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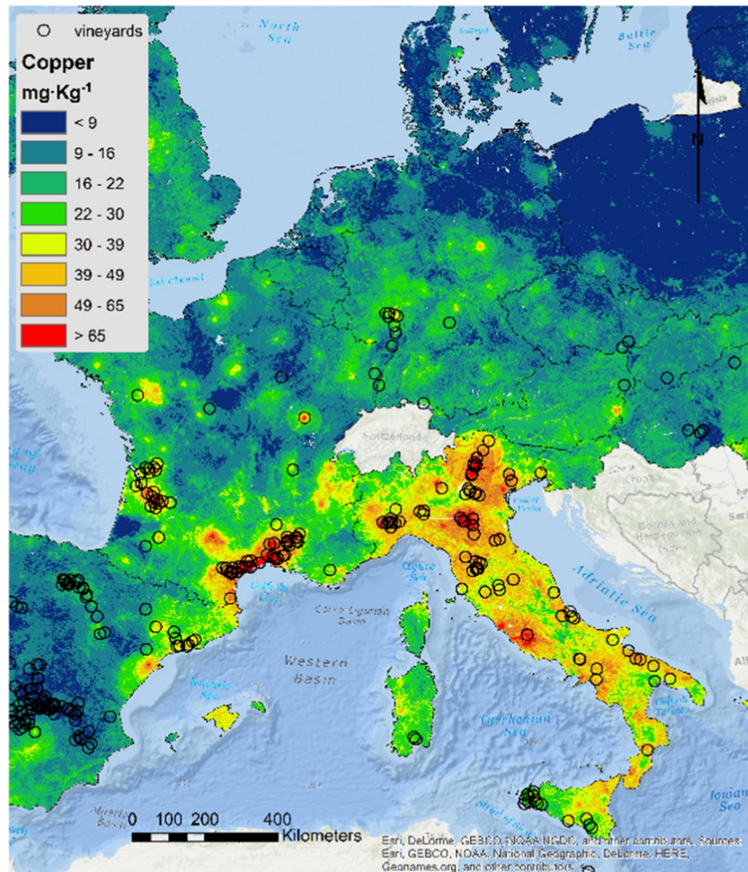


# Using climate change scenarios to simulate mobility of metal contaminants in soils: the example of copper on a European scale

