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Satellite based Segregation of MSW dumping sites using digital image processing



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Study Objective

The primary goal of this study was to develop a computer based model for auto identification of Municipal Solid Waste (MSW) dumping sites and segregation of its different units on the basis of the age of dumped waste to facilitate the decisions and the potential development of better environmental management strategies.

Study Area

Faisalabad has been taken as the main study area, having two open dumps of MSW.

- MF-MSWOD
- NF-MSWOD

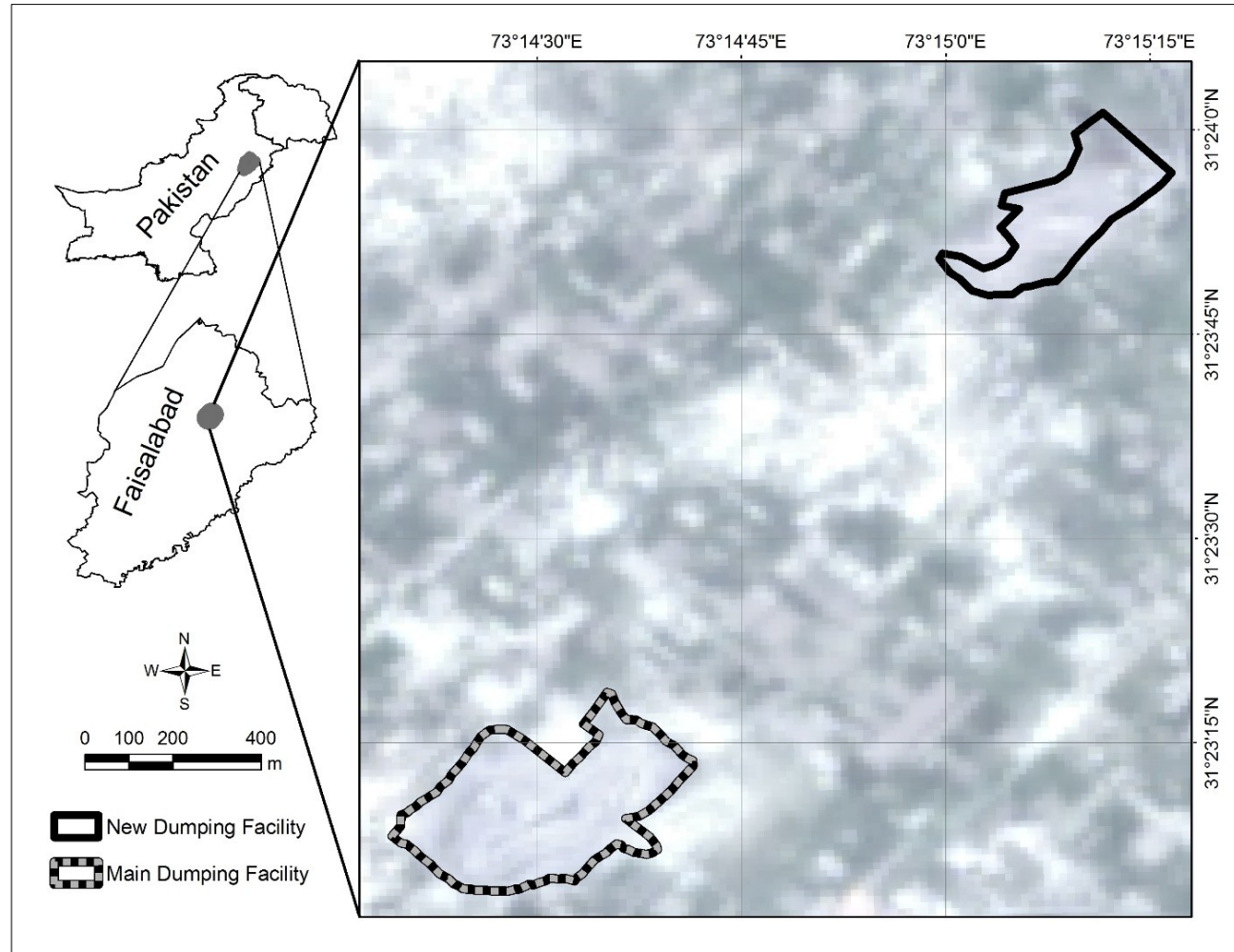


Figure 1: Study area

Extension of the Study Area

To elaborate the difference of spectral response for different dumping facilities the study area has been extended to include two dumps from another city named Lahore. So finally we have considered four of the open dumping sites.

