08/05/2019

Barbara Zanuttigh

METTIAMOCI
IN RIGA

Tecnologie innovative per coste europee più sicure in un clima che cambia

UNIONE EUROPEA
Fondo Sociale Europeo
Fondo Europeo di Sviluppo Regionale

Agenzia per la Coesione Territoriale

MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

PON GOVERNANCE E CAPACITÀ ISTITUZIONALE 2014-2020

SOGESID SPA
INGEGNERIA TERRITORIO AMBIENTE

Title: Innovative technologies for safer European coasts in a changing climate (THESEUS)

Instrument: Large Integrated Project - FP7

Total Cost: 8.519.726 €, EC Contribution: 6.530.000 €

Duration: 48 months, Start Date: 01/12/2009

Consortium: 31 partners from 18 countries

Project Coordinator: Barbara Zanuttigh, Università di Bologna (Italy)

Outline

- Planning interventions
- Decision-making: concise information and support tools
- THESEUS contribution to risk management: the GIS based Decision Support System
- Steps and challenges for R&I

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Where? *Prioritisation of intervention on an impact basis*

How? *Best portfolio of adaptation solutions considering sustainable development*

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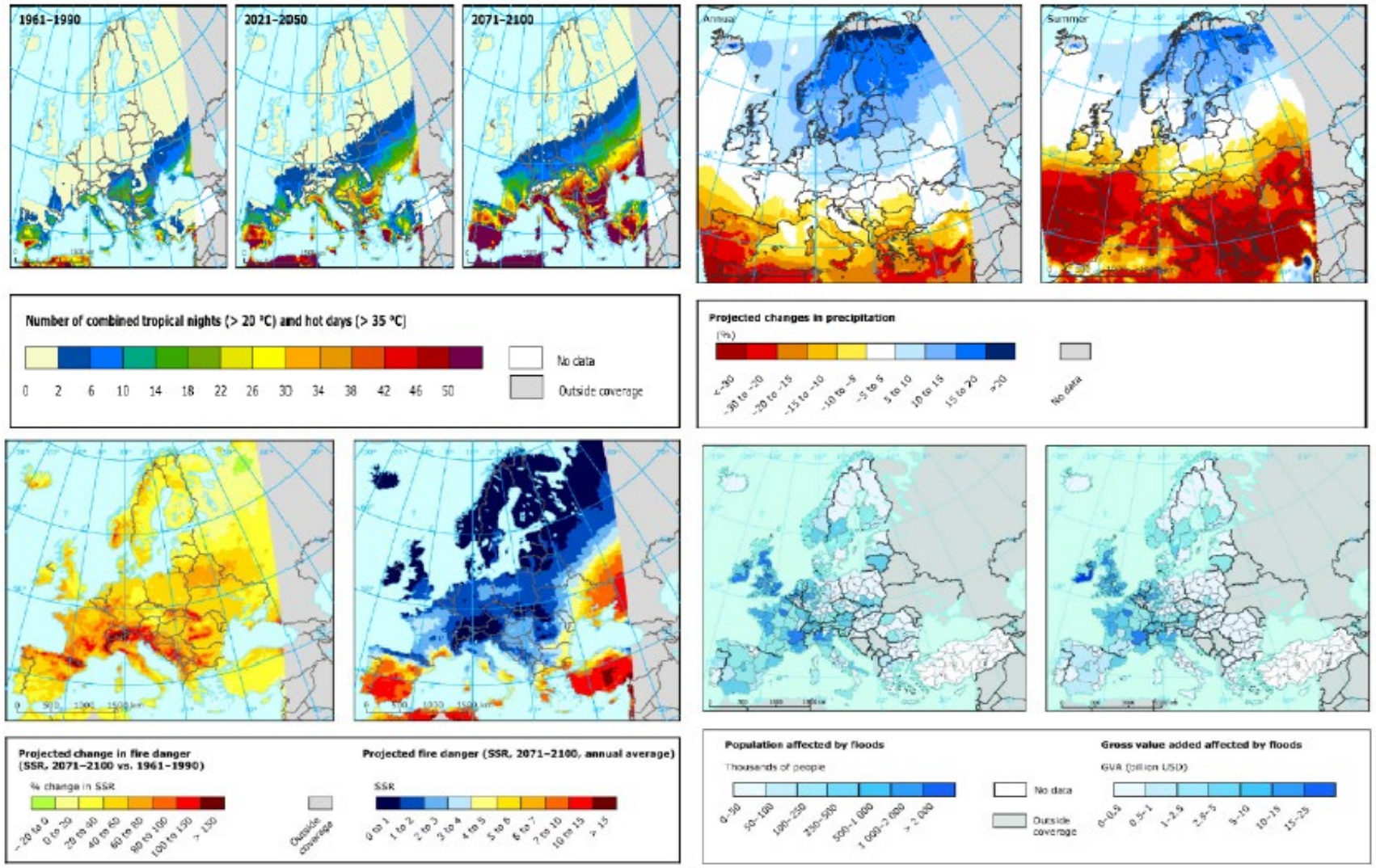
Uncertainty: quantitative scenarios?



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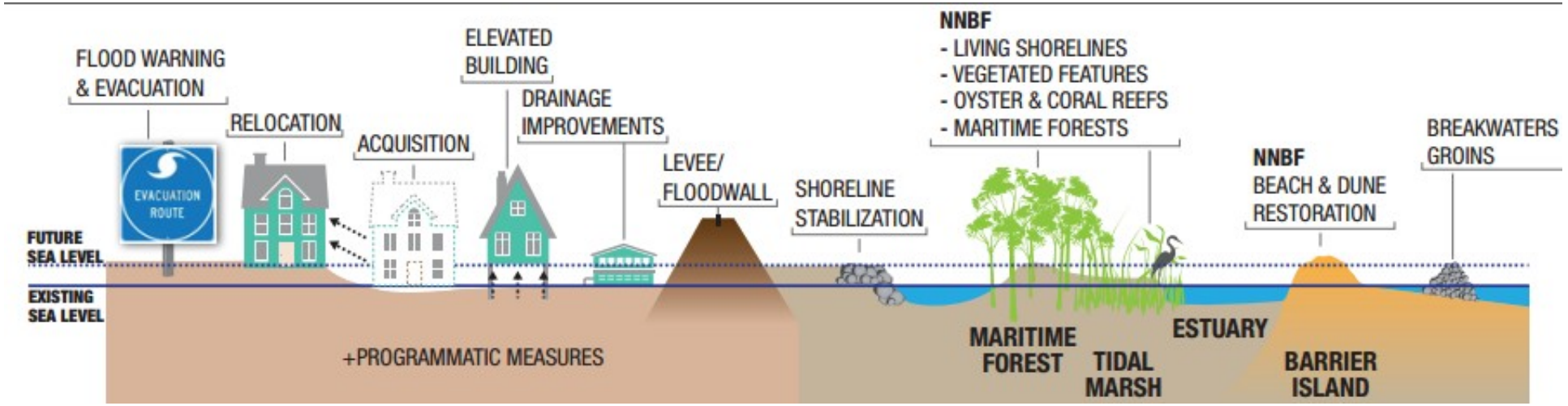
Flood risk reduction strategies



- Multiple lines of defences
- More combinations of (types of) interventions
- More complex risk models required for screening and evaluation

Innovative technologies

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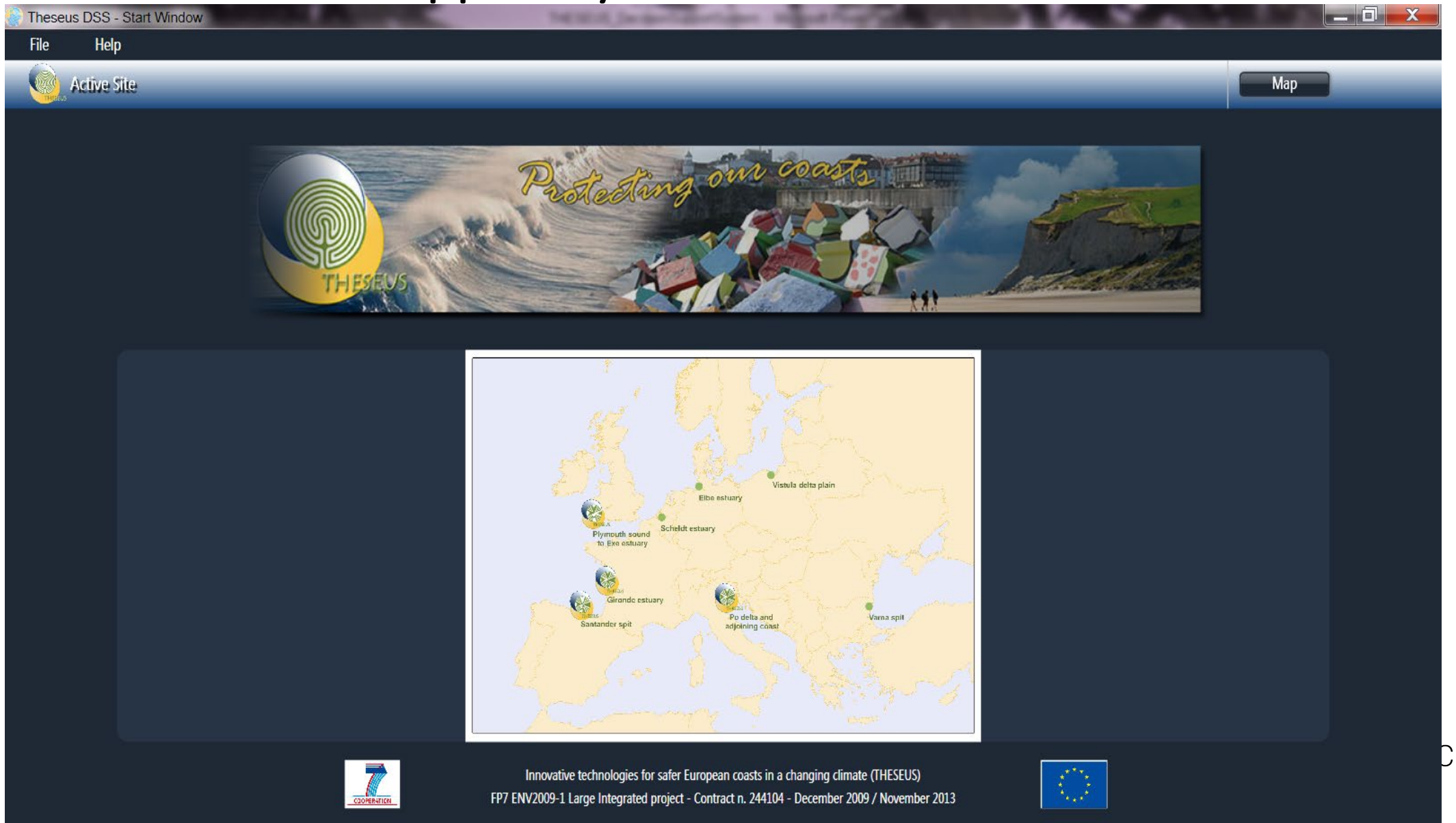
THESEUS Decision Support System



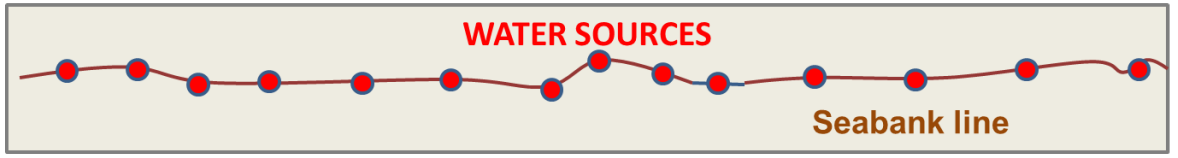
CLIMATE, SOCIAL, ECONOMIC AND ENVIRONMENTAL DATA & SCENARIOS

MITIGATIONS @SEA (ENGINEERING, ECOLOGICALLY BASED)

WAVE TRANSFER

EROSION MODEL

MITIGATIONS @BEACH (ENGINEERING, ECOLOGICALLY BASED)



FLOODING MODEL (WATERHSED SEGMENTATION ALGORITHM)

FLOODING MAPS (DEPTH, VELOCITY, DURATION)
HYDRAULIC VULNERABILITY MAP (EROSION, FLOOD)

MITIGATIONS @LAND
(ENGINEERING, ECOLOGICALLY BASED, SOCIAL, ECONOMIC)

ECONOMIC IMPACT FUNCTION

SOCIAL IMPACT FUNCTION

ECOLOGICAL IMPACT FUNCTION

ECONOMIC VULNERABILITY MAP

SOCIAL VULNERABILITY MAP

ECOLOGICAL VULNERABILITY MAP

INTEGRATED RISK ASSESSMENT MAP

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IN RIGA

The steps

- First step: identify and collect (harmonised!) data
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- Iteratively through the development: discuss with end users!

