Evaluating the Performance a Newly Proposed Built-up Index Against Established Indices

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Introduction:

This study introduces a novel built-up index (NewBI) derived from Sentinel-2 satellite imagery, tailored to enhance built-up extraction, particularly in areas dominated by white roofs. The index is further used for urban landscape pattern analysis. Employing the Total Operating Characteristics (TOC) provides a more robust evaluation compared to conventional accuracy assessment methods. We apply this method to assess the performance of NewBI, BUI, and NDBI. Subsequently, we conduct a comparative analysis between NewBI and BUI to delineate differences and highlight NewBI's superior performance. This study offers potential insights into urban development and environmental sustainability.

Results & Discussion:

1. Upon analyzing the TOC plot comparing NDBI, BUI, and NewBI, we observed a positive correlation with built-up areas, with the order of influence being NDBI < BUI < NewBI. Considering that BUI is derived from NDBI (Zha et al., 2003; He et al., 2010), we conducted a comparison between BUI and NewBI to delineate their disparities. [fig.3, fig.4, fig.5]

2. NewBI demonstrates the ability of distinguish most types of built-up areas from non-built-up areas but red roofs and roads, which share similar ranges with bare soil. Conversely, while BUI can separate built-up objects from vegetation, it struggles to differentiate them from water and bare soil.[fig.6, fig.8]

