

# Operations With Raster Data II

HES 505 Fall 2022: Session 12

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# Today's Plan

# Objectives

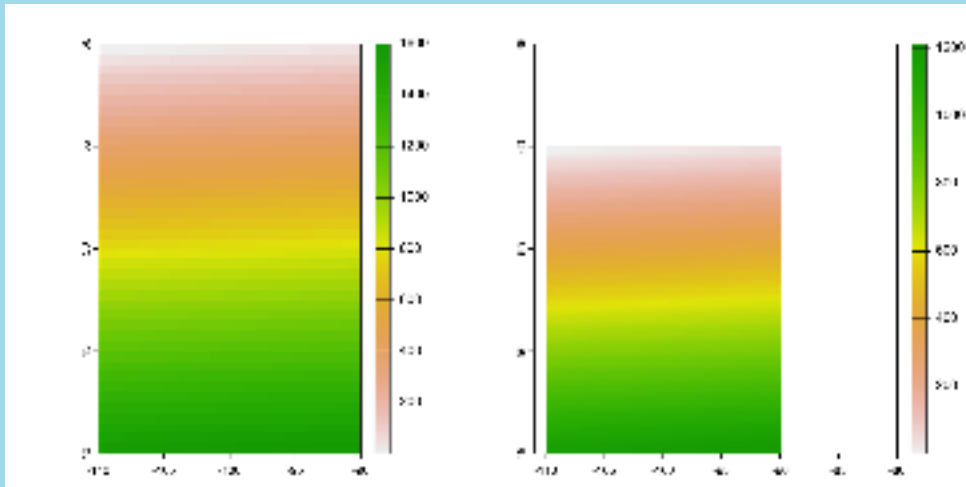
- By the end of today, you should be able to:
  - Access and manipulate cell values
  - Generate new rasters using mathematical functions
  - Summarize rasters using global functions
  - Generate new rasters describing the spatial context of individual cells

# Revisiting Projections

# Revisiting Projections

- **resample** transfers values between SpatRaster objects that do not align
- Must have same **crs**

```
1 a <- rast(ncols=40, nrows=40, xmin=-110, xmax=-90,  
2         crs="+proj=longlat +datum=WGS84")  
3 values(a) <- 1:ncell(a)  
4  
5 b <- rast(ncols=94, nrows=124, xmin=-111, xmax=-80,  
6         crs="+proj=longlat +datum=WGS84")  
7 w <- resample(a, b)
```



```
1 origin(a)
```

```
[1] 0 0
```

```
1 origin(b)
```

```
[1] 0.1382979 0.0000000
```

```
1 origin(w)
```

```
[1] 0.1382979 0.0000000
```

```
1 res(a)
```

```
[1] 0.5 0.5
```

```
1 res(b)
```

```
[1] 0.3297872 0.1612903
```

```
1 res(w)
```

```
[1] 0.3297872 0.1612903
```

# Revisiting Projections

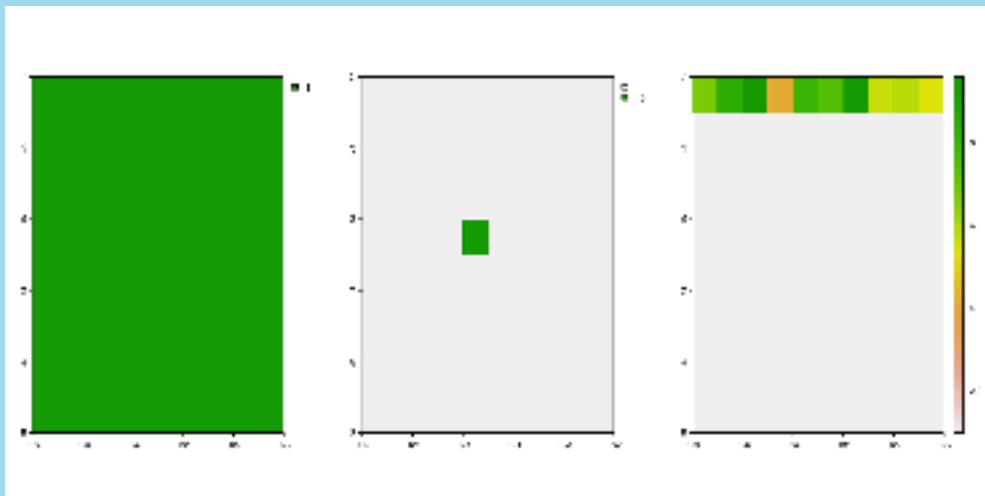
- if origin and extent are the same consider using aggregate, disaggregate, extend or crop

