

Oracle Spatial 101 for APEX Developers

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NL.OUG
NL ORACLE USER GROUP



***„Everything is related
to everything else. But
near things are more
related than distant
things.”***

Tobler's first law of geography

Agenda for today



- What is Oracle Spatial?
- How do spatial data look like?
- How are spatial data stored in the Oracle Database?
- How can you access and use spatial data?
- Your choices for geocoding address data
- ADB Geocoder SQL API with APEX
- Custom Background Maps in APEX
- Q&A
- More information

What is Oracle Spatial?

Oracle Spatial is free

- ✓ Every edition
- ✓ Every Oracle DB service
- ✓ Wherever it is deployed

Oracle Spatial Technologies

*OGC = Open Geospatial Consortium

Oracle Database

- In-depth support for different data models and types, including
 - Geospatial data
 - Vector data (aka Simple features, geometries)
 - Network data
 - Geo-referenced raster imagery
 - 3D point cloud data
 - Topology data
 - Streaming point data
 - Spatial processing
 - Spatial analysis and mining
- Included in
 - All editions of the Oracle database
 - All Database Cloud Services
- Available through Oracle Cloud Infrastructure accounts including **Always Free**



Deployable Services

- Map visualization
- Geocoding
- Routing
- Network models
- Publishing (OGC* Web Services)

Interfaces

- SQL, PL/SQL
- Java, Python, .NET, Node.js
- REST



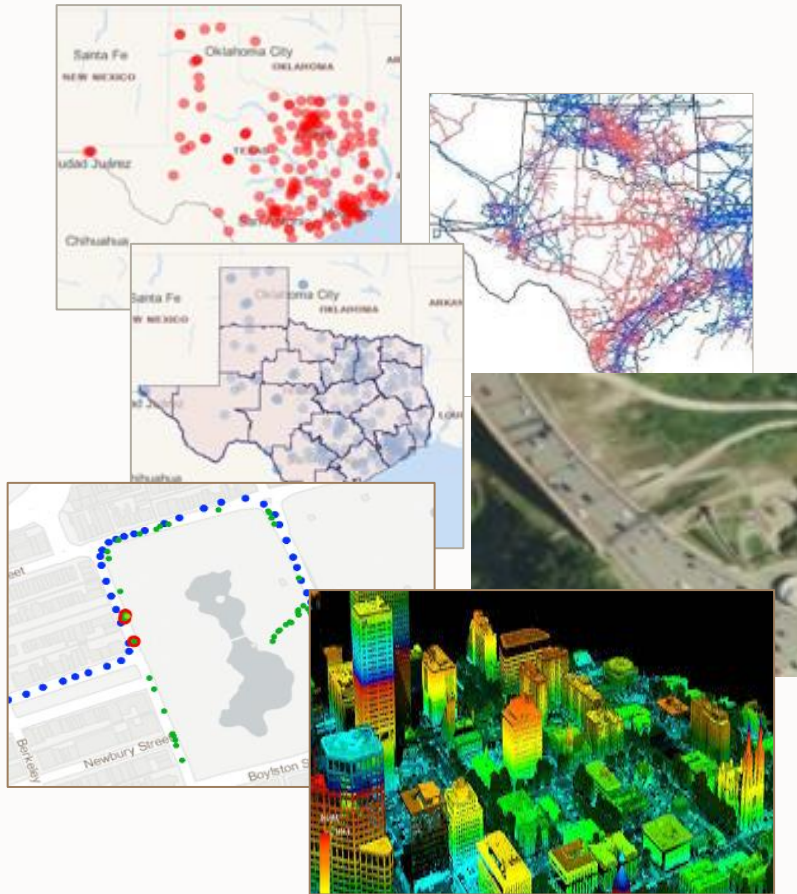
Tools

- Oracle Spatial Studio (No-code visual interface)
- SQL Developer (IDE)



Core functionality of the Oracle Database

Native geospatial data management



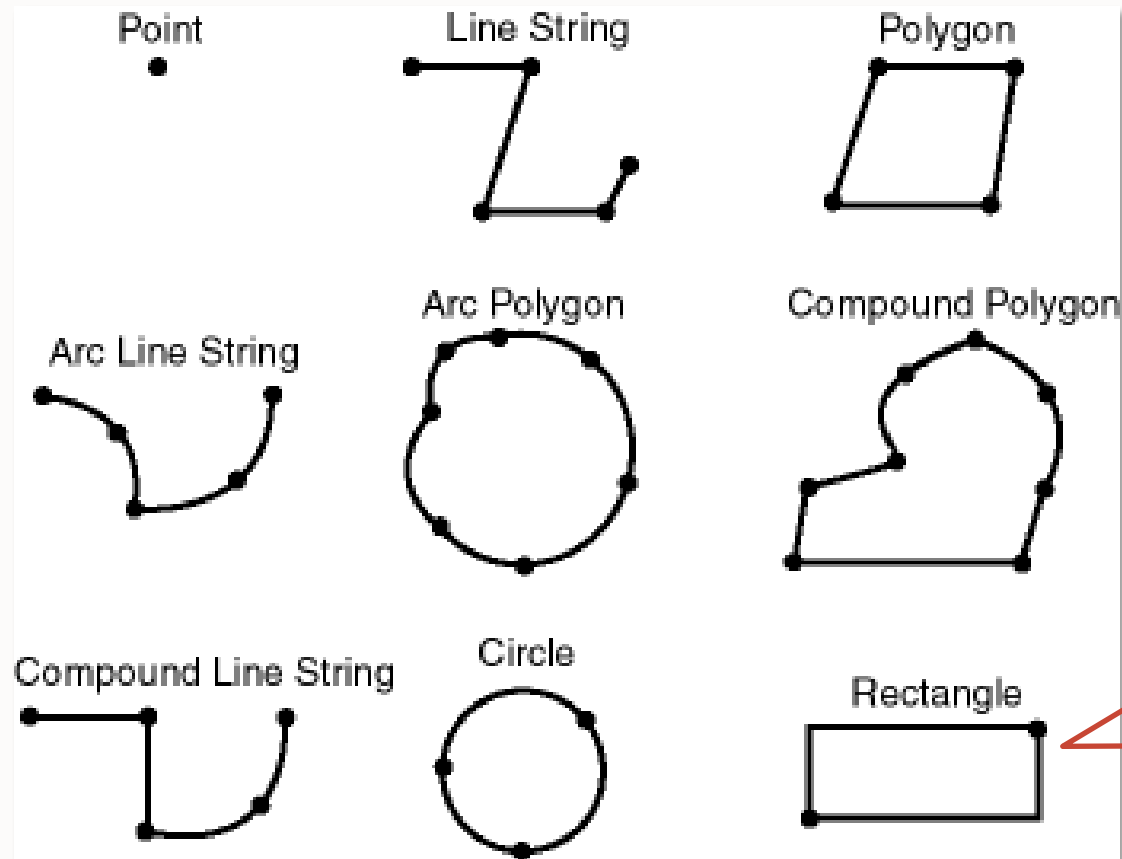
Analyze and relate information based on location

- Which properties are **contained** in a flood zone?
- Which schools are **within a mile** of a hurricane path?
- Where are the **5 nearest** maintenance facilities?
- Where can we deliver **within 35 minutes**?
- What is the **vegetation index** of certain regions in a given country or state?

How do (raw) spatial data look?

Simple Features

Open Geospatial Consortium Standards: Simple Feature Access - www.ogc.org/standards/sfa



APEX 23.2 supports
“Optimized Rectangles”

Simple Features

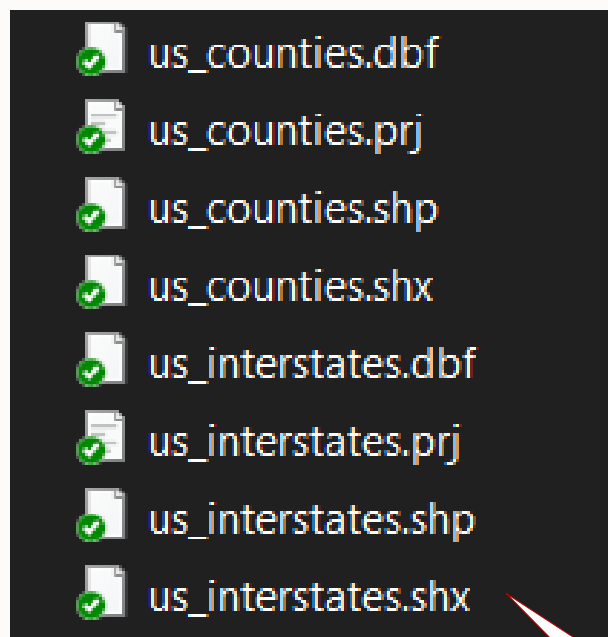


Simple Features

```
STORE_NAME, STORE_TYPE, POSTAL_CODE, LONGITUDE, LATITUDE
Marshall,WHOLESALE,75672,-94.35579,32.50555
Austin-2,RETAIL,78745,-97.75902,30.20538
Grand Prairie,RETAIL,75050,-96.99732,32.76199
Pasadena,WHOLESALE,77505,-95.15763,29.64587
Sulphur Springs,RETAIL,75482,-95.5972,33.12357
San Angelo-1,RETAIL,76901,-100.49426,31.44721
Houston-6,WHOLESALE,77025,-95.43044,29.67853
Mount Pleasant,WHOLESALE,75455,-94.98048,33.17527
Palestine,RETAIL,75802,-95.63011,31.77344
```