3. The NewBI - BUI plot illustrates the contrast between these two indices, emphasizing NewBI's capability in highlighting urban areas, particularly white roofs, and its ability to differentiate waterbodies and bare soil from urban areas. [fig.7]
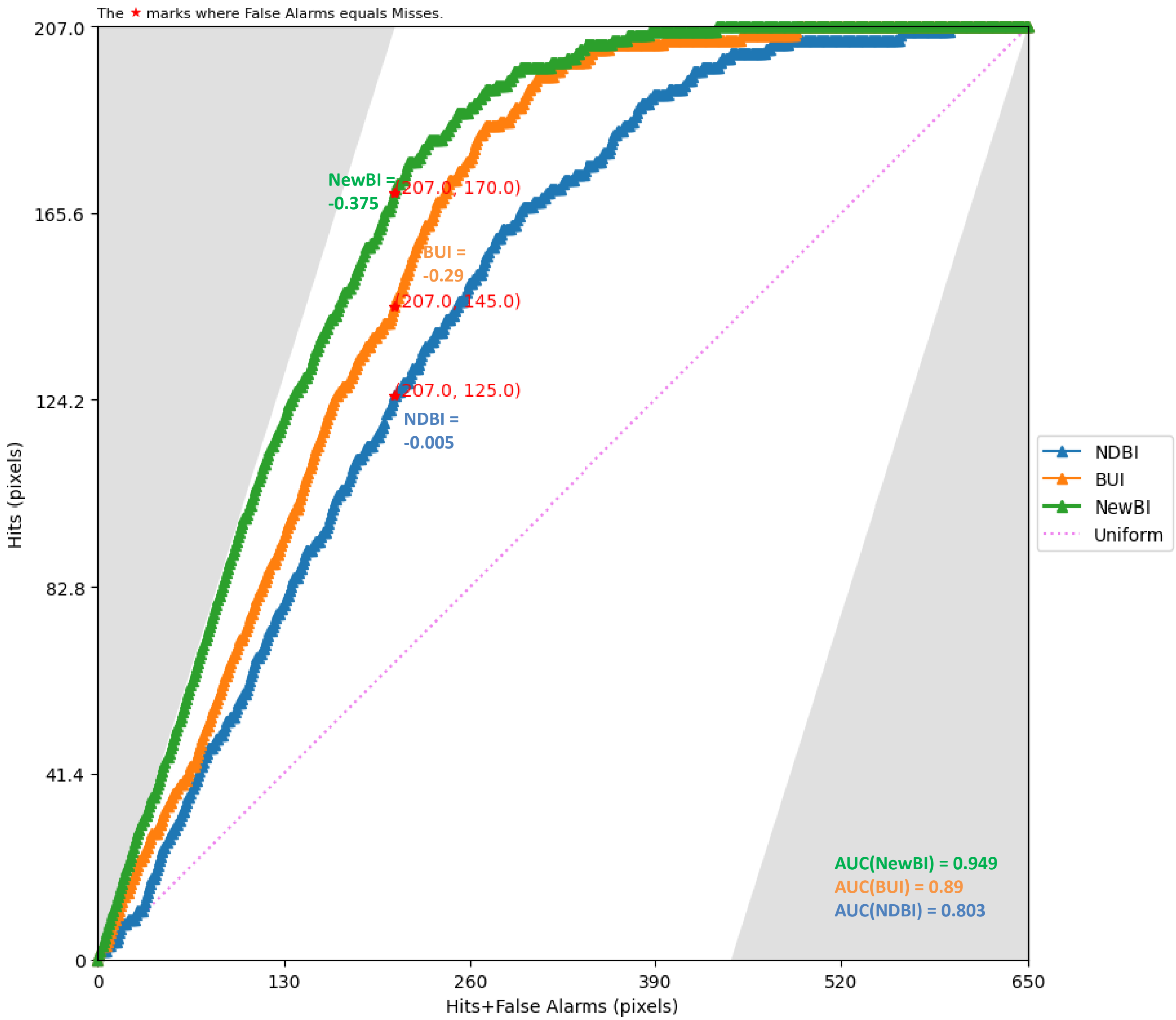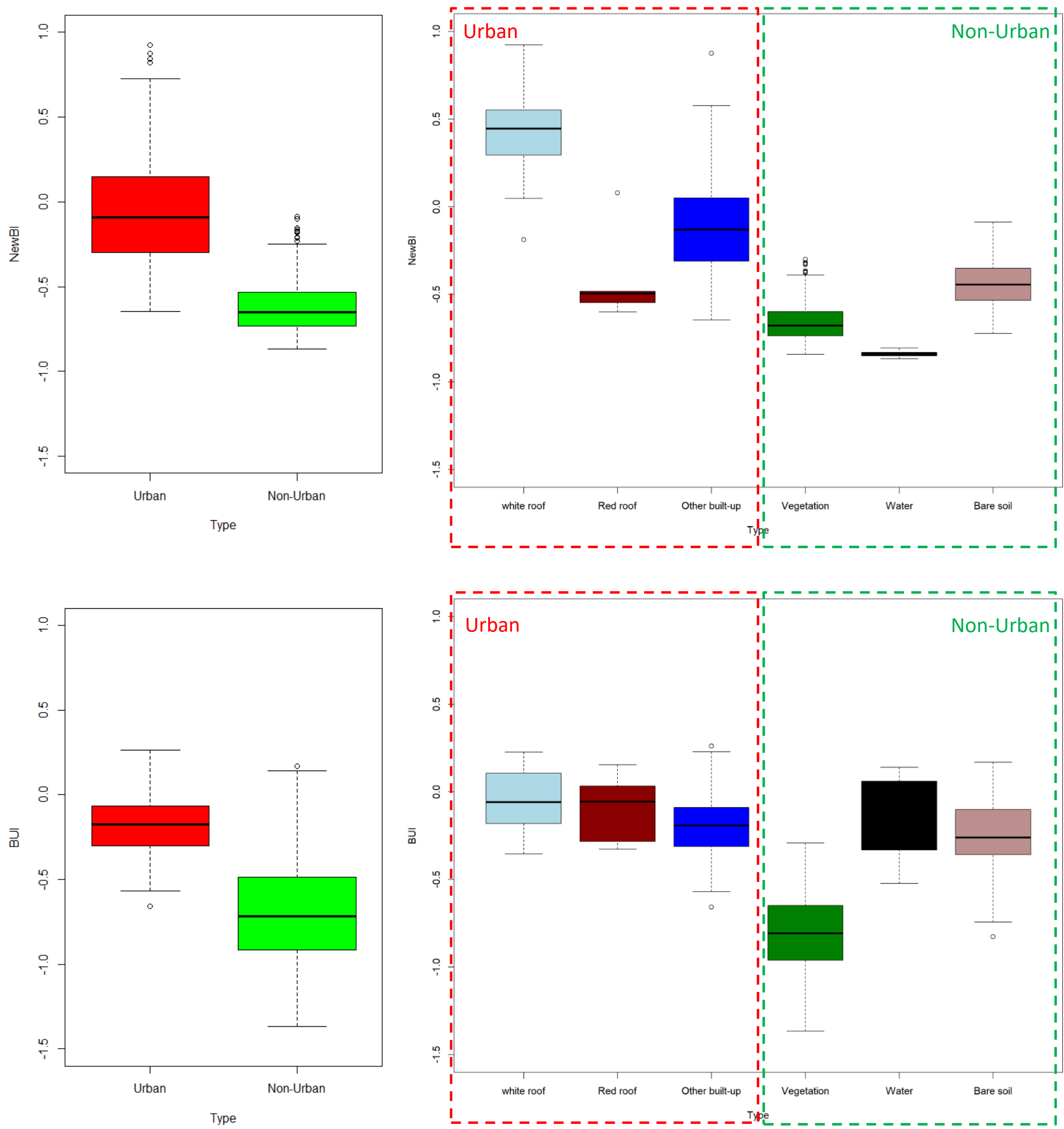