L. SERENI, J.-M. PARIS, I. LAMY, B. GUENET

INRAE, AgroParisTech, EcoSys,

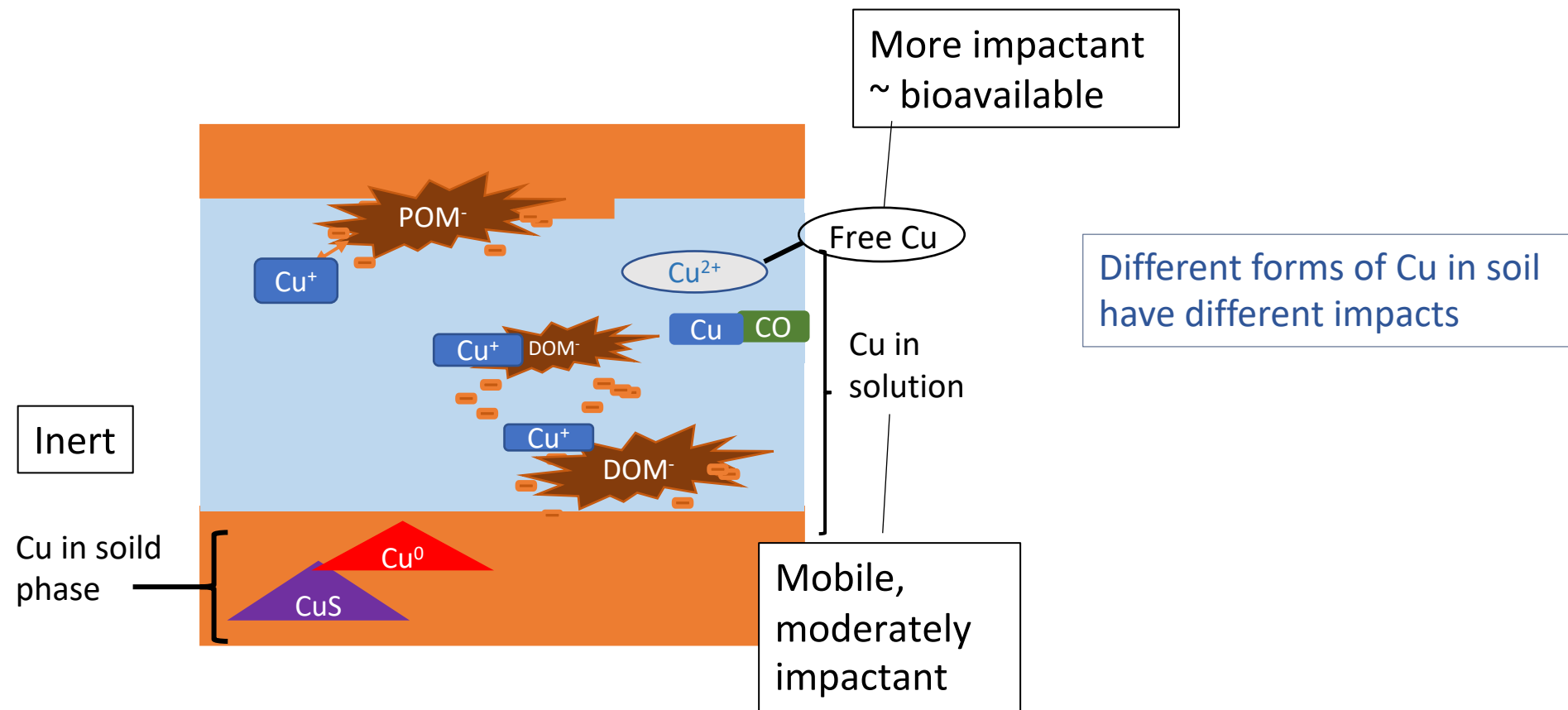
<sup>1</sup> CNRS, Laboratoire de Géologie ENS,



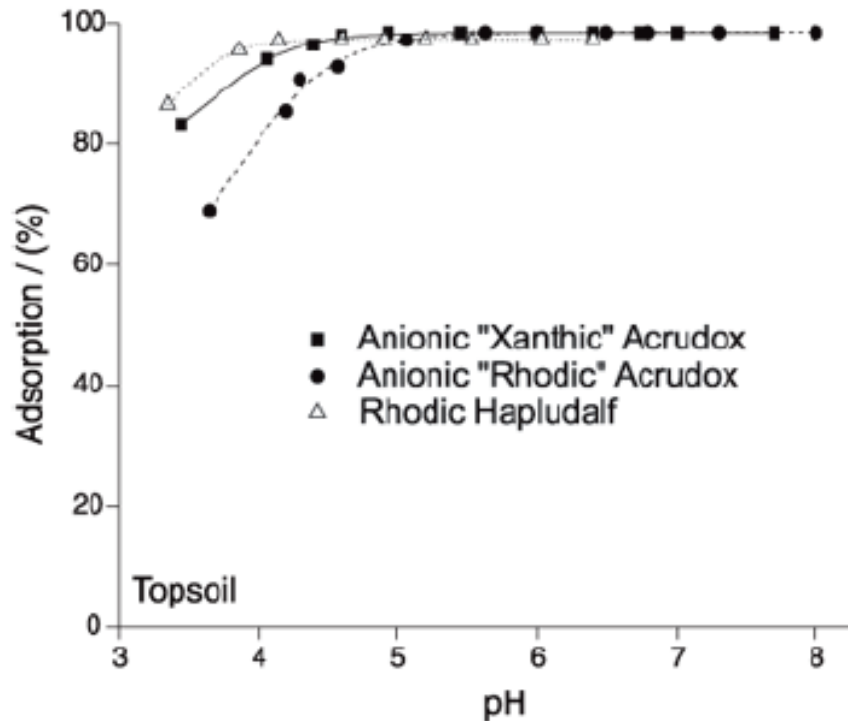
Soil Cu contamination concerns large area but varies widely spatially

