R Geospatial Workshop

October 07, 2020

Set-up:

1. Make sure you have R installed and working
Instructions to download R and Rstudio here: https://rstudio.com/products/rstudio/download/

2. Make sure you have the following packages installed and working:

- dplyr, tidyr, ggplot2 (or the entire 'tidyverse')
- rgdal
- sp
- raster
- sf

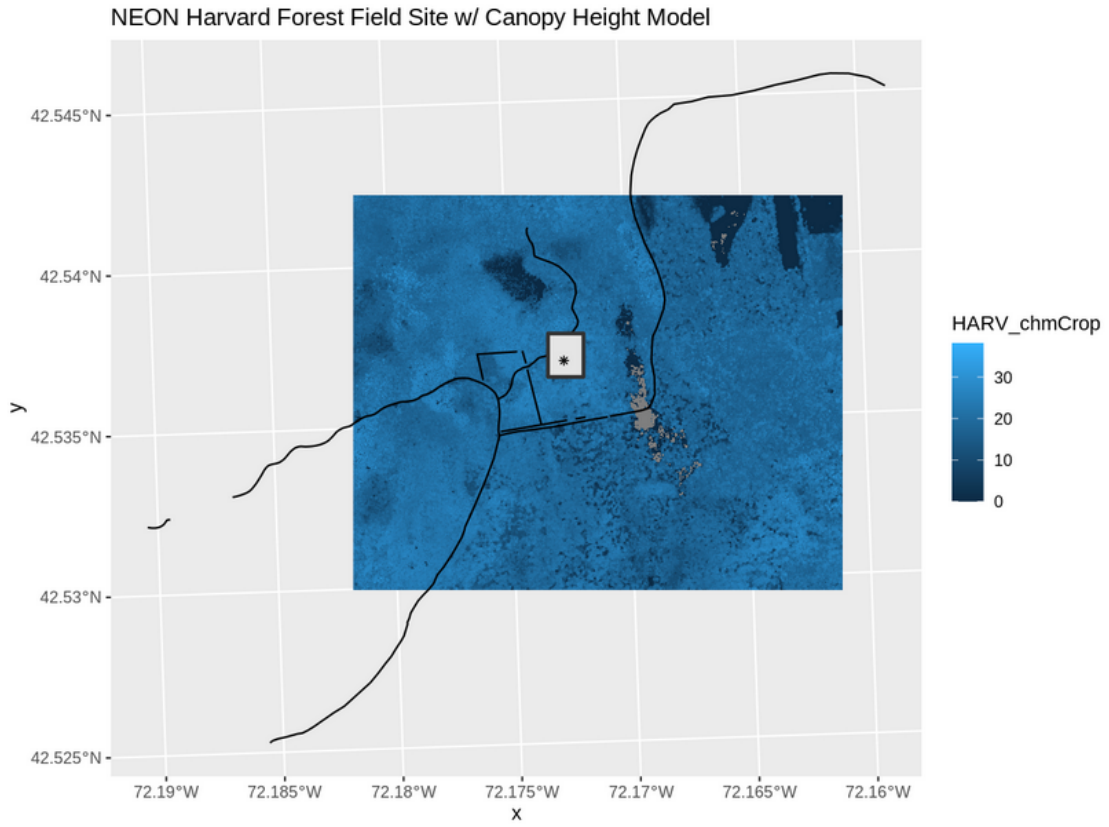
To install packages: install.packages(c("dplyr", "tidyr", "ggplot2", "rgdal", "sp", "raster", "sf"))
To load: library(dplyr), library(tidyr), etc.

3. Download or clone the repository at https://github.com/fdavenport/r-geospatial-100720 (more instructions are at the link)

Workshop Outline:

- What is geospatial data?
- **Raster** data:
  - Reading and plotting **raster** data
  - Calculations with **raster** data
- **Vector** data:
  - Reading and plotting
- Combining raster and vector data
- **Coordinate reference systems**

→ Breakout Group Exercises



Raster data

Common file types:

TIFF (.tif)

GRIB (.grb or .grb2)

netcdf (.nc)

HDF5 (.h5 or .hdf5)

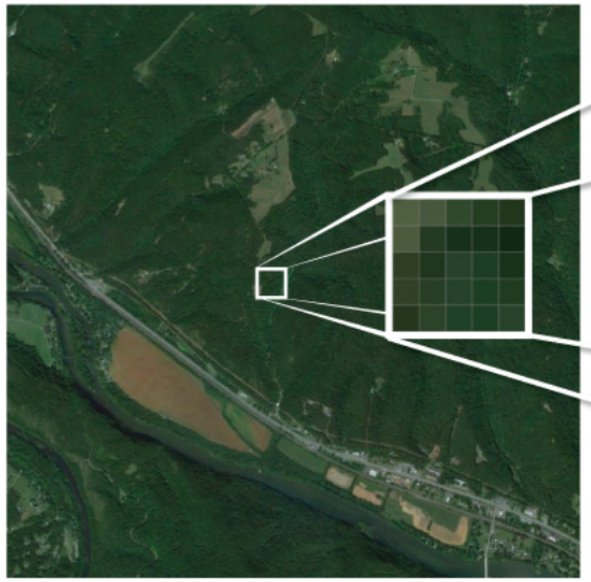
BIL (.bil)

