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>_A02_CodingBasics.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 to **answer the questions** in this assignment document.
5. When you have completed the assignment, **Knit** the text and code into a single PDF file.

The completed exercise is due on Friday, Oct 21st @ 5:00pm.

Set up your session

1. Set up your session. Verify your working directory and load the tidyverse, lubridate, & 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] "/Users/hbliska/Desktop/EDA-Fall2022"
```

```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.3.6      v purrr   0.3.4
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.4.1
## v readr   2.1.2      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
##
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
library(cowplot)
```

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

```
Peter.Paul.Nutrients.Chem <- read.csv(
  "./Data/Processed/NTL-LTER_Lake_Chemistry_Nutrients_PeterPaul_Processed.csv",
  stringsAsFactors = TRUE)
Niwot.Litter <- read.csv(
  "./Data/Processed/NEON_NIWO_Litter_mass_trap_Processed.csv",
  stringsAsFactors = TRUE)

#2
Peter.Paul.Nutrients.Chem$sampledate <- as.Date(
  Peter.Paul.Nutrients.Chem$sampledate,
  format = "%Y-%m-%d") #formatting date
Niwot.Litter$collectDate <- as.Date(
  Niwot.Litter$collectDate, format = "%Y-%m-%d") #formatting date
```

Define your theme

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

```
#3
mytheme <- theme_classic(base_size = 12) + theme(
  axis.text = element_text(color="black"),
  legend.position = "right")
#building my theme
#using classic theme with black text, size 13 text,
#and legend position to the right

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.

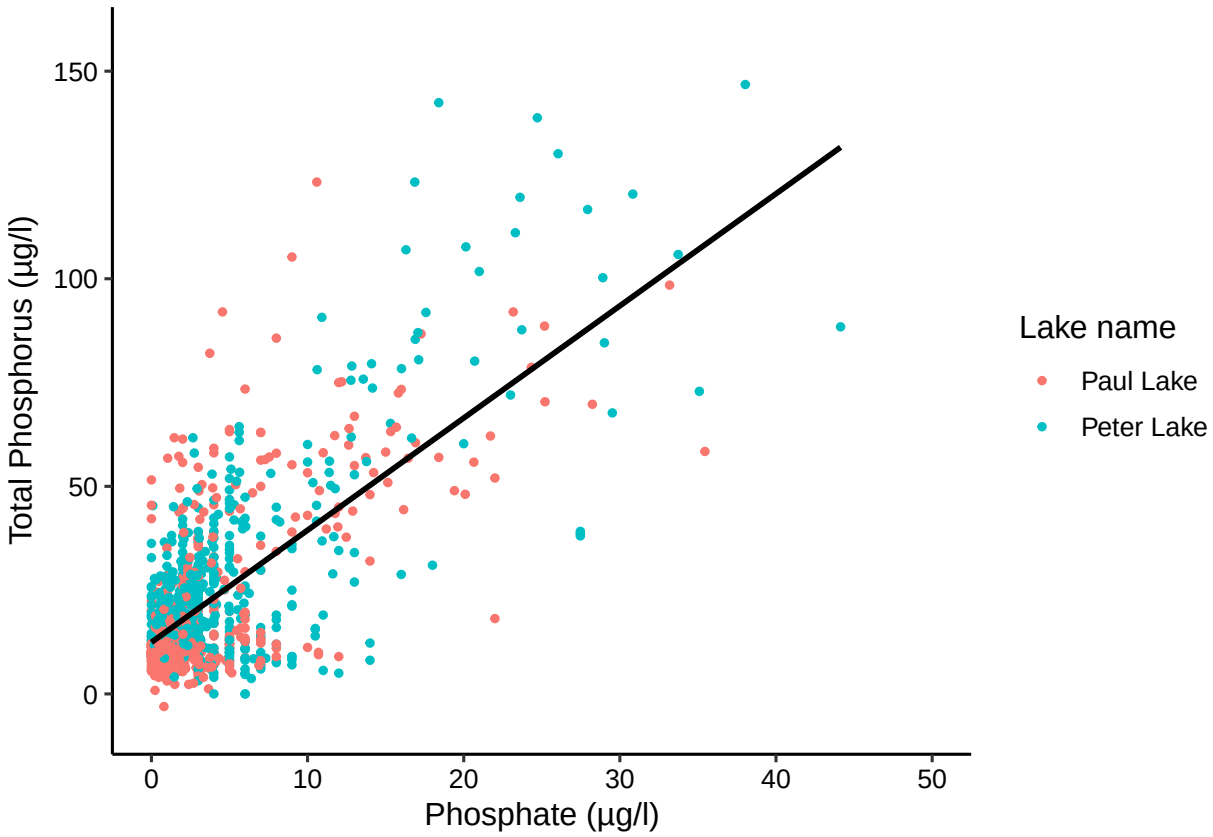
4. [NTL-LTER] Plot total phosphorus (`tp_ug`) by phosphate (`po4`), with separate aesthetics for Peter and Paul lakes. Add a line of best fit and color it black. Adjust your axes to hide extreme values (hint: change the limits using `xlim()` and/or `ylim()`).

```
#4
Plot_TotalP_Phosphate <- ggplot(Peter.Paul.Nutrients.Chem, aes(x = po4, y = tp_ug)) +
  geom_point(aes(color=lakename), size=1) + #creating scatter plot
  xlim(0, 50) + #adjusting axis
  geom_smooth(method=lm, se = FALSE, color="black") +
  ylab(expression("Total Phosphorus (µg/l)")) + #setting y axis label
  xlab(expression("Phosphate (µg/l)")) + #setting x axis label
  labs(color="Lake name") #setting legend label
print(Plot_TotalP_Phosphate)
```

```
## `geom_smooth()` using formula 'y ~ x'

## Warning: Removed 21947 rows containing non-finite values (stat_smooth).

## Warning: Removed 21947 rows containing missing values (geom_point).
```



