Assignment 5: Data Visualization

Shana Shapiro Section #1

OVERVIEW

This exercise accompanies the lessons in Environmental Data Analytics on Data Visualization

Directions

1. Change "Student Name" on line 3 (above) with your name.
2. Work through the steps, **creating code and output** that fulfill each instruction.
3. Be sure to **answer the questions** in this assignment document.
4. When you have completed the assignment, **Knit** the text and code into a single PDF file.
5. After Knitting, submit the completed exercise (PDF file) to the dropbox in Sakai. Add your last name into the file name (e.g., "Fay_A05_DataVisualization.Rmd") prior to submission.

The completed exercise is due on Monday, February 14 at 7:00 pm.

Set up your session

1. Set up your session. Verify your working directory and load the tidyverse and cowplot packages. Upload the NTL-LTER processed data files for nutrients and chemistry/physics for Peter and Paul Lakes (use the tidy [`NTL-LTER_Lake_Chemistry_Nutrients_PeterPaul_Processed.csv`] version) and the processed data file for the Niwot Ridge litter dataset (use the [`NEON_NIWO_Litter_mass_trap_Processed.csv`] version).

2. Make sure R is reading dates as date format; if not change the format to date.

```
#1
getwd()
```

```
## [1] "Z:/EnvironmentalDataAnalytics/Environmental_Data_Analytics_2022/Assignments"
```

```
library("tidyverse","ggplot2")
```

```
## Warning: package 'tidyverse' was built under R version 4.0.5
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.6     v dplyr   1.0.7
## v tidyr   1.1.4     v stringr 1.4.0
## v readr   2.1.1     v forcats 0.5.1
```

```
## Warning: package 'ggplot2' was built under R version 4.0.5
```

```
## Warning: package 'tibble' was built under R version 4.0.5
```

```
## Warning: package 'tidyr' was built under R version 4.0.5
```

```
## Warning: package 'readr' was built under R version 4.0.5
```

```
## Warning: package 'purrr' was built under R version 4.0.5
```

```
## Warning: package 'dplyr' was built under R version 4.0.5
```

```
## Warning: package 'stringr' was built under R version 4.0.5
```

```
## Warning: package 'forcats' was built under R version 4.0.5
```

```
## -- Conflicts --------------------------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library("cowplot")
```

```
## Warning: package 'cowplot' was built under R version 4.0.5
```

```
lakes <- read.csv("../Data/Processed/NTL-LTER_Lake_Chemistry_Nutrients_PeterPaul_Processed.csv")
litter <- read.csv("../Data/Processed/NEON_NIWO_Litter_mass_trap_Processed.csv")

#2
class(lakes$sampledate) #character
```

```
## [1] "character"
```

```
lakes$sampledate <- as.Date(lakes$sampledate)
class(lakes$sampledate) #date
```

```
## [1] "Date"
```

```
class(litter$collectDate) #character
```

```
## [1] "character"
```

```
litter$collectDate <- as.Date(litter$collectDate)
class(litter$collectDate) #date
```

```
## [1] "Date"
```

Define your theme

3. Build a theme and set it as your default theme.

```
#3
mytheme <- theme_light(base_size = 14) +
  theme(axis.text = element_text(color = "black"),
        plot.title = element_text(face = "bold",size=12),
        axis.ticks = element_line(colour="grey70", size = 0.2),
        panel.grid.major = element_line(colour="grey70", size = 0.2),
        panel.grid.minor = element_blank())
theme_set(mytheme)
```