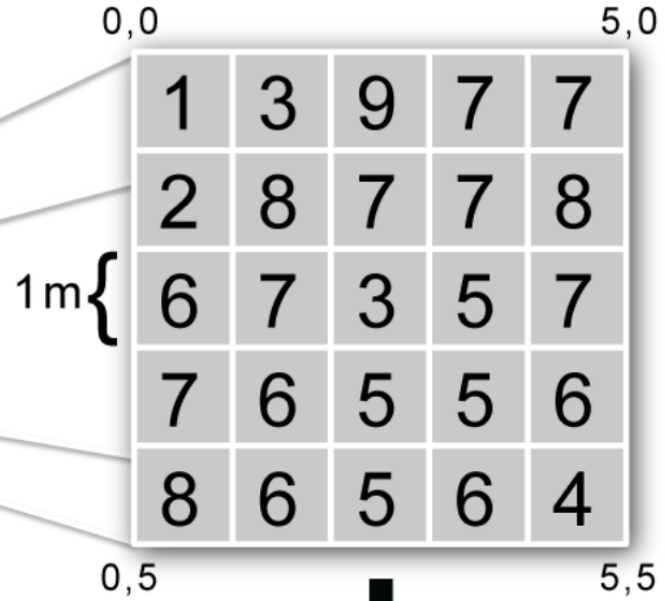
JPEG (.jpg) or PNG (.png)

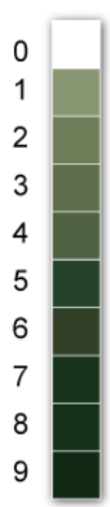
ASCII Grid (.asc)

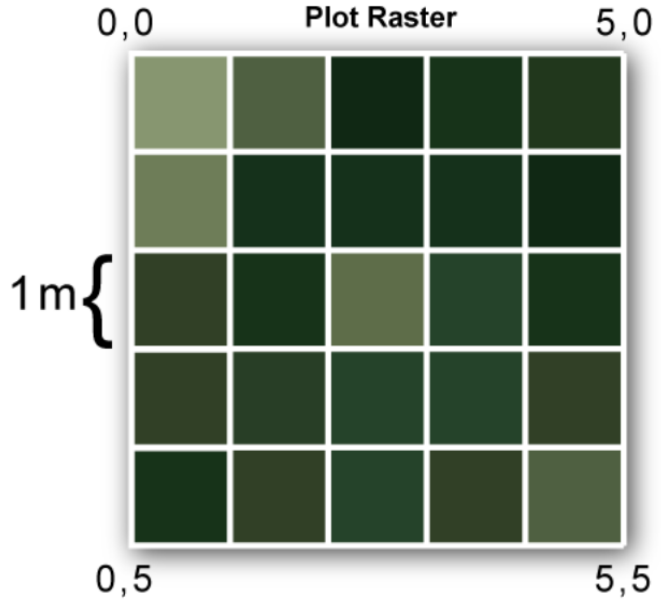
.grd (native R raster format)