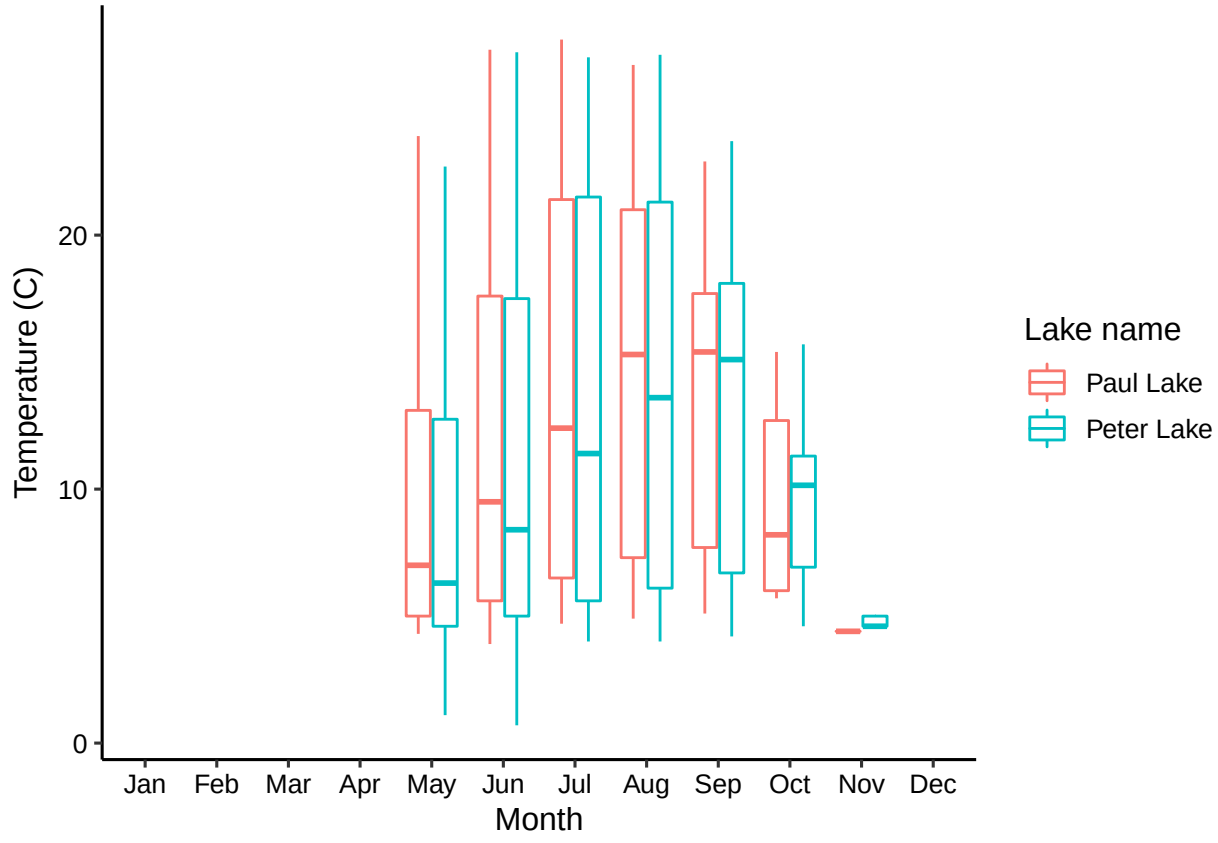
5. [NTL-LTER] Make three separate boxplots of (a) temperature, (b) TP, and

