The background image shows a wide river winding its way through a lush, green tropical forest. A prominent, light-colored sandbar or bar of land extends from the bottom left towards the center of the frame. The water in the river is a dark, muddy brown color.

Terrain Analysis and Satellite Imagery in Madre de Dios, Peru

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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

From USGS Global Visualization Viewer:
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>)



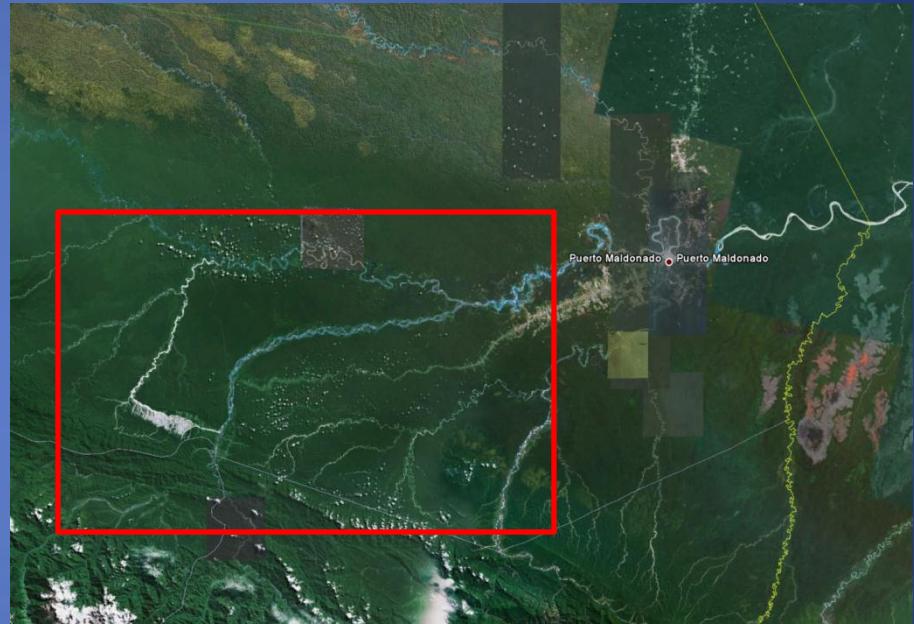
From NASA Reverb ECHO:
ASTER GDEM 2 (Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Digital Elevation Model Version 2)
(http://testbed.echo.nasa.gov/reverb/#utf8=%E2%9C%93&spatial_map=satellite&spatial_type=rectangle)



The screenshot shows the Reverb | ECHO search interface. It includes three main sections: Step 1: Select Search Criteria, Step 2: Select Datasets, and Step 3: Discover Granules. In Step 1, there are tabs for Spatial, Temporal, Platforms & Instruments, Campaigns, Processing Levels, and Science Keywords. A bounding box is set over the world map. In Step 2, a list of datasets is shown, including: 2000 Pilot Environmental Sustainability Index (ESI), 2001 Environmental Sustainability Index (ESI), 2002 Environmental Sustainability Index (ESI), 2005 Environmental Sustainability Index (ESI), 2007 Natural Resource Management Index (NRMI), and 2008 Environmental Performance Index (EPI). In Step 3, it says "No Datasets Selected".

