TEMP temperature comparison

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Introduction

This .Rmd file is to show the results of water temperature comparison between the global model prediction and the tributary field observation for 11 Great Lake locations. (missing Saginaw data)

For all the graphs below, the black line is the mean weekly average temperature, the blue lines are the 95% confidence interval, the red dots are field observations by week.

```
library(ggplot2)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

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

```
library(knitr)
```

```
## Warning: package 'knitr' was built under R version 4.1.3
```

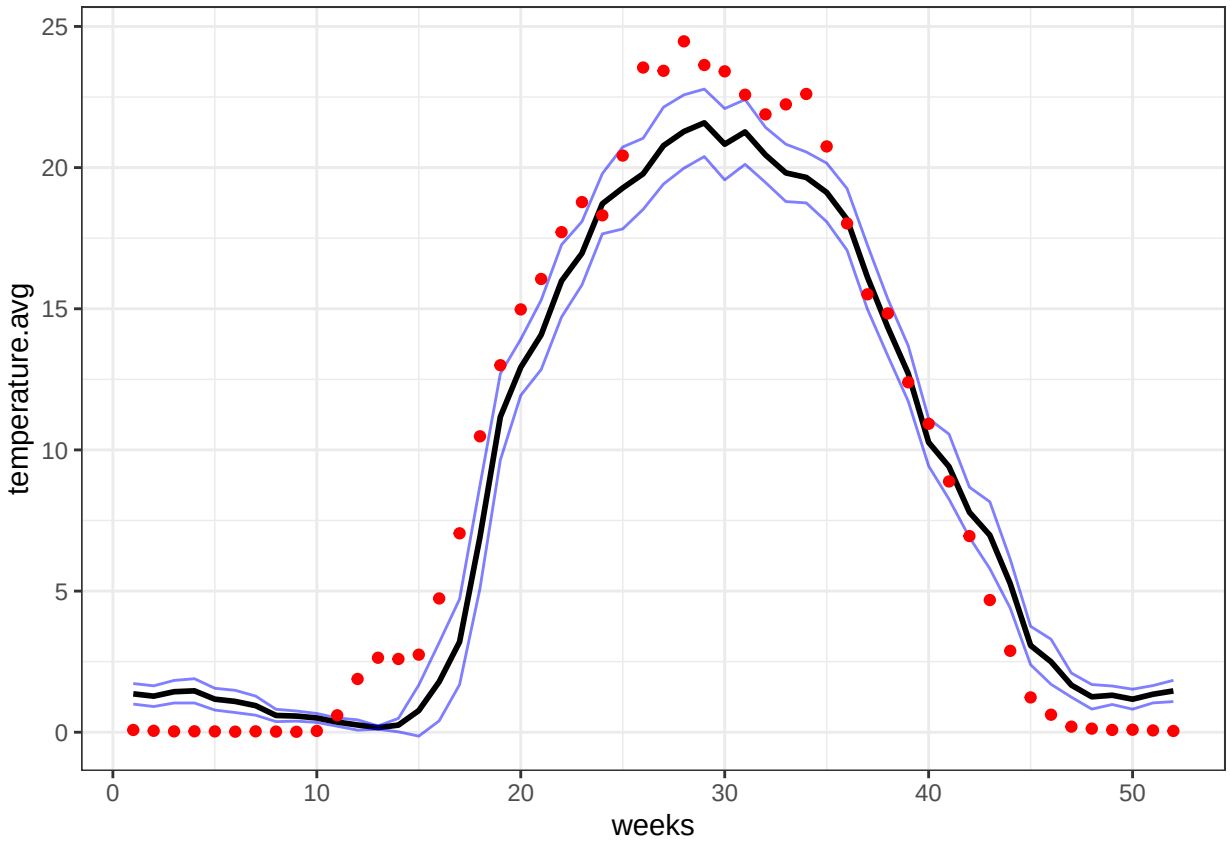
```
tri.location <- read.csv("tributary locations.csv")
WT <- read.csv("water temperature clean/water_temperature_final_clean.csv",
               stringsAsFactors = TRUE)
```

St. Louis River

```
# observed values
st.louis.field <- WT %>% filter(river == "stlouis")