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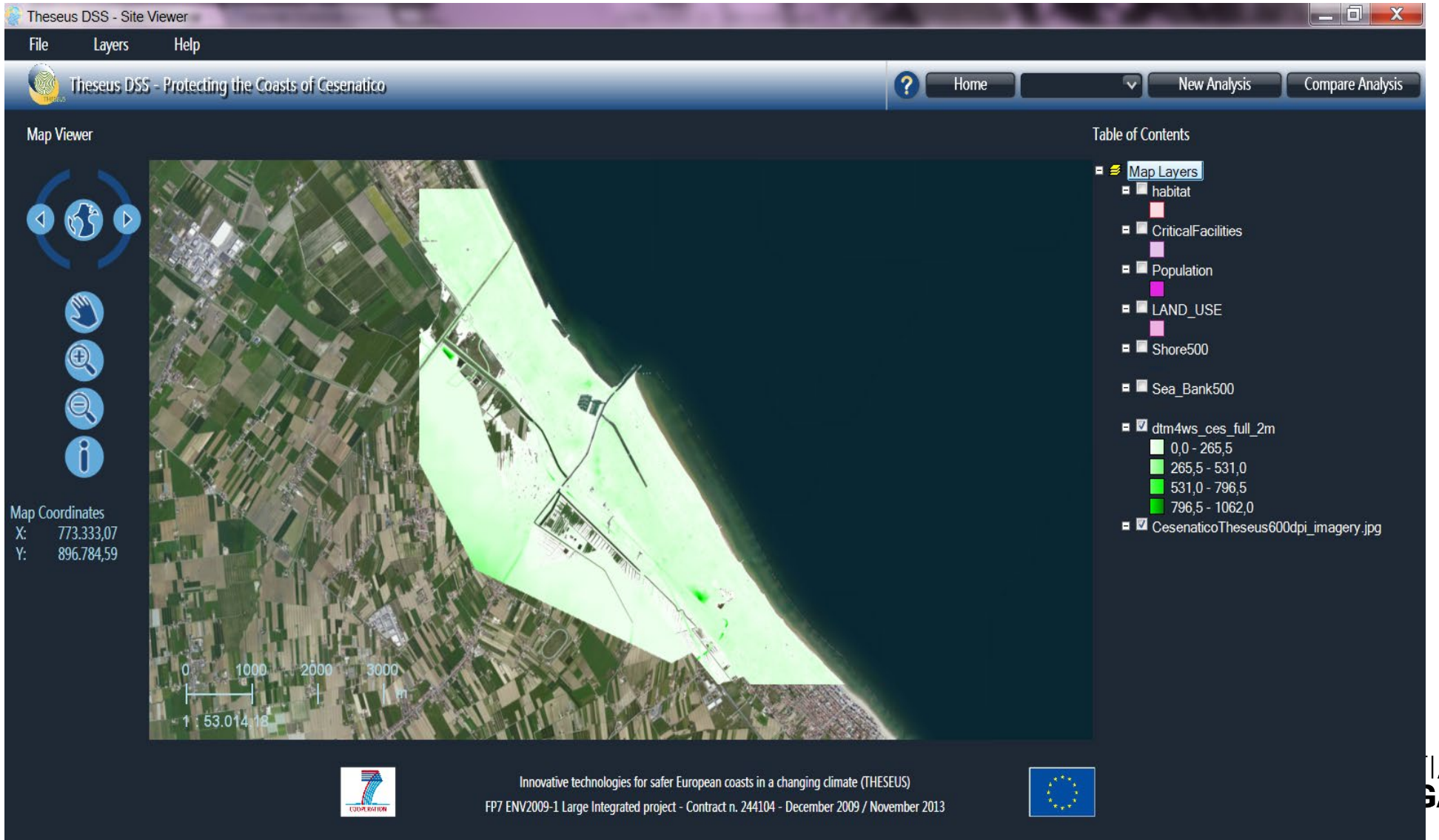
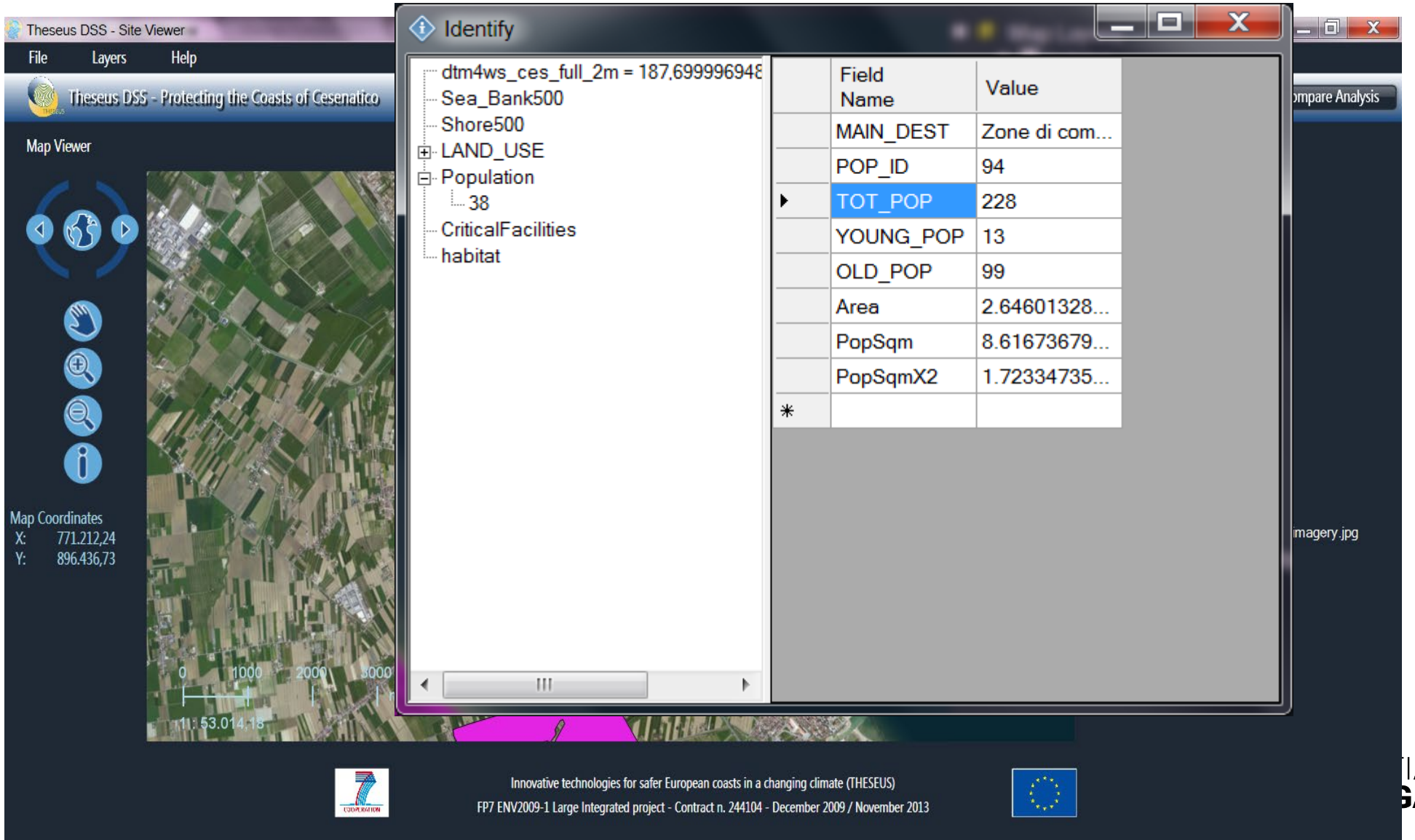
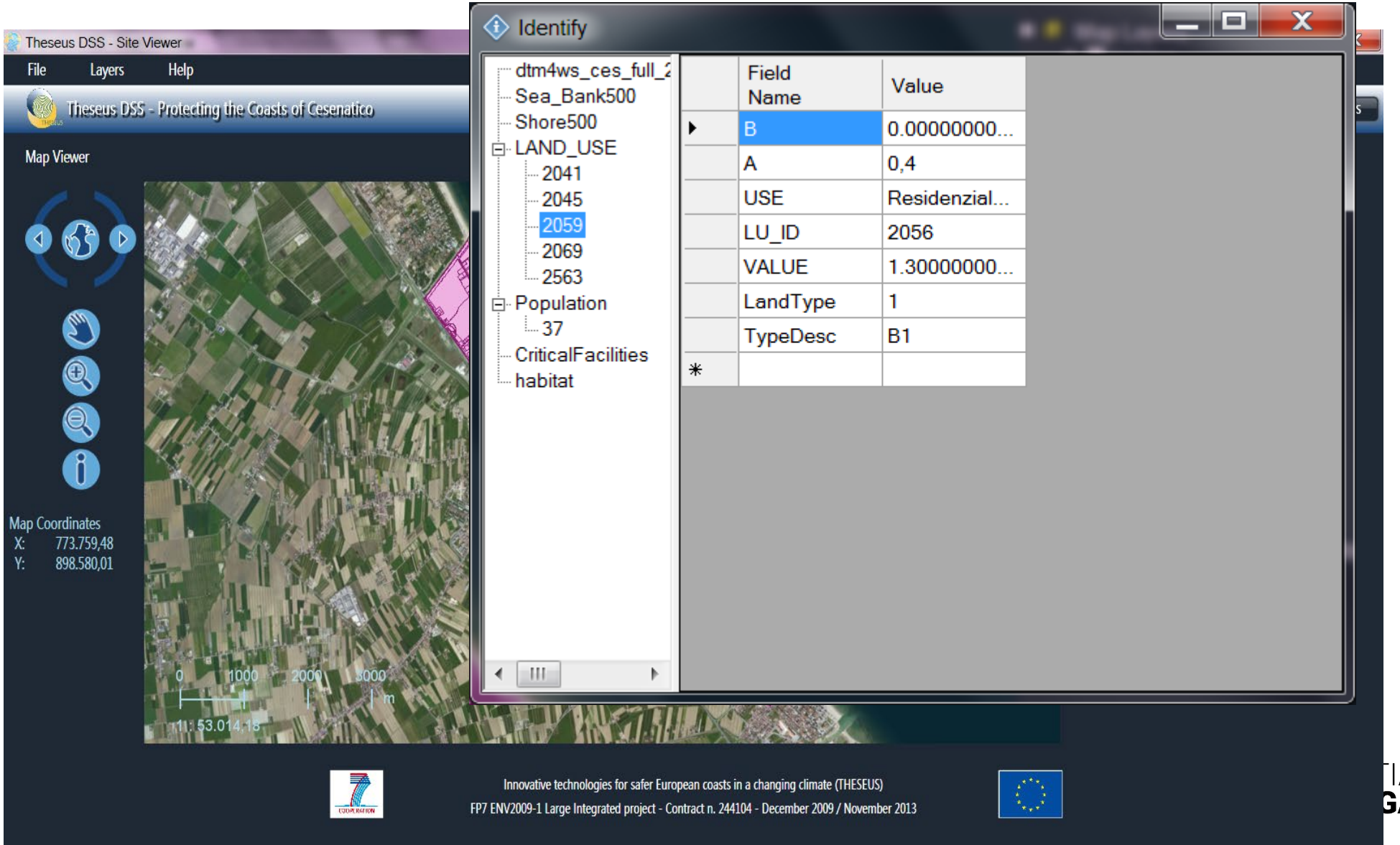
Data: dtm model



