Struktura bazy danych

```
C:\Program Files\PostgreSQL\13\bin>pg_restore -h localhost -p 5432 -U postgres -d cw6 -v "C:\Users\acer\Desktop\Geoinformatyka\Bazy danych p
estrzennych\cw6\OneDrive_2021-11-18\PostGIS raster - dane\rasters\postgis_raster.backup"
pg_restore: warning: restoring tables WITH OIDS is not supported anymore
pg_restore: warning: restoring tables WITH OIDS is not supported anymore
pg_restore: connecting to database for restore
Password:
```

Ładowanie danych rastrowych

Przykład 1 – ładowanie rastru przy użyciu pliku .sql

```
C:\Program Files\PostgreSQL\13\bin>raster2pgsql.exe -s 3763 -N -32767 -t 100x100 -I -C -M -d "C:\Users\acer\Desktop\Geoinformatyka\Bazy danych przes
trzennych\cw6\OneDrive_2021-11-18\PostGIS raster - dane\rasters\srtm_1arc_v3.tif" rasters.demo > "C:\Users\acer\Desktop\Geoinformatyka\Bazy danych p
rzestrzennych\cw6\OneDrive_2021-11-18\PostGIS raster - dane\rasters\demo.sql"
Processing 1/1: C:\Users\acer\Desktop\Geoinformatyka\Bazy danych przestrzennych\cw6\OneDrive_2021-11-18\PostGIS raster - dane\rasters\srtm_1arc_v3.t
if
```

Przykład 2 – ładowanie rastru bezpośrednio do bazy

```
C:\Program Files\PostgreSQL\13\bin>raster2pgsql.exe -s 3763 -N -32767 -t 100x100 -I -C -M -d "C:\Users\acer\Desktop\Geoinformatyka\Bazy danych przestrze
nnych\cw6\OneDrive_2021-11-18\PostGIS raster - dane\rasters\srtm_1arc_v3.tif" rasters.dem | psql -d cw6 -h localhost -U postgres -p 5432
Processing 1/1: C:\Users\acer\Desktop\Geoinformatyka\Bazy danych przestrzennych\cw6\OneDrive_2021-11-18\PostGIS raster - dane\rasters\srtm_1arc_v3.tif
Password for user postgres:
BEGIN
NOTICE:  table "dem" does not exist, skipping
DROP TABLE
CREATE TABLE
INSERT 0 1
INSERT 0 1
INSERT 0 1
INSERT 0 1
```

Przykład 3 – załadowanie danych landsat 8 o wielkości kafelka 128x128 bezpośrednio do bazy danych.

```
C:\Program Files\PostgreSQL\13\bin>raster2pgsql.exe -s 3763 -N -32767 -t 128x128 -I -C -M -d "C:\Users\acer\Desktop\Geoinformatyka\Bazy danych przestrze
nnych\cw6\OneDrive_2021-11-18\PostGIS raster - dane\rasters\Landsat8_L1TP_RGBN.TIF" rasters.landsat8 | psql -d cw6 -h localhost -U postgres -p 5432
Processing 1/1: C:\Users\acer\Desktop\Geoinformatyka\Bazy danych przestrzennych\cw6\OneDrive_2021-11-18\PostGIS raster - dane\rasters\Landsat8_L1TP_RGBN
.TIF
Password for user postgres:
BEGIN
NOTICE:  table "landsat8" does not exist, skipping
DROP TABLE
CREATE TABLE
INSERT 0 1
```

Tworzenie rastrów z istniejących rastrów i interakcja z wektorami

Przykład 1 - ST_Intersects

```
CREATE TABLE schema_brach.intersects AS
SELECT a.rast, b.municipality
FROM rasters.dem AS a, vectors.porto_parishes AS b
WHERE ST_Intersects(a.rast, b.geom) AND b.municipality ilike 'porto';
```

	rast raster
1	01000001006172BF3E4D5A3
2	01000001006172BF3E4D5A3
3	01000001006172BF3E4D5A3
4	01000001006172BF3E4D5A3
5	01000001006172BF3E4D5A3
6	01000001006172BF3E4D5A3

municipality character varying (254)
PORTO
PORTO
PORTO
PORTO
PORTO
PORTO

1. dodanie serial primary key:

```
8  alter table schema_brach.intersects
9  add column rid SERIAL PRIMARY KEY;
10
11 CREATE INDEX idx_intersects_rast_gist
```

