

Hydrogeological and Hydrological Modelling of the Impact of Water Resources on Mineral Resource Production

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Abstract

The increasing global demand for mineral resources, particularly copper, nickel, lithium, and cobalt, driven by the energy transition, presents challenges to the mining industry, especially amidst increasing global water scarcity. Water plays a vital role in all stages of mineral extraction and, as water stress intensifies, its availability becomes a limiting factor for mining operations. Given that global water consumption is increasing at twice the rate of population growth, concerns over water availability are intensifying, particularly in regions experiencing severe scarcity.

This study introduces HYIR (HYdrological and Industrial Resilience), a global-scale integrated tool designed to assess water availability for mining operations by combining multiple data layers and models. HYIR utilizes climate data from the Coupled Model Intercomparison Project Phase 6 (CMIP6) (Eyring et al., 2016), driven by Shared Socioeconomic Pathways (SSP) scenarios, to simulate future climate scenarios. These projections provide critical insights into expected changes in precipitation patterns and other climate variables that will influence water resources in the world in general and in mining regions in particular.

To evaluate the effects of these climatic changes on water resources, HYIR incorporates hydrological models and global databases (Oki, 1998) to simulate river networks and large-scale hydrological processes. The tool also takes into account data on surface water bodies, including lakes, dams (Lehner, 2023), and groundwater reservoirs (aquifers).

HYIR's key capability will lie in its ability to generate spatiotemporal assessments of water availability, accounting for both climate and hydrological dynamics. By integrating climate projections, river routing data, and surface and groundwater storage data, HYIR will be able to evaluate water availability at specific locations and times. This allows for the identification of regions at risk of water scarcity, providing insights into the future viability of mineral extraction in those areas.

In particular, HYIR aims to assess whether certain mineral deposits are likely to remain exploitable in the future or if they are vulnerable to water stress. This tool shall serve as a decision-support framework, facilitating assessments of the risks associated with water scarcity for mining operations and informing long-term planning and resource management.

Keywords: Hydrology, water stress, climate change, mining, water availability, global water resource, mineral production

References

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