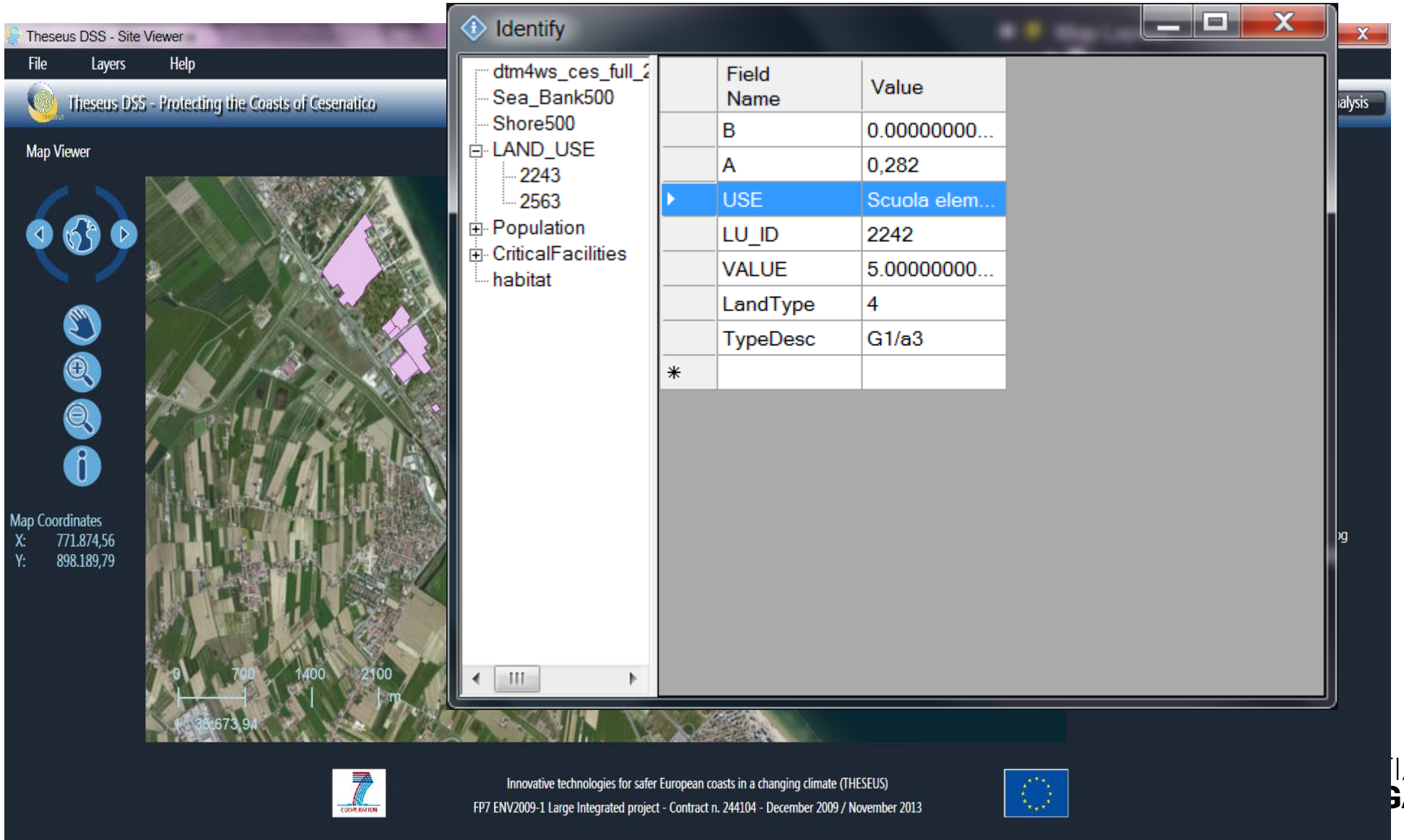
Data: population



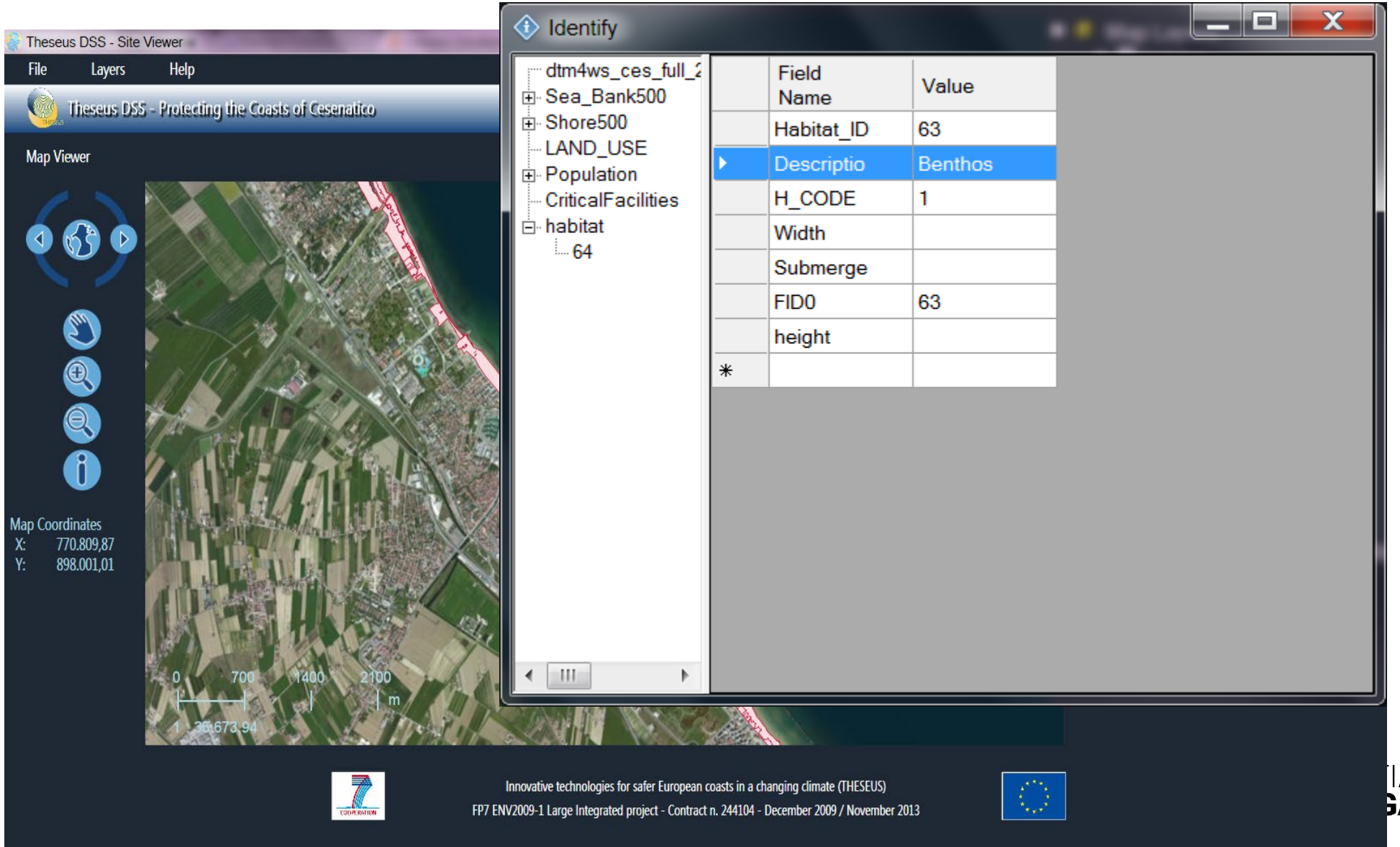
Data: land use



Data: critical facilities



Data: habitats



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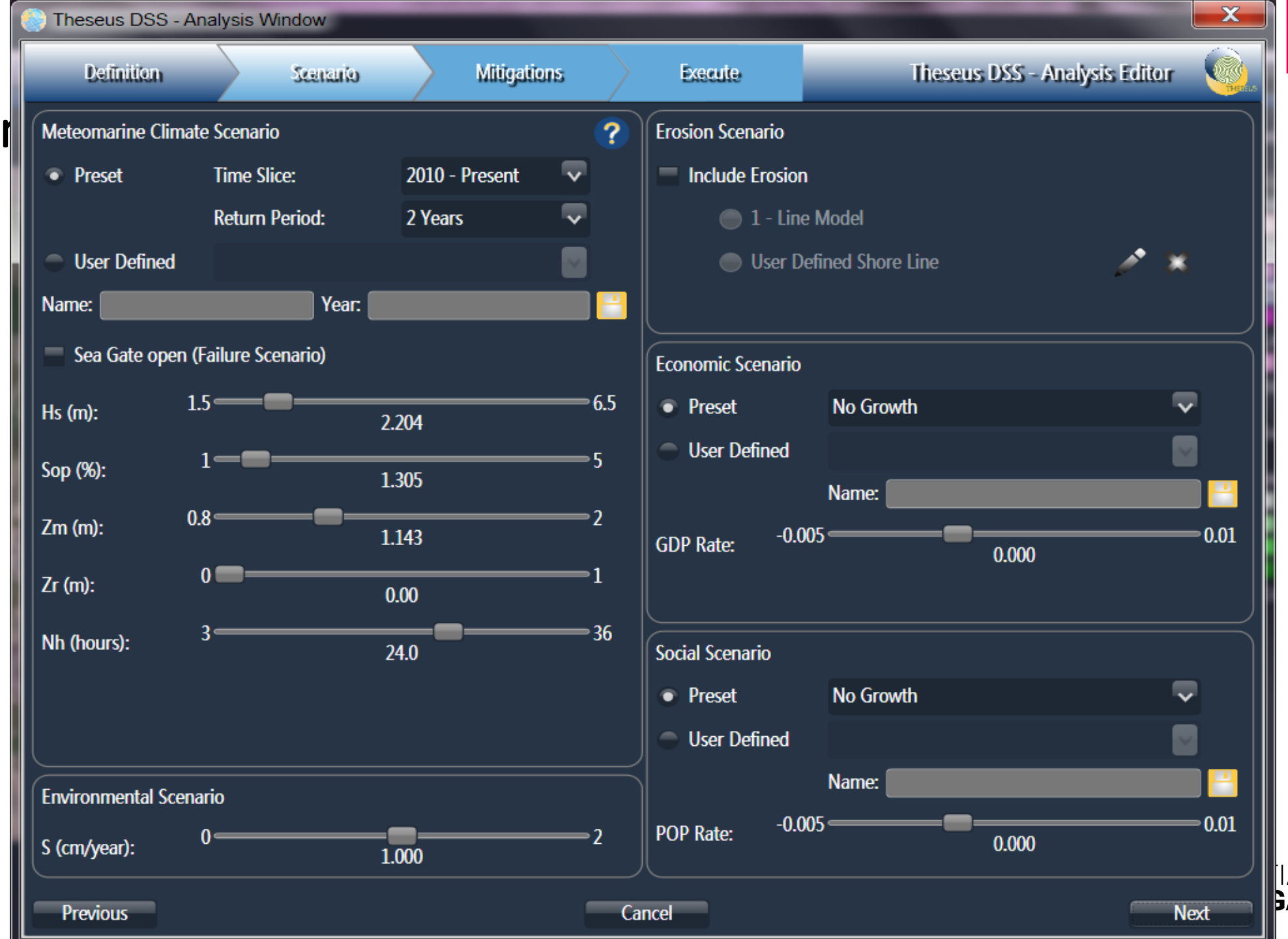

