Catskill Mountains Vegetation

Metadata:

Identification_Information:
> *Originators:* Kenneth L. Driese, Gary M. Lovett, William A. Reiners, Samuel M. Simkin
> *Publication_Date:* 2002
> *Title:* Catskill Mountains Vegetation
> *Publication_Places:* Laramie, WY and Millbrook, NY
> *Publishers:* Wyoming Geographic Information Science Center (WyGISC) and Institute of Ecosystem Studies
> *Abstract:*   The general objective of the project described here was to provide a vegetation map of the Catskills that: 1) emphasizes the distribution of tree species, 2) is highly resolved in terms of individual tree species dominance, and 3) has sufficient spatial resolution to capture the fine-grained character of vegetation in this region map, using Landsat Thematic Mapper (TM) satellite imagery and other digital data.
> *Use_Constraints:*   Acknowledgement of the Wyoming Geographic Information Science Center (WyGISC) and the Institute of Ecosystem Studies would be appreciated in products derived from these data.
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Raw_Data_Source_Information:
> Landsat Thematic Mapper 5 data (Path/Row = 14/31) obtained from the USGS for four scene dates that take advantage of phenological differences between deciduous tree species.

Scene ID (USGS entity ID)	Date of satellite image	Scene Source	Phenological Stage (based on 1998-99 field notes)
MGM0140310428198900	28 April 1989	USGS/MRLC Program	Leaf off (pre-green-up)
MGT0140310509199300	9 May 1993	USGS/MRLC Program	Low elevation green-up
MGM0140310621199100	21 June 1991	USGS/MRLC Program	Full leaf on
LT5014031008630210	29 Oct 1986	USGS/EROS Data Center	Oak leaf on, other species leaf off.

> Scenes are not all from the same year because of a lack of cloud-free imagery for some target dates and the high cost of some satellite scenes. TM data include 6 reflected spectral bands and an emitted thermal band. The thermal band was not used for mapping in this project.
> *Attribute_Accuracy_Report:*   These scenes are cloud free, with the exception of the 9 May scene, which included a few clouds in the southeast corner of the study area, and the 21 June scene, which had some high clouds in the northeastern portion of the study area.
> *Horizontal_Positional_Accuracy_Value:* 0.56-0.86 RMSE (pixels) for MRLC products, which for the 30 m pixel size equals an RMSE of 16.8 - 25.8 meters
> *Type_of_Source_Media:* Landsat Thematic Mapper 5 imagery
> *Source_Time_Period_of_Content:* 29 Oct 1986 to 9 May 1993

Spatial_Reference_Information:
> *Grid_Coordinate_System_Name:* Universal Transverse Mercator

UTM_Zone_Number: 18
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Abscissa_Resolution: 30 meters
Ordinate_Resolution: 30 meters
Horizontal_Datum_Name: North American Datum of 1983
 Spheroid_Name: GRS1980
Spatial_Domain: The data are centered on approximately N 41º45'41" W 74º27'08" and cover an area extending from approximately Wilkes-Barre, PA in the southwest, to Yonkers, NY in the southeast and from Pittsfield, MA in the northeast to Sherburne, NY in the northwest.
Bounding_Coordinates: (for MRLC source data, slightly different for non-MRLC data)
Northwest_Bounding_Coordinate: N 42˚ 42' 36" Lat, W 75˚ 51' 45" Long
Northeast_Bounding_Coordinate: N 42˚ 41' 45" Lat, W 73˚ 00' 46" Long
Southeast_Bounding_Coordinate: N 40˚ 48' 59" Lat, W 73˚ 04' 11" Long
Southwest_Bounding_Coordinate: N 40˚ 49' 46" Lat, W 75˚ 50' 16" Long
Processing_Notes: All scenes were geographically and terrain corrected by the USGS

Vegmap_Attribute_Information:
   Overview:
   The vegmap data layer is composed of a grid of classification codes which correspond to 24 cover types, as indicated in the following table.

