Introducing the PostGIS Add-ons:
An easy way to add functionality to PostGIS

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UNIVERSITÉ LAVAL

cef
Centre d'étude de la forêt

Pierre Racine
Research assistant
GeoElucubrations

The PostGIS Add-ons

- Contributing to PostGIS core is hard
  - Complex code with lots of history
  - Hard to compile under Windows
- A single SQL file of PL/pgSQL only functions
  - Self documented
  - Companion tests and uninstall scripts
- Provide and easy way for advanced PostGIS users to contribute with new PL/pgSQL functions (via GitHub)
  - Good practice to write new functions as prototypes in PL/pgSQL before integrating them in PostGIS core
  - Make them available to other users to test and comment
  - Give time to determine the best function signature

Simple Functions

- **ST_DeleteBand(**rast, band**)**
- **ST_RandomPoints(**geom, nb, seed**)**
- **ST_AddUniqueID(**schemaname, tablename, colname,
  replace, indexit**)**

Useful to other functions

- **ST_ColumnExists(**schemaname, tablename, colname**)**
- **ST_HasBasicIndex(**schemaname, tablename, colname**)**
- **ST_ColumnIsUnique(**schemaname, tablename, colname**)**

More Complex Functions

Topology

- ST_GeoTableSummary()
- ST_DifferenceAgg()
- ST_SplitAgg()

Complex Geometries

- ST_TrimMulti()
- ST_NBiggestExteriorRings()
- ST_BufferedSmooth()
- ST_BufferedUnion()

Raster/Vector Analysis

- ST_CreateIndexRaster()
- ST_AreaWeightedSummaryStats()
- ST_ExtractToRaster()
- ST_GlobalRasterUnion()
- ST_SplitByGrid()
- ~~ST_SummaryStatsAgg()~~

Others

- ST_Histogram()

ST_GeoTableSummary()

- **Provides 9 types of summary about a geometry table**
  1. **Duplicate ids (S1 or IDDUP)**
  2. **Duplicate geometries (S2, GDUP or GEODUP)**
  3. **Overlapping geometries (S3 or OVL)**
  4. **Geometry types (S4, TYPES, GTYPES or GEOTYPES)**
  5. **Vertexes stats (min, max, mean) (S5 or VERTX)**
  6. **Vertexes histogram (S6 or VHISTO)**
  7. **Areas stats (min, max, mean) (S7, AREA or AREAS)**
  8. **Areas histogram (S8 or AHISTO)**
  9. **Small areas count (S9 or SACOUNT)**
- **ST_GeoTableSummary(**
  schemaname, tablename, geomcolumnname, uidcolumnname,
  nbhistobins,
  list_of_summaries_to_do,
  list_of_summaries_to_skip,
  where_clause
)
- **A uid column is created and indexed if necessary**
- **The geometry column is indexed if necessary**

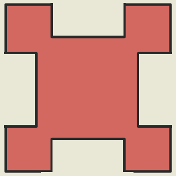
Still a lot of work to do:

- Add a gap summary
- Add a fixquery column
- Provide better search queries
- Support tables of linestrings
  - Intersections instead of overlaps
  - Length instead of areas
- Make it an aggregate?

ST_DifferenceAgg() and ST_SplitAgg()

Two methods to remove overlaps in a (multi)polygon table

ST_DifferenceAgg(geomA, geomB)



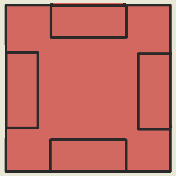
- The state function removes, using ST_Difference(), all **geomB** from **geomA**
- Except the first **geomB** identical to **geomA**
- The final function simply returns the clipped geometry

```
SELECT a.id, ST_DifferenceAgg(a.geom, b.geom) geom
FROM overlappingtable a, -- Join the table with itself
          overlappingtable b
WHERE a.id = b.id OR -- Make sure the polygon is passed to and returned by the function
     ((ST_Contains(a.geom, b.geom) OR -- Select all the containing, contained and overlapping polygons
       ST_Contains(b.geom, a.geom) OR
       ST_Overlaps(a.geom, b.geom)) AND
      (ST_Area(a.geom) < ST_Area(b.geom) OR -- Make sure bigger polygons are removed from smaller ones
       (ST_Area(a.geom) = ST_Area(b.geom) AND -- If areas equals, arbitrarily rem. one from the other in a det. order
       a.id < b.id)))
GROUP BY a.id
HAVING ST_Area(ST_DifferenceAgg(a.geom, b.geom)) > 0 AND -- Do not select polygons completely erased poly
             NOT ST_IsEmpty(ST_DifferenceAgg(a.geom, b.geom));
```

