Geospatial concepts

- Geospatial data
- Vector data
- Raster data
- Coordinate reference system (CRS)

  - Geodetic datum

  - Projection
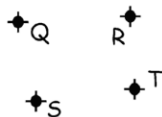- Data for this workshop

Geospatial Data

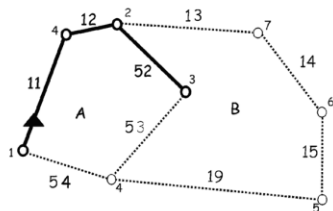Data that has a geographic component to it. The component can be X and Y coordinates, address, city, or zip code.
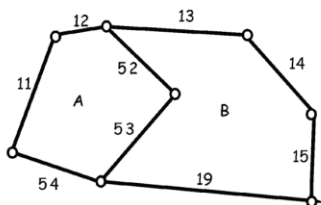
Vector data

Points

Point ID	X	Y
Q	32.7	45.6
R	76.3	19.5
S	22.7	15.8
etc...		

Lines

Line ID	Begin node	End node	Left poly	Right poly
11	1	4	...	A
12	4	2	...	A
52	2	3	B	A
etc ..				

Polygons

Polygon ID	Lines
A	11,12,52,53,54
B	52,53,19, 15,14,13

STATION	ADDRESS
1	1264 N JACKSON
2	7114 N WEST
3	1406 FRESNO
4	3065 E IOWA
5	3131 N FRESNO
6	4343 E GETTYSBURG
7	2571 S CHERRY
8	1428 S CEDAR
9	2340 N VAGEDES
10	5545 AIRCORP WAY
11	5544 N FRESNO
12	2874 W ACACIA
13	815 E NEES
14	6239 N POLK
15	5630 E PARK CIRCLE
16	2510 N POLK
17	10512 N MAPLE
18	5938 N LA VENTANA
19	3187 W BELMONT
20	4537 N WISHON
AR	5065 E ANDERSEN

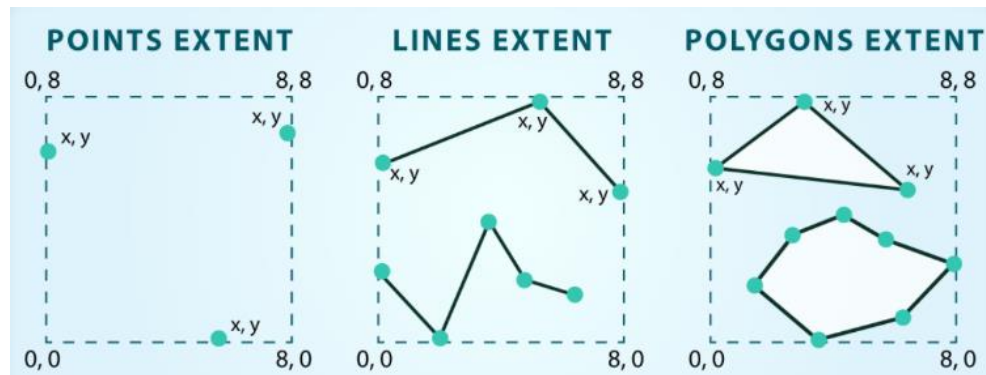https://www.fresno.gov/fire/station-locations/

3

Vector data – metadata & attributes

Metadata:

- Spatial extent
- File type
- Geometry feature type
- Coordinate reference system
- Other attributes:

FID	Shape	OBJECTID	TYPE	NOTES	RULEID	MAPLABEL	SHAPE_LENG	LABEL	BIKEHORSE	Shape_Le_1	ResVehic_1
0	Polyline	48	woods road	Locust Opening Rd	5	Locust Opening Rd	1297.357062	Locust Opening Rd	Y	1297.106167	R1 - All Research Vehicles Allowed
1	Polyline	91	footpath		6		146.299845		Y	146.299831	R1 - All Research Vehicles Allowed
2	Polyline	106	footpath		6		676.718042		Y	676.718065	R2 - 4WD/High Clearance Vehicles Only
3	Polyline	279	stone wall		1		231.789569			231.789625	
4	Polyline	280	stone wall		1		45.508638			45.508587	
5	Polyline	281	stone wall		1		198.390429			198.390409	
6	Polyline	282	stone wall		1		143.192395			143.192406	
7	Polyline	283	stone wall		1		90.331182			90.331137	
8	Polyline	284	stone wall		1		35.881462			35.881519	
9	Polyline	674	boardwalk		2		67.434638		N	67.434658	R3 - No Vehicles Allowed
10	Polyline	71	woods road	Pierce Farm Rd	5	Pierce Farm Rd	3808.432519	Pierce Farm Rd	Y	1771.631075	R2 - 4WD/High Clearance Vehicles Only
11	Polyline	71	woods road	Pierce Farm Rd	5	Pierce Farm Rd	3808.432519	Pierce Farm Rd	N	144.565593	R3 - No Vehicles Allowed
12	Polyline	71	woods road	Pierce Farm Rd	5	Pierce Farm Rd	3808.432519	Pierce Farm Rd	Y	1885.829115	R2 - 4WD/High Clearance Vehicles Only

Vector data

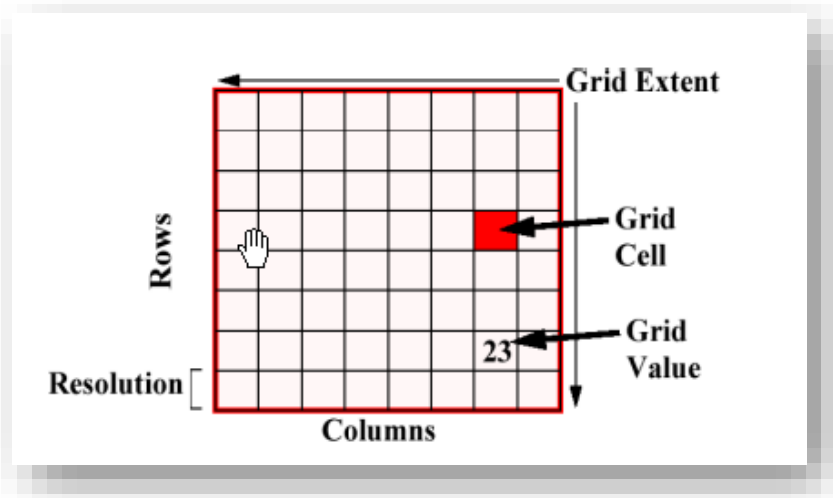File types:

Shapefile (ESRI ArcGIS)
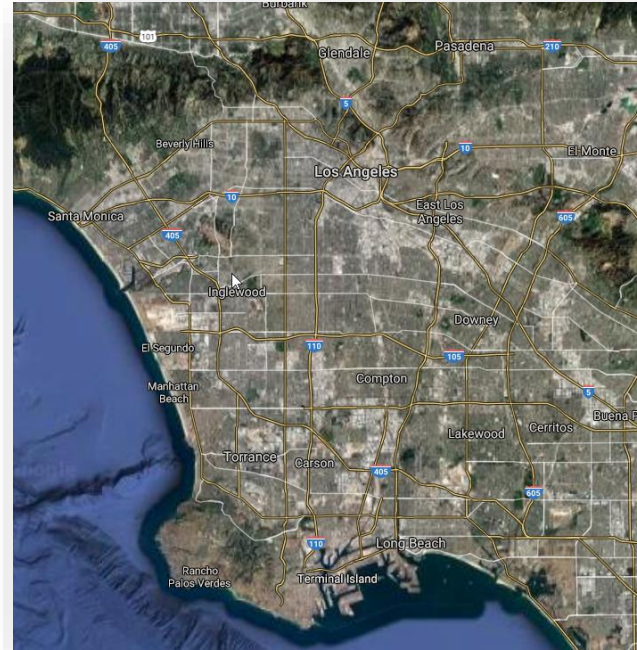
GeoJson

KML /KMZ (Google Earth)

GeoPackage (QGIS)

QGIS can process all these types of files.

Raster data

File type:

GeoTIFF, JPG

Satellite image

Raster data – attributes

Raster Spatial Extent

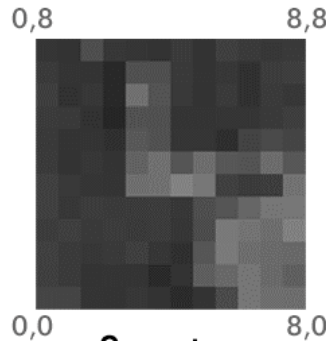X min, Y max   X max, Y max
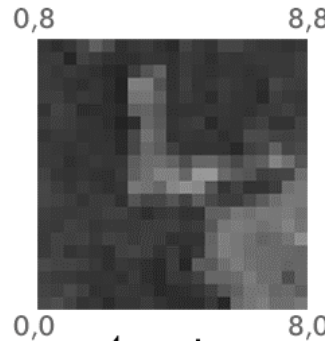
Extent

X min, Y min

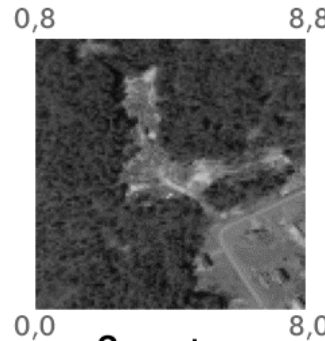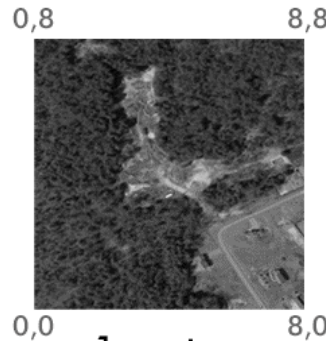The spatial **resolution** of a raster refers to **the size of the cells in a raster dataset.**

