Terrain and Hydrology with Rasters

AIA-AHMP GIS Course 3
January 2021

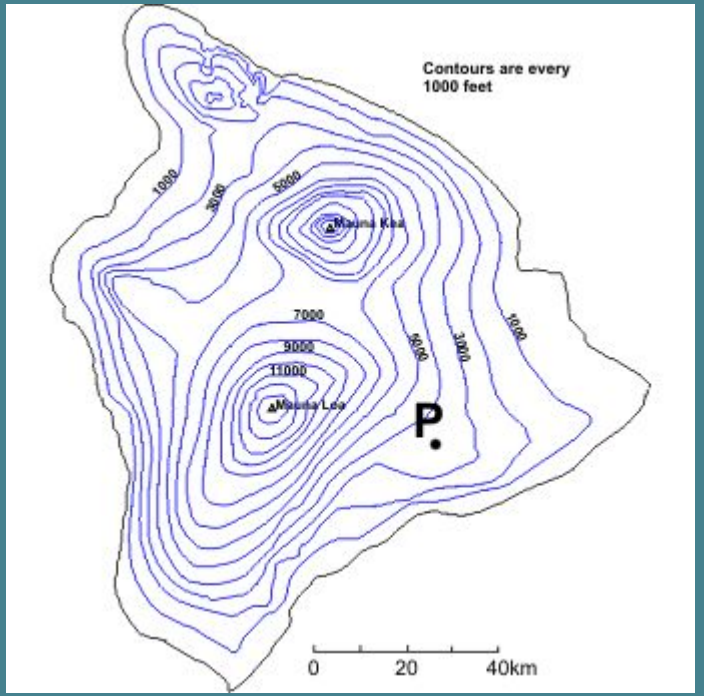
Summary

- Rasters review
  - Resolution
- Terrain
  - Displaying terrain in different formats
  - Elevation models
  - Hillshading
  - Slope
  - Aspect
  - Downloading DEMs
- Hydrology
  - Modeling with rasters
  - Using WWF Hydrosheds data

Terrain

We use the word “terrain” to describe the shape of the surface of the planet--hills, valleys, etc.

To show terrain on a paper map we usually use **contours** or shading. Contours are very easy to generate in GIS software and show terrain using vector data (lines)



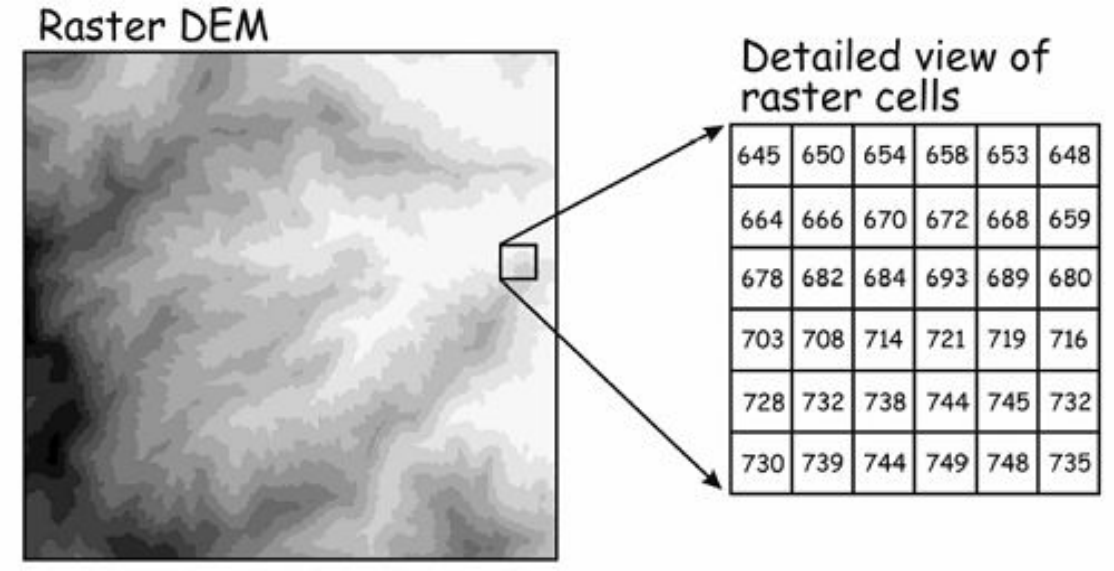
Raster review

Rasters are image files that are made of individual pixels that record different values (numbers)

