

SF Data Tips and Tricks

OEWD Data and Performance Team

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Introduction

This WIP Quarto ‘book’ is a collection of (mostly R) tips and tricks relevant to data professionals with the City and County of San Francisco.

Comments, questions, or suggestions? [Create an issue here](#).

Edits, additions, or corrections? Open a pull request.

To learn more about Quarto books visit <https://quarto.org/docs/books>.



1 DataSF

Getting data from DataSF is a matter of copying the relevant URL into one of R's many read functions, e.g. `readr::read_csv`, `jsonlite::fromJSON`, `st::st_read`, etc.

```
library(readr)
library(sf)
```

Linking to GEOS 3.9.1, GDAL 3.4.3, PROJ 7.2.1; `sf_use_s2()` is TRUE

```
reg_businesses <- read_csv("https://data.sfgov.org/resource/g8m3-pdis.csv")
```

Rows: 1000 Columns: 37

```
-- Column specification -----
Delimiter: ","
chr  (22): uniqueid, ttxid, certificate_number, ownership_name, dba_name, fu...
dbl   (7): business_zip, supervisor_district, :@computed_region_6qbp_sg9q, :...
lgl   (2): parking_tax, transient_occupancy_tax
dtm   (6): dba_start_date, dba_end_date, location_start_date, location_end_d...
```

i Use ``spec()`` to retrieve the full column specification for this data.
i Specify the column types or set ``show_col_types = FALSE`` to quiet this message.

Warning

Behind the scenes there is a limit parameter that defaults to 1000, *even if the 'All data' radio button is selected*. To retrieve all the data, either read the same URL with the RSocrata package:

```
reg_businesses <- RSocrata::read.socrata("https://data.sfgov.org/resource/g8m3-pdis.csv")
```

Or append ?\$limit=9999999 to the end of the URL:

```
reg_businesses <- read_csv("https://data.sfgov.org/resource/g8m3-pdis.csv?$limit=9999999")
```

Read in a 'spatial' object with `st_read` and the URL with the geojson file extension:

```
sup_dists <- st_read("https://data.sfgov.org/api/geospatial/f2zs-jevy?accessType=DOWNLOAD&method=export&format=geojson")
```

Reading layer `OGRGeoJSON' from data source

```
`https://data.sfgov.org/api/geospatial/f2zs-jevy?accessType=DOWNLOAD&method=export&format=geojson'
using driver `GeoJSON'
```

Simple feature collection with 11 features and 7 fields

Geometry type: MULTIPOLYGON

Dimension: XY

Bounding box: xmin: -123.1738 ymin: 37.63983 xmax: -122.3279 ymax: 37.8632

Geodetic CRS: WGS 84

2 Spatial Stuff

The most essential packages for doing GIS work (with ESRI products) are:

- sf
- mapview
- arcgislayers
- arcgisbinding
- tidycensus

Honorable mention:

- tmap
- terra
- leaflet

```
library(sf)
```

Linking to GEOS 3.9.1, GDAL 3.4.3, PROJ 7.2.1; sf_use_s2() is TRUE

```
library(mapview)
library(arcgis)
```

Attaching core arcgis packages:

```
> arcgisutils v0.1.1.9000
> arcgislayers v0.1.0
```

```
library(tidyverse)
```

```
-- Attaching packages ----- tidyverse 1.3.2 --
v ggplot2 3.4.0      v purrr   0.3.4
v tibble  3.1.8      v dplyr  1.1.0
v tidyr   1.2.1      v stringr 1.5.0
v readr   2.1.3      v forcats 0.5.2
-- Conflicts ----- tidyverse_conflicts() --
x purrr::%||%()      masks arcgisutils::%||%()
x purrr::compact()  masks arcgisutils::compact()
x dplyr::filter()   masks stats::filter()
x dplyr::lag()       masks stats::lag()
```

2.1 ArcGIS REST API

The `{arcgislayers}` package allows users to read and write data from and to the ArcGIS REST API.