Create graphs

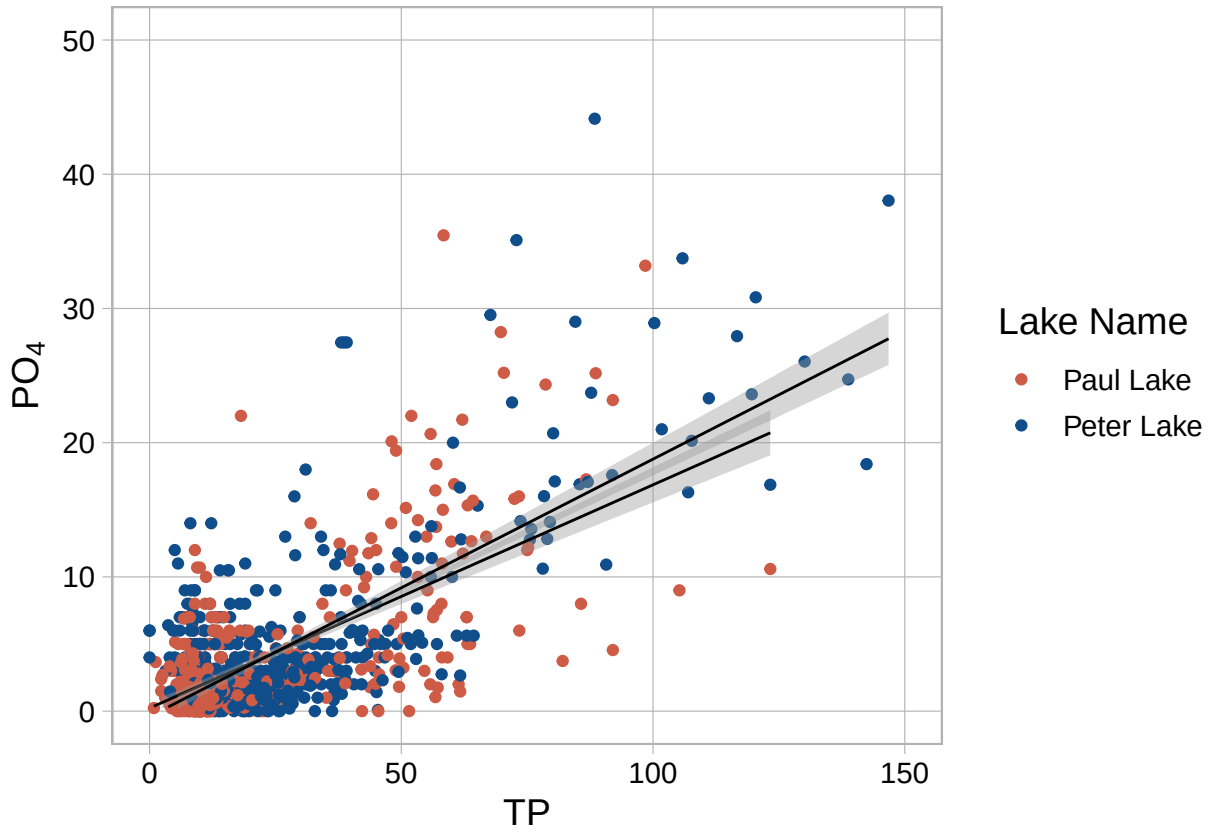
For numbers 4-7, create ggplot graphs and adjust aesthetics to follow best practices for data visualization. Ensure your theme, color palettes, axes, and additional aesthetics are edited accordingly.

4. [NTL-LTER] Plot total phosphorus (`tp_ug`) by phosphate (`po4`), with separate aesthetics for Peter and Paul lakes. Add a line of best fit and color it black. Adjust your axes to hide extreme values (hint: change the limits using `xlim()` and `ylim()`).

```
#4
phos <- ggplot(lakes, aes(x=tp_ug, y=po4, color = lakename)) +
  geom_point() +
```

```
  xlim(0,150) +
  ylim(0,50) +
  geom_smooth(aes(group=lakename), method="lm", color = "black", size=0.5) +
  ylab(expression("PO"[4])) +
  xlab(expression("TP")) +
  scale_color_manual(values = c("Paul Lake" = "coral3",
                                "Peter Lake" = "dodgerblue4"),"Lake Name")
print(phos)
```

```
## `geom_smooth()` using formula 'y ~ x'
## Warning: Removed 21948 rows containing non-finite values (stat_smooth).
## Warning: Removed 21948 rows containing missing values (geom_point).
## Warning: Removed 2 rows containing missing values (geom_smooth).
```



5. [NTL-LTER] Make three separate boxplots of (a) temperature, (b) TP, and (c) TN, with month as the x axis and lake as a color aesthetic. Then, create a cowplot that combines the three graphs. Make sure that only one legend is present and that graph axes are aligned.

```
#5
temp <- ggplot(lakes, aes(x=as.factor(month), y=temperature_C, color = lakename)) +
  geom_boxplot() +
  ylab(expression("Temperature C")) +
  xlab(expression("")) +
  theme(legend.position = "none") +
  scale_color_manual(values = c("Paul Lake" = "coral3",
```

```
                                "Peter Lake" = "dodgerblue4"))
#print(temp)
TP <- ggplot(lakes, aes(x=as.factor(month),y=tp_ug,color=lakename)) +
  geom_boxplot() +
  ylab(expression("TP")) +
  xlab(expression("")) +
  theme(legend.position="none") +
  scale_color_manual(values = c("Paul Lake" = "coral3",
                                "Peter Lake" = "dodgerblue4"))
#print(TP)
TN <- ggplot(lakes, aes(x=as.factor(month),y=tn_ug,color=lakename))+
  geom_boxplot() +
  ylab(expression("TN")) +
  xlab(expression("Month")) +
  theme(legend.position="bottom") +
  scale_color_manual(values = c("Paul Lake" = "coral3",
                                "Peter Lake" = "dodgerblue4"),"Lake Name")
#print(TN)
PeterPaul.temp.TP.TN <- plot_grid(temp, TP, TN, nrow =3, align = "h", rel_heights = c(1.25,1))
```

