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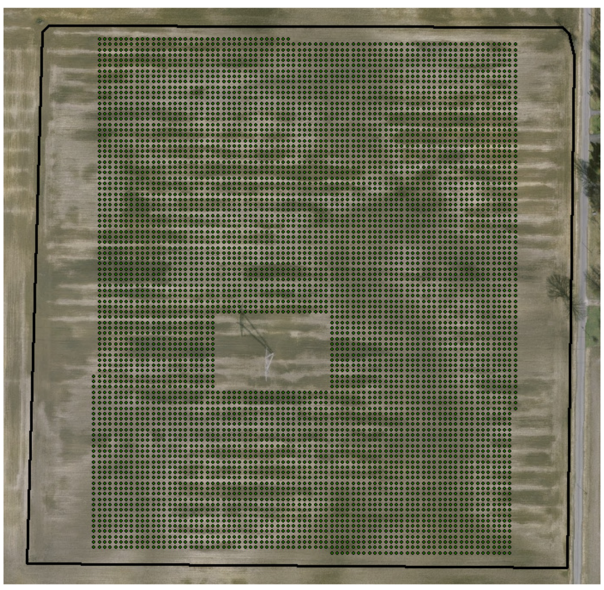
Example of Analysis of Yield or Landsat Data Based on Assessing the Consistently Lowest 20 Percent by Using Soil Darkness, Flow Accumulation, Convex Areas, and Sinks

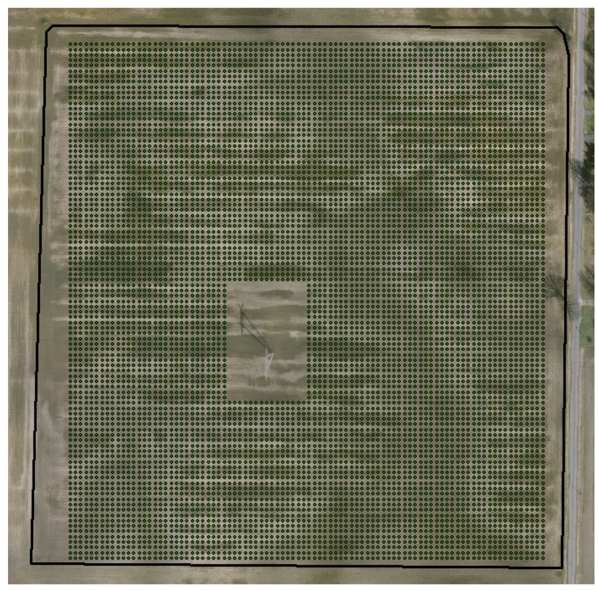
Two aspects to focus on when analyzing yield or Landsat maps (which can be used in place of yield maps to a similar accuracy and the resolution as shown in this website) are areas of higher and lower yield or Landsat values, and areas of high variability. The point of the analysis should be to determine if low production areas or areas with high variability can be explained by corresponding data (in this example, soil darkness, flow accumulation, curvature, and sinks will be assessed). If an analysis shows why low production areas perform the way they do, then a cost-benefit assessment for repairs can be made.

In the analysis, only the more reliably valid data should be used (although any data can be included if requested). For yield monitor data, if applicable, avoid using points from the headlands, the void adjacent to headlands, data at the end rows with start/end pass delay errors, and from areas where the combine had to steer around obstacles (such as the electrical installation shown below). For Landsat, exclude pixels that could be including surfaces from outside the extent of the field, shadows, or obstacles (the Landsat map in this example is interpolated to extent of pixel boundaries based on centroid values and predicted values at outside extent of pixels, which is an option).

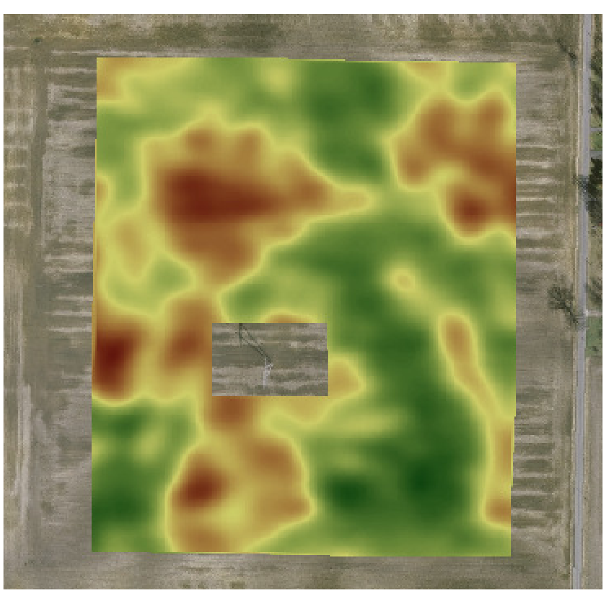
Clean yield monitor data to be used for analysis



Landsat data to be used for analysis



Next, maps of average yield or Landsat values for many seasons should be made based on normalized (to the mean, by the highest value, or whatever your preference is) data so values representing different crops can be averaged together.