ST_DifferenceAgg() and ST_SplitAgg()

ST_SplitAgg(geomA, geomB, tolerance)

- The state function split (using ST_Difference()) **geomA** with all **geomB**
- Sliver smaller than tolerance are not removed from the results
- The final function returns an array of the splitted geometries
- Arrays have to be unnested and Duplicates polygons have to
- be cleaned with DISTINCT



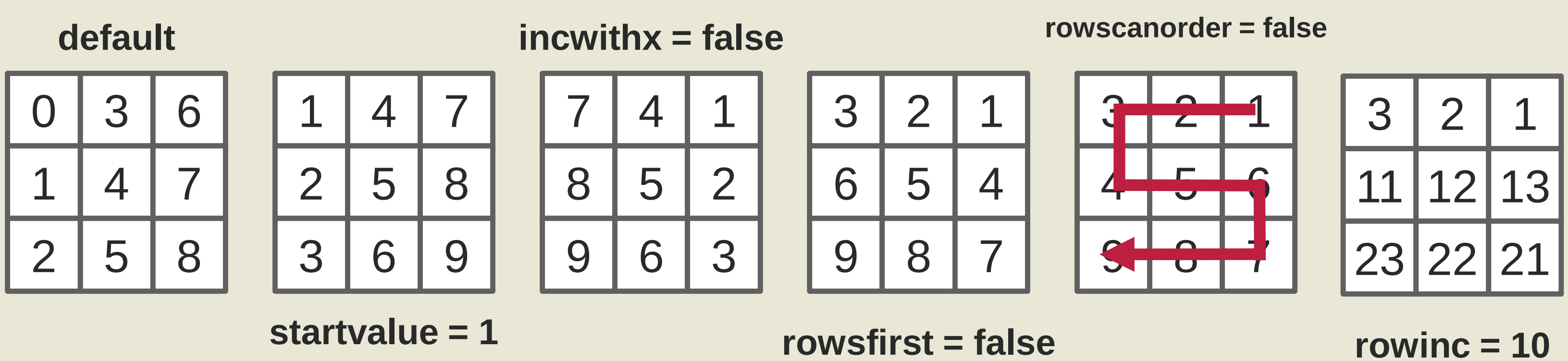
```
SELECT DISTINCT ON (geom) a.id,
                           unnest(ST_SplitAgg(a.geom, b.geom, 0.00001)) geom
FROM   overlappingtable a, -- join the table with itself
       overlappingtable b
WHERE  ST_Equals(a.geom, b.geom) OR -- select the polygon itself
       ST_Contains(a.geom, b.geom) OR -- and overlapping ones
       ST_Contains(b.geom, a.geom) OR
       ST_Overlaps(a.geom, b.geom)
GROUP BY a.id
ORDER BY geom, max(ST_Area(a.geom)) DESC; -- select the id of the biggest
```

ST_CreateIndexRaster()

- **Create a raster having a specified index ordering**
- **ST_CreateIndexRaster**

rast,	***a reference raster (ST_MakeEmptyRaster)***
startvalue,	***the start value***
pixeltype,	***the pixel type of the pixels***
incwithx, incwithy,	***left to right or right to left, top to bottom or bottom to top***
rowsfirst,	***vertically of horizontally***
rowscanorder,	***row scan or prime-row scan***
colinc, rowinc	***increment in x and y***

)

