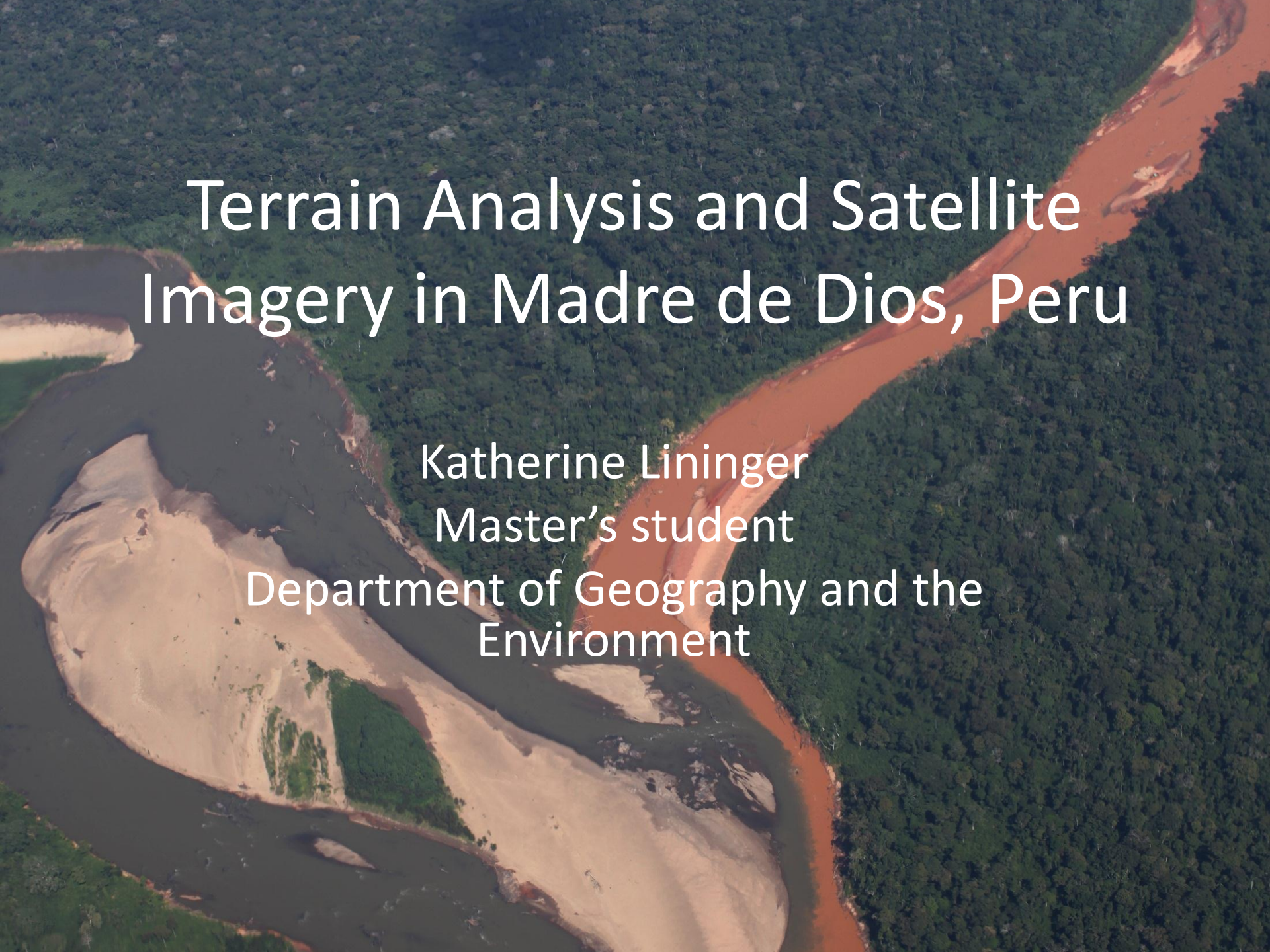
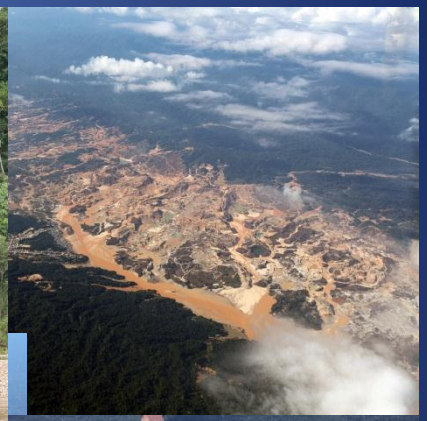


