Assignment 5: Data Visualization

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OVERVIEW

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

Directions

1. Rename this file `<FirstLast>_A05_DataVisualization.Rmd` (replacing `<FirstLast>` with your first and last name).
2. Change "Student Name" on line 3 (above) with your name.
3. Work through the steps, **creating code and output** that fulfill each instruction.
4. Be sure your code is tidy; use line breaks to ensure your code fits in the knitted output.
5. Be sure to **answer the questions** in this assignment document.
6. When you have completed the assignment, **Knit** the text and code into a single PDF file.

Set up your session

1. Set up your session. Load the tidyverse, lubridate, here & cowplot packages, and verify your home directory. Read in 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 in the Processed_KEY folder) and the processed data file for the Niwot Ridge litter dataset (use the `NEON_NIWO_Litter_mass_trap_Processed.csv` version, again from the Processed_KEY folder).

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

```
#1
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.4.4     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.0
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```r
library(lubridate)
library(here)
```

```
## here() starts at /Users/sarah/Documents/872_EDA/EDA_Spring2024
```

```r
library(cowplot)
```

```
##
## Attaching package: 'cowplot'
##
## The following object is masked from 'package:lubridate':
##
##     stamp
```

```r
library(ggplot2)
library(ggthemes)
```

```
##
## Attaching package: 'ggthemes'
##
## The following object is masked from 'package:cowplot':
##
##     theme_map
```

```r
#2
processed_data = "Data/Processed_KEY"
PeterPaul.chem.nutrients <- read.csv(
  here(
    processed_data,
    "NTL-LTER_Lake_Chemistry_Nutrients_PeterPaul_Processed.csv"),
  stringsAsFactors = TRUE
  )

Niwot.Ridge.Litter <- read.csv(
  here(
    processed_data,"NEON_NIWO_Litter_mass_trap_Processed.csv"),
  stringsAsFactors = TRUE
  )
```

Define your theme

3. Build a theme and set it as your default theme. Customize the look of at least two of the following:

- Plot background
- Plot title
- Axis labels
- Axis ticks/gridlines
- Legend

```
#3
A05_theme <- theme_base() + theme(
    plot.title = element_text( #Updating Title
      color= 'darkslategray',
      size = 14
    ),
    axis.text = element_text( #Updating axis text
      color = "black",
      size = 10
    ),
   axis.title.x = element_text( #Updating x-axis
     color = "black",
     size = 12
   ),
   axis.title.y = element_text( #Updating y-axis
     color = "black",
     size = 12
   ),
    legend.position = "top", #Putting legend to top
     legend.title = element_text( #Updating legend
      color='black',
      size = 12
    ),
   legend.text = element_text( #Updating legend text
     size = 12
     ),
    plot.background = element_blank() #takeaway plot edge
   )
```