(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.

Tip: R has a build in variable called `month.abb` that returns a list of months; see https://r-lang.com/month-abb-in-r-with-example

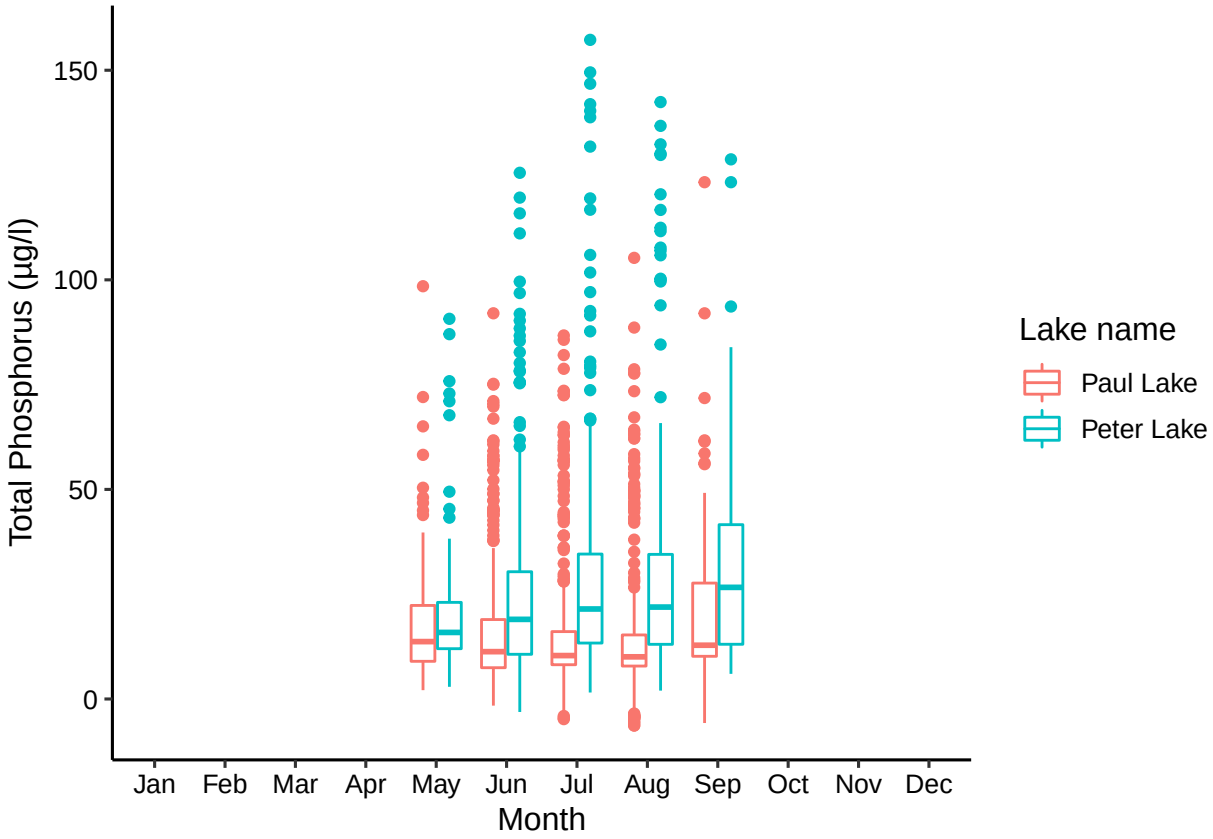
```
#5
Plot_Temp <- ggplot(Peter.Paul.Nutrients.Chem, aes(
  x = factor(month, levels=c(1:12)), y = temperature_C)) +
  #creating a level for each month for the x axis, setting y axis as temp
  geom_boxplot(aes(color=lakename)) + #creating box plot
  scale_x_discrete(labels=month.abb, drop=FALSE) + #creating month labels
  ylab(expression("Temperature (C)")) + #setting y axis label
  xlab(expression("Month")) + #setting x axis label
  labs(color="Lake name") #setting legend label
print(Plot_Temp)
```

