

Mapping Desert Grassland Community Type with EOS MISR Multi-angle Data and SVM algorithms

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Goal: To improve estimates of above- and belowground C pools in desert grasslands by providing more accurate maps of plant community type, canopy structural parameters, and soil/shrub/grass cover. The ability to model biogeochemical processes depends on knowledge of cover and community type, as well as other parameters. Moderate resolution Earth Observation is the only technology which provides a means to regularly map changes in community type and structure over large areas. Here we evaluate applicability of Multi-angle Imaging Spectro-Radiometer (MISR) data and surface anisotropy patterns derived from kernel-driven and MRPV BRDF models in classification and review the accuracy improvement with SVM algorithms.

Study Area and Date: In the Chihuahuan semi-desert province, the intensive study sites are the Jornada Experimental Range in southern New Mexico near Las Cruces and Sevilleta National Wildlife Refuge in central New Mexico south of Albuquerque, NM. Date from May 24 to June 3, 2002. This period is the end of the dry season. All shrubs are leafed out but grasses and some other small plants are dormant.

Data: The 3 MISR products were used in the experiments. They are (1) the MISR level 1B2 MI1B2T terrain-corrected product, (2) the MISR Level 1B2 MI1B2GEOP Geometric parameters product, and (3) the MISR Level 2 MIL2ASAE aerosol product.

Method: Maximum likelihood classification (MLC) and support vector machine (SVM) classification algorithms were used to perform several classification experiments. The area covered by the Jornada and Sevilleta vegetation maps is around 1492.4 square kilometers (23,978 pixels at 250 meter spatial resolution). We used 15 classes for these classification experiments, where there are 5 classes from the Jornada and 11 classes from the Sevilleta.

Results: The results of the experiments are shown in the following tables and figures. When only spectral data were used the overall accuracies were 45% and 64% for the MLC and SVM methods, respectively; much lower.