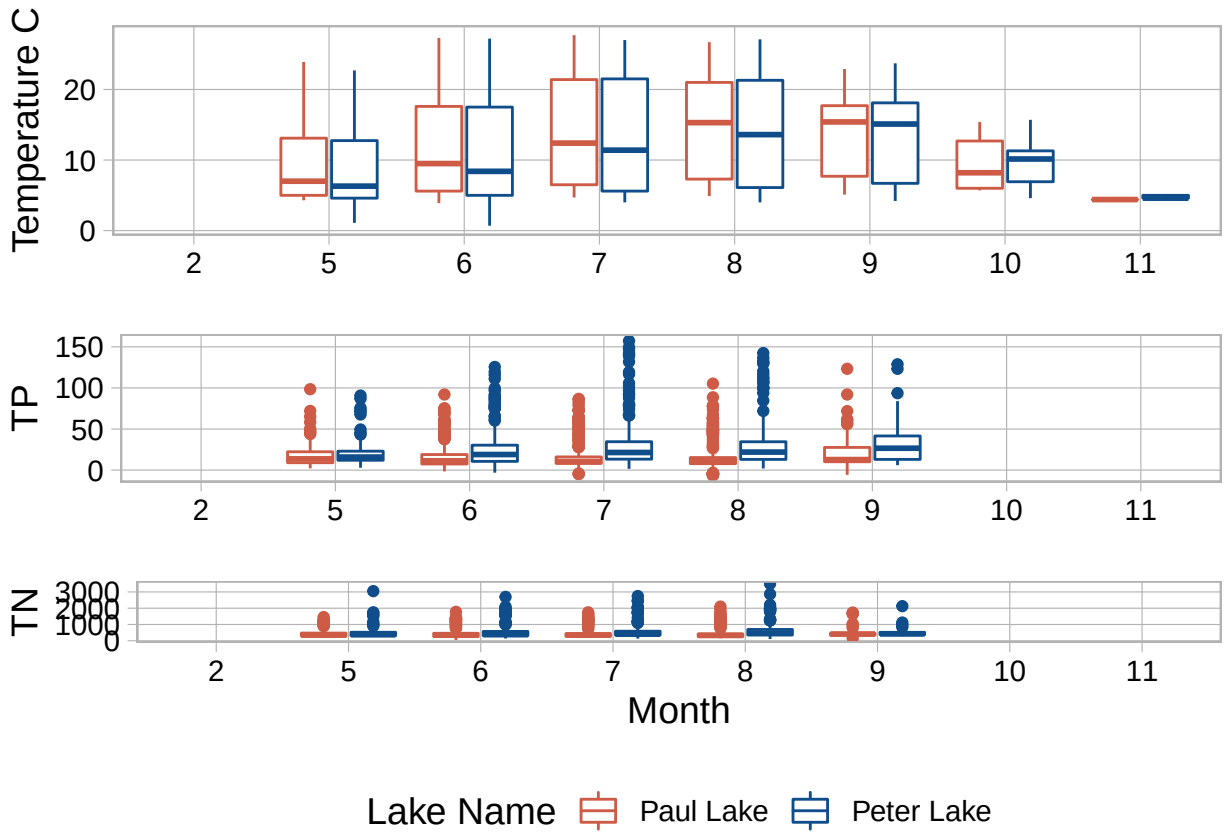
```
## Warning: Removed 3566 rows containing non-finite values (stat_boxplot).
```

```
## Warning: Removed 20729 rows containing non-finite values (stat_boxplot).
```

```
## Warning: Removed 21583 rows containing non-finite values (stat_boxplot).
```

```
## Warning: Graphs cannot be horizontally aligned unless the axis parameter is set.
## Placing graphs unaligned.
```

```
print(PeterPaul.temp.TP.TN)
```



Question: What do you observe about the variables of interest over seasons and between lakes?

