
Land Cover Mapping in Alaska Based on Satellite Image Classification – Lessons Learned

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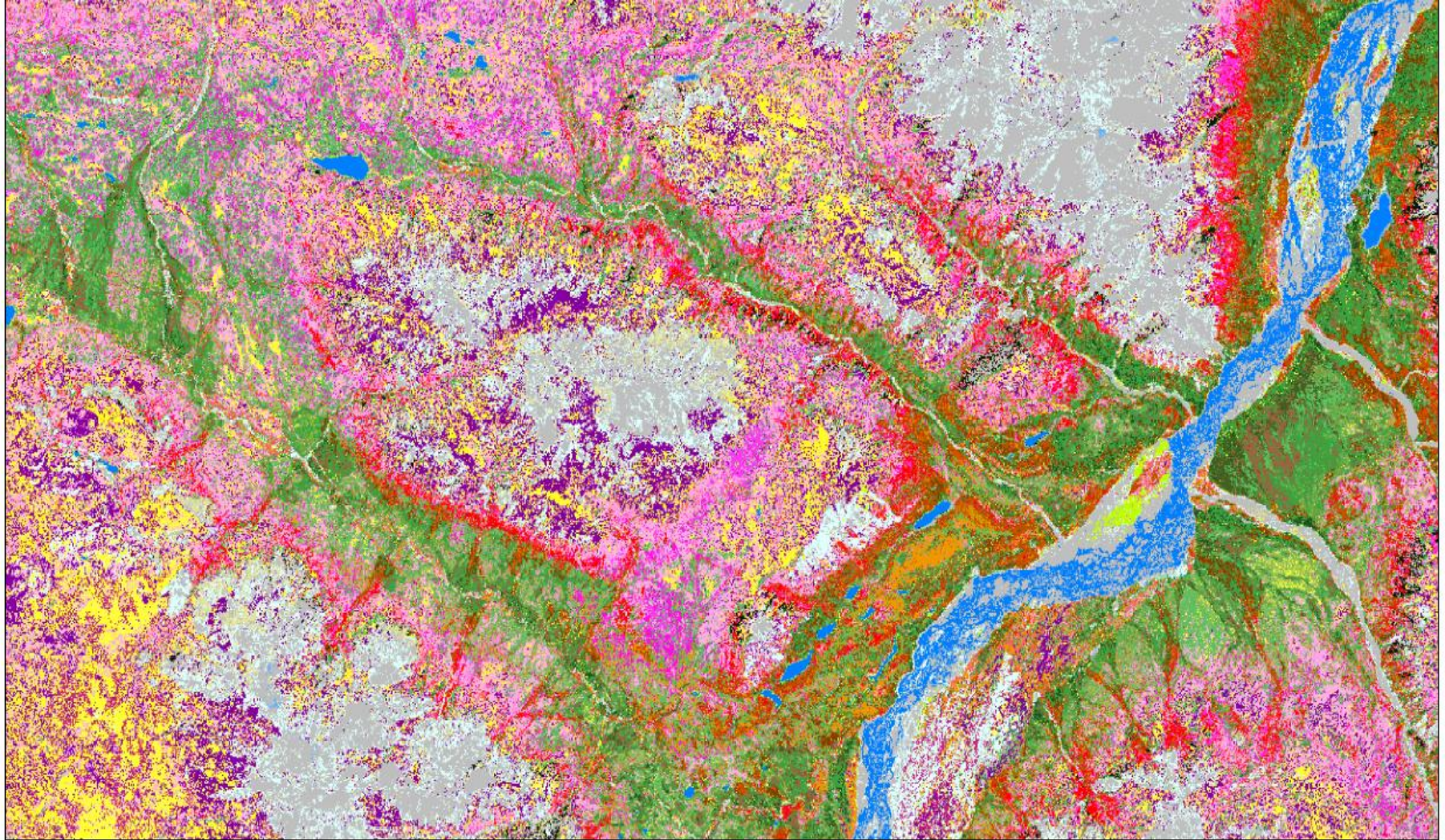
GINA/UAF

Anchorage, AK

jess@gina.alaska.edu







Wrangell-St. Elias Land Cover Map

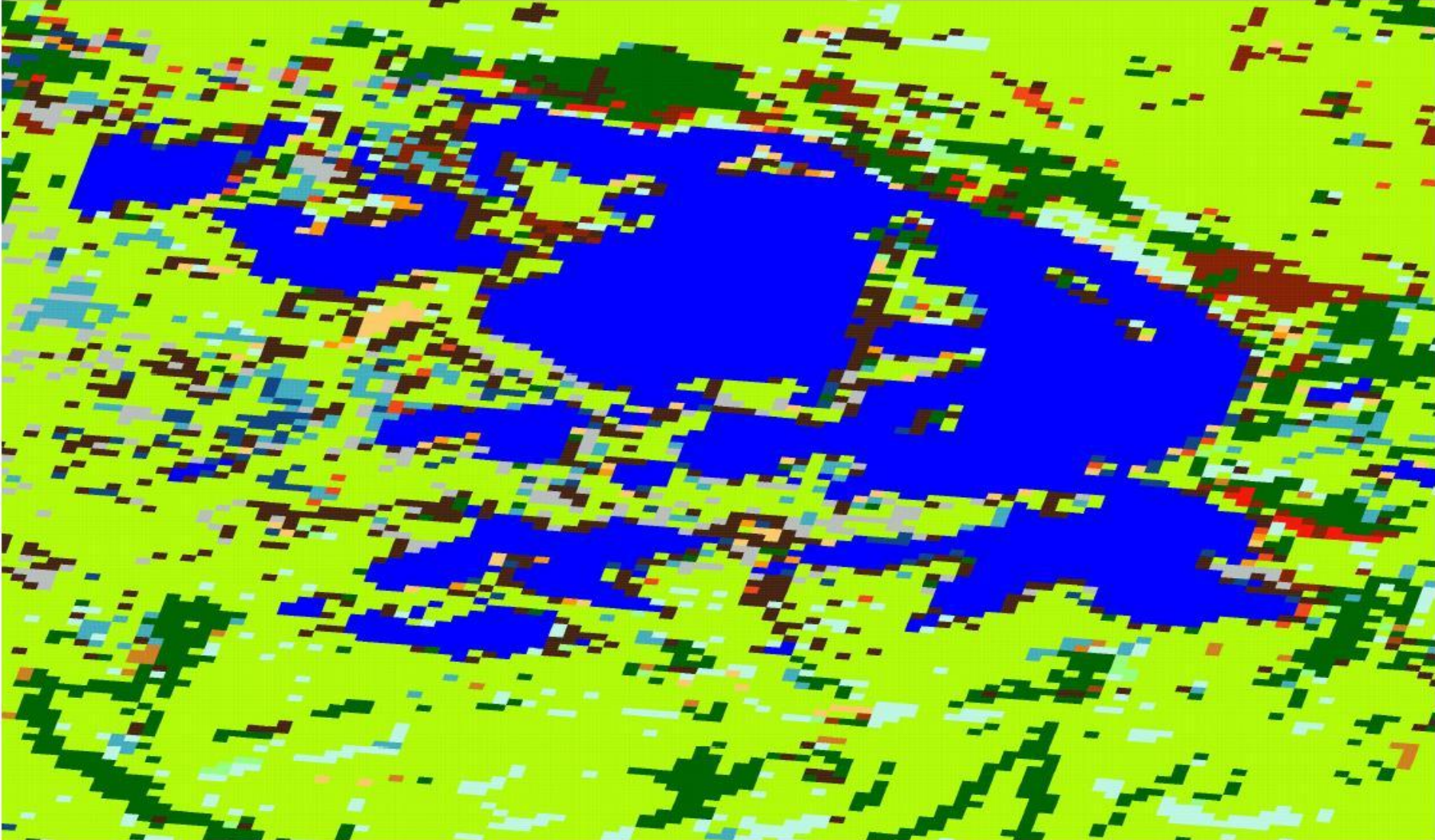
Legend





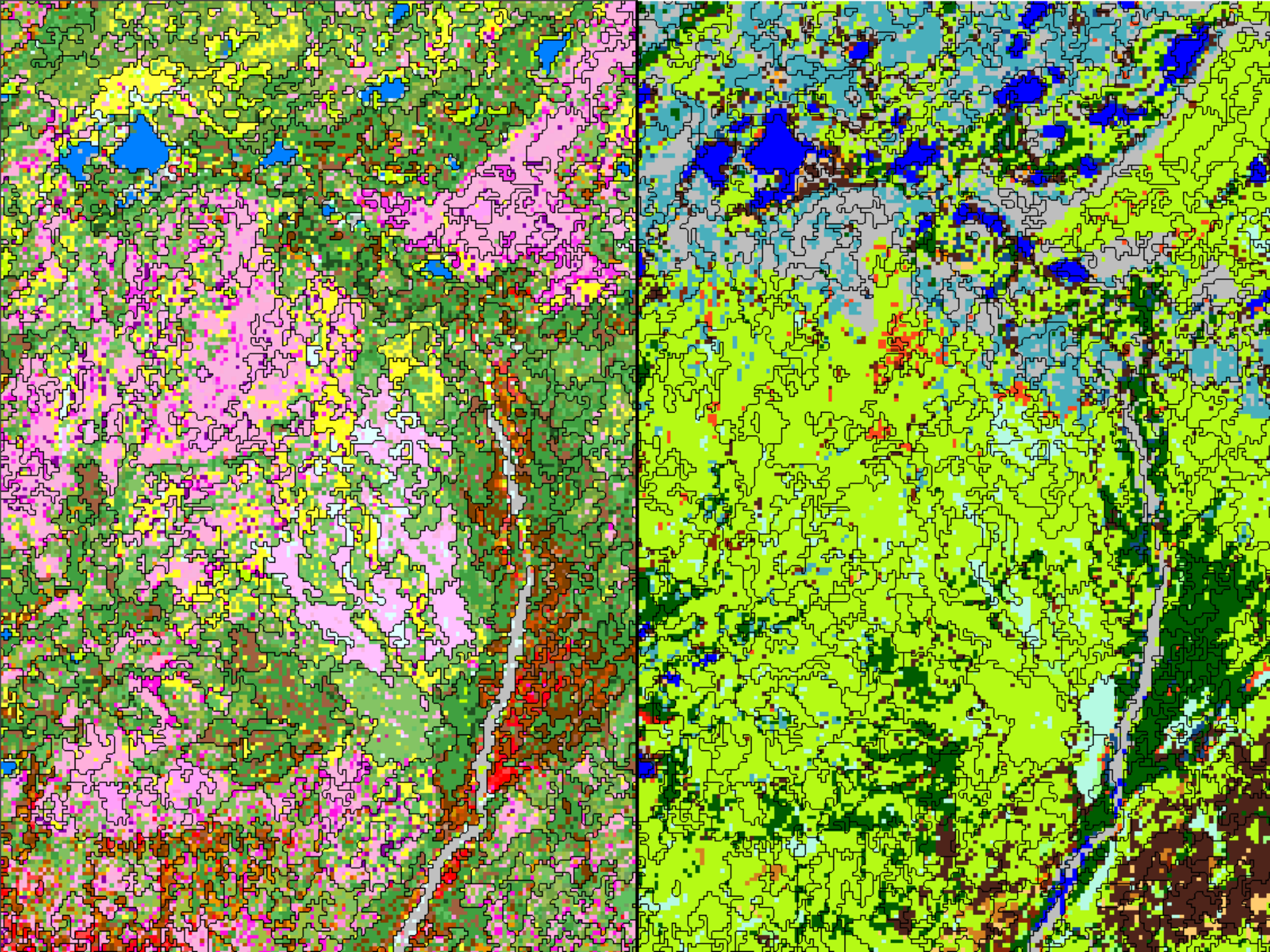
science for a changing world

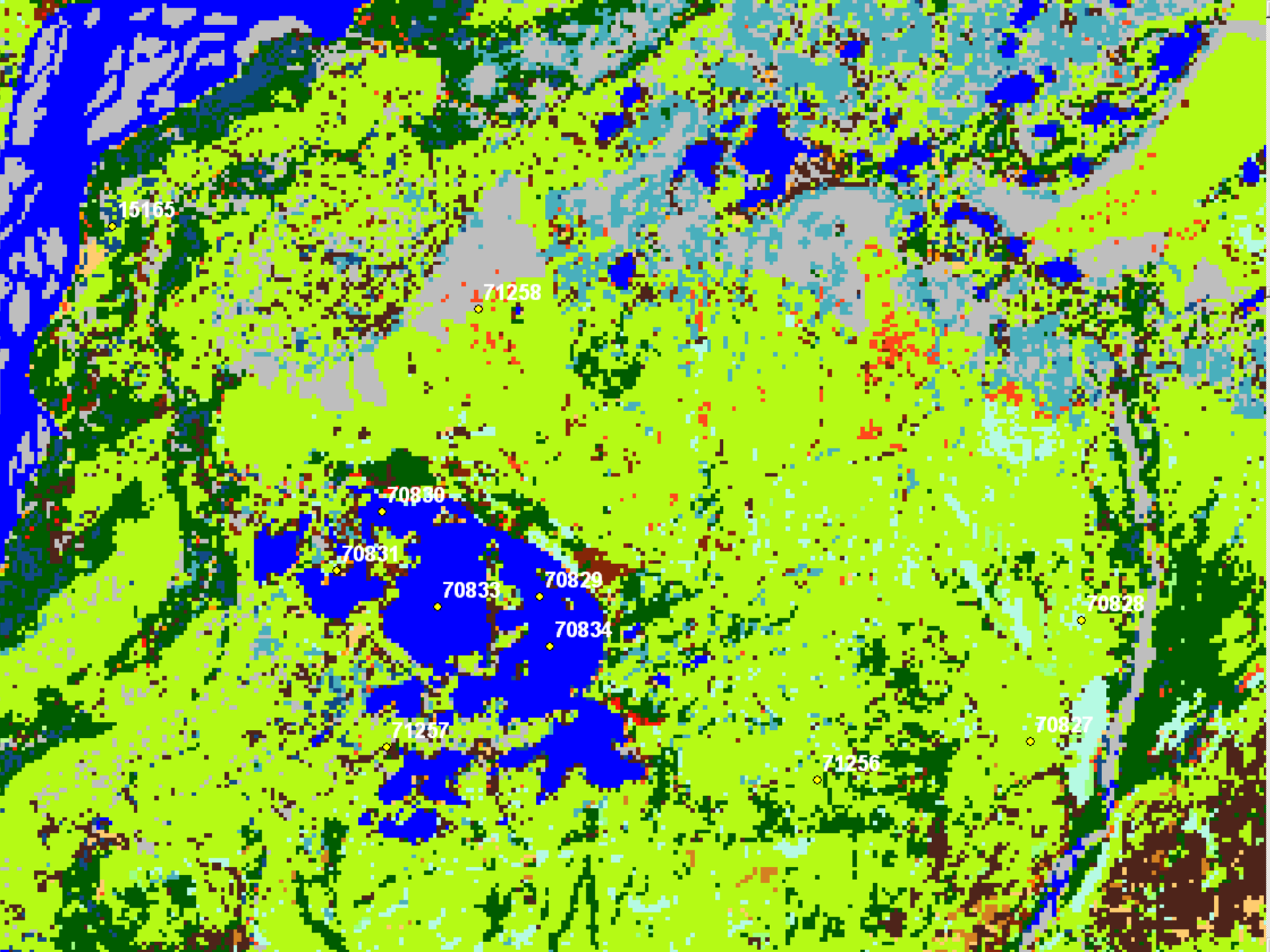
Pickerel Lake, AK



U.S. Department of the Interior || Not accurate for measurement purposes. || Visit us at <http://gisdata.usgs.net>

U.S. Geological Survey || Images are derived from *The National Map* Seamless Server