Fig 5: TOC for NDBI, BUI, and NewBI

Fig 6: Boxplots in two level labels
Level I (left): (Urban and Non-Urban);
Level II (right): (white roof, red roof, other built-up, vegetation, water, and bare soil)
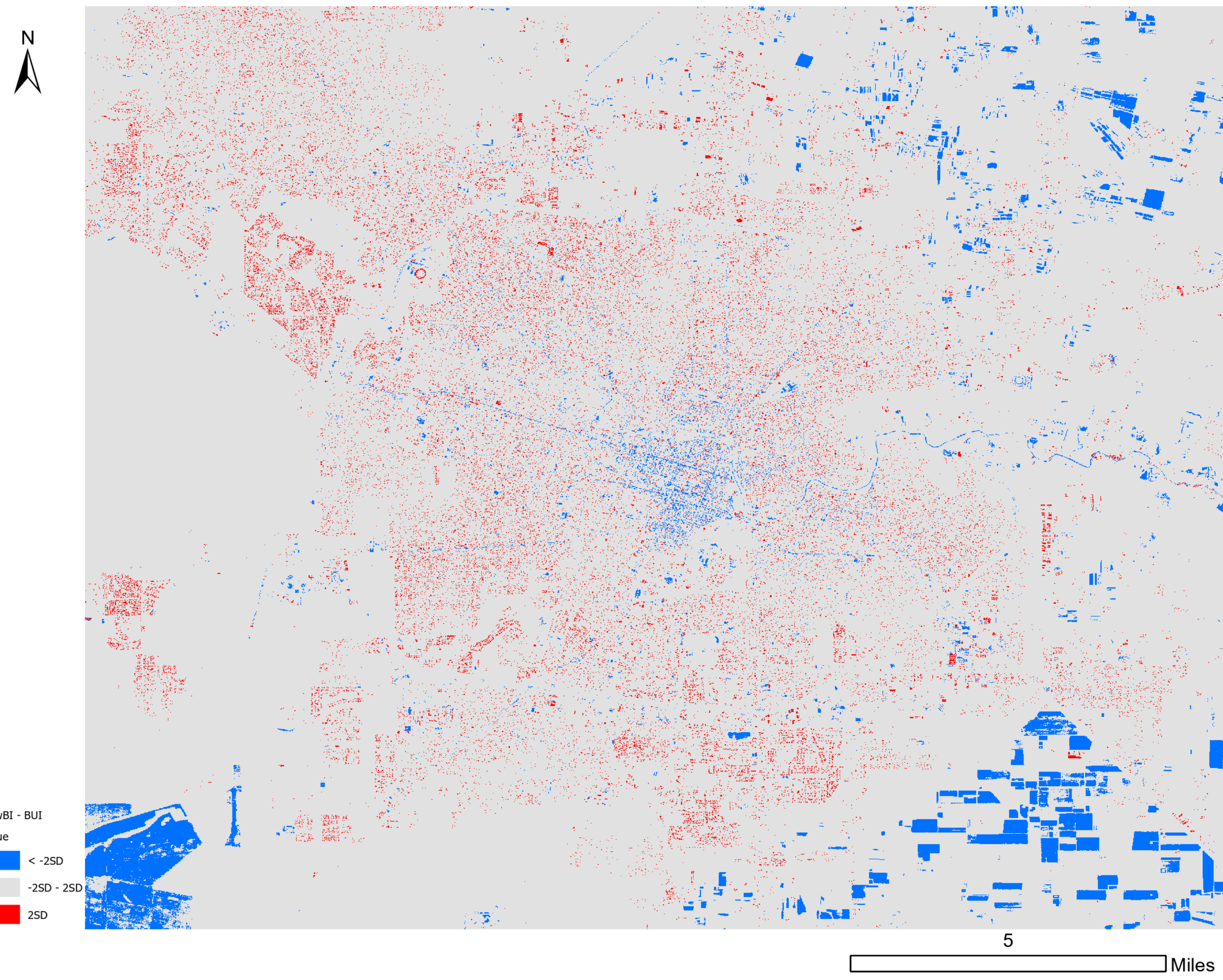

