Replies to Reviewer 2

This manuscript address an important problem in hydrology, the optimal design of soil moisture monitoring networks. The approach utilizes principal components analysis and cluster analysis informed by gridded data from the WRF weather forecasting model. The general approach shows good potential, although no observed data were available for testing, only the WRF soil moisture outputs. I have two primary concerns with the manuscript.
Reply: We thank the reviewer in acknowledging the good potential of the paper. The two primary concerns are addressed as follows.

First, the approach is unclear. In particular, the relationships between the number of principal components, the number of clusters, and the number of station locations need to be more explicitly described. The assumptions related to these relationships need to be stated and justified.

Reply: We apologise that the methodology part needs further clarification. In essence, for the soil moisture network design, three main problems need to be tackled. The first is how redundant the network is, the second is how many soil moisture sensors are needed within a catchment, and finally where are the best locations to place them. To solve the first problem, the PCA is used to investigate the redundancy degree of the network (in relation to different variance contribution rates). For the latter two problems, the k-means cluster analysis is adopted (i.e., the elbow method for the determination of sensor number in accordance to the variance contribution rates), and CA-Med, CA-Max for finding the optimal sensor placements).

In the updated manuscript, the methodology section (i.e., Soil Moisture Network Design) will be reorganised and rewritten to avoid the concerned confusion to the readers.

Second, a major source of uncertainty about the success of the method needs to be added to the text. The method implicitly assumes that a soil moisture station placed inside a 5-km grid cell will perfectly represent the mean soil moisture condition for that grid cell. Of course, in reality it will not do so. The scale mismatch between the footprint of an in situ soil moisture station and the 5-km data set used here would be expected to degrade the performance of the resulting network. The uncertainty introduced by this scale mismatch may be quite large and cannot be quantified by the data in the manuscript. This issue needs to be discussed in the text.
Reply: We agree with the reviewer that a soil moisture station placed inside a 5-km grid cell cannot perfectly represent the mean soil moisture condition for that grid cell. Advanced soil moisture sensing technologies such as the Global Navigation Satellite Systems (GNSS) and the Cosmic-ray could provide alternative solutions over point-based sensors to reduce the mismatch impacts. In particular, COSMOSUK network is moving towards integration with operational weather forecasts, and Cosmic-ray is suitable in complex terrain and might be a good option to be used for national network as compared with in-situ point sensors (Cosmic-ray sensors are also more cost-effective [e.g., cost over 10 years is probably similar to point sensors with increased maintenance replacement etc.])

This discussion will be included in the updated manuscript.

I have included 55 specific comments, edits, and questions in a pdf version of the manuscript attached with this review.
Reply: We thank the reviewer for the detailed specific comments. They will all be addressed in the updated manuscript.