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

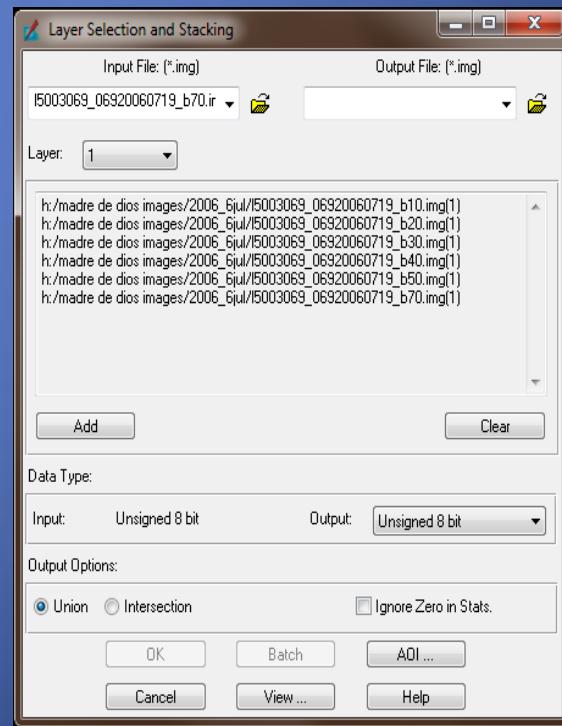
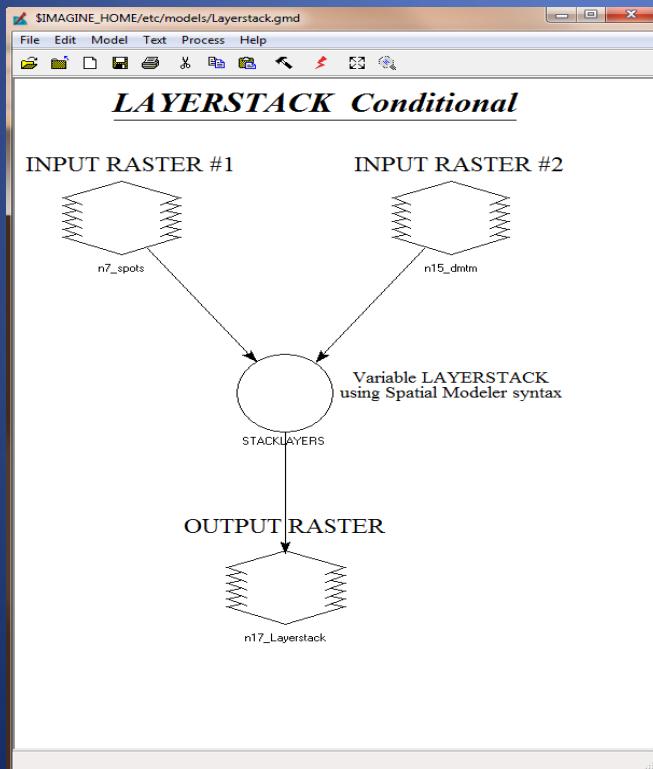
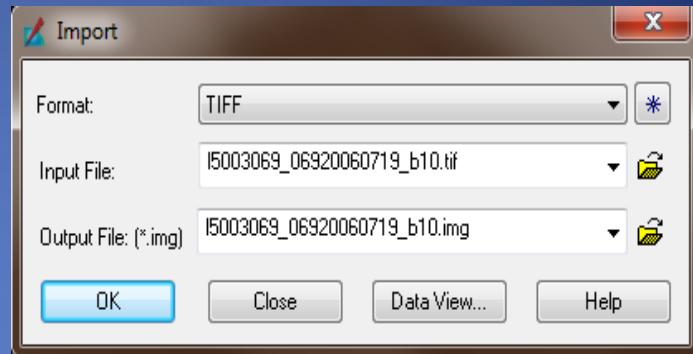


