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Detecting quick clay with CPTu

Introduction

The goal of the study is to show that by using three CPTu parameters simultaneously, the presence of quick clay can be detected with increased accuracy.

CPTu tests are both quick and inexpensive compared to soil sampling and laboratory tests. A reliable method for detecting quick clay in-situ would reduce the need for- and better focus the soil sampling in our projects, saving both time and resources.

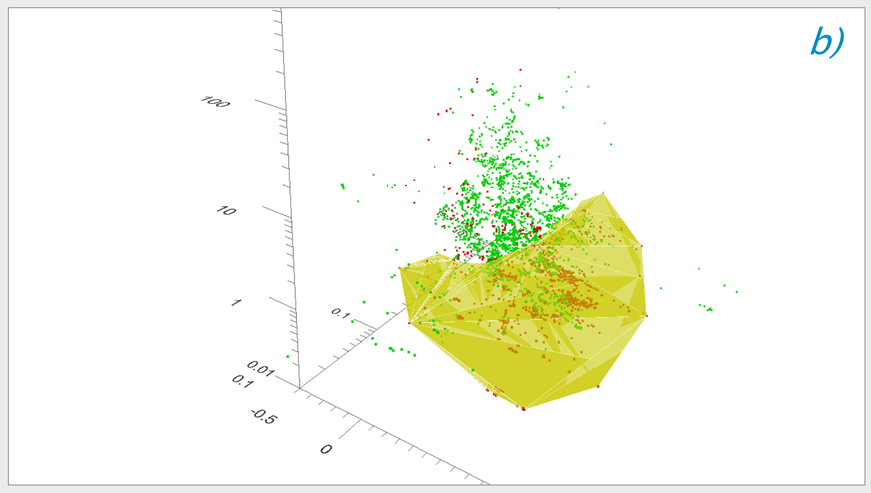
Proposed model

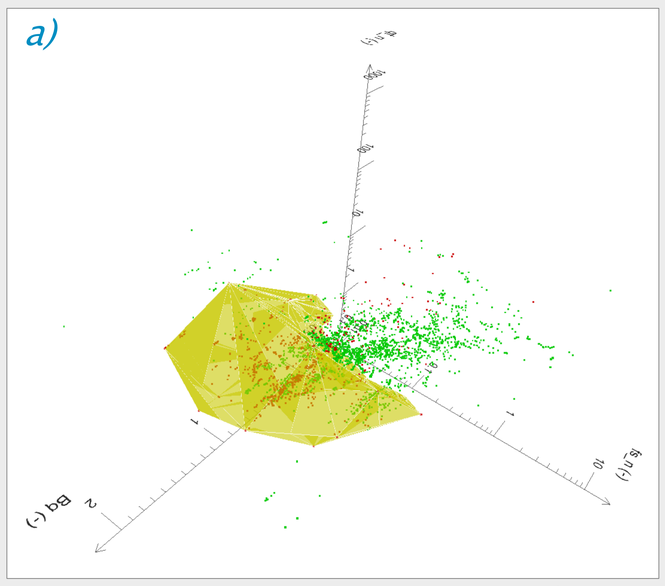
Parameters for new model chosen after a visual study

$$B_q = \frac{u_2 - u_0}{q_t - \sigma_{V0}}$$

$$f_{sn} = \frac{f_s}{\sigma'_{V0}}$$

$$q_{tn} = \frac{q_t}{\sigma'_{V0}}$$





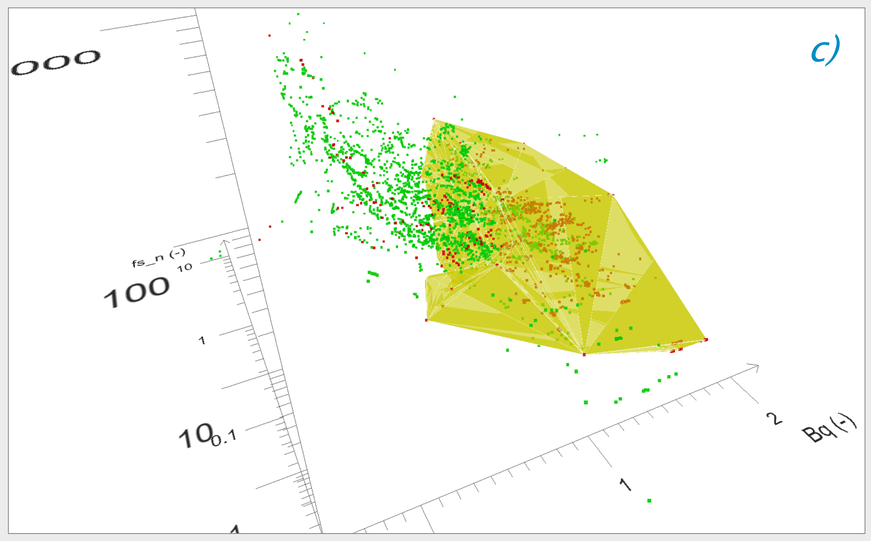


Fig. 2 a-c: Proposed model with points from study. **Green:** non-sensitive **Red:** quick clay

