Spatial Data Analysis in R

Deck 1a: Main Projects and Selected Spatial Operations in R

Eco 697DR – University of Massachusetts, Amherst – Spring 2022
Michael France Nelson

Announcements

- Becky Seifried data sources talk next Monday!
  - Come with questions about main project data ideas! More info in the following slides.
- For today:
  - Main project info
  - In-class R vector data operations practice

Main Projects

Course Main Projects

- You may work individually or in pairs
- More details on GitHub
- Consists of 3 parts:

1. Pre-proposal and consultation – Feb 18th
   - Your chance to explore general ideas
2. Research proposal – March 11th
   1. Refine your pre-proposal ideas
3. Report – May 12
   1. Mini scientific paper format

Main Projects: Pre-Proposal

For the pre-proposal, you should be thinking about:

- What kinds of questions can I ask using spatial data?
- Do I have any specific questions or areas of interest?
  - It's ok if you don't yet!
- Do I have my own data to use?
  - Don't worry if you don't!
- What is my data wish list?

In-Class Vector Data Practice

Instructions

- Locate the activity instructions on the class GitHub site.
- Download the .RData file to your project ‘data’ subdirectory.
- Use the info on these slides as a guide.

R Vector Data Functions: Mini Cheat Sheet

```
# Dissolve within a SPDF
rgeos::gUnaryUnion()

# Buffer
rgeos::gBuffer()

# Buffer + dissolve
raster::buffer()

# Query whether features overlap
rgeos::gIntersects()
```

```
# Union with dissolve
regos::gUnion()

# Union without dissolve
raster::union()
```

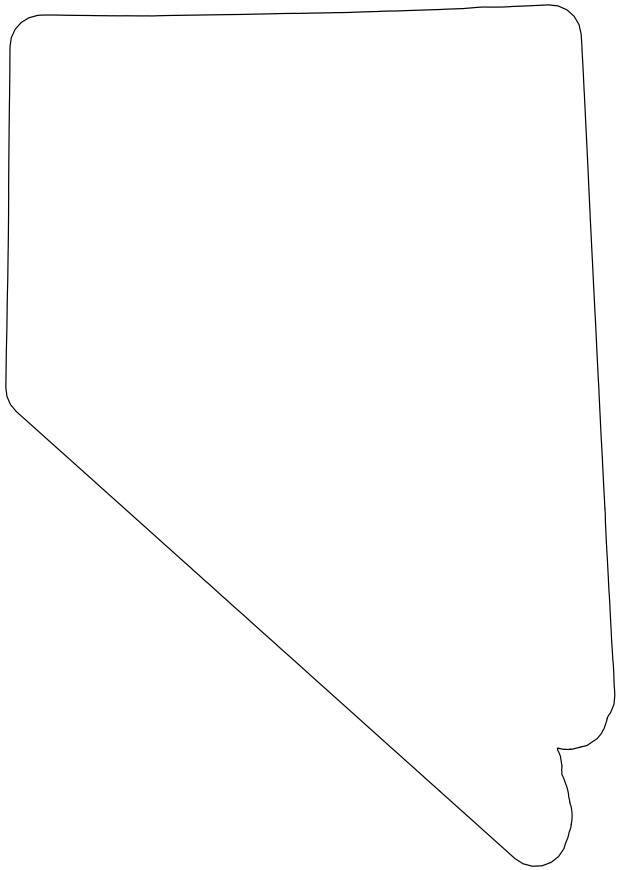
```
# Erase parts of polygons (or lines)
raster::erase()
```

```
# Intersection with dissolve
rgeos::gIntersection()

# Intersection without dissolve
raster::intersect()
```

Buffer – Raster Package

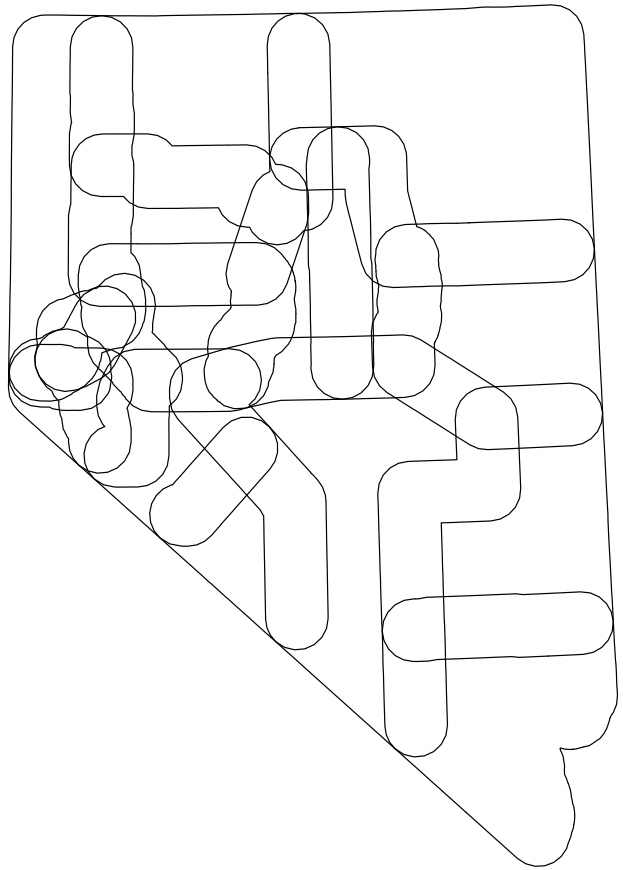
With Dissolve: puffy Nevada

```
raster::buffer(nv_cnty, 1e5, dissolve = T)
```