Terrain Analysis and Satellite Imagery in Madre de Dios, Peru

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

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



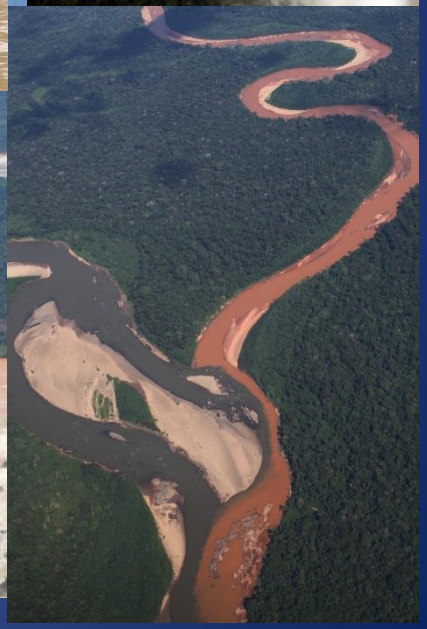


Photo credit: Rhett Butler/mongabay.com

Purpose of Project

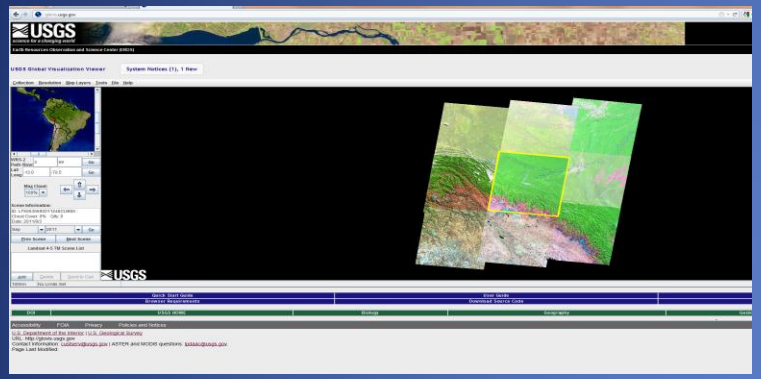
- Gather available data sources
  - Multi-temporal satellite imagery
  - ASTER elevation data (30m resolution)
- Hydrologic terrain analysis

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

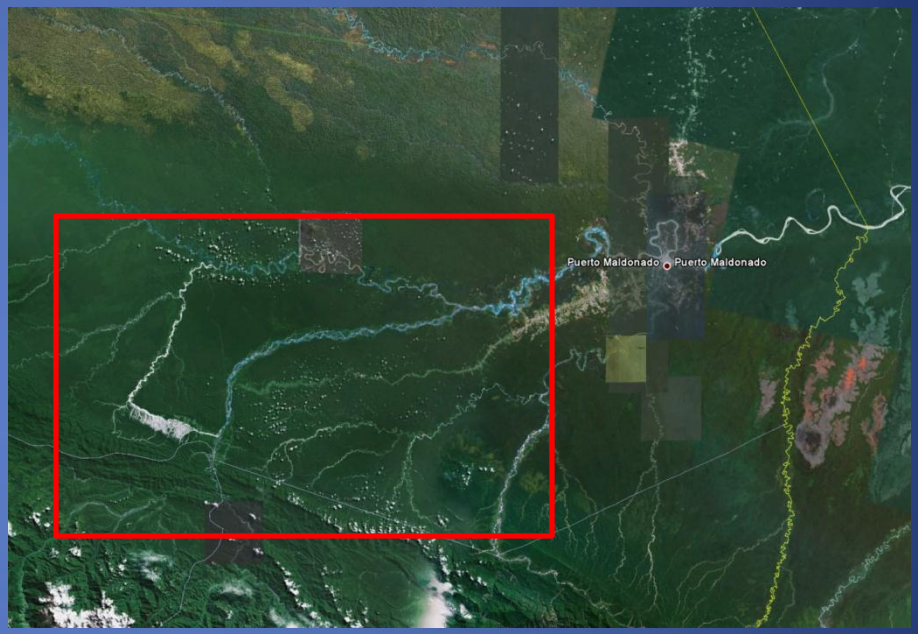
From NASA Reverb ECHO:

ASTER GDEM 2 (**A**dvanced **S**paceborne **T**hermal **E**mission and **R**eflection Radiometer **G**lobal **D**igital **E**levation **M**odel Version 2)

(http://testbed.echo.nasa.gov/reverb/#utf8=%E2%9C%93&spatial_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

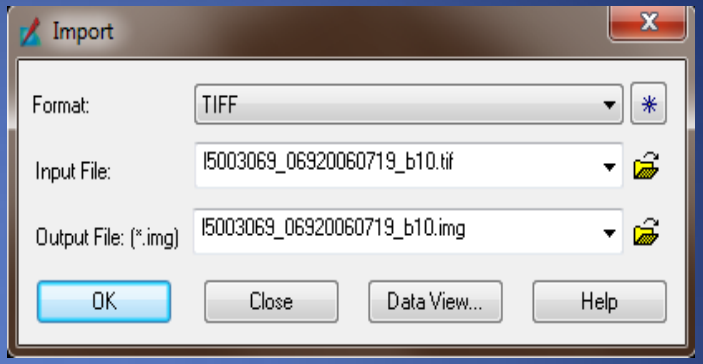


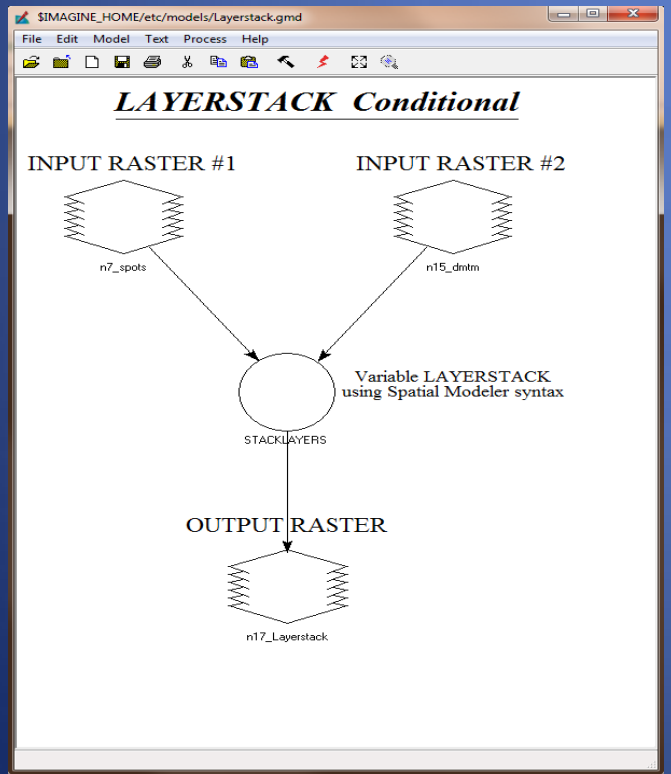
Google earth image of region

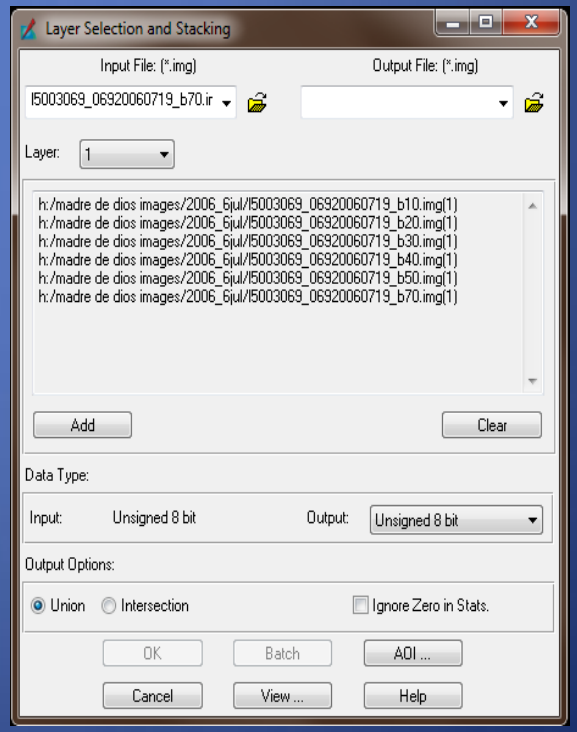
Band	Spectral Bands	Wavelength (micrometers)	Potential Information Content	Resolution (meters)
Band 1	Blue	0.45 - 0.52	Discriminates soil and rock surfaces from vegetation. Provides increased penetration of water bodies	30
Band 2	Green	0.52 - 0.60	Useful for assessing plant vigor	30
Band 3	Red	0.63 - 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

