Operations on Raster Data I

HES 505 Fall 2023: Session 13

Matt Williamson

Today's Plan

Objectives

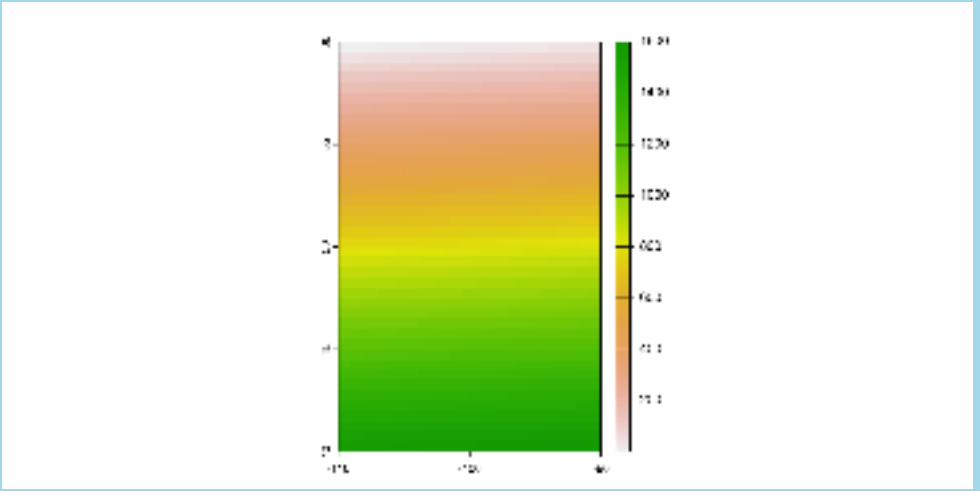
- By the end of today, you should be able to:
  - Align rasters for spatial processing
  - Adjust the resolution of raster data
  - Combine (or reduce) rasters to match the extent of your analysis

Aligning rasters for spatial processing

Projecting raster data

- Transformation from lat/long to planar CRS involves some loss of precision
- New cell values estimated using overlap with original cells
- Interpolation for continuous data, nearest neighbor for categorical data
- Equal-area projections are preferred; especially for large areas

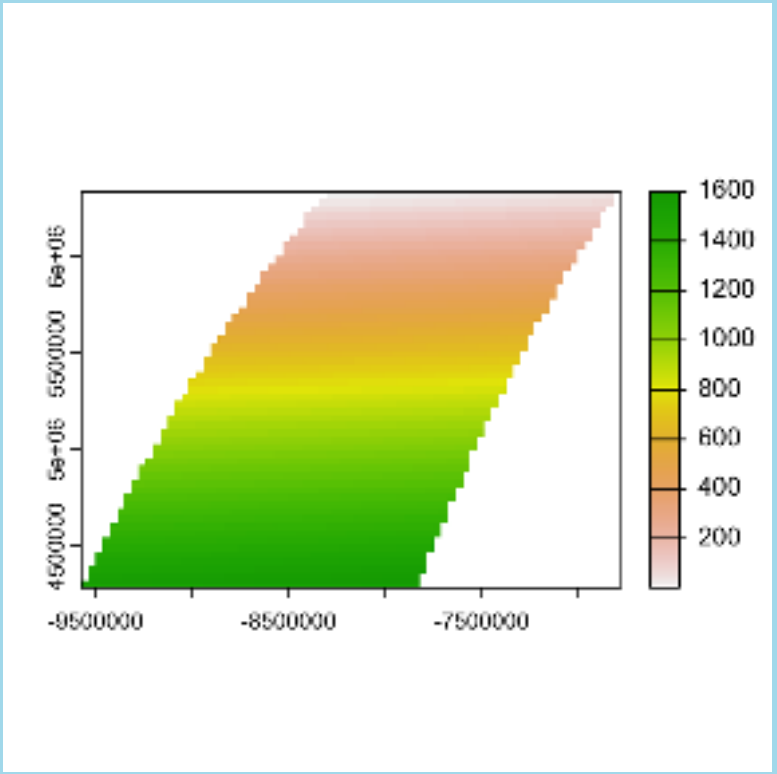
```
library(sf)
library(terra)
library(spDataLarge)
r <- rast(xmin=-110, xmax=-90, ymin=40, ymax=60, n
values(r) <- 1:ncell(r)
plot(r)
```



