OR/19/064 About the GeoClimate datasets

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Jump to navigation Jump to search

Harrison, A, White, J, Jones, L, Entwisle, D, Hulbert, A, Lee, K, Mansour, M, and Wang, L. 2019. User Guide for the British Geological Survey GeoClimateUKCP09: Clay shrink - swell dataset. *British Geological Survey Internal Report*, OR/19/064.

Geology and climate change

Across the UK, clay-rich geological deposits, such as the London Clay Formation, are susceptible to volume change due to changes in water content. The susceptibility to this shrinking and swelling varies, dependant on the clay mineralogy and lithology. Changes in annual rainfall and temperature patterns are increasing the likelihood of this volume change occurring (Harrison et al., 2012). These changes can lead to ground movement that damages houses, near surface infrastructure, and other light structures. This damage can result in insurance claims due to subsidence (Crilly, 2001).

Water content within a clay-rich lithology is the overarching controlling factor (primarily from rainfall), however, water loss, due to evapotranspiration, also has an influence. Specific sites can be affected by local factors such as trees and other vegetation, which remove water from the ground, as well as human induced factors such as 'surface sealing', where rainwater enters drains rather than naturally infiltrating into the ground (Jones, 2002, 2004).

Licensed and open data packages

The GeoClimate data product is provided as two options, either Open data (under an O pen Government Licence) or more detailed licenced Premium version. The data content of each package is as follows:

GeoClimate open

This is a 1:200 000 scale product, consisting of 2 km grid squares, and is made freely available on the BGS GeoIndex. The outputs are shown for time period envelopes, centred on 2030, 2050 and 2080, and based on the medium emissions scenarios, with no percentile statistics provided.

One dataset is provided for each time period, based on the average outcome for the medium emissions scenario and the most susceptible GeoSure value (worst case) within the grid cell.

GeoClimate Open is provided for 3 11-year windows:

- Centred on 2030 (11 year window 2025 to 2035)
- Centred on 2050 (11 year window 2045 to 2055)
- Centred on 2080 (11 year window 2075 to 2085)

File:OR19064fig1.jpg
Figure 1 GB overview of GeoClimate Open datasets for 2030, 2050 and 2080.

GeoClimate premium

This is a 1:50 000 scale product, provided as area polygons, for 5 time period envelopes, centred on 2020, 2030, 2040, 2050 and 2080, and based on the medium emissions scenarios, with the 10th and 90th percentile (wetter and drier) statistics provided. GeoClimate Premium is provided for 5 11-year windows:

- Centred on 2020 (11 year window 2015 to 2025)
- Centred on 2030 (11 year window 2025 to 2035)
- Centred on 2040 (11 year window 2035 to 2045)
- Centred on 2050 (11 year window 2045 to 2055)
- Centred on 2080 (11 year window 2075 to 2085)

File:OR19064fig2.jpg
Figure 2 GeoClimate premium data showing the likelihood that foundations will be affected by wetter (a), average (b) and drier (c) conditions.

Table 1 GeoClimate Open and Premium comparison.

	GeoClimate Open	**GeoClimate Premium**
Susceptibility categorisation	3 categories	5 categories
Scale	1:200 000	1:50 000
Coverage	Great Britain	Great Britain
UKCP09 Emissions scenario	Medium emissions	Medium emissions
Temporal projections (11 year windows)	2030s, 2050s, 2080s	2020s, 2030s, 2040s, 2050s, 2080s.
Projections provided	Median average	Median average, wetter, drier
Number of individual layers supplied	3	15
Format	Vector grid, supplied as ESRI shp.	Vector polygons, supplied as ESRI shp.

Background

Shrink-swell is recognised as the most costly geohazard across Great Britain. For example due to the hot dry summer of 2018, more than 10 000 households made insurance claims worth a total of £64 million to deal with the impact of subsidence between July and September, according to the Association of British Insurers (ABI) (Insurance Times, 2018). This was the highest level of subsidence insurance claims since the heatwaves of 2006 and 2003 (Which.co.uk, 2018). Over an average year, insurers would usually expect to pay out approximately £75 million to rectify the impact of subsidence on homes (Guardian, 2018).

