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Climate change in safety assessment of a surface disposal facility

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The Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) aims to develop a surface disposal facility for LILW-SL in Dessel (North-East of Belgium). Given the time scale of interest for the safety assessment (several millennia), a number of parameters in the modelling chain near field – geosphere – biosphere may be influenced by climate change. The present study discusses how potential climate change impact was accounted for the following quantities: (i) near field infiltration through the repository earth cover, (ii) partial pressure of CO_2 in the water infiltrating the cover and draining the concrete, and (iii) groundwater recharge in the vicinity of the site. For these three parameters, the impact of climate change is assessed using climatic analogue stations, i.e. stations presently under climatic conditions corresponding to a given climate state.

Results indicate that :
(i) Using Gijon (Spain) as representative analogue station for the next millennia, infiltration at the bottom of the soil layer towards the modules of the facility is expected to increase (from 346 to 413 mm/y) under a subtropical climate. Although no colder climate is foreseen in the next 10 000 years, the approach was also tested with analogue stations for a colder climate state. Using Sisimiut (Greenland) as representative analogue station, infiltration is expected to decrease (109 mm/y).

(ii) Due to changes of the partial pressure of CO_2 in the soil water, cement degradation is estimated to occur more rapidly under a warmer climate.

(iii) A decrease of long-term annual average groundwater recharge by 12% was simulated using Gijon representative analogue (from 314 to 276 mm), although total rainfall was higher (947 mm) in the warmer climate compared to the current temperate climate (899 mm). For a colder climate state, groundwater recharge simulated for the representative analogue Sisimiut showed a decrease by 69% compared to current climate conditions.

The advantages and weaknesses of using analogue stations are also discussed.