

Supplementary for

A Remotely Sensed Framework for Spatially-Detailed Dryland Soil Organic Matter Mapping: Coupled Cross-Wavelet Transform with Fractional Vegetation- and Soil-Related Endmember Time Series

Qiangqiang Sun ^{1,2}, Ping Zhang ¹, Xin Jiao ¹, Fei Lun ^{1,2}, Shiwei Dong ³, Xin Lin ¹, Xiangyu Li ¹ and Danfeng Sun ^{1,2*}

1 College of Land Science and Technology, China Agricultural University, Beijing 100193, China; qiangsun@cau.edu.cn (Q.S.); pingzh@cau.edu.cn (P.Z.); jiaoxin@cau.edu.cn (X.J.); lunfei@cau.edu.cn (F.L.); linx@cau.edu.cn (X.L.); leexu@cau.edu.cn (X.L.)

2 Research Center of Land Use and Management, China Agricultural University, Beijing 100193, China

3 Beijing Academy of Agriculture and Forestry Sciences, Beijing 100097, China; dongsw@nercita.org.cn

* Correspondence: sundf@cau.edu.cn

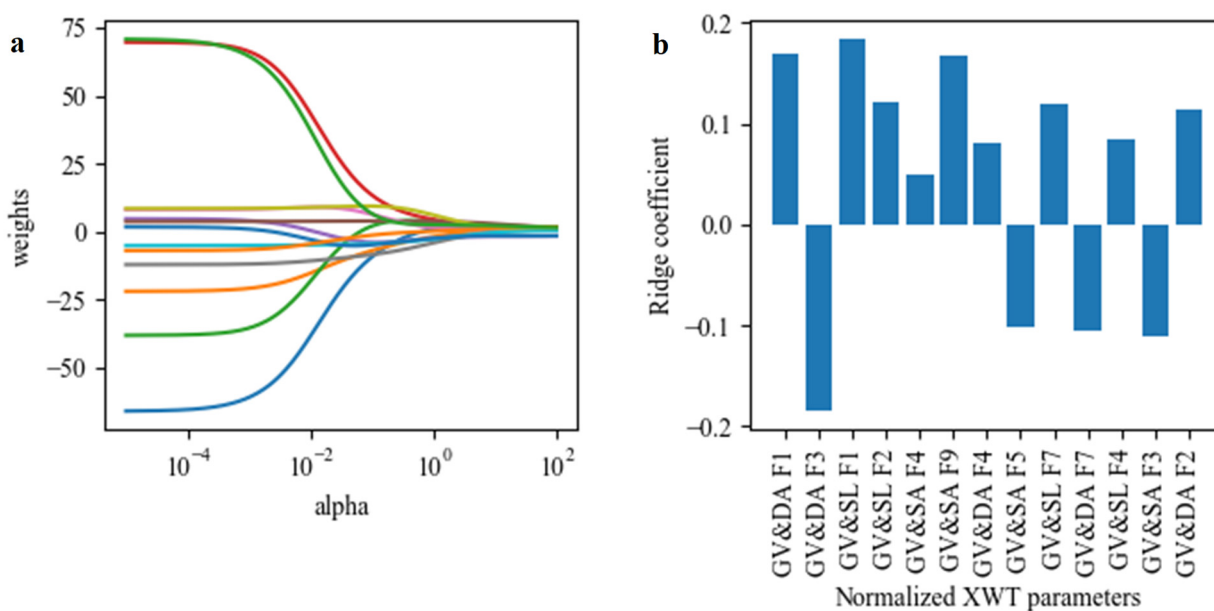


Figure S1. The plot of ridge coefficients as a function of the regularization and ridge coefficient using RR Model. **a**, the weights of normalized XWT parameters have levelled off after α as 5. **b**, the GV&DA F3, GV&SA F5, GV&DA F7, and GV&SA F3 are negatively correlated with SOM, while other normalized XWT parameters are positively related to SOM.

