pdal

POINTCLOUD DATA ABSTRACTION LIBRARY

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About the Library

- 1.1.0 november 2015
- 1.2.0 april 2016
- 1.3.0 august 2016
- 1.4.0 december 2016
- 1.5.0 april 2017
- 1.6.0 sept/oct 2017
- bsd licensed (supports proprietary plugins)
- c++ development
  - git repo (https://github.com/PDAL/PDAL)
  - pull requests welcome

1.4 / 1.5 Changes

- json everywhere - xml is gone
- gdal writer
- mbio reader (bathy data)
- smrf bare earth filter
- stream mode
- pdal metadata and pipeline VLRs options for writer.las
- filename globbing
- java/jni bindings
- greyhound reader

1.6 Changes

- filters.cpd and filters.icp
- filters.predicate and programmable merged to filter.python
- new filters.matlab
- native filters.poisson (watertight surface)
- enhancements to writers.gdal
- new openscenegraph reader/writer
- new head/tail/randomize filter
- new laz 1.4 writing

readers / writers

- readers.bpf
- readers.buffer
- readers.faux
- readers.gdal
- readers.geowave
- readers.greyhound
- readers.ilvis2
- readers.las
- readers.mbio
- readers.mrsid
- readers.nitf
- readers.oci
- readers.optech
- readers.pcd
- readers.pgpointcloud
- readers.ply
- readers.pts
- readers.qfit
- readers.rxp
- readers.sbet
- readers.sqlite
- readers.text
- readers.tindex
- writers.bpf
- writers.gdal
- writers.geowave
- writers.las
- writers.matlab
- writers.nitf
- writers.null
- writers.oci
- writers.pcd
- writers.pgpointcloud
- writers.ply
- writers.sqlite
- writers.text

Filters

- filters.approximatecoplanar
- filters.assign
- filters.chipper
- filters.cluster
- filters.colorinterp
- filters.colorization
- filters.computerange
- filters.crop
- filters.decimation
- filters.divider
- filters.eigenvalues
- filters.elm
- filters.estimaterank
- filters.ferry
- filters.greedyprojection
- filters.gridprojection
- filters.groupby
- filters.hag
- filters.hexbin
- filters.iqr
- filters.kdistance
- filters.locate
- filters.lof
- filters.mad
- filters.merge
- filters.mongus
- filters.mortonorder
- filters.movingleastsquares
- filters.normal
- filters.outlier
- filters.overlay
- filters.pclblock
- filters.pmf
- filters.poisson
- filters.predicate
- filters.programmable
- filters.radialdensity
- filters.randomize
- filters.range
- filters.reprojection
- filters.sample
- filters.smrf
- filters.sort
- filters.splitter
- filters.stats
- filters.transformation
- filters.voxelgrid

Applications

- delta
- density
- diff
- ground
- hausdorff
- info
- merge
- pcl
- pipeline
- random
- sort
- split
- tindex
- translate

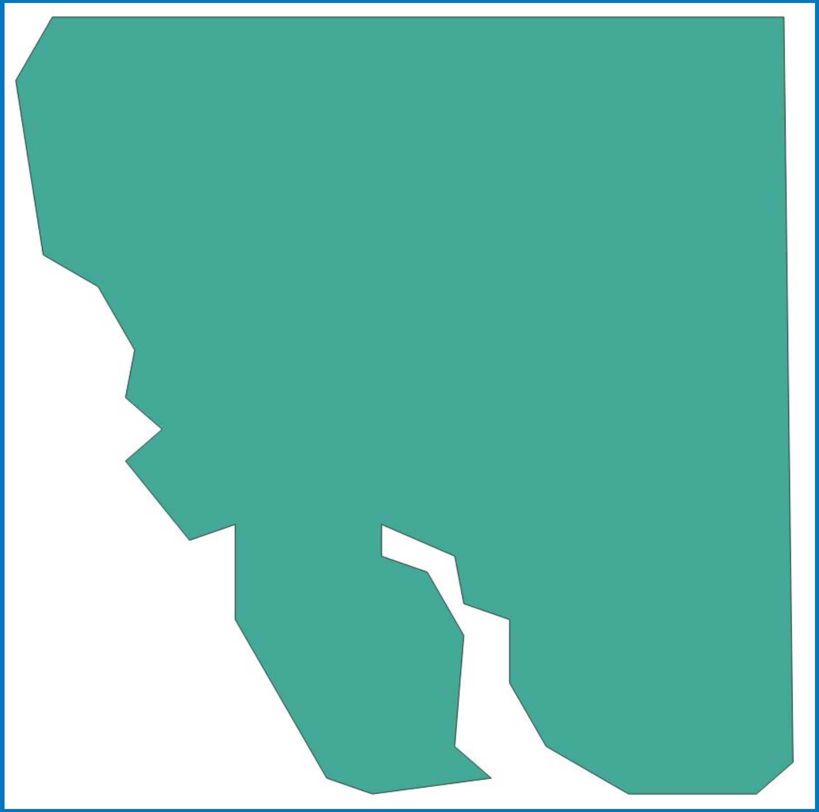
INFO

- --stats filter.stats, bbox, counts, ranges, enumerations
- --metadata reads header values, srs values and info
- --boundary wkt and json, density, area, filters.hexbin
- --dimensions limit stats to dimension(s) list
- --schema dimension list and types
- --point individual point values

TOP DOWN VIEW

Info

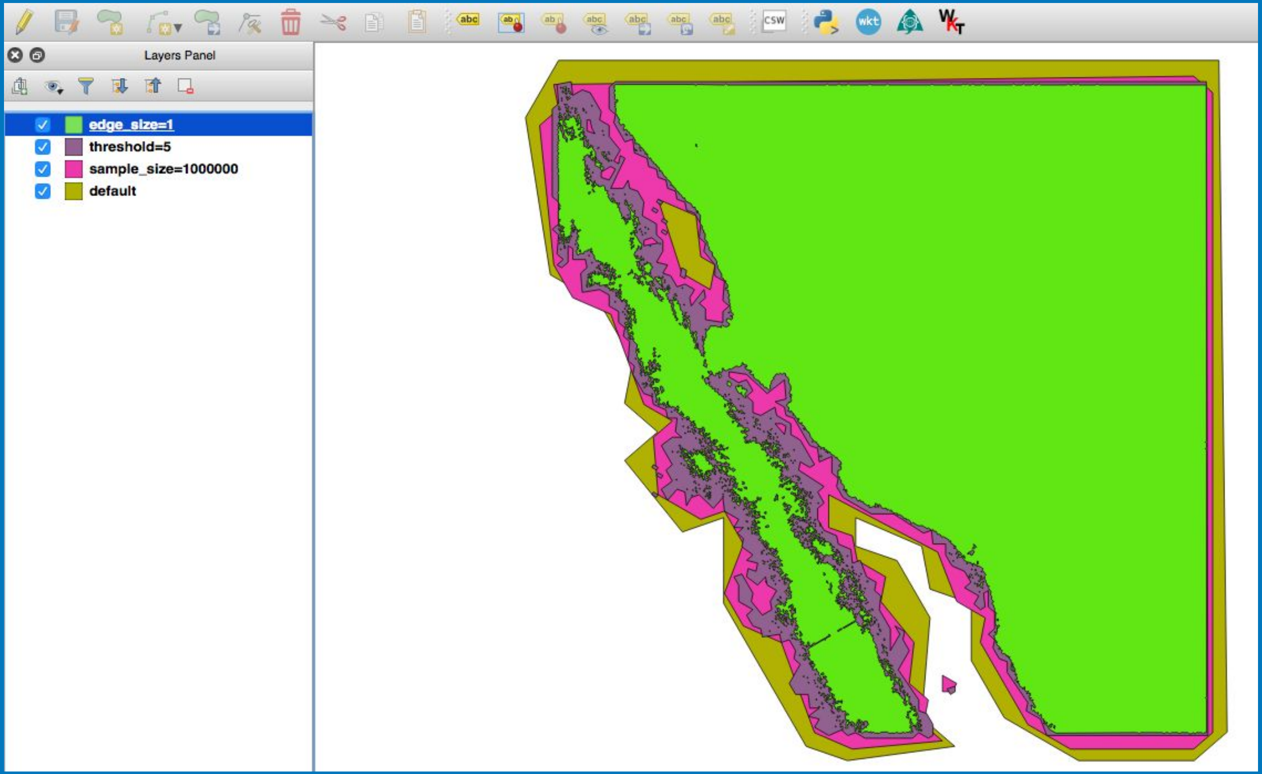
```
$ pdal info --boundary
source.laz
```