# Cell-wise operations

# Accessing Cell Values

- We can extract or change cell values using `[]`

```
1 a <- rast(ncols=10, nrows=10, xmin=-110, xmax=-100, ymin=40, ymax=50,  
2         crs="+proj=longlat +datum=WGS84")  
3 values(a) <- 1  
4 b1 <- a  
5 b2 <- a  
6 b1[5,5] <- 10  
7 b2[1, 1:10 ] <- runif(10,4,10)
```



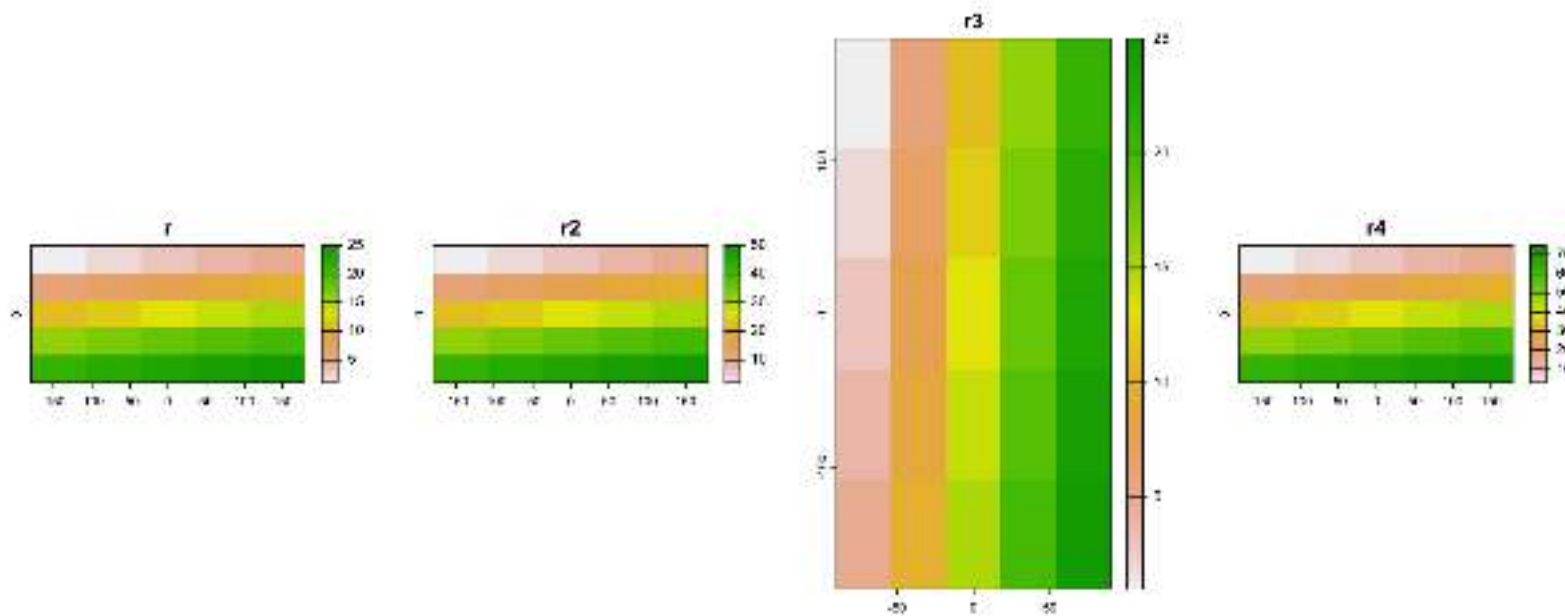


# Raster Math

- Performs cell-wise calculations on 1 (or more) **SpatRasters**
- Generally works the same as matrix operations
- All layers must be aligned