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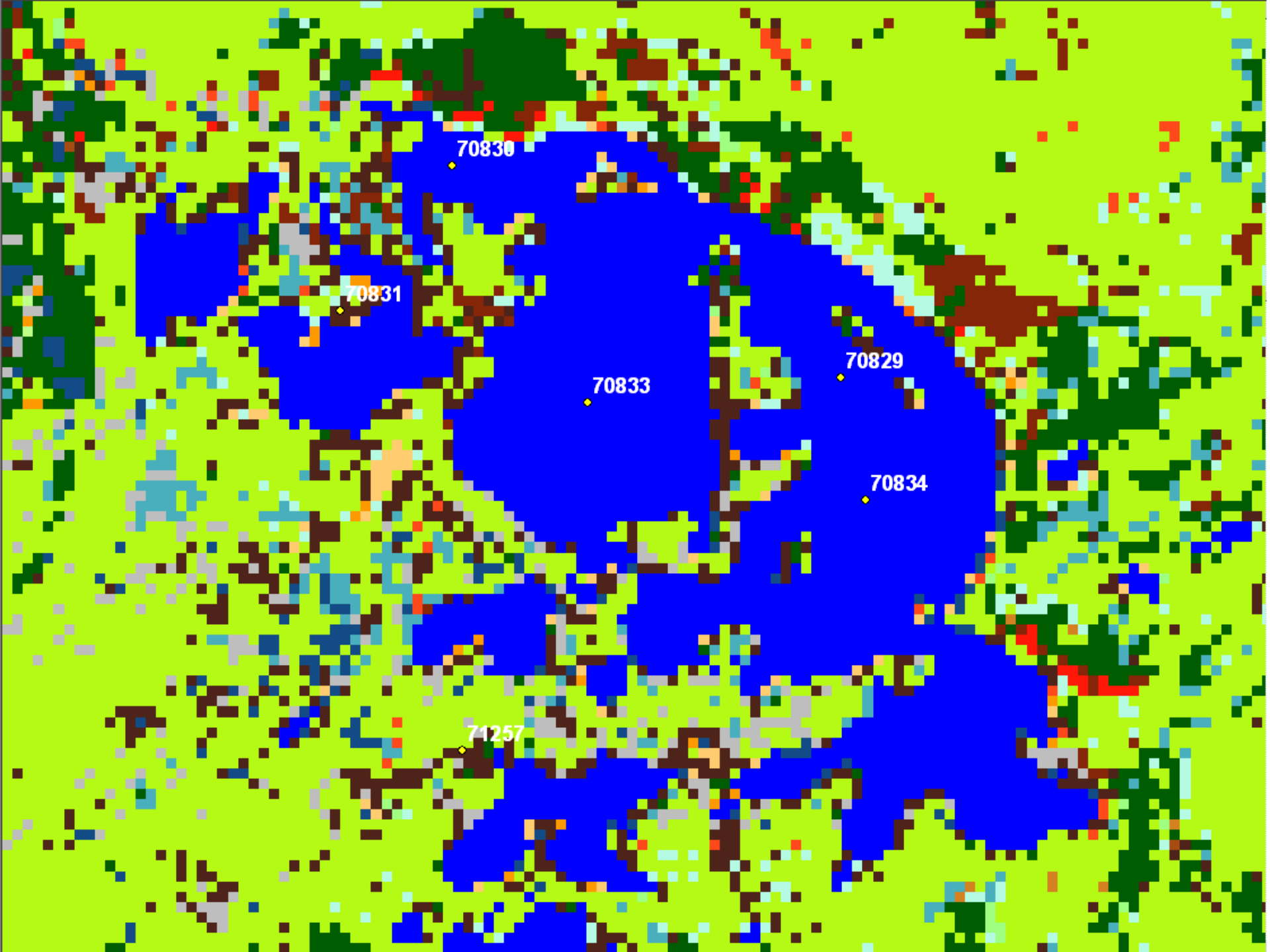
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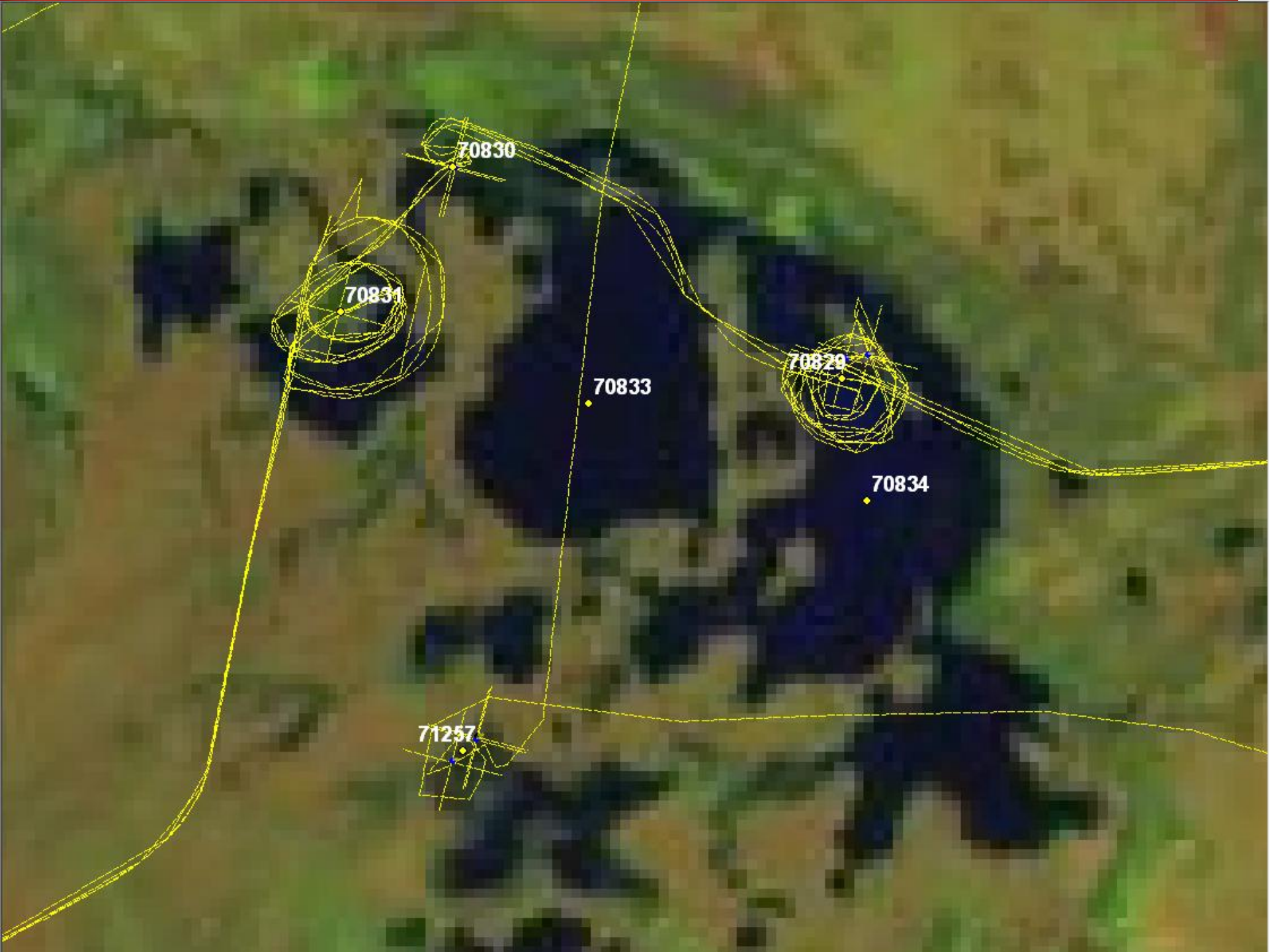
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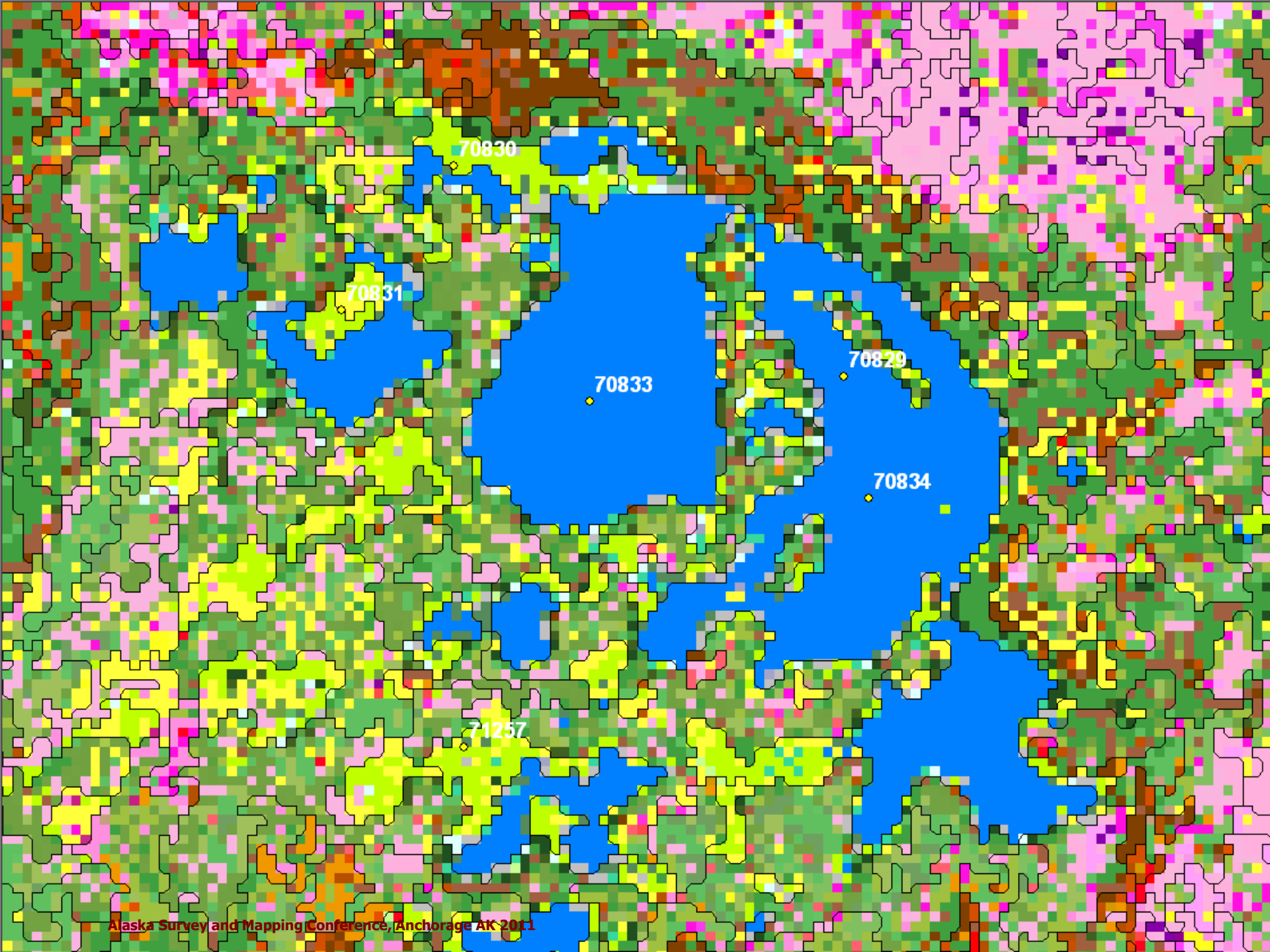
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8 5:07 PM

