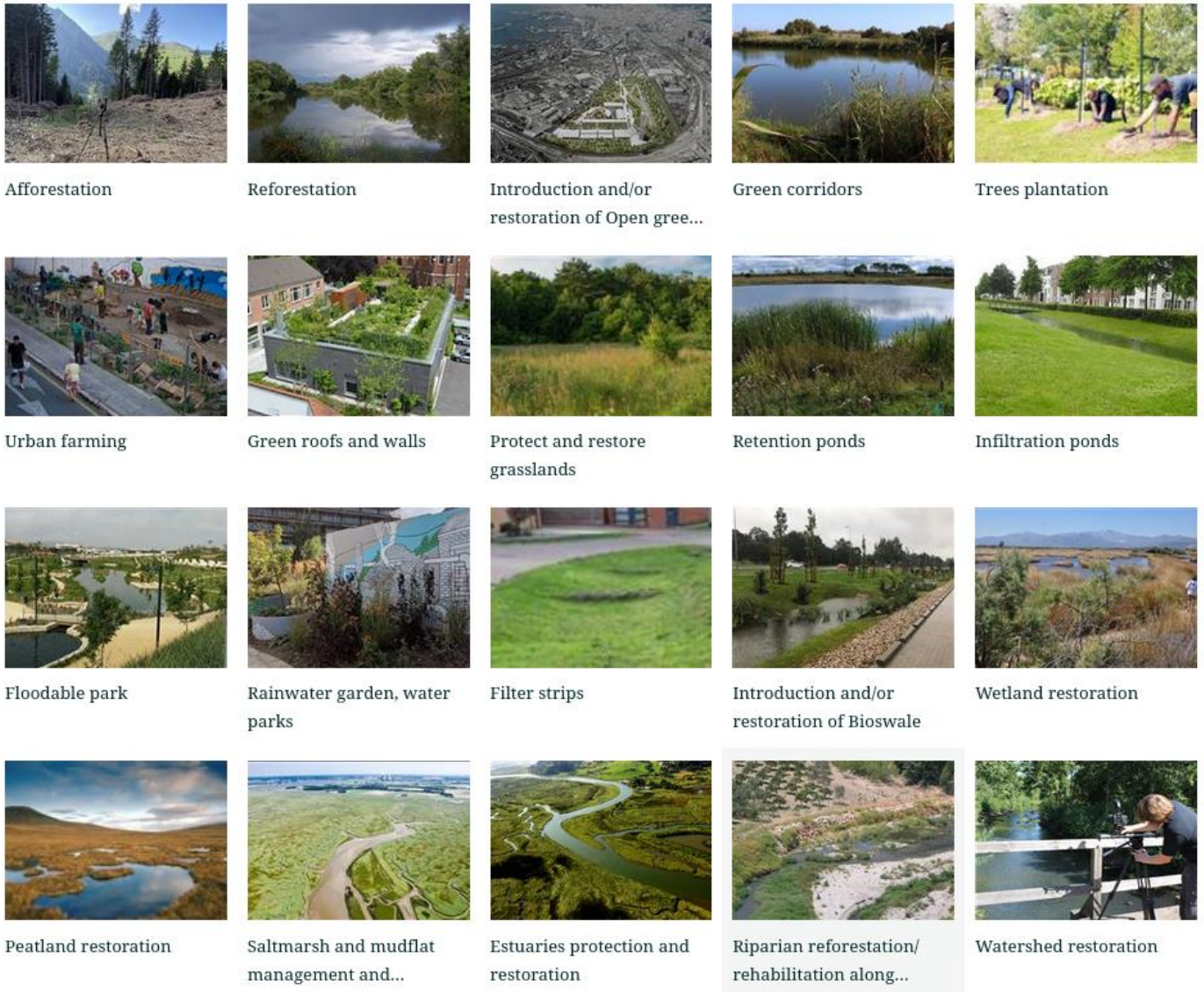
3. System usage:
   - The Grafical User Interface (GUI)
   - Simulations outputs: some examples

Ecosystem-Based Adaptation (1)

EBAs *makes use of* ***biodiversity and ecosystem services*** *as part of the strategy* ***to adapt to*** *the adverse effects of* ***climate change*** *and increase resilience.*

In SCORE, 33 types are divided in 6 categories:

- Urban green
- Permeable surfaces
- River floodplains
- Wetlands
- Coastal shoreline
- Marine waters



