



MOVIDA

Floods Directive Implementation in the Po River District:

first results of the implementation
of state of art modelling tools

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IAHR-SPAIN WATER WORKSHOP
Management of catastrophic risks in the marine
and continental water environment
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Context of the MOVIDA project

According to the Floods Directive, River Districts must update Preliminary Risk Analyses, Flood Hazard and Risk Maps, and Flood Risk Management Plans every 6 years

Activities implemented by the Po River District (13 universities/research centres involved)



State of art hydrological analysis (considering climate change effects) to update design precipitation and discharge data



Implementation of state of art modelling tools for the definition of flooded areas and the spatial distribution of water depth and velocity (i.e. hazard maps)



Implementation of state of art modelling tools for the definition of the spatial distribution of expected damage (i.e. damage/risk maps)

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Objective of the MOVIDA project

To reach an analytical evaluation of expected damage, to support the updating of the Floods Directive in the Po District, especially regarding the CBA of mitigation measures

Focus of the analysis

- Five macro-categories of exposed elements as identified by the Floods Directive: people, infrastructures, economic activities, cultural and environmental heritage, factories at major accident risk.
- Identification of **specific, physically-based models for each category** (and sub-categories)

Requirements of the methodological approach

- To guarantee consistency and applicability of results, at the level of each category and at the district scale
- To adopt **models calibrated/validated for the Italian context**, easy to be implemented by non-expert users





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Sub-objectives

- To identify institutional (if possible) **input data available for the whole District.**
- To standardise analysis outputs, i.e. definition of output maps
- To develop an **Open GIS Information System** to elaborate input data and to represent analysis output, by means of tables and maps

The screenshot displays the 'Anagrafe Agricola Unica - Data Warehouse e Open Data' website. The main content area is titled 'Osservatorio del Mercato Immobiliare' and features a table with the following data:

Pubblicazioni
Banche dati
> Quotazioni immobiliari
> Valori agricoli medi
> Volumi di compravendita

Below the table, there is a section for 'Quotazioni immobiliari' with a description: 'Le quotazioni immobiliari semestrali individuano, per ogni delimitata zona territoriale omogenea (zona OMI) di ciascun comune, un intervallo minimo/massimo, per unità di superficie in euro al mq, dei valori di mercato e locazione, per tipologia immobiliare e stato di conservazione. Quando per una stessa tipologia sono valorizzati più stati di conservazione è comunque specificato quello prevalente. In particolare:'

- per Box, Posti auto ed autorimesse non risulta significativo il diverso apprezzamento del mercato secondo lo stato conservativo;
- per Negozi e Centri commerciali il giudizio Ottimo (O) / Normale (N) / Scadente (S) è da intendersi riferito alla posizione commerciale e non allo stato conservativo dell'unità immobiliare.

Le quotazioni OMI, disponibili in un semestre, sono relative ai comuni censiti negli archivi catastali. E' quindi, possibile che l'elenco dei comuni presenti in Banca Dati differisca nei diversi semestri per effetto di variazioni circoscrizionali (in esito alle quali sono costituiti nuovi comuni e soppressi altri).

- *GeoPortali Regioni: Database Topografico*
- *Banca dati Istat: Censimento popolazione e abitazioni 2011, Database ASIA*
- *Anagrafe Agricola Regioni*
- *Agenzia delle Entrate - Osservatorio Mercato Immobiliare*