INFO

```
$ pdal info --boundary
source.laz
--filters.hexbin.threshold=5
--filters.hexbin.sample_size=
1000000
--filters.hexbin.edge_size=1
```

density: 25.15629811
default density was 18.72858644



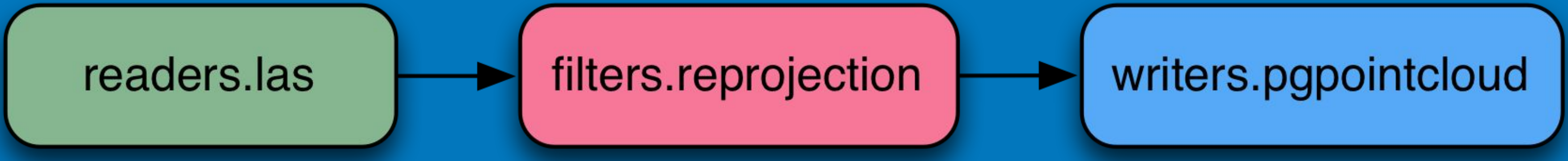
Translate

- basic format changes
- options to set readers/writers/filters
- --json option for reading filters from pipeline file
- --pipeline option to create a pipeline file

```
pdal translate -i myfile.las -o myfile.laz

pdal translate myfile.las myfile.laz --writers.las.system_id="Custom"
--writers.las.scale_z=0.00001

pdal translate myfile.ntf oufile.laz -f filters.reprojection
--filters.reprojection.out_srs="epsg:32641+3755"
```

Pipeline

- Access to the full power of pdal
- allows stacking of range of operations with one pass through data
- great for programmatically building workflows
- supports command line override of values for batch processing



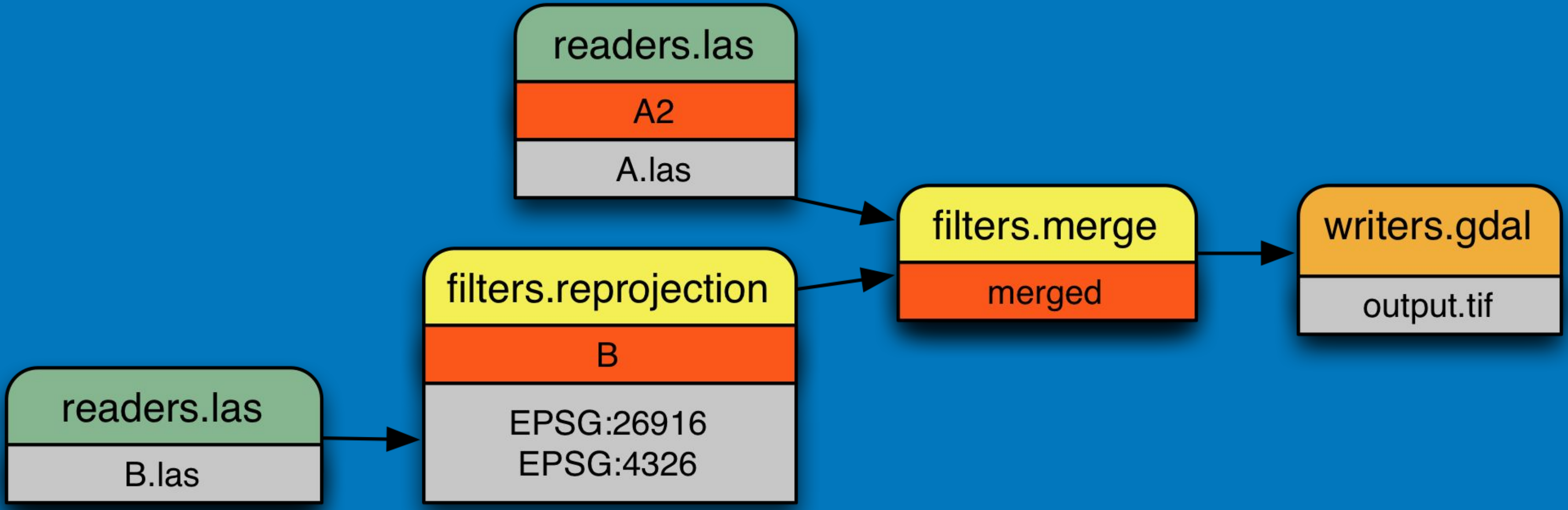
Pipeline

```
$ pdal pipeline range.json
--readers.las.filename=myfile.las
--writers.las.filename=myrangefile.laz

$ find . -name "*.laz" | xargs -I{}
pdal pipeline range.json
--readers.las.filename={}
--writers.las.filename=newdir/{}
```

```
{
  "pipeline":[
    {"type": "readers.las"},
    {
      "type":"filters.range",
      "limits":"Z[0:99999]"
    },
    {"type":"writers.las"}
  ]
}
```

Pipeline

- supports globbed inputs
- tagging of stages to choose what gets applied
- complex workflows



