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C3S Demo Case “Soil Erosion”

Climate Change

CLIMATEUROPE WEBSTIVAL

Understanding future soil erosion: a new tool

Assessing climate change impacts on soil erosion

Santini M., Rianna G., Mancini M., Padulano R.,Noce S., Stojiljkovic M.
Fondazione CMCC Centro Euro-mediterraneo sui Cambiamenti Climatici

17 September 2020

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C3S Demo Case "Soil Erosion": applications and datasets

Three main products are expected to be released in next weeks:

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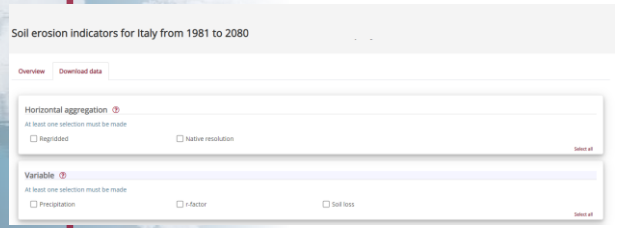

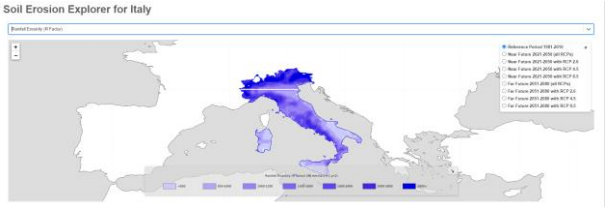

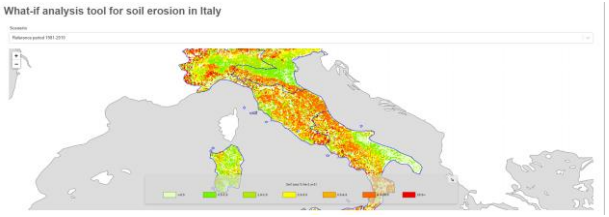

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Soil erosion indicators for Italy from 1981 to 2080

Variable:

Precipitation *r-factor* *soil loss*

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Annual statistic:

1-day maximum amount

Spell length of day with liquid water equivalent than 1 mm

5-day maximum amount

Number of days with liquid water equivalent greater than 1 mm

Total amount

Number of days with liquid water equivalent greater than 20 mm

The indicators have been selected following the stakeholders requirements and suggestions. They are given as anomalies between future time horizons and a reference current period. No bias correction adoption has been adopted for these ones.

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Soil erosion indicators for Italy from 1981 to 2080

Product type:

ERA5 *ERA5 land* *EURO-CORDEX (EUR-11)* *E-OBS*

Global Climate Models:

CNRM-CM5 (CNRM-CERFACS, France) *EC-EARTH (ICHEC, Ireland)* *MPI-ESM-LR (MPI, Germany)*

... *...* *...*

Regional Climate Models:

CCLM4-8-17 (CLM-Community, EU) *RCA4 (SMHI, Sweden)* *HIRHAM5 (DMI, Denmark)*

... *...* *...*

Simulation version:

v1 *v1a*

v2 *v3*

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Soil erosion indicators for Italy from 1981 to 2080

Period:

1981-2010 *2021-2050* *2051-2080*

Experiment:

All RCP *RCP2.6* *RCP4.5* *RCP8.5*

Ensemble statistics:

Mean *Standard deviation*

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Soil erosion indicators for Italy from 1981 to 2080