Ecosystem-Based Adaptation (2)

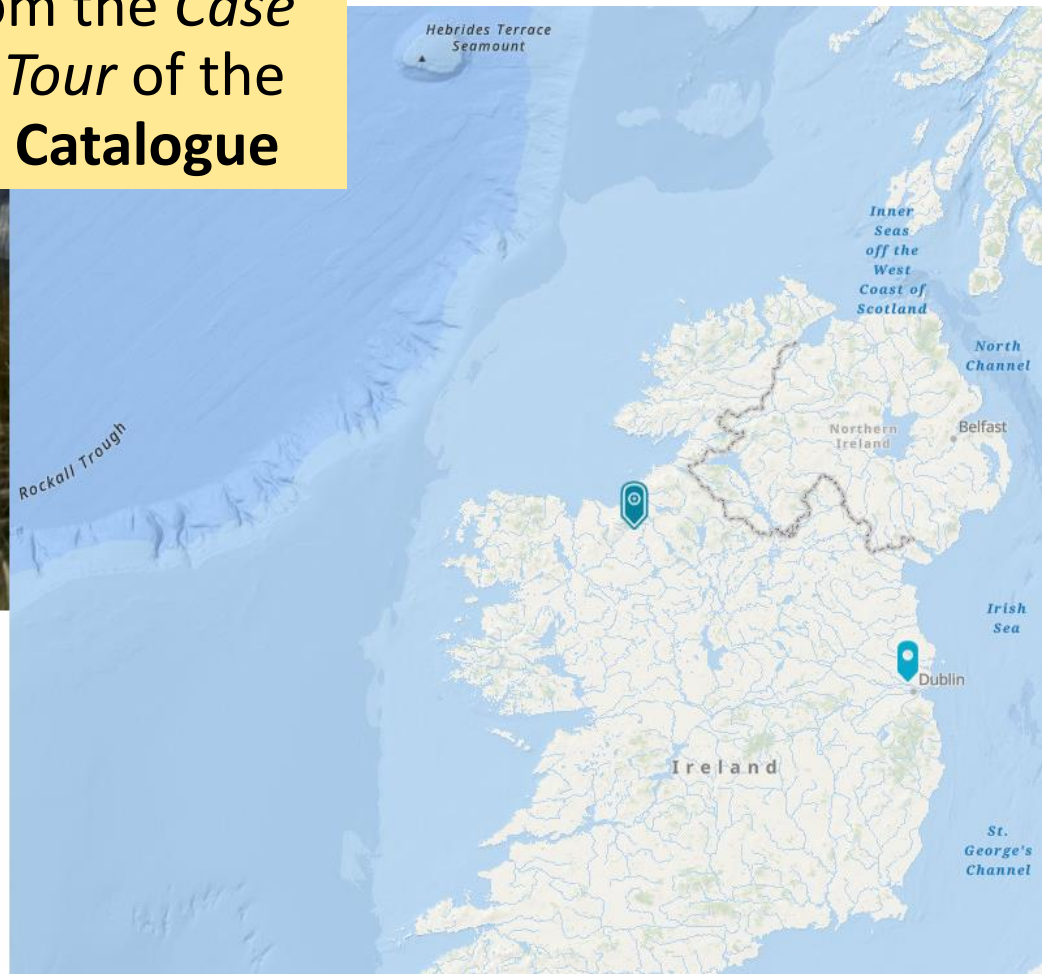
example from the *Case Study Map Tour* of the **SCORE Eba Catalogue**

Marram grass planting

Definition: Planting vegetation on sand dunes for coastal protection.

Objectives: to reduce flood risk and storm surges, to support biodiversity.

