

Using Google Earth Imagery to Target Assessments of Ephemeral Gully Erosion

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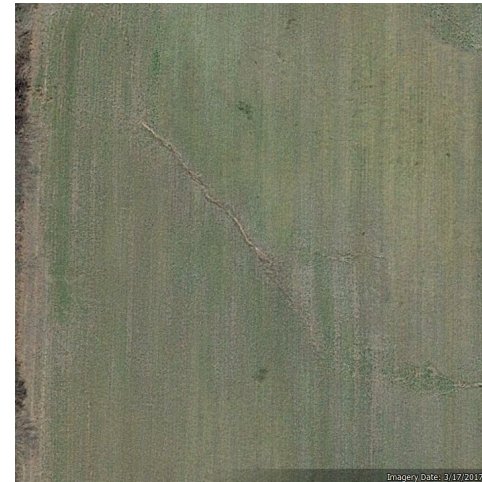
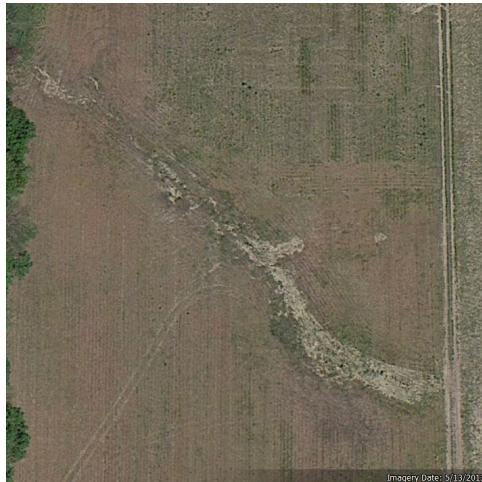
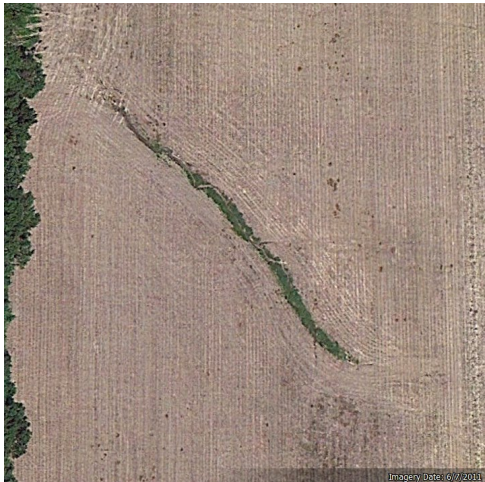
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Introduction

- Ephemeral gullies are a challenge / seem to be getting more attention
- Current practice: NRCS personnel visit fields with HEL to assess for compliance – a labor and resource intensive practice
- Google Earth offers a way of targeting assessments through historical imagery
- Several studies have used GE to delineate ephemeral gullies
- Accuracy of both the tool and the operator may be assumed
- Maignard et al. (2014) clearly demonstrated operator variability



Introduction

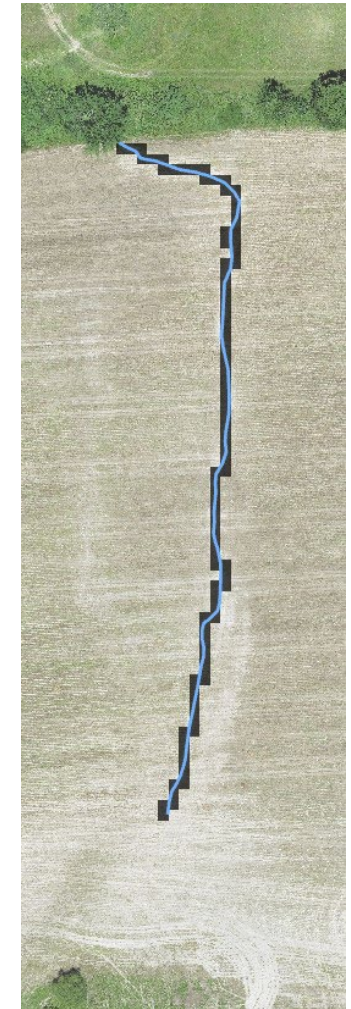
- We attempted to limit operator bias or error and also tested GE, in conjunction with other publicly available imagery, against our ground truth in two ways:
 1. **The degree of overlap for one random line (Analysis One)**
 2. **The rate of success or failure for all lines in the field (Analysis Two)**