All satellite imagery is in raster format

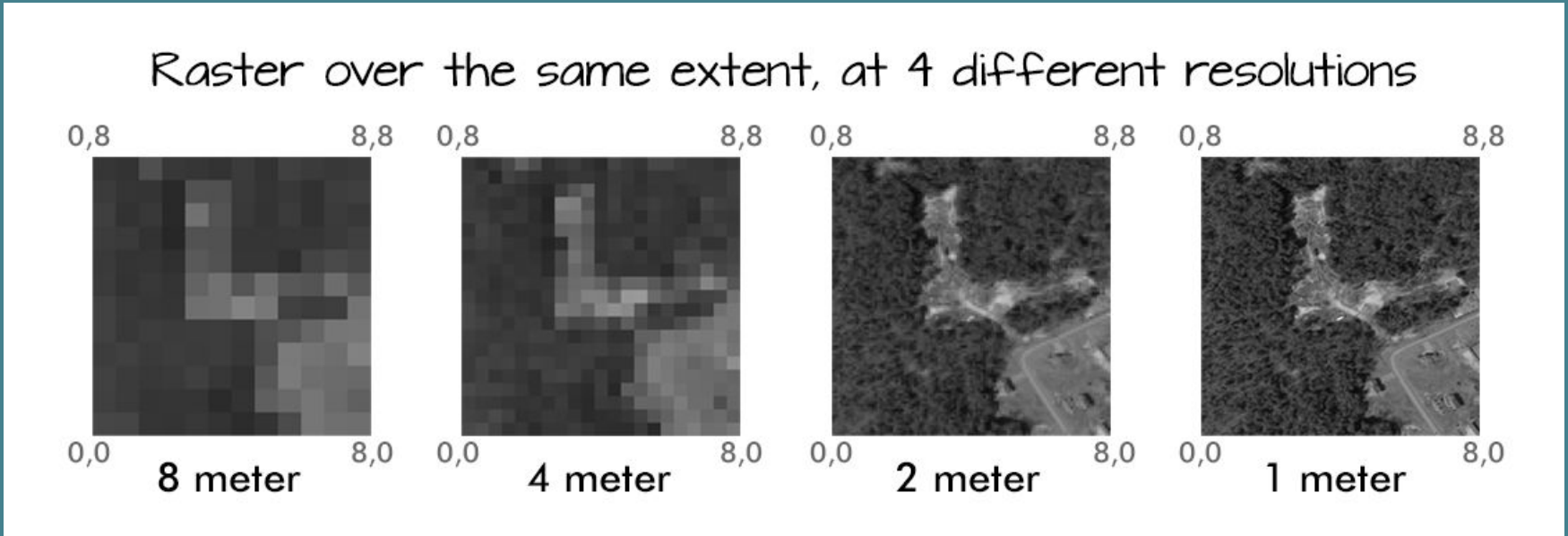
Raster pixels correspond to space on the ground