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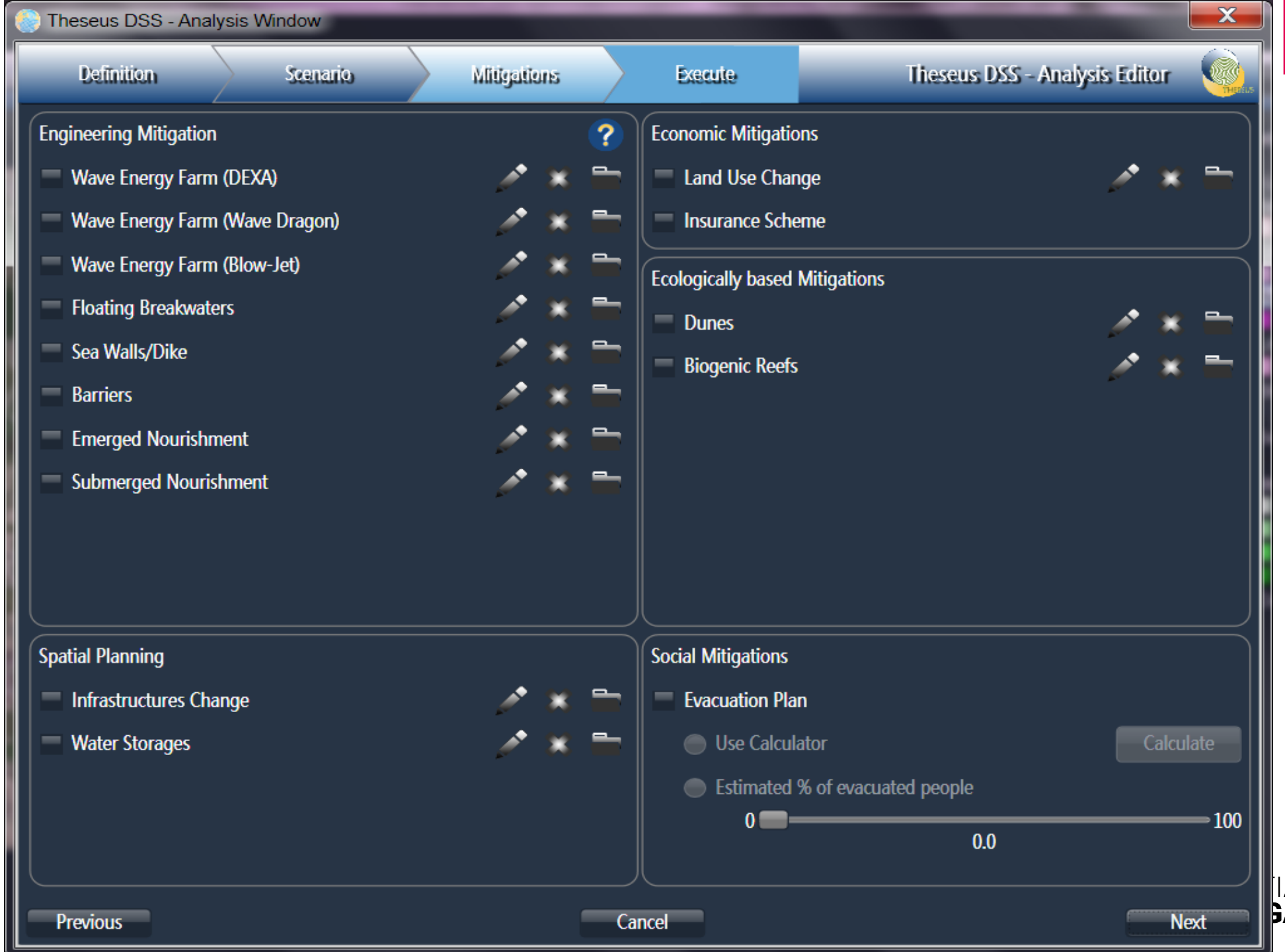
Theseus DSS - Analysis Window
Definition
Scenario
Mitigations
Execute
Theseus DSS - Analysis Editor
Engineering Mitigation
Wave Energy Farm (DEXA)
Wave Energy Farm (Wave Dragon)
Wave Energy Farm (Blow-Jet)
Floating Breakwaters
Sea Walls/Dike
Barriers
Emerged Nourishment
Submerged Nourishment
Economic Mitigations
Land Use Change
Insurance Scheme
Ecologically based Mitigations
Dunes
Biogenic Reefs
Spatial Planning
Infrastructures Change
Water Storages
Social Mitigations
Evacuation Plan
Use Calculator
Calculate
Estimated % of evacuated people
0
100
0.0
Previous
Cancel
Next

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The steps

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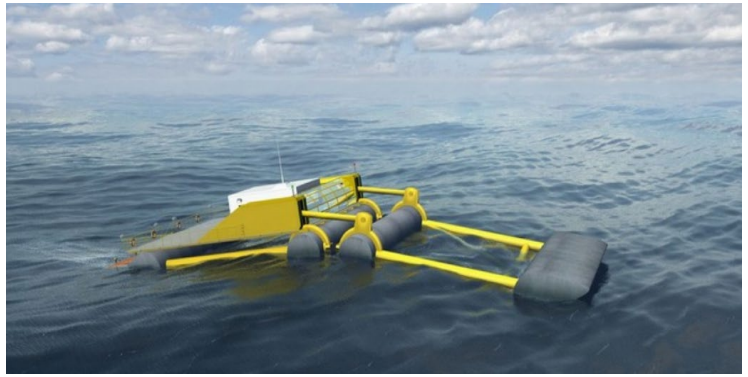
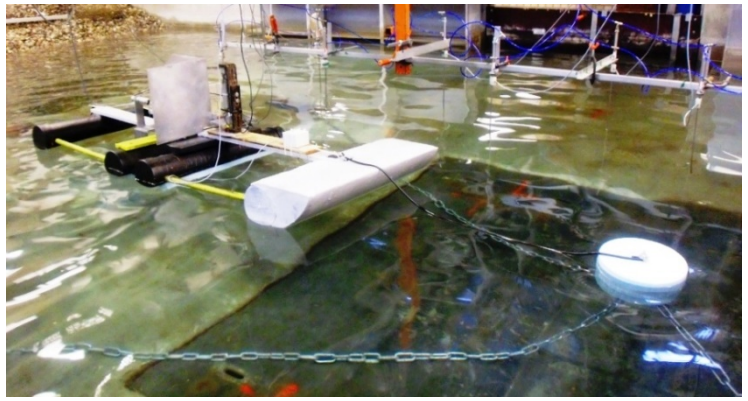
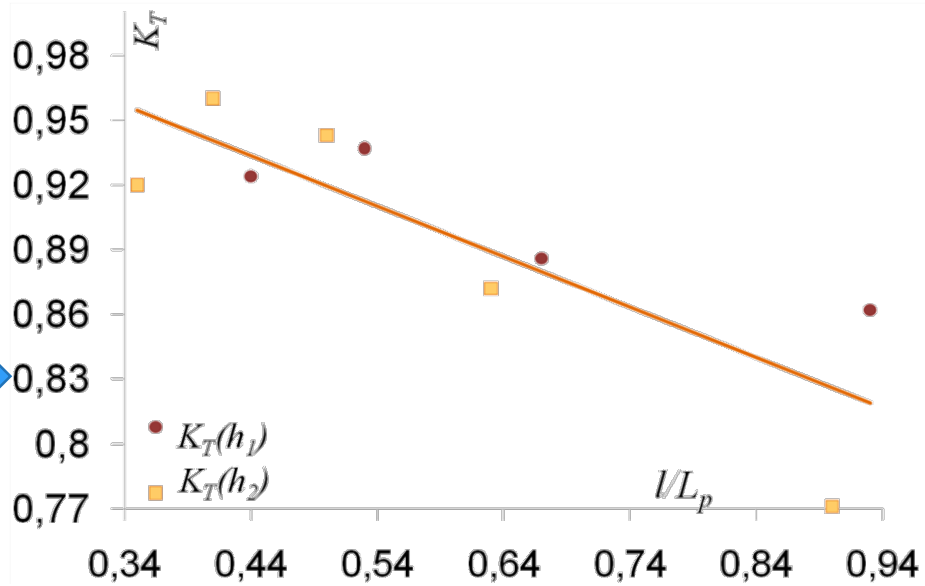
Synthesise through analytical functions or Fuzzy bayesian models or metamodels







