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Attempting to estimate the influence of wildfires on water levels of Alluvial and Dakota Aquifers in Western Kansas

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Attempting to Estimate the Influence of Wildfires on Water Levels of Alluvial and Dakota Aquifers in Western Kansas

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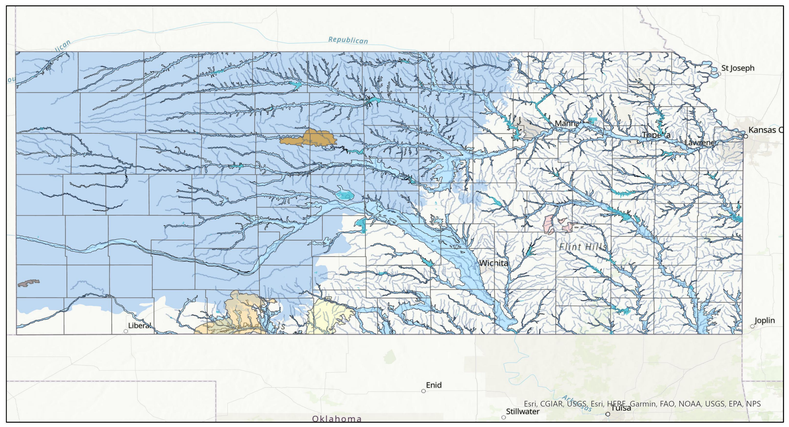
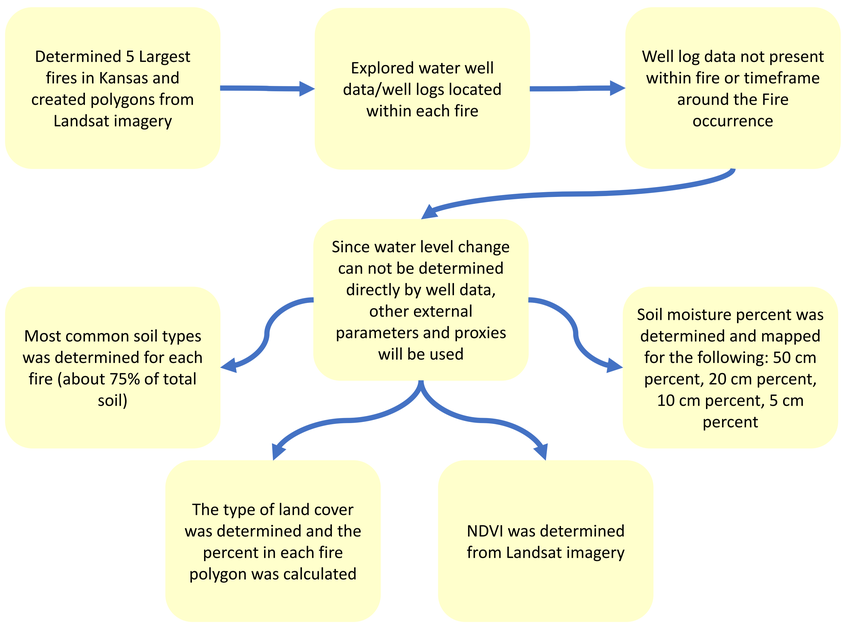
Scope

Wildfires are prevalent events in many areas throughout the world, and this study specifically focuses on wildfires in Western Kansas. The aim of this study is to determine relationships between the landscape, the Alluvial and Dakota Aquifers, and five wildfires to determine possible relationships between these wildfires and groundwater levels. Ideally, water levels from wells within and outside wildfires would be utilized; however, due to the limited number of wells with actual water level measurements in this region, remote sensing imagery coupled with land cover, soil distribution, and soil moisture maps will be utilized to estimate the contribution of wildfires to water level changes. Since the direct groundwater level changes are not able to be determined, external parameters and proxies will need to be used and compared to other regions of the Alluvial and Dakota Aquifers with adequate well data.

Study Area: Kansas Wildfires and Alluvial and Dakota Aquifers in Kansas

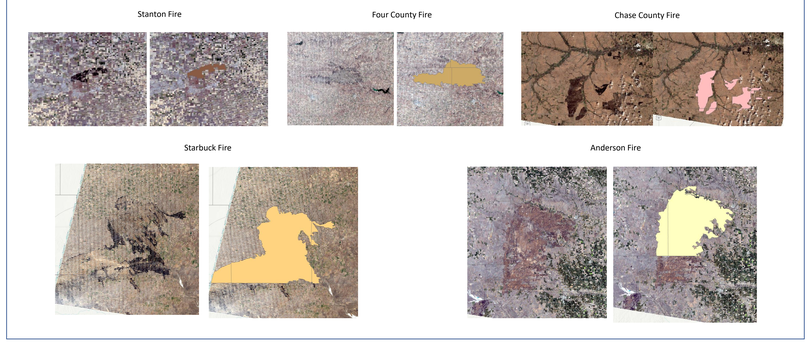


Methods and Process



NDVI, land cover, soil moisture and soil type will be used as proxies to develop an interpretation of the potential influences of wildfires on unconfined groundwater levels by comparing effects to other areas with well data coverage within the aquifers.