Google earth image of region

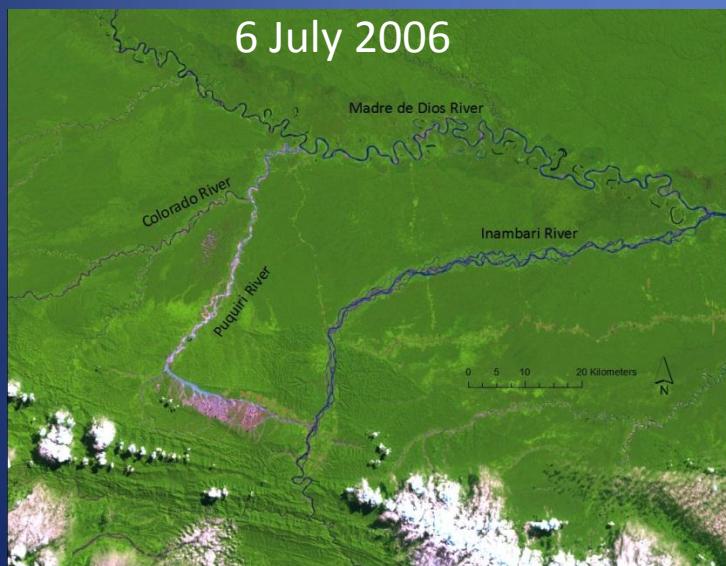
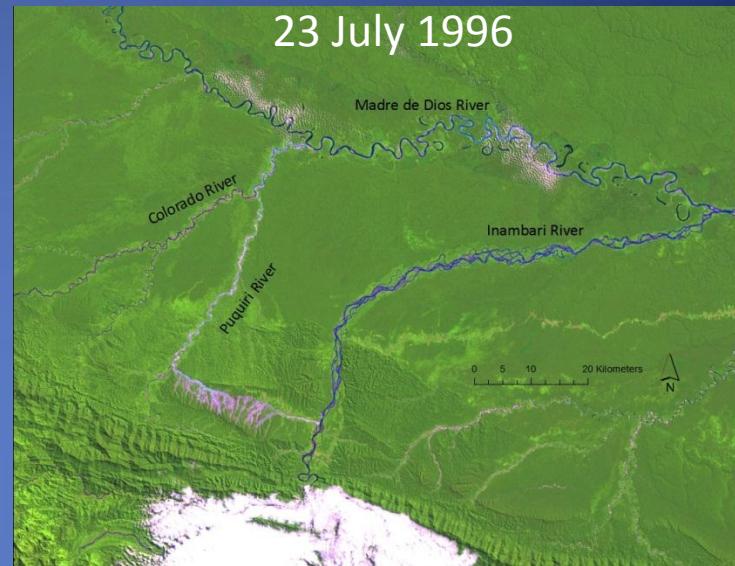
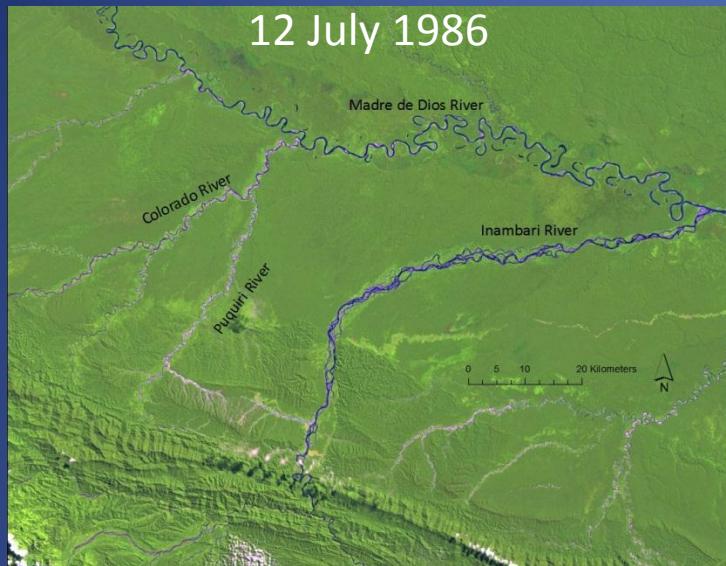
Band	Spectral Bands	Wavelength (micrometers)	Potential Information Content	Resolution (meters)
Band 1	Blue	0.45 - 0.52	Discriminates soil and rock surfaces from vegetation. Provides increased penetration of water bodies	30
Band 2	Green	0.52 - 0.60	Useful for assessing plant vigor	30
Band 3	Red	0.63 - 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 → .img files
- Layer stack bands 1-5, 7
- Display 3 bands at a time