| 0,8 | 8,8 | 0,8 | 8,8 | 0,8 | 8,8 | 0,8 | 8,8 |

| 0,0 | 8,0 | 0,0 | 8,0 | 0,0 | 8,0 | 0,0 | 8,0 |

8 meter   **4 meter**   **2 meter**   **1 meter**

Larger cell size
Low feature spatial accuracy
Smaller file size

Smaller cell size
High feature spatial accuracy
Larger file size

Raster data – continuous

Continuous Elevation Map - NEON Harvard Forest Field Site
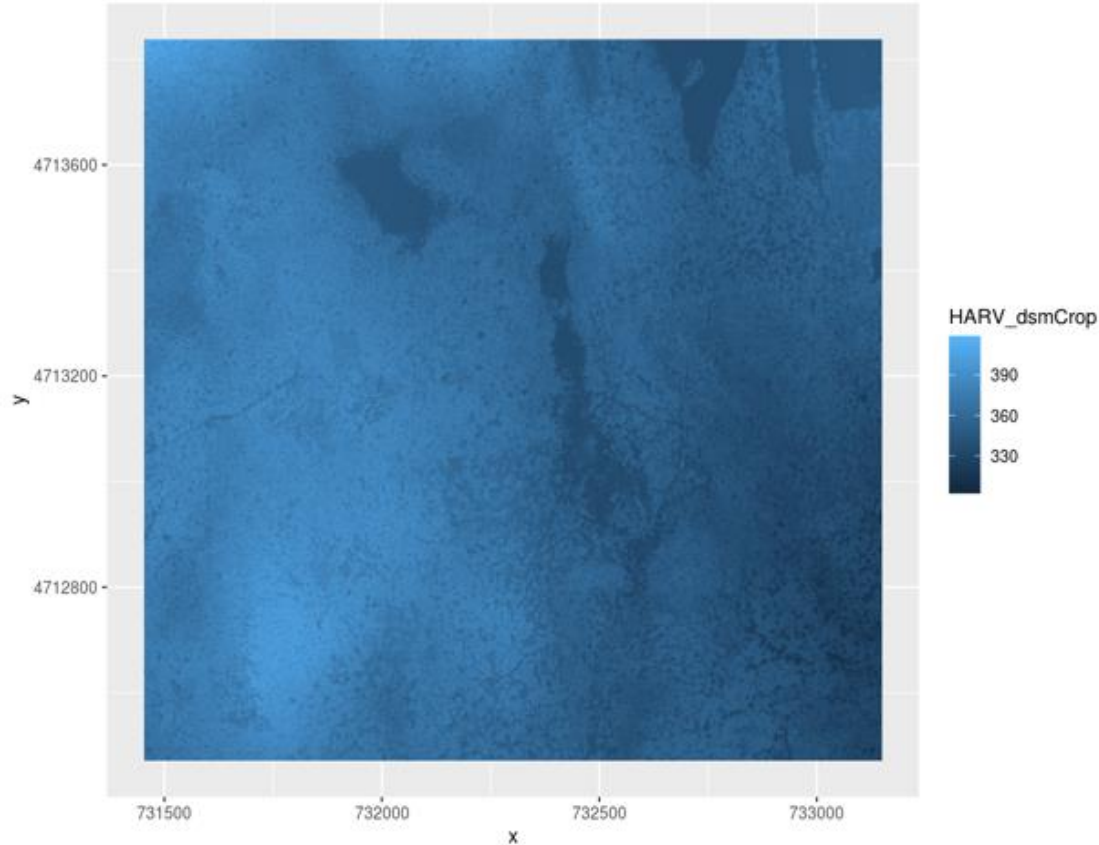
value of a pixel can be continuous (e.g. elevation)
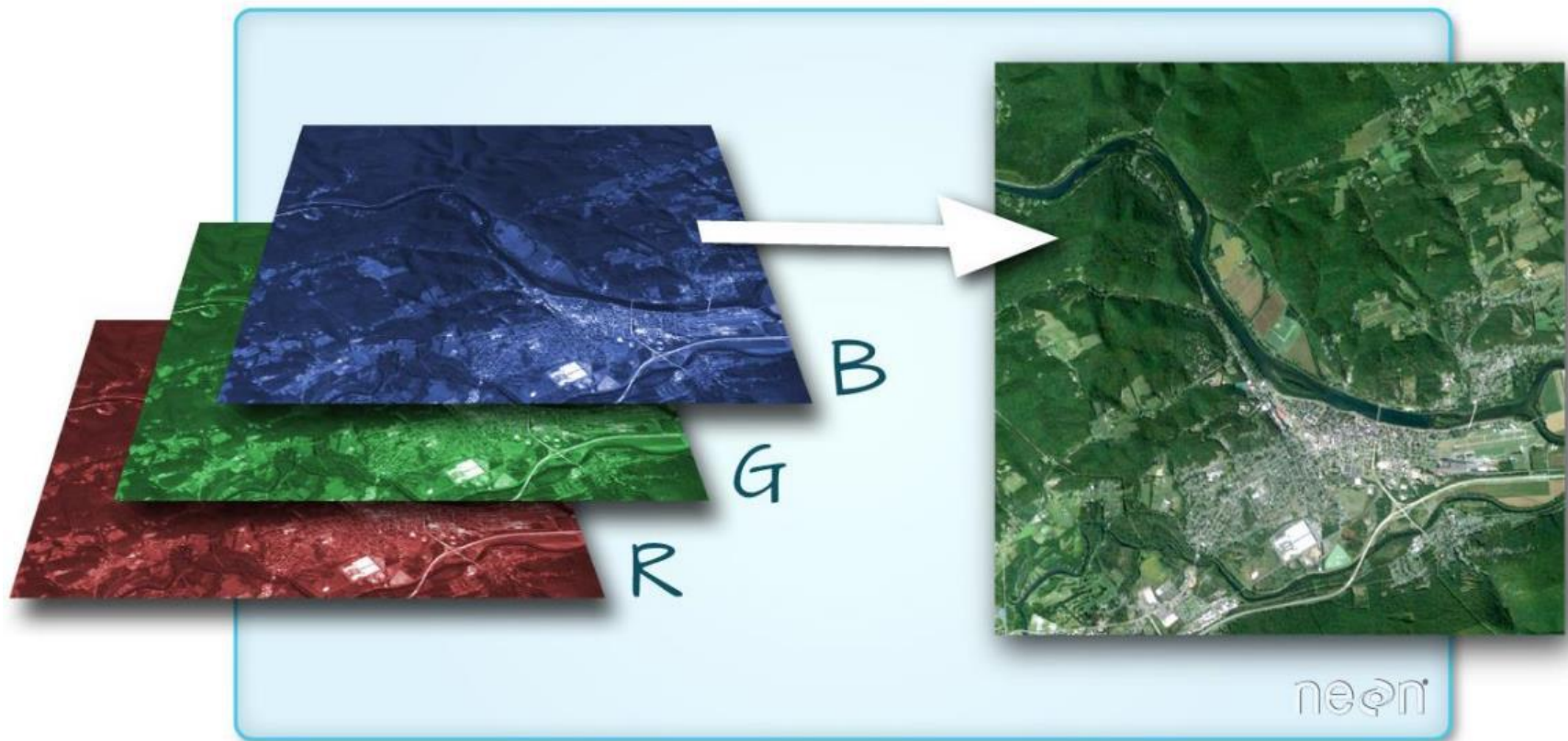
Rster data – categorical
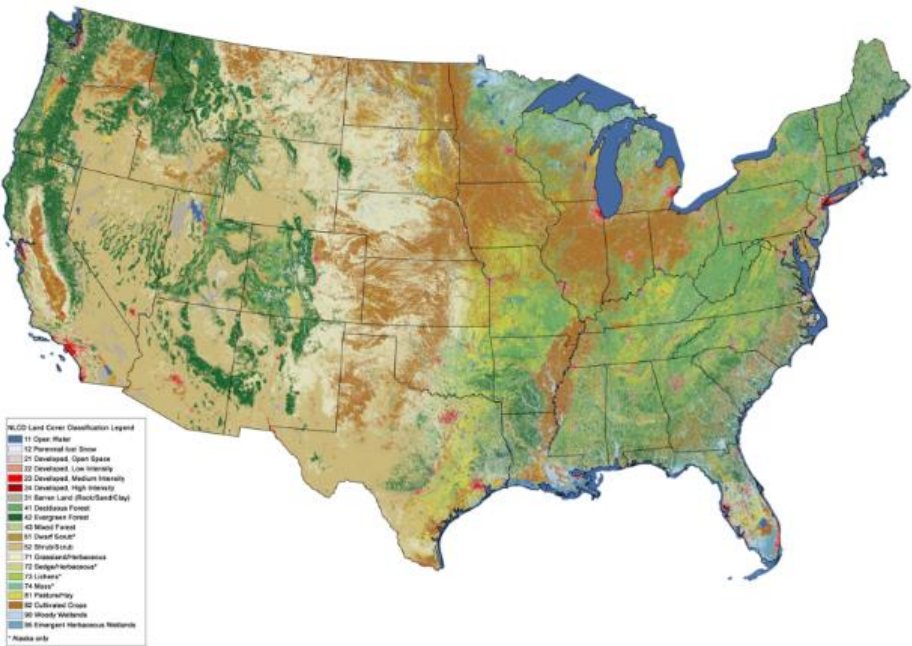
or each pixel can represent
a discrete class such as land cover...

