The Influence of Soil Organic Matter on Soil Erodibility (K-factor) in Alpine Soils: Insights from Aosta Valley (NW, Italy)

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1 Introduction

- **Soil organic matter (SOM)** and **surface stone cover (St)** are key factors in **protecting alpine soils from erosion**, as they enhance aggregation and reduce erodibility [2][3].
- **K estimation models,** not originally designed for mountain ecosystems, **may overestimate soil vulnerability**, since SOM levels in these soils often exceed those considered in conventional assessments..

2 Questions?

a **How suitable are K estimation methods for complex mountain environments, where SOM and St strongly influence soil erodibility?**

b **Are some soil types more erodible than others?**

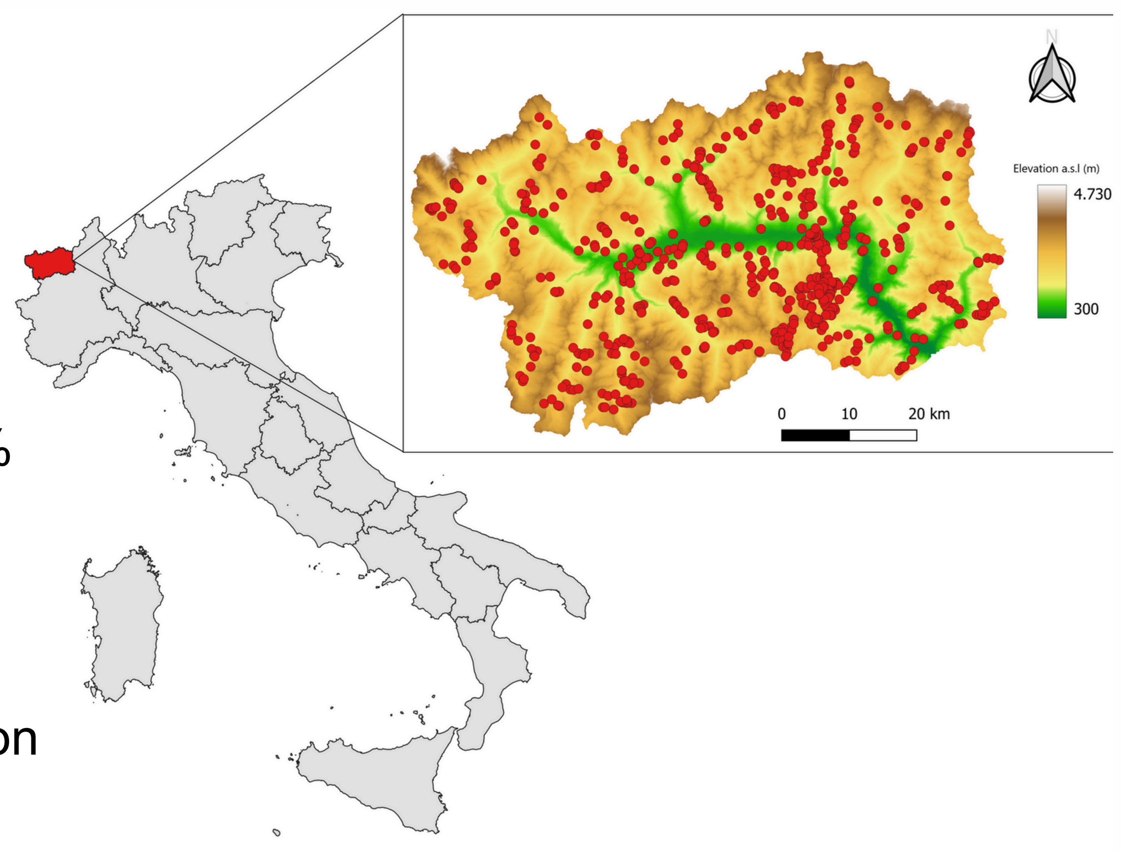
3 Materials and Methods

Study area

Location: Aosta Valley, NW Italian Alps (3,262 km²)

Elevation range: 350–3000 m (87% >800 m).