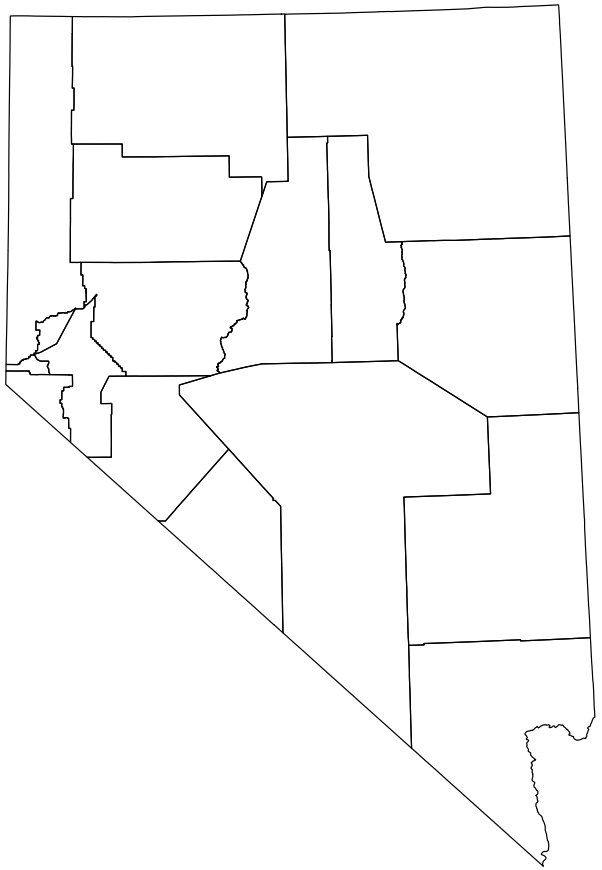
No Dissolve: puffy Nevada with worms

```
raster::buffer(nv_cnty, 1e5, dissolve = F)
```