Lon/Lat

Simple Features



**ESRI Shape
Files**

Simple Features



```
POINT(6 10)
LINESTRING(3 4,10 50,20 25)
POLYGON(((1 1,5 1,5 5,1 5,1 1),(2 2, 3 2, 3 3, 2 3,2 2)))
MULTIPOINT((3.5 5.6),(4.8 10.5))
MULTILINESTRING((3 4,10 50,20 25),(-5 -8,-10 -8,-15 -4))
MULTIPOLYGON((((1 1,5 1,5 5,1 5,1 1),(2 2, 3 2, 3 3, 2 3,2 2)),((3 3,6 2,6 4,3 3)))
GEOMETRYCOLLECTION(POINT(4 6),LINESTRING(4 6,7 10))
POINT ZM (1 1 5 60)
POINT M (1 1 80)
POINT EMPTY
MULTIPOLYGON EMPTY
```

**Well-Known
Text (WKT)**

Simple Features

```
1  <?xml version="1.0" encoding="utf-8"?>
2  <kml xmlns="http://www.opengis.net/kml/2.2">
3    <Document>
4      <Placemark>
5        <name>Portland</name>
6        <Point>
7          <coordinates>-122.681944,45.52,0</coordinates>
8        </Point>
9      </Placemark>
10     <Placemark>
11       <name>Rio de Janeiro</name>
12       <Point>
13         <coordinates>-43.196389,-22.908333,0</coordinates>
14       </Point>
15     </Placemark>
16     <Placemark>
17       <name>Istanbul</name>
18       <Point>
19         <coordinates>28.976018,41.01224,0</coordinates>
20       </Point>
21     </Placemark>
22     <Placemark>
23       <name>Reykjavik</name>
24       <Point>
25         <coordinates>-21.933333,64.133333,0</coordinates>
26       </Point>
27     </Placemark>
```

KML

Simple Features

```
<gml:Polygon>
  <gml:outerBoundaryIs>
    <gml:LinearRing>
      <gml:coordinates>0,0 100,0 100,100 0,100 0,0</gml:coordinates>
    </gml:LinearRing>
  </gml:outerBoundaryIs>
</gml:Polygon>
<gml:Point>
  <gml:coordinates>100,200</gml:coordinates>
</gml:Point>
<gml:LineString>
  <gml:coordinates>100,200 150,300</gml:coordinates>
</gml:LineString>
```

GML

How are spatial data mapped to the earth?

Coordinate reference systems

- Identified by their **SRID** (SR = Spatial reference)
- Most commonly known is WGS 84 (GPS) with SRID = 4326
- Often used in APEX is also SRID = 3857 (WGS 84 / Pseudo-Mercator -- Spherical Mercator, Google Maps, OpenStreetMap, Bing, ArcGIS, ESRI)

epsg.io powered by MapTiler

Search Map Transform About

EPSG:4326


WGS 84 -- WGS84 - World Geodetic System 1984, used in GPS

Share on:  

Attributes

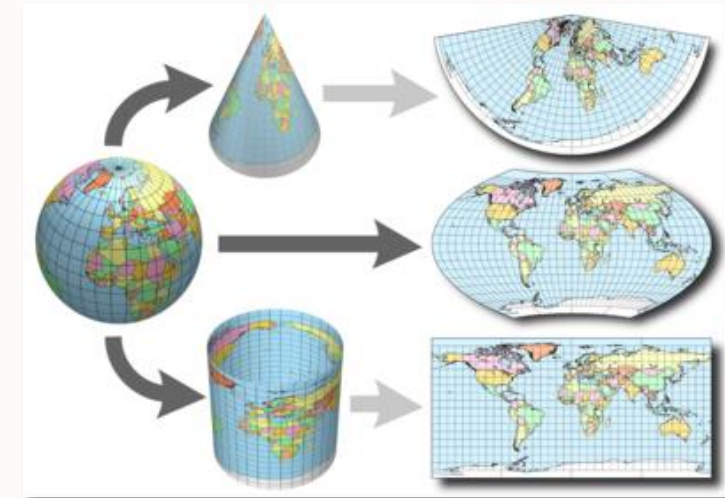
Unit: degree (supplier to define representation)	Scope: Horizontal component of 3D system.
Geodetic CRS: WGS 84	Area of use: World.
Datum: World Geodetic System 1984 ensemble	Coordinate system: Ellipsoidal 2D CS. Axes: latitude, longitude. Orientations: north, east. UoM: degree
Data source: EPSG	
Information source: EPSG. See 3D CRS for original information source.	
Revision date: 2020-03-14	

Covered area powered by MapTiler



© MapTiler © OpenStreetMap contributors

Geodetic vs. projected coordinate reference systems



Source: www.earthdatascience.org/courses/use-data-open-source-python/intro-vector-data-python/spatial-data-vector-shapefiles/geographic-vs-projected-coordinate-reference-systems-python/

Source: epsg.io

Coordinate Systems Definitions

Format: OGC Well Known Text (WKT)

```
GEOGCS["WGS 84",  
  DATUM["WGS_1984",  
    SPHEROID["WGS  
84",6378137,298.257223563,  
      AUTHORITY["EPSG","7030"]],  
    AUTHORITY["EPSG","6326"]],  
  PRIMEM["Greenwich",0,  
    AUTHORITY["EPSG","8901"]],  
  UNIT["degree",0.0174532925199433,  
    AUTHORITY["EPSG","9122"]],  
  AUTHORITY["EPSG","4326"]]
```

```
PROJCS["WGS 84 / Pseudo-Mercator",  
  GEOGCS["WGS 84",  
    DATUM["WGS_1984",  
      SPHEROID["WGS 84",6378137,298.257223563,  
        AUTHORITY["EPSG","7030"]],  
      AUTHORITY["EPSG","6326"]],  
    PRIMEM["Greenwich",0,  
      AUTHORITY["EPSG","8901"]],  
    UNIT["degree",0.0174532925199433,  
      AUTHORITY["EPSG","9122"]],  
    AUTHORITY["EPSG","4326"]],  
  PROJECTION["Mercator_1SP"],  
  PARAMETER["central_meridian",0],  
  PARAMETER["scale_factor",1],  
  PARAMETER["false_easting",0],  
  PARAMETER["false_northing",0],  
  UNIT["metre",1,  
    AUTHORITY["EPSG","9001"]],  
  AXIS["Easting",EAST],  
  AXIS["Northing",NORTH],  
  EXTENSION["PROJ4",  
    "+proj=merc +a=6378137 +b=6378137  
    +lat_ts=0 +lon_0=0 +x_0=0 +y_0=0 +k=1  
    +units=m +nadgrids=@null +wktext +no_defs"],  
  AUTHORITY["EPSG","3857"]]
```

How are spatial data managed in the Oracle Database?

Manage simple features in the Oracle Database

SDO_GEOMETRY data type

ID	Type
2001	Point
2002	Line
2003	Polygon

COLUMN_NAME	DATA_TYPE
WAREHOUSE_NAME	VARCHAR2(30 BYTE)
LAT	NUMBER
LON	NUMBER
GEOMETRY	SDO_GEOMETRY

```
SDO_GEOMETRY(  
  [geometry type]           -- ID for points/lines/polygons  
  , [coordinate system]     -- ID of coordinate system  
  , [point coordinate]      -- used for points only  
  , [line/polygon info]     -- used for lines/polygons only  
  , [line/polygon coordinates] -- used for lines/polygons only  
)
```

SRID

ID	Coordinate System
4326	Latitude/Longitude
3857	World Mercator

```
SDO_GEOMETRY(  
  2001           -- 2D point  
  , 4326         -- Coordinate system  
  , SDO_POINT_TYPE(  
    -100.123, 20.456, NULL) -- lon/lat values  
  , NULL         -- Not used for points  
  , NULL         -- Not used for points  
)
```