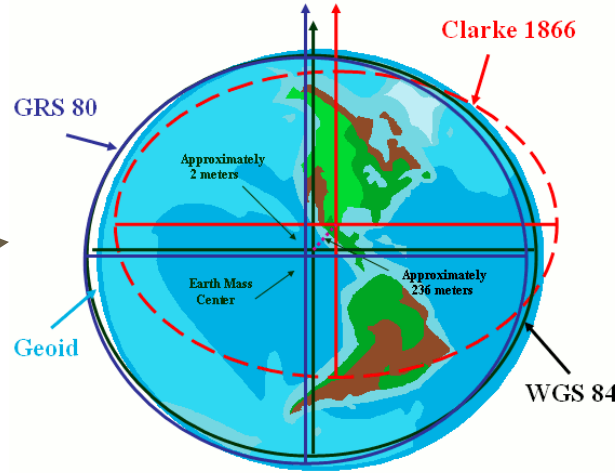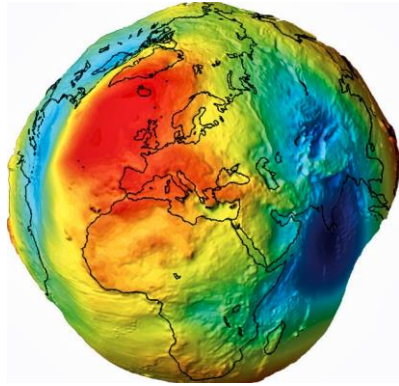

Classified Elevation Map - NEON Harvard Forest Field Site

fct_elevation
- Low Elevation
- Middle Elevation
- High Elevation
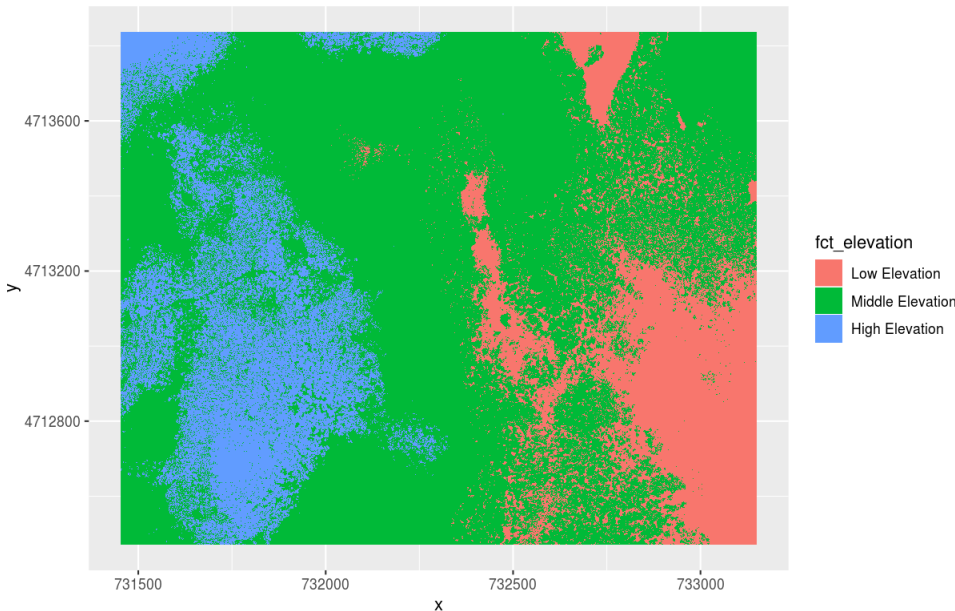
...or elevation

Raster data – multi-band

Coordinate reference system- Geodetic datum

Geoid: Earth shape

A geodetic datum is **a coordinate system**, and a set of reference points, used for locating places on the Earth (or similar objects).

Coordinate reference system- Geodetic datum

- A datum is the choice of fruit to use. Is the earth an orange, a lemon, a lime, a grapefruit?

Geodetic datum - WGS84

WGS84 is one of geodetic datums. It is the standard U.S. Department of Defense definition of **a global reference** system for geospatial information and is the reference system for the Global Positioning System (**GPS)**.

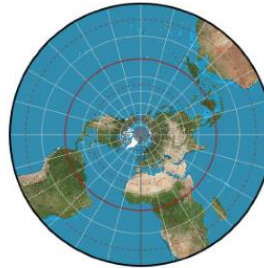GPS collected data represents locations on the globe.

GPS - X and Y Coordinate

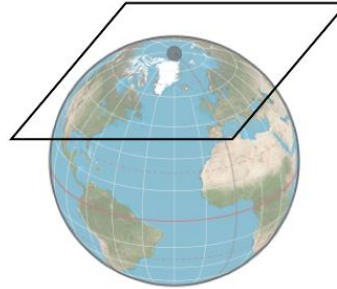| POINT_X	POINT_Y	
-114.058097	51.045328	
-77.036366	38.895114	
2.352223	48.856618	
-118.144513	34.147788	
-71.292388	42.296799	
-73.908186	42.012871	
-73.196795	42.878094	
-71.059772	42.358431	
-118.243683	34.052235	
-118.564225	34.389818	
-124.082835	40.86652	
-84.772169	37.645634	
-81.935142	40.805058	
-75.394444	40.535835	
-75.163785	39.95234	
-74.005972	40.714354	
-77.036366	38.895114	

X: Longitude

Y: Latitude
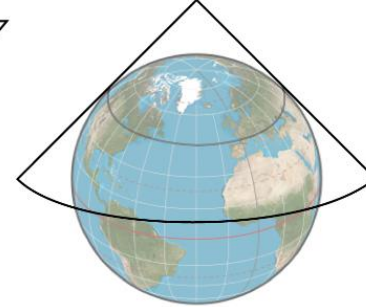
14

Coordinate reference system- Projection

A map projection is a way to flatten a globe's surface into a plane in order to make a map.
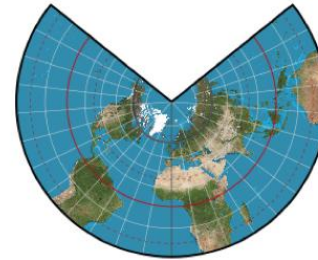
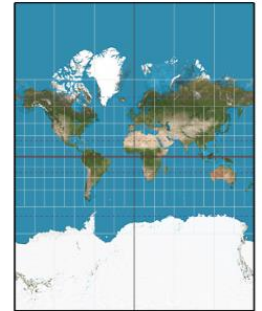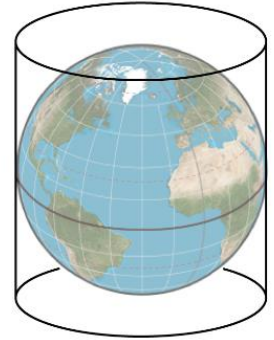Flat plan   Cone   Cylinder