Pipeline

```
{
  "pipeline":
  [
    {

"filename":"Eastman_LAZ_Final/Input/*.laz",
      "type":"readers.las"
    },
    {
      "assignment":"Classification[:]=0",
      "tag":"filtersassign",
      "type":"filters.assign"
    },
    {
      "inputs":
      [
        "filtersassign"
      ],
      "extract":"true",
      "tag":"filtersoutlier",
      "type":"filters.outlier"
    },
  {
      "inputs":
      [
        "filtersoutlier"
      ],
      "max_distance":"7",
      "approximate":"true",
      "tag":"filterspmf",
      "type":"filters.pmf"
    },
```

```
    {
      "inputs":
      [
        "filterspmf"
      ],
      "length":"1000",
      "type":"filters.splitter",
      "tag":"filterssplitter"
    },
{
      "inputs":
      [
        "filterssplitter"
      ],
      "type":"writers.las",
      "tag":"writerslas",
      "a_srs":"EPSG:26911",
      "scale_x":"0.001",
      "scale_y":"0.001",
      "scale_z":"0.001",
      "offset_x":"auto",
      "offset_y":"auto",
      "offset_z":"auto",

"filename":"Eastman_LAZ_Final/Output/Eastman_1
61115_GND_CLS_#.laz"
    },
{"inputs":[ "writerslas"],
       "type":"filters.merge",
       "tag":"filtersmerge"
     },
```

```
    {
      "inputs":
      [
        "filtersmerge"
      ],
      "limits":"Classification[2:2]",
      "type":"filters.range",
      "tag":"filtersrange"
    },
    {
      "inputs":
      [
        "filtersrange"
      ],
      "type":"writers.gdal",

"filename":"Eastman_LAZ_Final/Output/Eas
tman_161115_GND_CLS_50CM_DEM.tif",
      "radius":0.7071,
      "resolution":0.5,
      "output_type":"idw",
      "nodata":-9999,
      "window_size":2,
      "gdalopts":"predictor=3,
tiled=yes, compress=deflate"
    }
  ]
}
```

Reprojection

- assigning and reprojecting data via pipeline
- can also set via translate
- includes vertical datum reprojection (with grid shift files)

```
{
  "pipeline":[
    {"type":"readers.las" },
    { "type":"filters.reprojection",
      "in_srs":"EPSG:26918",
      "out_srs":"EPSG:26919"
    },
    { "type":"writers.las"}
  ]
}
```

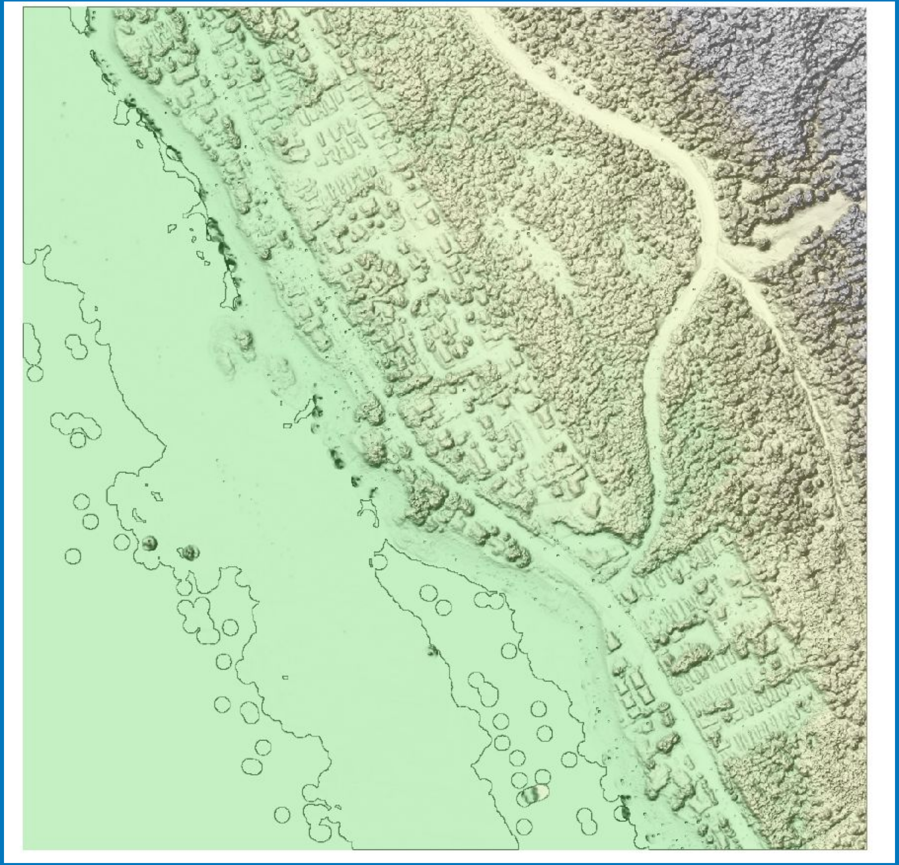
```
pdal pipeline proj.json
--readers.las.filename=src.laz
--writers.las.filename=dest.laz
```

```
 ls *.laz | xargs  pdal translate --filters filters.reprojection
--filters.reprojection.in_srs=epsg:32641+5773
--filters.reprojection.out_srs=epsg:32641+3775 -i {}  -o newdir/{}
```

GDAL Writer

- turn a point cloud into a surface
- min/max/mean/count/stdev/idw
- output to most gdal raster types (single band)
- supports an array of gdal creation options
- stream mode for reducing memory overhead

