Dynamic modelling of soil erosion and sediment delivery in Europe

A collaborative doctoral partnership between the JRC and KU Leuven

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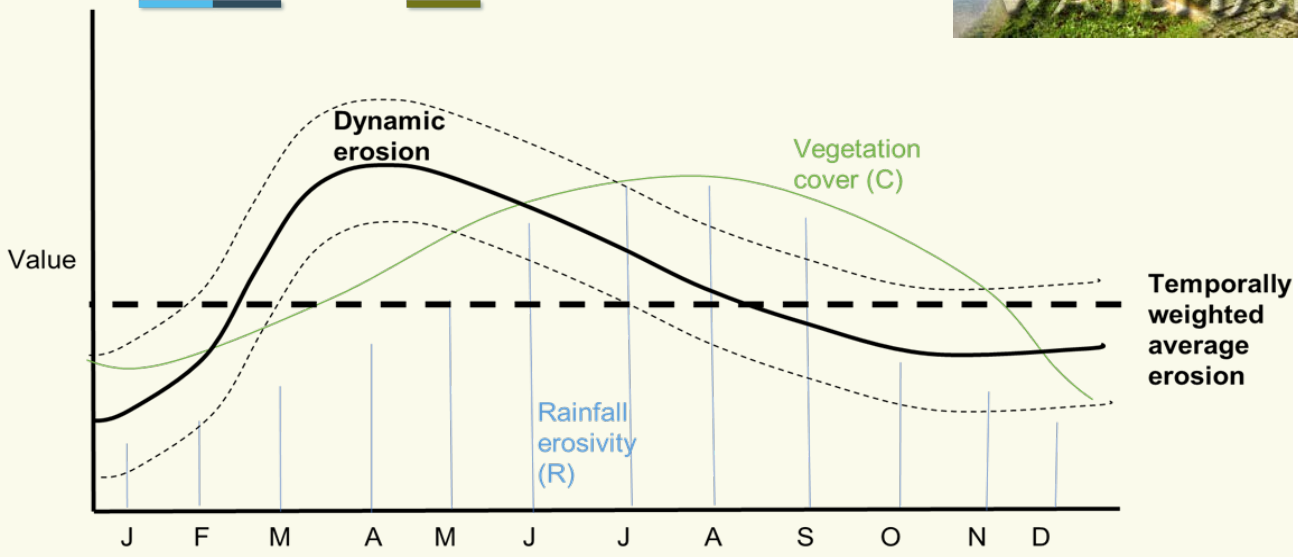
EUSO Young Soil Researchers Forum

Dynamic simulation of soil erosion

RKLSCP



The surface erosion process continuum

RUSLE

Inter-rill erosion → rill erosion → Gullying and incised channels

- Increasing flow concentration and transport capacity
- Increasing landscape-scale translocation of soil

FAO (2019)

Why do we care?

- On-site: 16 % of global agricultural soils have a lifespan < 100 years (Evans et al., 2020)
- Off-site: Soil erosion causes reservoir infilling, muddy floods, eutrophication…
- Mitigation: Management practices are the primary control – time dependent

