Black Bear Road Mortality & Land- use Change in Southern Florida

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IDCE 376 Spring 2023

04/28/2023

Agenda

- Background
- Study Objectives
- Data& Methods
- Results
- Conclusion & Future Work

About Wildlife-Vehicle Conflict (WVC)?

- Physical Damage to
  - Animal
  - Human
- Financial Cost from
  - Cars
  - Accident Treatment

According to previous research….

- Significant risk to bears in FL to be involved in WVC
- mainly factors influencing

1. Sociodemographic Factors (e.g., population growth)
2. Natural and Built Environmental factors

- Environmental characteristics may be able to forecast WVC -- Use population density and road network predict WVC hotspot

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Study Objectives

Basic Overview of WVC data:

- How many records in different times and spaces?

Focus Data on Biological Factor of Bears (age, sex) and Land Use

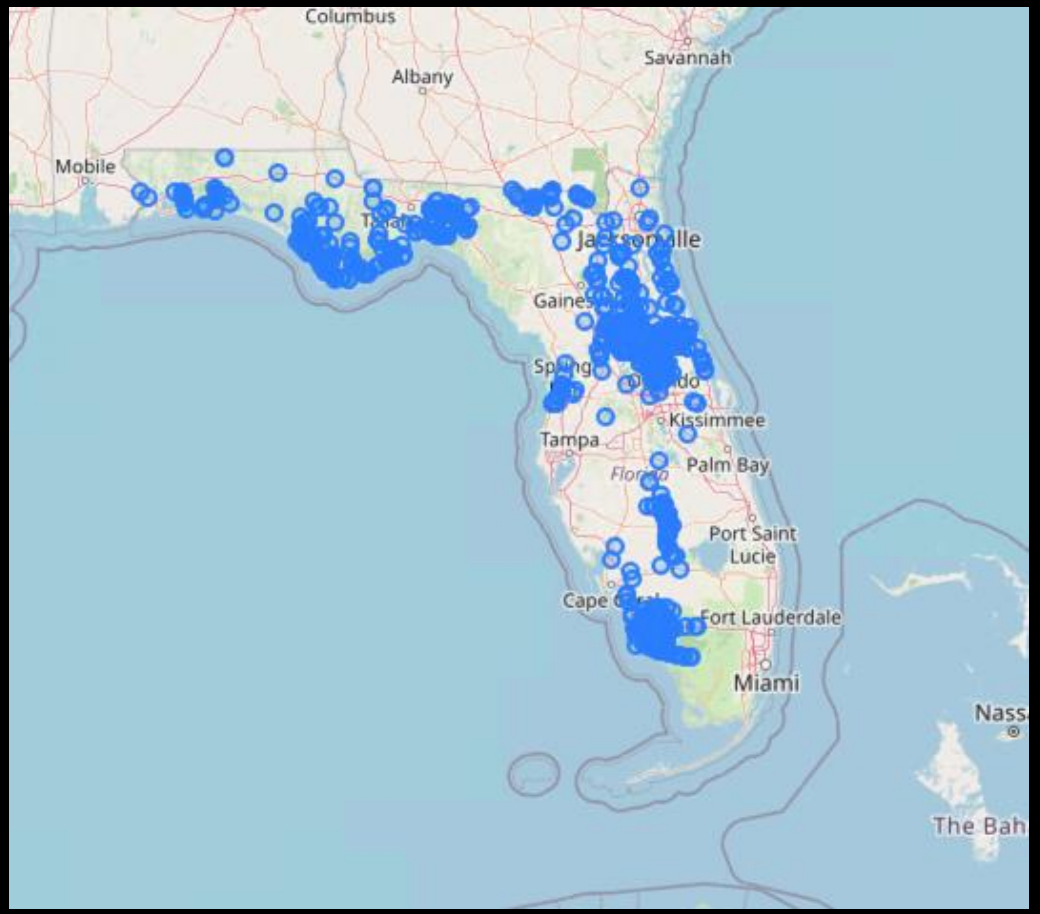
Analyzing LULC (1995,2015) around WVC Points in South FL:

- How did the land change in 20 years around bear mortality?

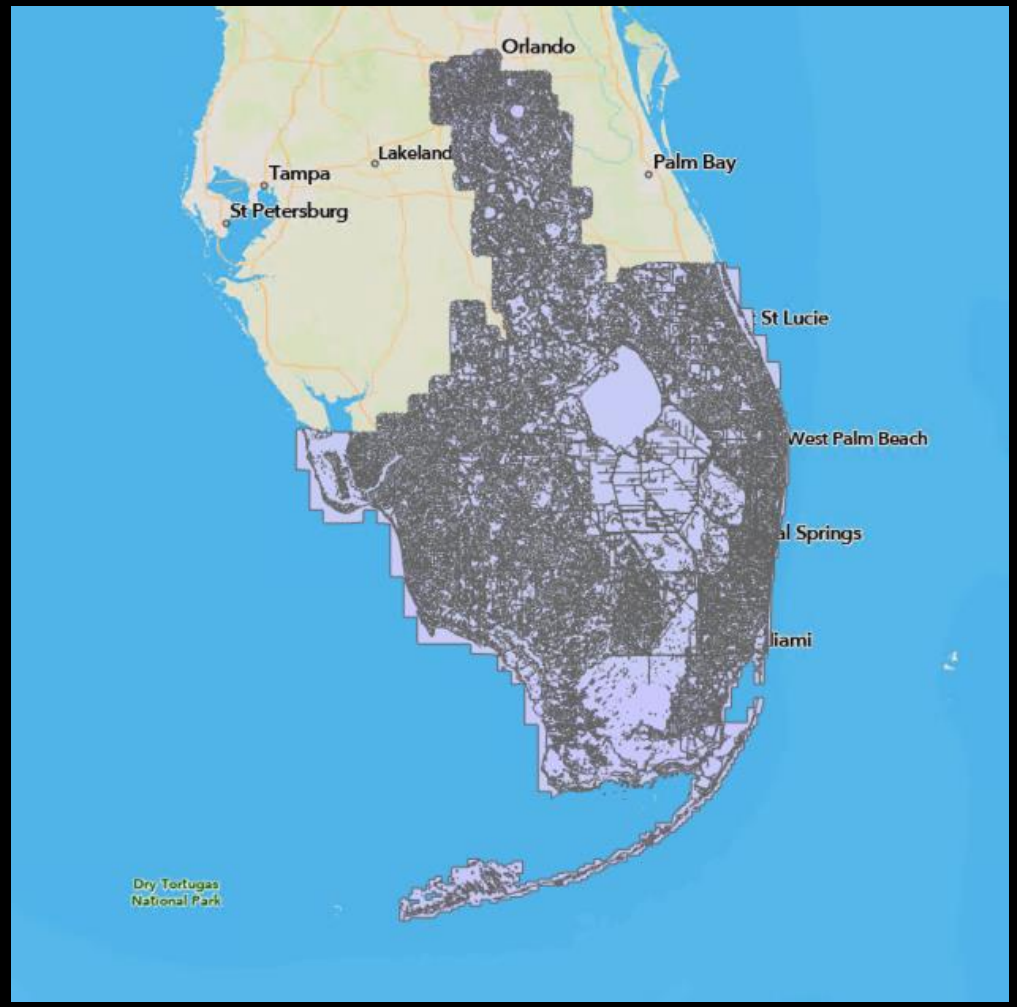
Test Model to Predict WVC Locations by Land Use Change (Focus on Urban Area)