Data Output | Explain | Messages | Notifications

```
ALTER TABLE
```

2. utworzenie indeksu przestrzennego:

```
8  CREATE INDEX idx_intersects_rast_gist ON schema_brach.intersects
9  USING gist (ST_ConvexHull(rast));
10
11
```

Data Output | Explain | Messages | Notifications

```
CREATE INDEX

Query returned successfully in 69 msec.
```

3. dodanie raster constraints:

```
14 -- schema::name table_name::name raster_column::name
15 SELECT AddRasterConstraints('schema_brach'::name,
16 'intersects'::name,'rast'::name);
17
18
```

Data Output | Explain | Messages | Notifications

	addrasterconstraints boolean
1	true

Przykład 2 - ST_Clip

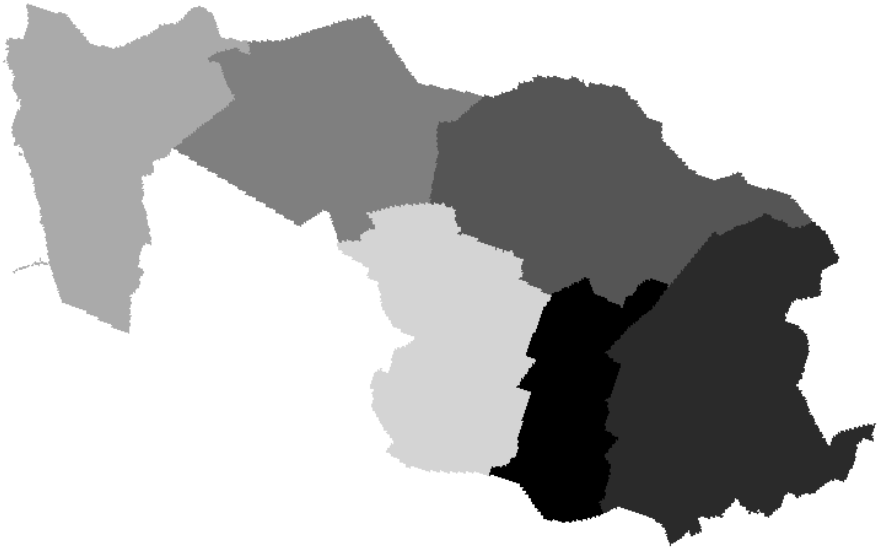
Obcinanie rastra na podstawie wektora.

```
18 CREATE TABLE schema_brach.clip AS
19 SELECT ST_Clip(a.rast, b.geom, true), b.municipality
20 FROM rasters.dem AS a, vectors.porto_parishes AS b
21 WHERE ST_Intersects(a.rast, b.geom) AND b.municipality like 'PORTO';
```

Data Output | Explain | Messages | Notifications

```
SELECT 25
```

Przykład 3 - ST_Union



Połączenie wielu kafelków w jeden raster.

```
23  CREATE TABLE schema_brach.union AS
24  SELECT ST_Union(ST_Clip(a.rast, b.geom, true))
25  FROM rasters.dem AS a, vectors.porto_parishes AS b
26  WHERE b.municipality ilike 'porto' and ST_Intersects(b.geom,a.rast);
```

Data Output | Explain | Messages | Notifications

```
SELECT 1
```

Tworzenie rastrów z wektorów (rastrowanie)

Poniższe przykłady pokazują rastrowanie wektoru.

```
28  CREATE TABLE schema_brach.porto_parishes AS
29  WITH r AS (
30  SELECT rast FROM rasters.dem
31  LIMIT 1
32  )
33  SELECT ST_AsRaster(a.geom,r.rast,'8BUI',a.id,-32767) AS rast
34  FROM vectors.porto_parishes AS a, r
35  WHERE a.municipality ilike 'porto';
```

Data Output | Explain | Messages | Notifications

```
SELECT 7
```

Przykład 2 - ST_Union

```
37  DROP TABLE schema_brach.porto_parishes; --> drop table porto_parishes first
38  CREATE TABLE schema_brach.porto_parishes AS
39  WITH r AS (
40  SELECT rast FROM rasters.dem
41  LIMIT 1
42  )
43  SELECT st_union(ST_AsRaster(a.geom,r.rast,'8BUI',a.id,-32767)) AS rast
44  FROM vectors.porto_parishes AS a, r
45  WHERE a.municipality ilike 'porto';
```