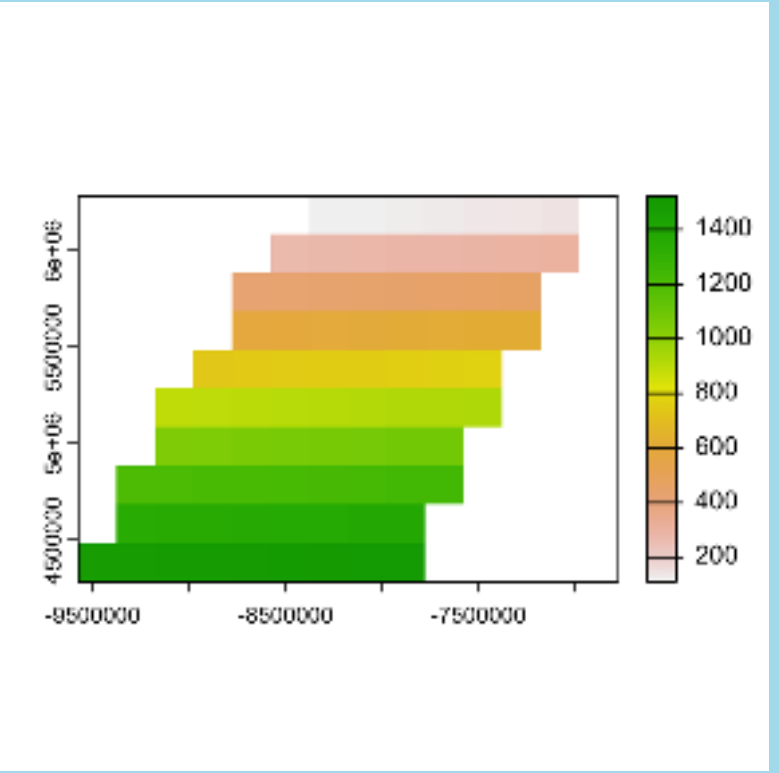
Projecting raster data

- simple method; alignment not guaranteed

```
1  newcrs <- "+proj=robin +datum=WGS8
2  pr1 <- terra::project(r, newcrs)
3  plot(pr1)
```