Next we'll look at showing terrain with rasters



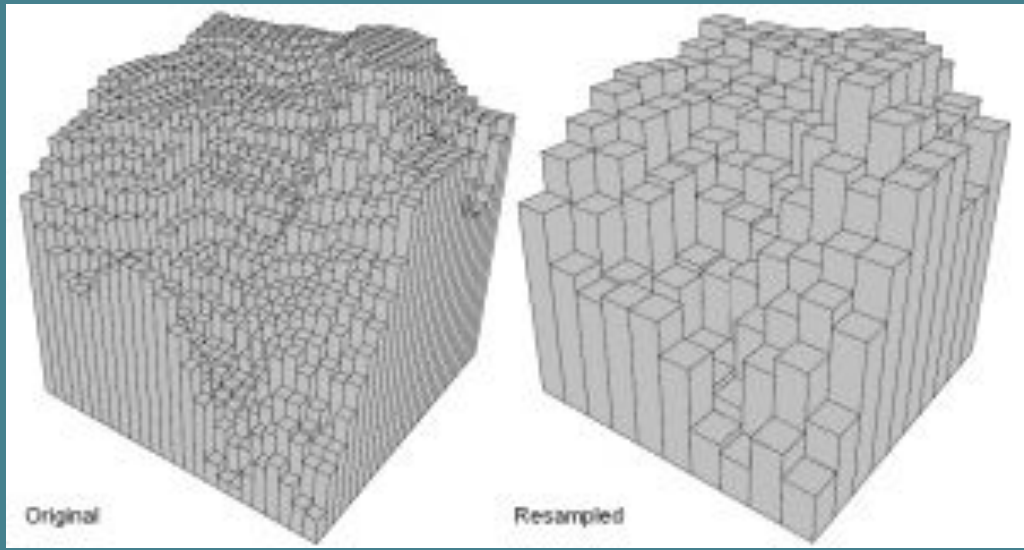
Raster Resolution

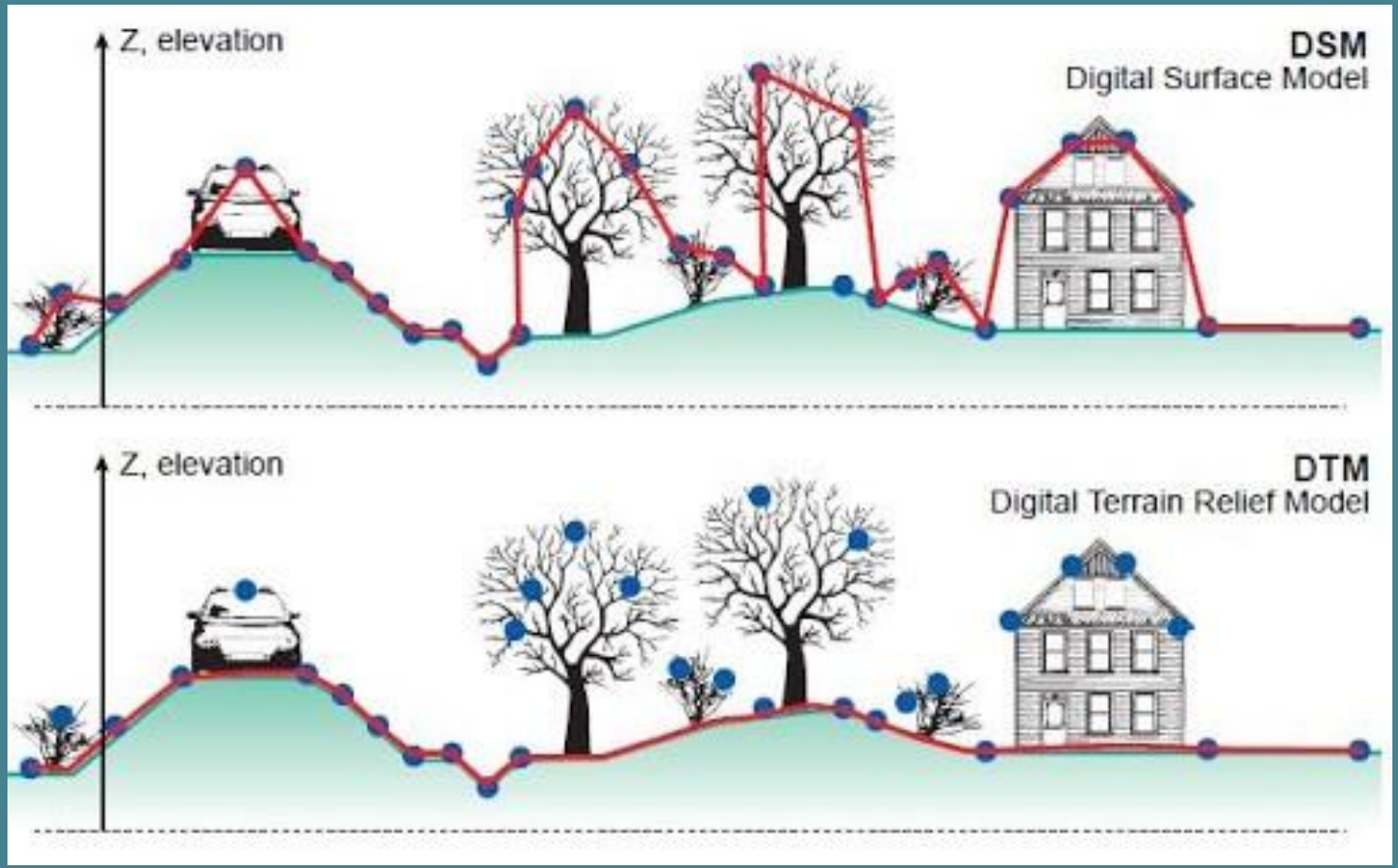
The resolution of a raster is the same as the space on the ground of one pixel