Climate: Inner-alpine, mean annual precipitation 485–2,000 mm

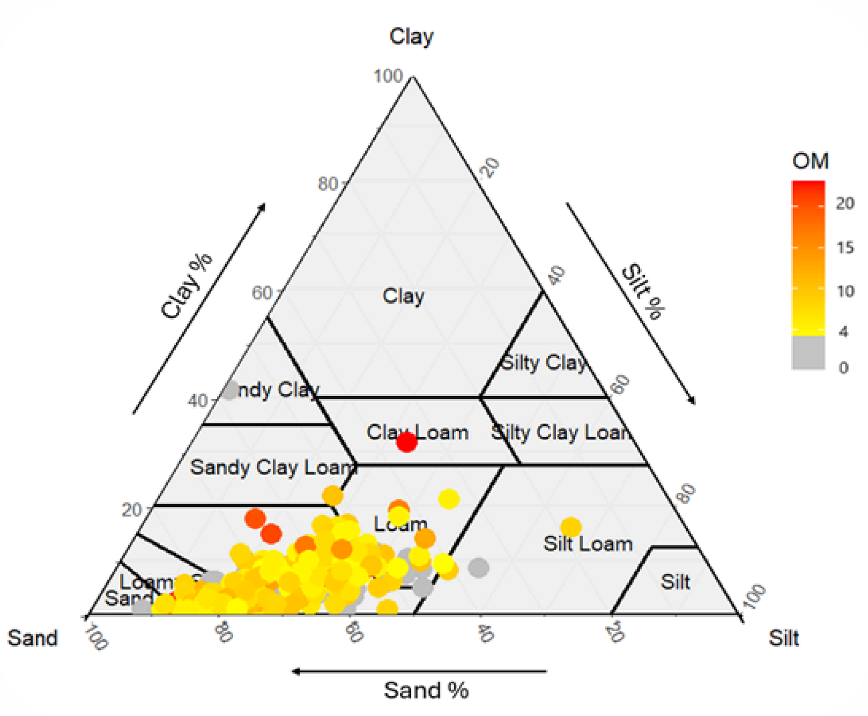


Main soil types : Regosols, Podzols, Cambisols

Dataset

308 soil profiles (upper mineral horizons: A, AE, Ap, E) from previous studies (1990–2023) [1].

SOM/Texture of samples



Textural triangle with SOM indicated by color gradient above 4%.

Textural classes: Sandy Loam (62.7%), Loamy Sand (25.6%)