Data Output | Explain | Messages | Notifications

```
SELECT 1
```

Przykład 3 - ST_Tile

```
47  DROP TABLE schema_brach.porto_parishes; --> drop table porto_parishes first
48  CREATE TABLE schema_brach.porto_parishes AS
49  WITH r AS (
50  SELECT rast FROM rasters.dem
51  LIMIT 1 )
52  SELECT st_tile(st_union(ST_AsRaster(a.geom,r.rast,'8BUI',a.id,-32767)),128,128,true,-32767) AS rast
53  FROM vectors.porto_parishes AS a, r
54  WHERE a.municipality ilike 'porto';
```

Data Output | Explain | Messages | Notifications

```
SELECT 8
```

Konwertowanie rastrów na wektory (wektoryzowanie)

Przykład 1 - ST_Intersection

```
56  create table schema_brach.intersection as
57  SELECT a.rid,(ST_Intersection(b.geom,a.rast)).geom,(ST_Intersection(b.geom,a.rast)).val
58  FROM rasters.landsat8 AS a, vectors.porto_parishes AS b
59  WHERE b.parish ilike 'paranhos' and ST_Intersects(b.geom,a.rast);
```

Data Output | Explain | Messages | Notifications

```
SELECT 6649
```

Przykład 2 - ST_DumpAsPolygons

```
61  CREATE TABLE schema_brach.dumppolygons AS
62  SELECT a.rid,(ST_DumpAsPolygons(ST_Clip(a.rast,b.geom))).geom,(ST_DumpAsPolygons(ST_Clip(a.rast,b.geo
63  FROM rasters.landsat8 AS a, vectors.porto_parishes AS b
64  WHERE b.parish ilike 'paranhos' and ST_Intersects(b.geom,a.rast);
```

Data Output | Explain | Messages | Notifications

```
SELECT 6442
```

Analiza rastrów

Przykład 1 - ST_Band

```
66  CREATE TABLE schema_brach.landsat_nir AS
67  SELECT rid, ST_Band(rast,4) AS rast
68  FROM rasters.landsat8;
```

Data Output | Explain | Messages | Notifications

```
SELECT 630
```

Przykład 2 - ST_Clip

```
70  CREATE TABLE schema_brach.paranhos_dem AS
71  SELECT a.rid,ST_Clip(a.rast, b.geom,true) as rast
72  FROM rasters.dem AS a, vectors.porto_parishes AS b
73  WHERE b.parish ilike 'paranhos' and ST_Intersects(b.geom,a.rast);
```

Data Output | Explain | Messages | Notifications

```
SELECT 4
```

Przykład 3 - ST_Slope

```
75  CREATE TABLE schema_brach.paranhos_slope AS
76  SELECT a.rid,ST_Slope(a.rast,1,'32BF','PERCENTAGE') as rast
77  FROM schema_brach.paranhos_dem AS a;
```

Data Output | Explain | Messages | Notifications

```
SELECT 4
```

Przykład 4 - ST_Reclass

```
79  CREATE TABLE schema_brach.paranhos_slope_reclass AS
80  SELECT a.rid,ST_Reclass(a.rast,1,']0-15]:1, (15-30]:2, (30-9999:3', '32BF',0)
81  FROM schema_brach.paranhos_slope AS a;
```

Data Output | Explain | Messages | Notifications

```
SELECT 4
```

Przykład 5 - ST_SummaryStats

```
83  SELECT st_summarystats(a.rast) AS stats
84  FROM schema_brach.paranhos_dem AS a;
```

Data Output | Explain | Messages | Notifications

	stats summarystats
1	(2616,278385,106.41628440366972,11.622628762211638,87,143)
2	(6463,816615,126.35231316725978,14.0438229209133,94,158)
3	(682,95581,140.14809384164224,12.078072186605759,103,158)
4	(216,31874,147.5648148148148,4.262830628315728,137,158)

Przykład 6 - ST_SummaryStats oraz Union

```
86  SELECT st_summarystats(ST_Union(a.rast))
87  FROM schema_brach.paranhos_dem AS a;
```

Data Output | Explain | Messages | Notifications

	st_summarystats summarystats
1	(9977,1222455,122.52731281948482,16.908004202736272,87,158)