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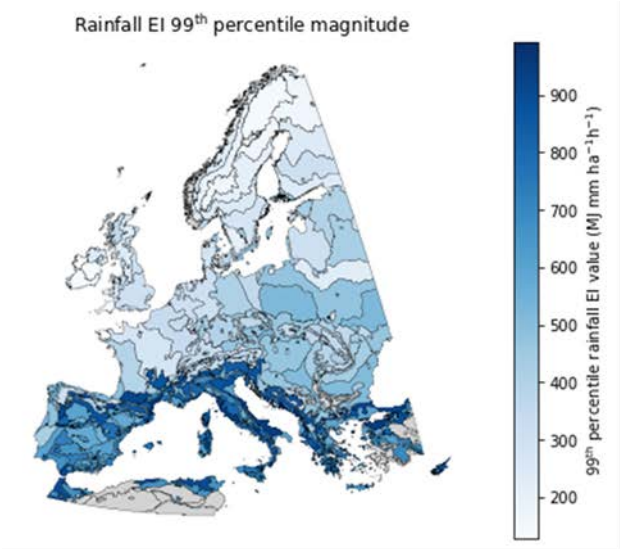
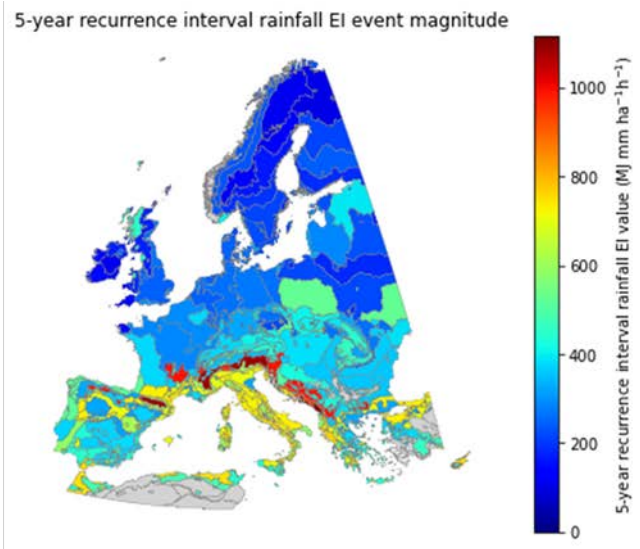
Time compression of erosion in Europe

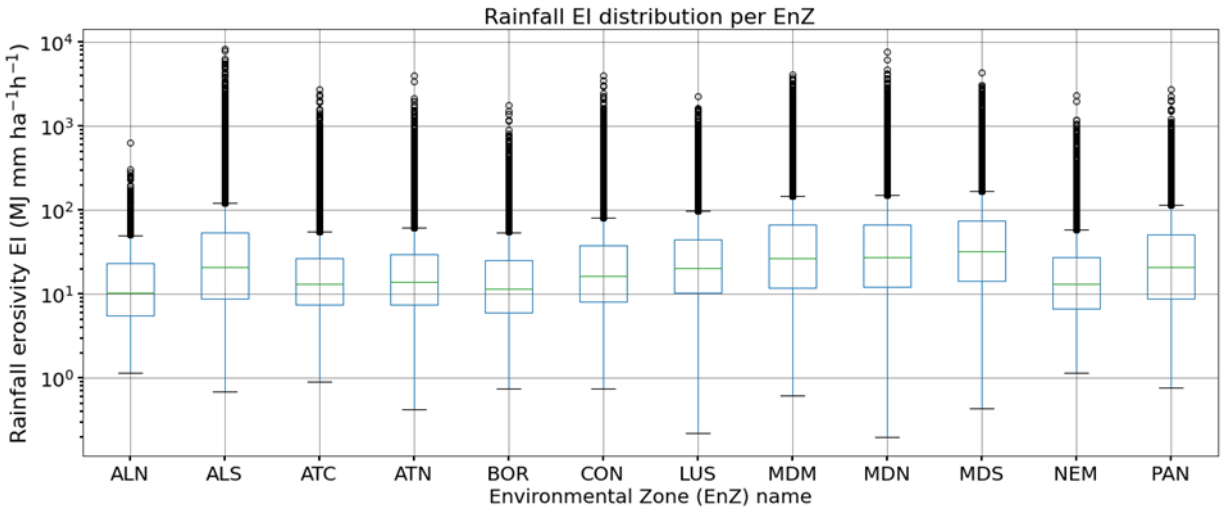
Rainfall erosivity events indicate the distribution of erosion event severity

~11% of erosive events contribute to 50% of the total erosivity (Bezak et al., 2021)

In many cases, the 5-year rainfall erosivity event approaches the total annual average