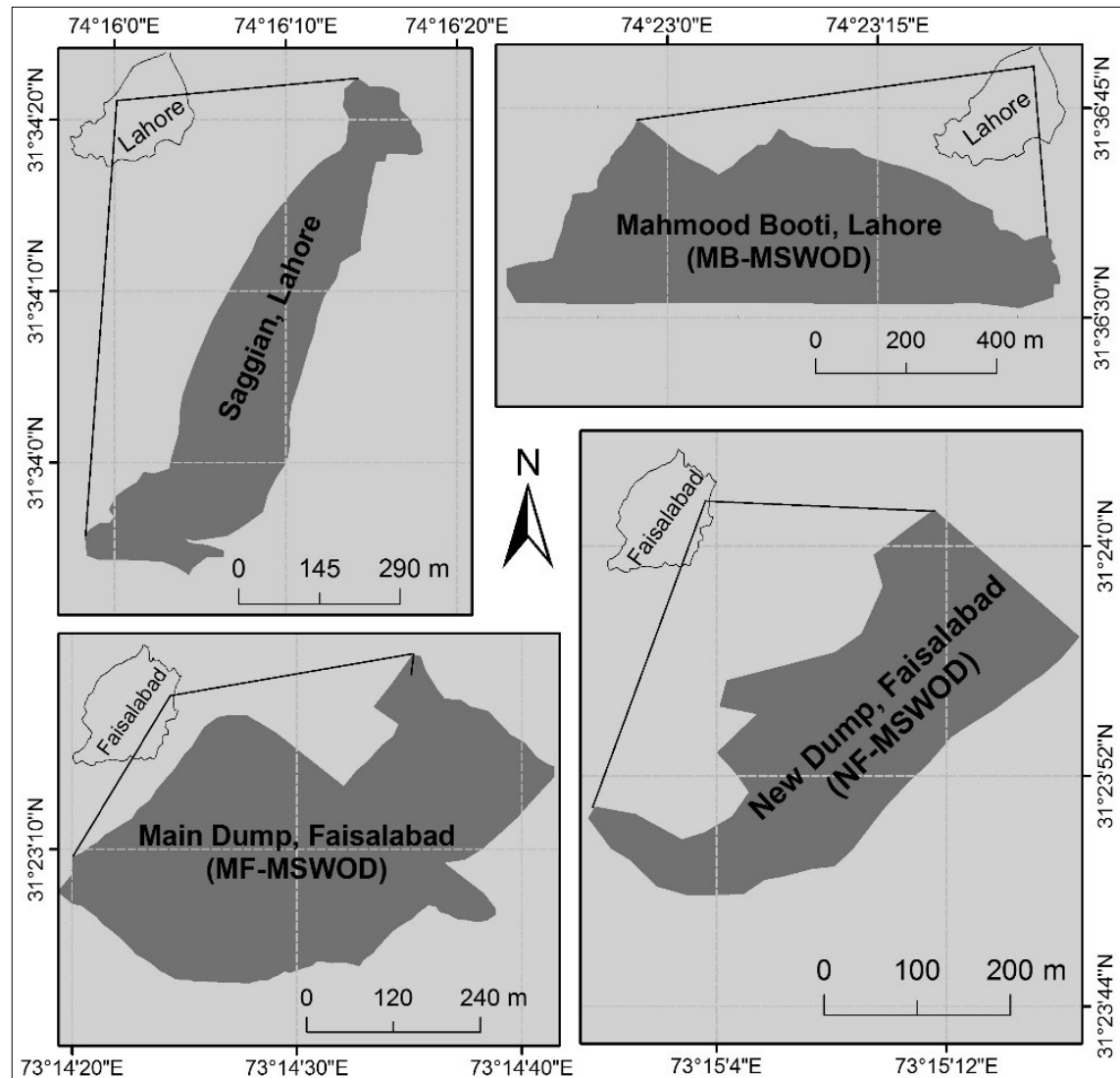


Figure 2: Extended study area

Material and Methods

- Data of Landsat-8 satellite has been used (149, 038).
- Image has been cut to study area, such that all the major land covers should be included in it.