Create graphs

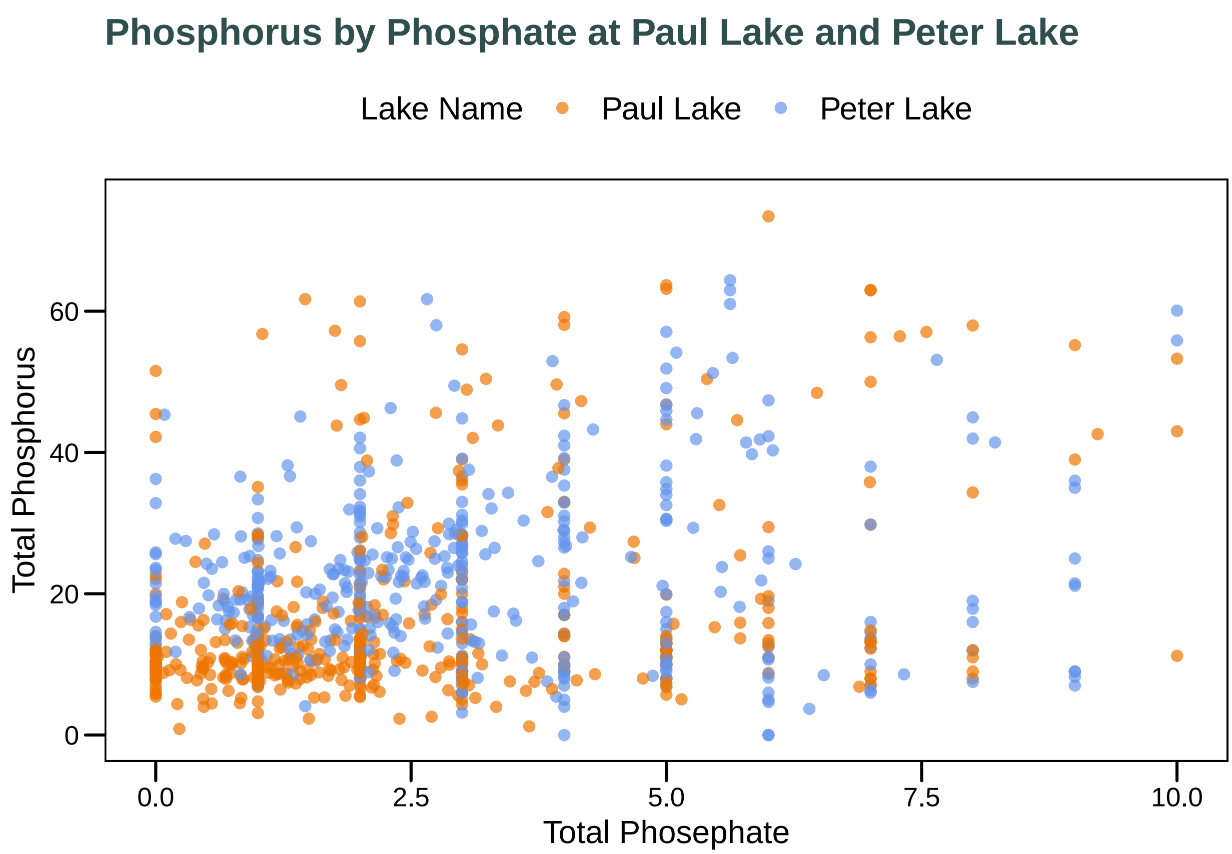
For numbers 4-7, create ggplot graphs and adjust aesthetics to follow best practices for data visualization. Ensure your theme, color palettes, axes, and additional aesthetics are edited accordingly.

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

```
#4
plot4 <- PeterPaul.chem.nutrients %>%
  ggplot(aes(
      x=po4,
      y=tp_ug,
      color=lakename)
    )  +
  geom_point(alpha=0.70) +
  xlim(0, 10) + # is this the correct way to hide the extreme values? should i keep it at 5, 10, 25?
  ylim(0, 75) +
  ylab("Total Phosphorus") +
  xlab("Total Phosephate") +
  ggtitle("Phosphorus by Phosphate at Paul Lake and Peter Lake") +
  scale_color_manual(values = c("darkorange2", "cornflowerblue"),
```

```
                       name = "Lake Name") +
  A05_theme
print(plot4)
```

```
## Warning: Removed 22064 rows containing missing values (`geom_point()`).
```