…and more

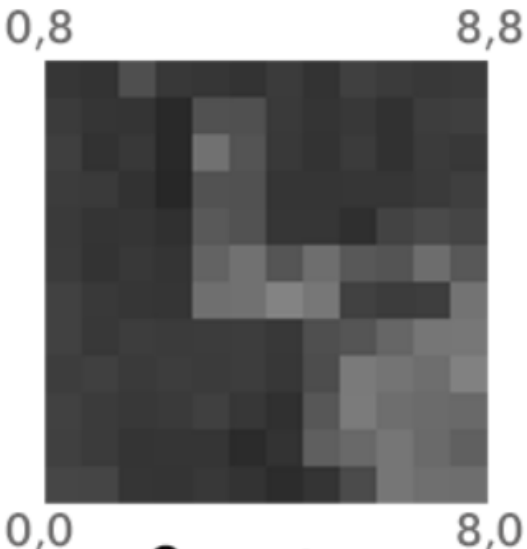




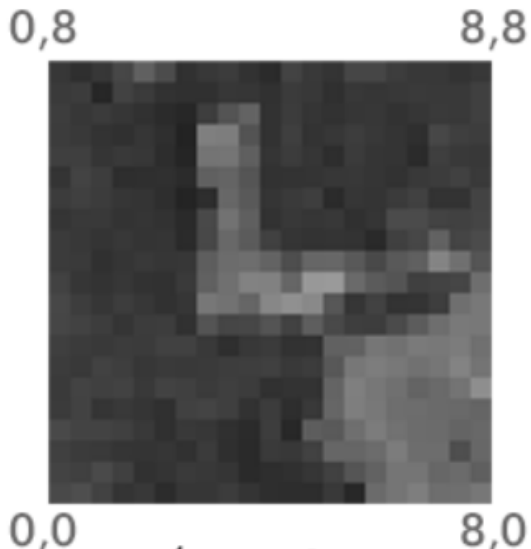




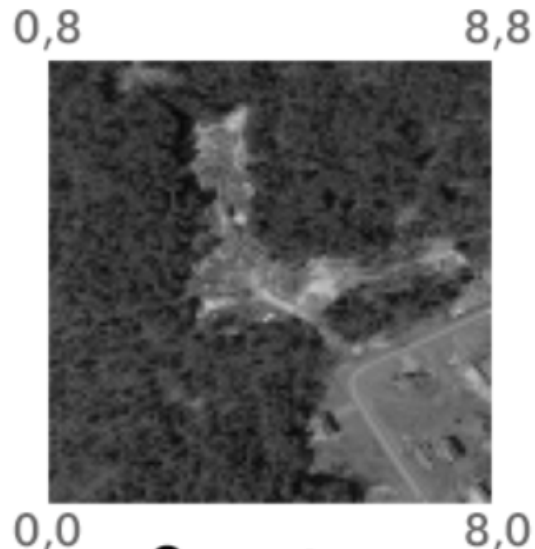
Raster over the same extent, at 4 different resolutions