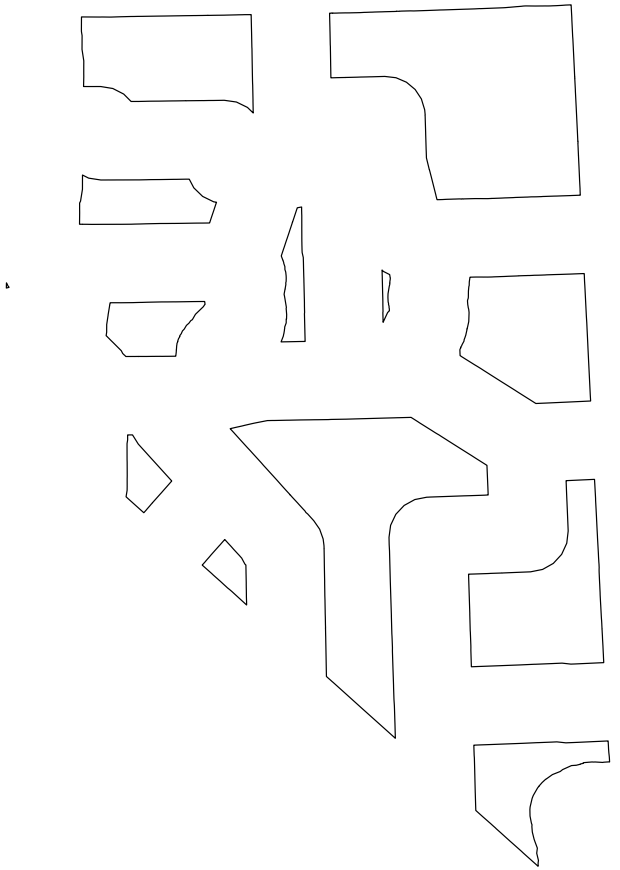
Buffer – Negative Buffer

Original



100km negative buffer

```
raster::buffer(nv_cnty, -1e5, dissolve = F)
```



Dissolve

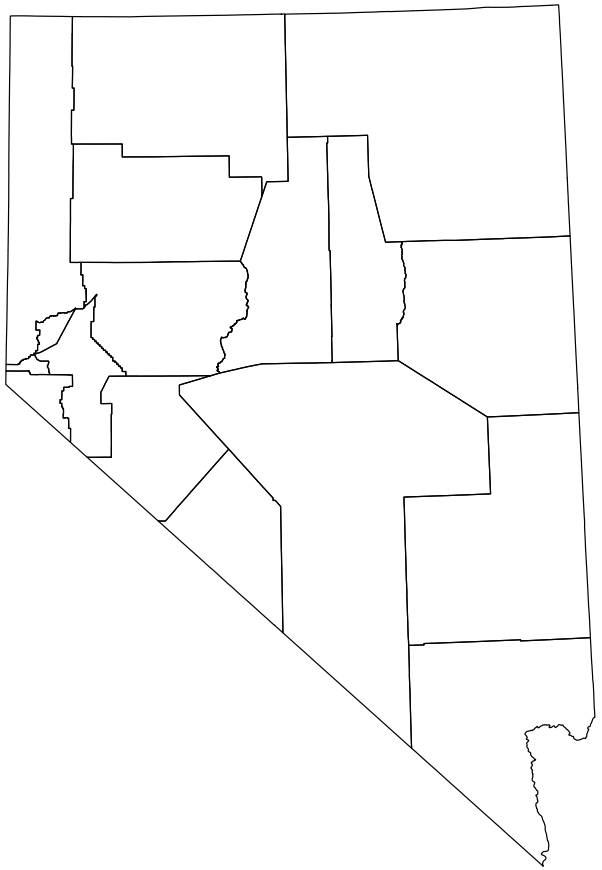
Original

Dissolved

`gUnaryUnion(ca_cnty)`

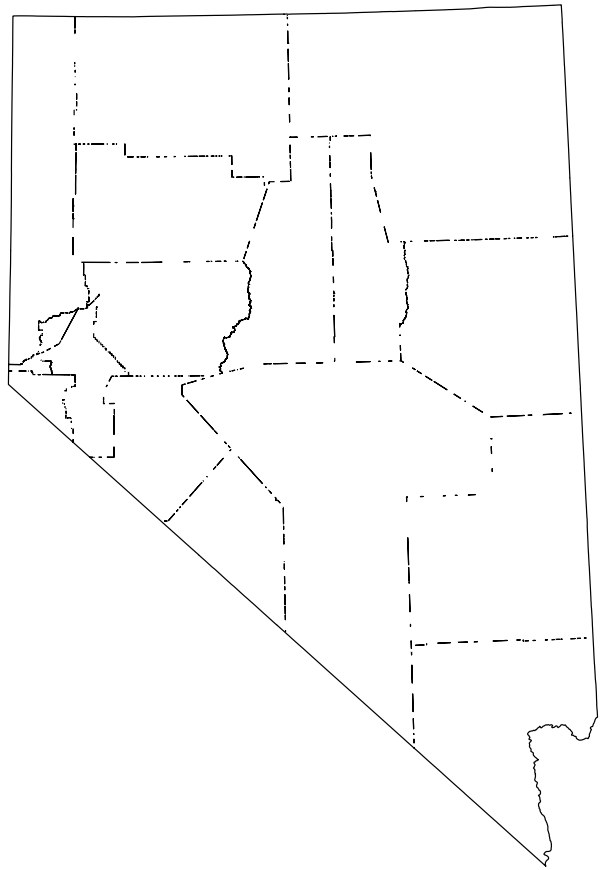
Dissolve

Original



Dissolved

`gUnaryUnion(nv_cnty)`



What happened???

- Nevada counties shapefile: county vertices were slightly misaligned
  - Most likely due to round-off errors: edge coordinates are stored as double or float numbers
  - Round-off errors can happen when you reproject, or if decimal values are truncated.
- We're left with micropolygons: sliver polygons
  - Sliver polygons are hard to get rid of
- How to fix?
  - First buffer by a small amount, then dissolve