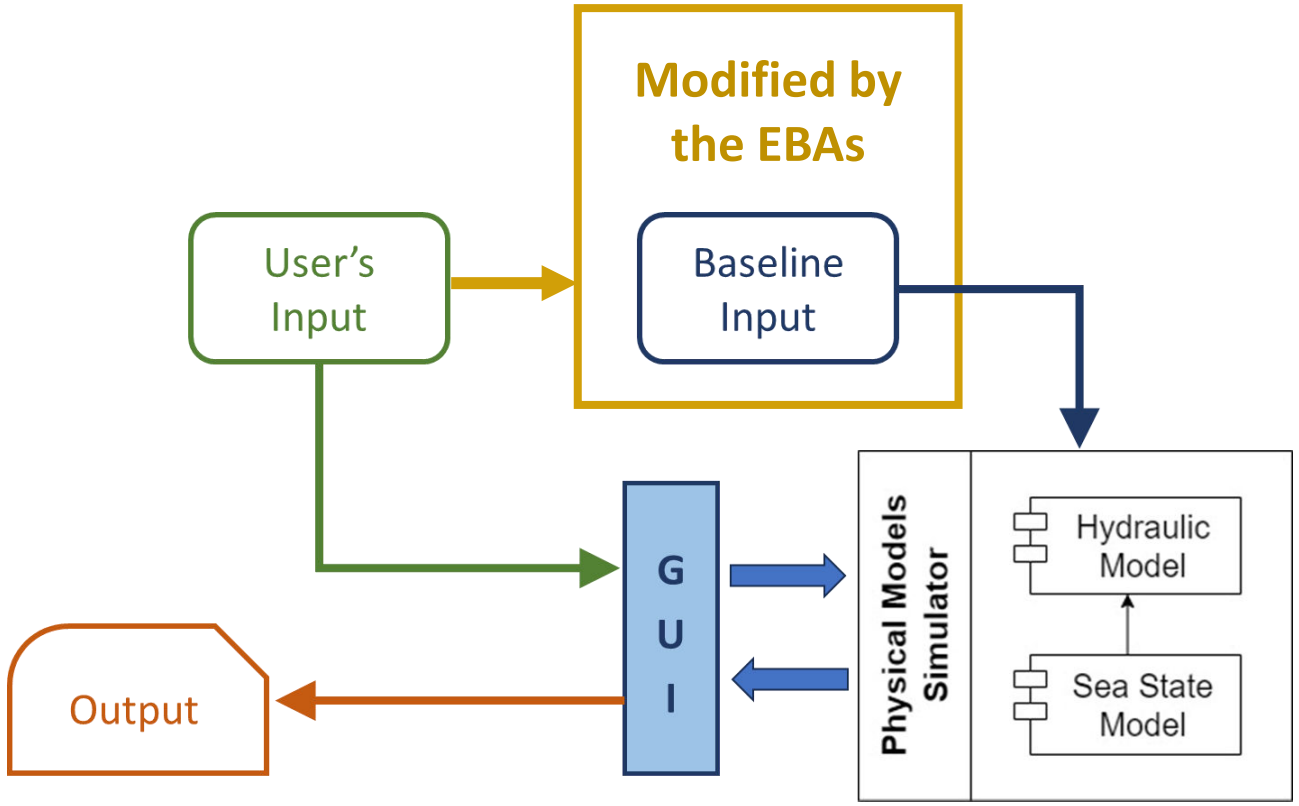
Benefits: coastal flood risk reduction; facilitate tourism and recreation; facilitate biodiversity; water quality and sediment management.



Ecosystem-Based Adaptation (3)

Effects of **EBAs can be simulated** through the USE subsystem

- Selected from the **SCORE catalogue**
- Definition on the application area in the Digital Terrain Model of the CCLL
- **Possible customization** depending on the specific EBA



Ecosystem-Based Adaptation (4)

Table 2-2d Runoff curve numbers for arid and semiarid rangelands 1/

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition 2/	A 3/	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

example of tabulated runoff coefficient of different terraincover types

Each EBA enters the hydraulic model as a modification of the baseline input

User's input

- The user **selects an EBA** type from the **SCORE catalogue**
- Th user **traces one or multiple polygons** on the city map where the **EBA type must be simulated**
- → **Manning coefficient** (local roughness **variation**)
- → **Curve Number** (local runoff / infiltration **change**)
- **Elevation** / shift (if applicable)

Ecosystem-Based Adaptation (5)

Manning's coefficient

- Related the **roughness or friction** of a surface
- Represents **the resistance of water to flow** in channels and floodplains
- It tells us if water flows away, or it **accumulates**, contributing to flooding
- Each point in the **DSM is associated to a certain value** of the Manning's coefficient

