

Utah Car Accidents Data and Code

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Load Libraries and Data file

```
# For Data Cleaning and Visualization
library("dplyr")

## Warning: package 'dplyr' was built under R version 4.1.1
##
## 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("tigris")

## Warning: package 'tigris' was built under R version 4.1.1
## To enable
## caching of data, set `options(tigris_use_cache = TRUE)` in your R script or .Rprofile.
library("ggplot2")

## Warning: package 'ggplot2' was built under R version 4.1.1
library("sf")

## Warning: package 'sf' was built under R version 4.1.1
## Linking to GEOS 3.9.1, GDAL 3.2.3, PROJ 7.2.1; sf_use_s2() is TRUE
crash <- read.csv("../data-raw/RawCrashData2020.csv")
stations <- read.csv("../data-raw/i_15_Flow_Data_2020.csv")
```

Data Prepping

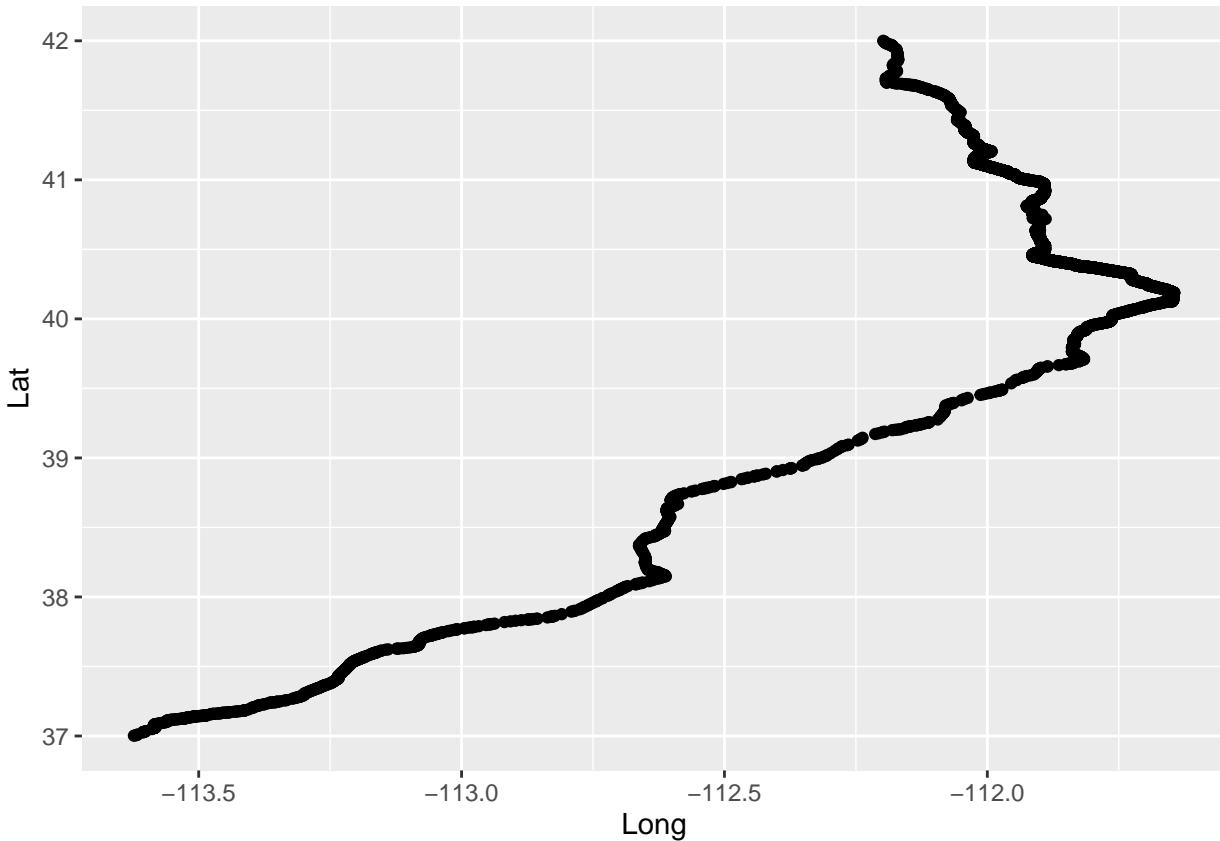
Car Accidents

```
# subset to retain only potentially useful information
# Route: I-15 Highway route
# milepoint: Milepoint of accident
# Coords: Lat and Long

crash_i15 <- crash %>%
```

```
dplyr::filter(Route == "0015") %>%
dplyr::select(., Lat, Long)
```

```
# Basic plot of points of accidents
ggplot() +
  geom_point(
    data = crash_i15,
    aes(x = Long, y = Lat)
  )
```