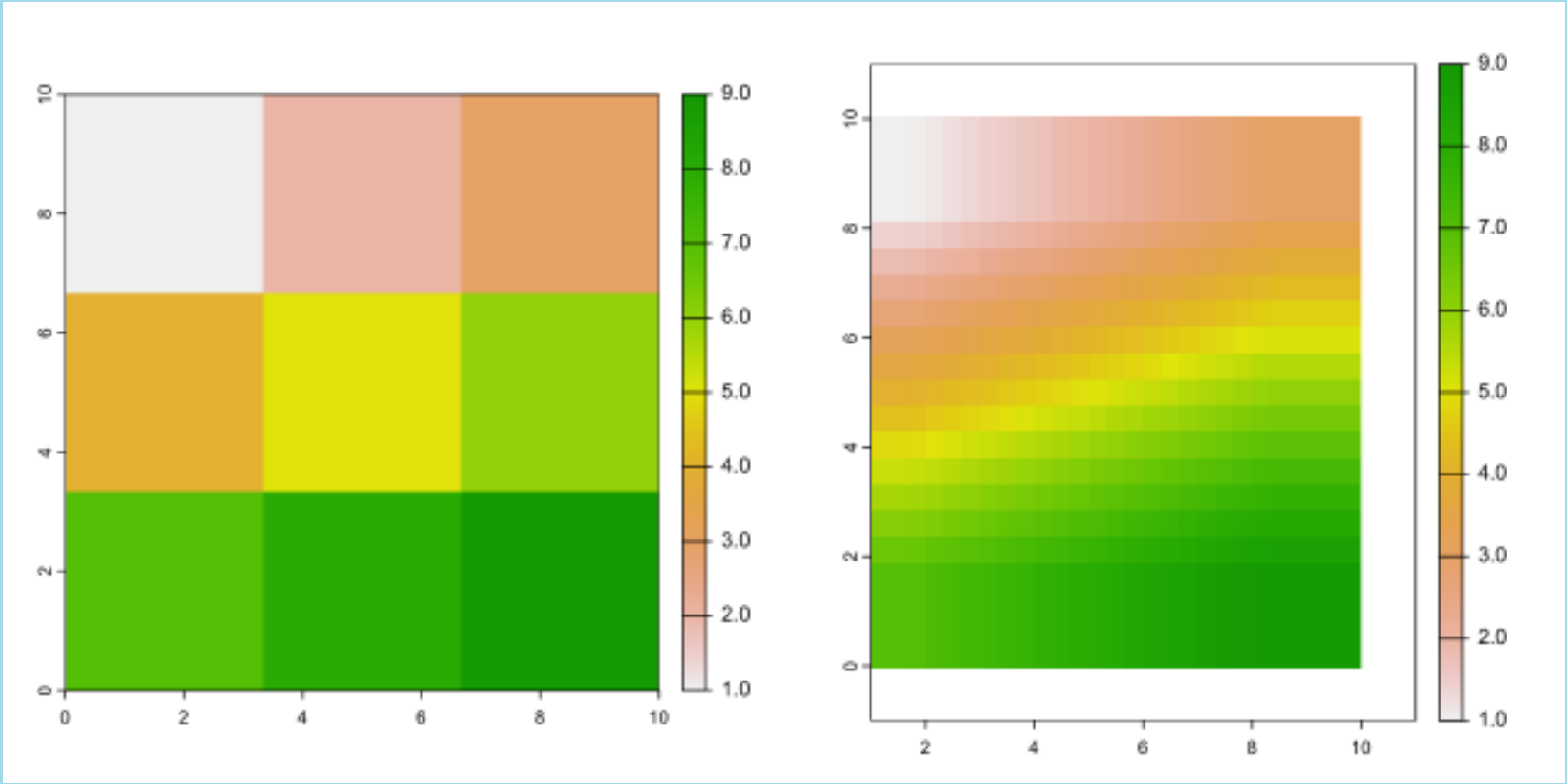


- providing a template to ensure alignment



Aligning Data: resample

```
r <- rast(nrow=3, ncol=3, xmin=0, xmax=10, ymin=0, ymax=10)
values(r) <- 1:ncell(r)
s <- rast(nrow=25, ncol=30, xmin=1, xmax=11, ymin=-1, ymax=11)
x <- resample(r, s, method="bilinear")
```



Adjusting resolution

Downscaling and Upscaling

- Aligning data for later analysis
- Remembering *scale*
- Thinking about support

Changing resolutions

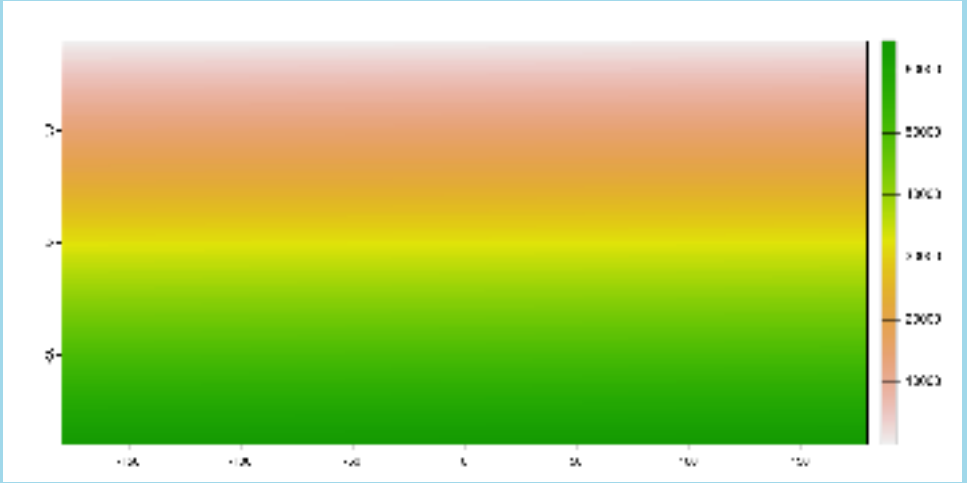
- `aggregate`, `disaggregate`, `resample` allow changes in cell size
- `aggregate` requires a function (e.g., `mean()` or `min()`) to determine what to do with the grouped values
- `resample` allows changes in cell size **and** shifting of cell centers (slower)

Changing resolutions: aggregate

```
r <- rast()
r
```

```
class       : SpatRaster
dimensions  : 180, 360, 1  (nrow, ncol, nlyr)
resolution  : 1, 1  (x, y)
extent      : -180, 180, -90, 90 (xmin, xmax, ymin, ymax)
coord. ref. : lon/lat WGS 84
```