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



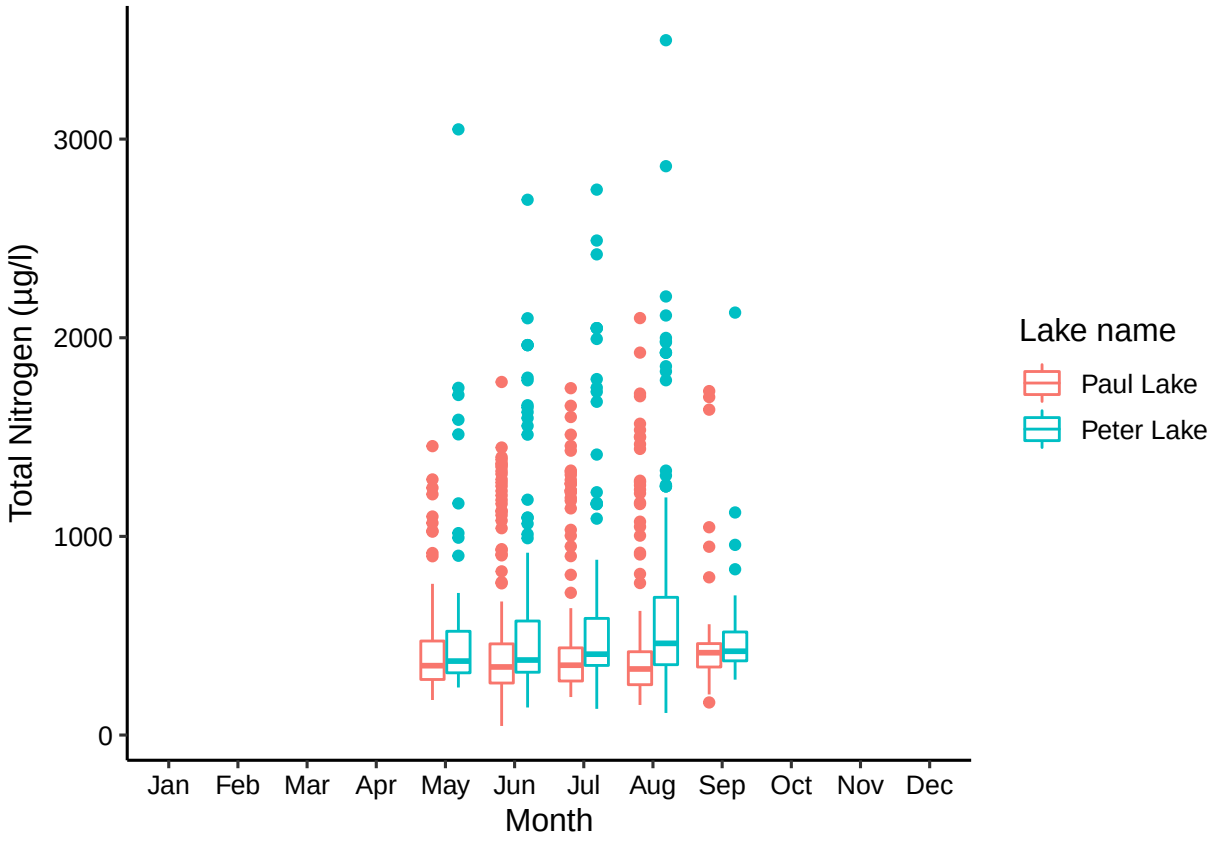

```
Plot_TP <- ggplot(Peter.Paul.Nutrients.Chem, aes(
  x = factor(month, levels=c(1:12)), y = tp_ug)) +
  #creating a level for each month for the x axis, setting y axis as total p
  geom_boxplot(aes(color=lakename)) + #creating box plot
  scale_x_discrete(labels=month.abb, drop=FALSE) + #creating month labels
  ylab(expression("Total Phosphorus (µg/l)")) + #setting y axis label
  xlab(expression("Month")) + #setting x axis label
  labs(color="Lake name") #setting legend label
print(Plot_TP)
```