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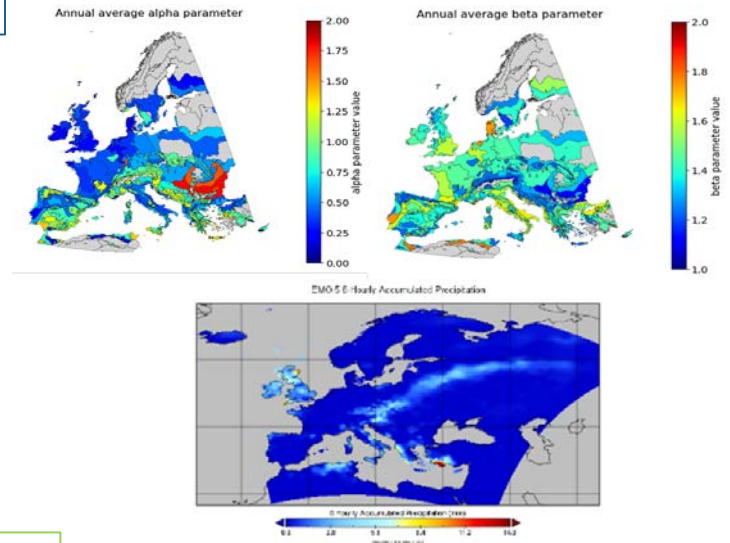
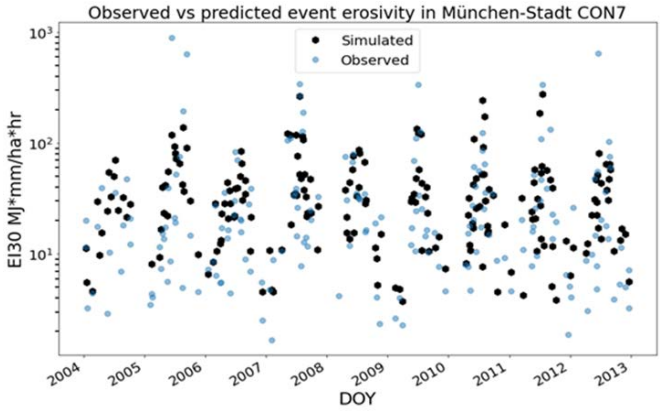
Part 1: Dynamic RUSLE model parameters

Rainfall erosivity



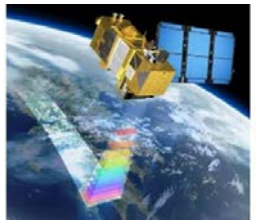
Rainfall erosivity – a scalable EU approach based on REDES



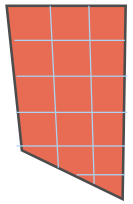
Vegetation cover dynamics

C-factor – parcel-specific crop-phenology approach

1) Parcel object-based approach to define the agricultural spatial extent



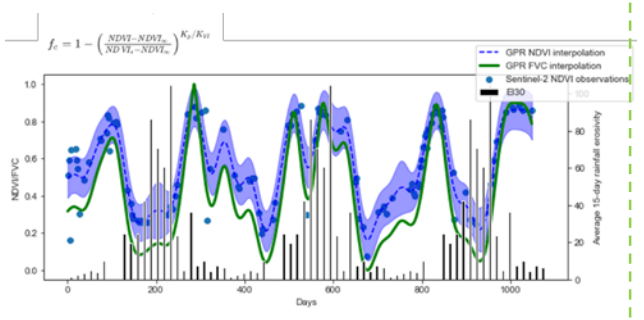
2) Timeseries of optical satellite observations