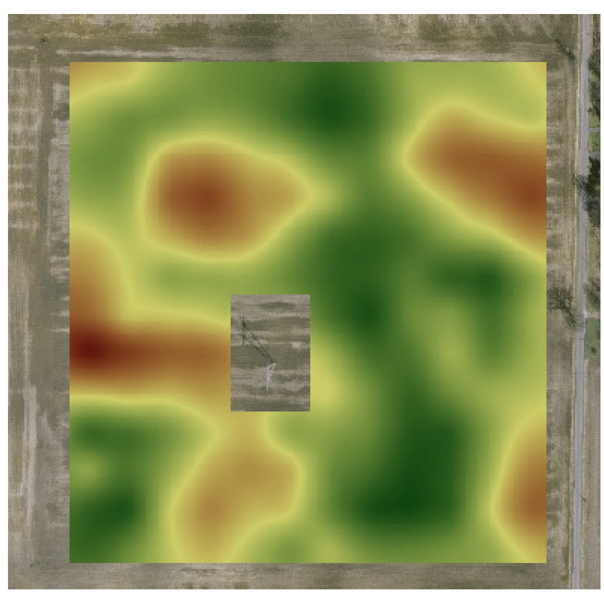


Average of clean yield maps for 2004 corn, 2005 soybeans, 2006 corn, and 2007 soybeans that were normalized to the maximum value (number show average percent of maximum yield).

97.61

60.15

↑
N

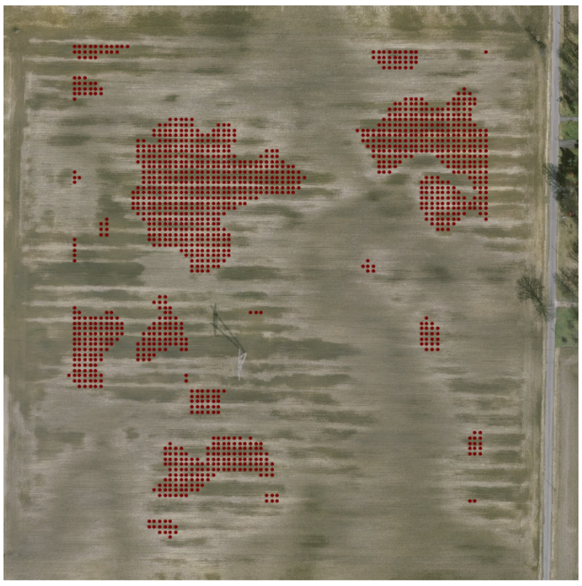


Average of corresponding Landsat values for 2005 soybeans, 2006 corn, and 2007 soybeans (there was no appropriate imagery for 2004 corn); normalized the same as yield maps to left.

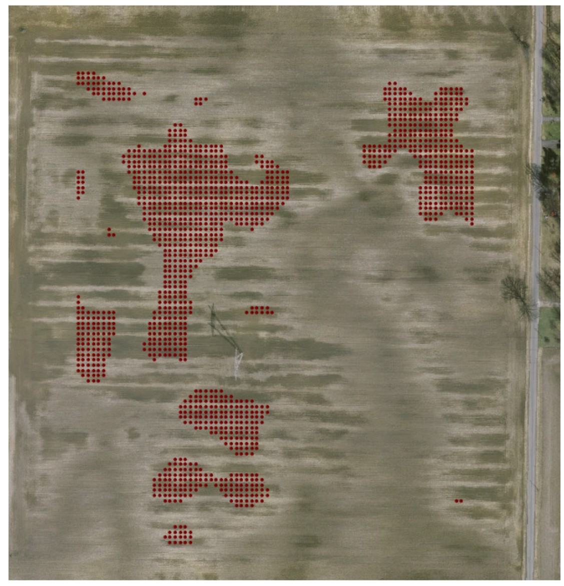
95.97

58.57

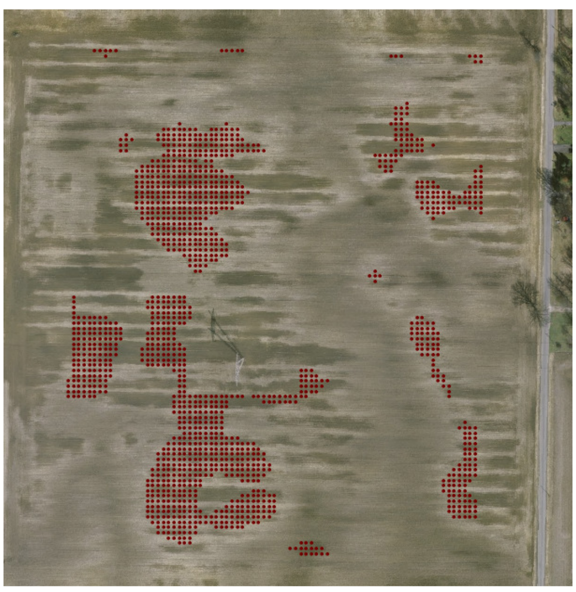
Another way to analyze yield or Landsat values is to map a particular lowest percent for multiple seasons and determine which points are always in the lower percentile group. In following example, this is applied to the yield maps; the lowest 20 percent of yield values is applied. As with the above maps, an answer should be sought as to why areas are consistently low.