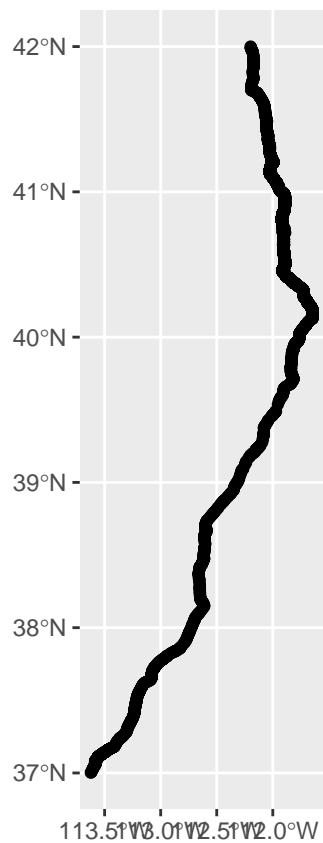


```
# Sf with NAD83 matches CRS of Utah map and Roads
```

```
i15_spat <- sf::st_as_sf(
  x = crash_i15,
  coords = c("Long", "Lat"),
  crs = 4269
)
```

```
# Plot of spatial object crashes
```

```
crash_plot <- ggplot(i15_spat) +
  geom_sf()
crash_plot
```



Roads

https://www2.census.gov/geo/pdfs/maps-data/data/tiger/tgrshp2020/TGRSHP2020_TechDoc.pdf

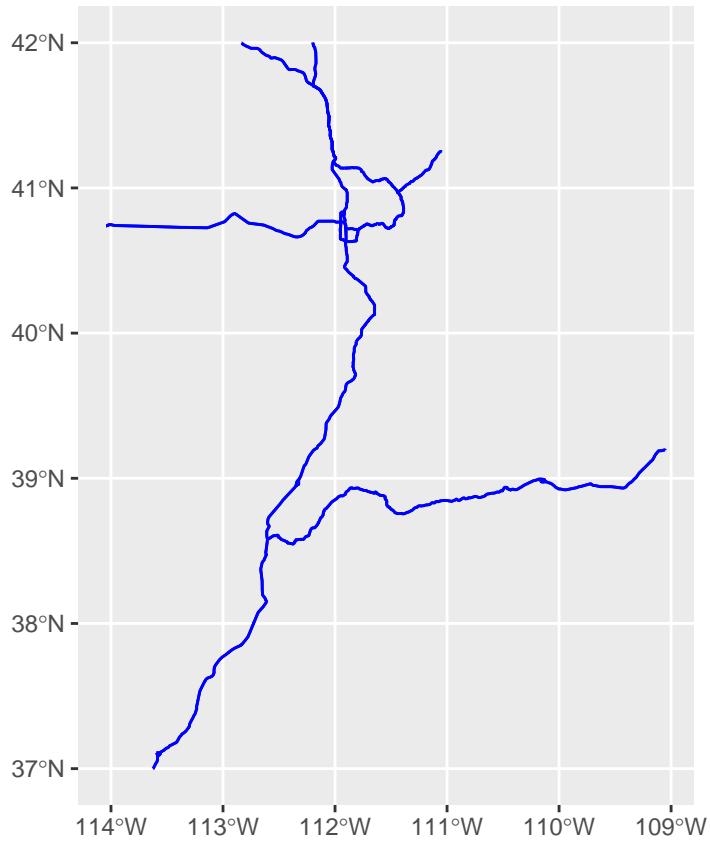
Link: Census.gov information on Tigris shapefiles