# predicted values
st.louis.pred <- read.csv("water temperature clean/st_louis_model.csv")

## Plotting
ggplot(st.louis.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(st.louis.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.st.louis <- sqrt(mean((st.louis.field$temp - st.louis.pred$temperature.avg)^2))
RMSE.st.louis
```

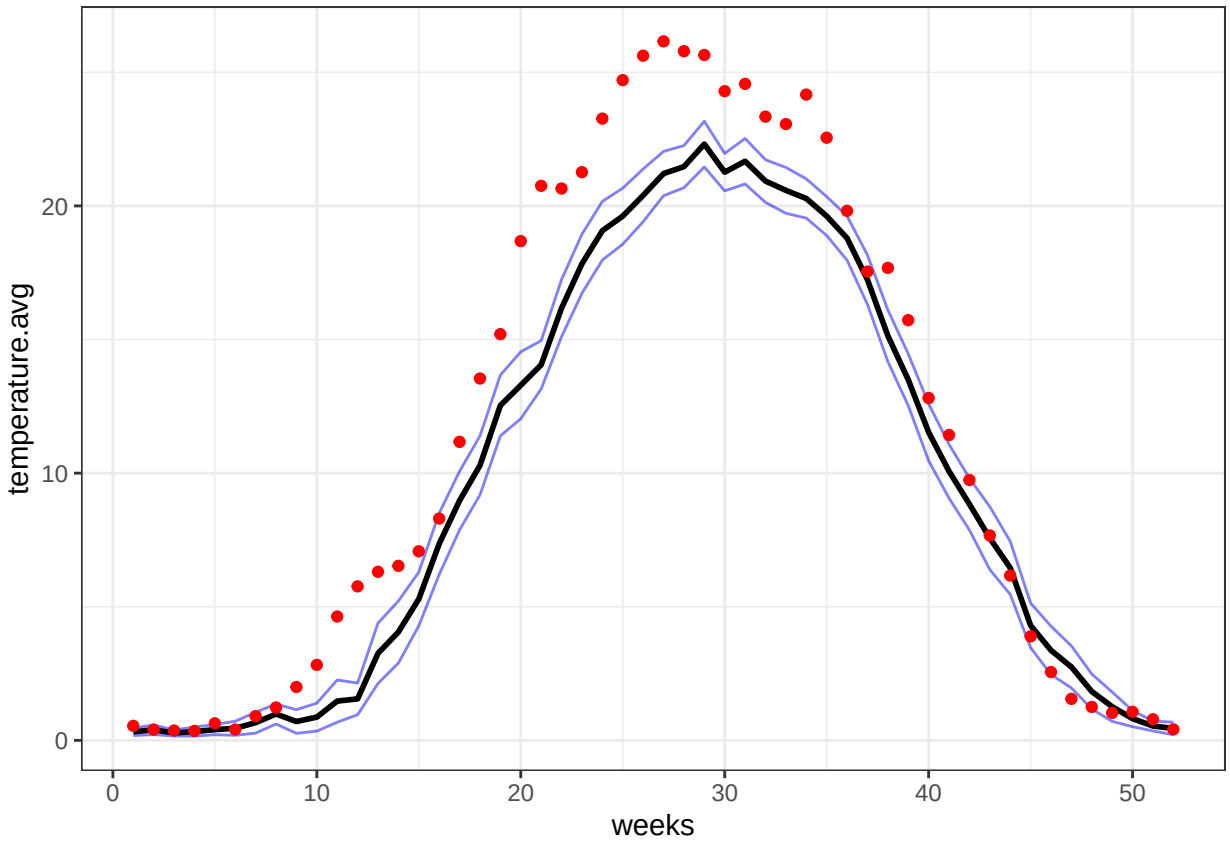
```
## [1] 1.850184
```

Fox River

```
# observed values
fox.field <- WT %>% filter(river == "fox")

# predicted values
fox.pred <- read.csv("water temperature clean/fox_model.csv")

## Plotting
ggplot(fox.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(fox.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.fox <- sqrt(mean((fox.field$temp - fox.pred$temperature.avg)^2))
RMSE.fox
```

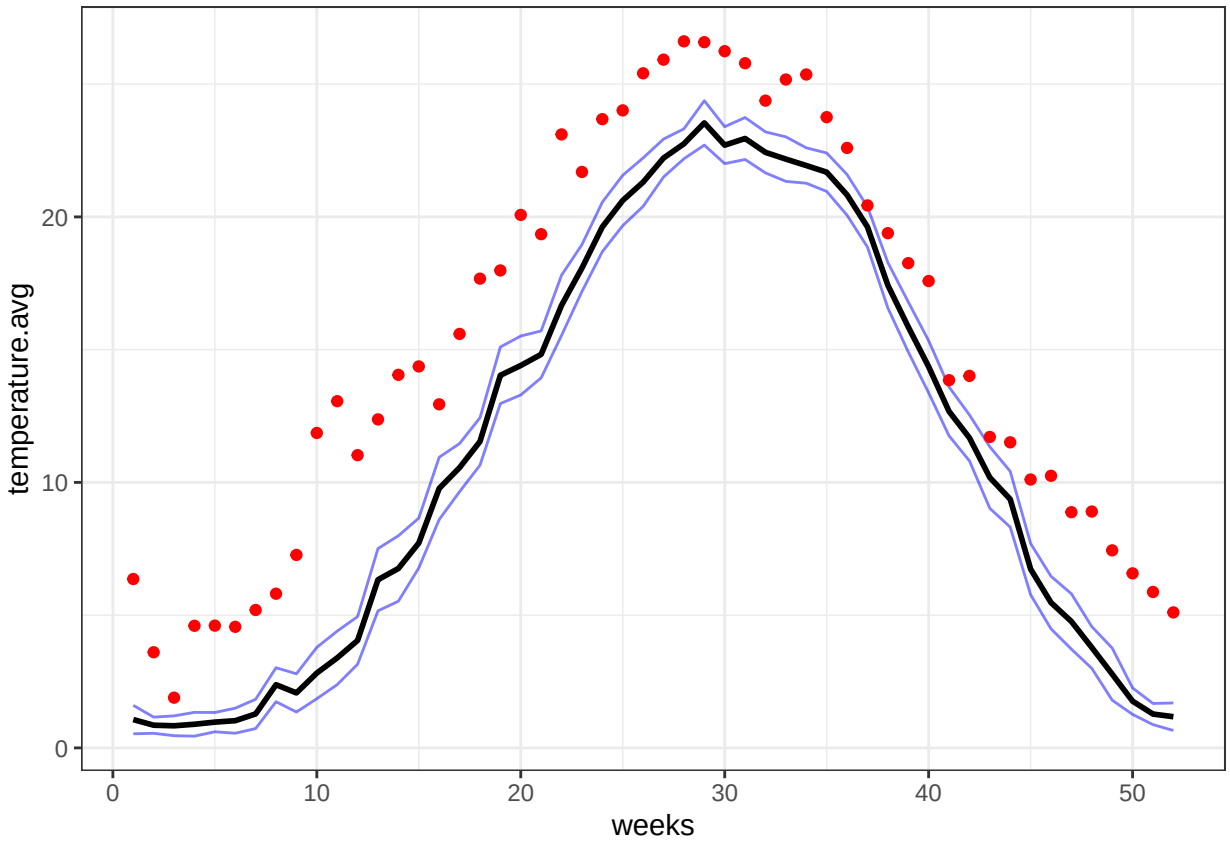
```
## [1] 2.701411
```

Portage-Burns Waterways

