Numerical modelling of climate actions on embankments. The case of Agrópolis large-scale field experiment

Vinicio F. Guachizaca*, Claudia J. Villarraga[†], Ignasi Solà[†], Antonio Lloret[†], Jean Vaunat[†] and Marcel Hürlimann[†]

[*] DICONSGEOTÉCNICO CÍA. LTDA.
Av. de Los Paltas, Loja, Ecuador
e-mail: vfguachizaca@gmail.com

[†] Department of Civil and Environmental Engineering
Universitat Politècnica de Catalunya
Campus Norte UPC, 08034 Barcelona, Spain
e-mail: jean.vaunat@upc.edu

ABSTRACT

As compacted geo-structures placed on top of the ground, many embankments are sensitive to the interactions with the atmosphere, which play a central role in the analysis of the natural risks associated to slope movements. Interactions between ground and atmosphere essentially include solar, atmospheric and ground radiation, infiltration, runoff, evaporation, evapotranspiration, and wind effect [1]. Moreover, vegetation plays often an additional non-negligible role by intercepting part of the rainfall, limiting the runoff, releasing back vapour to the atmosphere and providing the soil with root reinforcement, when not creating settlements or increasing soil permeability by desiccation[2].

A field experiment has been developed to monitor these phenomena. It consists in a purpose build embankment instrumented with several sensors to survey temperature, liquid pressure and water content inside the soil and a meteorological to survey atmospheric variables [3]. Two years of measurements are presently available.

In order to better interpret the coupled thermo-hydro-mechanical effects due to ground-atmosphere interaction, data obtained from the experimental field are used to feed a finite element method model built using the code Code_Bright [4], which includes a module of soil-atmosphere interactions. Numerical results can be compared favourably compared with the measurements [5], giving interesting insight into the mechanisms underlying the field response and providing in the same time a validation to equations and numerical model developed.

REFERENCES

[1] G. Blight, "Interactions between the atmosphere and the earth," *Geotechnique*, vol. 47, no. 4, pp. 715–767, 1997.
[2] J. Noilhan and S. Planton, "A simple parameterization of land surface processes for meteorological models," *Mon. Weather Rev.*, vol. 17, pp. 536–549, 1989.
[3] G. R. Oorthuis, "Diseño de un experimento a gran escala para estudiar el efecto de las interacciones suelo-vegetación-atmósfera en laderas," Universitat politècnica de Catalunya, 2016.
[4] S. Olivella, J. Carrera, A. Gens, and E. E. Alonso, "Nonisothermal multiphase flow of brine and gas through saline media," *Transp. Porous Media*, vol. 15, no. 3, pp. 271–293, 1994.
[5] V. F. Guachizaca Contento, "Análisis de las interacciones suelo-vegetación-atmósfera en un talud experimental," Universitat politècnica de Catalunya, 2018.