Data Collection

Data	Source	Description
State Major Roads	Florida Department of Transportation	FL's main road data, polyline shape, total of 1962 records, projection: UTM 17; Datum: NAD 83
Land Use Southern FL in 1995	South Florida Water Management District	A series of land use (LU) maps have been produced by the SFWMD since the early 1970s.
Land Use Southern FL 2014 - 2016	South Florida Water Management District	Land Cover and Land Use for 2014-2016 within the boundaries of the SFWMD and supports various missions of the district. In this project will use record 2014-2015
Black Bear Range in FL	Florida Fish and Wildlife Conservation Commission	This shapefile contains four levels of occurrence (frequent, common, occasional, and rare range) for the Florida black bear.
Black Bear Road Mortality Locations in Florida	Florida Fish and Wildlife Conservation Commission	Locations of black bear (Ursus americanus floridanus) roadkill in the state of Florida. A total of 5210 record from 1976 to 2022

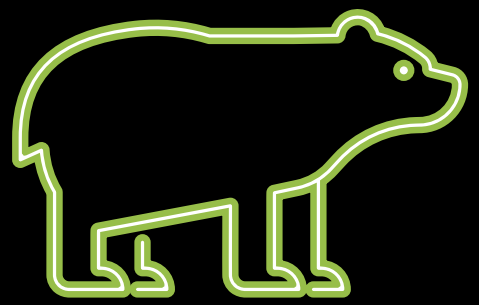


Black Bear Road Mortality Records in Geometry Viewer



Land Use 1995 Polygons

Methods



Getting Overview of Mortality and Land Use Change

- Count(), ST_Area() Functions
- WHERE, GROUP BY, ORDER BY Clauses
- Graph Visualizer

Calculating Areas around the Mortality Locations

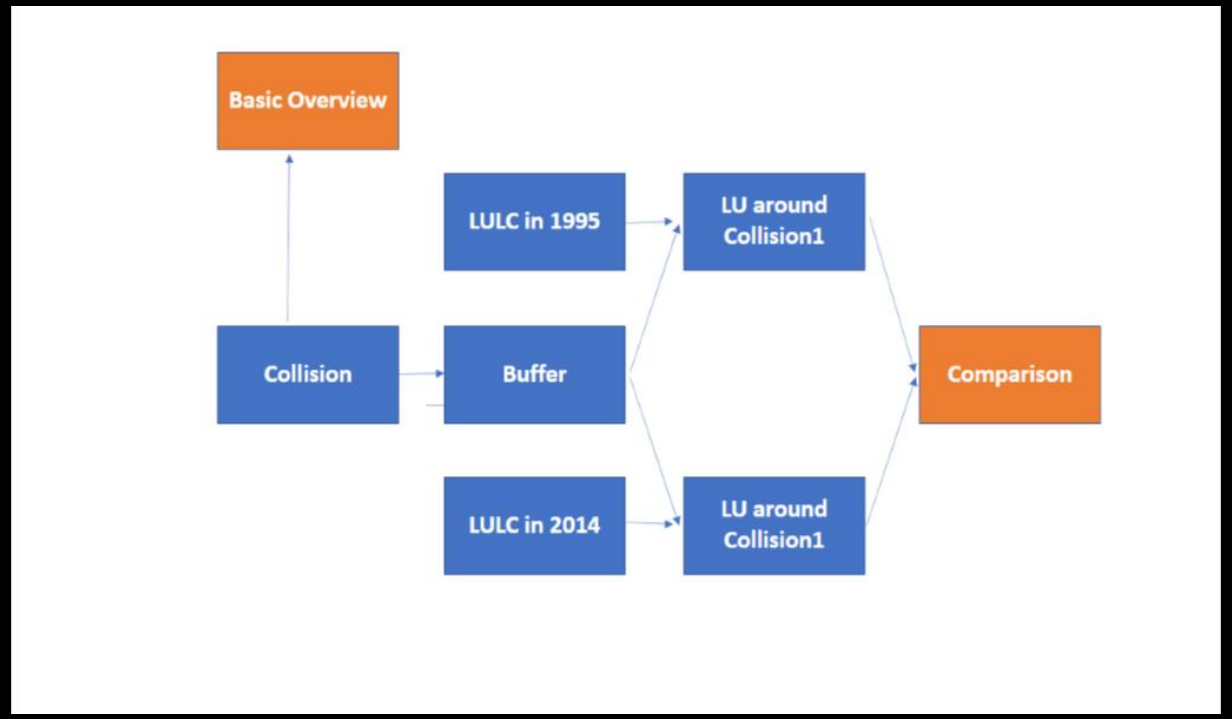
- ST_Buffer(), ST_Intersection(), ST_Area()

Making a Prediction Model

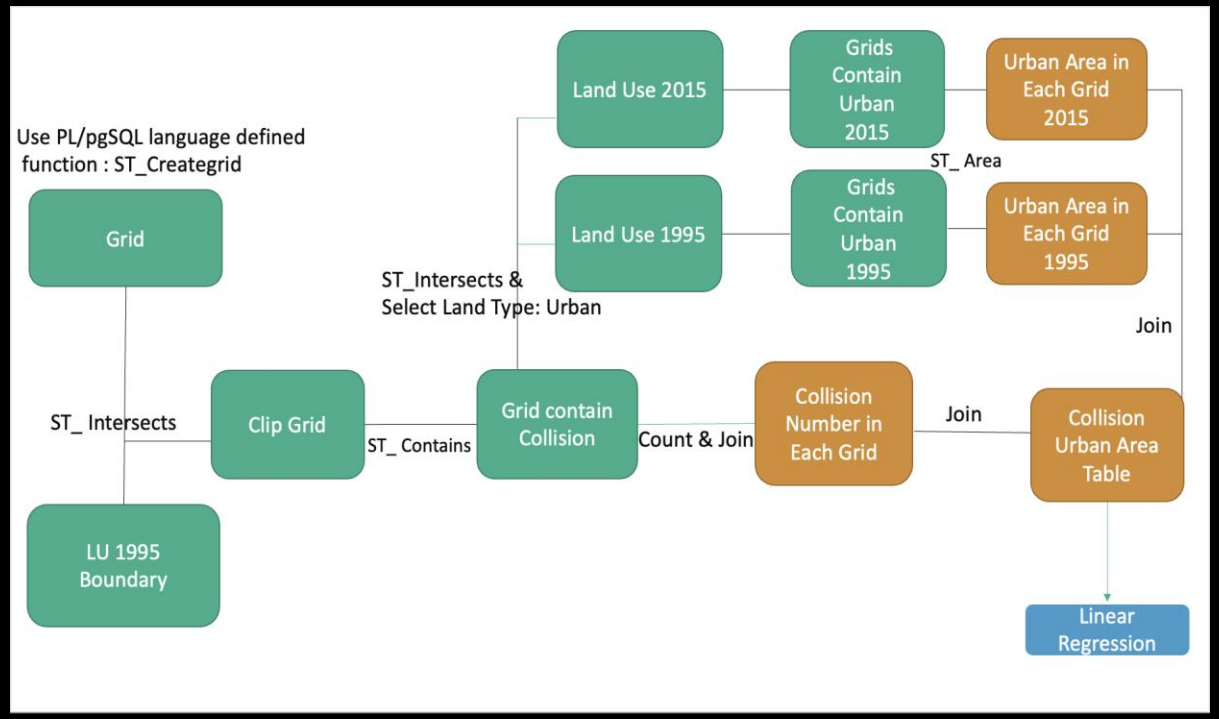
- ST_Intersection, create function: ST_creategrid, ST_Contains, Regressions
  - Independent Variable: Urban Land Use Change Rate
  - Dependent Variable: Mortality Record