## Cu concentrations in Europe

Ballabio et al. 2018

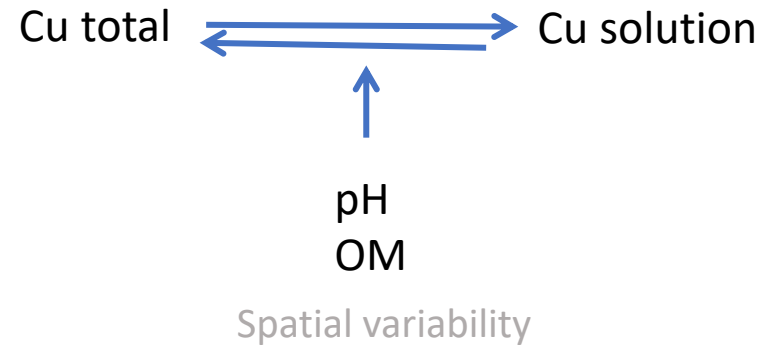


Schematic representation of Cu forms in soils

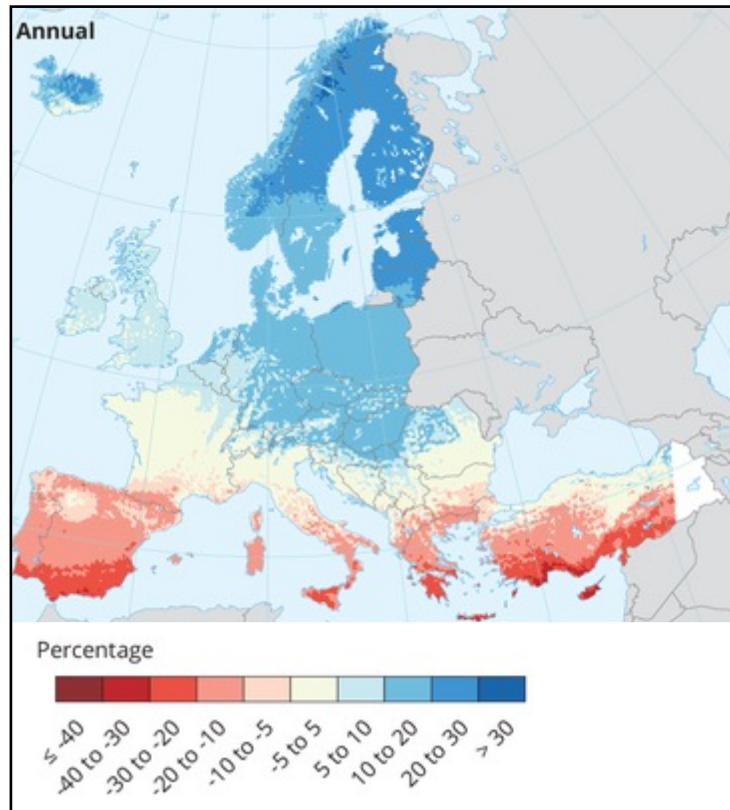


Cu-pH adsorption curves for 3 different soils

Mouta et al., 2008



Availability and mobility of  
contaminants depend on  
environmental factors



Annual precipitations change between and 2071-2100 compared to 1971-2000

<https://www.eea.europa.eu/data-and-maps/figures/projected-changes-in-annual-and-6>

