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Ground Sample Data for the Conterminous U.S. Land Cover Characteristics Database

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Abstract

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Ground sample data were collected for a land cover database and raster map that portray 159 vegetation classes at 1 km^2 resolution for the conterminous United States. Locations for 3,500 1 km^2 ground sample plots were selected randomly across the United States. The number of plots representing each vegetation class was weighted by the proportionate coverage of each vegetation class. Field data collected for 2,560 of these plots included dominant vegetation species; coverage, height, and diameter estimates of major tree species; coverage, depth, and density estimates for shrubs and grasses; and photographs of the sample plots. These data were compared to vegetation labels assigned in the USGS, EROS Data Center's Land Cover Characteristics (LCC) database. The vegetation types were comparable in most cases, but the ground data provided labels ordered according to decreasing vegetation frequency. A formal accuracy assessment of the LCC map was not attempted. All data are available on a CD-ROM from the EROS Data Center.

Keywords: vegetation types, vegetation mapping, satellite data

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Introduction

A land cover characteristics (LCC) database and an associated raster map layer, which may serve a variety of land management functions, have been produced by the U.S. Geological Survey's EROS Data Center (EDC) and the University of Nebraska-Lincoln (Loveland and others 1991). The database consists of 159 classes that identify seasonally distinct regions of land cover, attributes that define the characteristics of each class, seasonality, and site characteristics. The LCC database can be remapped through different definitions of land cover and environmental parameters for use in simulation models of processes such as global climate change.

Cover classes were derived using seasonal profiles of Normalized Difference Vegetation Index (NDVI) data from the Advanced Very High Resolution Radiometer (AVHRR) sensor deployed on polar-orbiting satellites operated by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration. The data resolution is nominally 1.1 km. AVHRR coverages were taken from March through October 1990. Daily acquisitions made nearly cloud-free data possible.

The LCC classes provide a framework for assessment of spatial vegetation patterns. Rather than being based on defined mapping units in a land cover classification scheme, the seasonal land cover classes serve as summary units for both descriptive and quantitative attributes. Regions are composed of relatively homogenous land cover associations that exhibit unique phenology and have common levels of primary production. The vegetation labels assigned to each class are generally to the level of species or genus, or both. Examples of vegetation classes include class 107 (lodgepole pine, ponderosa pine, western white pine), class 92 (maple, birch, beech), and class 90 (maple, birch, white pine, red pine).

The database accompanying the map provides ancillary characteristics like elevation, climate, ecoregion, land use/land cover, and major land resource area data for each class. While there are problems with these data (Zhu and Yang 1996) they remain the best current source for broad-scale vegetation mapping. The land cover map reasonably portrays vegetation patterns, but the actual vegetation names associated with each LCC class are not adequate for derivation of secondary map products.

The LCC database is a flexible data set of land characteristics. It incorporates the concept of regionalizing several data layers, thus implying a mixture of land cover types within each class. Land cover regions can be translated to various classification schemes, thereby meeting the requirements of various applications such as endangered species management, forest planning, and ecosystem management. However, it must be recognized that at 1 km resolution, each pixel contains a mosaic of different cover types.

The Forest Inventory and Analysis project of the USDA Forest Service, Southern Forest Experiment Station (Zhu and Evans 1992), produced a map similar to the LCC map but it had just 26 classes that address only forested areas within the conterminous United States while the LCC map has 159 classes covering all vegetation types.

The Fire Behavior Research Work Unit of the USDA Forest Service, Rocky Mountain Research Station, worked with the EROS Data Center to improve understanding of, and vegetation labels for, each LCC class. We used the LCC database and field data to develop a national fuels map for the next generation fire danger/behavior system (Burgan and others 1998).

We discuss the LCC classes rather than assess their accuracy. An alternative validation method (the multivariate composite estimator) for these data presented by Zhu and others (1996) discussed the rationale against performing a conventional accuracy assessment. There are ambiguities within and among the vegetation descriptors for the LCC categories. Indeed, one objective in development of the LCC database was to produce "flexible results that are not application specific" (Loveland and Ohlen 1993). These ambiguities confound a primary tenet of conventional accuracy assessments that the reference data (ground-truth observations) correspond to a predefined classification scheme (the LCC vegetation categories). In their development of the LCC database, Loveland and others (1991) defined vegetation labels subsequent to the classification process to suggest probable vegetation types within each land cover class.

A probability proportional to size sampling design was chosen to represent the variability in the classes. Cost considerations prevented sufficient sample size for many classes. The smaller size classes were dropped from the analysis. Statistical summaries and graphical representations were compiled, and original LCC vegetation category labels were refined to the extent allowed by the ground-truth data.

The purposes of this paper are to: (1) describe the sampling design and statistical summarization of the dataset, (2) present an improved list of major vegetation-type labels for the LCC database, and (3) provide information on how to access the data.

Sampling Design and Statistical Summary

Methods

Plot Selection and Identification—For the national field verification process, 3,500 1 km^2 ground-truth plots were selected. The sample size was determined by estimating what was possible to accomplish in a reasonable amount of time. These plots were distributed proportionally to the number of land pixels in each respective LCC class. That is:

Plots per LCC class = (Pixels per LCC class/total land pixels)*3,500 (1)

Ground-truth plots were located by randomly selecting 700 USGS 7.5 minute quadrangle maps, from a total of 45,000 such maps, within the bounds of the conterminous United States (fig. 1). To achieve the proportionality calculated by equation 1, five 1 km^2 plots were randomly located within each quadrangle map. There were two constraining rules for selection of a pixel as a plot: (1) the selected plot must consist of a single pixel within a group of three or more adjacent pixels of the same LCC class; and (2) LCC classes covering less than 5 percent of the total LCC map area were excluded from sampling.