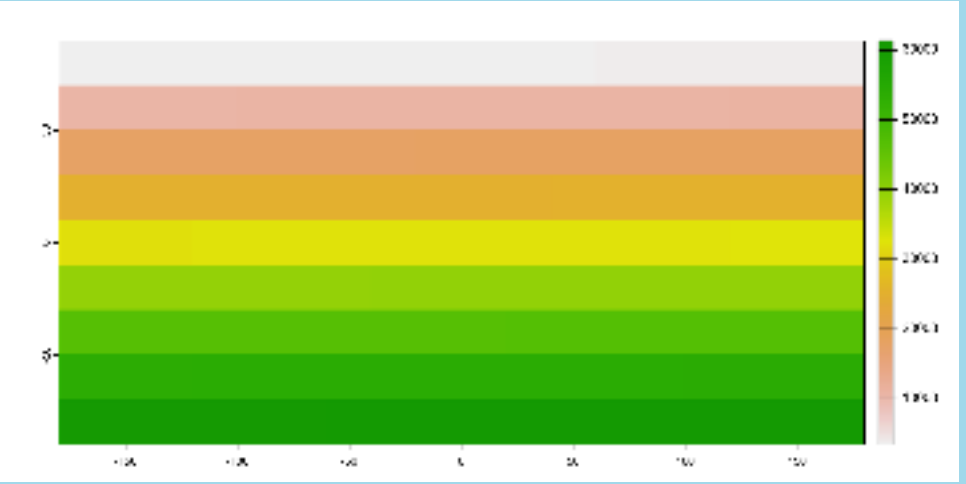
```
values(r) <- 1:ncell(r)
plot(r)
```



```
ra <- aggregate(r, 20)
ra
```

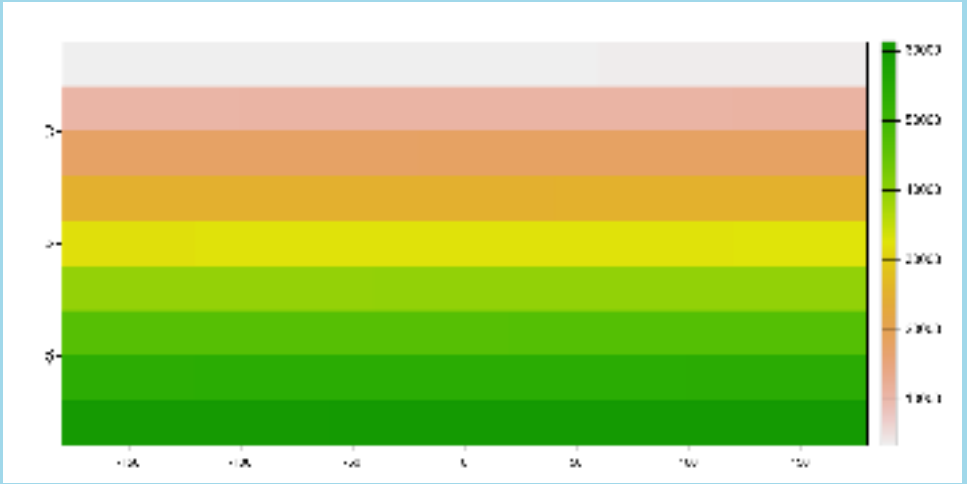
```
class       : SpatRaster
dimensions  : 9, 18, 1  (nrow, ncol, nlyr)
resolution  : 20, 20  (x, y)
extent      : -180, 180, -90, 90 (xmin, xmax, ymin, ymax)
coord. ref. : lon/lat WGS 84
source(s)   : memory
name        :   lyr.1
min value   :  3430.5
max value   : 61370.5
```

```
plot(ra)
```