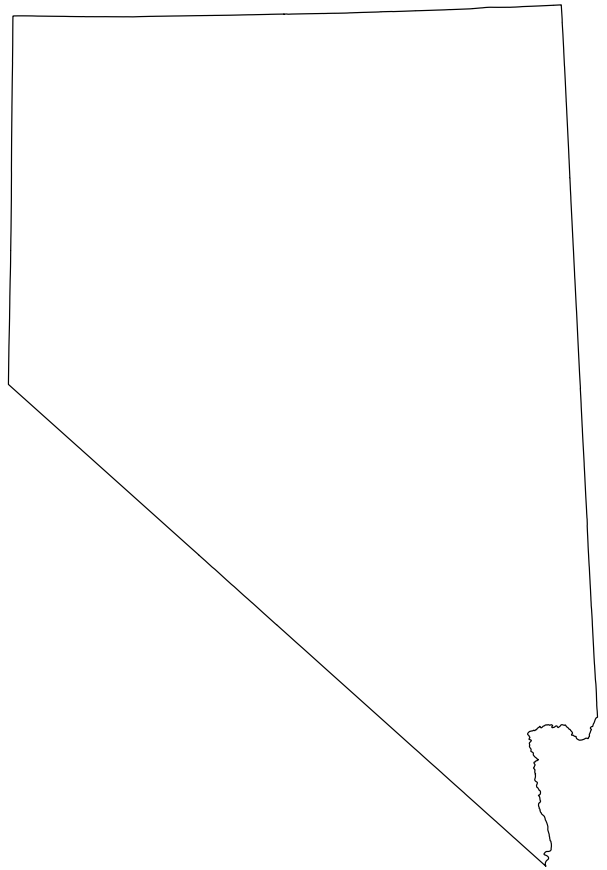
Trick to fix mis-aligned polygons

Code to fix it

1. First, buffer by a tiny amount
2. Next, perform the dissolve

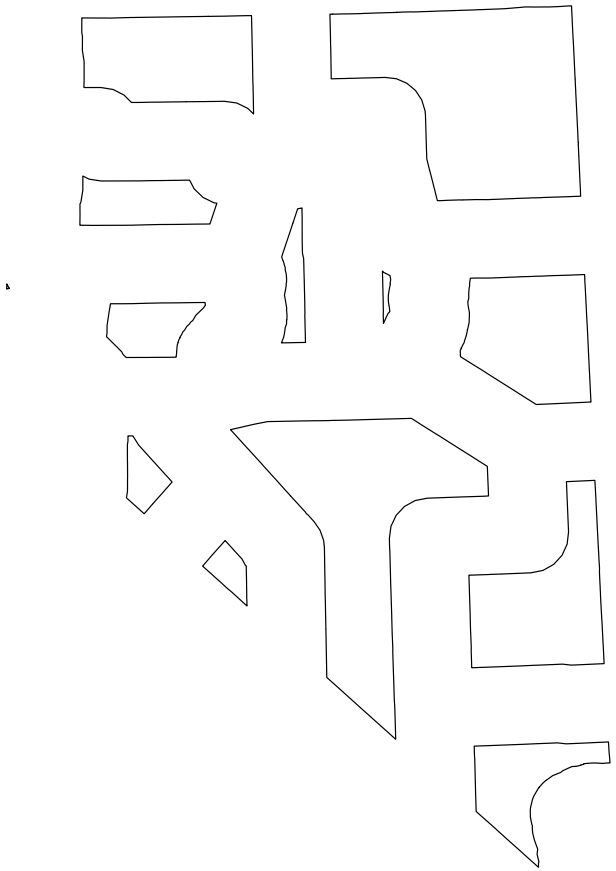
```
gUnaryUnion(
  raster::buffer(
    nv_cnty,
    1 # Buffer by 1 meter
    )
  )
```

Success!

