

A Map of the Vegetation of South America Based on Satellite Imagery

Summary:

This dataset is a 1 km resolution land cover map of South America produced from 1-15 km NOAA AVHRR data (from the period 1988-1990). Thirty-nine land cover classes are distinguished, including deforestation.

1. Data Set Overview

Data Set Identification:

A Map of the Vegetation of South America Based on Satellite Imagery

Data Set Introduction:

This dataset is a 1 km resolution land cover map of South America produced from 1-15 km data available through the Advanced Very High Resolution Radiometer (AVHRR) weather satellites of the National Oceanic and Atmospheric Administration (NOAA) from the period 1987-1991. Thirty-nine land cover classes are distinguished, including deforestation.

Objective/Purpose:

The purpose of this map was to develop an objective appraisal of land use change over the South American continent

Summary of Parameters:

Land Cover Classes

There are 39 land cover classes distinguished in this dataset and these were consolidated into 13 broader groups (see DATA DESCRIPTION, Data Characteristics, Variable Description/Definition for a complete listing).

Discussion: Not Available

Related Data Sets: Not Applicable

2. Investigator(s)

Investigator(s) Name and Title:

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Title of Investigation:

A Map of the Vegetation of South America Based on Satellite Imagery

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3. Theory of Measurements

Not Available

4. Equipment

Sensor/Instrument Description: Not Available
Collection Environment: Not Available
Source/Platform: Not Available
Source/Platform Mission Objectives: Not Available
Key Variables: Not Available
Principles of Operation: Not Available
Sensor/Instrument Measurement Geometry: Not Available
Manufacturer of Sensor/Instrument: Not Available
Calibration:
Specifications: Not Available
Tolerance: Not Available
Frequency of Calibration: Not Available
Other Calibration Information: Not Available

5. Data Acquisition Methods

The data were acquired from The Woods Hole Research Center, Woods Hole, MA, see World Wide Web address:
<http://www.whrc.org>

6. Observations

Data Notes: Not Available
Field Notes: Not Available

7. Data Description

Spatial Characteristics:
Spatial Coverage:
Location
Min X -81.3572464
Max X -34.8444290
Min Y -56.0928993
Max Y 12.4712601
In decimal degrees of Longitude and Latitude
Spatial Coverage Map: Not Available
Spatial Resolution: 1 km x 1 km
Projection: Geographic
Grid Description: 7624 rows by 5172 columns
Temporal Characteristics:
Temporal Coverage:
The source satellite data spanned the period from 1987-1991.
Temporal Coverage Map: Not Applicable
Temporal Resolution: Not Applicable
Data Characteristics:
Parameter/Variable:
Land Cover Classes
Variable Description/Definition:

Land Cover Classes

The 39 landcover classes distinguished in this dataset were consolidated into 13 broader groups listed below. They include:

Group 1. Intact Tropical Moist Forests. Includes Semi-Deciduous Tropical Moist Forests, Tropical Moist Forest with Bamboo, and Tropical Gallery Forests. These regions have relatively high vegetation vigor throughout the year. All are considered to be closed canopy forests. This group is a sub-set of Group 3.

Group 2. Degraded Tropical Moist Forest and Secondary Forest in the TMF region. Includes large blocks of cleared forest surrounded by intact tropical moist forest that were both spectrally and visually distinct. As more clearing occurs and as older clearings are abandoned to secondary regrowth the distinction becomes less well-defined. We assumed that the observed visual patterns of cleared forest were relatively recent and probably have occurred within the last 10 years. This group is a sub-set of Group 4.

Group 3. Intact Closed Forest. Includes all of Group 1 as well as Tropical Seasonal or Deciduous forest, Montane Forest and Cool Deciduous Forest and Deciduous Temperate Forest. Deciduous forests have a relatively high vegetation vigor during a part of the year. We have made this category because other classifications of forests of South America have included closed forest as a distinct category.

Group 4. Degraded Closed Forests. This includes all of Group 2 and Degraded Deciduous Temperate Forest, Secondary Seasonal Forest with Agricultural Activity, Urban Regions, Degraded Tropical Seasonal Forest and Mixed Pine with secondary forest and agriculture. Most of these categories were defined based on information from either the Brazilian vegetation map (IGBE 1988) or the UNESCO map (1980).