A plot location overlay was prepared for each 7.5 minute quadrangle map by outlining the locations of the five 1 km^2 plots on a mylar sheet and then placing it on the quadrangle map.

Data Collection—Numerous State and Federal agencies provided field personnel with the majority coming from wildland fire management offices. Knowledge of local plant species was the primary requirement. USGS 7.5 minute quadrangle maps and mylar overlays, black and white National High Altitude Aerial Photos (1:80,000) or National Aerial Photos (1:40,000), a study plan, and a set of annotated training slides were provided to field personnel. They transferred the boundaries of each 1 km^2 plot from the USGS quadrangle map to an aerial photo, then delineated the primary vegetation types within each plot area. Vegetation types that covered less than 10 percent of the plot were not delineated. The sum of the general plot vegetation type coverages totaled 100 percent.

Plot data were recorded on two resolution levels. An overview was based on field assessment of the general character of the entire plot with respect to primary vegetation cover and geomorphology. Within the plot overview, landform was entered as flat plains, highly dissected plains, rolling, or mountainous. Elevation was recorded for the plot center. Soil color was recorded as white, grey, tan, red, brown, or black. Land use was entered as

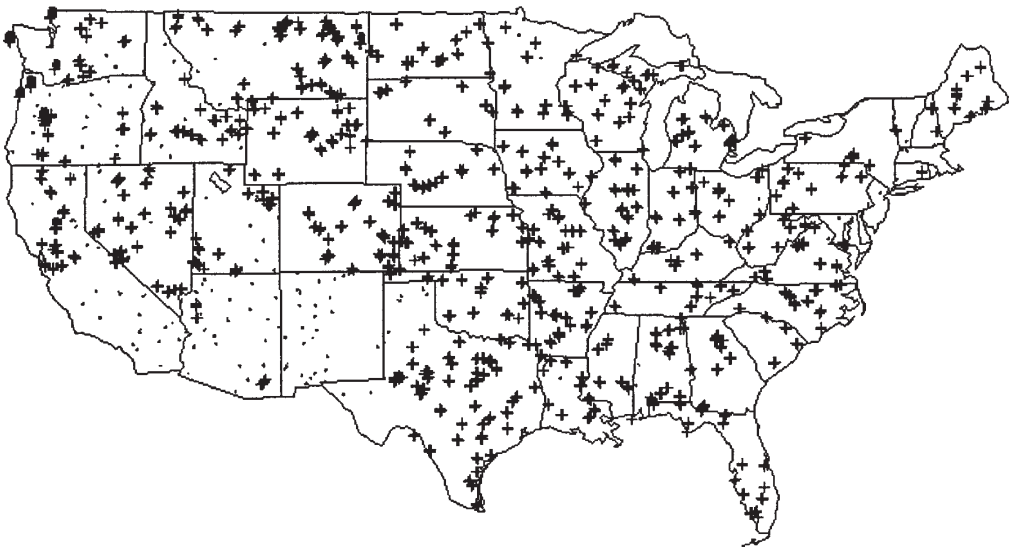

Figure 1—USGS 7.5 minute quads were randomly distributed across the United States. There are five ground-truth plots per quad. Plus signs represent quads for which ground-truth data were collected. Dots represent quads for which ground-truth data were not obtained.

cropland, forestry, military, mining, or ranching. Ocular estimates were made of the proportion of the 17 dominant cover classes plot within each plot:

- Conifer — <30 percent crown closure
- Conifer — 30 to 60 percent crown closure
- Conifer — >60 percent crown closure
- Mixed — <30 percent crown closure
- Mixed — 30 to 60 percent crown closure
- Mixed — >60 percent crown closure
- Deciduous — <30 percent crown closure
- Deciduous — 30 to 60 percent crown closure
- Deciduous — >60 percent crown closure
- Shrub
- Grass
- Shrub/grass
- Agriculture
- Water
- Nonvegetated
- Forbs
- Mosses/lichens

Field personnel then walked into a representative portion of the vegetation type that covered the highest percentage of the 1 km^2 plot area and recorded the following information for the second level of resolution:

- Trees: Percentage cover, average height, and average diameter of up to four major species.
- Shrubs: Morphology, density, percentage cover, and depth of up to four major species.
- Subshrubs: Percentage cover and depth of two major subshrubs.
- Forbs: Percentage cover and depth.
- Mosses: Percentage cover and depth.
- Grass: Morphology, density, percentage cover, depth, and whether annual or perennial.
- Agriculture: Percentage cover and whether or not irrigated, for up to four crop types.

Grass and shrub density estimates were made by comparing actual vegetation with photo-keys of known grass and shrub types and density classes (Burgan and Rothermel 1984). With the exception of depth measurements, all data were obtained through ocular estimates.

Up to four photos were taken of a representative site within each plot. A selected set of these photos was scanned and recorded on a CD-ROM.

The field data from each plot were entered into a relational database, then transferred to the statistical package Splus as input for displaying graphical and tabular summaries for each land cover class. Splus was developed by Statistical Sciences, Inc. The graphical summaries are also on the CD-ROM.

