Appendix A

Table A1. Microsoft Building Footprints distribution of area (m2) and nearest neighbor distance by region and material type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material** | **Region** | **Mean Area (m2)** | **90th Percentile Area (m2)** | **Mean Side Length (m)** | **90th Percentile Side Length (m)** | **Nearest Neighbor Distance (m)** |
| AP | Denver | 220.3 | 334.7 | 15.4 | 21.9 | 26.6 |
| CN | Denver | 379.3 | 590.0 | 21.2 | 34.8 | 44.5 |
| CS | DC | 95.6 | 166.2 | 9.8 | 17.8 | 14.2 |
| CS | Denver | 173.9 | 255.9 | 13.6 | 20.2 | 20.5 |
| ME | DC | 82.7 | 116.7 | 10.0 | 19.9 | 8.8 |
| SH | DC | 104.7 | 182.1 | 10.6 | 19.0 | 71.4 |
| SL | DC | 107.9 | 184.2 | 10.6 | 19.0 | 18.8 |
| SL | Denver | 542.7 | 1027.9 | 27.1 | 54.1 | 214.8 |
| TG | Denver | 498.9 | 825.0 | 22.8 | 49.1 | 175.9 |
| TL | DC | 126.2 | 222.3 | 11.5 | 20.6 | 48.9 |
| TL | Denver | 261.4 | 440.4 | 16.5 | 26.7 | 63.6 |
| UR | DC | 87.1 | 117.2 | 10.5 | 20.8 | 29.0 |
| WS | DC | 109.3 | 212.3 | 10.6 | 19.0 | 50.9 |
| WS | Denver | 250.8 | 393.9 | 16.7 | 27.5 | 44.6 |
| **Average** | Denver | 332.5 | 552.5 | 19.0 | 33.5 | 84.4 |
| **Average** | DC | 101.9 | 171.6 | 10.5 | 19.4 | 34.6 |

Figure A1. Band correlation matrices for (A) Washington, D.C. and (B) Denver, Colorado.

A comparison of colors and numbers

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Figure A2. ResNet-18 hyperparameter tuning results for Washington, D.C. (A) validation loss during the 12-epoch model training across all trials; (B) validation F1-score across trials. The variability in validation F1-score and, to a lesser extent, in model loss, highlights the importance of hyperparameter tuning for ResNet-18 architecture.

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Figure A3. Distribution of ResNet-18 model classification confidence by material type for both Washington, D.C. (purple) and Denver, Colorado (green). AP=Asphalt; CN=Concrete; CS=Composition Shingle; ME=Metal; SH=Shingle; SL=Slate; TL=Tile; TG=Tar and Gravel; UR=Urethane; WS=Wood Shake/shingle.

A graph of a number of different colored boxes

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Table A2. Classification accuracy by material type include precision, recall, and F1-score. Accuracy of roofprint classification on unlabeled image data is assessed using *all* roofprints with thematic information in both AOIs. We applied the trained model to unlabeled image data and calculated the classification summary report for all training roofprints (i.e., training, validation, and holdout sets).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Washington, D.C.** | | | |  | **Denver, CO** | | | |
| *Material* | *Precision* | | *Recall* | *F1-score* | *Support* |  | *Precision* | *Recall* | *F1-score* | *Support* |
| Asphalt | | n/a | n/a | n/a | n/a |  | 0.822 | 0.969 | 0.889 | 7991 |
| Concrete | | n/a | n/a | n/a | n/a |  | 0.746 | 0.879 | 0.807 | 2690 |
| Composition shingle | | 0.851 | 0.837 | 0.844 | 30392 |  | 0.975 | 0.949 | 0.962 | 84606 |
| Metal | | 0.831 | 0.675 | 0.745 | 28011 |  | n/a | n/a | n/a | n/a |
| Slate | | 0.482 | 0.749 | 0.587 | 10918 |  | 0.000 | 0.000 | 0.000 | 213 |
| Urethane | | 0.132 | 0.270 | 0.177 | 1135 |  | n/a | n/a | n/a | n/a |
| Tar & gravel | | n/a | n/a | n/a | n/a |  | 0.234 | 0.282 | 0.256 | 195 |
| Tile | | 0.272 | 0.127 | 0.173 | 670 |  | 0.715 | 0.722 | 0.718 | 2717 |
| Wood shingle | | 0.380 | 0.157 | 0.223 | 870 |  | 0.686 | 0.717 | 0.701 | 10285 |
| Shingle | | 0.286 | 0.003 | 0.007 | 588 |  | n/a | n/a | n/a | n/a |
| ***Weighted average*** | | **0.736** | |  |  |  | **0.918** | |  |  |

Figure A4. Spectral response of roofing materials for Denver, Colorado (left) and Washington, D.C. (right) from the original PSB.SD bands (visible to near-infrared). Band center wavelengths are denoted by shading. We calculated the average reflectance for all roofprints in both AOIs. With some exceptions (tile in Denver, urethane and metal in D.C.), there is minimal spectral separability of materials across many of the bands.

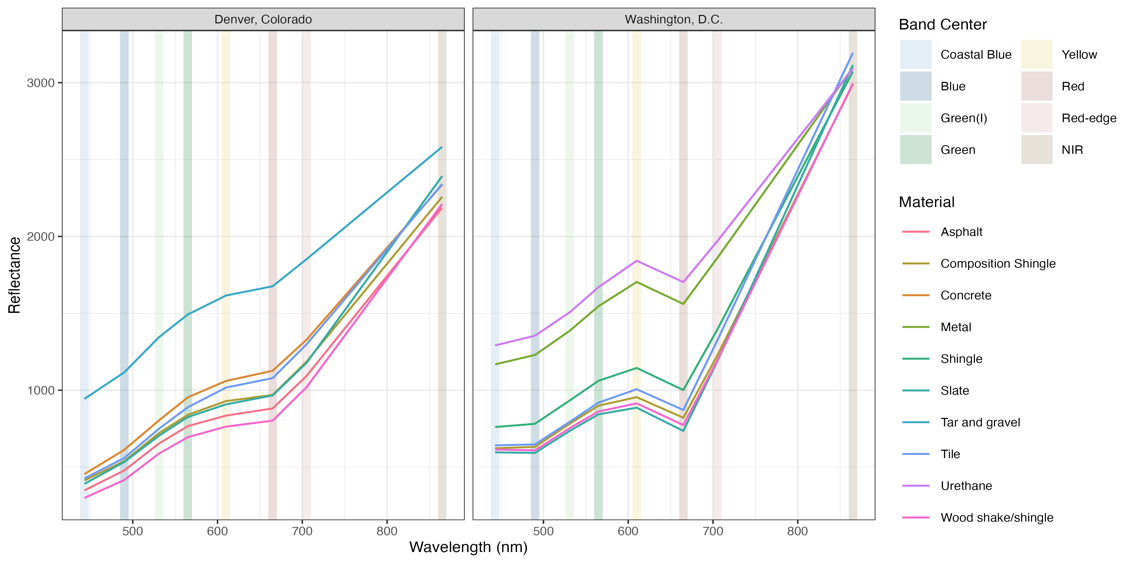


Figure A5. Spectral similarity of roofing materials for Denver, Colorado (top row) and Washington, D.C. (bottom row) from the derived spectral indices and image transformation. Spectral indices and image transformations improve the separability of roofing materials compared to just the original visible to near-infrared bands.

A chart of different colored squares

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