

# Susceptibility of soils to piping erosion in Europe

*Anita Bernatek-Jakiel<sup>1\*</sup>, Matthias Vanmaercke<sup>2</sup>, Jean Poesen<sup>2,3</sup>, Anna Biernacka<sup>1</sup>, Joanna Hałys<sup>1</sup>,  
Dawid Piątek<sup>1</sup>, Taco H. Regensburg<sup>4</sup>, Jan Rodzik<sup>3</sup>, Estela Nadal-Romero<sup>5</sup>, Mateusz Stolarczyk<sup>1</sup>,  
Patryk Wactawczyk<sup>1</sup>, Wojciech Zgłobicki<sup>3</sup>*

<sup>1</sup> Institute of Geography and Spatial Management, Jagiellonian University, Kraków, Poland

<sup>2</sup> Division of Geography and Tourism, KU Leuven, Heverlee, Belgium

<sup>3</sup> Institute of Earth and Environmental Sciences, UMCS, Lublin, Poland

<sup>4</sup> School of Geography, University of Leeds, United Kingdom

<sup>5</sup> Instituto Pirenaico de Ecología, Consejo Superior de Investigaciones Científicas (IPE-CSIC), Zaragoza, Spain

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952327.

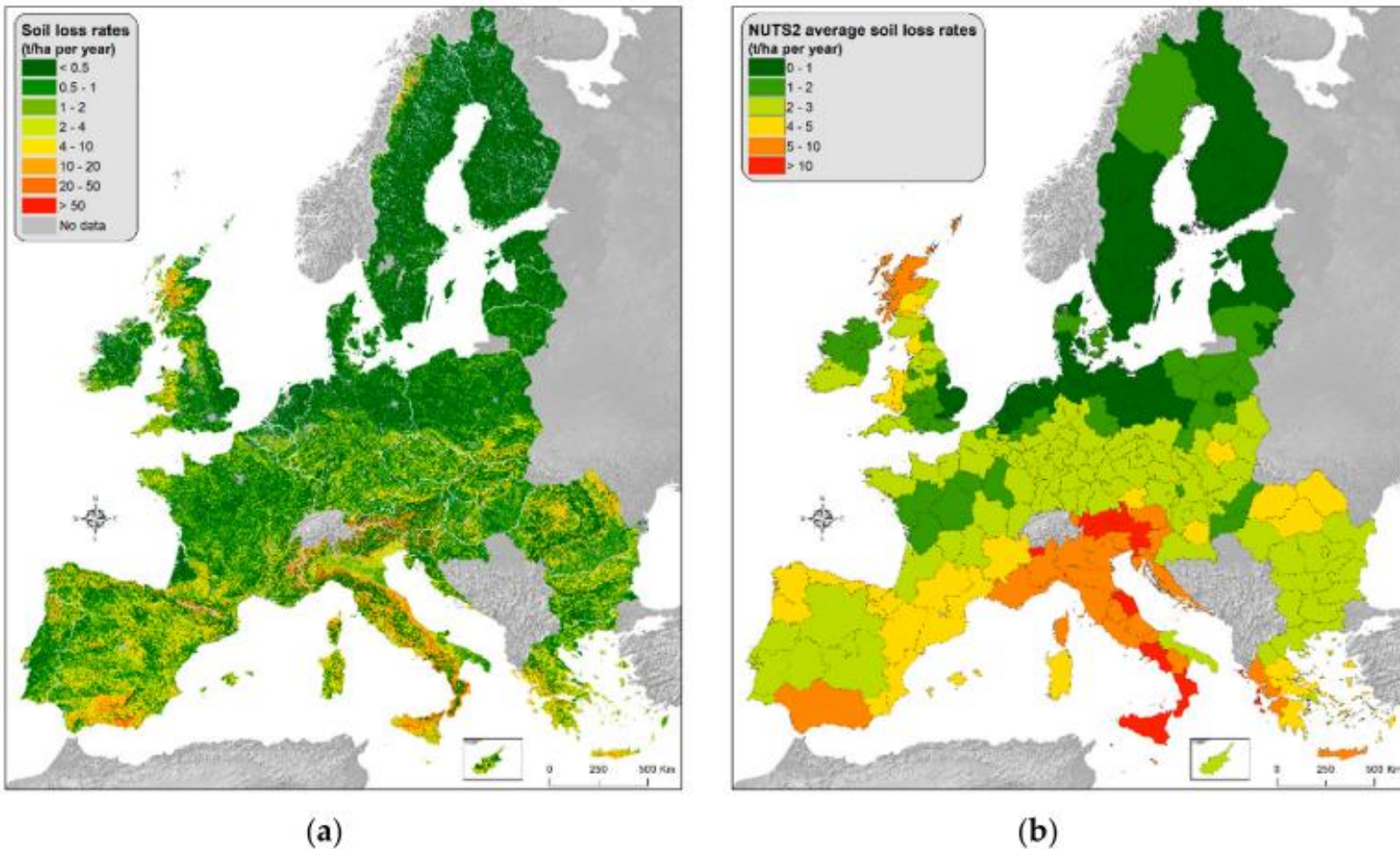


# Land degradation by soil erosion

## **"Caring for Soil is Caring for Life" EU Mission**

- ❑ land degradation by soil erosion as a major threat for food security and the environment
- ❑ 'raising awareness'
- ❑ research related to soil degradation and protection in order to reduce soil erosion

# Soil erosion rates by water erosion



**Figure 3.** (a) The updated soil loss rates by water erosion (2016); (b) The indicator “estimated mean soil erosion rate ( $\text{t ha}^{-1} \text{yr}^{-1}$ )”.

Panagos et al., 2020

Based on RUSLE model

Surface erosion:  
sheet and rill erosion



# Soil erosion by water

## Surface flow

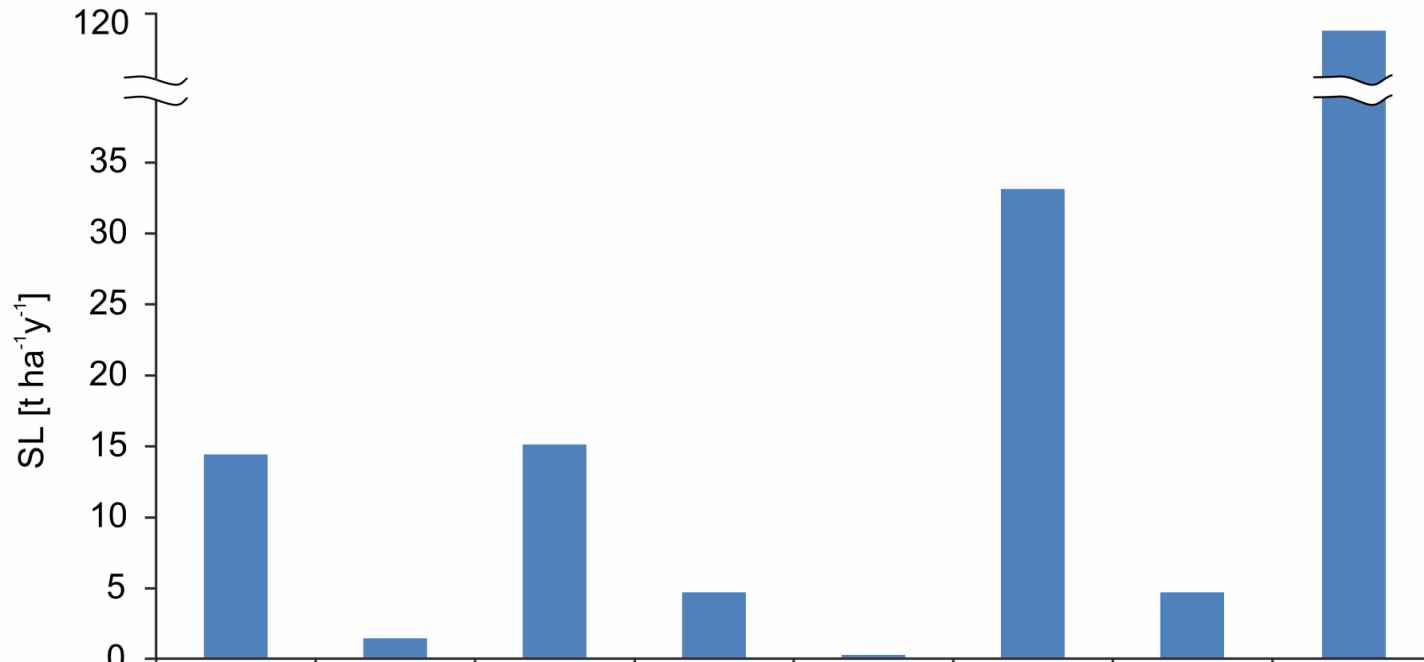
- sheet (interrill) erosion
- rill erosion
- gully erosion