2.5km

Data Overview & Land-use Comparison



Test Regression for WVCs and Urban Area Change



Agenda

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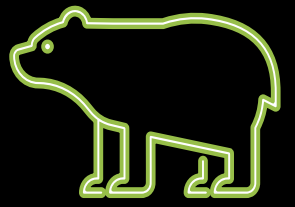
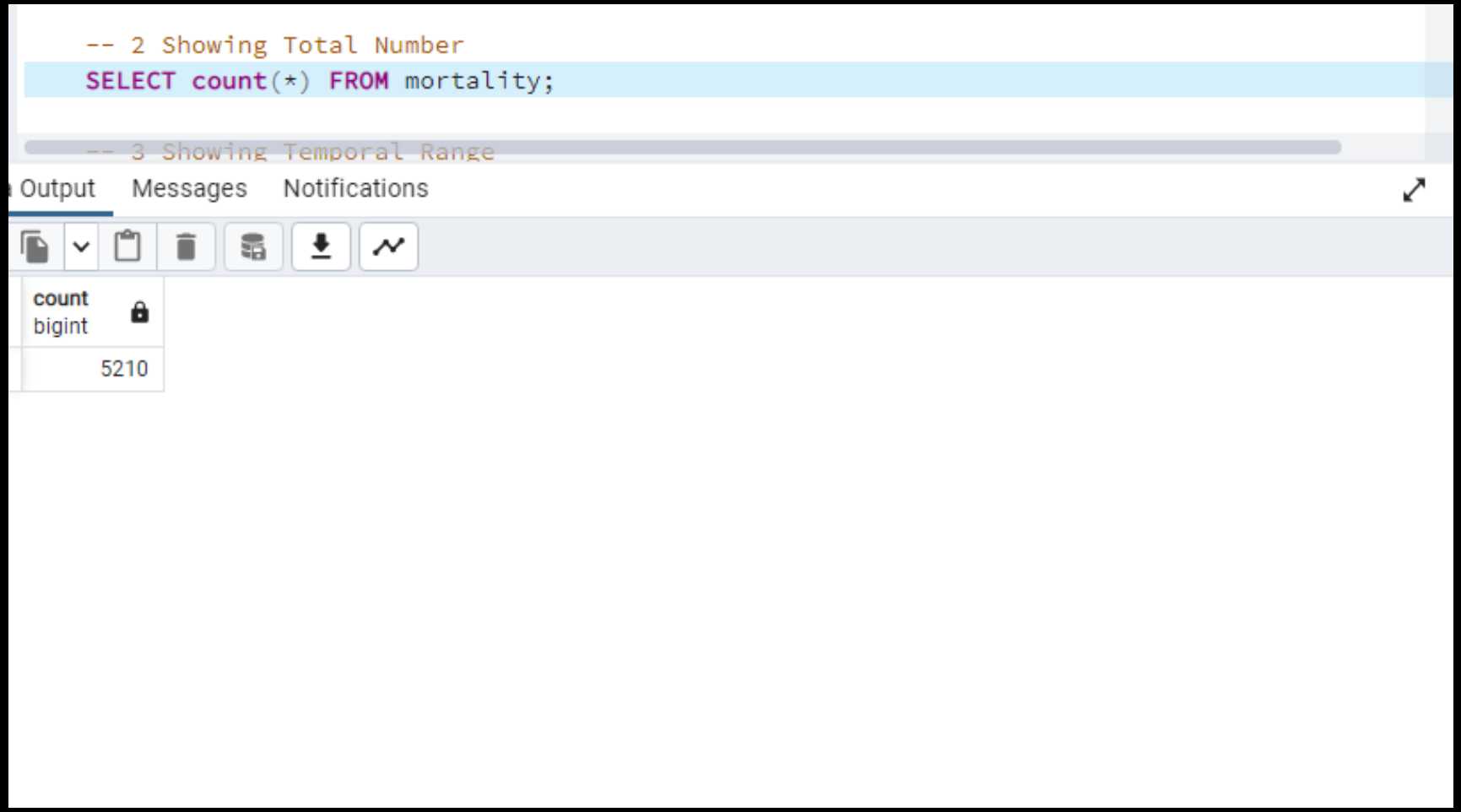
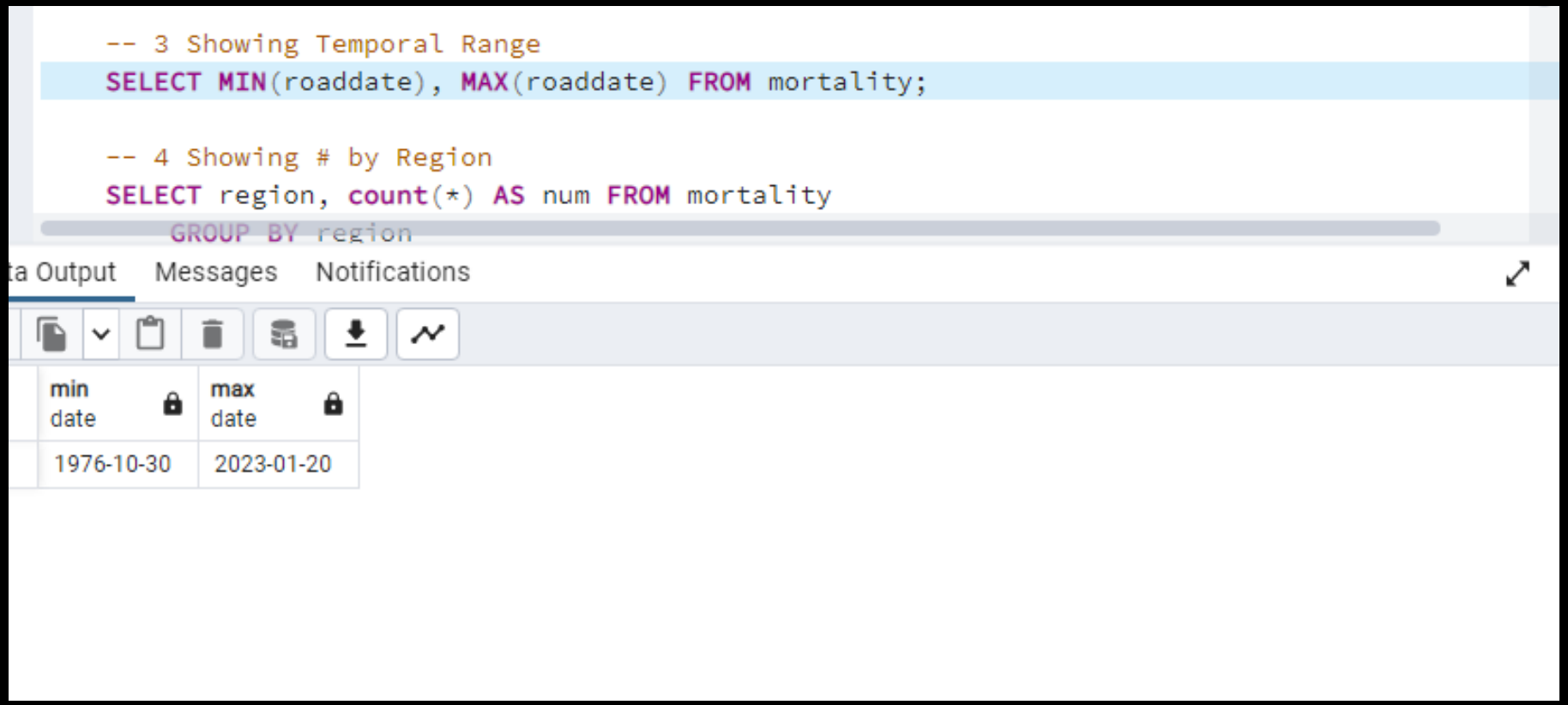
2. Study Objectives
3. Data& Methods
4. Our Results
5. Conclusion and Future Work



How Many Records?



When the Record Started & Ended?