2.1.1 Reading Layers

```
sf_libraries_url <- "https://services.arcgis.com/Zs2aNLFN00jrS4gG/arcgis/rest/services/SF_
# arc_open can read a FeatureServer or a FeatureLayer directly
(sf_libraries_fs <- arc_open(sf_libraries_url))
```

```
<FeatureServer <2 layers, 0 tables>>
CRS: 3857
Capabilities: Query
  0: Libraries (esriGeometryPoint)
  1: Libraries with Air Conditioning (esriGeometryPoint)
```

```
(sf_libraries_lyr <- get_layer(sf_libraries_fs, name = "Libraries"))
```

```
<FeatureLayer>
Name: Libraries
Geometry Type: esriGeometryPoint
CRS: 3857
Capabilities: Query
```

```
sf_libraries <- arc_select(sf_libraries_lyr)
```

Registered S3 method overwritten by 'jsonify':

```
method      from
print.json  jsonlite
```

```
glimpse(sf_libraries)
```

Rows: 33

Columns: 23

```
$ objectid      <int> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16~
$ gross_sq_f    <chr> "8500", "6465", "6096", "8536", "7633", "6100", "8000~
$ block_lot     <chr> "8708110", "3564095", "6539034", "2919031", "0469001"~
$ zip_code      <chr> "94158", "94114", "94114", "94127", "94123", "94112",~
$ facility_i    <chr> "1113", "648", "1184", "1853", "1053", "896", "1858",~
$ city          <chr> "San Francisco", "San Francisco", "San Francisco", "S~
$ latitude      <chr> "37.775369728", "37.76406037", "37.750228042", "37.74~
$ department    <chr> "Public Library", "Public Library", "Public Library",~
$ longitude     <chr> "-122.393097384", "-122.431881717", "-122.435090242",~
$ dept_id       <chr> "48", "48", "48", "48", "48", "48", "48", "48", "48",~
$ common_nam    <chr> "Mission Bay Library", "Eureka Valley Branch Library/~
$ address       <chr> "960 04th St", "1 Jose Sarria Ct", "451 Jersey St", "~
$ supervisor    <chr> "6", "8", "8", "7", "2", "7", "5", "6", "10", "8", "9~
$ city_tenan    <chr> " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " "
$ owned_leas    <chr> "Own", "Own", "Own", "Own", "Own", "Own", "Own", "Own~
$ globalid      <chr> "755632fc-18d9-4c0e-b65d-ec53d18a132b", "195a2a2b-302~
$ created_user  <chr> "nancy.milholland_sfdem", "nancy.milholland_sfdem", "~
$ created_date  <dtm> 2019-06-07 21:44:34, 2019-06-07 21:44:34, 2019-06-07~
$ last_edited_user <chr> "nancy.milholland_sfdem", "nancy.milholland_sfdem", "~
$ last_edited_date <dtm> 2019-06-07 21:44:34, 2019-06-07 21:44:34, 2019-06-07~
$ eas_id        <lgl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
$ air_conditioning <chr> "Yes", "No", "No", "No", "No", "No", "No", "No", "No", "Sec~
$ geometry      <POINT [m]> POINT (-13624737 4547742), POINT (-13629055 454~
```

```
# You can also specify which columns to select, e.g.:
# arc_select(
#   sf_libraries_lyr,
#   fields = c("common_nam", "gross_sq_f", "address"),
#   where = "gross_sq_f < 8000"
# )
```

```
# With pipes:
```

