Terrain Analysis and Satellite Imagery in Madre de Dios, Peru

> Katherine Lininger Master's student Department of Geography and the Environment

Why Madre de Dios, Peru? Small-scale gold mining and fluvial geomorphology



Purpose of Project

- Gather available data sources
 - Multi-temporal satellite imagery
 - ASTER elevation data (30m resolution)
- Hydrologic terrain analysis

Data Sources

<u>From USGS Global Visualization Viewer:</u> Landsat 4-5 Thematic Mapper (TM) imagery (http://glovis.usgs.gov/)



From Peru Ministry of the Environment Website: Shapefiles of Peruvian watersheds (Cuencas Hidrográficas)

(http://geoservidor.minam.gob.pe/geoservidor/download.aspx



From NASA Reverb ECHO: ASTER GDEM 2 (Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Digital Elevation Model Version 2) (http://testbed.echo.nasa.gov/reverb/#utf8=%E2%9C%93&spati al map=satellite&spatial type=rectangle)



Landsat 5 TM Imagery

- Path, Row (3, 69)
- Dry season images from 1986, 1996, 2006, 2011
- Geo-referenced and projected (WGS_1984_UTM_Zone_19N)
- Data comes as .tif files—7 separate bands



Google earth image of region

Pand	Enactral Panda	Wavelength (Potential Information Content	Resolution
Dallu	Spectral Bands	micrometers)		(meters)
Band 1	Blue	0.45 - 0.52	Discriminates soil and rock surfaces from vegetation. Provides increased penetration of water bodies	30
Band 2	Green	0.52 - 0.60	Useful for assessing plant vigor	30
Band 3	Red	0.63 - 0.69	Discriminates vegetation slopes	30
Band 4	Near IR	0.76 - 0.90	Biomass content and shorelines	30
Band 5	Mid IR	1.55 - 1.75	Discriminates moisture content of soil and vegetation; penetrates thin clouds.	30
Band 6	Thermal IR	10.40 - 12.50	Thermal mapping and estimated soil moisture	120
Band 7	Mid IR	2.08 - 2.35	Mapping hydrothermally altered rocks associated with mineral deposits	30

Stacking Layers in ERDAS Imagine

- .tif \rightarrow .img files
- Layer stack bands 1-5, 7
- Display 3 bands at a time



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Landsat 5 TM through time (Bands 5,4,3)









Hydrologic Terrain Analysis using ASTER GDEM version 2

• ASTER GDEM version 2:

- 1 arc-second resolution (30mx30m at equator)
- Accuracy of 17 meters at 95% confidence level
- Referenced to WGS84



 Study area spans two watersheds—Inambari Watershed and Alto Madre de Dios Watershed

Processing ASTER GDEM data

- Download as .tif files
- Project individual tiles (WGS_1984_UTM_Zone_18S), resample to 30m pixel size
- Mosaic tiles





Mosaic to New Raster

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Processing ASTER GDEM data

- New theme from watershed shapefile— Only Alto Madre de Dios and Inambari Watersheds
- Extract by Mask Tool

DEM of Alto Madre de Dios and Inambari Watersheds



Hydrologic Terrain Analysis

- 1. Pit removal
- 2. Flow direction field derivation
- 3. Flow Accumulation
- 4. Stream Links and Catchments
- 5. Raster to Vector Connection

Hydrologic Terrain Analysis



- Inambari watershed: 19,837.899 km²
- Alto Madre de Dios watershed: 34,760.1204 km²

Satellite Image with drainage lines and catchments:



Delineate Puquiri subwatershed of Alto Madre de Dios





Puquiri drainage area: 896.26 km²

Future Master's Research

- Classification of satellite imagery
- Creation of geomorphologic maps over time
- Identification of fieldwork sampling sites