```
# observed values
pb.field <- WT %>% filter(river == "portage burns")

# predicted values
pb.pred <- read.csv("water temperature clean/pb_model.csv")

## Plotting
ggplot(pb.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(pb.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.pb <- sqrt(mean((pb.field$temp - pb.pred$temperature.avg)^2))
RMSE.pb
```

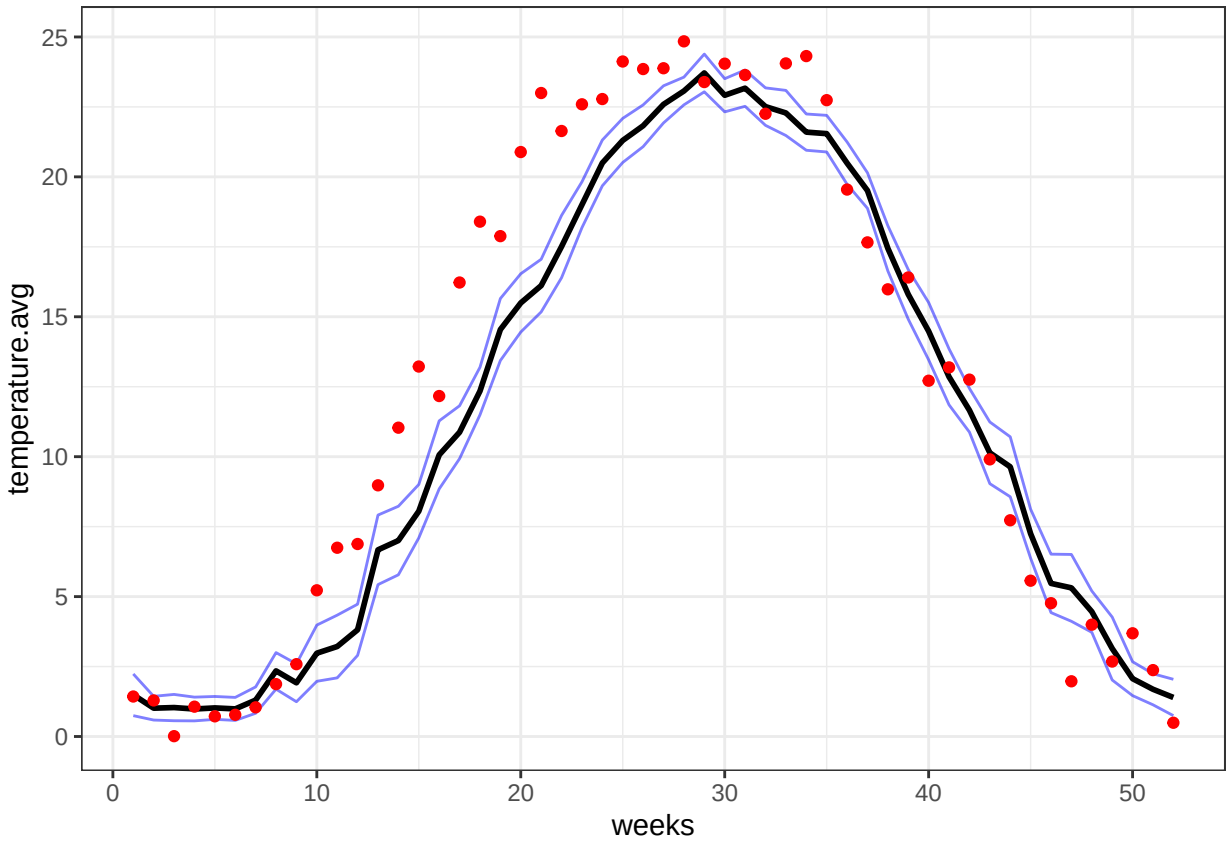
```
## [1] 4.412528
```

Vermilion River

```
# observed values
vermilion.field <- WT %>% filter(river == "vermilion")