Results

We received and analyzed data for 2,560 of the 3,500 randomly selected field sample plots. The number of observations completed per LCC category is illustrated by the frequency distribution in figure 2. No data were recorded for 33 of the 159 LCC categories—this was the result both of an *a priori* exclusion of LCC categories occupying less than 5 percent of the conterminous

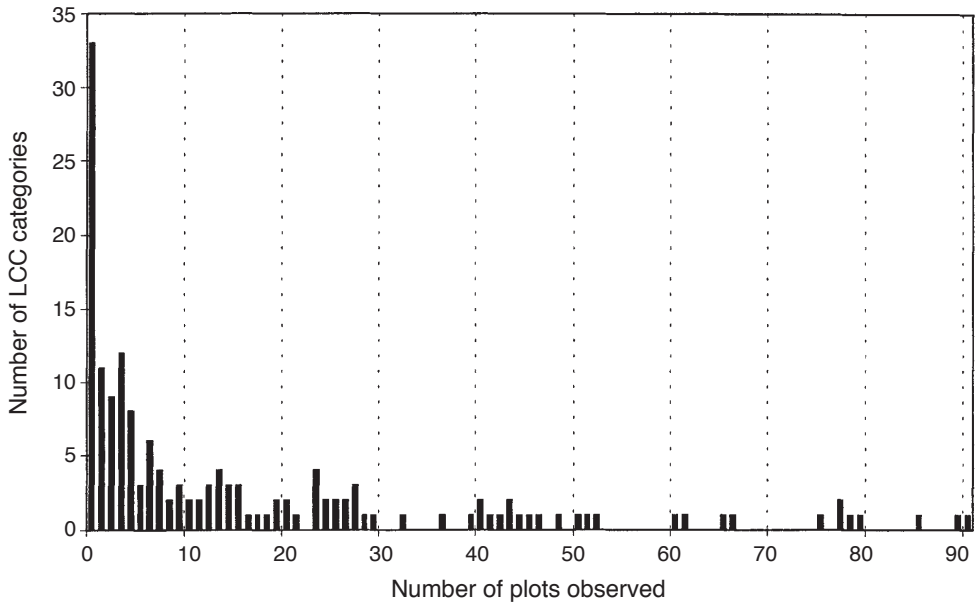

Figure 2—Frequency distribution of the number of land cover characteristics (LCC) class categories (y-axis) that had a given number of observations (x-axis). Example: 33 LCC classes had no observations, 11 classes had 1 observation, 2 classes had 9 observations, and so forth.

U.S. and the inability to acquire data from some field plots. The maximum number of plots completed for any LCC category was 90. Only 4 percent of the 159 LCC categories were represented by more than 75 plots, which is the minimum number recommended for an accuracy assessment (Congalton 1991). Another 4 percent of the LCC categories had 51 to 75 plots; 13 percent had 26 to 50 plots; 30 percent had 6 to 25 plots; and 27 percent had only 1 to 5 plots per LCC category.

Although a map accuracy assessment was not possible, the plot data were summarized graphically. Examples of all available graphs is beyond space limitations, so they are summarized in table 1. Four types of graphs were utilized: box plots with whiskers, bar charts, line graphs, and polar plots. Sample graphic outputs for LCC class 122 are presented in figures 3 to 6.

Figure 3 summarizes overall plot data from the plot overview form. These data relate to the entire 1 km^2 ground-truth plot and reflect plot coverage estimates by cover type as obtained from type mapping on the aerial photos. The graphical summary includes bar graphs showing the number of plots on which each of the 17 general cover types dominate (fig. 3a), the number of plots where the cover types exists (fig. 3b), and the median percent cover where the cover type exists (fig. 3d). Figure 3c is a box plot showing the proportion of the plot in each cover type. The box plots with whiskers show the median value as a dot within the box; the ends of the box designate the first and third quartiles. The whiskers above and below the box represent 1.5 times the inner quartile range, which given a normal distribution, should include 95 percent of the data. Outliers are shown as dots beyond the whiskers.

Figure 4 summarizes data observed within a representative area of the dominant vegetation type, as recorded for four dominant tree species on the

Table 1—Statistical summary graphics available for most land cover classes.

