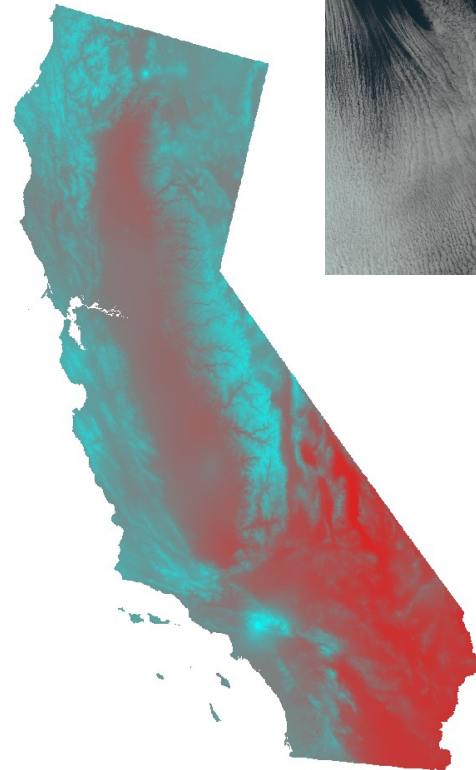# PostGIS raster

What is a raster?

- In essence, a 3-D array of numerical values with spatial data

- Examples

  - Satellite imagery

  - Aerial imagery

  - Modeled output

PostGIS raster
PostgreSQL

- raster2pgsql

  - Loader to add raster to database

- rasters are typically broken down into smaller pieces, known as tiles

- Data is stored as VARLENA

- GIST indexes for BBOX spatial tests

- HASH indexes for equality test (2.1+)

- Column constraints to maintain uniformity of rasters in a table column

- Ability to store raster inside or outside the

PostGIS raster
In-db or Out-db

- In-db
  - Raster contents are stored in the database
  - Read-write
  - Works best for smaller rasters (10s of bands)
  - Backup planning is no different from any other data in database
- Out-db
  - Only a reference (absolute path) to the raster is stored in the database
  - Read-only
  - Works best for massive rasters (100s of bands)

PostGIS raster
Capabilities in 2.0

- Basic raster operations

  - Sampling pixel values

  - Summary stats

  - Create/modify rasters

  - Output rasters to GDAL-supported formats

PostGIS raster
Sampling pixel values

- ## Sampling using a point geometry

  SELECT

      ST_Value(rast, 1, geom)

  FROM tops

  WHERE ST_Intersects(rast, 1, geom)

- ## Sampling using a grid X and Y

  SELECT

      ST_Value(rast, 1, 5, 23)

  FROM tops

PostGIS raster
Summary Stats

- ## ST_SummaryStats

SELECT (ST_SummaryStats(rast, 1)).* FROM ned WHERE rid = 1022

count	sum	mean	stddev	min	max
101124	52051213.2368317	514.72660532447	153.039848905508	243.488494873047	904.853698730469

- ## ST_Quantile

SELECT (ST_Quantile(rast, 1)).* FROM ned WHERE rid = 1022

quantile	value
0	243.488494873047
0.25	403.659355163574
0.5	471.152267456055
0.75	604.505065917969
1	904.853698730469

PostGIS raster
Summary Stats

- ## ST_Histogram

SELECT (ST_Histogram(rast, 1)). FROM ned WHERE rid = 1022*

```
      min        |       max        | count |       percent
-----------------+------------------+-------+---------------------
 243.488494873047 | 280.231006198459 |  1288 |  0.0127368379415371
 280.231006198459 | 316.973517523872 |  3253 |   0.032168426881848
...
 831.368676079645 | 868.111187405057 |  4006 |  0.0396147304299672
 868.111187405057 | 904.853698730469 |   701 | 0.00693208338277758
```

- ## ST_ValueCount

SELECT (ST_ValueCount(rast, 1, true, NULL::double precision[], 2)). FROM ned WHERE rid = 1022*

```
 value | count
-------+-------
   310 |  1052
   320 |  1248
...
   890 |   142
```

PostGIS raster
Create/Modify Rasters

- New empty raster

  SELECT ST_MakeEmptyRaster(5, 5, 0, 0, 1, -1, 0, 0, 4326)

