CherryBlssm_Pred

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Loading training data

```
cherry <- read.csv("data/washingtondc.csv") |>
  bind_rows(read.csv("data/liestal.csv")) |>
  bind_rows(read.csv("data/kyoto.csv")) |>
  bind_rows(read.csv("data/vancouver.csv")) |>
  bind_rows(read.csv("data/nyc.csv"))
```

Function to obtain weather data:

```
get_ghcn_station= function(station_id, destdir = tempdir()) {
  base_url= "https://www.ncei.noaa.gov/pub/data/ghcn/daily/by_station/"
    file_name= paste0(station_id, ".csv.gz")
    url= paste0(base_url, file_name)
    destfile= file.path(destdir, file_name)
    if (!file.exists(destfile)) {
      download.file(url, destfile, mode = "wb")
    }
    data=read.csv(destfile, header = FALSE)
    data=data[, -c(5:8)]
    data$Date=as.Date(as.character(data$V2), "%Y%m%d")
    data$Year=as.integer(format(data$Date, "%Y"))

    #Pivot to get vars as columns
    data_wide=data %>%
      select(Date, Year, V3, V4) %>%
      pivot_wider(
        names_from = V3,
        values_from = V4)

    # Calculate TAVG if TMAX and TMIN exist
    if (all(c("TMAX", "TMIN") %in% colnames(data_wide))) {
      data_wide= data_wide %>%
        mutate(TAVG = (TMAX + TMIN)/2)
    }

    # Keep only the desired elements
    elements_to_keep= c("TMIN", "TMAX", "TAVG", "PRCP")
    data_wide= data_wide %>%
      select(Date, Year, any_of(elements_to_keep))
```

```
    # Remove rows without both TMIN and TMAX
    data_wide= data_wide %>%
      filter(!is.na(TMIN) & !is.na(TMAX))

    return(data_wide)
}
```

Weather by location, putting it into one "daily" dataframe.

```
kyototemp=get_ghcn_station("JA000047759")
washdc=get_ghcn_station("USW00013743")
vancouvertemp=get_ghcn_station("CA001108395")
newyorkcity=get_ghcn_station("USW00014732")
liestaltemp=get_ghcn_station("SZ000001940")

#Adding a location variable for identification
kyototemp$location <- "kyoto"
liestaltemp$location <- "liestal"
newyorkcity$location <- "newyorkcity"
vancouvertemp$location <- "vancouver"
washdc$location <- "washingtondc"
```

```
library("rvest")
```

```
##
## Attaching package: 'rvest'

## The following object is masked from 'package:readr':
##
##     guess_encoding
```

```
AccuWeather <- read.csv("accuweather_forecast_2026.csv")


get_weather_table <- function(url)
  read_html(url) %>%
  html_nodes("div.monthly-calendar") %>%
  html_text2() %>%
  str_replace("N/A", "N/A N/A") %>%
  str_remove_all("°|Hist. Avg. ") %>%
  str_split(" ", simplify = TRUE) %>%
  parse_number() %>%
  matrix(ncol = 3,
         byrow = TRUE,
         dimnames = list(NULL, c("day", "tmax", "tmin"))) %>%
  as_tibble() %>%
  filter(row_number() >= day) %>%
  filter(!duplicated(day))

vancouver2025 <-
  tibble(
    base_url = "https://web.archive.org/web/20260224/https://www.accuweather.com/en/us/vancouver/98661/
```

```
    month = month.name[10:12],
    year = 2025,
    url = str_c(base_url, tolower(month), "-weather/331419?year=", year)) %>%
  mutate(temp = map(url, get_weather_table)) %>%
  pull(temp) %>%
  reduce(bind_rows) %>%
  transmute(date = seq(as.Date("2025-10-01"), as.Date("2025-12-31"), 1),
            year = parse_number(format(date, "%Y")),
            tmax,
            tmin,
            temp = (tmax + tmin) / 2)

vancouver2026<-
  tibble(
    base_url = "https://web.archive.org/web/20260224/https://www.accuweather.com/en/us/vancouver/98661/
    month = month.name[1:2],
    year = 2026,
    url = str_c(base_url, tolower(month), "-weather/331419?year=", year)) %>%
  mutate(temp = map(url, get_weather_table)) %>%
  pull(temp) %>%
  reduce(bind_rows) %>%
  transmute(date = seq(as.Date("2026-01-01"), as.Date("2026-02-28"), 1),
            year = parse_number(format(date, "%Y")),
            tmax,
            tmin,
            temp = (tmax + tmin) / 2)

vancouver_binded <- vancouver2025 %>%
  bind_rows(vancouver2026)   %>%
  mutate(
    Date = as.Date(date),
    year = year(Date),
    TMIN = tmin,
    TMAX = tmax,
    TAVG = temp,
    PRCP = NA,
    location = "vancouver",
    month = month(Date),
    bloom_year = ifelse(month >= 10, year + 1, year)
  ) %>%
  select(-date, -tmin, -tmax, -temp)
```

```
#Now putting them all into one file
Cherry_day <- bind_rows(kyototemp,liestaltemp, newyorkcity, vancouvertemp, washdc) %>%
  rename(year = Year)%>% #to match with the original cherry year label
  mutate(Date = as.Date(Date),
         year = as.numeric(format(Date, "%Y")),
         month = as.numeric(format(Date, "%m")),
         bloom_year = ifelse(month >= 10, year+1, year)
         )

#Adding on the vancouver weather data from this year
Cherry_day <- bind_rows(Cherry_day, vancouver_binded)
```