Materials and Methods

Ground Truth

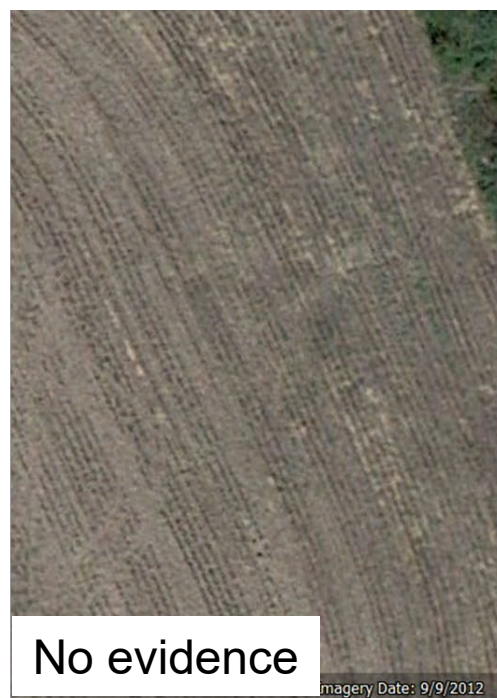
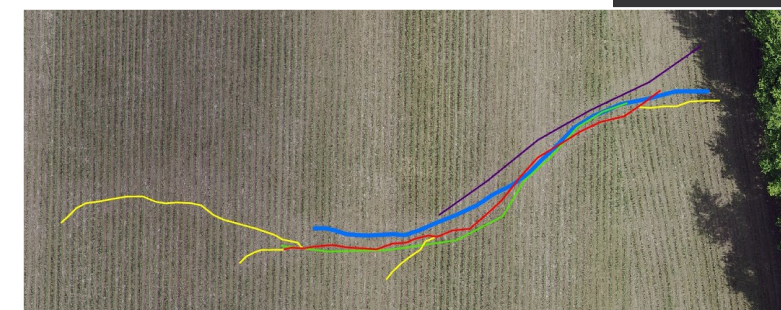
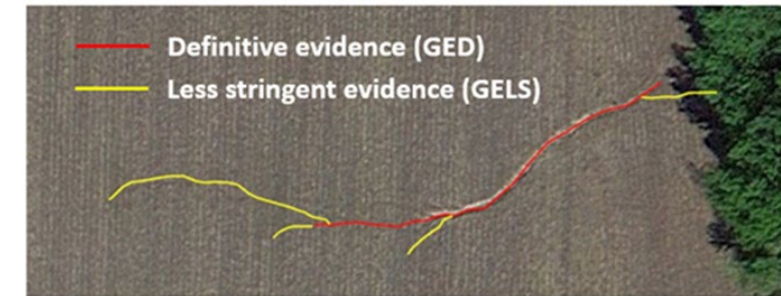
- 72 central Missouri fields with HEL were visited in the spring seasons of 2018-2020
- Imagery collected with UAV at 75-100m AGL (2.1 and 2.7 cm GSD)
- 24 fields selected with evidence of ephemeral gully erosion
- All lines were digitized using strict criteria (clear cutting of soil across cropping patterns, visible soil movement, etc.)
- One random line was converted to a 2m x 2m raster for overlap analysis