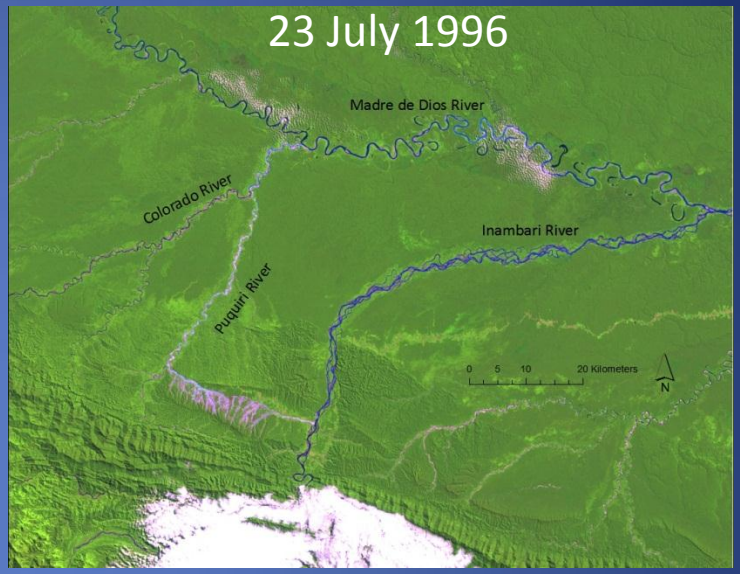
- .tif → .img files
- Layer stack bands 1-5, 7
- Display 3 bands at a time

