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Determining the response of hydrate offshore Svalbard to ocean warming during the next century

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Methane is a potent greenhouse gas and large-scale and sudden methane release from hydrates may have contributed to past abrupt climate change inferred from the geological record. The discovery in 2008 of over 250 plumes of methane gas escaping into the ocean offshore of west Svalbard, and of bubble plumes and high dissolved methane concentrations in ocean waters above regions of subsea permafrost, has led to suggestions that such a process may be occurring in the present-day Arctic. In both settings there is evidence for the presence of hydrate. Based on a recently published modelling study, offshore of Svalbard the methane release is occurring predominantly in a region where hydrate is likely to have been destabilised by ocean warming over the past 30 years. However, the future significance of this methane release remains uncertain.

In order to understand the causes of methane release and likely future development, it is necessary to predict the response of seabed sediments containing hydrates to changing temperatures in the overlying ocean. Here, we use the TOUGH+Hydrate code to model hydrate growth and dissociation in response to a range of possible future ocean temperature scenarios in the Svalbard region obtained from climate models. Estimates of bottom temperature have been extracted at the relevant locations from the CMIP5 model simulation archive, which spans the period 1860-2100. The model time series has been validated against available observations and also against the NOC 1/12 degree ocean model, which is forced by atmospheric reanalysis and has been shown to perform well in the Arctic. Below the seabed the structure and stratigraphy of the sediments and their gas and hydrate contents are constrained using high-resolution and very-high-resolution seismic data acquired in 2008, 2011 and 2012 and wide-angle seismic data acquired in 2008 and 2011.