Updating the groundwater methane baseline for Great Britain

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Widespread hydraulic fracturing for shale gas in the USA and the presence of elevated groundwater methane concentrations have led to considerable debate about a link between the two. Although methane has no known health effects to humans or animals when consumed, methane is a potent greenhouse gas and can form an asphyxiation or explosion hazard in confined spaces. These concerns and the debate in the USA have highlighted the need for baseline groundwater methane surveys in areas prior to widespread shale gas exploitation. England is in the early stages of developing a shale gas industry and in 2017 the British Geological Survey (BGS) published the first groundwater methane baseline for Great Britain. This baseline consisted of 439 concentration measurements across 336 unique locations. However, the Environment Agency in England has also measured groundwater methane concentrations at a range of locations since the year 2000. These data consist of a further 2,153 concentration measurements across 571 unique locations, the majority of which overly a large portion of the prospective Bowland Shale. These additional measurements provide one of the largest groundwater methane datasets in the world, but were not included in the BGS baseline because of their differing detection limit. In this study we provide an overview of these additional measurements and combine them with the existing BGS baseline using Bayesian generalised linear modelling. The Bayesian generalised linear modelling provides a mechanism by which these two datasets can be combined and allows for the incorporation of further datasets. We also investigate redox conditions associated with 11 unique locations where methane concentrations have been measured above the US Department of the Interior risk action level of 10 mg/l. Furthermore, local baseline methane measurements at current hydraulic fracturing sites in England are presented and discussed.