



Upstream Environmental Project Review



Remote Sensing for Environmental Baselining and Monitoring Oak Ridge National Laboratory U. S. Geological Survey Agricultural Research Service

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Outline



- **Background**
- **Objective**
- **Approach**
- **Osage County**
- **Data Analysis**
- **Conclusions**



Background



Hyperspectral remote sensing can be used to rapidly assess present conditions and monitor environmental change at low cost.

Alternatives are: slow, expensive, and not comprehensive.

Field monitoring: \$20,000/acre.

Hyperspectral remote sensing: \$1/acre.



Objective



Develop hyperspectral remote sensing methods to identify areas impacted by oil production.

- **Collect airborne hyperspectral imagery.**
- **Identify distinct groups of similar spectra.**
- **Prepare geobotanical maps.**
- **Perform field validation.**



Approach



Paper: “A New Clustering Algorithm for Unsupervised Classification” submitted to IEEE Transactions on Geoscience and Remote Sensing.

Number of Pixels

| | |
|--------------------------------------|----------------|
| ● Jornada field measurements: | 211 |
| ● USGS Site B | 12,740 |
| ● Zink Site 127 | 36,960 |
| ● TGP Site 122 | 49, 020 |
| ● Bluestem Site 134 | 104,160 |



Osage County, OK



**Osage Indian Reservation.
38,500 oil wells since 1896.**

**1,480 (of 2,260) square miles are within a quarter
mile of an oil well.**

Many brine scars or weathered oil pits.

**Tallgrass Prairie, USGS, John Zink Ranch, and
Bluestem Ranch.**



HyVista



On Oct. 12, HyVista imaged three regions with overlapping strips of 126 band hyperspectral data.

| | |
|---------------------------|---------------------------|
| Tall Grass Prairie | 18 km² |
| Bluestem | 61 km² |
| USGS + Zink | 106 km² |

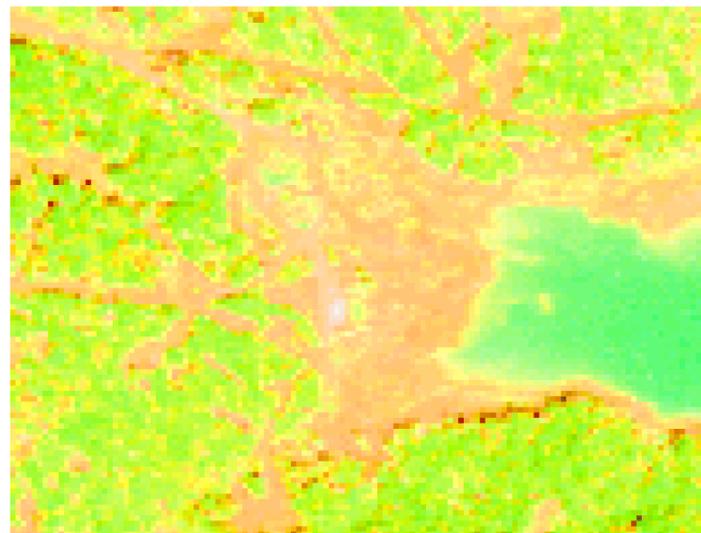
On Oct. 27 & 28, Field measurements by team.

On Nov. 10, 5 DVD with 14.4 Gigabytes of data.

USGS Site B



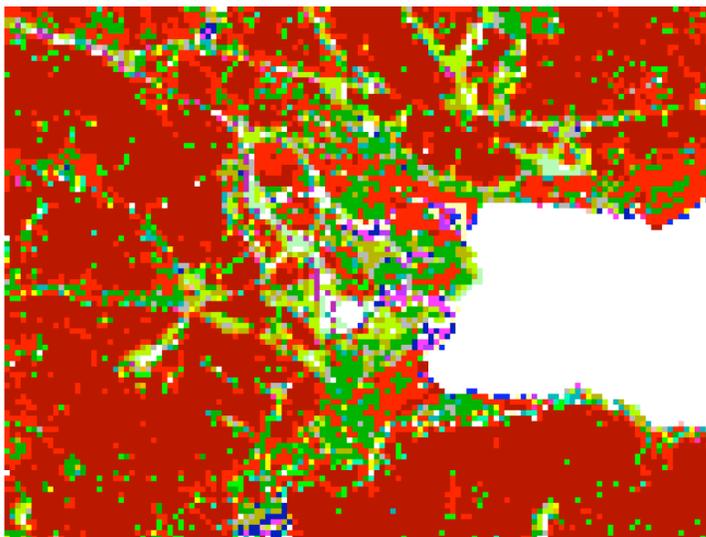
Site B. RGB. Bright pixel.



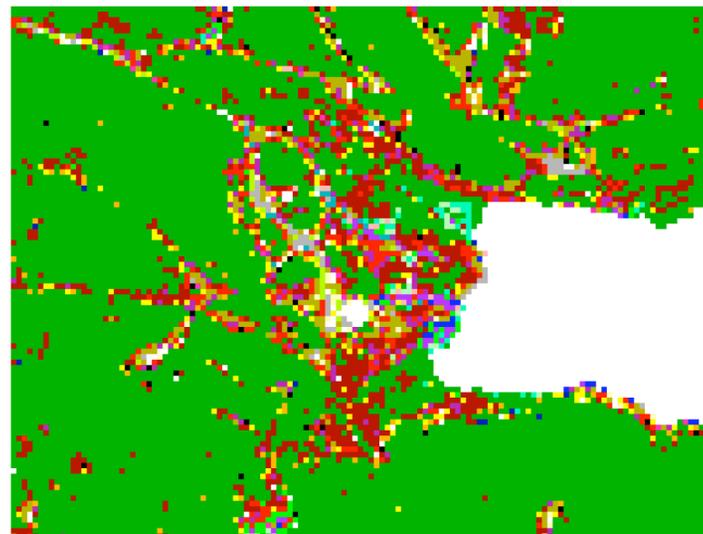
Site 127 & Site B

USGS Site B

Site B. Big Clusters (members > 4)