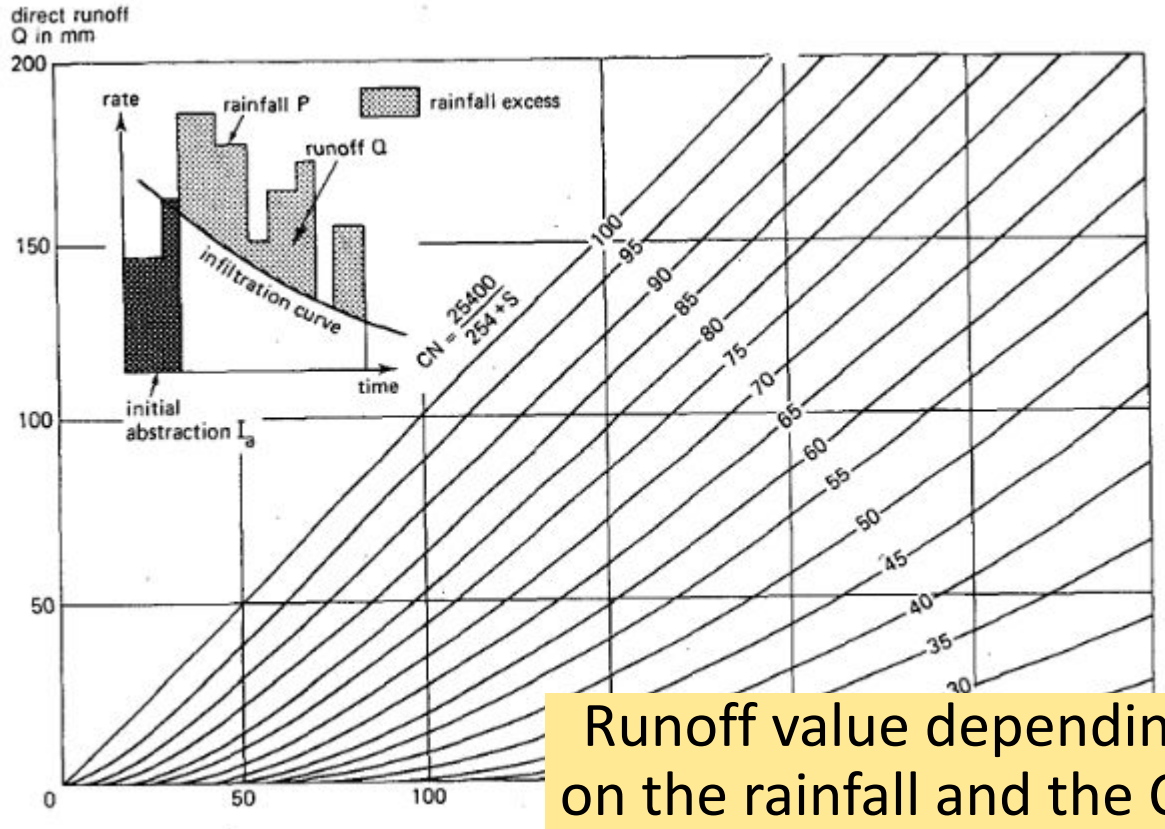
Land use type	Manning's n Value
Barren Land	0.030
Bush	0.050
Cultivation Area	0.035
Cutting Area	0.040
Forest	0.100
Grass land	0.035
Orchard	0.055
River	0.040
Sand	

example of tabulated roughness coefficient of different cover types (Chow, 1959)

Ecosystem-Based Adaptation (6)

Runoff Curve Number (CN)

- Related the **infiltration or porosity** of a surface, it models the amount of infiltration from a rainfall event
- It tells us if the soil **absorbs water**, or if **water accumulates** on the surface, contributing to flooding
- **Depending on the land use**, the treatment and hydrologic condition
- Each point in the **DSM is associated to a certain value** of the CN



Runoff value depending on the rainfall and the CN (USDA, TR55 1986)

Ecosystem-Based Adaptation (7)

Elevation or shift

- **Some EBAs** depends also on the **variation of elevation** of the terrain
- Can be **set up by the user** on a polygon with the GUI specifying:
  - 1) **New elevation** of the DSM
  - 2) **Shift** of the current shape

River bed deepening

Definition: The lowering and deepening of the riverbed accommodate greater depths of water to prevent overf

Objectives: to reduce peak flows and downstream flood room for water fluctuations, to facilitate sediment tran

Benefits: riverine flood risk reduction; heat stress risk r resources production; facilitate tourism and recreation storage and sequestration; facilitate biodiversity; water management.

Beach nourishment

Definition: Replenishment or nourishment of the lost beach sediment with suitable (preferably indigenous or identical) filling sediments, and preferably retrieved from local sources.

Objective: to protect beach, carrying capacity for recreation purposes under increasing sea-level rise.