# predicted values
vermilion.pred <- read.csv("water temperature clean/vermilion_model.csv")

## Plotting
ggplot(vermilion.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(vermilion.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.vermilion <-
  sqrt(mean((vermilion.field$temp - vermilion.pred$temperature.avg)^2))
RMSE.vermilion
```

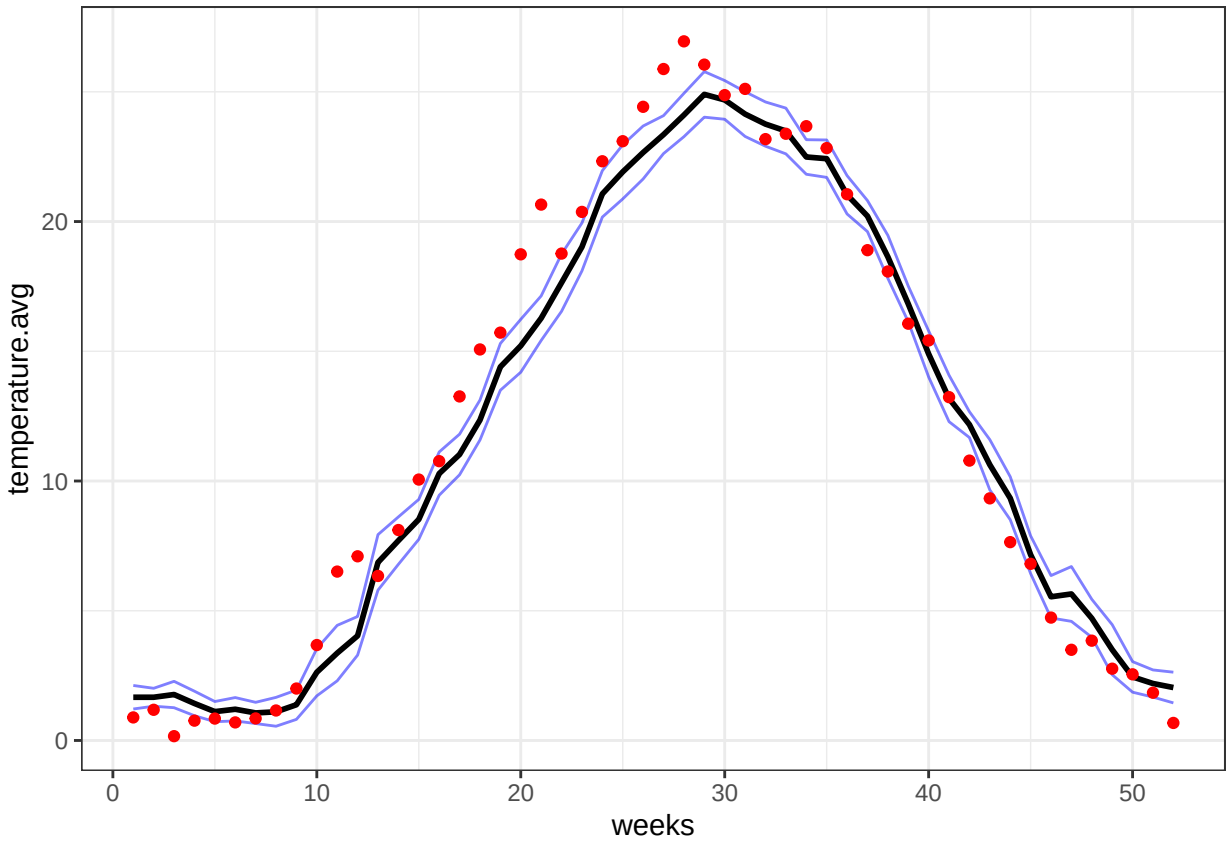
```
## [1] 2.534179
```

Genesee River

```
# observed values
genesee.field <- WT %>% filter(river == "genesee")

# predicted values
genesee.pred <- read.csv("water temperature clean/genesee_model.csv")

## Plotting
ggplot(genesee.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(genesee.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.genesee <- sqrt(mean((genesee.field$temp - genesee.pred$temperature.avg)^2))
RMSE.genesee
```

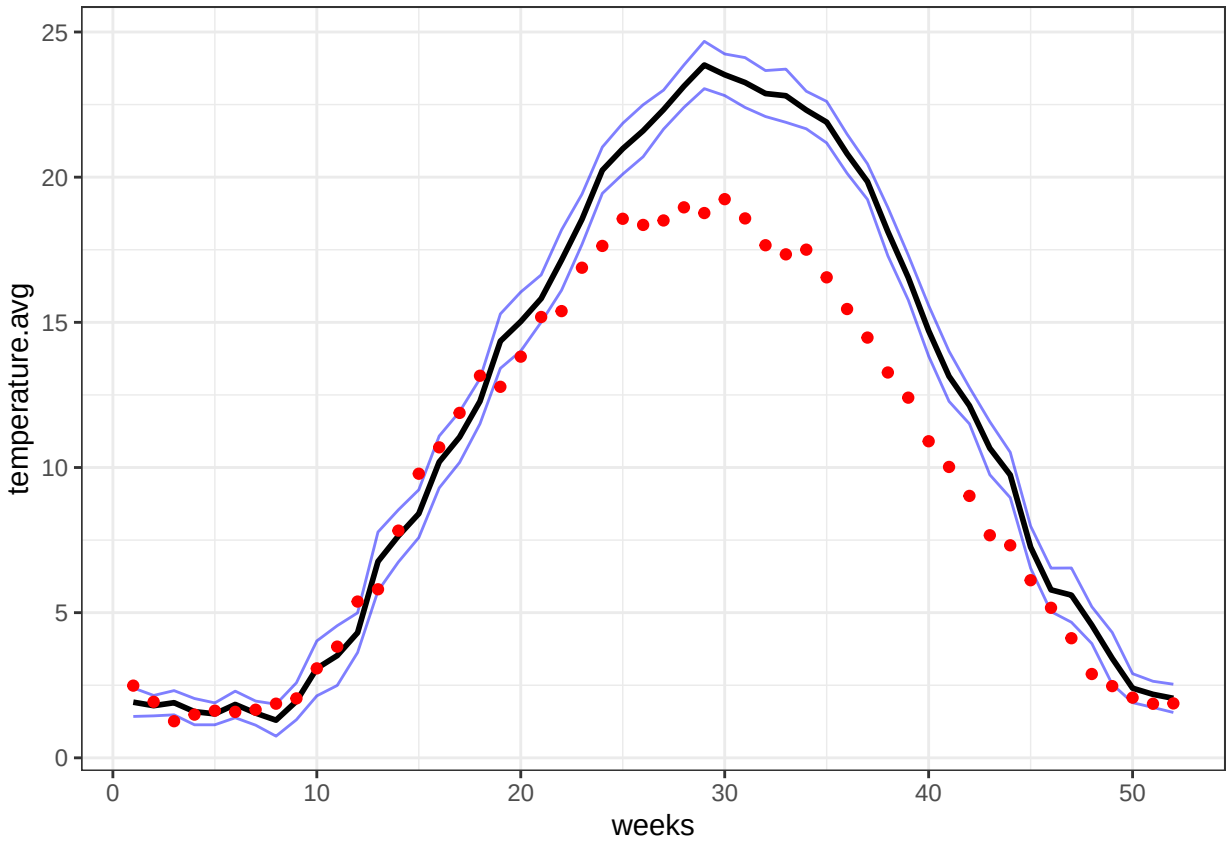
```
## [1] 1.516492
```

Big Creek River