Graphic subject	Graph type
Number of plots where cover type is dominant	Bar chart
Number of plots where cover type exists	Bar chart
Proportion of plot covered by cover type	Box plo
Median percent cover where cover type exists	Bar chart
Number of plots by land use class	Bar chart
Number of plots by soil color	Bar chart
Number of plots by land form	Bar chart
Number of plots by major land resource area	Bar chart
Number of plots by ecological region	Bar chart
Number of plots by land use/land cover	Bar chart
Number of plots by USGS 7.5 minute quadrangle map	Bar chart
Plot elevation (ground-truth and LCC determination)	Box plot
NDVI quartiles for 8 monthly periods	Box plot
1990 NDVI plot profiles for 8 monthly periods	Line graph
1990 NDVI median absolute deviations about the median	Line graph
Duration of growing season by year	Box plot
Time integrated new growth NDVI by year	Box plot
Time integrated growing season NDVI by year	Box plot
Maximum baseline NDVI by year	Box plot
Onset of growing season by year	Polar plot
End of growing season by year	Polar plot
Period of maximum NDVI by year	Polar plot
NDVI value at onset of growing season by year	Box plot
NDVI value at end of growing season by year	Box plot
Maximum NDVI value by year	Box plot
Rate of senescence by year	Box plot
Rate of greenup by year	Box plot
Percentage distribution of neighboring pixels by LCC class	Bar chart
Plot count of neighboring pixels having same LCC class	Bar chart
Plot count of major tree species	Bar chart
Proportional representation of major tree species	Box plot
Mean height of major tree species	Box plot
Mean diameter of major tree species	Box plot
Plot count of major shrub species	Bar chart
Shrub density class by species	Box plot
Proportional representation of major shrub species	Box plot
Average shrub height by major shrub species	Box plot
Plot count by shrub stem and leaf morpholgy class	Bar chart
Shrub density class by stem and leaf morphology class	Box plot
Proportional representation by stem and leaf morphology class	Box plot
Average shrub height by stem and leaf morphology class	Box plot
Plot count of subshrub species	Bar chart
Proportional representation of subshrubs by species	Box plot
Average subshrub height by species	Box plot
Plot count of forb coverage by percent ranges	Box plot
Plot count of forb depth by height ranges	Box plot
Plot count of moss and lichen coverage by percent ranges	Box plot
Plot count of moss and lichen depth by height ranges	Box plot
Plot count of grass morphology classes	Box plot
Plot count of annual and perennial grass types	Box plot
Grass density class for continuous and clumped grasses	Box plot
Proportion of continuous and clumped grasses	Box plot
Average grass depth by continous and clumped grasses	Box plot
Plot count by dominant agricultural crop type	Bar chart
Proportional representation by dominant agricultural crop type	Box plot
Percent irrigated by crop type	Bar chart

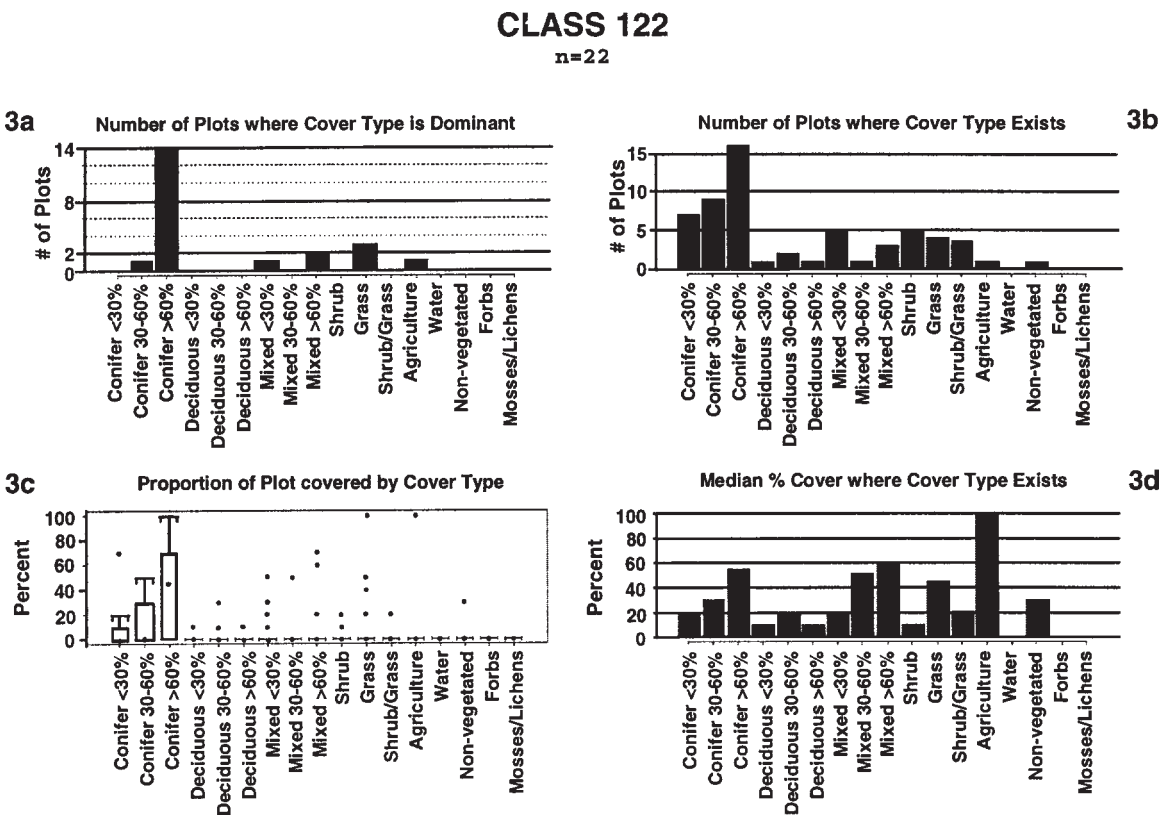

Figure 3—Example, graphical summary of plot overview data.