Test site locations

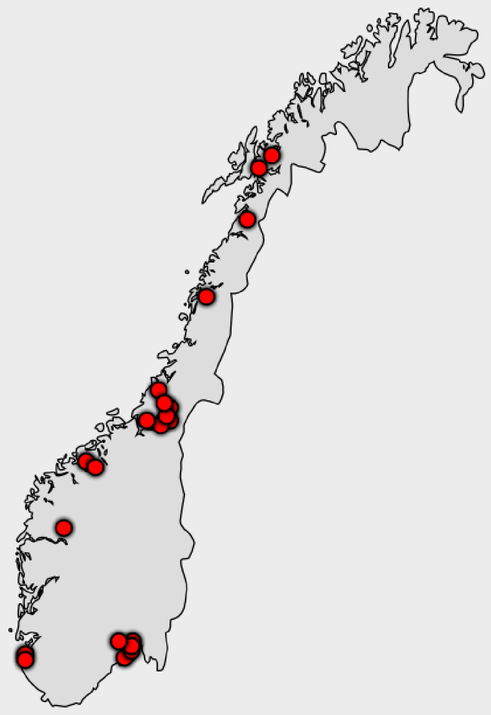


Fig. 1 Test site locations

The database contains data from 123 CPTus and lab tests on roughly 300 soil samples from 20 sites in Norway.

Comparison to 2D behaviour type diagrams

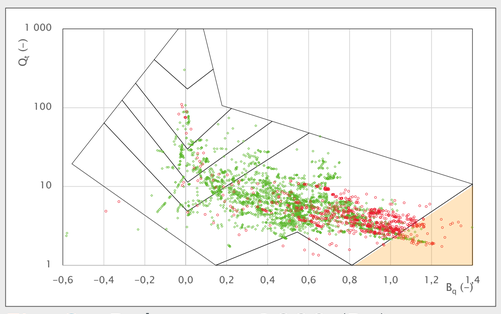


Fig. 3 Robertson 1990 (Bq)

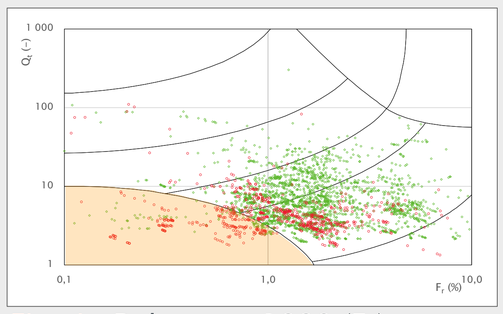


Fig. 4 Robertson 1990 (Fr)

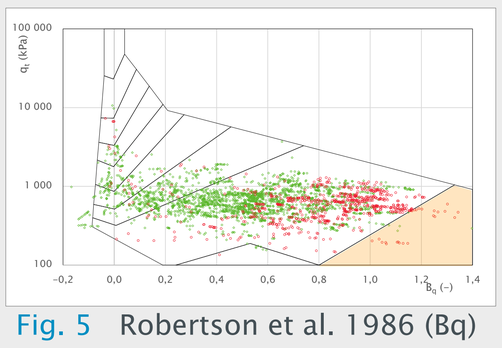


Fig. 5 Robertson et al. 1986 (Bq)

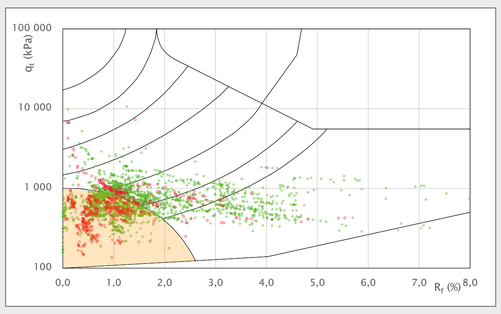


Fig. 6 Robertson et al.1986 (Rf)

