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Authors' reply

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The authors appreciate Xing Zheng Wu's comments and his interest in our paper. Regarding the points he raised, clarifications are given below to address each point in turn:

1. The main objective of our paper is to develop a Bayesian method for quantifying the site-specific cross-correlation between effective cohesion c' and effective friction angle ϕ' from a limited number of c' and ϕ' data pairs obtained from a project. The shear strength data (i.e., c' and ϕ' data pairs) on the alluvial fine-grained soils in Central Italy addressed by the discusser were only used as an illustration of the proposed Bayesian method. This dataset was published by Di Matteo et al. (2013) in the Bulletin of Engineering Geology and the Environment, and it showed a strong negative correlation with a correlation coefficient of about −0.9. We have no intention of claiming that such a strong negative correlation is generic or applicable to other kinds of soil. Since the discusser is concerned with how Di Matteo et al. interpreted their direct shear test results for obtaining the data pairs, the discusser is kindly advised to take this matter up directly with Di Matteo et al. If the discusser has a similar dataset with a large number of c' and ϕ' data pairs obtained from a specific site and is willing to share his dataset, we will be pleased to test and illustrate the proposed Bayesian method using his dataset.
2. We agree with the discusser that "*it would be preferable to conduct multiple tests under the same or similar experimental conditions for a specific site.*" However, more tests would mean more time and higher costs. Who is going to pay for them? This is why there are often only a limited number of data points in engineering practice and why the large number of c' and ϕ' data pairs published by Di Matteo et al. (2013) is valuable. Obtaining a proper probability density function or meaningful statistics for soil or rock properties from a limited number of data points at a specific site is challenging when performing a reliability analysis in geotechnical engineering. A series of Bayesian methods has been developed to address this challenge (e.g., Wang and Cao, 2013; Cao and Wang, 2014; Wang and Aladejare, 2015, 2016; Wang et al., 2016a), and an Excel-based user-friendly software has been developed to facilitate the application of the developed Bayesian methods in engineering practice (Wang et al., 2016b). A Bayesian sequential updating approach has also been developed to integrate multiple measurements from different test procedures and to make full use of different types of sparse data that are generally available in a geotechnical site characterization (Cao et al., 2016a).
3. Quantification of prior knowledge is a key element in Bayesian methods. A subjective probability assessment framework (SPAF) has been developed for geotechnical engineering (Cao et al., 2016b). Interested readers are referred to Cao et al. (2016b) for details on SPAF and the typical ranges in various soil properties and to Aladejare and Wang (2017) for typical ranges in various rock properties.

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