Inside the Oracle Database

SDO_GEOMETRY metadata

```
INSERT INTO USER_SDO_GEOM_METADATA VALUES (  
  <table name>,  
  <geometry column name>,  
  SDO_DIM_ARRAY(  
    SDO_DIM_ELEMENT('X',<min x>,<max x>,<tolerance>),  
    SDO_DIM_ELEMENT('Y',<min y>,<max y>,<tolerance>)),  
  <coordinate system id>  
);
```

```
INSERT INTO USER_SDO_GEOM_METADATA VALUES (  
  <table name>,  
  <geometry column name>,  
  SDO_DIM_ARRAY(  
    SDO_DIM_ELEMENT('X', -180, 180, 0.005),  
    SDO_DIM_ELEMENT('Y', -90, 90, 0.005)),  
  4326  
);
```

```
begin  
  apex_spatial.insert_geom_metadata (  
    p_table_name => '<table_name>',  
    p_column_name => '<geom_column_name>',  
    p_diminfo     => sdo_dim_array(  
      sdo_dim_element('X',-180,180,1),  
      sdo_dim_element('Y',-90,90,1) ),  
    p_srid        => apex_spatial.c_wgs_84 )  
end;  
/
```

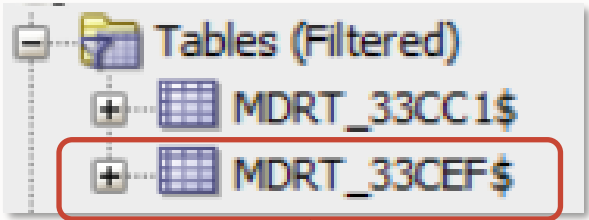


Inside the Oracle Database

R-Tree index on SDO_GEOMETRY columns

```
CREATE INDEX WAREHOUSES_SIDX ON
WAREHOUSES (
    GEOMETRY
)
INDEXTYPE IS MDSYS.SPATIAL_INDEX_V2;
```

Additional parameters to optimize index creation, maintenance and usage, e.g.: PARAMETERS ('LAYER_GTYPE=POINT')



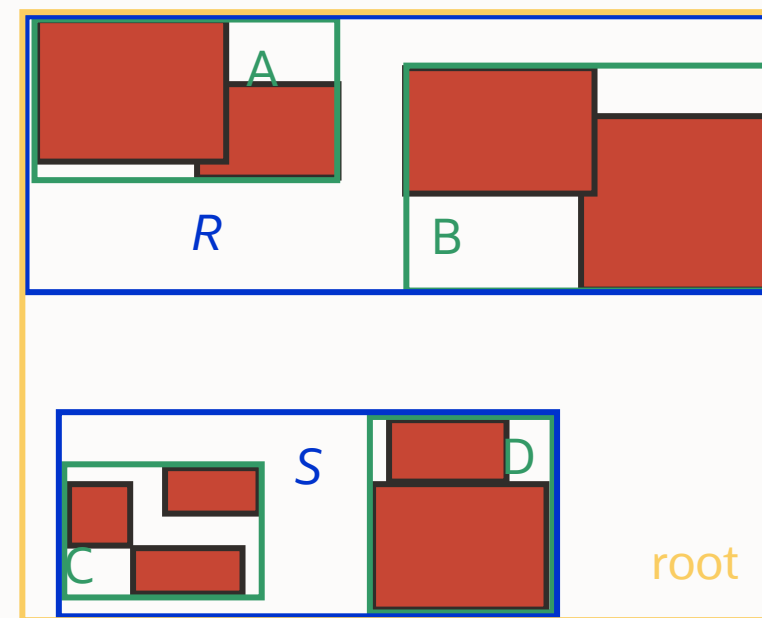
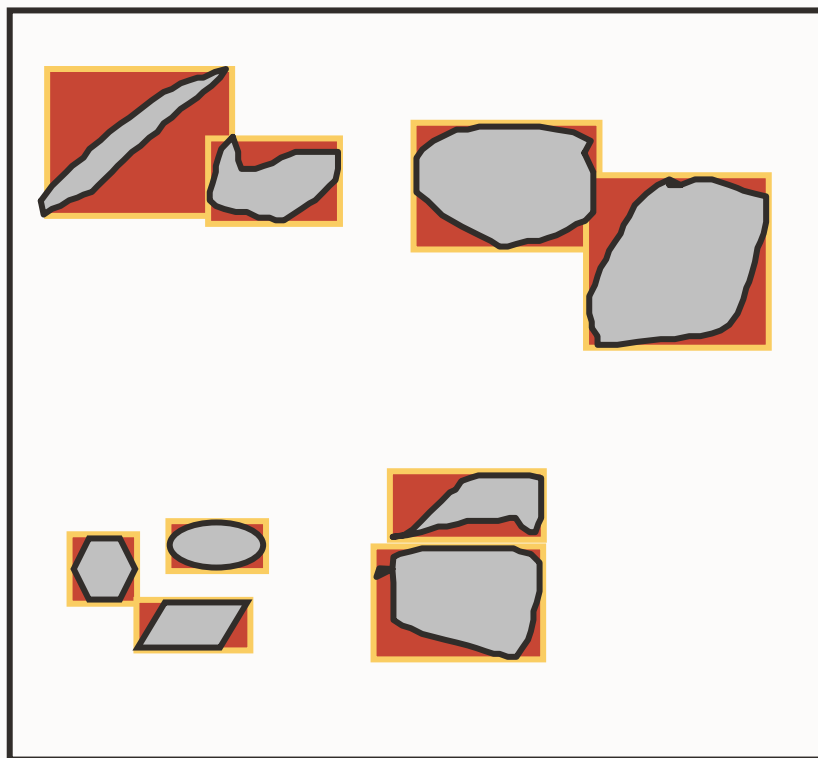
select * from user_sdo_index_metadata where sdo_table_name = 'WAREHOUSES';

SDO_INDEX_OWNER	SDO_INDEX_TYPE	SDO_INDEX_NAME	SDO_TABLE_NAME	SDO_COLUMN_NAME	SDO_INDEX_TABLE
SPATIALUSER	RTREE	WAREHOUSES_SIDX	WAREHOUSES	GEOMETRY	MDRT_33CEF\$



Inside the Oracle Database

R-Tree index on SDO_GEOMETRY columns



How can you access and use spatial data?

Flip the (power) switch

Recommendation: Turn on **Vector Performance Accelerator**

```
show parameter spatial_vector_acceleration
```

```
alter session set spatial_vector_acceleration=true
```

```
-- or
```

```
alter system set spatial_vector_acceleration=true [scope=both]
```

Documentation:

docs.oracle.com/en/database/oracle/oracle-database/19/refrn/SPATIAL_VECTOR_ACCELERATION.html

Oracle Spatial SQL API

Spatial operators and functions (from basic to advanced/from general purpose to specialized)

SDO_ANYINTERACT

SDO_CONTAINS

SDO_COVEREDBY

SDO_COVERS

SDO_EQUAL

SDO_FILTER

SDO_INSIDE

SDO_JOIN

SDO_NN

SDO_NN_DISTANCE

SDO_ON

SDO_OVERLAPBDYDISJOINT

SDO_OVERLAPBDYINTERSECT

SDO_OVERLAPS

SDO_POINTINPOLYGON

SDO_RELATE

SDO_TOUCH

SDO_WITHIN_DISTANCE

SDO_AGGR_CENTROID

SDO_AGGR_CONCAT_LINES

SDO_AGGR_CONCAVEHULL

SDO_AGGR_CONVEXHULL

SDO_AGGR_LRS_CONCAT

SDO_AGGR_MBR

SDO_AGGR_SET_UNION

SDO_AGGR_UNION

SDO_GEOM.RELATE

SDO_GEOM.SDO_ALPHA_SHAPE

SDO_GEOM.SDO_ARC_DENSIFY

SDO_GEOM.SDO_AREA

SDO_GEOM.SDO_BUFFER

SDO_GEOM.SDO_CENTROID

SDO_GEOM.SDO_CLOSEST_POINTS

SDO_GEOM.SDO_CONCAVEHULL

SDO_GEOM.SDO_CONCAVEHULL_BOUNDARY

SDO_GEOM.SDO_CONVEXHULL

SDO_GEOM.SDO_DIAMETER

SDO_GEOM.SDO_DIAMETER_LINE

SDO_GEOM.SDO_DIFFERENCE

SDO_GEOM.SDO_DISTANCE

SDO_GEOM.SDO_INTERSECTION

SDO_GEOM.SDO_LENGTH

SDO_GEOM.SDO_MAX_MBR_ORDINATE

SDO_GEOM.SDO_MAXDISTANCE

SDO_GEOM.SDO_MAXDISTANCE_LINE

SDO_GEOM.SDO_MBC

SDO_GEOM.SDO_MBC_CENTER

SDO_GEOM.SDO_MBC_RADIUS

SDO_GEOM.SDO_MBR

SDO_GEOM.SDO_MIN_MBR_ORDINATE

SDO_GEOM.SDO_POINTONSURFACE

SDO_GEOM.SDO_SELF_UNION

SDO_GEOM.SDO_TRIANGULATE

SDO_GEOM.SDO_UNION

SDO_GEOM.SDO_VOLUME

SDO_GEOM.SDO_WIDTH

SDO_GEOM.SDO_WIDTH_LINE

SDO_GEOM.SDO_XOR

SDO_GEOM.VALIDATE_GEOMETRY_WITH_CONTEXT

SDO_GEOM.VALIDATE_LAYER_WITH_CONTEXT

SDO_GEOM.WITHIN_DISTANCE



Inside the Oracle Database

Query spatial data using spatial operators and functions

```
SELECT
    STORE_NAME,
    STORE_TYPE
FROM
    STORES A,
    WAREHOUSES B
WHERE
    B.WAREHOUSE_NAME = 'Dallas Warehouse'
AND SDO_WITHIN_DISTANCE(
    GET_GEOMETRY(A.LONGITUDE, A.LATITUDE),
    B.GEOMETRY,
    'distance=20 unit=mile') = 'TRUE'
```

