Digital Elevation Model

DEM, DSM, DTM?

- DSM: digital surface model. Height of the earth's surface, including houses, trees, boulders...etc.

- DTM: digital terrain model. Bare-earth earth surface model. Filtered results of DSM.

- DEM: digital elevation model. Some people use DEM as DSM, some regard it as DTM. Lately, it is more synonymous to a general terms describing the height of surface.
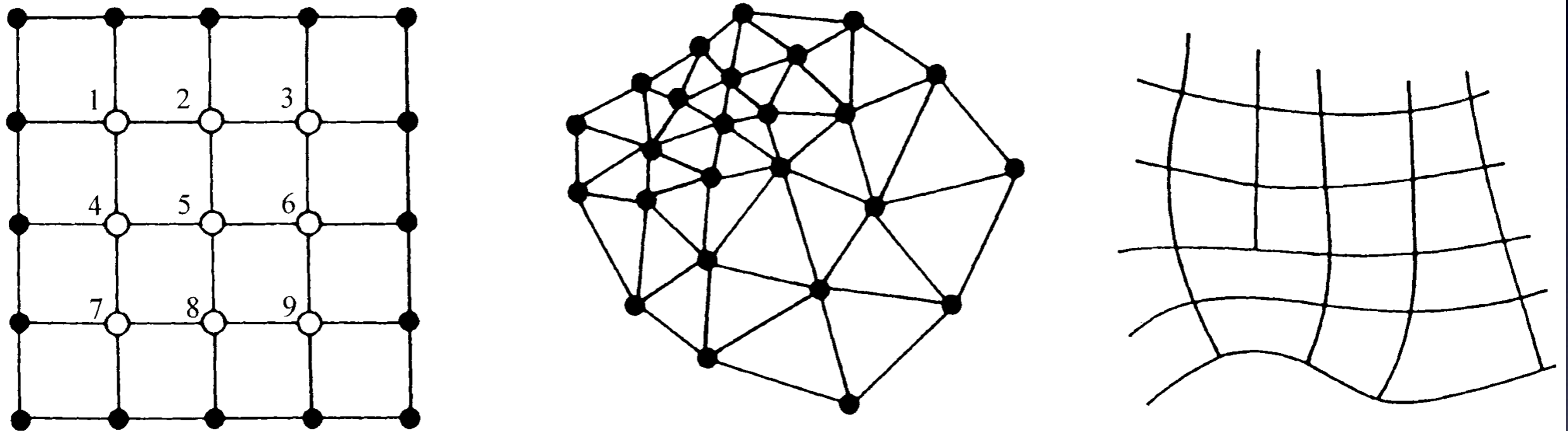
Grid, triangulation, contour-based network

Figure 1.2. Methods of structuring an elevation data network: (a) square-grid network showing a moving 3 by 3 submatrix centered on node 5; (b) triangulated irregular network; and (c) contour-based network. Reprinted with permission from Moore, Grayson, and Ladson (1991) Digital terrain modeling: A review of hydrological, geomorphological, and ecological applications. *Hydrological Processes* 5: 3–30. Copyright © 1991 by John Wiley and Sons Ltd.

File format

- Endian

- BSQ, BIL, and BIP

Image Dimensions	Abbreviation	Alternative Name
M-N-3	BSQ	Band-Sequential or Band-Interleaved
3-M-N	BIP	Band-Interleaved-by-Pixel or Pixel-Interleaved
M-3-N	BIL	Band-Interleaved-by-Line or Row-Interleaved

Usage of DEM

- need to orthorectify your satellite or aerial imagery

- require 3D visualisation

- need to extraction information that has a height element

- observe parameters of landform: roughness, slope

- Model flow directions

- Input for numerical models

Sources of DEM

- GTOPO30 <http://edc.usgs.gov/products/elevation/gtopo30/gtopo30.html>

- ETOPO2 / ETOPO5 <http://www.gfdl.noaa.gov/products/vis/data/datasets/etopo2_topography.html>

- SRTM <ftp://e0srp01u.ecs.nasa.gov>

- SRTM plus <http://topex.ucsd.edu/WWW_html/srtm30_plus.html>

- Taiwan DEM <http://www.csrsr.ncu.edu.tw>

Attribute	Definition	Significance
Altitude	Elevation	Climate, vegetation, potential energy
Upslope height	Mean height of upslope area	Potential energy
Aspect	Slope azimuth	Solar insolation, evapotranspiration, flora and fauna distribution and abundance
Slope	Gradient	Overland and subsurface flow velocity and runoff rate, precipitation, vegetation, geomorphology, soil water content, land capability class
Upslope slope	Mean slope of upslope area	Runof velocity
Dispersal slope	Mean slope of dispersal area	Rate of soil drainage
Catchment slope	Average slope over the catchment	Time of concentration
Upslope area	Catchment area above a short length of contour	Runoff volume, steady-state runoff rate
Dispersal area	Area downslope from a short length of contour	Soil drainage rate
Catchment area	Area draining to catchment outlet	Runoff volumn
Specific catchment area	Upslope area per unit width of contour	Runoff volume, steady-state runoff rate, soil characteristics, soil-water content, geomorphology
Flow path length	Maximum distance of water flow to a point in the catchment	Erosion rates, sediment yield, time of concentration
Upslope length	Mean length of flow paths to a point in the catchment	Flow acceleration, erosion rates
Dispersal length	Distance from a point in the catchment to the outlet	Impedance of soil drainage
Catchment length	Distance from highest point to outlet	Overland flow attenuation
Profile curvature	Slope profile curvature	Flow acceleration, erosion/deposition rate, geomorphology
Plan curvature	Contour curvature	Converging/diverging flow, soil-water contnet, soil characteristics
Tangential curvature	Plan curvature multiplied by slope	Provides alternative measre of local flow convergence and divergence
Elevation percentile	Proportion of cells in a user-defined circle lower than the center cell	Relative landscape position, flora and fauna distribution and abundance

Production

- Traditional survey

- Modern survey - GPS survey, Leveling...etc.

- Digitizing contour map

- LiDAR

- InSAR