Materials and Methods

Gully Delineation for Public Imagery

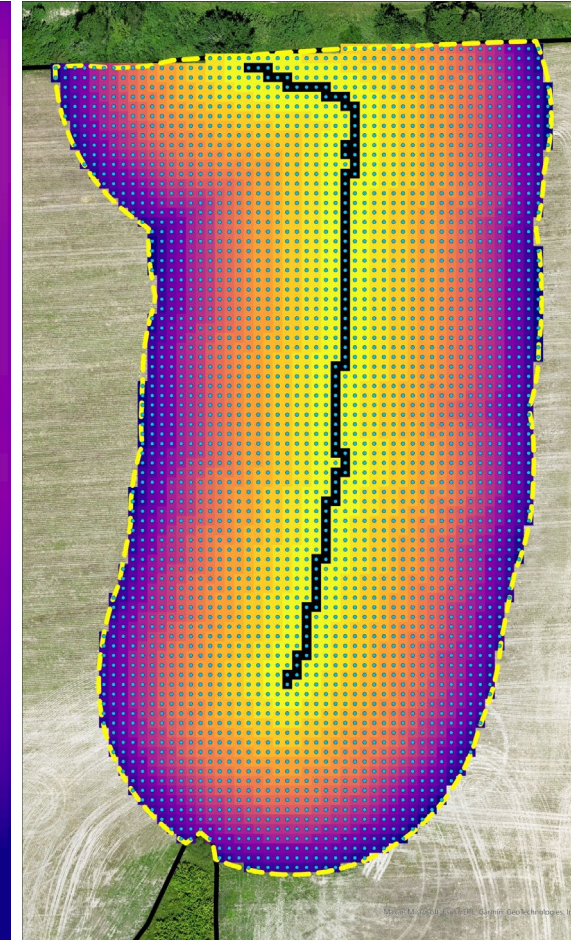
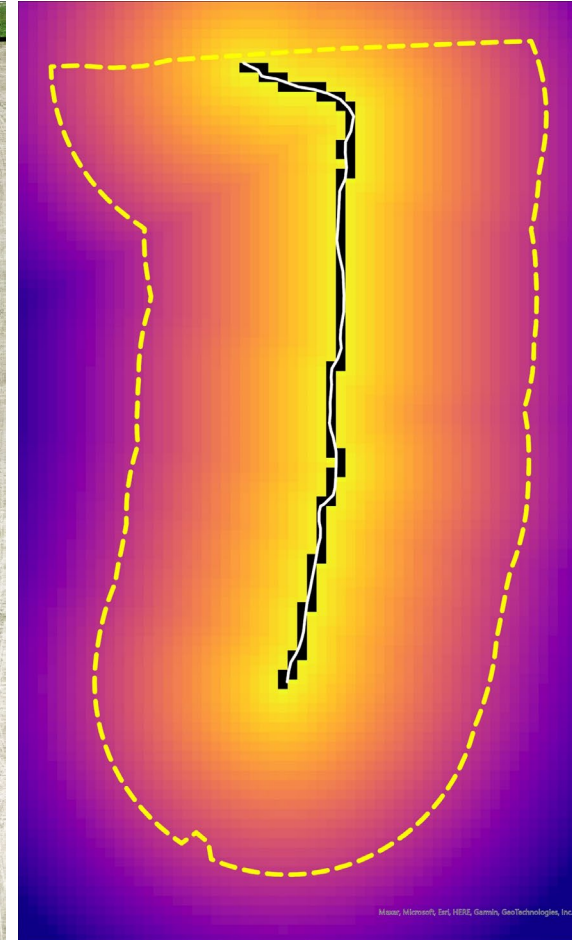
- GE images classified back to 2010 at all locations
- Two criteria levels were used for GE lines: 'definitive' and 'less stringent' after image assessment
- Images were combined to delineate maximum extent
- Less stringent criteria also used for other publicly available sources (MSDIS, 2008 and 2015)
- Result was five sets of line data: GT, GED, GELS, M08, and M15
- Reviewed for QC