Coordinate reference system- Projection

POINT_X	POINT_Y
-114.058097	51.045328
-77.036366	38.895114
2.352223	48.856618
-118.144513	34.147788
-71.292388	42.296799
-73.908186	42.012871
-73.196795	42.878094
-71.059772	42.358431
-118.243683	34.052235
-118.564225	34.389818
-124.082835	40.86652
-84.772169	37.645634
-81.935142	40.805058
-75.394444	40.535835
-75.163785	39.95234
-74.005972	40.714354
-77.036366	38.895114

X and Y Coordinates are Longitude and Latitude. They represent the locations on the curved surface. We need to project the X and Y coordinates into a flat paper.

Coordinate reference system- Projection

- A projection is how you peel your orange and then flatten the peel.

Coordinate reference system- Projection

- A PROJ4 string includes the following information:
- **proj=:** the projection of the data
- **zone=:** the zone of the data (this is specific to the **UTM** projection)
- **datum=:** the datum use
- **units=:** the units for the coordinates of the data
- **ellps=:** the ellipsoid (how the earth's roundness is calculated) for the data

Example:

+proj=utm +zone=18 +datum=WGS84 +units=m +no_defs +ellps=WGS84 +towgs84=0,0,0

No default

Parameter values if transform to WGS

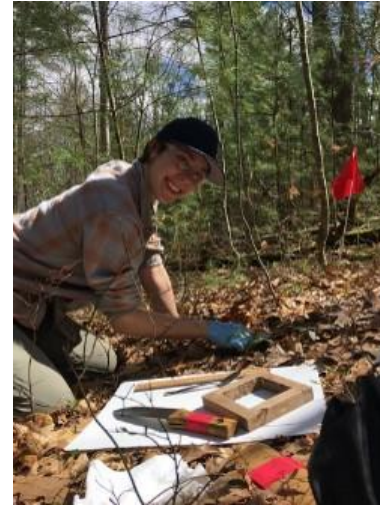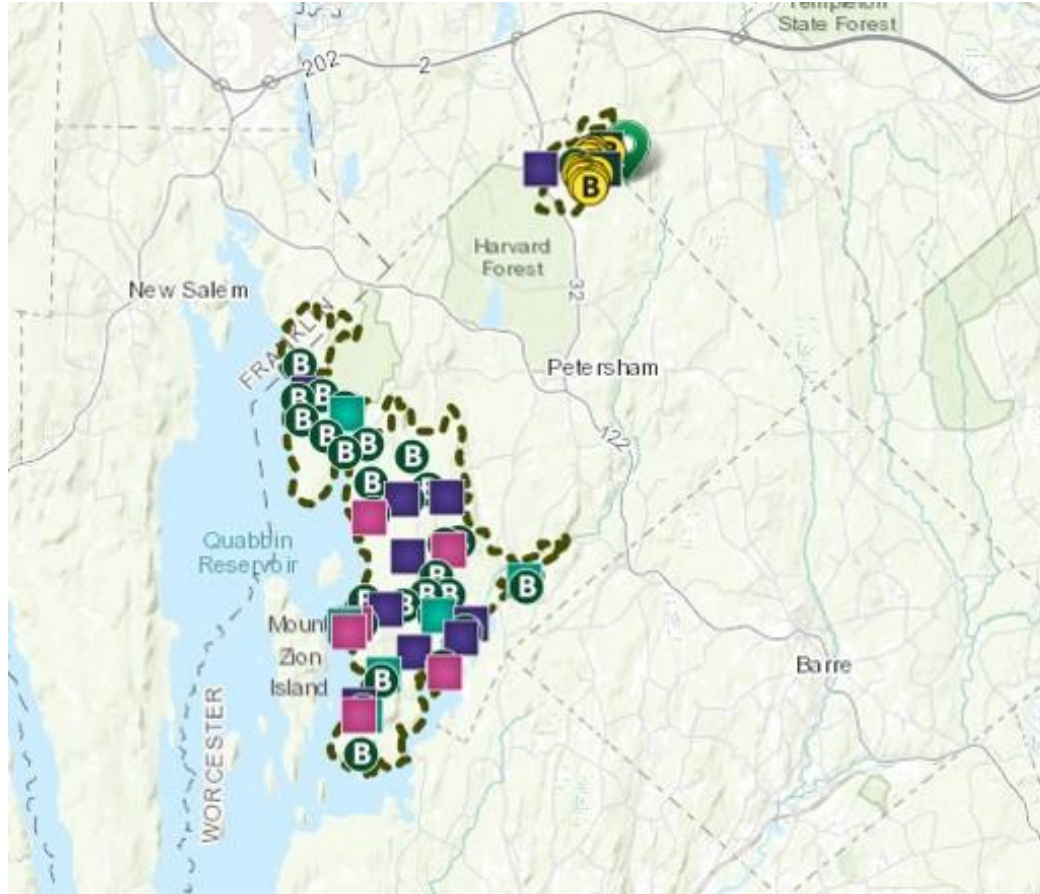# Spatio-temporal data for 2 field sites: National Ecological Observatory Network
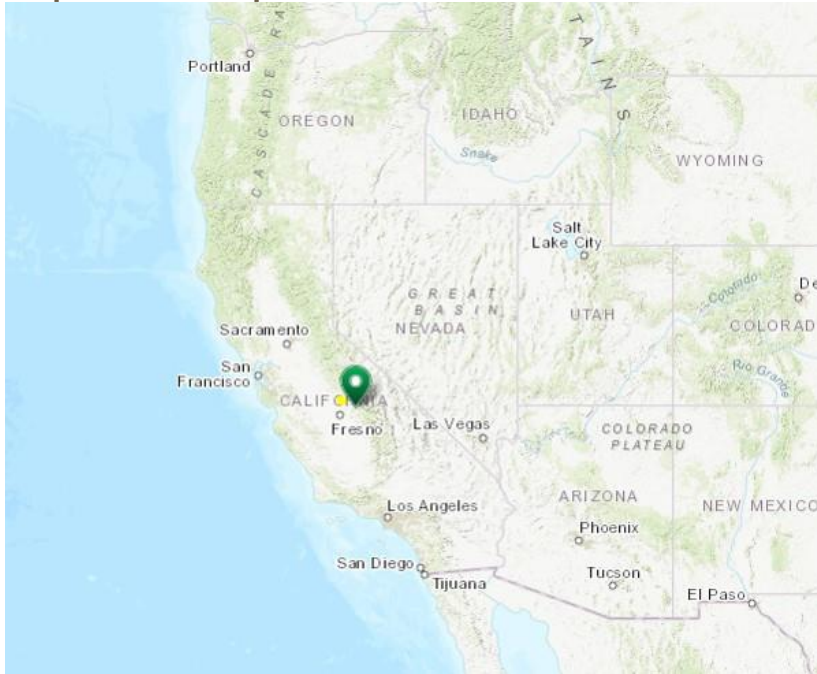
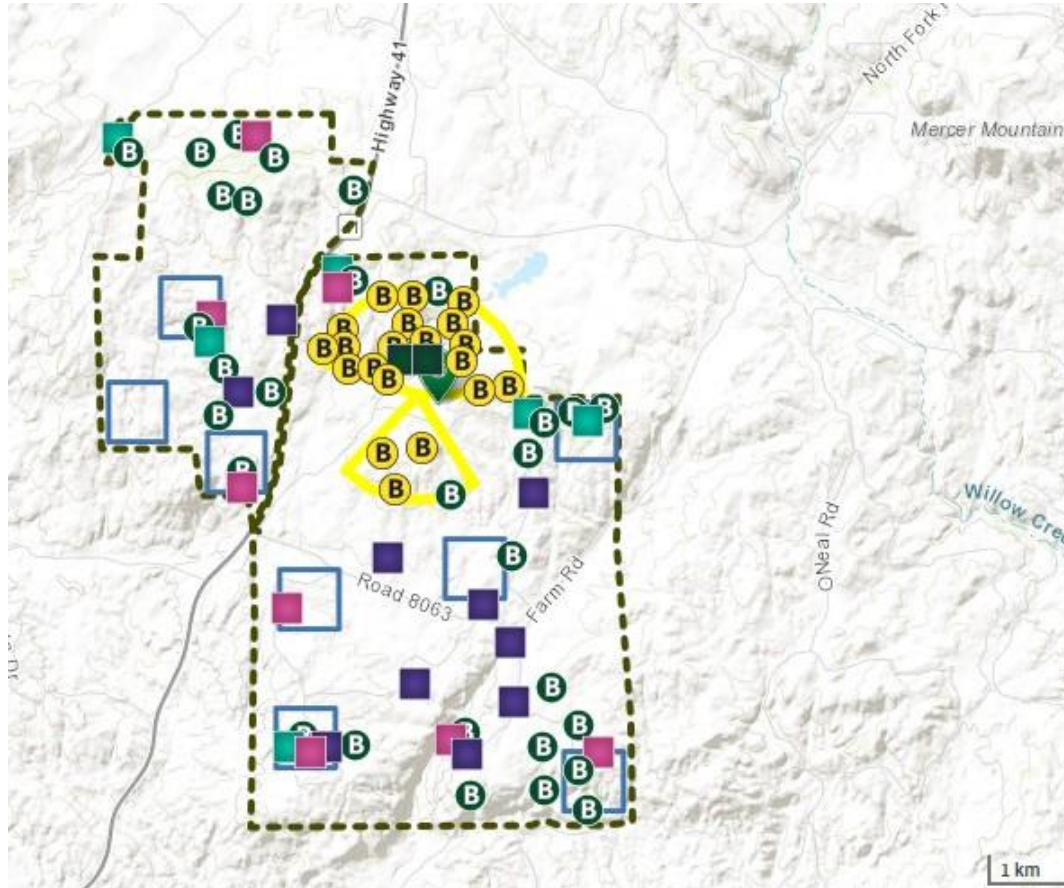San Joaquin Experimental Range (SJER) - California
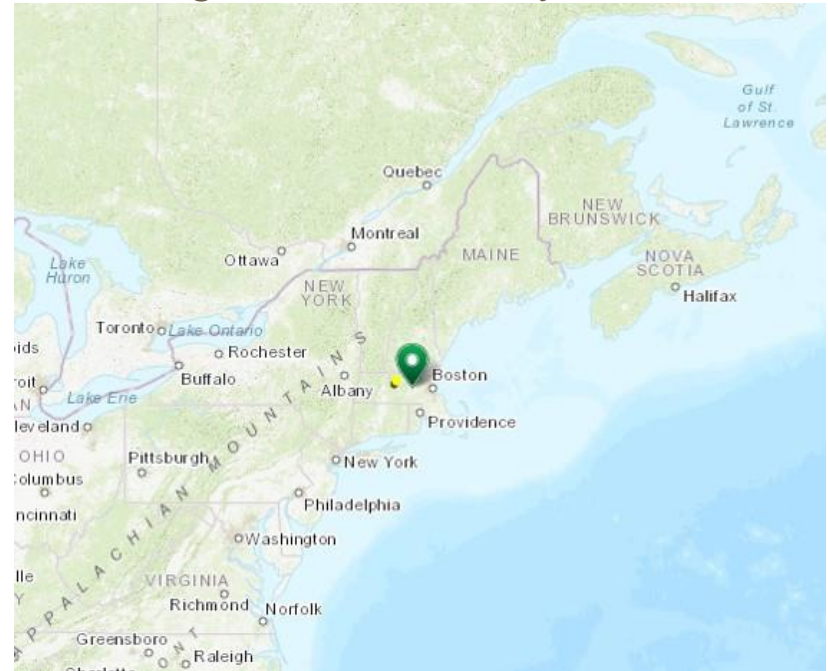
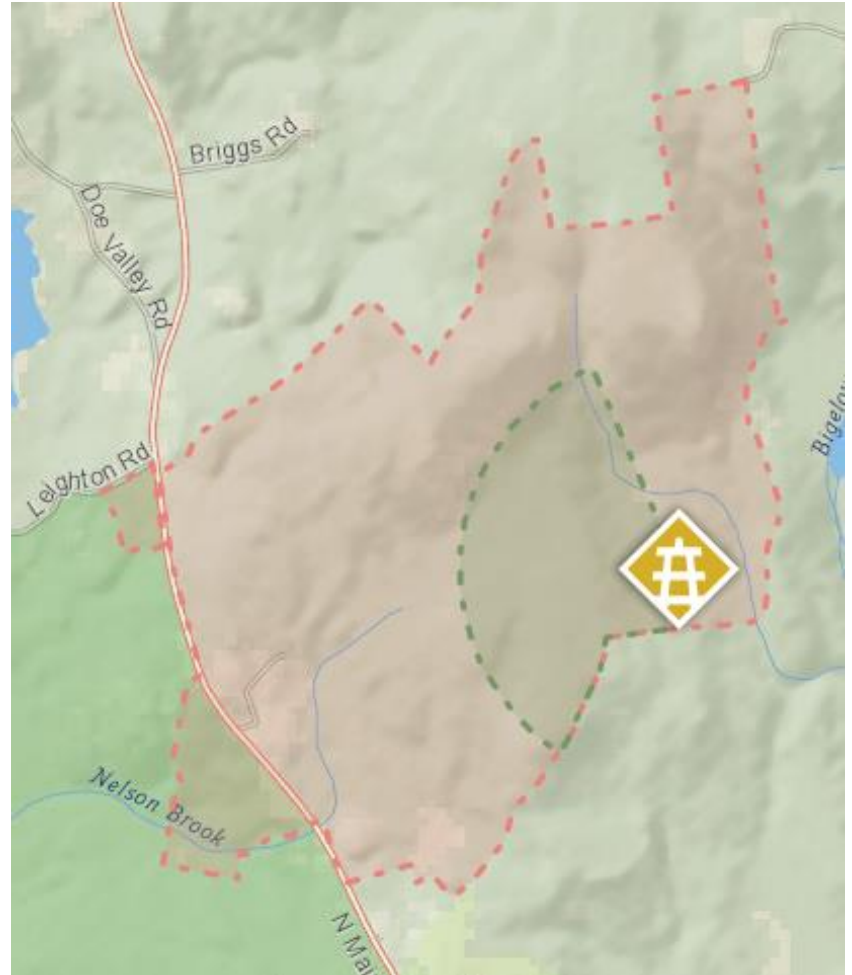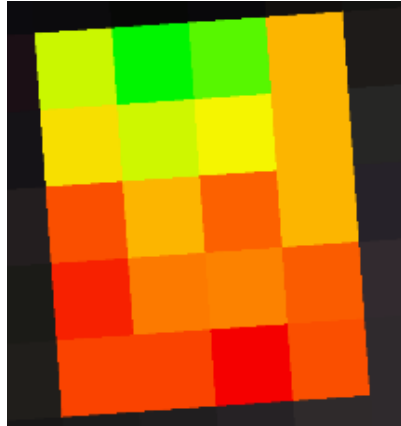Harvard Forest (HARV) - Massachusetts
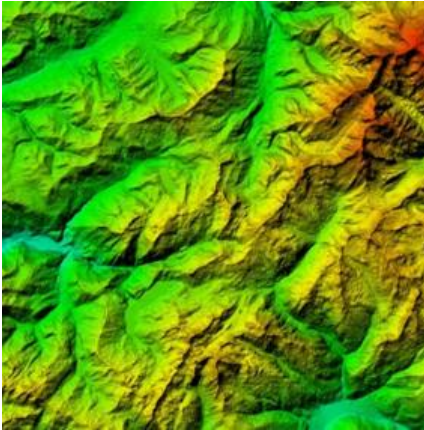
Harvard Forest - HARV