Przykład 7 - ST_SummaryStats z lepszą kontrolą złożonego typu danych

```
89  WITH t AS (
90  SELECT st_summarystats(ST_Union(a.rast)) AS stats
91  FROM schema_brach.paranhos_dem AS a
92  )
93  SELECT (stats).min,(stats).max,(stats).mean FROM t;
```

Data Output | Explain | Messages | Notifications

	min double precision	max double precision	mean double precision
1	87	158	122.52731281948482

Przykład 8 - ST_SummaryStats w połączeniu z GROUP BY

```
95  WITH t AS (
96  SELECT b.parish AS parish, st_summarystats(ST_Union(ST_Clip(a.rast, b.geom,true))) AS stats
97  FROM rasters.dem AS a, vectors.porto_parishes AS b
98  WHERE b.municipality ilike 'porto' and ST_Intersects(b.geom,a.rast)
99  group by b.parish
100 )
101 SELECT parish,(stats).min,(stats).max,(stats).mean FROM t;
```

Data Output | Explain | Messages | Notifications

	parish character varying (254)	min double precision	max double precision	mean double precision
1	Bonfim	1	159	107.5658842667906
2	Campanhã	0	178	74.66732213085449
3	Paranhos	87	158	122.52731281948482
4	Ramalde	48	108	77.58444444444444
5	União das freguesias de Aldoar, Foz do Douro e Nevogilde	-4	83	34.66735489791237
6	União das freguesias de Cedofeita, Santo Ildefonso, Sé, Miragaia, São Nicolau e Vitória	1	157	95.00277741039545
7	União das freguesias de Lordelo do Ouro e Massarelos	-1	117	49.50051440329218

Przykład 9 - ST_Value

```
SELECT b.name,st_value(a.rast,(ST_Dump(b.geom)).geom)
FROM
rasters.dem a, vectors.places AS b
WHERE ST_Intersects(a.rast,b.geom)
ORDER BY b.name;
```

Data Output | Explain | Messages | Notifications

	name character varying (48)	st_value double precision
1	Aldeia São Miguel	96
2	Alpendurada e Matos	145
3	Amarante	71
4	Baião	581
5	Cabeceiras de Basto	[null]
6	Castelo de Paiva	284
7	Celorico de Basto	227
8	Cinfães	405
9	Espinho	14
10	Fafe	338
11	Fajozes	53

Topographic Position Index (TPI)

Przykład 10 - ST_TPI

```
create table schema_brach.tpi30 as
select ST_TPI(a.rast,1) as rast
from rasters.dem a;
```

Data Output | Explain | Messages | Notifications

```
SELECT 589

Query returned successfully in 41 secs 294 msec.
```

Poniższa kwerenda utworzy indeks przestrzenny:

```
CREATE INDEX idx_tpi30_rast_gist ON schema_brach.tpi30
USING gist (ST_ConvexHull(rast));

SELECT AddRasterConstraints('schema_name'::name, 'tpi30':
```

Data Output | Explain | Messages | Notifications

```
CREATE INDEX
```

Dodanie constraintów:

```
SELECT AddRasterConstraints('schema_brach'::name, 'tpi30'::name,'rast'::name);
```

Data Output | Explain | Messages | Notifications

	addrasterconstraints boolean
1	true

Problem do samodzielnego rozwiązania

```
226 create table schema_brach.tpi30_porto as
227 SELECT ST_TPI(a.rast,1) as rast
228 FROM rasters.dem AS a, vectors.porto_parishes AS b
229 WHERE ST_Intersects(a.rast, b.geom) AND b.municipality ilike 'porto'
230
```

Data Output | Explain | Messages | Notifications

```
SELECT 25

Query returned successfully in 5 secs 458 msec.
```

```
232 CREATE INDEX idx_tpi30_porto_rast_gist ON schema_brach.tpi30_porto
233 USING gist (ST_ConvexHull(rast));
234
```