Benefits: coastal flood risk reduction; facilitate tourism and recreation; facilitate biodiversity; improve cultural and social interaction; water quality and sediment management.

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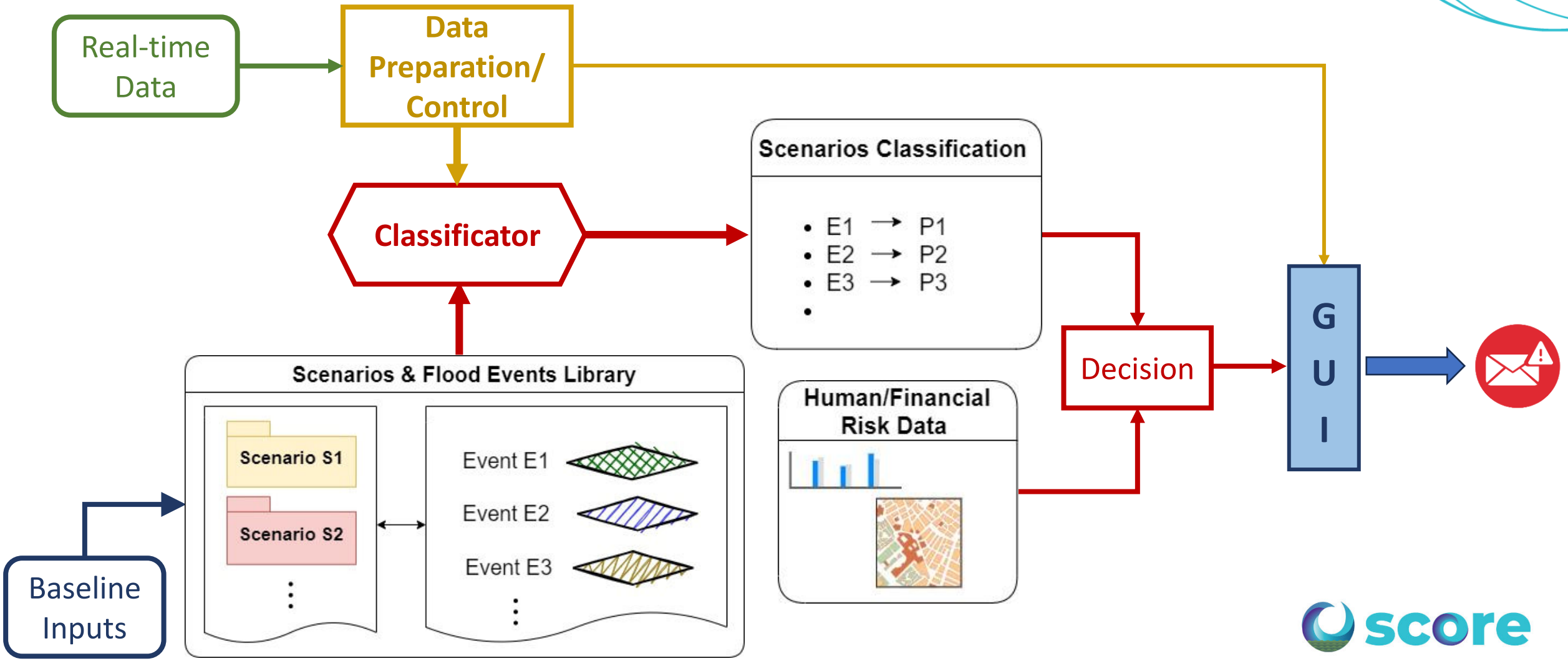
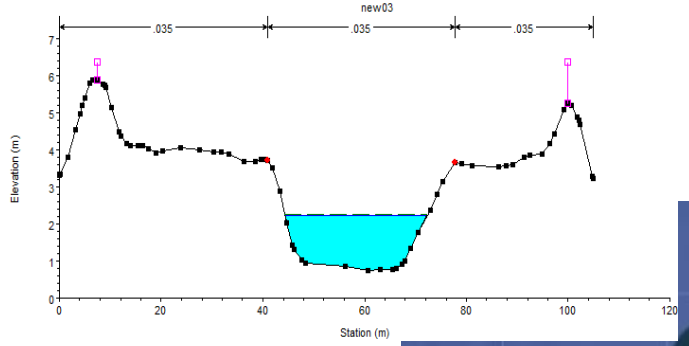
The Early-Warning Support module – Structure

