Water and Development

Part 3b: Models, Maps and GIS

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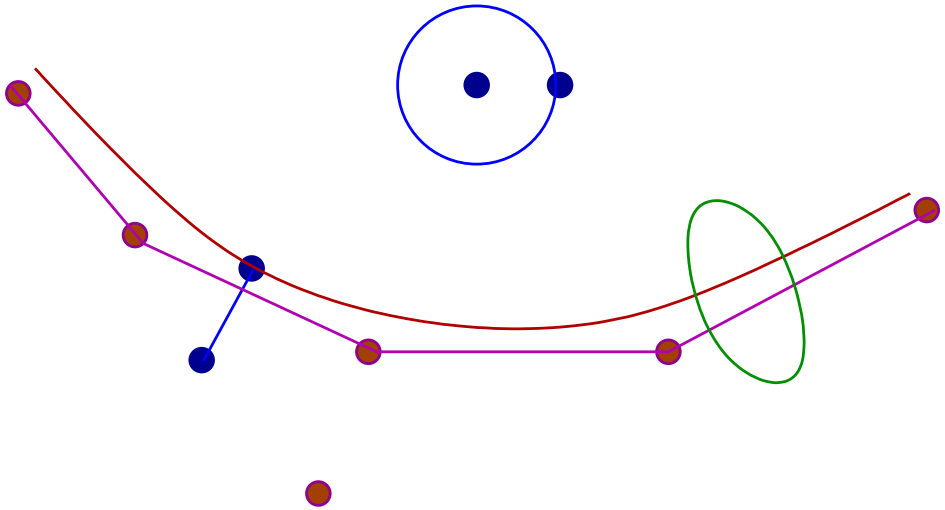
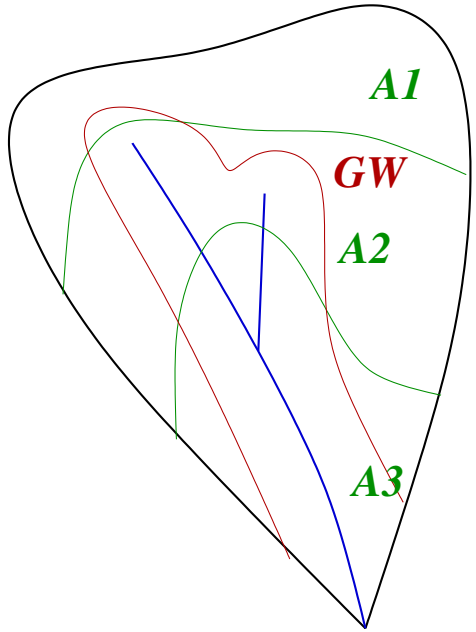
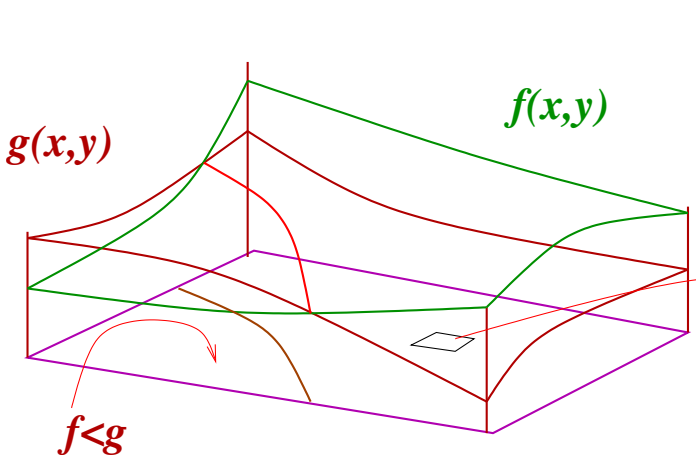
2D objects

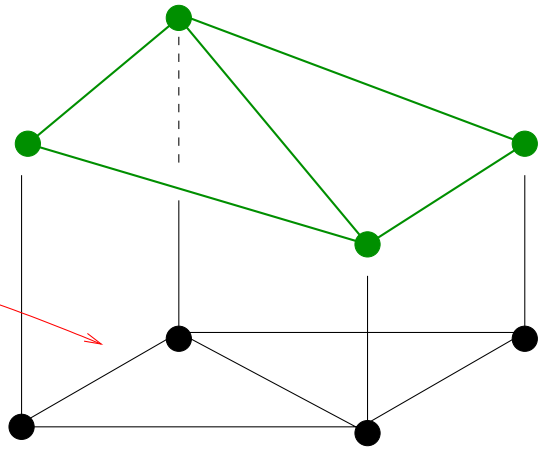


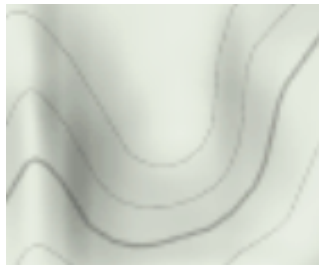


- 0-d: points with (x, y), *location*. 1-D: lines and curves. *notion of length*. 2-D: closed curves and polygons. *notion of area*.
- Operations: *centroid:* $2D \rightarrow 0D$, computes the centroid of an area. *intersect:* $2D \times 2D \rightarrow 2D$: computes the intersection of two areas.
- Attributes. 0D: location of schools, number of pupils. 1D: streams, roads.width. 2D: plots of lands, wards, village boundaries. census data.

3D







- Basic 3d: functions on 2D, i.e., $f(x, y)$.. Operations: Compute miminum. Restrict domain.
- Various uses: Elevation, Rainfall, distance to school.
- Discretization. : Representation as DEM. Generalization: Making function out of point data.