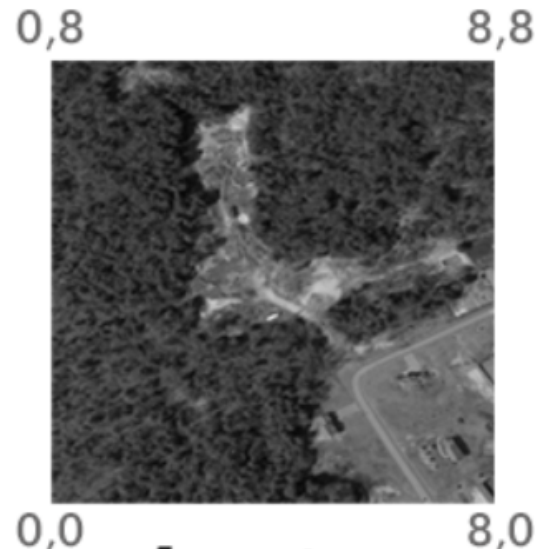
8 meter



4 meter

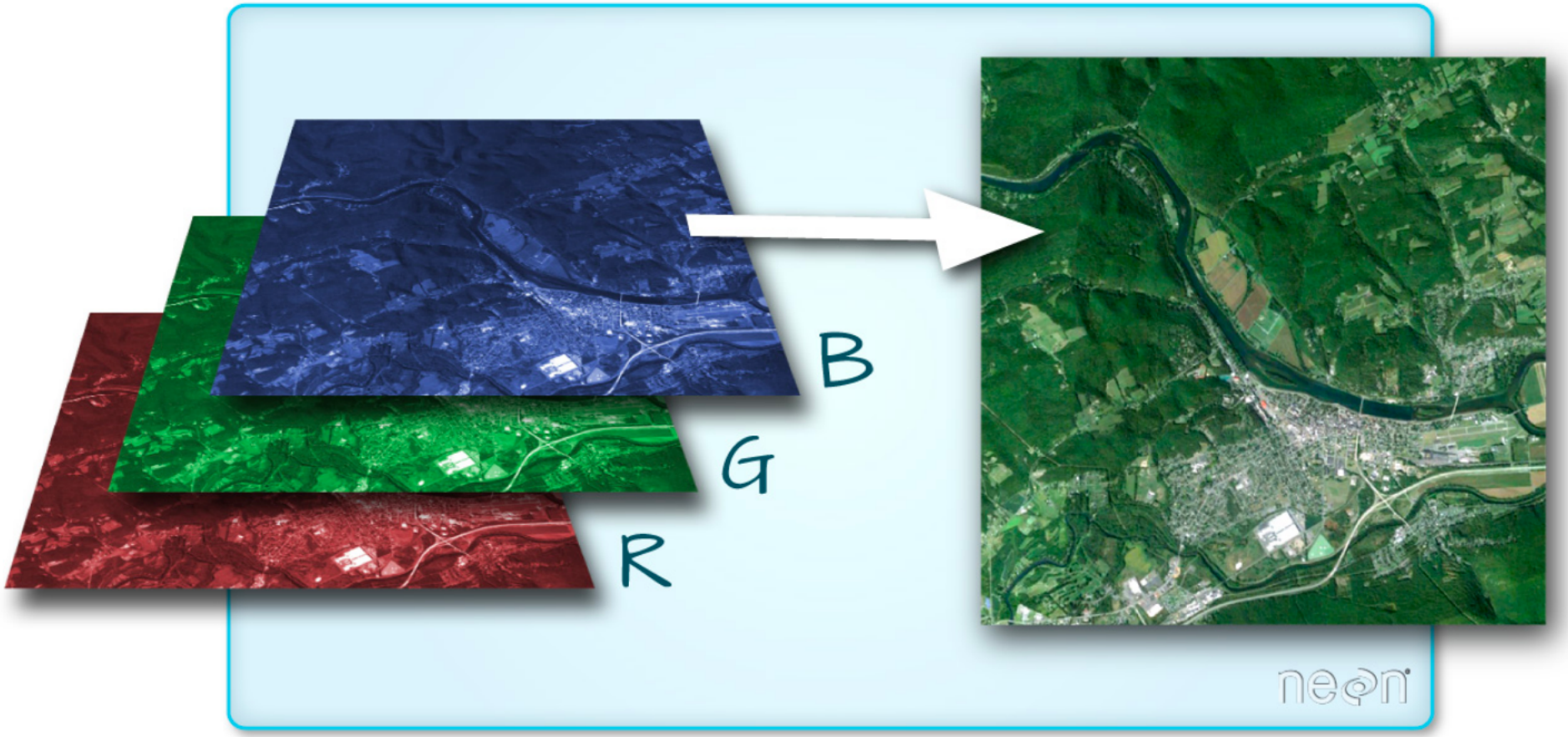


2 meter