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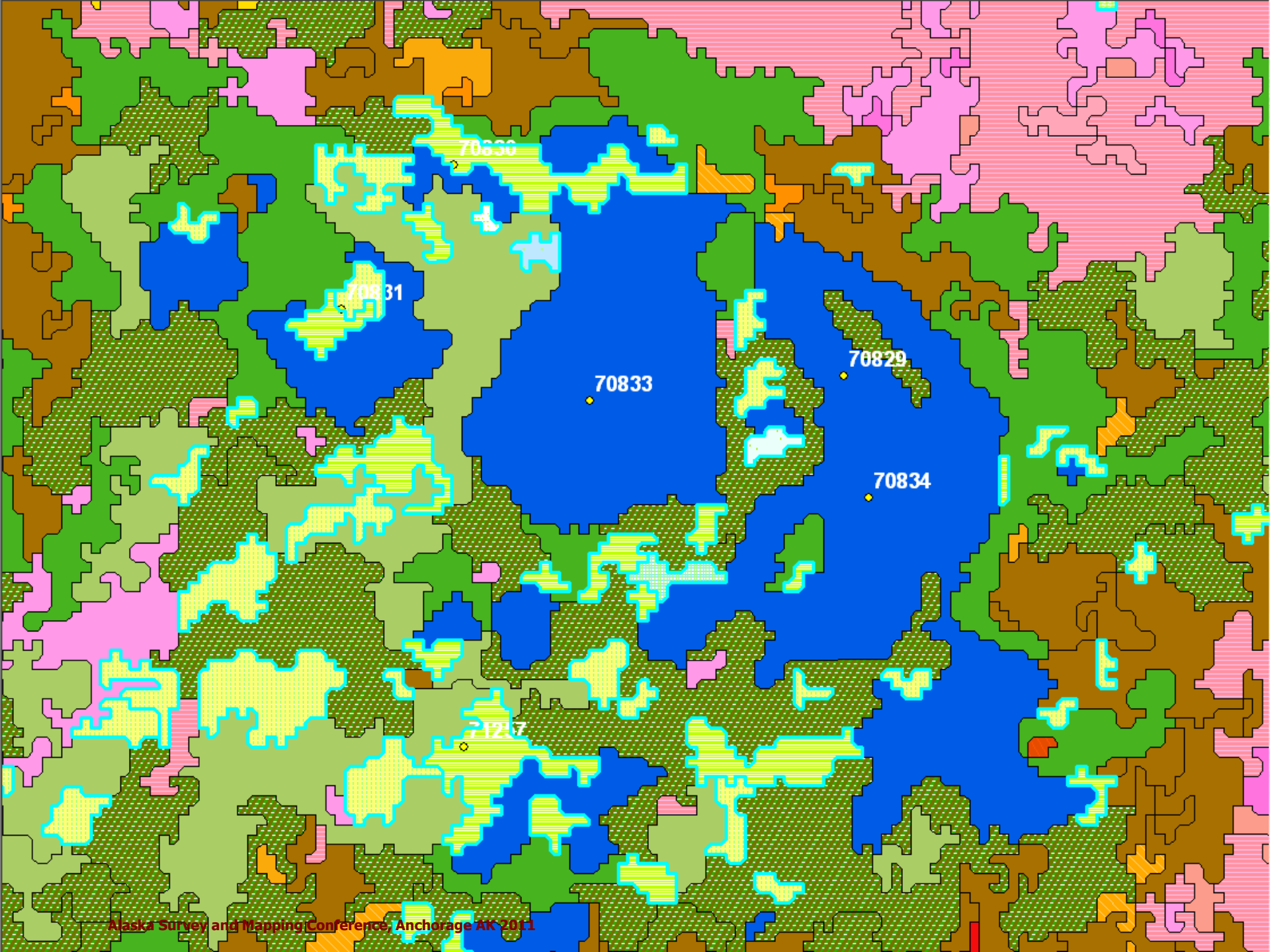
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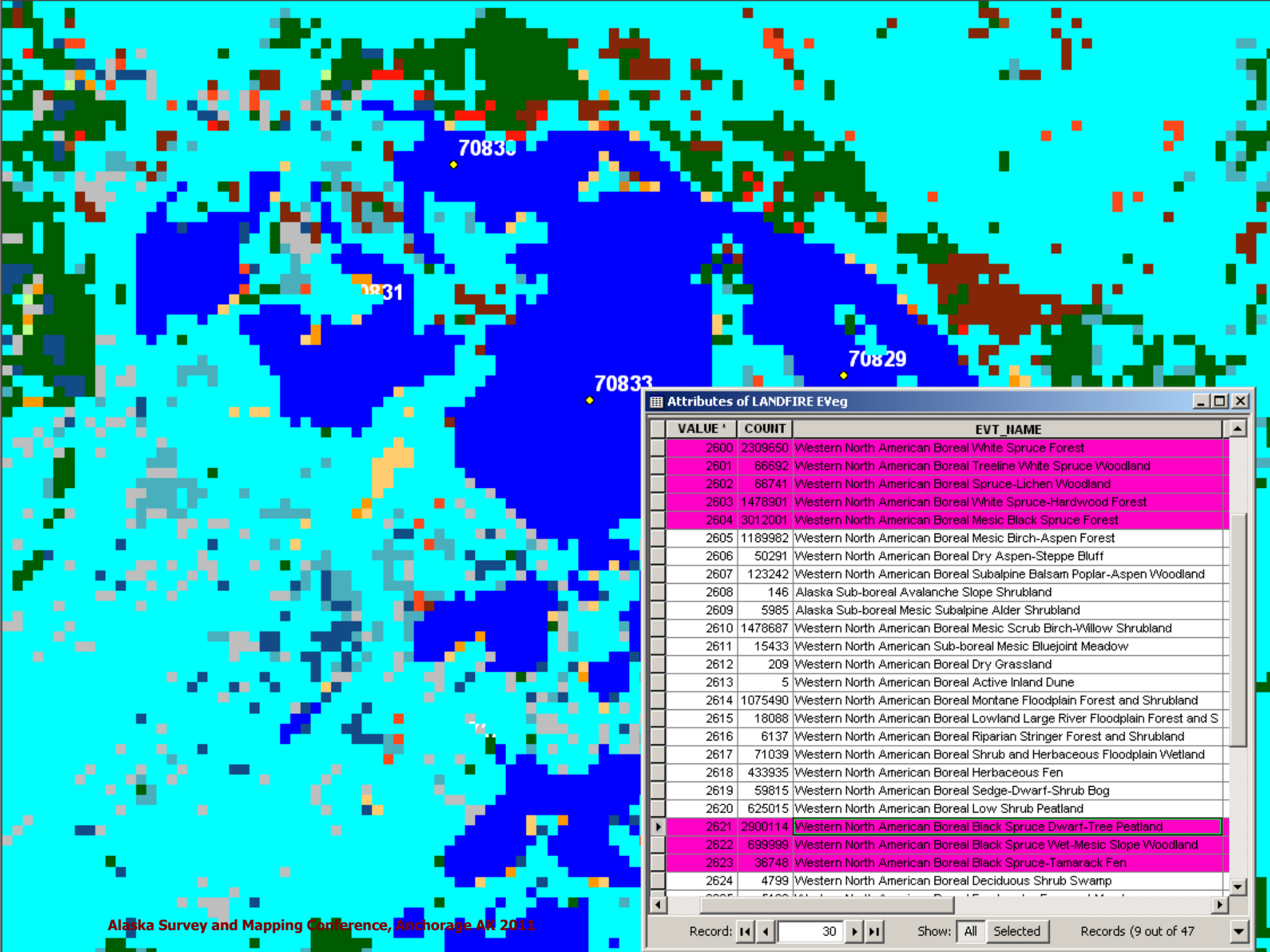
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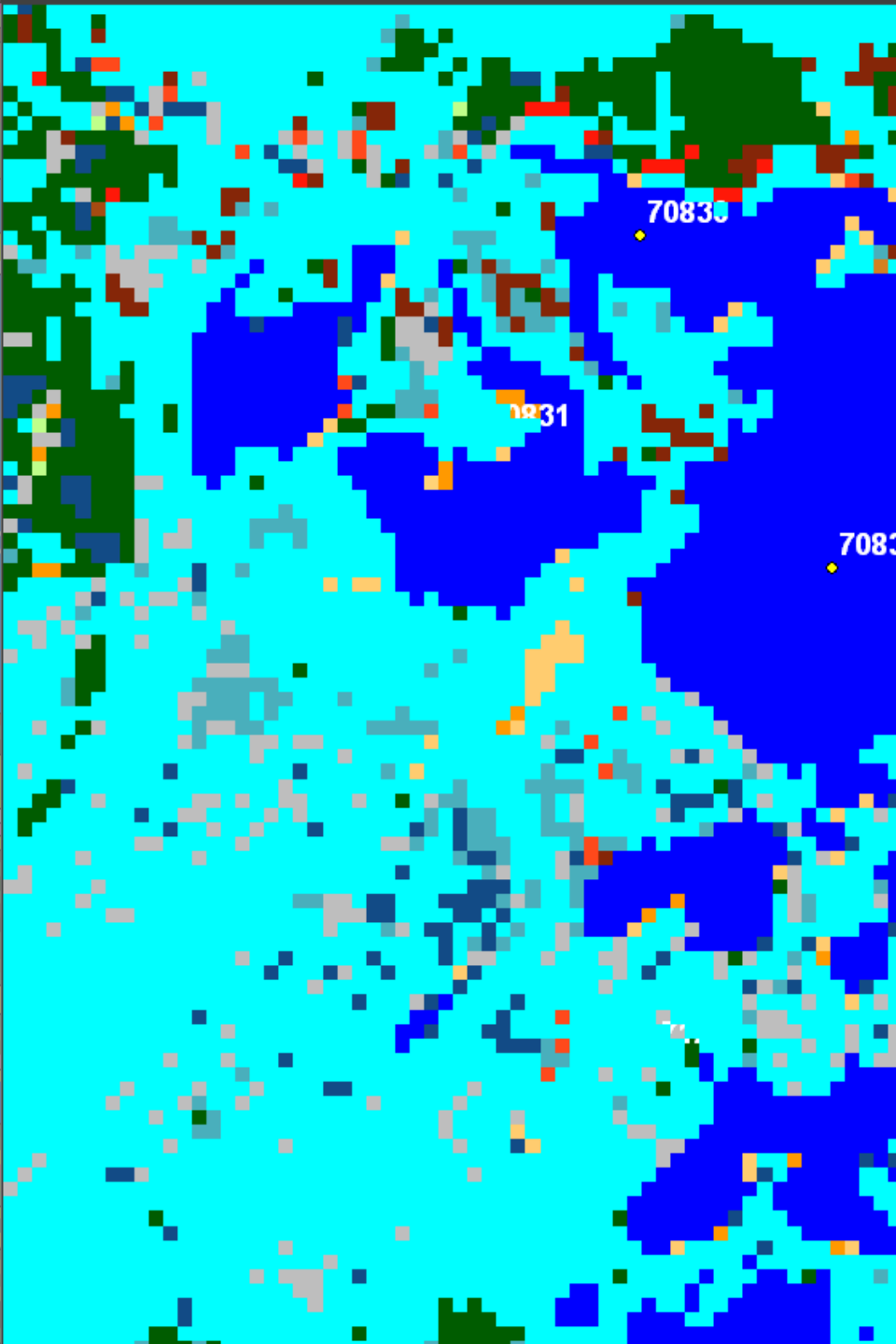
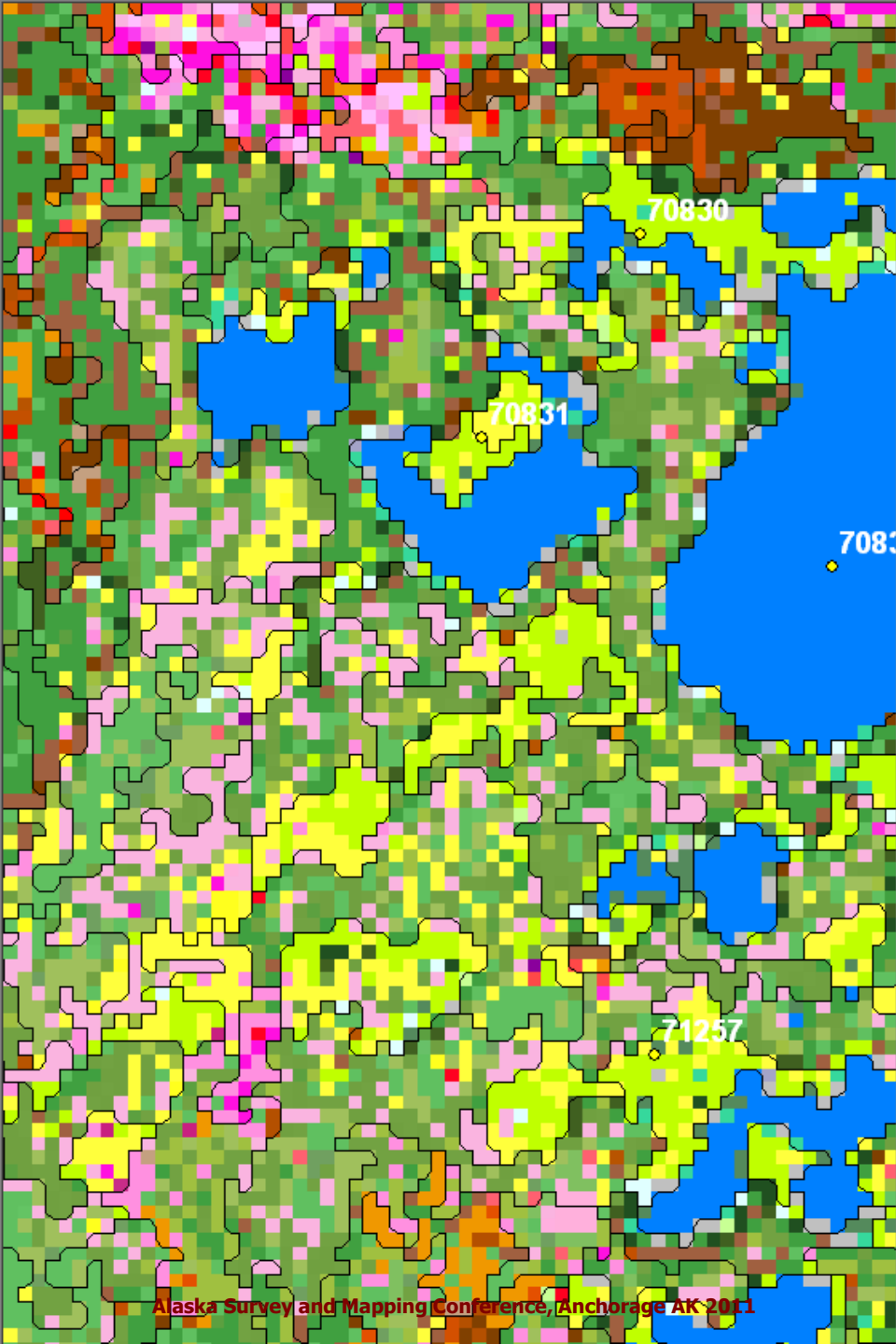
71237



Attributes of LANDFIRE EVeg

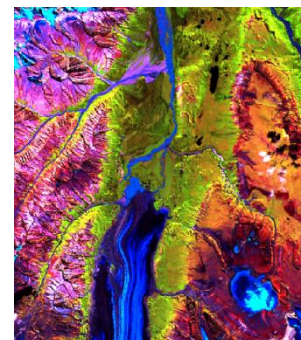
VALUE *	COUNT	EVT_NAME
2600	2309650	Western North American Boreal White Spruce Forest
2601	66692	Western North American Boreal Treeline White Spruce Woodland
2602	66741	Western North American Boreal Spruce-Lichen Woodland
2603	1478901	Western North American Boreal White Spruce-Hardwood Forest
2604	3012001	Western North American Boreal Mesic Black Spruce Forest
2605	1189982	Western North American Boreal Mesic Birch-Aspen Forest
2606	50291	Western North American Boreal Dry Aspen-Steppe Bluff
2607	123242	Western North American Boreal Subalpine Balsam Poplar-Aspen Woodland
2608	146	Alaska Sub-boreal Avalanche Slope Shrubland
2609	5985	Alaska Sub-boreal Mesic Subalpine Alder Shrubland
2610	1478687	Western North American Boreal Mesic Scrub Birch-Willow Shrubland
2611	15433	Western North American Sub-boreal Mesic Bluejoint Meadow
2612	209	Western North American Boreal Dry Grassland
2613	5	Western North American Boreal Active Inland Dune
2614	1075490	Western North American Boreal Montane Floodplain Forest and Shrubland
2615	18088	Western North American Boreal Lowland Large River Floodplain Forest and S
2616	6137	Western North American Boreal Riparian Stringer Forest and Shrubland
2617	71039	Western North American Boreal Shrub and Herbaceous Floodplain Wetland
2618	433935	Western North American Boreal Herbaceous Fen
2619	59815	Western North American Boreal Sedge-Dwarf-Shrub Bog
2620	625015	Western North American Boreal Low Shrub Peatland
2621	2900114	Western North American Boreal Black Spruce Dwarf-Tree Peatland
2622	699999	Western North American Boreal Black Spruce Wet-Mesic Slope Woodland
2623	36748	Western North American Boreal Black Spruce-Tamarack Fen
2624	4799	Western North American Boreal Deciduous Shrub Swamp

Record: 30 Show: All Selected Records (9 out of 47)



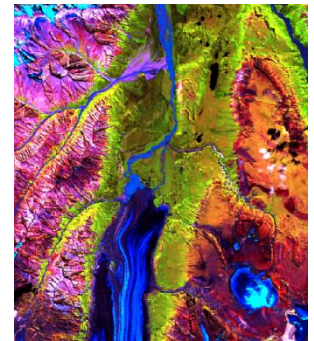
Not a New Problem

- I have seen this spruce/wet marsh confusion in
 - Wrangell – St. Elias National Park & Preserve
 - Katmai National Park & Preserve
 - LANDFIRE
 - Four other Alaskan landcover mapping projects I have reviewed
- Prompted us to talk about problems like this that we have seen in similar landcover mapping projects ...



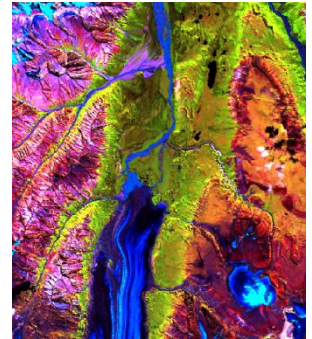
Recurring Issues

- **Spruce-Wet Marsh Confusion**
 - Level III Viereck will be wrong
- **White Spruce-Black Spruce Confusion**
 - Can't map species specific Level IV Viereck Classes
- **Live vs Dead Canopy Cover**
 - Can't map mortality ... invalid class names applied ?
- **Hardwood-Tall (Tree) Shrub Confusion**
- **Terrain Shadowing and Water Confusion**



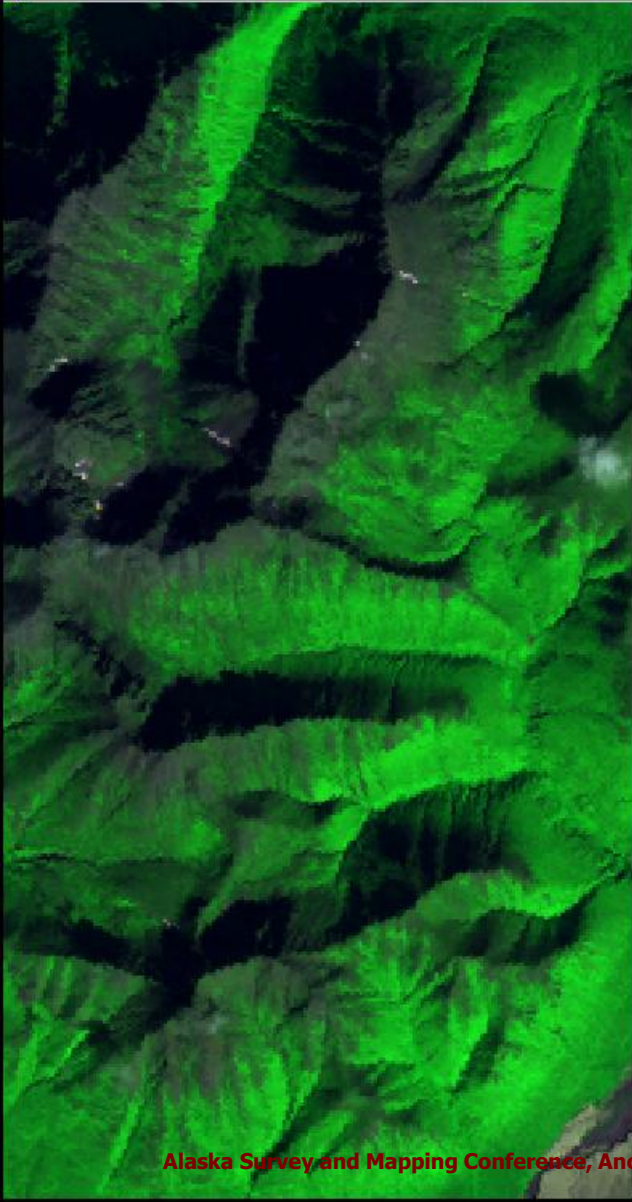
Mapping Errors Due to ...