GDAL Writer

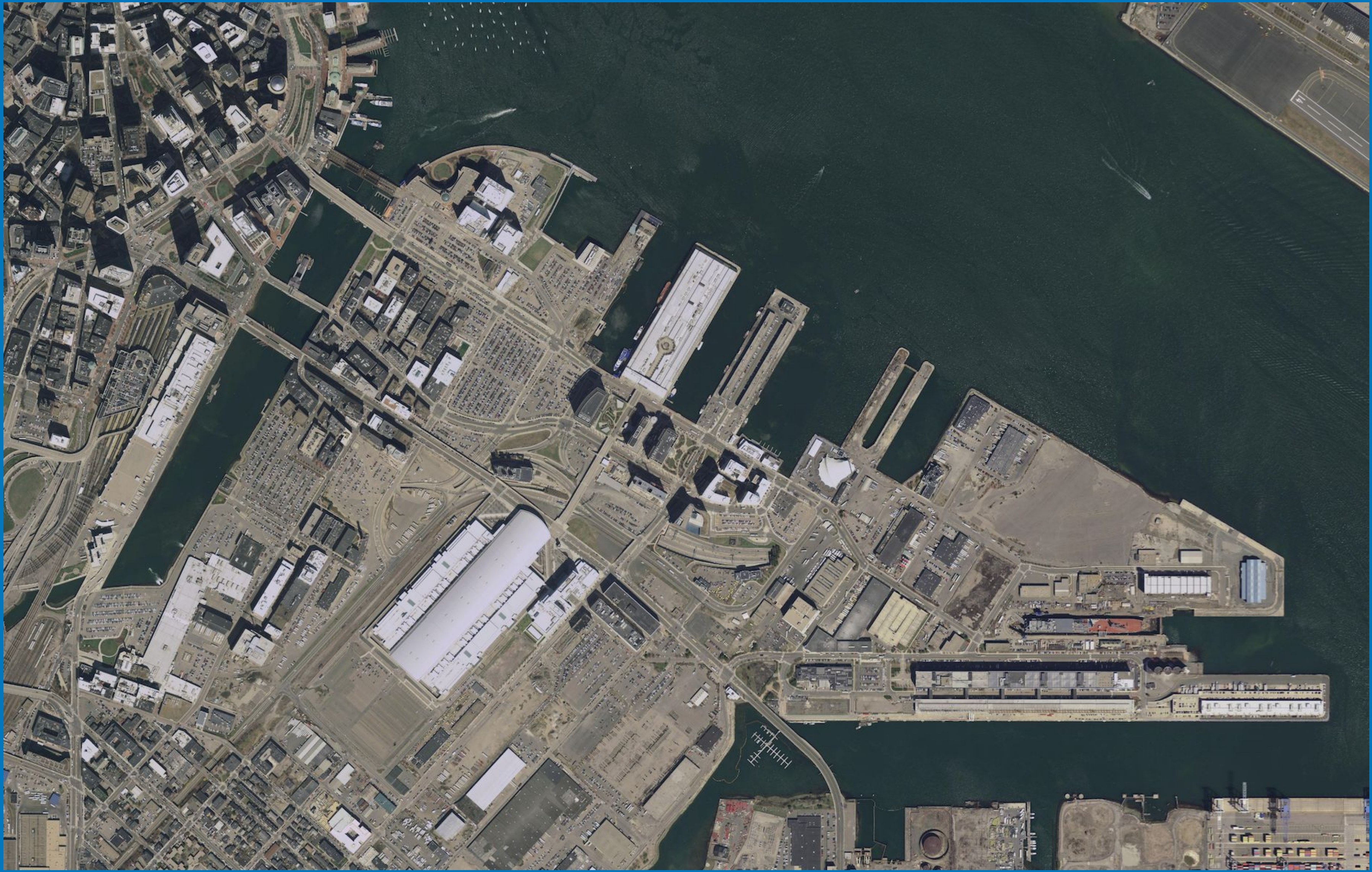


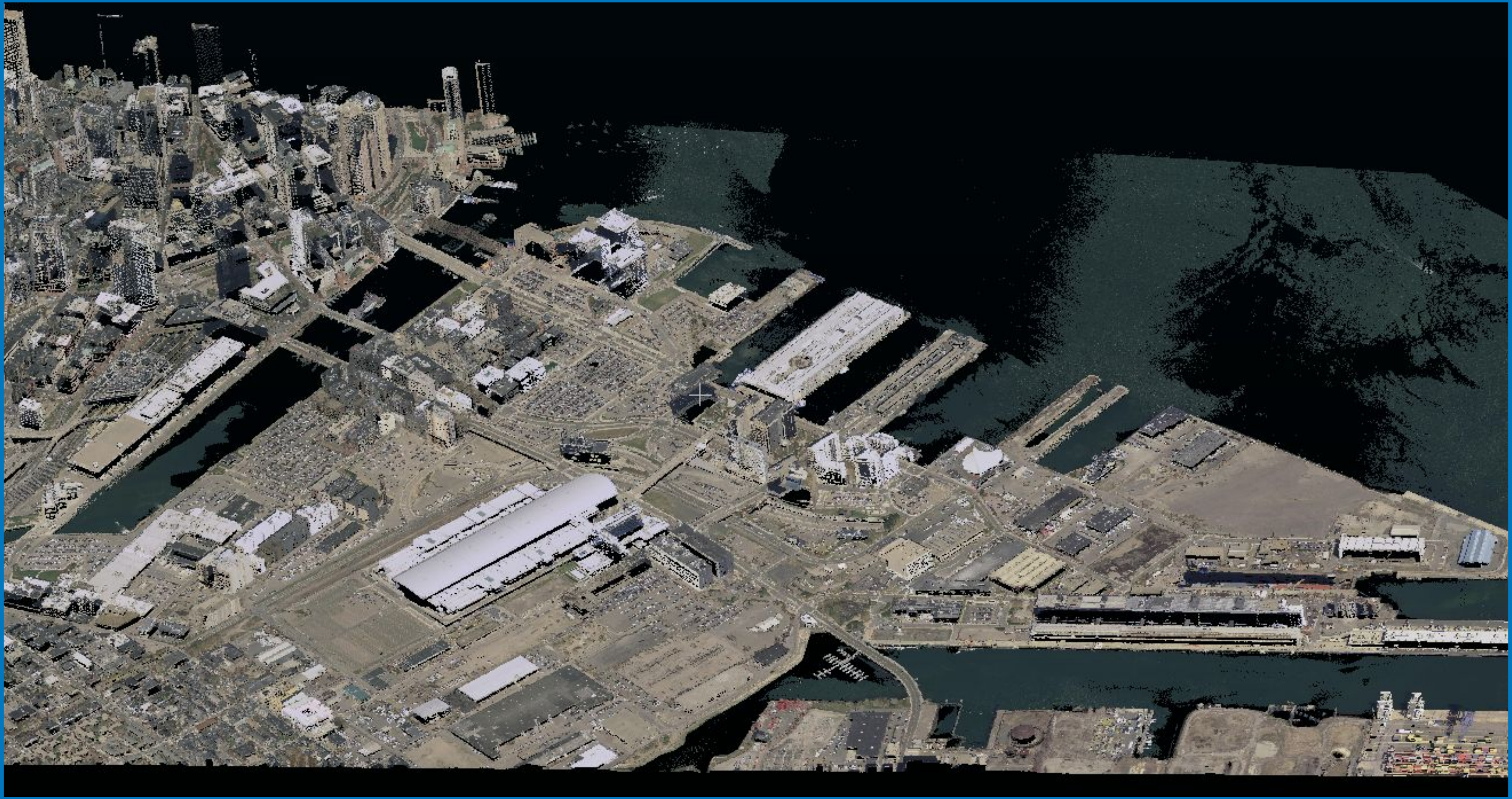
```
{
  "pipeline":[

    {
     "type":"readers.las",
     "filename":"source.laz"
    },
    {
     "type": "filters.range",
     "limits":"Classification[2:2]"
    {
     "type": "writers.gdal",
     "resolution": "1.0",
     "filename": "destination",
     "output_type": "idw",
     "gdaldriver": "GTiff",
     "gdalopts"  : "TILED=YES",
     "gdalopts"  : "COMPRESS=DEFLATE"

    }
  ]
}
```

colorization

- can use any gdal image source
- projections need to match

```
{
  "pipeline":[
    { "type":"filters.colorization",
"raster":"https://isse.cr.usgs.gov/arcgis/rest/services/Orthoimagery/USGS_EROS_Ortho_1
Foot/ImageServer/exportImage?f=image&bbox=333615,4691634,330227,4689471&imageSR=26919&
bboxSR=26919&size=3388,2163&format=tiff&pixelType=U8"
    }
  ]
}
```