How many mortality in each region?

```
12    SELECT region, count(*) AS num FROM mortality
13        GROUP BY region
14        ORDER BY num DESC;
15
```

Data Output | Messages | Notifications

	region character varying (13)	num bigint
1	Northeast	2754
2	Northwest	1471
3	North Central	406
4	South	400
5	Southwest	179

How many mortality in each county?

```
17    SELECT region, county, count(*) AS num FROM mortality
18        GROUP BY region, county
19        ORDER BY num DESC;
20
```

Data Output | Messages | Notifications

	region character varying (13)	county character varying (10)	num bigint
1	Northeast	Lake	966
2	Northeast	Marion	801
3	Northeast	Volusia	440
4	South	Collier	343
5	Northwest	Franklin	209
6	Northwest	Bay	204
7	Northwest	Jefferson	177
8	Northeast	Seminole	171
9	Northwest	Leon	164
10	Northwest	Okaloosa	161
11	Northwest	Wakulla	157
12	Northeast	Putnam	140
13	Northeast	Orange	126
14	Northwest	Santa Rosa	113
15	Northwest	Gulf	108
16	Southwest	Highlands	101
17	North Central	Clay	76
18	Northwest	Liberty	71
19	North Central	Baker	63
20	North Central	Columbia	60
21	North Central	Alachua	54
22	North Central	Taylor	45
23	Northeast	Flagler	44
24	Northwest	Calhoun	43
25	Northeast	St. Johns	42
26	North Central	Hamilton	33

How many # in each year?

```
-- 7 Showing # by Year
SELECT from_year, count(mortality.objectid) as num
    FROM (SELECT generate_series AS from_year,
            generate_series + '1 year'::interval AS to_year
            FROM generate_series('1976-01-01'::date, '2023-01-01'::date, '1 year')) AS ra
    JOIN mortality
        ON from_year::timestamp < mortality.roaddate::timestamp
            AND to_year::timestamp> mortality.roaddate::timestamp
    GROUP BY from_year
    ORDER BY num DESC;

-- 8 Showing the Area of Each Land Use
```

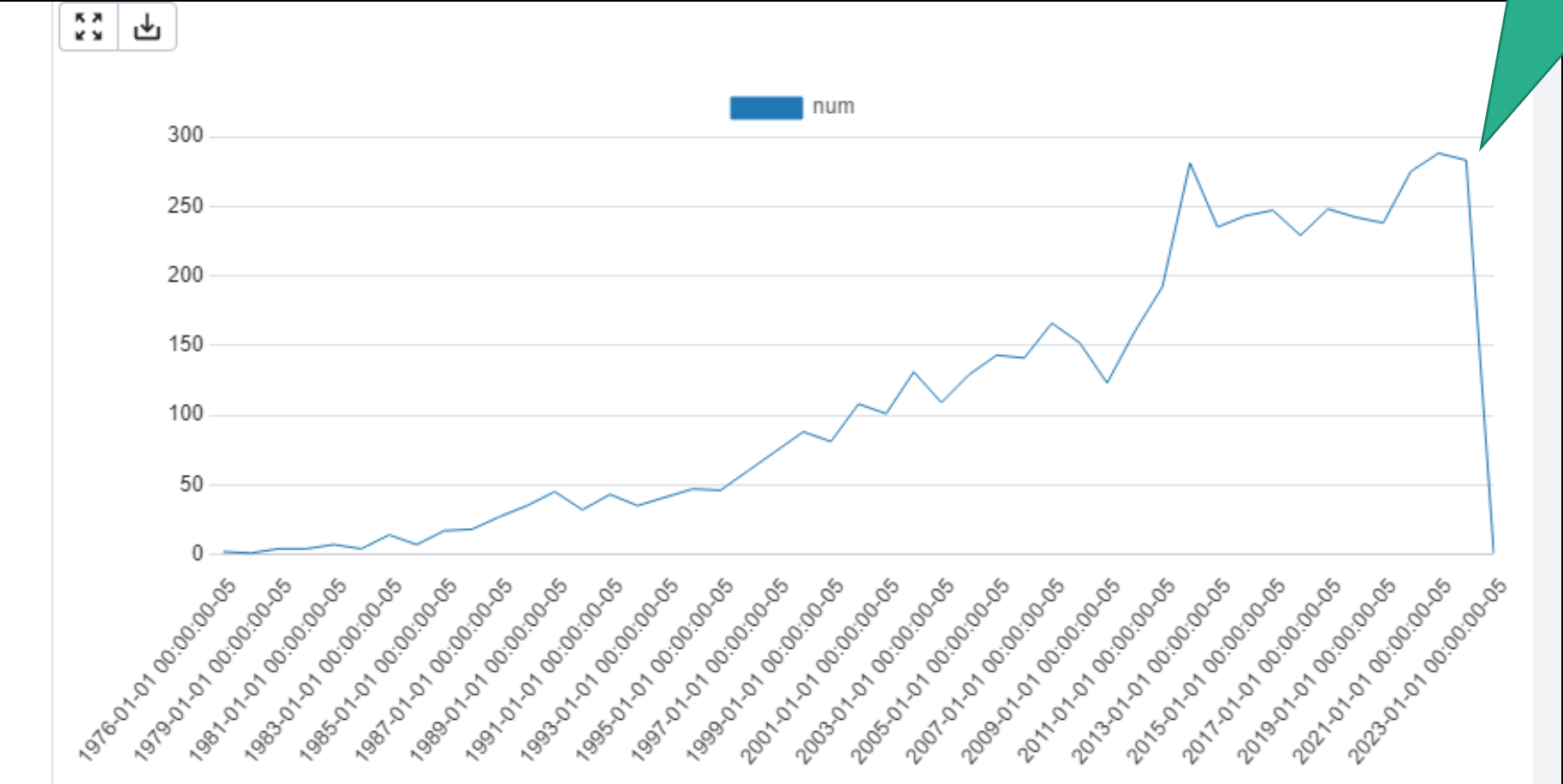
Output | Messages | Notifications

from_year timestamp with time zone	num bigint
2021-01-01 00:00:00-05	288
2022-01-01 00:00:00-05	283
2012-01-01 00:00:00-05	281
2020-01-01 00:00:00-05	275
2017-01-01 00:00:00-05	248
2015-01-01 00:00:00-05	247
2014-01-01 00:00:00-05	243
2018-01-01 00:00:00-05	242
2019-01-01 00:00:00-05	238
2013-01-01 00:00:00-05	235
2016-01-01 00:00:00-05	229
2011-01-01 00:00:00-05	192
2007-01-01 00:00:00-05	166
2010-01-01 00:00:00-05	160
2008-01-01 00:00:00-05	152
2005-01-01 00:00:00-05	143
2006-01-01 00:00:00-05	141
2002-01-01 00:00:00-05	131
2004-01-01 00:00:00-05	129
2009-01-01 00:00:00-05	123

Successfully run. Total query runtime: 86 msec. 47 rows affected.