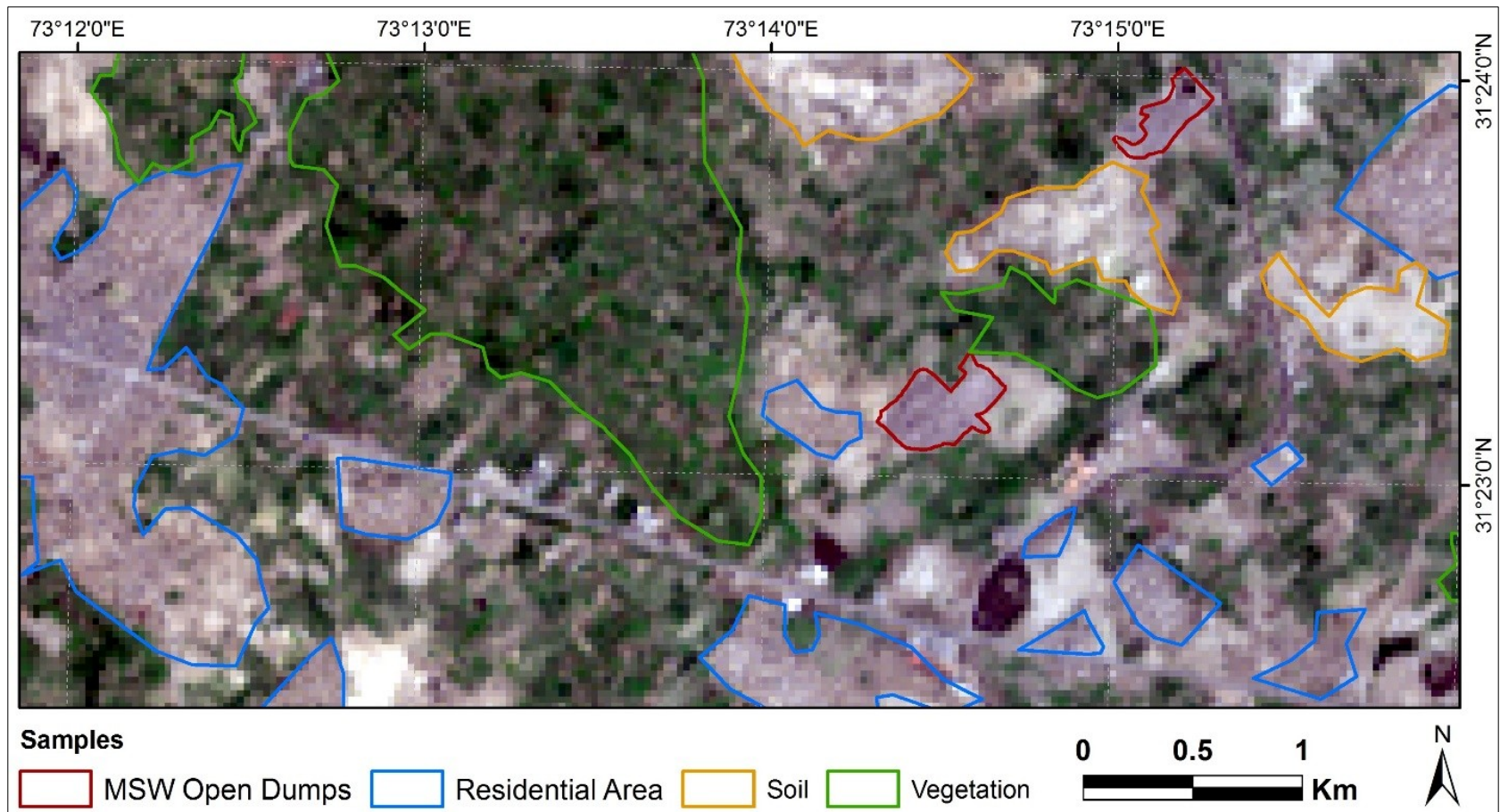


Figure 3: Subset of Landsat-8 image for identification of MSWODs

Material and Methods

- Visible, Near InfraRed (NIR) and Midle InfraRed (MIR) bands of the satellite image were stacked together, followed by zonal statistical operation.
- Keeping in view the spectral response patterns a detailed spectral sampling has been done for residential areas and soil patterns to accommodate all the possible variations in the spectral signatures mixing or contributing to MSW dumps.
- Unsupervised classification with varying number of landcover classes has been done in order to discriminate MSW dumps from other landcovers.

Material and Methods

CLASSIFICATION

- This process was initiated with 30 spectral classes using ISODATA algorithm, performed 15 iterations having 0.99 convergence threshold.
- Number of classes were then gradually increase for a better class discrimination representing dumps as a separate spectral class from other landcover features.
- Maximum 50 spectral classes were developed with the same number of iterations and convergence threshold. Classes identified as MSW dumps were merged to get a representative spectral signature.