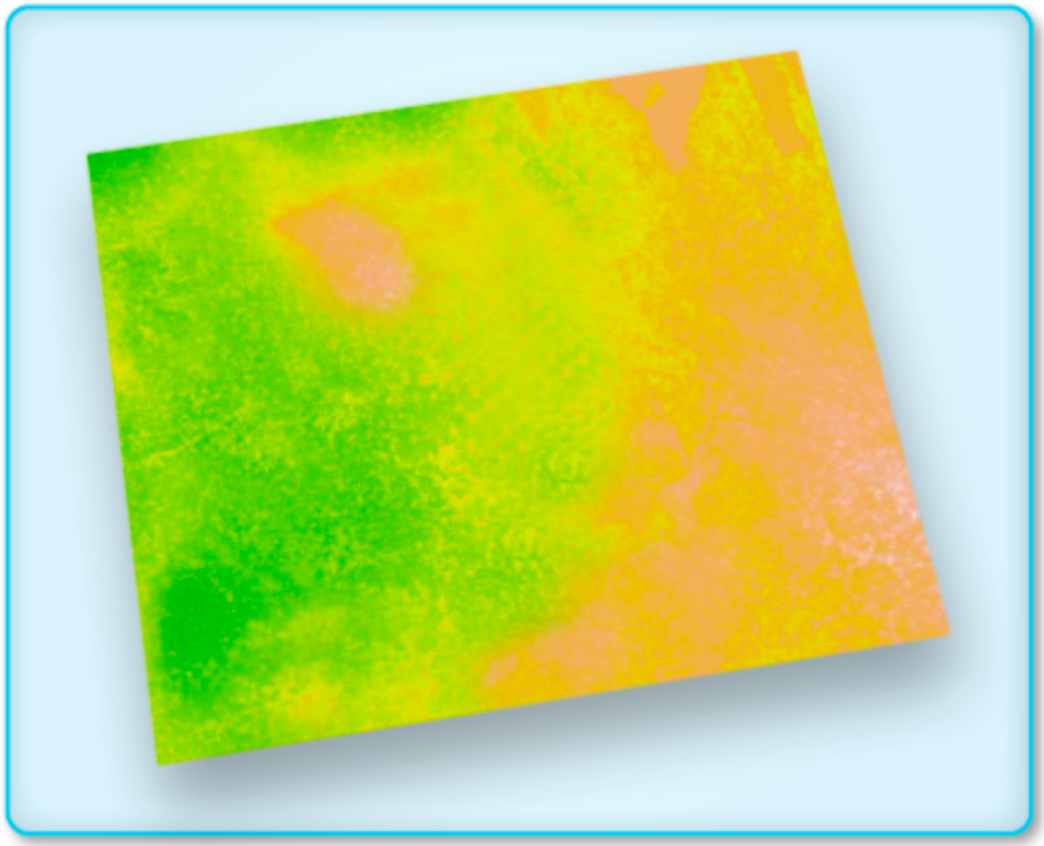


1 meter

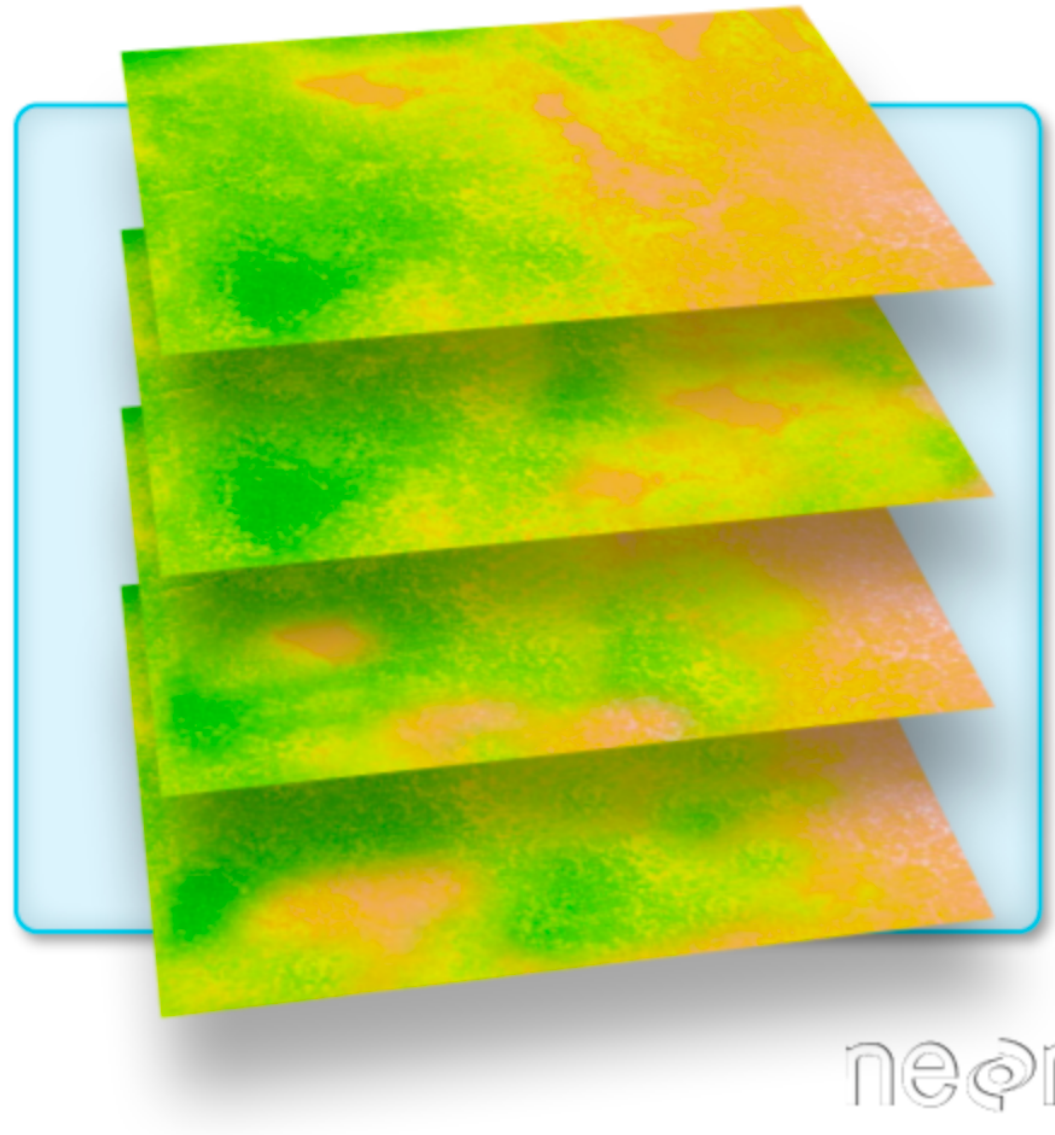
Rasters can have multiple ‘bands’ or ‘layers’