CSC		current	RCP 2.6		RCP 4.5		RCP 8.5	
GCM	RCM	1981-2010	2021-2050	2051-2080	2021-2050	2051-2080	2021-2050	2051-2080
CNRM-CM5 (CNRM-CERFACS, France)	CCLM4-8-17 (CLM-Community, EU)	✓			✓	✓	✓	✓
	RACMO22E (KNMI, Netherlands)	✓	✓	✓	✓	✓	✓	✓
	RCA4 (SMHI, Sweden)	✓			✓	✓	✓	✓
EC-EARTH (ICHEC, Ireland)	RACMO22E (KNMI, Netherlands)	✓			✓	✓	✓	✓
IPSL-CM5A-MR (IPSL, France)	RCA4 (SMHI, Sweden)	✓			✓	✓	✓	✓
HadGEM2-ES (UK Met Office, UK)	CCLM4-8-17 (CLM-Community, EU)	✓			✓	✓	✓	✓
	RACMO22E (KNMI, Netherlands)	✓	✓	✓	✓	✓	✓	✓
	RCA4 (SMHI, Sweden)	✓	✓	✓	✓	✓	✓	✓
MPI-ESM-LR (MPI, Germany)	CCLM4-8-17 (CLM-Community, EU)	✓			✓	✓	✓	✓
	CSC-REMO2009 (MPI, Germany)	✓	✓	✓	✓	✓	✓	✓
	RCA4 (SMHI, Sweden)	✓	✓	✓	✓	✓	✓	✓
NorESM1-M (NCC, Norway)	HIRHAM5 (DMI, Denmark)	✓			✓	✓	✓	✓

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Precipitation | *r-factor* | *soil loss*

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For the future time spans, climate projections included in EURO-CORDEX have been bias-adjusted by using as reference ERA5 land (reference 1981-2010). The method is known as Quantile Delta Mapping (QDM) proposed by Cannon et al. (2015) aimed at preserving the anomalies returned by raw models.

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Soil loss is made available as regridded dataset at 500mx500m exploiting regridded R-factor:
-on the current period for ERA5 land
-on the future time spans as ensemble mean under the different and the joint RCPs
The corresponding R-factor computations are available also at native resolution.

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Soil erosion indicators for Italy from 1981 to 2080

The dataset includes a **Product User Guide** where detailed information about the inputs, methods (e.g. RUSLE for soil loss or bias adjusting procedures) and performed validation activities are provided.

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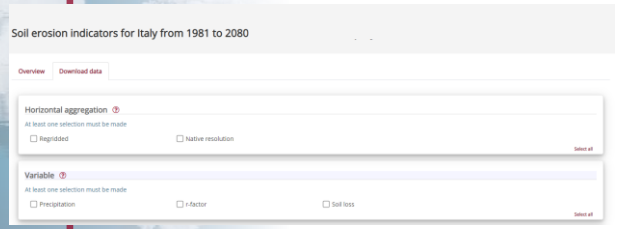

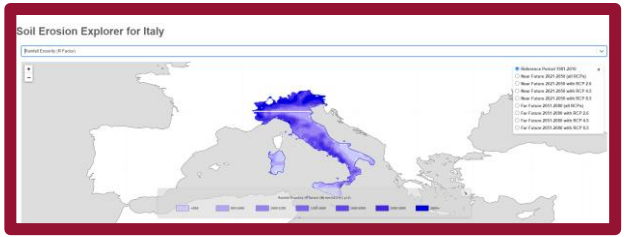

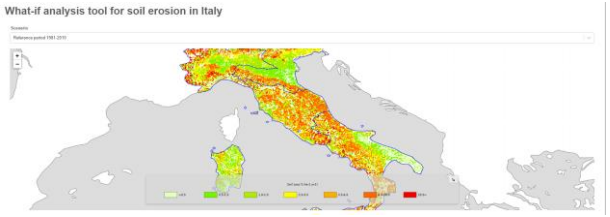

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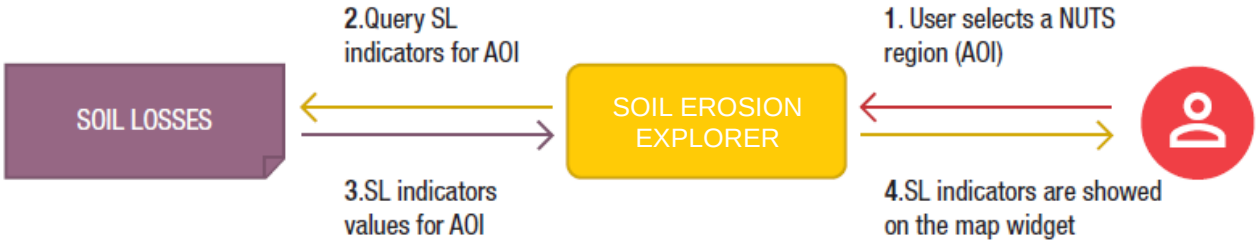
Soil Erosion Explorer for Italy

The Application allows exploring maps and spatial statistics for soil loss or rainfall erosivity over user-selected territorial units' levels, for both historical and near to far future periods, and under alternative greenhouse gases concentration scenarios.