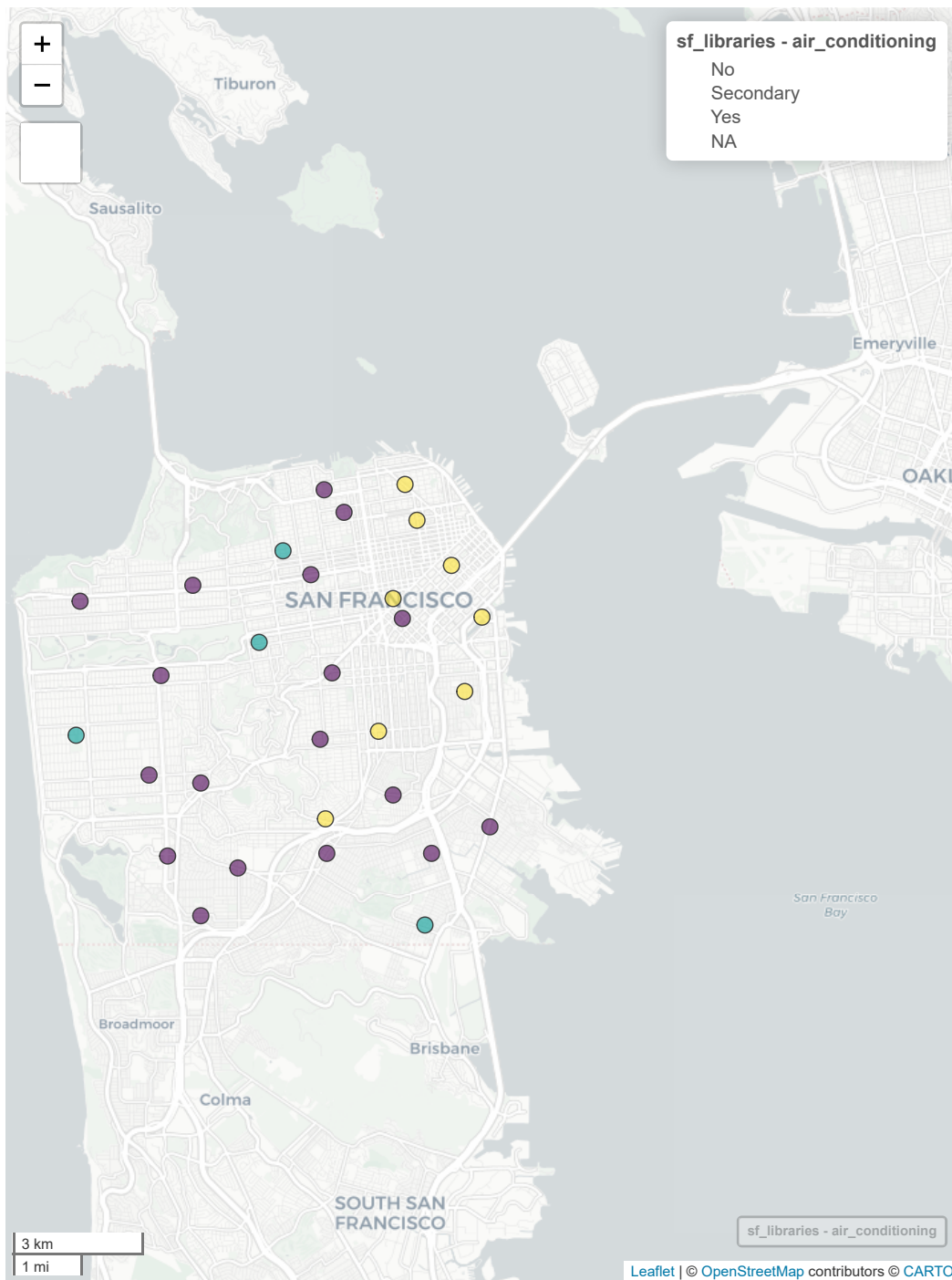


```

# sf_libraries_url %>%
#   arc_open() %>%
#   get_layer(name = "Libraries") %>%
#   arc_select()

# With pipes and tidyverse:
# (if the url points to a FeatureLayer instead of a FeatureServer)
# sf_libraries_url %>%
#   arc_open() %>%
#   select(common_nam, gross_sq_f, address) %>%
#   filter(gross_sq_f < 8000) %>%
#   collect()
mapview(sf_libraries, zcol = "air_conditioning")

```



It is also convenient to wrap this up into the body of a single function:

```
get_arcgis_layer <- function(lyr_name) {  
  url <- glue::glue("https://services.arcgis.com/Zs2aNLFN00jrS4gG/arcgis/rest/services/{lyr_name}/MapServer")  
  out <- arcgislayers::arc_select(arcgislayers::arc_open(url))  
  return(out)  
}  
  
libraries <- get_arcgis_layer("SF_Libraries")
```

2.1.2 Writing Layers

If you have an sfgov.maps.arcgis.com account, you can write layers directly to your content. Read [the authorization page](#) for more information on credentials and tokens.

```
nc <- st_read(system.file("shape/nc.shp", package = "sf"))  
tkn <- auth_code()  
set_arc_token(tkn)  
  
publish_res <- publish_layer(nc, "North Carolina SIDS sample")
```