## Subsurface flow

- piping erosion



# Soil loss due to piping erosion

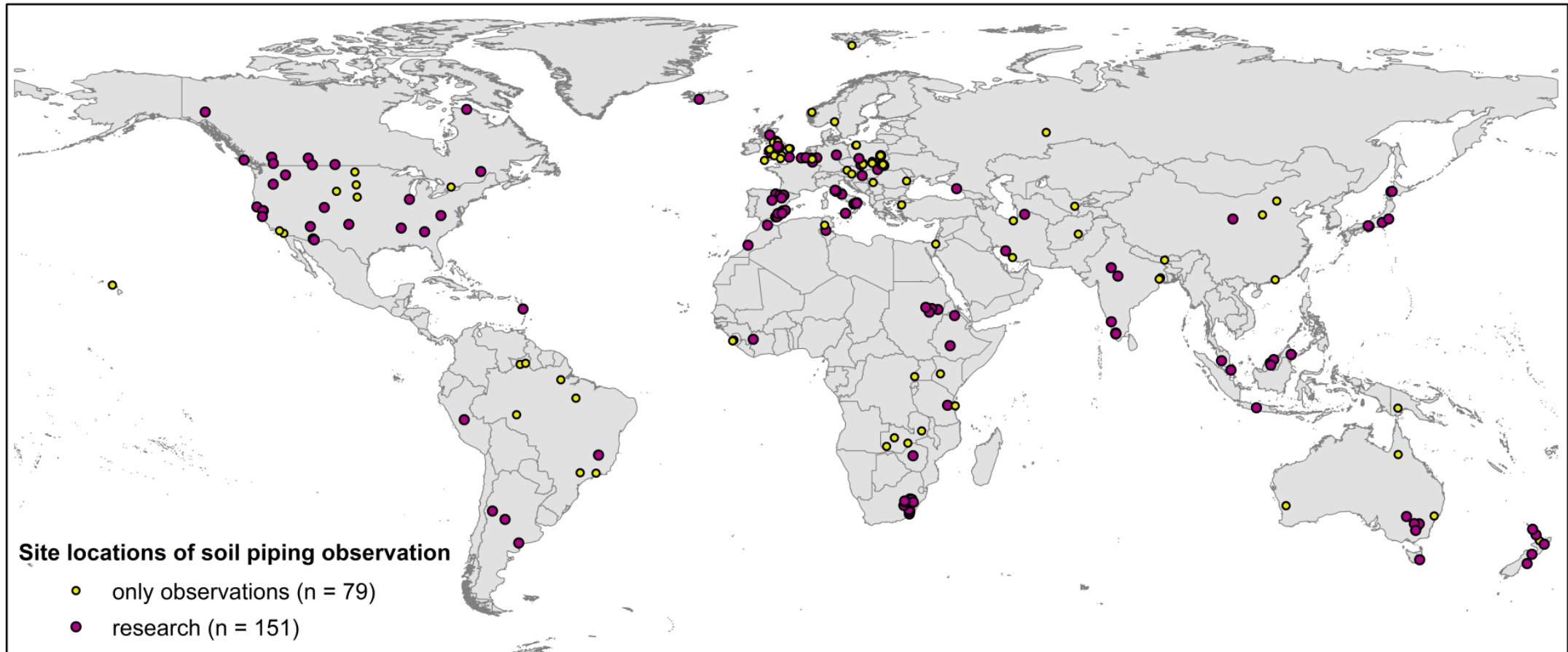


	Hungary	Poland	Germany	Belgium	USA	China	South Africa	Spain
SL [t ha <sup>-1</sup> y <sup>-1</sup> ]	14.3	1.3	15.0	4.6	0.2	33.0	4.6	119.7
SP [y]	25	45	0.25	5–10	1	12	15	40
SA [ha]	2.0	0.42	1.0	0.3	14.6–19.6	20.6	18–25	0.000198
land use	vineyards	grassland	grassland	grassland	cropland	pasture	grassland	farmland