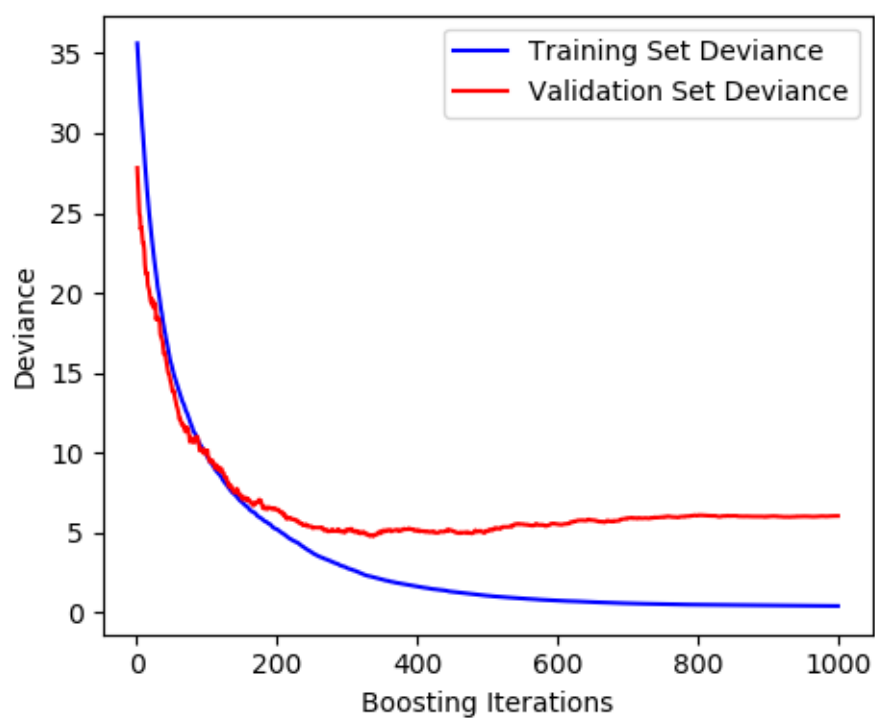


Figure S2. Loss profile example of GBRT for both training set and validation set. We selected the Least Squares to construct loss profile, setting the number of CART weak regression trees as 200, the maximum tree depth as 3, the minimum sample segmentation as 2, and the learning rate as 0.05 to prevent the fluctuation of the learning profile.