Single Band Raster



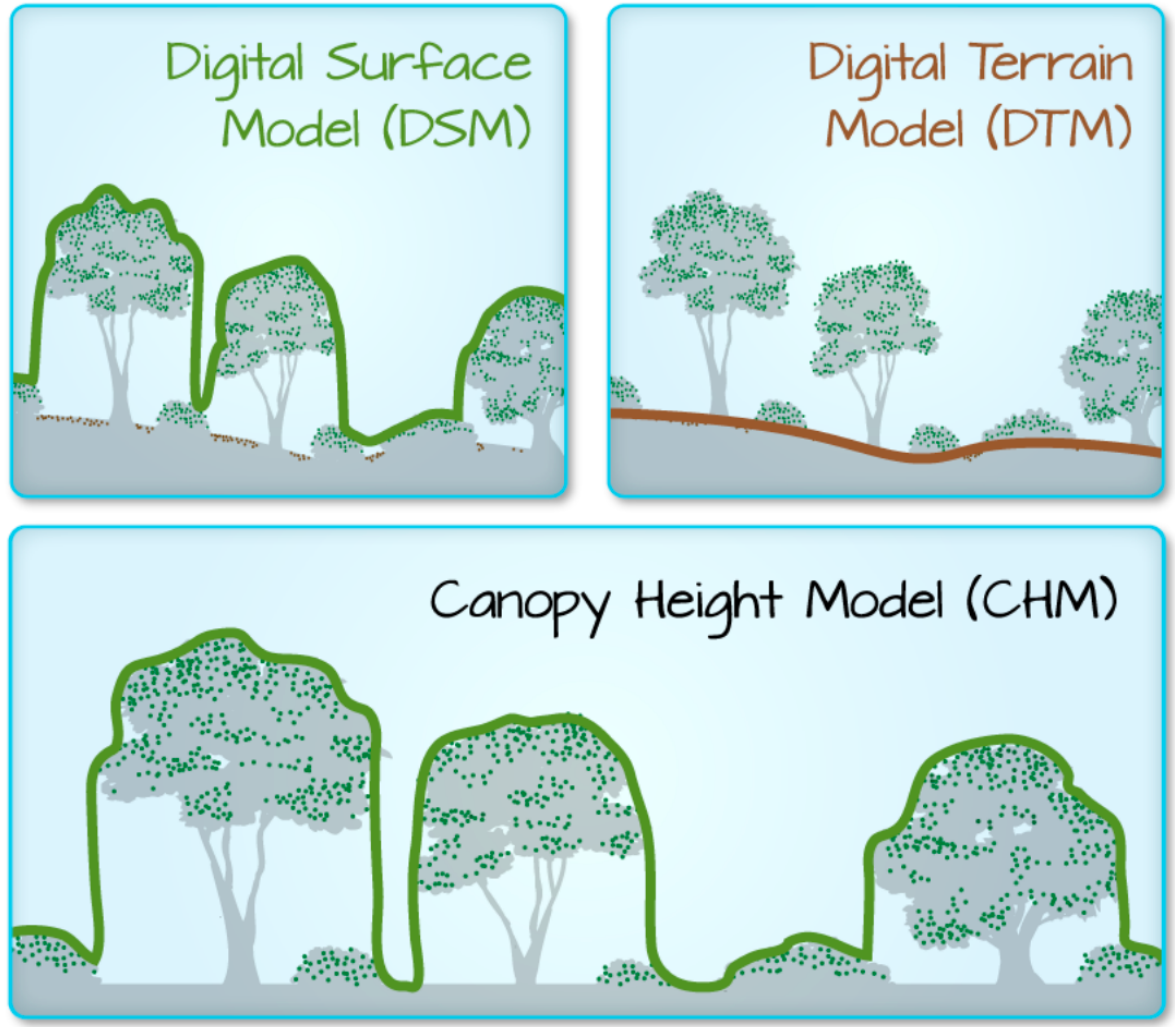
Multi Band Raster



Breakout Exercises: practicing with **raster** data

Some ideas…

- Calculate a different summary statistic of the raster (ex: standard deviation)
- Read a variable along one ‘latitude’ of the data and plot the result
- Create a new raster where canopy height is measured in feet
  - hint: one meter is 3.28 feet
- Calculate average elevation for each ‘latitude’ (row) of the dtm raster
  - hint: you can convert with as.matrix() and use rowMeans(), or convert with as.data.frame() and use tidyr functions
- Practice formatting one of your maps with custom labels, color scheme, etc.



DSM (Digital Surface Model)

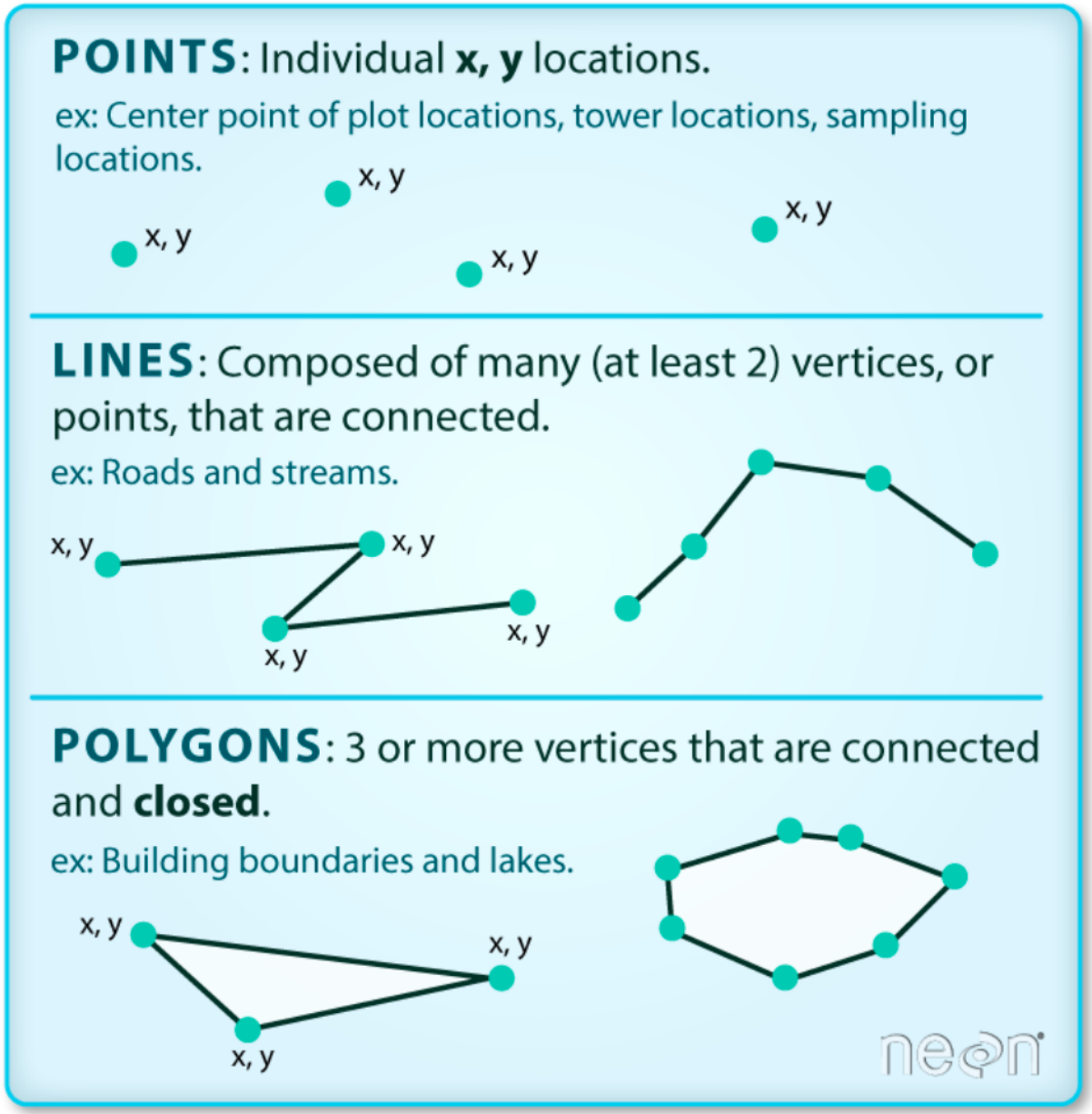
-DTM (Digital Terrain Model)