```
# observed values
big.creek.field <- WT %>% filter(river == "bigcreek")

# predicted values
big.creek.pred <- read.csv("water temperature clean/bigcreek_model.csv")

## Plotting
ggplot(big.creek.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(big.creek.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.big.creek <-
  sqrt(mean((big.creek.field$temp - big.creek.pred$temperature.avg)^2))
RMSE.big.creek
```

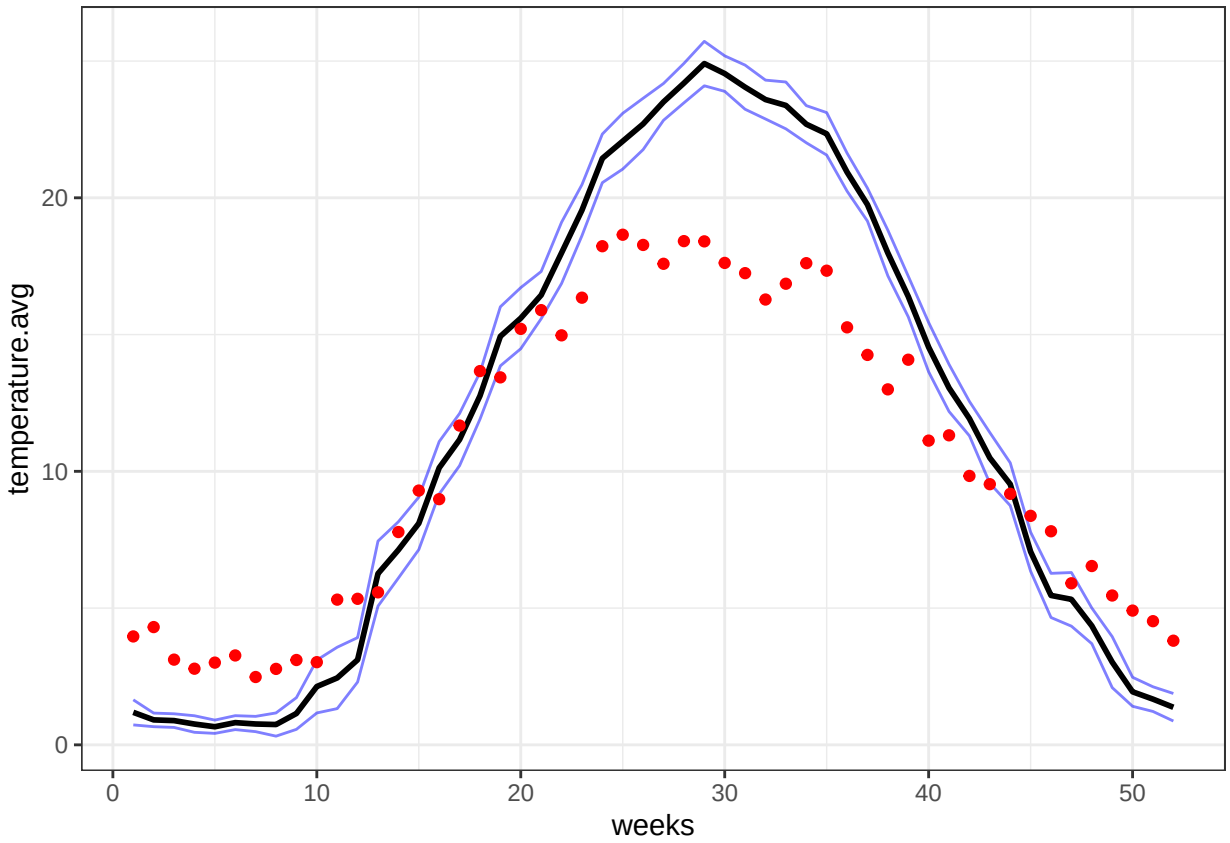
```
## [1] 2.780845
```

Big Otter River

```
# observed values
big.otter.field <- WT %>% filter(river == "bigotter")