2004 corn lowest 20 percent

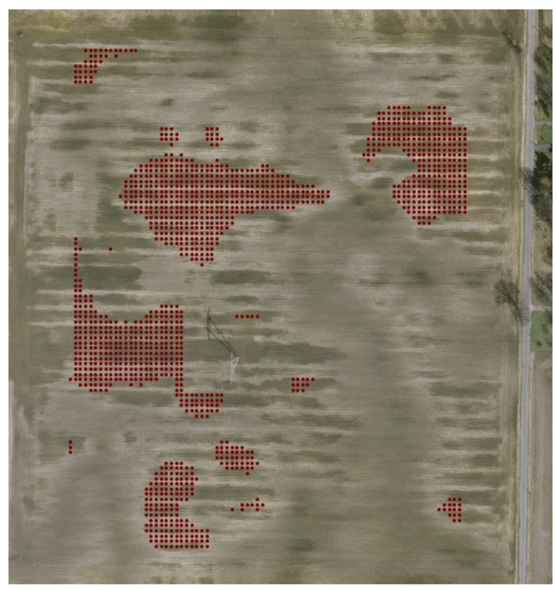


2005 soybeans lowest 20 percent

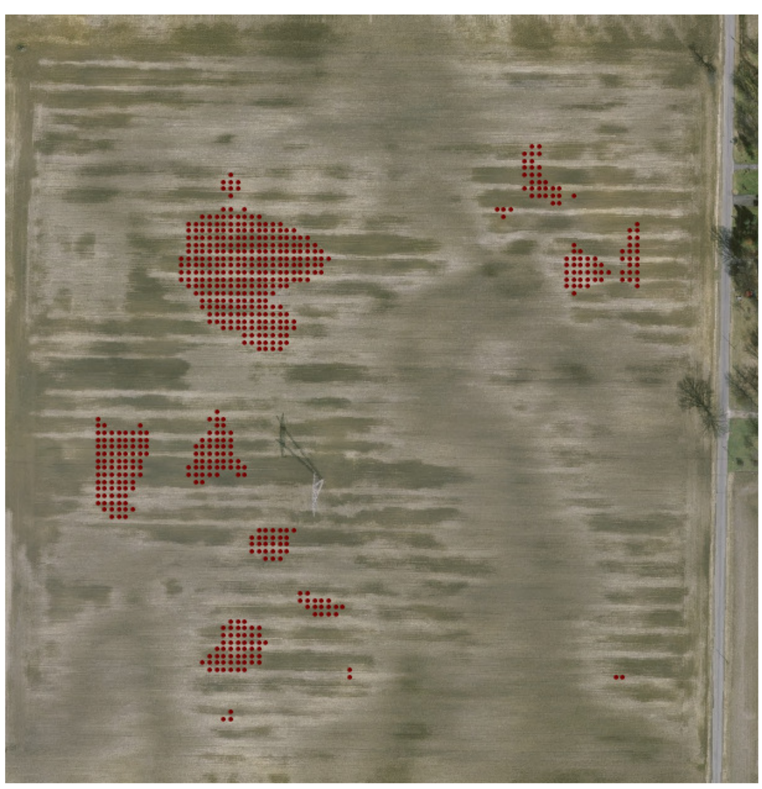


2006 corn lowest 20 percent

↑ N

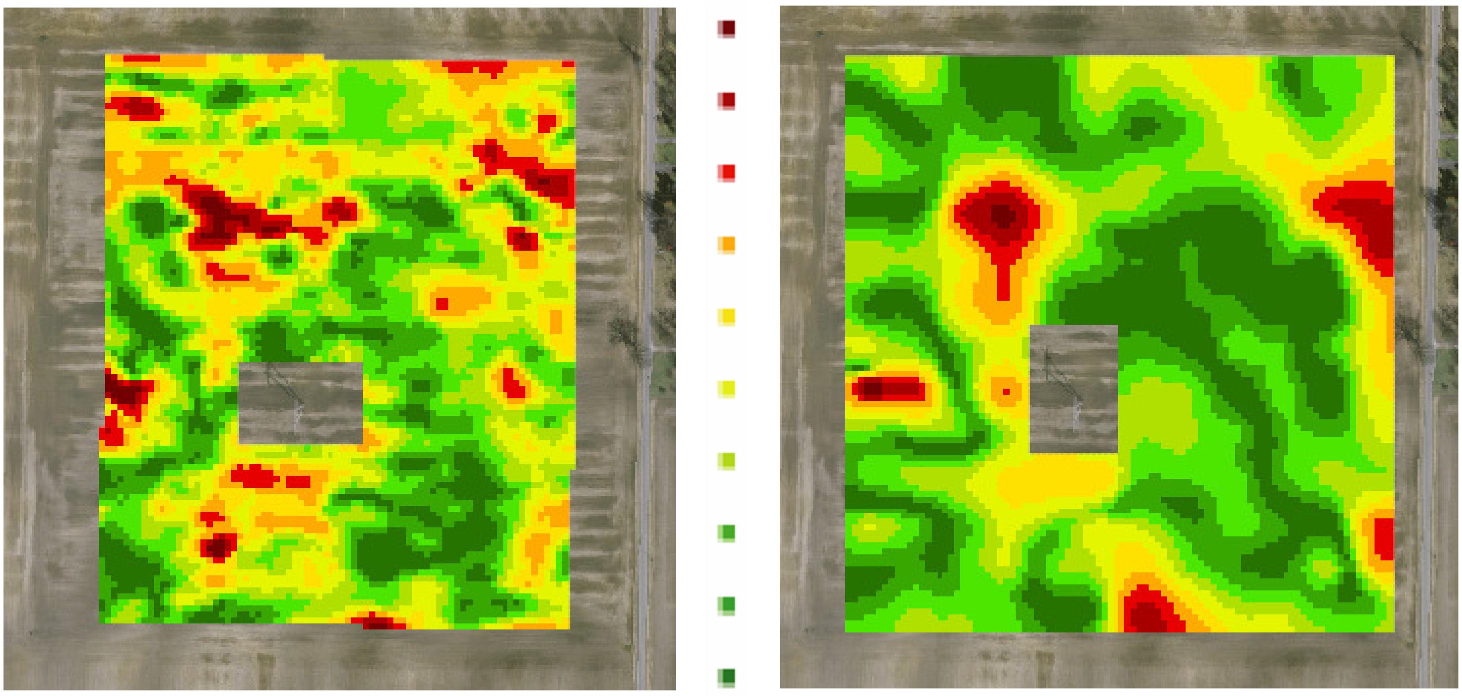


2007 soybeans lowest 20 percent



Lowest 20 percent of yield in common for 2004 corn, 2005 soybeans, 2006 corn, and 2007 soybeans.