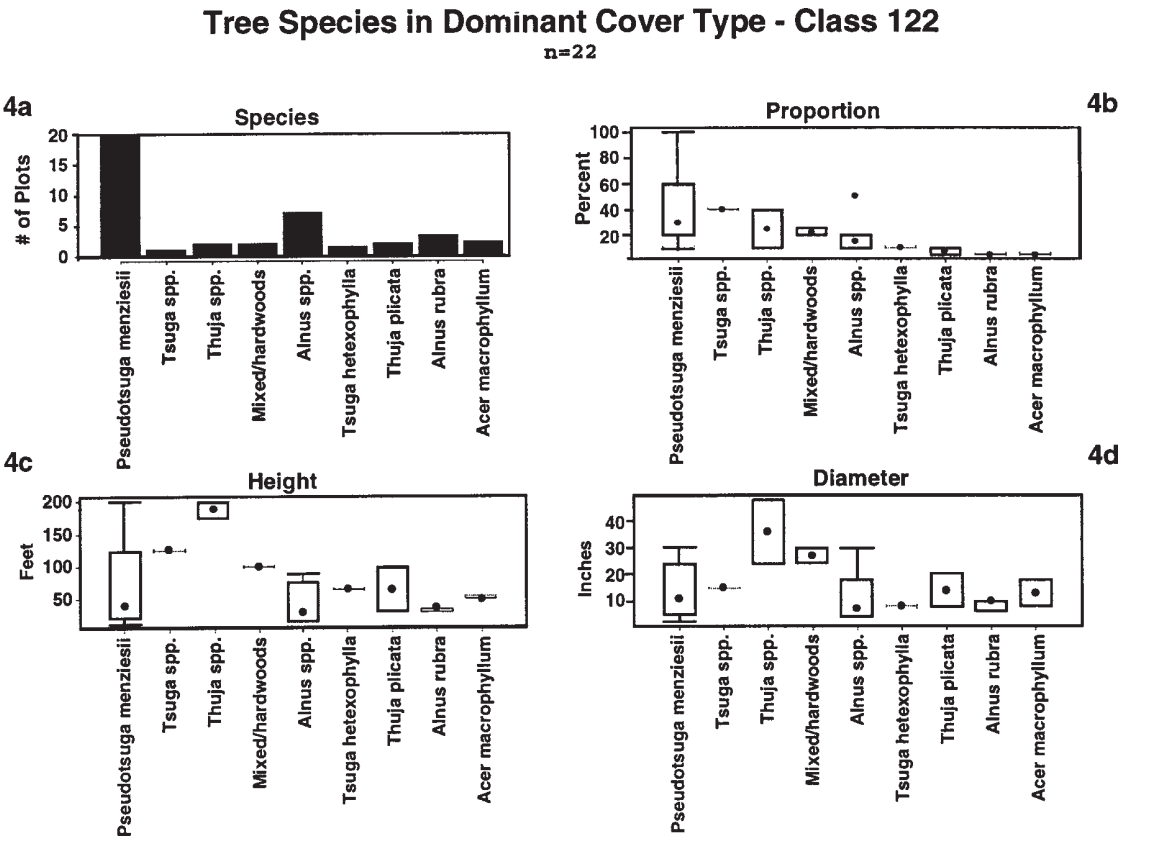

Figure 4—Example, graphical summary of data observed within a representative area of the dominant vegetation type.

upper portion of the dominant cover data form. The information is presented as a graphical summary of the number of plots by tree species (fig. 4a), the proportional occurrence by species (fig. 4b), and the mean height and diameter (fig. 4c, 4d).

Figures 5 and 6 summarize NDVI-related data rather than ground-sampled information (Reed and others 1994). The box plots of figure 5 summarize statistics on the length of the growing season, in number of biweekly periods (fig. 5a); the sum of biweekly Normalized Difference Vegetation Index (NDVI) values during the period of increasing vegetation greenness, by year (fig. 5b); the sum of biweekly NDVI values during the entire growing season, by year (fig. 5c); and the maximum NDVI for the land cover class, by year (fig. 5d).

Figure 6 is a polar plot illustrating when greenup occurred. The point at which the radius line meets the circle indicates the composite period and the percentage number indicates how often greenup occurred for the most frequently occurring composite period. For example, for LCC class 122, in 1991, the onset of greenup for 41 percent of the samples occurred in composite period 3, which is late January to early February. Other numbered nodes within the circle show the relative amount of greenup that occurred during those composite periods, with the center of the circle indicating zero greenup. For example, since node 2 is about ¾ of the distance from the center of the circle to the edge, greenup occurred ¾ as often in the mid-January composite period as in composite period 3, the most frequent greenup composite period. The sum of the greenup percentages for all the nodes is 100.

Vegetation Labels

In addition to providing statistical summaries of the ground-sampled data, a major objective of the study was to improve the vegetation labels attached to each land cover class in EDC's original LCC database. This was accomplished by using Splus routines to determine the four most frequent primary vegetation types within each land cover class. The results, in table 2, provide a comparison between the LCC map vegetation labels and the ground-observed primary vegetation types. The species listed in the LCC map