2.2 ArcGIS Pro

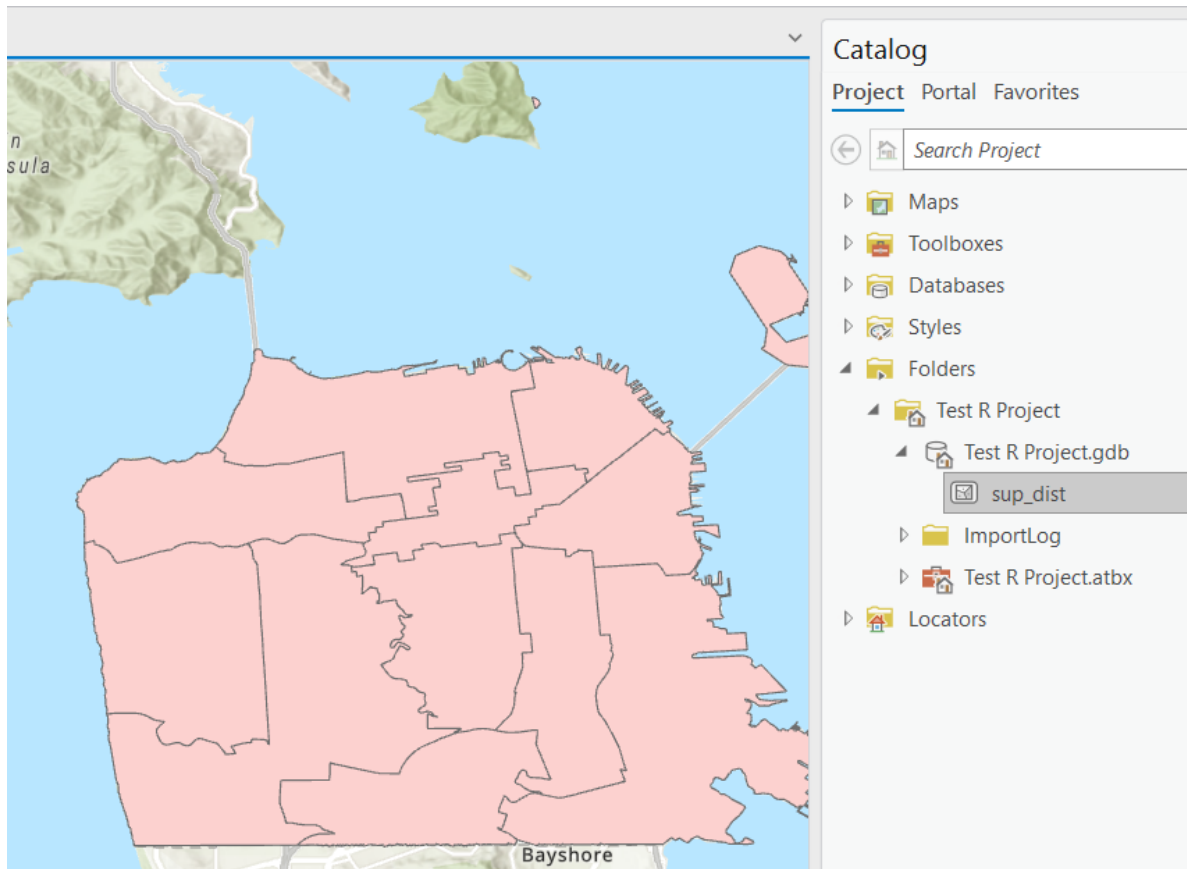
If you have an ArcGIS Pro license, you can write directly to geodatabases within Projects using the `{arcgisbinding}` package.

```
Reading layer `OGRGeoJSON' from data source  
  `https://data.sfgov.org/api/geospatial/f2zs-jevy?accessType=DOWNLOAD&method=export&format=GeoJSON'  
  using driver `GeoJSON'  
Simple feature collection with 11 features and 7 fields  
Geometry type: MULTIPOLYGON  
Dimension:      XY  
Bounding box:   xmin: -123.1738 ymin: 37.63983 xmax: -122.3279 ymax: 37.8632  
Geodetic CRS:   WGS 84
```

```
library(arcgisbinding)  
# arc.check_product()  
  
# Get Supervisor Districts from DataSF:
```

```
sup_dists <- st_read("https://data.sfgov.org/api/geospatial/f2zs-jevy?accessType=DOWNLOAD&")

# Write to ArcGIS Pro project geodatabase
proj_path <- "...<full_path>.../ArcGIS/Projects/Test R Project/Test R Project.gdb/sup_dists"
arc.write(path = proj_path, data = sup_dists)
```



2.3 Spatial Joins

Use spatial joins to determine which points are ‘within’ which polygon:

```
nhoods <- st_read("https://data.sfgov.org/resource/j2bu-swwd.geojson")
```

Reading layer ‘j2bu-swwd’ from data source

‘https://data.sfgov.org/resource/j2bu-swwd.geojson’ using driver ‘GeoJSON’

