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Shrinking and swelling clays under droughts: measurements at the Mormoiron test-site and first analyses (Vaucluse, South-East of France)

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In France, exceptional periods of rainfall deficit (1976, 1989 to 1991 and 1996 to 1997) have caused damages to houses due to their vulnerability to shrinking and swelling clays phenomenon. Between 1998 and 2010, BRGM has been producing a national hazard map related to shrinking and swelling clays, built by crossing geological data and information on density of damages for each geological formation (methodology developed since 1995). The intense drought of summer 2003 has pointed out the necessity of a better understanding of this phenomenon. At the request of the French Ministry of Environment, BRGM has developed a new method for measuring the moisture evolution with depth in order to study its impact on the swelling capacity of clayed soil.
The site of Mormoiron (Vaucluse, South-East of France) has then been instrumented for that purpose, with moisture sensors (since December 2004) and extensometers (since March 2009) at different depths. These data have been used to test and improve existing empirical models which are supposed to assess settlements and swellings, depending on the soil water content.
Compilations of different measurements have shown, after basic processing made on the data (filtering, resampling, etc.), evident correlations between rain and surface displacements. The model finally obtained gives quite good dependence between these two quantities for the uppermost soil layers (0.2m and 0.5m). More research are being undertaken to physically explain this relationship, particularly for deeper layers. These results should lead to propose a calibrated model for predicting soil deformations from climatic data.