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THE ROLE OF VEGETATION ON EVAPORATION AND INFILTRATION PROCESSES FOR SILTY PYROCLASTIC SOILS

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Rainfall-induced shallow landslides as those occurred over the Campania silty pyroclastic slopes are usually triggered by a heavy and persistent rainfall event acting with a predisposing soil state -in terms of high saturation degree or low suction levels- which derives from the complex interaction between soil, vegetation and atmosphere over an antecedent period lasting typically several weeks-months. The predisposing soil state mainly results from the balance of ingoing and outgoing water fluxes through the soil surface, regulated by atmospheric forcing and the topsoil state. Incoming fluxes are due mainly to rainfall events; outcoming fluxes are regulated primarily by evapotranspiration and/or deep drainage. In this sense land cover features can strongly affect the actual soil state. The presence of a vegetated cover can induce relevant variations in the soil-atmosphere water balance: during dry days to soil evaporation are added losses through the plants; during wet days, according their geometry, vegetation may intercept rainfall that can directly return in atmosphere not reaching the soil or successively entering the soil.

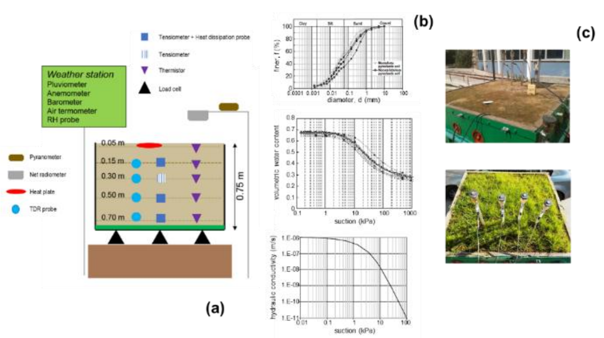

Figure 1. (a) Scheme of the lysimeter with installed monitoring devices; (b) grain-size distribution, soil water characteristic curve and hydraulic conductivity function; (c) layer surface covering.

For these reasons, the proper characterization of land cover is a crucial point for the assessment of slope stability conditions. This work investigates the role of land cover features on soil-atmosphere exchanges for silty pyroclastic soils.

The investigation is carried out thanks to availability of observations for a silty volcanic layer posed in a lysimeter[1] (Figures 1a,b). The layer was exposed to the weather elements and extensively monitored since 2010 to measure energy fluxes, water fluxes, and internal variables (suction, water content, water storage, and temperature). Two-antipodal land cover conditions are considered: bare soil (2010-2014 hydrological years)[1] and full natural vegetation (2014-2018 hydrological years) (Figure 1c).
During the hydrological monitoring, the layer was subjected to natural sequences of precipitation and evaporation which allowed the characterization of the soil hydrological response under different weather conditions and for different levels of suction, water content and water storage (Figure 2a). The study is performed recurring to a "scenario-based" approach in which the soil hydraulic behaviour in bare and vegetated conditions is characterized for events with similar initial soil state and weather forcing. In this perspective, measurements could be used to build representations of the layer's behaviour patterns depending on weather forcing, initial soil states and surface covering, comparing the behaviours in vegetated conditions with behaviours observed under bare conditions ("scenario-based" investigation) (Figure 2b).

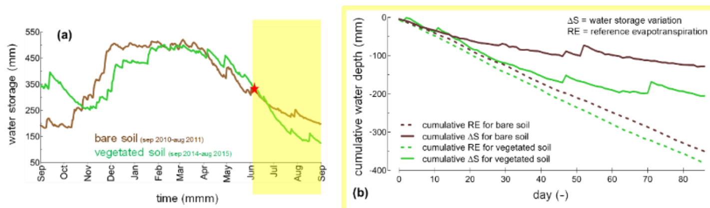

Figure 2. (a) water storage evolution monitored under bare (first hydrological year) and vegetated (fifth hydrological year) conditions; (b) trends of cumulative reference evaporation and water storage variations

As an instance, Figure 2 compares the evolutions of water storage experienced by soil layer during two long dry periods (about 80 days) with different land cover. The crucial role played by vegetation clearly arise inducing water losses quite higher (about 90 mm) although the difference in reference atmospheric demand do not exceed 30 mm.
The identified behaviour patterns constitute the reference dataset to calibrate and validate for silty pyroclastic soils some of the most popular simplified models accounting for infiltration[2,3] and actual evapotranspiration[4,5] on the base of different proxy variables (namely time and topsoil water content). These models are used to reproduce water storage evolution observed in the lysimeter both to their calibration and validation, in view of their use as early warning prediction.

Keywords: silty pyroclastic soil, soil-vegetation-atmosphere interaction, lysimeter, simplified models

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