Adding precipitation counter, I wanted to capture the rain accumulation over a week, as an inch per week is considered ideal for cherry tree growth and health. This is also where I had to start collapsing each individual day's min/max/average temperature, in order to start looking at things more broadly. Because this is only looking at data starting in October until February, I was not expecting a lot of really hot weather to begin with, but I wasn't counting out the possibility.

```
#To filter things weekly ###
Cherry_week <- Cherry_day %>%
  filter(month >= 10 | month <= 2) %>%
  mutate(week = isoweek(Date)
  ) %>%
  group_by(location, bloom_year, week) %>%
  summarise(
    weekly_PRCP = sum(PRCP,na.rm = TRUE),
    mean_TAVG   = mean(TAVG),
    min_TAVG    = min(TAVG),
    max_TAVG    = max(TAVG),
    .groups = "drop"
  ) %>%
  mutate(
    PRCP_indicator    = ifelse(weekly_PRCP > 254, 1, 0),  # > 254 tenths of mm, as is meausured by data
    TooCold_indicator = ifelse(min_TAVG < -29, 1, 0), #more important if it's been too cold for an enti
    TooHot_indicator  = ifelse(max_TAVG > 29, 1, 0)
  )
```

Now to make our data usable in the model and prediction, collapsing and summarizing it into a year in order to match the original "cherry" format.

```
Cherry_Year <- Cherry_week %>%
  group_by(location,bloom_year) %>%
  summarize(
    precipitation = sum(PRCP_indicator),
    avg_TMAX = mean(max_TAVG),
    avg_TMIN = mean(min_TAVG),
    AVG = mean(mean_TAVG),
    TooCold = sum(TooCold_indicator),
    TooHot = sum(TooHot_indicator),
    .groups = "drop"
) %>%
  #select(-year) %>%
  rename(year = bloom_year ) %>%
  mutate(precipitation = replace_na(precipitation, 0))
```