Landsat and Fire Polygons

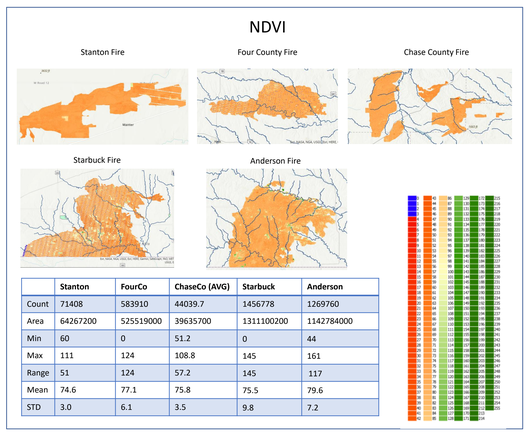


Wells within each Fire

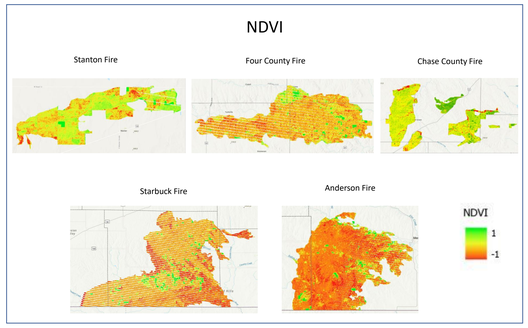
Fire	Number of Wells	Wells-Well Log Data
Stanton	31	1*
Four County	153	0
Chase County	27	0
Starbucks	863	0
Anderson	214	1*
Key:	*	Data not in time frame of fire

The well data was retrieved from KGS Water Information Storage and Retrieval Database (WISARD, a.k.a, WIZARD). Out of a total of **1,288** wells located within the wildfire polygons, only **two** wells contained Well Log data with groundwater levels. ***Neither of these were within proximity to the time of the respective fire.***

NDVI



	Stanton	FourCo	ChaseCo (AVG)	Starbuck	Anderson
Count	71408	583910	44039.7	1456778	1269760
Area	64267200	525519000	39635700	1311100200	1142784000
Min	60	0	51.2	0	44
Max	111	124	108.8	145	161
Range	51	124	57.2	145	117
Mean	74.6	77.1	75.8	75.5	79.6
STD	3.0	6.1	3.5	9.8	7.2



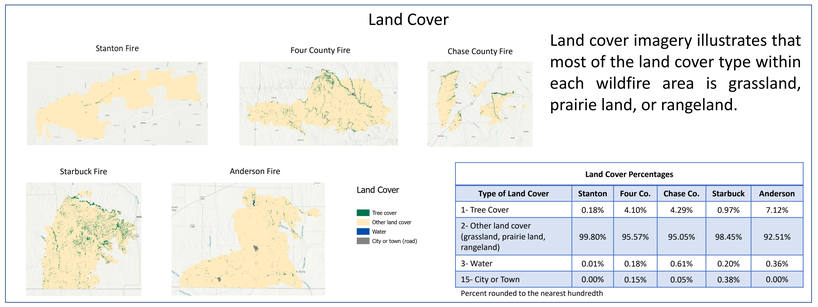
Normalized Difference Vegetation Index (NDVI)

NDVI is created as two graphic. One uses the default symbology and the other is changed to the common scientific NDVI

- Negative values indicate cloud, water, or dead vegetation.
- Positive values near zero indicate bare soil or urbanized area.
- Higher positive values of NDVI show sparce vegetation like shrubs and grasslands with values around 0.1-0.5.
- Dense green vegetation is around values 0.6-1.0.

The majority of the fires show highly negative values, likely representing dry grass vegetation, especially given the climate and land use of the region. Stanton and Chase wildfires have more shrubs and dense green vegetation, possibly due to the timing of the burn being in the height of the spring growing season.

Land Cover

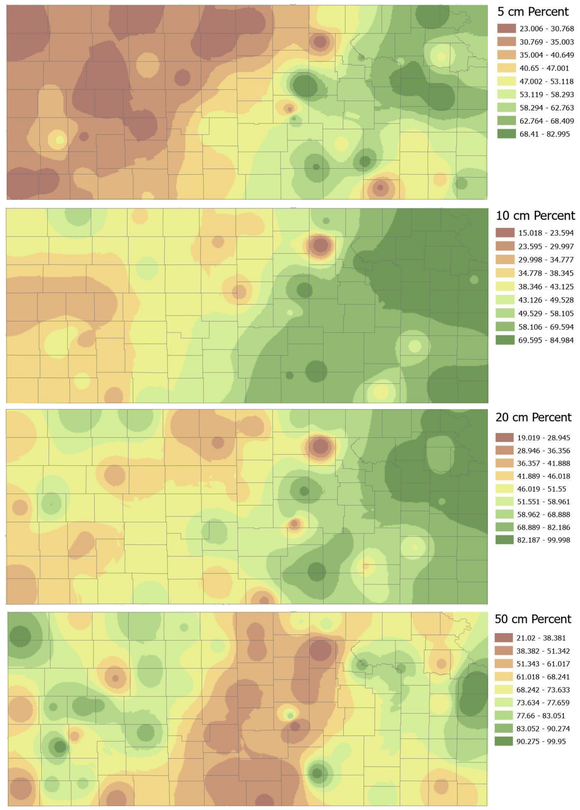


Land cover imagery illustrates that most of the land cover type within each wildfire area is grassland, prairie land, or rangeland.