GIS-Geographical Information System

- A universal (x, y, z) frame:
  - (latitude, longitude, elevation).
  - Usually, only a lat-long (X-Y) plane, with z as a function.
- Layers and Functions
  - Layers: Diagrams in the X-Y plane, such as features, polygons etc, e.g., a farm-plot, or a stream.
  - Functions: Storing functions $f(x, y)$, e.g., $rainfall(x, y)$.
- Layers will have names:
  - drainage, land-use
- Each layer:
  - points, lines, curves, polygons-wells, streams, farm-plots
  - functions-elevations
- Operations
  - Intrpolation, Extrapolation, Subdomains
  - Use-specific: watershed delineations, run-off models etc.
- Display tools-converting layers and functions into images.

Papagni Watershed

The Papagni river water shed is about 2500 sq. km, in a border district of Andhra Pradesh. It is one of the study areas of the Foundation for Ecological Security (www.fes.org.in). The following maps are from FES.

- The physical map- The toposheet.
- The Drainage-outlines all streams and rivers in the water shed.
- The sub-water shed map-outline all sub-domains down to micro-watersheds, which are about 3-10 sq. km.
- The next two are the geological data sheets.
- Next, we have the land use data.
- Finally we have the development-potential. This is a basic input for any development plan.

Question-Static Data

What goes into the collection of such data and its representation?

The Papagni maps

- 1:250,000 maps of a particular district/valley in A.P.
- These cover various attributes related to ground and surface water.
- Water related: Drainage, Digital terrain Map (DTM), Micro-watershed, Geology, Landscape, Land-Use/Cover, Groundwater potential, Sub-watershed priority.
- Ancillary: Soil erosion, Risk of Fire.
- Development related: Composite Land Development Unit.

Scales:

Scale	1m	1 Hectare (in mm.)	Typical use
1:250,000	250 km	$<$ 1sq. mm	District
1:50,000	50 km	2×2	Taluka
1:5,000	5 km	20×20	Gram-Panchayat

Legends

- Drainage, DTM obvious and so is the micro-water shed map.
- What is the data required and how is it obtained?
  - DTM is the base map which is remote-sensed (How?).
  - Watersheds are outlined through an auotomatic delineation.
  - Drainage:
  - Towns, villages, roads, political boundaries: a GIS layer.

- Geological:This is about the origins of soil/rock of the area. It is also typically, what lies below the *regalith* , i.e., unconsolidated overlying material.
  - Crystalline: substrate rock, typically crystalline, in this case, gneiss and granite.
  - Intrusive: that which intrudes from beneath the crystalline base rock. Usually a dike (planar fault) or pipes (tubular fault), or because of a different rock-type, in this case quartz.
  - Residual: The parent rock.

More Legends

Geomorphological/Landscape: The shape rather than the origin.

- Structural hill: Largely uneroded outcrops.
- Denudational hill: Weathered hills.
- Pediment: roughly planar rock, with or without a thin layer of soil. Typically between hills.
- Pediplain: A tapestry of pediments.
- Pediment-Inselberg: A hill outcrop from a pediment.
- Piedmont: Plains at the base of hills formed by stream deposits.
- Papagni: largely structural hills and pediplains.

Land Use/Cover: Agricultural (season,fallow), Forest, Waste.

- Papagni: Largely kharif, fallow. Forests on the hill-slopes.
- Also note the correlation with the geo-morphology.

Groundwater Potential: seems correlated with dikes and drainages. Generally poor.

Erosion: seems correlated with the *slope-map*.

Finally, Land Dev. Unit : Prescriptions, largely water interventions.

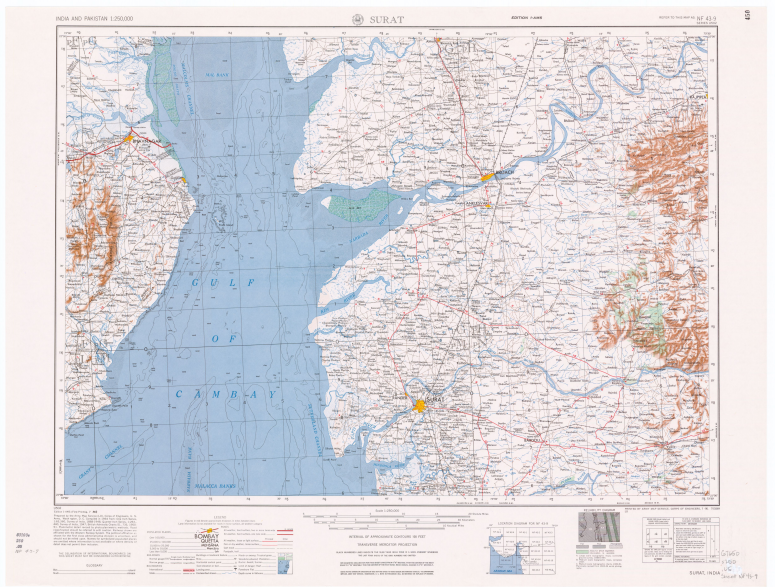
Typography of data

Name	Type	Means of gathering
Elevation	Scientific	Satellite, Surveying
Geology	Scientific	Surveys, bore-logs
Rainfall etc.	Climatological	weather stations
Drainage	Intermediate	Surveys, Mathematics
Infiltration	Intermediate	mathematical
Land Use	Socio-economic	*talathi*, satellite
Cropping pattern	Socio-economic	Agriculture
Census, roads	administrative	various departments
Household compensation	policy	composite
Development Priority	planning	composite

Maps

The main national source of maps are:

- Survey of India, Geological Survey of India for 1:250,000 standard data and geology.
- `http://www.lib.utexas.edu/maps/ams/india/` US army series U502 again 1:250,000.
- National Remote Sensing Center



Thanks