Predicting the impact of climate change to groundwater and its implications for the built environment

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Climate change is expected to have a significant impact on groundwater- and pore pressure conditions and as a result, on stability of natural slopes, geotechnical structures that support buildings, infrastructure and other facilities. Predictive models for groundwater and pore pressure are therefore of importance to planners, developers, owners of infrastructure and property etc. to assess the need for climate change related mitigation. To meet this societal need, an ongoing research project (PIGALL) is developing tools and strategies to predict groundwater levels and pore pressure in both site specific and regional scales.

The research project combines predictive climate models, conceptual Hydrogeological Reference Conditions (see i.e. Surendran et al., 2020) and specific geological and hydrogeological data and interpretations as input data for regional and site specific hydrogeological predictive models.

Regional scale

A parallel ongoing project is developing predictive groundwater models for climate change in unconfined aquifers with a four-by-four km resolution for Sweden using the SGU-HYPE model. The regional scale model is used to provide groundwater recharge input to site-specific models. Within PIGALL, a further development of the SGU-HYPE model to produce groundwater predictive models also for confined conditions is planned.

Site-specific scale

The site-specific models are developed to exemplify groundwater predictive models for e.g. a specific location as for the design of geotechnical constructions, assessing the impact to existing constructions and infrastrucutre or as input to municipal physical planning. Within PIGALL, site-specific models are developed with MODFLOW 6 for selected case studies (in different types of location) based on geological and hydrogeological data and conceptual Hydrogeological Reference Conditions.

The first site-specific model is being developed for a case study in Kolmården, located approximately 15 km northeast of Norrköping, Sweden. This case study includes complex hydrogeological conditions including cohesive sediments (prone to subsidence) as well as hydrogeologically relatively conductive sediments.

Use of output data

The output from the predictive groundwater models is to be used as input data for further assessment of impact to geotechnical structures.

Furthermore, the output from the regional scale models provides a foundation for the planning of infrastructure projects, planning of communal water resources as well as for municipal and regional spatial planning.

References

Surendran, P., Fransson, Å., Johnson, M.D., 2020. Hydrogeological Reference Conditions - A Relevant Basis for Rock Engineering. In: Engineering, I.S.f.R.M.a.R. (Ed.), ISRM International Symposium-EUROCK 2020, Norway.