On the Stability of a Fully Instrumented River Embankment Under Transient Conditions

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On the stability of a fully instrumented river embankment under transient conditions

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Abstract Time-dependent boundary conditions, uncertainties and variability of soil suction and water content of the filling material together with the use of proper retention and strength soil models are crucial aspects to be included for reliable analyses of the actual stability of river embankments. However, due to a typical lack of information in many practical cases, the use of simplistic assumptions on both hydraulic and mechanical response of earth infrastructures to hydrometric water level fluctuation and atmospheric loading is largely diffused, thus providing erroneous conclusions on the effective safety margins towards possible slope instability and collapse. Within this context, site measurements down to relevant depths, combined to an accurate soil characterization under partially saturated conditions, can be extremely useful to evaluate unsaturated variables (i.e. soil water content and suction) under transient flow conditions and hence carry out realistic stability analyses. A comprehensive monitoring system has been therefore designed and installed on a relevant representative section along river Secchia, a right-hand tributary of river Po (Northern Italy). The paper aims at presenting a methodological approach for a sustainable performance assessment of such geotechnical infrastructures, based on the complementary use of laboratory tests, field measurements and numerical analyses.

Keywords: River embankment, slope stability, field monitoring, unsaturated soil, transient flow.

1 Introduction

The safety conditions assessment of river earth infrastructures represents a critical issue for both geotechnical and environmental engineering and becomes a crucial aspect, in the framework of hydrogeological instability, for land-use planning and flood risk management. In particular, the Emilia Romagna region, with a territorial extension of 22452 km^2, has the highest portion of territory in danger for flood hazard (ISPRA, 2018). The sudden collapse of embankment sections of Secchia, Enza e Panaro rivers between 2014 (Fig. 1) and 2017, the very recent collapse of Reno river em-