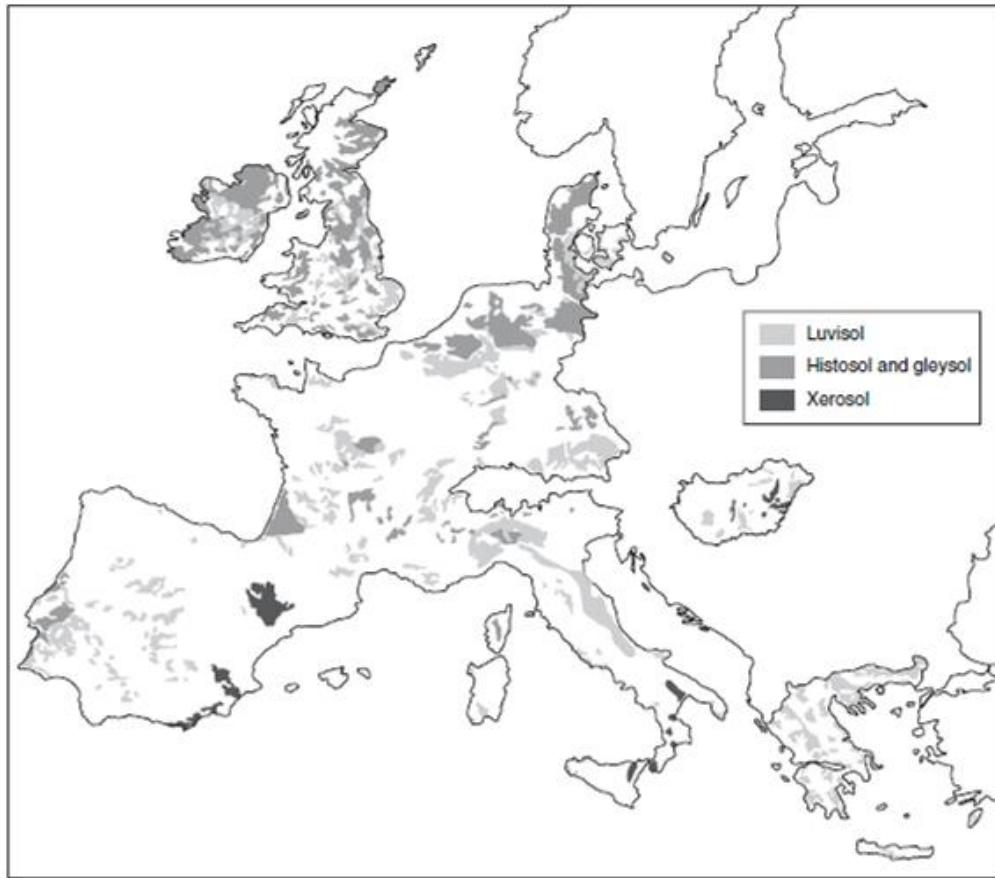
Soil losses due to piping erosion:

- in some places exceed values of severe erosion rates,
- induce significant uncertainties on assessments and projections of soil loss by water.

# Sites with reports on piping erosion



# Piping prone areas – European scale



**Figure 2.6.1** Distribution of three types of piping-prone materials in Europe (data as available May 2004): Luvisols of the north and central European Loess belt; Histosols (peats) and Gleysols of uplands in Northern Europe; dispersive Xerosols of the southern Mediterranean

- ❑ Based just on soil types
- ❑ Without Eastern European countries

# Aims

## **identifying areas prone to soil piping at a European scale**

- preparing an inventory of pipe collapses in the European Union and the UK using GIS tools and remote sensing analyses
- collecting information on factors potentially controlling soil pipe formation and development

**better understanding and predicting of pipe development and collapses and, thus indicating areas of special interests where prevention and control measures should be implemented**



## Environmental factors :

- land use/land cover and its changes
- soil properties
- hydraulic gradient
- geology

Google Earth

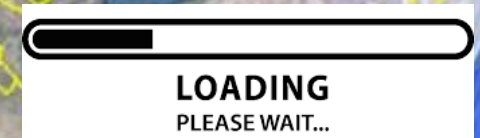
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image Landsat / Copernicus

Image IBCAO

Image U.S. Geological Survey

Up to now almost 1000 pipe collapses mapped in Europe



z kosmosu (wysokość: 5809 km)



# Final remarks

**Ebro Depression (Spain)**



**Bieszczady Mts. (Poland)**



**Flemish Ardennas (Belgium)**



CONTEXT: LULC changes (e.g., the conversion of arable lands to pastures), climate change

Incorporating subsurface erosion into general soil erosion studies, incl. models

LUCAS Topsoil sites – monitoring soil erosion, incl. piping?

Thank you for your attention 😊

anita.bernatek@uj.edu.pl



@Anita\_Bernatek



Young Soil Researchers Forum: Soil Erosion  
21 October 2021