Effects of coastal change in the selection of a Geological Disposal Facility

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Geological disposal of radioactive waste is one of the UK’s largest environmental protection projects. It aims to provide a safe and secure long-term solution for the disposal of higher activity radioactive waste. As such, environmental change represents an important consideration regarding the siting process and post-closure safety.

More specifically, areas within or close to the coastal zone are subject to significant environmental forcing and are continuously evolving. Even within a single year, tidal and wave forcing can lead to significant changes in the location of the shoreline and seabed profile. Recent climate projections indicate that changes in the mean sea-level, ocean circulation and storminess will have a profound effect on coastal dynamics in the longer term. This means that many areas will experience considerable geographical modifications. Such effects are already becoming apparent through increased rates of erosion and more frequent occurrences of coastal flooding. These processes can potentially have a significant impact on the viability of a Geological Disposal Facility (GDF).

Present projections from the International Panel for Climate Change (IPCC) provide predictions on climate changes for the next hundred(s) years. These largely indicate that anthropogenic emissions have a dominant role in driving global warming, sea-level rise, and subsequent coastal erosion. Considering that the lifetime of a GDF extends to 100,000-200,000 years, present climate information represents only short-term effects. Over longer time scales additional considerations regarding the global state of the climate arise (e.g., land-level changes and global ocean circulation changes). These considerations require a deeper understanding of the physical system and a better description of the future state of the biosphere.

The purpose of the present project is to develop methodologies appropriate to the description of coastal evolution under a changing climate around the UK. This will be achieved by a combination of improved physical understanding of the coastal system and advanced statistical and numerical techniques. In integrating the detailed modelling of coastal processes into long-term climate prediction, the research outcomes will provide the necessary tools to predict coastal change in
time scales ranging from 100s to 100,000s years. The main objectives of the project are summarised as follows:

- Develop process-based simulations of coastal change using dynamically downscaled global climate around UK coasts.
- Incorporate human interventions (coastal protection structures) and additional sediment source/sink terms in coastal evolution modelling.
- Dimensional reduction of morphodynamic loops using improved physical understanding and advanced statistical methods (surrogate modelling, storm sequencing).
- Provide an improved representation of coastal change in short-term time scales (100s of years) under climate change scenarios obtained from IPCC predictions. Integrate the short-term methodology into long-term predictions (100,000s of years).
- Quantify the uncertainty in models.

This information will provide critical insights regarding the selection and assessment of coastal sites as potential Geological Disposal Facilities and provide a sound basis for assessing their safety in the long term.