Map Code	Type Name	Description
1	Water	Open water – Lakes, rivers, reservoirs, etc.
2	Non-forest	Grass, bare soil, etc.
3	Human built up	Roads, urban areas, etc.
4	Oak/laurel forest	Relatively pure oak dominated forest with laurel understorey
5	Oak forest	Relatively pure oak dominated forest
6	Oak/maple forest	Oak dominated forest with significant maple component
7	Oak/beech or birch or "other" forest	Oak dominated forest with significant beech *or* birch component
8	Maple forest	Relatively pure maple dominated forest.
9	Maple/oak forest	Maple dominated forest with significant maple component
10	Maple/birch forest	Maple dominated forest with significant birch component
11	Maple/beech forest	Maple dominated forest with significant beech component
12	Maple/birch/beech forest	Maple dominated forest with significant birch *and* beech components
13	Maple/other forest	Maple dominated forest with significant "other" hardwoods present (e.g. ash, cherry, aspen)
14	Birch forest	Relatively pure birch dominated forest
15	Birch/maple or beech or "other" forest	Birch dominated forest with significant maple *or* beech components
16	Beech forest	Relatively pure beech dominated forest
17	Beech/maple forest	Beech dominated forest with significant maple component
18	Beech/other forest	Beech dominated forest with "other" hardwoods (e.g. ash, cherry, aspen)
19	"Other" forest	Forest dominated by deciduous species not including beech, maple, oak, birch.
20	"Other"/maple	Forest dominated by "other" species with significant maple component
21	Spruce/fir forest	Forest dominated by spruce and/or fir species
22	Hemlock/pine forest	Forest dominated by hemlock and/or pine species
24	Spruce/fir/decid forest	Forest with a mixture of spruce, fir, and deciduous species.
25	Hemlock/pine/decid forest	Forest with a mixture of pine, hemlock, and deciduous species.

   Processing steps:

The Catskills map was built in stages by performing a series of digital classifications (using Erdas Imagine version 8.4, Erdas, Inc., Atlanta, GA) designed to separate particular target classes or groups of classes. Evergreen and deciduous species were initially separated from one another using a supervised maximum likelihood classification of the April green, red and near-infrared (NIR) bands from the satellite data (bands 2, 3 and 4 respectively). Data exploration for each group diverged after this, with evergreen species distinguished primarily using data derived from the DEM, and deciduous species distinguished using spectral data enhancements. Classification of deciduous species was the core of the project and the data used to distinguish species arose from trial and error using many combinations of spectral data. The final classification of deciduous species resulted from a supervised maximum likelihood classification, using all of the training data, of a 10-band image consisting of four data enhancements. These enhancements included: 1) the temporal profile of the 2nd Tasseled Cap component, 2) the temporal NDVI profile, 3) an oak index and 4) a maple index.

Attribute_Accuracy_Report:
Ground data were collected at a total of 249 sites, located along roads and trails in the Catskills to avoid the difficulties of accessing more remote areas. Of the 249 total sites visited on the ground, 135 were used for training data and 114 were set aside for accuracy assessment. Results of the accuracy assessment are presented in the following four contingency tables, beginning with the primary vegetation classification with 24 cover types and proceeding to increasingly simplified classifications derived by lumping cover types from the primary classification. Given the limited number of accuracy assessment sites at present (114), the accuracy assessments presented here should be considered very preliminary.

1) Accuracy assessment of vegetation classification with 24 classes
Perfect matches are highlighted in orange, stippled areas are pixels for which dominant genus is correct, and cross-hatched areas highlight confusion between maple and beech types. Producer's accuracy is on the right and user's accuracy is shown across the bottom of the matrix. "ND" signifies types for which there were no validation data. Overall, 28% of the reference(ground) vs. mapped vegetation comparisons are perfect matches using this classification.