# predicted values
big.otter.pred <- read.csv("water temperature clean/bigotter_model.csv")

## Plotting
ggplot(big.otter.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(big.otter.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.big.otter <-
  sqrt(mean((big.otter.field$temp - big.otter.pred$temperature.avg)^2))
RMSE.big.otter
```

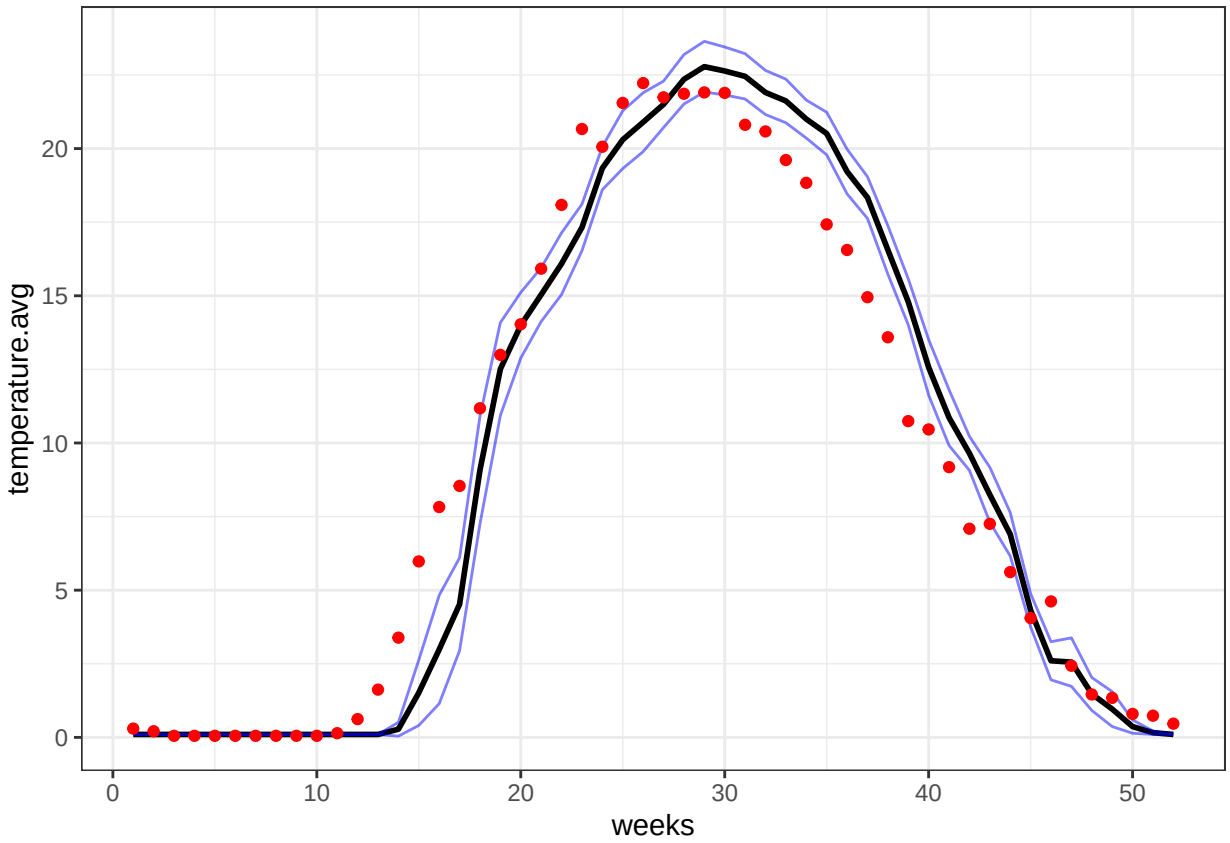
```
## [1] 3.503981
```

Still River

```
# observed values
still.field <- WT %>% filter(river == "still")

# predicted values
still.pred <- read.csv("water temperature clean/still_model.csv")

## Plotting
ggplot(still.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(still.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.still <- sqrt(mean((still.field$temp - still.pred$temperature.avg)^2))
RMSE.still
```

```
## [1] 1.88997
```

Mississagi River

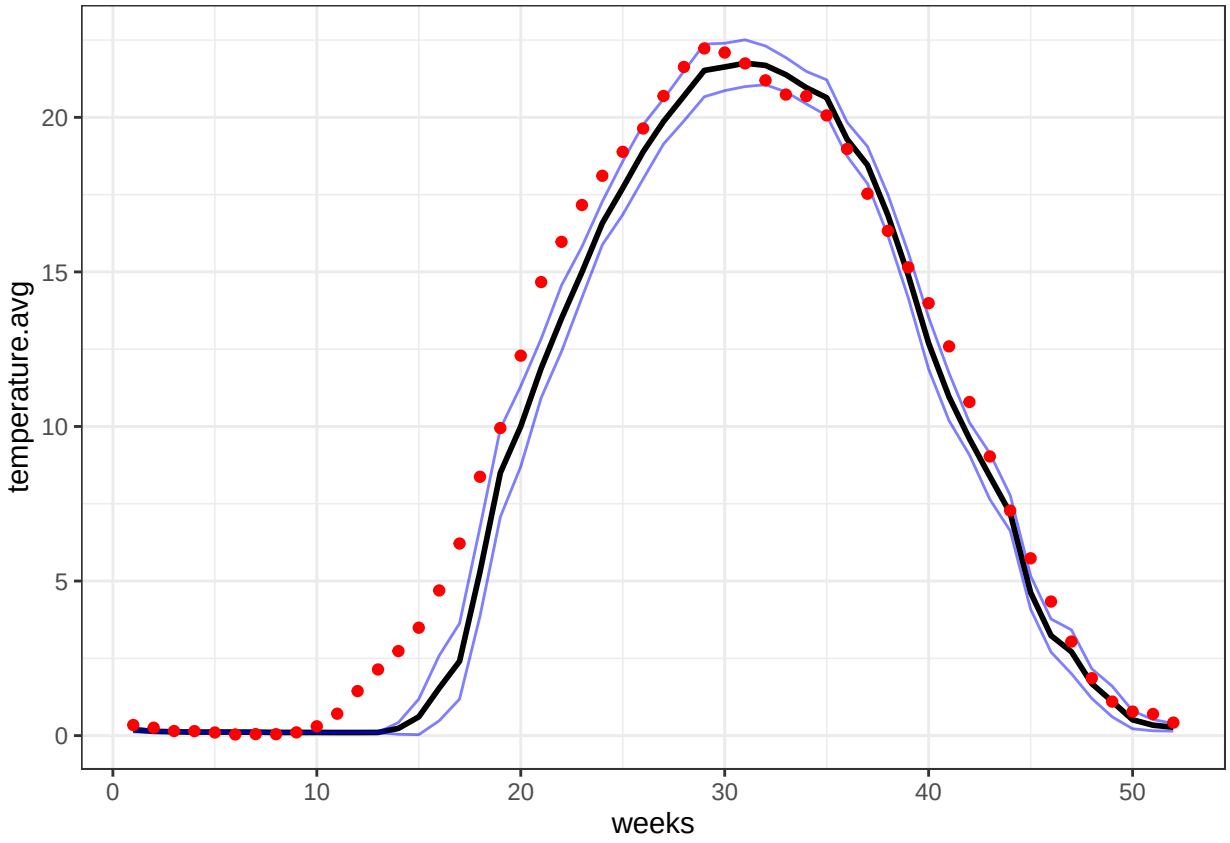
```
# observed values
mississagi.field <- WT %>% filter(river == "mississagi")
str(mississagi.field)
```