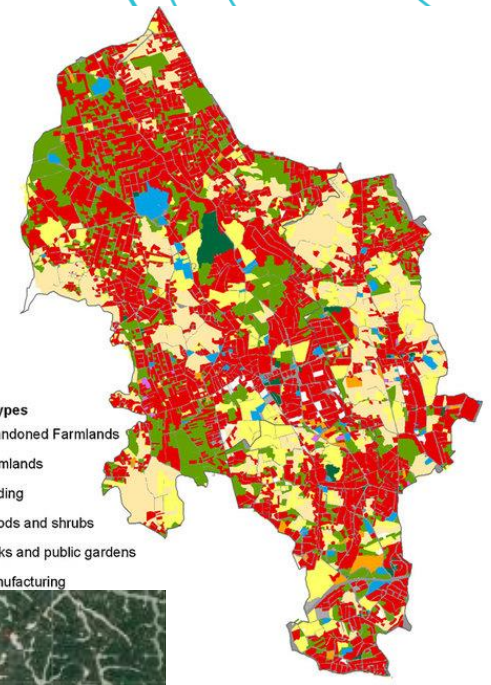
This subsystem is deputed to urban areas real-time monitoring

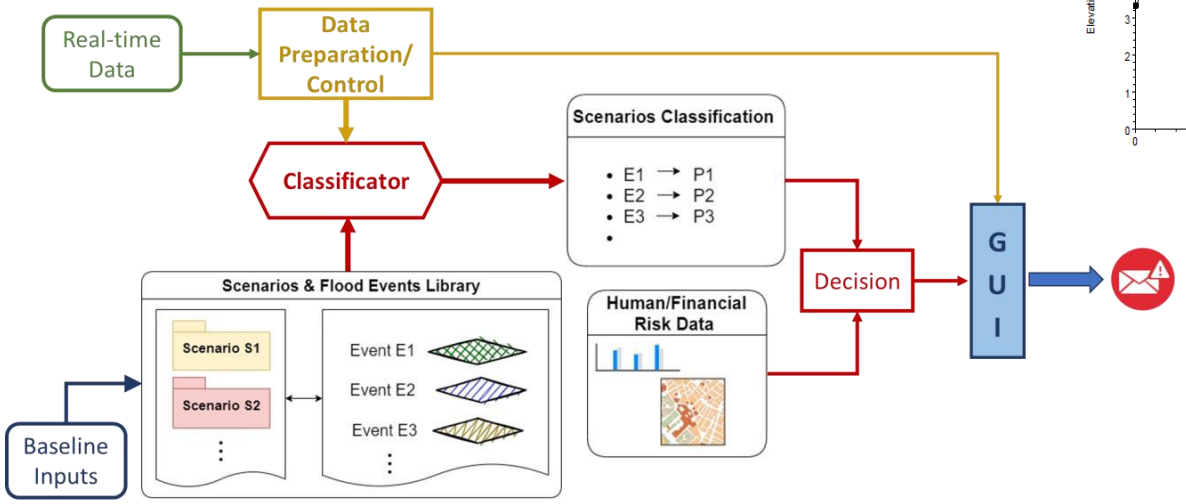


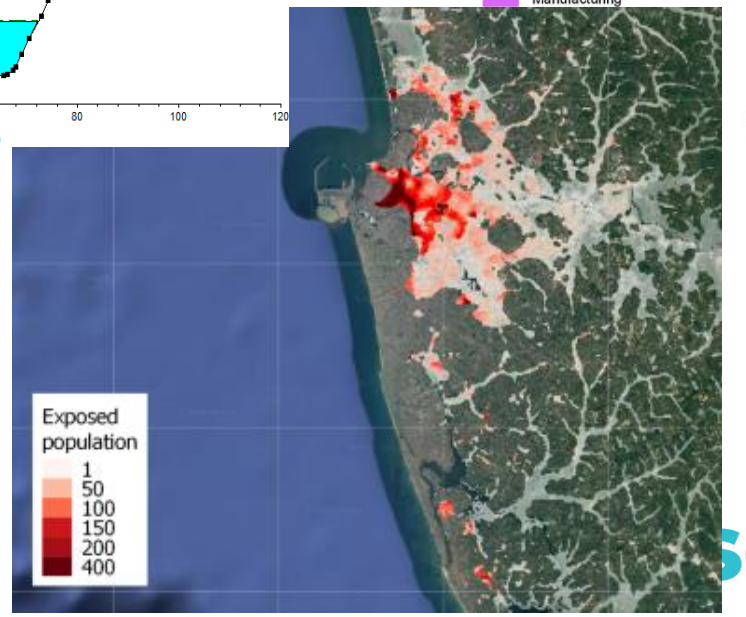
The Early-Warning Support module – Baseline Inputs

- The baseline data required by the EWS module are **the same as for the USE**





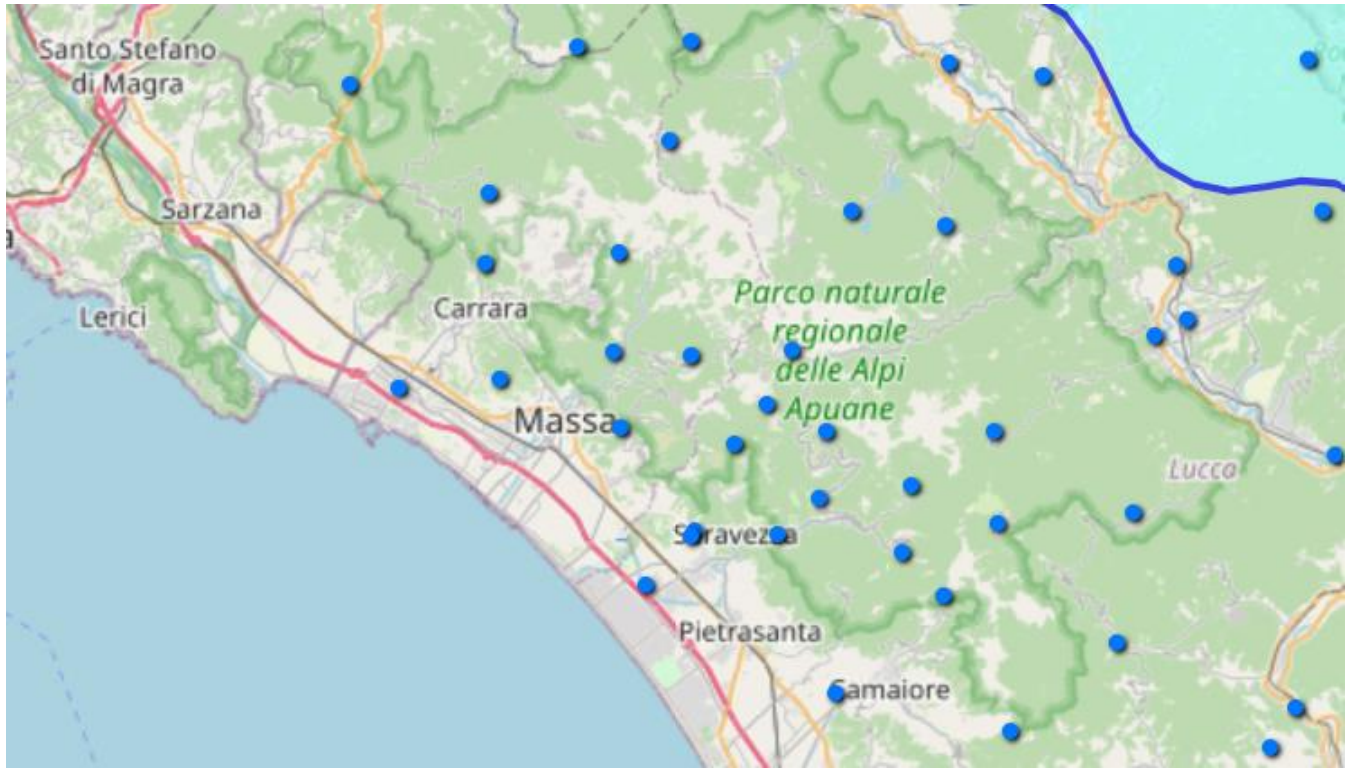




The Early-Warning Support module – Real-time data

Real-time Data

- **Data streams from official sensors** distributed on the study area
  - Rain rate
  - Rivers level/discharge
  - Sewage system level/discharge
  - Sea state
- Data from **weather forecasts**
- In the SCORE project, **citizen science sensors** will be also integrated into the network employed by the DT-EWS



The Early-Warning Support module – Outputs

- **Alerts:** In case of flooding/important damages, sent to officially appointed persons
- **Warnings:** Related to specific sensors, in case of inconsistent data streams
- Maps of the **expected flooding**
- **Human/financial** risk maps on the study area