Data Output | Explain | Messages | Notifications

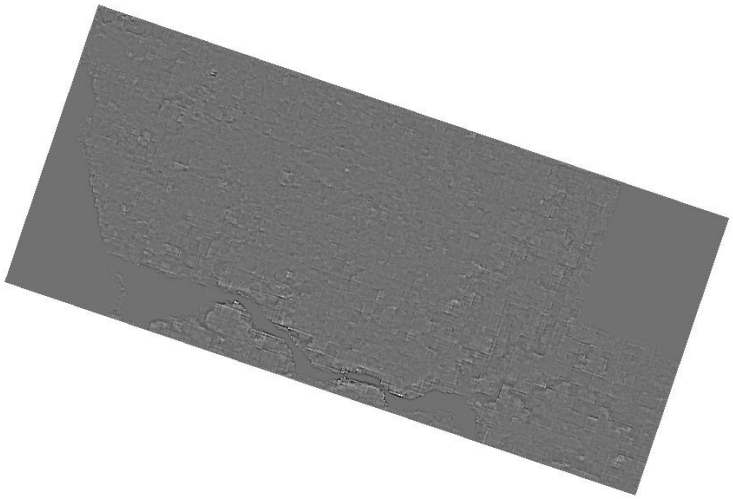
```
CREATE INDEX

Query returned successfully in 97 msec.
```

```
235 SELECT AddRasterConstraints('schema_brach'::name, 'tpi30_porto'::name,'rast'::name);
236
237
238
239
```

Data Output | Explain | Messages | Notifications

	addrasterconstraints boolean
1	true



Algebra map

```
118 CREATE TABLE schema_brach.porto_ndvi AS
119 WITH r AS (
120 SELECT a.rid,ST_Clip(a.rast, b.geom,true) AS rast
121 FROM rasters.landsat8 AS a, vectors.porto_parishes AS b
122 WHERE b.municipality ilike 'porto' and ST_Intersects(b.geom,a.rast)
123 )
124 SELECT
125 r.rid,ST_MapAlgebra(
126 r.rast, 1,
127 r.rast, 4,
128 '([rast2.val] - [rast1.val]) / ([rast2.val] + [rast1.val])::float','32BF'
129 ) AS rast
130 FROM r;
131
132
```

Data Output | Explain | Messages | Notifications

```
SELECT 29
```

Poniższe zapytanie utworzy indeks przestrzenny na wcześniej stworzonej tabeli:

```
132 CREATE INDEX idx_porto_ndvi_rast_gist ON schema_brach.porto_ndvi
133 USING gist (ST_ConvexHull(rast));
```

Data Output | Explain | Messages | Notifications

```
CREATE INDEX
```

Dodanie constraintów:

```
135 SELECT AddRasterConstraints('schema_brach'::name, 'porto_ndvi'::name,'rast'::name);
136
137
```

Data Output | Explain | Messages | Notifications

	addrasterconstraints boolean
1	true

Przykład 2 – Funkcja zwrotna

```
create or replace function schema_brach.ndvi(
value double precision [] [] [],
pos integer [][],
VARIADIC userargs text []
)
RETURNS double precision AS
$$
BEGIN
--RAISE NOTICE 'Pixel Value: %', value [1][1][1];-->For debug purposes
RETURN (value [2][1][1] - value [1][1][1])/(value [2][1][1]+value [1][1][1]); --> NDVI
END;
$$
LANGUAGE 'plpgsql' IMMUTABLE COST 1000;
```

Data Output | Explain | Messages | Notifications

```
CREATE FUNCTION
```

W kwerendzie algebry map należy można wywołać zdefiniowaną wcześniej funkcję:

```
CREATE TABLE schema_brach.porto_ndvi2 AS
WITH r AS (
SELECT a.rid,ST_Clip(a.rast, b.geom,true) AS rast
FROM rasters.landsat8 AS a, vectors.porto_parishes AS b
WHERE b.municipality ilike 'porto' and ST_Intersects(b.geom,a.rast)
)
SELECT
r.rid,ST_MapAlgebra(
r.rast, ARRAY[1,4],
'schema_brach.ndvi(double precision[], integer[],text[])'::regprocedure,
'32BF'::text
) AS rast
FROM r;
```

Data Output | Explain | Messages | Notifications

```
SELECT 29
```

Dodanie indeksu przestrzennego:

```
CREATE INDEX idx_porto_ndvi2_rast_gist ON schema_brach.porto_ndvi2
USING gist (ST_ConvexHull(rast));
```

Data Output | Explain | Messages | Notifications

```
CREATE INDEX
```

Dodanie constraintów:

```
170  SELECT AddRasterConstraints('schema_brach'::name, 'porto_ndvi2'::name,'rast'::name);
171
172
```