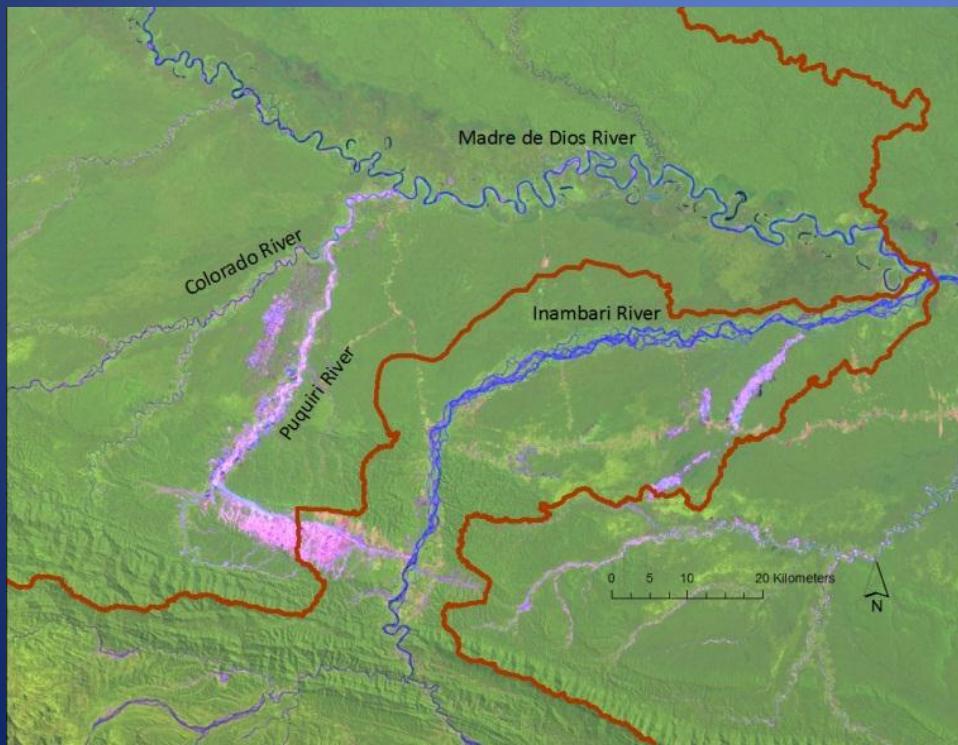


Landsat 5 TM through time (Bands 5,4,3)



Hydrologic Terrain Analysis using ASTER GDEM version 2

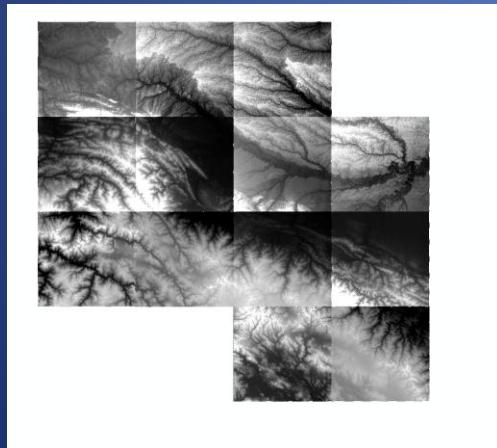
- ASTER GDEM version 2:
 - 1 arc-second resolution (30mx30m at equator)
 - Accuracy of 17 meters at 95% confidence level
 - Referenced to WGS84



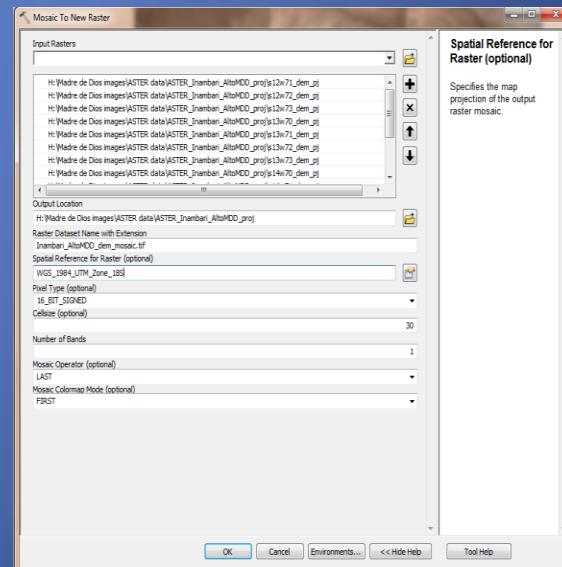
- Study area spans two watersheds—Inambari Watershed and Alto Madre de Dios Watershed