Important: Original CRS = NAD83

```
# subset of Interstates in Utah
roads <- tigris::primary_secondary_roads("Utah") %>%
  dplyr::filter(RTTYPE %in% c("I"))

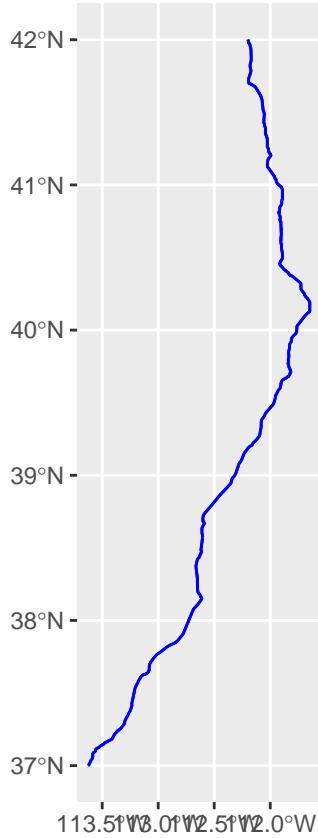
## | 

# plot of ALL Interstates in Utah (Utah not fitted)
ggplot() +
  geom_sf(
    data = roads,
    color = "blue",
    aes(geometry = geometry)
  )
```



```
# subset of I-15 and convert to MultiLineString
roads_i15 <- roads[which(roads$FULLNAME == "I- 15"), ] %>%
  sf::st_cast(., "MULTILINESTRING")
```

```
# plot of i-15 in Utah (Interstate only)
road_plot <- ggplot() +
  geom_sf(
    data = roads_i15,
    color = "blue",
    aes(geometry = geometry)
  )
road_plot
```