Simple feature collection with 41 features and 1 field
 Geometry type: MULTIPOLYGON
 Dimension: XY
 Bounding box: xmin: -122.5149 ymin: 37.70813 xmax: -122.357 ymax: 37.8333
 Geodetic CRS: WGS 84

```
# The coordinate reference systems must match
st_crs(sf_libraries) == st_crs(sup_dists)
```

```
[1] FALSE
```

```
sf_libraries %>%
  select(common_nam) %>%
  st_transform(st_crs(sup_dists)) %>%
  st_join(sup_dists %>% select(sup_dist), join = st_within) %>%
  st_join(nhoods, join = st_within)
```

Simple feature collection with 33 features and 3 fields
 Geometry type: POINT
 Dimension: XY
 Bounding box: xmin: -122.4981 ymin: 37.71245 xmax: -121.9681 ymax: 37.80253
 Geodetic CRS: WGS 84
 First 10 features:

	common_nam	sup_dist
1	Mission Bay Library	6
2	Eureka Valley Branch Library/ Harvey Milk Memorial Branch Library	8
3	Noe Valley Branch Library	8
4	West Portal Branch Library	7
5	Marina Branch Library	2
6	Ingleside Branch	7
7	Western Addition Branch Library	5
8	Library Support Services	6
9	Visitation Valley Branch Library	10
10	Glen Park Branch Library	8

	nhood	geometry
1	Mission Bay	POINT (-122.3931 37.77537)
2	Castro/Upper Market	POINT (-122.4319 37.76406)
3	Noe Valley	POINT (-122.4351 37.75023)
4	West of Twin Peaks	POINT (-122.4661 37.74137)
5	Marina	POINT (-122.4341 37.80137)

```
6 West of Twin Peaks POINT (-122.4563 37.72406)
7      Japantown POINT (-122.4375 37.78412)
8      South of Market POINT (-122.4137 37.77501)
9      Visitacion Valley POINT (-122.4079 37.71245)
10     Glen Park POINT (-122.4338 37.73398)
```

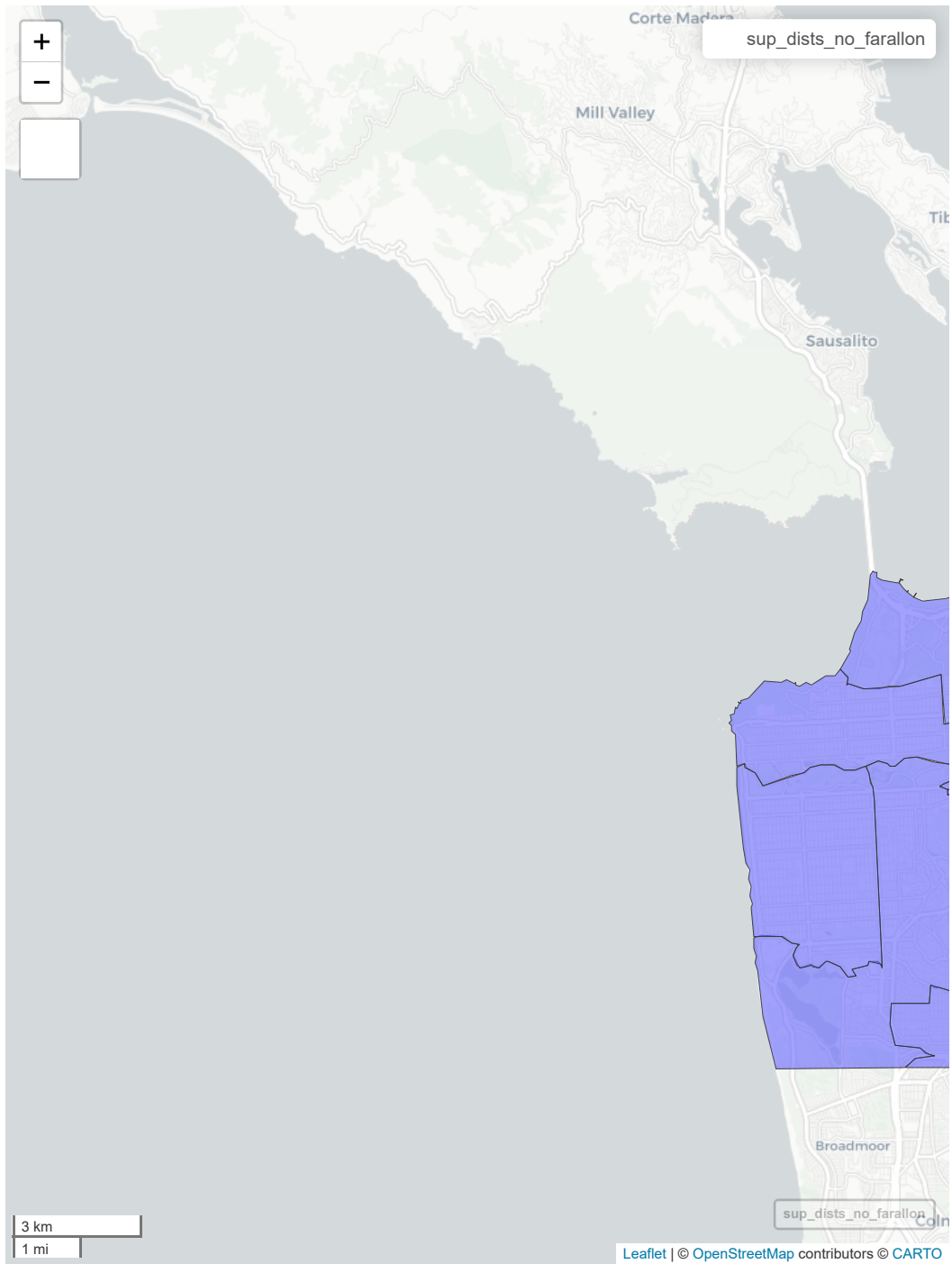
2.4 Removing Farallon Islands from Supervisor Districts

```
d4 <- sup_dists %>%
  filter(sup_dist == 4) %>%
  st_cast("POLYGON") %>%
  slice(1) %>%
  st_cast("MULTIPOLYGON")
```