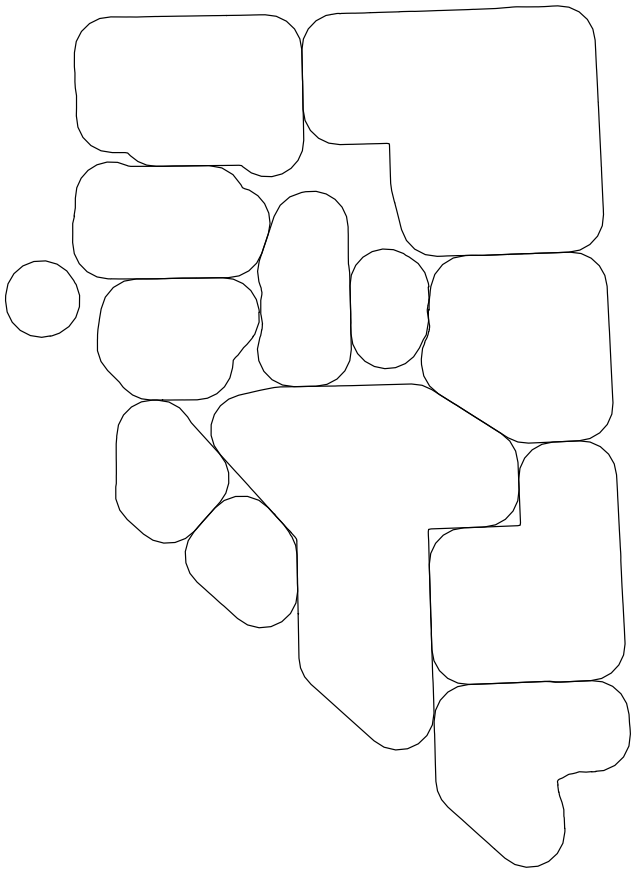


Buffering is Destructive

Negative Buffer



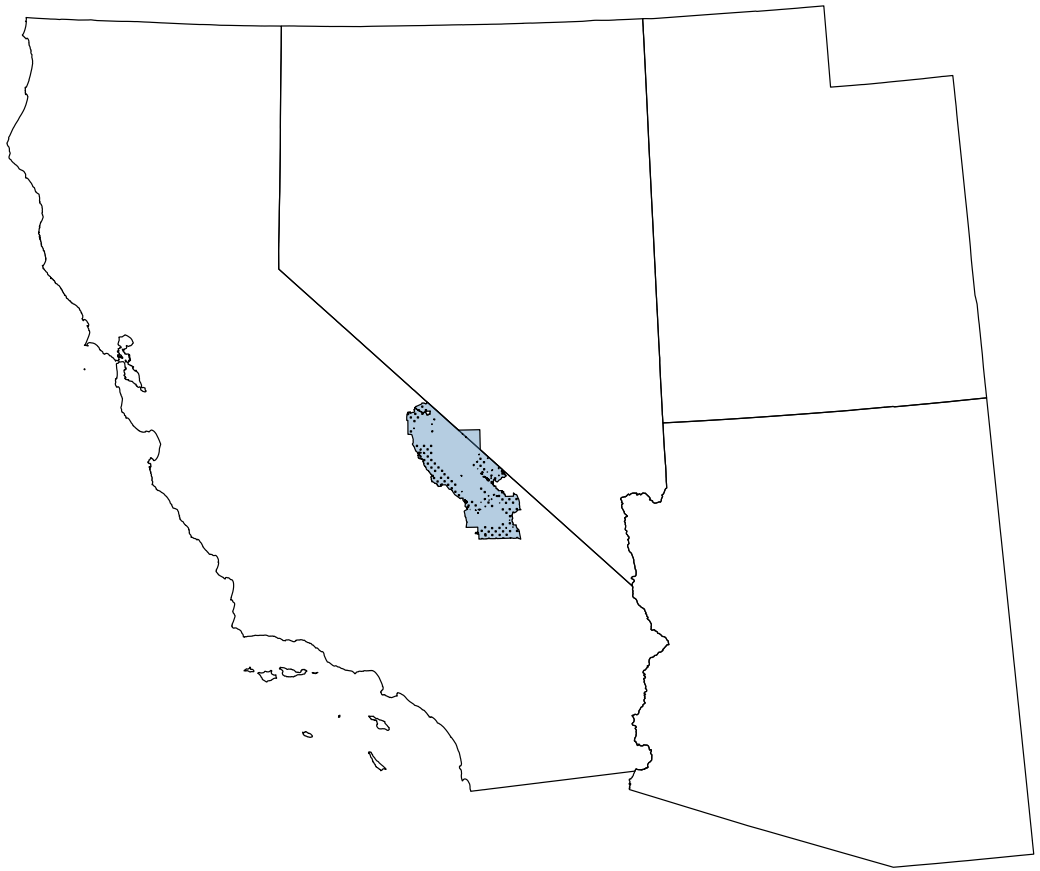
Negative + Positive Buffer = Marshmallow Counties



Which polygons intersect?

Southwest States + Death Valley

Which states does the park cover?



Use gIntersects()

- gIntersects() returns a logical vector:
  - Which features of layer 1 overlap any part of layer 2.
  - Returns TRUE for each polygon in spgeom1 that overlaps any part of spgeom2.
- Us which() to get the indices of the TRUE values.
- The byid argument is important.
  - You should set it to TRUE

Which polygons intersect?