The BGS GeoSure shrink-swell dataset considers the physical properties of the geology to provide a susceptibility rating for potential ground movement. It does not, however, account for changes in climate, and parameters that will affect soil water content.

GeoClimate clay shrink-swell has been developed to enable the climate variables to be considered,

alongside the geotechnical properties of the ground immediately below and around the foundations, and provide a longer term, modelled analysis for resilience assessments. It is essentially a national hazard susceptibility map, showing change in susceptibility with time, due to changes in climate. This methodology has been developed by engineering geologists, hydrogeologists, geophysicists and information developers at the British Geological Survey, following stakeholder engagement, and is presented as a series of GIS data layers.

The UK Climate Projections (UKCP)[note 1] provide an assessment of how the UK climate may change, providing projections of rainfall, temperature and sea level rise during the 21st Century. In 2009 the UK Met Office Hadley Centre, in collaboration with a consortium of organisations and funded by the Department of Environment, Food and Rural Affairs (DEFRA), released UKCP09, based on the most sophisticated scientific research, providing projections for three scenarios: low, medium and high greenhouse emissions.

Alongside these global climate models (GCMs), the Centre for Ecology & Hydrology (CEH) also produced 11 regional climate models (11RCMs) realisations, based on UKCP09 medium emission scenario. CEH utilised these 11RCM to generate the 'Future Flows' datasets, providing available precipitation and GB potential evapotranspiration for hydrological and groundwater modelling (Prudhomme et al., 2012, Boorman et al., 1995, Murphy et al., 2009). This enabled BGS to access the UKCP09 medium emission projection and combine it with BGS geological datasets and groundwater models, to produce GeoClimate.

Who might require this data?

Natural ground stability hazards, such as clay shrink-swell may lead to financial loss for anyone involved in the ownership or management of property. These hazards could increase in likelihood and propensity when considering the impacts of a changing climate. These impacts could relate to increased insurance premiums, depressed house prices and, in some cases, engineering works to stabilise land or property.

The identification of areas of potential increased risk of clay shrink–swell susceptibility from climate change will be of use to all those required to plan for longer-term resilience into the 21st Century. This includes planners, developers, construction companies, and utility companies, consulting engineers, builders, loss adjusters, the insurance industry, architects and surveyors. These hazards may also impact on anyone involved in infrastructure networks (road or rail) or utility companies.

The key benefit of GeoClimate is that it provides a 'hot spot' map of potential risk areas, which can inform mitigation strategies (and therefore save time associated with fewer manual site visits), prioritise works and aid risk reduction. The product might be used to inform changes in the design of foundations so buildings are not affected by the increased hazard. The cost of such prevention may be very low, and is often many times lower than the repair bill following ground movement. When integrated within the workflows of our intended user base it can support prioritisation of remedial action, or help define buildings at most risk, thereby reducing subsidence events and potentially saving the costs of rebuild and disruption.

Footnote

1. ↑ http://ukclimateprojections.metoffice.gov.uk/

8’
Categories:

- Pages with broken file links
- OR/19/064 User Guide for the British Geological Survey GeoClimateUKCP09: Clay shrink - swell dataset

Navigation menu

Personal tools

- Not logged in
- Talk
- Contributions
- Log in
- Request account

Namespaces

- Page
- Discussion

□

Variants

Views

- Read
- Edit
- View history
- PDF Export

□

More

Search

Search Go

Navigation

- Main page
- Recent changes
- Random page
- Help about MediaWiki

Tools

- What links here
- Related changes
- Special pages
- Permanent link
- Page information
- Cite this page
- Browse properties

- This page was last modified on 22 May 2020, at 13:20.

- Privacy policy
- About Earthwise
- Disclaimers
-
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