Fig 1: True Color Sentinel-2 in Cordoba, Argentina
(Date: 2024/01/24)

Fig 2: False Color Sentinel-2 (B8, B4, B3)
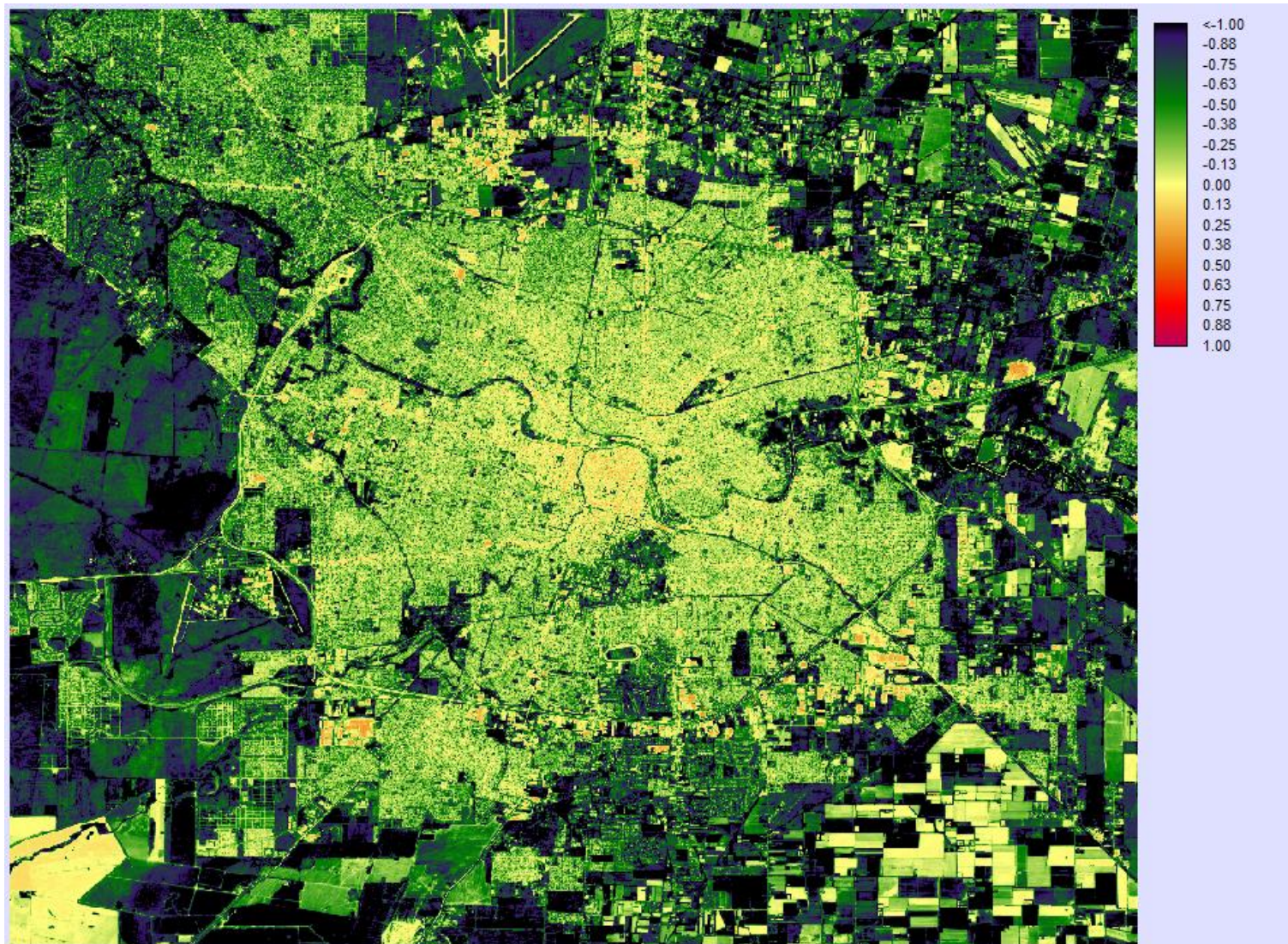
Fig 3: BUI (NDBI – NDVI)