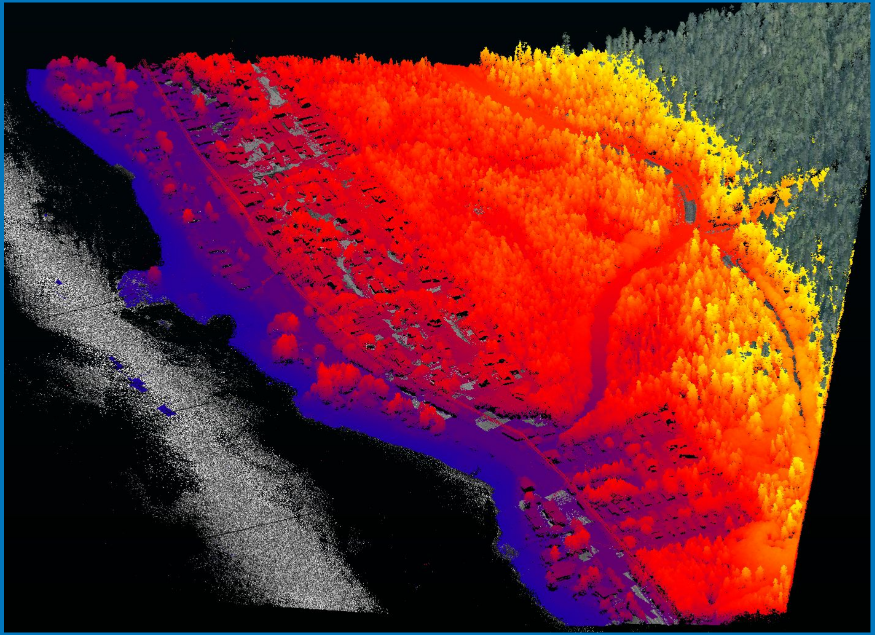




colorinterp

- applies a color range (predefined or specified) to a dimension
- can set min/max or calculate, or filters.mad

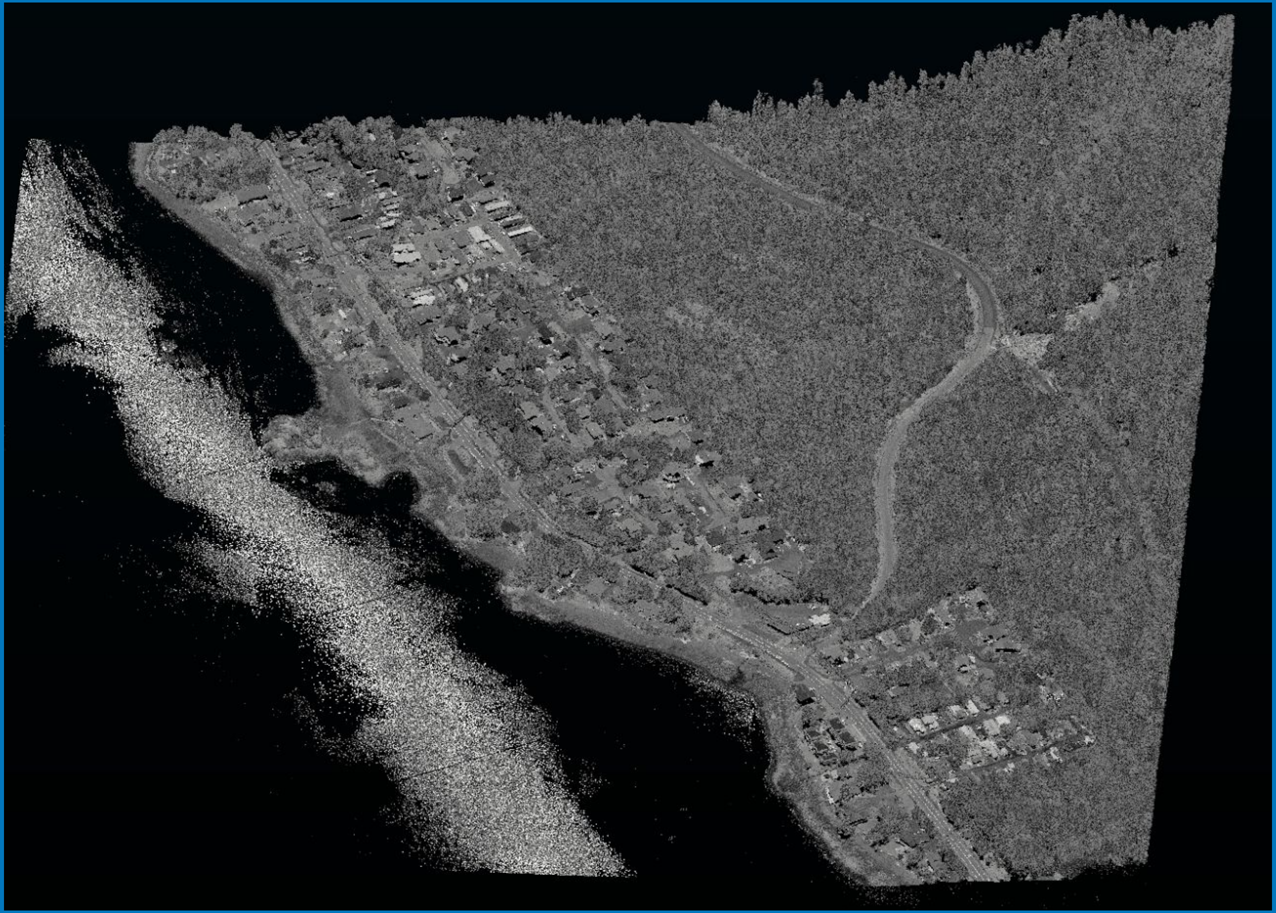
```
{
    "type":"filters.colorinterp",
    "ramp":"heat_map"
    "mad": true,
    "k":  2
}
```