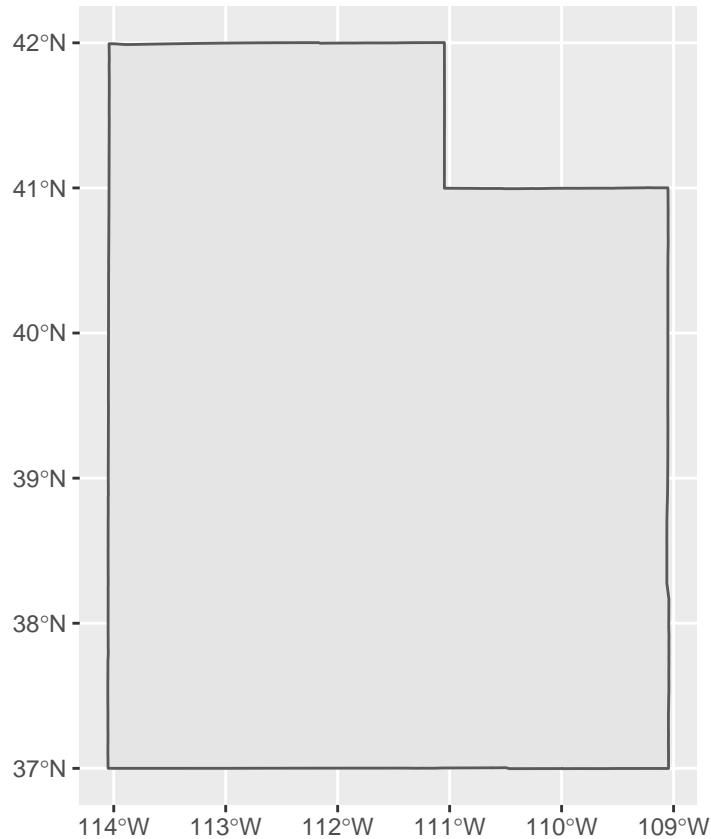


Utah

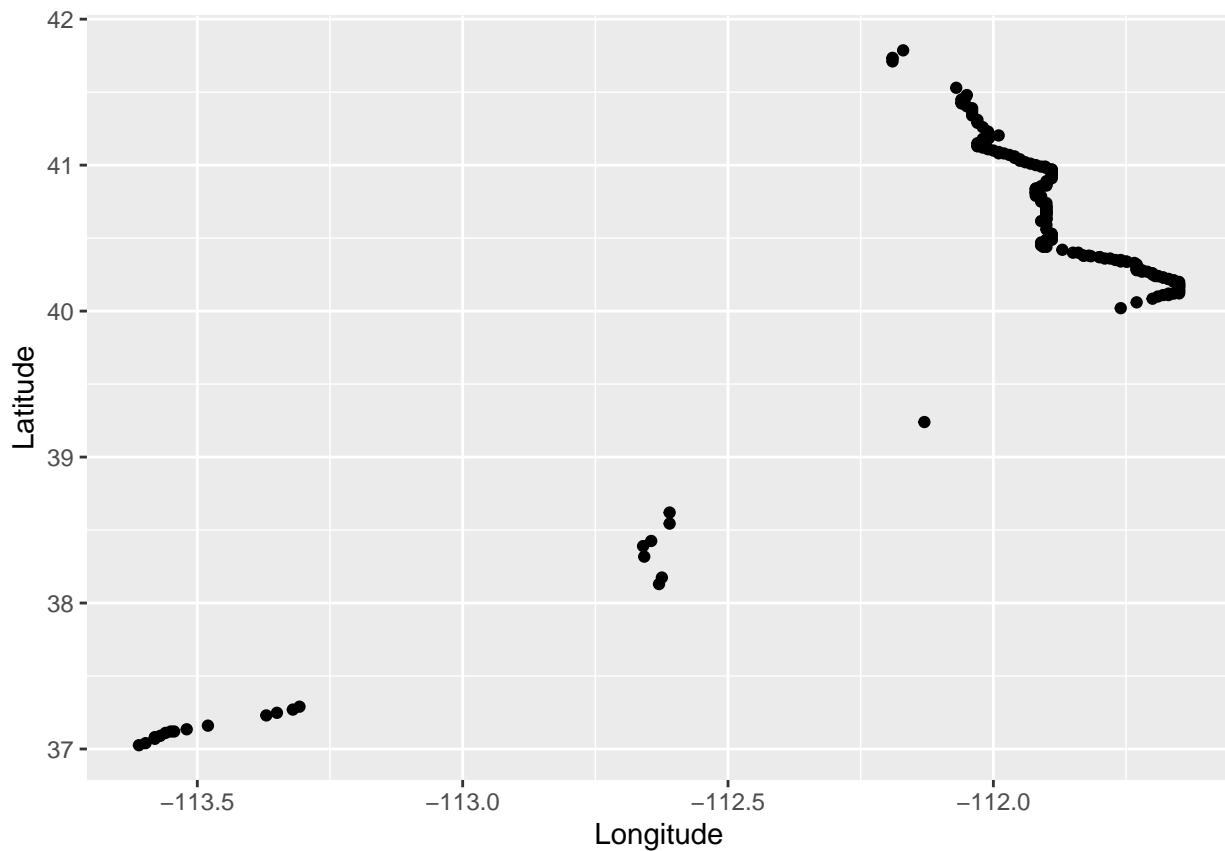
```
# sf of USA
us_geo <- tigris::states(class = "sf", cb = TRUE) %>%
  shift_geometry()

## | 
# Subsetting to Utah and changing crs to match roads in Utah
ut_map <- us_geo[which(us_geo$NAME == "Utah"), ] %>%
  st_transform(., crs = st_crs(roads_i15))

# plot of Utah
ut_plot <- ggplot(ut_map) +
  geom_sf()
ut_plot
```

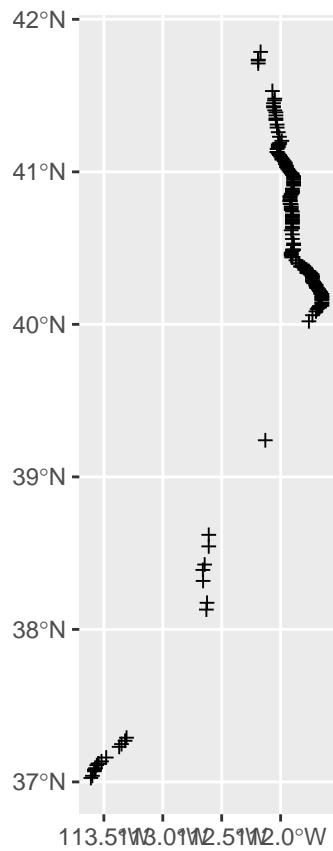


```
# plot of Stations
ggplot() +
  geom_point(
    data = stations,
    aes(x = Longitude, y = Latitude)
  )
```