Fig 4: NewBI

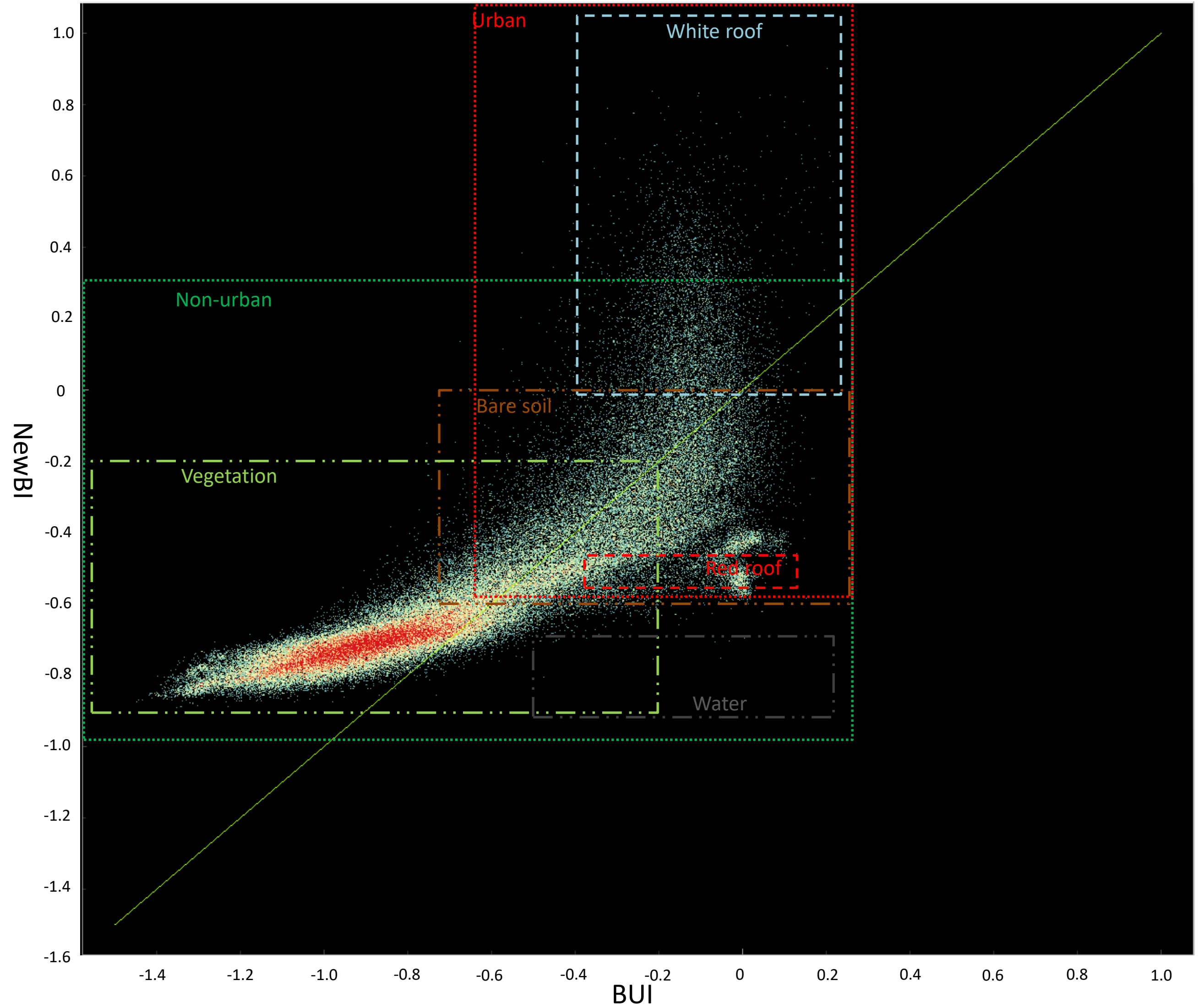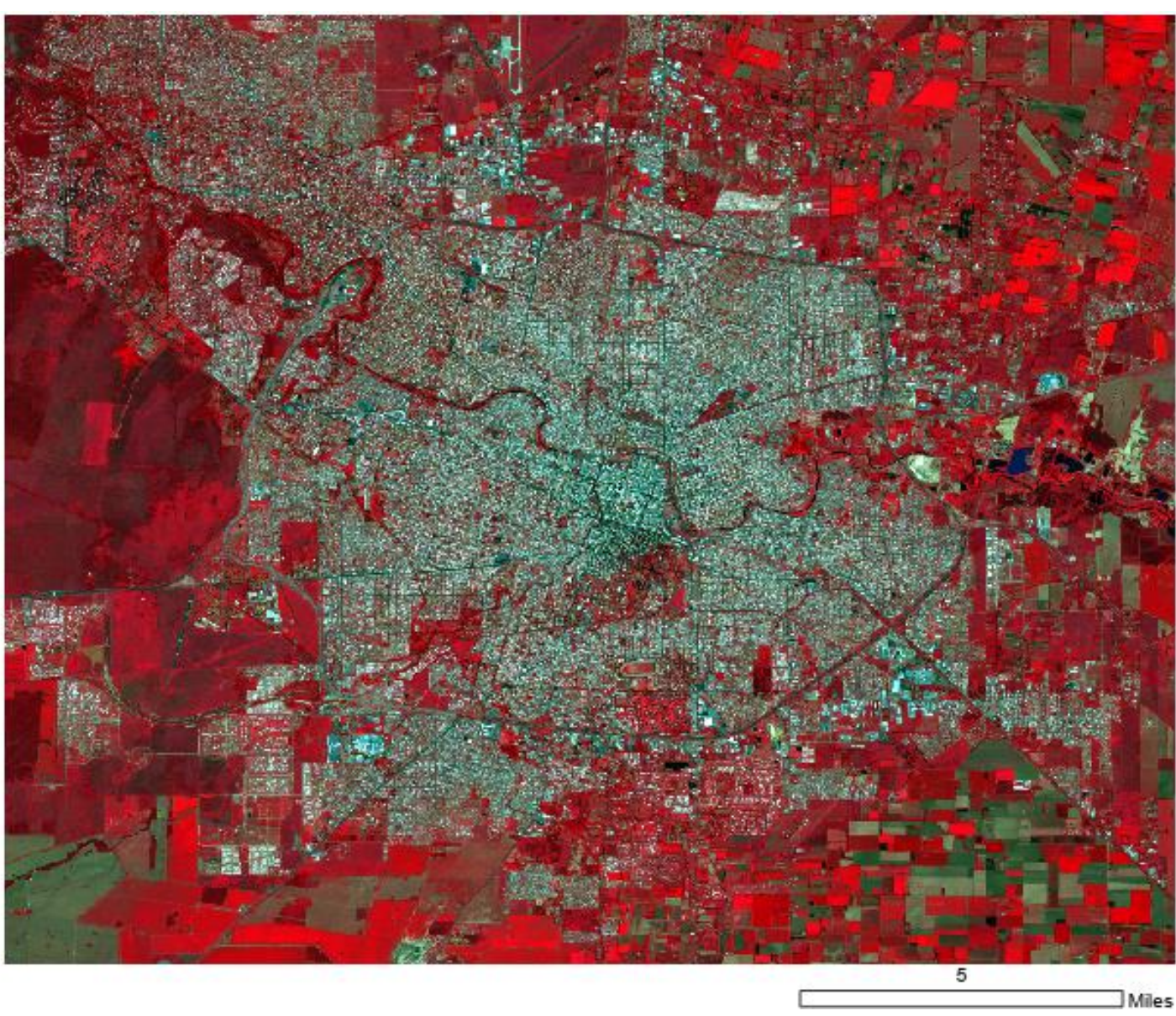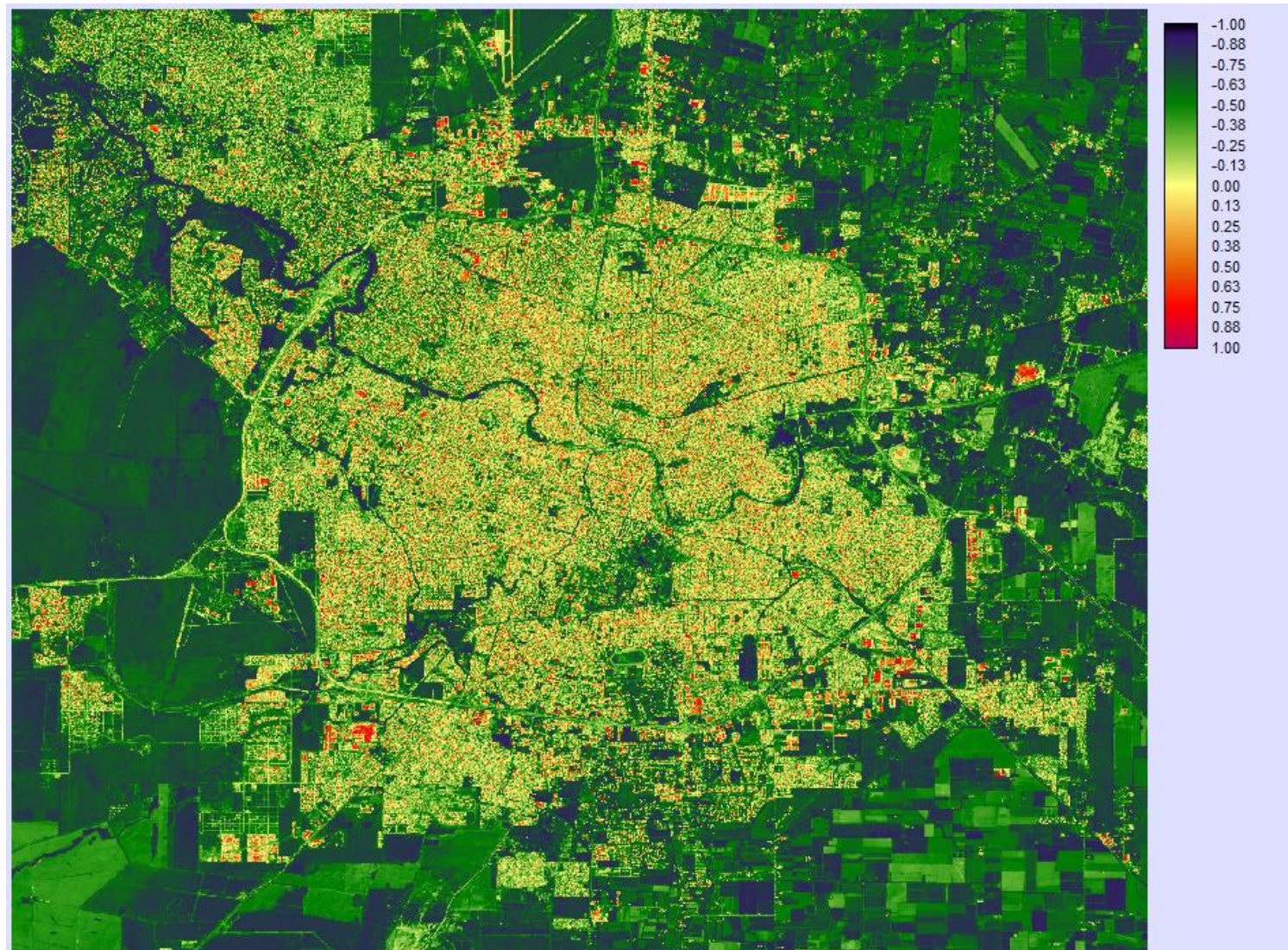**Fig 7:** (NewBI – BUI) Reclassification map in 2 SD intervals

Fig 8: scatterplot for NewBI vs. BUI

Key Reference:
He, C., Shi, P., Xie, D., & Zhao, Y. (2010). Improving the normalized difference built-up index to map urban built-up areas using a semiautomatic segmentation approach. Remote Sensing Letters, 1(4), 213-221.
Pontius Jr, R. G., & Si, K. (2014). The total operating characteristic to measure diagnostic ability for multiple thresholds. International Journal of Geographical Information Science, 28(3), 570-583.
Zha, Y., Gao, J., & Ni, S. (2003). Use of normalized difference built-up index in automatically mapping urban areas from TM imagery. International journal of remote sensing, 24(3), 583-594.