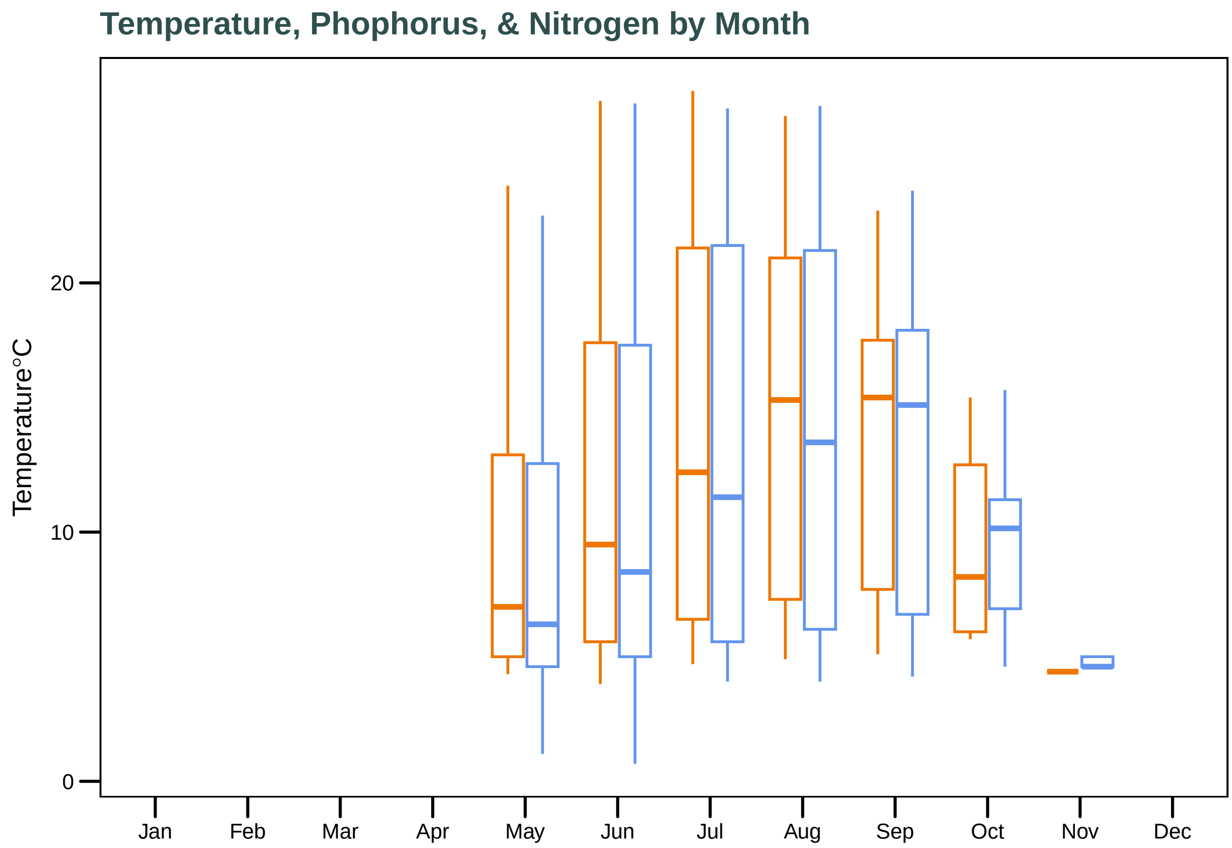
5. [NTL-LTER] Make three separate boxplots of (a) temperature, (b) TP, and (c) TN, with month as the x axis and lake as a color aesthetic. Then, create a cowplot that combines the three graphs. Make sure that only one legend is present and that graph axes are aligned.

Tips: * Recall the discussion on factors in the lab section as it may be helpful here. * Setting an axis title in your theme to `element_blank()` removes the axis title (useful when multiple, aligned plots use the same axis values) * Setting a legend's position to "none" will remove the legend from a plot. * Individual plots can have different sizes when combined using `cowplot`.

```
#5
A05_theme1 <- theme_base() + theme(
    plot.title = element_text(
      color= 'darkslategray',
      size = 12
    ),
    axis.text = element_text(
      color = "black",
      size = 8
```