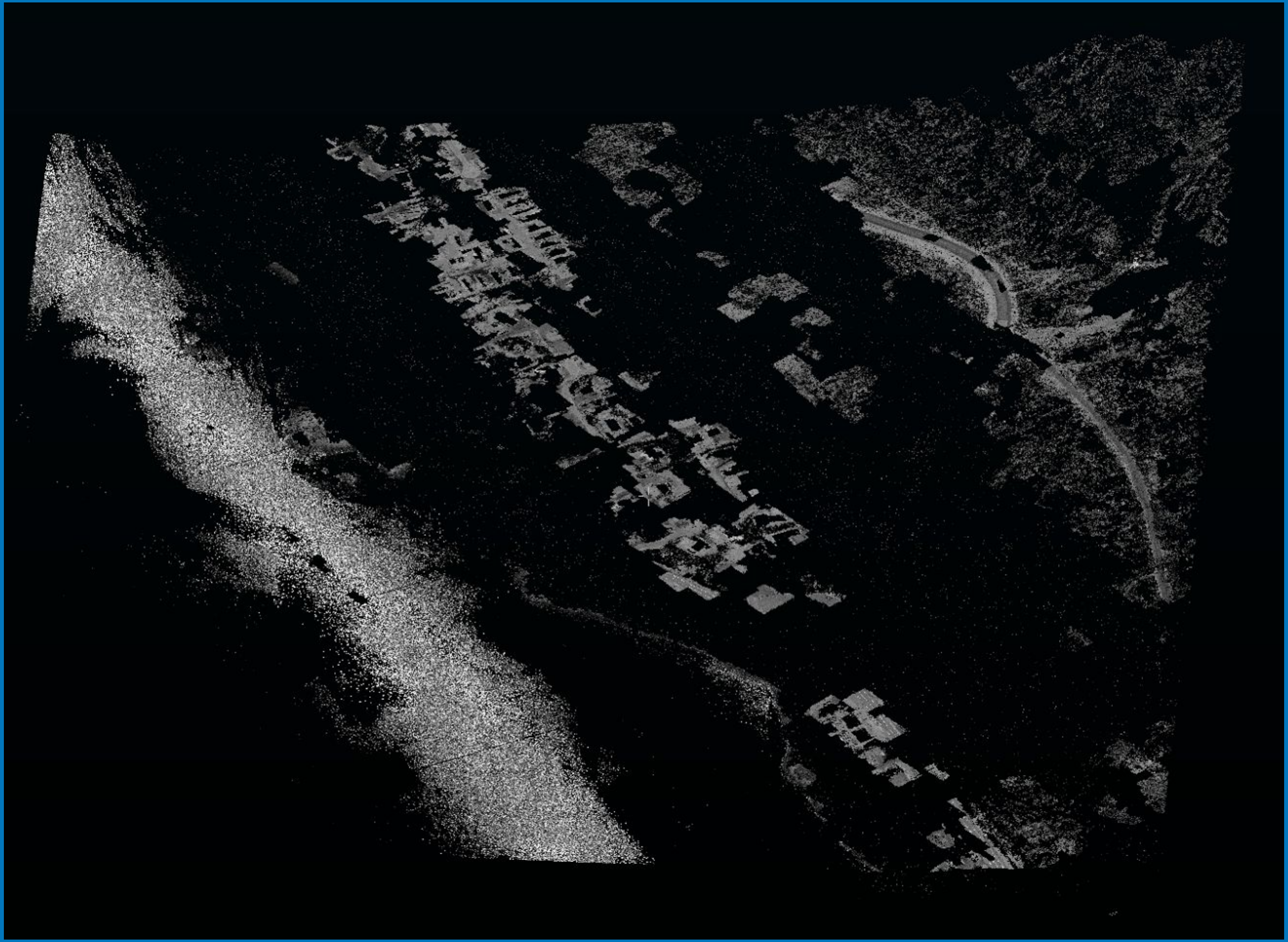
Ground

- Classifies a pointcloud into ground and non-gound
  - a filter and an app
  - classify and extract have been removed
  - use filters.range to extract
  - use filters.assign to clear existing classes
  - pdal ground uses Progressive Morphological Filter
  - same as a pipeline with filters.pmf
  - filters.smrf can *often* produce better/faster results