Materials and Methods

Analysis One

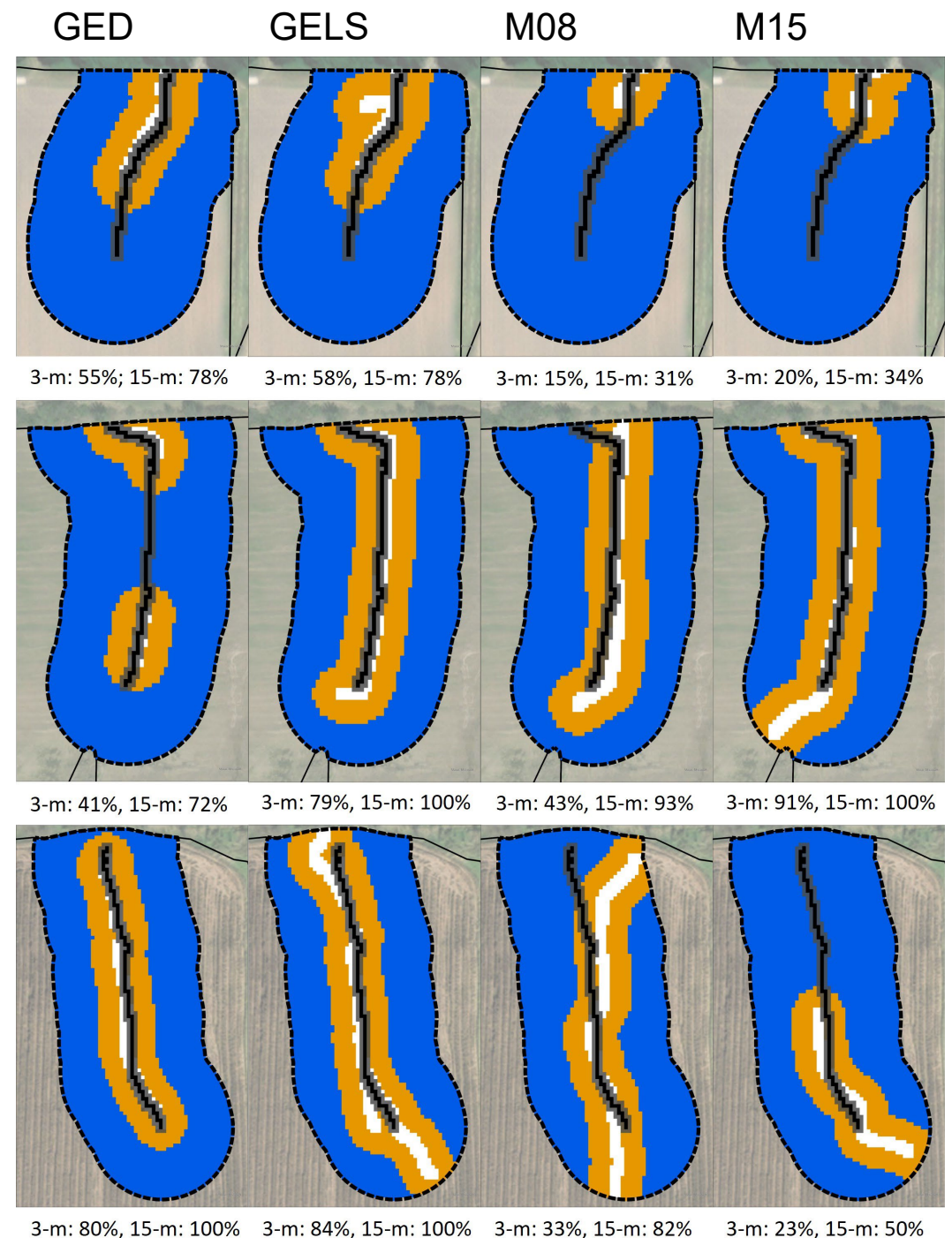
- What is the degree of overlap between the publicly available imagery and the ground truth?
- In Arc GIS, we:
 1. Followed same process as ground truth (shown here)
 2. Converted closest line within the GT ROI, from each set of lines, to a 2m x 2m raster
 3. Created Euclidean distance rasters with 2m x 2m pixels aligned to the same grid
 4. Clipped within 40m AOI just to limit range
 5. Converted pixel centroids to points with distance values
 6. Extracted all point data to Excel



Materials and Methods

Analysis One

- Shown here is a visualization
- In SAS, we then:
 1. Used two 'buffers' to test the overlaps:
 - a) one pixel (~3m diagonally) to account for ortho differences
 - b) seven pixels (~15m diagonally) to account for sightlines if scouting or flying a targeted location
 2. Calculated the percentage of the 3m GT pixels that overlapped the buffers
 3. Also created two combos of data: MSD and ALL