Maps of variability are also important to produce. Below are maps of coefficient of variation (CV) ([standard deviation / mean] x 100; CV is variability as a percent of the mean [average]). A higher CV represents more variability or the years. Maps of solely standard deviation can also be produced.



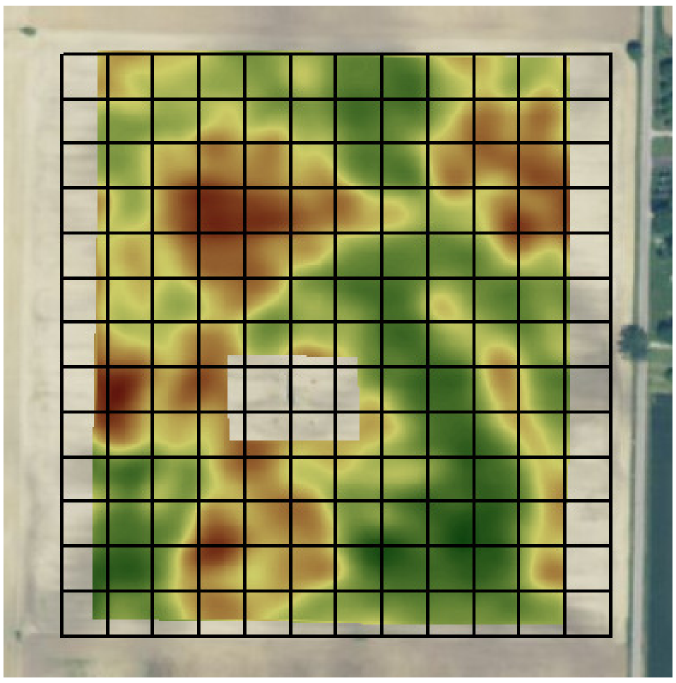
CV classified with natural breaks; darker red is higher, darker green is lower.

