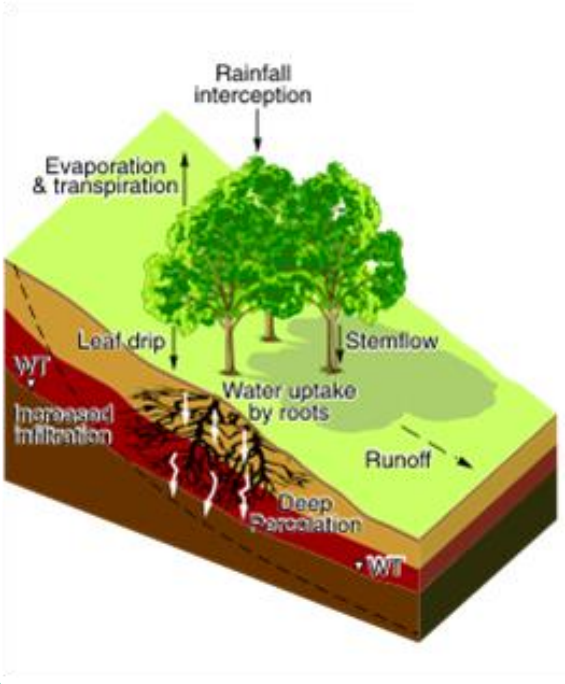

The role of the soil-vegetation-atmosphere interaction in the landslide activity in clayey slopes and a possible nature-based solution for risk mitigation

Vito Tagarelli

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Abstract

The soil-vegetation-atmosphere (SVA) interaction has been recognized to be often the triggering factor of several landslide reactivations in clayey slopes. Indeed, all the processes within the SVA interaction, which can differ in their nature (thermodynamic, hydraulic, mechanical and chemical), strongly impact the balances of both the liquid and gas masses in the soil pores and the energy balance of the slope system, and result in the generation of a transient water seepage from the ground surface to depth, which in turn cause variations of the effective stresses and the available shear strengths over time, impacting the slope stability.

All the above mentioned motivated a research activity aimed at controlling the thermo-hydro-mechanical slope boundary condition with time so that to reduce the amount of water infiltrating through the slope ground surface, causing beneficial effects on the pore pressures fluctuations in the slope soils at depth, and correspondingly an increase of the stability level of the slopes.

To this aim, the effect of selected vegetation as nature-based sustainable measure to mitigate the landslide risk was investigated with reference to a full scale in-situ test-site. The latter (about 2000m2) was realized within the toe area of a deep landslide active mechanism by seeding selected crops, whose impact on the soil state was monitored together with the forcing atmospheric action; also the vegetation features (root system, crop density, LAI, etc.) was characterized both in-situ and in the laboratory.

The impact of the vegetation on the soil state was investigated, not only within the vegetated test site but also outside of it, where only spare and spontaneous wild crops occur, to assess the effects of the seeding of the selected vegetation. Furthermore, the properties of the rooted clayey soil cover were investigated in laboratory and in-situ in terms of both saturated permeability and retention properties.

Some interesting and unexpected results came from the monitoring of the test-site, all of them corroborating that the impact of the selected vegetation and their roots system was not negligible on both the soil thermo-hydro-mechanical properties and soil state. On the whole, the preliminary results of this research activity are believed to represent promising data to further corroborate the relevance of the beneficial role that selected vegetation may play within the SVA interaction, stimulating more effort in deepening the scientific knowledge of such processes together with the corresponding practical implications.

Biosketch

Vito Tagarelli gained a PhD in 2019 at the Politecnico di Bari (Italy), defending a thesis dealing with the slope-vegetation-atmosphere interaction aimed at designing mitigation measures of landslide risk in clayey slopes. During his PhD, he carried out numerical modelling of whether-induced landsliding, in-situ slope monitoring, and the set up of a vegetated field-test at the slope scale, by seeding selected deep-rooted vegetation. Part of his PhD research was conducted at the UPC (Barcelona), where he carried out thermo-hydraulic numerical modelling.

From 2019 to 2022 Vito Tagarelli was a post doc researcher at the Politecnico di Bari, where since March 2023 he holds the position of assistant professor in Geotechnics and Slope Stability. His main research topics are: i) thermo-hydro-mechanical numerical modelling, ii) diagnosis of the landsliding and design of mitigation measures, iii) slope-vegetation-atmosphere interaction in unsaturated slopes, iv) early warning system for weather-induced landslides, v) numerical modelling of the drainage efficacy.

Contacts: Department of Civil, Environmental, Land, Building Engineering and Chemistry (DICATECh), Politecnico di Bari, Via Edoardo Orabona, 4, 70126 Bari, Italy

vito.tagarelli@poliba.it