Proximity

```
SELECT
    A.STORE_NAME,
    A.STORE_TYPE
FROM
    STORES A,
    REGIONS B
WHERE REGION = 'REGION-02'
AND SDO_INSIDE(
    GET_GEOMETRY(A.LONGITUDE, A.LATITUDE),
    B.GEOMETRY) = 'TRUE';
```

Containment/Topological relationship

Inside the Oracle Database

Validating and Rectifying Spatial Data in the Oracle Database

April 15, 2020 | 3 minute read



Hans Viehmann
Product Manager EMEA

It always amazes me, how many of the complaints about unexpected results or errors in spatial queries we hear about can be traced back to invalid geometries. In our documentation, should you ever bother to read it, we are actually very clear about this:

“You should validate all geometry data, and fix any validation errors, before performing any spatial operations on the data. The recommended procedure for loading and validating spatial data is as follows:

1. Load the data, using a method described in Bulk Loading or Transactional Insert Operations Using SQL.
2. Use the SDO_GEOM.VALIDATE_GEOMETRY_WITH_CONTEXT function or the SDO_GEOM.VALIDATE_LAYER_WITH_CONTEXT procedure on all spatial data loaded into the database.
3. For any geometries with the wrong orientation or an invalid ETYPE or GTYPE value, use SDO_MIGRATE.TO_CURRENT on these invalid geometries to fix them.
4. For any geometries that are invalid for other reasons, use SDO_UTIL.RECTIFY_GEOMETRY to fix these geometries.”

The need to eliminate invalid geometries is probably immediately obvious. If you have, say, a self-crossing polygon, how would you know what is inside and what is outside? What makes this trickier is that across the industry, tools and solutions have varying levels of strictness when it comes to tolerating errors in spatial data. This means that an incorrect geometry may have been loaded into a GIS tool without problems, but once it is saved to the database, it could raise errors when it is used in a subsequent query. Moreover, the Oracle Database has become less forgiving from one release to the next in this regard, so that an invalid geometry may have gone unnoticed in 11gR2 while in 19c it would cause issues.

blogs.oracle.com/oraclespatial/post/validating-and-rectifying-spatial-data-in-the-oracle-database