Results: Analysis One

ID	GED		GELS		M08		M15		MSD		ALL	
	3m	15m	3m	15m	3m	15m	3m	15m	3m	15m	3m	15m
	Buffer Overlap Percent (%)											
1	91	100	95	100	82	100	80	100	88	100	98	100
2	0	0	85	100	74	100	73	100	83	100	92	100
3	55	78	58	78	15	31	20	34	21	34	59	78
4	37	66	57	79	58	94	53	80	63	94	70	94
5	0	0	0	0	43	74	0	0	43	74	43	74
6	78	100	81	100	59	85	54	89	75	99	92	100
7	45	63	69	98	49	75	53	75	66	86	82	98
8	81	100	82	100	21	62	0	0	21	62	87	100
9	48	71	52	73	0	0	66	84	66	84	73	84
10	55	100	55	100	25	72	56	100	58	100	58	100
11	0	0	33	60	4	7	0	0	4	7	34	60
12	41	72	79	100	43	93	91	100	93	100	95	100
13	91	100	95	100	80	98	80	100	88	100	98	100
14	69	100	77	100	67	100	81	100	82	100	83	100
15	15	43	87	100	0	0	32	66	32	66	87	100
16	55	83	62	91	27	49	26	50	33	52	70	92
17	0	0	49	74	57	94	40	59	70	94	75	94
18	0	0	0	0	0	0	0	0	0	0	0	0
19	80	100	84	100	33	82	23	50	40	82	89	100
20	91	100	91	100	62	89	84	100	93	100	98	100
21	87	100	89	100	79	100	98	100	100	100	100	100
22	86	100	91	100	41	95	72	100	81	100	95	100
23	61	100	71	100	24	77	58	100	60	100	74	100
24	86	100	86	100	39	48	82	99	87	99	89	100
Mean	52	70	68	86	41	68	51	70	60	81	77	91
Zeros	21	21	8	8	13	13	17	17	4	4	4	4

- Table shows overlap percentages
- Most zeroes were using definitive criteria in Google Earth
- Least were in GELS, or the combos
- Worst average was with MSDIS 2008
- Best average was GELS or ALL for both buffers
- Most overlap with 15m buffer
- Only one zero on all types, which was small GT line and showed no evidence in public imagery
- 15 of 24 were 100% in ALL combo, 19 over 90%, lowest was 60%

Materials and Methods

Analysis Two

- What is the success or failure rate for the publicly available imagery intersecting within 15m of the ground truth across the whole field?