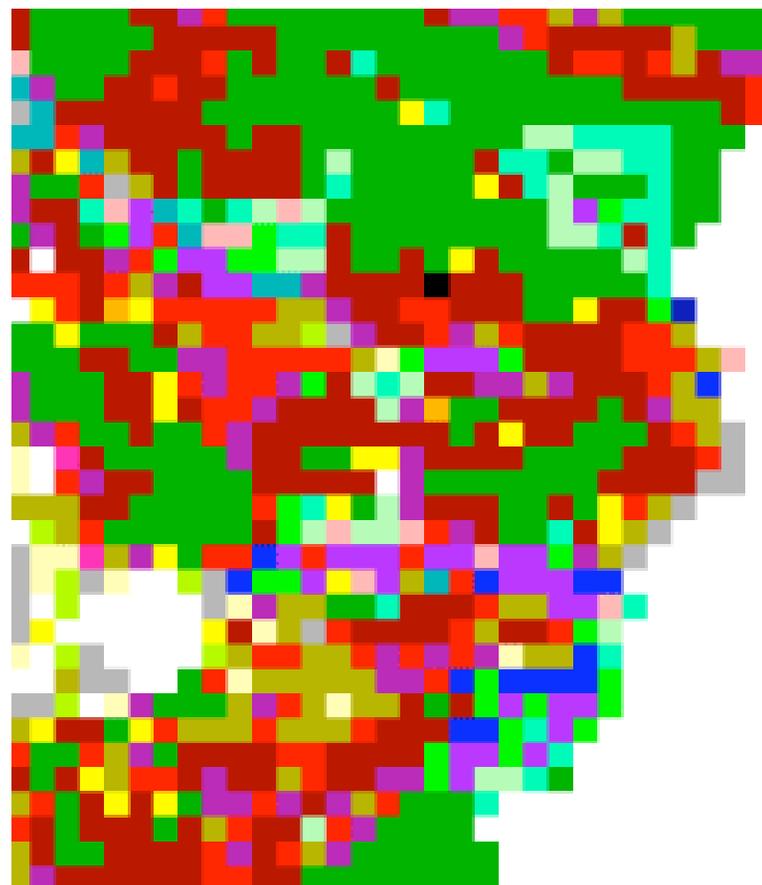
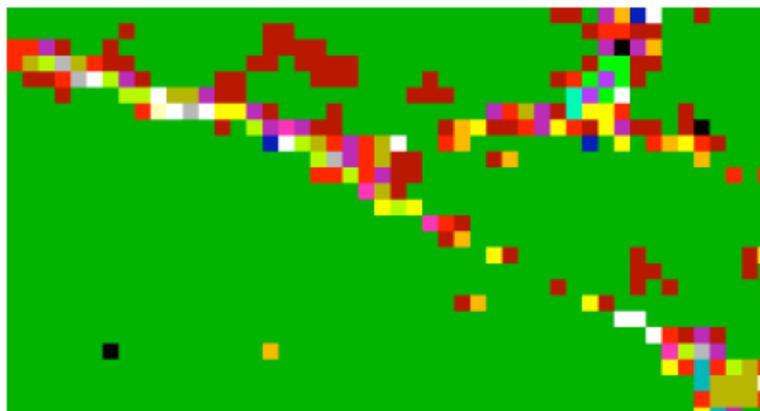


Site B. All Clusters (members > 2)



38 Clusters

USGS Site B



Road: 2.

Both: 7.

Site B: 9.

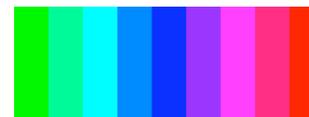
Road different than brine scar.



USGS Site B

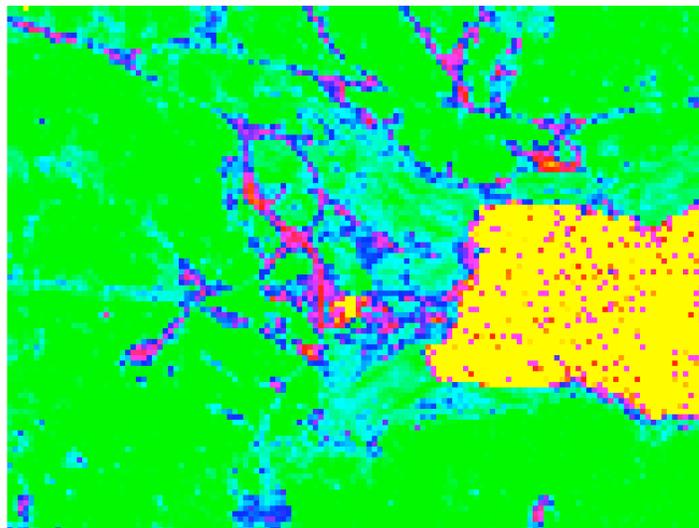


Correlation with Root Vectors

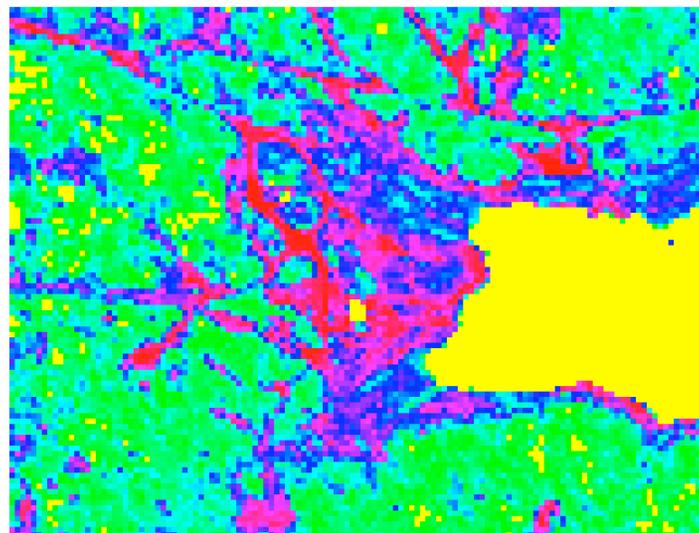


Color Scale

Site B. CC Row 0. Cut 0.40 Jan 9



Site B. CC Row 22. Cut 0.35 Jan 9



Zink Site 131

Zink 131. RGB. Bright pixel.