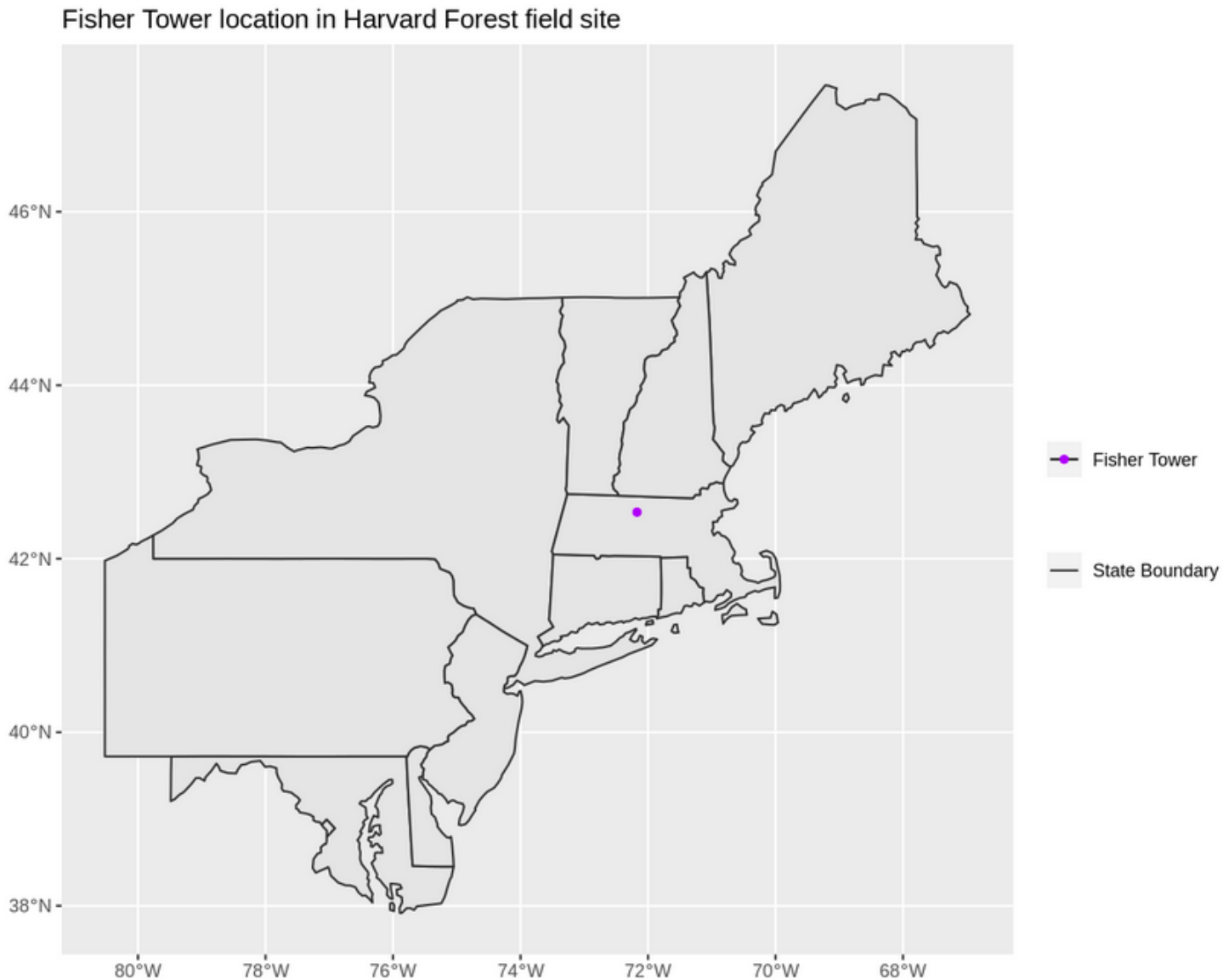
CHM (Canopy Height Model)

Vector data

Most common/basic file type:

‘shapefiles’ (.shp)




Fisher Tower location in Harvard Forest field site
46°N
44°N
42°N
40°N
38°N
80°W
78°W
76°W
74°W
72°W
70°W
68°W
Fisher Tower
State Boundary