Warning in st_cast.sf(., "POLYGON"): repeating attributes for all sub-geometries for which they may not be constant

```
sup_dists_no_farallon <- sup_dists %>%
  filter(sup_dist != 4) %>%
  bind_rows(d4)

mapview(sup_dists_no_farallon)
```



2.5 Census Data

The `{tidycensus package}` is fantastic, and the documentation is full of helpful examples.

```
library(tidycensus)

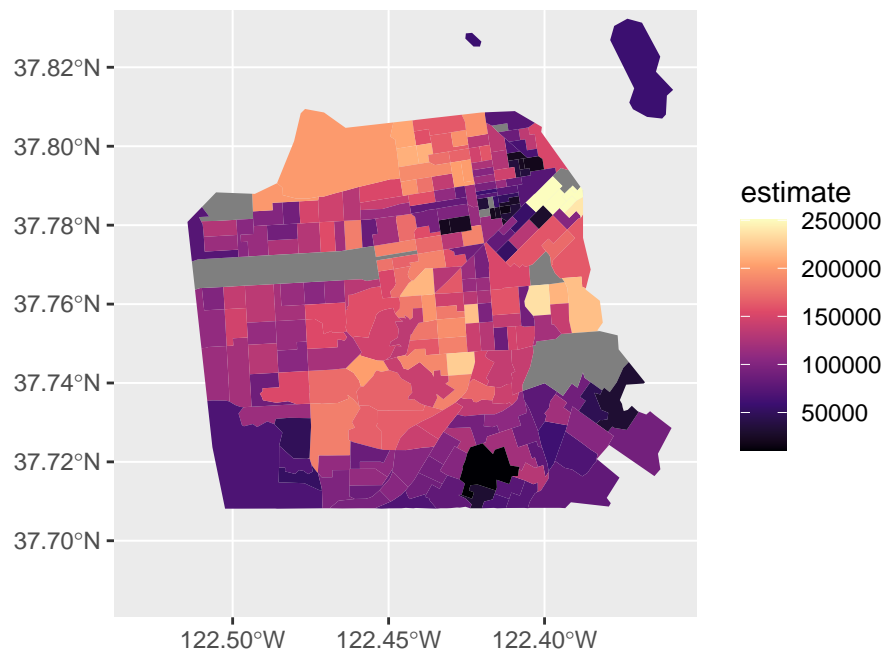
sf <- get_acs(
  state = "CA",
  county = "San Francisco",
  geography = "tract",
  variables = "B19013_001",
  geometry = TRUE,
  year = 2020
) %>%
  st_transform(3857)
```