Spatial and temporal variability

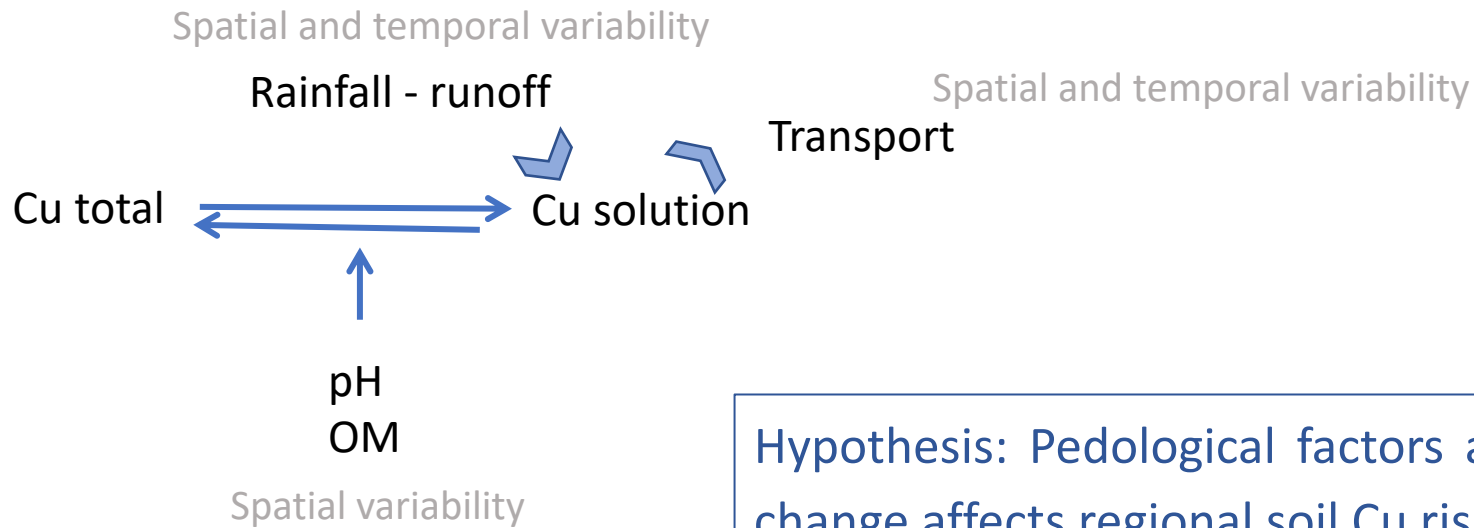
Rainfall - runoff

Spatial and temporal variability

Transport

Cu solution

Precipitations and soil runoff  
will changed



Hypothesis: Pedological factors and climate change affects regional soil Cu risks

- Soil contamination concerns large surfaces
- Regional Cu availability depends on environmental factors
- Climate change affects soil solutions fluxes
- Cu risk depends on Cu availability and runoff fluxes

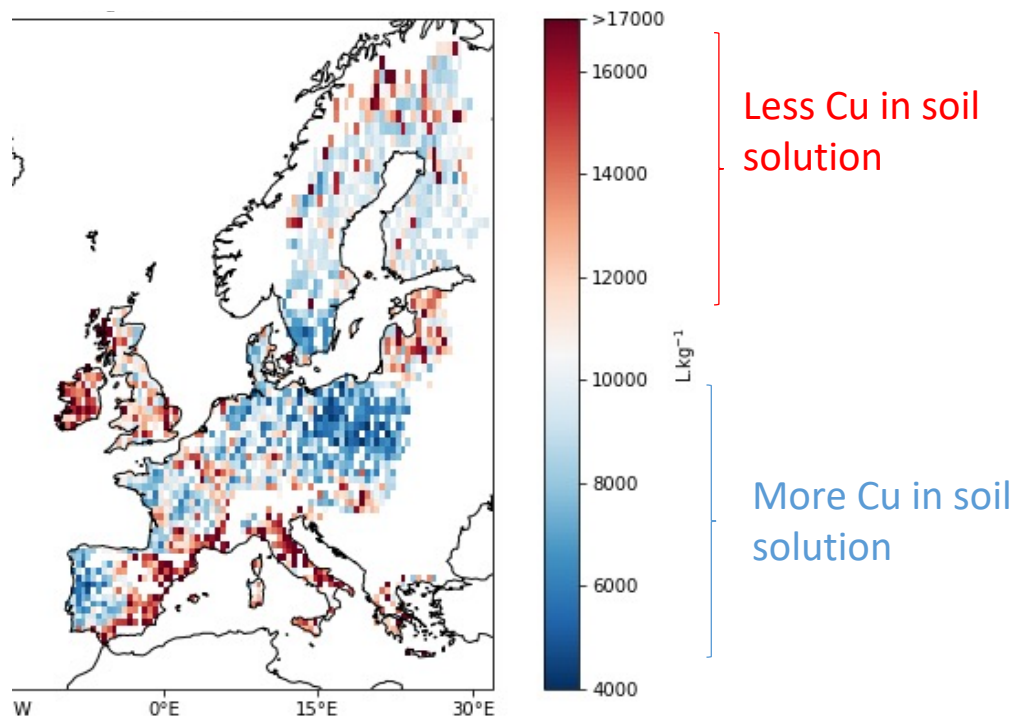
How will Cu transport in soil runoff evolved during the XXI<sup>th</sup> century ?