- **Confusion – calling something what it is not !**
 - ... during image processing efforts
 - ... during field work
 - Botanically
 - Quantitatively
- **Must be resolved using**
 - Illumination Correction
 - Appropriate Field/Training Data
 - Masks / Modeling

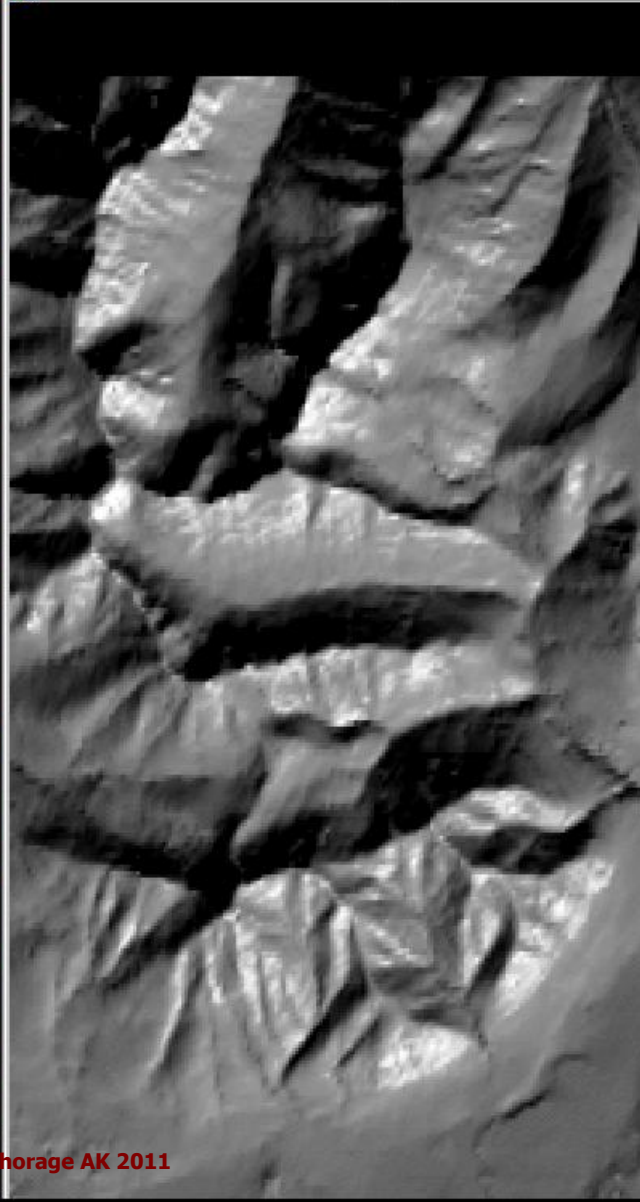


Illumination Correction Example

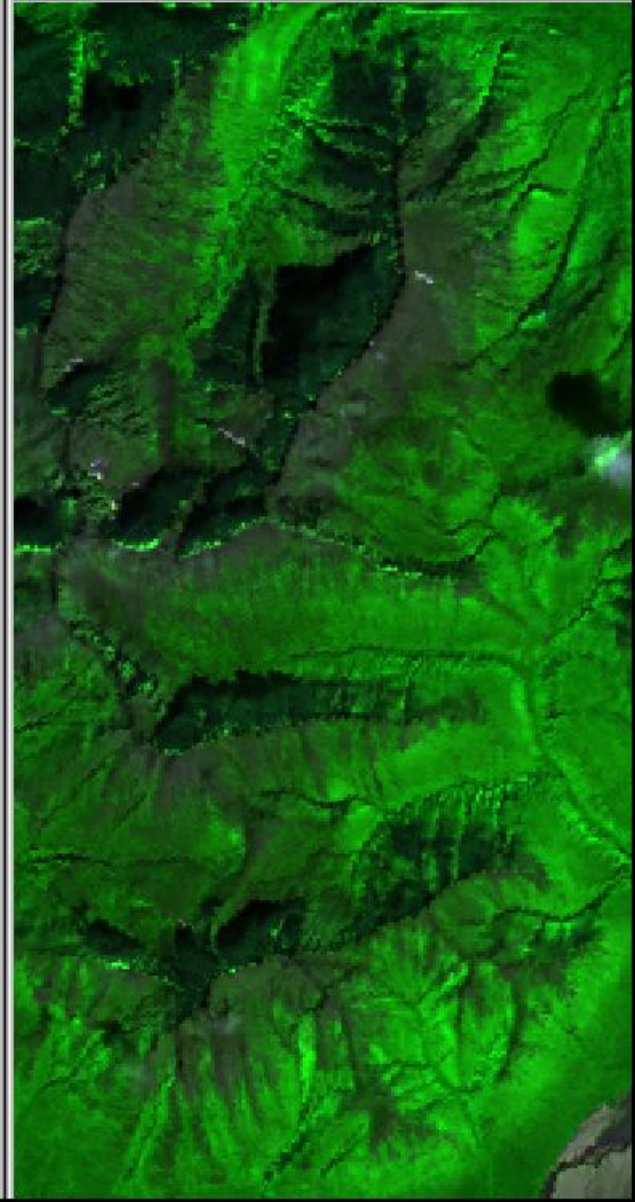
View 1 - Raw Bands - 341RGB



View 2 - Shaded Terrain Relief of Subject Area

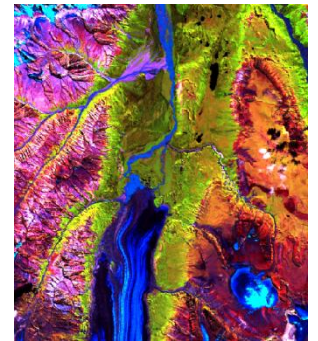


View 3 - Corrected Bands - 341RGB



Illumination Correction

- Equalizes signatures of same landcover features on different aspect and slope
- Separates confused signatures for different landcover types on different aspect and slope
- Reduces confusion
- Reduces field sampling
- Pre-mapping activity ... error prevention



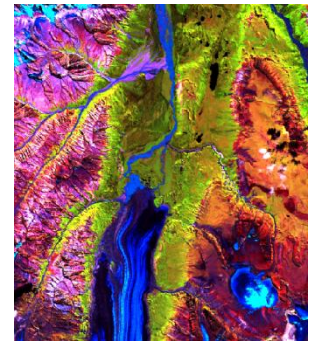
Error Detection

- **Accuracy Assessment**

- Post-mapping
- Too late to fix error(s) unless due to a systematic error that can be reversed
- Withheld training data is highly questionable

- **Diagnostic Assessments**

- Before making the map
- Identify problems
 - Resolve problems



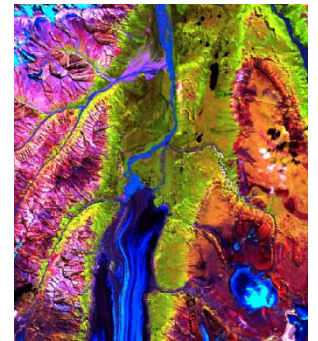
Diagnostic Assessments

- **Confusion Report**

- Spectral confusion of training classes (sites)
 - Expressed in terms of land cover characteristics
 - “Good” confusion versus “bad” confusion

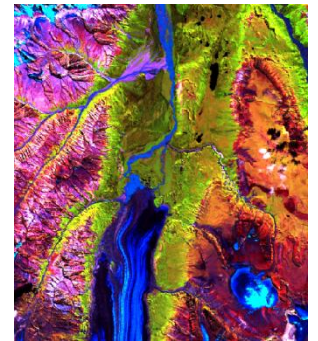
- **Fidelity Report**

- How well is each site classified relative to its original land cover characteristics
- “Bad” confusion causes a site’s characteristics to migrate away from its own characteristics



Spruce – Wet Marsh Confusion

- **Open-Closed stands at Hallow Bay, Malaspina Glacier, Bremner River, and Nabesna vicinities**
- **Very different vegetation but nearly identical digital values - band by band**
 - Means and variances result in overlapping signatures
- **Sitka, White, and Black Spruce stands**
- **Late season imagery**
 - Wet marsh vegetation is “senescent”



Spectral Confusion

Confusion: J-M Distance

	70822	71051	71257	71258	71866
70822	0.000	1.224	0.973	2.000	1.308
71051	1.224	0.000	0.991	2.000	1.305
71257	0.973	0.991	0.000	2.000	1.173
71258	2.000	2.000	2.000	0.000	2.000
71866	1.308	1.305	1.173	2.000	0.000

Confusion Report

Trsite_id: 71257 0 0 0 2037

Training Set	Confused trsite_id	J-M Dist	Iso Class	Aspect	Slope	Elev
6467sSup	70822	0.973	21103	39	2	3366
6467sSup	71051	0.991	21062	81	4	3198
6467sSup	71866	1.173	0	135	0	1650

Confusion Report

Trsite_id:	71257	0	0	0	2037	Hrb	Herbaceous	0	0	0	0	60	25	15	
Training Set	Confused trsite_id	J-M Dist	Iso Class	Aspect	Slope	Elev	Cover Type	Calculated Class	Tree Cover	Pct Conifer	Shr Cover	Dsh Cover	Forb Cover	Bar. Cover	Oth Cover
6467sSup	70822	0.973	21103	39	2	3366	PGI	White Spruce:Open	32	100	25	5	7	9	22
6467sSup	71051	0.991	21062	81	4	3198	PGI	White Spruce:Open	25	100	37	0	4	0	34
6467sSup	71866	1.173	0	135	0	1650	HrC	Graminoid	0	0	20	0	62	0	18



Classification Fidelity Report

Source	trsite_id	Comments	Type-Match	Self-Match	Percent Pure	#pixels	Type	pr_comp	comp cover	cover class	tree cover	veg cover	conf cover	hdwd cover	shrub cover	TSh cover	LSh cover	DSh cover	hrb cover	aqu cover	other cover	bar cover	water cover	undf cover
6378Sup	71601				27.5%	229	PGI	White Spruce	33.2	Open	43	415	86.6	13.4	30.1	9.1	21	1.7	9.7	0	14.7	0.7	0	0
6467sSup	71601				19.1%	89	PGI	White Spruce	26.2	Open	41.1	32.9	88	12	25.2	9.3	15.9	1.1	6.6	0	23.5	1.8	0.7	0
65678Sup	71601				48.2%	195	PGI	White Spruce	31.4	Open	43.4	36.1	91.7	8.3	29.5	11.8	17.7	0.7	6	0	19.1	1.3	0.1	0
6567Sup	71601				69.4%	85	PGI	White Spruce	43.2	Open	50.9	39.2	87.5	12.5	31.8	12.7	19.1	0.2	7.3	0	9.6	0.2	0	0
CalcTypeCall06	71601	OK			TR	1	PGI	White Spruce	50.0	Open	55.0	45.0	90.9	9.1	35.0	15.0	20.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0
TrainCalc'ed	71601	White Spruce:Open	mm	nn	39.0%	598	PGI	White Spruce	33	Open	44	38.2	88.6	11.4	29.4	10.5	18.9	1.1	7.7	0	16.7	1	0.1	0
TrainCall	71601				TR		PGI	White Spruce	50	Open	55	40	90.9	9.1	35	15	20	0	5	0	5	0	0	0
	71602										DIFF													
6378Sup	71602				44.0%	75	PGI	White Spruce	31.7	Open	38	44.4	93.1	6.9	30.1	6.1	24	3	11.4	0	16.2	1.4	0	0
6467sSup	71602				6.6%	61	PGI	White Spruce	23.9	Open	37.5	30.4	86.6	13.4	23.1	9.6	13.5	0.8	6.5	0	30.2	1.9	0	0
65678Sup	71602				36.2%	47	PGI	White Spruce	29	Open	38.1	39.1	95.3	4.7	25.3	4.5	20.8	4	9.9	0	20.6	2.2	0	0
6567Sup	71602				50.0%	52	PGI	White Spruce	31.7	Open	41	41.1	84.1	15.9	24.6	5.3	19.2	2.7	13.8	0	16.9	1	0	0
CalcTypeCall06	71602	OK			TR	1	PGI	White Spruce	35.0	Open	35.0	63.0	100.0	0.0	30.0	0.0	30.0	0.0	33.0	0.0	0.0	2.0	0	0
TrainCalc'ed	71602	White Spruce:Open	mm	nn	34.0%	235	PGI	White Spruce	29.1	Open	38.5	39	89.8	10.2	26.1	6.5	19.6	2.6	10.3	0	20.9	1.6	0	0
TrainCall	71602				TR		PGI	White Spruce	35	Open	35	50	100	0	30	0	30	0	20	0	13	2	0	0
	71603																							
6378Sup	71603				48.7%	189	PGI	White Spruce	35.1	Open	50.5	40.7	78.7	21.3	30.5	16.7	13.8	0.3	9.9	0	7.4	1.4	0	0
6467sSup	71603				27.9%	86	PGI	White Spruce	33.4	Open	44.9	38.7	89.4	10.6	29.5	13.2	16.3	3.9	5.3	0	14.6	1.6	0.1	0
65678Sup	71603				35.0%	183	PGI	White Spruce	38.1	Open	48.6	40.8	82.6	17.4	30.6	17.6	13	2.1	8.2	0	9.7	0.9	0	0
6567Sup	71603				85.7%	49	PGI	White Spruce	43.5	Open	49.3	45.7	88.2	11.8	38.4	23	15.4	0.3	7	0	4.9	0.1	0	0
CalcTypeCall06	71603	OK			TR	1	PGI	White Spruce	45.0	Open	50.0	50.0	90.0	10.0	40.0	25.0	15.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0
TrainCalc'ed	71603	White Spruce:Open	M	nn	43.8%	507	PGI	White Spruce	36.7	Open	48.8	40.8	82.7	17.3	31.2	17.1	14.1	1.5	8.2	0	9.2	1.1	0	0
TrainCall	71603				TR		PGI	White Spruce	45	Open	50	47	90	10	40	25	15	0	7	0	3	0	0	0
	71604																							
6378Sup	71604				87.2%	180	DSD	Dwarf shrb drg	68.8		4.9	73.5	53.6	46.4	4.5	0	4.5	68.8	0.2	0	2.3	19.4	0	0
6467sSup	71604				80.7%	384	DSD	Dwarf shrb drg	63.9		4.7	72.5	53.3	46.7	4.5	0.1	4.4	66.6	1.3	0	2.3	20.5	0	0
65678Sup	71604				77.0%	427	DSD	Dwarf shrb drg	62		4.7	67.9	50.2	49.8	4	0	3.9	62.6	1.4	0	2.2	25.2	0	0
6567Sup	71604				96.5%	227	DSD	Dwarf shrb drg	72.9		4.9	79.1	59.2	40.8	4.8	0	4.8	73.9	0.4	0	0.4	15.6	0	0
CalcTypeCall06	71604	OK			TR	1	DSh	Dwarf shrb mix	75.0		5.0	80.0	60.0	40.0	5.0	0.0	5.0	75.0	0.0	0.0	0.0	15.0	0	0
TrainCalc'ed	71604	Dwarf Shrub:Drgas	M	M	83.33%	1218	DSD	Dwarf shrb drg	65.6		4.8	72.2	53.4	46.6	4.4	0	4.3	66.9	1	0	1.9	21.1	0	0
TrainCall	71604				TR		DSD	Dwarf shrb drg	75		5	80	60	40	5	0	5	75	0	0	0	15	0	0
	71605																							
6378Sup	71605				94.0%	348	SVg	Dwarf shrb mix	5.7		0.9	15.3	0	100	0.2	0	0.2	9.4	5.7	0	0	83.7	0	0
6467sSup	71605				86.5%	784	SVg	Dwarf shrb mix	5.3		0.9	14.1	0	100	0	0	0	8.8	5.3	0	0	85	0	0
65678Sup	71605				93.0%	142	SVg	Dwarf shrb mix	5.6		0.9	14.9	0	100	0	0	0	9.3	5.6	0	0	84.2	0	0
6567Sup	71605				95.5%	242	SVg	Dwarf shrb mix	5.8		1	15.5	0.4	99.6	0	0	0	9.7	5.8	0	0	83.5	0	0
CalcTypeCall06	71605	OK			TR	1	SVg	Dwarf shrb mix	6.0		1.0	16.0	0.0	100.0	0.0	0.0	0.0	10.0	6.0	0.0	0.0	83.0	0	0
TrainCalc'ed	71605	Sparse Vegetation	M	M	90.24%	1516	SVg	Dwarf shrb mix	5.5		0.9	14.7	0.1	99.3	0.1	0	0.1	9.1	5.5	0	0	84.4	0	0
TrainCall	71605				TR		SVg	Dwarf shrb mix	6		1	16	0	100	0	0	0	10	6	0	0	83	0	0
	71606																							
6378Sup	71606				24.4%	45	UP	White Spruce	13.8	Open	34.3	44.4	84.8	15.2	30.7	11.1	19.6	2.2	11.5	0	21.2	0	0	0
6467sSup	71606				41.2%	51	UP	Black Spruce	15.3	Open	26.2	55.6	91.8	8.2	37	13.5	23.5	2.5	16.1	0	15.4	2.2	0.5	0
65678Sup	71606				53.5%	43	PMa	Black Spruce	24.3	Open	35.4	51.3	93.8	6.2	31.6	13.5	18.1	4	15.7	0	12.3	1	0	0
6567Sup	71606				73.1%	52	PMa	Black Spruce	22.9	Open	27.7	61.2	96.9	3.1	36.7	12.6	24.1	1.7	22.8	0	8.5	1.7	0.9	0
CalcTypeCall06	71606	OK			TR	1	PMa	Black Spruce	30.0	Open	30.0	70.0	100.0	0.0	40.0	15.0	25.0	0.0	30.0	0.0	0.0	0.0	0.0	0.0
TrainCalc'ed	71606	Black Spruce:Open	M	nn	48.7%	191	PMa	Black Spruce	19	Open	30.6	53.5	91.7	8.3	34.2	12.7	21.5	2.5	16.7	0	14.2	1.3	0.4	0
TrainCall	71606	confused w/71257			TR		PMa	Black Spruce	30	Open	30	65	100	0	40	15	25	0	25	0	5	0	0	0
	71607																							
6378Sup	71607				98.1%	52	LSh	Low shrub mix	44.1	Open	0	94.7	0	100	59.9	0.1	59.8	0	34.8	0	5	0.3	0	0
6467sSup	71607				76.1%	67	LSh	Low shrub mix	34.3	Open	1.2	88.4	96.4	3.6	55	4.2	50.9	1.5	31.8	0	8.2	2.1	0.1	0
65678Sup	71607				45.3%	75	LSh	Low shrub mix	20.6	Open	8.4	78.7	92.1	7.9	41.6	1.5	40.1	7.7	29.4	0	3.2	3	0.7	0
6567Sup	71607				81.6%	49	LSh	Low shrub mix	36.7	Open	2.3	88.1	100	0	52.6	0.2	52.4	6.1	29.4	0	8.7	0.8	0	0
CalcTypeCall06	71607	OK			TR	1	LSh	Low shrub mix	45.0	Open	0.0	100.0	0.0	0.0	60.0	0.0	60.0	0.0	40.0	0.0	0.0	0.0	0.0	0.0
TrainCalc'ed	71607	Low shrub:Open:Mix	mm	mm	72.43%	243	LSh	Low shrub mix	32.7	Open	3.4	86.7	93.4	6.6	51.4	1.7	49.8	4	31.2	0	7.9	1.7	0.2	0
TrainCall	71607				TR		LSh	Low shrub mix	45	Open	0	95	0	0	60	0	60	0	35	0	5	0	0	0
	71608																							
6378Sup	71608				100.0%	14	H2O	Water	95		0	5	0	0	0	0	0	0	5	0	0	0	95	0
6467sSup	71608				100.0%	8	H2O	Water	95		0	5	0	0	0	0	0	0	5	0	0	0	95	0
65678Sup	71608				85.7%	14	H2O	Water	95.7															