gIntersects() syntax

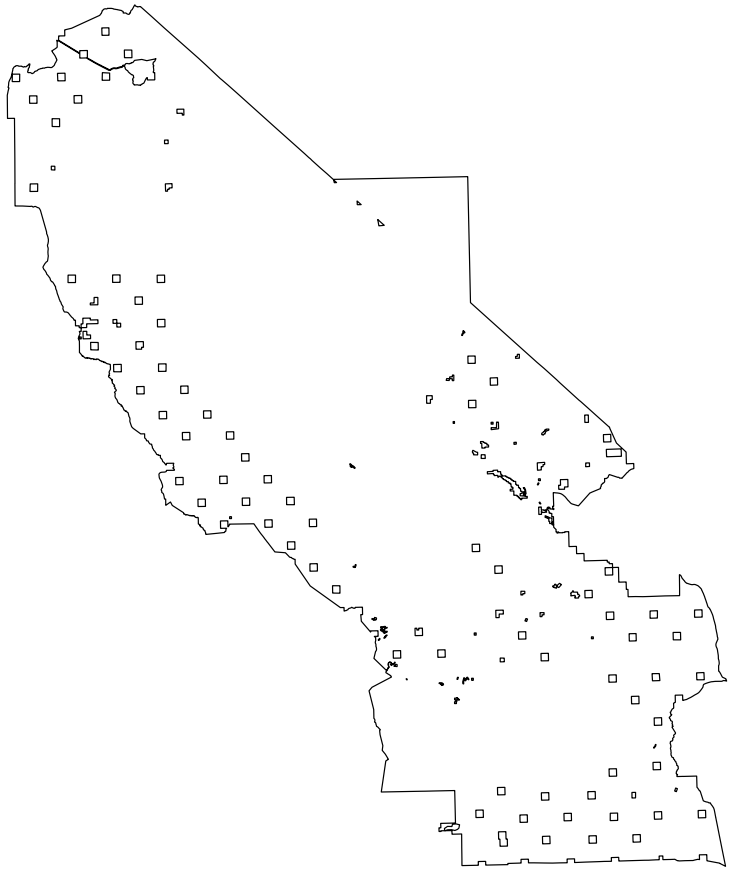
```
# Create logical subset
dvnp_intersects = which(
  gIntersects(
    us_states2,
    dvnp,
    byid = TRUE))

# Subset a SPDF like a data.frame
plot(us_states2[dvnp_intersects, ])

# Use add = T to overplot
plot(
  dvnp,
  add = T,
  col = adjustcolor("steelblue", 0.4)
)
```