1. Determine area at high risk of soil Cu export
2. Assess evolution for different Earth model and climate change scenario



- Evolution of Cu transport risk with climate change
  - Computation of dissociations constant Cu total /Cu solution  $K_f$  ( $0.5^\circ$ )

$$\log_{10}(K_f) = 1.75 + 0.21 \times pH + 0.51 \times \log_{10}(MO)$$

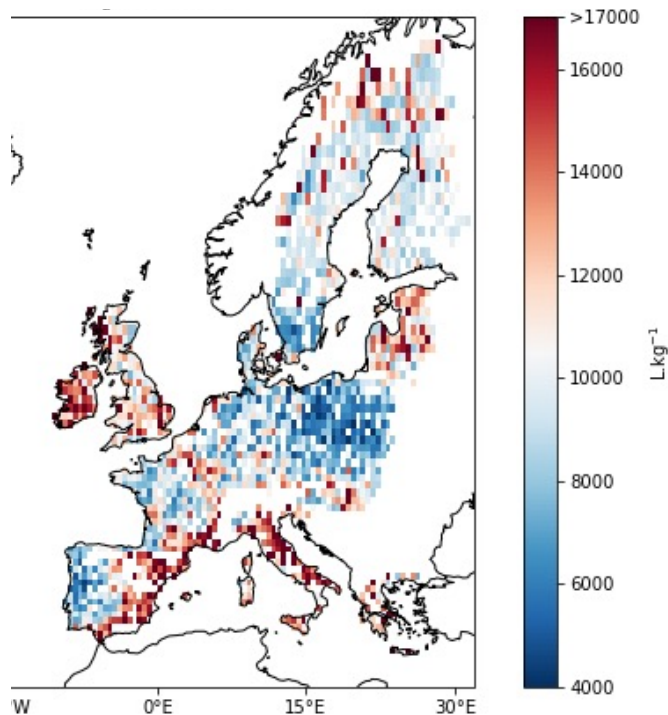


$$K_f = \frac{Cu_{total}}{Cu_{solution}^n}$$

Dissociations constants map in Europe

- Evolution of Cu transport risk with climate change
  - Computation of dissociations constant Cu total /Cu solution  $K_f$  ( $0.5^\circ$ )
  - Compare with runoff during the century

$$\log_{10}(K_f) = 1.75 + 0.21 \times pH + 0.51 \times \log_{10}(MO)$$



X

Soil runoff for

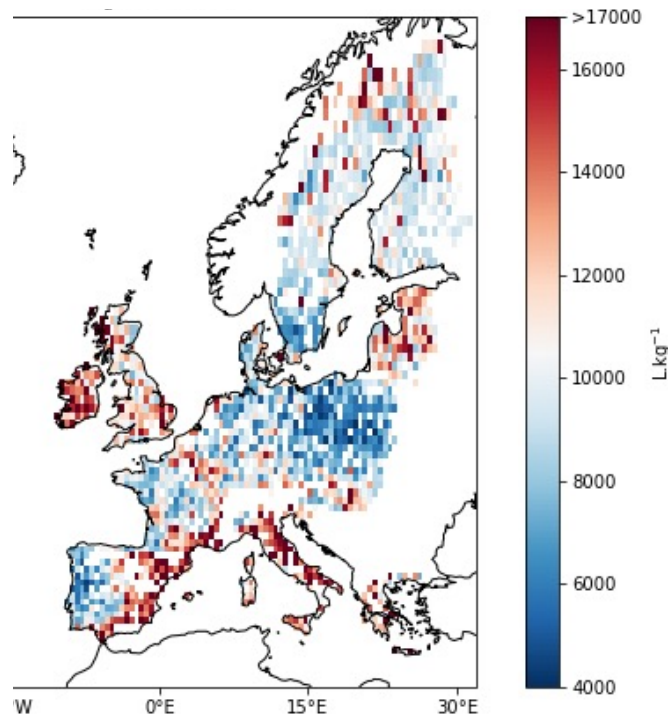
- 2 RCP: 2.6 et 6.0  $W.m^{-2}$
- 3 time period :  
2001-2005 ; 2051-2055 et 2091-2095
- 2 land surface scheme (ORCHIDEE and LPJmL)
- 2 climate forcing (CM5a and ESM2m)