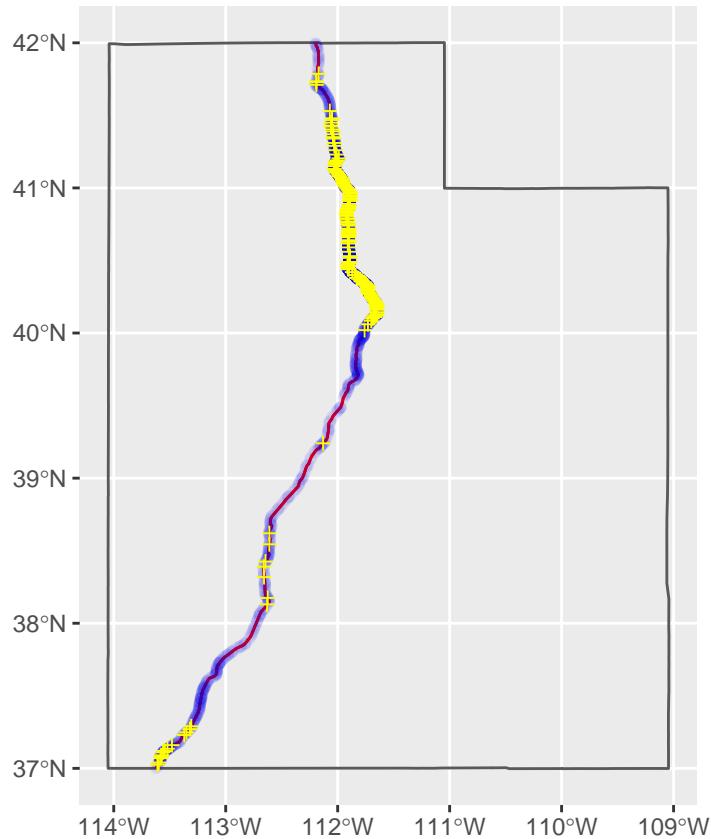


```
# Sf with NAD83 matches CRS of Utah map and Roads
stat_spat <- sf::st_as_sf(
  x = stations,
  coords = c("Longitude", "Latitude"),
  crs = 4269
)

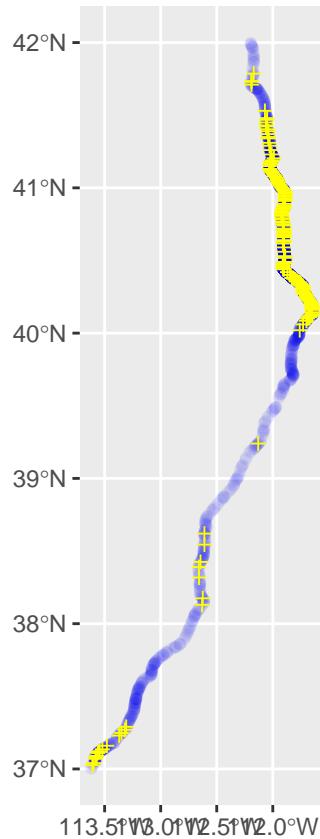
# Plot of spatial object crashes
station_plot <- ggplot(stat_spat) +
  geom_sf(shape = 3)
station_plot
```



```
# plot of Utah, I-15, and Car Accidents
all_plot <- ggplot(ut_map) +
  geom_sf(fill = NA) +
  geom_sf(
    data = roads_i15,
    color = "red"
  ) +
  geom_sf(
    data = i15_spat,
    color = "blue",
    alpha = 0.025
  ) +
  geom_sf(
    data = stat_spat,
    shape = 3,
    color = "yellow"
  )
all_plot
```



```
# car crashes and stations
ggplot()+
  geom_sf(
    data = i15_spat,
    color = "blue",
    alpha = 0.025
  ) +
  geom_sf(
    data = stat_spat,
    shape = 3,
    color = "yellow"
  )
```



```

library(ggmap)

## Warning: package 'ggmap' was built under R version 4.1.1
## Google's Terms of Service: https://cloud.google.com/maps-platform/terms/.
## Please cite ggmap if you use it! See citation("ggmap") for details.
bbox <- sf::st_bbox(ut_map)
names(bbox) <- c("left", "bottom", "right", "top")
samp_map <- ggmap::get_map(location = bbox,
                            maptype = "terrain",
                            source = "google"
)