Result

Union and Intersection

CA Counties

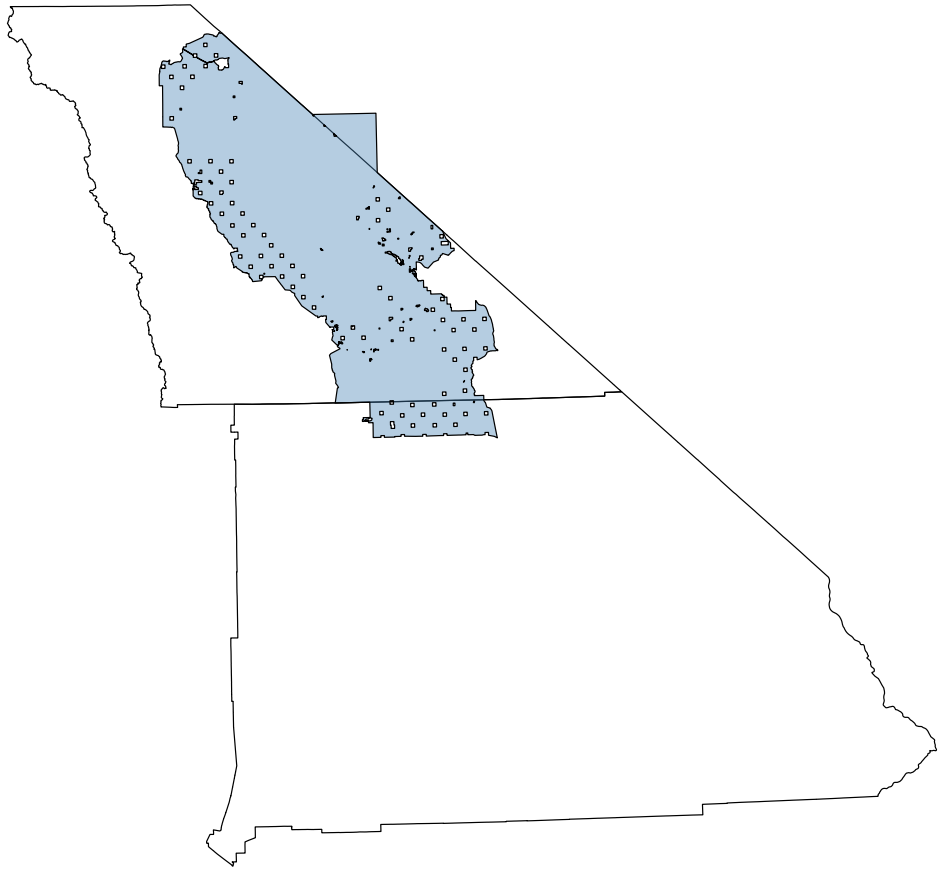
Death Valley National Park



California Counties and Death Valley

CA Counties + Death Valley

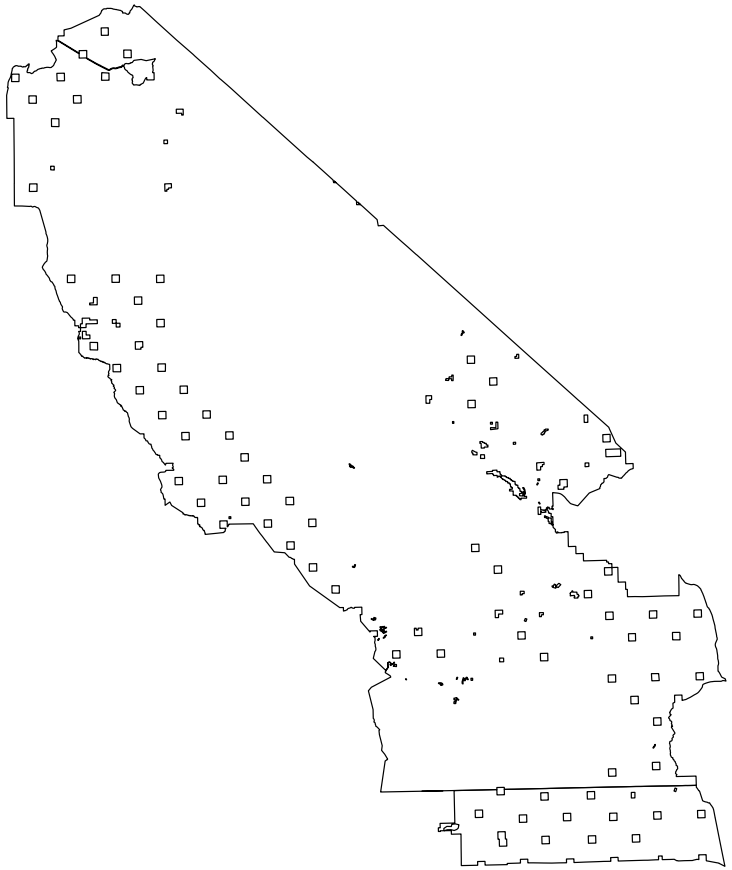
Zoom-in



Intersection

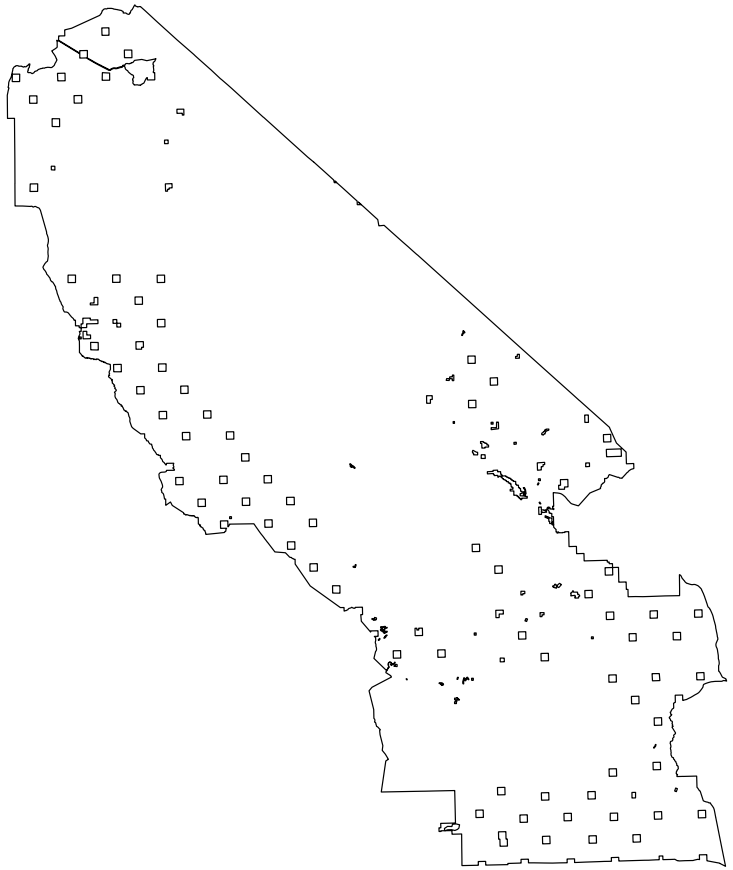
No Dissolve

raster::intersect(dvnp, ca_cnty)