Dissociations constants map in Europe

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Dissociations constants map in Europe

Soil runoff for

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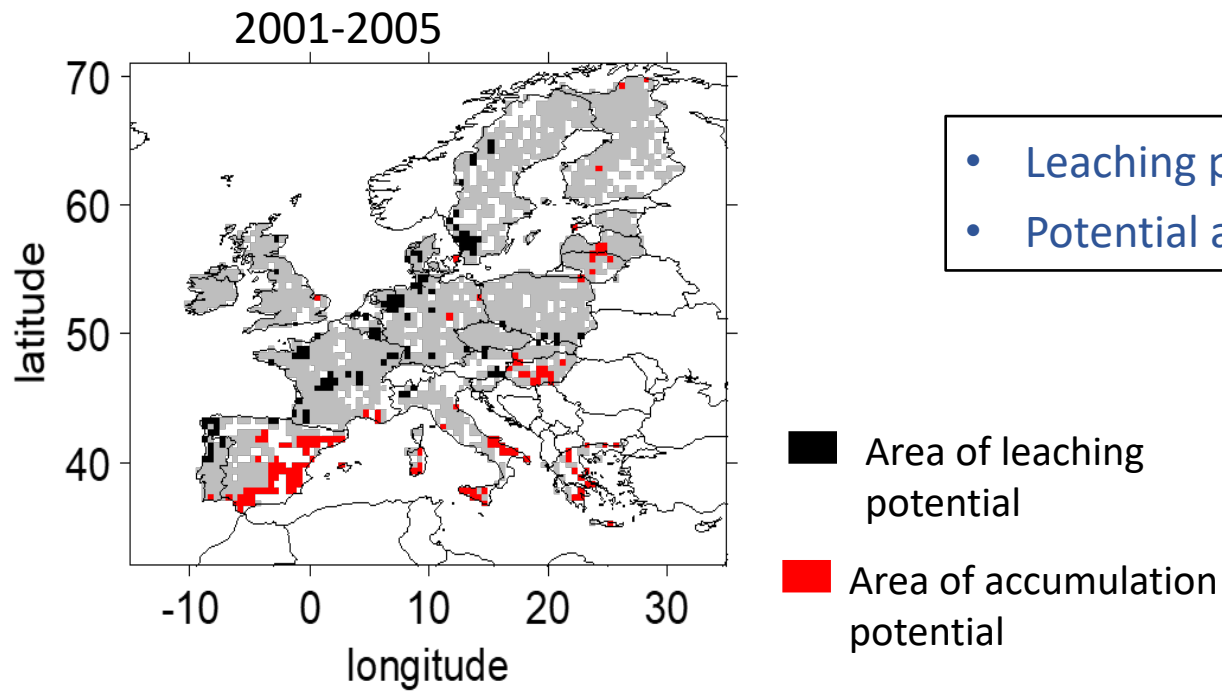
- Area of leaching potential :

$\left\{ \begin{array}{l} K_f \text{ Low} \\ \text{Runoff high} \end{array} \right.$

- Area of potential accumulation:

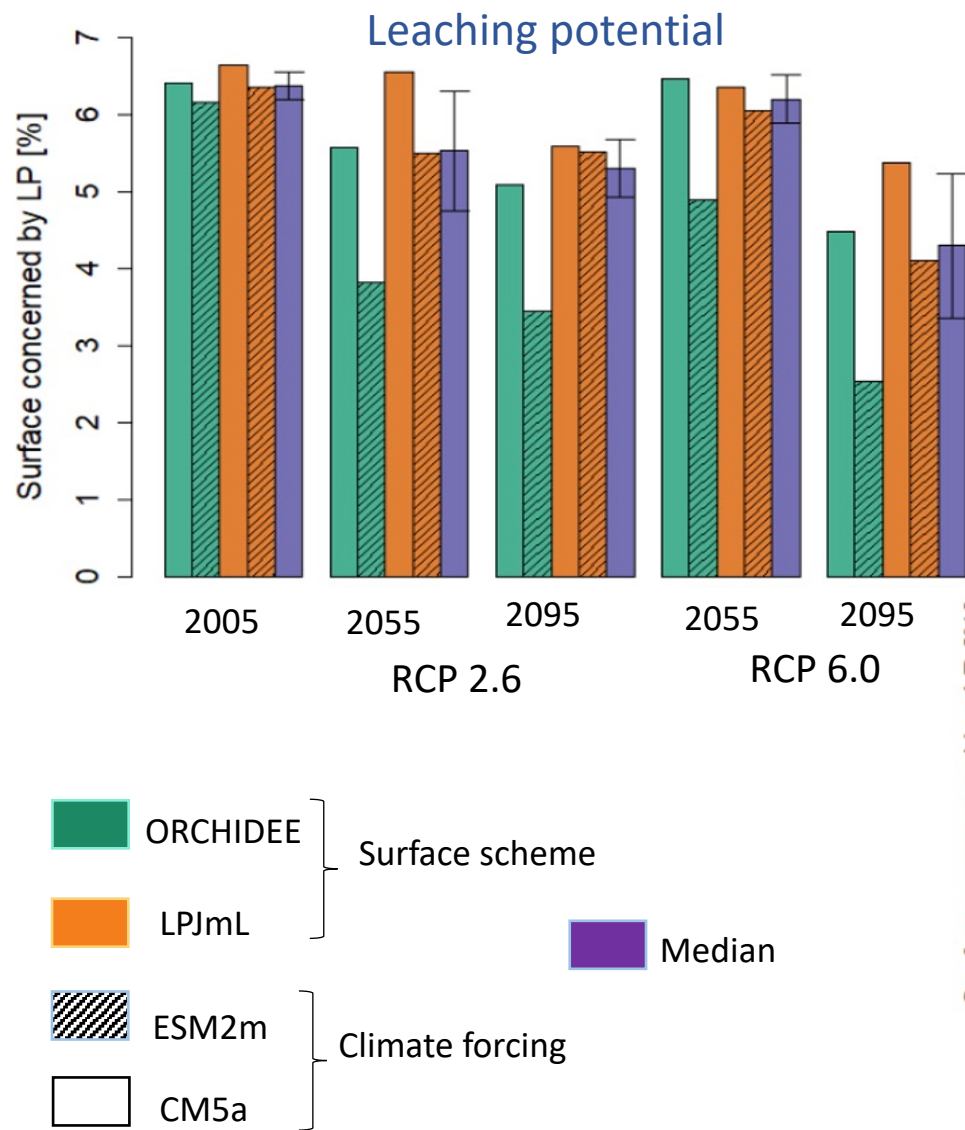
$\left\{ \begin{array}{l} K_f \text{ High} \\ \text{Runoff low} \end{array} \right.$