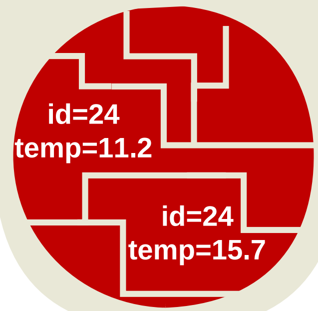


ST_AreaWeightedSummaryStats()

- Simplify the writing of aggregates values after an intersection
  - ST_AreaWeightedSummaryStats(geom, val)

  or

  - ST_AreaWeightedSummaryStats(geomval)




```
WITH inter AS (
  SELECT gt.id, ST_Intersection(rt.rast, gt.geom) gv
  FROM  raster_table rt,
        geometry_table gt
  WHERE ST_Intersects(rt.rast, gt.geom)
), aws AS (
  SELECT id, ST_AreaWeightedSummaryStats(gv) aws
  FROM inter
  GROUP BY id
)
SELECT id, (aws).geom, (aws).totalarea,
          (aws).weightedmean
FROM aws;
```

count,
distinctcount,
geom,
totalarea,
meanarea,
totalperimeter,
meanperimeter,
weightedsum,
weightedmean,
maxareavalue,
minareavalue,
maxcombinedareavalue,
mincombinedareavalue,
sum,
mean,
max, min

ST_ExtractToRaster()

- Iterate over every pixels of a raster an extract a metric from a vector coverage
- Bit slow but provides much flexibility over the type of metric computed

```
SELECT ST_ExtractToRaster(
          ST_AddBand(
            ST_MakeEmptyRaster(rast), '32BF'::text, -9999, -9999),
          'public', 'forestcover', 'geom',
          'height',
          'AREA_WEIGHTED_MEAN_OF_VALUES'
        ) rast
FROM ref_raster_tiled_coverage;
```

COUNT_OF_VALUES_AT_PIXEL_CENTROID
MEAN_OF_VALUES_AT_PIXEL_CENTROID
COUNT_OF_POLYGONS
COUNT_OF_LINESTRINGS
COUNT_OF_POINTS
COUNT_OF_GEOMETRIES
VALUE_OF_BIGGEST

VALUE_OF_MERGED_BIGGEST
VALUE_OF_MERGED_SMALLEST
MIN_AREA
SUM_OF_AREAS
SUM_OF_LENGTHS
PROPORTION_OF_COVERED_AREA
AREA_WEIGHTED_MEAN_OF_VALUES

ST_GlobalRasterUnion()

- Iterate over every pixels of a raster an extracts a metric from a raster coverage
- Bit slow but provides much flexibility over the type of metric computed

```
SELECT ST_GlobalRasterUnion(
        'source_raster_public',
        'source_raster_table',
        'rast',
        'MEAN_OF_RASTER_VALUES_AT_PIXEL_CENTROID'
) rast;
```