Oracle Spatial SQL API

SDO_UTIL.AFFINETRANSFORMS

SDO_UTIL.APPEND

SDO_UTIL.BEARING_TILT_FOR_POINTS

SDO_UTIL.CIRCLE_POLYGON

SDO_UTIL.CONCAT_LINES

SDO_UTIL.CONVERT_UNIT

SDO_UTIL.CONVERT3007TO3008

SDO_UTIL.DELETE_SDO_GEOM_METADATA

SDO_UTIL.DENSIFY_GEOMETRY

SDO_UTIL.DROP_WORK_TABLES

SDO_UTIL.ELLIPSE_POLYGON

SDO_UTIL.EXPAND_GEOM

SDO_UTIL.EXTRACT

SDO_UTIL.EXTRACT_ALL

SDO_UTIL.EXTRACT3D

SDO_UTIL.EXTRUDE

SDO_UTIL.FROM_GEOJSON

SDO_UTIL.FROM_GML311GEOMETRY

SDO_UTIL.FROM_GMLGEOMETRY

SDO_UTIL.FROM_JSON

SDO_UTIL.FROM_KMLGEOMETRY

SDO_UTIL.FROM_WKBGEOMETRY

SDO_UTIL.FROM_WKTGEOMETRY

SDO_UTIL.GEO_SEARCH

SDO_UTIL.GET_2D_FOOTPRINT

SDO_UTIL.GET_COORDINATE

SDO_UTIL.GETFIRSTVERTEX

SDO_UTIL.GETLASTVERTEX

SDO_UTIL.GETNUMELEM

SDO_UTIL.GETNUMVERTICES

SDO_UTIL.GETNURBSAPPROX

SDO_UTIL.GETVERTICES

SDO_UTIL.INITIALIZE_INDEXES_FOR_TTS

SDO_UTIL.INSERT_SDO_GEOM_METADATA

SDO_UTIL.INTERIOR_POINT

SDO_UTIL.POINT_AT_BEARING

SDO_UTIL.POLYGONTO LINE

SDO_UTIL.RECTIFY_GEOMETRY

SDO_UTIL.REMOVE_DUPLICATE_VERTICES

SDO_UTIL.REVERSE_LINestring

SDO_UTIL.SIMPLIFY

SDO_UTIL.SIMPLIFYVW

SDO_UTIL.THEME3D_GET_BLOCK_TABLE

SDO_UTIL.THEME3D_HAS_LOD

SDO_UTIL.THEME3D_HAS_TEXTURE

SDO_UTIL.TILE_GEOMETRY

SDO_UTIL.TO_GEOJSON

SDO_UTIL.TO_GML311GEOMETRY

SDO_UTIL.TO_GMLGEOMETRY

SDO_UTIL.TO_JSON

SDO_UTIL.TO_JSON_VARCHAR

SDO_UTIL.TO_KMLGEOMETRY

SDO_UTIL.TO_WKBGEOMETRY

SDO_UTIL.TO_WKTGEOMETRY

SDO_UTIL.VALIDATE_3DTHEME

SDO_UTIL.VALIDATE_SCENE

SDO_UTIL.VALIDATE_VIEWFRAME

SDO_UTIL.VALIDATE_WKBGEOMETRY

SDO_UTIL.VALIDATE_WKTGEOMETRY

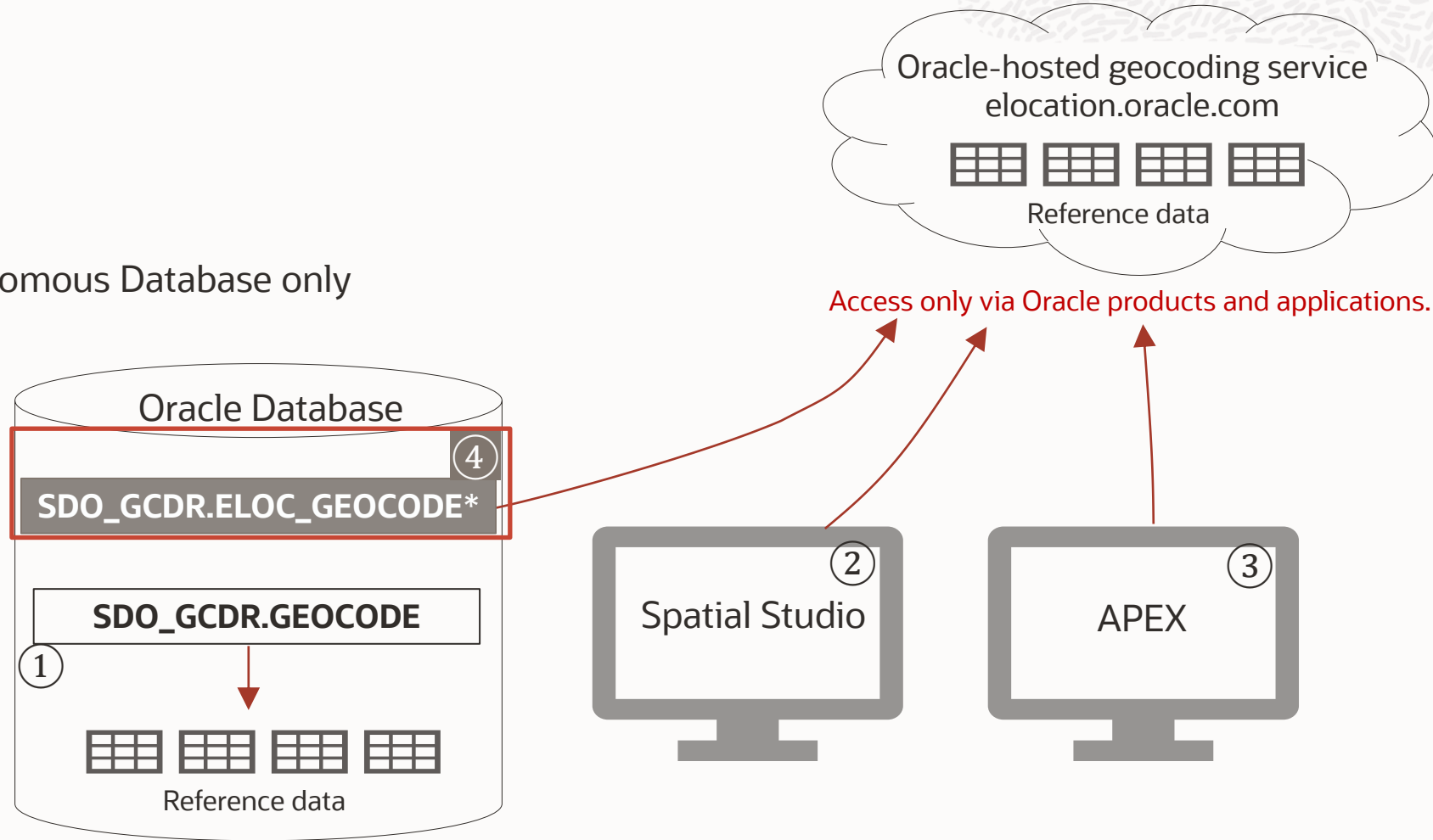
And many more

Turn textual data into spatial data

—
Geocoding

Geocoding options - Overview


* Autonomous Database only



Geocoding using SQL API for Autonomous Database Basics

Format

```
SDO_GCDR.ELOC_GEOCODE (
  street      IN VARCHAR2,
  city        IN VARCHAR2,
  region      IN VARCHAR2,
  postal_code IN VARCHAR2,
  cc2         IN VARCHAR2,
  match_mode  IN VARCHAR2 default 'DEFAULT');
```

 Copy


or

```
SDO_GCDR.ELOC_GEOCODE (address IN VARCHAR2);
```

 Copy

or

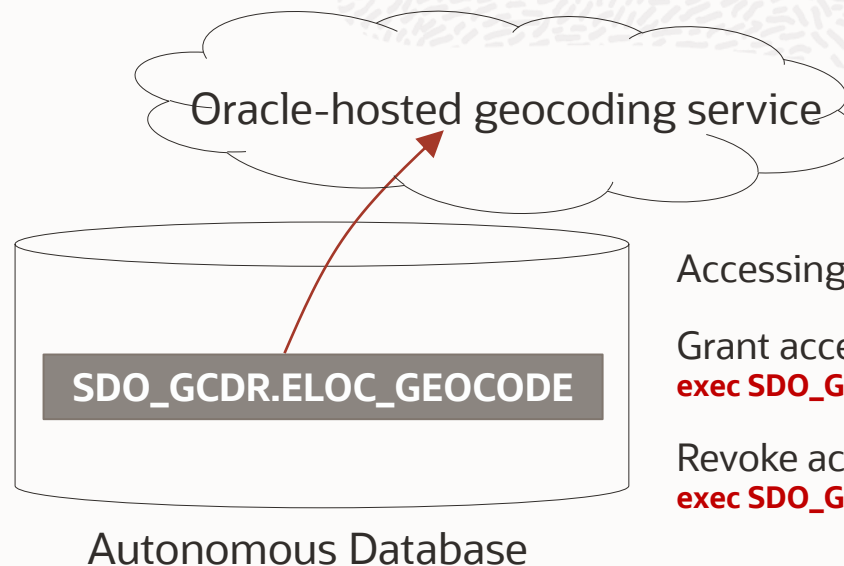
```
SDO_GCDR.ELOC_GEOCODE (
  longitude IN NUMBER,
  latitude  IN NUMBER);
```

 Copy

Description

Geocodes a formatted (address parts in separate fields) or an unformatted (complete address in a single string field) address and returns the standardized address with geographic coordinates and geocoding metadata in JSON format.

For longitude and latitude input, the function reverse geocodes the location and returns the address in JSON format.



Accessing the service requires:

Grant access to a Database user via
exec SDO_GCDR.ELOC_GRANT_ACCESS('SCOTT');

Revoke access via
exec SDO_GCDR.ELOC_REVOKE_ACCESS('SCOTT');

- **No local reference data is needed**
- Dependency on public internet access from the database
- Currently only on ADB-Shared
- Blog: blogs.oracle.com/database/post/new-in-database-geocoder-for-autonomous-database-shared
- Doc: docs.oracle.com/en/database/oracle/oracle-database/19/spatl/SDO_GCDR-reference.html

Geocoding using SQL API for Autonomous Database Usage


```
-- sample address data
street,city,region,postal_code,country
De Nieuwe Poort 20,Amersfoort,PA,3812,NL
Bötzower Str. 24,Berlin,BE,10407,DE
Bd Carl-Vogt 67,Genève,,1205,CH
100 N Renfrew St,Vancouver,BC,V5K 4W3,CA
2 Chome-5-8 Kitaaoyama,Tokyo,,107-0061,JP
123 Beacon St,Boston,MA,02116,US


-- Structured input returning JSON or SDO_GEOMETRY
select sdo_gcdr.eloc_geocode(street, city, region,
postal_code, country, 'RELAX_POSTAL_CODE') from
sample_addresses;
select sdo_gcdr.eloc_geocode_as_geom(street, city,
region, postal_code, country, 'RELAX_POSTAL_CODE') from
sample_addresses;

-- Unstructured input returning JSON or SDO_GEOMETRY
select sdo_gcdr.eloc_geocode(address_line) from
sample_addresses;
select sdo_gcdr.eloc_geocode_as _geom(address_line)
from sample_addresses;
```

- Returned values
 - ELOC_GEOCODE** → JSON document containing one or more best matches
 - Additional address information, such as a municipality, side of the street, or to fill missing address data
 - Match vector to tell you about the accuracy of the geocoded address
 - ELOC_GEOCODE_AS_GEOM** → SDO_GEOMETRY object for the best match

- Oracle LiveLabs Sprint

 LiveLabs

 geocode

How do I geocode
addresses in
Autonomous Database?



Explore converting addresses to
geographic coordinates with
geocoding in Autonomous
Database.

🕒 5 mins

How to use the ADB Geocoder SQL API in APEX?

Figure 1. The effect of the number of trials on the number of correct responses. The number of correct responses was significantly higher than the number of incorrect responses for all groups. The number of correct responses was significantly higher than the number of incorrect responses for all groups. The number of correct responses was significantly higher than the number of incorrect responses for all groups.

```
perform structured address geocoding using match mode: %s', c_match_mode );

s := mdsys.sdo_gcdr.eloc_geocode(
    cc2          => c_country_code,
    street       => l_street,
    postal_code  => v( c_zip_item ),
    city         => v( c_city_item ),
    region       => v( c_region_item ),
    --
    match_mode   => c_match_mode );

perform unstructured address geocoding.' );

address does not allow passing in a match mode?

s := mdsys.sdo_gcdr.eloc_geocode(
    address      => c_address_unstructured );
```

[illegible]

APEX App using the ADB Geocoder SQL API

Plug-in: *Server Side Geocoding*

Sample Geocoder

Home

Addresses

Map

Manual geocoding

Load addresses

Administration

Sample Geocoder

Home

Addresses

Map

Manual geocoding

Load addresses

Administration

Addresses

Search: All Text Columns

Go

Actions

Edit

Save

Address fields				
	Street	City	Postal Code	R
	106 Wattle St	Molteno	5500	
	Barchman Wuytie...	Amersfoort	3818 LH	