In Graph

Only 20 Days
Record in 2023



Showing death in Collier (South) by sex & age

```
SELECT sex, ageclass, count(*) AS num FROM mortality
    WHERE county = 'Collier'
        AND reportdate::date > '2000-01-01'
    GROUP BY sex, ageclass
    ORDER BY sex, ageclass;

-- 7 Showing # by Year
```

ta Output | Messages | Notifications

sex character varying (7)	ageclass character varying (8)	num bigint
Female	Adult	52
Female	Cub	7
Female	Juvenile	19
Male	Adult	70
Male	Cub	24
Male	Juvenile	71
Unknown	Adult	3
Unknown	Cub	5
Unknown	Juvenile	4
Unknown	Unknown	1

Land Use in 1995 & 2014-2016 in South FL

```
39      -- 8 Showing the Area of Each Land Use
40      CREATE OR REPLACE VIEW  lu_95_area AS
41          SELECT level_1__1 as lu, SUM(ST_AREA(geom)) AS sq_m FROM lu_95
42              GROUP BY lu
43              ORDER BY  sq_m DESC;
44      SELECT * FROM lu_95_area;
45
```

Data Output | Messages | Graph Visualiser | Notifications

	lu character varying (41)	sq_m double precision
1	Wetlands	17532629720.357674
2	Agriculture	12201764946.167976
3	Water	8640594260.54296
4	Urban And Built Up	4960831745.903725
5	Upland Forests	4458368877.05567
6	Upland Nonforested	1126275132.4450102
7	Transportation, Communication & Utilities	654996312.6152515
8	[null]	560752124.0901549
9	Barren Land	299613305.9942754

```
    -- 9 Showing the Area of Each Land Use in 2014-16
    CREATE OR REPLACE VIEW  lu_15_area AS
        SELECT level_1__1 as lu, SUM(ST_AREA(geom)) AS sq_m FROM lu_15
            GROUP BY lu
            ORDER BY  sq_m DESC;
    SELECT * FROM lu_15_area;
```

a Output | Messages | Graph Visualiser | Notifications

lu character varying (41)	sq_m double precision
Wetlands	17838115730.63298
Agriculture	12156467154.927227
Water	7595203619.965715
Urban And Built Up	6683816762.313297
Upland Forests	2241102910.721604
Upland Nonforested	1330069458.8435693
Transportation, Communication & Utilities	606947840.5670884
Barren Land	230970483.11867613

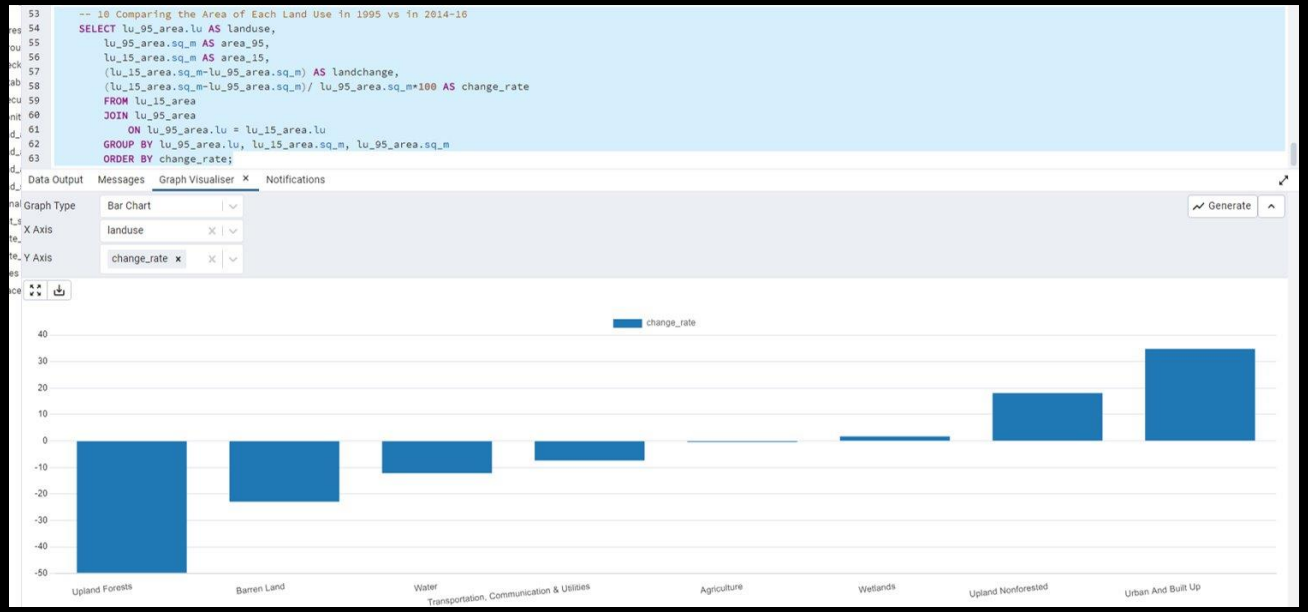
CRS: NAD83(HARN) / Florida GDL Albers (Unit: Meter)

Land Change Areas and Rate between ‘95- ‘15

```sql
-- 10 Comparing the Area of Each Land Use in 1995 vs in 2014-16
SELECT lu_95_area.lu AS landuse,
    lu_95_area.sq_m AS area_95,
    lu_15_area.sq_m AS area_15,
    (lu_15_area.sq_m-lu_95_area.sq_m) AS landchange,
    (lu_15_area.sq_m-lu_95_area.sq_m)/ lu_95_area.sq_m AS change_rate
    FROM lu_15_area
    JOIN lu_95_area
        ON lu_95_area.lu = lu_15_area.lu
    GROUP BY lu_95_area.lu, lu_15_area.sq_m, lu_95_area.sq_m;
```

ata Output | Messages | Graph Visualiser | Notifications

landuse character varying (41)	area_95 double precision	area_15 double precision	landchange double precision	change_rate double precision
Agriculture	12201764946.16795	12156467154.927235	-45297791.24071503	-0.0037123966443019475
Barren Land	299613305.9942752	230970483.11867607	-68642822.87559915	-0.22910472099296791
Transportation, Communication & Utilities	654996312.6152514	606947840.5670887	-48048472.0481627	-0.07335685884446597
Upland Forests	4458368877.055687	2241102910.721597	-2217265966.3340898	-0.4973267191382278
Upland Nonforested	1126275132.4450119	1330069458.8435664	203794326.39855456	0.18094541957624588
Urban And Built Up	4960831745.903736	6683816762.313292	1722985016.4095554	0.347317769410797
Water	8640594260.542961	7595203619.965725	-1045390640.5772362	-0.12098596567032248
Wetlands	17532629720.35775	17838115730.632984	305486010.2752342	0.017423855699212294



CRS: NAD83(HARN) / Florida GDL Albers (Unit: Meter)

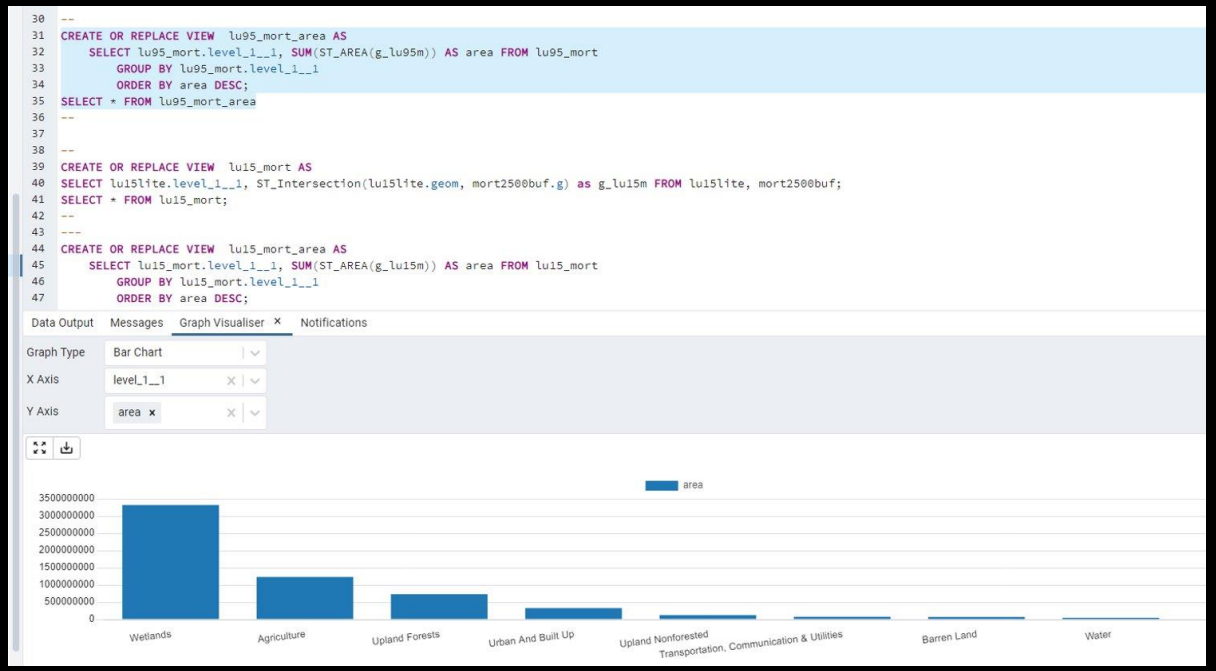
LU in '95 around the Mortality 2000- in South

```
CREATE OR REPLACE VIEW  lu95_mort_area AS
    SELECT lu95_mort.level_1__1, SUM(ST_AREA(g_lu95m)) AS area FROM lu95_mort
        GROUP BY lu95_mort.level_1__1
        ORDER BY area DESC;
SELECT * FROM lu95_mort_area
--

--
CREATE OR REPLACE VIEW  lu15_mort AS
SELECT lu15lite.level_1__1, ST_Intersection(lu15lite.geom, mort2500buf.g) as g_lu15m FROM lu15lite, mort2500buf;
SELECT * FROM lu15_mort;
--
---
CREATE OR REPLACE VIEW  lu15_mort_area AS
    SELECT lu15_mort.level_1__1, SUM(ST_AREA(g_lu15m)) AS area FROM lu15_mort
        GROUP BY lu15_mort.level_1__1
        ORDER BY area DESC;
```