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




```
Plot_TN <- ggplot(Peter.Paul.Nutrients.Chem, aes(
  x = factor(month,levels=c(1:12)), y = tn_ug)) +
   #creating a level for each month for the x axis, setting y axis as total N
  geom_boxplot(aes(color=lakename)) + #creating box plot
  scale_x_discrete(labels=month.abb, drop=FALSE) + #creating month labels
  ylab(expression("Total Nitrogen (µg/l)")) + #setting y axis label
  xlab(expression("Month")) + #setting x axis label
  labs(color="Lake name") #setting legend label
print(Plot_TN)
```

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




```
Plot_Temp_TP_TN <-
  plot_grid(
    Plot_Temp + theme(legend.position="none") + xlab(NULL),
    Plot_TP  + theme(legend.position="none") + xlab(NULL),
    Plot_TN  + theme(legend.position="bottom"),
            ncol=1, #all plots in one column
            nrows=3, #three rows, one for each plot
            align = 'v', #aligning vertically
            rel_heights = c(2,2,2.5)) #setting row heights
```

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

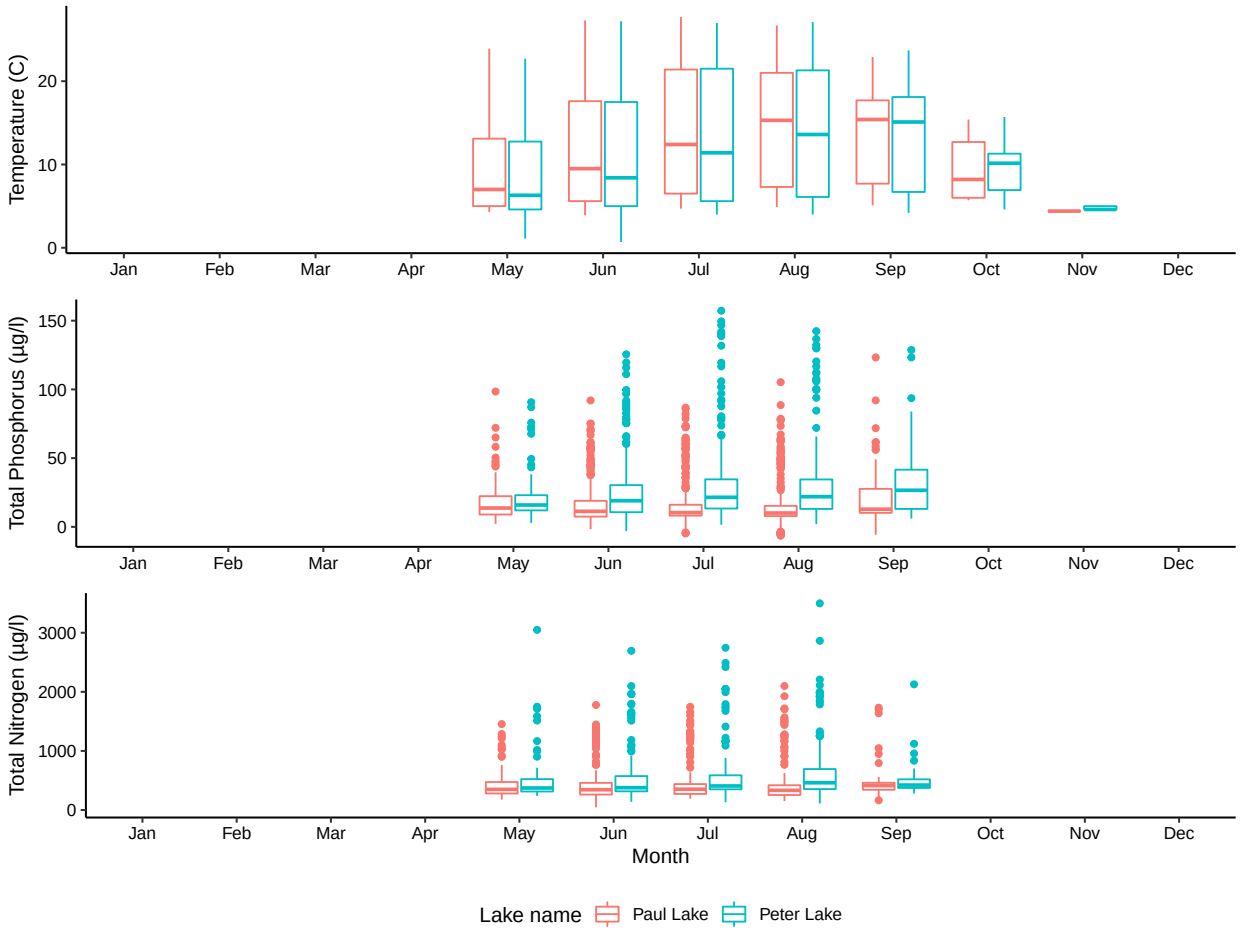
```
## Warning: Removed 20729 rows containing non-finite values (stat_boxplot).
```

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

```
## Warning in as_grob.default(plot): Cannot convert object of class numeric into a
## grob.
```

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

```
print(Plot_Temp_TP_TN)
```