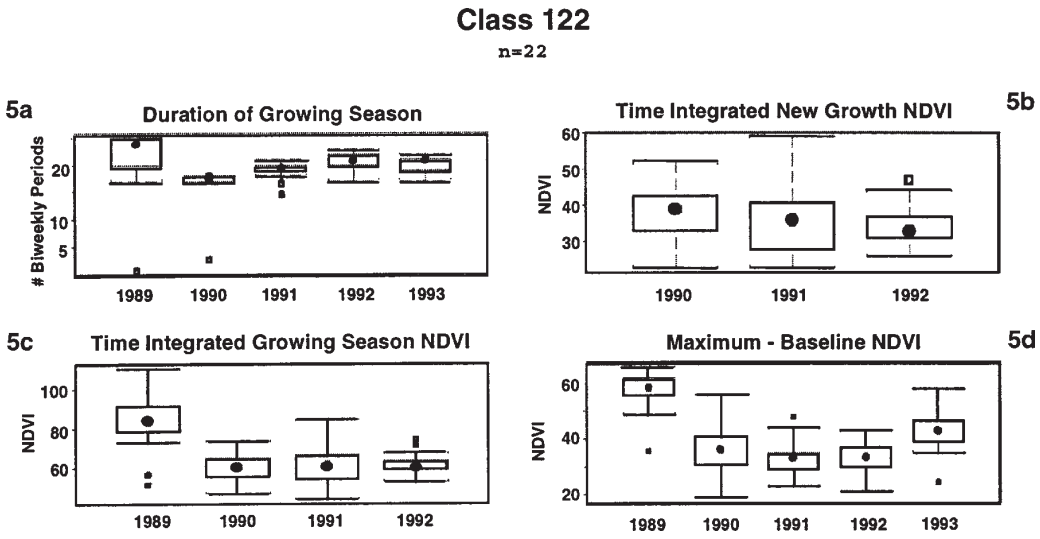

Figure 5—Graphical summary, growing season length for an LCC class.

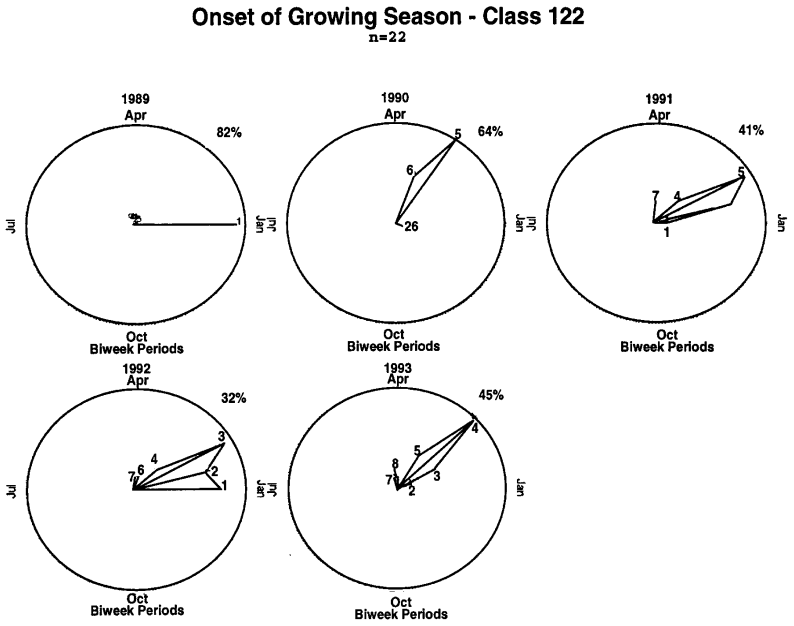

Figure 6—Polar plots in the database indicating the timing of greenup by year for each land cover class.

Table 2—Comparison between LCC map labels and ground observed primary vegetation types.

LCC	LCC map vegetation description	No. plots	Ground sampled vegetation type
1	Spring wheat	11	Wheat
2	Soybean, corn, cotton	3	Sorghum
3	Small grains, mixed row crops	19	Wheat
4	Small grains	7	Wheat
5	Small grains, mixed row crops	42	Wheat
6	Mixed row crops, small grains	5	Wheat
7	Mixed crops (wheat, sorghum, corn)	6	Corn
8	Soybeans, cotton, rice, corn	0	No data
9	Winter wheat	29	Wheat
10	Soybeans, cotton, rice, corn	13	Beans
11	Corn, soybeans	77	Corn
12	Small grains, row crops, pasture	41	Hay
13	Small grains, row crops, pasture	18	Corn
14	Wheat, sorghum, corn, alfalfa	23	Corn
15	Soybeans, cotton, corn	3	Rice
16	Corn, soybeans, alfalfa, flax	5	Corn
17	Corn, soybeans	78	Corn
18	Mixed cropland, pasture, woodland	21	Corn
19	Soybeans, corn, cotton	0	No data
20	Corn, soybeans, pasture	27	Rice, soybeans
21	Corn, soybeans, loblolly pine	0	No data
22	Irrigated pasture	0	No data
23	Irrigated pasture	2	Wheat
24	Irrigated pasture	0	No data
25	Irrigated pasture	4	Wheat
26	Irrigated pasture	0	No data
27	Irrigated pasture	8	Wheat
28	Irrigated pasture	0	No data

(con.)

Table 2—Con.