Model

The too hot indicator was insignificant due to it being fall and winter time during our windowed time frame. It's very unlikely that any of these locations would have a week or more long heatwave, but there is always the possibility.

```
model1<- cherry |>
  left_join(Cherry_Year,
            by = c("location", "year")) |>
  lm(formula = bloom_doy ~ year * location +  AVG + TooCold+TooHot +precipitation )
```

```r
summary(model1)
```

```
##
## Call:
## lm(formula = bloom_doy ~ year * location + AVG + TooCold + TooHot +
##     precipitation, data = left_join(cherry, Cherry_Year, by = c("location",
##     "year")))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -22.9175  -4.1267   0.0169   4.6572  18.2862
##
## Coefficients: (1 not defined because of singularities)
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 2.989e+02  9.522e+01   3.139  0.00188 **
## year                       -9.493e-02  4.814e-02  -1.972  0.04964 *
## locationliestal            -1.789e+01  1.018e+02  -0.176  0.86069
## locationnewyorkcity        -7.748e+00  8.050e+00  -0.963  0.33663
## locationvancouver          -2.383e+03  9.180e+03  -0.260  0.79536
## locationwashingtondc       -1.001e+02  1.188e+02  -0.842  0.40030
## AVG                        -1.250e-01  5.990e-02  -2.087  0.03785 *
## TooCold                     9.543e-01  3.000e-01   3.181  0.00164 **
## TooHot                     -2.713e-02  2.820e-01  -0.096  0.92342
## precipitation              -1.187e-01  2.322e-01  -0.511  0.60955
## year:locationliestal        4.499e-03  5.148e-02   0.087  0.93041
## year:locationnewyorkcity           NA         NA      NA       NA
## year:locationvancouver      1.173e+00  4.537e+00   0.259  0.79618
## year:locationwashingtondc   4.451e-02  5.990e-02   0.743  0.45813
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.501 on 274 degrees of freedom
##   (790 observations deleted due to missingness)
## Multiple R-squared:  0.3898, Adjusted R-squared:  0.363
## F-statistic: 14.58 on 12 and 274 DF,  p-value: < 2.2e-16
```