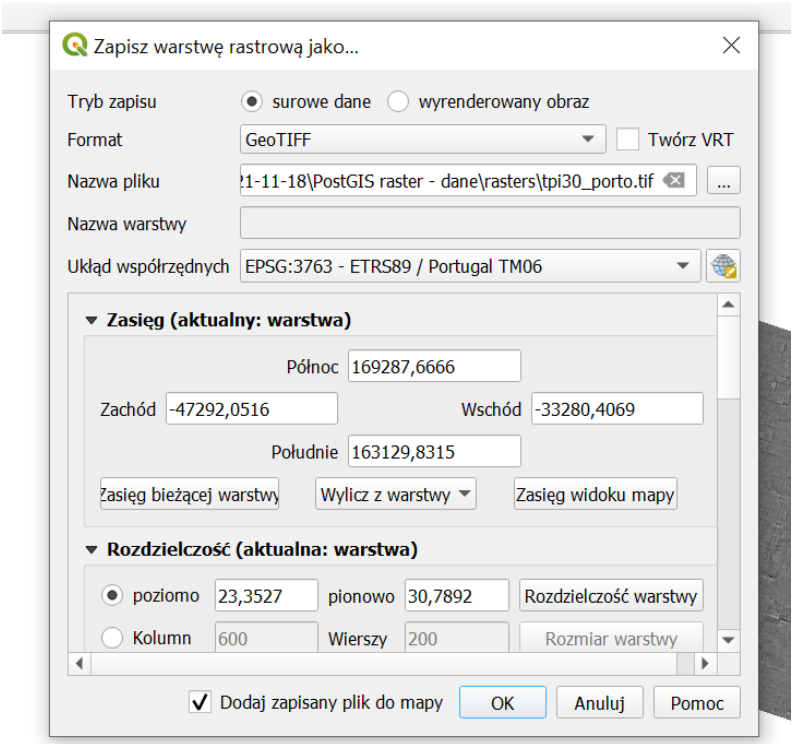
Data Output | Explain | Messages | Notifications

	addrasterconstraints boolean
1	true

//Przykład 3 - Funkcje TPI

Eksport danych

Przykład 0 - Użycie QGIS



Przykład 1 - ST_AsTiff

```
172  SELECT ST_AsTiff(ST_Union(rast))
173  FROM schema_brach.porto_ndvi;
174
175
176
177
```

Data Output | Explain | Messages | Notifications

	st_astiff bytea
1	[binary data]

Przykład 2 - ST_AsGDALRaster

```
SELECT ST_AsGDALRaster(ST_Union(rast), 'GTiff', ARRAY['COMPRESS=DEFLATE', 'PREDICTOR=2', 'PZLEVEL=9'])
FROM schema_brach.porto_ndvi;
```

Data Output | Explain | Messages | Notifications

	st_asgdalraster bytea
1	[binary data]

```
SELECT ST_GDALDrivers();
```

Data Output | Explain | Messages | Notifications

	st_gdaldrivers record
1	(0,GTiff,GeoTIFF,t,t,"<CreationOptionList> <Option name='COMPRESS' type='string-select'> <Value>NONE</Value> <Value>LZW</Value> <Value>PACKBITS</Value> <Value>JPE
2	(1,AAIGrid,"Arc/Info ASCII Grid",t,t,"<CreationOptionList>
3	(2,DTED,"DTED Elevation Raster",t,t,"")
4	(3,PNG,"Portable Network Graphics",t,t,"<CreationOptionList>
5	(4,JPEG,"JPEG JFIF",t,t,"<CreationOptionList>
6	(5,GIF,"Graphics Interchange Format (.gif)",t,t,"<CreationOptionList>
7	(6,USGSDEM,"USGS Optional ASCII DEM (and CDED)",t,t,"<CreationOptionList> <Option name='PRODUCT' type='string-select' description='Specific Product Type'> <Value>DEFAULT</Valu
8	(7,XYZ,"ASCII Gridded XYZ",t,t,"<CreationOptionList> <Option name='COLUMN_SEPARATOR' type='string' default=' ' description='Separator between fields.'/> <Option name='ADD_HEADER_L

Przykład 3 - Zapisywanie danych na dysku za pomocą dużego obiektu (large object, lo)

```
CREATE TABLE tmp_out AS
SELECT lo_from_bytea(0,
ST_AsGDALRaster(ST_Union(rast), 'GTiff', ARRAY['COMPRESS=DEFLATE', 'PREDICTOR=2', 'PZLEVEL=9'])
) AS loid
FROM schema_brach.porto_ndvi;
----------------------------------------------
SELECT lo_export(loid, 'myraster.tiff') --> Save the file in a place where the user postgres have access.
FROM tmp_out;
----------------------------------------------
SELECT lo_unlink(loid)
FROM tmp_out; --> Delete the large object.
```