Zink Site 131



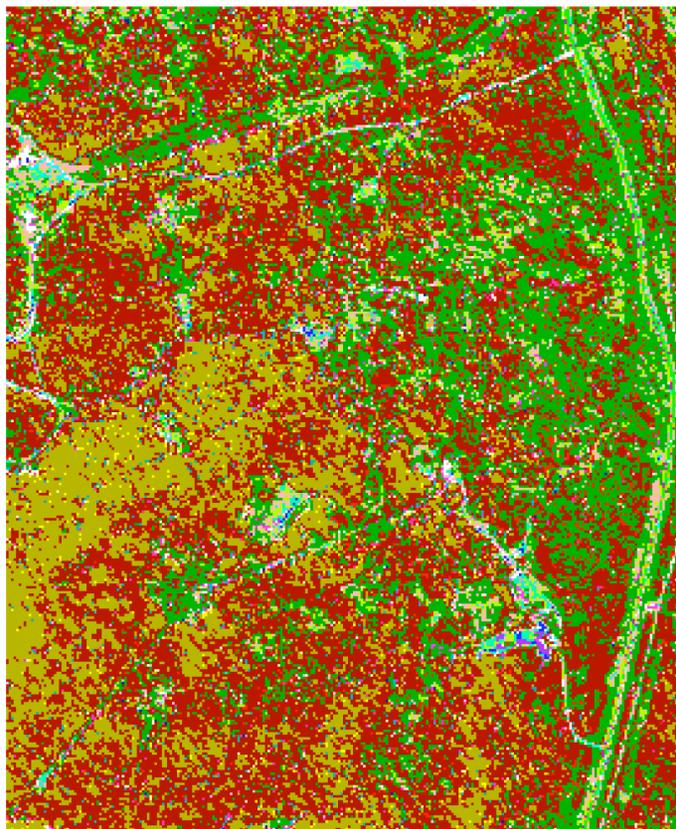


Zink Site 131

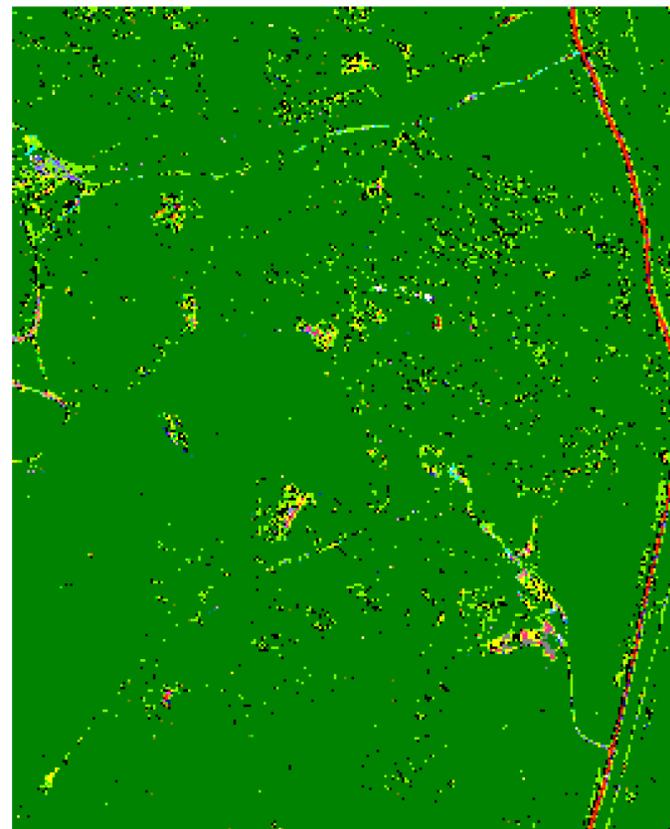


Zink 131. Big Clusters (members > 18)

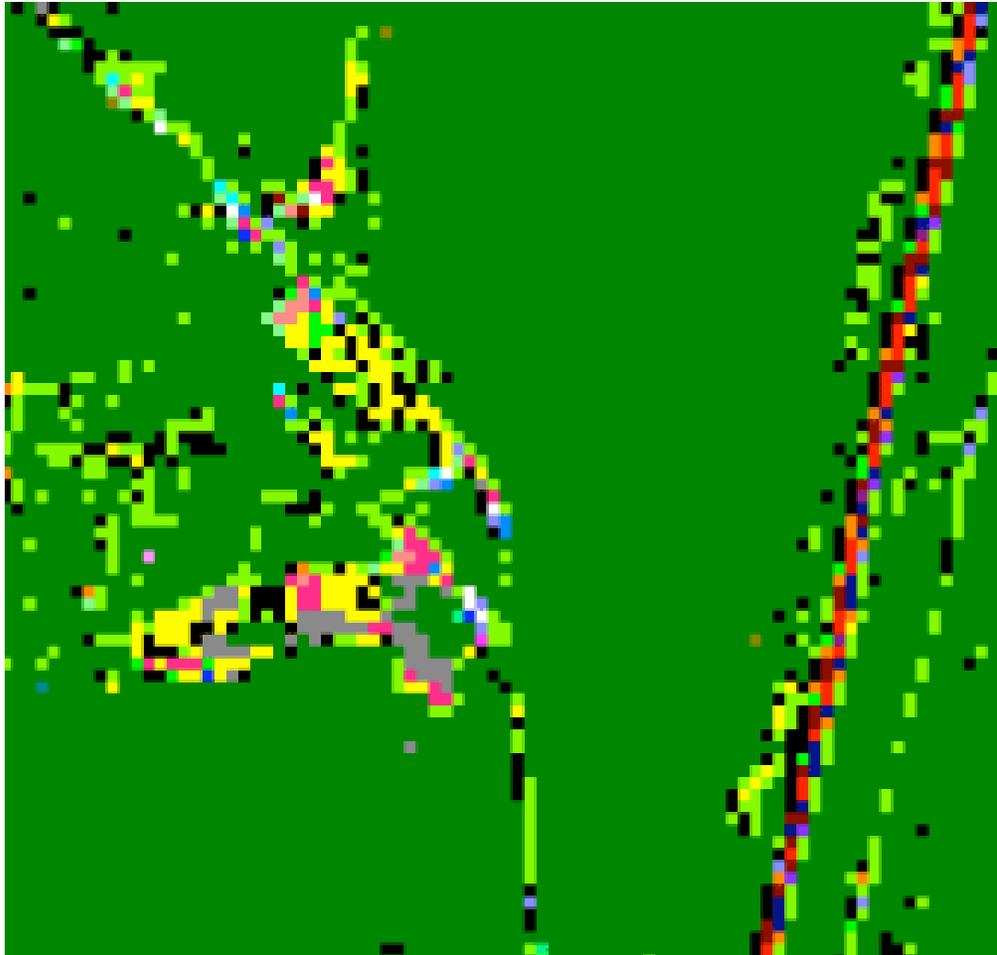
Zink 131. All Brown Clusters (members > 2)