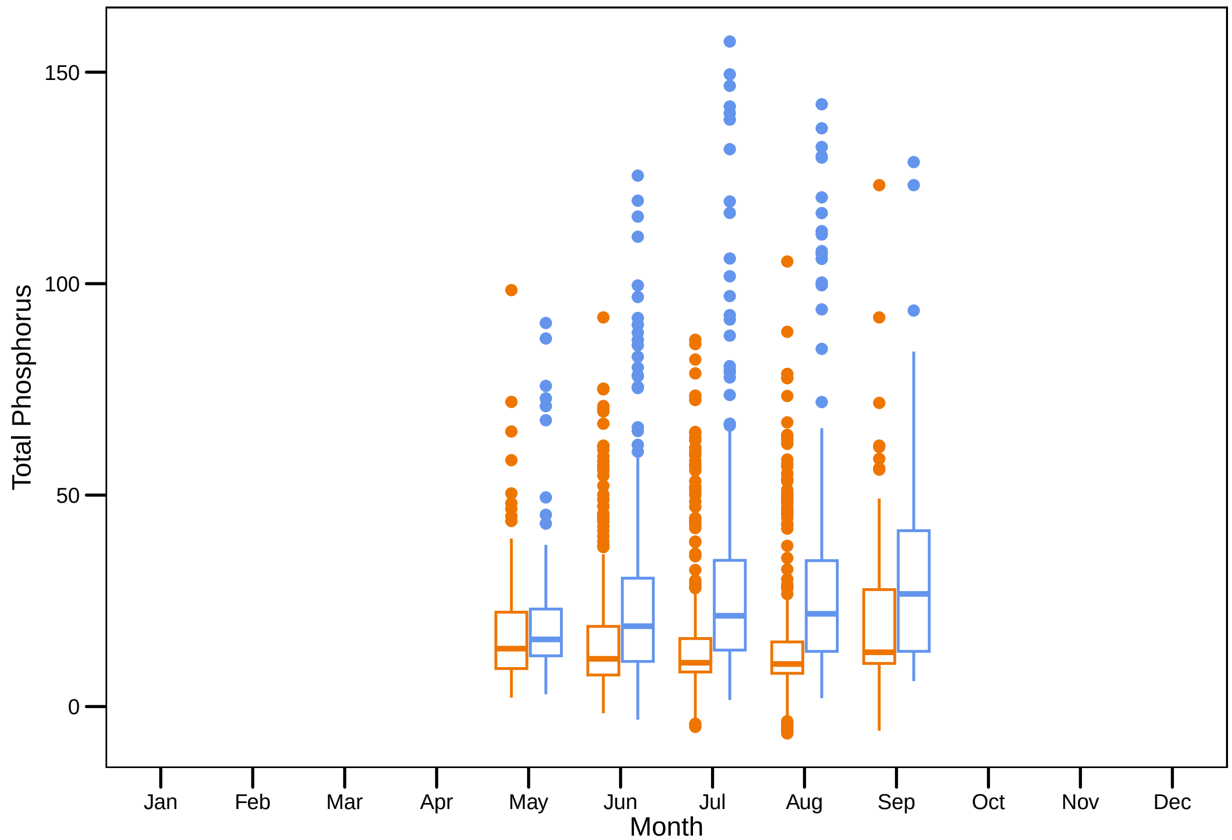
```
    ),
   axis.title.x = element_blank(), #leaving x-axis blank
   axis.title.y = element_text(
     color = "black",
     size = 10
   ),
     legend.title = element_text(
      color='black',
      size = 8
    ),
   legend.text = element_text(
     size = 8
     ),
   legend.position = "top",
   plot.background = element_blank()
   )

PeterPaul.chem.nutrients$month_f <- factor(
  PeterPaul.chem.nutrients$month,
  levels=1:12,
  labels = month.abb
  )

temp <- PeterPaul.chem.nutrients %>%
  ggplot(aes(
      x=month_f,
      y=temperature_C,
      color=lakename)
    )  +
  geom_boxplot() +
  ylab(expression(paste("Temperature", degree, "C"))) +
  ggtitle("Temperature, Phophorus, & Nitrogen by Month") +
  scale_color_manual(values = c("darkorange2", "cornflowerblue"),
                    name = "Lake Name") +
  A05_theme1 +
  theme(legend.position = "NONE") +
  scale_x_discrete(drop=FALSE)
temp
```