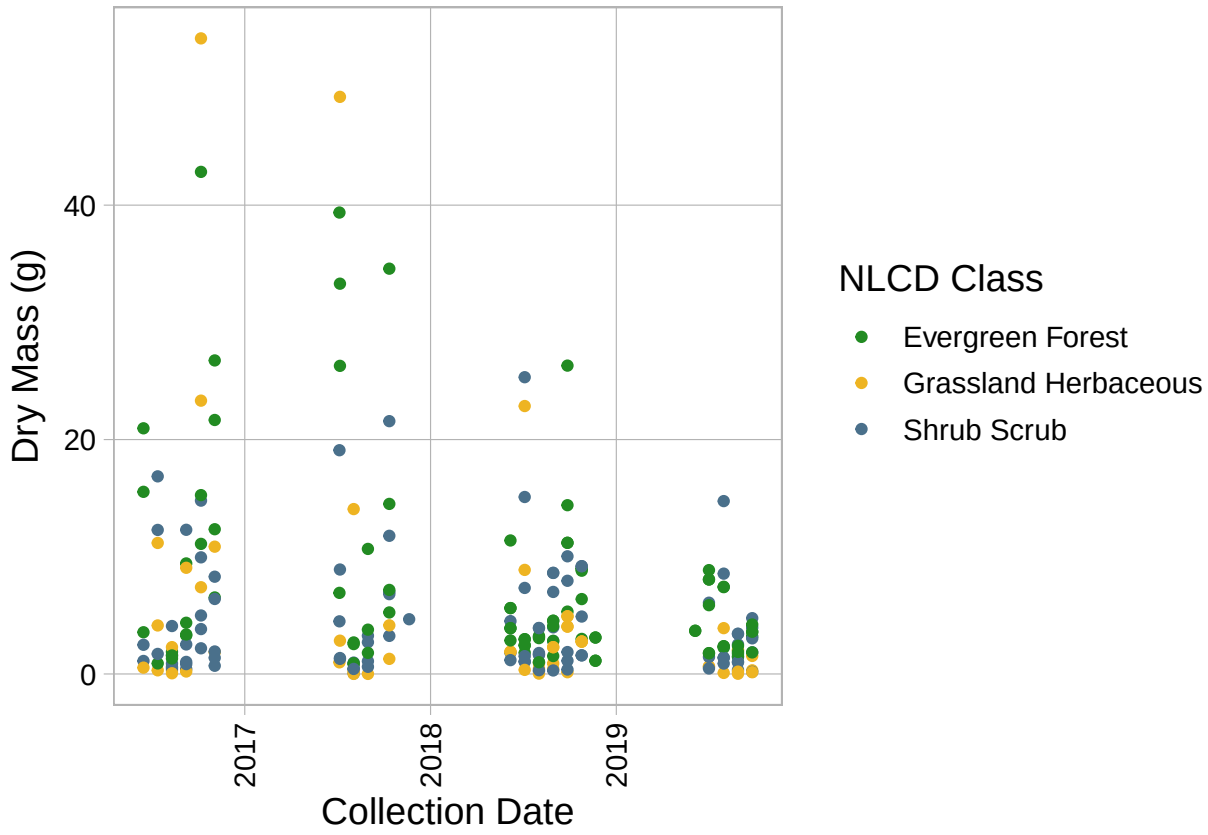
> Answer: Over seasons and between lakes, the variables of interest appear to follow similar trends.The temperates increase and then decrease from January to December, and that holds true for both Paul Lake and Peter Lake. The total phosphorous and total phosphate appear to increase throughout the spring and summer. The same holds true for both lakes.

6. [Niwot Ridge] Plot a subset of the litter dataset by displaying only the "Needles" functional group. Plot the dry mass of needle litter by date and separate by NLCD class with a color aesthetic. (no need to adjust the name of each land use)