Breakout Exercises: practicing with **vector** data

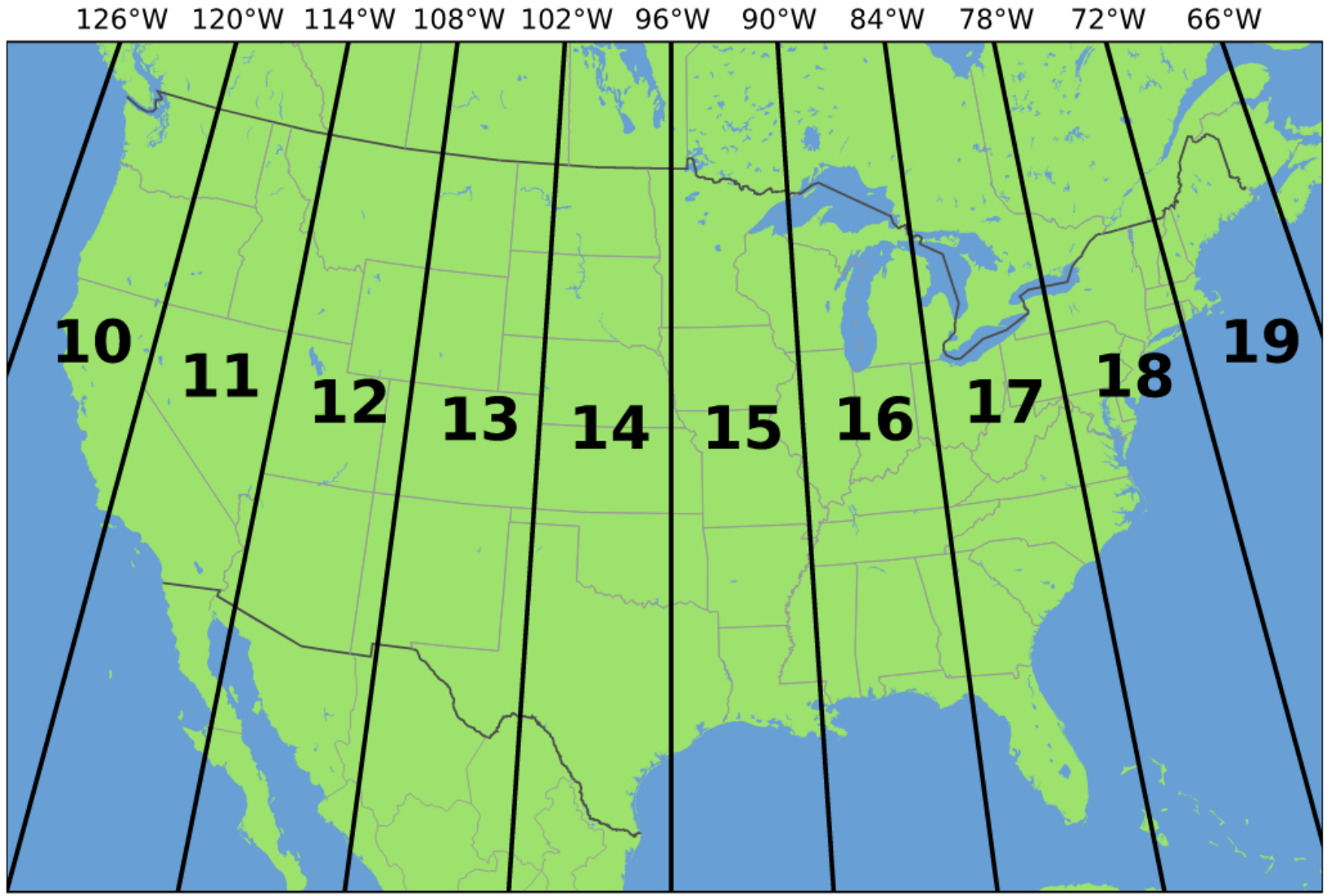
Some ideas…

- Calculate the ratio of water area (AWATER) to land area (ALAND) for the New England states. Make a map where the color of each state represents that ratio.
  - Hint: you can use mutate() to add a new variable to the spatial features data frame

- Make a map showing both the state of Massachusetts and the field site data (roads, tower, and area of interest).

- Format one of the maps by adding labels, custom color scales, adjusting the size of points/lines, etc.


Mercator
EPSG:3857
UTM Zone 11N
EPSG:2955
U.S. National Atlas
Equal Area
EPSG:2163
WGS 84
EPSG:4326


126°W
120°W
114°W
108°W
102°W
96°W
90°W
84°W
78°W
72°W
66°W
10
11
12
13
14
15
16
17
18
19

Breakout Exercises: combining **raster** and **vector** data

Some ideas…

- Use raster::extract to calculate elevation along one of the roads and plot the result
- Create a new buffer zone around of the objects and calculate mean NDVI time series for that area
- Create a new area of interest manually from coordinates. Calculate and plot a histogram of NDVI or elevation within your new area of interest.
  - hint: look at the st_polygon() function for creating a new polygon area
- Create a scatterplot of NDVI vs. canopy height (or elevation) at each grid cell
  - hint: use projectRaster() to convert the canopy height raster to the same resolution as the NDVI raster, and then use getValues() to convert the grid cell values of each raster to a vector
- Consult the **raster** or **sf** documentation and try a function we haven't used yet
- Format one of the maps to include legends, axis labels, custom color scales, etc.

Additional resources

- Data Carpentry geospatial lesson:
  https://datacarpentry.org/r-raster-vector-geospatial/

- Geocomputation with R online book:
  https://geocompr.robinlovelace.net/index.html

- Raster and sf package documentation