

Forest Carbon Codefest data skills example

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

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However, 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.

This markdown contains examples of a few graphics that participants would be expected to be able to create at the beginning of the Forest Carbon Codfest, as well as an example of the code used to create them.

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 packa
```

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", "IA", "MO", "KS", "OK", "TX", "CO", "NM", "UT", "AZ", "NV", "CA", "OR", "WA"),]

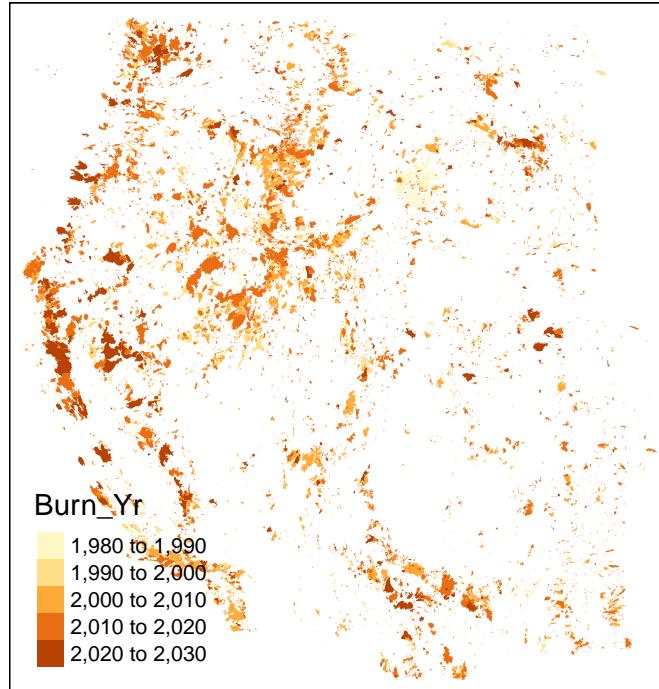
west <- usa[usa$STUSPS %in% c("WA", "OR", "CA", "ID", "MT", "WY", "NV", "AZ", "CO", "NM", "UT"),]

#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

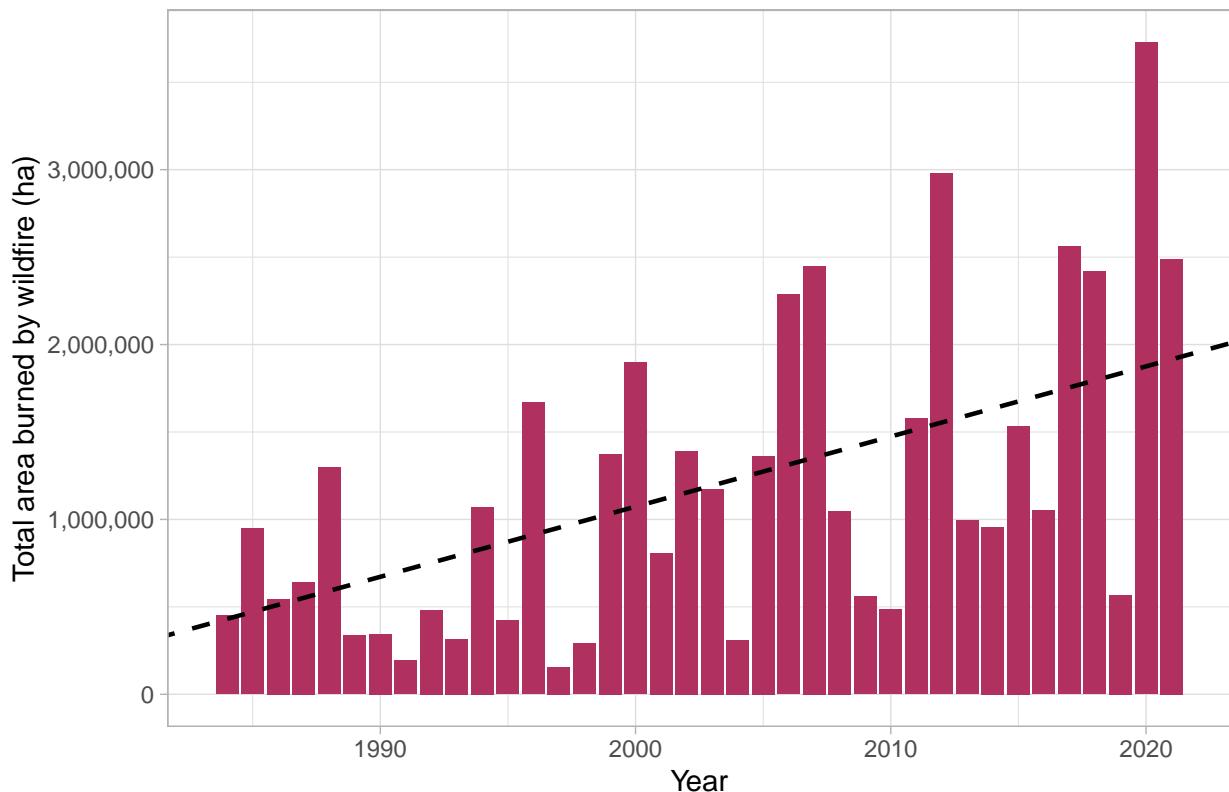
```
#summarize burned area by hectares
get.wildfire.burn.ha.summary <- function(perims) {
  burnedAc <- perims %>%
    filter(Incid_Type == "Wildfire") %>%
    select(Burn_Yr, BurnHa) %>%
    as.data.frame() %>%
    group_by(Burn_Yr) %>%
    summarise(totBurnHa = sum(BurnHa))
  return(burnedAc)
}

#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
```