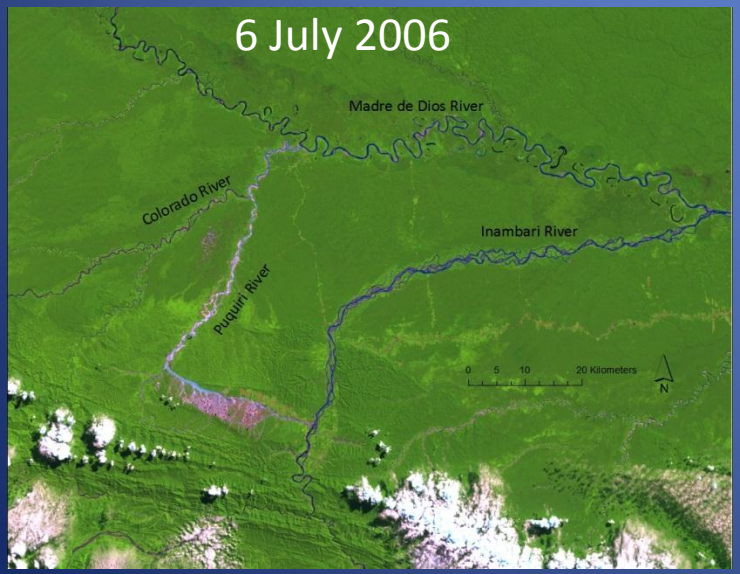


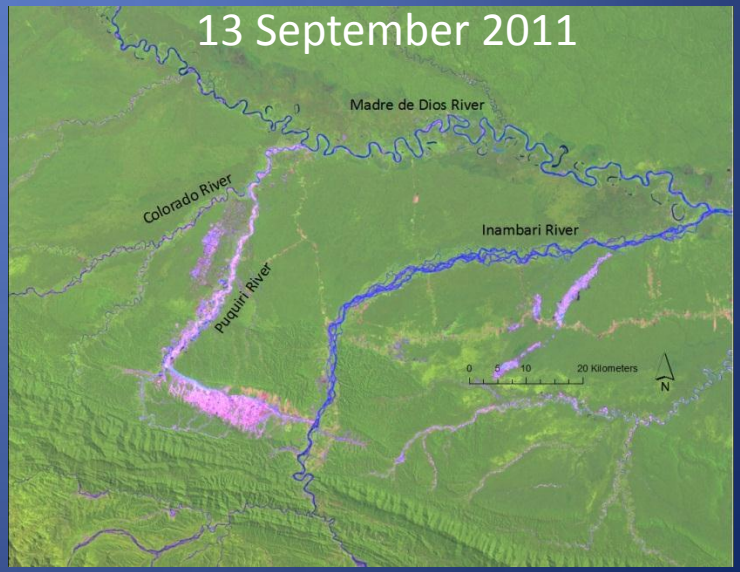




Landsat 5 TM through time
(Bands 5,4,3)

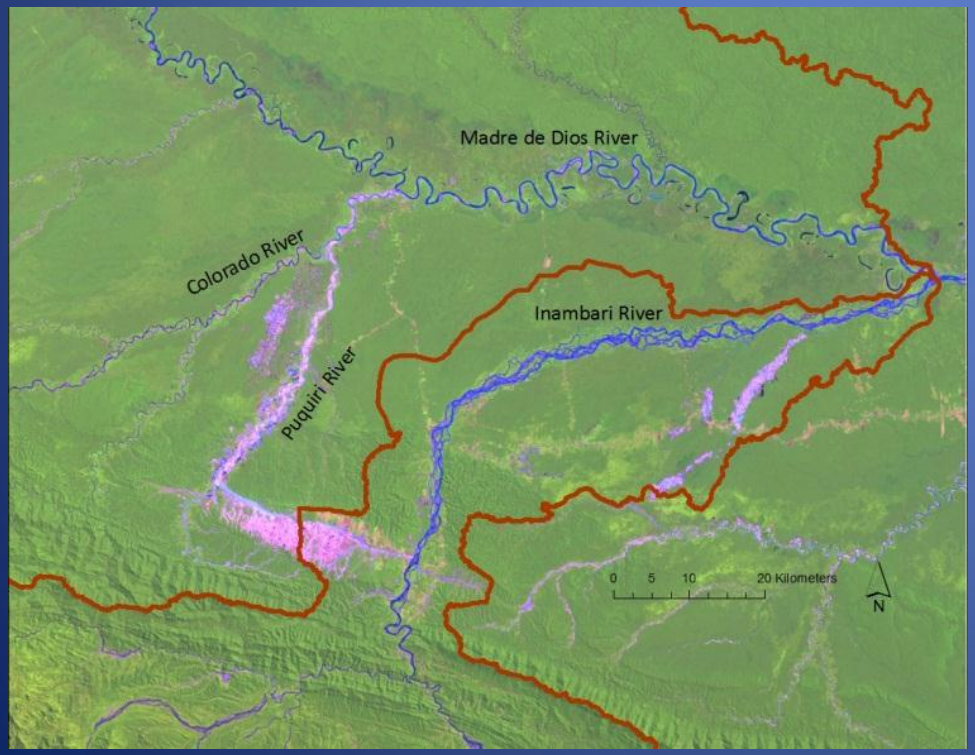






Hydrologic Terrain Analysis using ASTER GDEM version 2

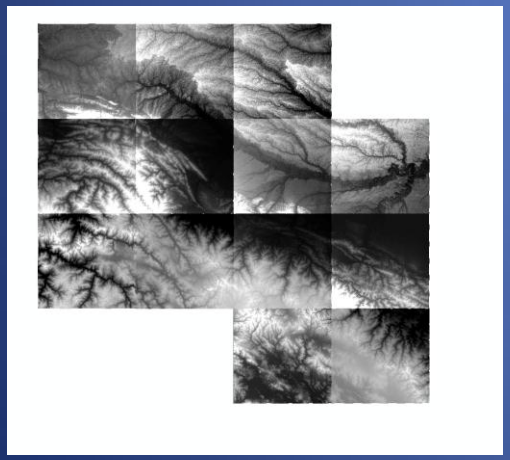
- ASTER GDEM version 2:
  - 1 arc-second resolution (30mx30m at equator)
  - Accuracy of 17 meters at 95% confidence level
  - Referenced to WGS84