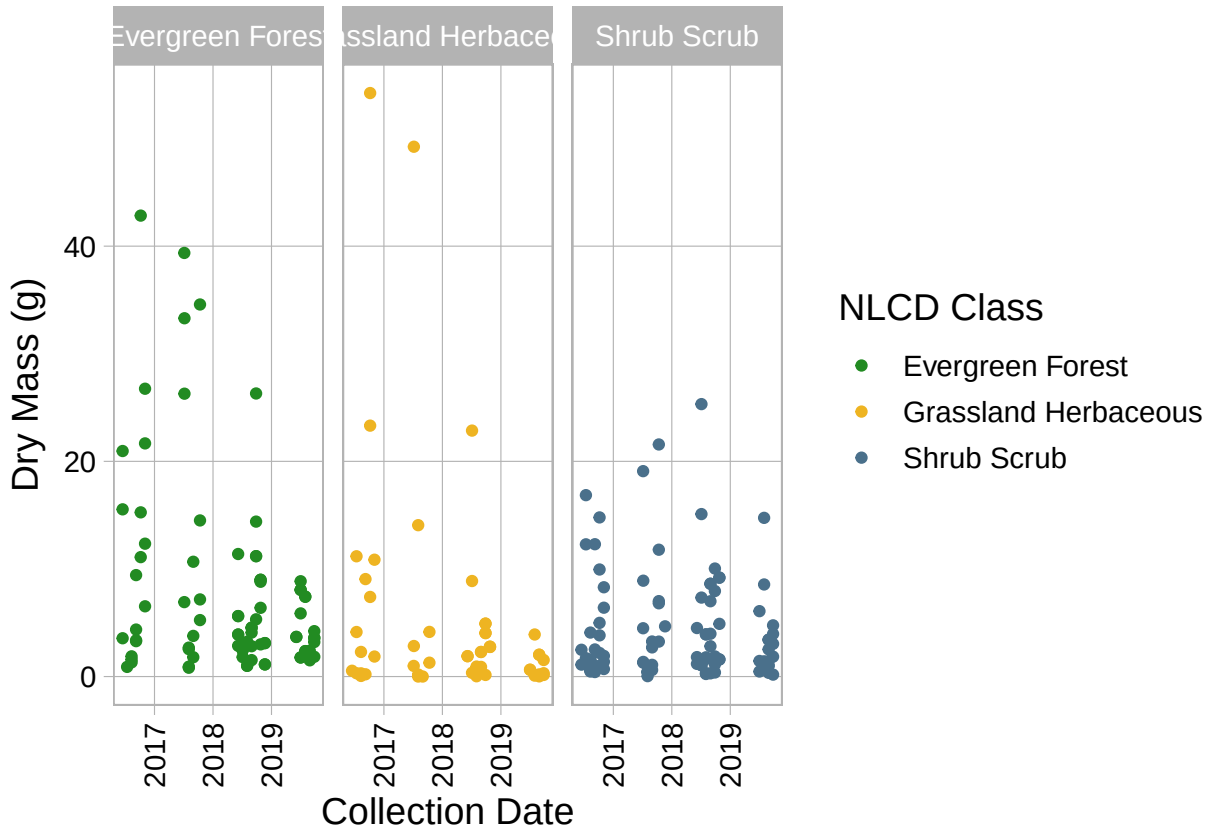
7. [Niwot Ridge] Now, plot the same plot but with NLCD classes separated into three facets rather than separated by color.

```
#6
needlecolor = c("evergreenForest" = "forestgreen","grasslandHerbaceous" = "goldenrod2","shrubScrub" = "
needlelabel = c("evergreenForest" = "Evergreen Forest","grasslandHerbaceous" = "Grassland Herbaceous","

needles <- ggplot(subset(litter, functionalGroup %in% "Needles"))+
  geom_point(aes(x=collectDate, y=dryMass,color=nlcdClass)) +
  scale_color_manual(labels = needlelabel, values = needlecolor, "NLCD Class") +
  xlab(expression("Collection Date")) +
  ylab(expression("Dry Mass (g)")) +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))
print(needles)
```




```
#7
needleSplit <- ggplot(subset(litter, functionalGroup %in% "Needles"))+
  geom_point(aes(x=as.Date(collectDate), y=dryMass,color=nlcdClass)) +
  scale_color_manual(labels = needlelabel, values = needlecolor, "NLCD Class") +
  facet_wrap(vars(nlcdClass),
             labeller = labeller(nlcdClass = c(evergreenForest = "Evergreen Forest",
                                               grasslandHerbaceous = "Grassland Herbaceous",
                                               shrubScrub = "Shrub Scrub"))) +
  xlab(expression("Collection Date")) +
  ylab(expression("Dry Mass (g)")) +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1)) +
  scale_x_date()
print(needleSplit)
```



Question: Which of these plots (6 vs. 7) do you think is more effective, and why?

Answer:The faceted graph is more effective because you can isolate the land use classes. When comparing the dry mass of the different classes across the entire collection date range, it is more visually simple to separate the classes. While the combined graph can allow you to determine differences more easily on a single collection day, the faceted graph allows you to make more comparisons of the trends over time.