GED lines



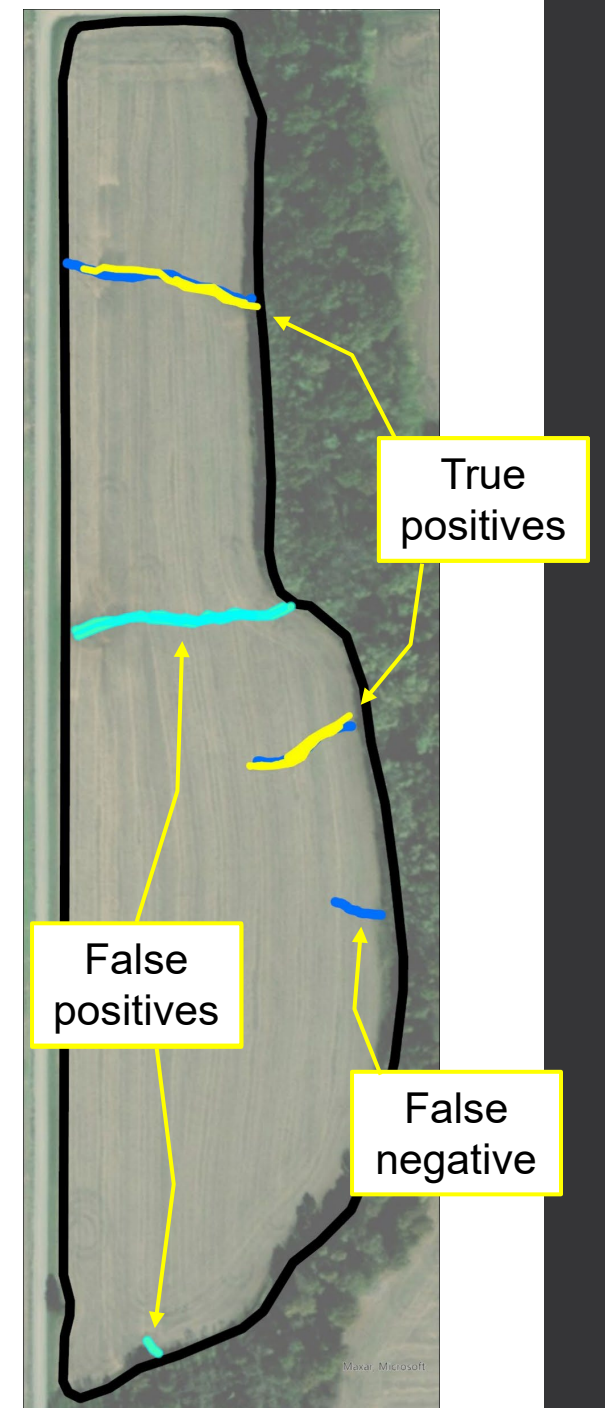
GELS lines



M08 lines



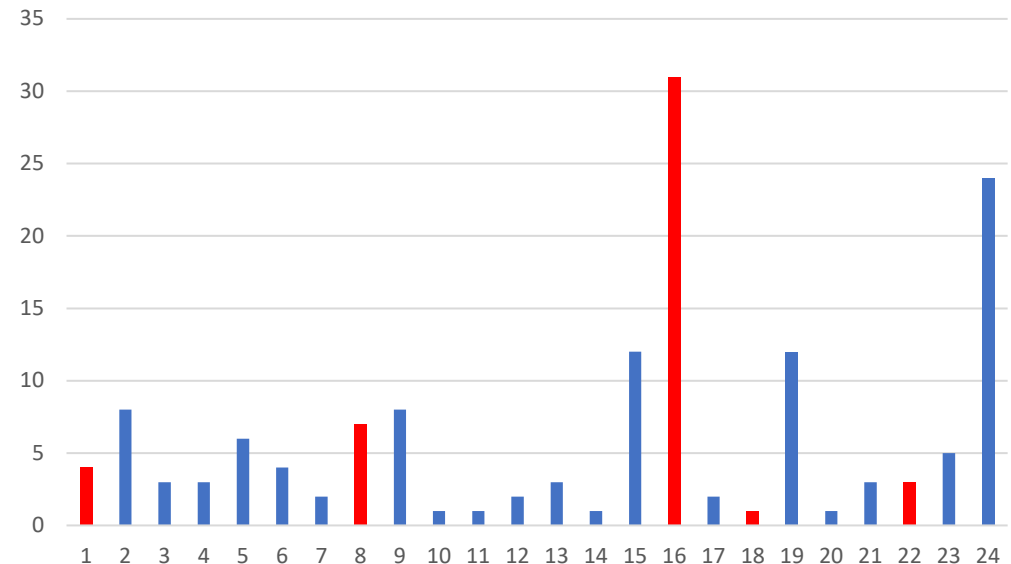
M15 lines



Results: Analysis Two

ID	GT		GELS		ALL		
	Line count	Line count	True Positives	False Positives	Line count	True Positives	False Positives
1	4	2	50	0	3	75	0
2	8	10	100	20	10	100	20
3	3	3	100	0	3	100	0
4	3	3	100	0	3	100	0
5	6	1	17	0	9	100	33
6	4	4	100	0	5	100	20
7	2	4	100	50	5	100	60
8	7	2	14	50	4	43	25
9	8	8	100	0	8	100	0
10	1	3	100	67	3	100	67
11	1	1	100	0	1	100	0
15	2	3	100	33	4	100	50
16	3	2	67	0	4	100	25
14	1	1	100	0	3	100	67
15	12	12	100	0	12	100	0
16	31	21	68	0	23	71	4
17	2	2	100	0	2	100	0
18	1	0	0	0	0	0	0
19	12	16	67	50	20	92	45
20	1	2	100	50	2	100	50
21	3	3	100	0	5	100	40
22	3	3	67	33	4	67	50
23	5	6	100	17	11	100	55
24	24	22	92	0	23	96	0
Count	147	134	-	-	167	-	-
Mean	6.1	5.6	81	15	7.0	89	25

- Table shows counts for GT, GELS, and ALL, and true and false positives
- False negatives would be the inverse value of the true positives
- Adding the MSDIS imagery raised *both* the true and false positive rate
- Sites 5 and 8 are examples of MSDIS imagery being important, though to varying degrees of success
- The same zero in site 18 with only one small line in GT, no false positives either
- GELS hit all the lines in 15 of the 24 sites, while ALL was 100% in 17 over 90% at 19