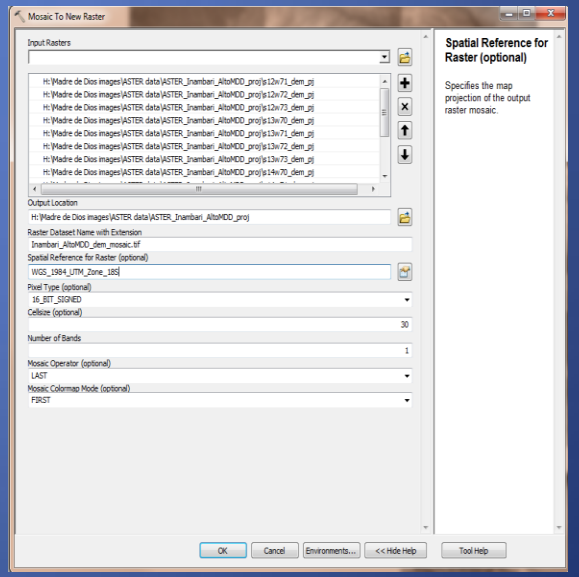
- Study area spans two watersheds—Inambari Watershed and Alto Madre de Dios Watershed

Processing ASTER GDEM data

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



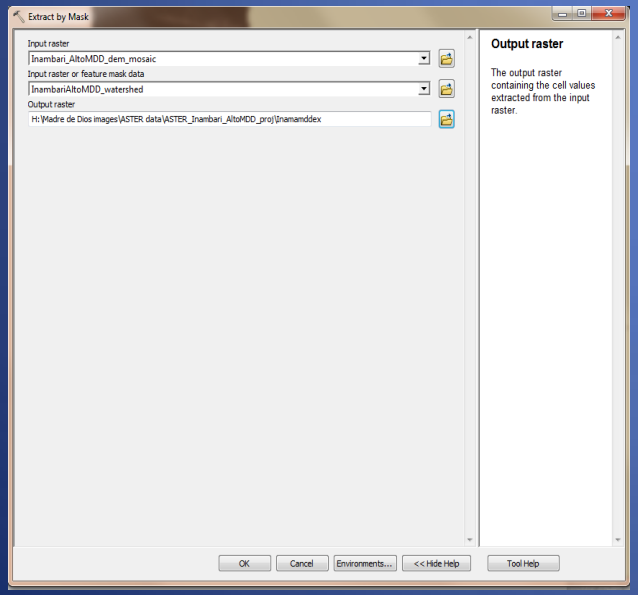
Mosaic to New Raster



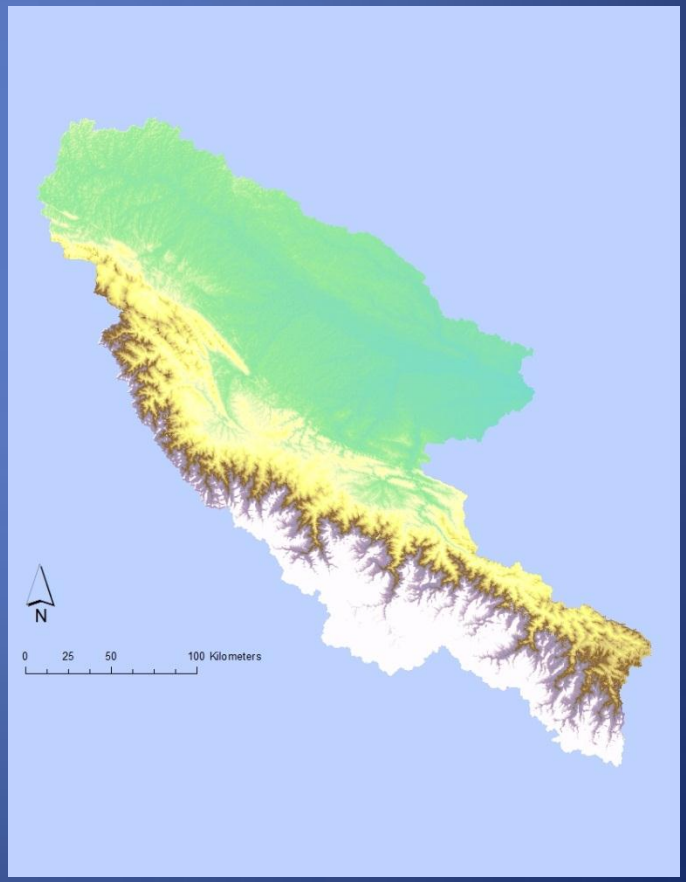
Processing ASTER GDEM data