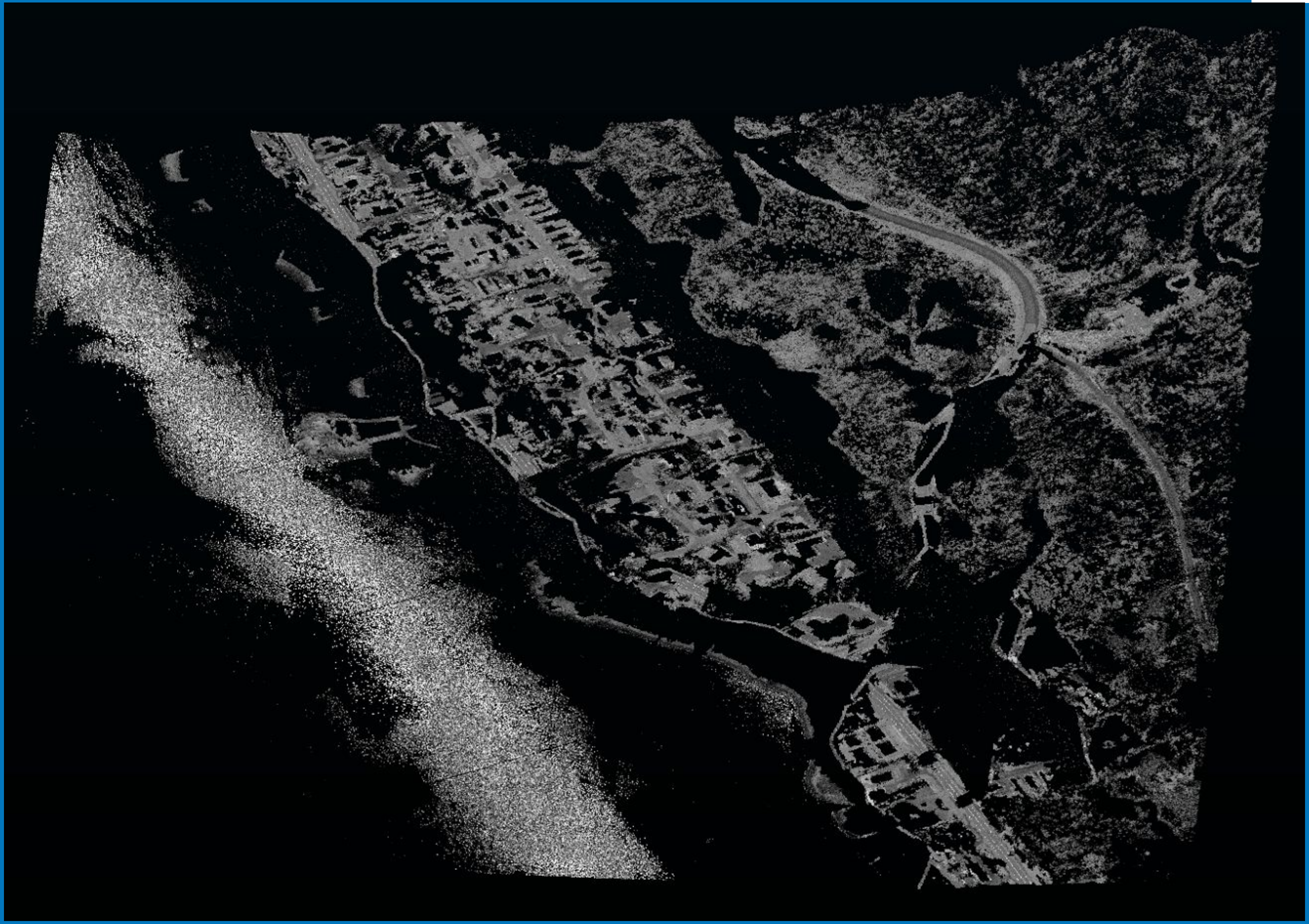
Ground - Pre



Ground - PMF



Ground - SMRF

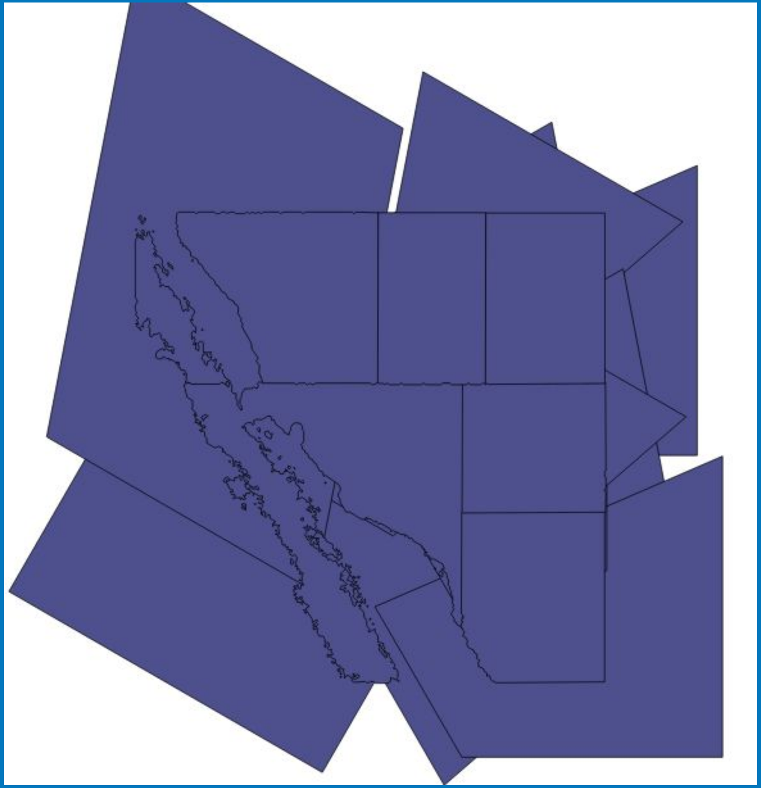


Using filters.smrf

SPLITTING

- an app or several filters
- filters.divider - point count or count of files

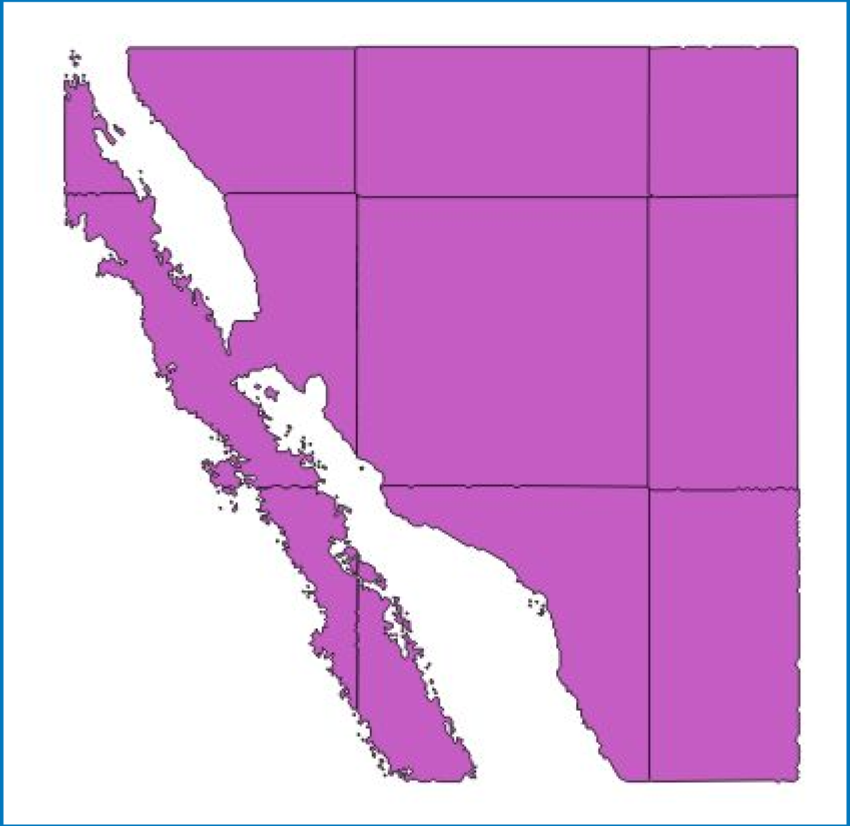
```
pdal split -i source.laz
-o dest_cap.las
--capacity 3000000
```



SPLITING

- can break in tiles by size
- optional specify an origin x/y
- used with pdal split or filters.splitter

```
pdal split
-i source.laz
-o dest_length.laz
--length 400
--origin_x 476000
--origin_y 6327000
```



sort

- an app or a filter
- applies a filters.sort to a file
- can be very useful to increase compression (laz)

```
pdal sort CO_ArkansasValley_2010_000536.laz
CO_ArkansasValley_2010_000536-time-sort.laz
    --filters.sort.dimension=GPSTime
    --writers.las.forward=all

22292036 CO_ArkansasValley_2010_000536-time-sort.laz
56629291 CO_ArkansasValley_2010_000536.laz
```