# Raster Math

```
1 r <- rast(ncol=5, nrow=5)
2 values(r) <- 1:ncell(r)
3 r2 <- r*2
4 r3 <- t(r)
5 r4 <- r + r2
```

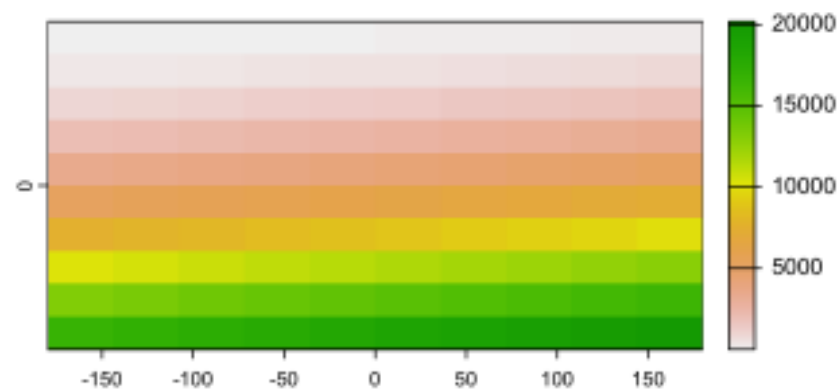
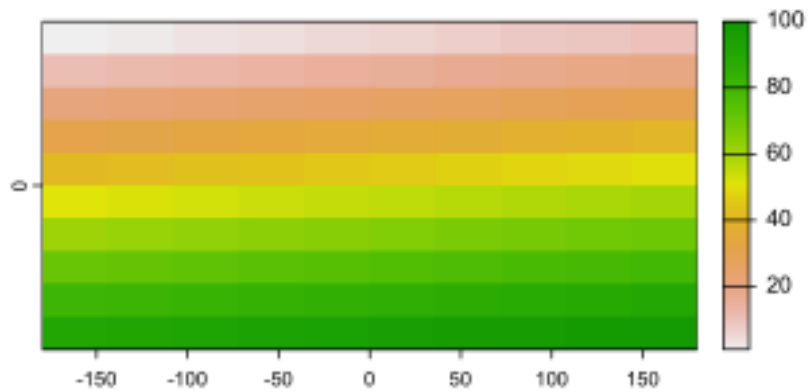


# Cell-wise operations

- **terra** has a special set of **apply** functions
- **app**, **lapp**, **tapp**
- **app** applies a function to the values of each cell
- **lapp** applies a function using the layer as the value
- **tapp** applies the function to a subset of layers

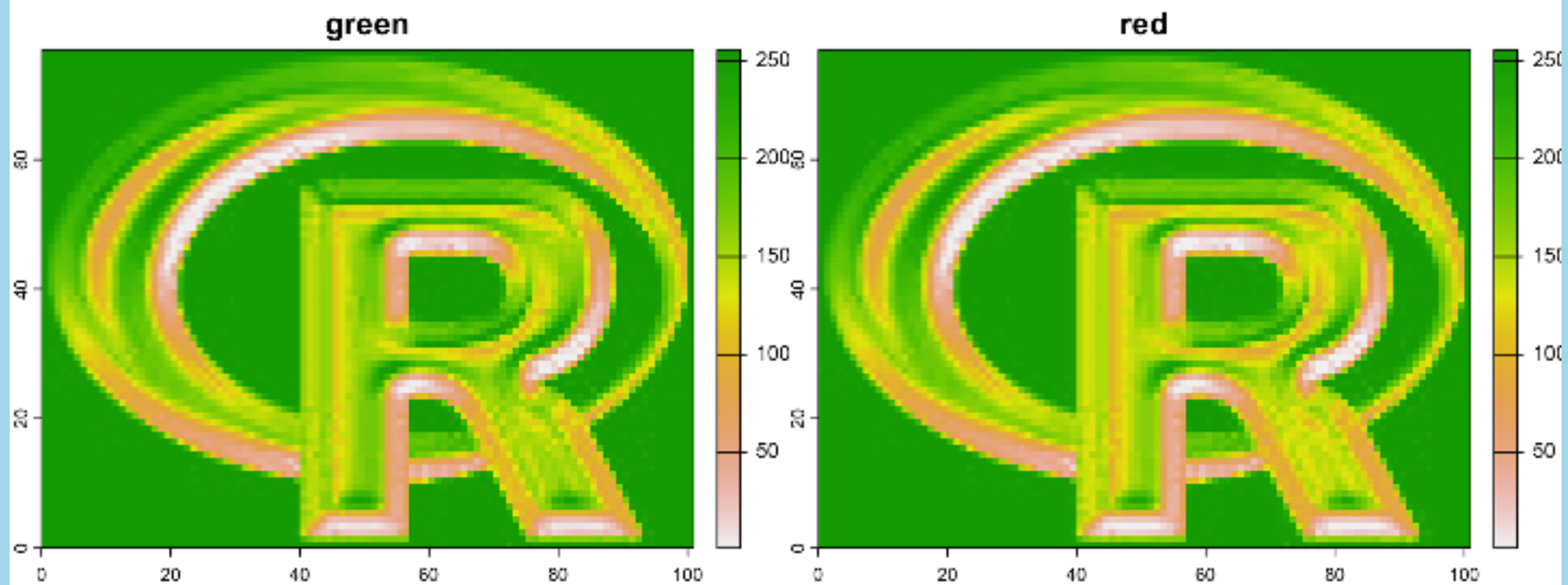
# Cell-wise operations

```
1 r <- rast(ncols=10, nrows=10)
2 values(r) <- 1:ncell(r)
3 f <- function(i) (i+1) * 2 * i + sqrt(i)
4 s <- app(r, f)
```



# Cell-wise Operations

```
1 s <- rast(system.file("ex/logo.tif", package="terra")) + 1
2 ss <- s[[2:1]]
3
4 fvi <- function(x, y){ (x - y ) / (x + y) }
5 x <- lapp(ss, fun=fvi)
```



# Global Methods

Global methods are those that can be applied to any problem, regardless of the specific details of the problem.