Group 5. Intact Woodlands. Includes Seasonally Deciduous Woodlands, Xerophytic Woodlands, Montane Woodlands, Cool Deciduous Woodlands and Tropical Open Forest Mixed. Major woodland categories included areas in Brazil described as Sertao or Caatinga and Cerrado and areas in Argentina and Paraguay described as Chaco. Typically these regions have a short growing season and are moisture limited.

Group 6. Degraded Woodlands. Includes Degraded Seasonally Deciduous Woodlands, Degraded Xerophytic Woodlands (Thornforest) and Montane Degraded Woodlands. Many of these categories were defined based on information from either the Brazilian vegetation map (IGBE 1988) or the UNESCO map (1980) or by pattern recognition.

Group 7. Intact Grasslands. Includes Savanna Grasslands and Pasture, Seasonally Flooded grasslands (Pantanal), Montane Grasslands, and Tundra or Polar Grasslands. These included the Pampas of Argentina and Uruguay, the Beni of Bolivia, the Llanos of Colombia and Venezuela, and some portions of the Altiplano of Bolivia and the Puna of Peru.

Group 8. Degraded Grasslands. Includes Agriculture, Grasslands with Agricultural Activity, and Montane Degraded Grasslands. Most agriculture was defined based on the UNESCO map and on numerous LANDSAT satellite photos of the Parana, Paraguay and Rio de la Plata river system.

Group 9. Shrub and Scrublands. Includes Xerophytic Scrubland, Xerophytic Littoral Vegetation, and Cool Deciduous Scrubland. Most of these regions are in Patagonia or along the dry coasts of Peru, Chile and Venezuela. Generally these regions have short and weak growing seasons limited by rainfall or by cold.

Group 10. Desert, Bare Soil, or Inland Salt Marsh Communities.

Group 11. Open Water.

Group 12. Snow, Rock, and Ice.

Group 13. Other: Wet Vegetation (mixed water and land pixels) and Mangroves. and Unclassified.

Unit of Measurement: Unitless

Data Source: Unsupervised Classifications of NOAA AVHRR LAC and GVI data

Data Range: Not Available

Sample Data Record: Not Available

8. Data Organization

Data Granularity:

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

This dataset consists of a single tarred and GNU-zipped of the filename SAM39CL2.taz comprised of 2,997,437 8-bit bytes.

Data Format:

Within the tarred and Gnu-gzipped file file are four files: a single flat binary raster image file, made up of 5172 columns by 7624 rows comprising 39,431,328 8-bit bytes; an ASCII documentation file (SAM39CL2.DOC); a graphic image of this dataset in ..JPG (JPEG) format (SAM39CL2.JPG) and an ASCII text file describing the projection parameters of the source data used to create this dataset (SAM39CL2.PRJ).

The structure of the ASCII documentation files is as follows (portions have been copied directly from the IDRISI for Windows v. 2.0 Help System, with the permission of the IDRISI Project, Clark University, Worcester, MA):

ITEM	DESCRIPTION
title	A descriptive name of the file.
data type	The type of numbers stored in the file. Allowable entries are byte, integer and real.
file type	The format in which the Image file is stored.
columns	The number of columns in the image.
rows	The number of rows in the image.
ref. system	The name of the geographic referencing system used with the file.
ref. units	The unit of measure used in the specified reference system. Allowable entries are m, ft, mi, km, deg and radians.
unit dist	The scaling factor between the given coordinates and actual measurements on the ground.
min X	The minimum X coordinate (left edge) of the image.
max X	The maximum X coordinate (right edge) of the image.
min Y	The minimum Y coordinate (bottom edge) of the image.

max Y	The maximum Y coordinate (top edge) of the image.
pos'n error	A measure of the accuracy of the positions in the image.
resolution	The inherent resolution of the image. In most cases, this should correspond to the result of dividing the range of reference coordinates in X by the number of columns in the image.
min value	The minimum value in the image.
max value	The maximum value in the image.
value units	The unit of measure of the values in the image. The term classes is used for all qualitative data sets, and that whenever standard linear units are appropriate, that the same abbreviations that are used for reference units should also be used (m, ft, mi, km, deg, rad).
value error	This field records the error in the data values that appear in image cells. For qualitative data, this should be recorded as a proportional error. For quantitative data, the value here should be an RMS error figure.
flag value	Any value in the image that is not a data value, but rather has a special meaning. If there is no flag value, this entry should remain blank.
flag def'n	Definition of the above flag value. The most common data flags are those used to indicate background cells and missing data cells.
legend cats	The number of legend categories present.
lineage	Description of the history by which the values were recorded/derived.
completeness	The degree to which the values describe the subject matter indicated.
consistency	The logical consistency of the file.