SOM content range: 0.36% – 20.0%

High SOM prevalence: **~65% of samples > 4% SOM**

Soil erodibility (K) estimation → 2 models

EPIC
- Texture
- SOC content

USLE
- Texture
- SOM content
- Permeability
- Structural class

4% SOM threshold ➤ **K4** ➤ **(K4+St)**

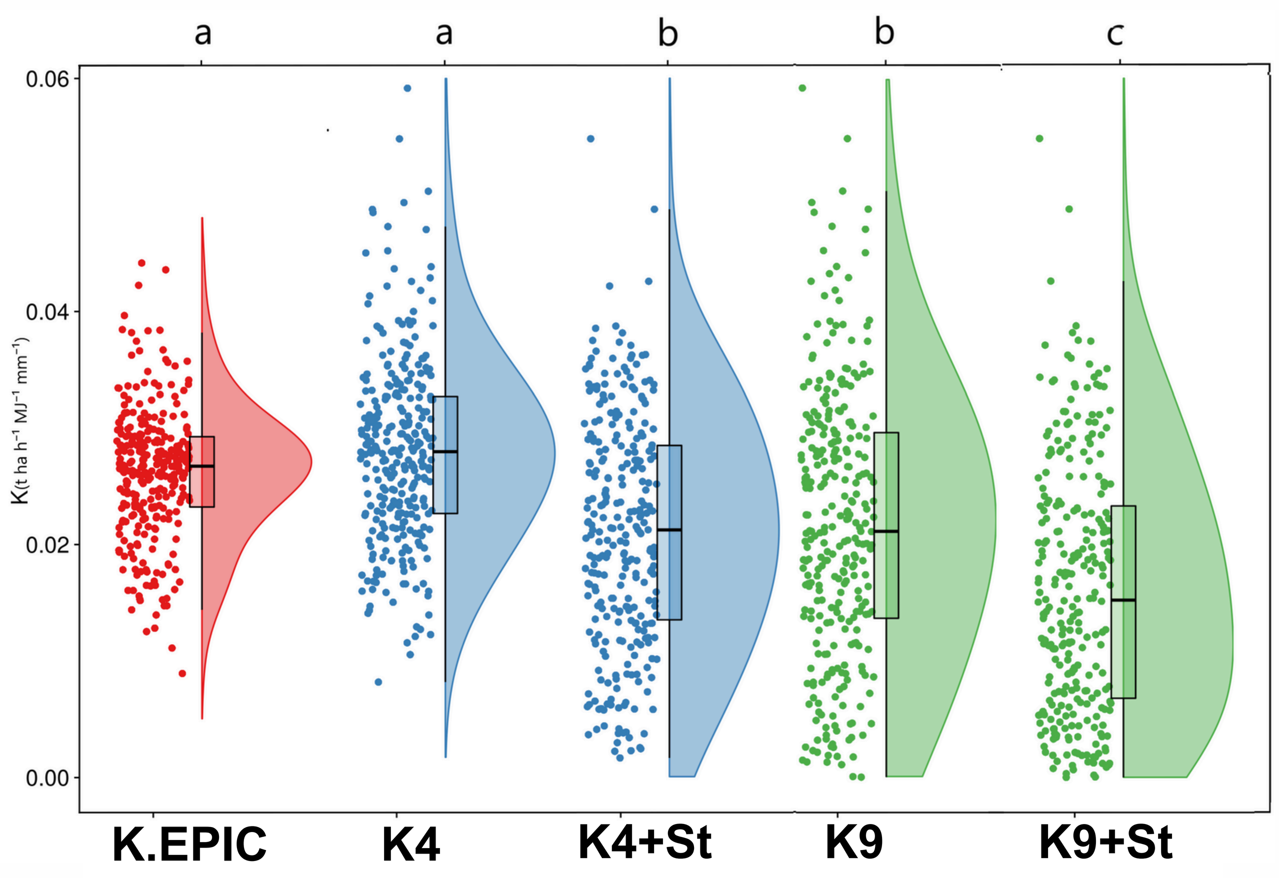
9% SOM threshold ➤ **K9** ➤ **(K9+St)**

+ Stoniness correction

4 Preliminary results and discussion

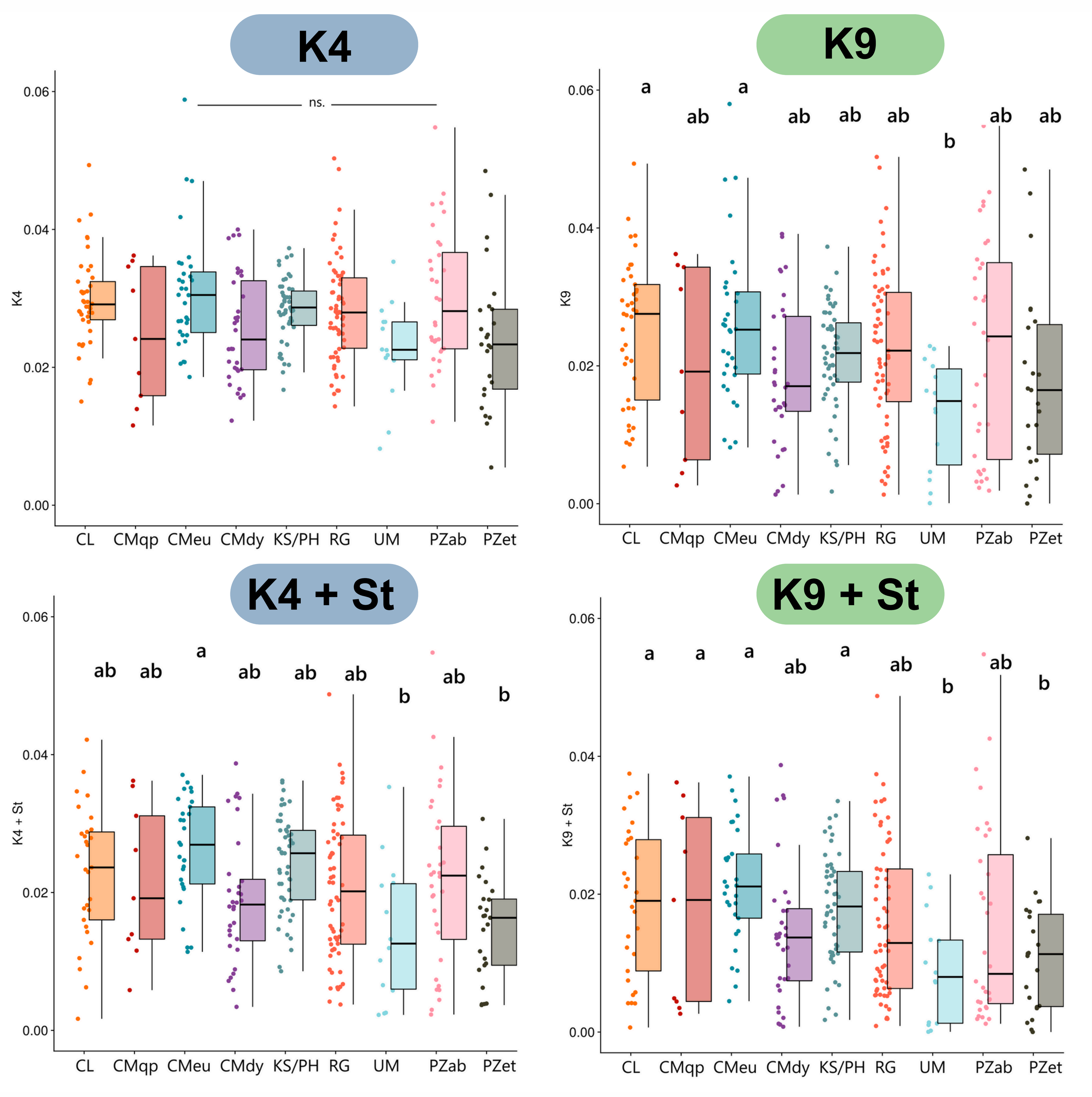
a Statistical comparison between K estimation methods

- The **EPIC** model **tends to flatten** K values, emphasizing texture over SOM.
- **USLE**-based estimates—especially K9—show **greater variability**, aligning more closely with field observations.
- Applying the **stoniness correction** (K4St and K9St) further **reduces K** values.



b Soil erodibility (K) across soil types

We decided to further explore the relationship between K and soil type excluding the EPIC model.



Soil type	Code
Calcisols	CL
Dystric Cambisols (Prot.)	CMqp
Eutric Cambisols	CMeu
Dystric Cambisols	CMdy
Phaeozem/Kastanozem	KS/PH
Regosols and Fluvisols	RG
Umbrisols	UM
Albic Podzols	PZab
Entic Podzols	PZet

- **K4** ➤ n.s.
- **K4+St**
  - → **More erodible:** Eutric Cambisols
  - → **Less erodible:** Umbrisols, Entic Podzol
- **K9** ➤
  - → **More erodible:** Calcisols, Eutric Cambisols
  - → **Less erodible:** Umbrisols
- **K9+St** ➤
  - → **More erodible:** Calcisols, Cambisols, Kastanozem/Phaeozem
  - → **Less erodible:** Umbrisols, Entic Podzol

Unit of measurement of K: (t ha⁻¹ h⁻¹ MJ⁻¹ mm⁻¹)

5 Conclusions

a
- **USLE best captured K variability** in mountain soils, outperforming EPIC.
- **Increasing SOM content** in the model and **accounting for stoniness** leads to a significant **decrease in K** values.

b Model adjustments (SOM threshold + St factor) revealed **K variability among observed soil types**, this explains the existence of well-developed soils with deep organic layers—which would not be possible if their vulnerability were truly as high as conventional estimates suggest in alpine environments.

References

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