Getting data from the 2016-2020 5-year ACS

Downloading feature geometry from the Census website. To cache shapefiles for use in future

```
sf_bbox <- libraries %>%
  drop_na(city) %>%
  st_buffer(3500) %>%
  st_bbox()

sf %>%
  ggplot(aes(fill = estimate)) +
  geom_sf(color = NA) +
  coord_sf(xlim = sf_bbox[c("xmin", "xmax")], ylim = sf_bbox[c("ymin", "ymax")], expand =
  scale_fill_viridis_c(option = "magma")
```

3 Geocoding

3.1 City Locator

There are several ways to geocode addresses from R, but the easiest (and cheapest) way is with the `{tidygeocoder}` package and one of the city's [internal locators](#).

i Note

The locator will only geocode San Francisco addresses.

```
library(tidygeocoder)
library(sf)
```

Linking to GEOS 3.9.1, GDAL 3.4.3, PROJ 7.2.1; `sf_use_s2()` is TRUE

```
library(mapview)
library(tidyverse)
```

```
-- Attaching packages ----- tidyverse 1.3.2
--
```

```
v ggplot2 3.4.0      v purrr   0.3.4
v tibble  3.1.8      v dplyr   1.1.0
v tidyr   1.2.1      v stringr 1.5.0
v readr   2.1.3      v forcats 0.5.2
```

```
-- Conflicts ----- tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()     masks stats::lag()
```

```
df <- tibble(address = c("1 South Van Ness", "1 Dr Carlton B Goodlett Pl"))
locator <- "https://gis.sf.gov/svc/rest/services/loc/c83_eas_str_ctrl_composite/GeocodeSer
```

```

coords <- df %>%
  geocode(
    api_url = locator,
    address = address,
    custom_query = list(outSR = "4326"), # outSR (Spatial Reference) is a required parameter
    method = "arcgis"
  )

```

Passing 2 addresses to the ArcGIS single address geocoder
 Query completed in: 0.3 seconds

```

coords

```

```

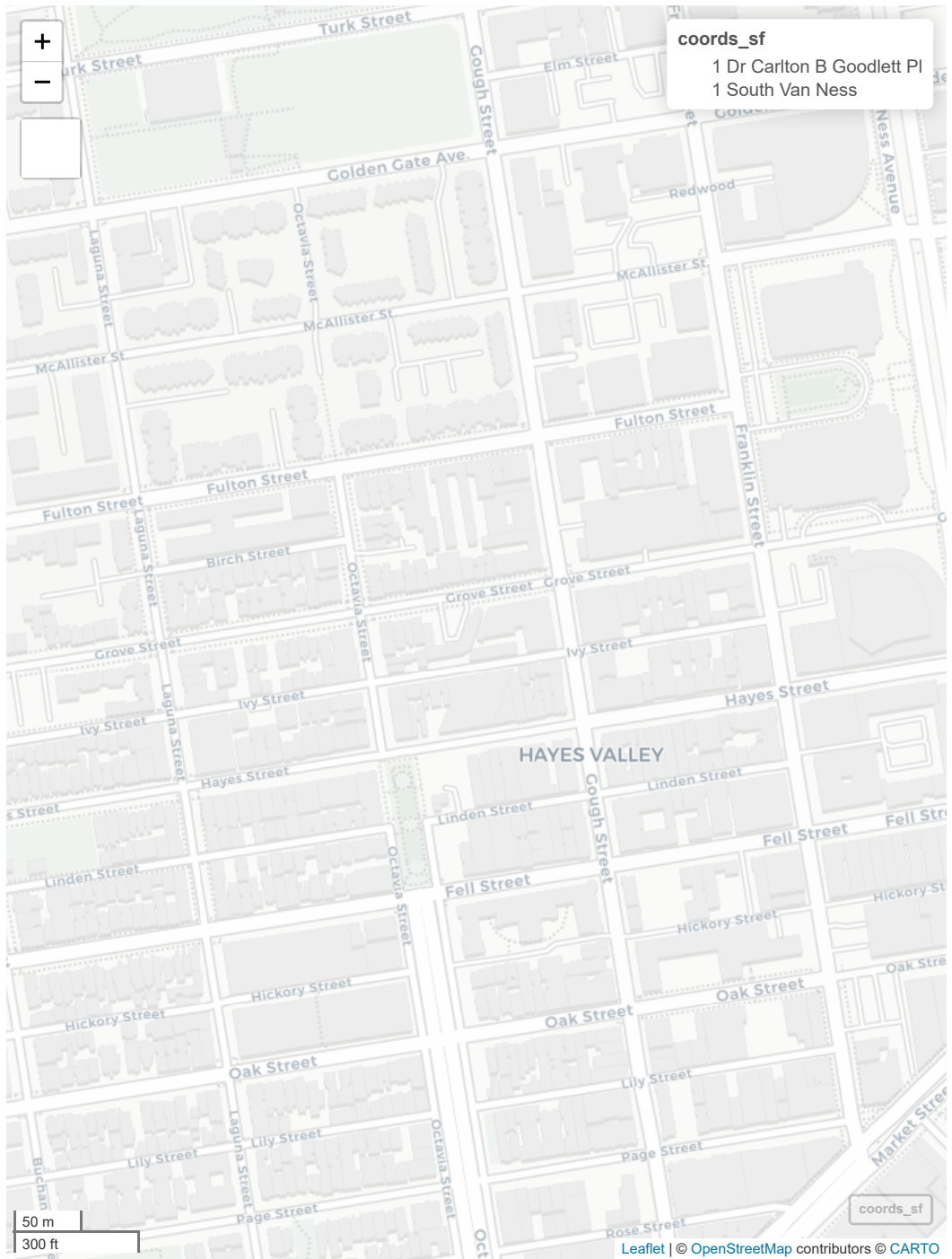
# A tibble: 2 x 3
  address          lat long
  <chr>          <dbl> <dbl>
1 1 South Van Ness      37.8 -122.
2 1 Dr Carlton B Goodlett Pl 37.8 -122.