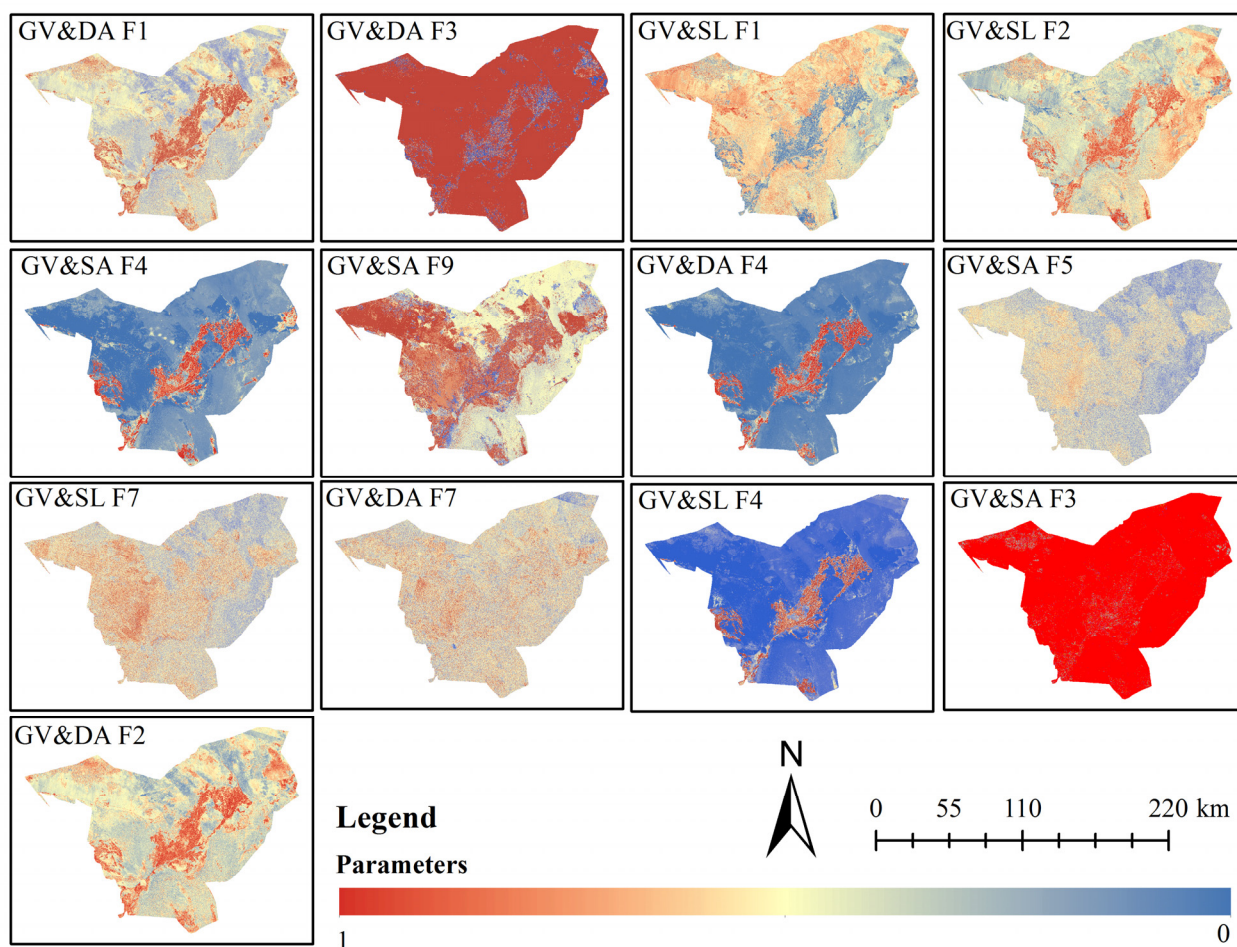


Figure S3. The 13 normalized XWT parameters selected as variables to map SOM. These were modified from Sun et al. (2020).