Data Output | Explain | Messages | Notifications

	lo_export integer
1	1

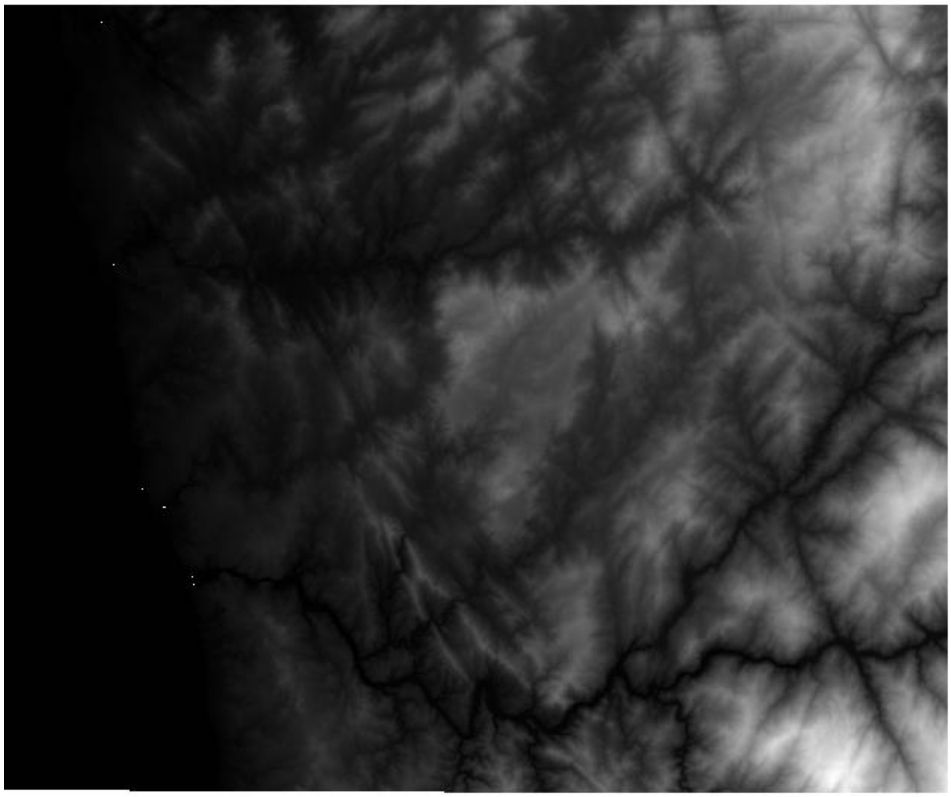
Przykład 4 - Użycie Gdal

```
Input file size is 384, 179
ERROR 1: SQLite error on SELECT name, ellipsoid_auth_name, ellipsoid_code, prime_meridian_auth_name, prime_meridian_code
, publication_date, frame_reference_epoch, deprecated FROM geodetic_datum WHERE auth_name = ? AND code = ?: no such colu
mn: frame_reference_epoch
ERROR 1: SQLite error on SELECT name, ellipsoid_auth_name, ellipsoid_code, prime_meridian_auth_name, prime_meridian_code
, publication_date, frame_reference_epoch, deprecated FROM geodetic_datum WHERE auth_name = ? AND code = ?: no such colu
mn: frame_reference_epoch
ERROR 1: SQLite error on SELECT name, ellipsoid_auth_name, ellipsoid_code, prime_meridian_auth_name, prime_meridian_code
, publication_date, frame_reference_epoch, deprecated FROM geodetic_datum WHERE auth_name = ? AND code = ?: no such colu
mn: frame_reference_epoch
0...10...20...30...40...50...60...70...80...90...100 - done.

C:\WINDOWS\system32>gdal_translate -co COMPRESS=DEFLATE -co PREDICTOR=2 -co ZLEVEL=9 PG:"host=localhost port=5432 dbname
=test user=postgres password=postgis schema=schema_brach table=porto_ndvi mode=2" "C:\Users\acer\Desktop\rasters\porto_n
dvi.tiff"
```

MapServer

http://127.0.0.1/cgi-bin/mapserv.exe?map=C:/Users/acer/Desktop/bazy.map&MODE=browse&TEMPLATE=openlayers&LAYERS=all



GeoServer