$$K_{T,D} = -0.276 \cdot (l/L_p)^2 + 0.4304 \cdot (l/L_p) + 0.6781$$

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IN RIGA

Definition
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Mitigations
Execute
Theseus DSS - Analysis Editor
Engineering Mitigation
Wave Energy Farm (DEXA)
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Floating Breakwaters
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Emerged Nourishment
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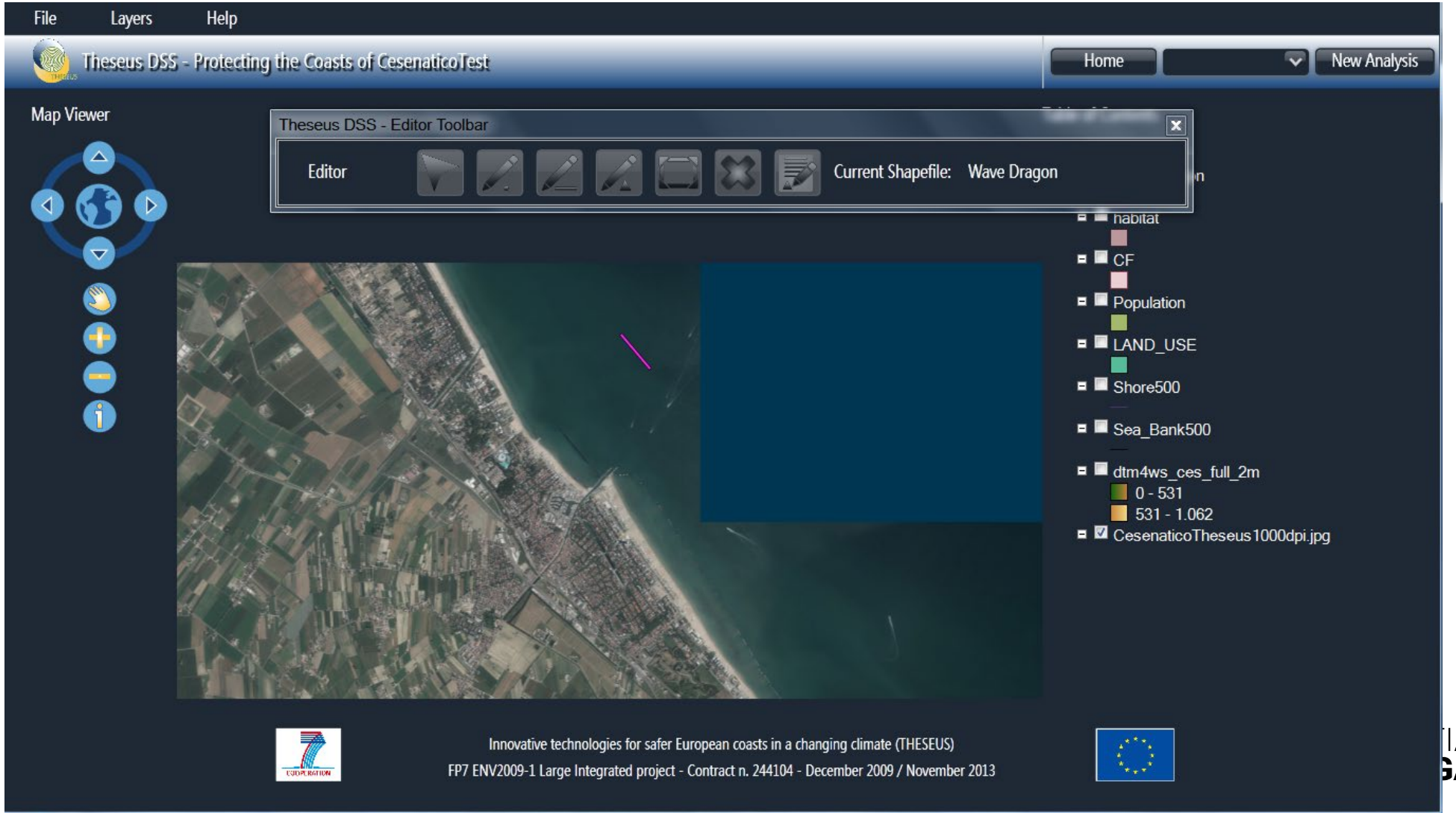
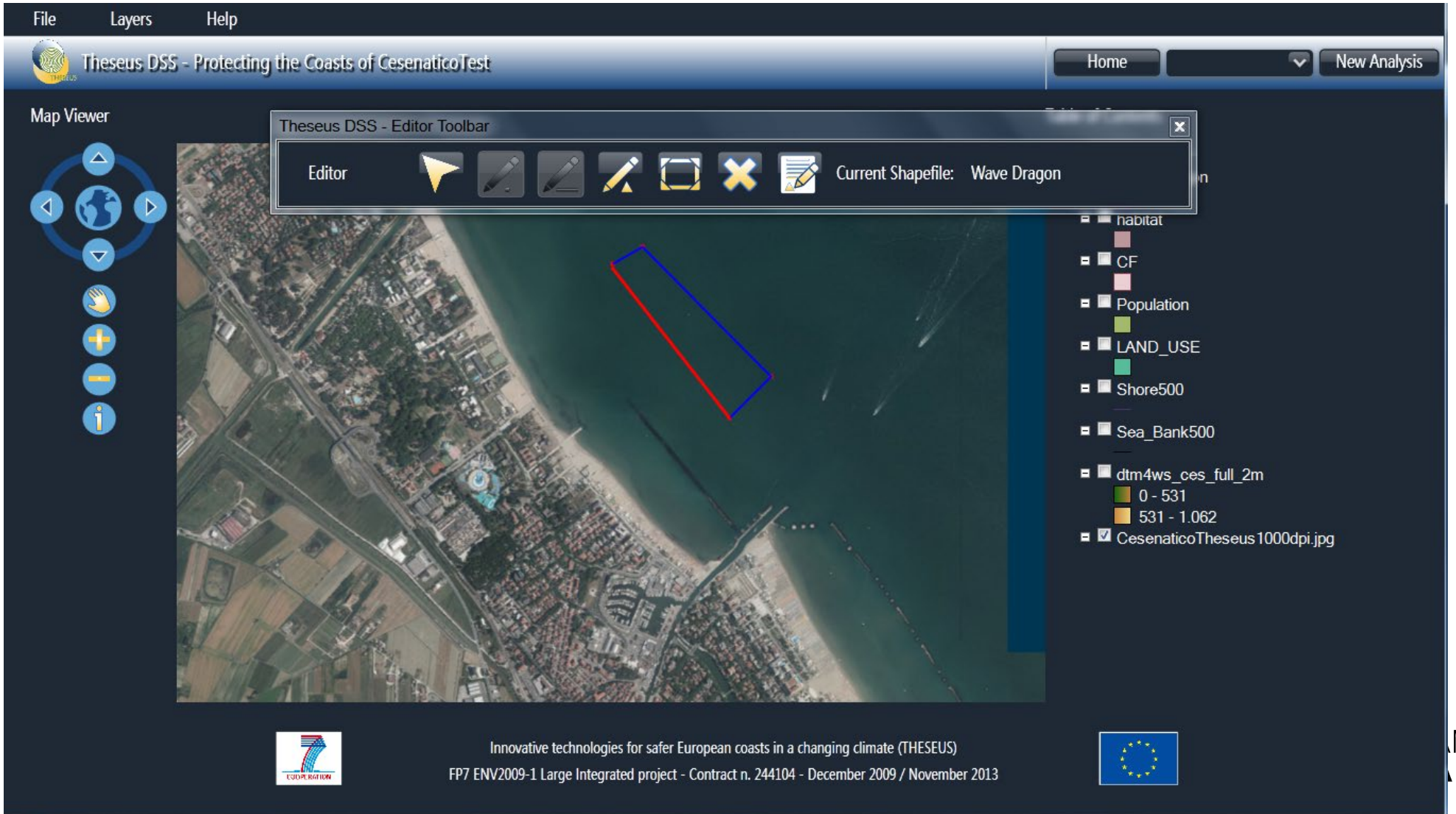
Economic Mitigations
Land Use Change
Insurance Premium
Environmental Mitigations
Dunes
Biogenic Reef
Saltmarsh creation/management
Seagrasses
Social Mitigations
Evacuation Plan
Use Calculator
Calculate
Estimated % of evacuated people
0
100
0.0
Previous
Cancel
Next

MOCI

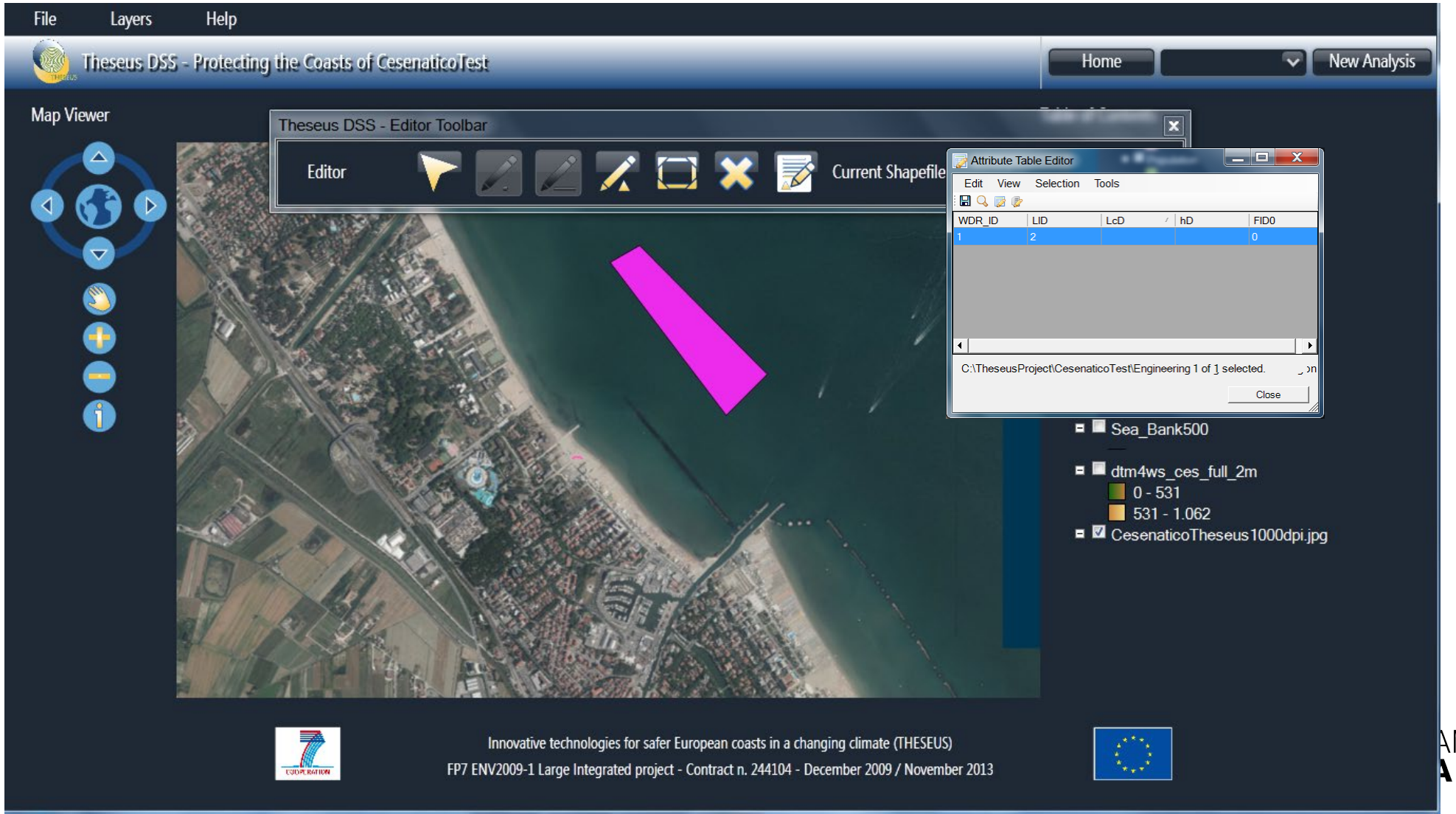
Mitigations: editing



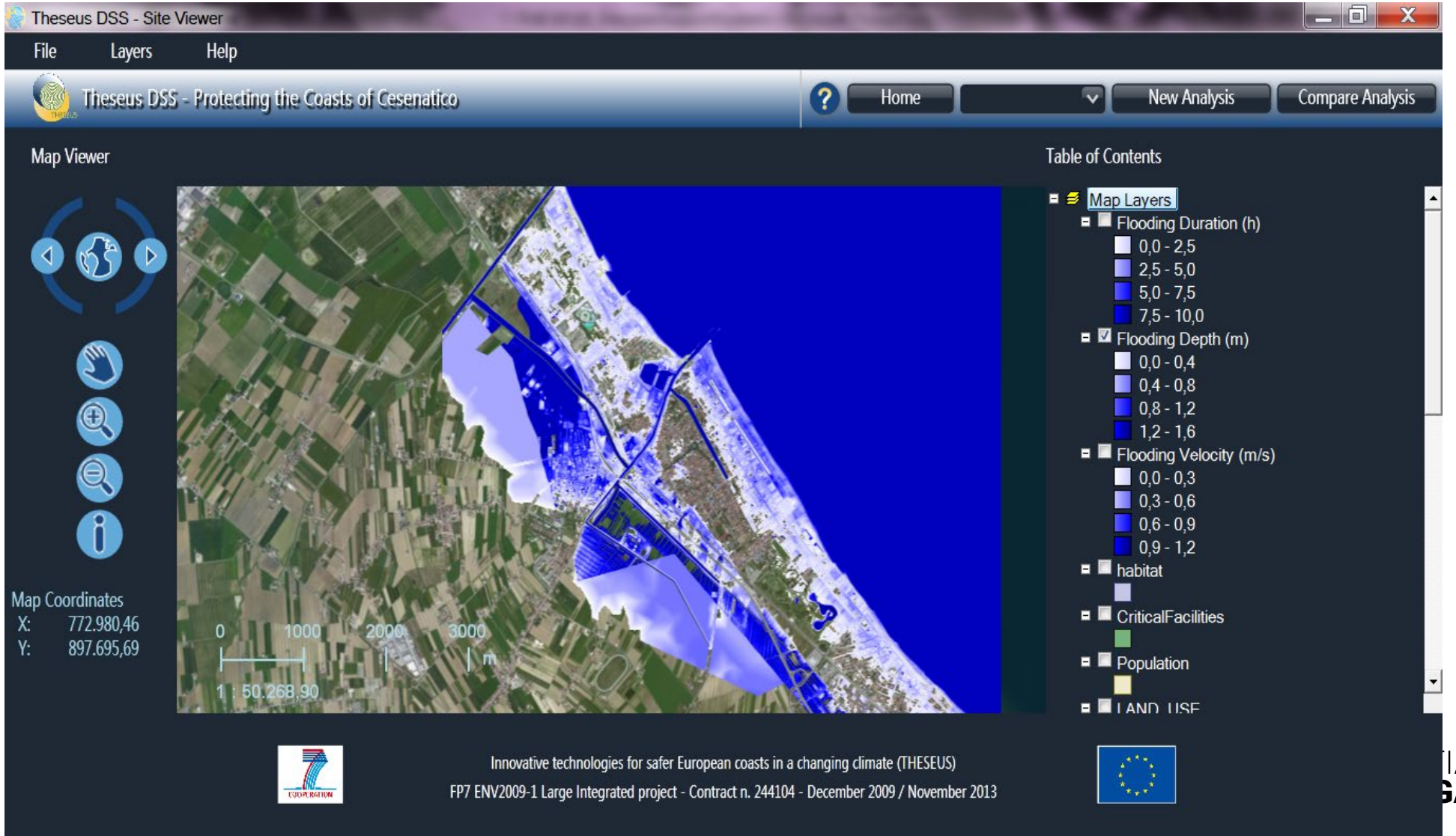
Mitigations: editing



Mitigations: editing



Flood Depth


Theseus DSS - Site Viewer
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Map Layers
Flooding Duration (h)
0,0 - 2,5
2,5 - 5,0
5,0 - 7,5
7,5 - 10,0
Flooding Depth (m)
0,0 - 0,4
0,4 - 0,8
0,8 - 1,2
1,2 - 1,6
Flooding Velocity (m/s)
0,0 - 0,3
0,3 - 0,6
0,6 - 0,9
0,9 - 1,2
habitat
CriticalFacilities
Population
LAND USE
Map Coordinates
X: 772.980,46
Y: 897.695,69
0
1000
2000
3000
m
1 : 50.268,90
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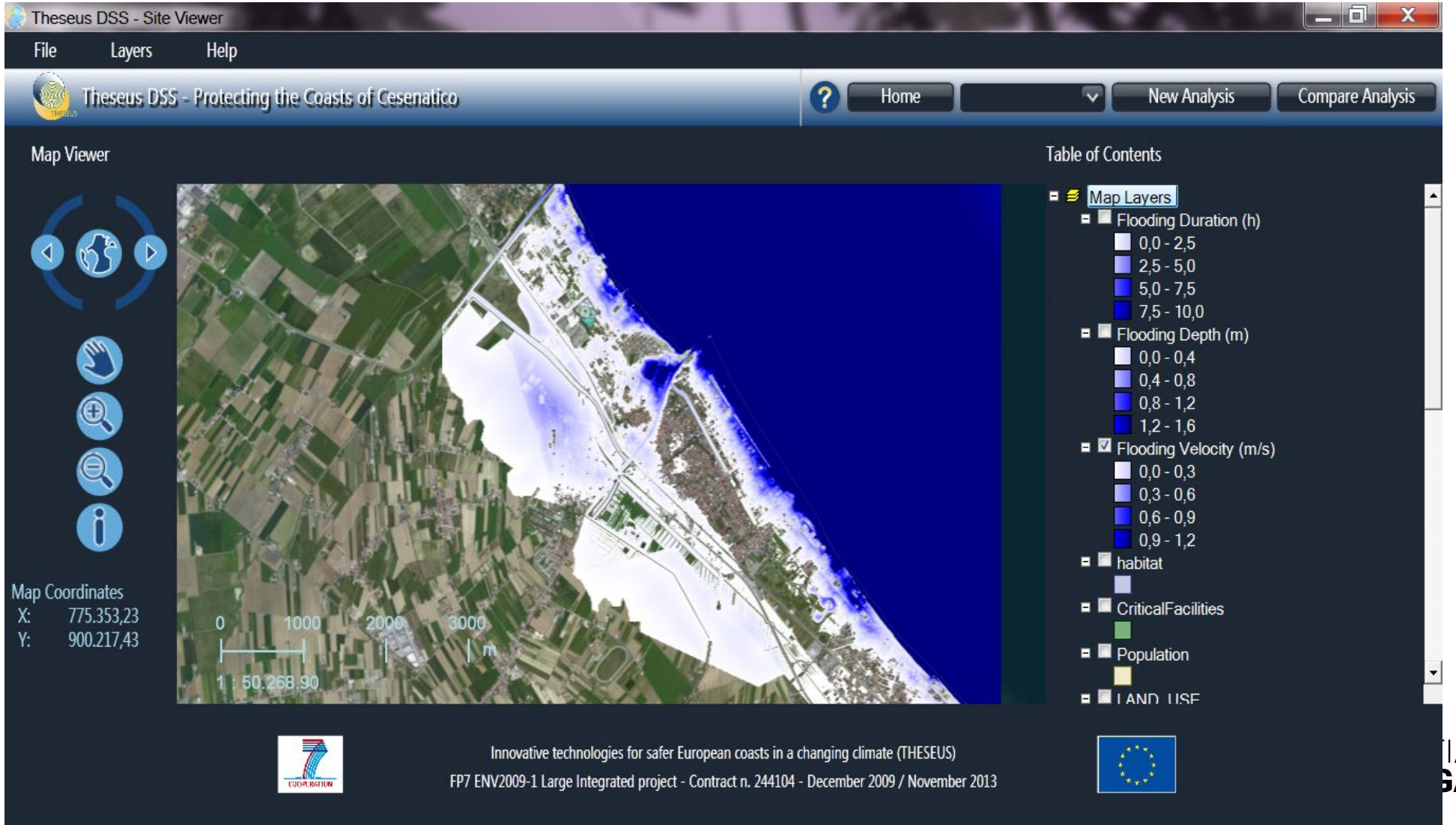
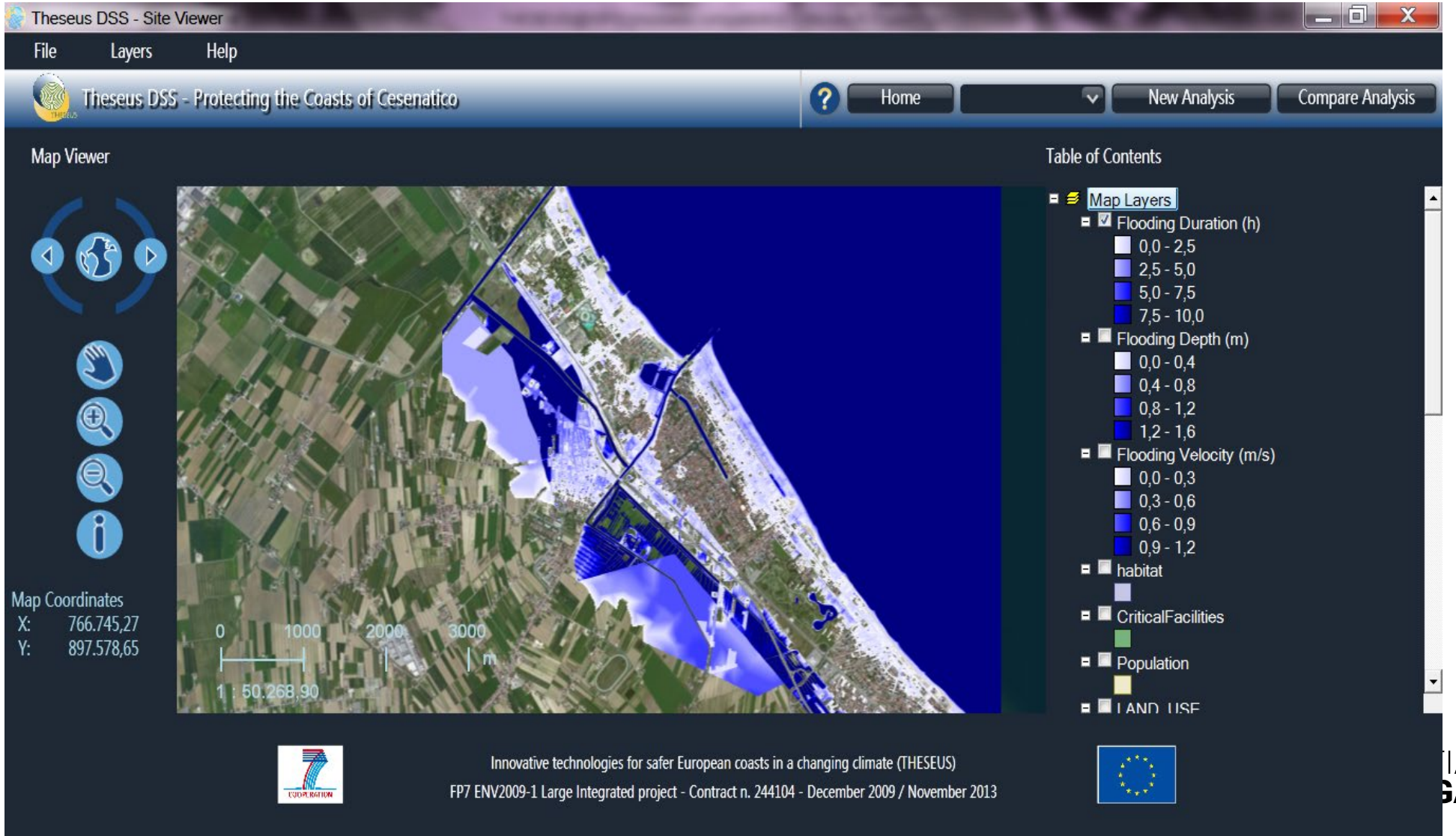
FP7 ENV2009-1 Large Integrated project - Contract n. 244104 - December 2009 / November 2013

Flood Velocity



Flood Duration



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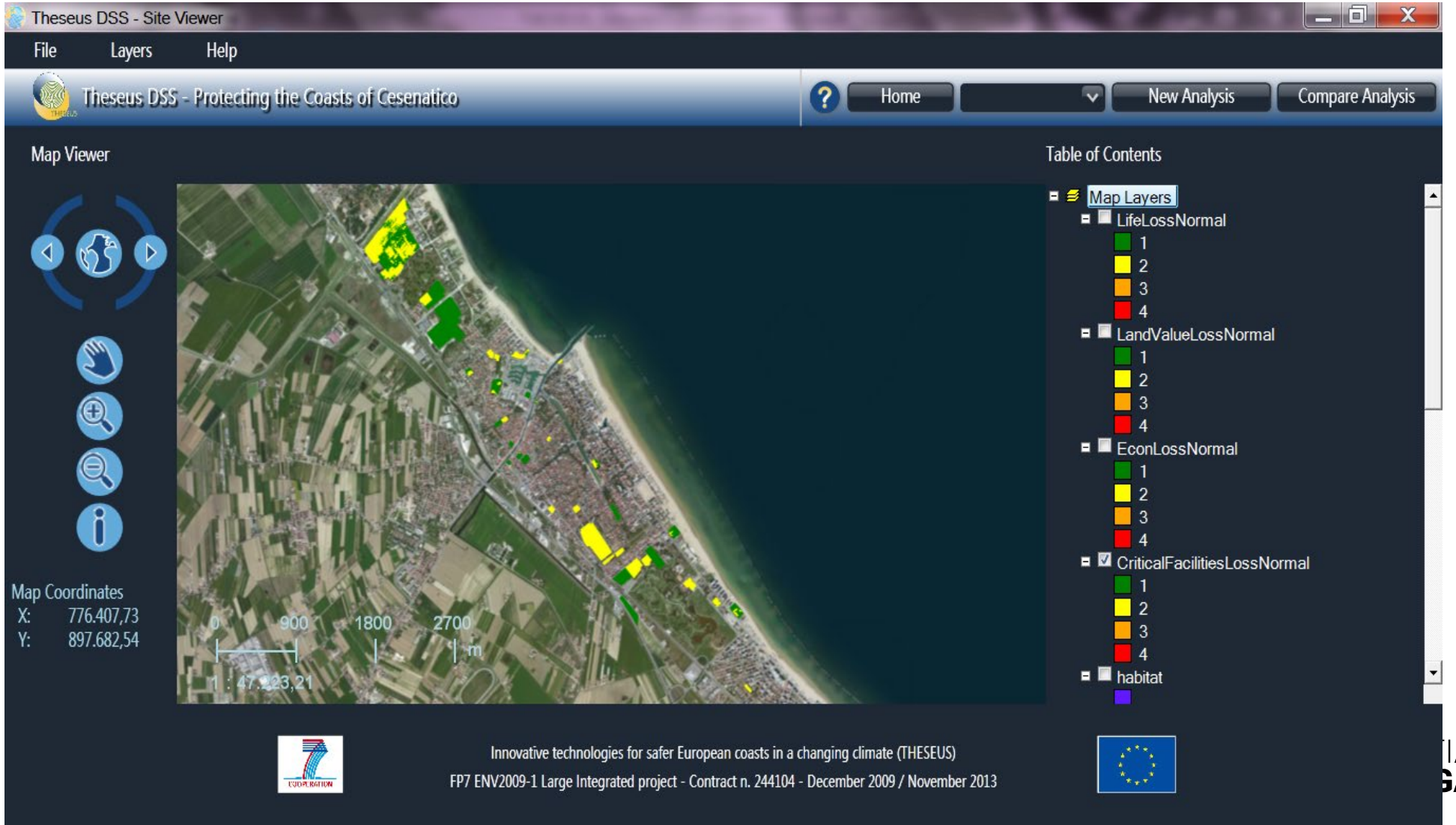
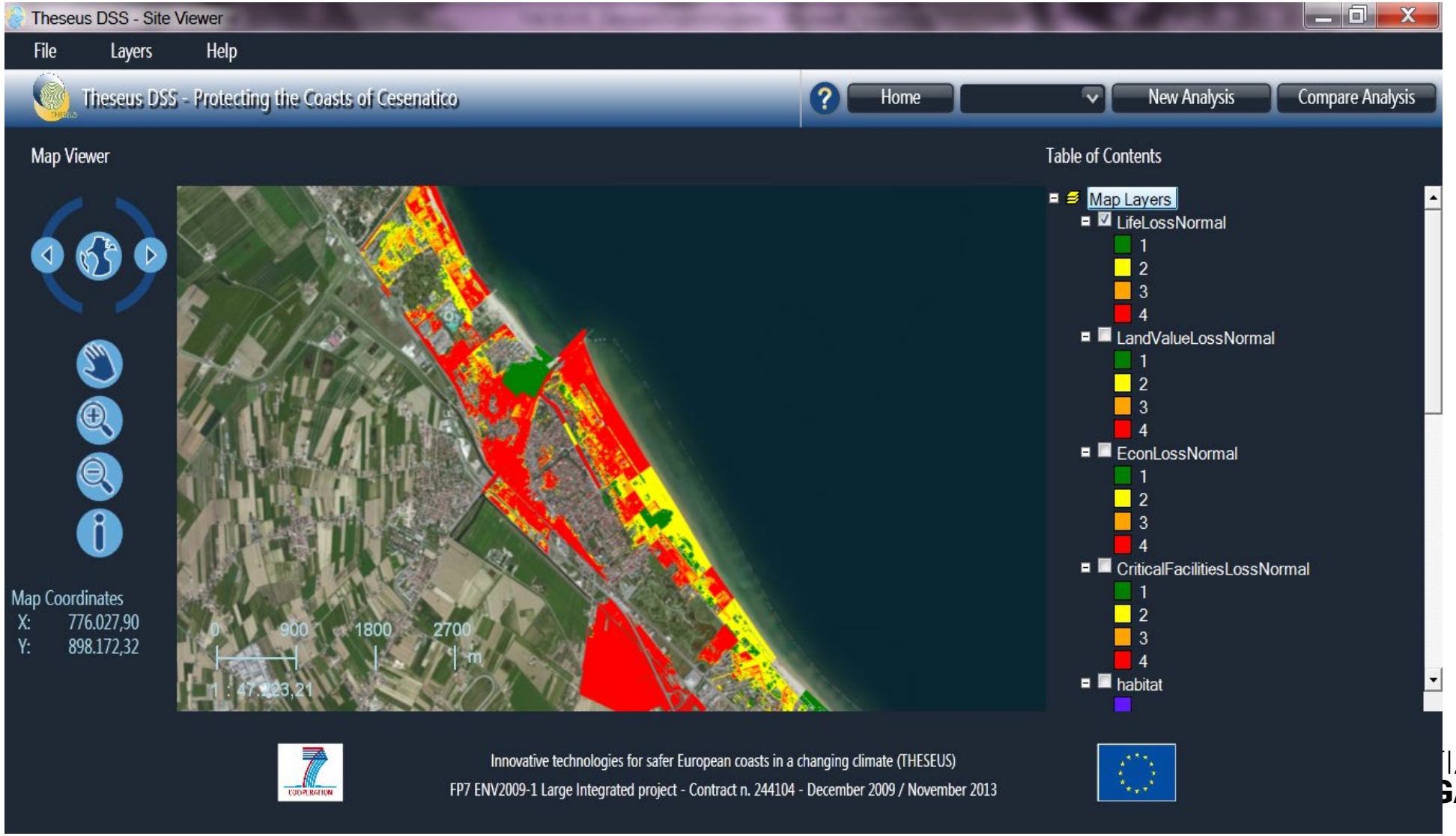
Critical Facilities Loss



Life Loss



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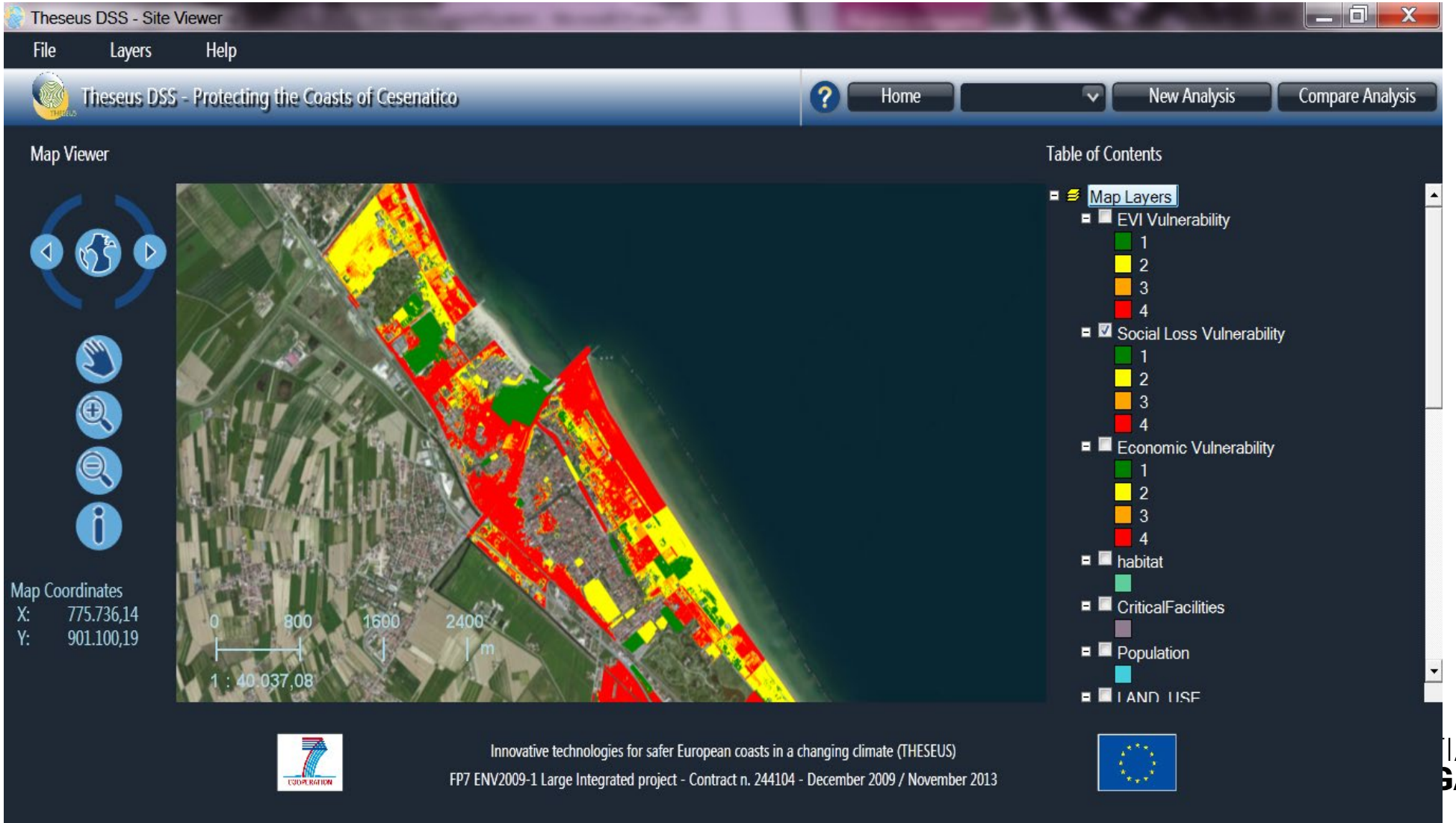
Social vulnerability map



Environmental vulnerability

	Negligible	Transient effect (no long term change anticipated)	Moderate effect/Semi permanent change	Permanent effect/change
EVI Index	0	1	2	3
Habitat/ Key species	Negligible impact to habitats / species	Changes within the range of Receptor's natural seasonal variation and full recovery is likely within a season	Changes are beyond Receptor's natural seasonal variation. Partial recovery is possible within several seasons, but full recovery is likely to require human intervention, or greater than 20 years for natural recovery	Changes are so drastic that natural recovery of receptor is very unlikely without human intervention. Or natural recovery will take longer than 20 years