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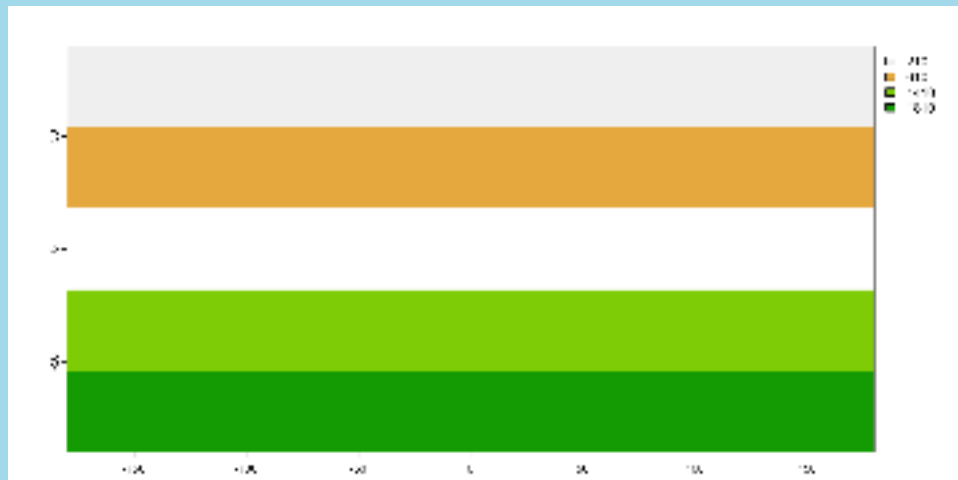
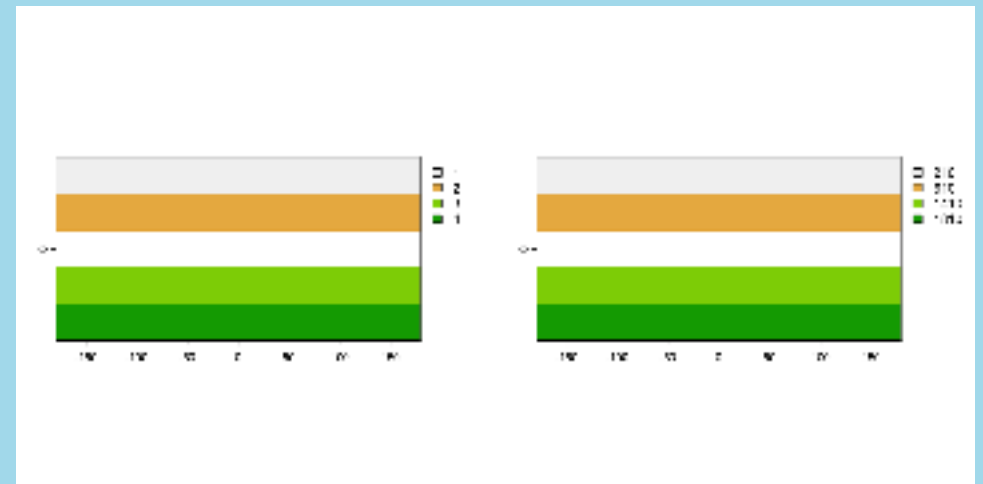
Global methods are those that can be applied to any problem, regardless of the specific details of the problem.

- Provide summaries of 1 or more layers
- Use **zonal** to extract values from one layer based on **categorical** layer

```

1 r <- rast(ncols=10, nrow=10)
2 values(r) <- 1:ncell(r)
3 z <- rast(r)
4 values(z) <- rep(c(1:2, NA, 3:4),
5 names(z) <- "zone"
6 a <- zonal(r, z, "sum", na.rm=TRUE)
7 b <- zonal(r, z, "sum", na.rm=TRUE)
8 plot(b)

```





# Context-specific Functions

- **distance** and relatives are based on relationships between cells
- **focal** provides moving windows for smoothing data
- **terrain** allows calculation of slope, ruggedness, aspect using elevation rasters
- **shade** calculates hillshade based on terrain

# Using **focal**

- **focal** requires a window (**w**) or weights matrix
- **na.policy** determines how to deal with **NAs** in the smoother
- **fillvalue** and **expand** tell **terra** what to do at the edges

```
1 r <- rast(ncols=10, nrows=10, ext(0, 10, 0, 10))
2 values(r) <- 1:ncell(r)
3
4 f <- focal(r, w=3, fun=function(x, ...) quantile(x, c(.25, .5, .75), ...),
5 plot(f)
```

# Using focal