49
Clusters



Zink Site 131



Production

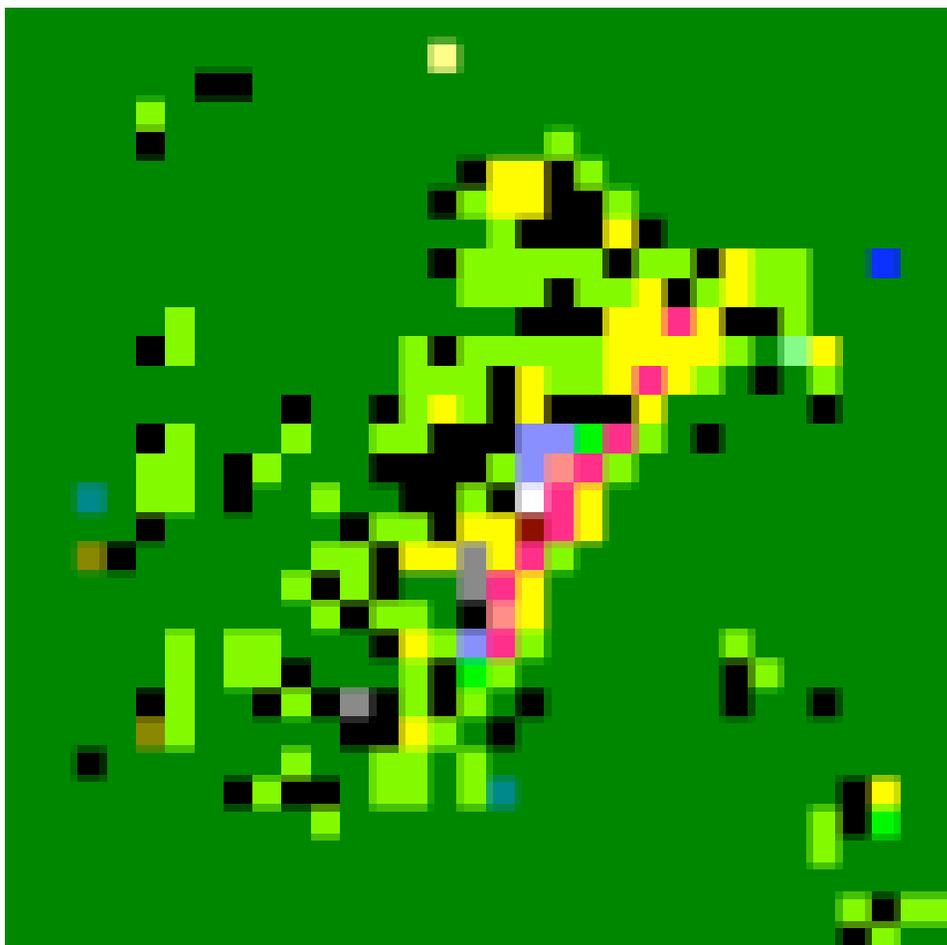
Road

**Production: Magenta,
Peach, Grey.**

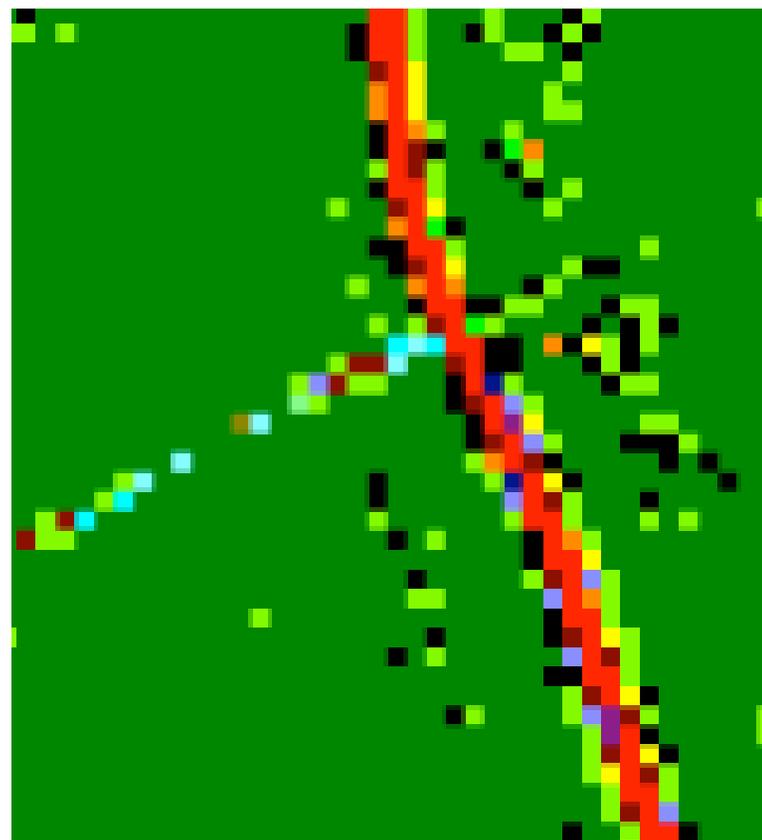
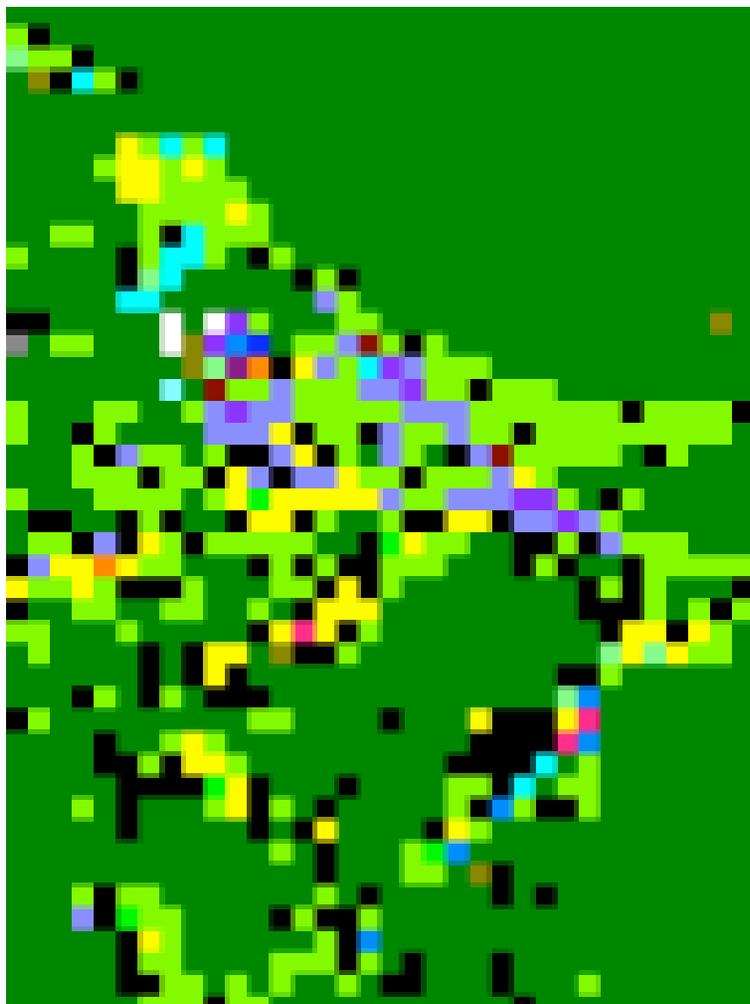
**Road: Brown, Red,
Orange, Blue.**