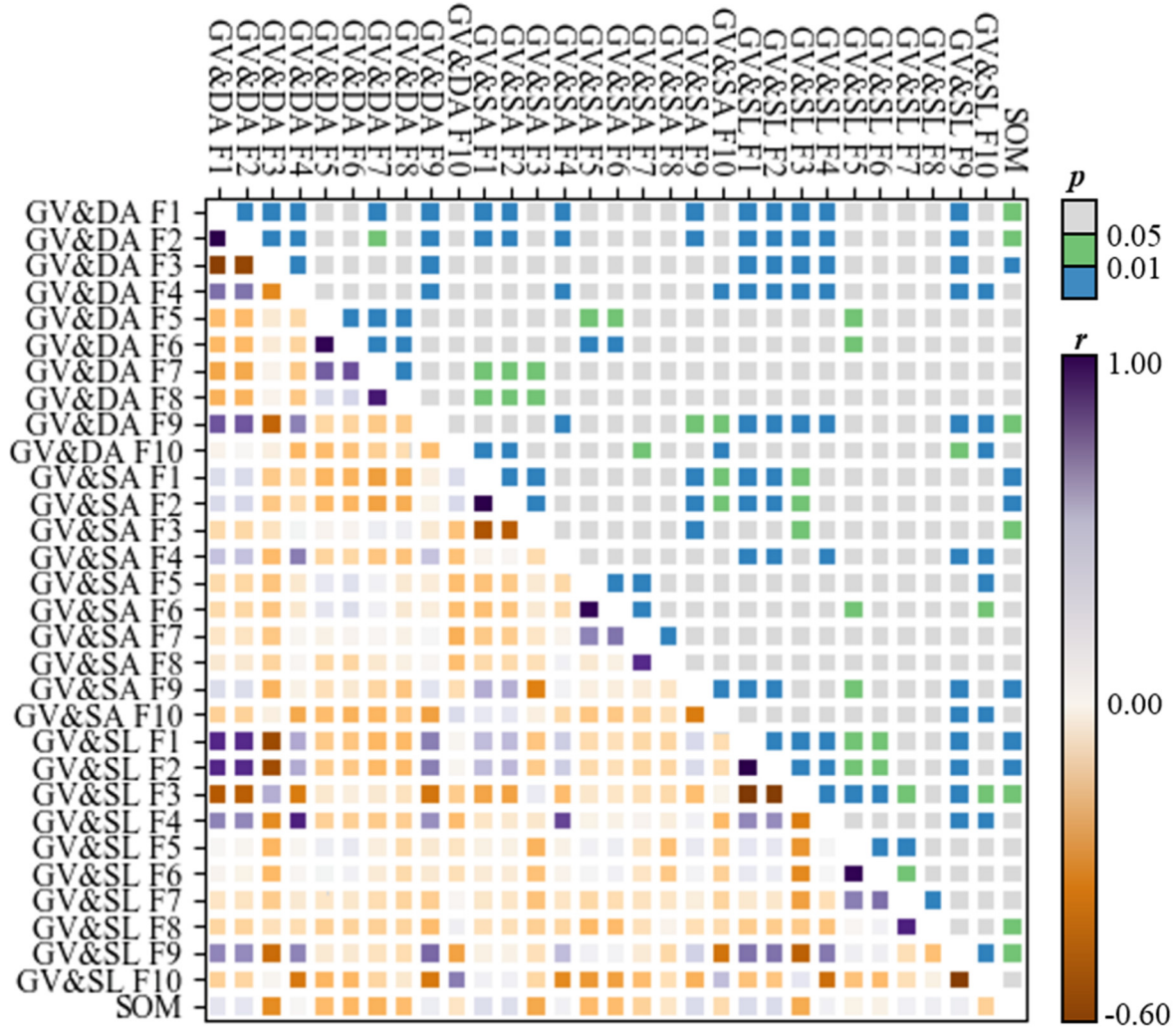


Figure S4. the Pearson correlation coefficient (r) and the significant level (p) between SOM and XWT parameters displayed in lower left and upper right, respectively.

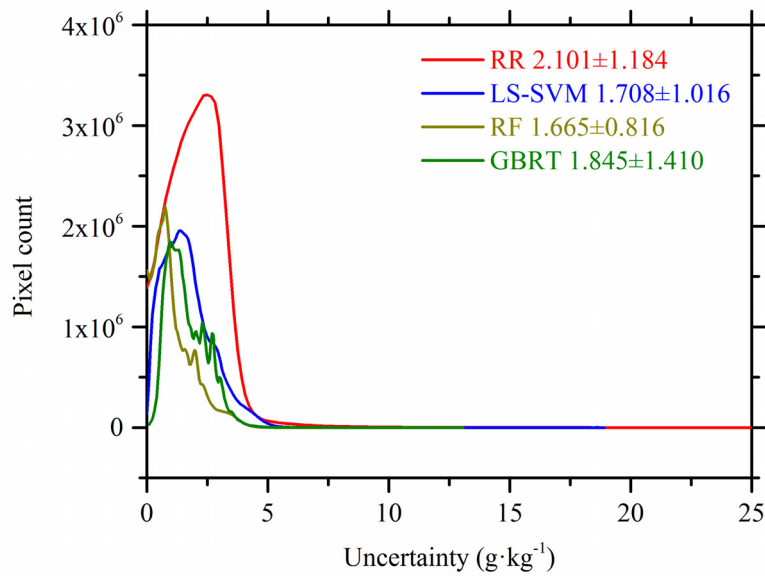


Figure S5. The histograms of estimation uncertainty of XWT-based framework using RR, LS-SVM, RF and GBRT.