Values computed from the centroids

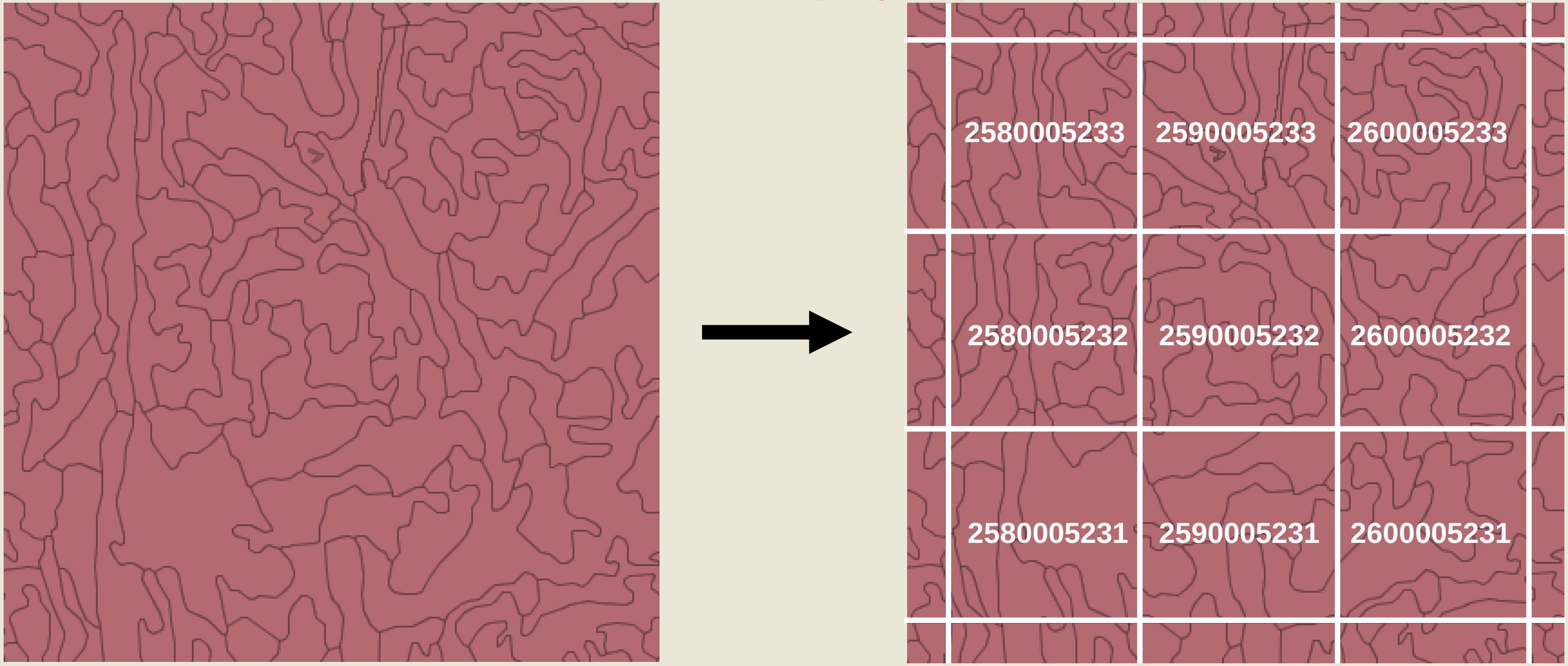
COUNT_OF_RASTER_VALUES_AT_PIXEL_CENTROID
FIRST_RASTER_VALUE_AT_PIXEL_CENTROID
MIN_OF_RASTER_VALUES_AT_PIXEL_CENTROID
MAX_OF_RASTER_VALUES_AT_PIXEL_CENTROID
SUM_OF_RASTER_VALUES_AT_PIXEL_CENTROID
MEAN_OF_RASTER_VALUES_AT_PIXEL_CENTROID
STDDEVP_OF_RASTER_VALUES_AT_PIXEL_CENTROID
RANGE_OF_RASTER_VALUES_AT_PIXEL_CENTROID

Values computed from the pixel extents

AREA_WEIGHTED_SUM_OF_RASTER_VALUES
SUM_OF_AREA_PROPORTIONAL_RASTER_VALUES
AREA_WEIGHTED_MEAN_OF_RASTER_VALUES

ST_SplitByGrid()

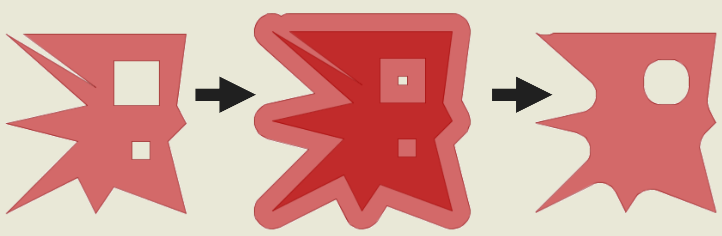
- (ST_SplitByGrid(geom, 1000)).* returns
  - each polygon splitted by a global grid and
  - the unique identifier of the cell (bigint)