**Both: Green, Black,
Yellow.**

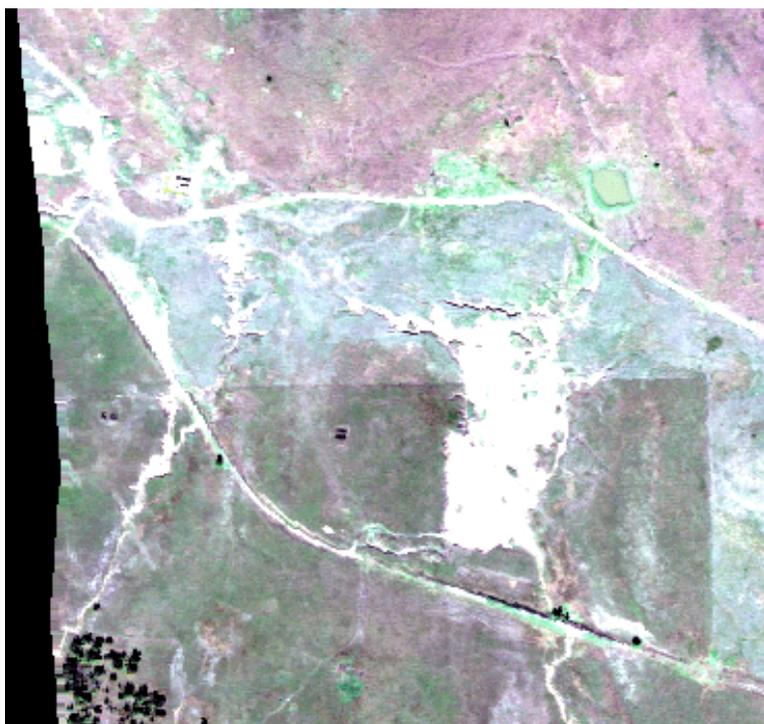
Zink Site 131



Zink Site 131

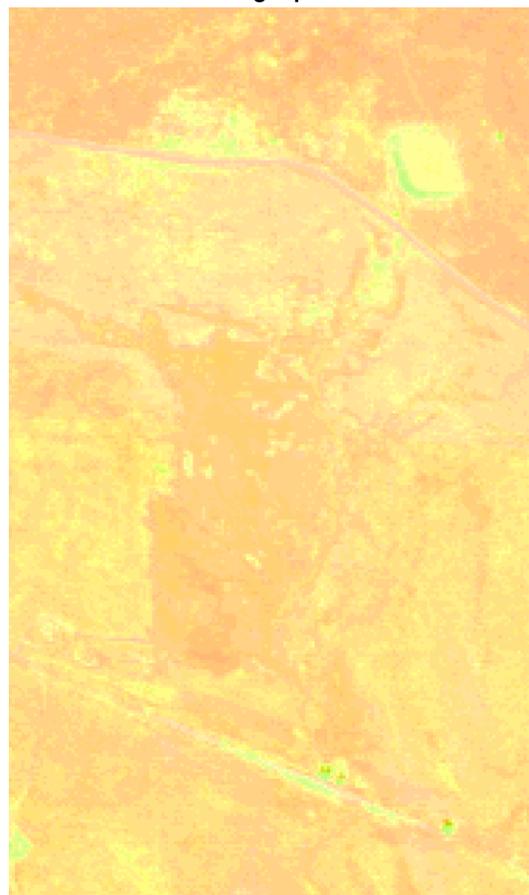


TGP Site 122



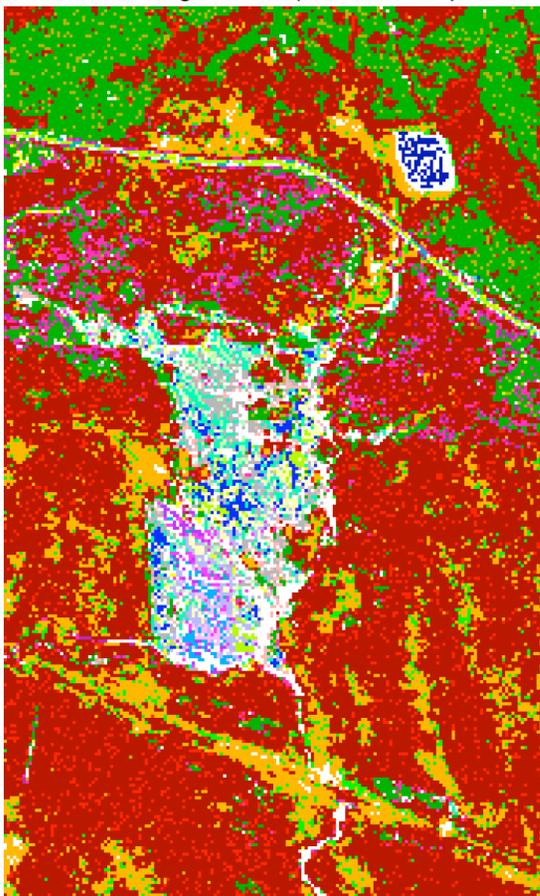
Site 122 & 120

TGP 122. RGB. Bright pixel.