Results and Discussions

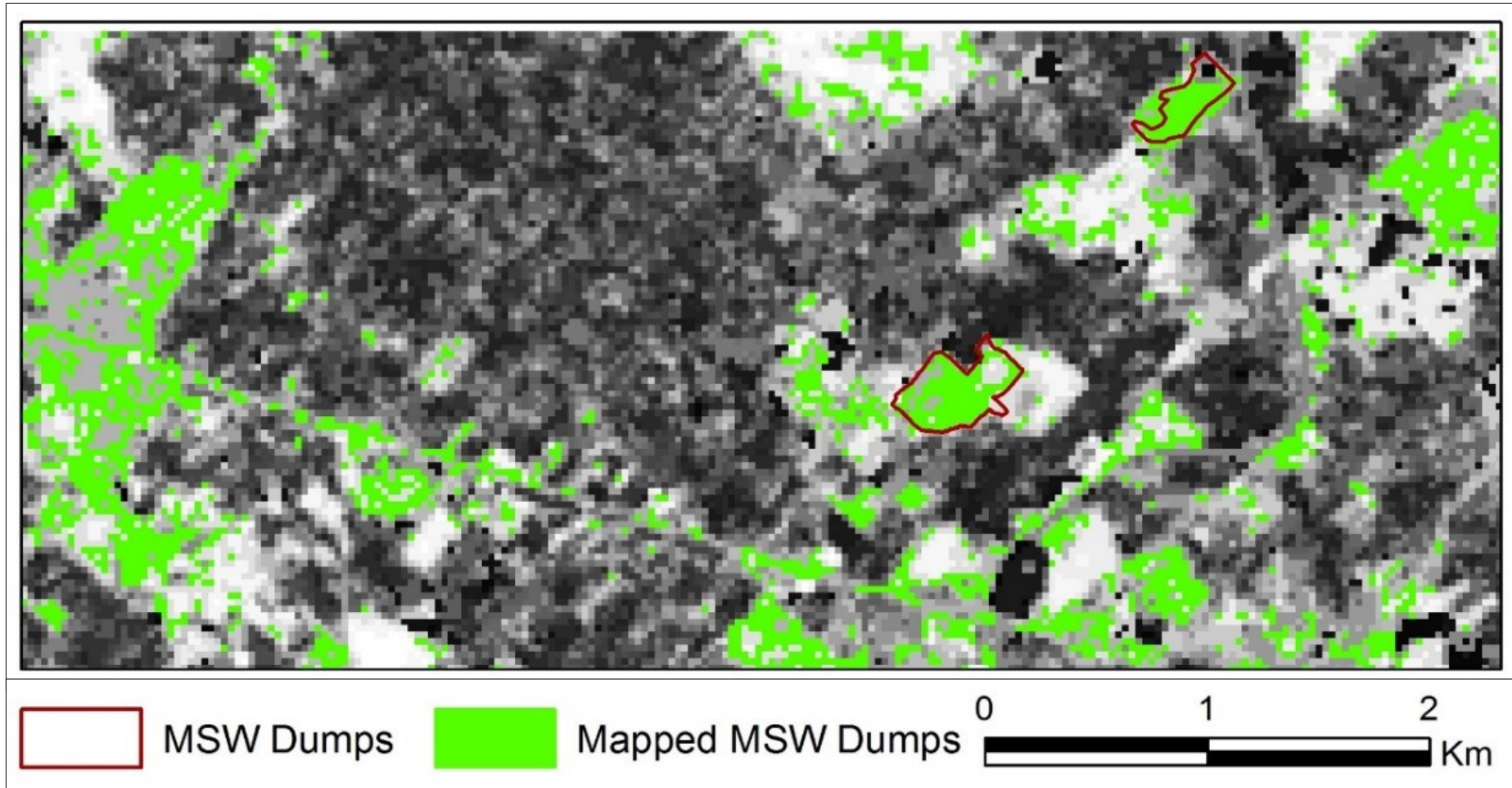


Figure 4: Image classified in to 30 classes, where MSW dumps fall in two classes

Results and Discussions

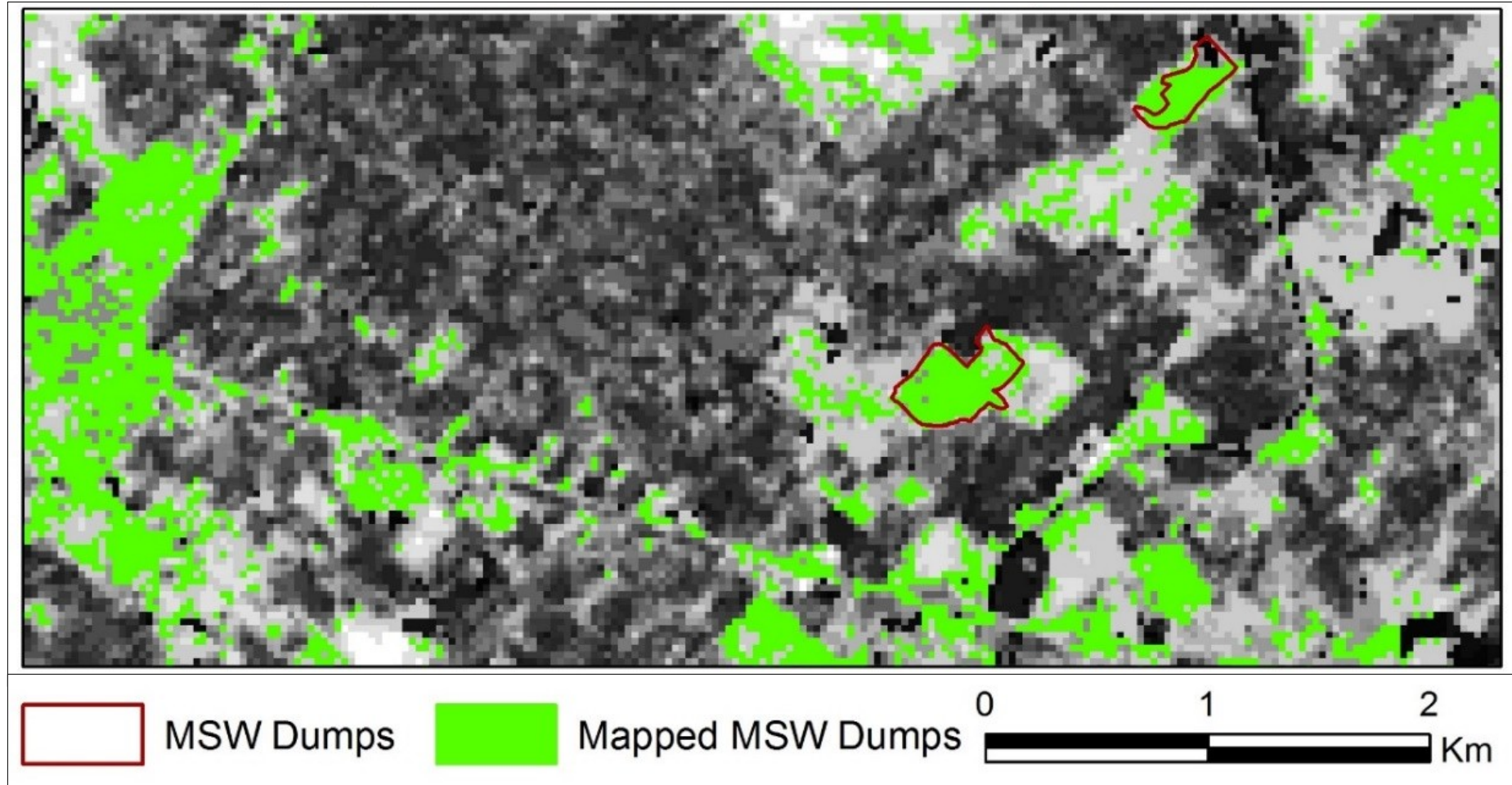


Figure 5: Image classified in to 40 classes, where MSW dumps fall in four classes