3) Spatial reduction of pixels within field boundaries

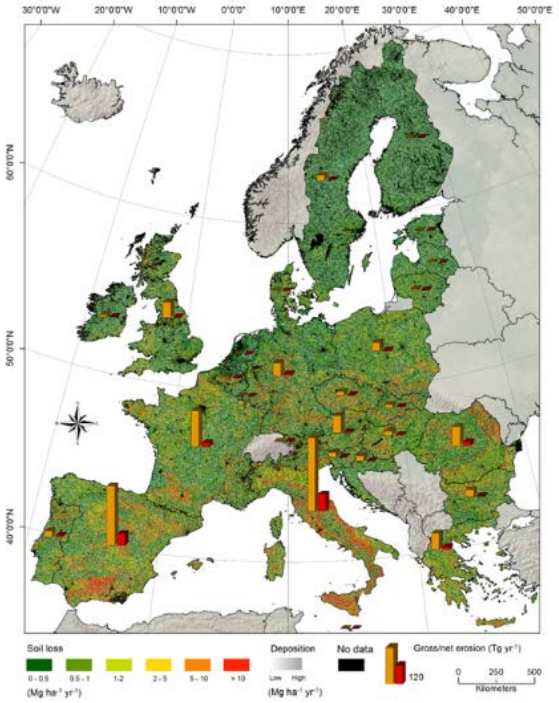
GPR

Field crop cover



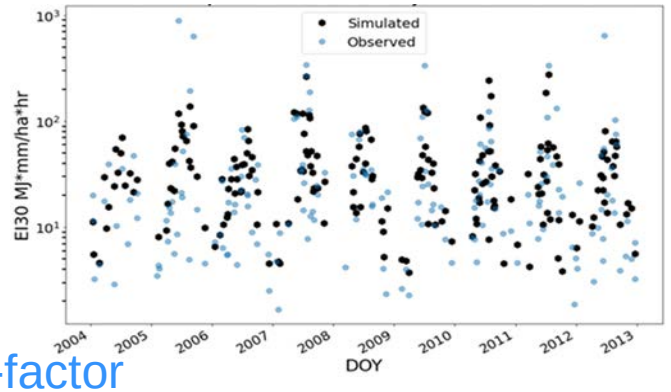
4) Machine learning prediction of the phenology cycle

Part 2: Simulating sediment delivery at the catchment scale

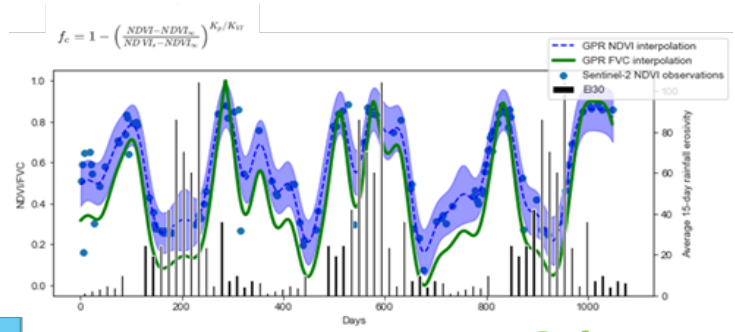


Current status: Long-term annual average gross and net soil erosion predictions in Europe (Borelli et al., 2018)

Dynamic production of RUSLE inputs – key determinants of gross soil erosion

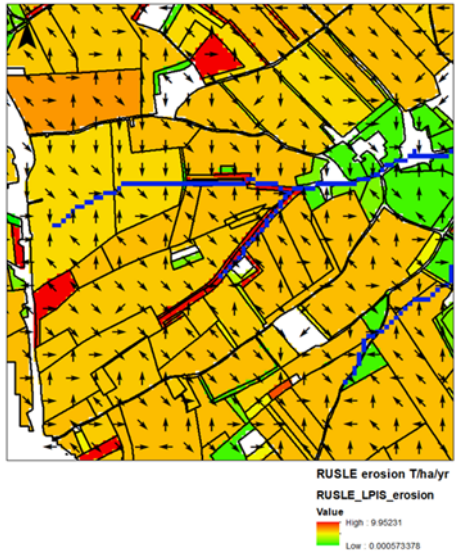


R-factor



C-factor

Soil erosion and sediment delivery modelling environment



- Connecting gross erosion with the net sediment delivery
- Dynamic sediment transport and routing using a modified WaTEM-SEDEM model
- Calibration and validation procedure based on European sediment yield datasets (EUSO objective)

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Conclusions

Simple models can potentially describe the dynamics of soil erosion

Widespread modern data and computational platforms facilitate new approaches for model parameterisation

Further work will seek to use scalable parametrisation methods at management-relevant spatial and temporal scales

Thank you

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