Changing resolutions: disagg

```
ra <- aggregate(r, 20)
plot(ra)
```



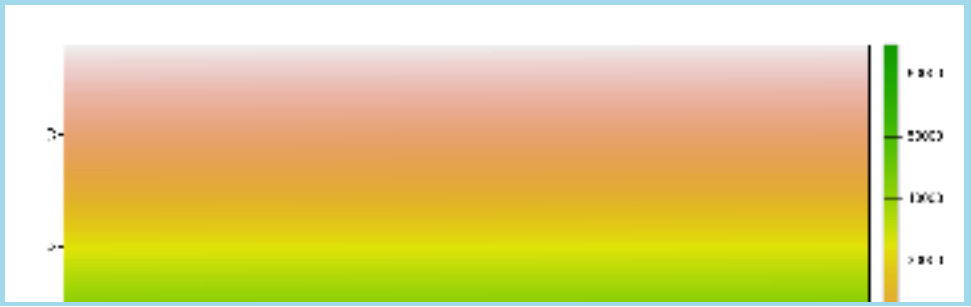
```
rd <- disagg(r, 20)
```

```
|---------|---------|---------|---------|
========
```

```
rd
```

```
class       : SpatRaster
dimensions  : 3600, 7200, 1  (nrow, ncol, nlyr)
resolution  : 0.05, 0.05  (x, y)
extent      : -180, 180, -90, 90 (xmin, xmax, ymin, ymax)
coord. ref. : lon/lat WGS 84
source      : spat_xkiiGK7x3gEZoSd_72946.tif
name        : lyr.1
min value   :     1
max value   : 64800
```