Results and Discussions

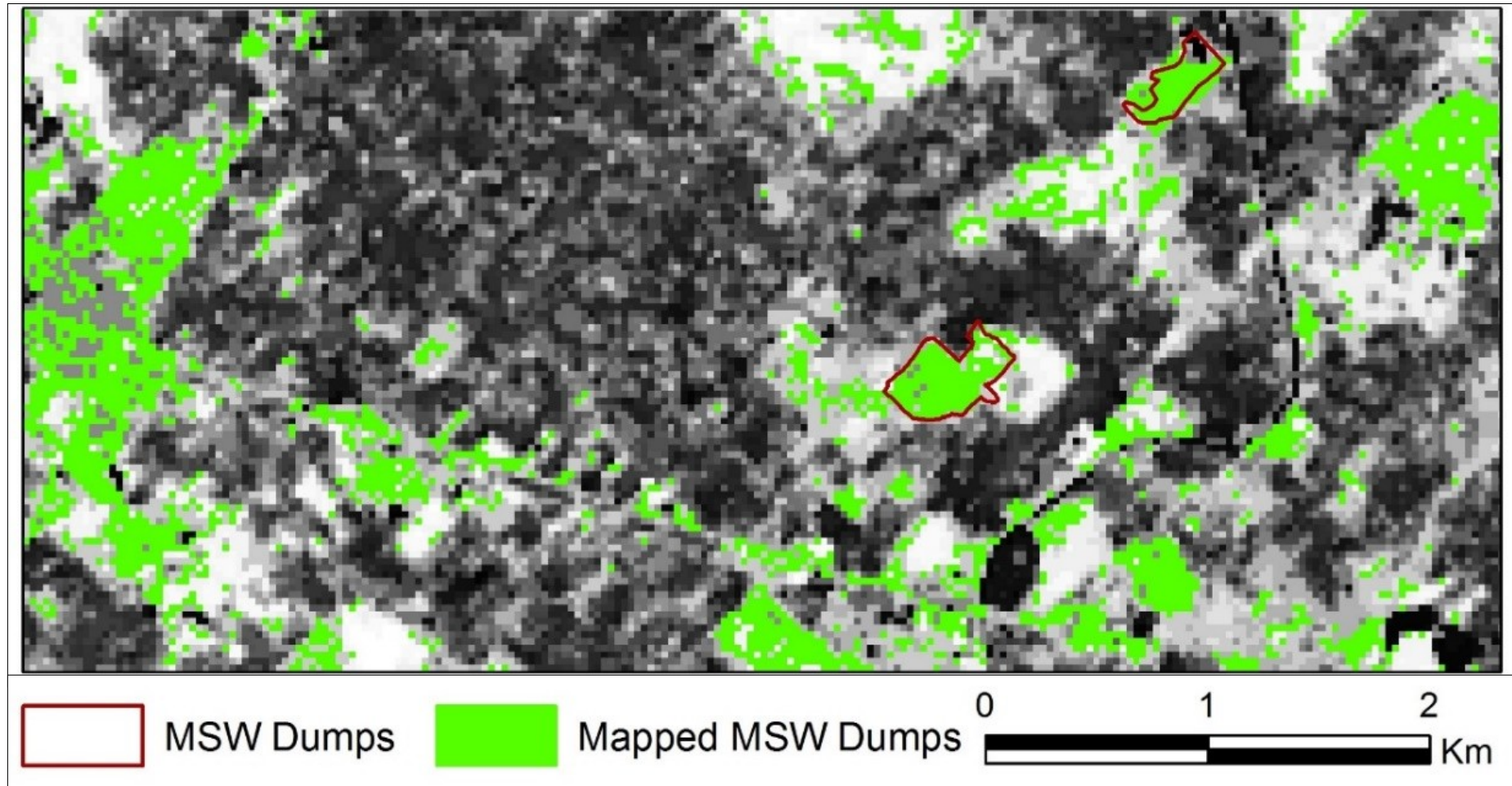


Figure 6: Image classified in to 50 classes, where MSW dumps fall in four classes