Land Cover Percentages					
Type of Land Cover	Stanton	Four Co.	Chase Co.	Starbuck	Anderson
1- Tree Cover	0.18%	4.10%	4.29%	0.97%	7.12%
2- Other land cover (grassland, prairie land, rangeland)	99.80%	95.57%	95.05%	98.45%	92.51%
3- Water	0.01%	0.18%	0.61%	0.20%	0.36%
15- City or Town	0.00%	0.15%	0.05%	0.38%	0.00%

Percent rounded to the nearest hundredth

Annual Estimated Soil Moisture (Percent Saturation)



Soil moisture can be used to indicate drought and wildfire prediction.

Sensors are placed at each depth to determine the soil moisture.

Some factors that can impact the soil moisture is soil type, ground cover, and soil depth.

The five wildfires for this study fall within a wide range of soil moistures, suggesting that soil moisture doesn't play as strong of a role in wildfire distribution; however, more temporal examinations of soil moisture may show correlations that these aggregated data do not show.

Soil Type

Soil type is being used to determine infiltration potential. Sandier soil would mean higher potential for infiltration. Soil with more clay content would mean less potential infiltration. Future classification will be conducted. The majority of soil type appears to be silt, clay, and fine sand.

Stanton		
MUSYM	Total Area	Reclassify
1761	660582684.2	Silt loam
1856	85132927.56	Silt loam
6061	22913159.81	Lincoln soils
1857	38941336.46	Silt loam
1808	21807744.92	Fine sandy loam
Sum Area	829377852.9	
Total Area	910022082.5	
Aerial Coverage %	91.13%	

Four County		
MUSYM	Total Area	Reclassify
9999	63157951.55	Water
2660	91454217.46	Complex
2720	121627095.7	Undetermined
2375	81184995.79	Silt loam
2620	39928483.59	Silt loam
2623	20859681.35	Complex
2540	63358795.92	Complex
2536	47087457.71	Clay
2658	49552517.29	Complex
2524	57461834.64	Complex
2594	108243929.6	silty clay loam
2546	57256359.13	Gravelly loam
2236	33590363.29	Silt loam
9994	9731684.589	Rivers
2613	100550579.6	Silt loam
2616	82338735.91	silty clay loam
2235	18849512.03	Undetermined
2592	43875304.11	Silty clay loam
Sum Area	1090109499	
Total Area	1470997749	
Aerial Coverage %	%74.12	

Note: Some MUSYM did not specify soil type, only name.

Chase		
MUSYM	Total Area	Reclassify
4590	576097652.9	Complex
4645	116794922.8	Silt loam
4655	178458172.7	Complex
4600	88761162.79	Silt loam
4780	74465720.47	Silty clay
4744	49494570.86	Complex
9999	15571564.61	Water
4665	71220919.4	Cherty silt loams
Sum Area	1170864687	
Total Area	1428357825	
Aerial Coverage %	81.97%	

Anderson		
MUSYM	Total Area	Reclassify
5859	251314067.3	Sandy loams
6441	421832393.2	Clay
5850	161953937.9	Sandy loams
6057	67621415.95	Loamy sand
5457	270296392.6	Loams
6444	111437594.8	Complex
5314	110437613.5	Clairmont soils
5433	166412652.8	Complex
5850	161953937.9	complex
9999	20083970.67	Water?
5941	46584451.6	Loamy fine sand
5436	54475679.7	Silty clay loam
5403	17197343.07	Silt loam
Sum Area	1743437626	
Total Area	2336839679	
Aerial Coverage %	74.61%	

Starbuck		
MUSYM	Total Area	Reclassify
2612	293116148.5	Silt loam
2562	207220723	Complex
2750	215254498.4	Clay loam
5455	183069806.2	Silty clay
5859	151691238.2	Sandy loams
6056	91377524.65	Fine sand
2613	134144891.2	Silt loam
5941	183733143.8	Loamy fine sands
6057	44594916.41	Loamy sand
5457	260554380.8	Loam
2236	45680179.49	Silt loam
5972	89716481.16	Fine sand
2814	57598366.4	Silt loam
5244	45461922	Complex
5326	36354489.81	Loam
5427	136134674.2	Fine sand loam
2710	109634240.1	Silty clay loam
5467	13596958.14	Silt loam
2153	25456613.55	Clay loam
2745	72570851.14	Clay loam
5496	116686542.2	Complex
1708	24481661.52	Complex
6062	49014037.62	Complex
5411	101275451.7	Silt loam
5242	55359825.01	Loamy fine sand
Sum Area	2743779565	
Total Area	3666043778	
Aerial Coverage %	74.84%	

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