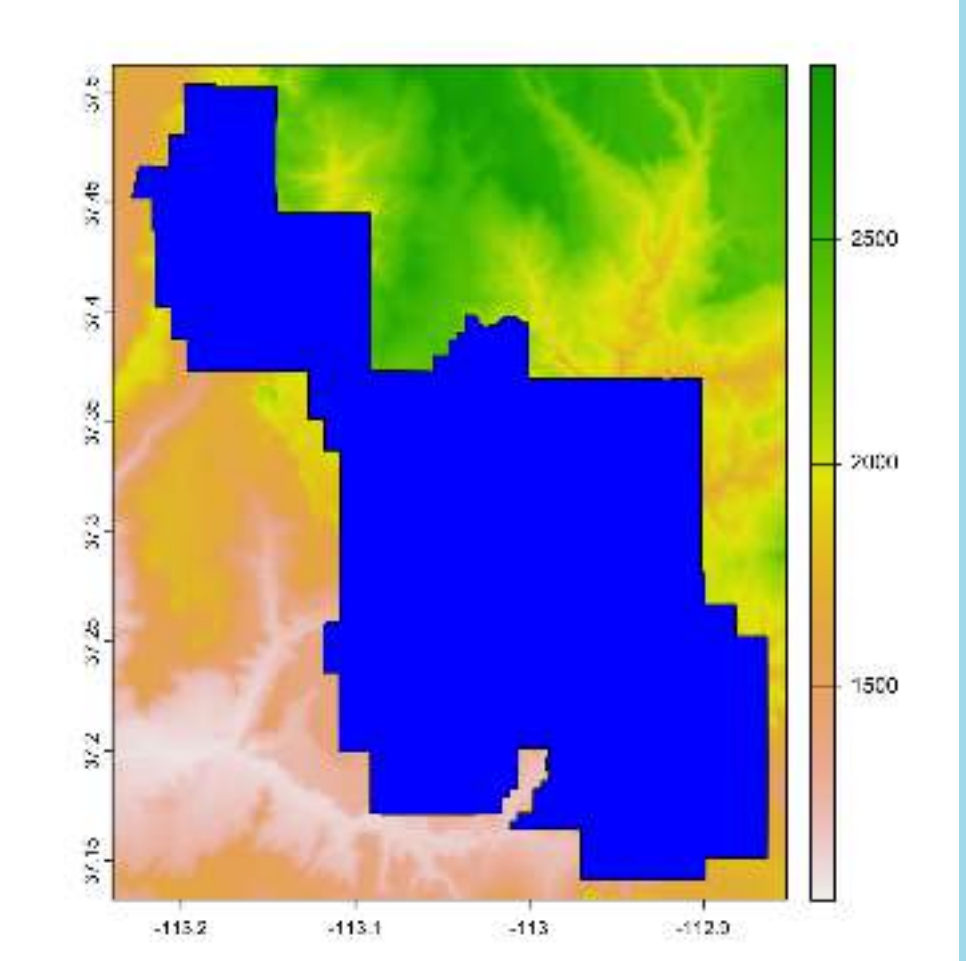
```
plot(rd)
```



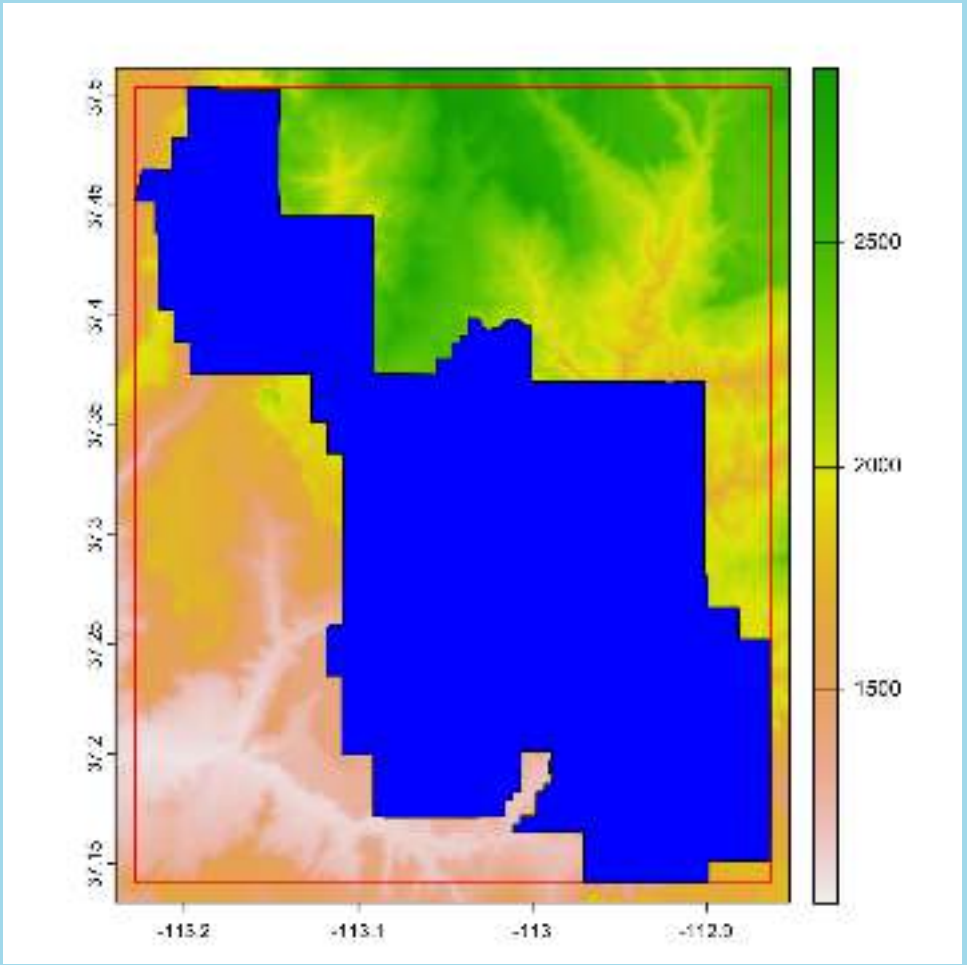
Modifying the Extent

Dealing with Different Extents

- Raster extents often larger than our analysis
- Reducing memory and computational resources
- Making attractive maps



Using `terra::crop()`



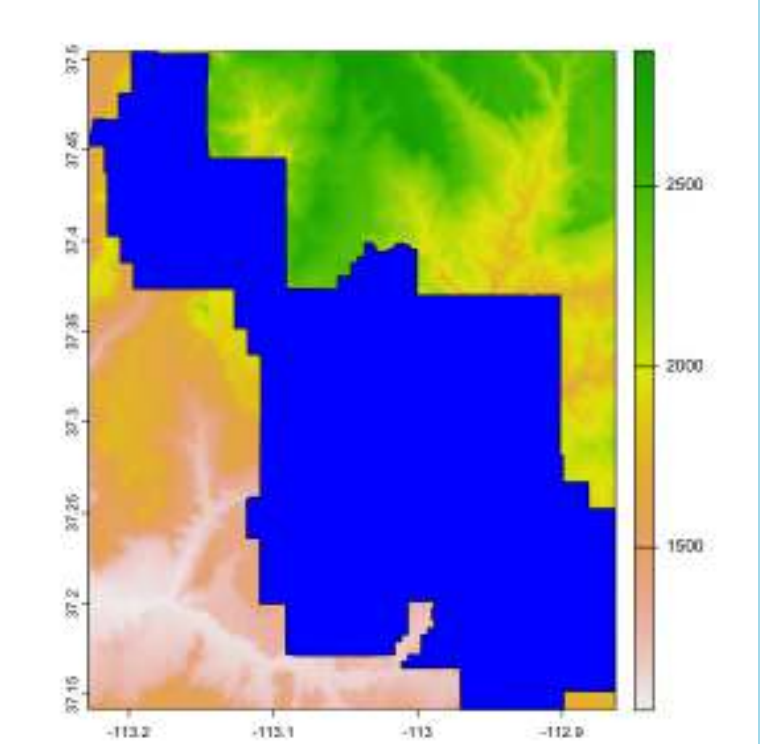
- Coordinate Reference System must be the same for both objects
- Crop is based on the (converted) `SpatExtent` of the 2nd object
- `snap` describes how `y` will be aligned to the raster
- Returns all data within the extent

