

Forest Carbon Codefest data skills example

Create a graphic with statistics from Monitoring Trends in Burn Severity (MTBS) perimeters

CU Boulder CIRES Earth Lab

A basic level of coding ability will be required to attend the Forest Carbon Codefest, such that any given participant can (in the coding language of their choosing): i) open and plot tabular and geospatial data, ii) compute summary statistics or create basic statistical models, and iii) create simple data visualizations.

Not sure what that means? This markdown contains a few example graphics; you should be able to create something similar, if given the appropriate data. Note that while this example is in R, similar ability in any coding language is sufficient!

SETUP

```
#Check the required libraries and download if needed
list.of.packages <- c("tidyverse",
                      "terra",
                      "sf",
                      "tmap",
                      "here",
                      "mblm", #Median-based linear models (i.e. thielsen)
                      "tigris", #US data
                      "scales", #add commas to ggplot axis
                      "tinytex")
new.packages <- list.of.packages[!(list.of.packages %in% installed.packages()[, "Package"])]
if(length(new.packages)) install.packages(new.packages)

invisible(lapply(list.of.packages, library, character.only = TRUE)) #apply library function to all packages
```

Read in MTBS & manipulate

```
#Read in MTBS data, ensure valid, add burn year
mtbsPerims <- sf::st_read("C:/Users/tyler/OneDrive - UCB-0365/dev/fast-fires/data/mtbs_perimeter_data_1"
                           st_transform(st_crs(4269)) #Data from https://www.mtbs.gov/

head(mtbsPerims)

#Get burn year for each polygon and the burn area in hectares instead of acres
mtbsPerims <- mtbsPerims %>%
  dplyr::mutate(Burn_Yr = year(as.Date(Ig_Date))) %>%
  dplyr::mutate(BurnHa = BurnBndAc * 0.404686) %>%
  sf::st_make_valid()

#Ensure polygon validity
sf::st_is_valid(mtbsPerims) %>% unique()
```

```

#Get shapefiles for the US
# Fetch all US states
usa <- tigris::states() %>%
  st_transform(st_crs(4269))

# Filter for contiguous states (excluding Alaska and Hawaii)
conus <- usa[usa$STUSPS %in% c("WA", "ID", "MT", "ND", "MN", "MI", "ME", "WI", "VT", "NH", "NY", "SD", "ND", "MN", "SD", "WY", "CO", "NM", "UT", "HI")]

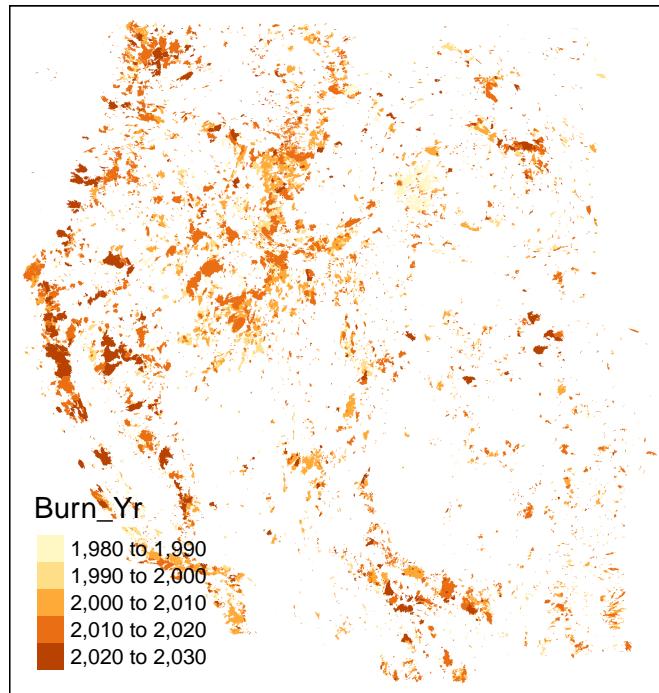
west <- usa[usa$STUSPS %in% c("WA", "OR", "CA", "ID", "MT", "WY", "NV", "AZ", "CO", "NM", "UT"),]

#Filter perimeters to just include the area we want
mtbsPerimsWest <- sf::st_filter(mtbsPerims, west)

#Plot the perimeters (could use mapview library here if wanted an interactive visual)
tmap::tm_shape(mtbsPerimsWest) +
  tmap::tm_fill(col = "Burn_Yr") +
  tmap::tm_layout(main.title = "MTBS Perimeters in the \nWestern U.S. by Burn Year")