Sample Geocoder

Map

Show addresses

About This Page

Reset map

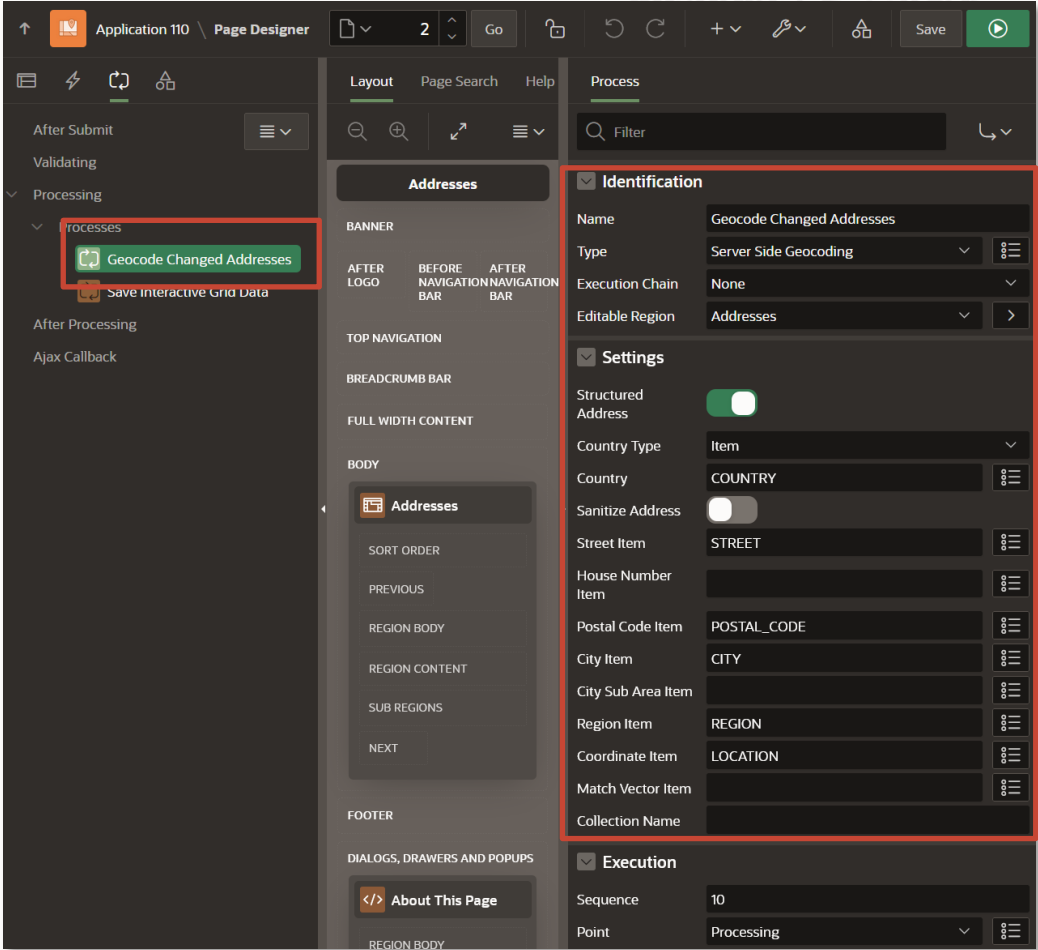
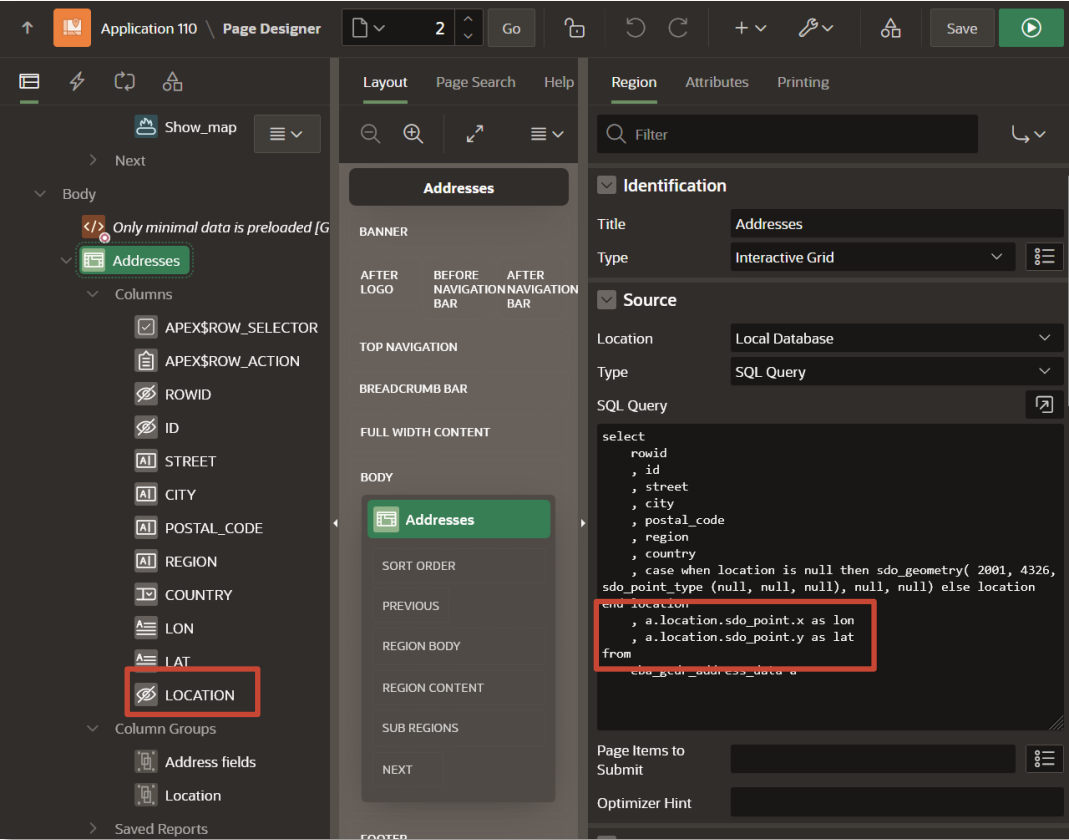
Geocoded addresses

ZA	26.362	-31.3971
NL	5.37281	52.1527



APEX App using the ADB Geocoder SQL API

Plug-in: *Server Side Geocoding*



Custom Map Backgrounds in APEX?

—
New feature in APEX 23.2

Define Map Backgrounds

Shared Components



Other Components



Lists of Values

Plug-ins

Component Settings

Shortcuts

Map Backgrounds

- You have three options:
 - Vector Tile Layer
 - Raster XYZ Tile Layer
 - OGC WMS
- Map backgrounds can be used in
 - Map regions
 - Display map
 - Geocoded address items
- **Note:**
 - OGC WMS as Map Background
 - APEX automatically adds a few URL parameters. You can omit those in the definition

Custom Map Backgrounds

Example: Vector Tile Layer Definition

Map Background: DATAVIZ BRIGHT

Show All Settings Subscription Advanced

Settings

* Name

* Type **Vector Tile Layer** Raster XYZ Tile Layer

API Key

* URL to Map Stylesheet

HTTP Headers

Subscription

Subscribe From

HTTP Headers

Add HTTP Request Headers, which are to be sent from the browser to the Map Server. Enter as Key-Value pairs, separated by =, and one per line. Entries in invalid format (for instance, with a missing equals sign) will be ignored.

Example:

header-1=value-1
header-2=value-2

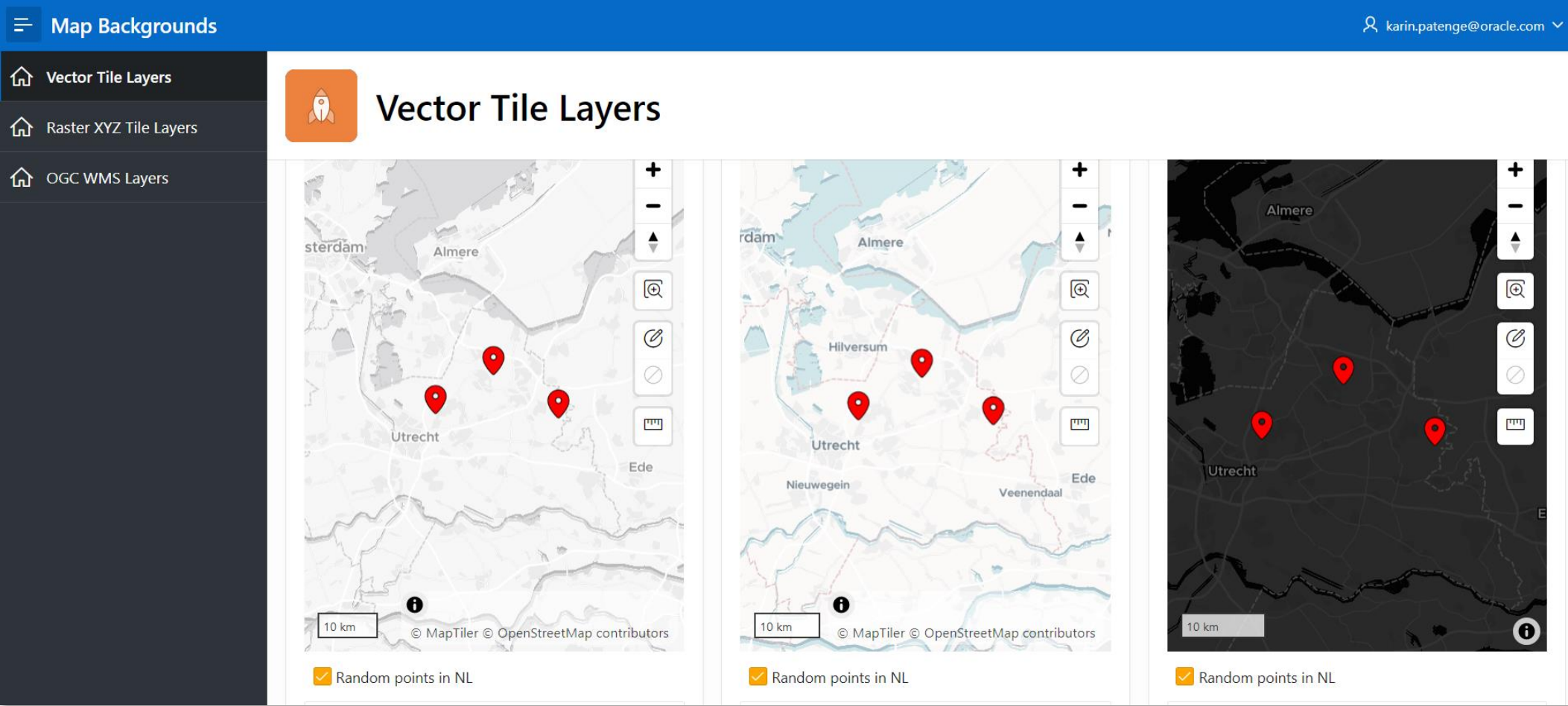
[View Documentation](#)