San Joaquin Experimental Range - SJER

4 types of datasets

1) Site layout shapefiles
2) Meteorological time series data
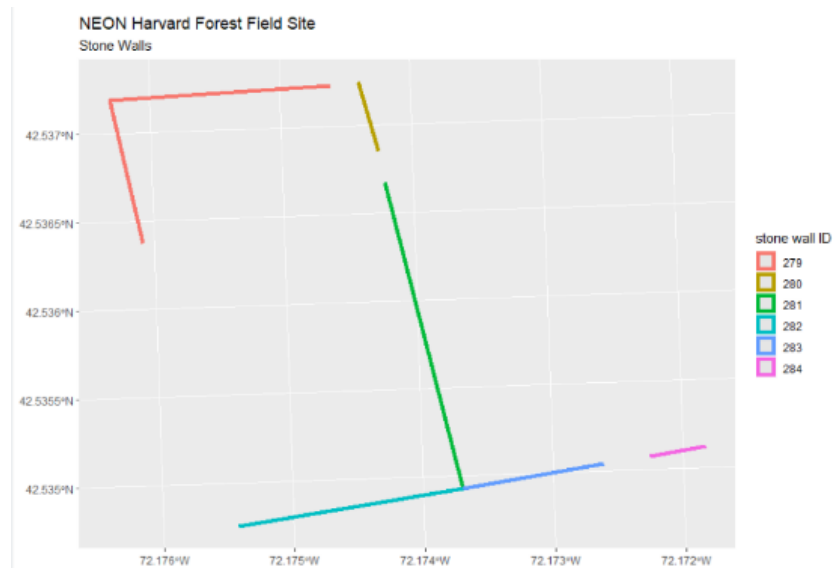3) Airborne remote sensing data
4) Landsat raster images

2 datasets (HARV only)

NEON-DS-Site-Layout-Files

Spatial data: boundaries, plot locations, roads

Format: shapefiles/vector

NEON-DS-Met-Time-Series

Meteorological data: precip, temp, day length

Format: text/tabular

	datetime	jd	airt	f.airt	rh	f.rh	dewp	f.dewp	prec	f.prec	slrr	f.slrr	parr
140255	1/1/2009 0:00	366	-17.3		76		-20.6		0		0		0
140256	1/1/2009 0:15	1	-17.4		75		-20.8		0		0		0
140257	1/1/2009 0:30	1	-17.5		75		-21		0		0		0
140258	1/1/2009 0:45	1	-17.6		75		-21.1		0		0		0
140259	1/1/2009 1:00	1	-17.8		75		-21.1		0		0		0
140260	1/1/2009 1:15	1	-17.8		74		-21.3		0		0		0
140261	1/1/2009 1:30	1	-17.9		74		-21.4		0		0		0
140262	1/1/2009 1:45	1	-18		74		-21.5		0		0		0
140263	1/1/2009 2:00	1	-18		73		-21.6		0		0		0
140264	1/1/2009 2:15	1	-18.1		73		-21.7		0		0		0
140265	1/1/2009 2:30	1	-18.2		73		-21.8		0		0		0
140266	1/1/2009 2:45	1	-18.3		73		-21.9		0		0		0
140267	1/1/2009 3:00	1	-18.4		72		-22.2		0		0		0