```

```

coords_sf <- coords %>% st_as_sf(coords = c("long", "lat"), crs = 4326)
mapview(coords_sf)

```



3.2 geocodio

If you need to geocode addresses outside the city, [the geocodio service](#) is a nice option, but you'll first need to obtain your API key. Sign up for an account and register for an API key. Once you have it, you need to put it in your .Renviron file, a special text file that runs every time you open/restart R.

Edit your .Renviron file with the usethis package:

```
library(usethis)
edit_r_environ() # this opens the file in RStudio
```

Paste your API key like so:

```
GEOCODIO_API_KEY='<your_api_key>'
```

Save the file and restart R. You should then be able to call `geocode` with the `method = 'geocodio'` argument. Note that there is a rate limit of 1000 addresses per hour.

4 Sharepoint

Sharepoint is part of many data pipelines, and the easiest way to interact with Sharepoint from R is through the [{Microsoft365R}](#) package. This package has been vetted by the Department of Technology (DT) and authentication should be straight-forward after calling one of the initial functions.

```
library(Microsoft365R)

wp <- get_sharepoint_site("ECN-Workforce Programs")
wp_docs <- wp$get_drive("Documents")

wp_docs$list_files()

wp_docs$download_file("path_to_file.xlsx")
```

It is helpful to wrap common read/write operations into more usable functions:

```
connect_to_sharepoint_site_docs <- function(sp_site) {
  sp_site <- Microsoft365R::get_sharepoint_site(sp_site)
  sp_site_doc <- sp_site$get_drive("Documents")
  return(sp_site_doc)
}

connect_to_wp_docs <- function() connect_to_sharepoint_site_docs("ECN-Workforce Programs")

download_from_wp <- function(sp_file, destination) {
  docs <- connect_to_wp_docs()
  docs$download_file(sp_file, dest = destination)
  cli::cli_alert_success(glue::glue("{sp_file} downloaded."))
}

upload_to_wp <- function(file, sp_destination) {
  docs <- connect_to_wp_docs()
  docs$upload_file(
    file,
```

```

    sp_location
  )
  cli::cli_alert_success("File uploaded.")
}

read_wp <- function(path) {
  tmp <- tempfile(fileext = "xlsx")
  download_from_wp(
    sp_file = glue("{path}.xlsx"),
    destination = tmp
  )
  out <- readxl::read_excel(tmp, .name_repair = janitor::make_clean_names)
  return(out)
}

```

5 Icons

The Digital Services team has provided [a nifty set of icons on the San Francisco Design System website](#). You can use these icons in Quarto (HTML) documents by installing [the sficons extension from GitHub here](#).

```
quarto install extension SFOEWD/sficons
```

To embed an icon, use the `sficon` shortcode. Some examples:

```
{{< sficon wip >}}  
{{< sficon alert >}}
```

```
{{< sficon arrow-right color=firebrick >}}
```

```
{{< sficon globe color=green size=5em >}}
```

```
{{< sficon pencil color=gold size=10em >}}
```

Control the color and size of the icons:

6 {targets} Pipelines

WIP

References