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

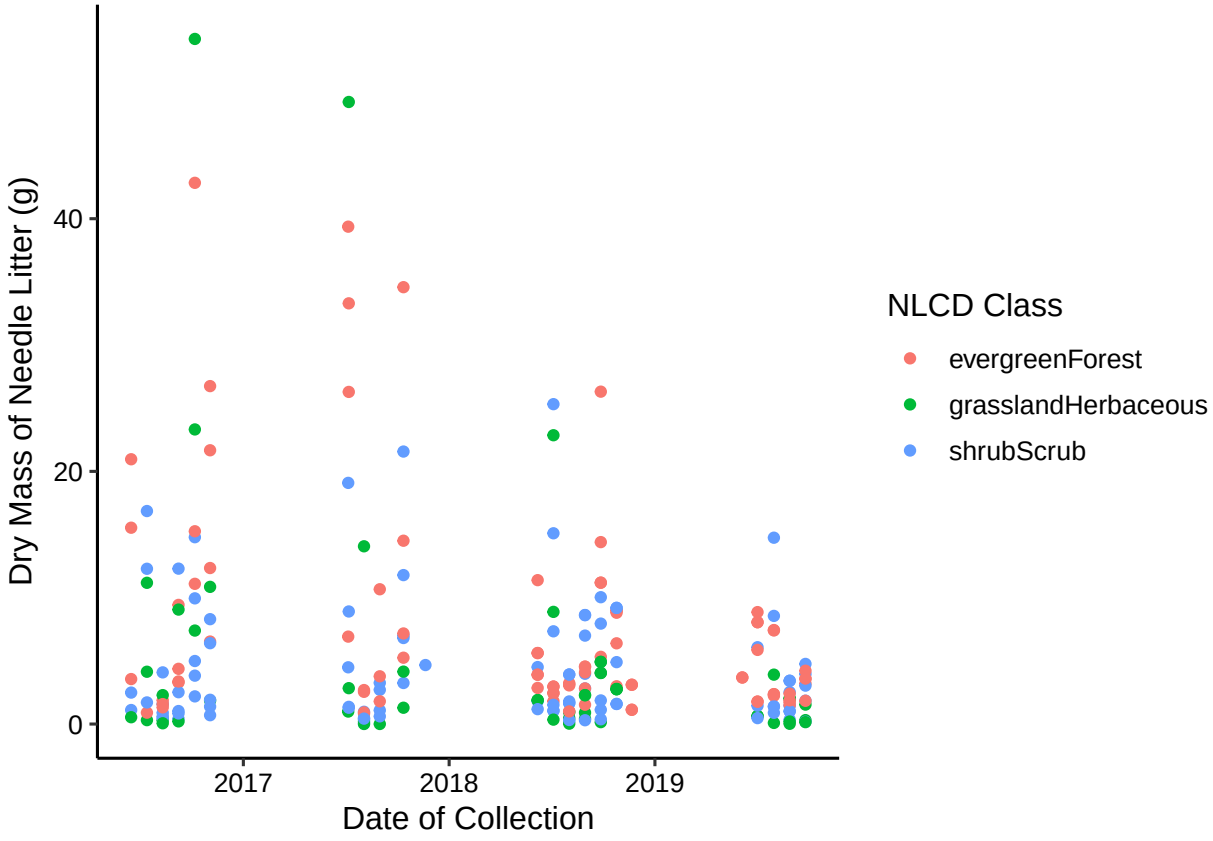
> Answer: It appears that median temperature of the lakes increases over the summer months with a peak in the late summer months of August and September. Median nitrogen and phosphorus levels also increase over the summer; median nitrogen levels are highest in August and September while median phosphorus levels are highest in September. There appears to be high variability in the nutrient samples in the summer months. Peter Lake appears to have slightly higher concentrations of nitrogen and phosphorus than Paul Lake. Paul Lake appears to have slightly higher lake temperatures from May to Septmeber than Peter Lake.

6. [Niwot Ridge] Plot a subset of the litter data set 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