Classification Fidelity

Source	trsite_id	Comments	Type-Match	Self-Match	Percent Pure	#pixels	Type	pr_comp	pr_comp cover	cover class	tree cov	other veg cov	conf cov	hdwd cov	shrb cov	TSh cov	LSh cov	DSh cov	hrb cov	aqu cov	other cov	bar cov	water cov	undf cov
6467sSup	70822	White Spruce:WdInd	mm	mm	64.3%	28	PGI	White Spruce	20	WdInd	22.8	43.6	100	0	20.1	6.7	13.4	3.4	20.1	0	18.1	12	3.6	0
TrainCall	70822	White Spruce:Open			TR		PGI	White Spruce	28	Open	32	37	100	0	25	10	15	5	7	0	22	9	0	0
																			DIFF					
6467sSup	71257	White Spruce:WdInd	n	mm	55.6%	18	PGI	White Spruce	9.6	WdInd	10.4	51.7	100	0	11.2	2.6	8.6	1.9	38.6	0	9.2	19.4	9.3	0
TrainCall	71257	Herbaceous			TR		Hrb	Forb	40		0	55	0	0	0	0	0	0	55	5	0	25	15	0
											DIFF				DIFF				DIFF					
6467sSup	71258		M	M	81.7%	262	LSm	Low shrub SaBe	18.6	Open	1.1	78.9	0	100	35.9	0.2	35.7	11.1	31.9	0	2.3	17.6	0	0
TrainCall	71258	Low shrub:Open:Willow-Birch Mix-Tus			TR		LSm	Low shrub SaBe	20	Open	1	79	0	100	34	0	34	10	35	0	0	20	0	0



Classification Fidelity

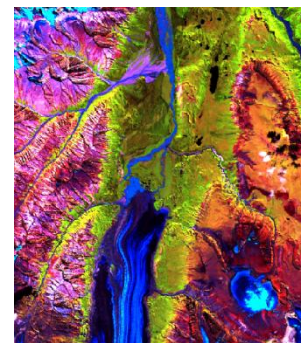
Source	trsite_id	Comments	Type-Match	Self-Match	Percent Pure	#pixels	Type
6467sSup	70822	White Spruce:WdInd	mm	mm	64.3%	28	PGI
TrainCall	70822	White Spruce:Open			TR		PGI
6467sSup	71257	White Spruce:WdInd	n	mm	55.6%	18	PGI
TrainCall	71257	Herbaceous			TR		Hrb
6467sSup	71258		M	M	81.7%	262	LSm
TrainCall	71258	Low shrub:Open:Willow-Birch Mix-Tus			TR		LSm

Source	trsite_id	pr_comp	pr comp cover	cover class	tree cov	other veg cov	conf cov	hdwd cov	shrb cov	TSh cov	LSh cov	DSh cov	hrb cov	aqu cov	other cov	bar cov	water cov	undf cov
6467sSup	70822	White Spruce	20	WdInd	22.8	43.6	100	0	20.1	6.7	13.4	3.4	20.1	0	18.1	12	3.6	0
TrainCall	70822	White Spruce	28	Open	32	37	100	0	25	10	15	5	7	0	22	9	0	0
													DIFF					
6467sSup	71257	White Spruce	9.6	WdInd	10.4	51.7	100	0	11.2	2.6	8.6	1.9	38.6	0	9.2	19.4	9.3	0
TrainCall	71257	Forb	40		0	55	0	0	0	0	0	0	55	5	0	25	15	0
					DIFF				DIFF				DIFF					
6467sSup	71258	Low shrub SaBe	18.6	Open	1.1	78.9	0	100	35.9	0.2	35.7	11.1	31.9	0	2.3	17.6	0	0
TrainCall	71258	Low shrub SaBe	20	Open	1	79	0	100	34	0	34	10	35	0	0	20	0	0



Resolution ...

- Attempts to refine training areas failed to separate signatures
 - Shape/extent of area
 - Restrict statistical thresholds



Confused Digital Values

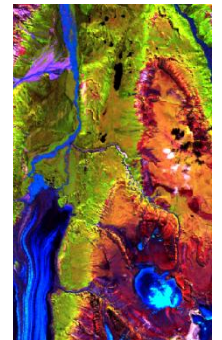
- Attempts to refine training areas failed to separate signatures

Class Name: 71257

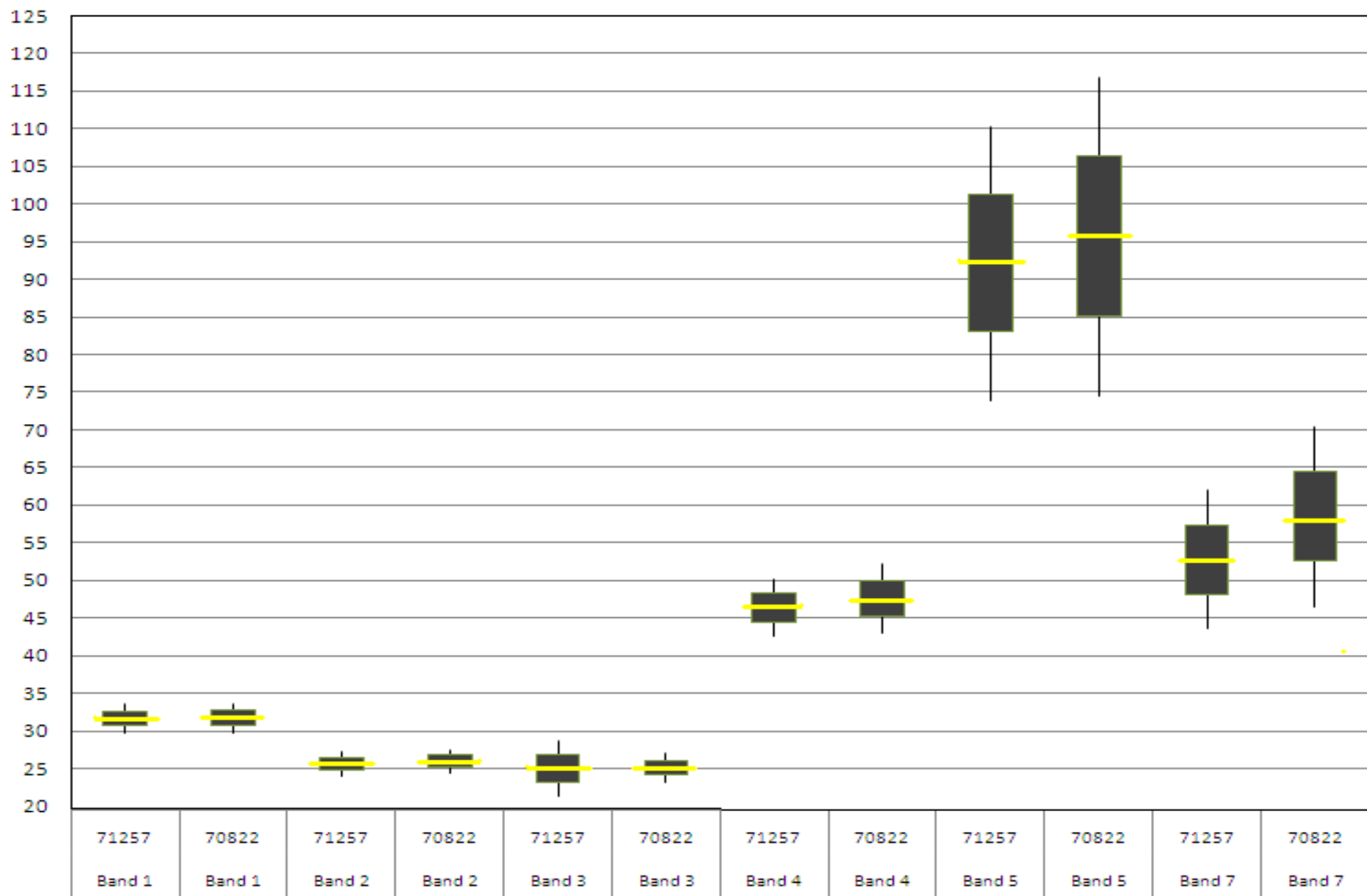
Band Name	Total	Minimum	Maximum	Median	Mode	Mean	Std. Dev.
6467s_1btm.tif	19	30	34	32	32	31.63	0.93
6467s_2btm.tif	19	24	27	26	25	25.63	0.81
6467s_3btm.tif	19	22	29	25	24	25.00	1.86
6467s_4btm.tif	19	43	51	47	45	46.37	1.87
6467s_5btm.tif	19	80	110	89	84	92.11	9.10
6467s_7btm.tif	19	44	59	54	56	52.74	4.59

Class Name: 70822

Band Name	Total	Minimum	Maximum	Median	Mode	Mean	Std. Dev.
6467s_1btm.tif	28	30	34	32	32	31.71	0.96
6467s_2btm.tif	28	25	27	26	26	25.96	0.78
6467s_3btm.tif	28	24	27	25	25	25.14	0.95
6467s_4btm.tif	28	44	51	48	48	47.54	2.32
6467s_5btm.tif	28	78	119	91	91	95.71	10.59
6467s_7btm.tif	28	48	72	58	56	58.46	5.96

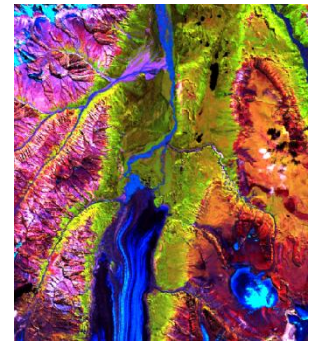


Paired Digital Values - Means and SDs - for 71257 and 70822 by Band for B1, B2, B3, B4, B5, and B7



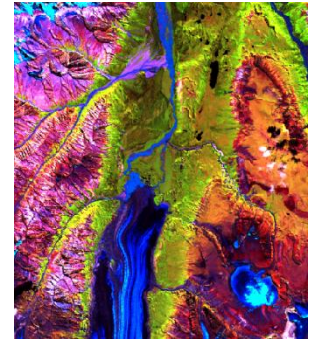
Can We Mask/Model the Correct Types ?

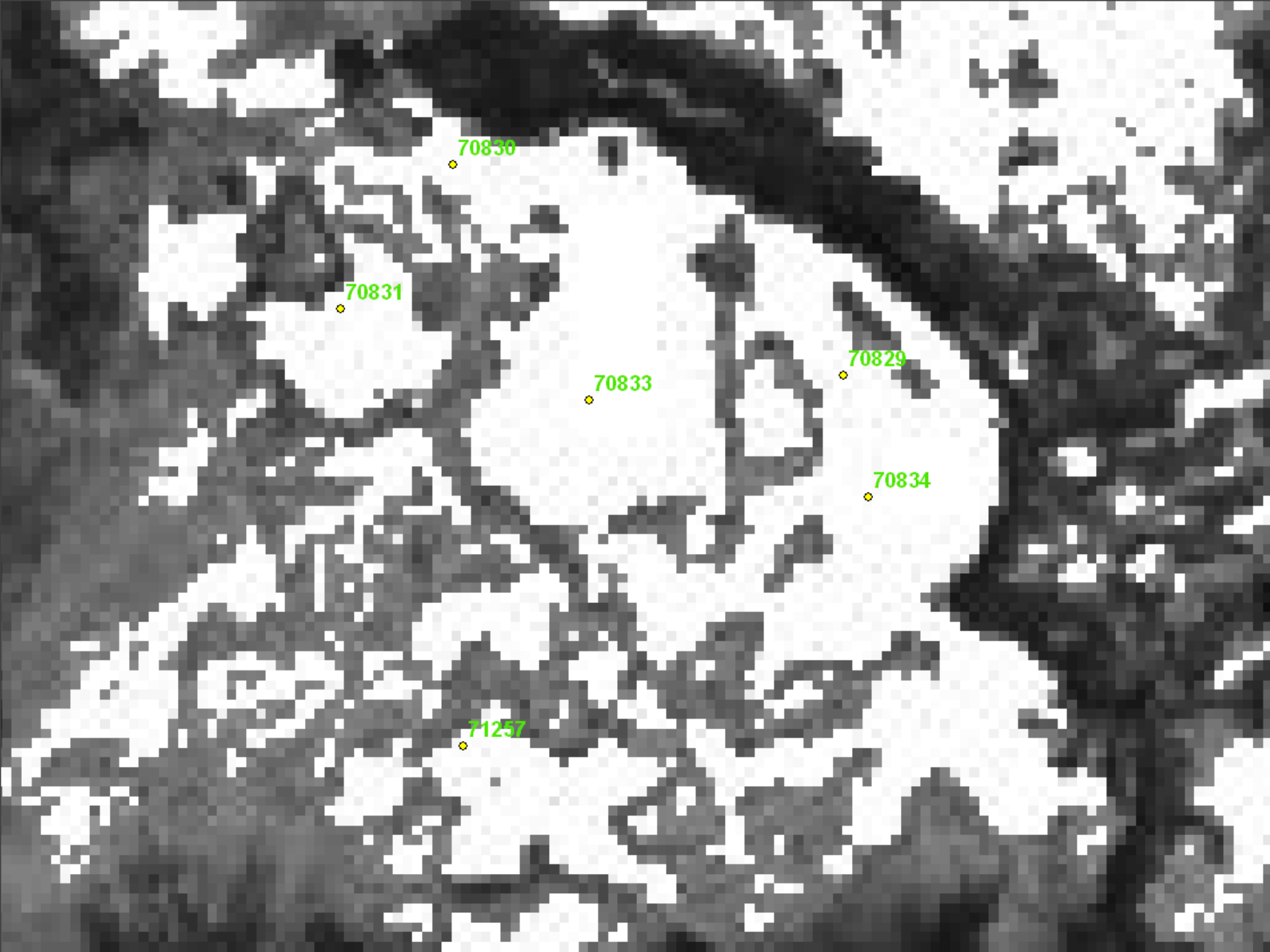
- Attempts to refine training areas failed to separate signatures
- **Different environmental factors ?**
 - Slope, aspect, elevation
- **Different ecotypes ?**
 - Types sometimes occur right next to each other
- **What is different ?**



