Actual geomorphological processes on steep hillslope vineyards. A comparison of Ruwertal (Germany) with the Montes de Málaga (Spain).

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Introduction

Steep hillslope viticulture areas are one of the most complex and degraded agricultural eco-geomorphological systems of Europe.

Precisely, the vineyards of the **Ruwer-Mosel valley (Germany)** and **Montes de Málaga-Axarquía (Spain)** are clear examples because both are characterized by:

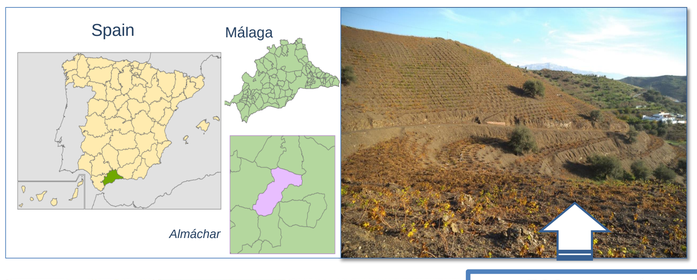
- Frequent heavy rainfall events.
- Steep slopes (20 and 45º) on metamorphic rocks (schist and slates).
- Intensive, non-conservative land use managements of the soil.

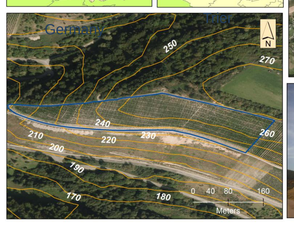
The aims of this study are:

1.to quantify the hydrological and erosive phenomena.
2.to compare both dynamics during diverse seasons and under different management conditions.

Study area

Figures 1-2. Location of the study areas





520 mm yr^{-1}
17.2ºC
Muscat of Alexandria
Soil tillage with hoes, shovels and animals.

765 mm yr^{-1}
9.3ºC
Riesling
Soil tillage with vine training system and heavy machinery.

Table 1. Principal characteristics of the soils

	>2 mm (%)	Sand (%)	Silt (%)	Clay (%)	LOI (%)	pH (H_2O)	SWC (fc)	SWC (wp)
Montes de Málaga	54.4	22.2	**72.2**	5.6	3.1	7.1	24.3	7.7
Ruwer-Mosel valley	37.9	26	**64.7**	9.4	6.1	7.2	27.7	12.3

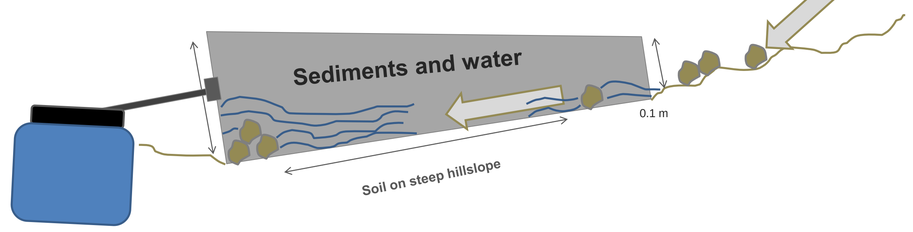
* = LOI: Lost on ignition (organic matter); SWC (fc): soil water content (field capacity); SWC (wp): soil water content (wilting point).

Methods of data collection

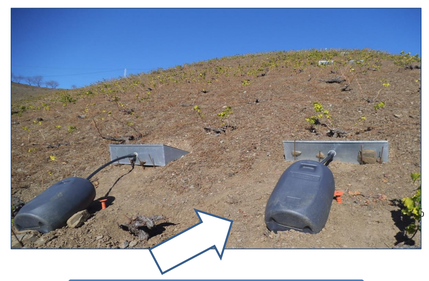
Always with the same methodology in both experimental areas!!

a) Sediment boxes and their respective collectors in an open plot (2015)

Figure 3. Schema of the method for soil erosion monitoring: soil loss, overland flow and sediment concentration



Ruwer-Mosel valley (Germany)



Montes de Málaga (Spain)

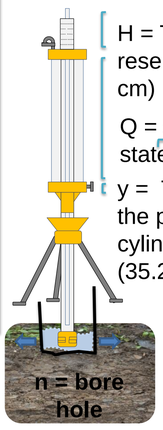
b) Rainfall simulations

Rainfall intensity: 40 mm h^{-1}
Total experiment duration: 30 minutes
Intervals of samples collection: 5 minutes

9 experiments (Ruwer-Mosel valley)

14 experiments (Montes de Málaga)

c) Guelph permeameter



Figures 5. Infiltration and hydraulic conductivity measurements

9 measurements (Ruwer-Mosel valley)

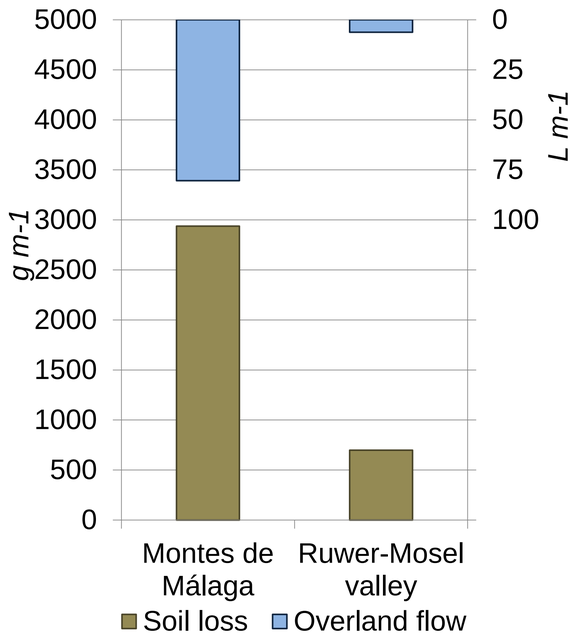
9 measurements (Montes de Málaga)