LCC	LCC map vegetation description	No. plots	Ground sampled vegetation type
29	Irrigated pasture	3	Wheat
30	Irrigated pasture	0	No data
31	Irrigated pasture	0	No data
32	Irrigated pasture	0	No data
33	Sorghum, small grains, irr. ag.	0	No data
34	Irr. ag., mixed row crops	15	Wheat
35	Bluestem, grama, small grains	45	Wheat
36	Grama, buffalograss, wheat	52	Wheat
37	Small grains, sorghum, blue grama	12	Wheat
38	Wheatgrass, needleandthread, peas	6	Hay
39	Bluestem, wheatgrass, wheat	25	Wheat
40	Riparian woods, irr. ag., grass	4	Pasture
41	Soybeans, cotton, rice, corn	2	Cotton
42	Corn, soybeans, sorghum, irr. ag.	23	Corn
43	Mixed pine, oak, soybeans, corn	4	Cotton
44	Pasture, small grains, Douglas-fir	0	No data
45	Soybeans, corn, peanuts, cotton	14	Cotton
46	Maple, birch, beech, corn	77	Corn
47	Oak, hickory, pine, corn	39	Corn
48	Citrus, pasture, slash pine	0	No data
49	Loblolly pine, slash pine, corn	44	Corn
50	Pine, oak, soybeans, corn	51	Corn
51	Pasture, hay, corn, soybeans	40	Corn
52	Forage crops, hay, woodlots	85	Corn
53	Oak, pine, soybeans, corn, cotton	10	Cotton
54	Soybeans, cotton, rice, corn, oak	0	No data
55	Wheatgrass, needlegrass	0	No data
56	Wheatgrass, needlegrass	64	Perennial and annual grass
57	Bluestem, blue grama	6	Perennial grass, wheat
58	Blue grama, wheatgrass	14	Perennial and annual grass, cotton
59	Wheatgrass, blue grama	58	Perennial and annual grass, wheat
60	Wheatgrass, fescue, big sage	6	Perennial grass
61	Wheatgrass, blue grama, big sage	60	Perennial and annual grass, wheat
62	Annual grasses, manzanita, oak	12	Annual grass, wheat
63	Wheatgrass, needlegrass	2	Perennial grass
64	Wheatgrass, needlegrass	26	Perennial grass, wheat
65	Bluestem, indiangrass	20	Perennial grass, alfalfa
66	Bur sage, saltbush, greasewood	13	Shadscale, greasewood, sagebrush
67	Greasewood, sage	32	Shadscale, sage, ragweed, juniper
68	Creosote, mesquite, saltbush	4	Annual and perennial grass
69	Creosote, saltbush, sand sage	0	No data
70	Dropseed, sand sage, creosote	2	Unidentified shrubs and grass
71	Saltbush, greasewood, big sage	25	Low sagebrush, big sage
72	Greasewood, sage, rabbitbrush	48	Big sage, low sage, juniper
73	Sand sage, creosote, ricegrass	3	Mesquite
74	Big sage, rabbitbrush, wheatgrass	20	Sage, mesquite, juniper, live oak
75	Greasewood, sage, wheatgrass	43	Sage, rabbitbrush, juniper, pinyon
76	Sand sage, blue grama, wheatgrass	9	Perennial grass
77	Creosote, sand sage, grama	3	Mesquite, perennial grass

(con.)

Table 2—Con.

LCC	LCC map vegetation description	No. plots	Ground sampled vegetation type
78	Big sage, rabbitbrush, wheatgrass	15	Big sage, perennial grass
79	Sand sage, creosote, dropseed	6	Cotton, perennial grass
80	Blue grama, big sage, saltbush	43	Sage, yucca, juniper, pinyon pine
81	Sand sage, oak, blue grama	27	Mesquite, juniper, mimosa,
82	Grama, buffalograss, creosote	3	Agriculture
83	Grama, buffalograss, creosote	0	No data
84	Annual grasses, manzanita, oak	4	Annual and perennial grasses
85	Annual grasses, manzanita, oak	0	No data
86	Bluestem, sand sage, oak, juniper	24	Mesquite, live oak, cenizo
87	Oak, juniper, bluestem, mesquite	0	No data
88	Oak, Bluestem, mesquite, juniper	36	Mesquite, juniper, oak, algerita
89	Oak, bluestem, juniper	23	Foresteria, mesquite, juniper, oak
90	Maple, birch, white and red pine	4	Maple
91	Oak, maple, ash, pasture	15	Aspen, birch, oak, hazel
92	Maple, birch, beech	3	Maple, birch, basswood
93	Beech, birch, maple, oak, pasture	50	Maple, oak, dogwood
94	Oak, hickory, mixed cropland	26	Oak, pine, hickory
95	Oak, hickory, poplar, beech	89	Hickory, oak
96	Loblolly, longleaf, slash pines	2	Aspen, subalpine fir
97	Aspen, mountain shrubs	0	No data
98	Loblolly, longleaf, slash pines	66	Loblolly, sweetgum, longleaf, oak
99	Fir, spruce	10	Subalpine fir, Engelmann spruce
100	Douglas-fir, pacific silver fir	0	No data
101	W. white, ponderosa pine, Douglas-fir	0	No data
102	Lodgepole pine, fir, spruce	26	Lodgepole, Douglas-fir, Engelmann spruce
103	Lodgepole pine, ponderosa pine	0	No data
104	Pondersa, lodgepole pine, Douglas-fir	2	Engelmann spruce
105	Lodgepole, ponderosa pine, Douglas-fir	0	No data
106	Ponderosa, lodgepole, juniper	13	Ponderosa, Douglas-fir, juniper
107	Lodgepole, ponderosa pine	0	No data
108	Ponderosa, pinyon pines, juniper	0	No data
109	Ponderosa, lodgepole pines	12	Douglas-fir, Lodgepole pine, fir
110	Douglas, pacific silver fir	0	No data
111	Ponderosa, lodgepole, juniper	17	Ponderosa, Douglas-fir, white oak
112	Douglas-fir, sitka spruce, hemlock	3	Lodgepole, Douglas-fir, western larch
113	Lodgepole, ponderosa pines	3	Douglas-fir, lodgepole pine
114	Ponderosa, pinyon pines, juniper	0	No data
115	Ponderosa, lodgepole, Douglas-fir, oak	0	No data
116	Ponderosa, lodgepole, Douglas-fir	9	Douglas-fir, noble fir, hemlock
117	Ponderosa, lodgepole, Douglas-fir	0	No data
118	Ponderosa pine, Douglas-fir	0	No data
119	Douglas-fir, ponderosa, sugar pines	7	Ponderosa pine
120	Ponderosa pine, Douglas-fir, oak	4	Douglas-fir, ponderosa pine
121	Ponderosa pine, Douglas-fir, oak	0	No data
122	Douglas-fir, w. hemlock, w. redcedar	22	Douglas-fir, alder, western redcedar
123	W. Hemlock, w. redcedar, Douglas-fir	0	No data
124	Ponderosa, sugar pines, Douglas-fir	8	Douglas-fir, California loral, oak
125	Douglas-fir, w. hemlock, oak	7	Douglas-fir, black oak