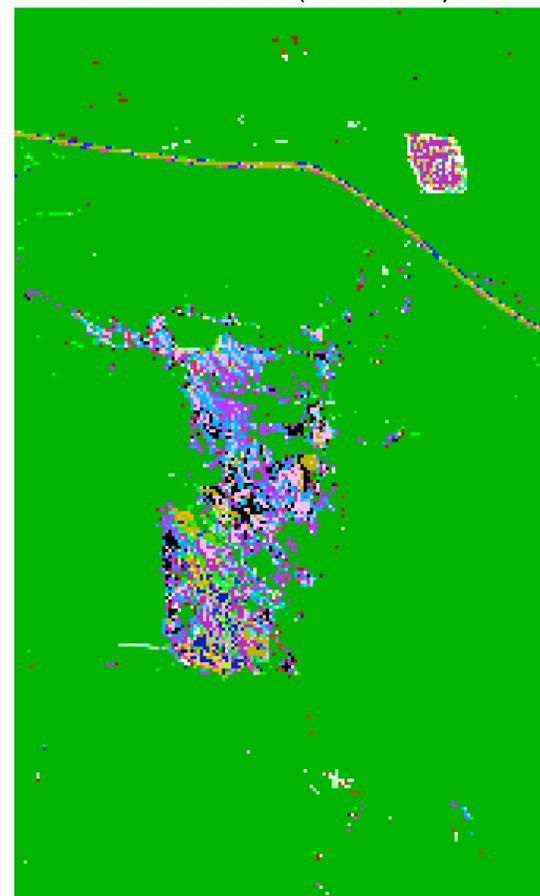


TGP Site 122

TGP 122. Big Clusters (members > 24)

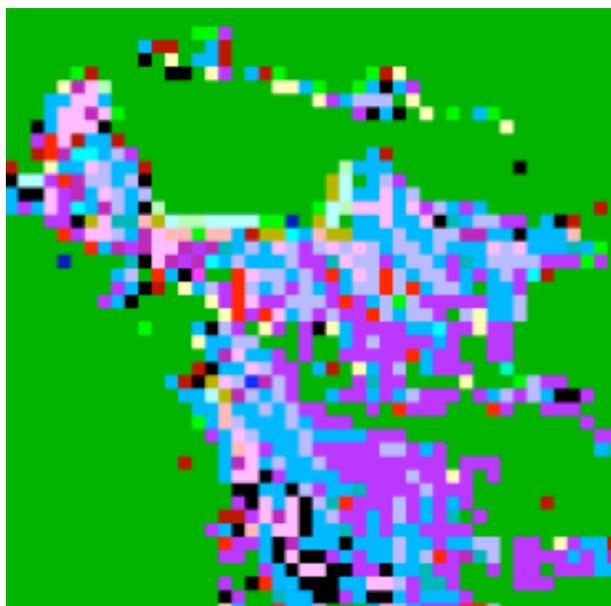
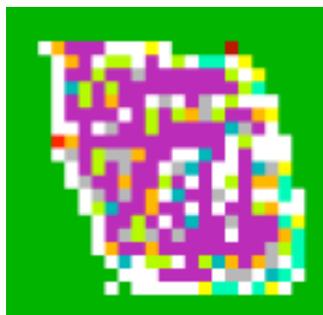


TGP 122. All Clusters (members > 2)