Figures 4. Rainfall simulation experiments (soil loss, overland flow, and sediment concentration)

Average of each 2 minutes with 5 cm and 10 cm height of water
Total experiment duration: 30 minutes

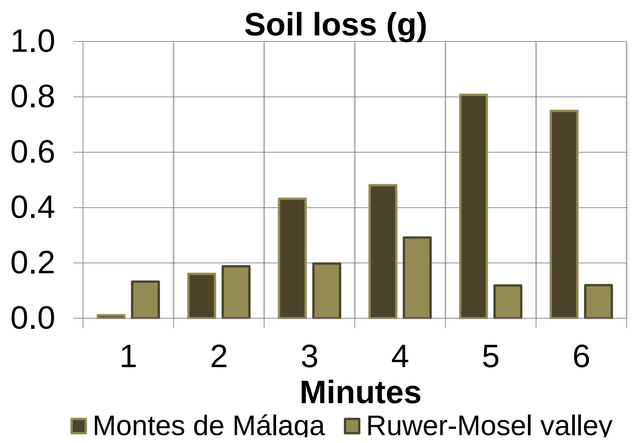
Results

Figure 6 and Table 2. Total registered soil loss and overland flow during 2015



2015	Overland flow (L m^{-1})	Soil loss (g m^{-1})	Sediment concentration (g L^{-1})	Total rainfall (mm)
Montes de Málaga	80.4	2938	36.5	335.1
Ruwer-Mosel valley	6.2	698	112.3	524.1

Figure 7. Soil loss and overland flow obtained with the rainfall simulations



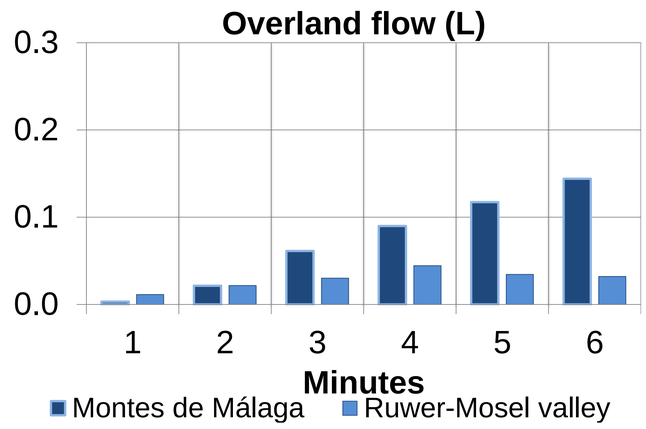
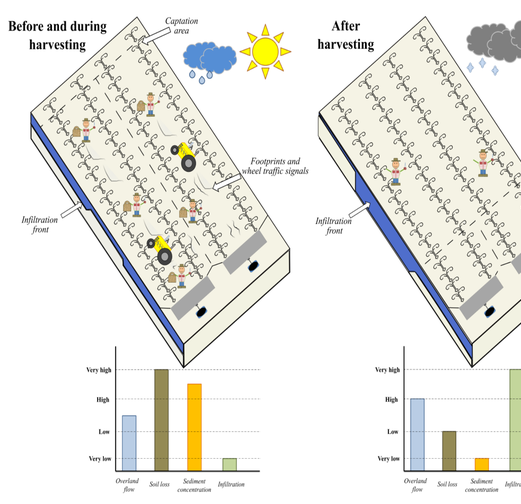


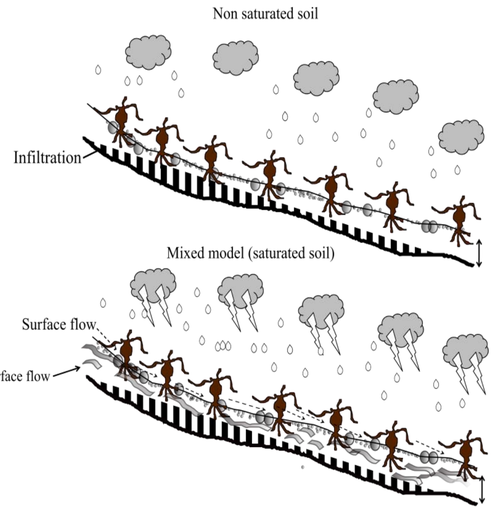
Table 4. Infiltration rates and hydraulic conductivity after harvesting (September-November, 2015)

Ruwer-Mosel valley				
Slope position	Upper	Middle	Foot	Average
Inf. (mm h^{-1})	67.2 (65)	21.4 (23.6)	6.3 (3.8)	31.6 (31.7)
Kf_s (mm h^{-1})	19.9 (19.3)	6.1 (6.7)	1.9 (1.1)	9.3 (9.4)

Montes de Málaga				
Slope position	Upper	Middle	Foot	Average
Inf. (mm h^{-1})	26.1 (26.8)	37.8 (26)	94.5 (36.2)	52.8 (36.6)
Kf_s (mm h^{-1})	9 (9.5)	11.6 (10)	32.3 (10.6)	17.7 (14.1)

Conclusions: high steep slopes + high silt content + high rock fragments





Ruwer-Mosel valley: high infiltration, high sediment concentration with differences before and after harvesting, and sub-surface flow

Montes de Málaga: high soil loss and surface flow, elevated impact of the extreme rainfall events and soil tillage.