9. Data Manipulations

Formulae:

Derivation Techniques and Algorithms: Not Available

Data Processing Sequence:

Processing Steps:

The primary reliance in this work was on the NOAA AVHRR Local Area Coverage (LAC) satellite data. These data have a resolution of 1.1 km at nadir and are available for the whole earth twice daily. They were supplemented by higher resolution satellite imagery available for certain sections of the continent, by photographs, by earlier maps, and by personal experience on the ground. Because the map produced from the work described here is digital, it has no specific map scale. The scale of a map is determined by the size of the paper map printed. If we were to print the map with each 1 km² cell at 1 mm², a reasonable choice, the map scale would be 1:1,000,000.

Source data included NOAA 9, 10 and 11 AVHRR satellite imagery for South America. The above-named satellites acquire digital reflectivity and emissivity data from the surface of the earth from the visible red (0.58 - 0.68 microns), near-infrared (0.725 - 1.1 microns), mid-infrared (3.5 - 3.93 microns) and thermal (10.3 - 11.3 and 11.5 - 12.5 microns) portions of the electromagnetic spectrum (Kidwell 1988). Thirty-four computer compatible tapes

were used, of which the majority were from 1988, the year of primary focus for this project. Others data were from 1987, 1989, 1990, and 1991 (see REFERENCES). The AVHRR data were purchased from the US Geological Survey's (USGS) EROS Data Center (EDC) in Sioux Falls, South Dakota. The AVHRR data were converted from the original 10 bit digital number format to an 8 bit format and corrected for radiometric and atmospheric effects. All five bands of AVHRR data were rectified to a latitude-longitude grid with 1 km resolution. With the LAC data acquired, we were able to cover, cloud-free, 69.6% of South America.

Because cloud-free 1 km resolution data was not available for all of all South America, a three year (1986-1988) weekly data set of 15 km resolution Global Vegetation Index (GVI) data from NOAA (Kidwell 1988) was utilized in the place of the missing 1 km data. The use of the 15 km data accounted for 30.4 % of final version the map. Various sources of supplemental information have been used (see REFERENCES).

Processing Changes: Not Applicable

Calculations:

Special Corrections/Adjustments: Not Applicable

Calculated Variables: Not Applicable

Graphs and Plots: Not Applicable

10. Errors

Sources of Error: Not Available

Quality Assessment:

Data Validation by Source: Not Available

Confidence Level/Accuracy Judgment: Not Available

Measurement Error for Parameters: Not Available

Additional Quality Assessments: Not Available

Data Verification by Data Center: Not Available

11. Notes

Limitations of the Data: Not Available

Known Problems with the Data: Not Available

Usage Guidance:

Latitude of True Scale: 0.0

False Easting: 0.0

False Northing: 0.0

Pixel Dimension: 1000 meters

Any Other Relevant Information about the Study: Not Available

12. Application of the Data Set

Regional, national, and sub-national-level vegetation and landuse change assessments

13. Future Modifications and Plans

Not Available

14. Software

Software Description:

Two softwares are required to read the files in this dataset:

the shareware tar program tar.exe

the GNU compression utility gzip.exe

Software Access:

The GNU-gzip program (gzip.exe) and shareware tar program (tar.exe) are available via Anonymous FTP from the following site: wuarchive.wustl.edu, in the directory, /systems/msdos/gnuish, files: gzip124x.zip and gnutar.zip

15. Data Access

Contact Information:

1) Source Data Contact:

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Data Center Identification:

Not Applicable

Procedures for Obtaining Data:

see Woods Hole Research Center FTP site: 1. [Land cover of South America](#) at 1 km resolution based on satellite imagery (sa39cl2.exe or sa39cl2.taz).

Data Center Status/Plans:

Not Applicable

16. Output Products and Availability

Not Applicable

17. References

The published reference for this work is:

Stone, T.A., P. Schlesinger, G.M. Woodwell, and R.A. Houghton, 1994. A Map of the Vegetation of South America Based on Satellite Imagery. Photogrammetric Engineering and Remote Sensing. 60(5):541-551.