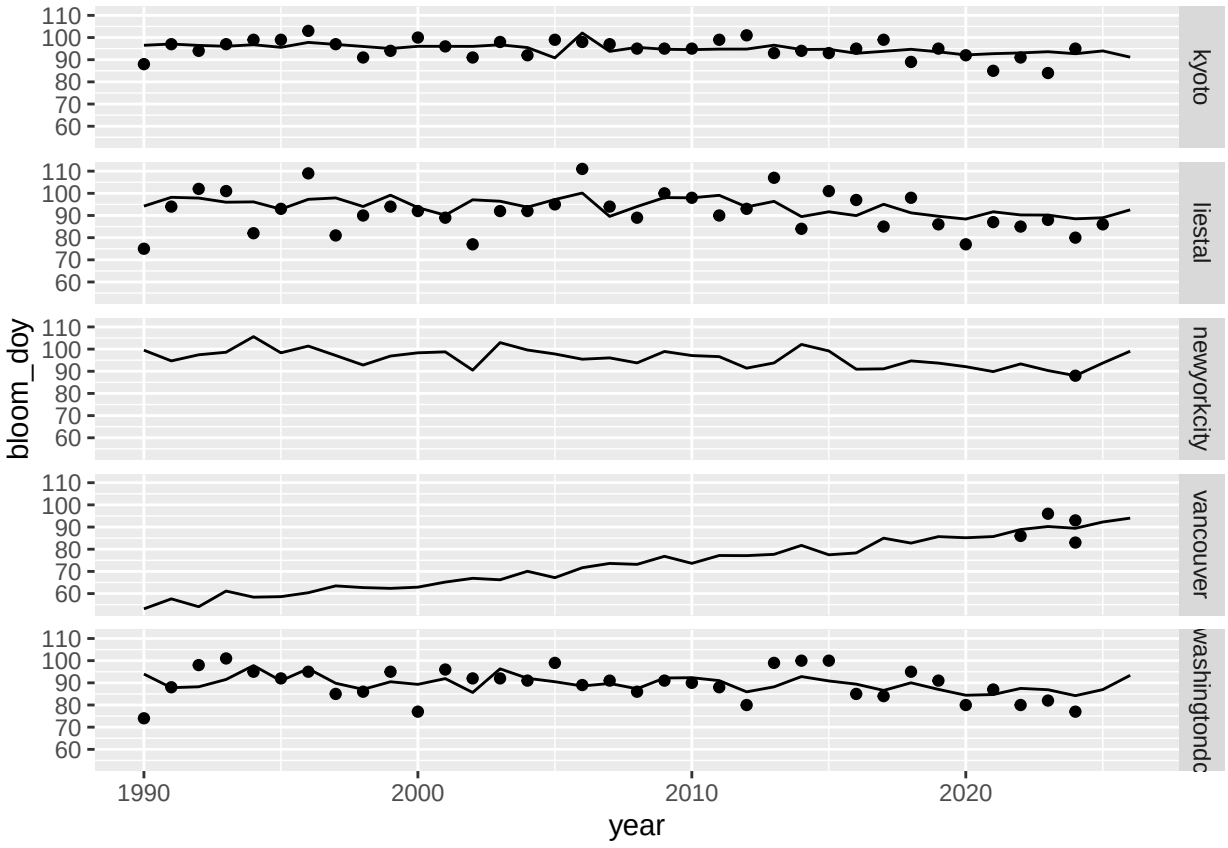
```r
###TEST PREDICTIONS
cherry_gridTEST <- expand_grid(location = unique(cherry$location),
                               year = 1990:2026) |>
  inner_join(Cherry_Year,
             by = c("location", "year"))

predictions2 <- cherry_gridTEST |>
  mutate(pred_bloom = predict(model1, newdata = cherry_gridTEST))
```

```
## Warning: There was 1 warning in `mutate()`.
## i In argument: `pred_bloom = predict(model1, newdata = cherry_gridTEST)`.
## Caused by warning in `predict.lm()`:
## ! prediction from rank-deficient fit; attr(*, "non-estim") has doubtful cases
```

```
predictions2 |>
  left_join(cherry,
            by = c("location", "year")) |>
  ggplot(aes(x = year)) +
  geom_point(aes(y = bloom_doy)) +
  geom_line(aes(y = pred_bloom)) +
  facet_grid(rows = vars(location))
```

```
## Warning: Removed 75 rows containing missing values or values outside the scale range
## (`geom_point()`).
```



Submission

```
predictions2 |>
  filter(year == 2026) |>
  mutate(predicted_date= strptime(paste(year,pred_bloom), "%Y %j") |>
           as_date())
```

```
## # A tibble: 5 x 10
##   location  year precipitation avg_TMAX avg_TMIN   AVG TooCold TooHot pred_bloom
##   <chr>    <dbl>         <dbl>    <dbl>    <dbl> <dbl>   <dbl>  <dbl>      <dbl>
## 1 washing~  2026             4    103.      27.4  64.5       6     19       93.4
```

```
## 2 liestal   2026             3     87.1     33.6  58.8       3     16       92.6
## 3 kyoto     2026             0    150.      92.4 120.       0     18       91.1
## 4 vancouv~  2026             0     45.5     41.6  43.5       0     22       94.0
## 5 newyork~  2026             5     86.6     13.7  50.6       8     19       99.0
## # i 1 more variable: predicted_date <date>
```

Predicted bloom dates as of 02/27/2026

DC: 04/03/2026

Liestal: 04/02/2026

Kyoto: 04/01/2026

Vancouver: 04/04/2026

NYC: 04/08/2026

The Vancouver problem. For some reason the Vancouver station has no reported any weather data since august of 2025, and since my model is specifically built from October to present day, that is a big no-no. To navigate this, I'll be using the basic accuweather data provided by our professor and essentially just doing what the demo analysis does, but only using January - now to predict bloom date. It's not ideal, however I feel a little more comfortable doing this since in my larger model precipitation was not found to be significant, and I can still track when the trees are exposed to temperatures that are detrimental to bloom.