Processing ASTER GDEM data

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

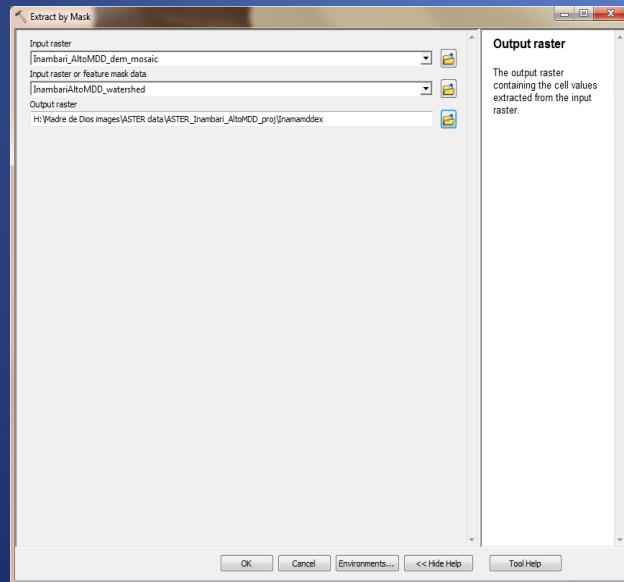


Mosaic to
New Raster



Processing ASTER GDEM data

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



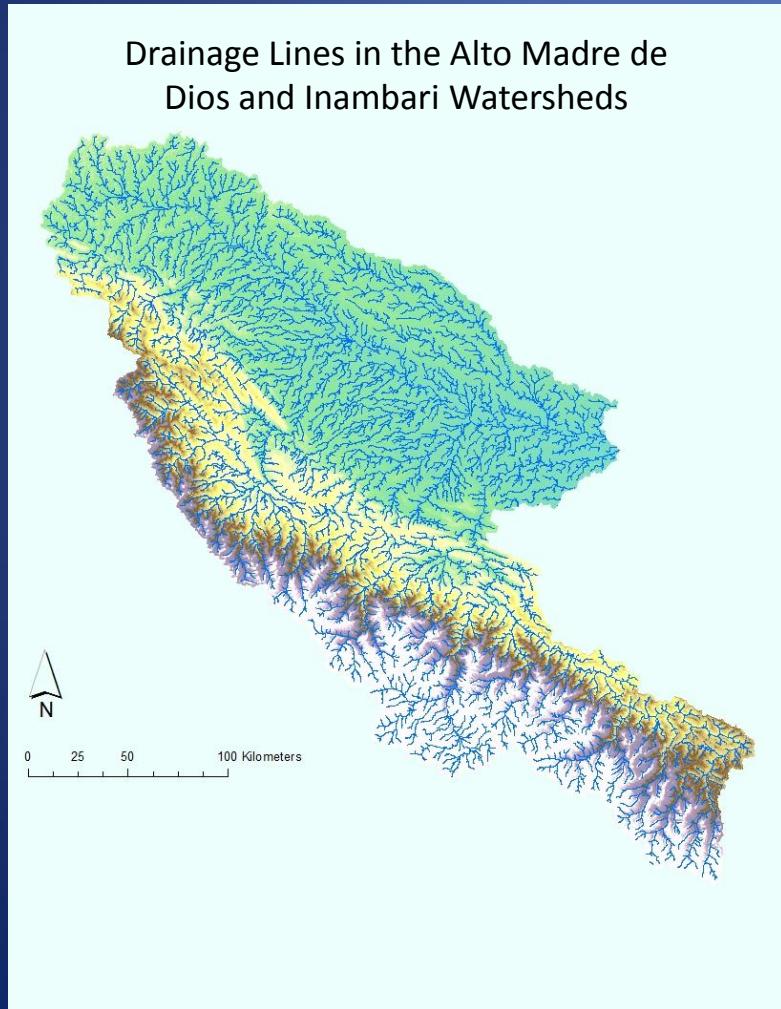
DEM of Alto Madre de Dios and Inambari Watersheds



Hydrologic Terrain Analysis

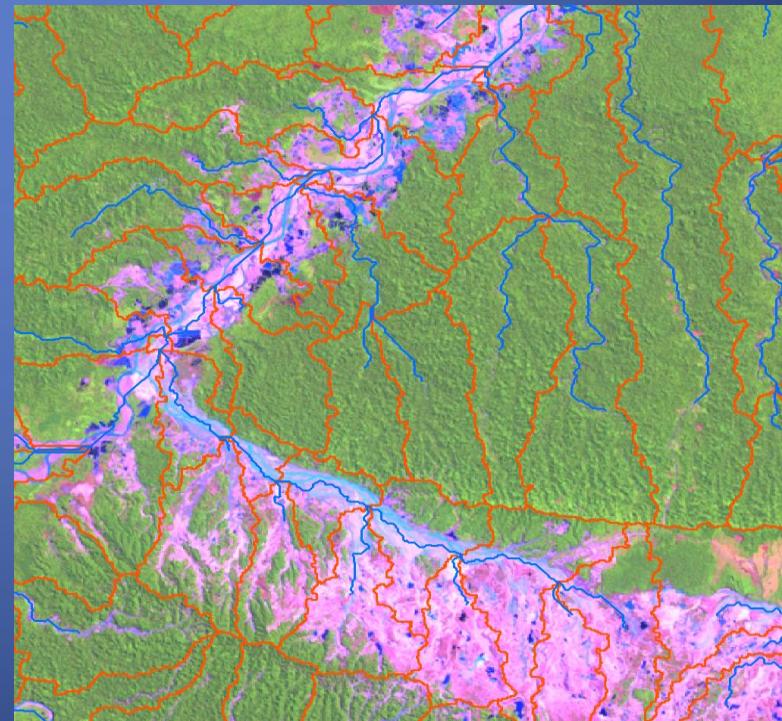
1. Pit removal
2. Flow direction field derivation
3. Flow Accumulation
4. Stream Links and Catchments
5. Raster to Vector Connection