MOVIDA - MOdello per la Valutazione Integrata del Danno Alluvionale

Working group



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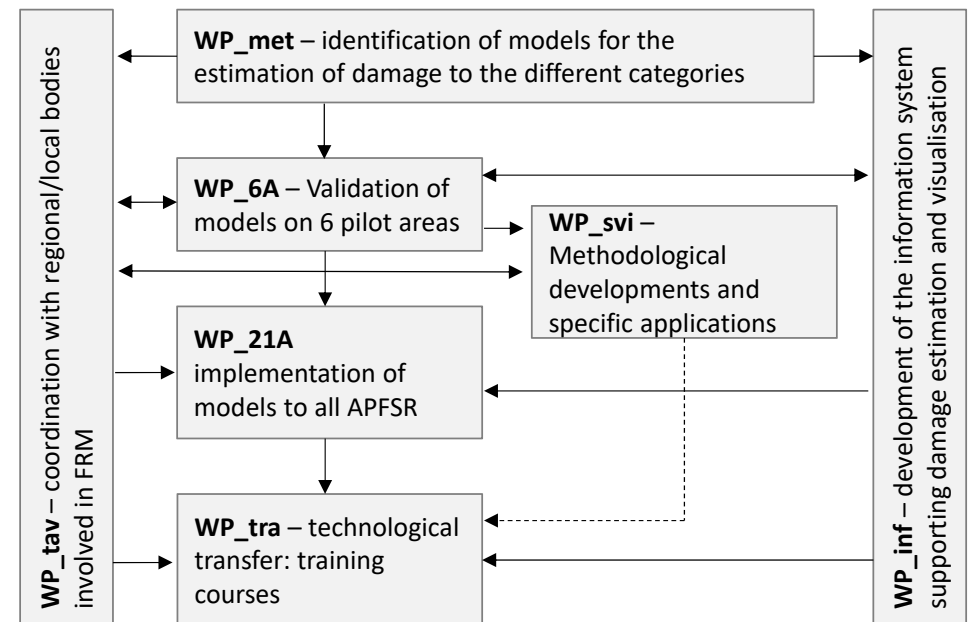


POLITECNICO
MILANO 1863

*Francesco Ballio
Daniela Molinari
Alice Gallazzi*

Structure of the project

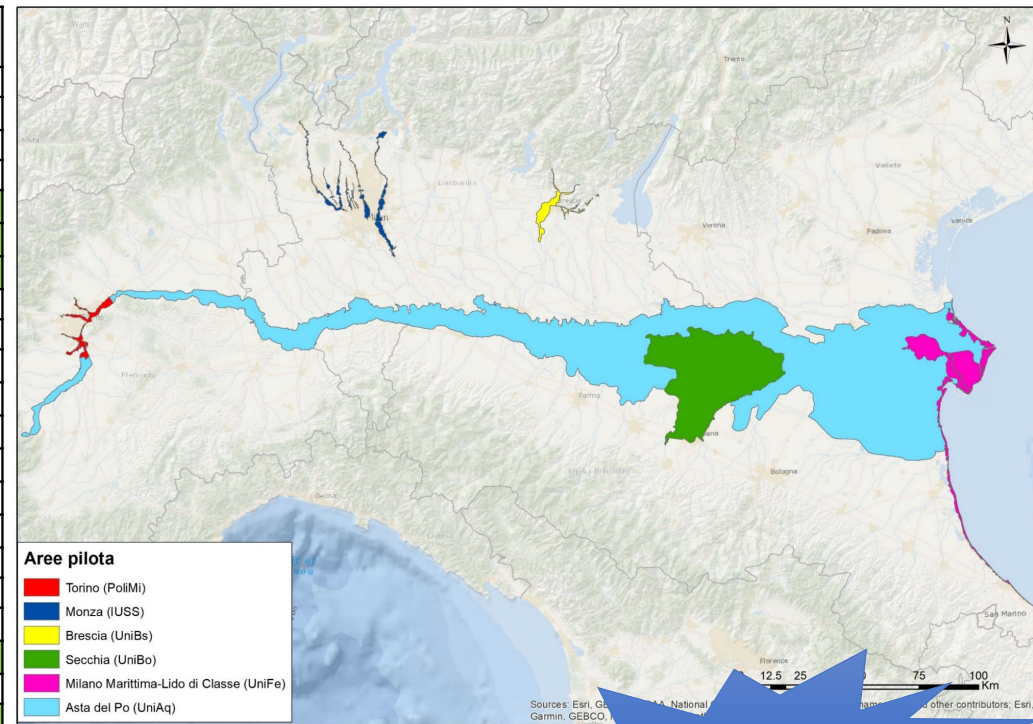
- 3 methodological steps (WP_met, WP_6A, WP_21A)
- 3 supporting activities (WP_inf, WP_tav, WP_tra)
- Methodological developments and specific applications (WP_svi)