## Source : http://tile.stamen.com/terrain/8/46/95.png
## Source : http://tile.stamen.com/terrain/8/47/95.png
## Source : http://tile.stamen.com/terrain/8/48/95.png
## Source : http://tile.stamen.com/terrain/8/49/95.png
## Source : http://tile.stamen.com/terrain/8/50/95.png
## Source : http://tile.stamen.com/terrain/8/46/96.png
## Source : http://tile.stamen.com/terrain/8/47/96.png
## Source : http://tile.stamen.com/terrain/8/48/96.png
## Source : http://tile.stamen.com/terrain/8/49/96.png
## Source : http://tile.stamen.com/terrain/8/50/96.png

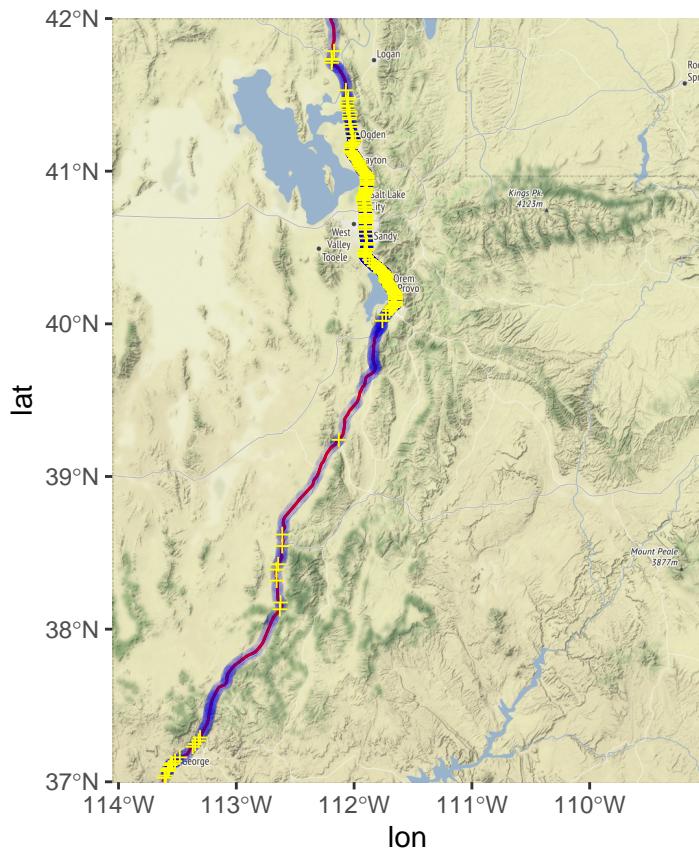
```

```

## Source : http://tile.stamen.com/terrain/8/46/97.png
## Source : http://tile.stamen.com/terrain/8/47/97.png
## Source : http://tile.stamen.com/terrain/8/48/97.png
## Source : http://tile.stamen.com/terrain/8/49/97.png
## Source : http://tile.stamen.com/terrain/8/50/97.png
## Source : http://tile.stamen.com/terrain/8/46/98.png
## Source : http://tile.stamen.com/terrain/8/47/98.png
## Source : http://tile.stamen.com/terrain/8/48/98.png
## Source : http://tile.stamen.com/terrain/8/49/98.png
## Source : http://tile.stamen.com/terrain/8/50/98.png
## Source : http://tile.stamen.com/terrain/8/46/99.png
## Source : http://tile.stamen.com/terrain/8/47/99.png
## Source : http://tile.stamen.com/terrain/8/48/99.png
## Source : http://tile.stamen.com/terrain/8/49/99.png
## Source : http://tile.stamen.com/terrain/8/50/99.png
# map is slightly off
ggmap(samp_map) +
  geom_sf(
    data = roads_i15,
    inherit.aes = F,
    color = "red"
  ) +
  geom_sf(
    data = i15_spat,
    inherit.aes = F,
    color = "blue",
    alpha = 0.025
  ) +
  geom_sf(
    data = stat_spat,
    inherit.aes = F,
    shape = 3,
    color = "yellow",
  )