Digital Elevation Models (DEMs)

- A DEM is a raster where the value in each pixel is the elevation above sea level
- There are two types of DEM
  - Digital Terrain Models (DTMs), which show only the actual surface of the earth
  - Digital Surface Models (DSMs), which show other features like trees, buildings, and other features




Z, elevation
DSM
Digital Surface Model
Z, elevation
DTM
Digital Terrain Relief Model

Digital Elevation Models

Digital Elevation Models can be made in many different ways

- Field survey (good results, but very slow and difficult)
- Drone/UAVs photogrammetry (very detailed, but expensive, and limited in area)
- Satellites (lower detail, but very fast and free)

DEMs of small areas can be very detailed, but aren’t widely available

DEMs of whole regions, countries, and landscapes are lower resolution but widely available

Digital Elevation Models

The most common source of DEM is satellites in orbit around the planet. They use RADAR to map terrain

- ASTER Global DEM (USA and Japan partnership), 30m/pixel
- SRTM (USA), 30m/pixel
- ALOS (Japan), 30m/pixel (DSM)

There are other DEMs, some of higher quality, but they are not widely available

ASTER and SRTM are available for free

Basic Analyses with DEMs

- Hillshading--Shows how sunlight falls over terrain, useful for displays
- Slope-A measure of how steep terrain is, in degrees
- Aspect-Shows which direction parts of the terrain are facing
- Hydrology

Hydrology

Terrain determines how water flows across the landscape. Rivers always run downhill, and water collects and sits in low spots (ponds, lakes, etc.)

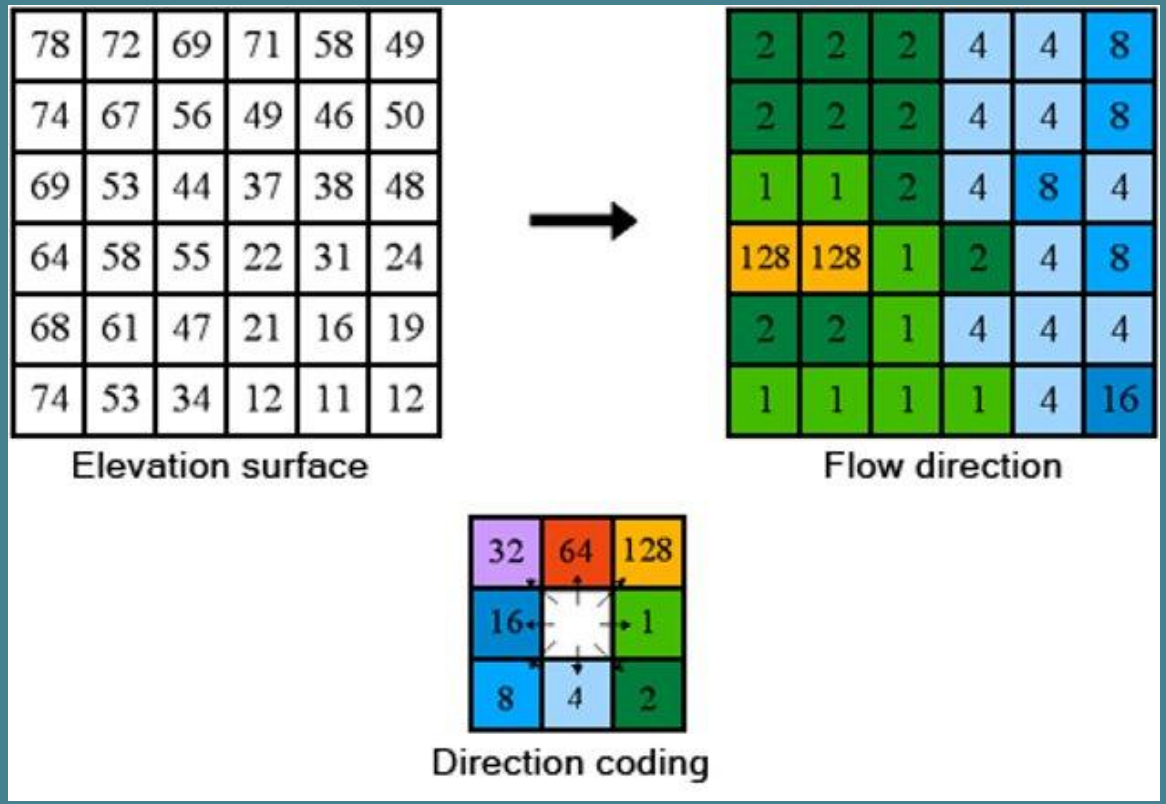
Studying hydrology with rasters usually leads to a shapefile showing river streams and channels, and a flow accumulation raster showing how much water would flow across a given pixel