↑
N

Analysis and explanations for low yield and high variability

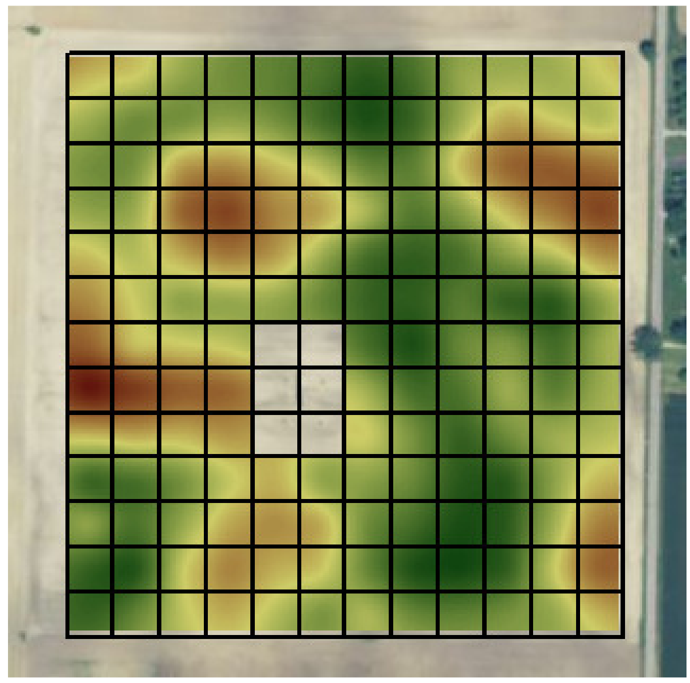
Once there are average yield or Landsat maps produced, variables can be assessed to see if there are logical reasons for low yielding areas or areas with high variability. For this example, the factors and order they will be analyzed are as follows: 1) higher and lower areas of average yield or Landsat values, 2) areas always in lowest 20 percent, and 3) explanation for high yield variability. **The analysis starts on the next page.**

Explanation for areas of lower and higher yield or Landsat value: soil darkness

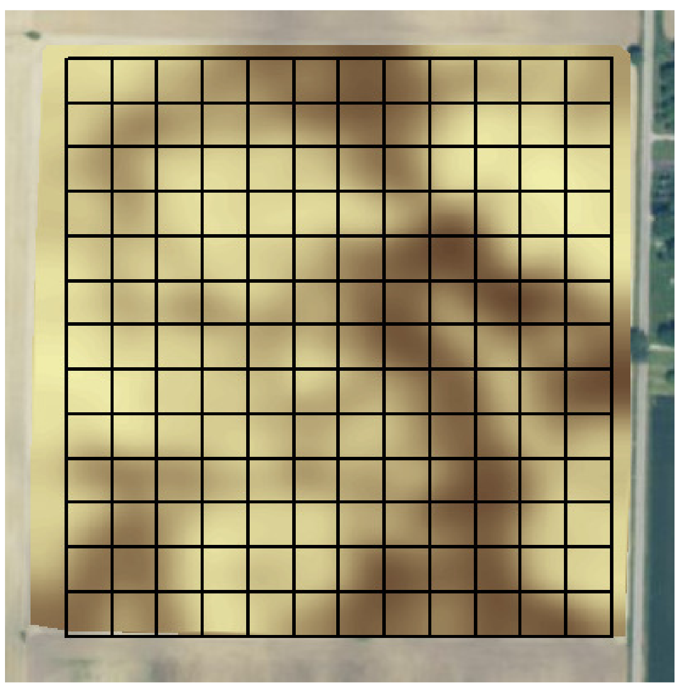


Average normalized yield map from above; darker green Is higher yield, yellow is middle of range, lower reddish is lower yield.

↑
N



Average normalized Landsat map from above; darker green Is higher yield, yellow is middle of range, lower reddish is lower yield.

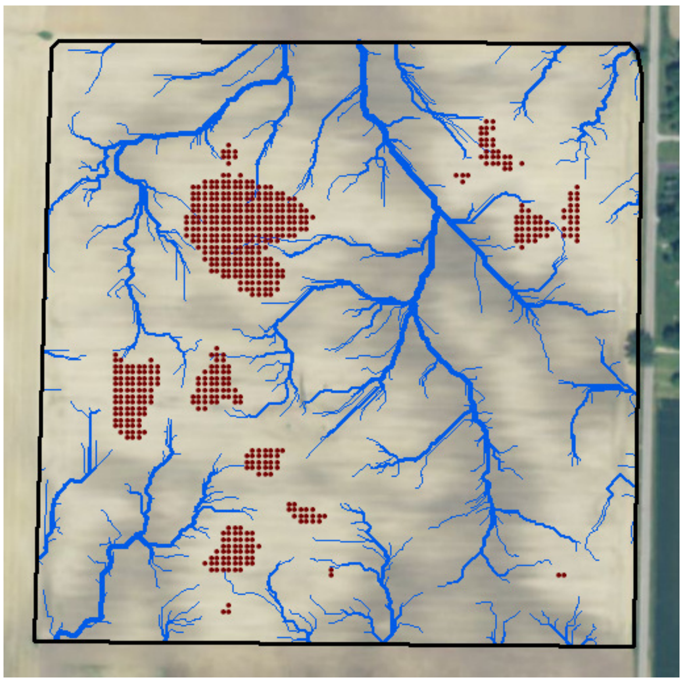


Soil darkness map produced as described in Imagery / yield prediction map section; pixel boundaries included for reference.