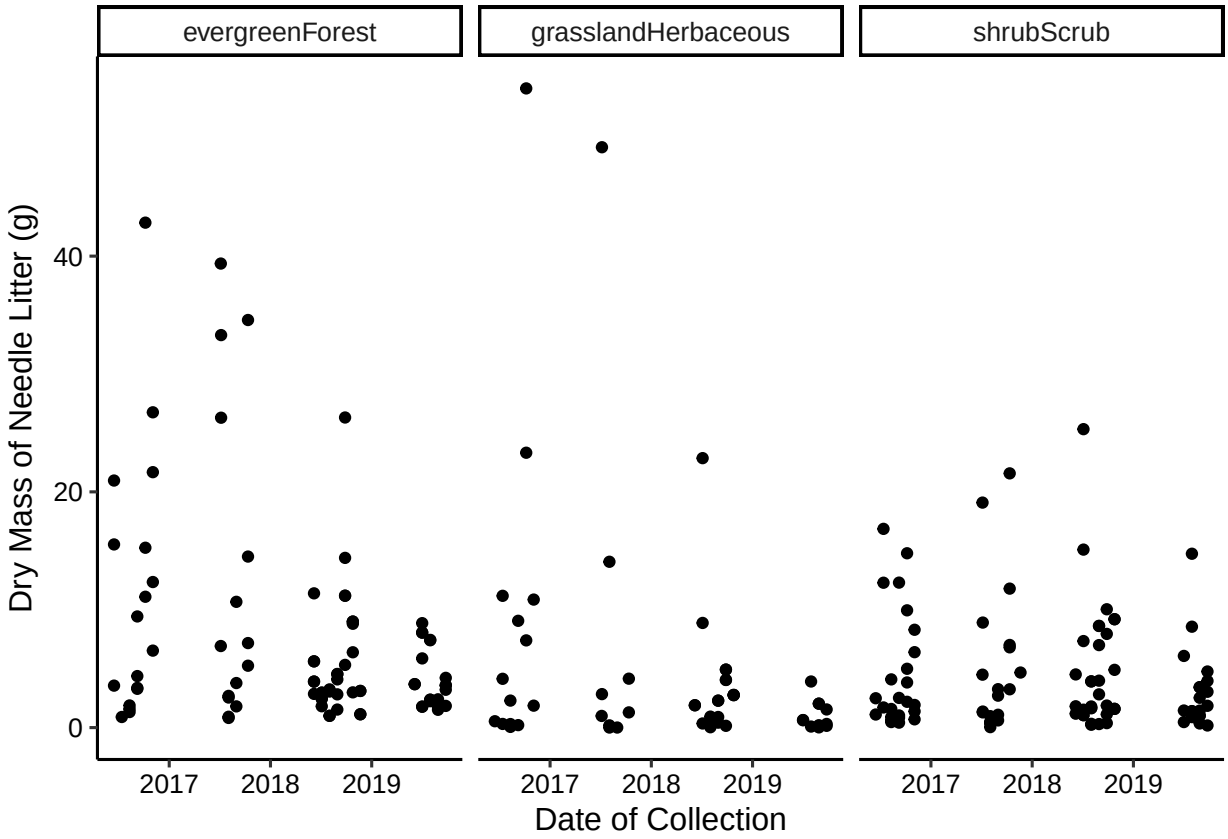
to adjust the name of each land use)

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

```
#6
Litter_Plot_Needles <- ggplot(subset(
  Niwot.Litter, functionalGroup == "Needles"), aes(
    x=collectDate, y=dryMass)) + #subsetting functional group by needles
  geom_point(aes(color=nlcdClass)) + #creating scatter plot
  ylab(expression("Dry Mass of Needle Litter (g)")) + #setting y axis label
  xlab(expression("Date of Collection")) + #setting x axis label
  labs(color="NLCD Class") #setting legend label
print(Litter_Plot_Needles)
```




```
#7
Litter_Plot_Needles_Faceted <- ggplot(subset(
  Niwot.Litter, functionalGroup == "Needles"), aes(
    x=collectDate, y=dryMass)) + #subsetting functional group by needles
  geom_point() + #creating a scatter plot
  ylab(expression("Dry Mass of Needle Litter (g)")) + #setting y axis label
  xlab(expression("Date of Collection")) + #setting x axis label
  facet_wrap(vars(nlcdClass)) #using facet grid to facet the plot
  #by NLCD class
print(Litter_Plot_Needles_Faceted)
```



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

Answer: I think that plot 7 is more effective for visualizing the data because it allows the viewer to see the differences in the distribution of dry mass data for each NLCD class more clearly. On plot 7, we can easily see that grassland herbaceous and evergreen forest classes had observations (potentially outliers) that were much higher in dry mass than the shrub scrub class. We are also more easily able to see clustering in the observations of dry mass in the shrub scrub class in Plot 7; this helps us to understand the tighter distribution of dry mass observations for this class as well as to understand that most of the observations were close to zero.