ORCHIDEE\_CM5a

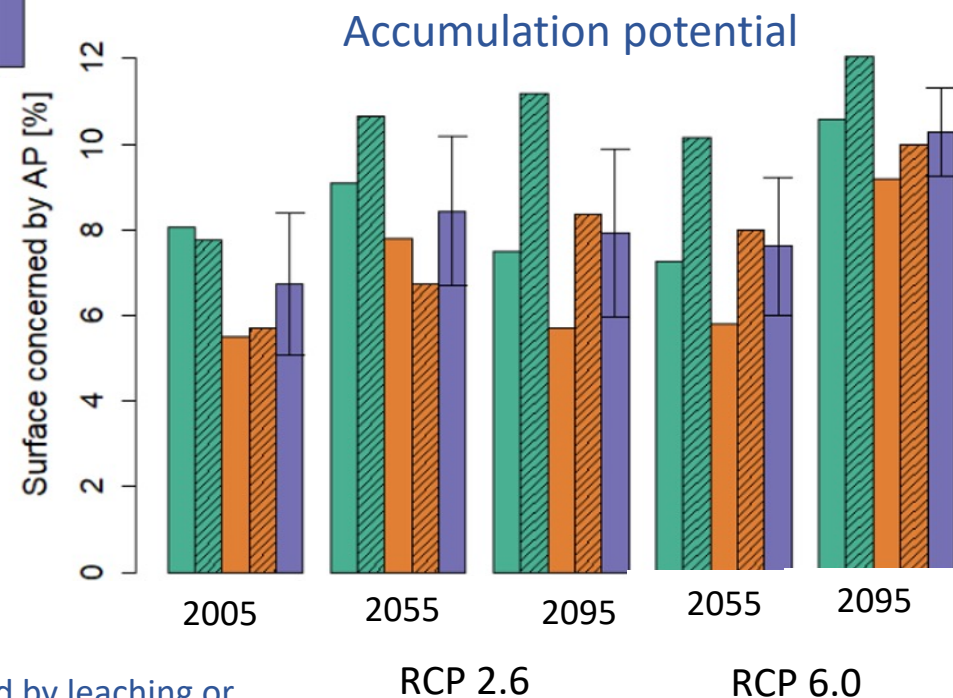


- Leaching potential in north of Europe
- Potential accumulation in south

Area of leaching and accumulation potential in Europe for ORCHIDEE CM5a and 2001-2005 period



- Decrease in leaching potential and increase in accumulation potential during the century
- Variation between 2001-2005 et 2091-2095 depends on model and scenario



Percentage of European soil surface concerned by leaching or accumulation potential risk over the XXI<sup>th</sup> century

ORCHIDEE\_CM5a

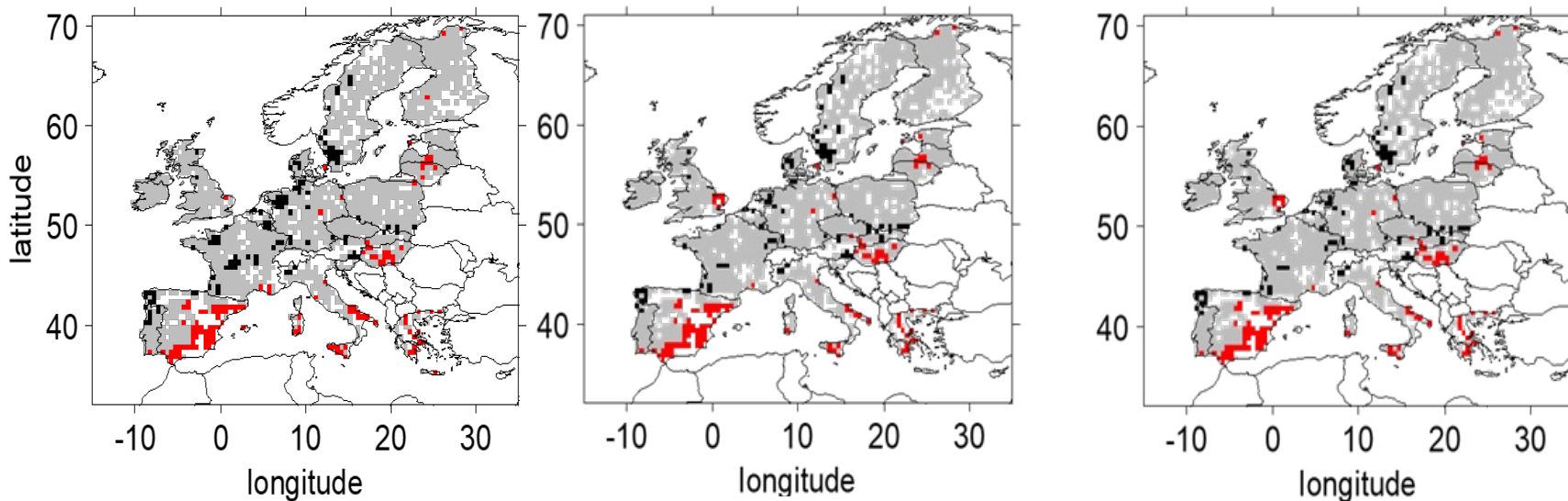
RCP 6.0

- Increase in accumulation potential in south and east
- Decrease in leaching potential in Scandinavia

2001-2005

2051-2055

2091-2095



Area of accumulation  
potential



Area of leaching  
potential

Accumulation and leaching area estimated for ORCHIDEE CM5a during the XXI<sup>th</sup> century for RCP 6.0

## Assess soil leaching risk over century

- We found that:

- Area of leaching potential tends to decrease by the end of the century.

- Area of accumulation potential will increase by the end of the century

- Over century, tendencies of variation depend on model and scenario of climate change

- Don't take into account intra annual variability of climate change in risk area nore effect of drought in  $K_f$  values.