Using `terra::crop()`

```
1  library(sf)
2  library(terra)
3  library(spDataLarge)
4  srtm = rast(system.file("raster/srtm.tif", package = "spDataLa
5  zion = read_sf(system.file("vector/zion.gpkg", package = "spDa
6  zion = st_transform(zion, crs(srtm))
7
8  crs(srtm) == crs(zion)
```

```
[1] TRUE
```

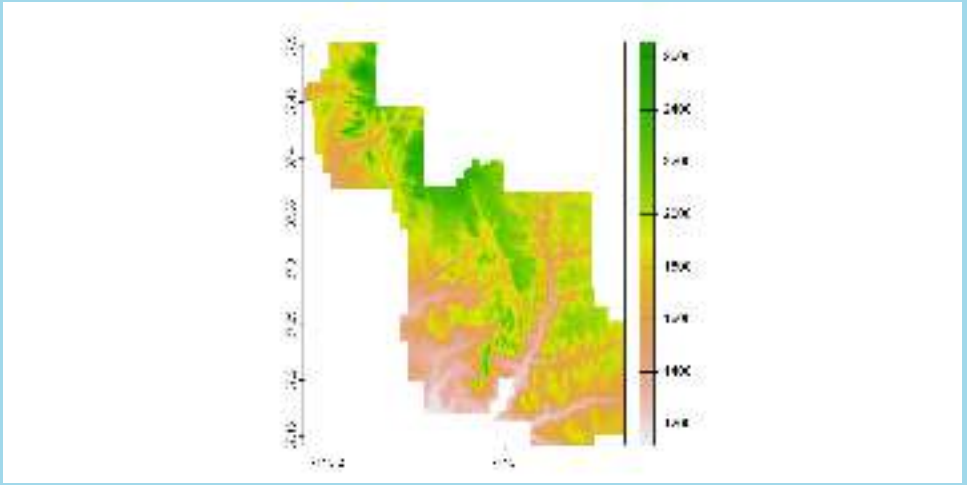
```
1  srtm.crop <- crop(x=srtm, y=zion, snap="near")
```



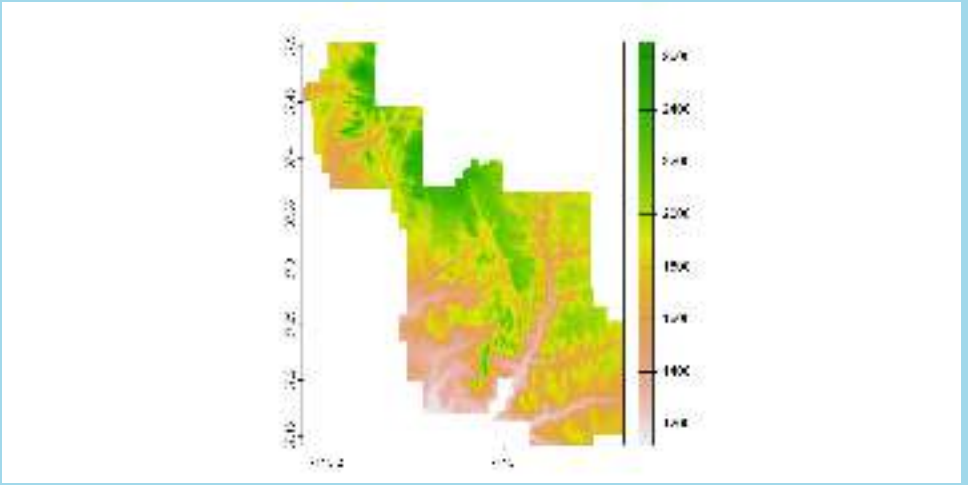
Using `mask()`

- Often want to get rid of all values outside of vector
- Can set `mask=TRUE` in `crop()` (`y` must be `SpatVector`)
- Or use `mask()`

```
1 srtm.crop.msk <- crop(x=srtm, y=ve
2 plot(srtm.crop.msk)
```