NEON-DS-Landsat-NDVI (HARV & SJER)

NDVI

Normalized difference vegetation index

Format: raster GeoTIFF
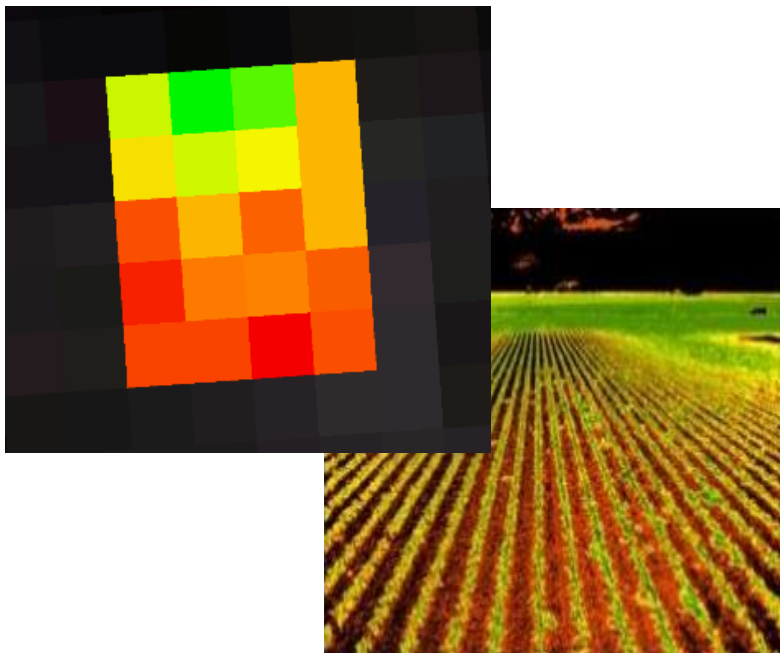
RBG

Georeferenced aerial photograph
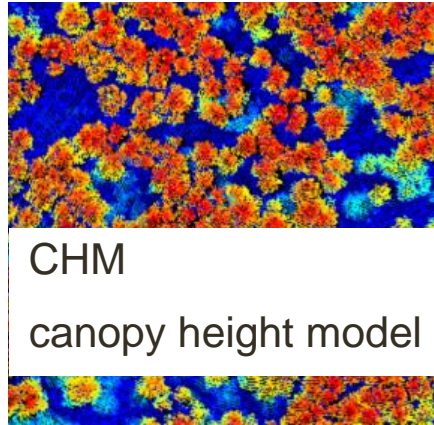
Format: raster GeoTIFF

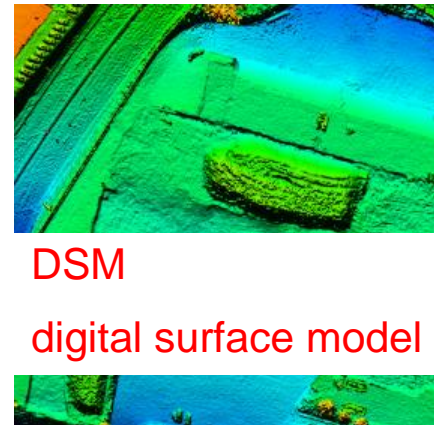# NEON-DS-Airborne-Remote-Sensing **(HARV & SJER)**
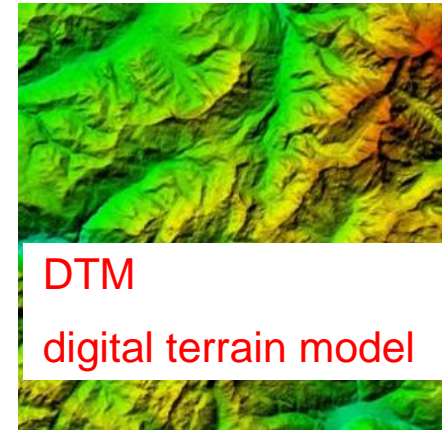

NEON - Airborne Observation Platform (AOP)

RGB_imagery

aerial photography

CHM
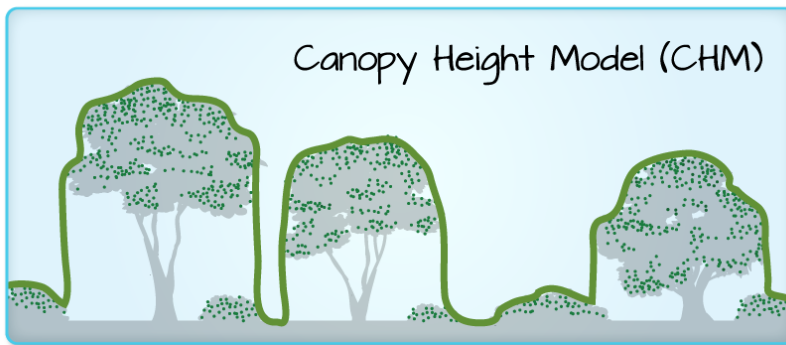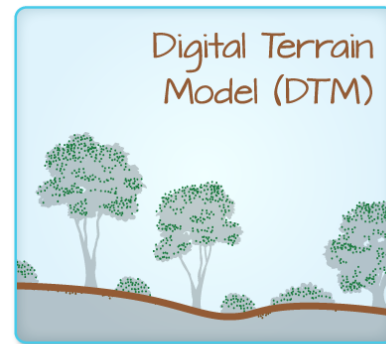
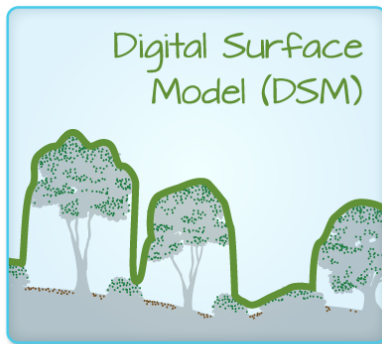canopy height model

DSM

digital surface model

DTM

digital terrain model

Geospatial concepts

- Geospatial data
- Vector data: points, line, polygon
- Raster data: pixel with values
- Coordinate reference system (CRS)

    ○ Geodetic datum

    ○ Projection
- Data for this workshop: NEON

Raster Calculation

Digital Surface Model (DSM)

Digital Terrain Model (DTM)

Canopy Height Model (CHM)

DSM (Digital Surface Model)
-DTM (Digital Terrain Model)
_____
CHM (Canopy Height Model)