Data Output | Messages | Notifications

level_1__1 character varying (41)	area double precision
Wetlands	3322138946.8333817
Agriculture	1232655477.2996497
Upland Forests	732030769.8826863
Urban And Built Up	328745802.5485776
Upland Nonforested	126770840.53525136
Transportation, Communication & Utilities	80974138.15864694
Barren Land	71884179.74419034
Water	51065746.89625452
[null]	6654.003897028125

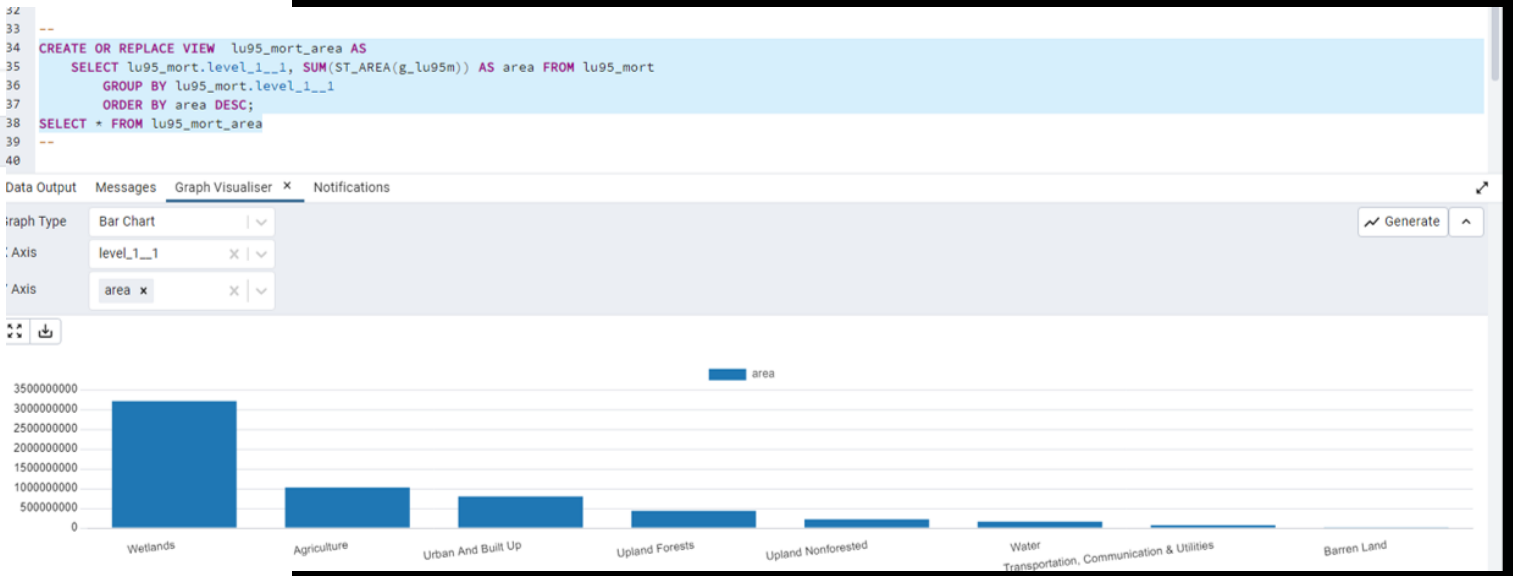


LU in '15 around the Mortality 2000- in South

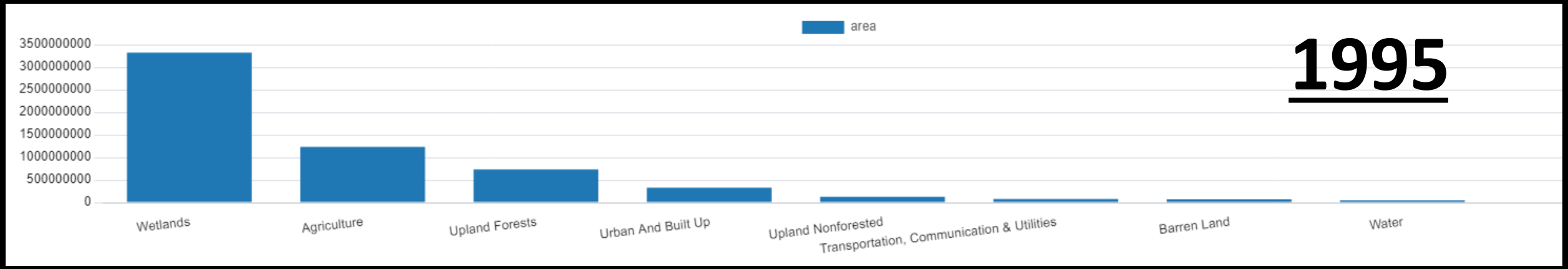
```
--
CREATE OR REPLACE VIEW  lu95_mort_area AS
    SELECT lu95_mort.level_1__1, SUM(ST_AREA(g_lu95m)) AS area FROM lu95_mort
        GROUP BY lu95_mort.level_1__1
        ORDER BY area DESC;
SELECT * FROM lu95_mort_area
--
```

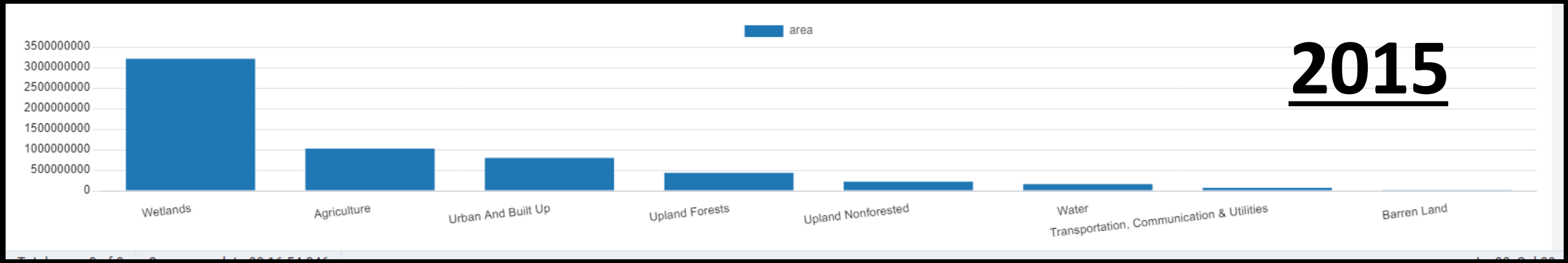
a Output | Messages | Graph Visualiser × | Notifications

level_1__1 character varying (41)	area double precision
Wetlands	3205793469.3930283
Agriculture	1027360903.2799152
Urban And Built Up	802270798.0716708
Upland Forests	438931406.7835417
Upland Nonforested	220507074.02619854
Water	162680952.23309636
Transportation, Communication & Utilities	71218297.68347026
Barren Land	21491920.008032758



