Addition of fine material is expected to strengthen fluvial dikes ... does it really?

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Overtopping of fluvial dikes occurs frequently during major floods and may lead to dike failure, with severe consequences in the protected areas. Mechanisms of fluvial dike breaching remain incompletely understood, while predicting the breach hydrograph is of paramount importance for the flood risk management.

Here, we present a new series of laboratory experiments, in which the evolving 3D fluvial dike geometry was monitored in detail using the laser profilometry technique. The experimental setup extends over about 20 m by 7 m and accommodates a 15 m long main channel and a 7 m-long dike section. The facility is located at LNHE of EDF-R&D (France). The present study extends former experiments by Rifai et al. (2017, 2018), which were conducted with uniform coarse sand (d₅₀ = 1.03 mm). In the new tests, various mixtures of coarse (d₅₀ = 1.03 mm) and fine (d₅₀ = 0.24 mm) sands were used as dike material (Rifai et al., 2020). The fraction of fine sand was varied systematically to assess its influence on the breaching process, specifically as regards the apparent cohesion.

The experimental observations reveal that the frequency of breach slope collapse tends to decrease as the fraction of fine sand is increased; but the collapsing volumes become larger. Consequently, in the tested configurations, the addition of fine sand to the dike material has virtually no effect on the overall breaching dynamics, due to compensation between less frequent but larger collapsing material volumes. In the presentation, the relative importance of the effects will be discussed in comparison with other influencing parameters such as the main channel discharge, floodplain backwater effects and the dike geometry.

All experimental data, including high resolution 3D dynamic models of the breach geometry, are publicly available online (Rifai et al., 2019).

References