Conclusions

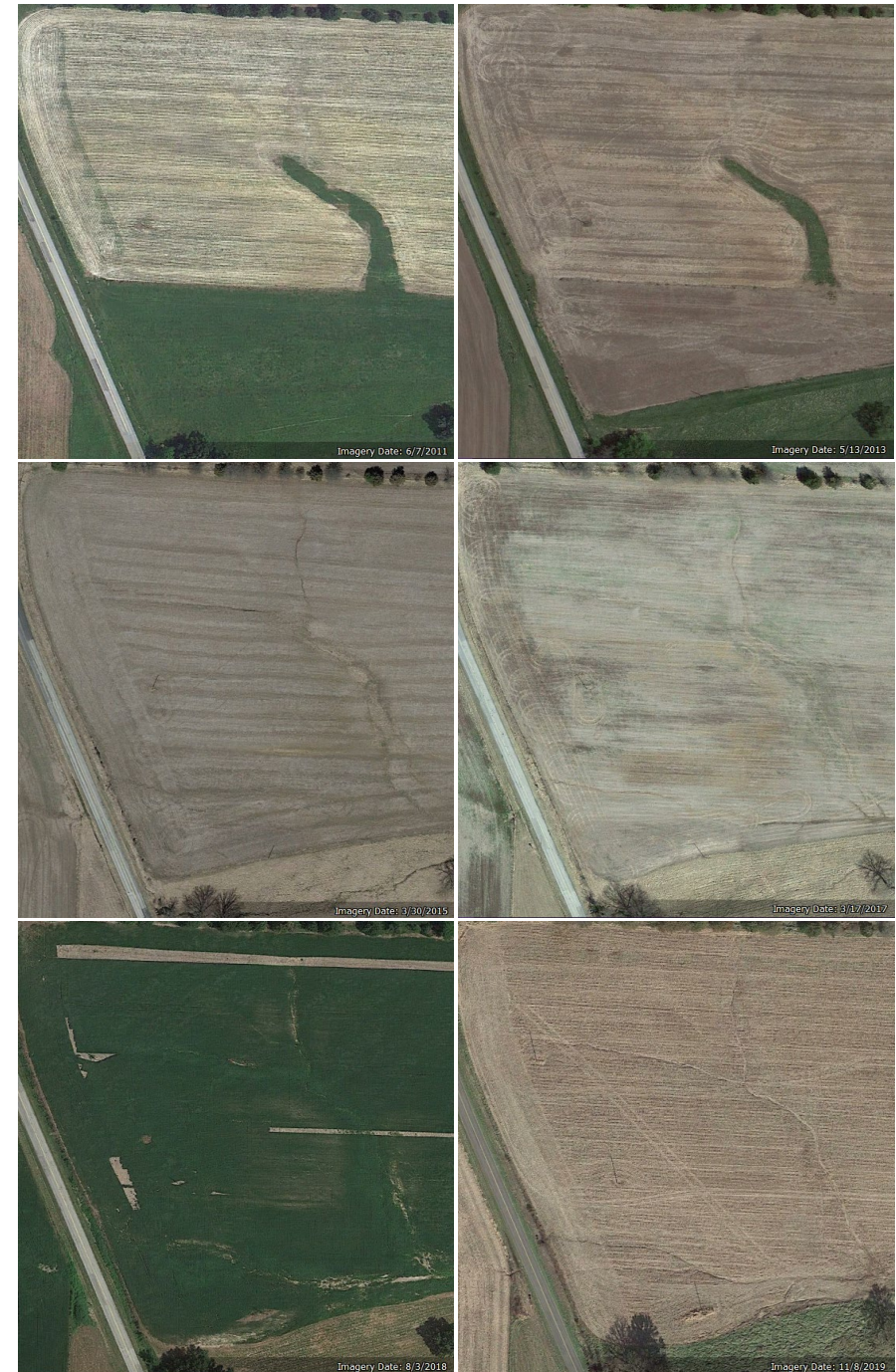
- Google Earth is a viable tool for targeting assessment efforts with a high chance of success
- Only one field was a total miss or false negative
- All GT gullies in the field were identified in 63% of the fields
- False positives are an issue but should not hinder field work

Qualifications

- Imagery availability may be a factor as well as recency- Three locations had only four images, but only one of those had zero evidence, while another had evidence in each image
- This area was a humid Midwestern US landscape

Future Work

- Using this method across larger region to track changes, or the lack of change, in ephemeral gully presence.



Thank you

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