Results and Discussions

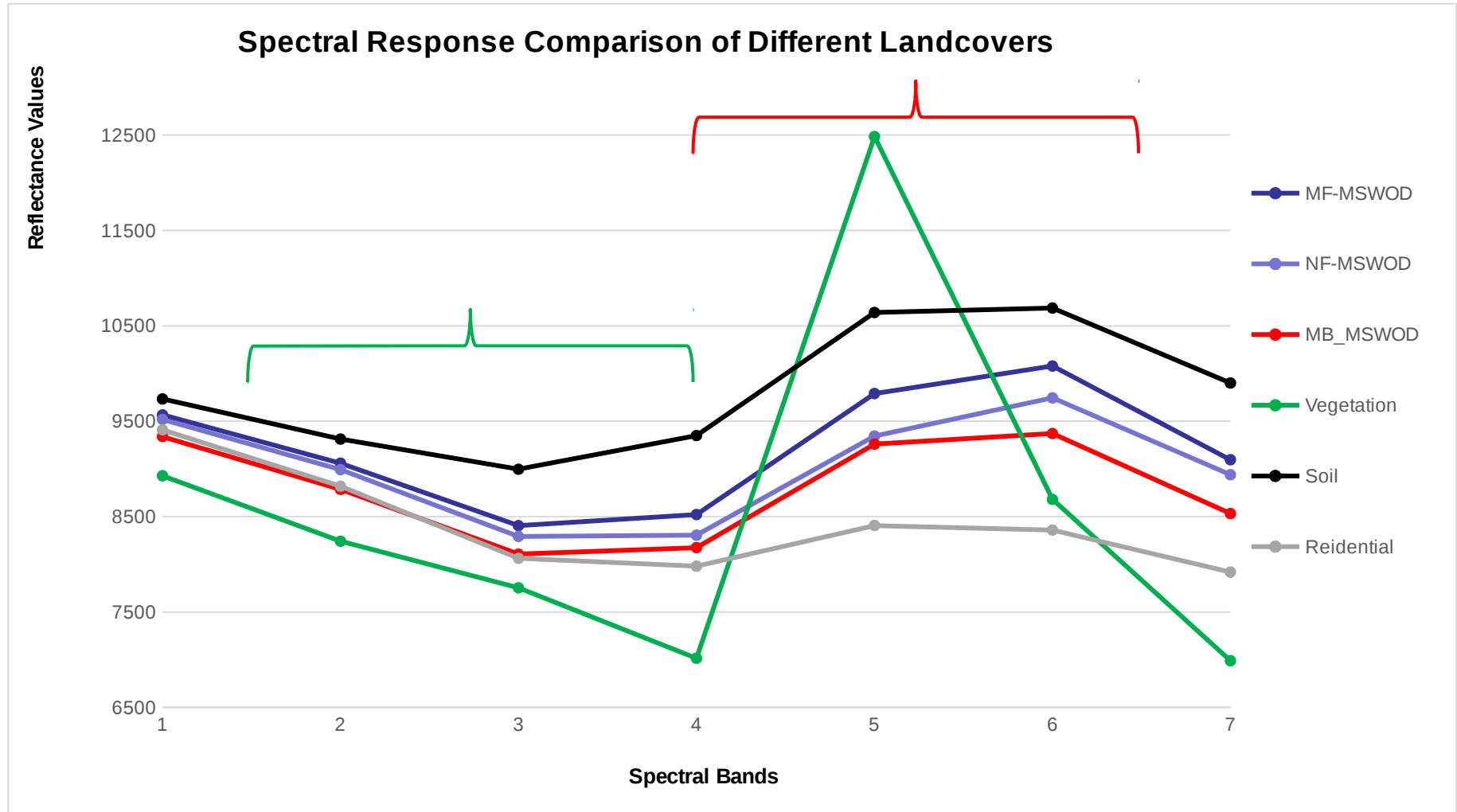


Figure 7: Spectral signature of various land covers

Results and Discussions

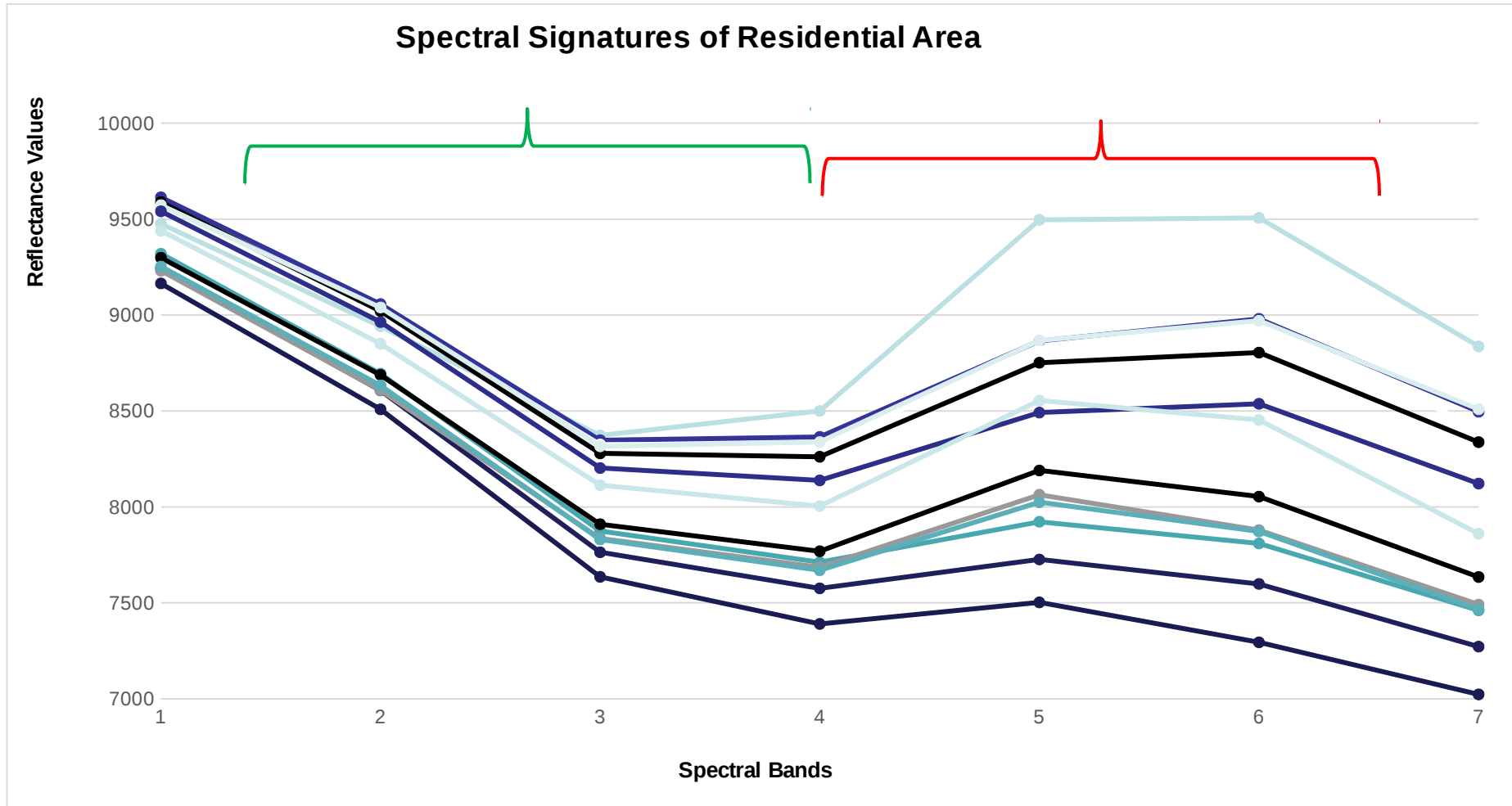


Figure 8: Range of spectral signatures for residential area

Results and Discussions

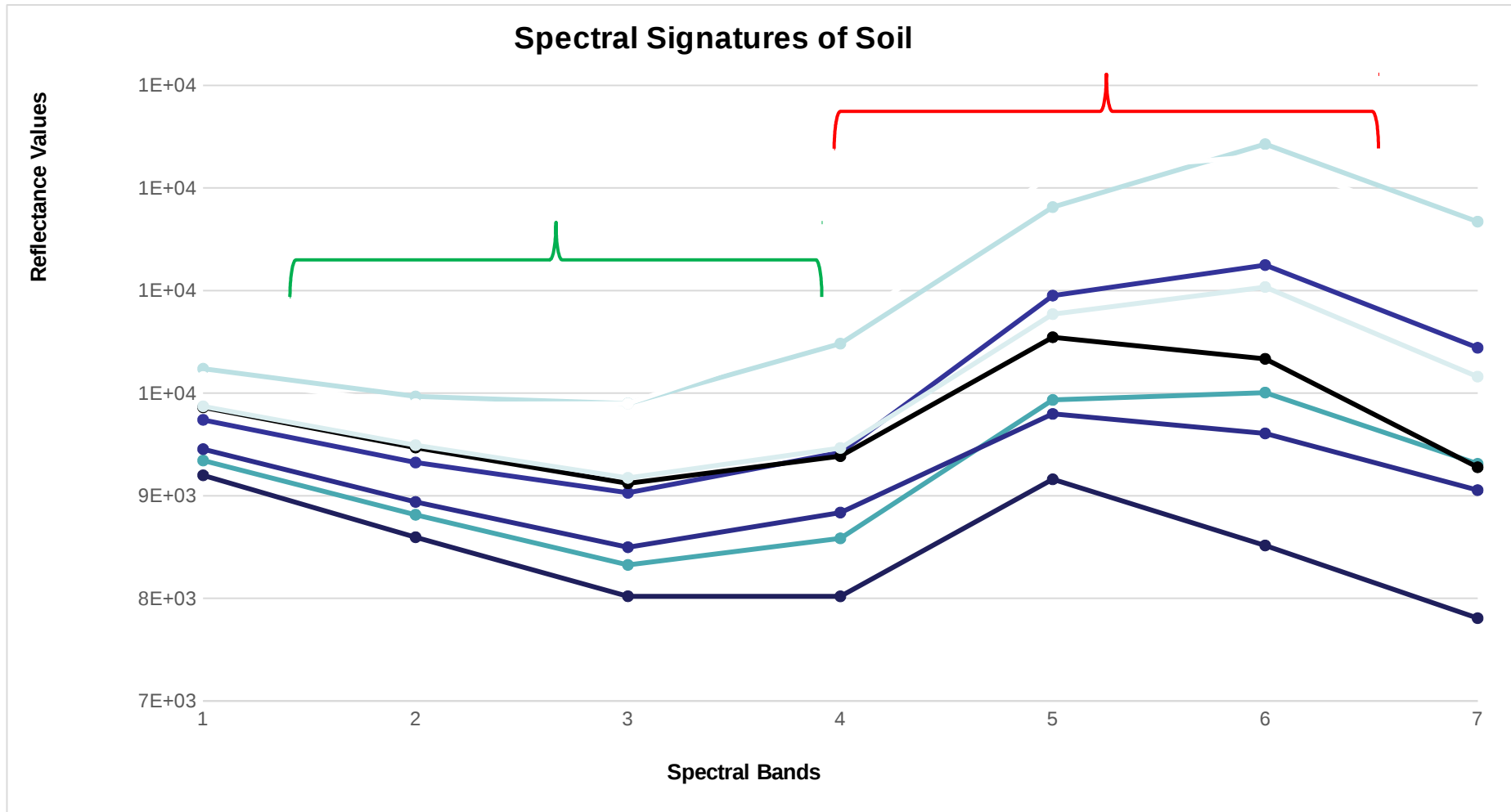


Figure 9: Range of spectral signatures for soil

Results and Discussions

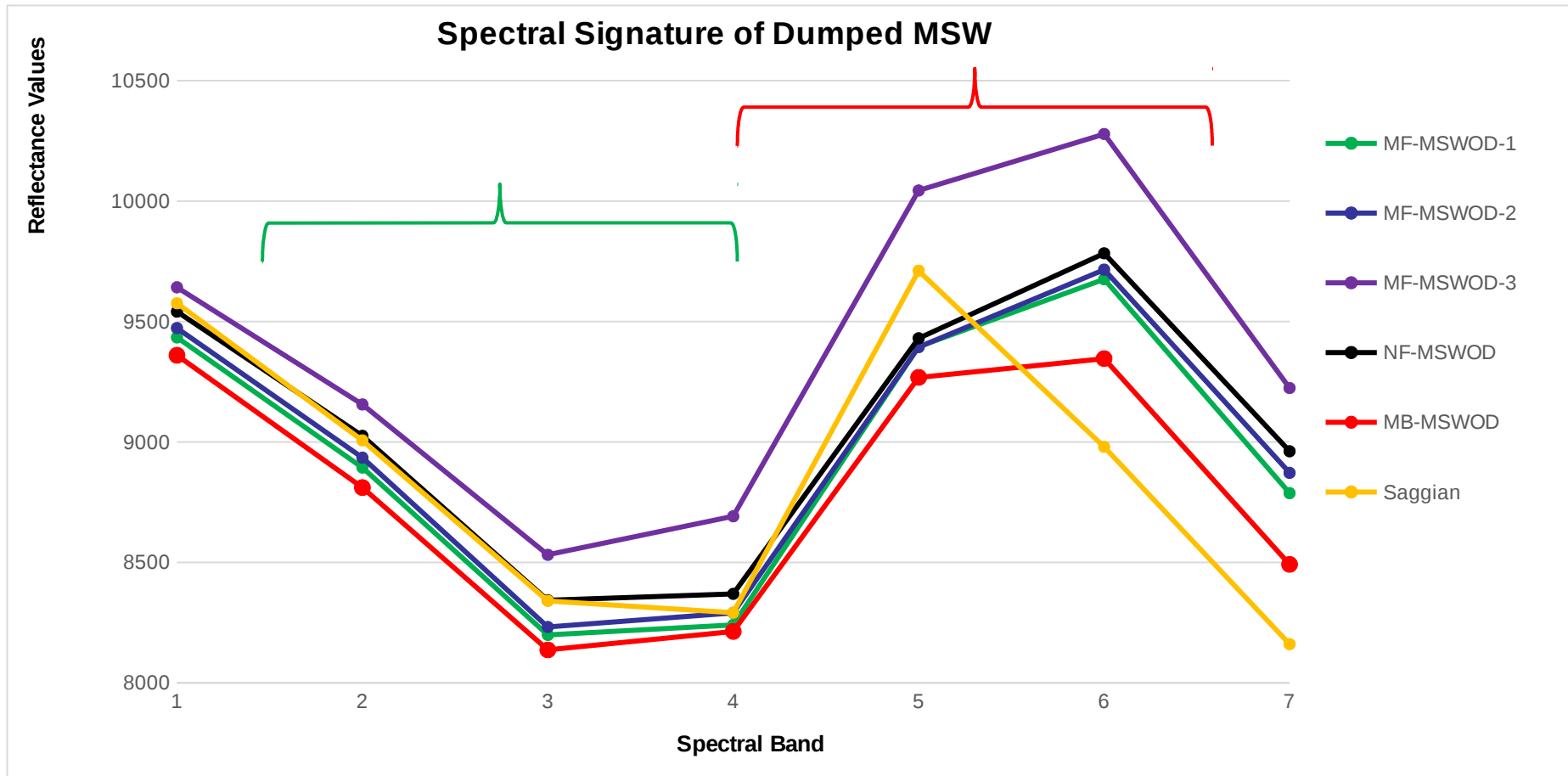


Figure 10: Spectral signature of dumped MSW at different dumps

Conclusions

- Remotely sensed satellite data can be use as an alternative to ground surveys for studying open dups of MSW
- This study can provide a basic understanding of the process and based on the information obtained model can be improved for proper identification and age wise segregation of MSW open dumps.
- These improvement may include development of suitable band ratios can also help to highlight minor differences between spectral signatures of mixing landcover and to produce contrast of the dumps.
- Another possibility raised is the use of thermal bands with temporal combination rather than spectral combinations.
- This study recommends the use of high resolution satellite data in context of both spatial and spectral resolutions for the development of preliminary models of identification.

Thank You