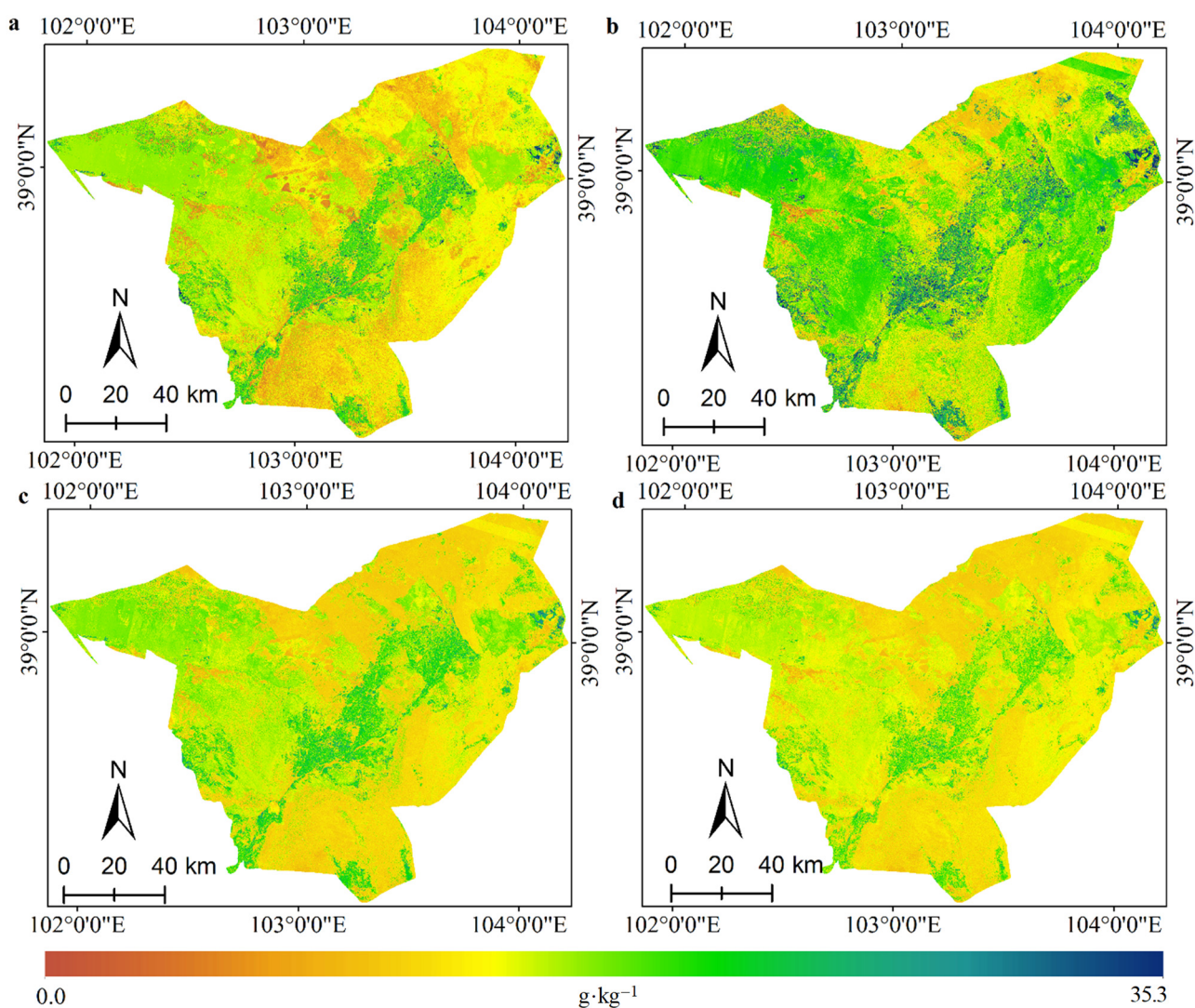


Figure S6. Average SOM estimated and mapped after 20 operations, using covariate conventionally averaged from endmembers time series. (a) RR, (b) LS-SVM, (c) RF, and (d) GBRT were used respectively. All of images were displayed within identical range (0-35.3 g·kg⁻¹).