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



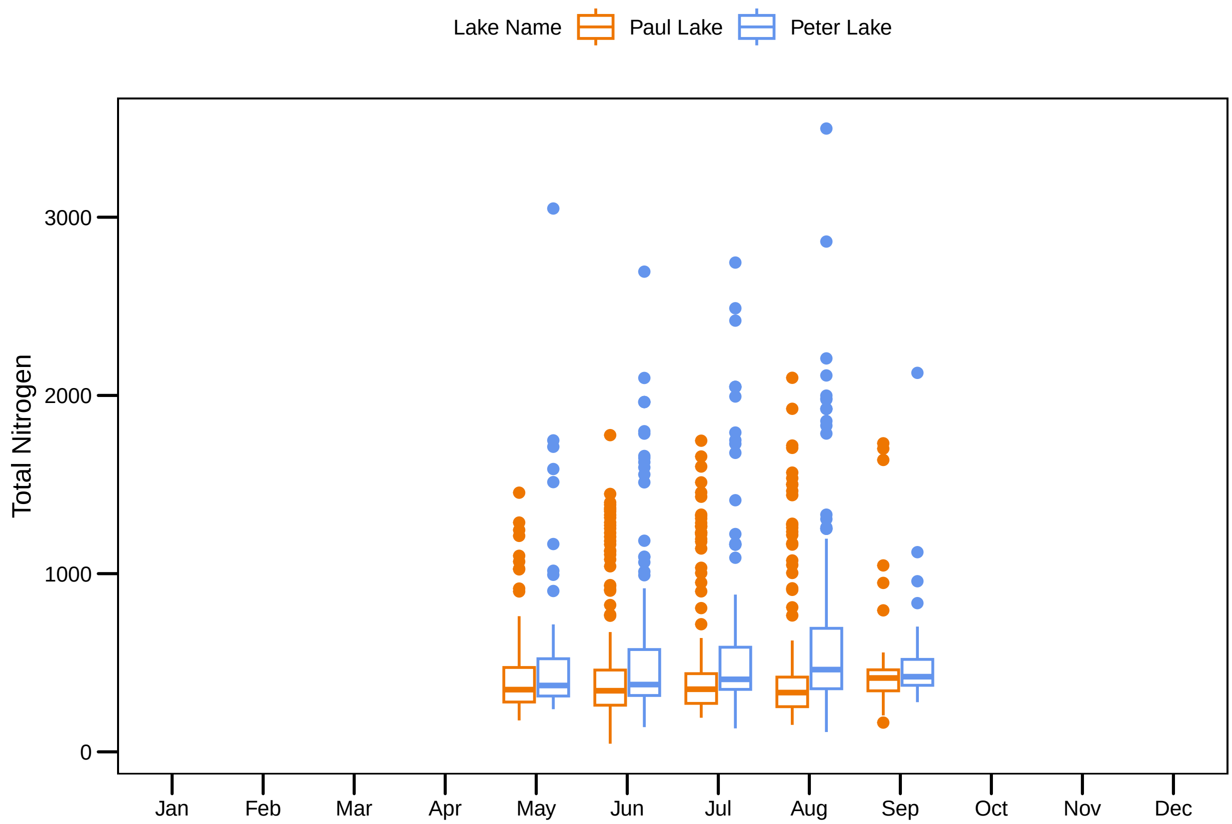

```
tp <- PeterPaul.chem.nutrients %>%
  ggplot(aes(
      x=month_f,
      y=tp_ug,
      color=lakename)
    )  +
  geom_boxplot() +
  ylab("Total Phosphorus") +
    xlab("Month") +
  scale_color_manual(values = c("darkorange2", "cornflowerblue"),
                     name = "Lake Name") +
  A05_theme1 +
  theme(legend.position = "NONE",
        axis.title.x = element_text(
     color = "black",
     size = 10),
     panel.border = element_blank()) +
  scale_x_discrete(drop=FALSE)
tp
```

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




```r
tn <- PeterPaul.chem.nutrients %>%
  ggplot(aes(
      x=month_f,
      y=tn_ug,
      color=lakename)
    )  +
  geom_boxplot() +
  ylab("Total Nitrogen") +
  scale_color_manual(values = c("darkorange2", "cornflowerblue"),
                     name = "Lake Name") +
  A05_theme1 +
  scale_x_discrete(drop=FALSE)
tn
```