Resolution

- Use winter imagery to develop a winter mask
 - Band 1 of Landsat 5 imagery
 - Bright areas indicators of flat and non-tree
 - Darker areas indicator of tree and/or shrub cover





70830

70831

70833

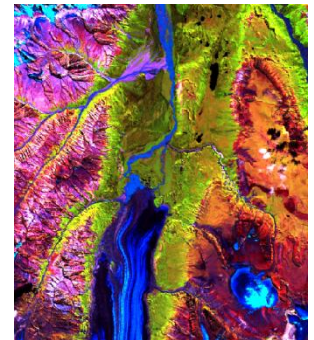
70829

70834

71257

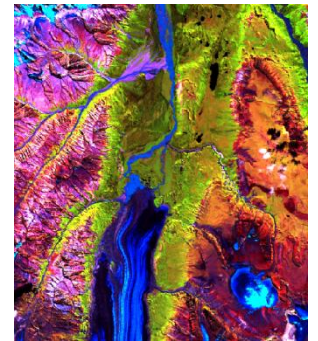
Brightness Relationships

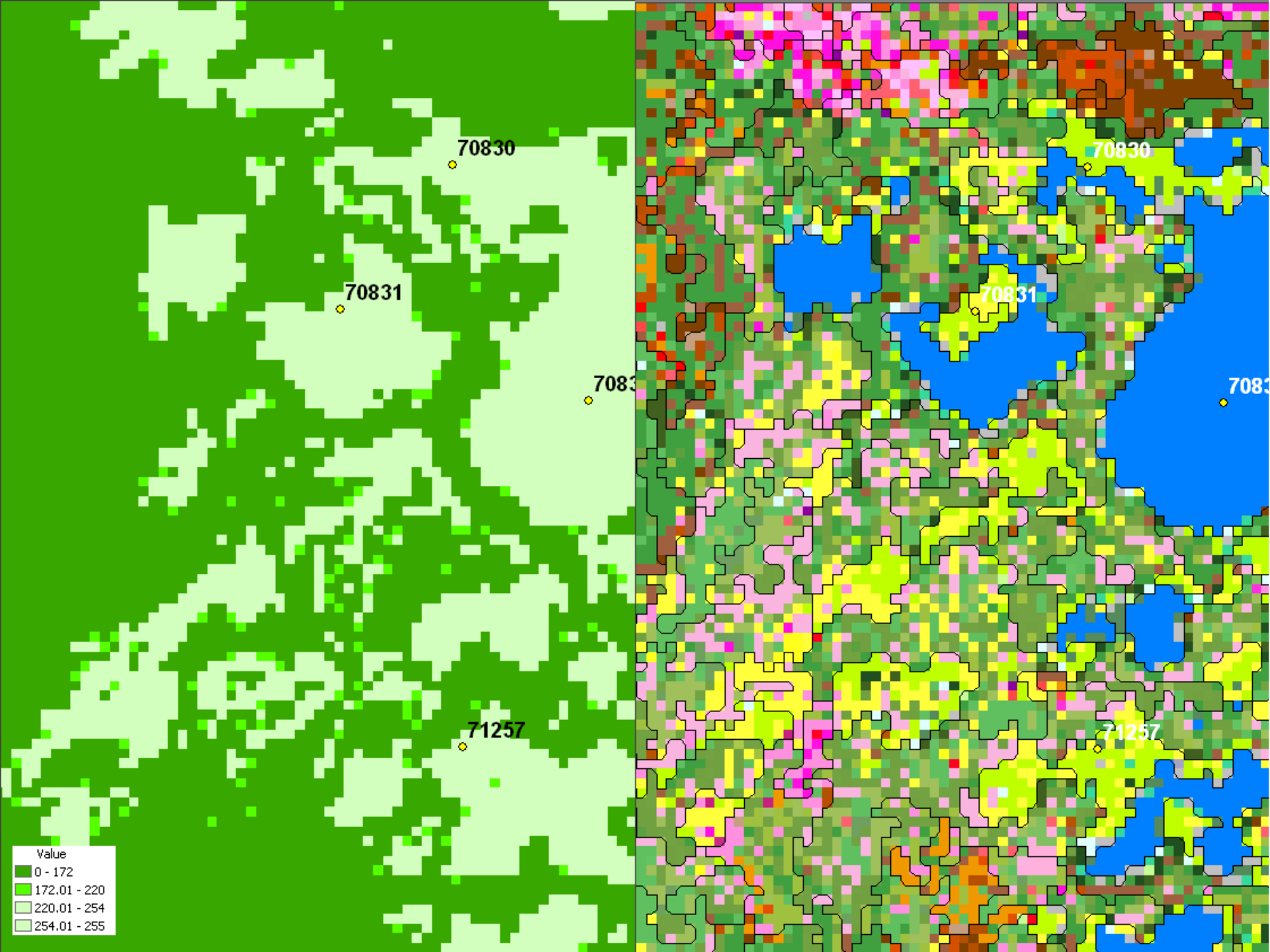
Site Characteristics	Elevation < 5000 feet
Band 1 Data	Slope - Flat ($\leq 5^\circ$)
"Brightest" Values (>220 && ≤ 254)	H5 Wet Herbaceous Types and Sparsest Tree Cover
"Brighter" Values (moderately bright) (>172 && ≤ 220 >	H6 Sparse Tree Cover and Woodland Tree Types and Wet Herbaceous Types
"Darker" Values (≤ 172)	T10 All Tree Types No Wet Herbaceous Types
Undefined (255)	H5 (See "Brightest " above)



Resolution

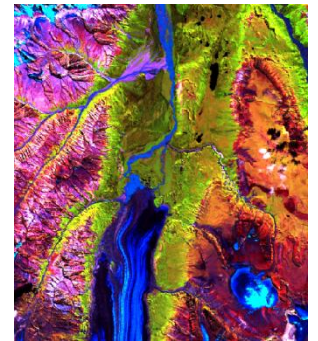
- **Develop a winter mask**
 - Band 1 of Landsat imagery
 - Use brightness to identify or mask different types
 - Bright areas indicators of flat and non-tree
 - Darker areas indicator of tree and/or shrub cover
- **Segregate training data into appropriate subsets that conformed to mask criteria**
 - Classify by training subsets within each masked class
 - Increased effort and complexity
 - Greatly improved results





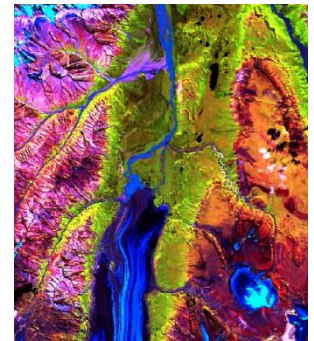
White Spruce-Black Spruce Confusion

- Skepticism that species can be distinguished
- Often mapped as “Needleleaf Conifer”



White Spruce-Black Spruce Confusion

- Typically Woodland densities
- Similar form
- Similar stand structure
- Species can be difficult to distinguish
 - from the air
 - on the ground
- Mixed composition does occur







18 2:25 PM



.....
Bad Confusion:

Trsite_id:	70518	2	2000	HrC	Graminoid	0	0	15	0	70	0	15	108	1	38	
Training Set	Confused trsite_id	J-M Dist	Eco-Type	Iso Class	Cover Type	Calculated Class	Tree Cover	Pct Conifer	Shrub Cover	Dsh Cover	Forb Cover	Bar. Cover	Oth Cover	Aspect	Slope	Elev
6118Sup	70532	1.072	2	2000	PSi	Sitka Spruce:Closed	70	90	10	0	0	15	5	131	1	393

.....
Good/Acceptable Confusion:

Trsite_id:	70220	7	7000	TSA	Tall shrub:Closed:Alder	0	0	80	0	20	0	0	239	40	1457	
Training Set	Confused trsite_id	J-M Dist	Eco-Type	Iso Class	Cover Type	Calculated Class	Tree Cover	Pct Conifer	Shr Cover	Dsh Cover	Forb Cover	Bar. Cover	Oth Cover	Aspect	Slope	Elev
6118Sup	70527	1.114	7	7000	TSh	Tall shrub:Closed:Mix	5	0	85	0	5	5	0	149	28	1519
6118Sup	70529	1.246	7	7000	TSA	Tall shrub:Closed:Alder	15	33	80	0	5	0	0	279	19	1215
6118Sup	70510	1.398	7	7000	TSA	Tall shrub:Closed:Alder	0	0	90	0	10	0	0	211	23	774

Trsite_id:	71669	12	0	PGL	White Spruce:Open	36	97	4	0	0	0	60	315	0	2469	
Training Set	Confused trsite_id	J-M Dist	Eco-Type	Iso Class	Cover Type	Calculated Class	Tree Cover	Pct Conifer	Shr Cover	Dsh Cover	Forb Cover	Bar. Cover	Oth Cover	Aspect	Slope	Elev
65678Sup	71672	0.845	12	0	PGL	White Spruce:Closed	60	100	10	0	10	0	20	167	12	2594
65678Sup	71903	0.893	3	0	PGL	White Spruce:Open	35	100	31	15	1	0	18	159	1	1496
6467aSup	71672	1.050	12	0	PGL	White Spruce:Closed	60	100	10	0	10	0	20	167	12	2594
6567Sup	72113	1.070	3	3000	PGL	White Spruce:Open	42	83	15	0	5	0	38	66	3	931
65678Sup	72102	1.165	3	3000	PGL	White Spruce:Open	45	88	5	0	3	5	42	22	1	1497
6567Sup	71861	1.174	3	21306	PHw	Mixed decid-conifer:Open	57	61	10	10	5	0	18	172	1	1298
6567Sup	71672	1.212	12	0	PGL	White Spruce:Closed	60	100	10	0	10	0	20	167	12	2594
65678Sup	71163	1.234	5	21004	PGL	White Spruce:Closed	61	98	6	10	3	5	15	39	0	2157
6467aSup	70954	1.325	6	21036	PGL	White Spruce:Open	25	100	25	0	1	5	44	143	6	3471
65678Sup	71864	1.377	3	21306	PGU	White Spruce Cmplx:Closed	65	76	30	0	0	0	5	186	14	1449

Trsite_id:	71970	1	21327	PMA	Black Spruce:Open	30	100	30	30	0	0	10	205	2	1772	
Training Set	Confused trsite_id	J-M Dist	Eco-Type	Iso Class	Cover Type	Calculated Class	Tree Cover	Pct Conifer	Shr Cover	Dsh Cover	Forb Cover	Bar. Cover	Oth Cover	Aspect	Slope	Elev
65678Sup	71855	0.756	3	21327	PMA	Black Spruce:Open	35	100	25	20	0	0	20	135	1	1560
65678Sup	71852	0.843	3	21399	PMA	Black Spruce:Wdlnd	22	100	15	35	10	0	18	169	2	1218
65678Sup	71901	0.956	3	3000	PMA	Black Spruce:Wdlnd	20	100	20	5	4	0	51	297	1	1526
65678Sup	71969	0.965	1	21399	UP	Spruce Mix:Open	40	100	15	30	0	0	15	185	4	1976
65678Sup	71853	1.121	3	21414	PMA	Black Spruce:Wdlnd	23	100	20	20	12	0	25	0	0	1801
65678Sup	71024	1.164	1	21399	PGL	White Spruce:Open	35	100	6	25	0	0	34	352	1	2416
65678Sup	71207	1.260	3	21327	PMA	Black Spruce:Wdlnd	20	100	26	10	4	5	35	38	4	1395
65678Sup	71758	1.268	1	21399	PMA	Black Spruce:Wdlnd	20	100	15	0	6	9	50	328	1	1848

Confusion and Fidelity Reports

Trsite_id:	71613	3000	346	3	2197	PGI	White Spruce:Open	40	100	20	0	2	
Training Set	Confused trsite_id	J-M Dist	Iso Class	Aspect	Slope	Elev	Cover Type	Calculated Class	Tree Cover	Pct Conifer	Shr Cover	Dsh Cover	For Cov
65678Sup	72101	0.927	3000	58	4	1442	PMa	Black Spruce:Open	26	96	25	5	1
65678Sup	71904	1.015	3600	327	2	1562	PMa	Black Spruce:Wdlnd	20	100	15	0	1
65678Sup	70916	1.052	21408	281	1	2327	PMa	Black Spruce:Closed	65	100	13	2	1
65678Sup	72117	1.173	3000	45	2	1555	UP	Spruce Mix:Wdlnd	15	100	35	15	1
65678Sup	71921	1.365	0	319	3	2379	PMa	Black Spruce:Open	30	100	25	20	1
65678Sup	72118	1.381	3000	305	4	1545	PMa	Black Spruce:Wdlnd	15	100	23	0	1

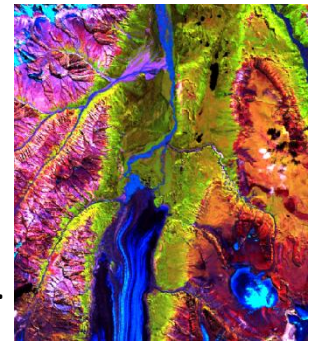
Source	trsite_id	Comments	Type-Match	Self-Match	Percent Pure	#pixels	Type	pr_comp	pr comp cover	cover class	tree cov	other veg cov
6467sSup	71613	Mixed Spruce:Open	nn	N	15.1%	86	UP	Black Spruce	15	Open	28.1	46.8
TrainCall	71613	White Spruce:Open			TR		PGI	White Spruce	40	Open	40	40
	71613										DIFF	

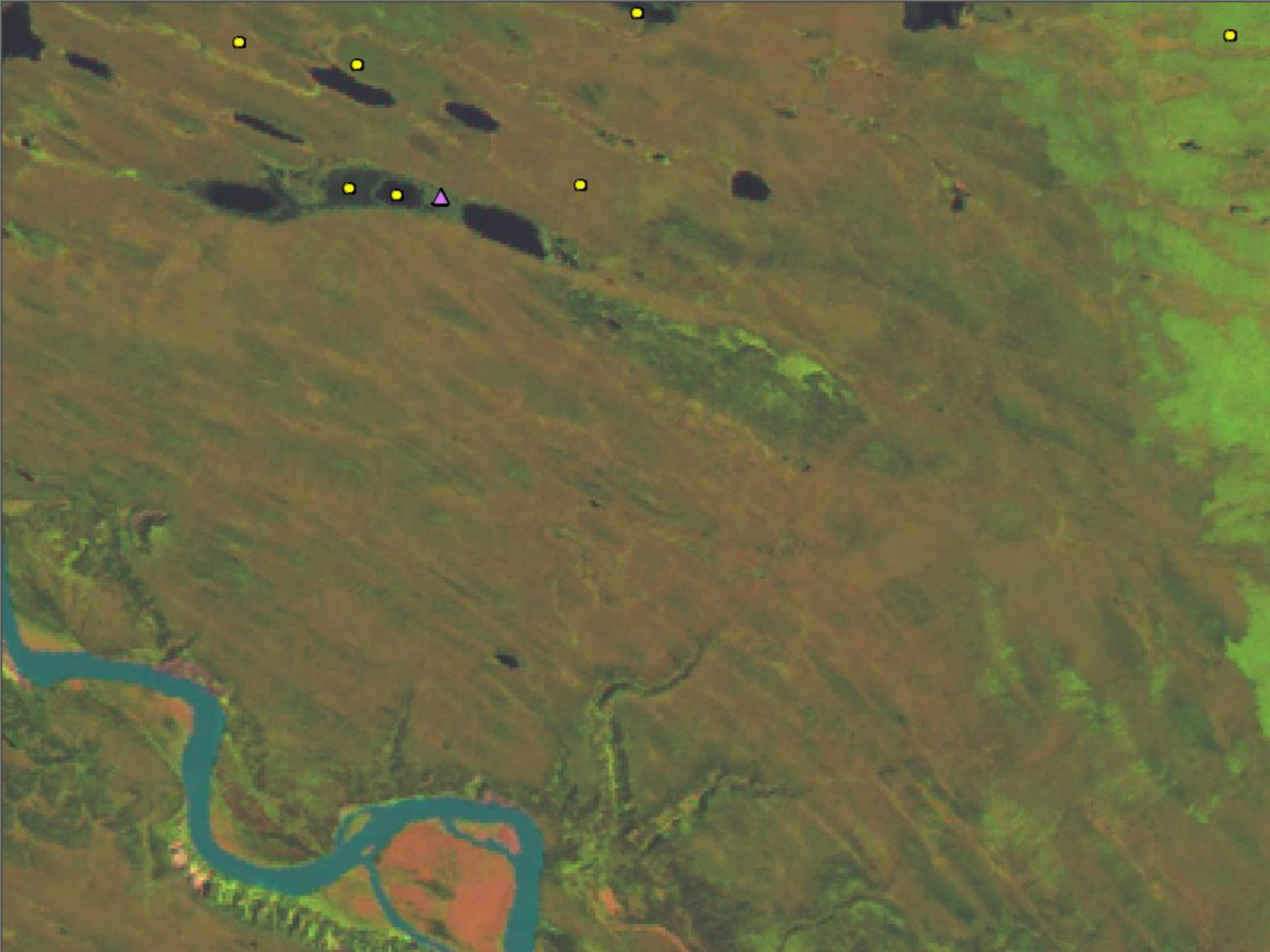


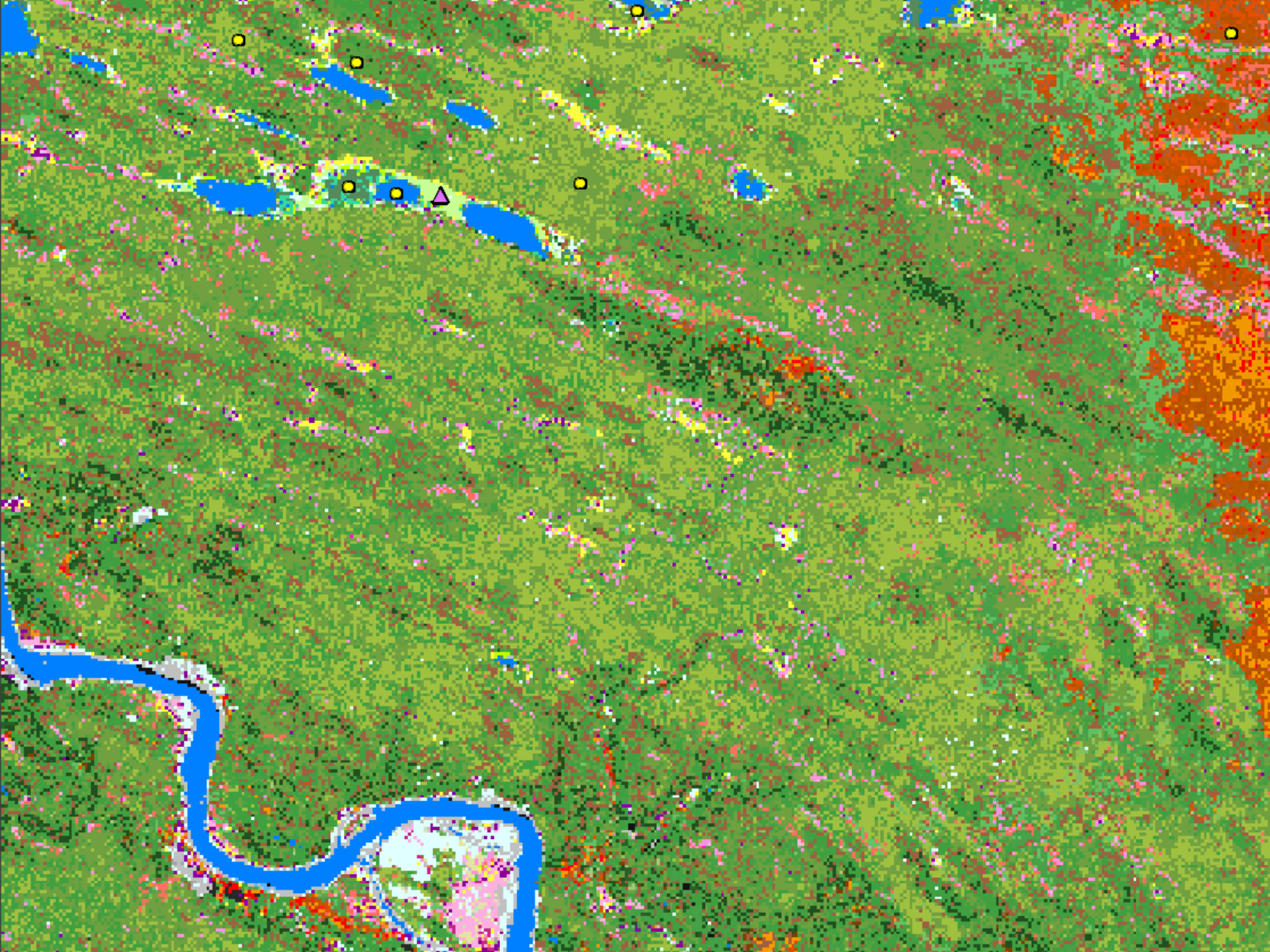


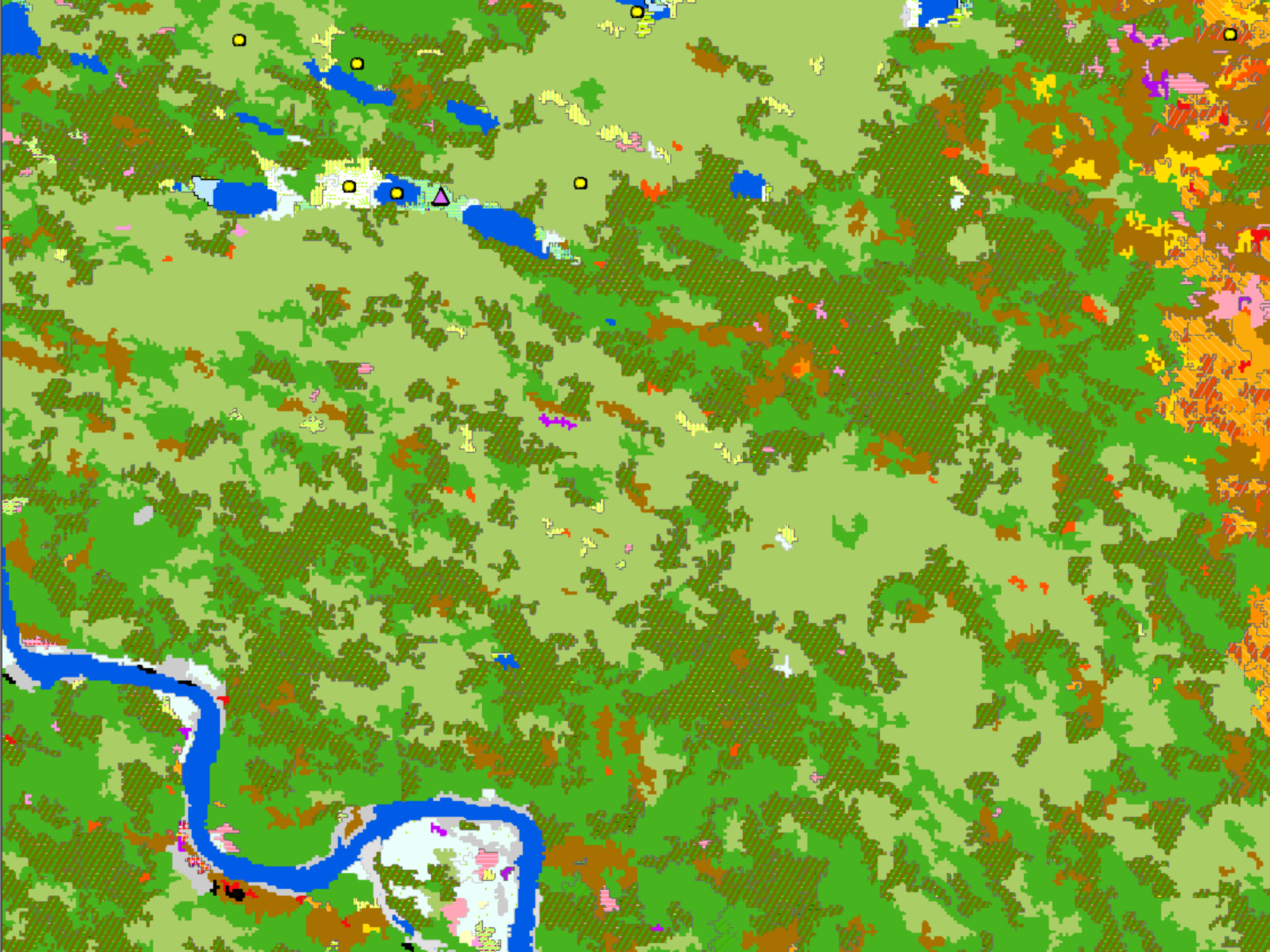
Resolution

- **Correct species identification - consensus**
- **Discrete Classification**
 - Do not cluster similar sites when developing training signatures
- **Spruce mask**
 - Elevation limits derived from botanical field observations
 - Excluded Black Spruce above 3200 feet, White Spruce above 5000
 - Limited distribution of Black Spruce
 - Excluded from White River Valley , Bremner River, upper Chitina,
- **Mixed-Spruce type**



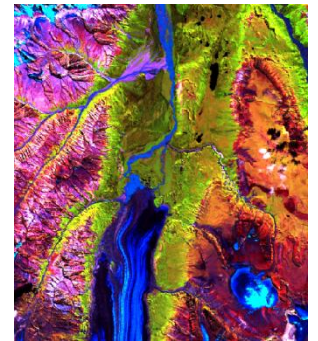






Live versus Dead Canopy Cover

- **Variable component of dead tree cover**
 - Mix of dead and alive
 - Nearly all dead
- **How is it counted in developing the type call ?**
 - Type definitions do not recognize dead tree cover
- **Misnomer to ignore**
 - Crosswalk to fire fuel models
 - Wildlife habitat suitability
 - Successional modeling



Polygon code: 070710 Lat/Long: / Azimuth: Slope (0-100 °): Aspect (0-360 °):
 Surveyors: C. Cater, K. Stump, J. Grunblatt Landcover class code: Landcover class name:
 Photos: Roll #: Frame # Dig photo: ses. #: photo #: azimuth:
 Modifier(circle all that apply): Alpine Subalpine Upland Lowland Riparian Boreal Tussock Bog Meadow Video:tape #: Footage:
 Hydrologic Regime (circle one): Dry - Mesic - Wet - Aquatic % Tussocks: Landform:

Hgt (m)	Tree (>5m)	%	Tall shrub (5m > 1.5m)	%	Low shrub (1.5m > 20cm)	%	Dwarf shrub (>20 cm)	%	Herbaceous	%	Herbaceous including moss, lichen & bare	%	
10	Picegia - live	7			Led gro	20	UK Shrub	5			Moss	15	
2	P. cgia - dead	5			Salix 1	10			UK Forb	10	Lichen - whitish	5	
					Salix 2	5					Soil	5	
					Betnan?	10					Litter	3	
Total		12	Total		Total		45	Total		5	Total		28

100

Spruce >5m	Deciduous forest	Mixed forest <=25% tree	Low shrub 20cm - 1.5m	Dwarf shrub 25-100%, <20cm	Herbaceous 25-100%	TOTAL
Closed White Spruce 60-100%	Closed Mixed 60-100%	Closed Mixed 60-100%	75-100%/sp	Dryas Dwarf Shrub >50%/sp	>50%g, <25% huss	
Open White Spruce 25-59%	Closed Birch >50%/sp	Open Mixed 25-59%	Closed Low Alder-Willow	Mixed Dwarf Shrub	Dry/Mesic Graminoid	
Open Black Spruce	Closed Aspen	Woodland Mixed 10-24%	Closed Low Shrub Birch-Willow	Mixed Dwarf Shrub-Sedge	>25% n, >25% forb, <25% huss	
Open Stunted Spruce-PIMA	Closed Balsam Poplar	Tall shrub >1.5m	Closed Low Willow	Mixed Dwarf Shrub-Lichen	Dry/Mesic Graminoid-Forb	
Open Spruce Lichen	Closed Mixed Deciduous >25%	Closed Tall Alder-Willow 75-100%	Closed Low Shrub Birch-Ericaceous Shrub-Willow	Mixed Dwarf Shrub-Rock >25% rock	Tussock >25% huss	
Woodland Spruce 10-24%	Open Birch >50%/sp	Closed Tall Alder 75-100%	Closed Low Shrub Birch	Mixed Dwarf Shrub-Rock	>50% emerg herb	
Woodland Stunted Spruce	Open Aspen	Closed Tall Willow	Open Low Alder-Willow		Wet Salt Marsh Herbaceous	
Woodland Spruce Lichen	Open Balsam Poplar	Open Tall Alder 25-74%	Open Low Alder		Wet Freshwater Herbaceous	
Other	Open Mixed Deciduous >25%	Open Tall Willow	Open Low Shrub Birch-Ericaceous Shrub-Willow		Aquatic >50% submerged, floating or penn h20	
Marine Mudflat <15%	Bedrock <15%	Silty Water	Open Low Willow		Sparse Vegetation 15-25%	
Sand/Gravel <15%	Shadow/Indeterminate	Clear Water	Open Low Shrub Birch-Ericaceous Shrub		rock gravel talus	
			Snow/Ice	Human Development	sand mud soil	
			Marine Water	Burn Site		

INCLUSION:	COMMENTS: photo 42-46
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7 4:35 PM



21 11:52 AM

Confusion with Tree Types

Trsite_id:	72106	3000	35	4	786	PGU	White Spruce Cmplx:Open	50	90	5	5	0	0	40
Training Set	Confused trsite_id	J-M Dist	Iso Class	Aspect	Slope	Cover Elev Type	Calculated Class	Tree Cover	Pct Conifer	Shr Cover	Dsh Cover	Forb Cover	Bar. Cover	Oth Cover
6467sSup	71810	0.895	11000	160	4	1965 PG1	White Spruce:Open	30	100	10	20	5	5	30
6467sSup	71861	0.944	21306	172	1	1298 PHw	Mixed deciduous-conifer:Open	57	61	10	10	5	0	18
6467sSup	10702	1.044	0	161	4	1637 PG1	White Spruce:Closed	70	100	10	15	0	0	5
6467sSup	71669	1.142	0	315	0	2469 PG1	White Spruce:Open	36	97	4	0	0	0	60
6467sSup	71808	1.176	10000	12	5	2101 PG1	White Spruce:Open	40	87	30	0	2	5	23
6467sSup	71903	1.180	0	159	1	1496 PG1	White Spruce:Open	35	100	31	15	1	0	18
6467sSup	72102	1.273	3000	22	1	1497 PG1	White Spruce:Open	45	88	5	0	3	5	42
6467sSup	70959	1.323	21040	324	4	3629 PG1	White Spruce:Open	32	93	17	0	0	5	46
6467sSup	71602	1.331	3000	259	0	1563 PG1	White Spruce:Open	35	100	30	0	20	2	13





16 4:22 PM

Confusion with Non-tree Types

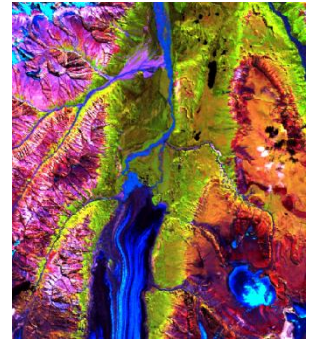
Trsite_id:	71722	11000	23	17	3152	PGU	White Spruce Cmplx:Wdlnd	15	100	55	0	20	0	10	
Training Set	Confused trsite_id	J-M Dist	Iso Class	Aspect	Slope	Elev	Cover Type	Calculated Class	Tree Cover	Pct Conifer	Shr Cover	Dsh Cover	Forb Cover	Bar. Cover	Oth Cover
65678Sup	72012	0.944	0	234	14	3821	TSh	Tall shrub:Closed:Mix	1	0	88	0	9	2	0
65678Sup	72323	1.167	0	230	17	2637	TSA	Tall shrub:Open:Alder	0	0	55	5	30	10	0
65678Sup	72202	1.168	17000	197	27	2033	TSA	Tall shrub:Closed:Alder	0	0	91	0	9	0	0
65678Sup	72129	1.179	0	86	20	3430	TSh	Tall shrub:Open:Mix	5	100	70	0	4	0	21
65678Sup	71623	1.196	0	241	15	3926	TSS	Tall shrub:Closed:Willow	0	0	85	0	15	0	0
65678Sup	10578	1.202	0	206	12	2722	TSh	Tall shrub:Closed:Mix	1	100	85	10	3	0	1
65678Sup	10779	1.220	0	345	10	2538	TSA	Tall shrub:Open:Alder	0	0	55	20	25	0	0
65678Sup	71462	1.244	21301	114	19	3538	TSS	Tall shrub:Closed:Willow	5	100	95	0	0	0	0
65678Sup	71618	1.292	11000	289	23	3678	TSh	Tall shrub:Closed:Mix	0	0	90	5	5	0	0
65678Sup	71663	1.304	21077	279	29	3894	TSA	Tall shrub:Closed:Alder	0	0	80	0	0	0	20

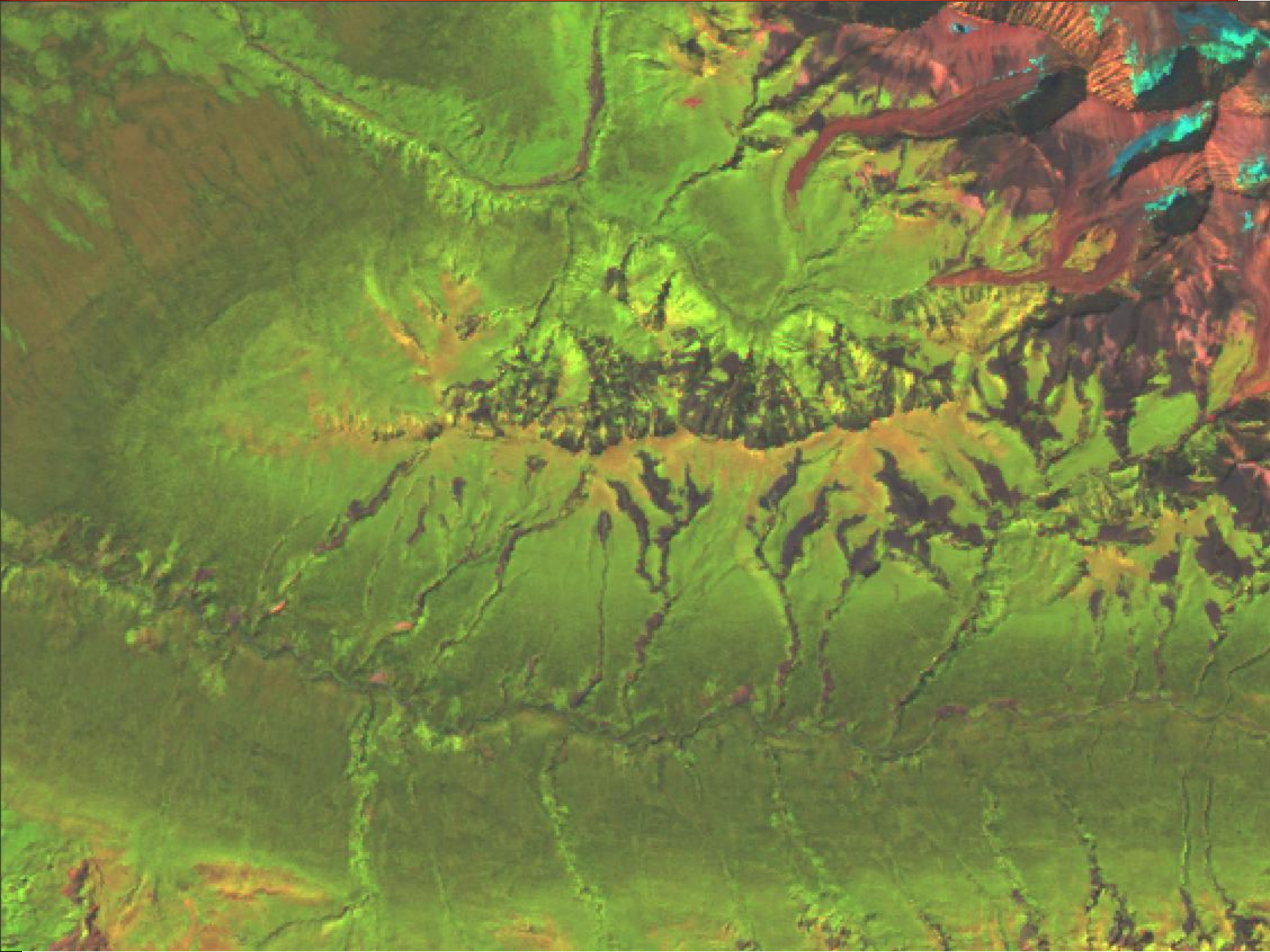


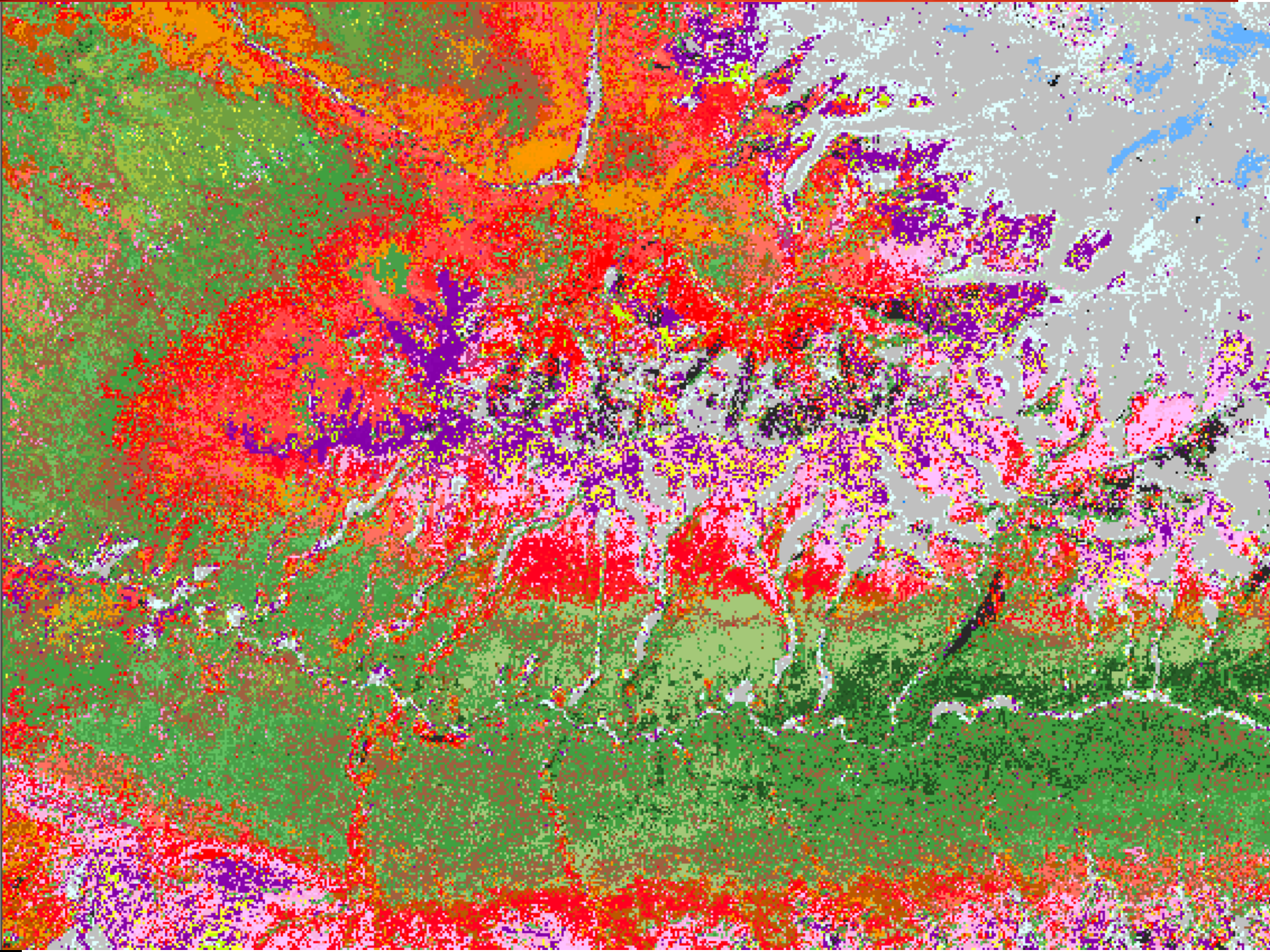
20 1:46 PM

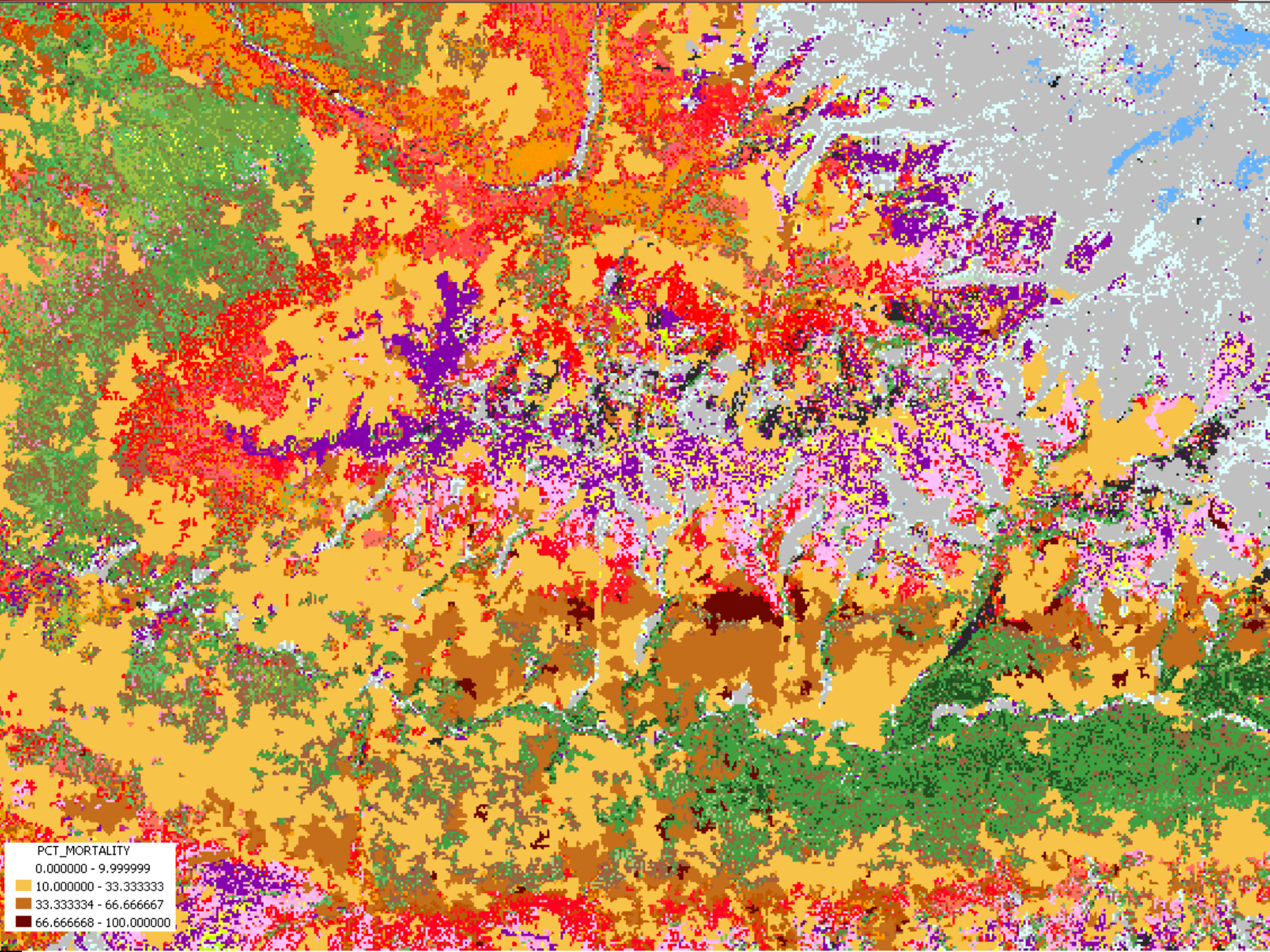
Resolution

- **Discrete Classification**
 - Do not cluster similar sites to develop training signatures
- **Create new type definition modifiers**
 - Mix of living and dead tree cover adds “Complex” modifier
 - Predominantly dead adds “Dead” modifier
- **Over 230,000 acres mapped in WRST**
 - Localized - not randomly distributed



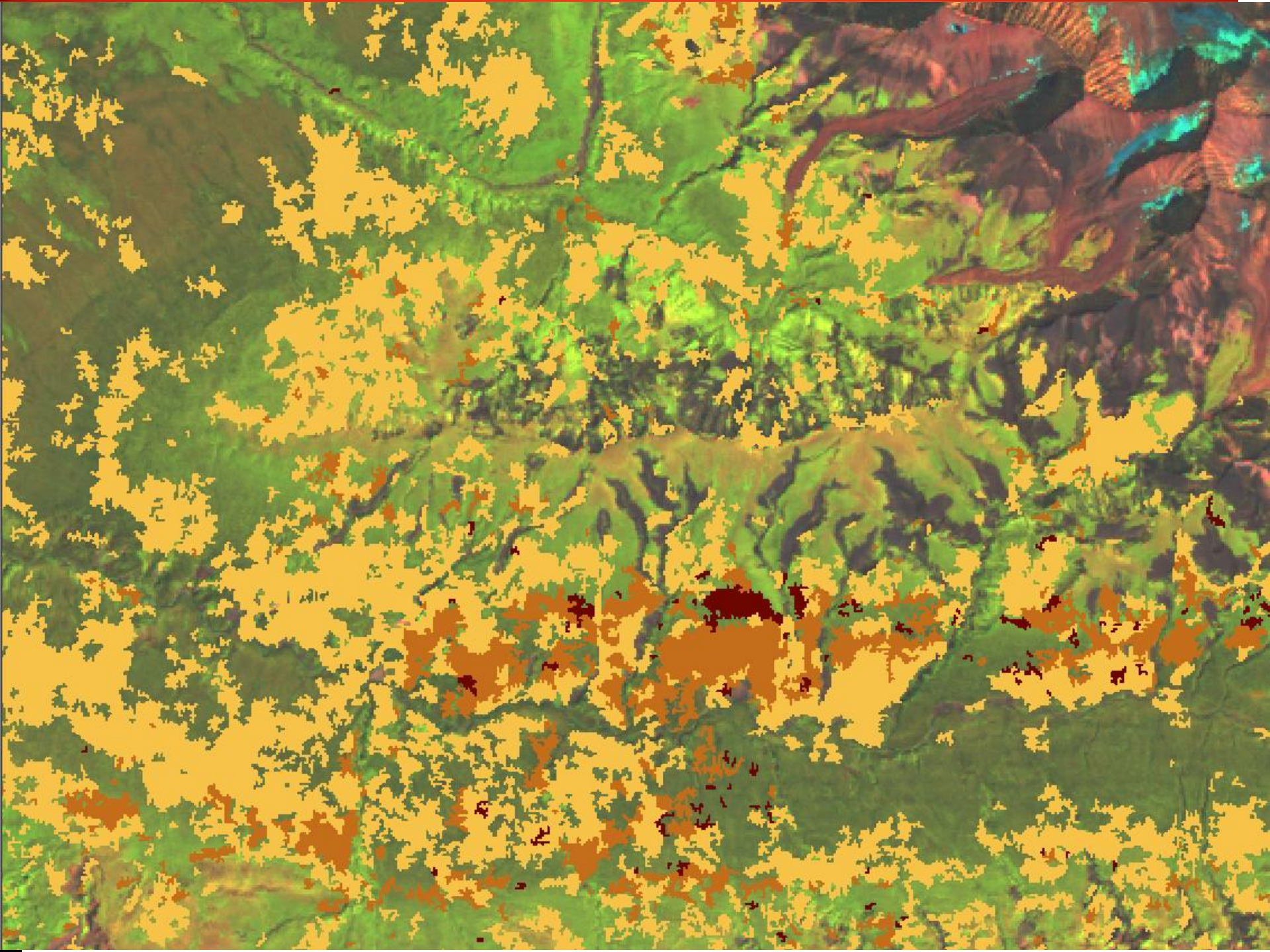






PCT_MORTALITY

- 0.000000 - 9.999999
- 10.000000 - 33.333333
- 33.333334 - 66.666667
- 66.666668 - 100.000000



Conclusions

- **Some types of “bad” confusion should be expected**
- **Problems need to be identified and resolved before making the map**
 - Different ways to recognize problems
 - Different ways to resolve problems
- **Using different methods to process the same imagery and field data can result in very different maps**
- **Species specific types (Viereck Levels IV) can be mapped**
- **Additional descriptive types/modifiers can be added**



Citations

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Questions and Comments