Hydrology

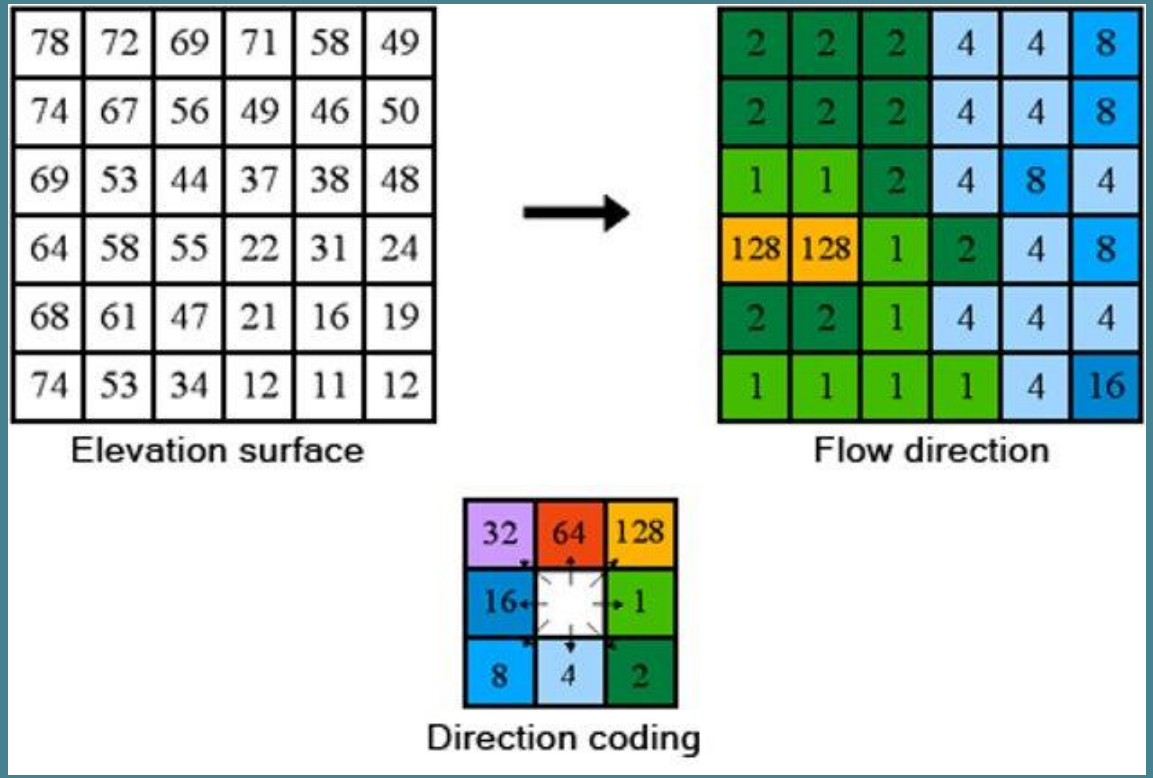
The procedure entails several steps:

- Filling the DEM
- Calculating flow direction
- Calculate flow direction
- Calculate flow accumulation
- Extract a shapefile of high flow areas

Hydrology: Flow Direction



Hydrology: Flow Accumulation



Hydrology: Flow Accumulation