Environment vulnerability assessment

Sampling, Historical data

Temperature
Wind
Currents
Granulometry
Sediment transport
……

FBEM learning algorithm

New sampling, Physical model, On line data

Δ Temperature
Δ wind
Δ currents
Δ granulometry
Δ sediment transport
……

FBEM predictive algorithm

Biological variables

Δ biological variables
+ biological autocorrelation

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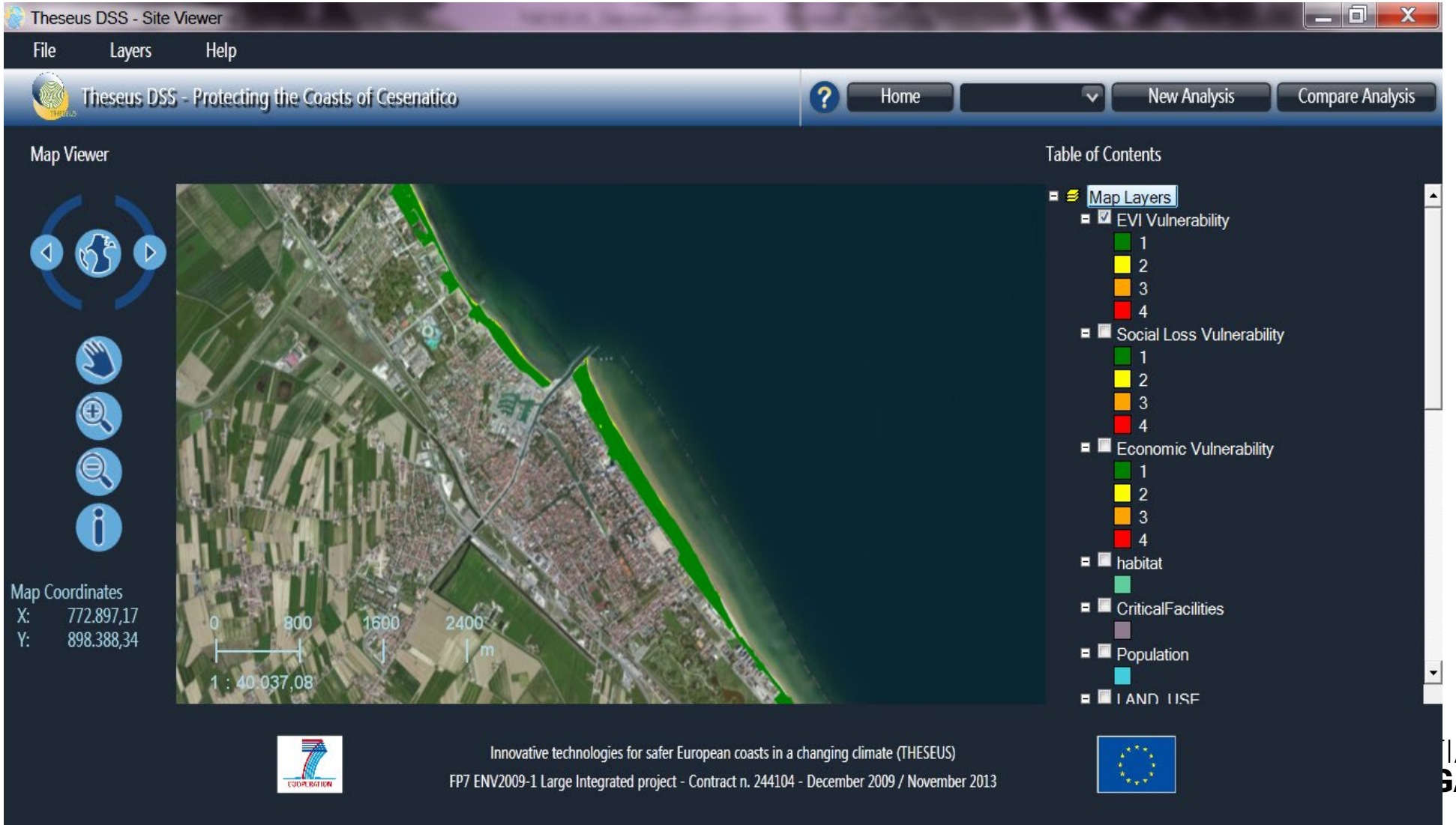
Ecological Vulnerability map



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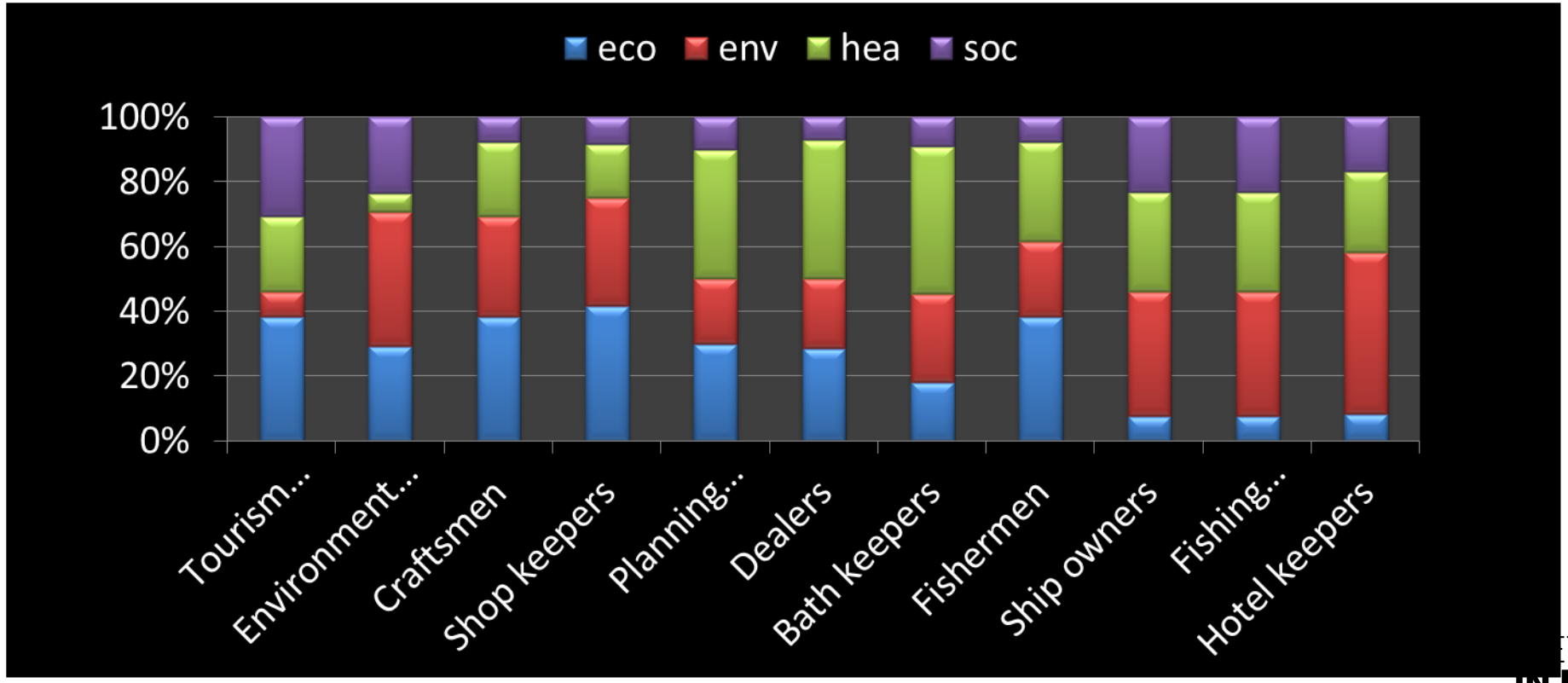
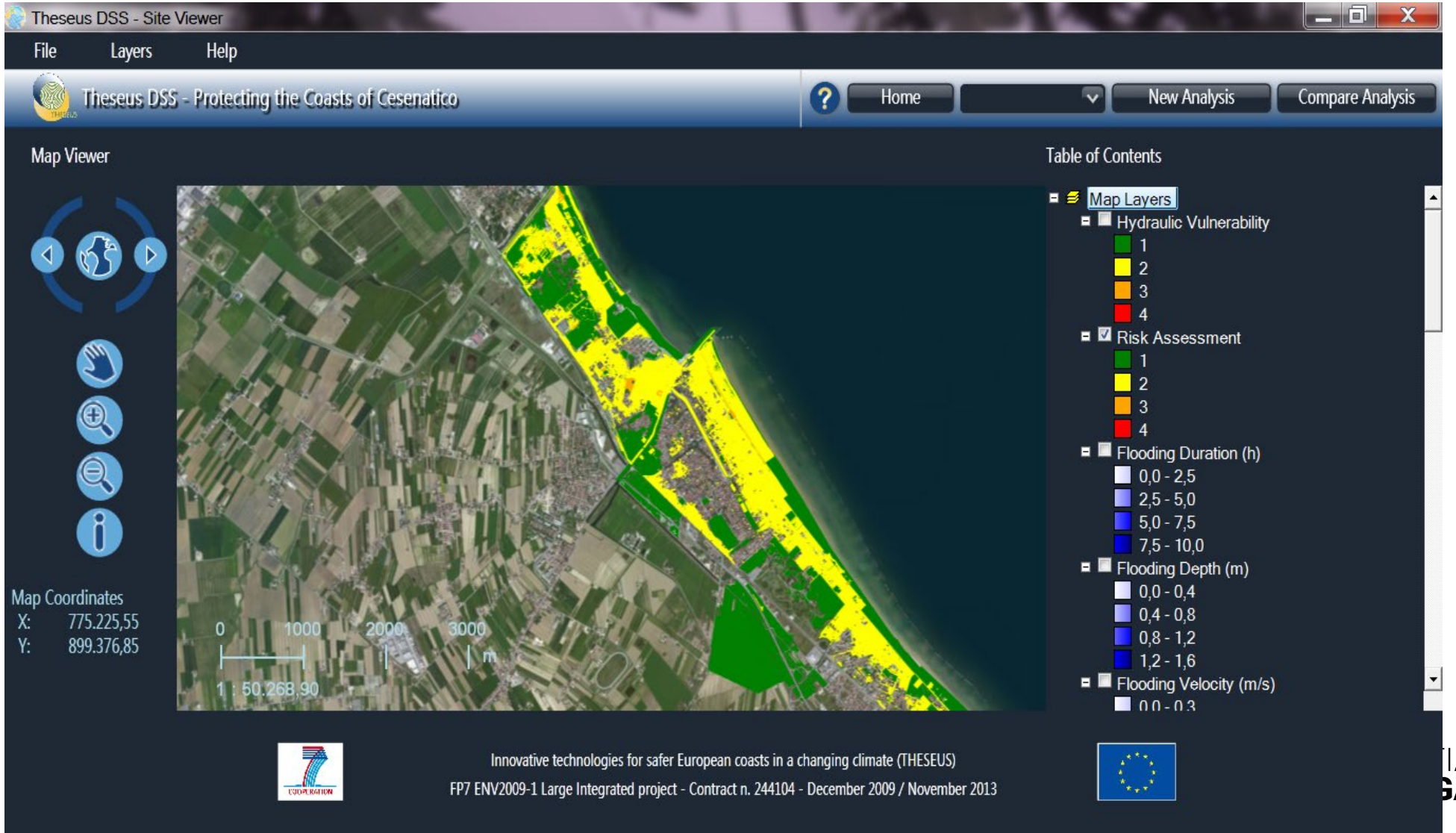
Stakeholder perception of damages

Priorities associated to injuries and social, environmental and economic damages



Risk map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3
4
Risk Assessment
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2
3
4
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Challenges?

- A common language
- Information sharing
- Harmonisation of data/methods
- Better assessment of uncertainty
- Better assessment of resilience
- Combination of different time scales (DRM &CCA)
- Combination of different spatial scales (different adaptation/mitigation solutions and cost-benefit assessments)
- Social risk component!

In progress…

- New hydraulic model: Inclusion of riverine discharges and representation of riverine floods; Inclusion of rainfalls and representation of combined extreme events

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THANK YOU!

Barbara Zanuttigh

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http://www.citg.tudelft.nl/over-faculteit/afdelingen/hydraulic-engineering/sections/hydraulic-structures-and-flood-risk/staff/

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