With Dissolve

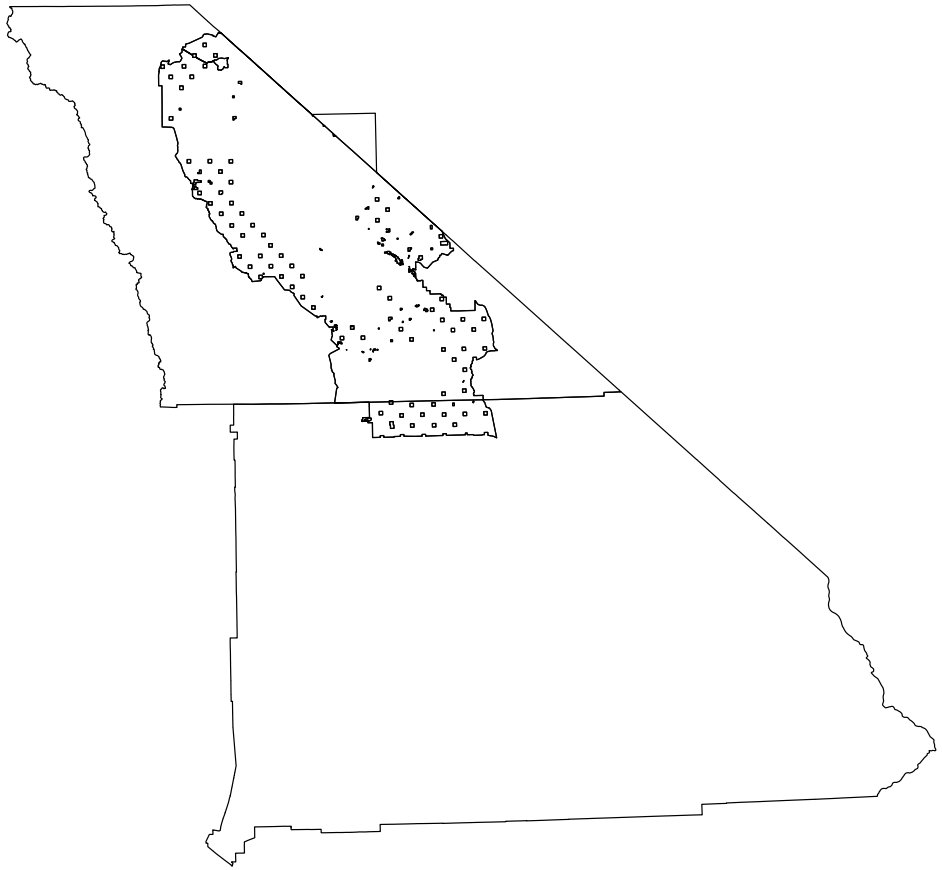
rgeos::gIntersection(dvnp, ca_cnty)



Union

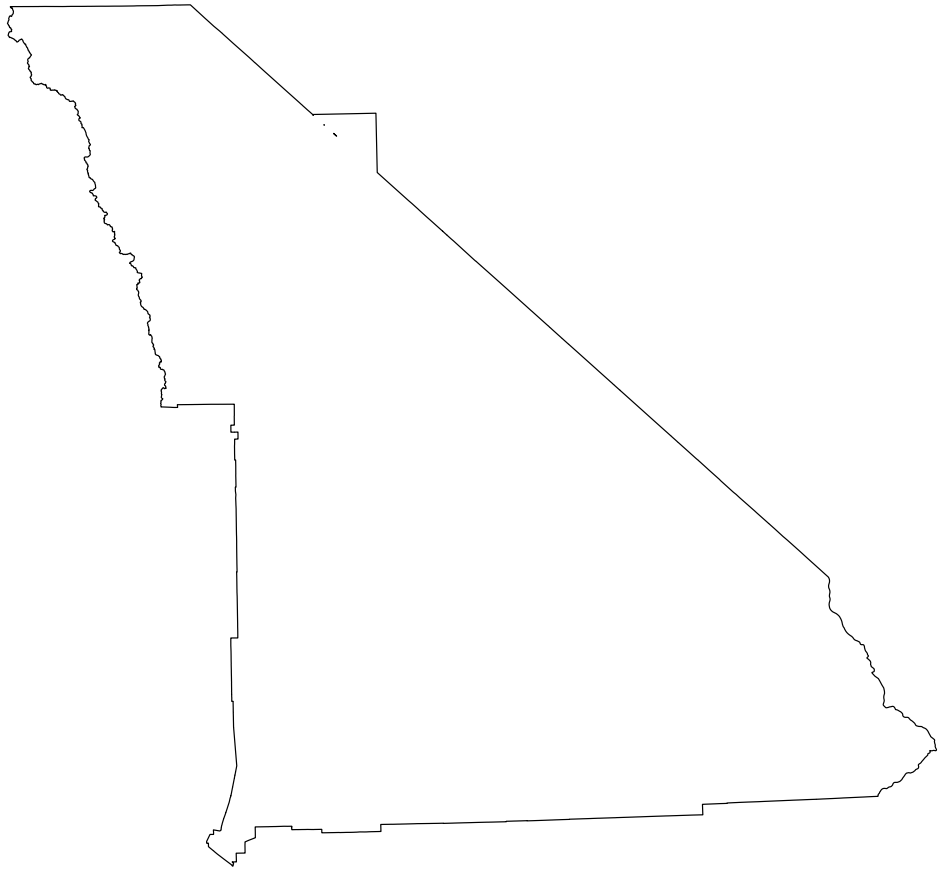
No Dissolve

raster::union(dvnp, int_cnt)



With Dissolve

rgeos::gUnion(dvnp, int_cnt)



Erase

- I'll let you figure out how to use this one…