- Add band to raster

  SELECT ST_AddBand(rast, 3, '32BF', 0, -9999) FROM tops

- Change raster values

  SELECT ST_SetValue(rast, 3, 3, 3, 99) FROM tops

- New raster from existing raster

  SELECT ST_Band(rast, 3) FROM tops

- Convert geometry to raster

  SELECT ST_AsRaster('POLYGON((0 0, 1 0, 1 -1, 0 -1, 0 0))')

PostGIS raster
Output rasters to GDAL-supported formats

- ## ST_AsGDALRaster()

  SELECT ST_AsGDALRaster(rast, 'netCDF') FROM ned WHERE rid = 1022

- ## ST_AsTIFF()

  SELECT ST_AsTIFF(rast, 1, 'LWZ') FROM ned WHERE rid = 1022

- ## ST_AsJPEG()

  SELECT ST_AsJPEG(rast, 1, 90) FROM ned WHERE rid = 1022

- ## ST_AsPNG()

  SELECT ST_AsPNG(rast, 2, 1) FROM ned WHERE rid = 1022

PostGIS raster
Capabilities in 2.0

- Advanced raster operations
  - Map Algebra
    - Examples using map algebra below
  - Elevation derivatives
  - Reclassification
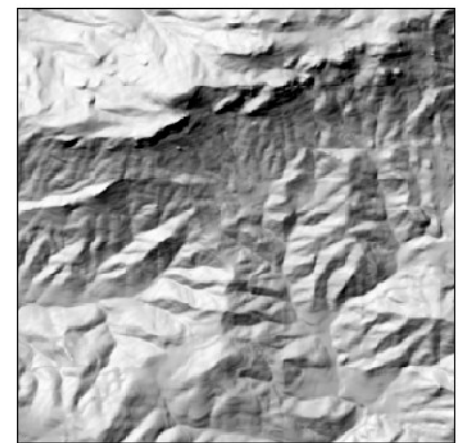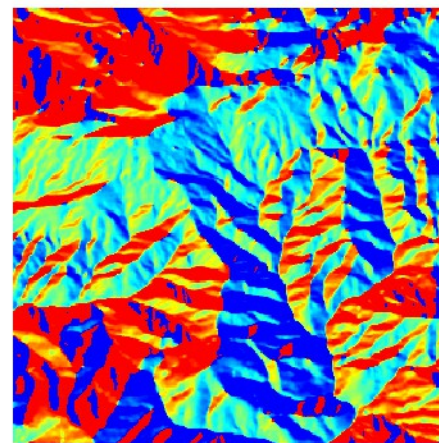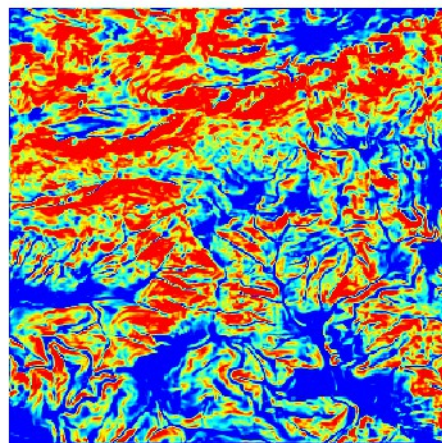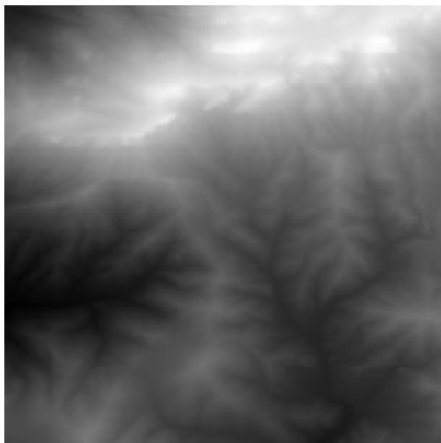
PostGIS raster
Elevation derivatives

- ## ST_Slope()

  SELECT ST_Slope(rast, 1, '32BF', 'DEGREES', 111120) FROM ned WHERE rid = 1022;

- ## ST_Aspect()

  SELECT ST_Aspect(rast, 1, '32BF', 'DEGREES') FROM ned WHERE rid = 1022;

- ## ST_HillShade()