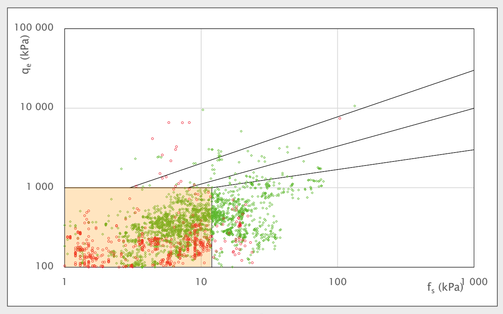


Fig. 7 Eslami et al. 2000

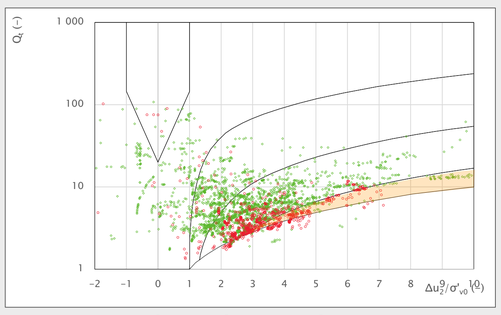


Fig. 9 Schneider et al. 2008

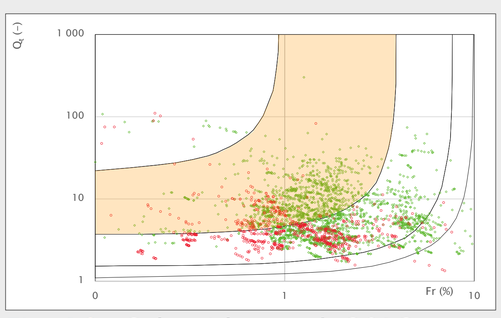


Fig. 10 Schneider et al. 2012

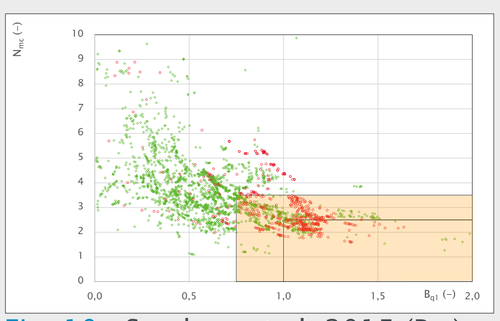


Fig. 10 Sandven et al. 2015 (B_{q1})

Fig. 11 Sandven et al. 2015 (R_{fu})

Results

The results shown in Fig. 12 indicate that quick clay can be detected in-situ with acceptable accuracy using the cone penetration test. The proposed model contains ~57% of the quick clay points, and ~11% of the non/sensitive points.

Increasing the database size should be a priority in future work.

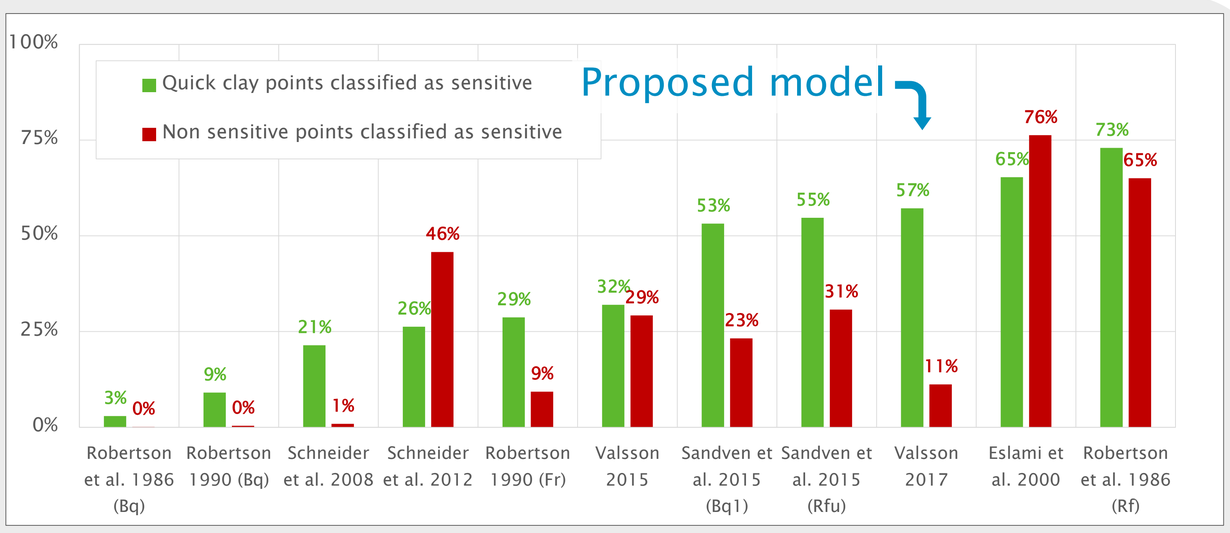


Fig. 12 Results from soil behaviour type classification of database points