```

MTBS Perimeters in the Western U.S. by Burn Year



Create summaries of MTBS data and plot

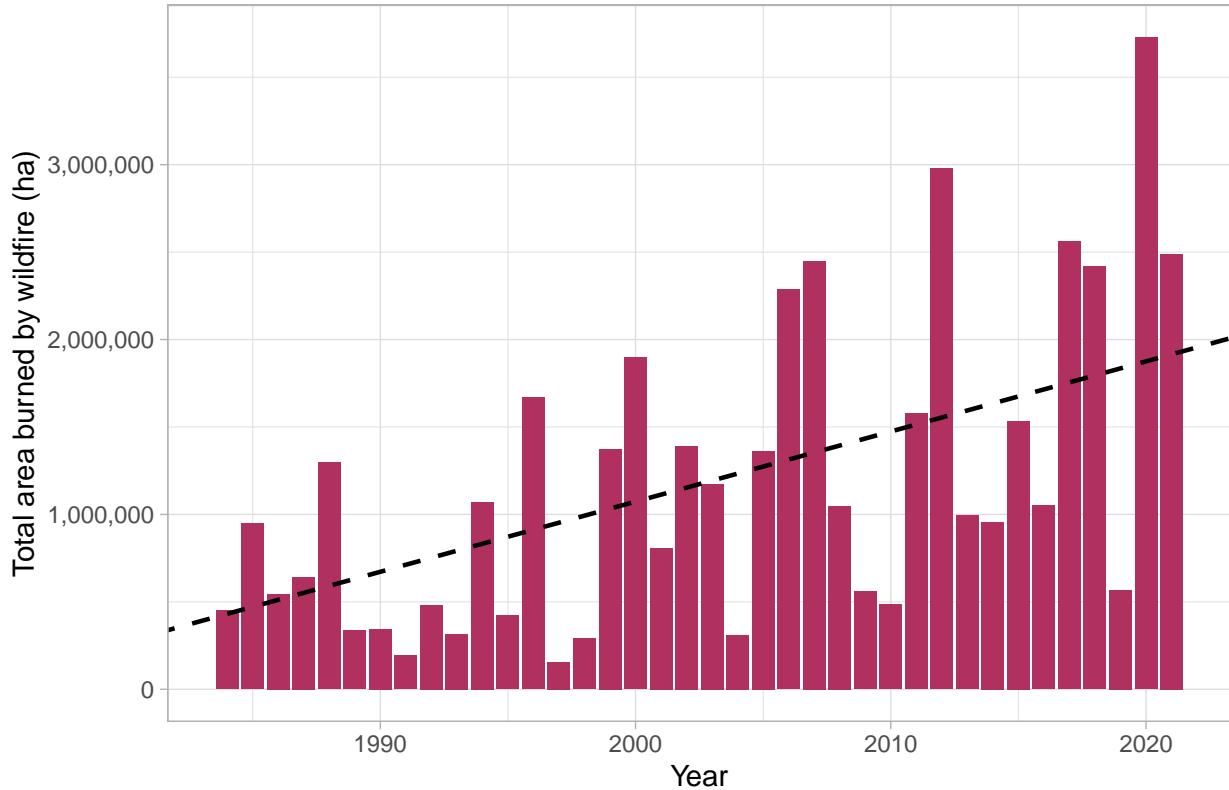
```
#summarize burned area by hectares
get.wildfire.burn.ha.summary <- function(perims) {
  burnedAc <- perims %>%
    filter(Incid_Type == "Wildfire") %>%
    select(Burn_Yr, BurnHa) %>%
    as.data.frame() %>%
    group_by(Burn_Yr) %>%
    summarise(totBurnHa = sum(BurnHa))
  return(burnedAc)
}

#Get summary stats
westBurned <- get.wildfire.burn.ha.summary(mtbsPerimsWest)

#Get theil-sen fits and graph
theilSenFitWest <- mblm::mblm(totBurnHa ~ Burn_Yr, westBurned, repeated = FALSE)

#Plot and add Theil-Sen fit line to graph
ggplot(westBurned, aes(x = Burn_Yr, y = totBurnHa)) +
  geom_col(fill = "maroon") +
  labs(title = "Western U.S. Burned Area 1984-2021") +
  xlab("Year") +
  ylab("Total area burned by wildfire (ha)") +
  scale_y_continuous(labels=comma) +
  geom_abline(intercept = theilSenFitWest$coefficients[["(Intercept)"]],
             slope = theilSenFitWest$coefficients["Burn_Yr"],
             linetype = "dashed",
             linewidth = 0.8) +
  theme_light()
```

Western U.S. Burned Area 1984–2021



Estimator coefficients and significance

```
#Get estimator significance
summary.mblm(theilSenFitWest)

##
## Call:
## mblm::mblm(formula = totBurnHa ~ Burn_Yr, dataframe = westBurned,
##             repeated = FALSE)
##
## Residuals:
##      Min       1Q     Median       3Q      Max 
## -1266116 -507636        0  549140 1852959 
## 
## Coefficients:
##             Estimate      MAD V value Pr(>|V|)    
## (Intercept) -79144301 808996    0 8.05e-08 ***
## Burn_Yr      40109   87280  175488 < 2e-16 ***
## ---        
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 726000 on 36 degrees of freedom
```