Model Updating for Geotechnical Design and Assessment

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Abstract. A categorization of subsoil characterization approaches is used as the basis for evaluating them according to their capacity for model updating, quantifying uncertainties and modelling complex geometries.

ground truth, subsoil characterization methods can be evaluated on metrics such as accuracy for complex geometries, data updating capabilities, and uncertainty quantification. Our study focuses on a voxel, cell-based subsoil characterization approach, serving as a proof-of-concept for this methodology, which can now be extended to analyse additional approaches.

2. Classification of probabilistic subsoil characterization methods

Figure 1 presents a classification of subsoil characterization approaches. At the highest level categorizes approaches into two types according to their representation: object-based and cell-based.

2.1 Object-based approach

The object-based approach involves a representation of the geometry of geological bodies and the relationship between layers directly (Lyu et al. 2021).

The 1D approach is utilized to identify stratigraphic layers from in-situ measurements assuming constant layers throughout the construction site. For example, Cao and Wang (2013) present a Bayesian approach to identifying soil layers and their thickness through CPT measurements, which differs from deterministic approaches that imply correlations based on empirical by clustering similar data points to identify layers. The Bayesian approach allows for the quantification of uncertainties. The approach output can serve as input for 2D/3D subsoil characterization methods.

The object-based approach for the 3D representation often differs in the definition of the function used to describe the geological interfaces. The surface-based approach functions, which describe open shapes, are conditioned to geological data.

property.

4. Gaussian Process Regression

A widely used cell-based approach to subsoil characterization be used, for example, to guide the selection of optimal locations for performing the next observations.

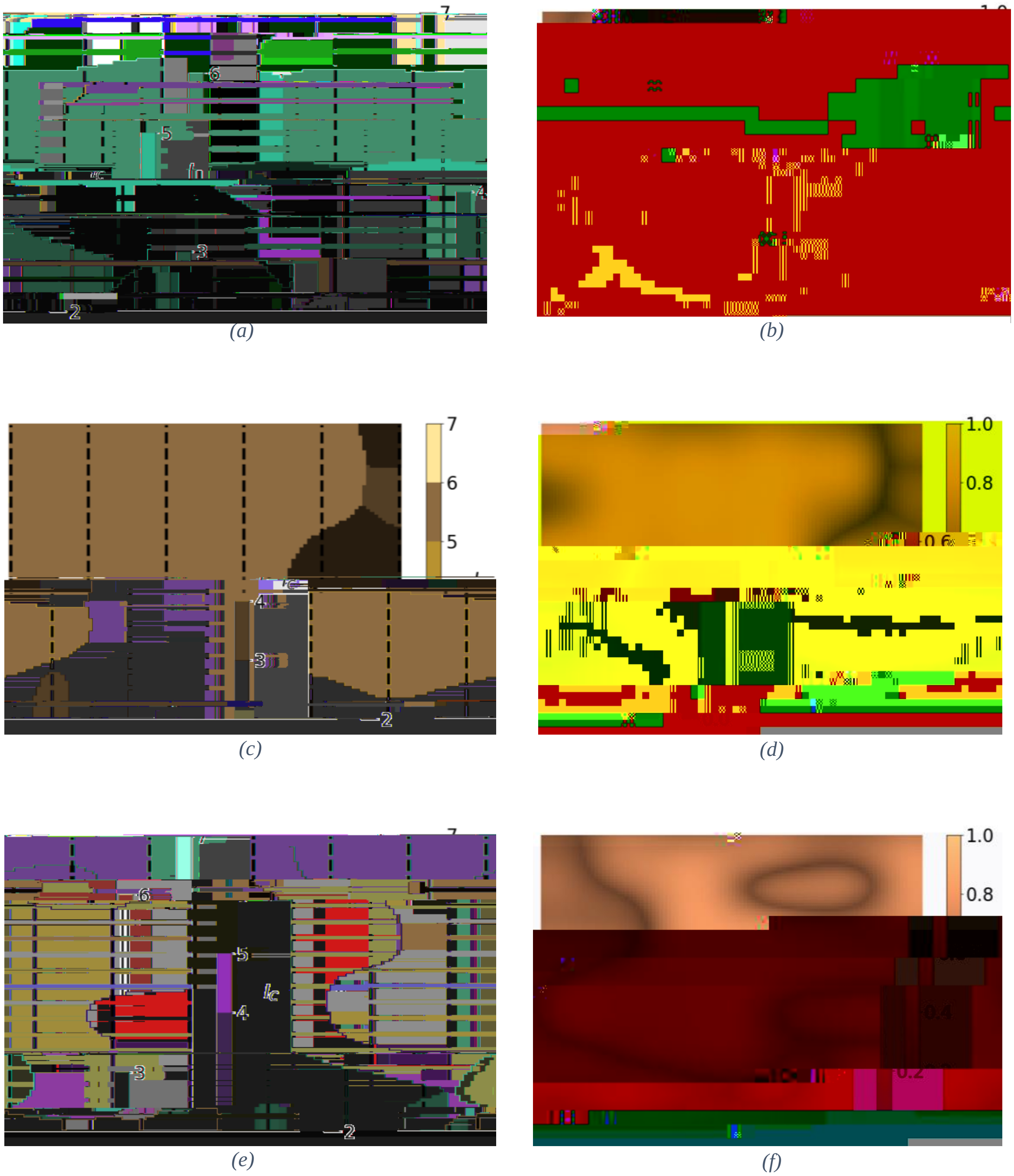

Figure 5: Left column: Resulting distribution of for the Topologies and six CPT measurements (that are visualized with the black dotted lines); Right column: Display of the probability for identified , which has the highest probability among all possible soil layers, at each grid point

Erosion, as presented in Topology 2 is more challenging for this approach. If the accuracy of each soil layer is considered individually (Figure 13), the accuracy varies largely between them. The largest source of error is the erosion in the clay layer (see Figure 5c). This is due to the correlation function, which offers equal importance to each CPT measurement.

The complexity of the layer distribution resulted from the simultaneous deposition is a large uncertainty for Topology 3. To obtain a more detailed representation, more measurements at critical points are required. In future work, it is of interest to research methods for the identification of such critical points and to quantify whether or not additional information will reduce the uncertainties. In addition, quantifying the value of additional observations can support the decision-making process to determine the best next step for investigatio/F1 12 Tf1 0 0 1 215.6 633.7 Tm0 g0 G[(