Let's look them again together

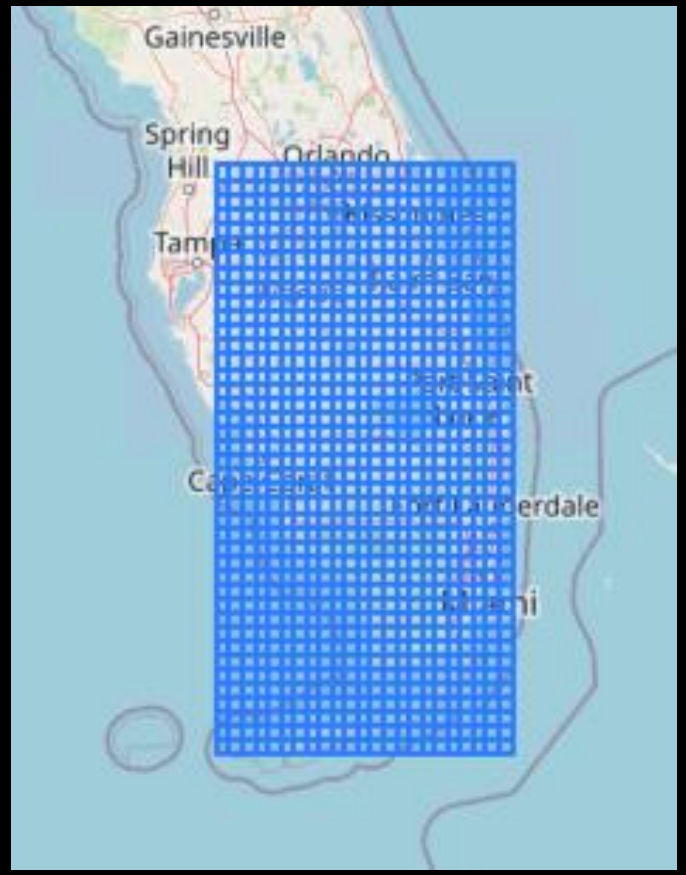


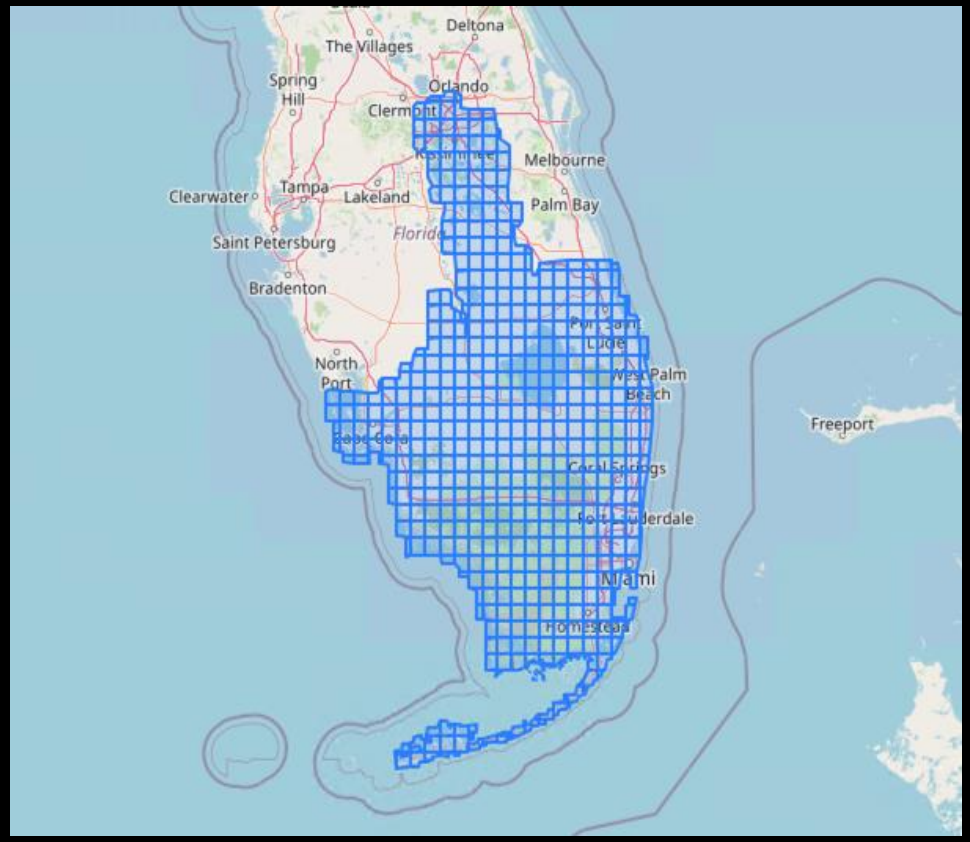


So how changed?

- Waterland & Transportation
  - Almost no change
- Agriculture & Barren Land
  - Decreased
- Urban Built Up & Non- forest
  - Drastically increased (Approx 2x for Urban)
- Upland Forest & Water
  - Drastically decreased