- 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



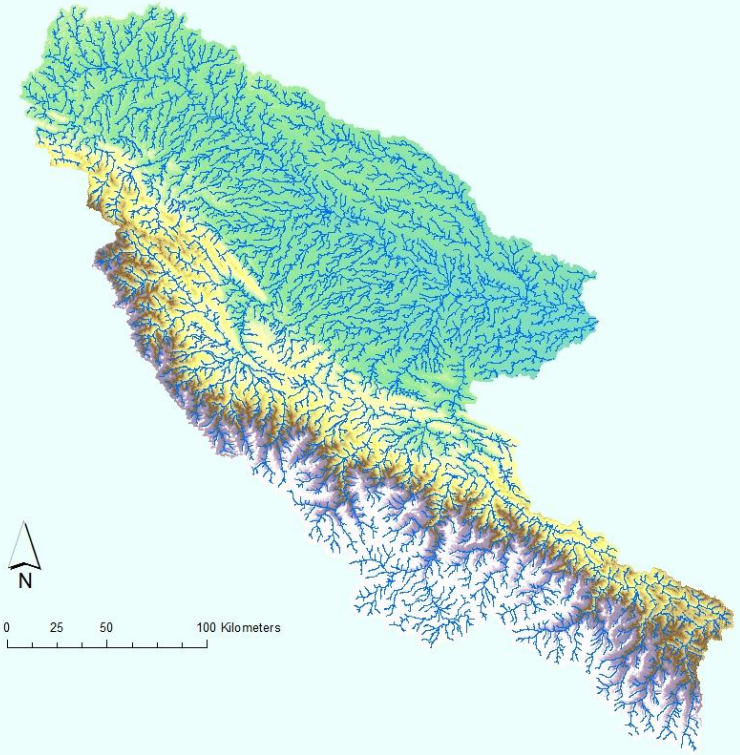
Hydrologic Terrain Analysis

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

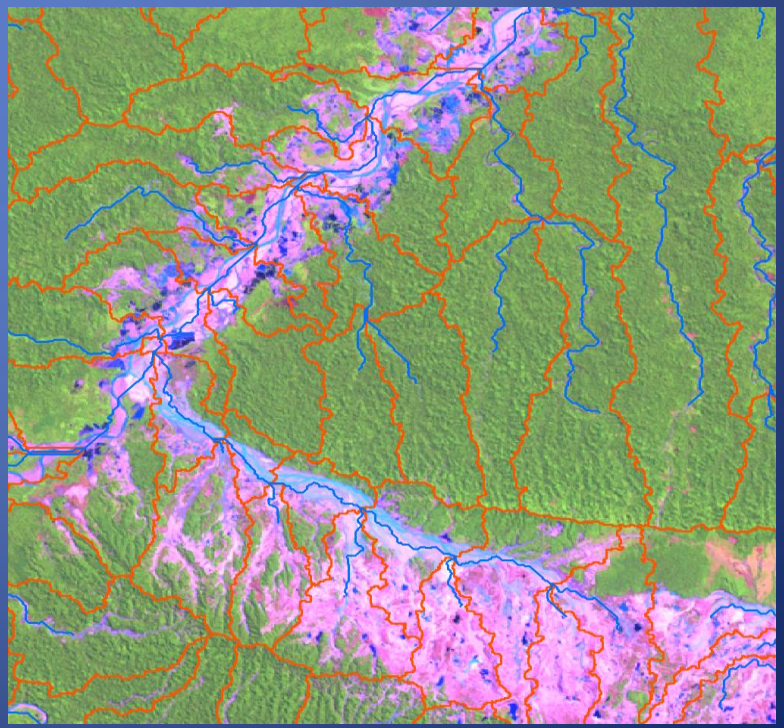
Hydrologic Terrain Analysis

- Inambari watershed: 19,837.899 km^2
- Alto Madre de Dios watershed: 34,760.1204 km^2