```
## 'data.frame':    52 obs. of  6 variables:
##  $ weeks: int  1 2 3 4 5 6 7 8 9 10 ...
##  $ temp : num  0.344 0.256 0.149 0.145 0.101 ...
##  $ river: Factor w/ 11 levels "bigcreek","bigotter",..: 6 6 6 6 6 6 6 6 6 6 ...
##  $ X    : logi  NA NA NA NA NA NA ...
##  $ X.1  : logi  NA NA NA NA NA NA ...
##  $ X.2  : logi  NA NA NA NA NA NA ...
```

```
# predicted values
mississagi.pred <- read.csv("water temperature clean/mississagi_model.csv")


## Plotting
ggplot(mississagi.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
```

```
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(mississagi.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.mississagi <-
  sqrt(mean((mississagi.field$temp - mississagi.pred$temperature.avg)^2))
RMSE.mississagi
```

```
## [1] 1.378092
```

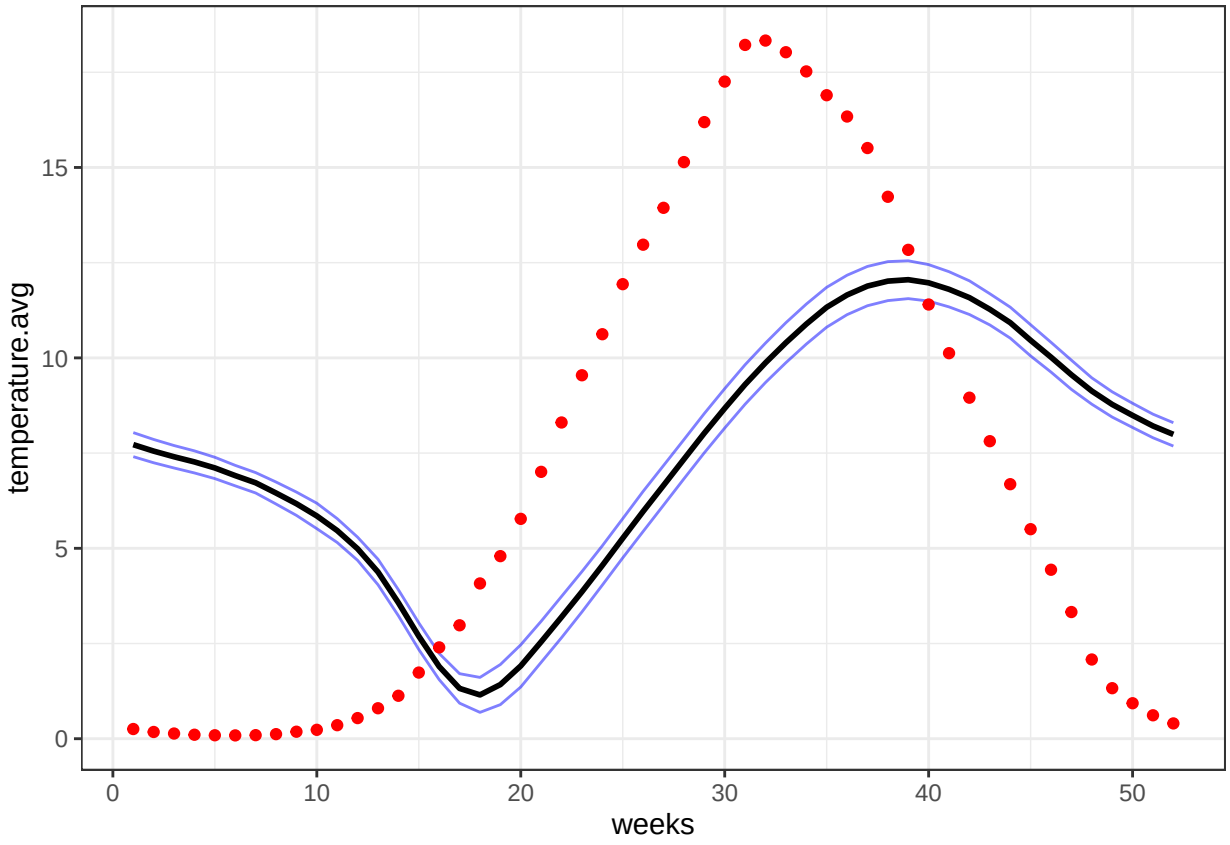
Nipigon River

```
# observed values
nipigon.field <- WT %>% filter(river == "nipigon")
str(nipigon.field)
```

```
## 'data.frame':    52 obs. of  6 variables:
##  $ weeks: int  1 2 3 4 5 6 7 8 9 10 ...
##  $ temp : num  0.2551 0.1772 0.1365 0.105 0.0912 ...
##  $ river: Factor w/ 11 levels "bigcreek","bigotter",..: 7 7 7 7 7 7 7 7 7 7 ...
##  $ X    : logi  NA NA NA NA NA NA ...
##  $ X.1  : logi  NA NA NA NA NA NA ...
##  $ X.2  : logi  NA NA NA NA NA NA ...
```