Prediction Model- Data Prepare

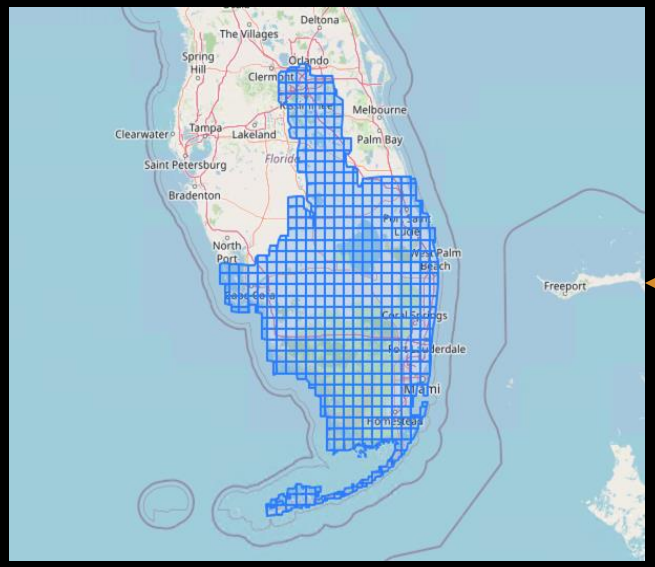


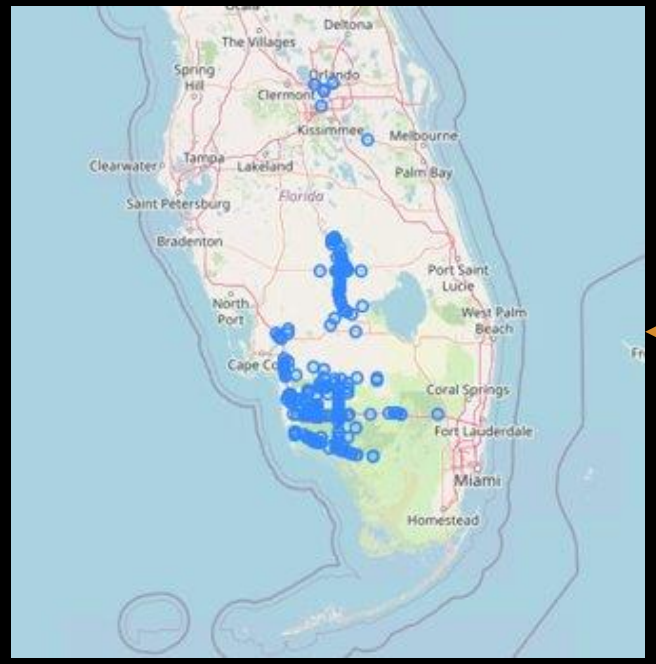


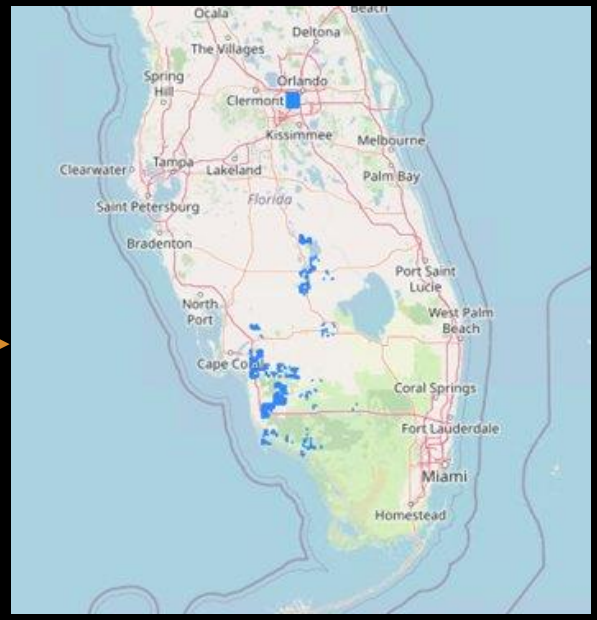

```
CREATE TABLE grid_cell_new_2 AS
SELECT *
FROM St_Creategrid(45, 20, 0.1, 0.1, 4326) AS Cells;
```

```
CREATE OR REPLACE FUNCTION ST_Creategrid(
        nrow integer, ncol integer,
        xsize float8, ysize float8,
        x0 float8 default -82.312, y0 float8 default 24.523,
        OUT "row" integer, OUT col integer,
        OUT geom geometry)
    RETURNS SETOF record AS $$
BEGIN
    RETURN QUERY
    SELECT i + 1 AS row, j + 1 AS col, ST_Translate(cell, j * xsize + x0, i * ysize + y0) AS geom
    FROM generate_series(0, nrow - 1) AS i,
         generate_series(0, ncol - 1) AS j,
    (
    SELECT ('POLYGON((0 0, 0 '||ysize||', '||xsize||' '||ysize||', '||xsize||' 0,0 0))')::geometry AS cell
    ) AS foo;
END;
$$ LANGUAGE plpgsql;
```

```
Create Table grid_cell_clip As
SELECT ST_Intersection(grid_cell_new2.geom, lulc.geom)
FROM grid_cell_new2 JOIN lulc ON ST_Intersects(grid_cell_new2.geom, lulc.geom);
```








```
CREATE Table grid_bear_3 AS
select a.gid,a.geom
From grid_cell_clip as a
Join bear_clip_newtime as b
On ST_Intersects(a.geom,b.geom)
Group by a.gid,a.geom
Having Count(b.gid) >0;
```

```
Create Table Land_1995_urban_Clip As
SELECT ST_Intersection(land_95.geom, Grid_bear_3.geom)
FROM land_95 JOIN Grid_bear_3 ON ST_Intersects(land_95.geom, Grid_bear_3.geom)
WHERE land_95.level_1__1 = 'Urban And Built Up';

ALTER TABLE Land_1995_urban_Clip ADD COLUMN id serial PRIMARY KEY;

select*from Land_1995_urban_Clip;
```

In our study area grids, there are:
275 Black Bear Collision Records
2441 Urban Use Polygons in 1995
4554 Urban Use Polygons in 2015

Assign Urban Land Use polygon to 62 Grids

```
CREATE TABLE urban_15 AS
SELECT Grid_bear_3.gid, array_agg(Land_2015_urban_Clip.id) AS polygon_ids, ST_Union(Land_2015_urban_Clip.st_intersection) AS geom
FROM Grid_bear_3, Land_2015_urban_Clip
WHERE ST_Intersects(Grid_bear_3.geom, Land_2015_urban_Clip.st_intersection)
GROUP BY Grid_bear_3.gid;
```

```
Create Table Urban_15_area as
SELECT gid, ST_Area(geom) AS area
```

Linear Regression Result:

SELECT regr_slope(count_bear, change_rate) as slope FROM all_rec

Slope:-0.758

select regr_intercept (count_bear, change_rate) as intercept from all_rec;

Intercept: 4.49

select regr_r2 (count_bear, change_rate) as rsq from all_rec;

R2:0.03

	count_bear bigint	urban_area_1995 double precision	urban_area_2015 double precision	change_rate double precision
1	1	0.00027365949547229117	0.0007340982402956139	0.6272167940872719
2	12	4.956288925799008e-05	8.92724962214627e-05	0.444813449205711
3	7	0.0010935797207911786	0.0014286929332287758	0.234559298673269
4	1	1.876819728967817e-05	4.661819994156457e-05	0.5974062208921856
5	2	0	1.0727444012939626e-05	1
6	5	0.004806548000927244	0.0055558223583233035	0.13486290760782774
7	1	0.0006637199139014804	0.0007806238895233066	0.14975710734809103
8	1	0.00010155973403887391	0.0001897210832124291 7	0.4646892568858133
9	6	9.66391082866939e-06	7.86832596340183e-06	-0.22820417883288188
10	2	0.00019617324966786598	0.00015488923366084855	-0.2665389648541648
11	2	0.005332460429951904	0.007154393384928134	0.2546593200779847
12	1	0.0003088417081179961	0.0020295895629350606	0.8478304610162809
13	15	0.0001890563340424254	0.0002943743325474628	0.3577689589769403
14	4	6.60821135216499e-06	0	0
15	4	0.00202763289531615	0.00434628585644091	0.5334791676641951
16	4	0.0008650846077428578	0.0012016778859246415	0.2801027481027406
17	9	0.0005388085858716116	0.0006170553555168452	0.12680672640738055
18	5	9.524703249711975e-05	9.772528916241502e-05	0.025359420131021777

Total rows: 62 of 62 | Query complete 00:00:00.166

All Record Table

Conclusion

Land Use Chage Around Black Bear Collision Record from 1995-2015:

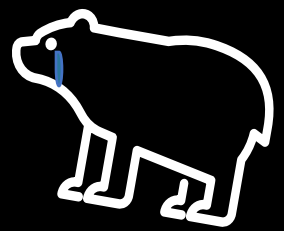
Urban Built Up & Non- forest

- Drastically increased

- Upland Forest & Water
  - Drastically decreased

Prediction Model in the Study:

Result from Collision Record and Urban Change Rate has No Reference Value, R2 only 0.03



Future Step

- Compare with Road Data
  - Which roads have higher mortality?
  - Road density
- Compare land changes in the whole & around the mortality location
  - Which LC rate is larger?
- Changing Buffer Size on Sex
- Regression by comparing another land use type

Reference

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- Llagostera, P., Comas, C., & López, N. (2022). Modeling road traffic safety based on point patterns of wildlife-vehicle collisions. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4032236

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Thank You!