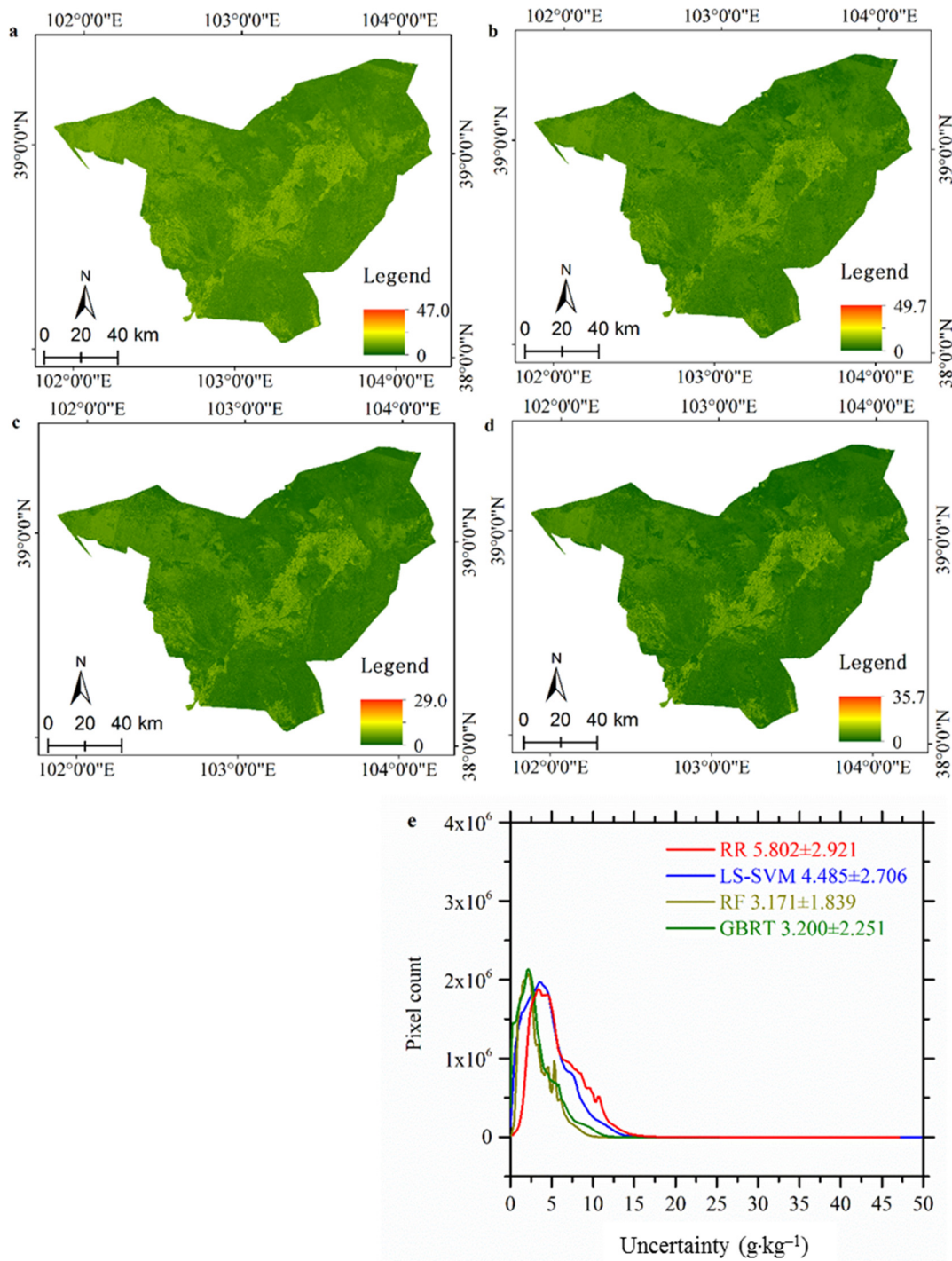


Figure S7. Estimation uncertainties of covariate conventionally averaged from endmembers time series. (a) RR, (b) LS-SVM, (c) RF, and (d) GBRT were used. e was histograms of estimation uncertainties. 1.645 times standard deviation were used as 90% prediction interval, after 20 operations with randomly changing the training set and validation set.

References

Sun, Q., Zhang, P., Wei, H., Liu, A., You, S., Sun, D. 2020. Improved mapping and understanding of desert vegetation-habitat complexes from intraannual series of spectral

endmember space using cross-wavelet transform and logistic regression. Remote Sensing of Environment, 236, 111516. DOI: 10.1016/j.rse.2019.111516