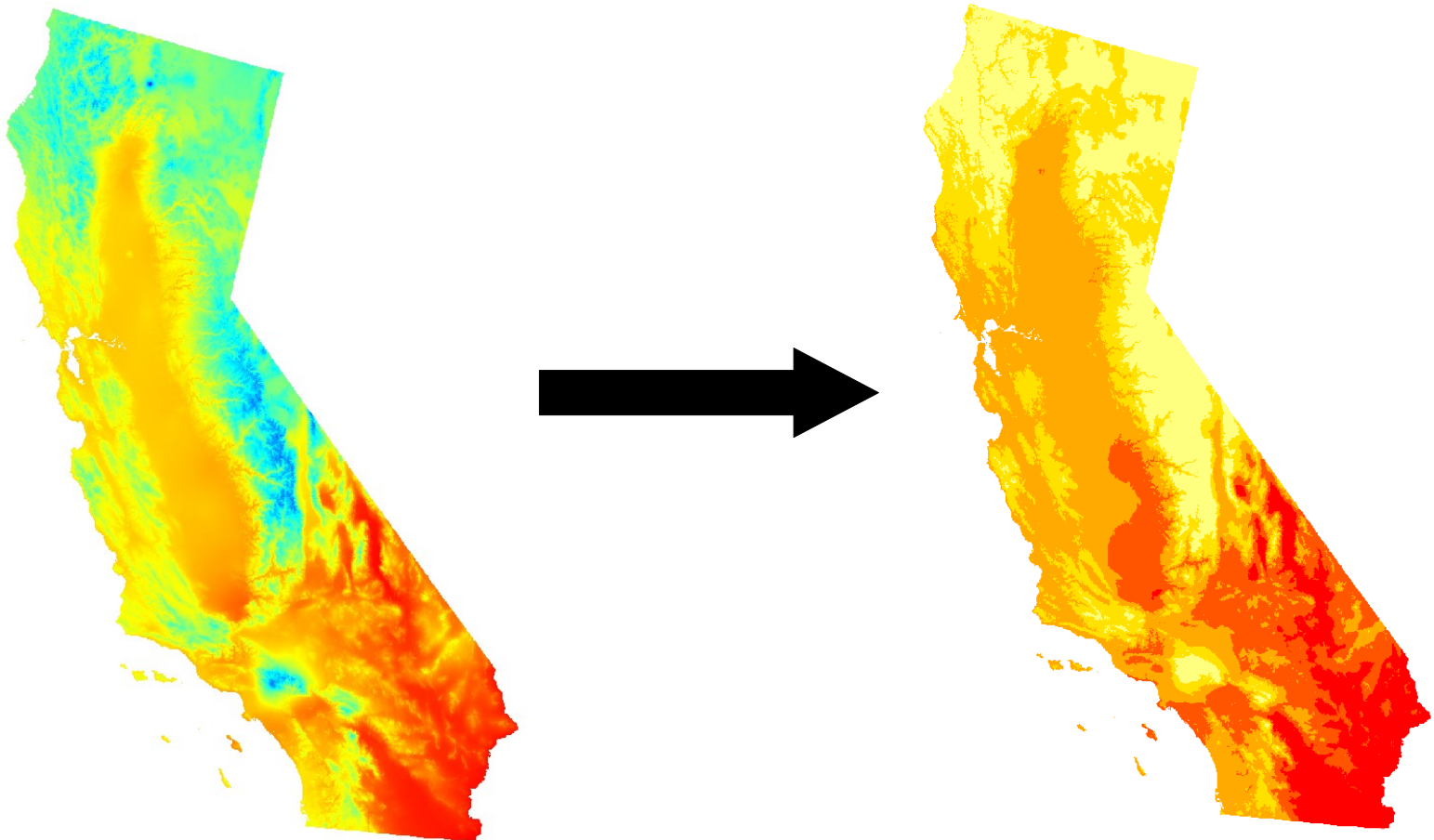 *SELECT ST_HillShade(rast, 1, '32BF', 315, 45, 255, 111120) FROM ned WHERE rid = 1022;*

PostGIS raster
Reclassification

- ## ST_Reclass()

SELECT ST_Reclass(rast, 1, '[-100-13.33]:1,(13.33-18.33]:2,(18.33-22.22]:3,(22.22-26.11]:4,(26.11-9999]:5', '8BUI', 0) FROM tops

PostGIS raster
Capabilites in 2.1 (svn trunk)

- ## Array support

  - ### Allows common methods of moving large quantity of data between languages, such as PL/R

- ## n-raster Map Algebra

  - ### n-raster

    - ability to run pixel operations for multiple spatially related rasters at once

    - primarily found in modeling applications

  - ### n-band

    - from multiple bands of one raster, run pixel operation

    - common example is vegetative indexes (EVI, NDVI)