74 Clusters

TGP Site 122



Pond

Road

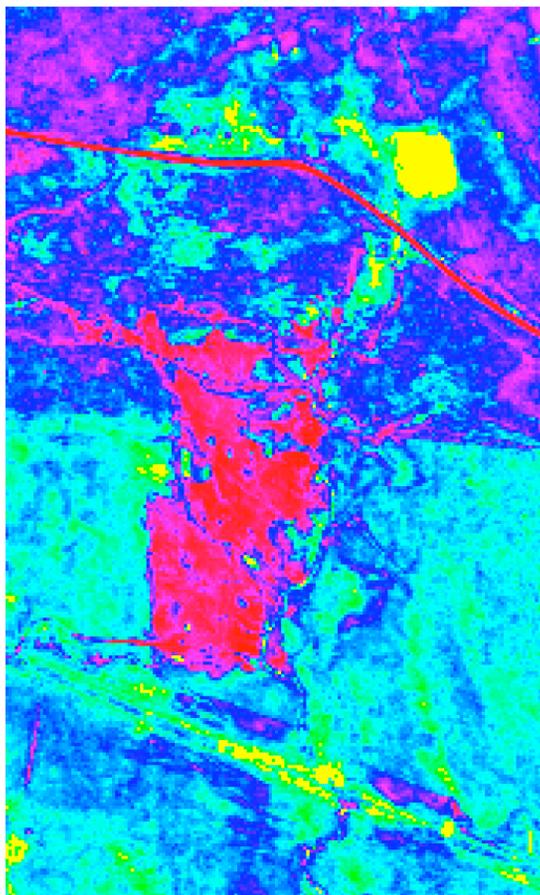
Scar NW

Scar SW



TGP Site 122

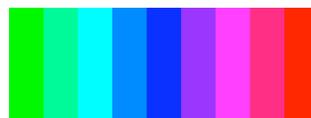
TGP 122. CC Row 12. Cut 0.40



CC Row 12

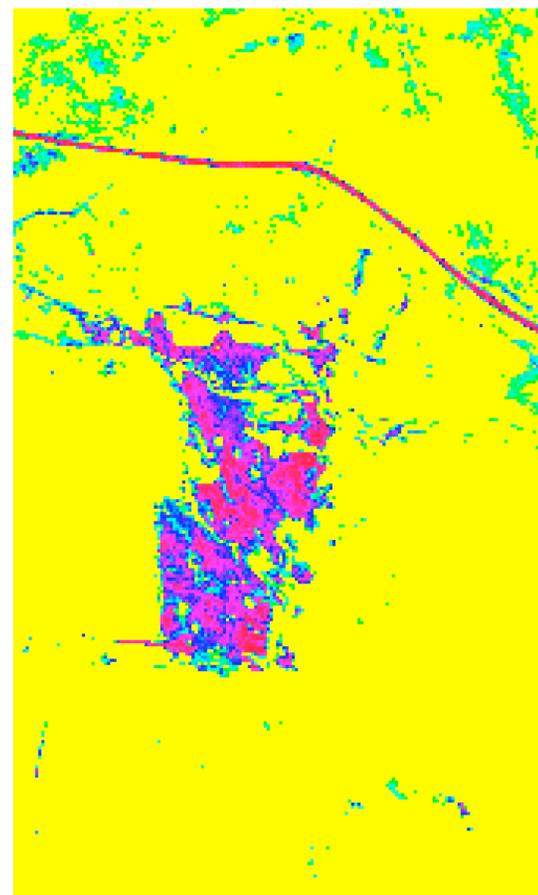
Cut 0.40

Cut 0.80

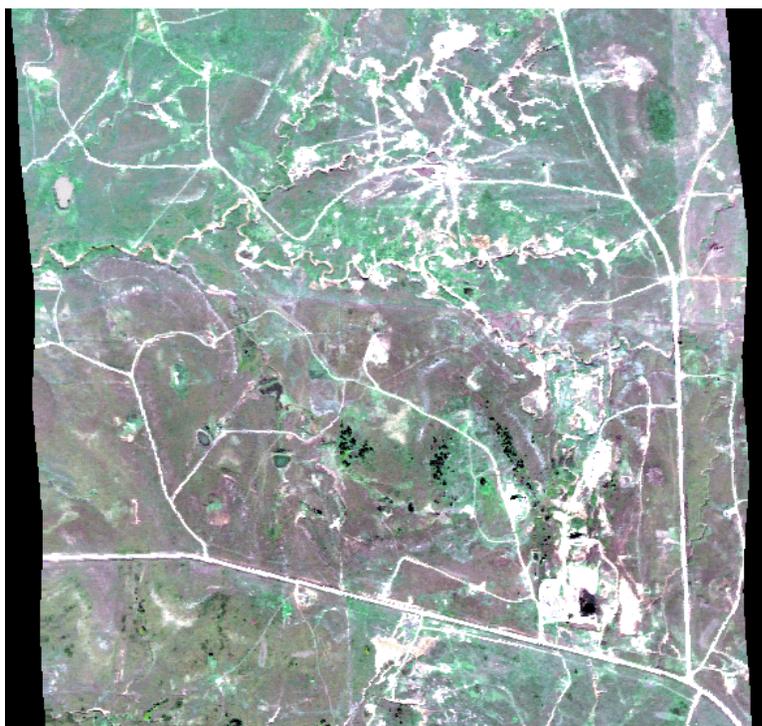


Color Scale

TGP 122. CC Row 12. Cut 0.80



Bluestem 134

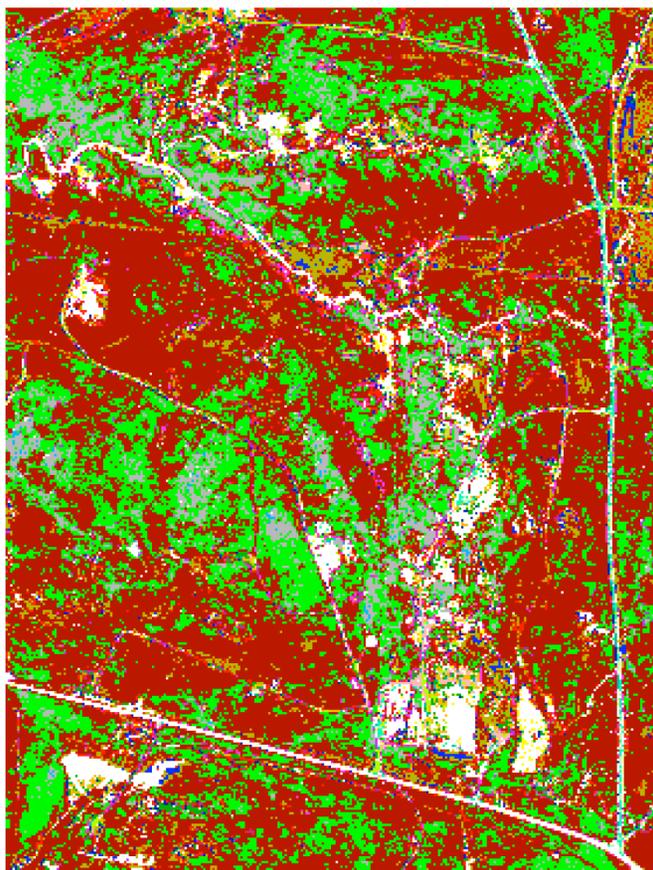


Bluestem 134. RGB. Bright pixel.



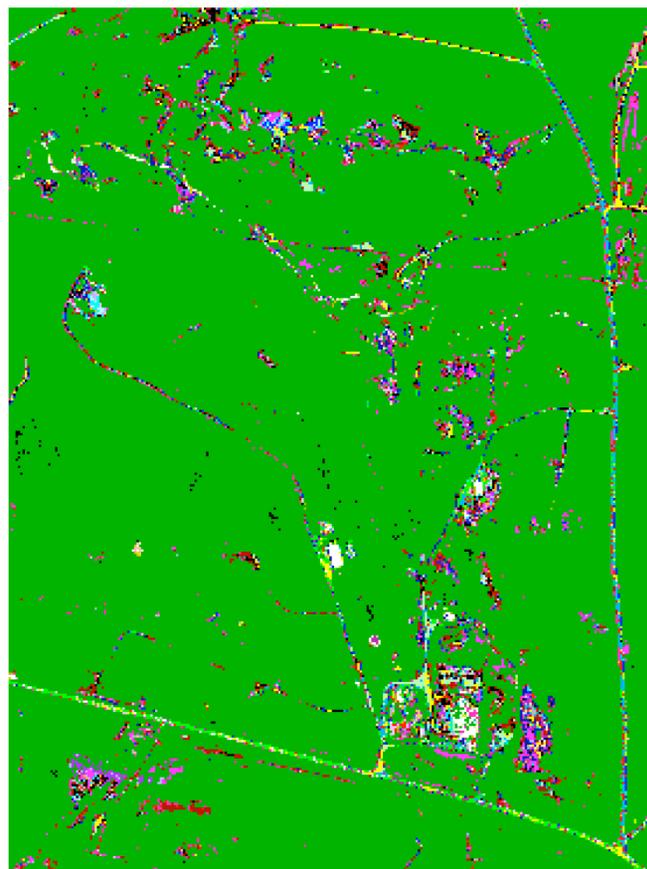
Bluestem 134

Bluestem 134. Big Clusters (members > 80)