Conclusion

Based on comparing the soil darkness map to the yield and Landsat maps, it is apparent that much of the higher and lower values can be explained by soil darkness. Darker soil correlates to higher values as it should (ineffective drainage lessens the correlation). Publications that discuss or mention darker soil correlating with higher yield can be accessed in the *Soil darkness and correlation to yield* page of the Articles folder. Explanations for values always in the lowest 20 percent will be assessed next.

Explanations for yield points always in lowest 20th percentile:
soil darkness, flow accumulation, and curvature



The thicker the blue line, the more flow accumulation (from LiDAR-based elevation).

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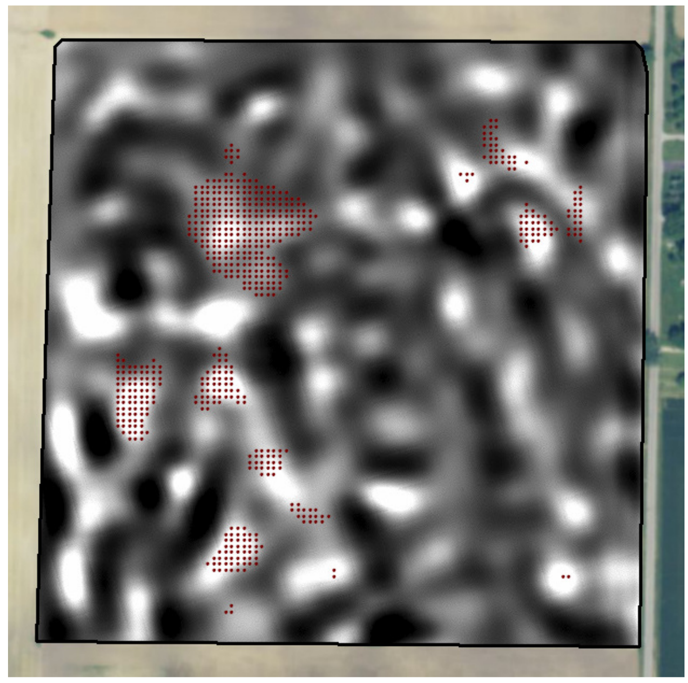


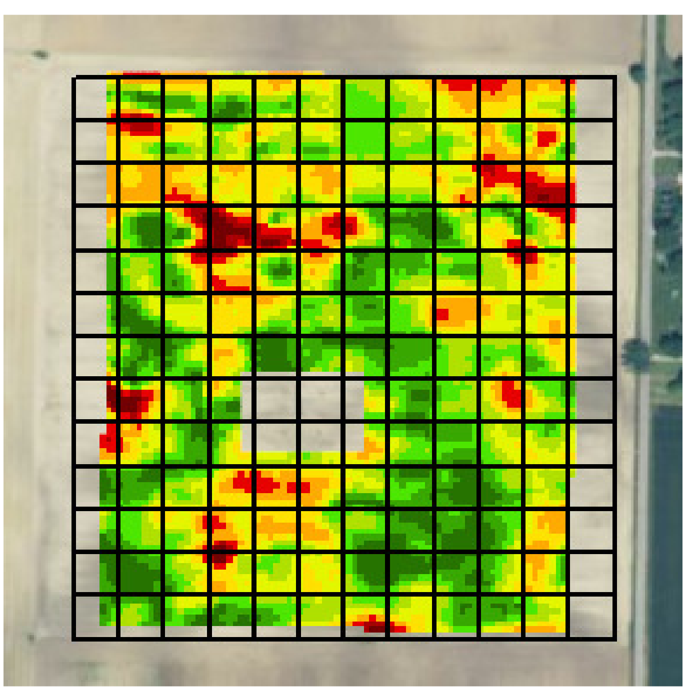
The lighter the shade, the more convex the curvature (from LiDAR-based elevation).

Conclusion

Yield points that are in the lowest twenty percent year after year can be explained reasonably well by soil darkness, flow accumulation, and curvature. The lowest points are in lighter soil, areas of low water flow, and are, overall, very much associated with relatively high convexity. Publications that discuss the correlation between convexity and yield can be accessed in the *Correlation between topography and yield* page of the Articles menu.