Deletion of the **master** map background automatically clears the map background references from subscribing map backgrounds.

[Learn More ...](#)

Custom Map Backgrounds

Example: Vector Tile Layer in Use (1)



Custom Map Backgrounds

Example: Vector Tile Layer in Use (2)


☰


Map Backgrounds

🏠 Vector Tile Layers

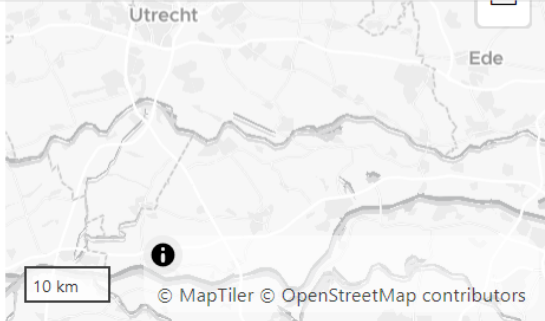
🏠 Raster XYZ Tile Layers

🏠 OGC WMS Layers

 karin.patenge@oracle.com ▼



Vector Tile Layers



10 km ⓘ
© MapTiler © OpenStreetMap contributors

✓ Random points in NL


Definition

URL to Map Stylesheet

<https://elocation.oracle.com/mapviewer/pvt/res/style/dataviz-light/style.json>

HTTP Headers

x-oracle-pvtile=OracleSpatial



10 km ⓘ
© MapTiler © OpenStreetMap contributors

✓ Random points in NL


Definition

URL to Map Stylesheet

<https://elocation.oracle.com/mapviewer/pvt/res/style/dataviz-bright/style.json>

HTTP Headers

x-oracle-pvtile=OracleSpatial



10 km ⓘ

✓ Random points in NL

Definition

URL to Map Stylesheet

<https://elocation.oracle.com/mapviewer/pvt/res/style/dataviz-bright/style.json>

HTTP Headers

x-oracle-pvtile=OracleSpatial

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Custom Map Backgrounds

Example: Raster XYZ Layer Definition

APEX App Builder SQL Workshop Team Development Gallery Search

Application 47931 Shared Components Map Backgrounds Map Background

Map Background: Natural Earth Raster Tiles Cancel Delete Apply Changes

Show All Settings Subscription Advanced

Settings

* Name Natural Earth Raster Tiles ?

* Type Vector Tile Layer **Raster XYZ Tile Layer** OGC WMS ?

API Key ?

* Raster Tiles (XYZ) URL `https://naturalearthtiles.roblabs.com/tiles/natural_earth_cross_blended_hypso_shaded_relief.raster/{z}/{x}/{y}.png` ?

Attribution Natural Earth ?

HTTP Headers ?

About

Map Backgrounds allow to use different background tile layers for Map Regions, Display Map Items or the Geocoded Address item.

Oracle APEX allows to reference *Vector Tile Layers*, *Raster Tile Layers* and map tiles fetched from *OGC WMS (Web Map Service)* endpoints.

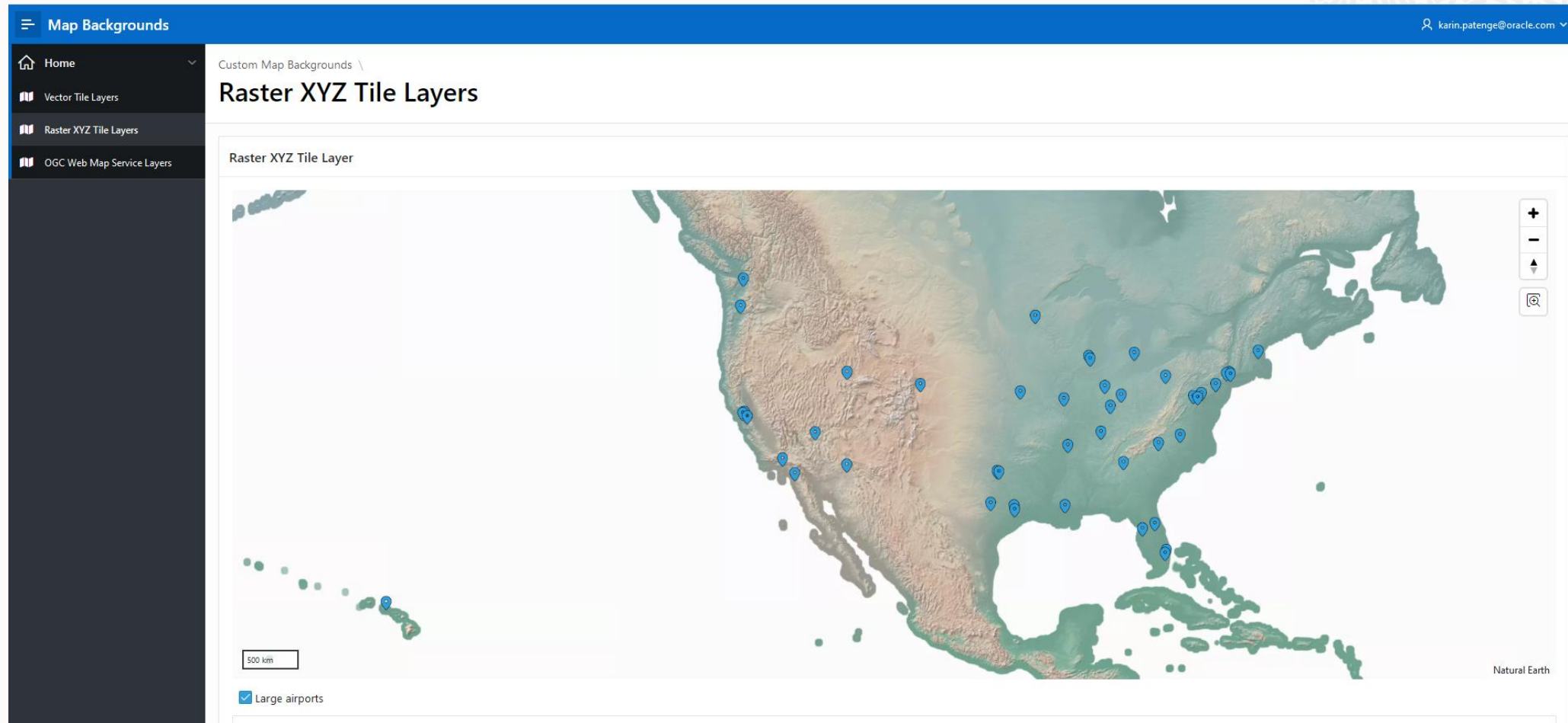
When map background is subscribed, then it is not possible to change any data.

Deletion of the **master** map background automatically clears the map background references from subscribing map backgrounds.