**124
Clusters**

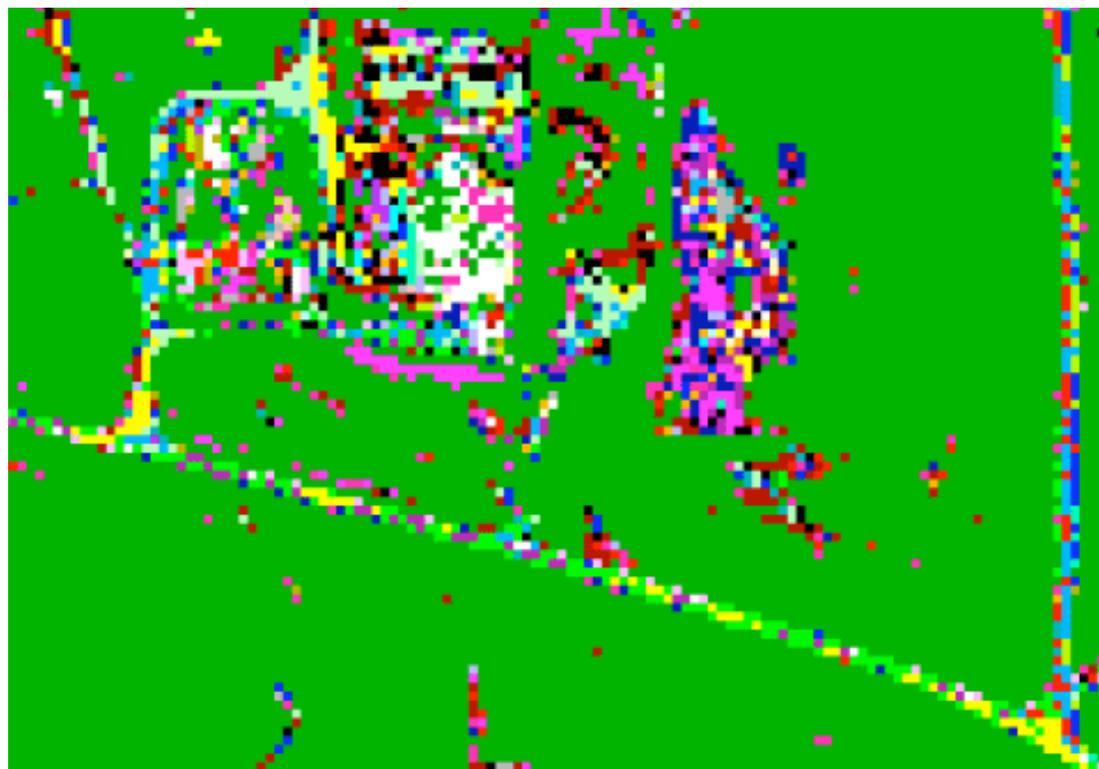
Bluestem 134. All Brown Clusters (members > 2)



BlueStem 134



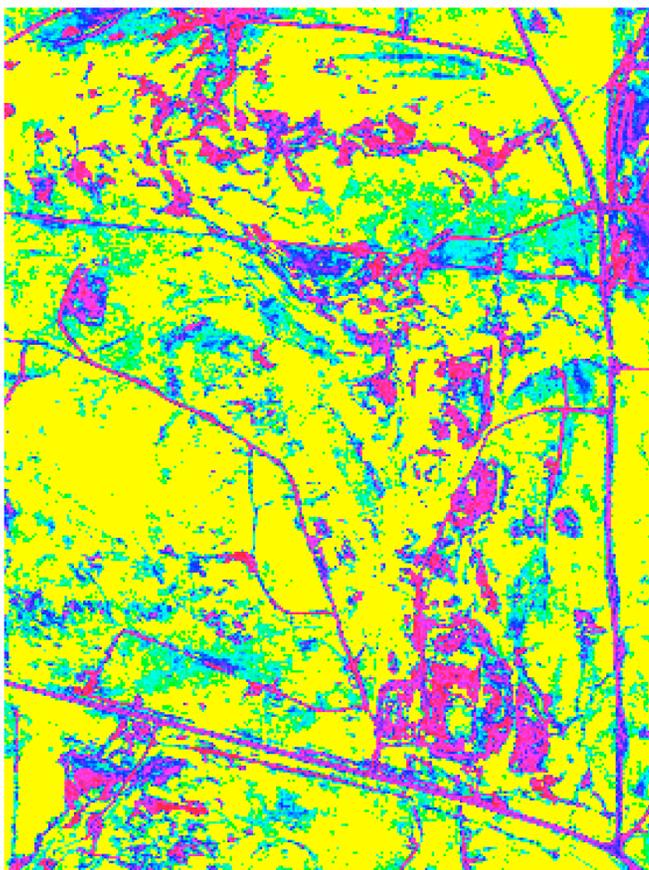
Site 133



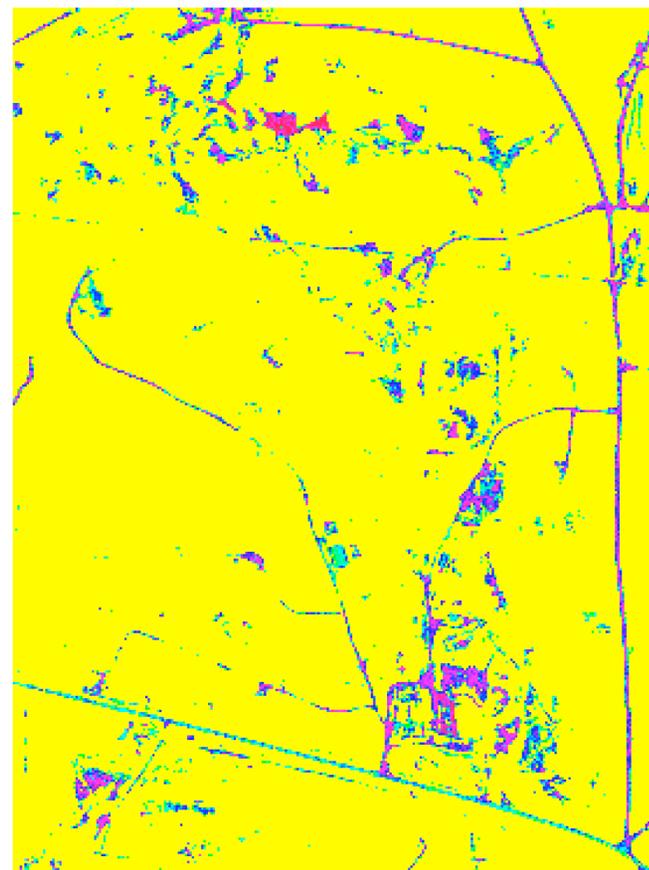
Site 134 Pit

Bluestem 134

Bluestem 134. CC Row 3. Cut 0.80



Bluestem 134. CC Row 30. Cut 0.80





Conclusions



- **Collected airborne hyperspectral imagery.**
- **Identified distinct groups of similar spectra.**
- **Prepared geobotanical maps.**
- **Can distinguish brine scars from roads.**
- **Next: Perform field validation.**