(con.)

Table 2—Con.

LCC	LCC map vegetation description	No. plots	Ground sampled vegetation type
126	Grasses, ponderosa, lodgepole	0	No data
127	Sage, annual grasses, oak, pine	16	Pinyon pine, juniper, mtn. mahogany
128	Ponderosa, lodgepole pine, sage	0	No data
129	Ponderosa, pinyon pines, juniper	2	Ponderosa pine
130	Pinyon, ponderosa pines, juniper	14	Douglas-fir, ponderosa pine, spruce
131	Ponderosa, w. white pine, grasses	12	Douglas-fir, aspen
132	Pinyon, ponderosa pines, juniper	0	No data
133	Maple, beech, birch, Jack pine	0	No data
134	Maple, birch, beech, spruce, fir	11	Red spruce, e. white pine, aspen
135	Spruce, pine, wetlands, n. hdwds	0	No data
136	Oak, maple, ash, beech, birch	40	Maple spp., aspen, balsam fir
137	Beech, birch, maple, hemlock, fir	46	Maple, hemlock, birch, beech
138	Slash, longleaf pines, wetlands	3	Baldcypress, slash pine
139	Loblolly, slash pines, oak, Gum	90	Loblolly pine, sweetgum, oak
140	Loblolly, longleaf, slash pines	75	Loblolly pine, red oak, sweetgum
141	Southern pines, oak, gum, poplar	79	Loblolly pine, sweetgum, mixed hardwood
142	Lodgepole pine, Douglas-fir, aspen	12	Douglas-fir, spruce, lodgepole pine
143	Lodgepole, w. white, ponderosa	0	No data
144	Lodgepole, w. white, ponderosa	2	Douglas-fir
145	Lodgepole, w. white, ponderosa	2	Lodgepole pine
146	Ldogepole pine, Douglas-fir, aspen	4	Douglas-fir, aspen
147	Ponderosa, lodgepole pine, aspen	0	No data
148	Ponderosa, lodgepole pine, aspen	0	No data
149	Water	0	No data
150	Fresh/saltwater marsh	0	No data
151	Fresh/saltwater marsh	0	No data
152	Fresh/saltwater marsh	0	No data
153	Fresh/saltwater marsh, cypress	3	Pondcypress
154	Fresh/saltwater marsh, oak, gum	0	No data
155	Barren or sparsely vegetated	27	Larrea, ragweed, sage, coleogyne
156	Lodgepole pine, Douglas-fir, aspen	5	Lodgepole pine, spruce, fir
157	Alpine tundra	0	No data
158	Alpine tundra	0	No data
159	Alpine tundra	0	No data

vegetation description column have no implied abundance levels—they simply are likely to exist to some extent in the land cover class. However, the species in the ground-sample vegetation description are listed in order of abundance. In many cases the species correspondence between the two lists is close, but the ground-truth list is more informative because the species are listed in decreasing order of abundance. The number of plots in each LCC class are also provided.

How to Obtain the Data Set

The ground-sample data set is available on a CD-ROM that contains: (1) an ASCII FoxPro database file of data entered into the field forms, (2) an Splus routine that will provide, for each land cover class, numerous statistical summaries and graphs (users of this routine must have Splus installed on a workstation), and (3) an HTML document that provides easy access to JPG files of slides scanned for many plots, and GIF files of all the graphical summary statistics for each LCC class (about 2,500 graphics). The HTML document makes the graphical summaries available to those not having access to Splus on a workstation. This CD-ROM is available to climate modelers, ecologists, the remote sensing community, and others who have an interest in broad-scale vegetation data. It can be ordered from the Customer Services Branch of the U.S. Geological Survey's EROS Data Center, Sioux Falls, SD 57198. Phone: 605-594-6151; email: custserv@edcmail.cr.usgs.gov

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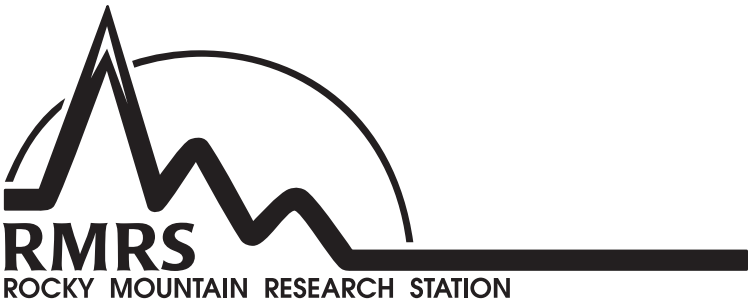

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