State of art: development and implementation of the methodology on six pilot areas

Exposed element	Level 1 (quantitative)	Level 2 (qualitative)	Level 3 (descriptive)
People			
Strategic infrastructures			
Roads and railways			
Other network			
Strategic buildings			
Economic activities			
Residential buildings (structure)			
Residential buildings (contents)			
Industrial and commercial activities (structure)			
Industrial and commercial activities (equipment)			
Agricultural activities (certain crops)			
Agricultural activities (other crops, livestock)			
Cultural and environmental heritage			
Cultural heritage			
Environmental heritage			
Factories at major accidental risk			



Meso-scale



Residential buildings: Level 1: quantitative evaluation of expected damage

METHODOLOGY

Modelling approach: evaluation of the economic damage to building structures by a set of models: simple-INSYDE (PoliMi), Carisi et al. (UniBo), Arrighi et al. (UniFi)

Map scale: ISTAT census block (meso-scale)

Scale of analysis: micro-scale (individual building); meso-scale (ISTAT census block) where micro-scale data are not available (i.e. Regional Database- DBTR)

Hazard data: FRMPs hazard maps

Physical exposure data: DBTR; where DBTR is not available, ISTAT – Population and household census 2011

Economic exposure data: CRESME – Italian Research Centre for the building sector

Vulnerability data: ISTAT – Population and household census 2011, Real Estate property database – 2019

Damage indicator:

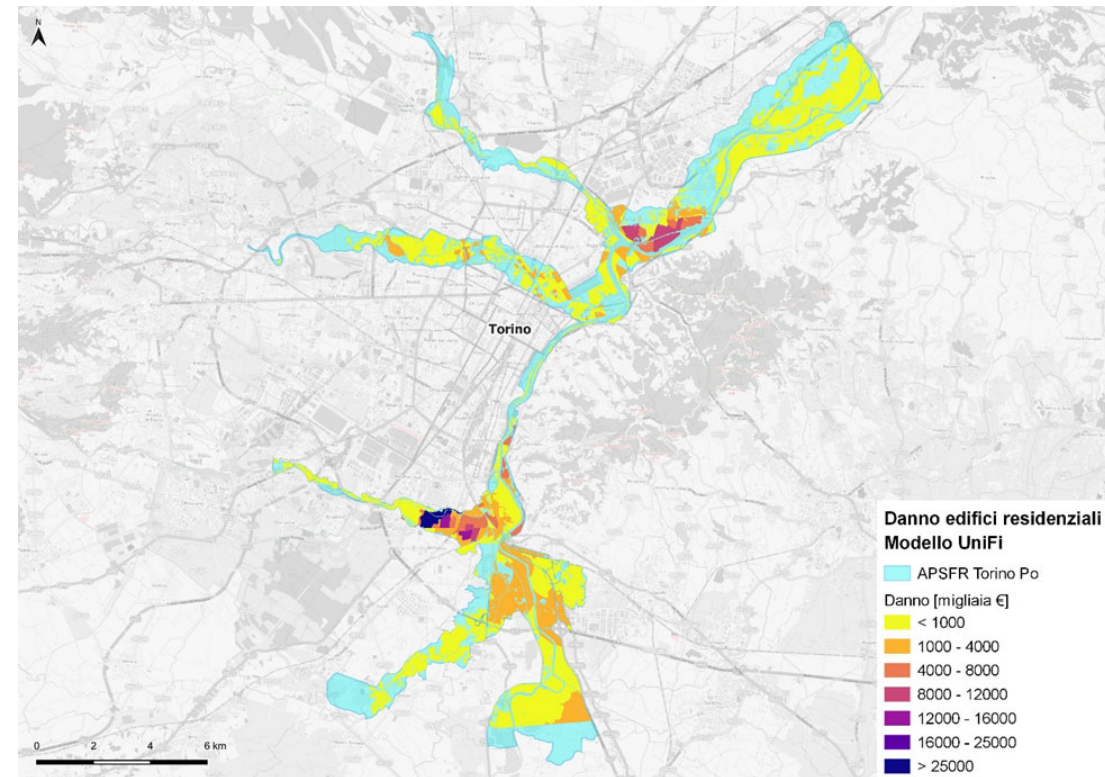
- Economic damage to building structure (€)



