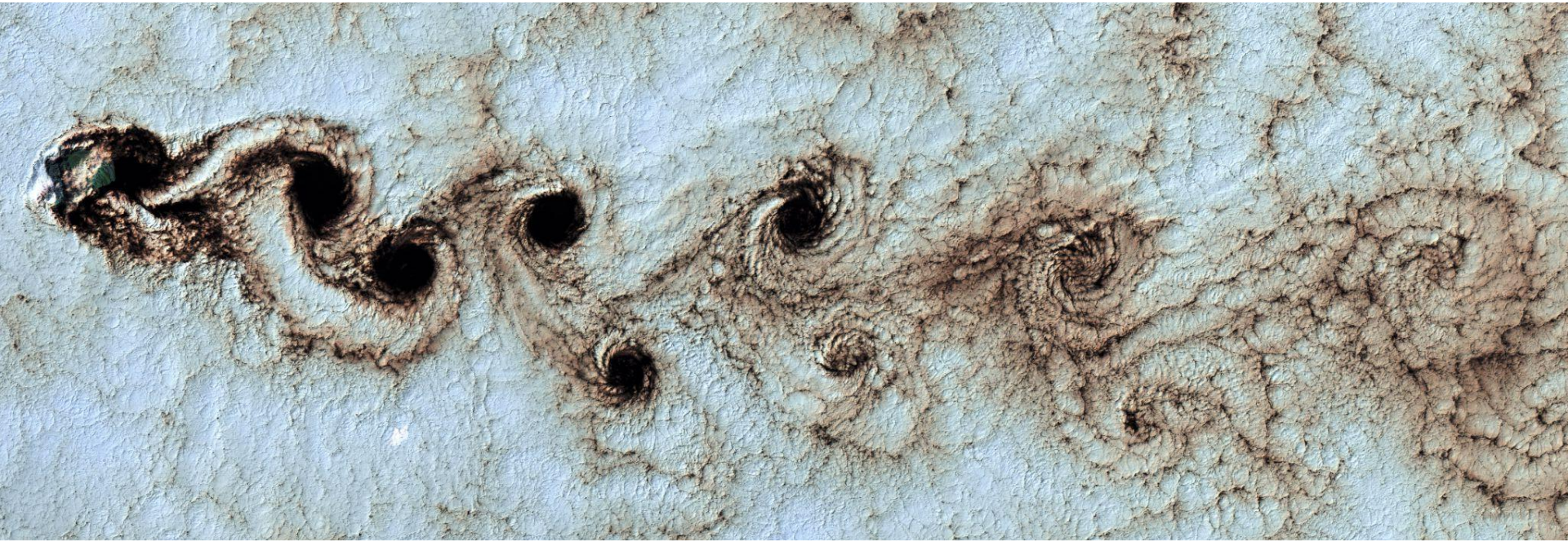
EDS 223: Geospatial Analysis & Remote Sensing
Week 4



USGS via Unsplash

Welcome!

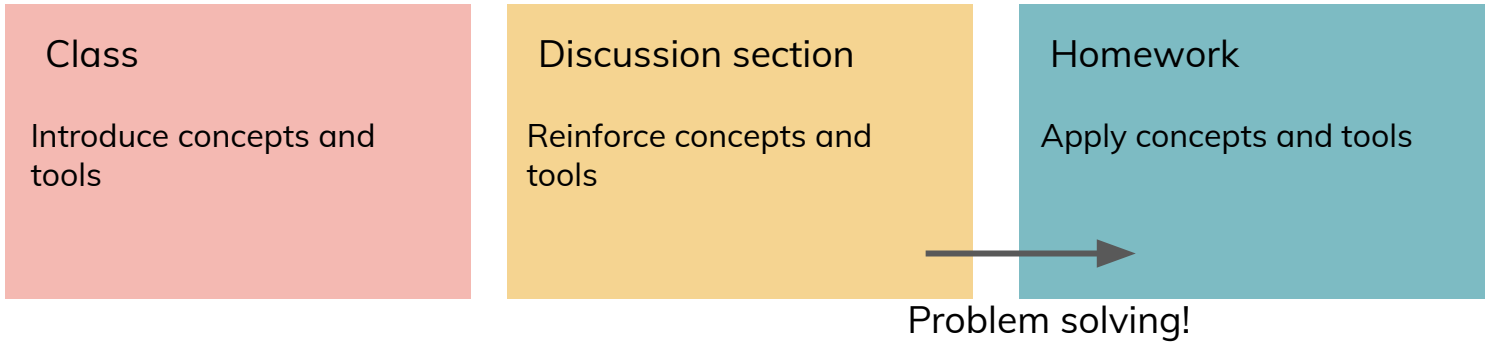
- **Course logistics**
  - Course expectations
  - Upcoming and past events
  - Plans for next week
- **Building a spatial analysis workflow**

How to get unstuck

Start here

Resource	Steps
Yourself	• Review the lecture/lab/discussion materials • Review the background reading • Google!
Your peers	• Talk to a friend • Ask the #eds-223-geospatial Slack channel
TA	• Ask questions in discussion section • Attend office hours • Send a message over Slack
Instructor	• Attend office hours • Send a message over Slack

Course preparation



How to solve an environmental data science problem

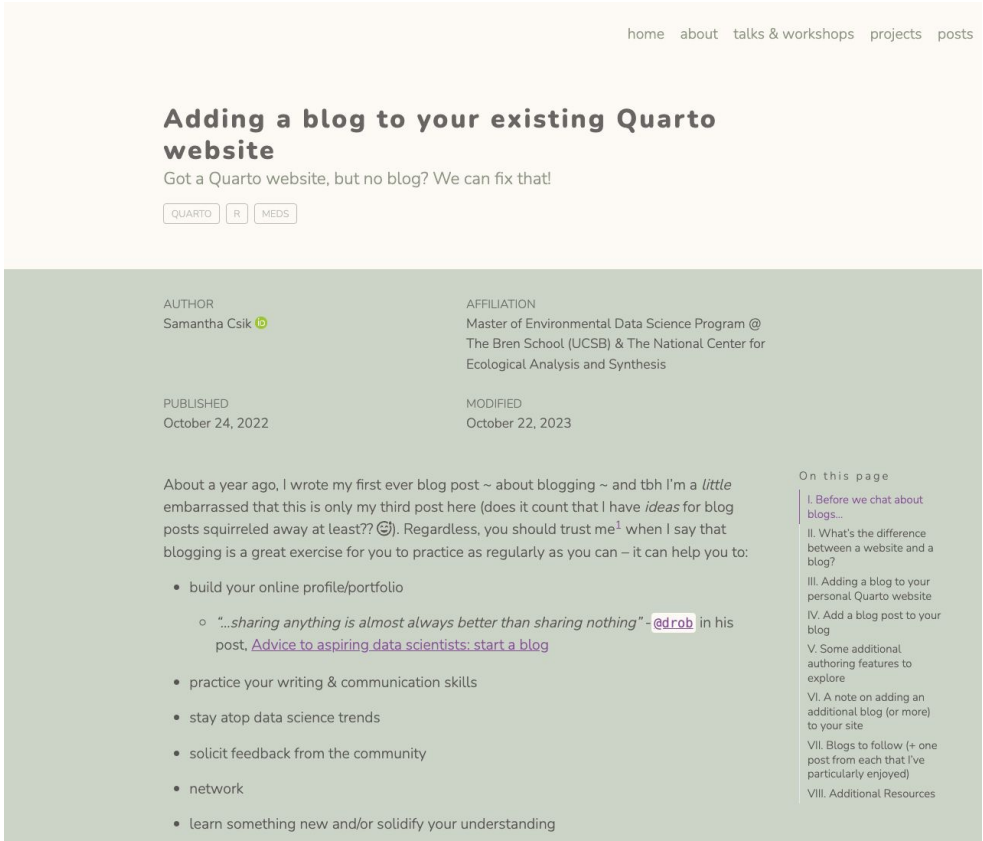
- Break the problem into parts
  - What data do you need?
  - What tools do you need?

- Make a plan
  - What are your inputs?
  - What outputs do you want to create?
  - How can you apply your tools to turn your inputs into outputs?
  - Create a diagram

- Develop your plan
  - Turn our diagram into code

- Test your plan
  - What are the outputs at each step?
  - Do they look right?

Catch up on blogging



home about talks & workshops projects posts

Adding a blog to your existing Quarto website

Got a Quarto website, but no blog? We can fix that!

QUARTO R MEDS

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AFFILIATION
Master of Environmental Data Science Program @ The Bren School (UCSB) & The National Center for Ecological Analysis and Synthesis

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October 22, 2023

About a year ago, I wrote my first ever blog post ~ about blogging ~ and tbh I'm a *little* embarrassed that this is only my third post here (does it count that I have *ideas* for blog posts squirreled away at least?? 😅). Regardless, you should trust me[1] when I say that blogging is a great exercise for you to practice as regularly as you can – it can help you to:

- build your online profile/portfolio
  - *"...sharing anything is almost always better than sharing nothing"* - `@drob` in his post, Advice to aspiring data scientists: start a blog
- practice your writing & communication skills
- stay atop data science trends
- solicit feedback from the community
- network
- learn something new and/or solidify your understanding

On this page

I. Before we chat about blogs...
II. What's the difference between a website and a blog?
III. Adding a blog to your personal Quarto website
IV. Add a blog post to your blog
V. Some additional authoring features to explore
VI. A note on adding an additional blog (or more) to your site
VII. Blogs to follow (+ one post from each that I've particularly enjoyed)
VIII. Additional Resources

EVENTS | COMMUNITY EVENT

Mantell Symposium in Environmental Justice and Conservation Innovation 2023

Advancing Environmental Justice and Conservation Innovation: Global Challenges, Local Solutions

Oct 26 2023 | 1:00pm PST
Bren Hall 1414 / Online

Expert panel on spatial data science

Jessica Couture
Conservation International

Emily Gaston
Rincon Consulting

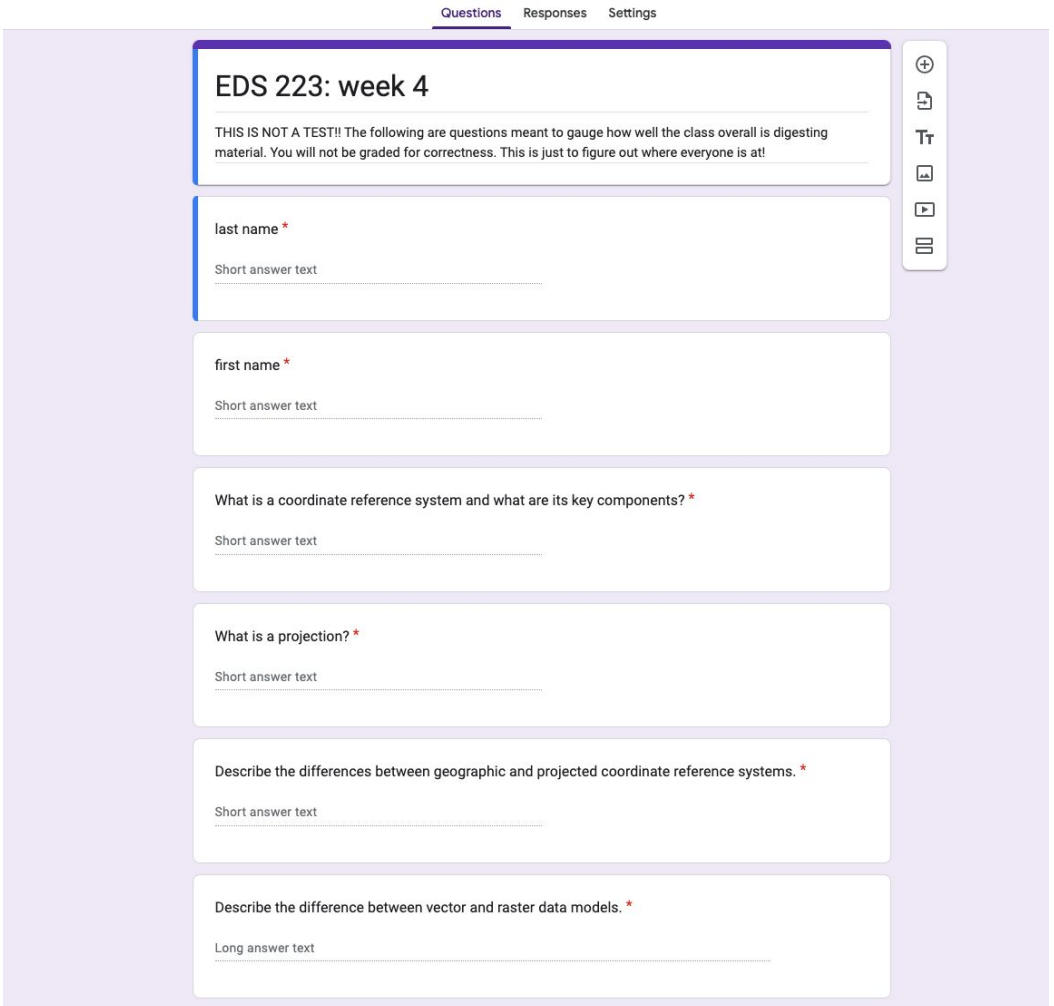
Julie Padilla
USGS

Alessandra Vidal Meza
Audubon Society

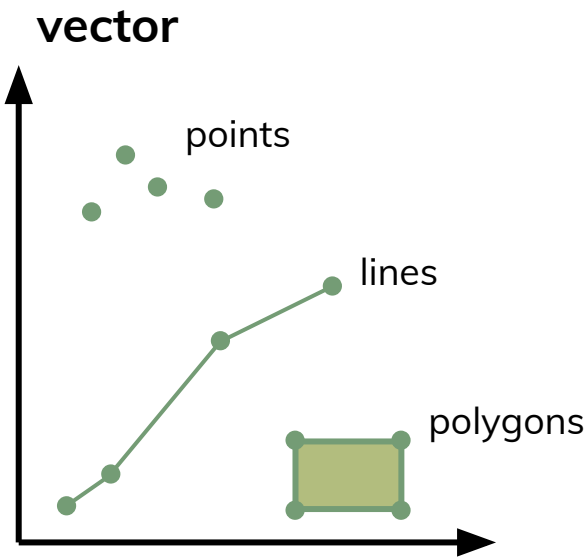
Expert speaker on conservation decision making

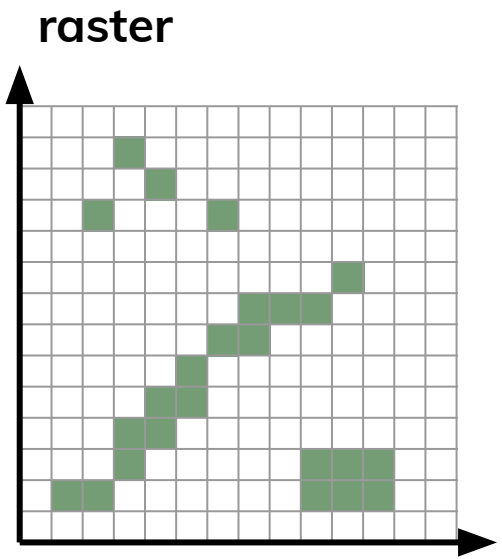
Millie Chapman
NCEAS

Due tonight by midnight!



Spatial data models



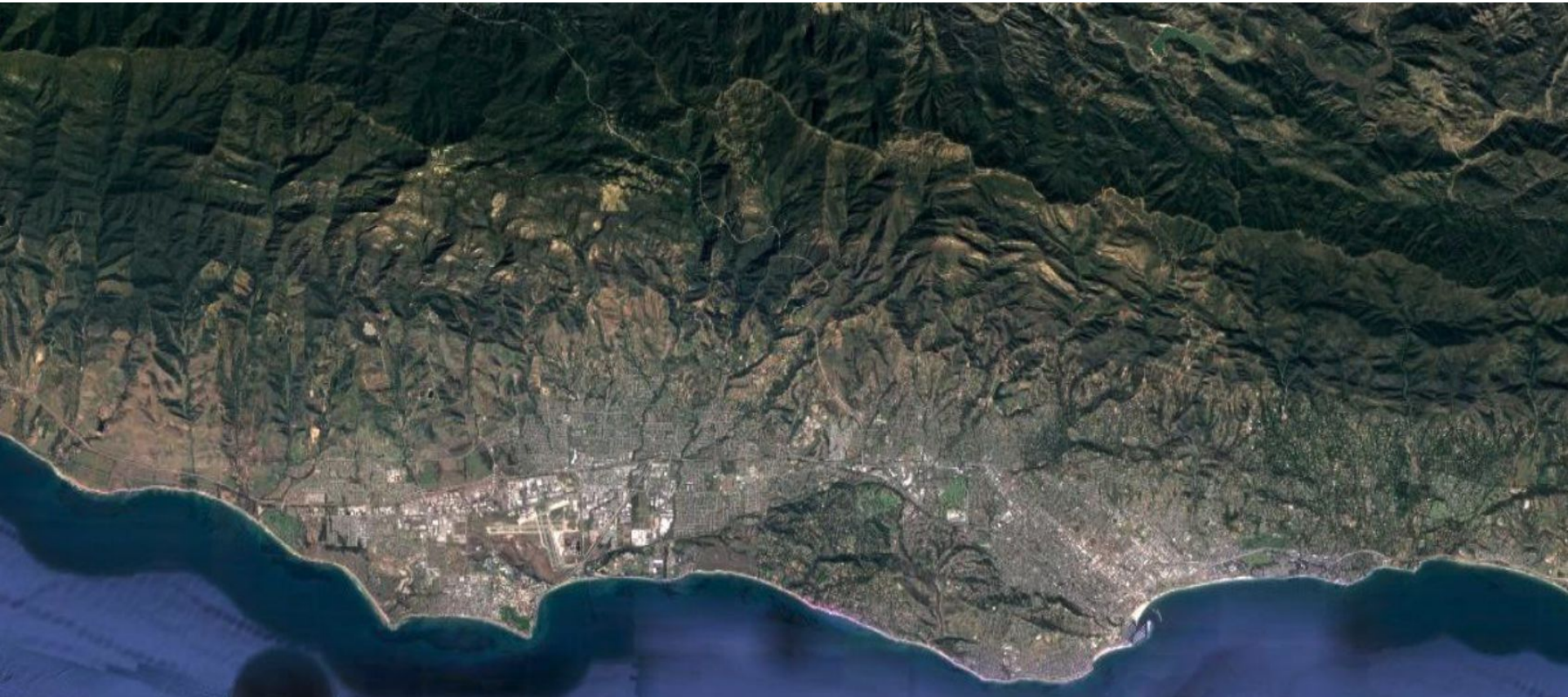


discrete

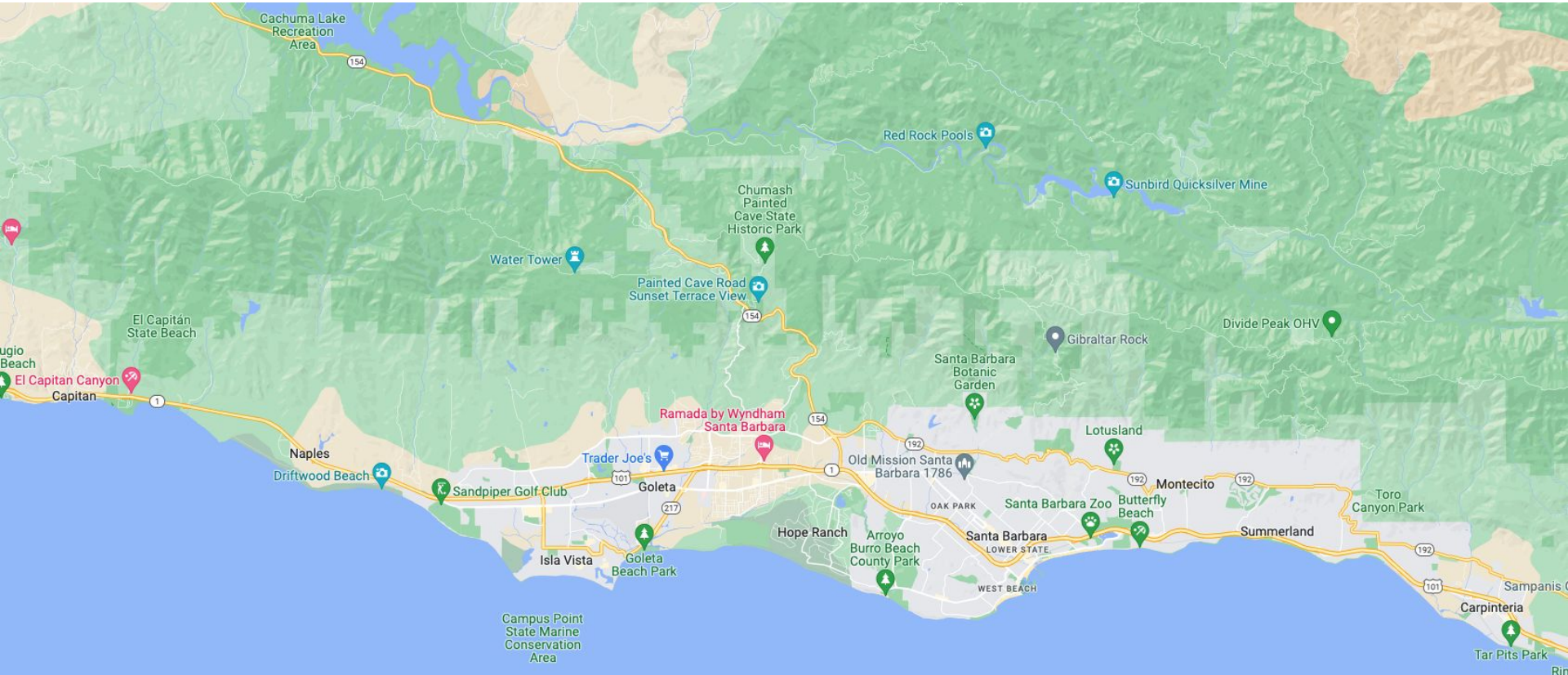
continuous

Modified from: GIS Fundamentals, Paul Bolstad

Spatial data models



Spatial data models



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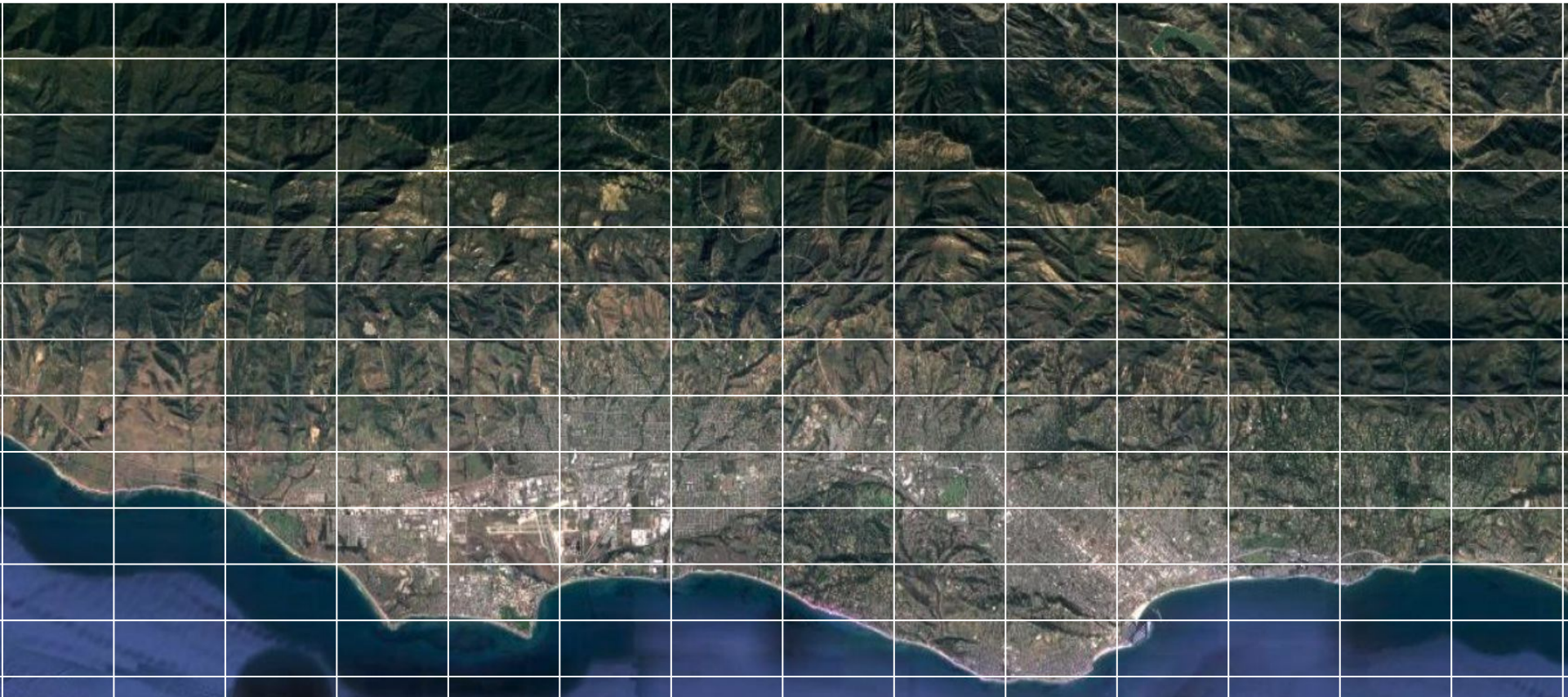

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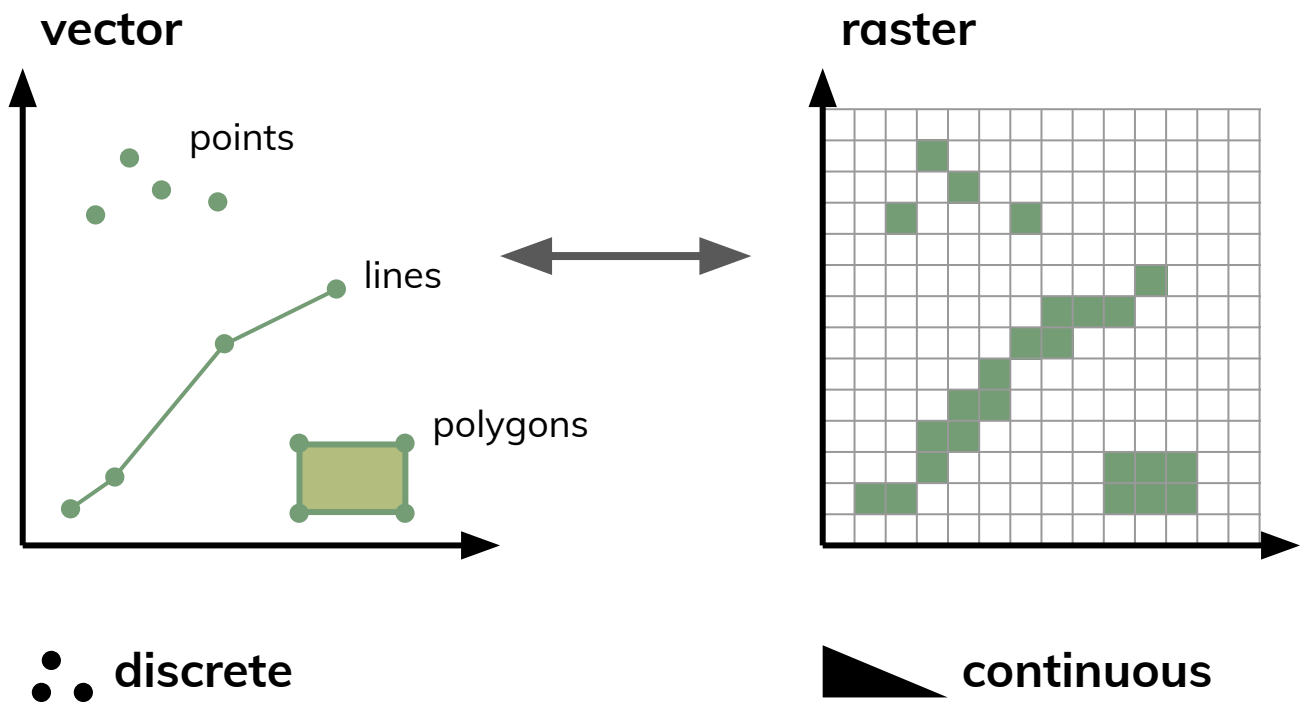
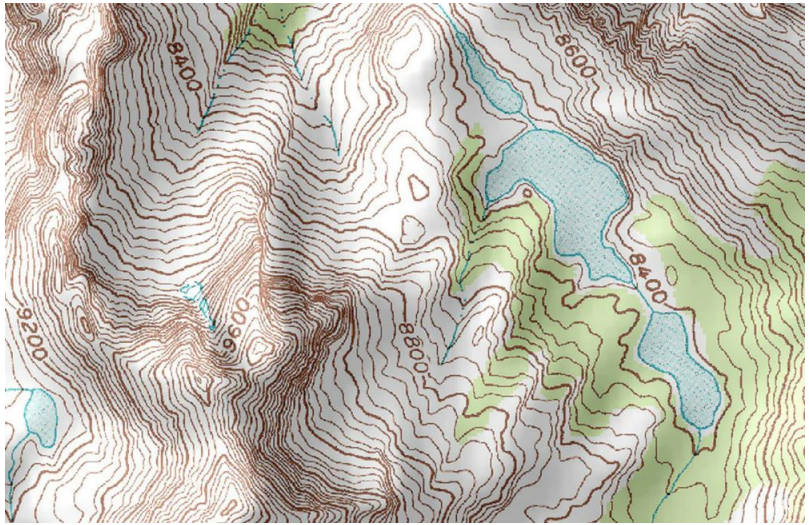


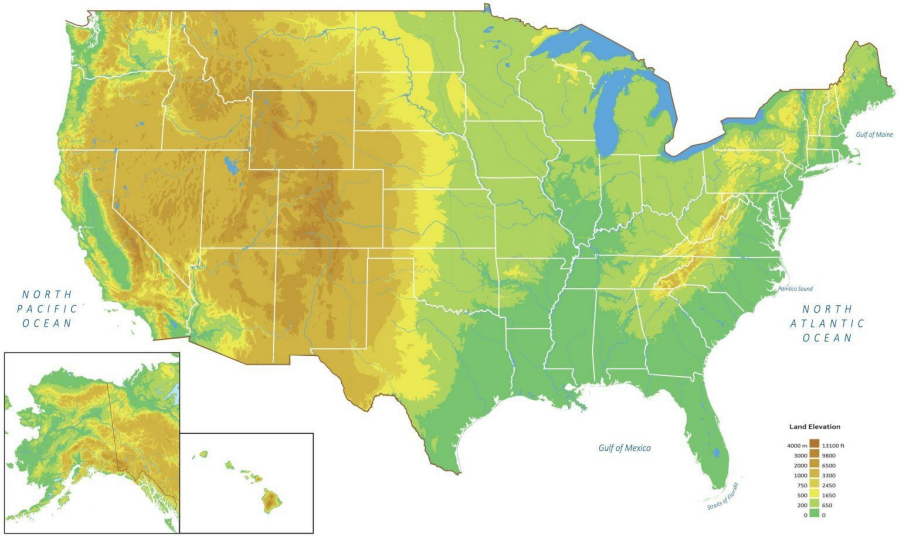
Modified from: GIS Fundamentals, Paul Bolstad

Spatial data models

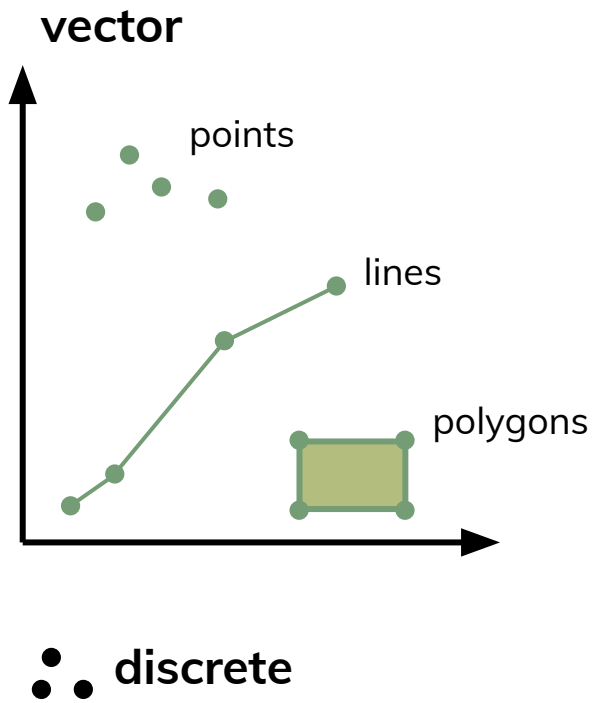
vector



raster



Vector data models



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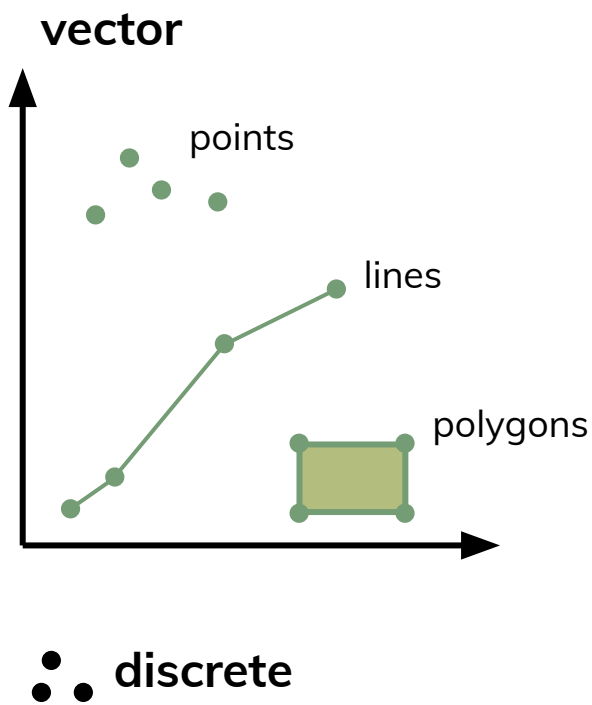
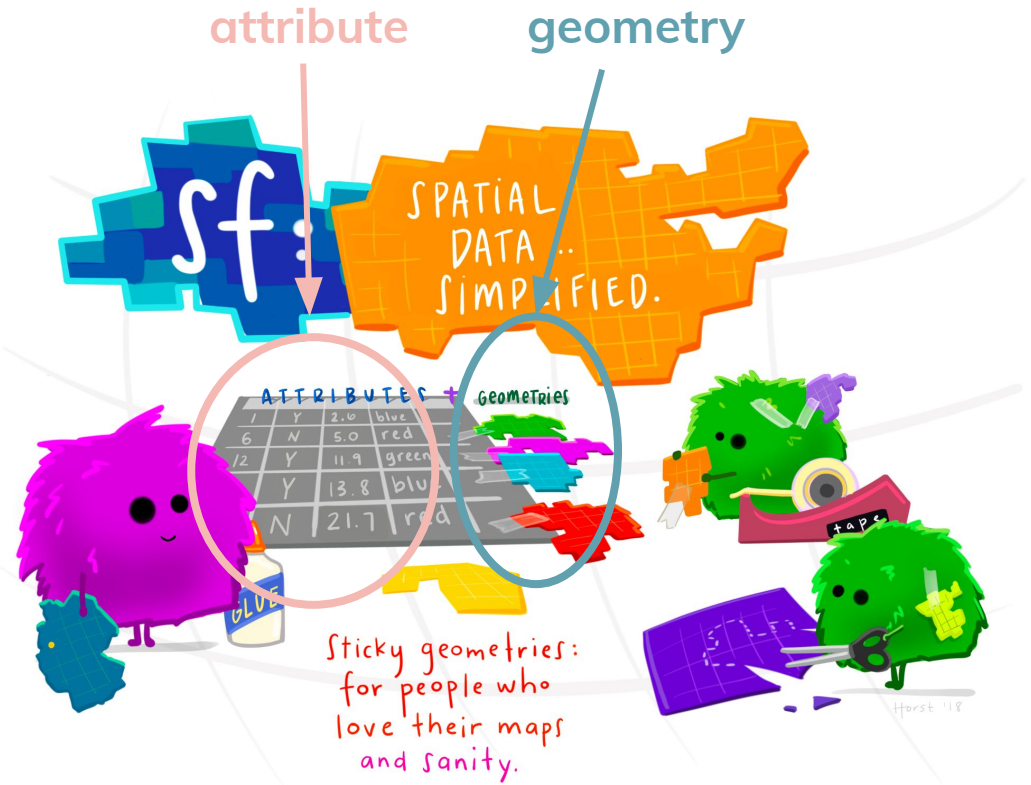
Vector data models

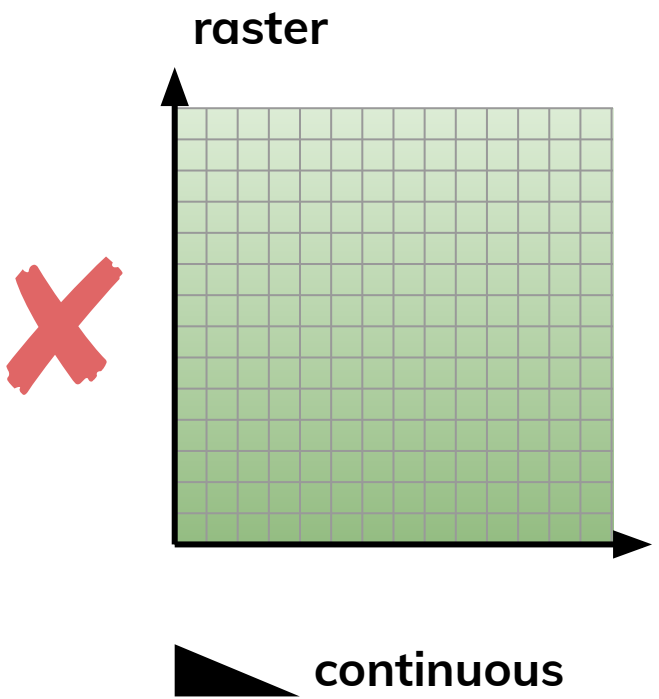




Modified from: GIS Fundamentals, Paul Bolstad

Raster data models

ID	Species	Age
1	Poplar	11
2	Oak	2
3	Beech	12
4	Cedar	15



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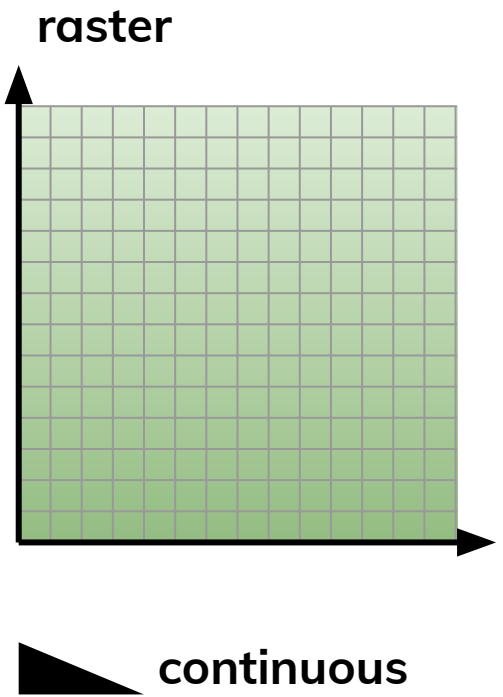
Raster data models

geometry

- ?

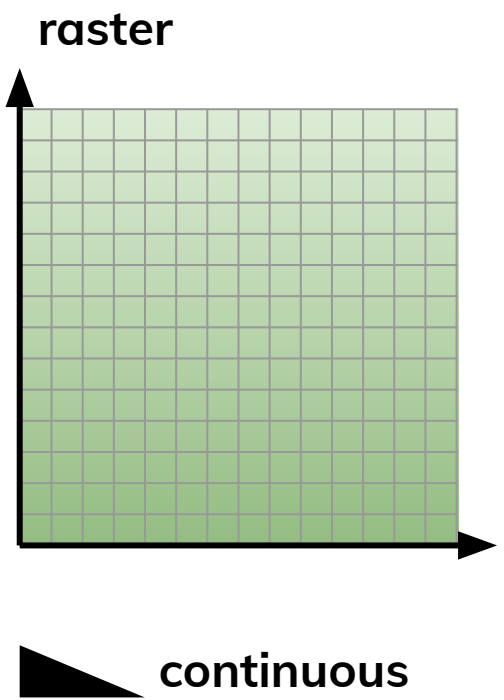


Modified from: GIS Fundamentals, Paul Bolstad

Raster data models

geometry

- Cell size
- Number of rows/columns
- Cell origin
- CRS



Modified from: GIS Fundamentals, Paul Bolstad

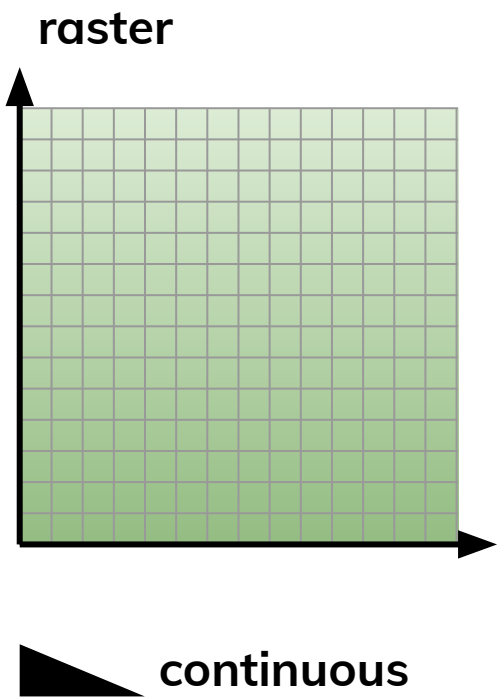
Raster data models

geometry

- Cell size
- Number of rows/columns
- Cell origin
- CRS

attribute

- One value per cell
- Categorical, numerical, logical



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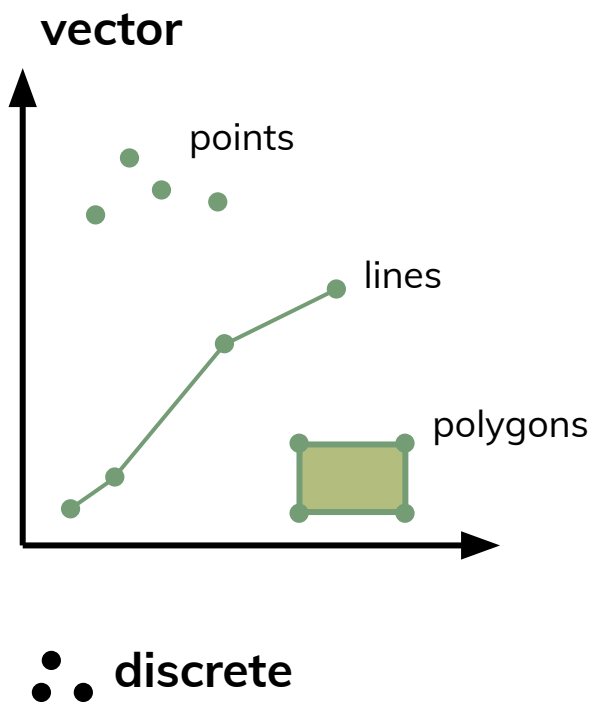
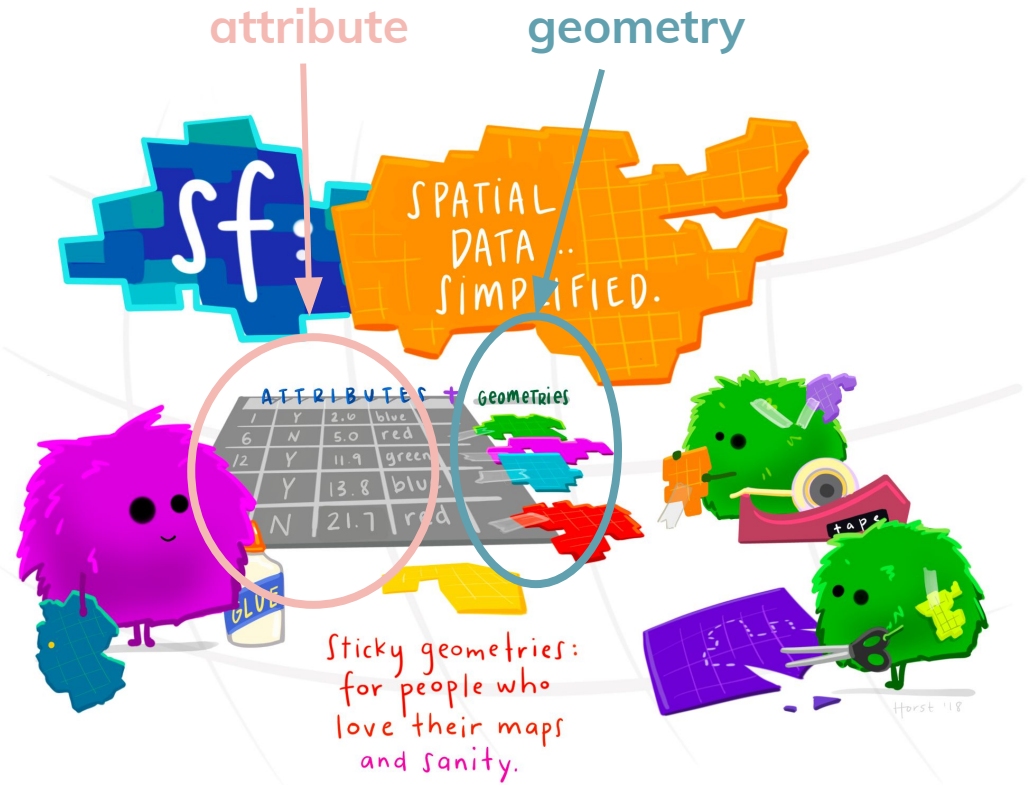
Vector data models





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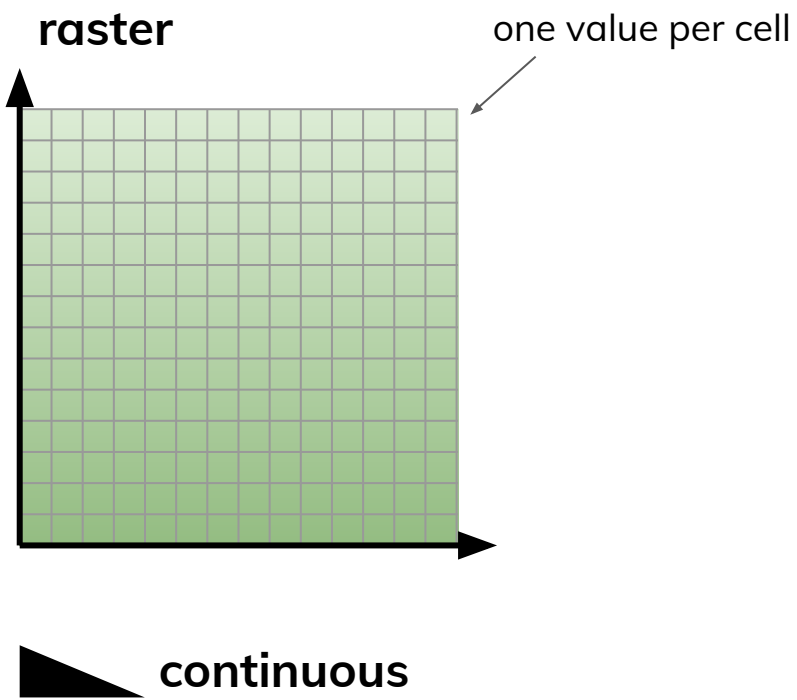

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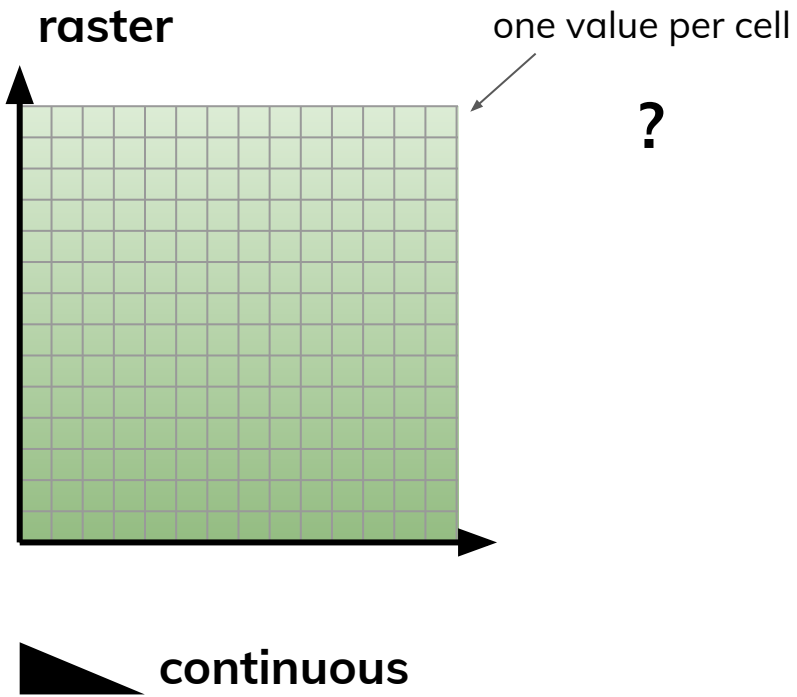

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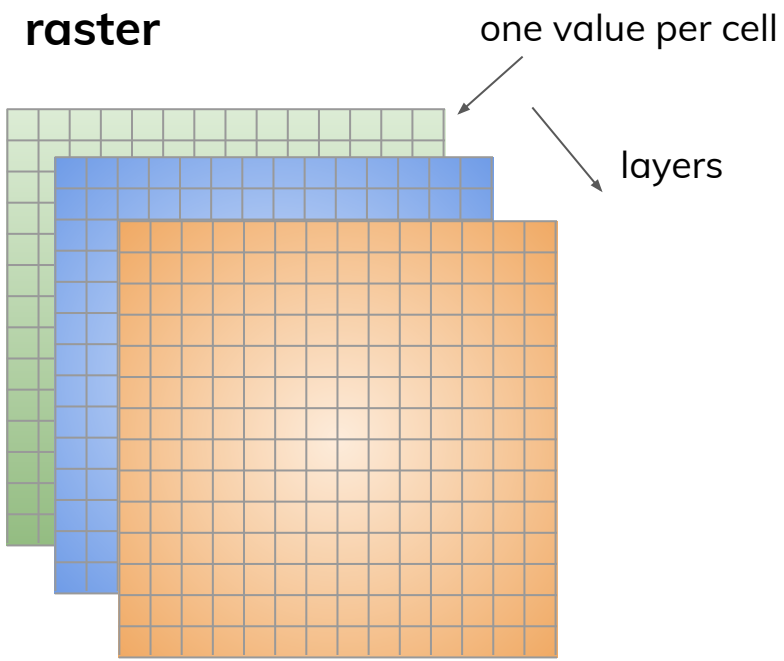


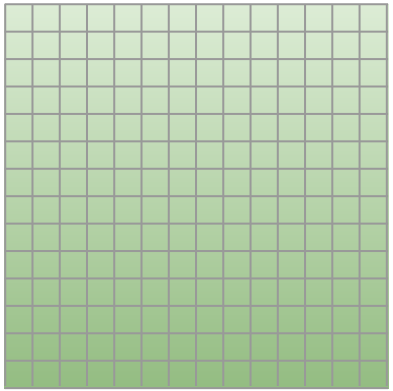
Modified from: GIS Fundamentals, Paul Bolstad

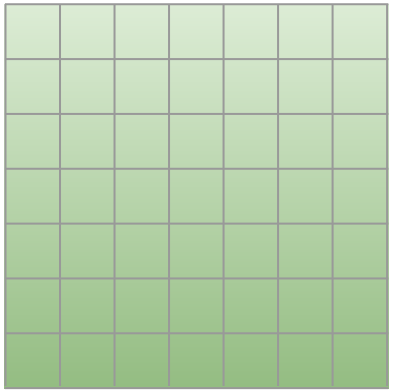
Raster data model

geometry

- Cell size
- Number of rows/columns
- Cell origin
- CRS

→ **resolution**



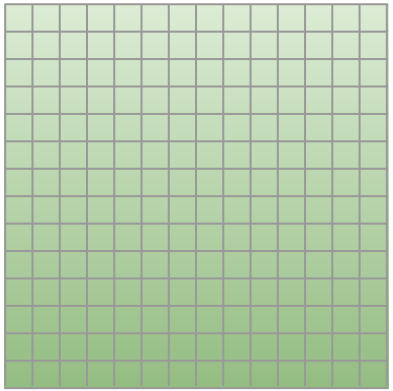


Raster data model

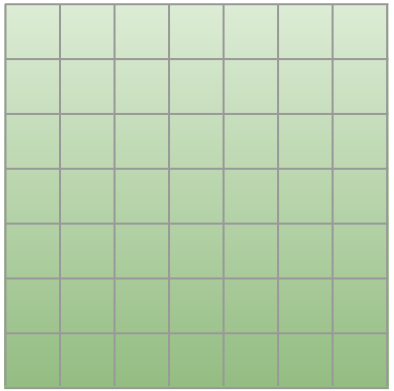
geometry

- Cell size
- Number of rows/columns
- Cell origin
- CRS

→ **resolution**



- “finer”
- “higher”



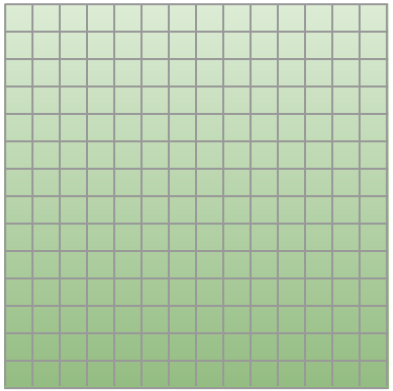
- “coarser”
- “lower”

Raster data model

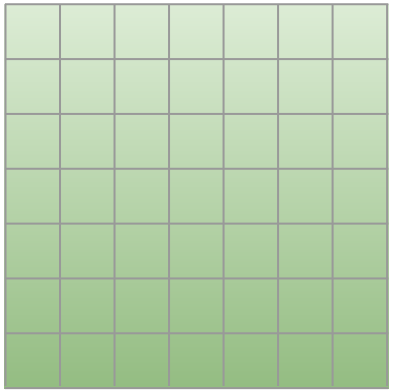
geometry

- Cell size
- Number of rows/columns
- Cell origin
- CRS

→ **resolution**

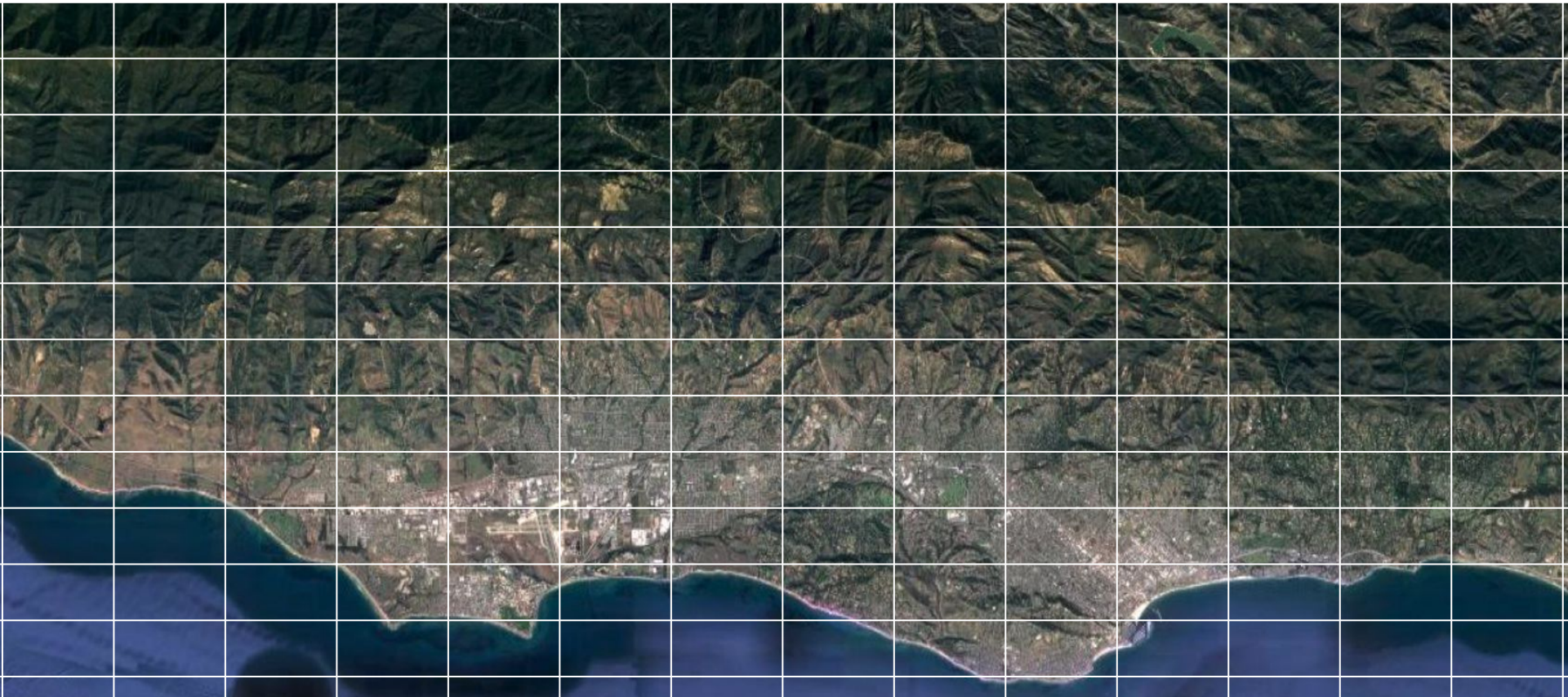


- “finer”
- “higher”
- 1 km

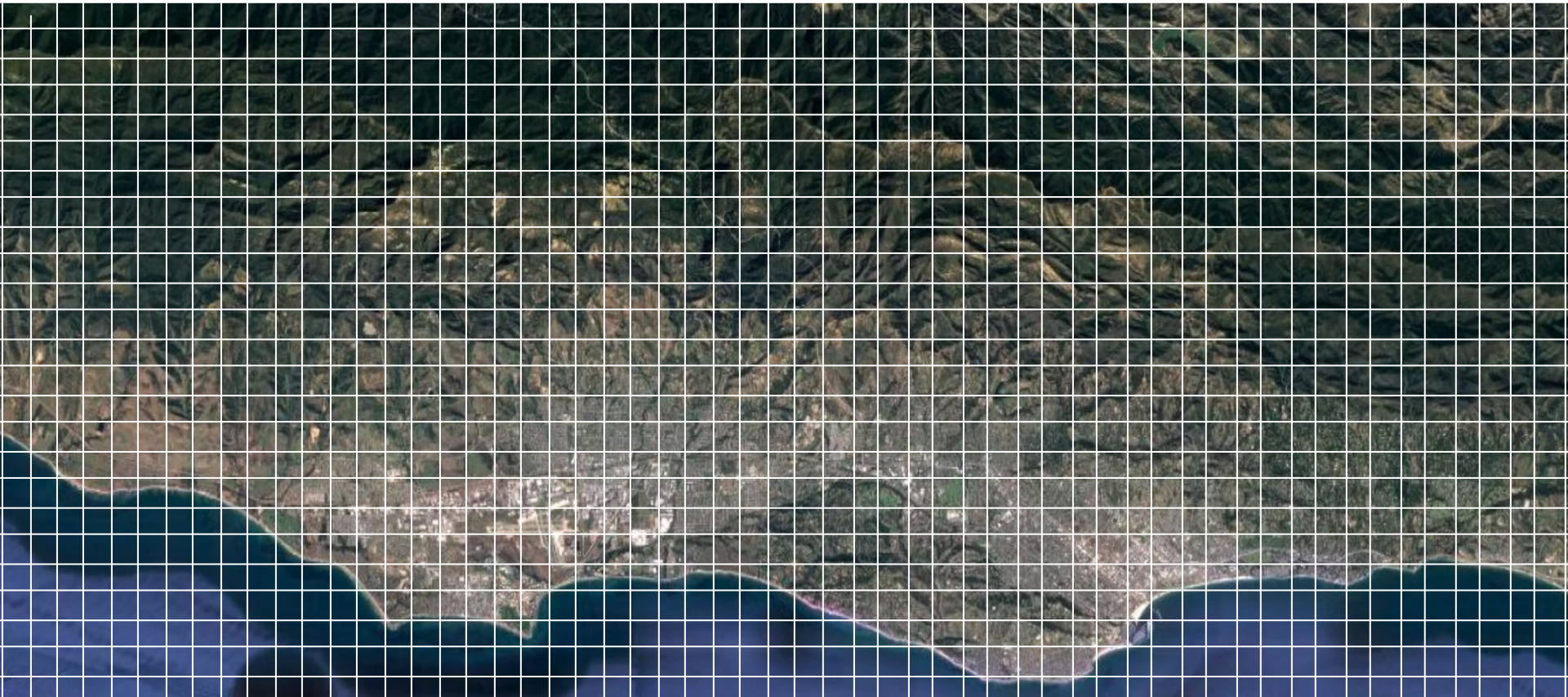


- “coarser”
- “lower”
- 5 km

Spatial data models



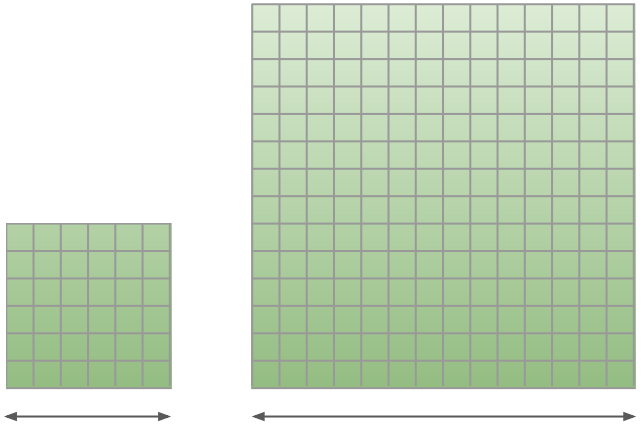
Spatial data models



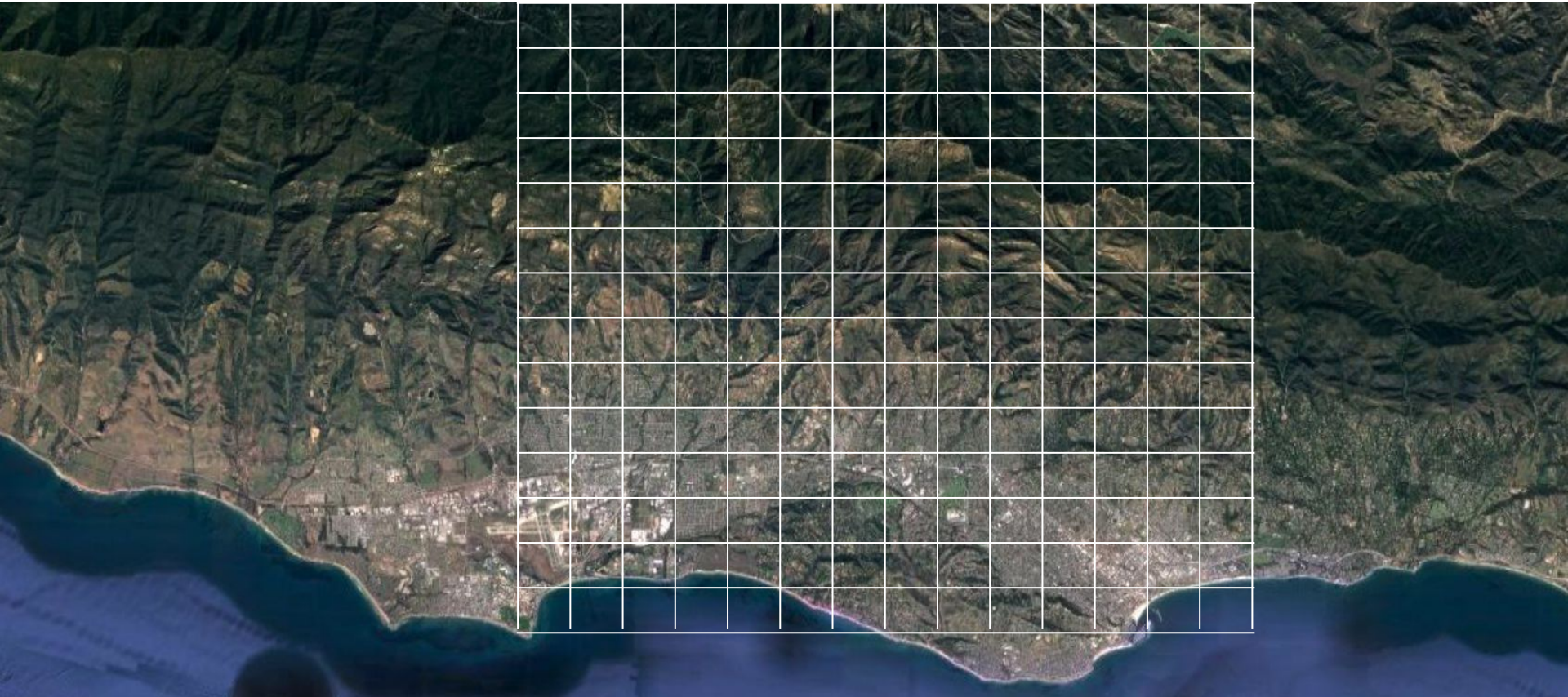
Raster data model

geometry

- Cell size
- Number of rows/columns → **extent**
- Cell origin
- CRS



Spatial data models

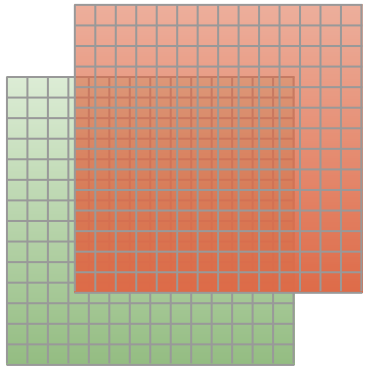


Spatial data models

Raster data model

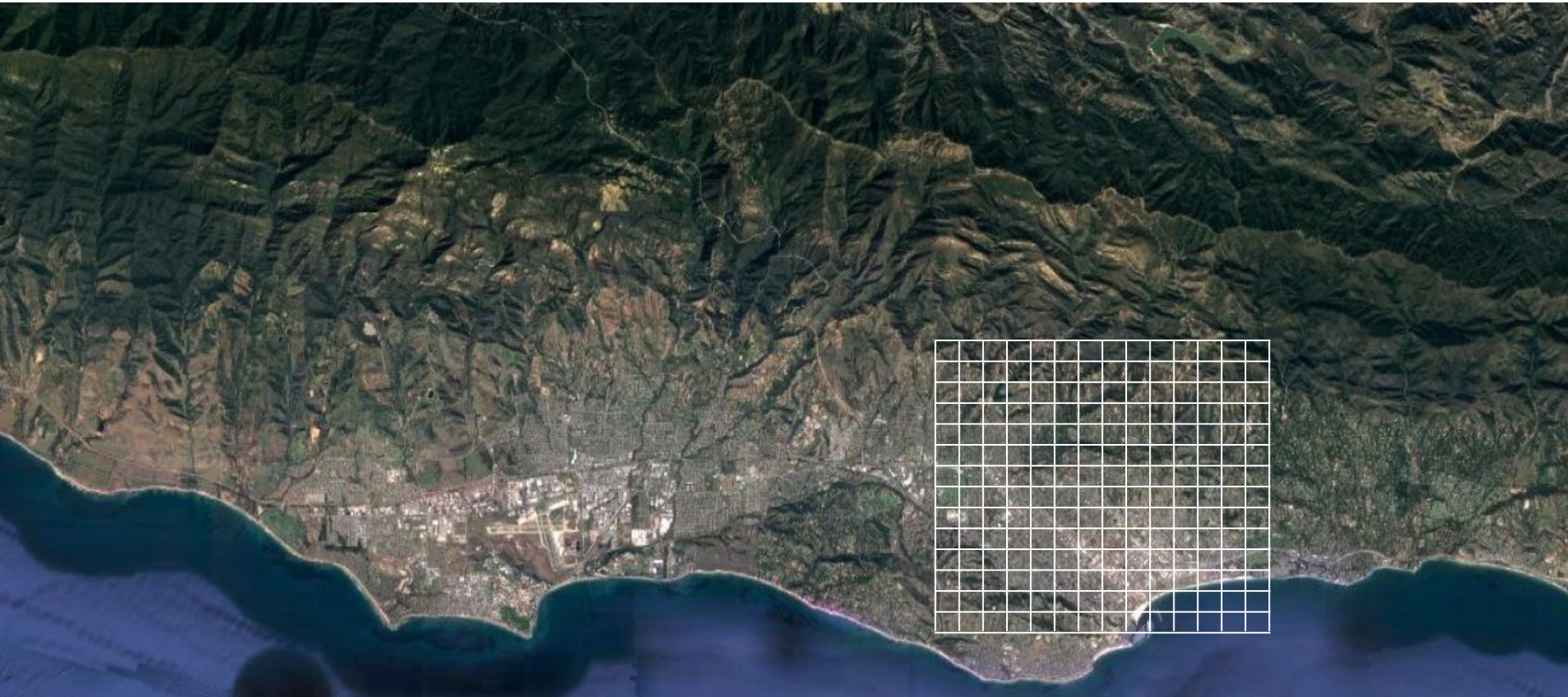
geometry

- Cell size
- Number of rows/columns
- Cell origin → **position**
- CRS

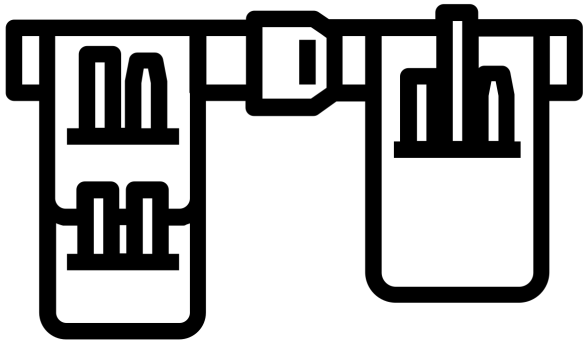


Spatial data models

Spatial data models



Toolbelt for solving spatial problems



New tools for a new data type

data frame

attributes

observations

type	food	site
otter	urchin	bay
shark	seal	channel

New tools for a new data type

data frame

attributes

observations

type	food	site
otter	urchin	bay
shark	seal	channel

matrix

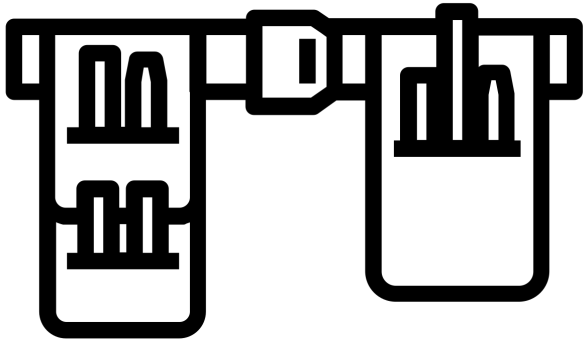
columns

rows

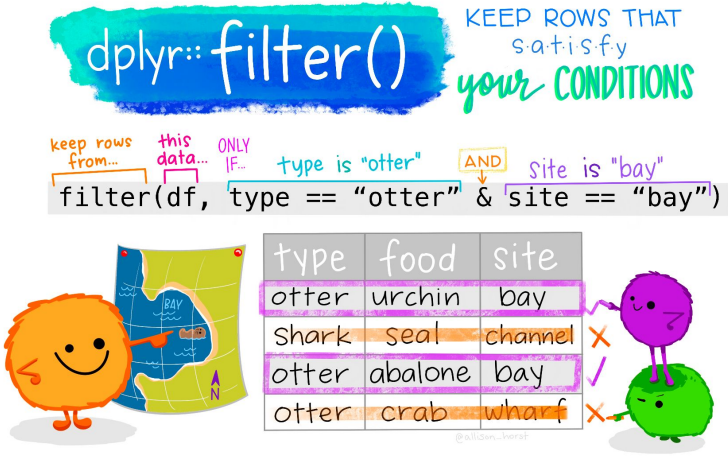
1	4	8
10	7	3
2	5	1

Toolbelt for solving spatial problems

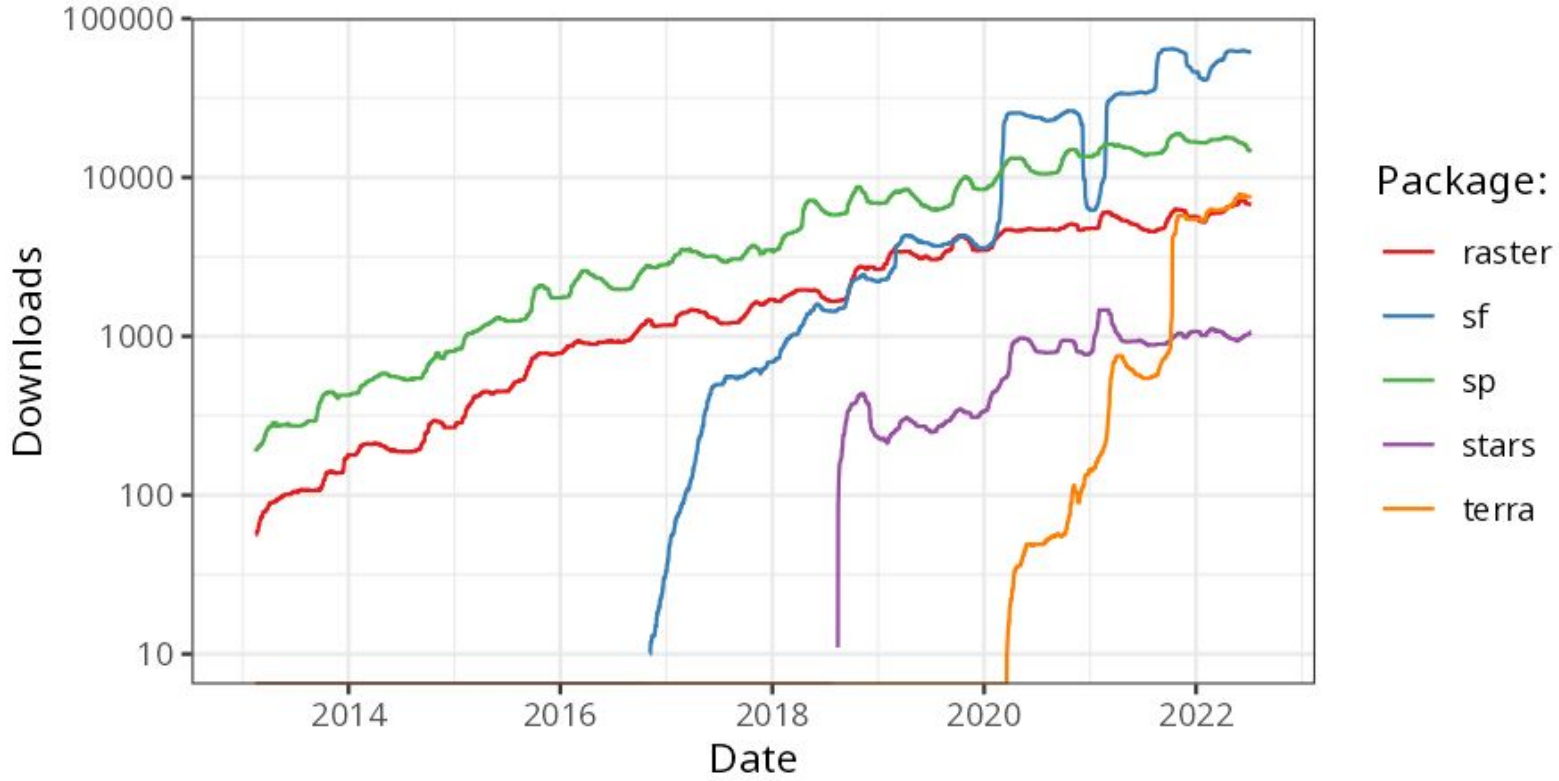
subsetting



New tools for a new data type

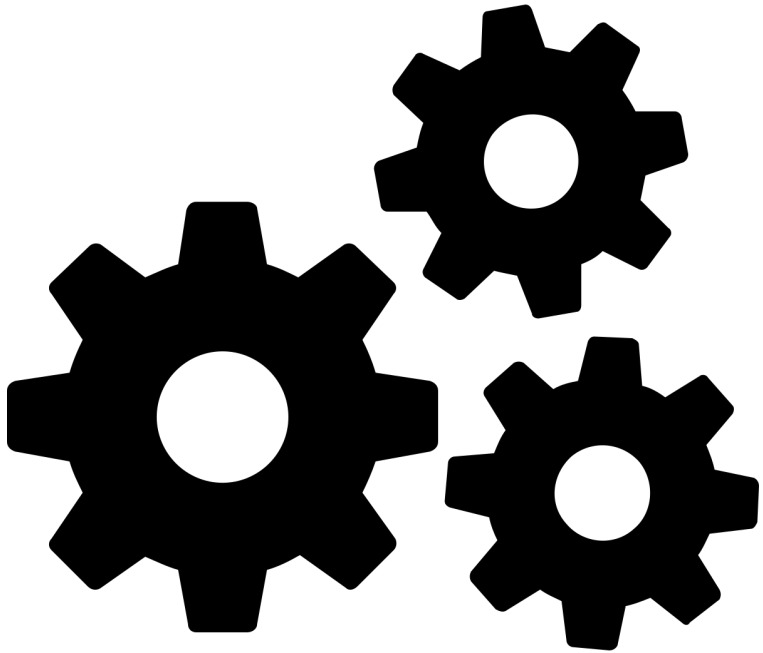


R's spatial ecosystem



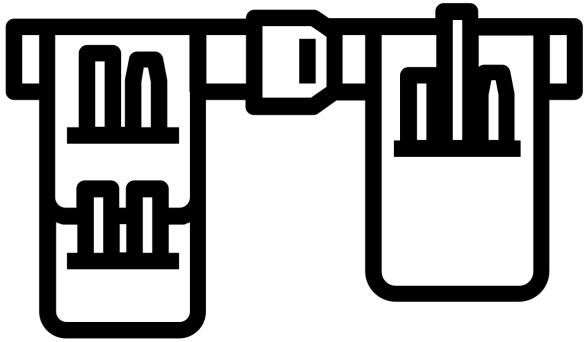
Source: Geocomputation with R

Switching gears...



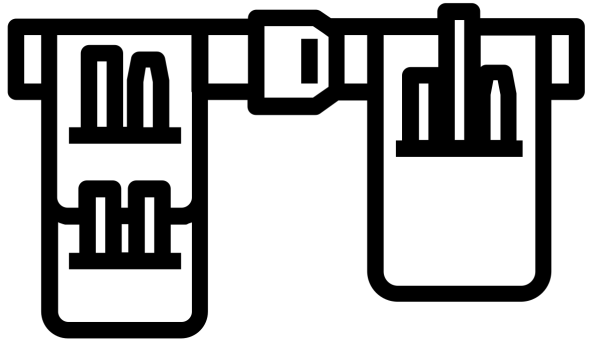
Toolbelt for solving spatial problems

spatial subsetting



Toolbelt for solving spatial problems

spatial subsetting

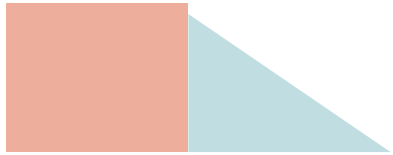


Topological relationships

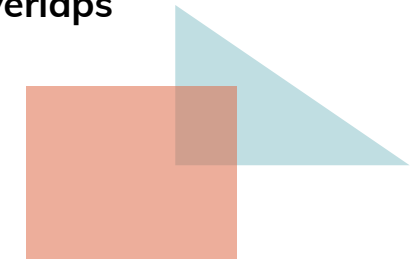
intersects

Yes or No

touches

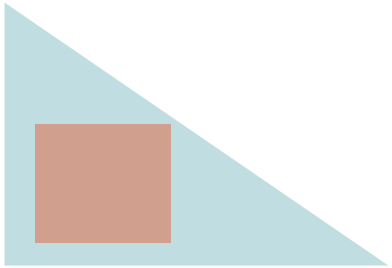


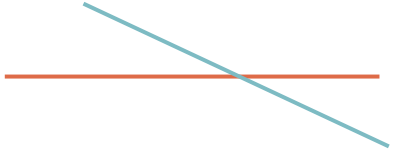
overlaps



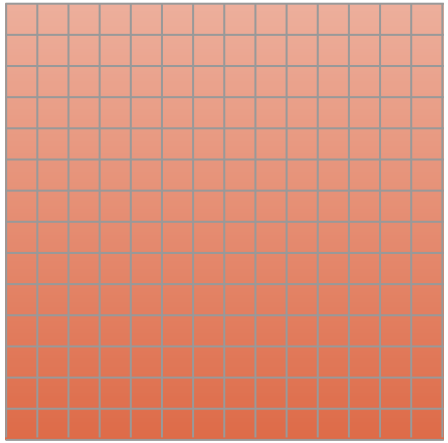
crosses

within

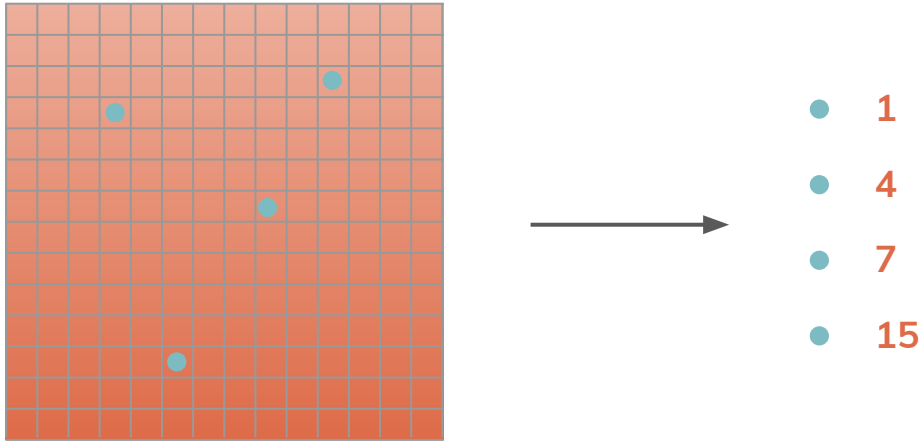




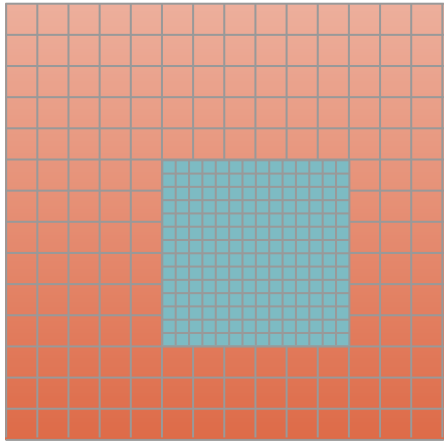
Spatial subsetting

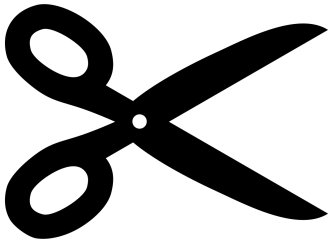


Spatial subsetting

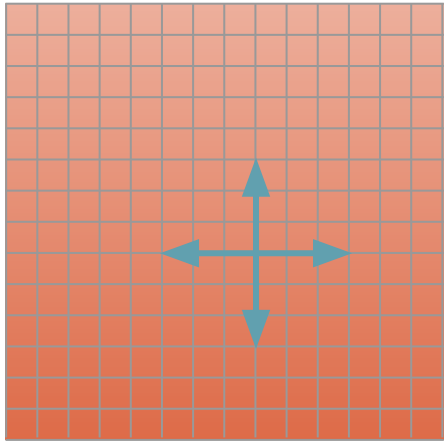


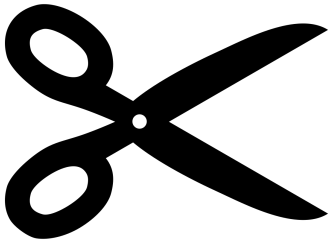
Spatial subsetting: clipping



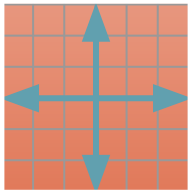


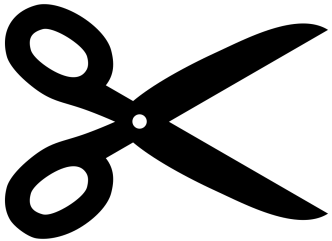
Spatial subsetting: clipping



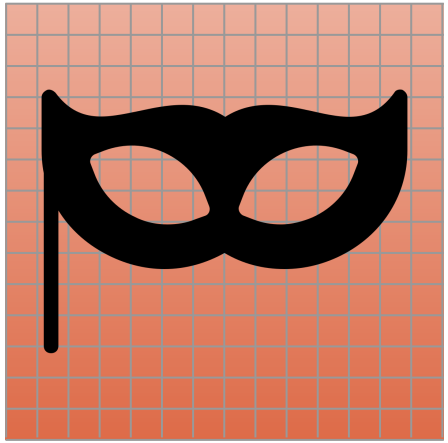


Spatial subsetting: clipping

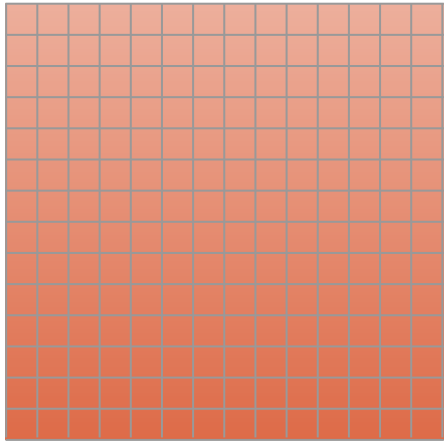


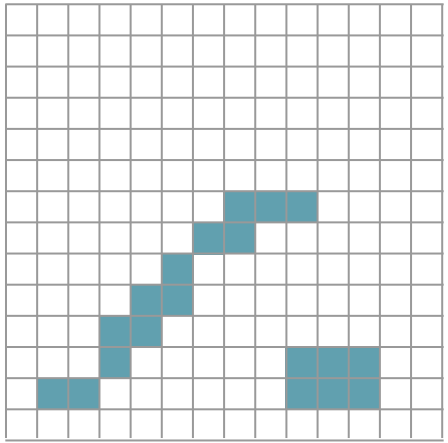


Spatial subsetting: masking

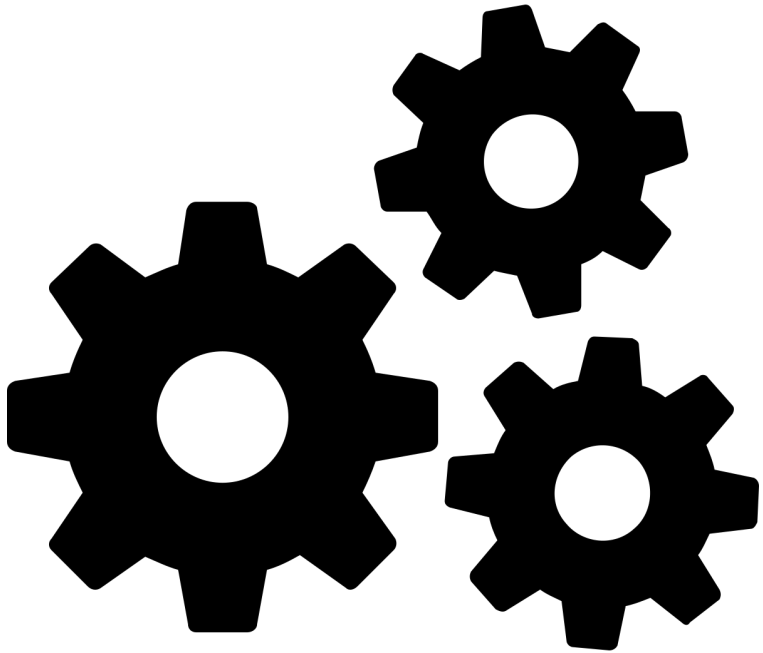


Spatial subsetting: masking

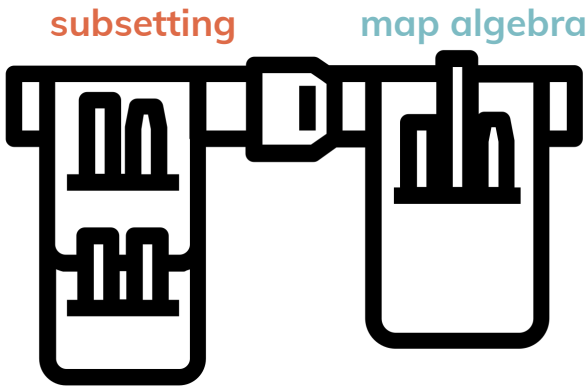




Switching gears...



Toolbelt for solving spatial problems



Map algebra

- Operations that modify or summarize raster cell values

Map algebra

- Operations that modify or summarize raster cell values
- Power of the Matrix

Map algebra

- Operations that modify or summarize raster cell values
- Power of the ~~Matrix~~, matrix

matrix

columns

rows

1	4	8
10	7	3
2	5	1

geometry

- Cell size
- Number of rows/columns
- Cell origin
- CRS

Map algebra

- Operations that modify or summarize raster cell values
- Power of the ~~Matrix~~, matrix
- “Raster is faster, vector is corrector”

matrix

columns

rows

1	4	8
10	7	3
2	5	1

geometry

- Cell size
- Number of rows/columns
- Cell origin
- CRS

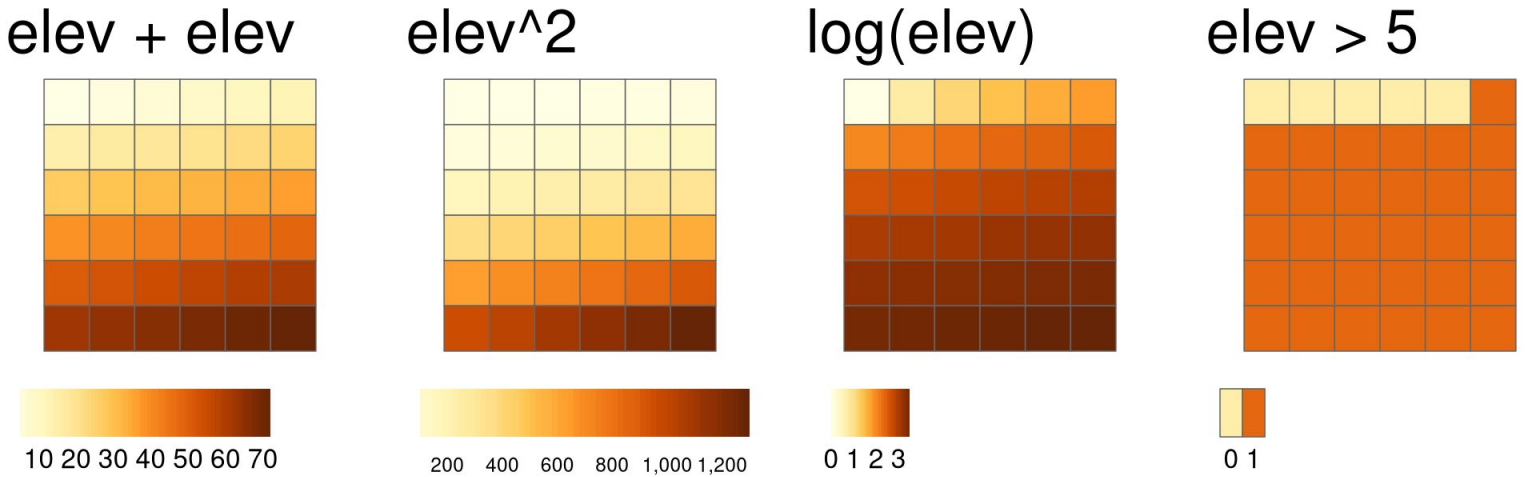
Map algebra

- Local
- Focal
- Zonal
- Global

Scale or number of cells

Map algebra

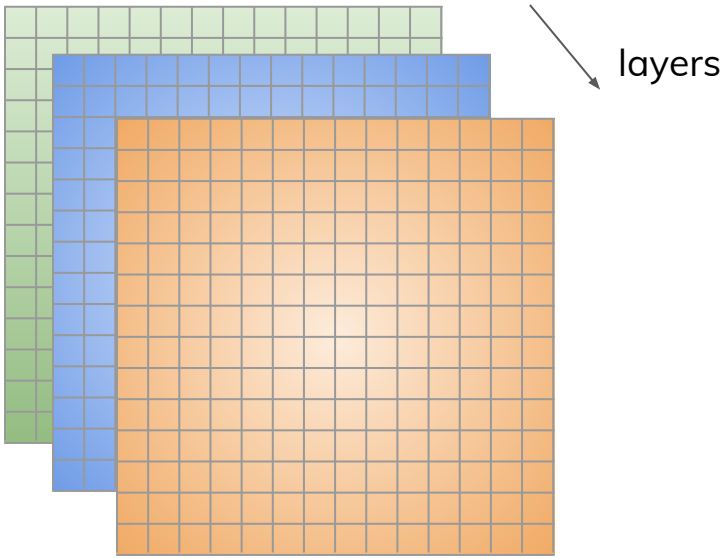
- **Local**
  - Cell-by-cell operations in one or several layers



Source: Geocomputation with R, chapter 4

Map algebra

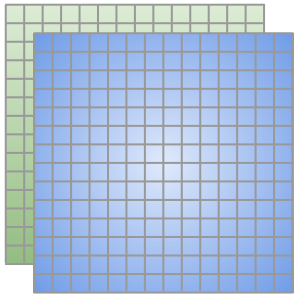
- **Local**
  - Cell-by-cell operations in one or several layers



Source: Geocomputation with R, chapter 4

Map algebra

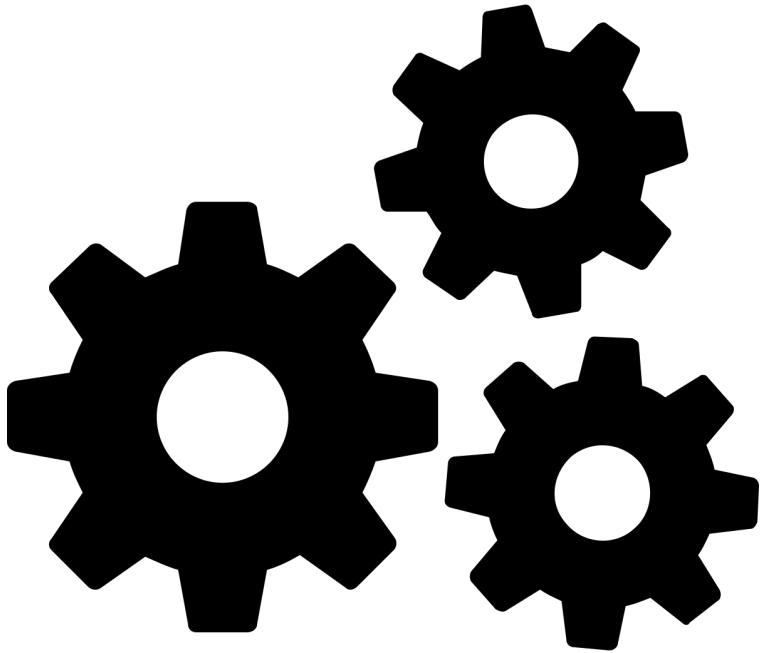
- **Local**
  - Cell-by-cell operations in one or several layers



$$\text{Normalized Difference Vegetation Index} = \frac{\text{NIR - Red}}{\text{NIR + Red}}$$

Source: Geocomputation with R, chapter 4

Switching gears...



Map algebra

- Local
- Focal
- Zonal
- Global

Scale or number of cells

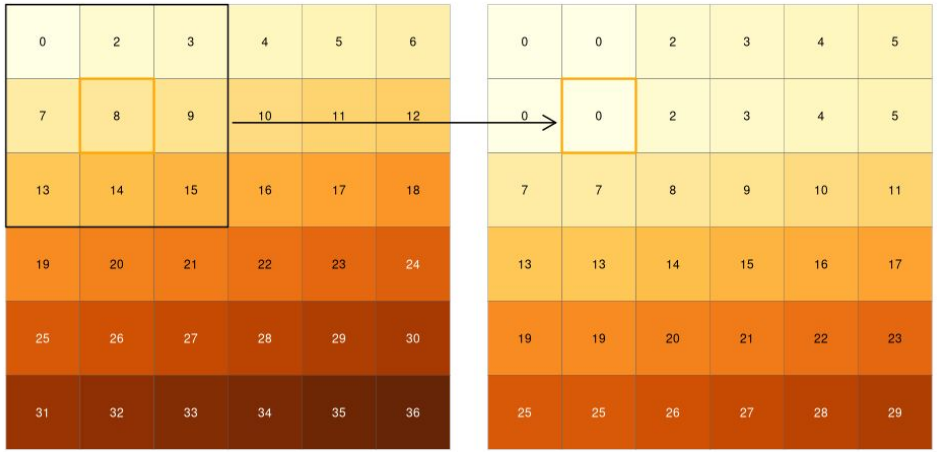
Map algebra

- **Focal**
  - Applies an aggregation function to all cells within a specified neighborhood, uses the corresponding output as the new value for the central cell, and moves on to the next central cell

Source: Geocomputation with R, chapter 4

Map algebra

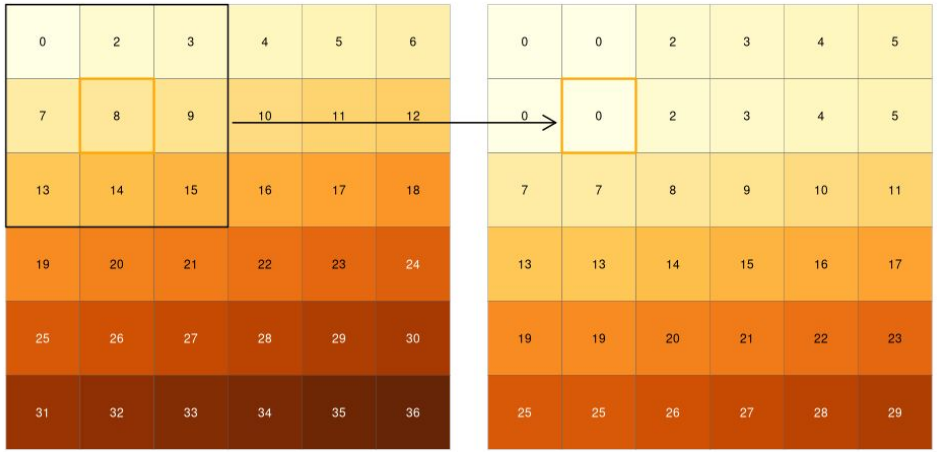
- **Focal**
  - Applies an aggregation function to all cells within a specified neighborhood, uses the corresponding output as the new value for the central cell, and moves on to the next central cell



Source: Geocomputation with R, chapter 4

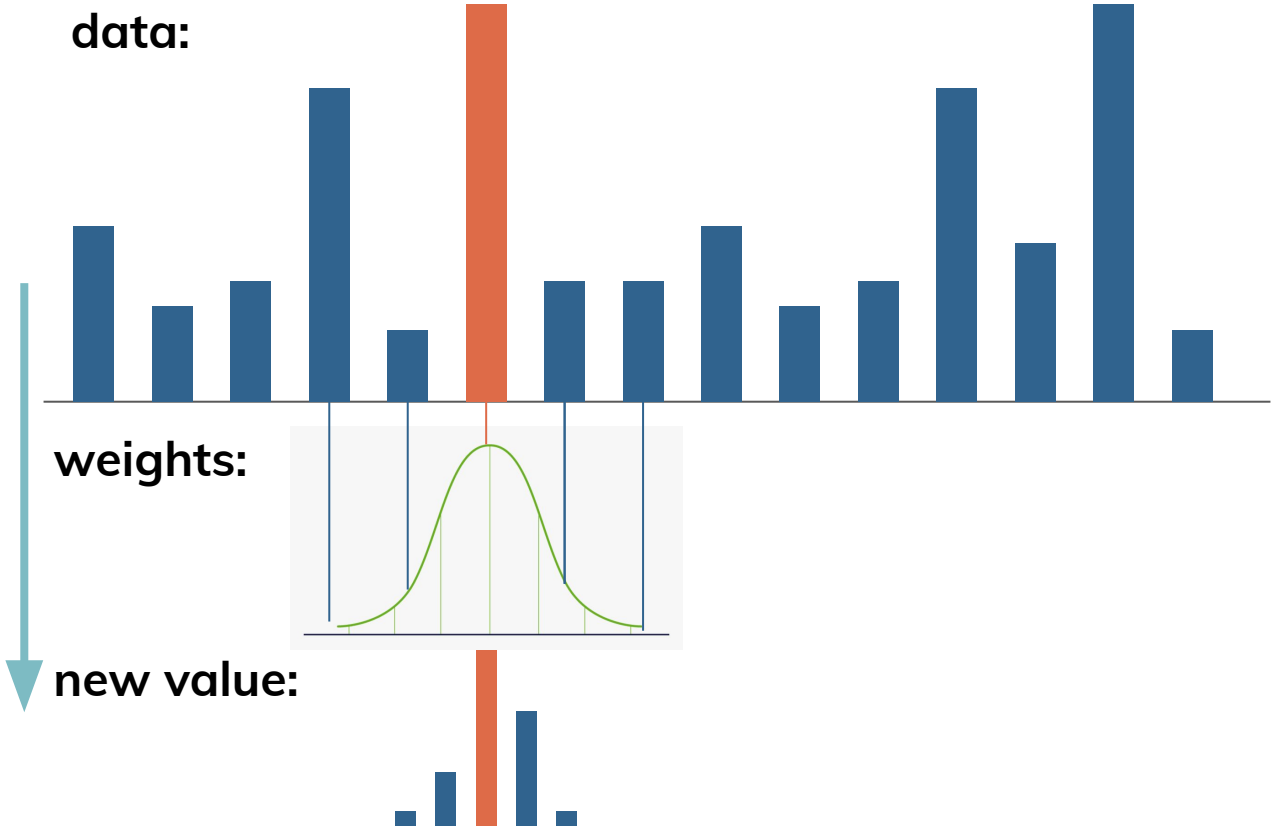
Map algebra

- **Focal**
  - Applies an aggregation function to all cells within a specified neighborhood, uses the corresponding output as the new value for the central cell, and moves on to the next central cell



Source: Geocomputation with R, chapter 4

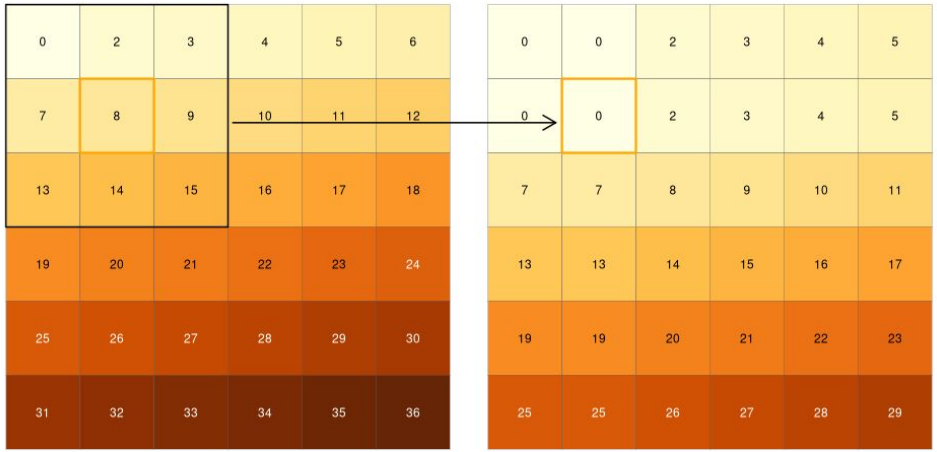
Smoothing: Gaussian kernel



Map algebra

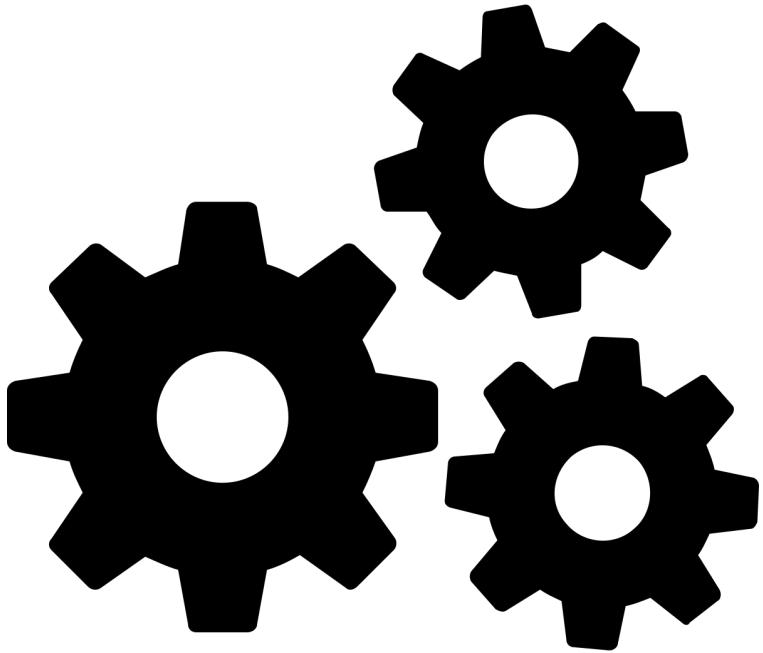
- **Focal**
  - Applies an aggregation function to all cells within a specified neighborhood, uses the corresponding output as the new value for the central cell, and moves on to the next central cell

kernel,
filter,
moving window



Source: Geocomputation with R, chapter 4

Switching gears...



Map algebra

- Local
- Focal
- Zonal
- Global

Scale or number of cells

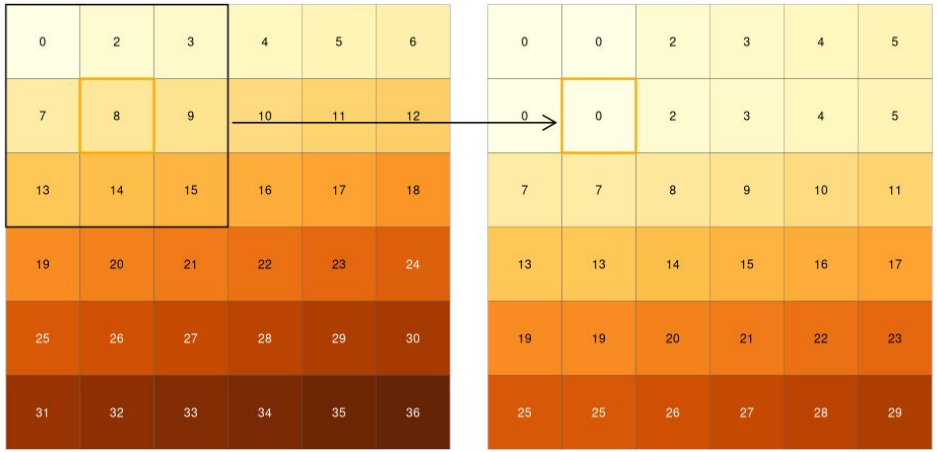
Map algebra

- **Zonal**
  - Applies an aggregation function to multiple cells based on a grouping variable

Source: Geocomputation with R, chapter 4

Map algebra

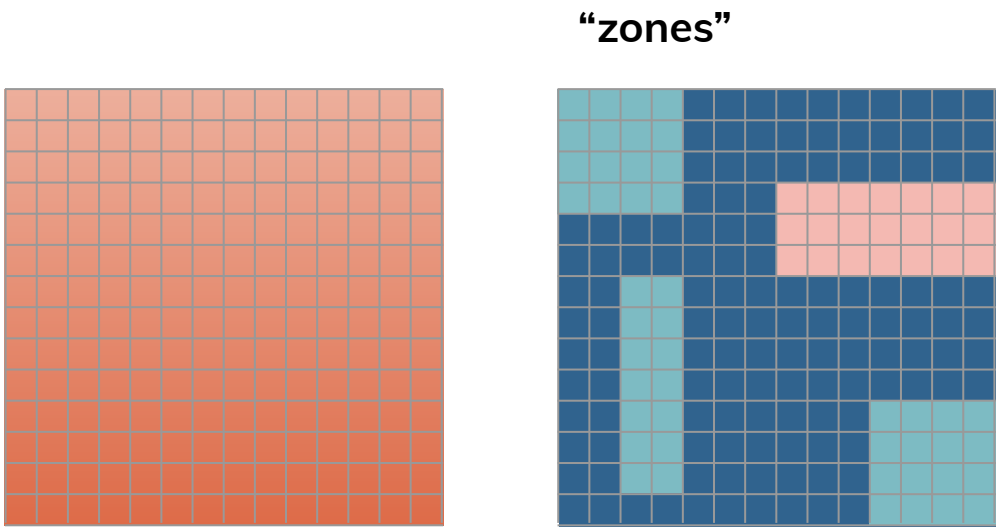
- **Zonal**
  - Applies an aggregation function to multiple cells based on a grouping variable



Source: Geocomputation with R, chapter 4

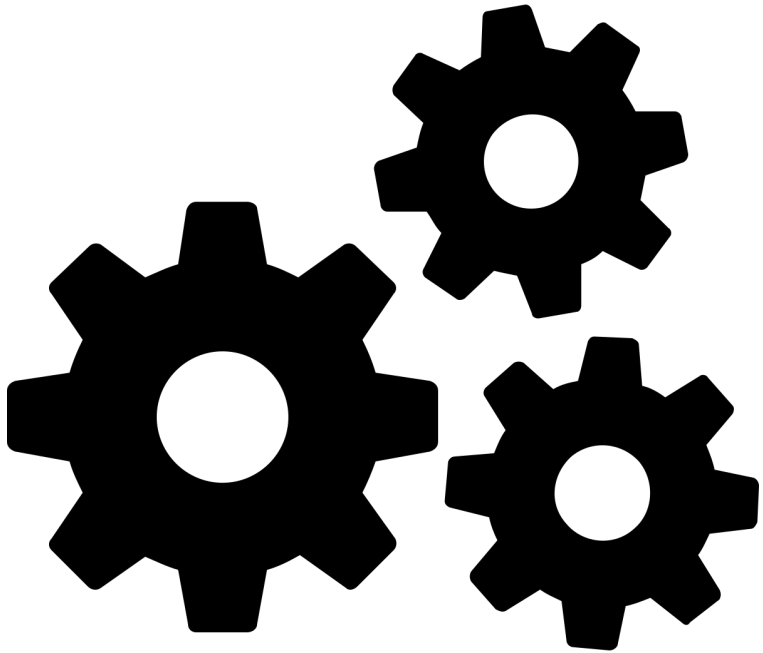
Map algebra

- **Zonal**
  - Applies an aggregation function to multiple cells based on a grouping variable



Source: Geocomputation with R, chapter 4

Switching gears...

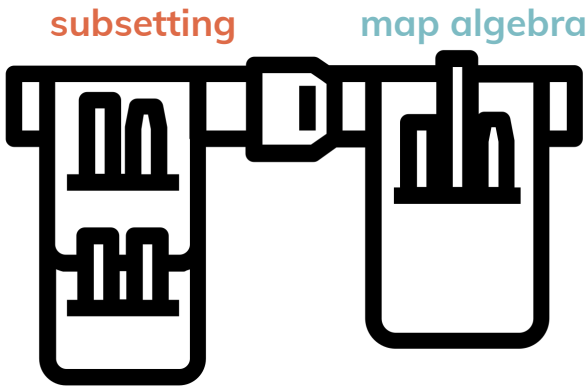


Map algebra

- Local
- Focal
- Zonal
- Global

Scale or number of cells

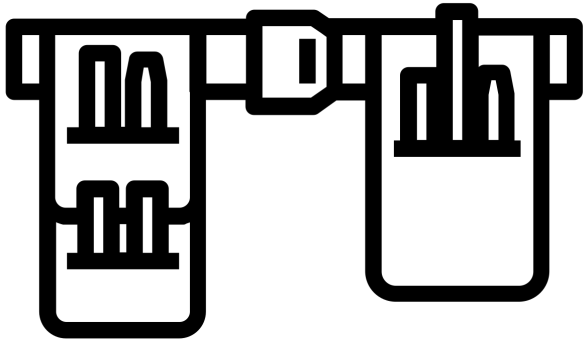
Toolbelt for solving spatial problems



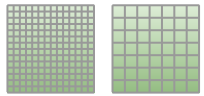
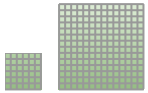
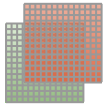
Toolbelt for solving spatial problems

map algebra:
summarizing
filtering
mutating

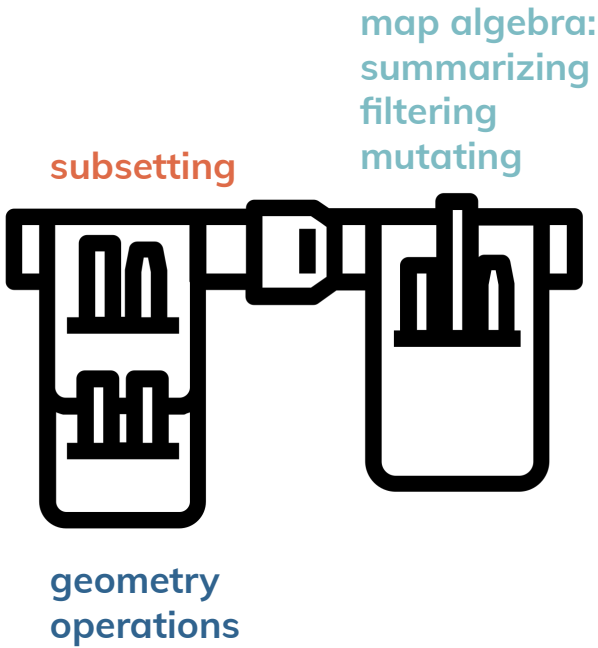
subsetting



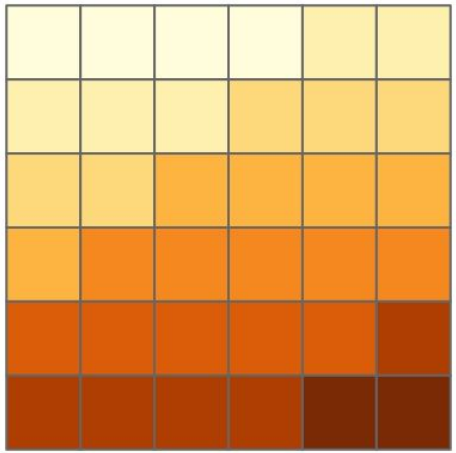
Raster data model

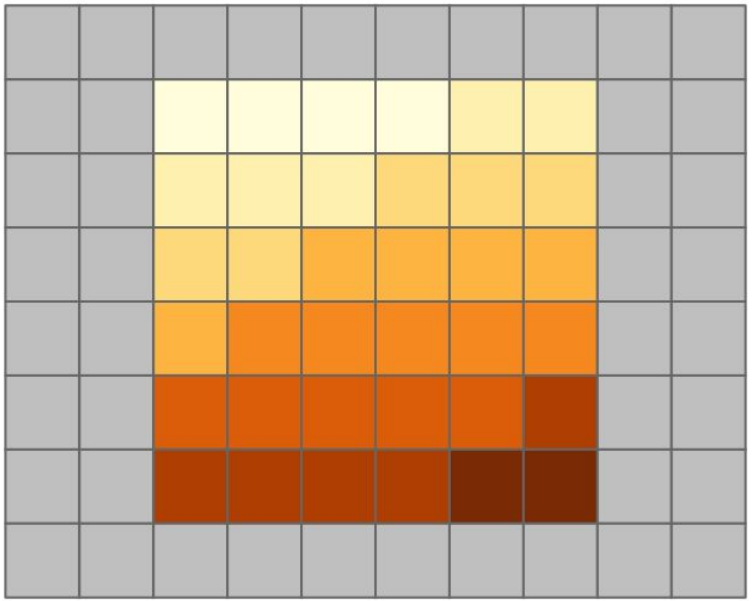
- Resolution 
- Extent 
- Position 

Toolbelt for solving spatial problems



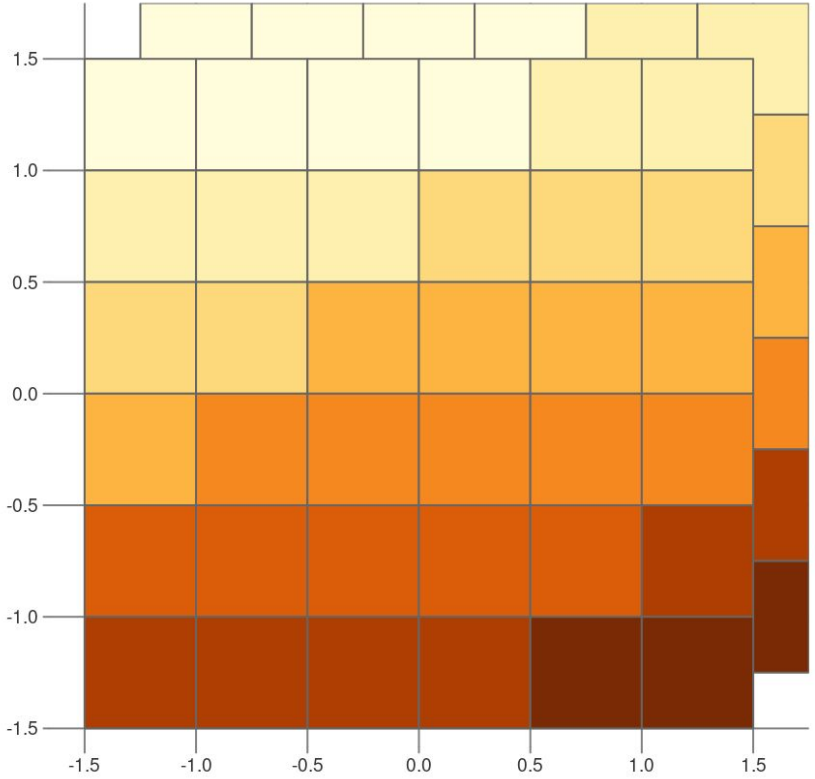
Changing extent and origin





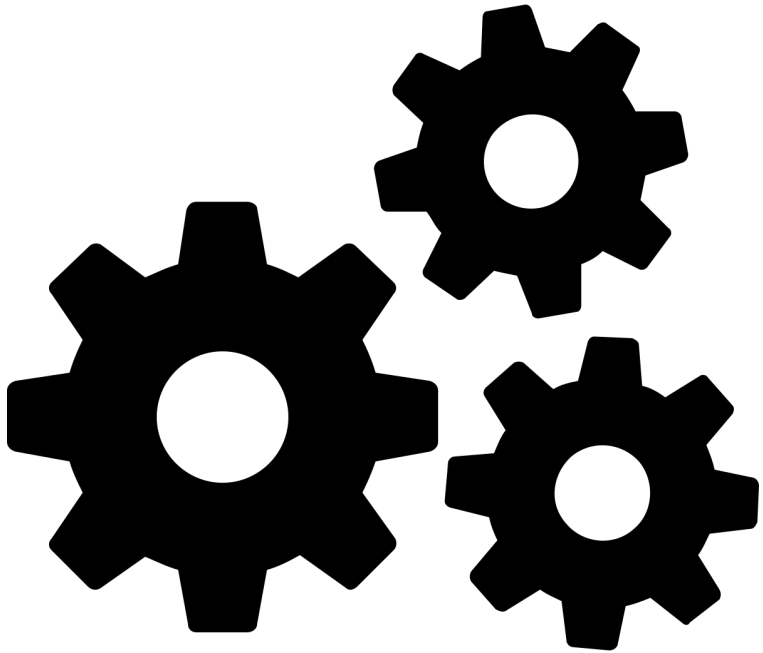
Source: Geocomputation with R, chapter 4

Changing extent and origin

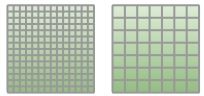
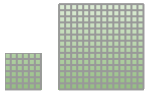
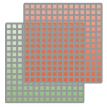


Source: Geocomputation with R, chapter 4

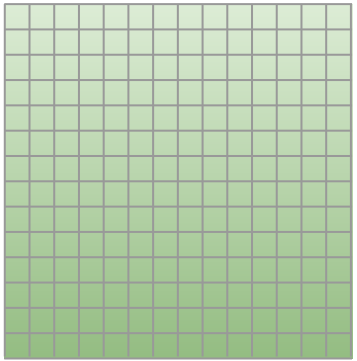
Switching gears...

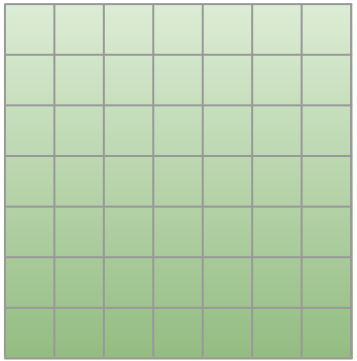


Raster data model

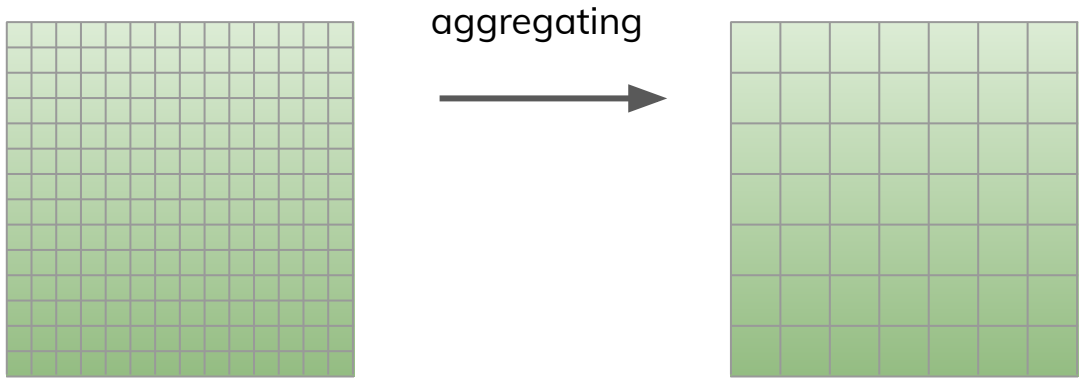
- Resolution 
- Extent 
- Position 

Changing resolution

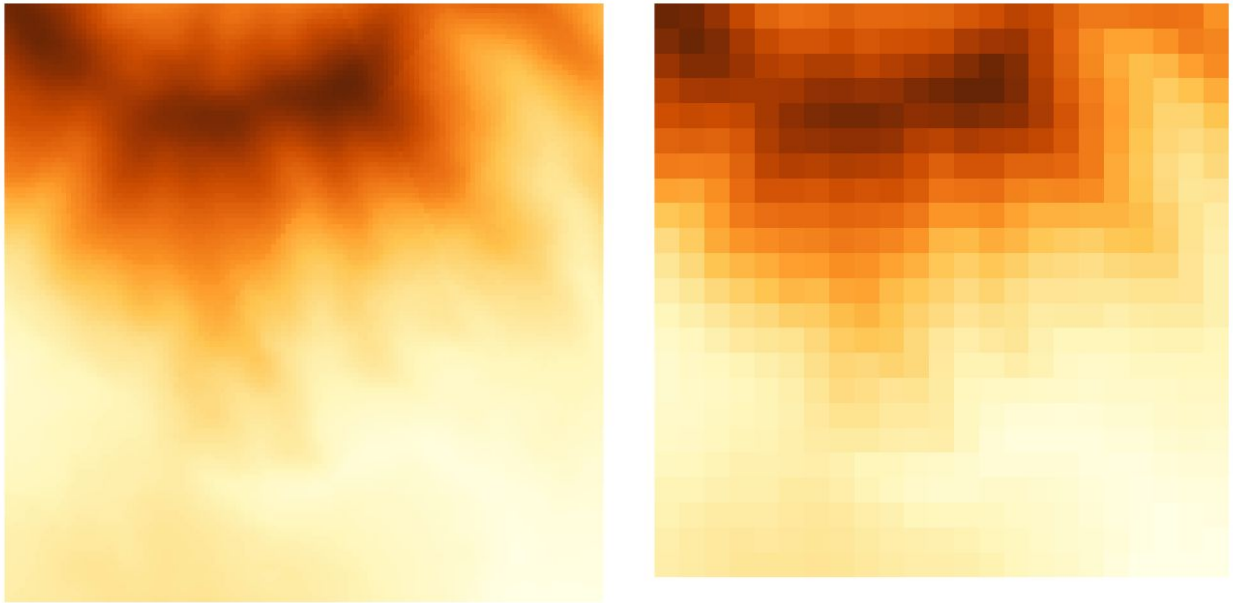




Changing resolution

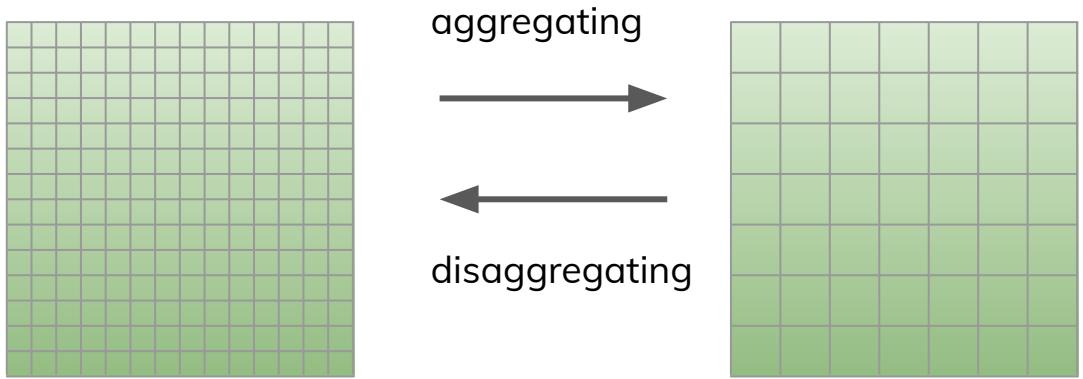


Changing resolution



Source: Geocomputation with R, chapter 5

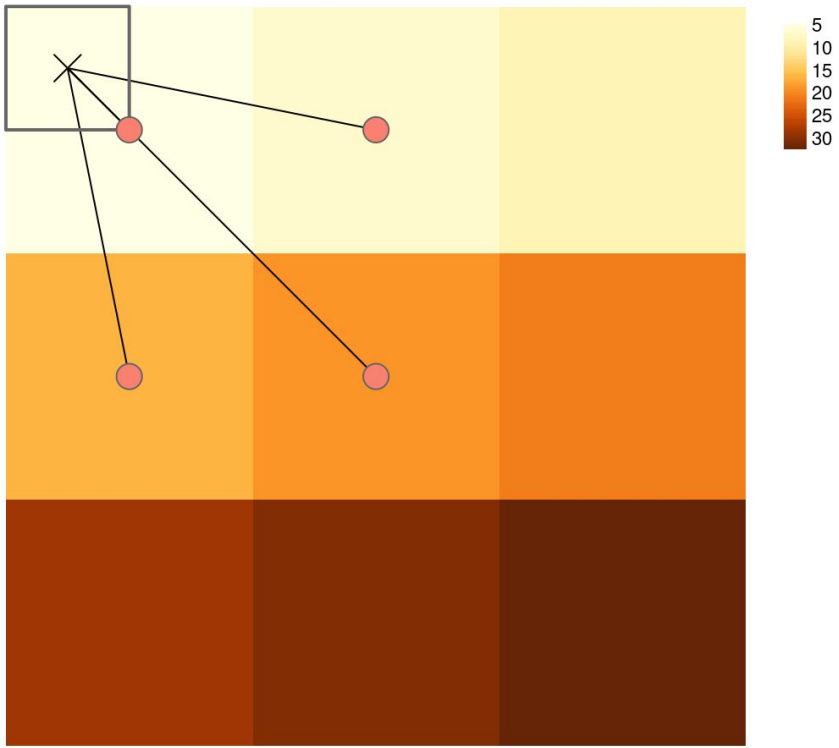
Changing resolution



Changing resolution

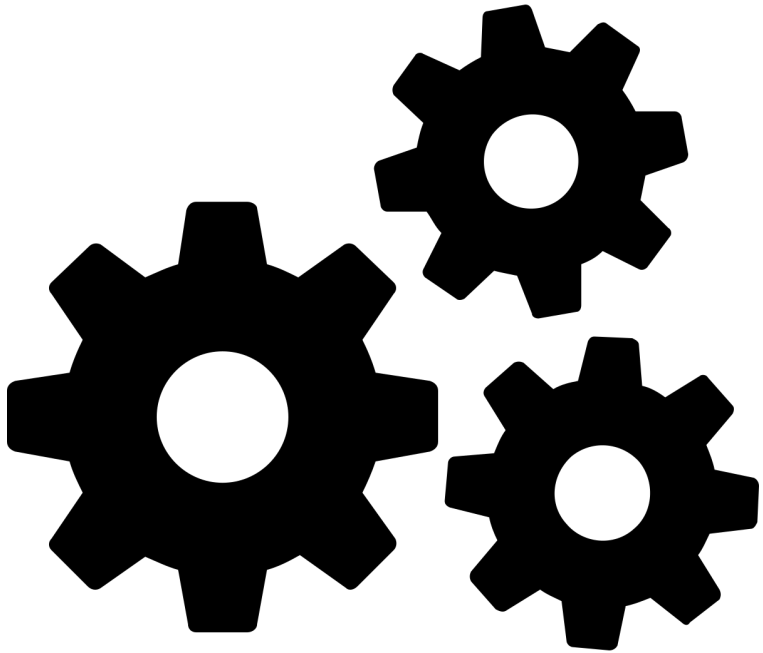
Nearest neighbor

Bilinear interpolation



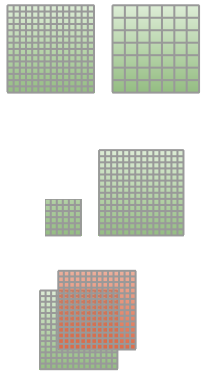
Source: Geocomputation with R, chapter 5

Switching gears...



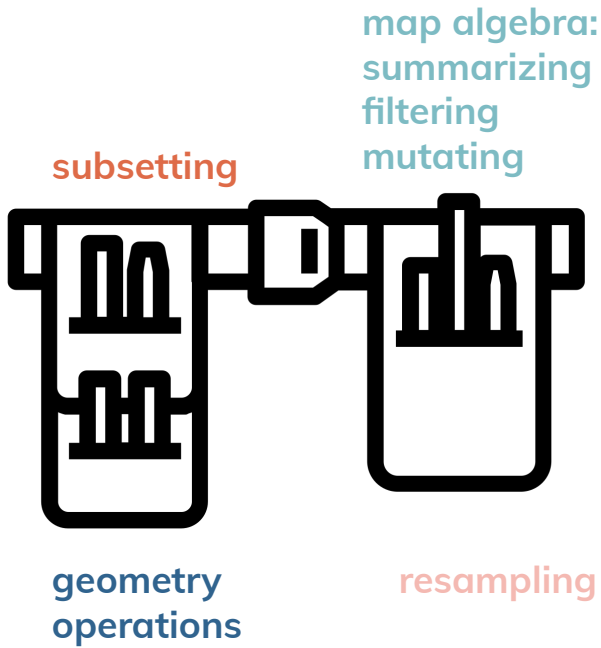
Raster data model

- Resolution
- Extent
- Position

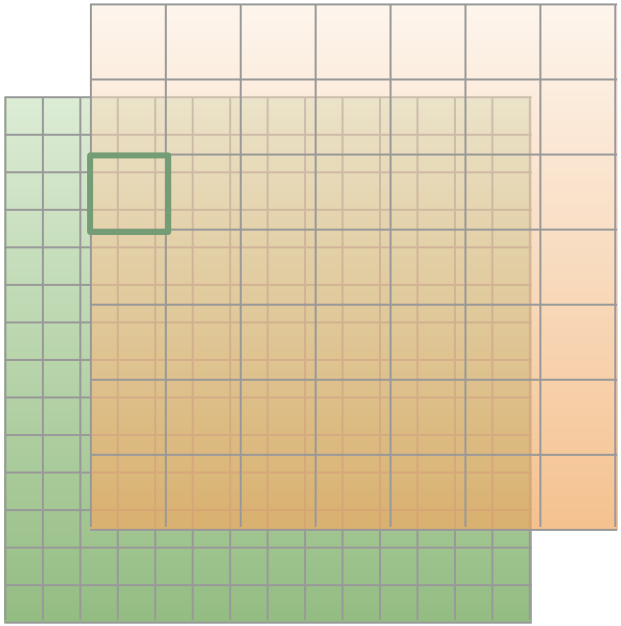


mismatch!

Toolbelt for solving spatial problems



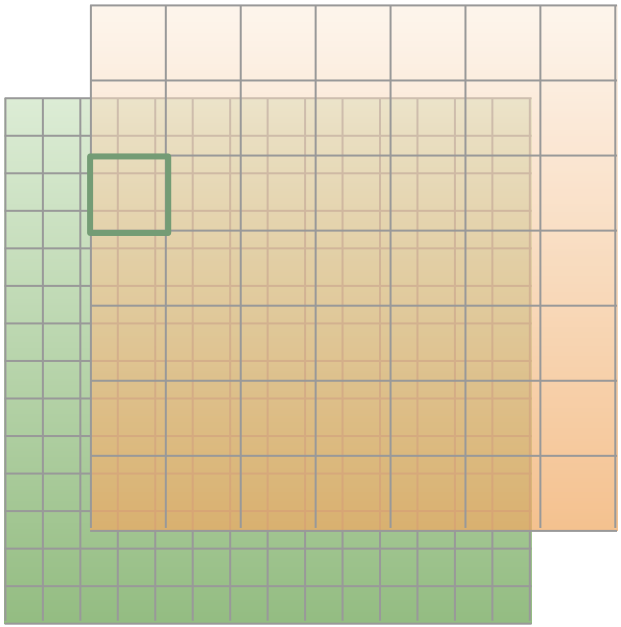
Resampling



Resampling

Nearest neighbor

Bilinear interpolation



Switching gears...