Hydrologic Terrain Analysis

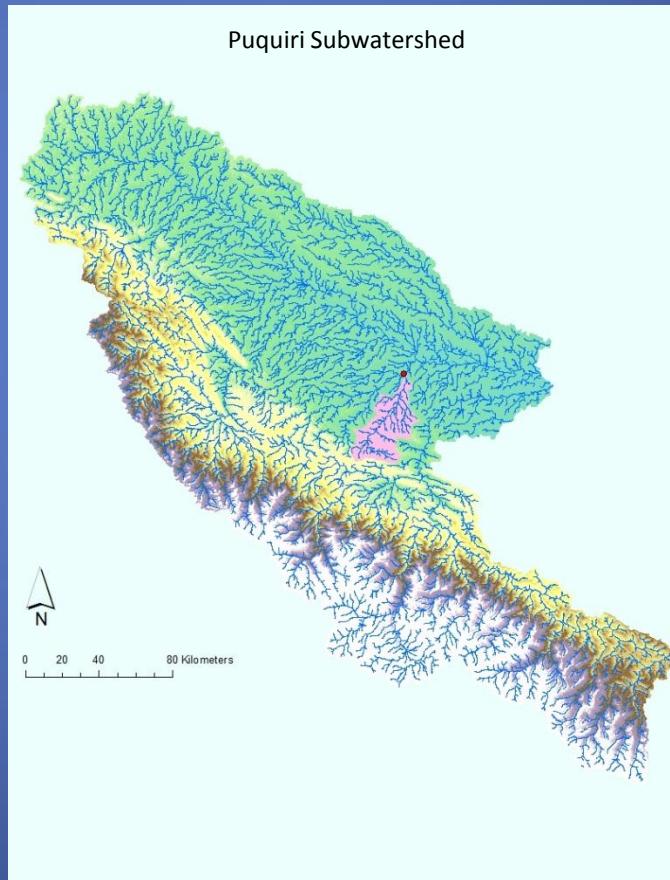
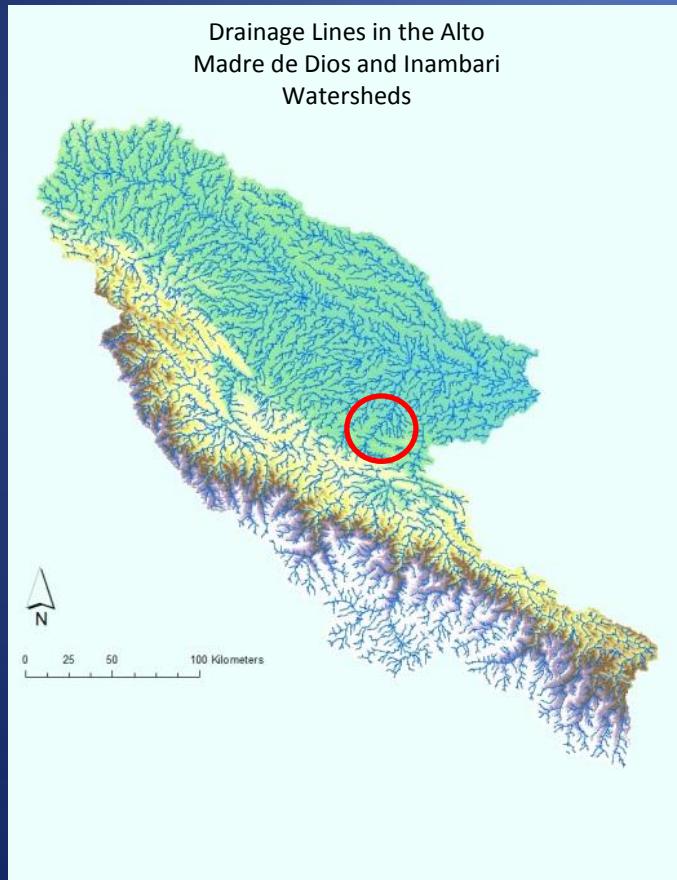


- Inambari watershed: 19,837.899 km²
- Alto Madre de Dios watershed: 34,760.1204 km²

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