Residential buildings: Level 1: quantitative evaluation of expected damage

Exposed residential buildings	Low probability scenario (TR=500 y)
Buildings in the flooded area [n.]	6 096
Surface of buildings in the flooded area [m ²]	1 099 775
Economic value of exposed buildings [M€]	1 675
Average Economic value per building [€]	274 728

Economic damage to the structure of exposed buildings	Low probability scenario (TR=500 y)
Total damage Arrighi et al. (UniFi) [M€]	447
Total damage Carisi et al. (UniBo) [M€]	243
Total damage Simple-INSYDE (PoliMi) [M€]	133
Average damage per building Arrighi et al. (UniFi) [€]	73 270
Average damage per building Carisi et al. (UniBo) [€]	39 833
Average damage per building Simple-INSYDE (PoliMi) [€]	21 823



Damage to residential buildings per census block – model by Arrighi et al.



Economic activities (industrial & commercial): Level 1: quantitative evaluation of potential damage (i.e. exposure)

METHODOLOGY

Modelling approach: evaluation of the economic value of building structures and equipment by means of the Flood-IMPAT procedure

Map scale: ISTAT census block (meso-scale)

Scale of analysis: meso-scale (ISTAT census block)

Hazard data : FRMPs hazard maps

Physical exposure data : ISTAT – Industry census 2011, ISTAT – ASIA (2018)

Economic exposure data : ISTAT – National data on economic activities (2018)

Vulnerability data: ISTAT – Industry census 2011, ISTAT – ASIA (2018)

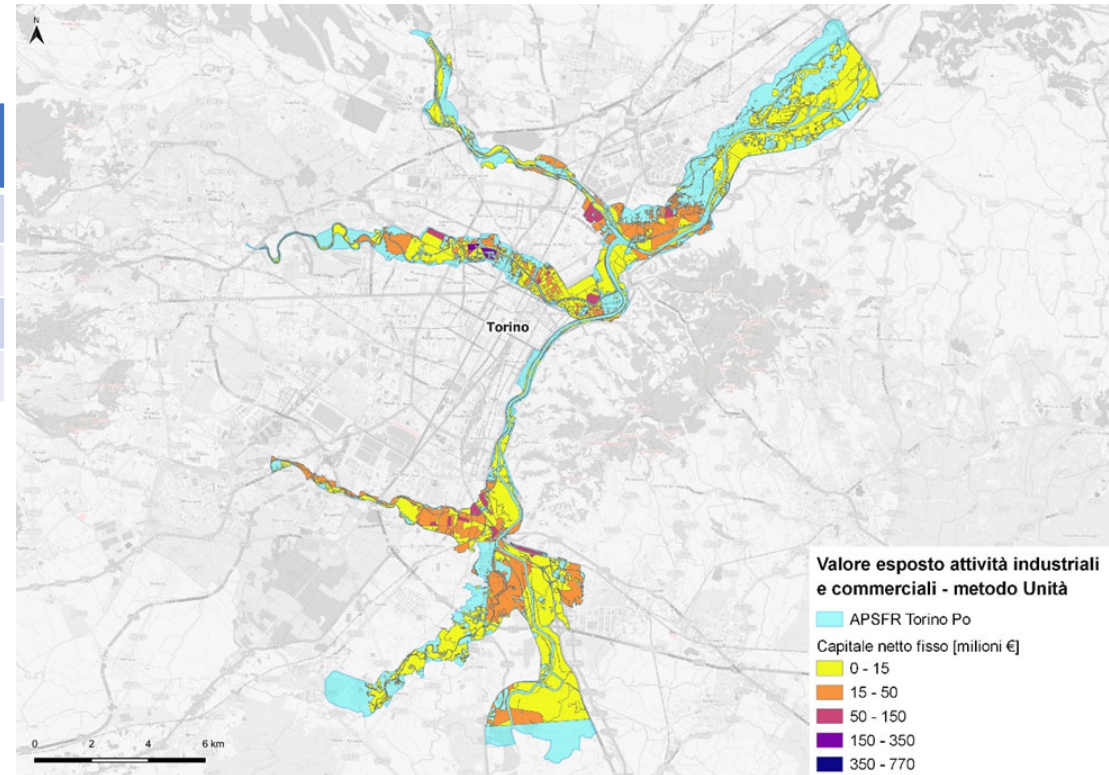
Potential damage indicators:

- Net capital stock of structure per NACE code (€)
- Net capital stock of equipment per NACE code (€)



Economic activities (industrial & commercial): Level 1: quantitative evaluation of potential damage (i.e. exposure)

Exposed economic activities	Low probability scenario (TR=500 y)
Activities in the flooded area [n.]	6 173
Employees in the flooded area [n.]	31 726
Net capital stock – structure [M€]	7 495
Net capital stock – equipment [M€]	1 213

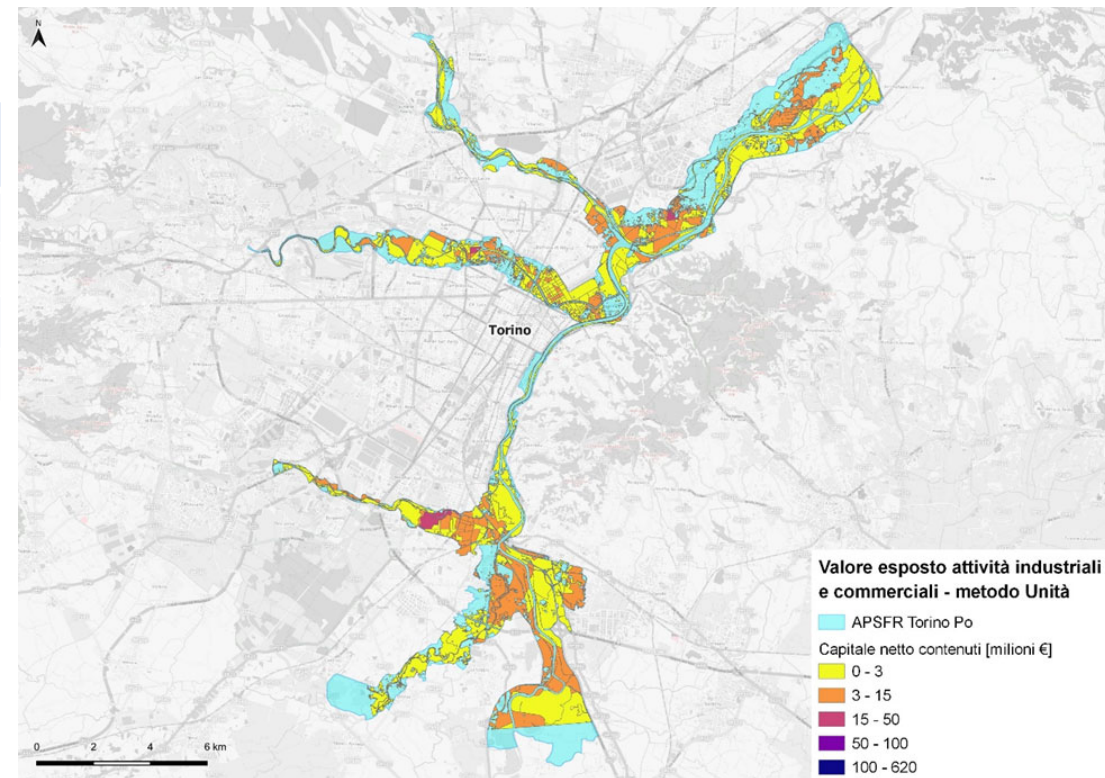


Economic value of economic activities structure, per census block



Economic activities (industrial & commercial): Level 1: quantitative evaluation of potential damage (i.e. exposure)