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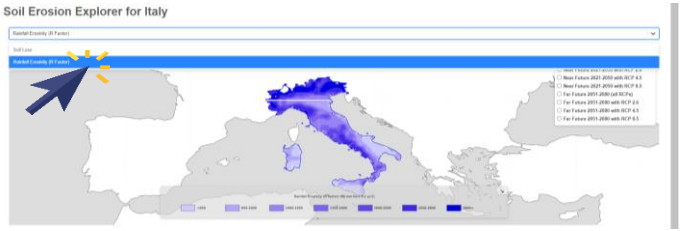
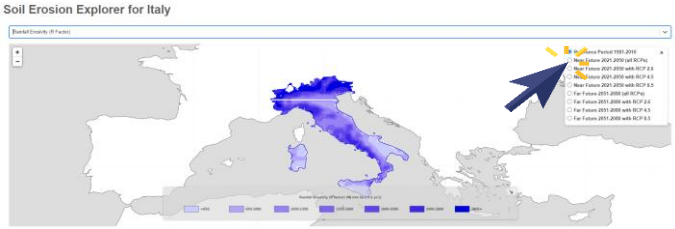
Soil Erosion Explorer for Italy

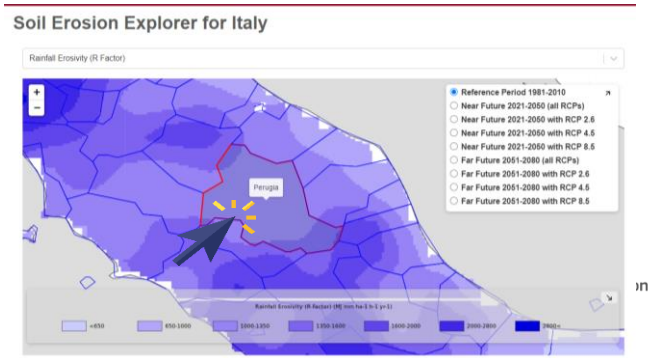
Selecting the variable



Selecting scenario: period and/or RCPs



Selecting AOI



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Soil Erosion Explorer for Italy

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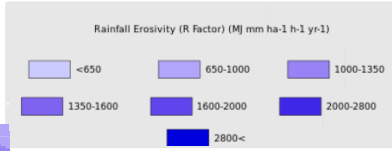
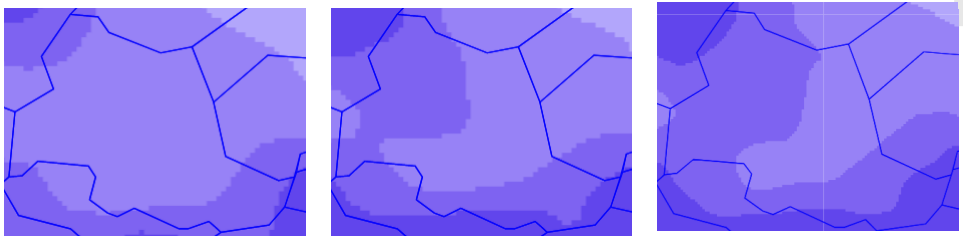
Two types of outputs:

The maps for the different scenarios

NUTS3:Perugia

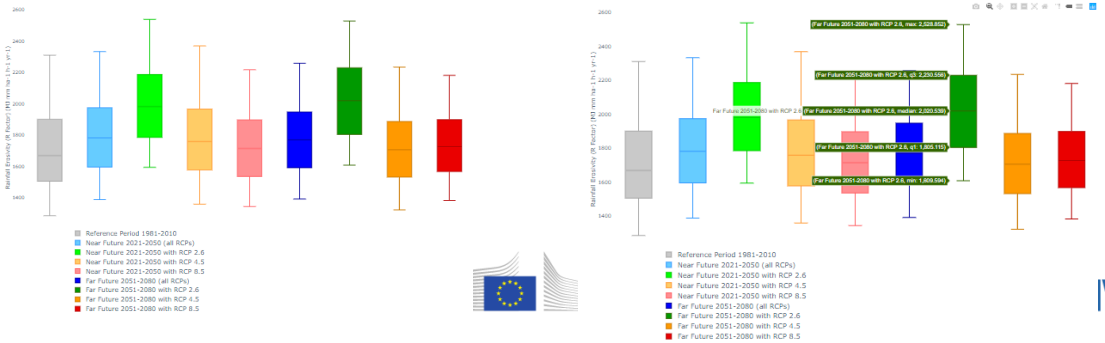




1981-2010 *RCP2.6 2021-2050* *RCP2.6 2051-2080*

NUTS3:Perugia

Spatial distribution of the data



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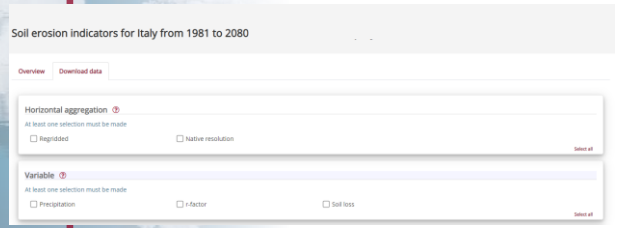

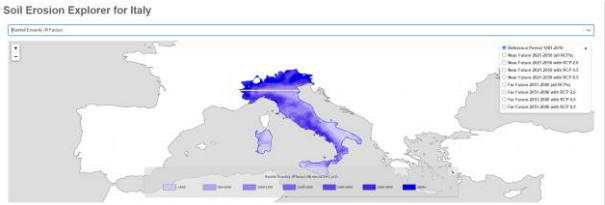

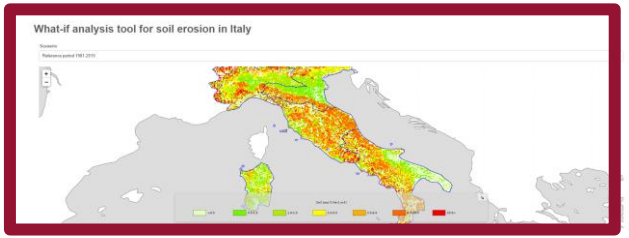

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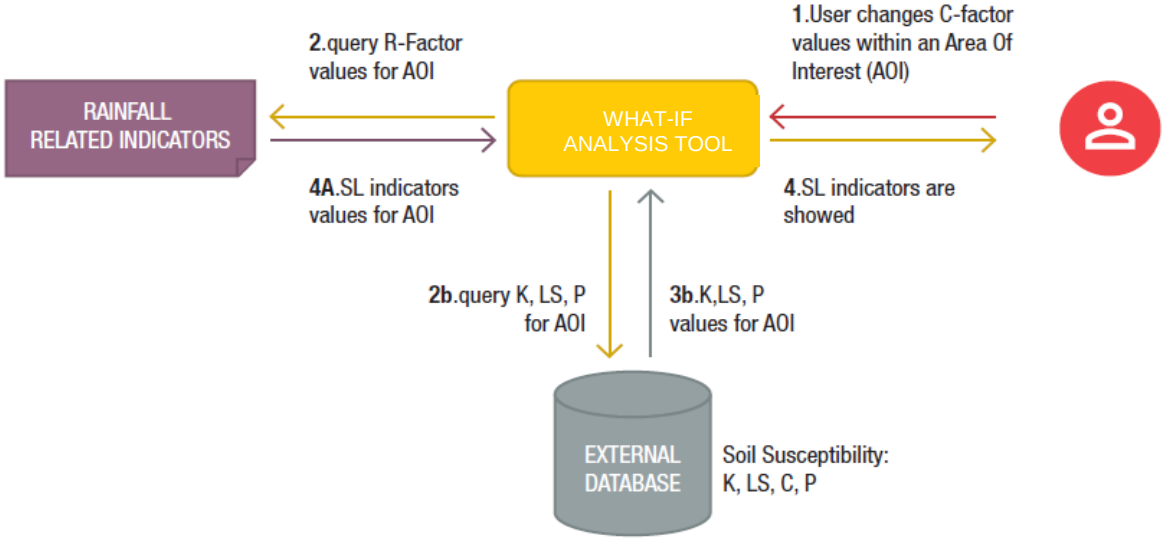
What-if analysis tool for soil erosion in Italy