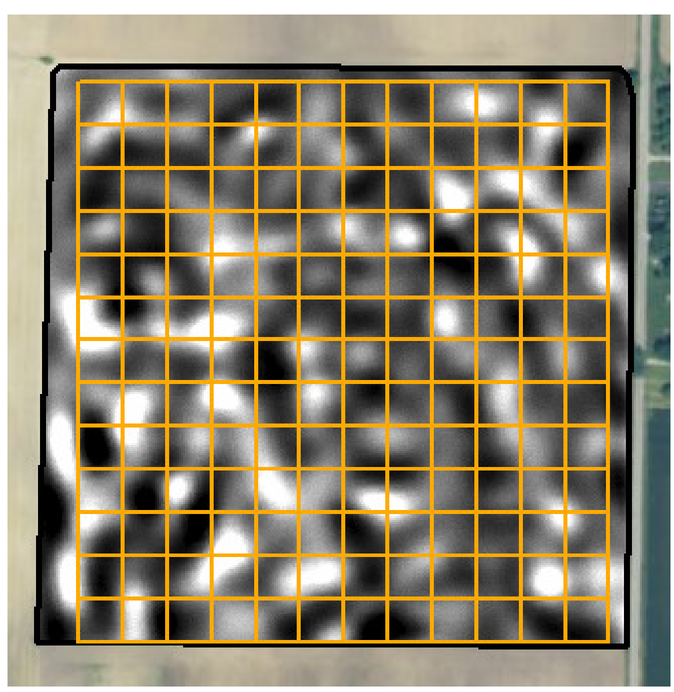
Explanations for high variability for yield data and Landsat data:
convex curvature and sinks

Yield data: convex curvature



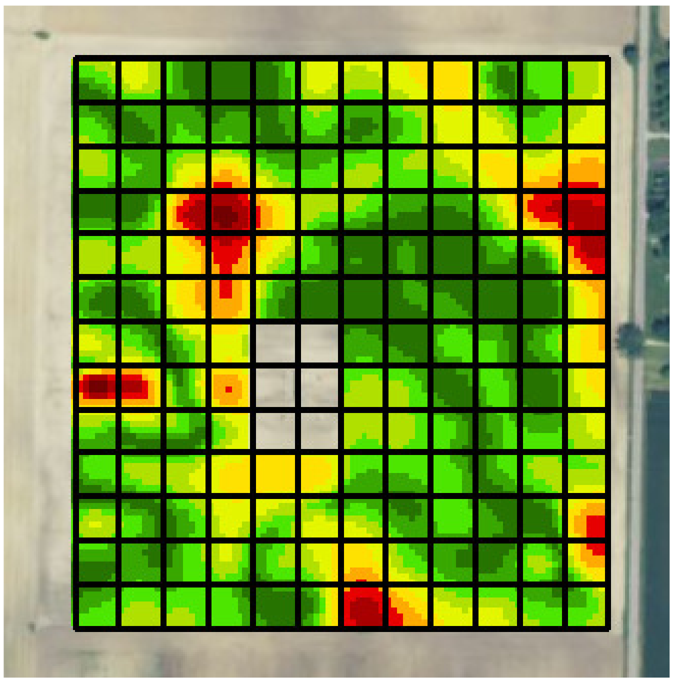
CV map with pixel boundaries for reference (darker red = more variable [higher CV], darker green = less variable [lower CV])

↑
N



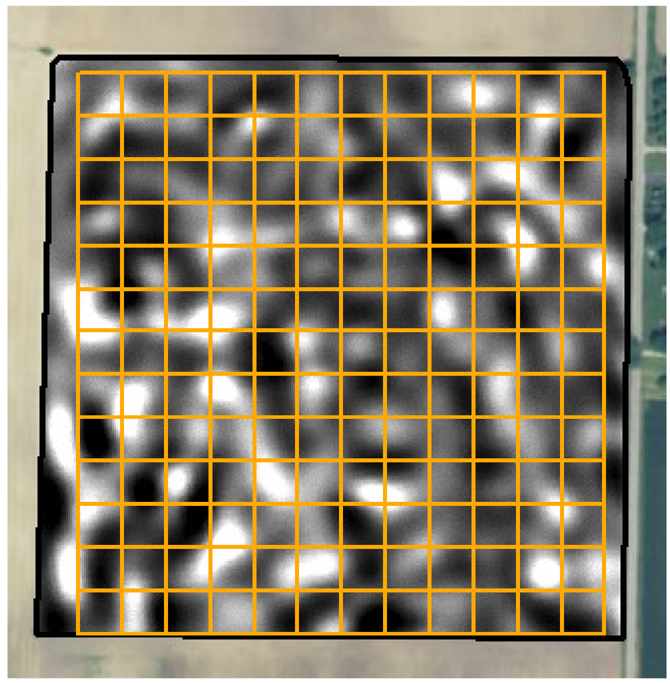
Curvature map with pixel boundaries for reference (lighter shades are more convex)

Landsat data: convex curvature



CV map with pixel boundaries for reference (darkest green = least variable, darkest red = most variable [lowest and highest CV, respectively])