Reference Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	24	25	TOTAL	Producer's Accuracy
Water (1)																									0	ND
Non-forest (2)																									0	ND
Human built-up (3)																									0	ND
Oak/laurel (4)																									0	ND
Oak forest (5)				7										2											9	0.00
Oak/maple forest (6)				2																					2	0.00
Oak/beech,birch or other (7)				1								1						1							3	0.00
Maple forest (8)								5		1															6	0.83
Maple/oak forest (9)							1										1								2	0.00
Maple/birch forest (10)								1	1	2															4	0.50
Maple/beech forest (11)				1											1	1	5								8	0.00
Maple/birch/beech forest (12)														1			1					1			3	0.00
Maple/other forest (13)												2					3			1					6	0.00
Birch forest (14)												1		3											4	0.75
Birch/maple, beech, other (15)								1		1		2		3			1	1							9	0.00
Beech forest (16)														1											1	0.00
Beech/maple forest (17)														1			3							1	5	0.60
Beech/other forest (18)								1	2					4			2								9	0.00
Other forest (19)						1						2		2			4	1	1						11	0.00
Other/maple forest (20)										1				1			2			1					5	0.20
Spruce/fir forest (21)																				1	5				6	0.83
Hemlock/pine forest (22)																					1			1	2	0.00
Spruce/fir/decid forest (24)														1								1	1	1	3	0.00
Hemlock/pine/decid forest (25)				1				2									1							12	16	0.75
TOTAL	0	0	0	12	0	1	1	9	2	7	3	6	0	19	1	1	22	3	0	3	7	1	1	15	114	
User's Accuracy	ND	ND	ND	0	ND	0	0	0.6	0	0.3	0	0	ND	0.2	0	0	0.1	0	ND	0.3	0.7	0	ND	0.8		

2) Accuracy assessment of vegetation classification with 7 classes (lumped by dominant genus)
Overall, 47% of the reference(ground) vs. mapped vegetation comparisons are perfect matches using this classification.

Reference Type	Mapped Type							TOTAL	Producer's Accuracy
	4-7	8-13,20	14-15	16-18	19	21-22	24-25		
Oak (4-7)	10	1	2	1				14	0.71
Maple (8-13,20)	2	14	3	13		1	1	34	0.41
Birch (14-15)		5	6	2				13	0.46
Beech (16-18)		4	5	5			1	15	0.33
Other Decid (19)	1	3	2	5				11	0.00
Evergreen (21-22)		1				6	1	8	0.75
Ever/Decid mix (24-25)	1	2	2			1	13	19	0.68
TOTAL	14	30	20	26	0	8	16	114	
User's Accuracy	0.71	0.47	0.30	0.19	ND	0.75	0.81		

3) Accuracy assessment of vegetation classification with 4 classes
Overall, 84% of the reference(ground) vs. mapped vegetation comparisons are perfect matches using this classification.

Reference Type	Mapped Type				TOTAL	Producer's Accuracy
	4-7	8-20	21-22	24-25		
Oak (4-7)	10	4			14	0.71
Other Decid (8-20)	3	67	1	2	73	0.92
Evergreen (21-22)		1	6	1	8	0.75
Ever/Decid mix (24-25)	1	4	1	13	19	0.68
TOTAL	14	76	8	16	114	
User's Accuracy	0.71	0.88	0.75	0.81		

4) Accuracy assessment of vegetation classification with 3 classes
Overall, 90% of the reference(ground) vs. mapped vegetation comparisons are perfect matches using this classification.

Reference Type	Mapped Type			TOTAL	Producer's Accuracy
	4-20	21-22	24-25		
Decid (4-20)	84	1	2	87	0.97
Evergreen (21-22)	1	6	1	8	0.75
Ever/Dec mix (24-25)	5	1	13	19	0.68
TOTAL	90	8	16	114	
User's Accuracy	0.93	0.75	0.81		

Once again, given the limited number of accuracy assessment sites at present (114), the accuracy assessments presented here should be considered very preliminary.

Metadata_Reference_Information:

This metadata file was prepared by Sam Simkin at the Institute of Ecosystem Studies on 12 July 2002. Most material is condensed from "Development of a Vegetation Map for the Catskill Mountains, NY, Using Multi-temporal Landsat Imagery: Final Report," which accompanied the vegmap data sent by Ken Driese in September 2001. Additional information provided by USGS Thematic Mapper metadata files and consultation with Ken Driese and Gary Lovett.