```
# predicted values
nipigon.pred <- read.csv("water temperature clean/nipigon_model.csv")

## Plotting
ggplot(nipigon.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(nipigon.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.nipigon <- sqrt(mean((nipigon.field$temp - nipigon.pred$temperature.avg)^2))
RMSE.nipigon
```

```
## [1] 5.825847
```

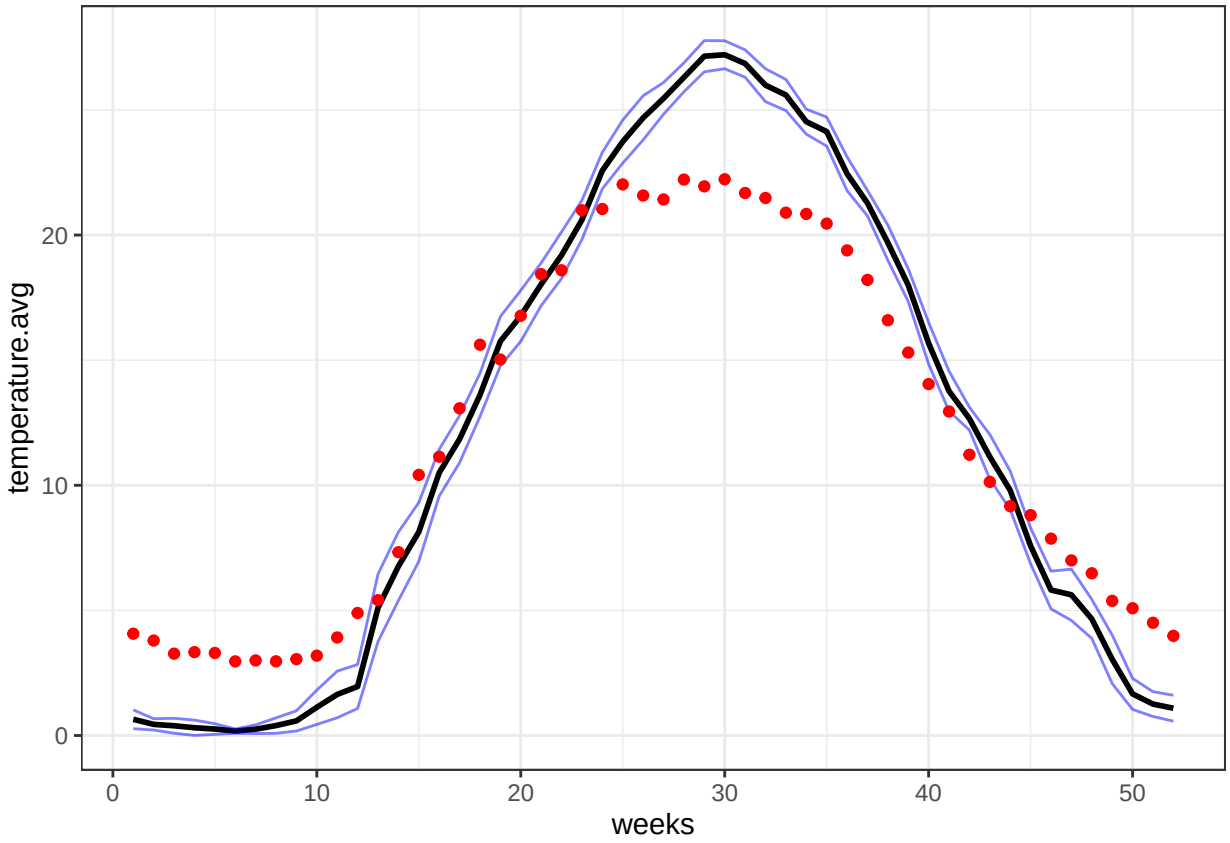
Humber River

```
# observed values
humber.field <- WT %>% filter(river == "humber")

# predicted values
humber.pred <- read.csv("water temperature clean/humber_model.csv")

## Plotting
```

```
ggplot(humber.pred, aes(x = weeks, y = temperature.avg))+
  geom_line(size = 1)+
  geom_line(aes(x = weeks, y = lower.CI), color = "blue", alpha = 0.5)+
  geom_line(aes(x = weeks, y = upper.CI), color = "blue", alpha = 0.5)+
  geom_point(humber.field, mapping = aes(x = weeks, y = temp), color = "red")+
  theme_bw()
```




```
## Calculate the Root Mean Square Error (RMSE)
RMSE.humber <- sqrt(mean((humber.field$temp - humber.pred$temperature.avg)^2))
RMSE.humber
```

```
## [1] 2.752697
```

Summary of RMSE for all locations

```
tri.location <- tri.location[tri.location$tributary.name != "Saginaw River",]

RMSE.summary <- data.frame(
  tributary = tri.location$tributary.name,
  lake = tri.location$corresponding.lake,
  RMSE = c(RMSE.st.louis, RMSE.fox, RMSE.pb, RMSE.vermilion, RMSE.genesee,
           RMSE.big.creek, RMSE.big.otter, RMSE.still, RMSE.mississagi,
           RMSE.nipigon, RMSE.humber)
)
kable(RMSE.summary)
```

tributary	lake	RMSE
St.Louis River	Superior	1.850184
Fox River	Michigan	2.701411
Portage-Burns Waterway	Michigan	4.412528
Vermilion River	Erie	2.534179
Genesee River	Ontario	1.516492
Big Creek River	Erie	2.780845
Big Otter Creek	Erie	3.503981
Still River	Huron	1.889970
Mississagi River	Huron	1.378092
Nipigon River	Superior	5.825847
Humber River	Ontario	2.752697