Exposed economic activities	Low probability scenario (TR=500 y)
Activities in the flooded area [n.]	6 173
Employees in the flooded area [n.]	31 726
Net capital stock – structure [M€]	7 495
Net capital stock – equipment [M€]	1 213



Economic value of equipment of economic activities, per census block



Roads & railways

Level 2: qualitative evaluation of expected damage

METHODOLOGY

Modelling approach: qualitative evaluation of functional damage by means of a new, ad-hoc method + collection of anecdotal data regarding the physical damage

Map scale: individual tract

Scale of analysis: individual

Hazard data : FRMPs hazard maps

Physical exposure and vulnerability data: Open Street Map, National and Regional Data

Anecdotal data: National Research Council Archive

Qualitative damage indicators:

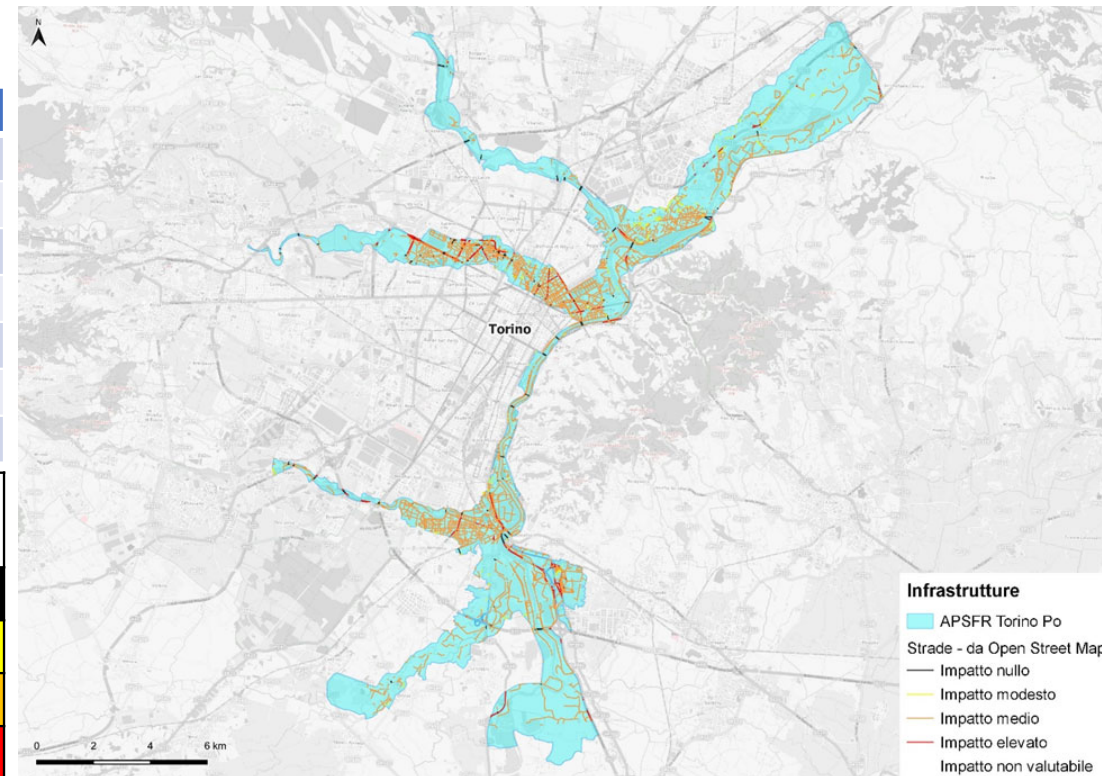
- Length of tracts with low impact (km)
- Length of tracts with significant impact(km)
- Length of tracts with high impact(km)



Roads & railways Level 2: qualitative evaluation of expected damage

Length of exposed tract by road typology [km]	Low probability scenario (TR=500 y)
Highways	4.0
Main roads	34.1
Secondary roads	167.2
Country/minor roads	123.6
Other (e.g. pedestrian, cycling)	106.3
Tunnels	1.9
Bridges	18.0

Length of exposed tract, by impact class [km]	Low probability scenario (TR=500 y)
No impact	18.0
Low impact	9.9
Significant impact	388.8
High impact	38.4
Not evaluable	0.0



Impact on the road network



ISYDE: open source GIS Information SYstem for Damage Estimation

- Development of a PostgreSQL database, with PostGIS extension, for the management/sharing of input and output data by project partners (i.e. project repository).
- **Implementation in «ISYDE» of developed models for the categories: residential buildings, roads & railways, population**

The screenshot shows a software window titled "Modello_db_piemonte" with the subtitle "Interface for the estimation of flood damage to residential buildings". The window contains a "Parametri" tab and a "Log" button. Below these are several input fields, each with a dropdown menu and a "..." button:

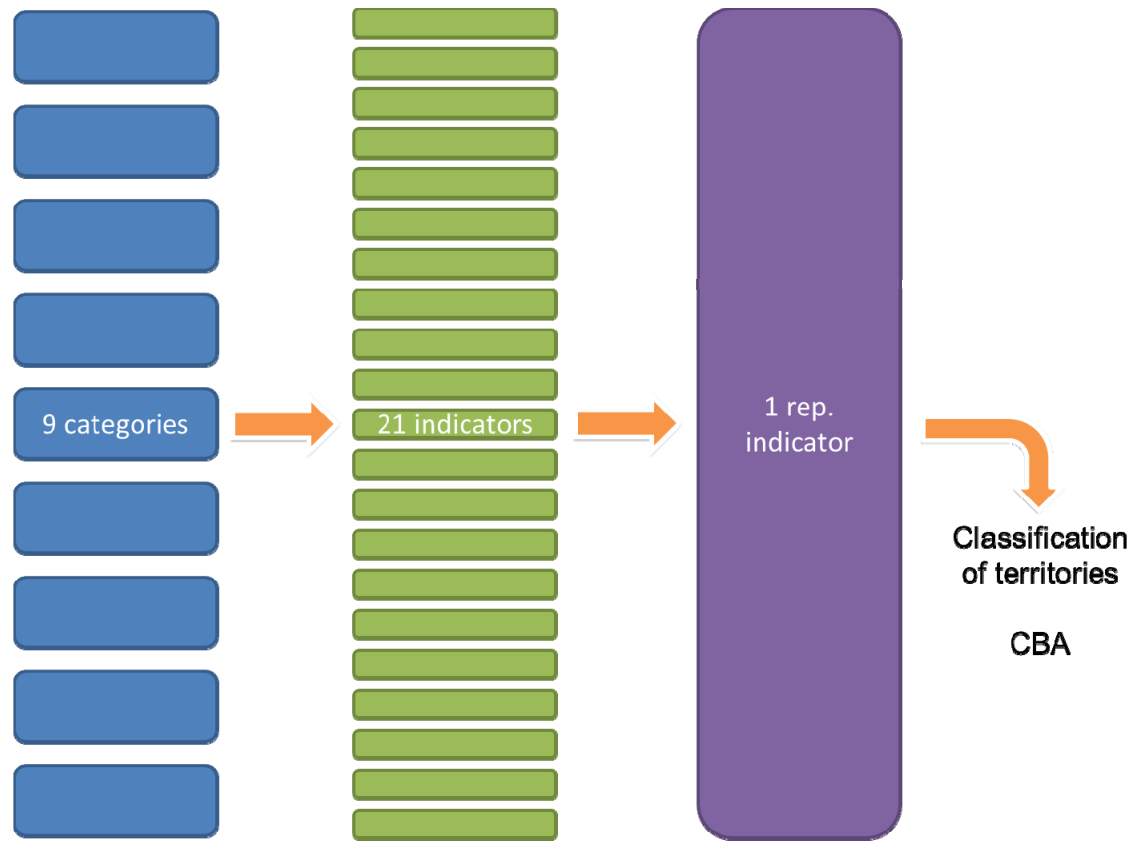
- Mappa tirante idraulico
- Edifici poligoni
- Fascia pericolosità
- Sezioni censuarie
- Unità volumetrica
- Zone OMI

There are also two sections for output layers:

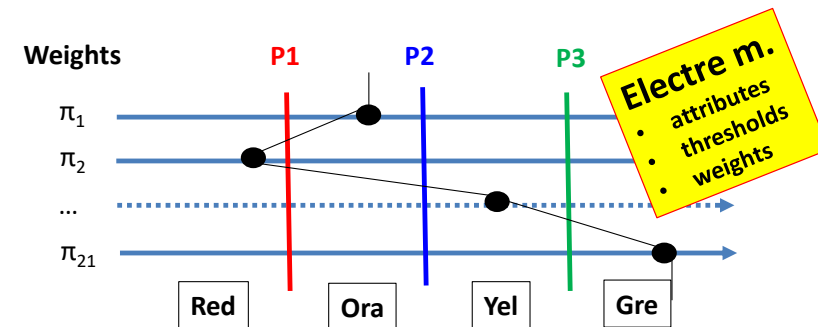
- output_micro**: [Crea layer temporaneo] ...
 Apri il risultato dopo l'esecuzione dell'algoritmo
- output_meso**: [Crea layer temporaneo] ...
 Apri il risultato dopo l'esecuzione dell'algoritmo

At the bottom, there is a progress bar showing "0%", an "Annulla" button, and a "Esegui come Processo in Serie..." button. On the right side, there are "Esegui" and "Chiudi" buttons.

Next steps: Development of a damage representative index



Multicriteria rating model



Next steps: WP_svi

Population:

- *Evaluation of commuters*
- *Identification of hotspot*
- *Evaluation of the probability for people to be damaged on the bases of hazard intensity*
- *Development of a model for the estimation of physical damage (i.e. death)*
- *Development of a model for the estimation of indirect damage*
- *Development of a model for the estimation of emergency costs linked to people*

Roads and Railways

- *Development of a model for the estimation of functional damage to subways*
- *Development of a model for the estimation of indirect damage linked to traffic disruption, on the basis of data on traffic flows*

Residential buildings

- *Development of a model for the estimation of damage in coastal areas*
- *Identification of a representative model among the three actually implemented*



Next steps: WP_svi

Economic activities (industrial and commercial)

- *Development of a new methodology to estimate the economic value of activities, on the basis of micro-data on business economic balance*
- *Evaluation of indirect damage to business (i.e. lack of income) for a pilot area*

Agricultural activities

- *Use of satellite data to define cultural types*
- *Extension of the implemented model to the coastal area, including the effect of salinity*

Cultural heritage

- *Evaluation of indirect damage, in terms of loss of visitors/tourists, for a pilot area (e.g. in an art city)*

Historical analysis

- *Development of complementary damage maps on the basis of historical damage data*



Next steps: dissemination and communication

Audience	Activity	Date
Universities	attendance EGU2021	30-apr
	attendance IDRA2021	June
	attendance IAHR - Spain	17-mar
	organisation/attendance GIT2021	June
	special issue	march/April
	scientific publications	to be defined
	final workshop	December
Technicians	webinars on flood risk for professional associations	April/September
	training course for engineers/geologists	November/December
	publication on technical magazines	from March
	contributions on technical websites	to be defined
	attendance REMTECH	September
	attendance ECOMONDO	September
	attendance to online target events	to be defined
Technical guidelines/book	December	
Business	Meeting with the insurance sector	January 2022
	webinars on flood risk	to be defined
Citizens/lay people	Research night	September
	Seminar for university students	September
	Short dissemination videos on YouTube	march/April
	Attendance to local events	to be defined