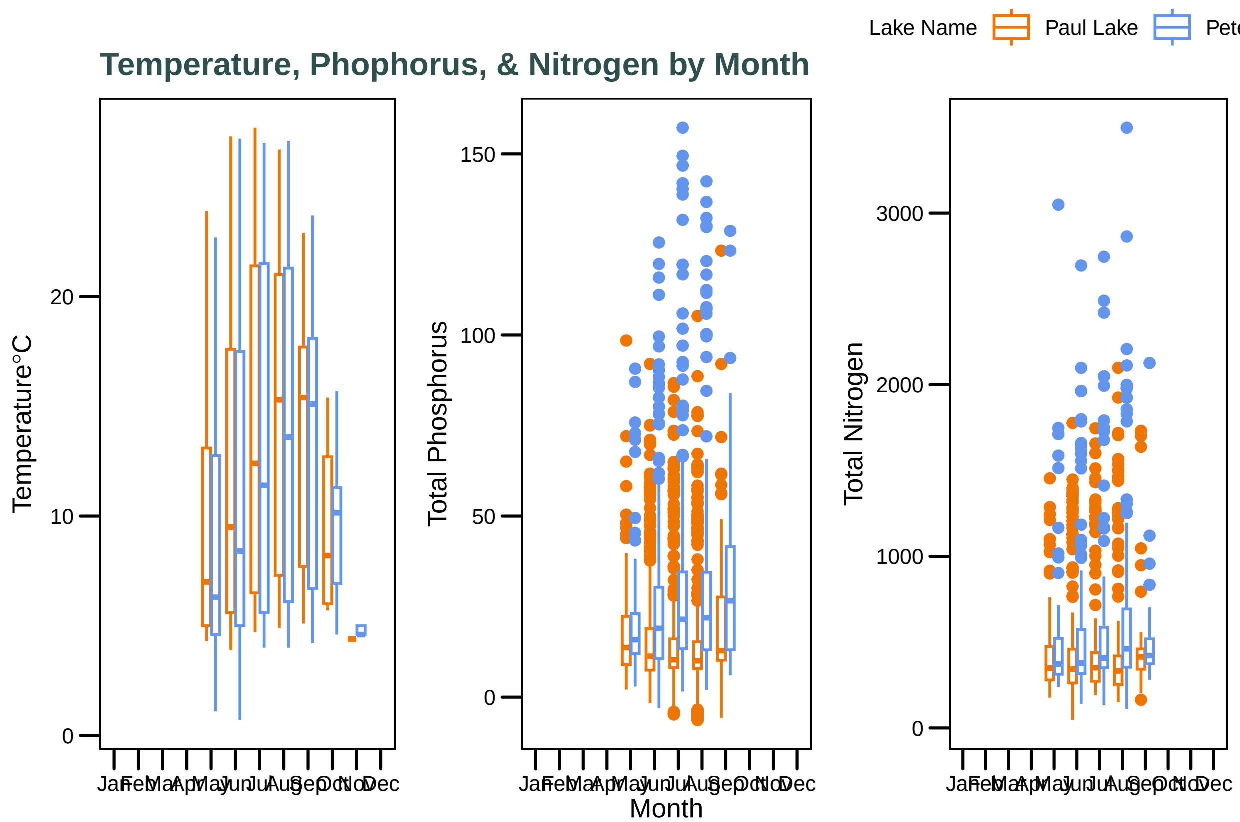
```
## Warning: Removed 21583 rows containing non-finite values (‘stat_boxplot()‘).
```




```
plot5 <- plot_grid(temp,
                   tp,
                   tn,
                   nrow = 1,
                   align = "h",
                   axis = "tblr",
                   rel_widths = c(1.5, 1.5, 1.5)
                   )
```

```
## 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()`).
```

```
print(plot5)
```



