EGU23-2155, updated on 06 Dec 2023
https://doi.org/10.5194/egusphere-egu23-2155
EGU General Assembly 2023

EroCA: a new tool for simulating constructed landform erosion

Shahla Yavari[1], Neil McIntyre[2], Qi Shao[3], and **Thomas Baumgartl**[3]
[1]1 Centre for Water in the Minerals Industry, Sustainable Minerals Institute, The University of Queensland, Brisbane, QLD 4072, Australia
[2]School of Civil Engineering, The University of Queensland, Brisbane, QLD 4072, Australia
[3]Geotechnical and Hydrological Engineering Research Group, Federation University, Churchill, VIC 3841, Australia

Extensive disturbances during the mining and rehabilitation process can include removal of vegetation, removal and storage of soils hence their modification, changes in topography, and planting of new vegetation. A main goal of mine rehabilitation is to produce a post-mining landscape that is resistant to geotechnical failure and to surface erosion processes. To achieve this, hydrology and erosion models are required to determine erosion rates under alternative landscape designs, including landscape form and cover options.

By critical review of the relevant literature, it was found that most previous erosion modelling studies have concentrated on surface hydrology in agricultural, forestry, and other natural systems, while disturbed ecosystems like mining regions have received little attention. Landscape evolution models have been developed for mined landform applications but modelling over long time-scales compromises the temporal and spatial resolution.

The main objectives of this research therefore were:

- Extend an existing plot-scale hydrological model to plot-scale erosion model.
- To improve knowledge of the errors and uncertainty in applying a high-resolution erosion model to mined landforms and to conclude on the potential applicability and limitations of EroCA.

The experimental data used in the research were from a 30 m × 30 m field plot on a mine waste rock dump in the wet tropical environment of the Ranger mine (north-east Australia) from the period 2009 to 2014. The new EroCA model is an extension to the RunCA model, which was developed to provide high resolution simulation of runoff and infiltration in constructed landforms. The extended model uses mass balance principles and established erosion and sediment transport models, covering both suspended and bedload, and solves the equations using the cellular automata approach. Code verification against analytical solutions of runoff and sediment illustrated small errors, which were partly due to approximations used in the analytical solutions. The EroCA model was then applied to the Ranger experimental plot data to assess the suspended and bedload erosion performance. EroCA was able to reasonably represent the observed flows and turbidity profiles. Although an arbitrary reduction in the erodibility parameter

value of 20% per year was needed to simulate the bedload depletion.