↑ N

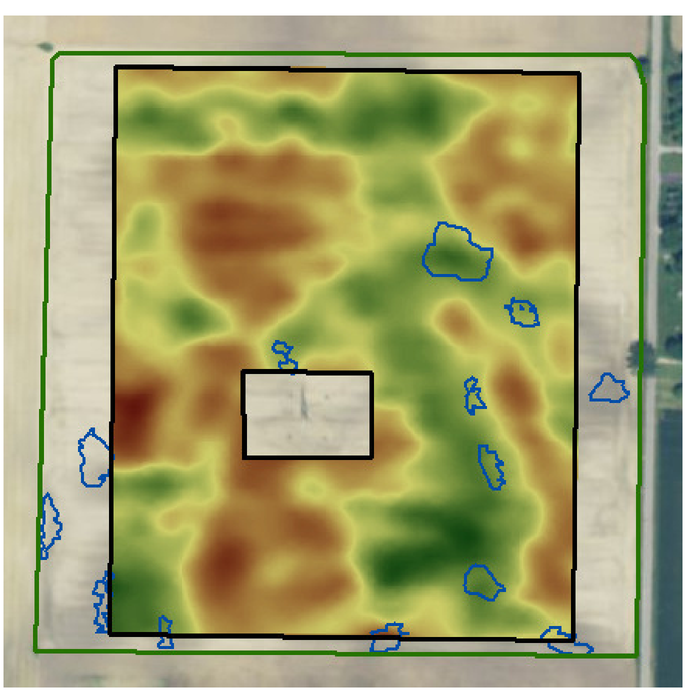


Curvature map with pixel boundaries for reference (lighter shades are more convex)

By using the pixel boundaries as reference, in many cases for both yield and Landsat data, the most variable areas are associated with relatively convex areas. This is logical because more convexity can cause more moisture variability; the areas can be more susceptible to lower yields in dryer seasons and can have yield improve relatively more than other areas in excessively wet seasons. The high variability area that is explained least by convexity is the area at the southern boundary.

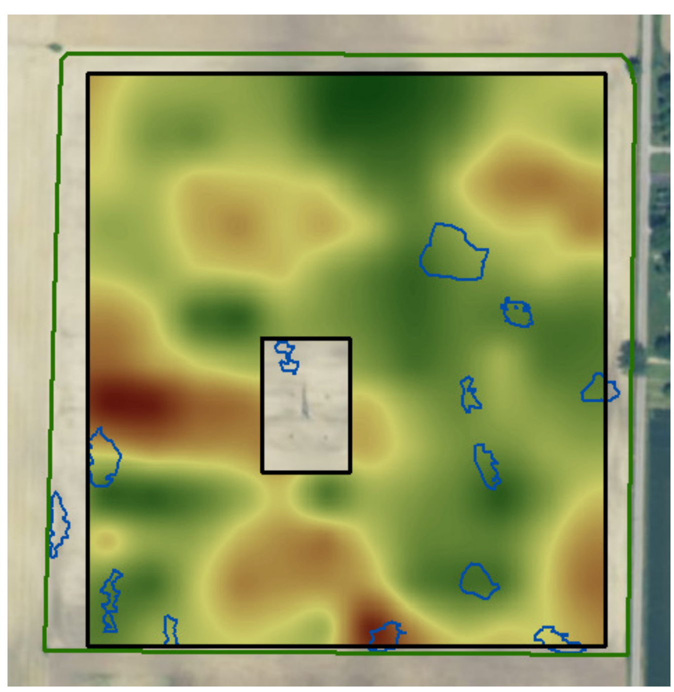
Yield and Landsat data:
sinks

Sinks (derived from LiDAR-based elevation) will be viewed to determine if they can explain the high variability area at the southern boundary. The yield and Landsat maps with sinks (blue lines) shown below correspond to the 2006 corn season which had heavy precipitation in June. There does not appear to be much of yield loss within and near the sink when viewing the average yield or Landsat maps above; but when viewing just the maps for the 2006 season below, it is apparent that there was less yield in that part of the field in 2006. The maps show that it is likely that the sink causes a loss of yield in a season with similar precipitation patterns to the 2006 season.



2006 corn yield; sink boundaries are blue lines, green line is field extent based on yield monitor data, black line is extent of clean yield monitor data used for analysis.

↑ N



2006 Landsat value; sinks boundaries are blue lines, green line is field extent based on yield monitor data, black line is extent of Landsat data used for analysis.

Final Conclusion

Overall, the analysis shows that the areas of higher and lower yield and yield variability can be explained by the spatial data shown here. The field performs well and needs no significant repairs. The only repair that might be cost-effective would be to remedy (drain or fill) the sink near the edge or the field. The sink is 279 square meters (0.07 acres) but appeared to affect an area larger than that during the 2006 season.