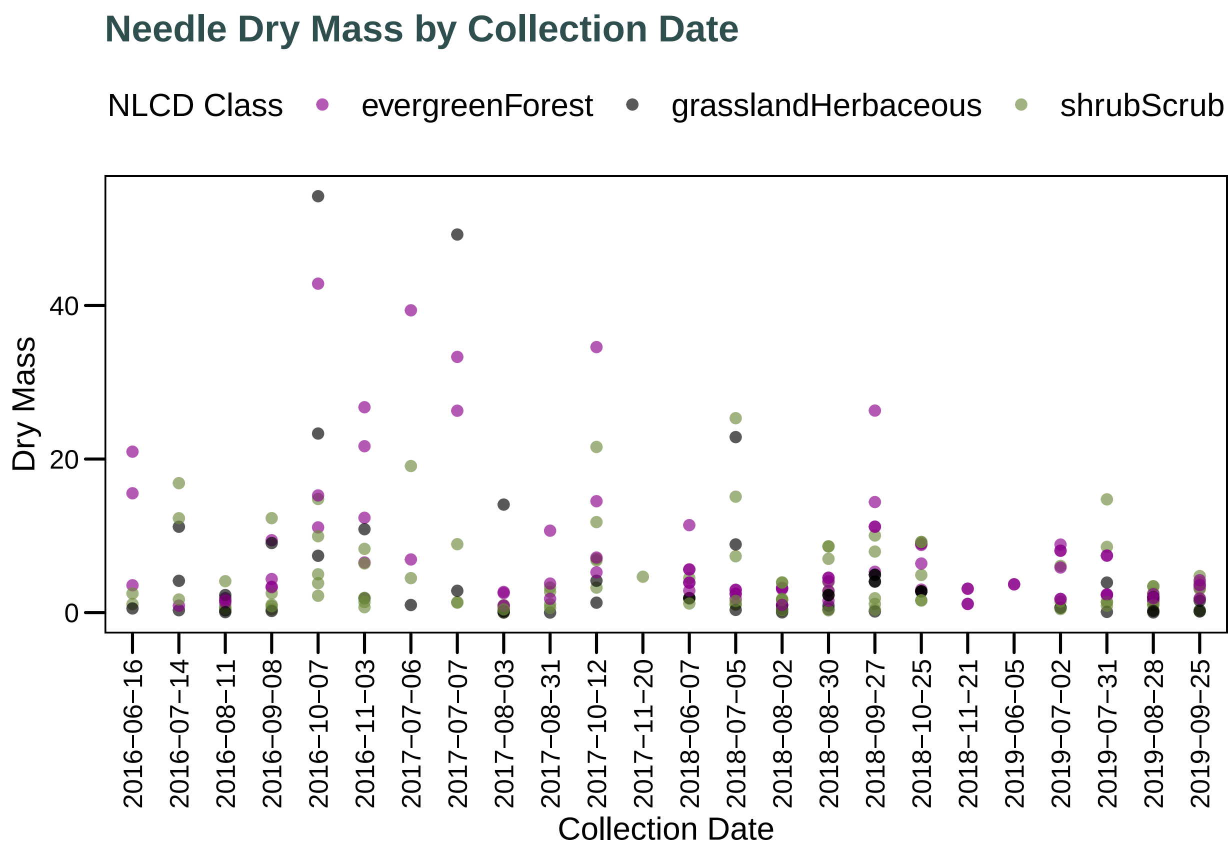
Question: What do you observe about the variables of interest over seasons and between lakes?

> Answer: Temp is fairly the same between both lakes throughout the year.