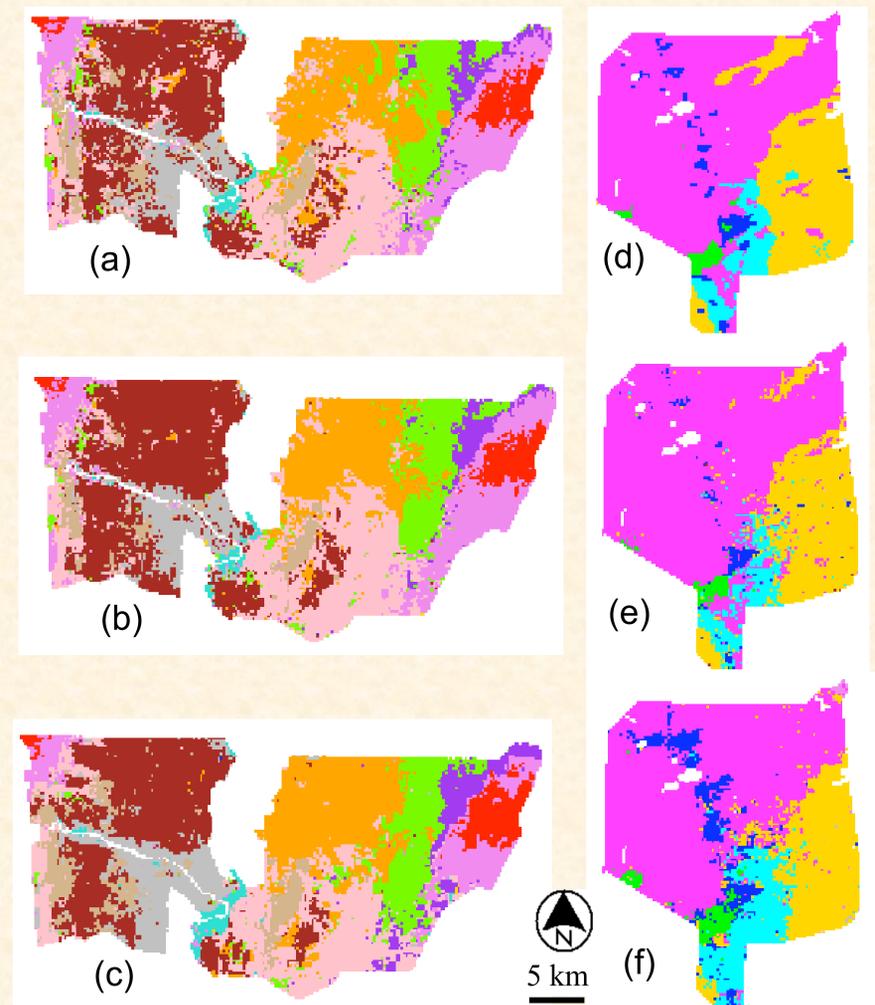


Table 1 Error matrix of the maximum likelihood classification

Classes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Sum	User
1	126	15	1	81	1	0	0	0	0	0	0	0	0	0	0	224	56.2
2	7	213	15	397	26	0	1	0	0	0	0	0	0	0	0	659	32.3
3	3	22	533	224	206	0	0	0	0	0	0	0	0	0	0	988	53.9
4	1	30	6	4863	388	0	0	0	0	0	0	0	0	0	0	5288	92.0
5	4	15	32	217	1703	0	1	0	0	0	0	0	4	0	0	1976	86.2
6	0	0	0	0	0	541	196	27	199	10	0	36	28	0	1	1038	52.1
7	0	0	0	0	0	116	2369	88	412	50	2	158	34	0	2	3231	73.3
8	0	0	0	0	0	17	58	1653	429	199	26	3	3	0	0	2388	69.2
9	0	0	0	0	1	74	243	161	1791	116	26	30	304	0	3	2749	65.2
10	0	0	0	0	0	2	21	164	138	872	77	5	74	0	0	1353	64.4
11	0	0	0	0	0	0	1	6	55	93	309	1	205	0	0	670	46.1
12	1	0	1	1	7	63	387	16	67	10	1	732	54	0	8	1348	54.3
13	0	0	0	26	4	2	16	1	27	16	10	7	887	60	2	1958	83.8
14	0	0	0	0	0	0	0	0	1	0	3	0	143	436	0	583	74.8
15	0	0	0	0	2	4	28	1	18	5	1	25	10	0	128	222	57.7
Sum	142	295	588	5809	2338	819	3321	2117	3137	1371	455	997	1746	496	144		
Producer	88.7	72.2	90.6	83.7	72.8	66.1	71.3	78.1	57.1	63.6	67.9	73.4	50.8	87.9	88.9		72.2

Table 2 Error matrix of the support vector machine classification

Classes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Sum	User
1	88	5	1	18	0	0	0	0	0	0	0	0	0	0	0	112	78.6
2	6	121	11	32	8	0	0	0	1	0	0	0	0	0	0	179	67.6
3	5	22	388	70	79	0	0	0	0	0	0	0	0	0	0	564	68.8
4	40	124	87	5567	255	0	0	0	0	0	0	1	0	0	0	6074	91.7
5	3	20	100	118	1981	0	2	0	1	0	1	2	2	0	0	2230	88.8
6	0	0	0	0	0	446	60	8	82	3	0	20	5	0	0	624	71.5
7	0	1	0	0	0	6	185	2764	80	474	53	1	271	29	0	3870	71.4
8	0	1	0	0	2	16	21	1629	224	153	4	7	4	0	1	2062	79.0
9	0	0	0	0	3	111	246	237	2163	107	31	40	113	0	8	3059	70.7
10	0	1	0	3	0	3	25	150	47	935	86	8	20	0	5	1283	72.9
11	0	0	0	0	0	0	0	1	5	69	266	0	30	0	0	371	71.7
12	0	0	0	0	2	45	171	6	34	5	0	628	15	0	22	928	67.7
13	0	0	1	1	1	10	23	5	105	44	66	11	1455	81	13	1816	80.1
14	0	0	0	0	0	0	0	0	0	0	0	0	71	415	1	487	85.2
15	0	0	0	0	1	3	9	1	1	2	0	9	2	0	88	116	75.9
Sum	142	295	588	5809	2338	819	3321	2117	3137	1371	455	997	1746	496	144		
Producer	62.0	41.0	66.0	95.8	84.7	54.5	83.2	76.9	69.0	68.2	58.5	63.0	83.3	83.7	61.1		79.6

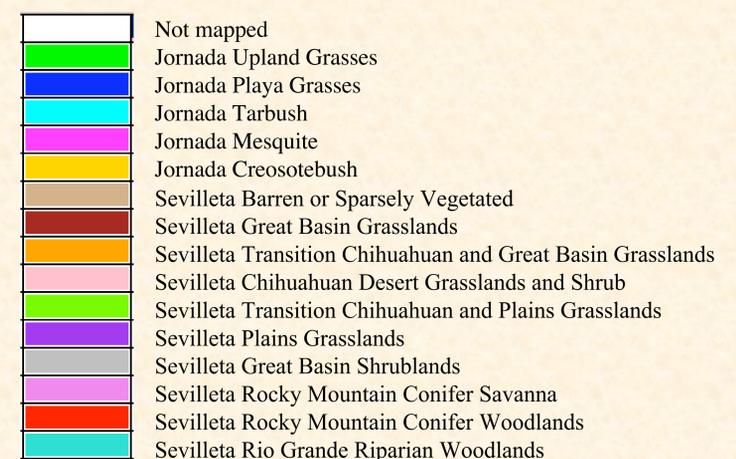


Figure 1. Community Type Maps for: the Sevilleta National Wildlife Refuge and the Jornada Experimental Range. (a) 1998 LTER Vegetation Map (d) 1998 LTER Vegetation Map (b) Support Vector Machine method (e) Support Vector Machine method. (c) Maximum likelihood method. (f) Maximum likelihood method

Conclusions: This research shows that **multi-angular observations, surface anisotropy patterns and SVM algorithms can provide much improved semi-arid vegetation type differentiation:**

- 1) Important additional information is provided by the $\rho\theta$, k , b parameters of the MRPV model and the *iso*, *vol* and *geo* parameters of the RossThin-LiSparseMODIS model in the red and NIR bands; and
- 2) SVM algorithms improve semi-arid vegetation type mapping substantially when used in conjunction with multi-angle data and derived products.