```

Coordinate system already present. Adding new coordinate system, which will replace the existing one



```

roads_3857 <- sf::st_transform(roads_i15, 3857)
crash_3857 <- sf::st_transform(i15_spat, 3857)
station_3857 <- sf::st_transform(stat_spat, 3857)

ggmapbbox <- function(map) {
  if (!inherits(map, "ggmap")) stop("map must be a ggmap object")
  # Extract the bounding box (in lat/lon) from the ggmap to a numeric vector,
  # and set the names to what sf::st_bbox expects:
  map_bbox <- setNames(unlist(attr(map, "bb")),
    c("ymin", "xmin", "ymax", "xmax"))

  # Convert the bbox to an sf polygon, transform it to 3857,
  # and convert back to a bbox (convoluted, but it works)
  bbox_3857 <- st_bbox(st_transform(st_as_sf(st_bbox(map_bbox, crs = 4326)), 3857))

  # Overwrite the bbox of the ggmap object with the transformed coordinates
  attr(map, "bb")$ll.lat <- bbox_3857["ymin"]
  attr(map, "bb")$ll.lon <- bbox_3857["xmin"]
  attr(map, "bb")$ur.lat <- bbox_3857["ymax"]
  attr(map, "bb")$ur.lon <- bbox_3857["xmax"]
  map
}

# final map
samp_map2 <- ggmapbbox(samp_map)

ggmap(samp_map2) +

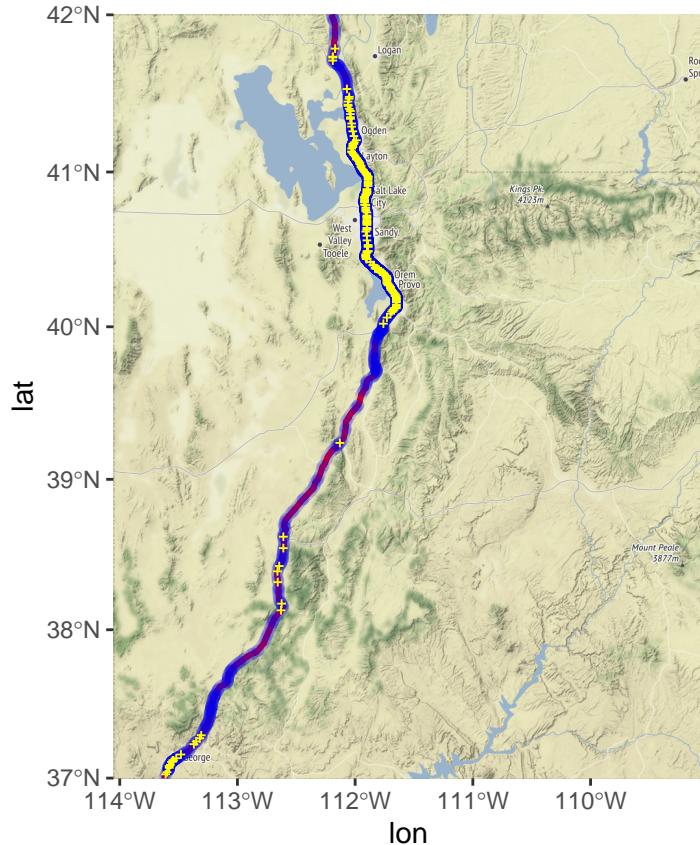
```

```

geom_sf(
  data = roads_3857,
  inherit.aes = FALSE,
  fill = NA,
  lwd = 1,
  color = "red"
) +
geom_sf(
  data = crash_3857,
  inherit.aes = FALSE,
  color = "blue",
  alpha = 0.05
) +
geom_sf(
  data = station_3857,
  inherit.aes = FALSE,
  shape = 3,
  color = "yellow",
  lwd = .75,
)

```

Coordinate system already present. Adding new coordinate system, which will replace the existing one



```
#save code
```

```
#roads_i15
#i15_spat
```

```
#stat_spat

save(roads_i15, file = "../data-raw/RObject/roads_i15")
save(i15_spat, file = "../data-raw/RObject/i15_spat")
save(stat_spat, file = "../data-raw/RObject/stat_spat")
```