Satellite Imagery Data Used in Ordered by Date

Satellite	Date Acquired	Satellite Scene ID
NOAA 09	January 08 1987	AL09010887205540
NOAA 09	January 09 1987	AL09010987204440
NOAA 09	February 17 1988	AL09021788203510
NOAA 09	March 09 1988	AL09030988200820
NOAA 09	July 01 1988	AL09070188192520
NOAA 09	July 02 1988	AL09070288191410
NOAA 09	July 03 1988	AL09070388190310
NOAA 09	July 03 1988	AL09070388204330
NOAA 09	July 04 1988	AL09070488203230

NOAA 09July 06 1988	AL09070688201210
NOAA 09July 09 1988	AL09070988193900
NOAA 09July 10 1988	AL09071088192800
NOAA 09July 12 1988	AL09071288190550
NOAA 09July 12 1988	AL09071288205040
NOAA 09July 14 1988	AL09071488202400
NOAA 09July 15 1988	AL09071588201440
NOAA 09July 17 1988	AL09071788195230
NOAA 09July 20 1988	AL09072088191920
NOAA 09August 16 1988	AL09081688192820
NOAA 11December 21 1988	AL11122188182200
NOAA 11December 29 1988	AL11122988183550
NOAA 11December 31 1988	AL11123188181559
NOAA 11January 11 1989	AL11011189180550
NOAA 10July 17 1990	AL10071790110200
NOAA 11July 22 1990	AL11072290104721
NOAA 11July 31 1990	AL11073190175240
NOAA 11August 29 1990	AL11082990173640
NOAA 11September 15 1990	AL11091590175229
NOAA 11November 16 1990	AL11111690181139
NOAA 11January 03 1991	AL11010391192442
NOAA 11January 13 1991	AL11011391191343
NOAA 11January 20 1991	AL11012091193647
NOAA 11February 08 1991	AL11020891192554
NOAA 11February 18 1991	AL11021891191340

Atlas and Map References Used:

Banco Central del Ecuador. 1982. Atlas del Ecuador. Paris: Les Editions J.A.

CIA, 1971. Argentina [map 1:7,550,000], 500044 10-71, Central Intelligence Agency, Washington.

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Defense Mapping Agency, various dates. Operational Navigation Chart(s) K26, K27, L26-28, M25-29, N25-28, P26-28, Q26-28, R23-24, S21, and T-18, Scale 1:1,000,000. St. Louis, Mo.

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International Travel Map Productions 1986-87, South America North 1:4,000,000, Lambert's Azimuthal Equal-Area Projection, Vancouver, Canada.

International Travel Map Productions, 1988-89, South America Northeast 1:4,000,000, Lambert's Azimuthal Equal-Area Projection, Vancouver, Canada.

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National Geographic Society. 1983. South America. 1:10,700,000. Chamberlin Trimetric Projection.

OAS. 1964. Indice Anotado de los Trabajos Aerofotograf y los Mapas Topo.

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UNESCO, 1981. Vegetation Map of South America Explanatory Notes. United Nations Educational, Scientific, and Cultural Organization, Paris, 189 pp.

World Resources Institute, 1990. World Resources 1990-1991. Oxford University Press, New York, 383 pp.

Other References Used in this Metadata:

Eastman, J.R., 1997. IDRISI for Windows Version 2.0. Clark Labs for Cartographic Technology and Geographic Analysis, Clark University, Worcester, MA

Kidwell, K., 1988. NOAA Polar Orbiter Data Users Guide, NOAA/NESDIS, Nat. Clim. Data Center, Washington, D.C.

18. Glossary of Terms

Not Available

19. List of Acronyms

Acronym	Definition
ASCII	American Standard Code for Information Interchange
AVHRR	Advanced Very High Resolution Radiometer
EDC	EROS Data Center
EROS	Earth Resources Observation Systems
GVI	Global Vegetation Index
GNU	GNU's not UNIX
JPEG	Joint Photographic Experts Group
LAC	Local Area Coverage
NOAA	National Oceanic and Atmospheric Administration
PAL	Pathfinder AVHRR Land program
RMS	Root Mean Square
TMF	Tropical Moist Forest
USGS	United States Geologic Survey

20. Document Information

Document Revision Date:

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Citation:

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Document Curator:

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