[Learn More ...](#)

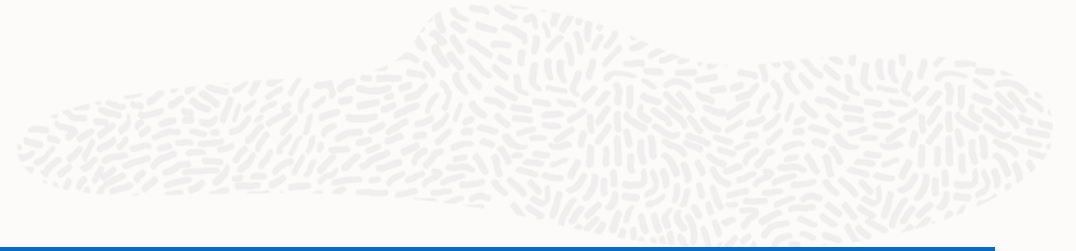
Custom Map Backgrounds

Example: Raster XYZ Layer in Use (1)



Custom Map Backgrounds

Example: Raster XYZ Layer in Use (2)



☰

Map Backgrounds

🏠 Home

📖 Vector Tile Layers

📖 Raster XYZ Tile Layers

📖 OGC Web Map Service Layers

Custom Map Backgrounds \ Raster XYZ Tile Layers

500 km

☒ Large airports

Definition

Raster XYZ Tiles URL definition



https://naturalearthtiles.roblabs.com/tiles/natural_earth_cross_blended_hypso_shaded_relief.raster/{z}/{x}/{y}.png

Source

[Usage & License: Natural Earth Tiles](#)

Custom Map Backgrounds

Example: OGC Web Map Service (WMS) Definition

↑  Application 47931 \ Shared Components \ Map Backgrounds \ Map Background 

Map Background: Terrestris OMS WMS

Cancel Delete **Apply Changes**

Show All

Settings

Subscription


Advanced

Settings

*

Name


Terrestris OMS WMS




*

Type

Vector Tile Layer Raster XYZ Tile Layer **OGC WMS**




API Key



*


WMS URL



https://ows.terrestris.de/osm/service?version=1.1.1&layers=TOPO-WMS&styles=default



Attribution

Terrestris



↑  Application 47931 \ Shared Components \ Map Backgrounds \ Map Background 

Map Background: USGS Topo WMS

Cancel Delete **Apply Changes**

Show All

Settings

Subscription


Advanced

Settings

*

Name


USGS Topo WMS




*

Type

Vector Tile Layer Raster XYZ Tile Layer **OGC WMS**




API Key



*


WMS URL

https://basemap.nationalmap.gov/arcgis/services/USGSTopo/MapServer/WmsServer?service=WMS&version=1.3.0&layers=0&styles=default



Attribution

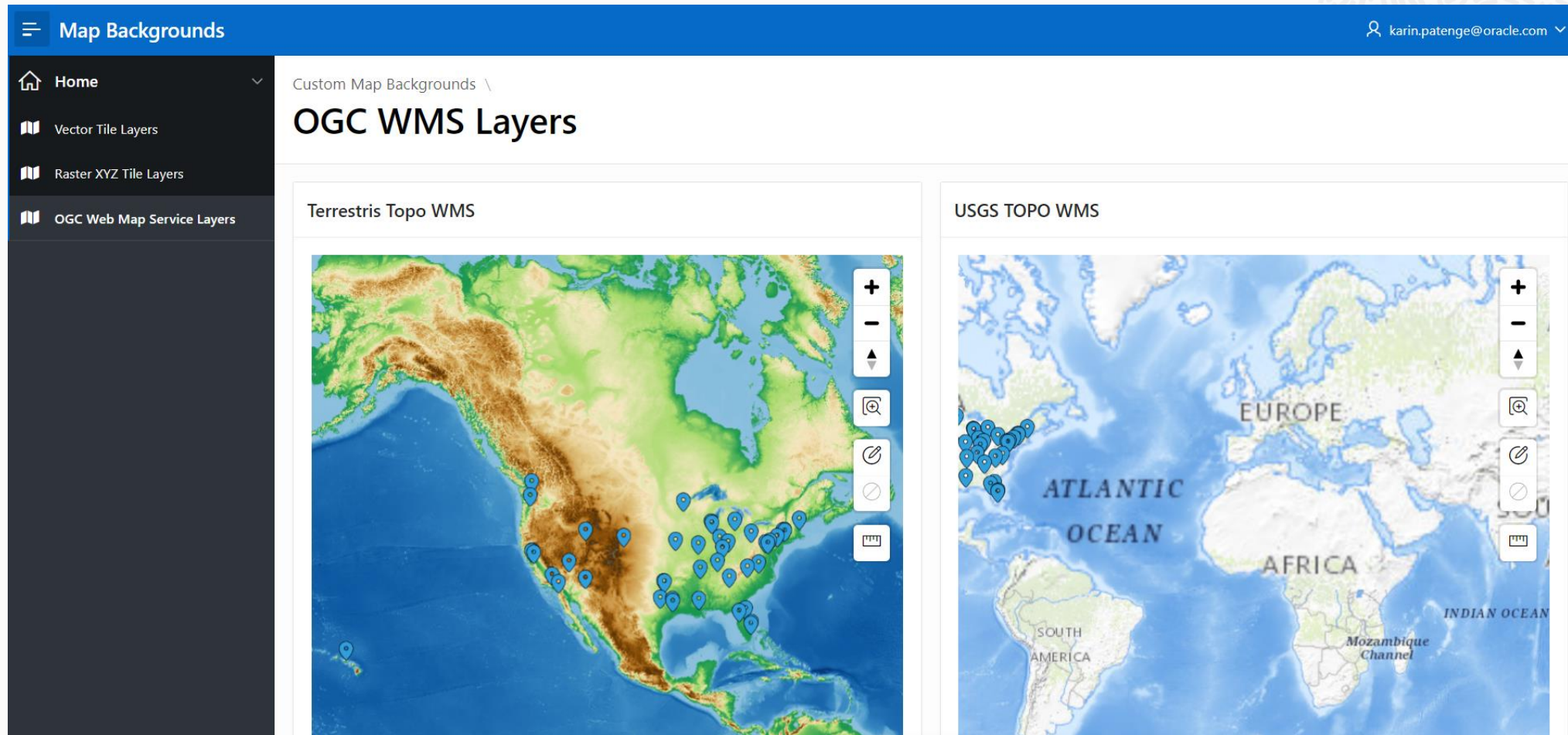
USGS Topo





Custom Map Backgrounds

Example: OGC Web Map Service (WMS) in Use (1)



Custom Map Backgrounds

Example: OGC Web Map Service (WMS) in Use (2)

Map Backgrounds

Home

Vector Tile Layers

Raster XYZ Tile Layers

OGC Web Map Service Layers

Custom Map Backgrounds \ OGC WMS Layers

2000 km

Terrestris

☒ Large airports

Definition

Name	GetMap request URL to define Map Background in Shared Components
Terrestris	https://ows.terrestris.de/osm/service?version=1.1.1&layers=TOPO-WMS&styles=default

getCapabilities Request

<https://basemap.nationalmap.gov/arcgis/services/USGSTopo/MapServer/WmsServer?request=getCapabilities&service=WMS&version=1.3.0>

3000 km

USGS Topo

☒ Large airports

Definition

Name	GetMap request URL to define Map Background in Shared Components
USGS Topo WMS	https://basemap.nationalmap.gov/arcgis/services/USGSTopo/MapServer/WmsServer?service=WMS&version=1.3.0&layers=0&styles=default

getCapabilities Request

<https://ows.terrestris.de/osm/service?request=getCapabilities&service=WMS&version=1.1.1>

Note: APEX appends a few OGC WMS getMap Request parameters such as SERVICE, REQUEST, SRS (CRS), WIDTH, HEIGHT, FORMAT, or BBOX itself. You can omit those in the definition.



Demo

1. Using the ADB Geocoder in APEX
2. Useful code samples
3. Map Backgrounds in APEX

Self-paced LiveLabs Workshop: Get Started with Maps and Spatial in APEX

apexapps.oracle.com/pls/apex/r/dbpm/livelabs/view-workshop?wid=936



Autonomous
Database

More Information

Make sure to always apply
the **latest Spatial Patch Bundle**

MOS Note ID 2514624.1

Where can you learn more about Spatial?

General information

- www.oracle.com/database/spatial

Spatial on Oracle LiveLabs

- <https://apexapps.oracle.com/pls/apex/f?p=133:100:::::SEARCH:spatial>

Documentation

- docs.oracle.com/en/database/oracle/apex/23.2/aeapi/AP_EX_SPATIAL.html
- docs.oracle.com/en/database/oracle/oracle-database/19/spatial-and-graph.html (version 19c)

Reference Architecture Center

- Build a geospatial platform on Oracle Autonomous Database
docs.oracle.com/solutions/?q=geospatial

AskTOM Spatial Office Hours

- Spatial for DBAs, Analysts and Developers (Every last Tuesday of a month)

Blogs

- blogs.oracle.com/database/category/db-spatial
- medium.com/tag/oracle-spatial
- blogs.oracle.com/oraclespatial (legacy)
- oracle-spatial.blogspot.com (legacy)

YouTube

- Oracle Spatial and Oracle Graph channel
bit.ly/Spatial-Graph-YouTube
- Spatial AskTOM OH Playlist
www.youtube.com/playlist?list=PL3ZqpALcm8HP5glGHJfYLVzQmJn9QEkn

LinkedIn

- Oracle Spatial and Graph group
www.linkedin.com/groups/1848520/



Thank you



karin.patenge@oracle.com



ORACLE