British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Compound geohazards: planning for environmental change

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Hypothesis

Increased occurrence and frequency of flooding could cause an increase in ground instability problems, resulting in compound geohazards. To test this hypothesis, the shrink-swell GeoSure layer was selected for trialling.

Introduction

This research sets out to determine the potential effects of climate change on geohazards in the UK and focuses on one of the foremost natural hazards affecting the UK — flooding. In addition to the immediate effects of flooding, areas that are prone to flooding could suffer further problems, accentuating factors such as subsidence and heave (due to the shrink-swell of clays) and reactivation of landslides. The geohazards within these potential flood zones will be heightened as a result. With this in mind, this research focuses on the potential effects of surface-water flooding (initially using the BGS Geological Indicators of Flooding dataset) on natural geohazards in the UK (as represented by BGS GeoSure layers).

What is shrink-swell?

Many soils contain clay minerals that absorb water when wet (making them swell), and lose water as they dry (making them shrink). The Association of British Insurers has estimated that the average cost of shrink-swell-related subsidence to the insurance industry stands at over £400M a year.

Figure 1 GeoSure shrink-swell hazard potential map of the UK.

GeoSure dataset © British Geological Survey

What do we mean by compound geohazards?

A compound geohazard is created when multiple natural hazards coincide to create an increased effect or susceptibility. For example flooding in an area of shrink-swell potential could substantially increase the potential for occurrence.

Figure 2 Damage caused by heave.

David Noe, Colorado Geological Survey.

Figure 3 Flooding of the River Severn, Mythe near Tewkesbury in 2007 (left) and the BGS GIF model of same area (right).

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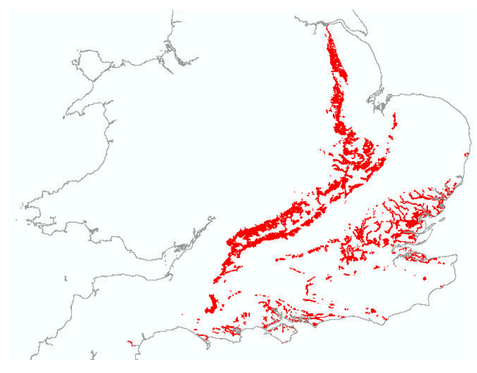

Figure 4 Distribution of deposits with high shrink-swell susceptibility from GeoSure. These deposits are high-very high plasticity clays that occur throughout eastern and southern England.

GeoSure dataset ©British Geological Survey

Results

- Over 10 000 km^2 of land is underlain by highly susceptible shrink swell clays, mainly located in the south and east of England.
- Of these areas, an estimated 46% lie within a flood-susceptible zone and will therefore be subject to increased potential for compound geohazards.
- It can be shown that a relatively wide area of high plasticity clays would be susceptible to a rapid increase in moisture content in the event of a large flood.
- If flood events are combined with shrink-swell clays of restricted moisture content due to surface sealing or, following a particularly dry season, they could create optimum conditions for initiating or worsening the geohazard.
- In a flood situation, deposits, with high soil moisture deficit, would suffer from
  - relatively rapid infiltration
  - swelling and an increase in pore water pressures
  - increased susceptibility to heave.

Figure 5 GeoVisionary image of the area around the Olympic Stadium (in the foreground), looking northwards along the River Lea, London. Blue is lower-lying flood plain, pink is the area of shrink-swell clay most susceptible to ground heave in the event of a flood.

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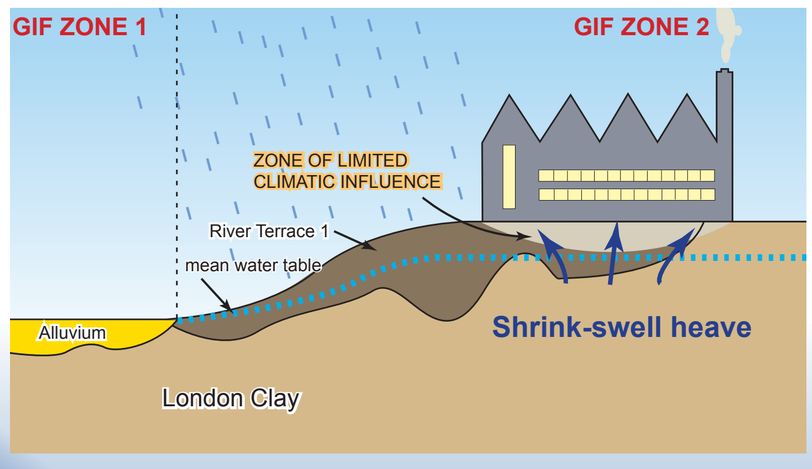

These zones of increased susceptibility lie beneath major roads, including part of the M25, railways and potentially buildings. Infrastructure like this could be affected by rapid infiltration of floodwaters, swelling of clays and heave processes.

Ongoing work

This poster represents the initial work in this area of research. Ideally, collaboration with other organisations to investigate correlations with events (subsidence and flooding), incorporate groundwater (mean and max) levels to refine the model, specific studies on past storm events, flood data, etc would be of great value. The model will also be extended to incorporate other GeoSure hazard layers such as landslides and soluble ground.

Contact information

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