# Impact of climate change projections on tailings dams survivability

Michael Gloor,*
Gaudenz Halter,*
Cesar H. Oboni,**
Franco Oboni**

* Correntics GmbH, Josefstrasse 219, 8005 Zurich, Switzerland

** Oboni Riskope Associates Inc., Vancouver B.C.

Higher average temperatures but also more frequent and severe temperature extremes are to be expected world-wide due to climate change. Furthermore, a warmer atmosphere can hold higher levels of water vapor, which can lead to an increased risk of extreme-precipitation events. This paper uses the latest climate projections and a well-known probabilistic dam risk assessment approach to estimate the changes in the probability of failure of dam systems in a changing climate. We use various climate scenarios based on the 6$^{th}$ phase of the Coupled Model Intercomparison Project (CMIP6) to analyze local increases in precipitation extremes. The results will tangibly affect risk-informed mitigation measures of tailings dams and their ancillary water management systems. An increase of precipitation extremes can indeed affect the dam's system in multiple ways, leading to variation of the dam-body performance through e.g., erosion, soil liquefaction, subsidence, as well as affecting the overall system performance and safety (diversions, spillways, overtopping, etc.).

For new dams, quantitative risk assessments are deployed during the mitigation design process in order to support decision-making. Indeed, the GISTM conformance protocols define the ALARP in terms of mitigation cost vs. risk abatement. The process allows to transparently and rationally discuss what constitutes an attainable and sustainable level of mitigation also when facing climate change events. Existing dams may be found to drift toward hazardous conditions, not meeting original design-criteria when facing changing climatic conditions. Climate-informed risk assessments will help prioritizing mitigation strategies and optimizing CAPEX actions.

These points will be illustrated using two examples, one located in Central Asia and the other in Southeast Asia. Mine names and exact location will be kept anonymous to preserve client's confidentiality.

The present risk assessment results will be shown and compared to those brought in when climate change data are included. These impacts will be shown to vary due to the dam system's initial conditions, location and selected climate change projections. For both locations, an increase in frequency of medium-severity precipitation events

is visible in the near-term while in the long-term, a significant shift of the whole frequency-severity distribution can be observed. Based on our analysis for the Southeast Asia location, the severity level of a 1-in-200-year precipitation extreme in a 20$^{th}$-century climate could occur every 40 years on average in the long-term under a severe-warming scenario during the 21$^{st}$ century. Even considering the inevitable uncertainties with climate-change projections, it will be shown that this type of analysis helps preserving value, invest mitigative funds wisely, comply with GISTM, and ultimately saving lives and the environment.