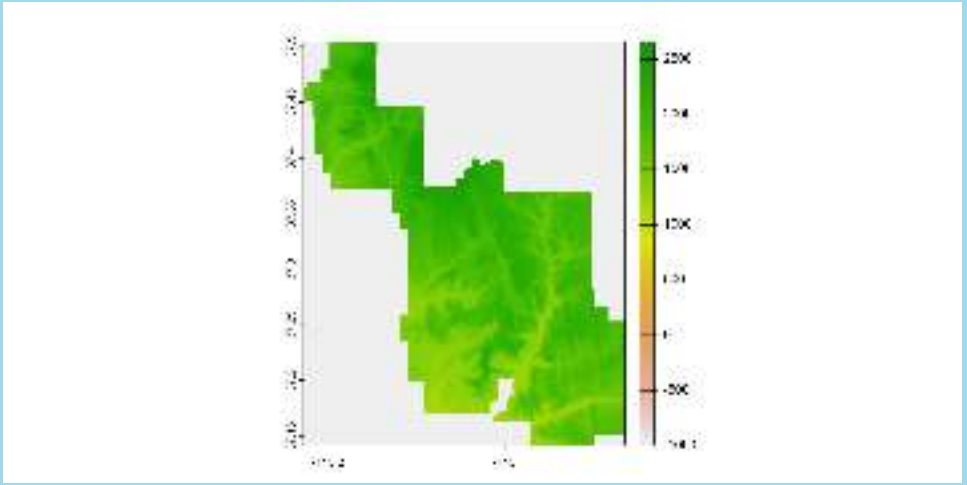
```
1 srtm.msk <- mask(srtm.crop, vect(z
2 plot(srtm.msk)
```



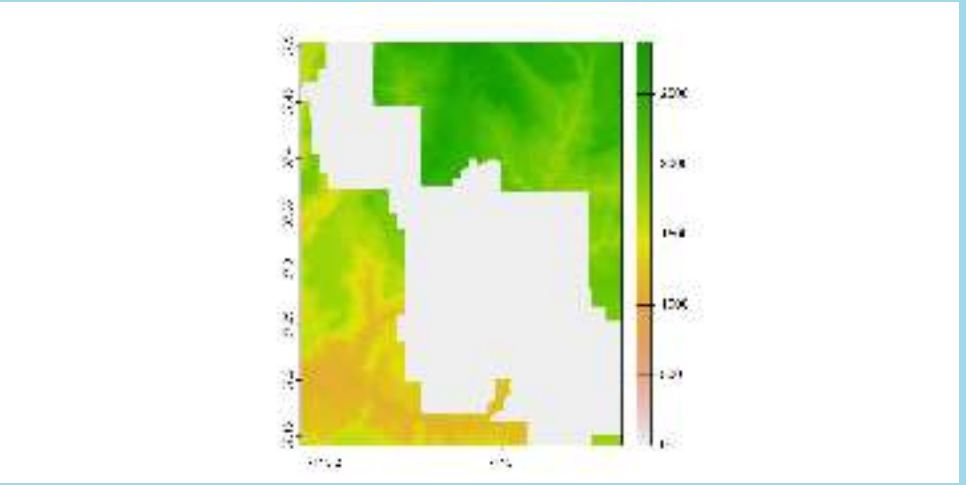
Using `mask()`

- Allows more control over what the mask does
- Can set `maskvalues` and `updatevalues` to change the resulting raster
- Can also use `inverse` to mask out the vector

```
1 srtm.msk <- mask(srtm.crop, vect(z
2 plot(srtm.msk)
```



```
1 srtm.msk <- mask(srtm.crop, vect(z
2 plot(srtm.msk)
```



Extending boundaries

- Vector slightly larger than raster
- Especially when using buffered datasets
- Can use `extend`
- Not exact; depends on `snap()`

```r
zion.buff <-  zion %>%
  st_buffer(., 10000)
srtm.ext <- extend(srtm, vect(zion
ext(srtm.ext)
```

```
SpatExtent : -113.343749879444,
-112.74791654615, 37.0479167631968,
37.5979167631601 (xmin, xmax, ymin,
ymax)
```

```r
ext(vect(zion.buff))
```

```
SpatExtent : -113.343652923976,
-112.747986193365, 37.0477357596604,
37.5977812137969 (xmin, xmax, ymin,
ymax)
```