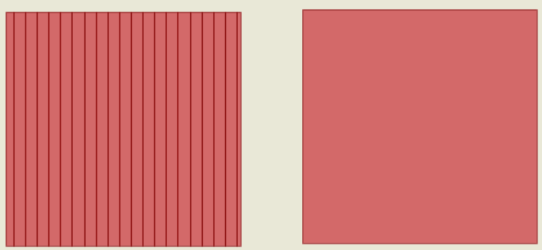
- Polygons (originally splitted) have to be reunioned afterward with ST_Union()

Functions Working With Complex Geometries

- ST_TrimMulti(geom, minarea)
  - Trim a multipolygon from small inner parts
- ST_NBiggestExteriorRings(geom, nbrings, comptype)
  - comptype = 'area': Returns the N biggest rings
  - comptype = 'nbpoints': Returns the N more complex rings
- ST_BufferedSmooth(geom, size)
  - Apply and remove a buffer in order to smooth sharp polygons concave angles and remove thin "inlets" (not removed by ST_TrimMulti) or holes



- ST_BufferedUnion(geom, size)
  - Apply a buffer before ST_Union() and remove it afterward
  - Make sure shared borders are unioned properly
  - Avoid many sliver interior rings after ST_Union()
  - Easier union of very complex vector coverage



ST_Histogram()

ST_Histogram(
schemaname,
tablename,
colname,
nbinterval DEF 10,
whereclause
)

	intervals text	cnt integer	query text
1	NULL	0	SELECT * FROM public.a forestcover mtm7 WHERE height IS NULL;
2	[0 - 2.4500000000000002[	2176	SELECT * FROM public.a forestcover mtm7 WHERE height >= 0 AND height < 2.4500000000000002 ORDER BY height;
3	[2.4500000000000002 - 4.9000000000000004[	1114	SELECT * FROM public.a forestcover mtm7 WHERE height >= 2.4500000000000002 AND height < 4.9000000000000004 ORDER BY height;
4	[4.9000000000000004 - 7.3499999999999996[	1126	SELECT * FROM public.a forestcover mtm7 WHERE height >= 4.9000000000000004 AND height < 7.3499999999999996 ORDER BY height;
5	[7.3499999999999996 - 9.8000000000000007[	1501	SELECT * FROM public.a forestcover mtm7 WHERE height >= 7.3499999999999996 AND height < 9.8000000000000007 ORDER BY height;
6	[9.8000000000000007 - 12.25[	0	SELECT * FROM public.a forestcover mtm7 WHERE height >= 9.8000000000000007 AND height < 12.25 ORDER BY height;
7	[12.25 - 14.699999999999999[	1551	SELECT * FROM public.a forestcover mtm7 WHERE height >= 12.25 AND height < 14.699999999999999 ORDER BY height;
8	[14.699999999999999 - 17.149999999999999[	0	SELECT * FROM public.a forestcover mtm7 WHERE height >= 14.699999999999999 AND height < 17.149999999999999 ORDER BY height;
9	[17.149999999999999 - 19.600000000000001[	90	SELECT * FROM public.a forestcover mtm7 WHERE height >= 17.149999999999999 AND height < 19.600000000000001 ORDER BY height;
10	[19.600000000000001 - 22.050000000000001[	0	SELECT * FROM public.a forestcover mtm7 WHERE height >= 19.600000000000001 AND height < 22.050000000000001 ORDER BY height;
11	[22.050000000000001 - 24.5]	2	SELECT * FROM public.a forestcover mtm7 WHERE height >= 22.050000000000001 AND height <= 24.5 ORDER BY height;

Thanks!

Pierre.Racine@sbf.ulaval.ca

https://github.com/pedrogit/postgisaddons

Boreal Avian Modelling Project

The Canadian BEACONs Project
Boreal Ecosystems Analysis of Conservation Networks

western boreal conservation initiative
l'initiative de conservation boréale de l'ouest
Environment Canada
Environnement Canada

Fondation canadienne pour l'innovation
Canada Foundation for Innovation

PostgreSQL

PostGIS
Geospatial Objects for PostgreSQL

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