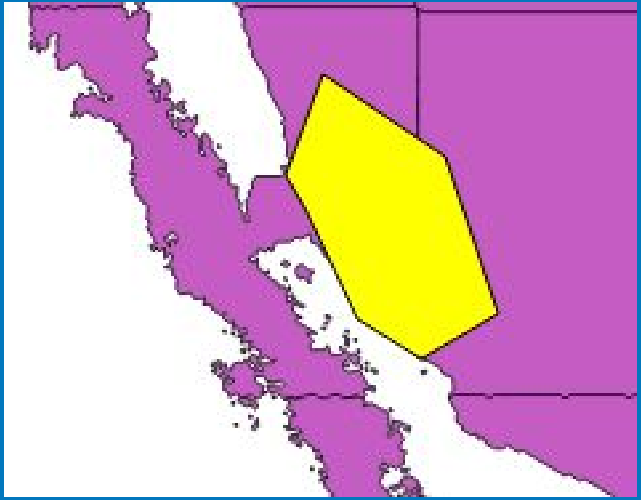
TINDEX

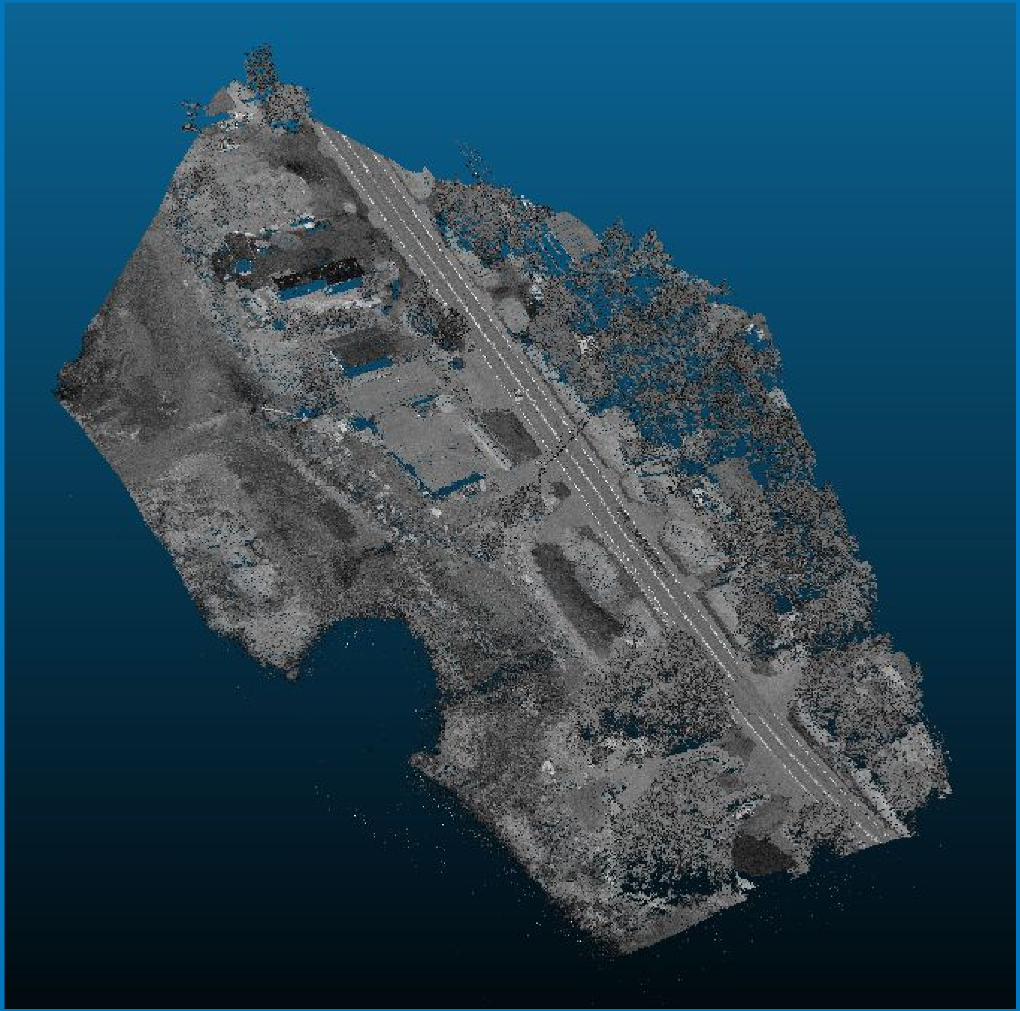
- app or filter
- creates a tile index of pointclouds in any ogr vector format
- extent or hexbin boundaries, can specify output srs
- can then be used for merge/clip operations
- readers.tindex for pipeline operations

```
pdal tindex filename.db -f sqlite "*.laz" --t_srs "epsg:4326"
```

TINDEX

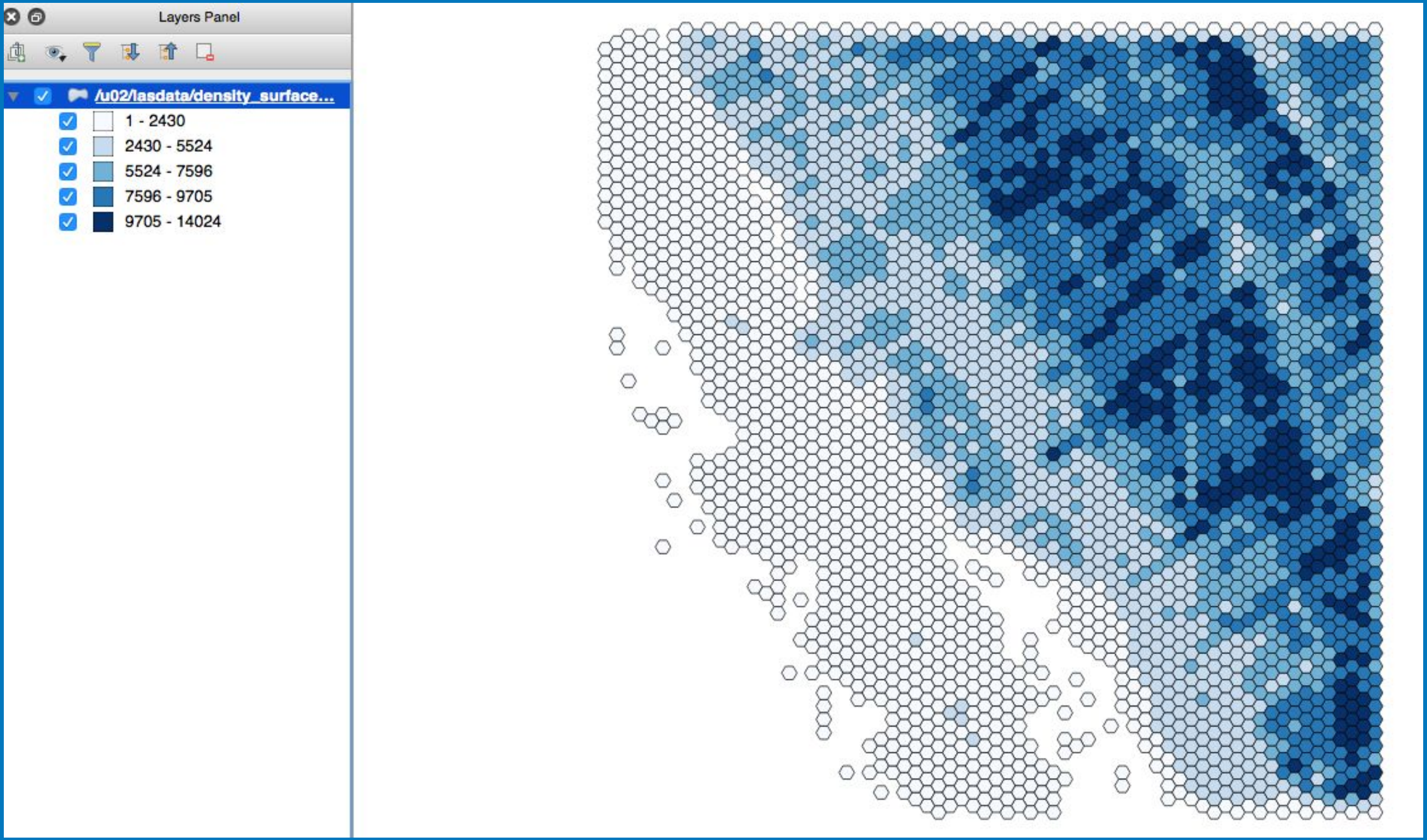
```
pdal tindex --merge
--tindex tileindex.shp
--filespec output.laz
--polygon "POLYGON ((476211 6327699,
 476296 6327664, 476326 6327560,
476247 6327508, 476101 6327519,
476063 6327617, 476211 6327699))"
```





Density Kernel

```
pdal density -i source.laz  -o density_surface.db  -f SQLite --filters.hexbin.edge_size=10
```



PYTHON API

- available via pypi
- read las data to numpy with

```
""" fetch PDAL data as a numpy array"""
   json = open('/data/pipeline/pipeline_read.json','rb').read
   r = libpdalpython.PyPipeline(json)
   r.execute()
   arrays = r.arrays()
```

Documentation

- http://pdal.io
  - rtd format
  - single pdf download
  - content reorganized
- new workshop documentation
  - 100+ pages
  - uses qgis and osgeo4w64
- new tutorials

Releases

- source: http://pdal.io
  - dev repo at https://github.com/PDAL/PDAL
- docker hub - fastest way to pdal
  - docker pull pdal/pdal:<release>
  - pdal/dependencies image for custom builds
- windows: OSGeo4W64 (up to date builds)
- linux centos/redhat rpms
- linux debian unstable

Questions?