The Application enables a sort of “what-if” analysis to assess how variations in land use management or soil protection practices could modify soil loss amounts.



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Rationale for what-if analysis

Two factors of RUSLE approach can be assumed varying at local scale under the direct anthropic influence:

C [0-1] cover and management (in particular, arable lands are accounted for)

P [0-1] conservation practices

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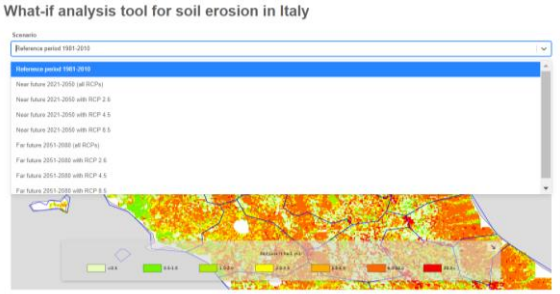
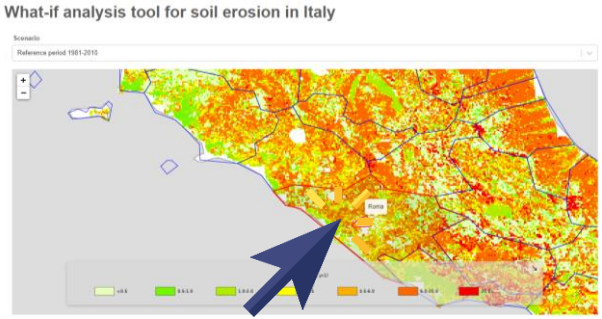
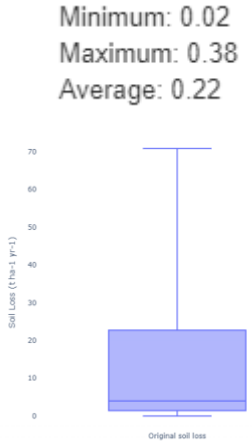


Selecting AOI



Statistical distribution of C for arable lands and soil loss within AOI



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Rationale for what-if analysis

Then, C-values are “perturbed” to assess the impacts of such variations

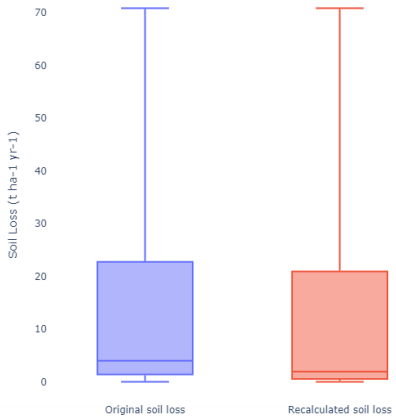
Minimum: 0.02
Maximum: 0.38
Average: 0.22

Factor new average (0-1)

0.1

In this case, a reduction from the average value AVG_{old} [0.22] to AVG_{new} [0.1] is considered entailing for the generic *x* arable land point, a variation equal to:

$$C_{xNEW} = \text{Min}\ (C_x * (AVG_{new}/AVG_{old}))$$



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THANK YOU FOR YOUR ATTENTION