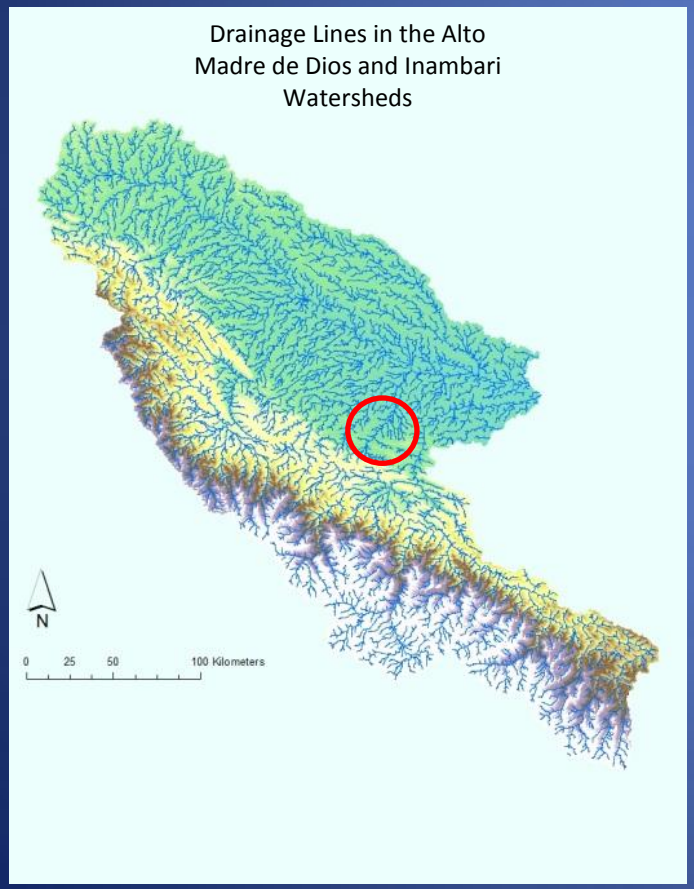
Drainage Lines in the Alto Madre de Dios and Inambari Watersheds

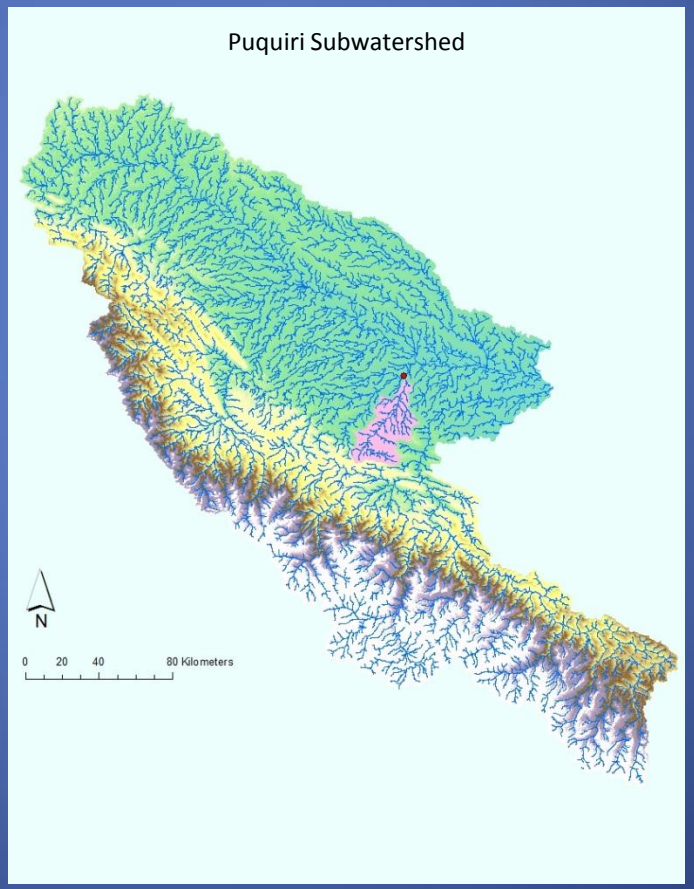


Satellite Image with drainage lines and catchments:



Delineate Puquiri subwatershed of Alto Madre de Dios





Puquiri drainage area: 896.26 km^2

Future Master's Research

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