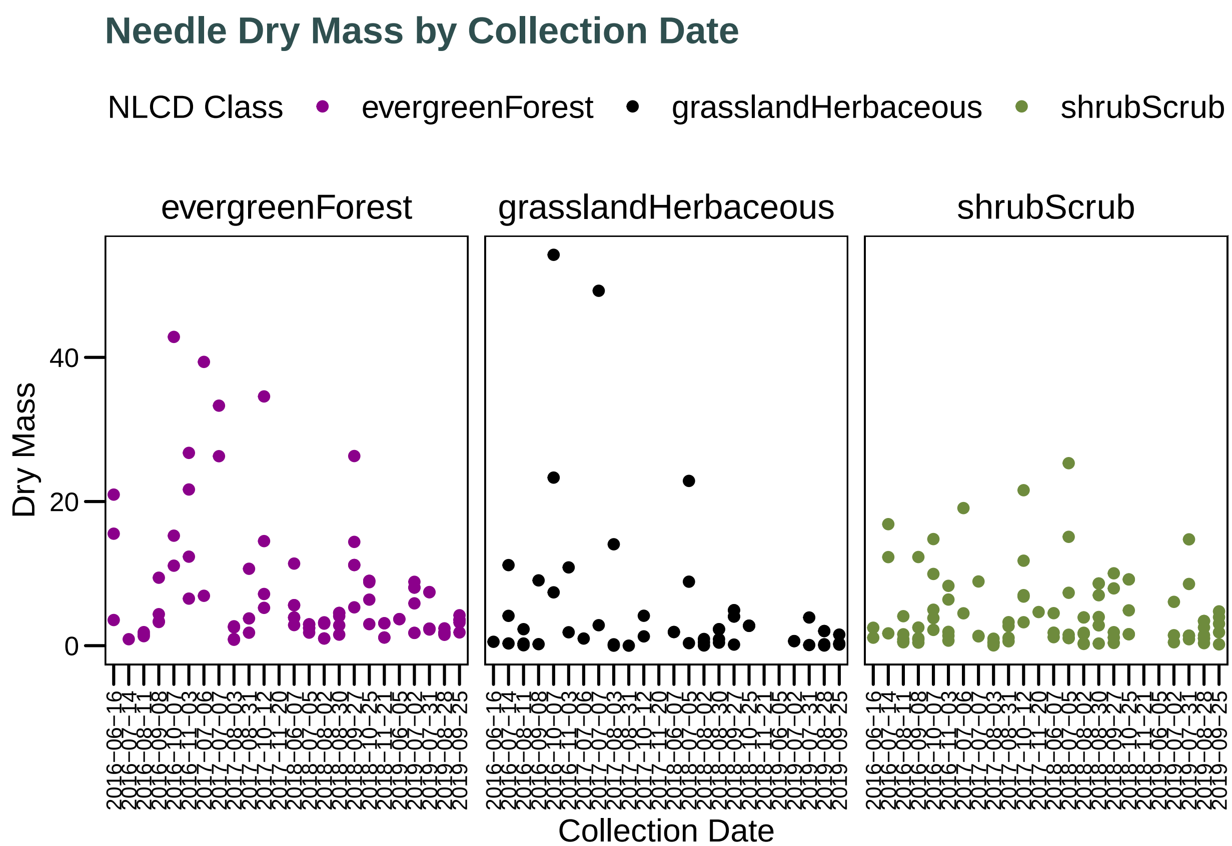
6. [Niwot Ridge] Plot a subset of the litter dataset by displaying only the "Needles" functional group. Plot the dry mass of needle litter by date and separate by NLCD class with a color aesthetic. (no need to adjust the name of each land use)
7. [Niwot Ridge] Now, plot the same plot but with NLCD classes separated into three facets rather than separated by color.

```
#6
plot6 <- Niwot.Ridge.Litter %>%
  filter(functionalGroup == "Needles") %>%
  ggplot(aes(
      x=collectDate,
      y=dryMass,
      color=nlcdClass)
    )  +
  geom_point(alpha=0.65) +
  ylab("Dry Mass") +
  xlab("Collection Date") +
  ggtitle("Needle Dry Mass by Collection Date") +
  scale_color_manual(values = c("darkmagenta", "black", "darkolivegreen4"),
    name = "NLCD Class") +
  A05_theme +
```

```
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))
print(plot6)
```




```
#7
plot7 <- Niwot.Ridge.Litter %>%
  filter(functionalGroup == "Needles") %>%
  ggplot(aes(
      x=collectDate,
      y=dryMass,
      color=nlcdClass))  +
  geom_point() +
  ylab("Dry Mass") +
  xlab("Collection Date") +
  ggtitle("Needle Dry Mass by Collection Date") +
  facet_wrap(vars(nlcdClass)) +
  A05_theme +
  scale_color_manual(values = c("darkmagenta", "black", "darkolivegreen4"),
    name = "NLCD Class") +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1, size = 8))
print(plot7)
```



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

Answer: