

OGC API – Tiles

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OGC API - Tiles

- **Publication Date:** 2022-11-10
- **Submitter:** Dr. Joan Maso: University Autonomia the Barcelona (UAB-CREAF) and others
- The OGC API — Tiles Standard is an **alternative** to the OGC’s Web Map Tile Service (**WMTS**) Standard focused on map tiles as Simple reusable REST API building blocks
- Standard defines the requirements that are relevant for anyone who wants to **share or use Tiled Data at a fine-grained level.**
- Specifies how different forms/types of geospatial resources are supported, such as **tiles of vector features (“vector tiles”), coverages, and maps (or imagery)**

OGC API – Tiles: TMS

- **Publication Date:** 2022-09-09
- OGC Two-Dimensional Tile Matrix Set (**TMS**) and **Tile Set Metadata**
- Standard client to request images: changing **parameters** (size, CRS)
- It is a tiling scheme that enables an application to **partition and index space based on a set of regular grids defined for multiple scales** in a Coordinate Reference System (CRS)

Introduction

- Building blocks which can be used in a Web API to retrieve geospatial data as **tiles that as visual portrayals of the data** created by applying a style to the data
- **support is not required for any specific CRS**
- geospatial data resources **replace** the concept of layer
- layers in WMTS were not defined by other OGC APIs and did not support other functionalities.

Requirements classes defining resources

specifies requirements that all implementation instances of the Tiles API

RESOURCE NAME	COMMON PATH
Tile	<code>.../{tileMatrix}/{tileRow}/{tileCol}</code>
Tileset	<code>.../tiles/{tileMatrixSetId}</code>
Tile	<code>.../tiles/{tileMatrixSetId}/{tileMatrix}/{tileRow}/{tileCol}</code>
Tileset list	<code>.../tiles</code>

Requirements classes defining data origins

Dataset tiles may combine content from multiple geospatial resources, regardless of whether those are available separately as tiles

Dataset tileset:

RESOURCE NAME	COMMON PATH
Vector tileset list	/tiles
Map tileset list	/map/tiles
Styled Map tileset list	/styles/{styleId}/map/tiles

Requirements classes defining data origins

Dataset tiles may **combine content from multiple geospatial resources**, regardless of whether those are available separately as tiles

Geospatial data resources tilesets:

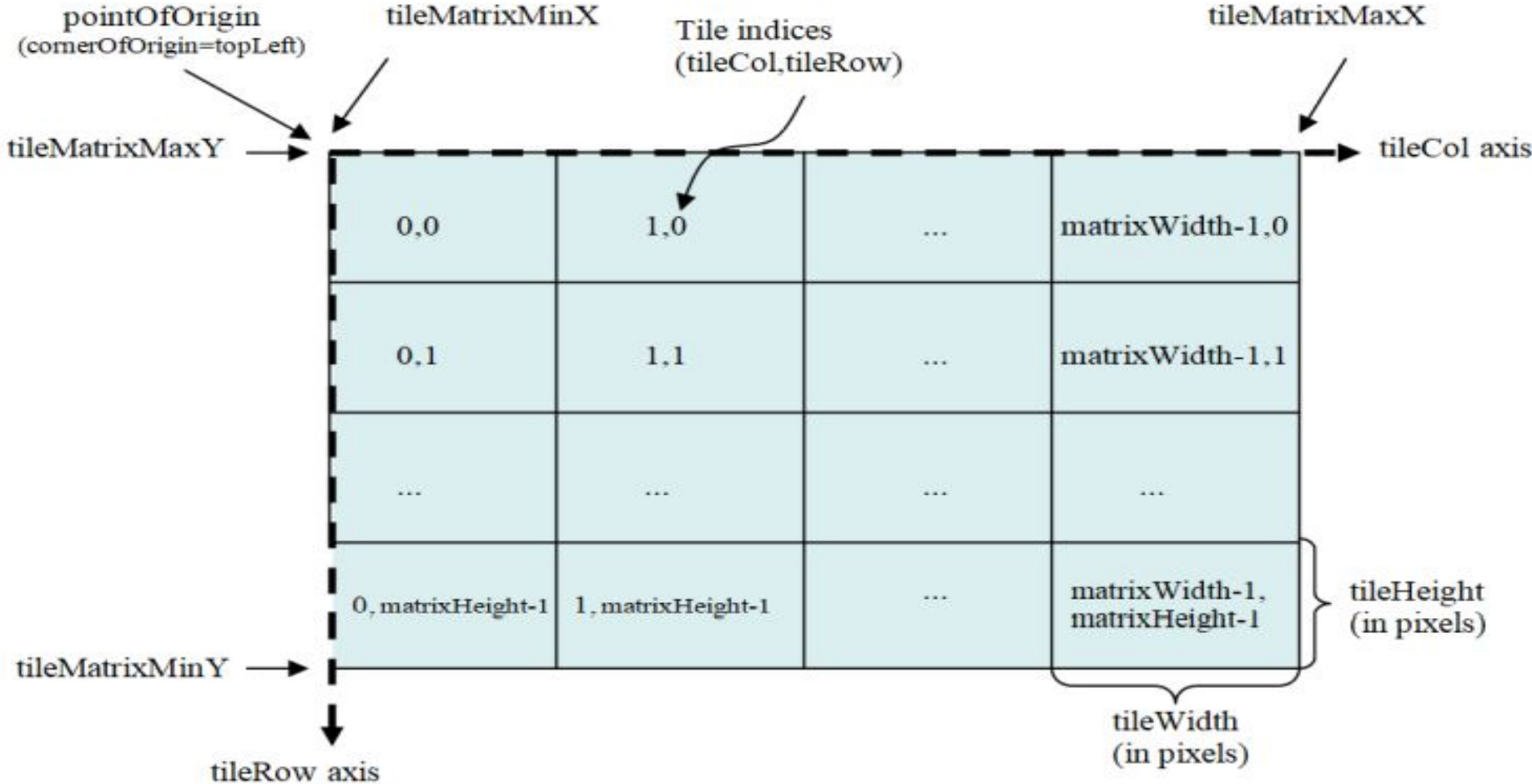
RESOURCE NAME	EXAMPLE OF POSSIBLE PATHS
Vector tileset list	<code>/collections/{collectionId}/tiles</code>
Map tileset list	<code>/collections/{collectionId}/map/tiles</code>
Styled Map tileset list	<code>/collections/{collectionId}/styles/{styleId}/map/tiles</code>

Requirements classes defining query parameters

- **Geodata selection:**

RESOURCE NAME	EXAMPLE OF POSSIBLE PATHS
Vector Tileset	<code>/tiles/{tileMatrixSetId}?collections={collectionId}, {collectionId},...</code>
Vector Tile	<code>/tiles/{tileMatrixSetId}/{tileMatrix}/{tileRow}/{tileCol}? collections={collectionId},{collectionId},...</code>
Map tileset	<code>/map/tiles/{tileMatrixSetId}?collections={collectionId}, {collectionId},...</code>
Map tile	<code>/map/tiles/{tileMatrixSetId}/{tileMatrix}/{tileRow}/ {tileCol}?collections={collectionId},{collectionId},...</code>

Tile Space



Tiles

Tiles can contain a variety of data types:

- Feature-based representations (**vector tiles**)
- Grid-based pictorial representations (**map tiles**)
- Coverage subsets (**coverage tiles**)

Vector Tile

- Tile that contains vector data that has been **generalized (simplified) at the tile scale resolution and clipped by the tile boundaries**
- Raster tile that contains information in a gridded form. Commonly the **values of the grid represent colors of each cell in the grid** for immediate pictorial representation on visualization devices, but can also be coverage subsets

```
{
  "title" : "Daraa multi-layer vector tiles",
  "description" : "Vector tiles of Daraa, Syria from NSG OpenStreetMap
Topographic Data Store",
  "keywords" : [ "Daraa", "Syria", "OpenStreetMap", "NSG", "TDS" ],
  "dataType" : "vector",
  "accessConstraints" : "unclassified",
  "crs" : "http://www.opengis.net/def/crs/EPSG/0/3857",
  "epoch" : 2021.33,
  "links" : [
    {
      "rel" : "self",
      "type" : "application/json",
      "href" : "/Daraa/ogcapi/tiles/WebMercatorQuad?f=json"
    }
  ],
}
```

Map tile

- Tile that contains information in a raster form where **the values of cells are colors** which can be **readily displayed on rendering devices**.
- Over time, in the OGC, the concept of a tile, initially used for **map** tiles has been **generalized to other data models** such as **feature** data (some vendors use the expression vector tiles) and even to **coverage** data or **processes** that can be parallelized dividing space into tiles.
- The OGC API — Tiles Standard presents an approach to tiles that can be **applied to almost any resource type that returns geospatial data**

Requirements classes for specific resource representations

Does not mandate a specific encoding or format for representing tiles

- PNG (<http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/png>)
- JPEG (<http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/jpeg>)
- TIFF (<http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/tiff>)
- NetCDF (<http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/netcdf>)
- GeoJSON (<http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/geojson>)
- Mapbox Vector Tiles (<http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/mvt>)

Declaration of conformance

CONFORMANCE CLASS	URI
Core	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/core
TileSet	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/tileset
Tilesets list	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/tilesets-list
Dataset tilesets	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/dataset-tilesets
Geodata tilesets	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/geodata-tilesets
Collections selection	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/collections-selection
DateTime	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/datetime
OpenAPI Specification 3.0	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/oas30
XML	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/xml
PNG	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/png
JPEG	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/jpeg
TIFF	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/tiff
NetCDF	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/netcdf
GeoJSON	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/geojson
Mapbox Vector Tiles	http://www.opengis.net/spec/ogcapi-tiles-1/1.0/conf/mvt

Landing page and Conformance classes

A landing page serves as **the root node of the API Resource** tree and provides the **information needed to navigate** all the resources exposed through the API. The landing page provides access to the root of a dataset.

REQUIREMENT 7

IDENTIFIER /req/core/conformance-success

A

If the API instance has a mechanism to advertise conformance classes, the list of conformance classes SHALL include the ones defined in this standard and listed in Table 7 that are supported by this API instance.

Tile

- A tile resource is a geospatial resource **presenting a fragment of a much bigger geospatial data resource** that is spatially constrained at the boundaries of the selected tile in a tile matrix set.
- geometric shape with known properties that may or may not be the result of a tiling (tessellation) process. A tile consists of a **single connected “piece” without “holes” or “lines”**
- An **HTTP GET request allows for the retrieval of a single tile** that represents information coming from geospatial data resources.

REQUIREMENT 1

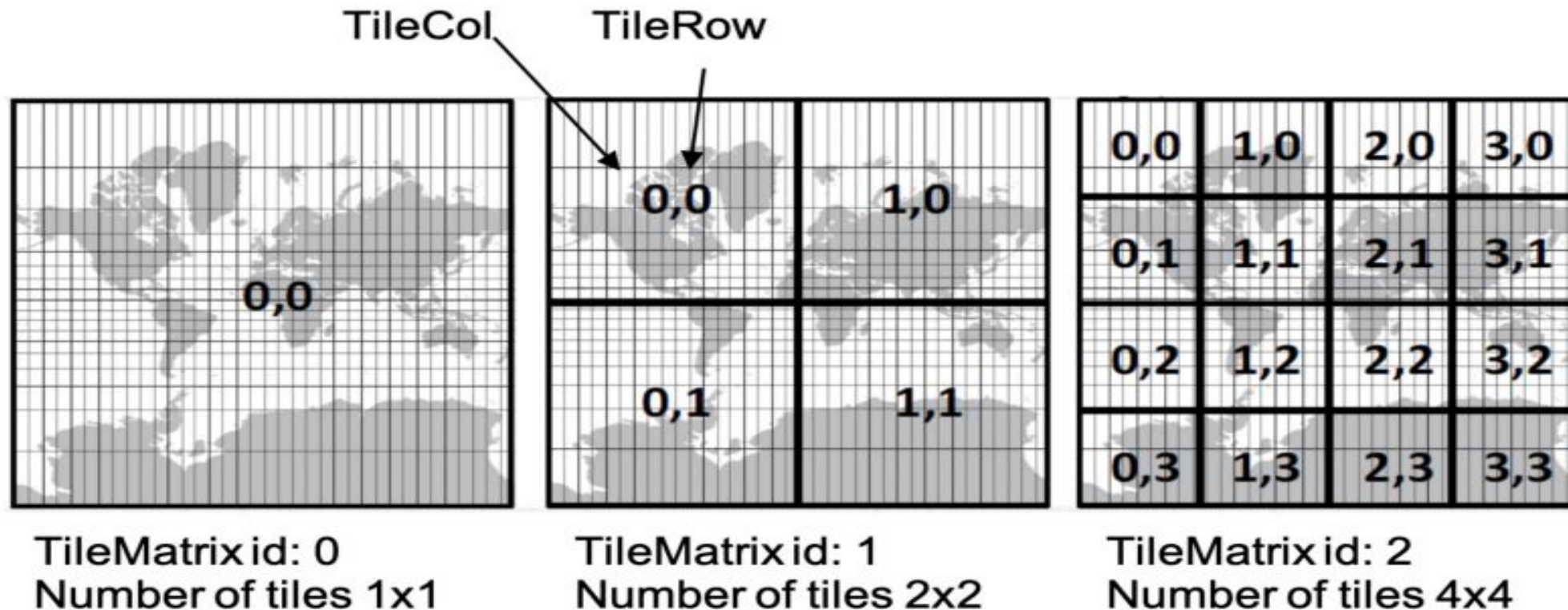
IDENTIFIER /req/core/tc-op

Tiles



Tile Matrix

- Tiling grid in a given **2D coordinate reference system**, associated to a **specific scale and partitioning space** into regular conterminous tiles, each of which being assigned a **unique identifier**.



Tile Matrix

RECOMMENDATION 1

IDENTIFIER /rec/core/tc-op

- A A tiles implementation SHOULD consider using the tiles URI template variables in the following common order and form: `{tileMatrix}/{tileRow}/{tileCol}`

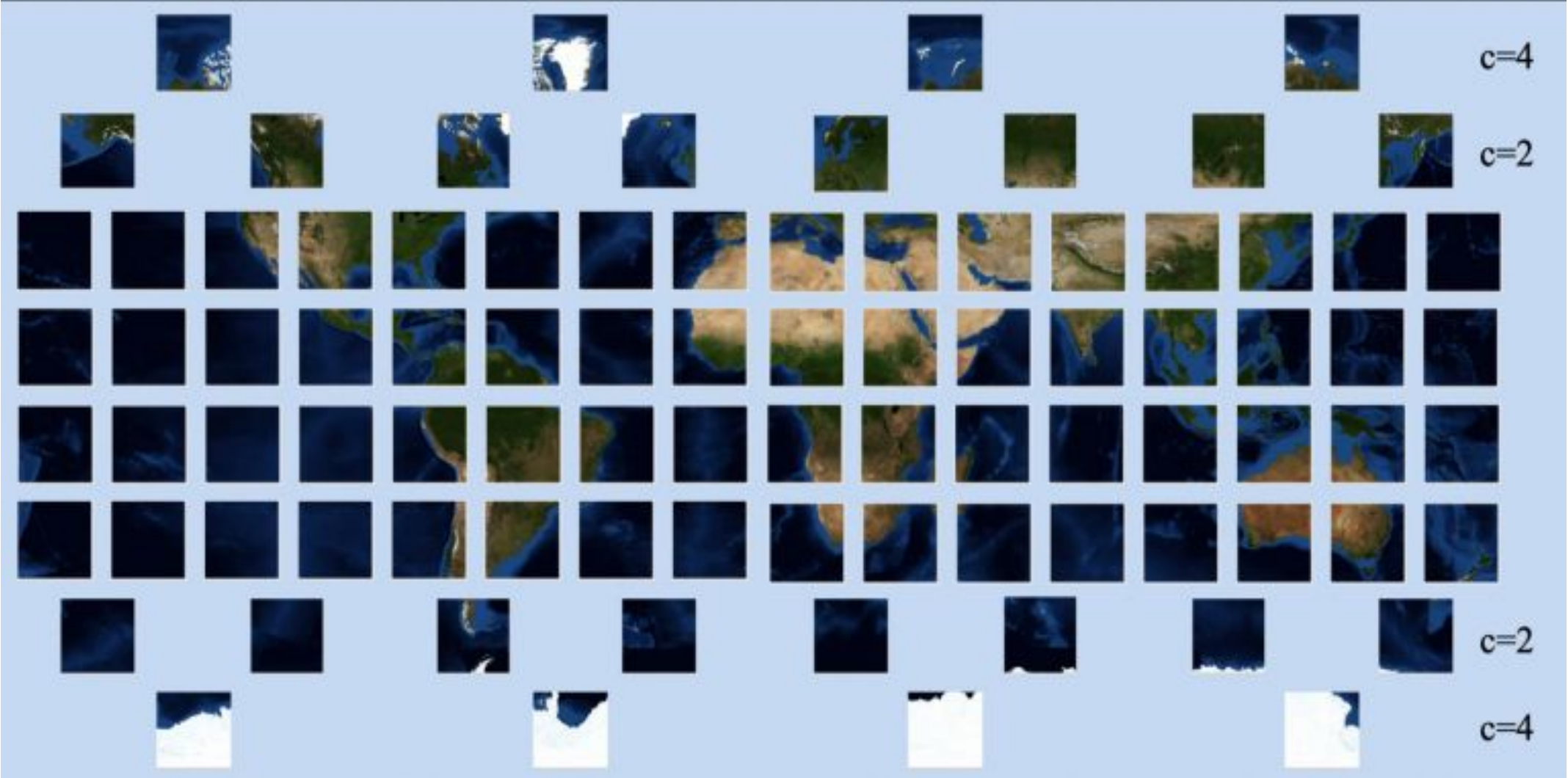
REQUIREMENT 2

IDENTIFIER /req/core/tc-tilematrix-definition

If the API implements *OGC API – Common – Part 1: Core*, the definition of this operation SHALL support a parameter `tileMatrix` with the following characteristics (shown as OpenAPI Specification 3.0 fragment):

- A
- ```
name: tileMatrix
in: path
description: Identifier selecting one of the scales defined in the
TileMatrixSet and representing the scaleDenominator the tile.
required: true
schema:
 type: string
example: '11'
```

# Tile Matrix with variable matrix length



# Tile Matrix

## REQUIREMENT 3

IDENTIFIER /req/core/tc-tilerow-definition

If the API implements *OGC API – Common – Part 1: Core*, the definition of this operation SHALL support a parameter `tileRow` with the following characteristics (shown as OpenAPI Specification 3.0 fragment):

```
A
 name: tileRow
 in: path
 description: Row index of the tile on the selected TileMatrix. It cannot
 exceed the MatrixWidth-1 for the selected TileMatrix
 required: true
 schema:
 type: integer
 minimum: 0
 example: '827'
```

## REQUIREMENT 4

IDENTIFIER /req/core/tc-tilecol-definition

A If the API implements *OGC API – Common – Part 1: Core*, the definition of this operation SHALL support a parameter `tileCol` with the following characteristics (shown as OpenAPI Specification 3.0 fragment):

## REQUIREMENT 4

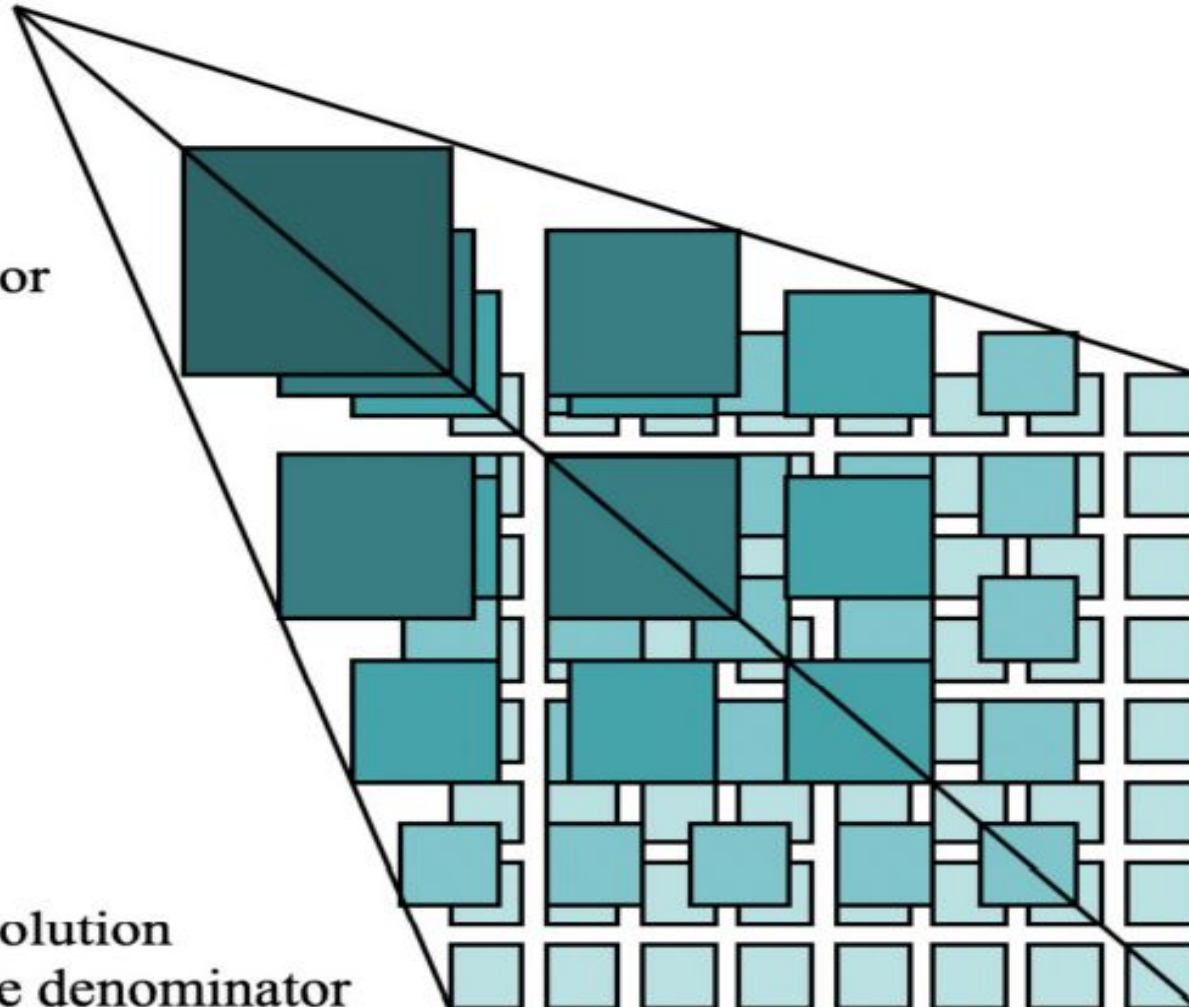
```
 name: tileCol
 in: path
 description: Column index of the tile on the selected TileMatrix. It cannot
 exceed the MatrixHeight-1 for the selected TileMatrix.
 required: true
 schema:
 type: integer
 minimum: 0
 example: 1231
```

# Tile Matrix Set

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Coarse resolution  
Highest scale denominator

Detailed resolution  
Lowest scale denominator





# Tile Matrix Set

- Tiling scheme consisting of **a set of tile matrices defined at different scales covering approximately the same area** and having a common coordinate reference system

## PERMISSION 1

IDENTIFIER /per/core/tc-tilematrixset-definition

**A** An extra {tileMatrixSetId} variable MAY be used by the API definition for simplification purposes and, this way, make all tileset paths homogeneous.

**B** The {tileMatrixSetId} variable will be interpreted as one of TileMatrixSet identifiers supported by the resource. In other words, tileMatrixSetId represents all the TileMatrixSets supported by the resource.

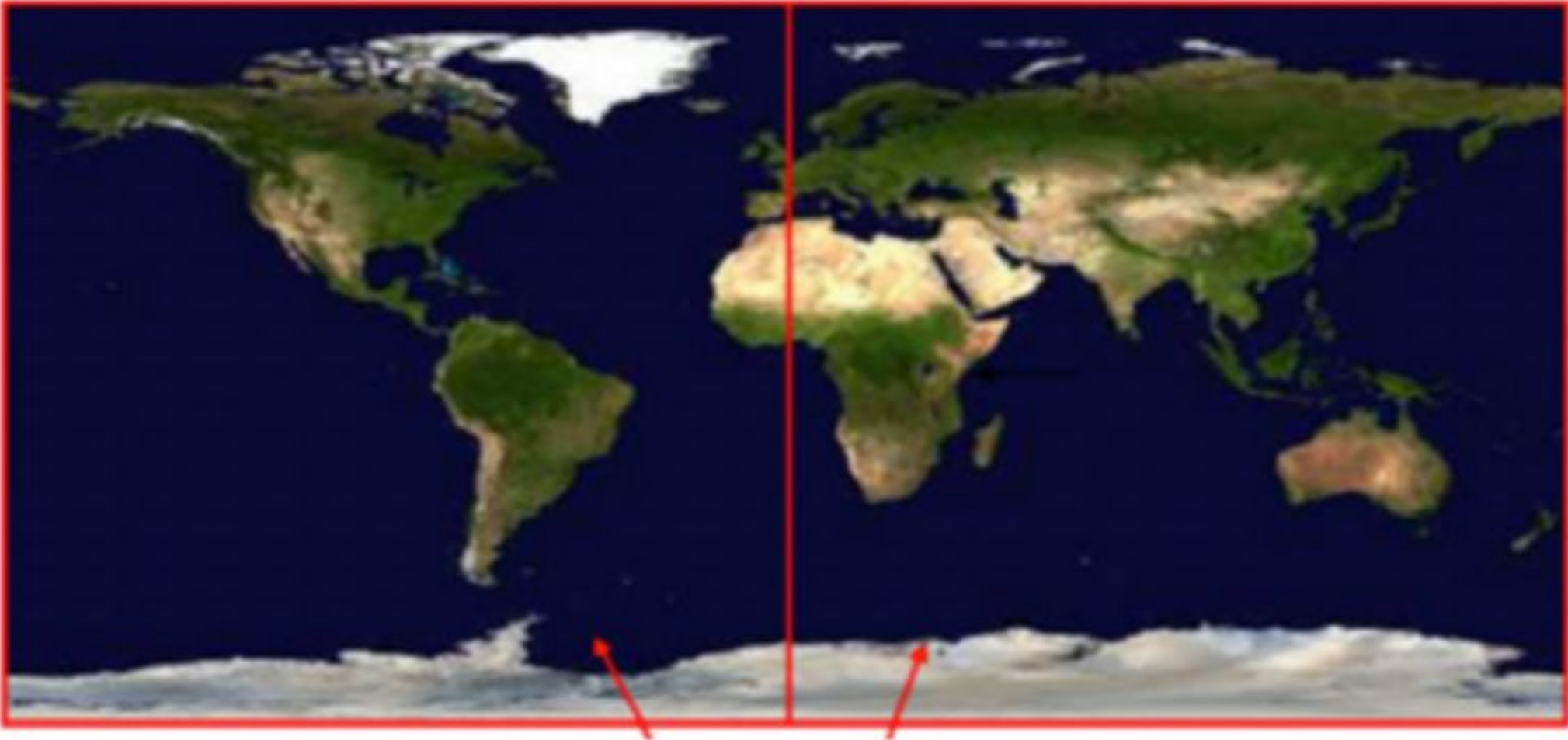
**C** The following OpenAPI Specification 3.0 fragment MAY be used in this case:

```
name: tileMatrixSetId
in: path
description: Identifier selecting one of the TileMatrixSetId supported by the
resource.
required: true
schema:
 type: string
example: 'WebMercatorQuad'
```

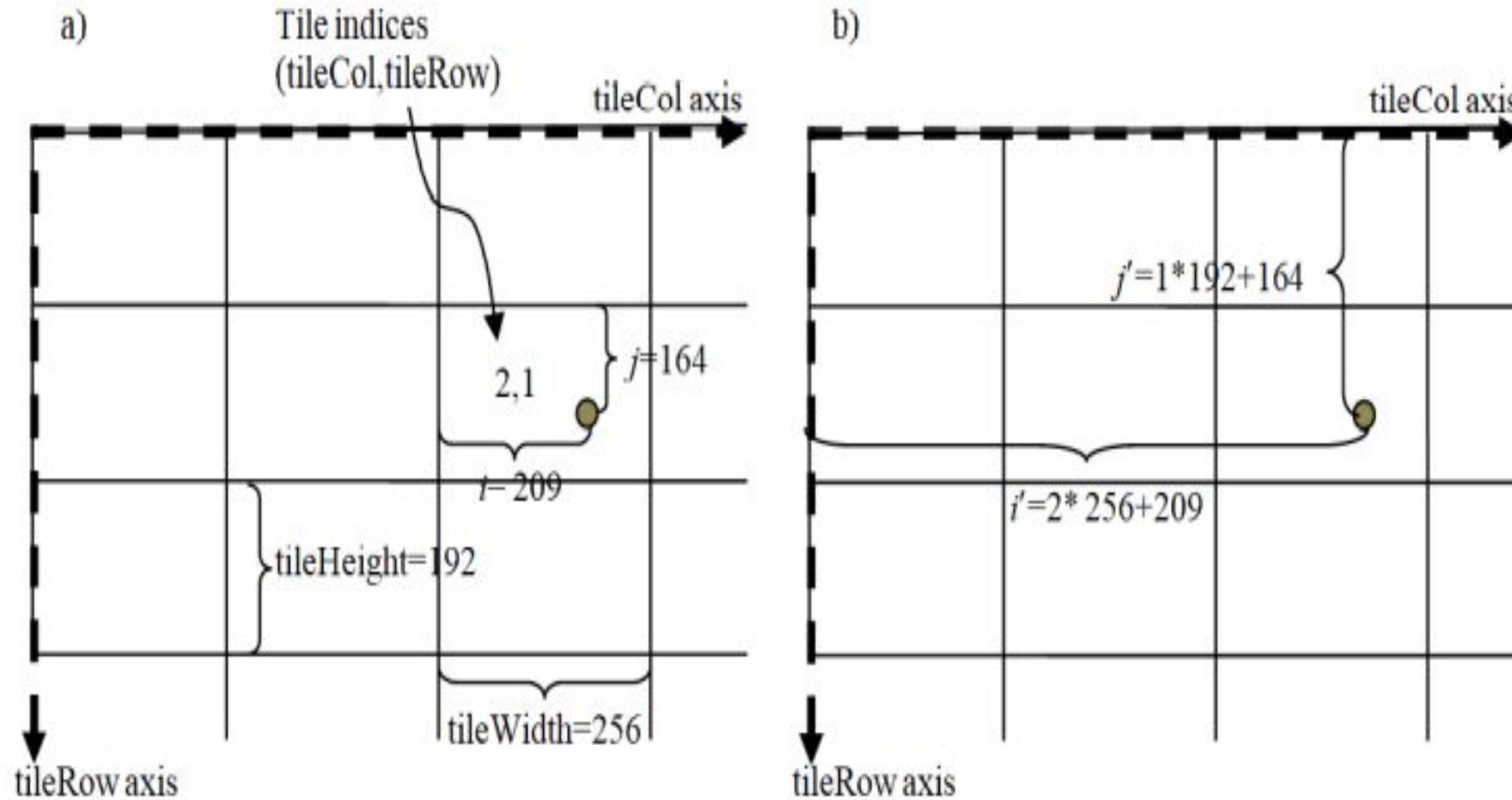


# Tile Matrix Set (2\*1 tiles)

---



# Tile and Tile Matrix Co-ordinates



tileMatrix identifier = "ZoomLevel3"

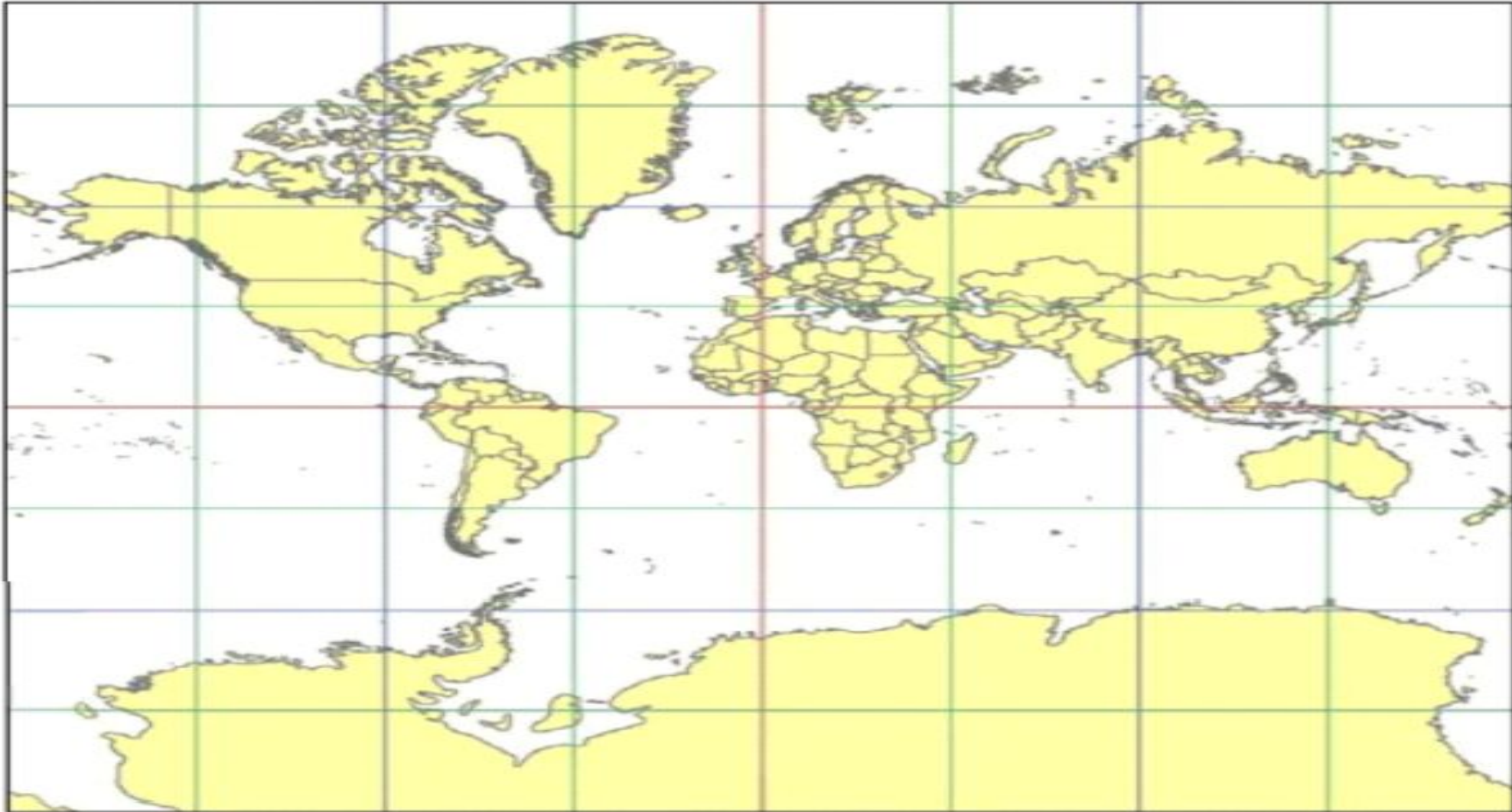
# Tile indexing scheme

- Scheme to **uniquely reference a tile in a tiling scheme by the use of a unique identifier** (or set of identifiers), and reversely, which unique identifier (or unique set of identifiers) corresponds to a space satisfying the geometric properties of a specific tile.

| URL TEMPLATE VARIABLE | MEANING                     | POSSIBLE VALUES                                                                                                                                     |
|-----------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| TileMatrix            | tile matrix identifier      | Identifier of the tile matrix (representing a zoom level, a.k.a. a scale) listed in the TileMatrixSet definition                                    |
| TileRow               | row index of tile matrix    | A non-negative integer between 0 and the MatrixHeight – 1. If there is a TileMatrixSetLimits the value is limited between MinTileRow and MaxTileRow |
| TileCol               | column index of tile matrix | A non-negative integer between 0 and the MatrixWidth – 1. If there is a TileMatrixSetLimits the value is limited between MinTileCol and MaxTileCol  |

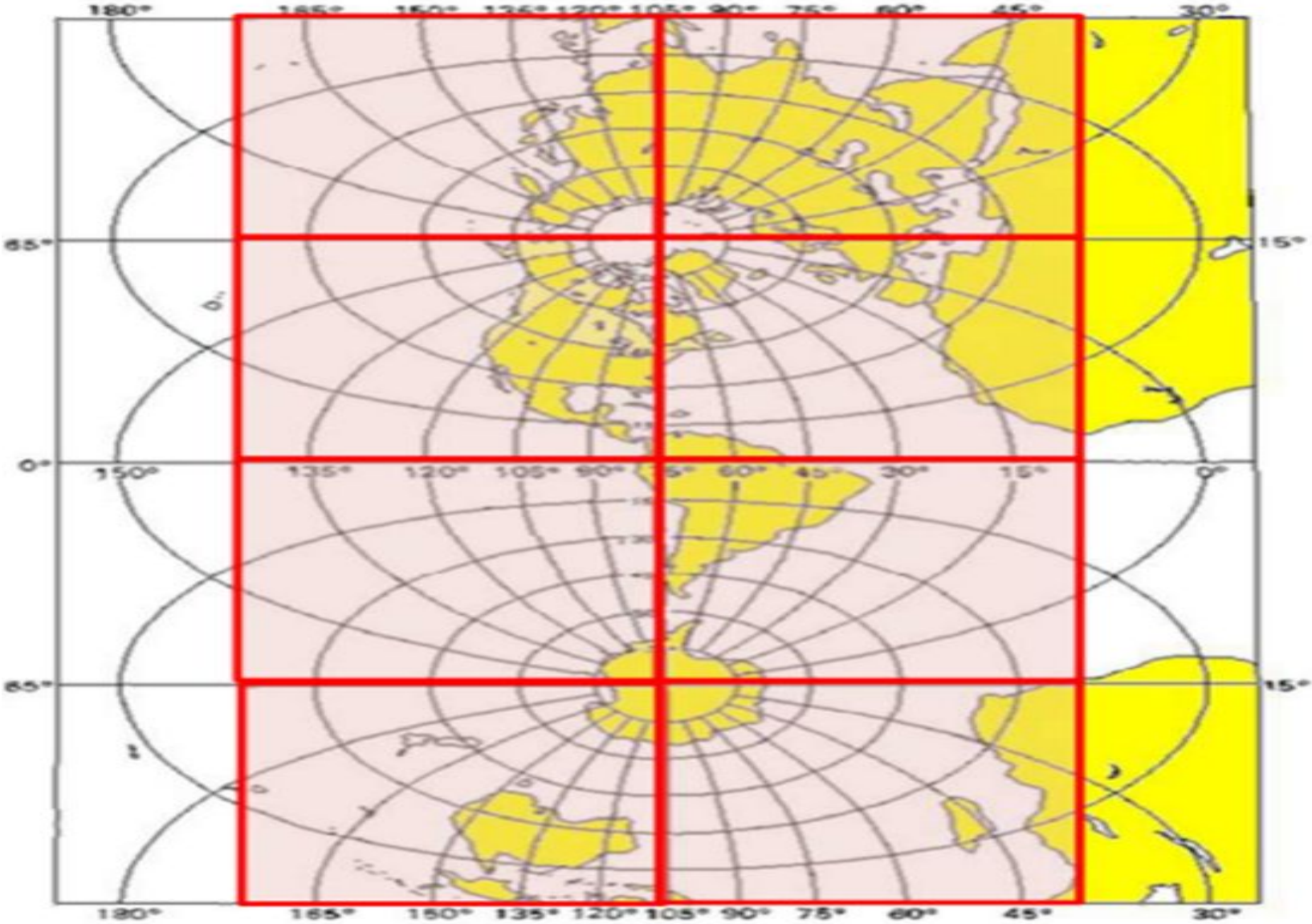
# Tile (2\*2) and (8\*8) tiles

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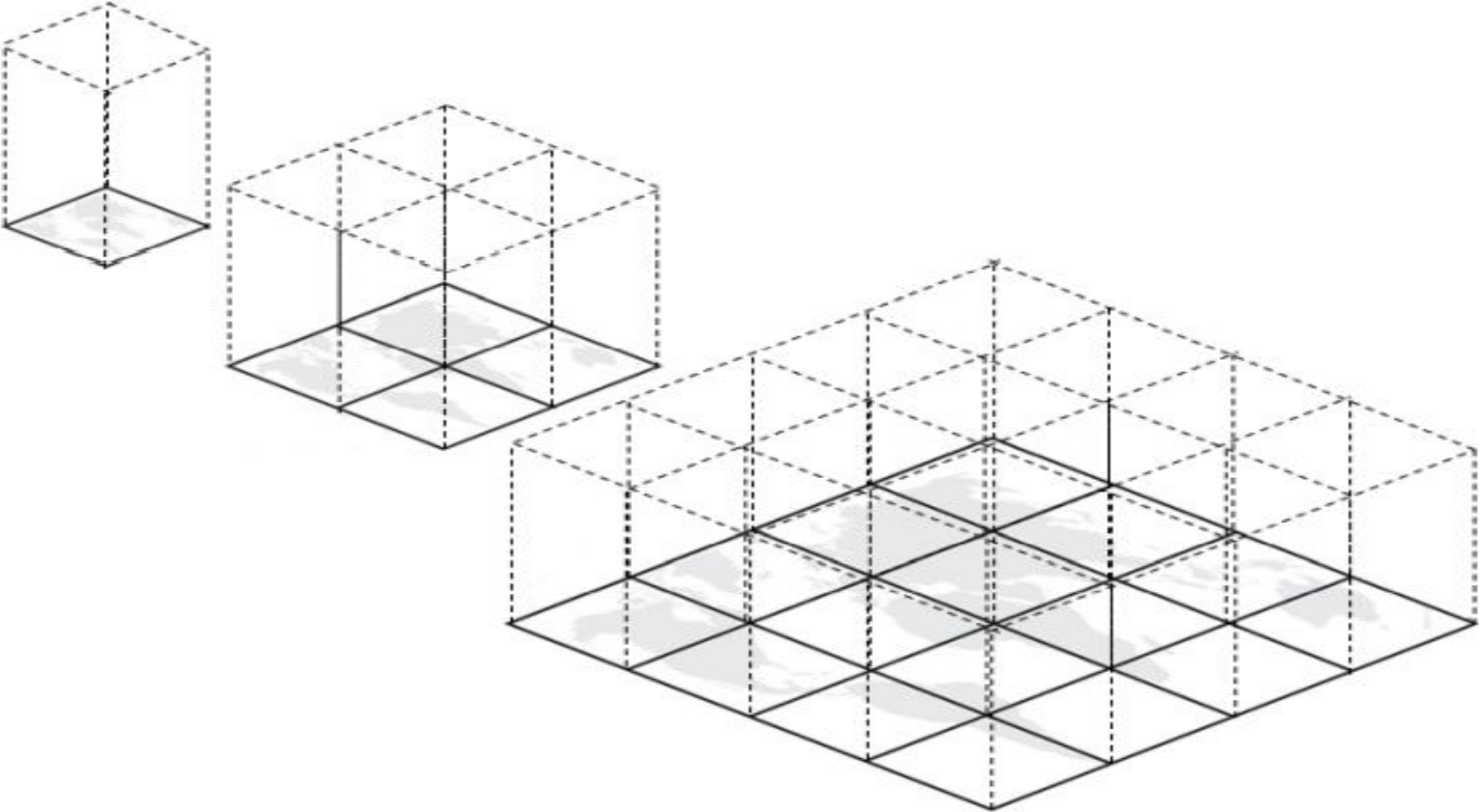


# Tile (2\*4) tiles



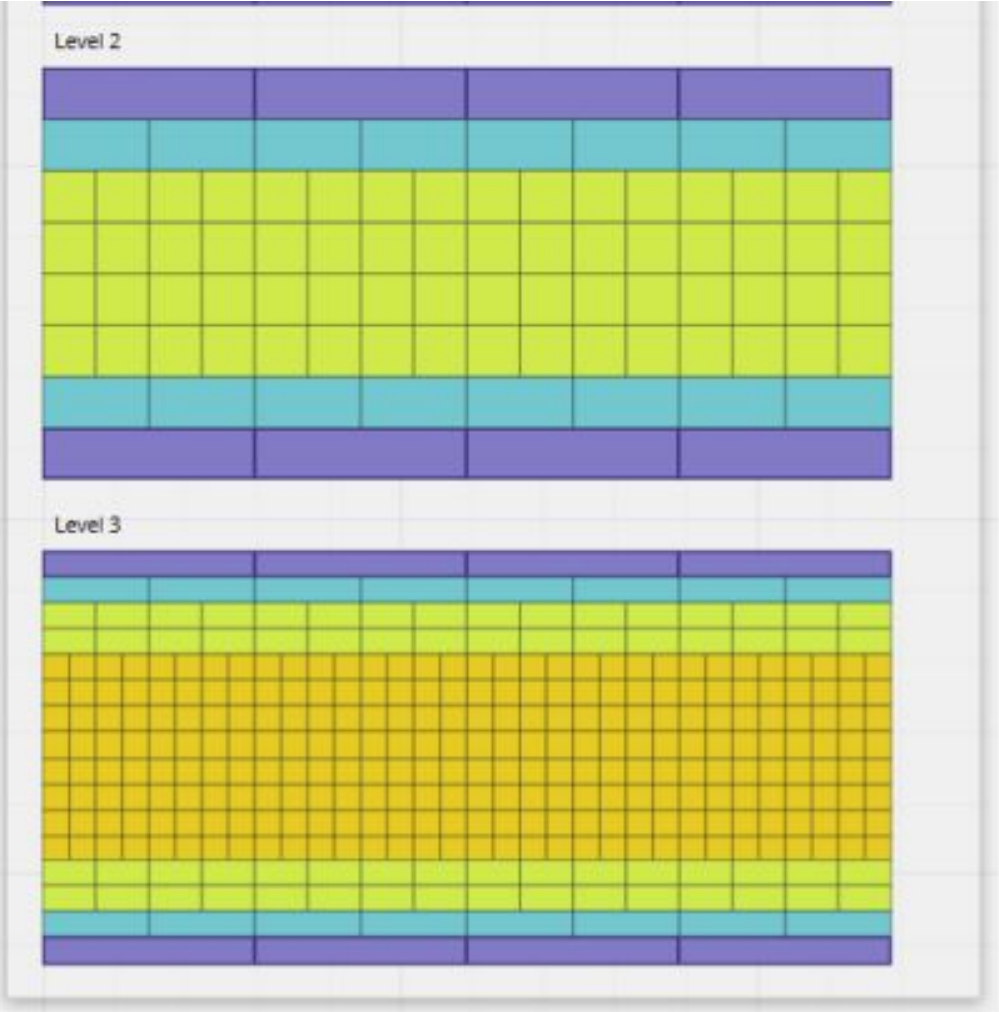
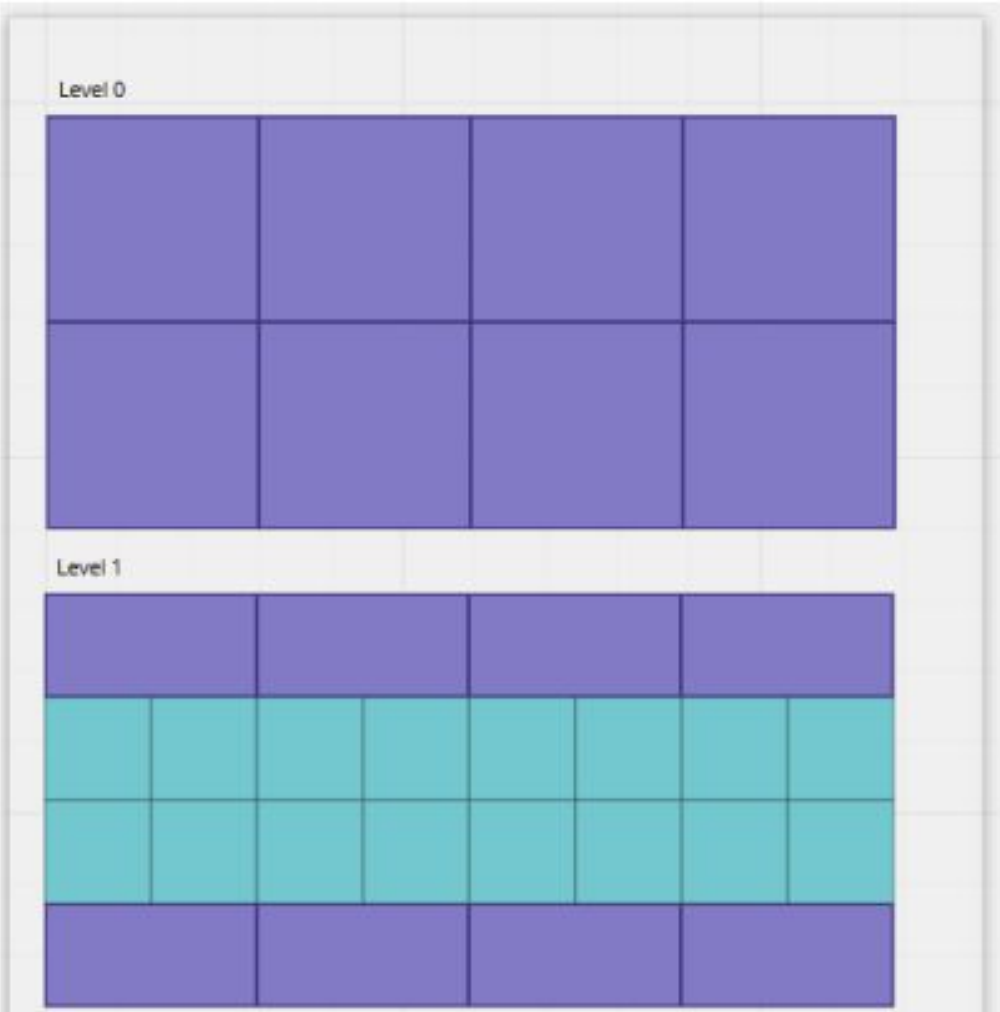
# Tile Matrix Set Vertical Extension

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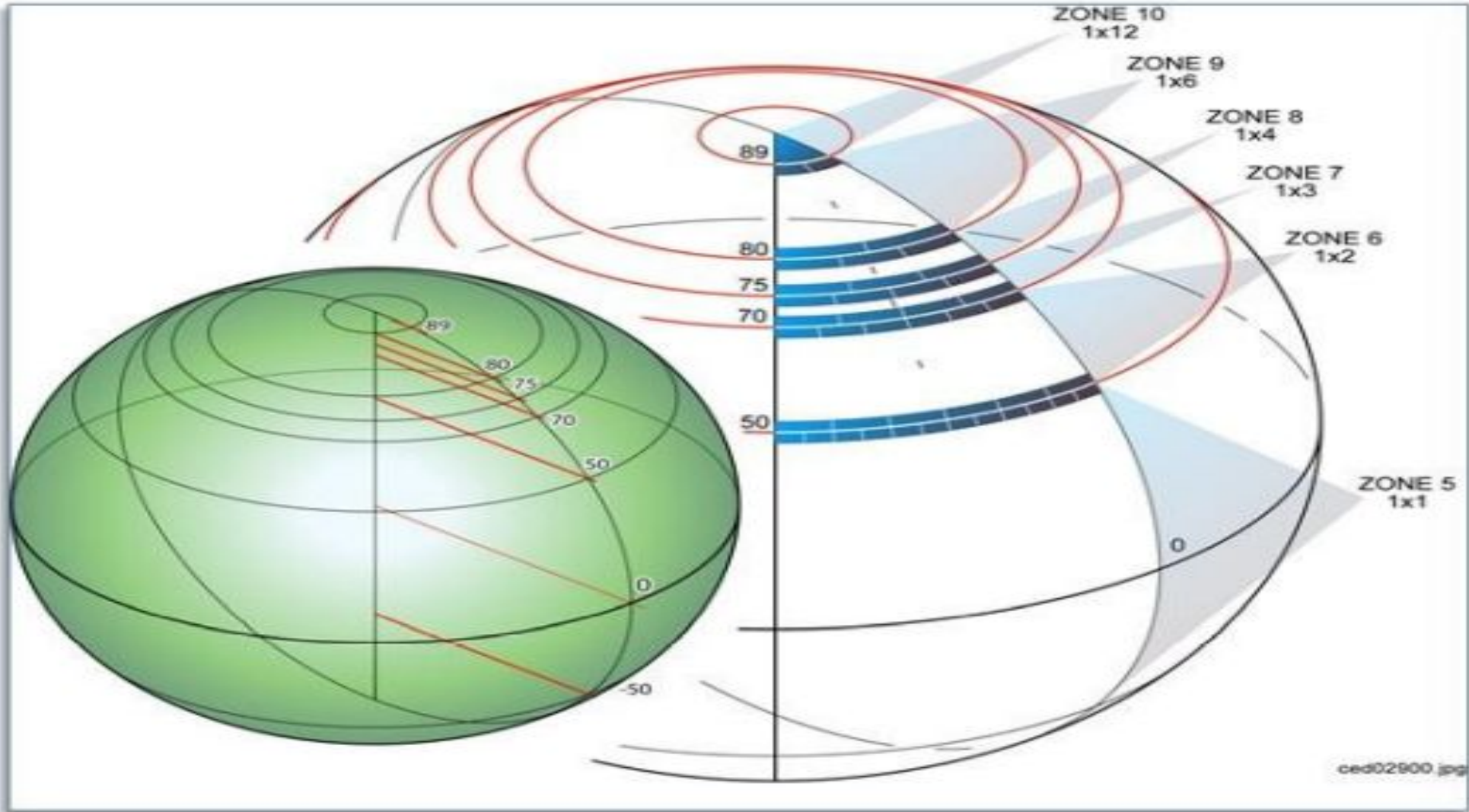


# Global Grid

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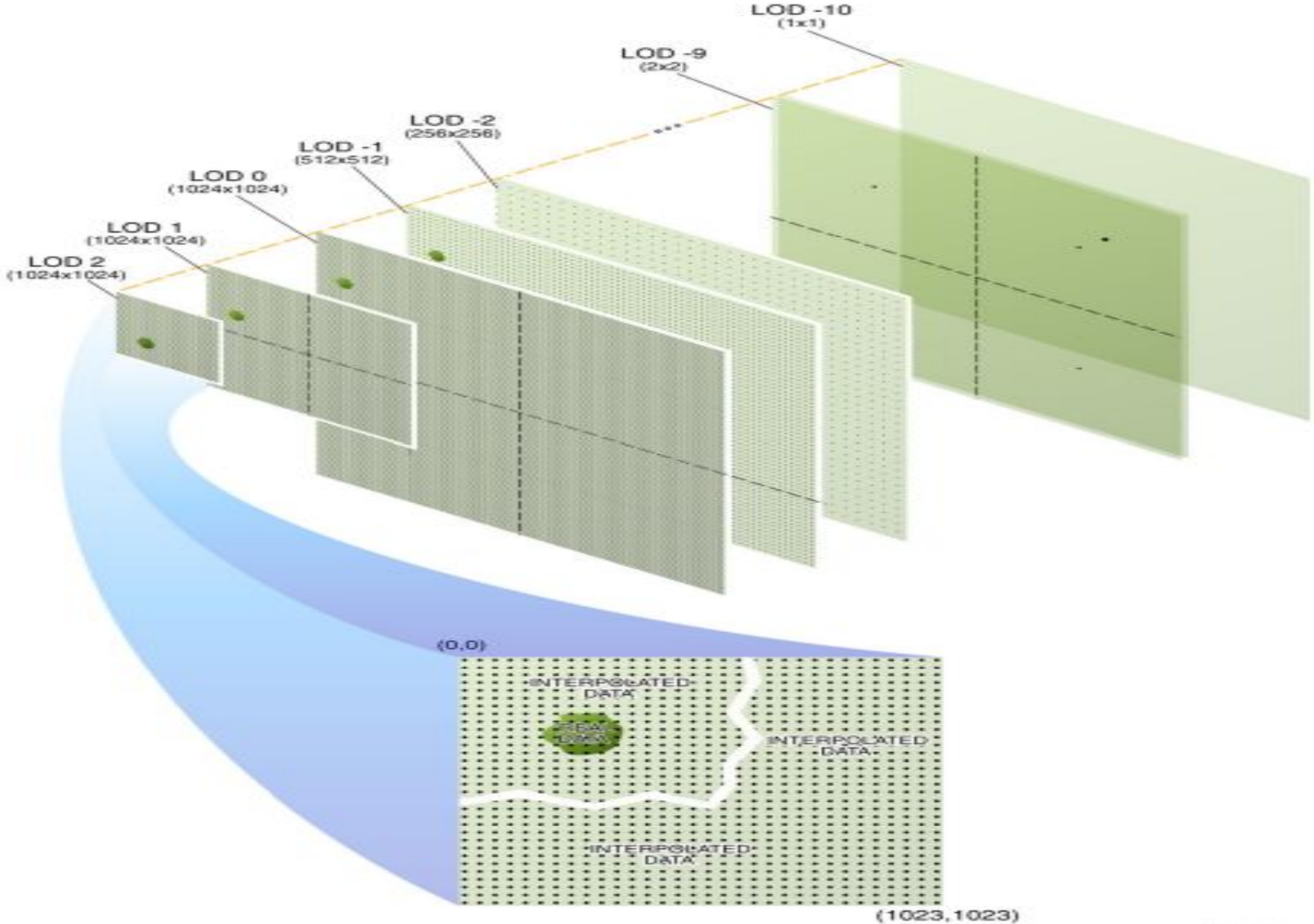


# OGC Zones





# OGC Level of Details



# Tile Set

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- A tileset consists of **a set of tiles obtained by partitioning geospatial data according to a particular TileMatrixSet.**
- A set of tiles resulting from tiling data according to **a particular tiling scheme.**

## REQUIREMENT 8

IDENTIFIER /req/tileset/description

A

The tileset endpoint SHALL support negotiation of an application/json response. In this case, a successful response of an HTTP GET for a specific tileset SHALL be encoded following the data model and JSON schema for tileset metadata, as defined by the OGC Two Dimensional Tile Matrix Set and Tile Set Metadata Standard 2.0.

# Requirement Class “Tilesets List”

- A **tilesets list** resource links to a list of sets of tiles, each one **belonging to a particular TileMatrixSet**.

## REQUIREMENT 9

IDENTIFIER `/req/tilesets-list/tileset-path`

A The API SHALL support a GET operation on a `.../tiles` path returning a list of available tilesets

## RECOMMENDATION 9

IDENTIFIER `/rec/tilesets-list/tileset_title`

A The tilesets array metadata (as defined by the 2D Tile Matrix Set and Tile Set Metadata standard) subset SHOULD include a short human readable title.

## PERMISSION 4

IDENTIFIER `/per/tilesets-list/tilesets-api`

A An API document can advertise a single resource path (expressed as a URI template) to get multiple tilesets.

# Requirement Class “Dataset Tilesets”

- The Dataset Tilesets Requirements Class **defines a mechanism to retrieve a list of tilesets for a dataset** (a.k.a., a root resource) which may contain **multiple geospatial data resources**

## REQUIREMENT 11

IDENTIFII /req/dataset-tilesets/landingpage

## REQUIREMENT 12

IDENTIFII /req/dataset-tilesets/operation

- A The dataset resource (the root resource) SHALL have at least one tileset accessible at .../tiles supporting an HTTP GET operation.

## RECOMMENDATION 11

IDENTIFIE /rec/dataset-tilesets/geodata-selection

- A When it is possible and sensible, all geospatial data resources (/collections) SHOULD be represented in the tiles.

# Requirement Class “Geodata Tilesets”

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- The GeoData Tilesets Requirements Class **assumes that data is organized into one or more geospatial data resources**
- The GeoData Tilesets Class defines **how to specify link(s) to one or more list(s) of tilesets** containing a representation of this geospatial data resource (path).

# Requirement Class “Geodata Tilesets”

## RECOMMENDATION 12

IDENTIFIER /rec/geodata-tilesets/api-common

- A An implementation of this Standard SHOULD consider implementing the requirements specified in the <http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core> (OGC API – Common – Part 1 version 1.0).

## REQUIREMENT 13

IDENTIFIER /req/geodata-tilesets/desc-links

## REQUIREMENT 14

IDENTIFIER /req/geodata-tilesets/operation

- A The geospatial data resource SHALL have an associated list of at least one tileset accessible at .../tiles supporting an HTTP GET operation.
- B The URI SHALL be composed of two parts: The initial part is the URI of the geospatial data resource that can be represented as tiles and the final part follows the pattern /tiles.



# Requirement Class “Collections Selection”

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- In a server providing access through a Web API to a complex dataset formed by **several geospatial data resources**, **selecting specific sub-resources of interest** when requesting data from this dataset can be useful.
- This requirements class defines **how to include a query parameter when requesting a resource** (e.g., dataset tiles) to specify which geospatial data resources (collections) should be used to generate the response

# Requirement Class “Collections Selection”

## REQUIREMENT 15

IDENTIFIER /req/collections-selection/query-collections

An operation that acts on a resource consisting of multiple geospatial data sub-resources (e.g., a resource derived from a root dataset) SHALL support an optional parameter `collections` with the following characteristics (shown as OpenAPI Specification 3.0 fragment)

A

```
name: collections
in: query
required: false
style: form
explode: false
schema:
 type: array
 items:
 type: string
```

## REQUIREMENT 16

IDENTIFIER /req/collections-selection/collections-response

A

Only the collections of geospatial data enumerated in the values of the `collections` parameter SHALL be used to generate the responses for the resources (tiles and tilesets) to which they apply.



# Requirement Class “Tile Encoding”

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- The OGC API — Tiles Standard is designed to **support tiling data that can potentially be encoded and provided in many of the existing geospatial formats** or new ones that could be invented in the future.
- This clause specifies six pre-defined **requirements classes for encodings** to be used by the tiles of the OGC API implementation:
  - PNG
  - JPEG
  - TIFF
  - NetCDF
  - GeoJSON
  - Mapbox Vector Tiles (MVT)

# Requirement Class “Tile Encoding”

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## REQUIREMENTS CLASS 10: REQUIREMENTS CLASS PNG

IDENTIFIER <http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/png>

## REQUIREMENTS CLASS 11: REQUIREMENTS CLASS JPEG

IDENTIFIER <http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/jpeg>

## REQUIREMENTS CLASS 12: REQUIREMENTS CLASS TIFF

IDENTIFIER <http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/tiff>

## RECOMMENDATION 15

IDENTIFIER [/rec/tiff/geotiff](#)

## REQUIREMENTS CLASS 14: REQUIREMENTS CLASS GEOJSON

IDENTIFIER <http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/geojson>

## REQUIREMENTS CLASS 15: REQUIREMENTS CLASS MVT

IDENTIFIER <http://www.opengis.net/spec/ogcapi-tiles-1/1.0/req/mvt>

# Tiling scheme

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- Scheme that defines **how space is partitioned into individual tiles**, potentially featuring multiple levels of detail (each tiling at a different granularity to reflect a different resolution or scale).
- A tiling scheme **defines the spatial reference system and the geometric properties of each tile** defined by the scheme.
- Those properties **include which space each tile occupies** (the tile's spatial extent), as well as a **tile coordinate origin** if a particular corner of origin convention is established

# Relationship to other OGC API standards

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The OGC API — Tiles Standard can be referenced by other OGC Standards that provide resources that can be offered as tiles.

For example:

- **The OGC API — Maps** candidate standard specifies the link relation types to **access map tilesets** from a dataset or collection.
- **The OGC API — Styles** candidate standard defines paths to list available styles from which tilesets can also be accessed.
- **The OGC API — Coverages** candidate standard specifies the link relation types and specifics of retrieving coverage tiles.
- **The OGC API — Processes** — Workflows and Chaining candidate standard provides a mechanism to trigger localized processing workflows as a result of retrieving tiles (for a specific area and resolution of interest).

# Overview of resources and common direct links

| RESOURCE NAME                                                                  | COMMON PATH                                                                    |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Landing page <sup>4</sup>                                                      | {datasetRoot}/                                                                 |
| Conformance declaration <sup>4</sup>                                           | {datasetRoot}/conformance                                                      |
| Tiling Schemes <sup>6</sup>                                                    | {datasetRoot}/tileMatrixSets                                                   |
| Tiling Scheme <sup>6</sup> (tile matrix set <sup>2</sup> )                     | {datasetRoot}/tileMatrixSets/{tileMatrixSetId}                                 |
| <b>Dataset Tiles</b>                                                           |                                                                                |
| <i>Dataset Feature Tiles<sup>3</sup></i>                                       |                                                                                |
| Dataset tileset list <sup>1,2</sup>                                            | {datasetRoot}/tiles                                                            |
| Dataset tileset metadata <sup>1,2</sup> (in one tile matrix set <sup>2</sup> ) | {datasetRoot}/tiles/{tileMatrixSetId}                                          |
| Dataset feature tile <sup>1,3</sup>                                            | {datasetRoot}/tiles/{tileMatrixSetId}/{tileMatrix}/<br>{tileRow}/{tileCol}     |
| <b>Dataset Map tiles</b>                                                       |                                                                                |
| Map tileset list <sup>2</sup> (geospatial resources <sup>1</sup> )             | {datasetRoot}/map/tiles                                                        |
| Map tileset metadata <sup>2</sup> (geospatial resources <sup>1</sup> )         | {datasetRoot}/map/tiles/{tileMatrixSetId}                                      |
| Map tile <sup>1</sup>                                                          | {datasetRoot}/map/tiles/{tileMatrixSetId}/{tileMatrix}/<br>{tileRow}/{tileCol} |
| <b>Geospatial data collections<sup>5</sup></b>                                 |                                                                                |
| Collections <sup>5</sup>                                                       | {datasetRoot}/collections                                                      |
| Collection <sup>5</sup>                                                        | {datasetRoot}/collections/{collectionId}                                       |

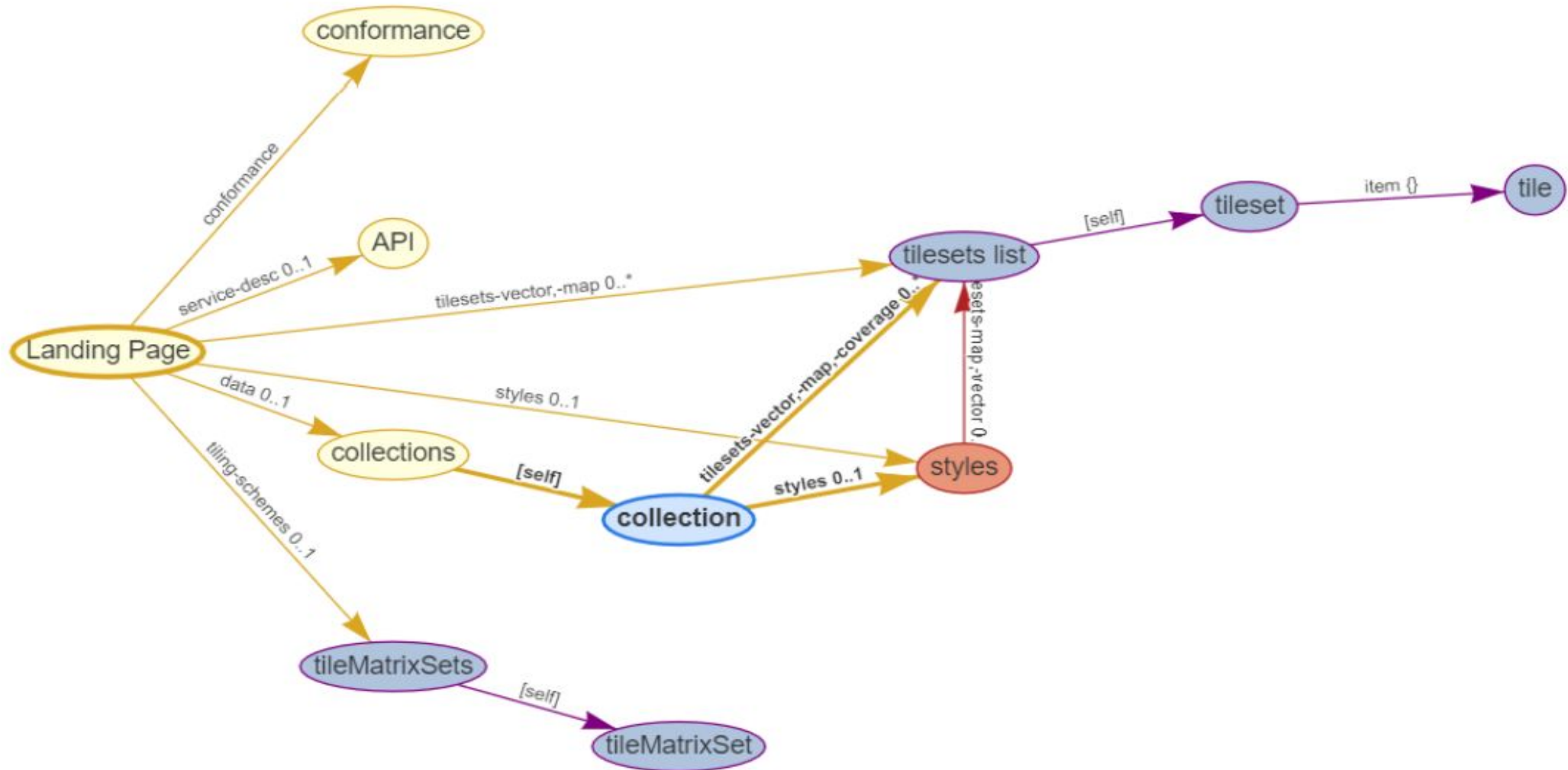
# Overview of resources and common direct links

| RESOURCE NAME                                | COMMON PATH                                                                                                                  |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <i>Collection Feature Tiles</i> <sup>3</sup> |                                                                                                                              |
| Feature tileset list <sup>2</sup>            | <code>{datasetRoot}/collections/{collectionId}/tiles</code>                                                                  |
| Feature tileset metadata <sup>2</sup>        | <code>{datasetRoot}/collections/{collectionId}/tiles/<br/>{tileMatrixSetId}</code>                                           |
| Feature tile <sup>3</sup>                    | <code>{datasetRoot}/collections/{collectionId}/tiles/<br/>{tileMatrixSetId}/{tileMatrix}/{tileRow}/{tileCol}</code>          |
| <i>Collection Map tiles</i>                  |                                                                                                                              |
| Map tileset list <sup>2</sup>                | <code>{datasetRoot}/collections/{collectionId}/map/tiles</code>                                                              |
| Map tileset metadata <sup>2</sup>            | <code>{datasetRoot}/collections/{collectionId}/map/tiles/<br/>{tileMatrixSetId}</code>                                       |
| Map tile                                     | <code>{datasetRoot}/collections/{collectionId}/map/tiles/<br/>{tileMatrixSetId}/{tileMatrix}/{tileRow}/{tileCol}</code>      |
| <i>Coverage tiles</i>                        |                                                                                                                              |
| Coverage tileset list <sup>2</sup>           | <code>{datasetRoot}/collections/{collectionId}/coverage/tiles</code>                                                         |
| Coverage tileset metadata <sup>2</sup>       | <code>{datasetRoot}/collections/{collectionId}/coverage/tiles/<br/>{tileMatrixSetId}</code>                                  |
| Coverage tile                                | <code>{datasetRoot}/collections/{collectionId}/coverage/tiles/<br/>{tileMatrixSetId}/{tileMatrix}/{tileRow}/{tileCol}</code> |



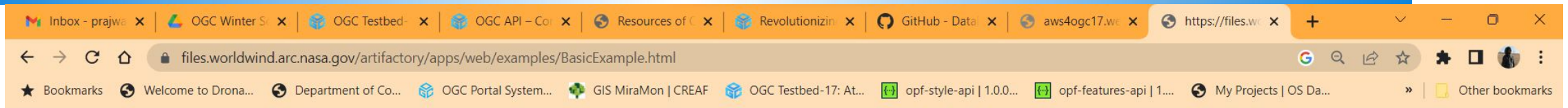
# How to approach an implementation of OGC API Standard

Resources and relations to them via links





# Hands-on: NASA-Web Worldwind



## Projection

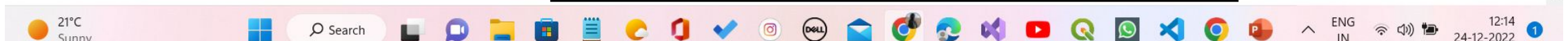
3D

## Layers

- Blue Marble
- Blue Marble & Landsat
- Bing Aerial
- Bing Aerial with Labels**
- Bing Roads
- Open Street Map
- Atmosphere
- Compass
- Coordinates
- View Controls

## Destination

GoTo



# WorldWind Geographic Text

## Projection

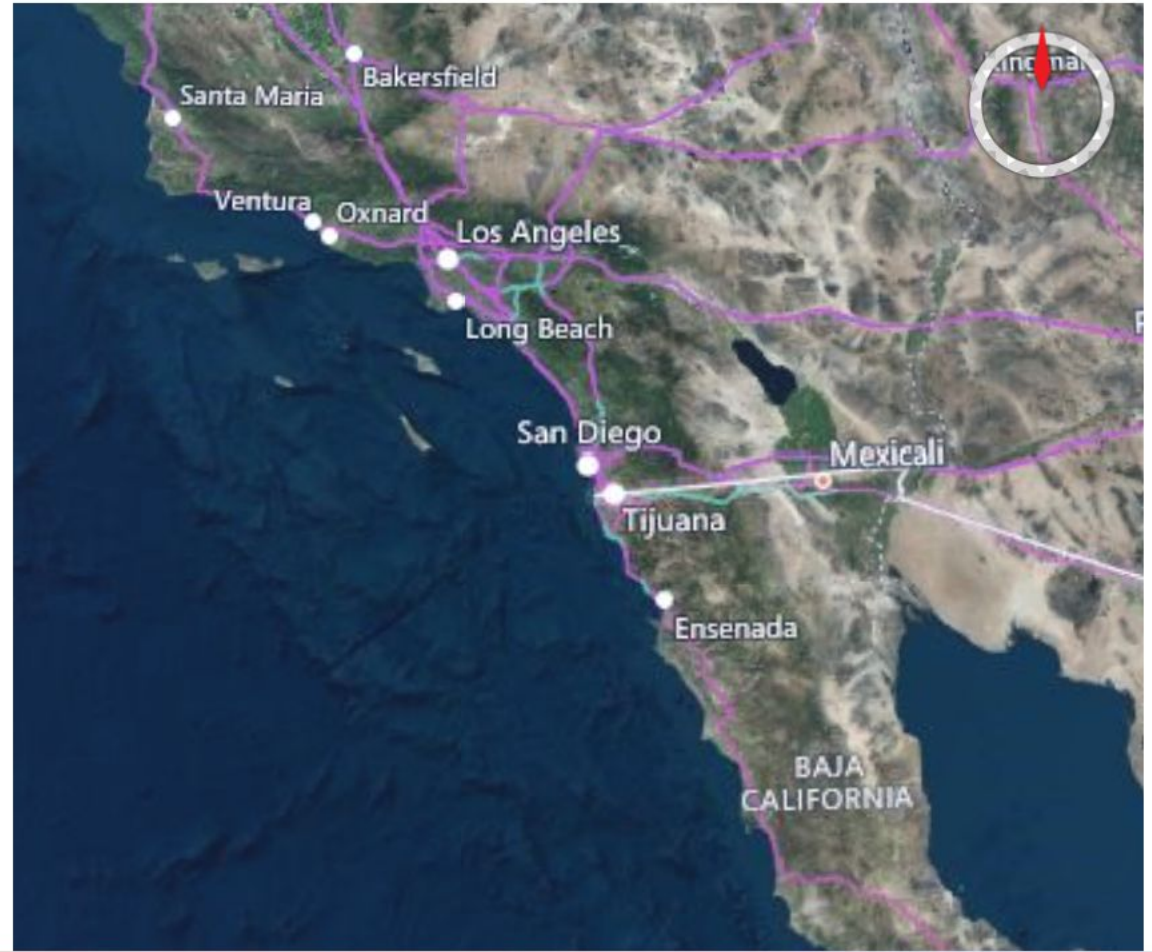
3D

## Layers

- Blue Marble
- Blue Marble & Landsat
- Bing Aerial with Labels
- Atmosphere
- Compass
- Coordinates
- View Controls
- Oregon Peaks

## Destination

GoTo





Projection

3D

Layers

- Blue Marble
- Bing Aerial with Labels
- Atmosphere
- Compass
- Coordinates
- View Controls
- Countries
- Cities
- Fort Story

Destination

GoTo



Projection

3D

Layers

Blue Marble

Blue Marble & Landsat

Bing Aerial

Bing Aerial with Labels

Bing Roads

Atmosphere

Compass

Coordinates

View Controls

Destination

GoTo





Projection

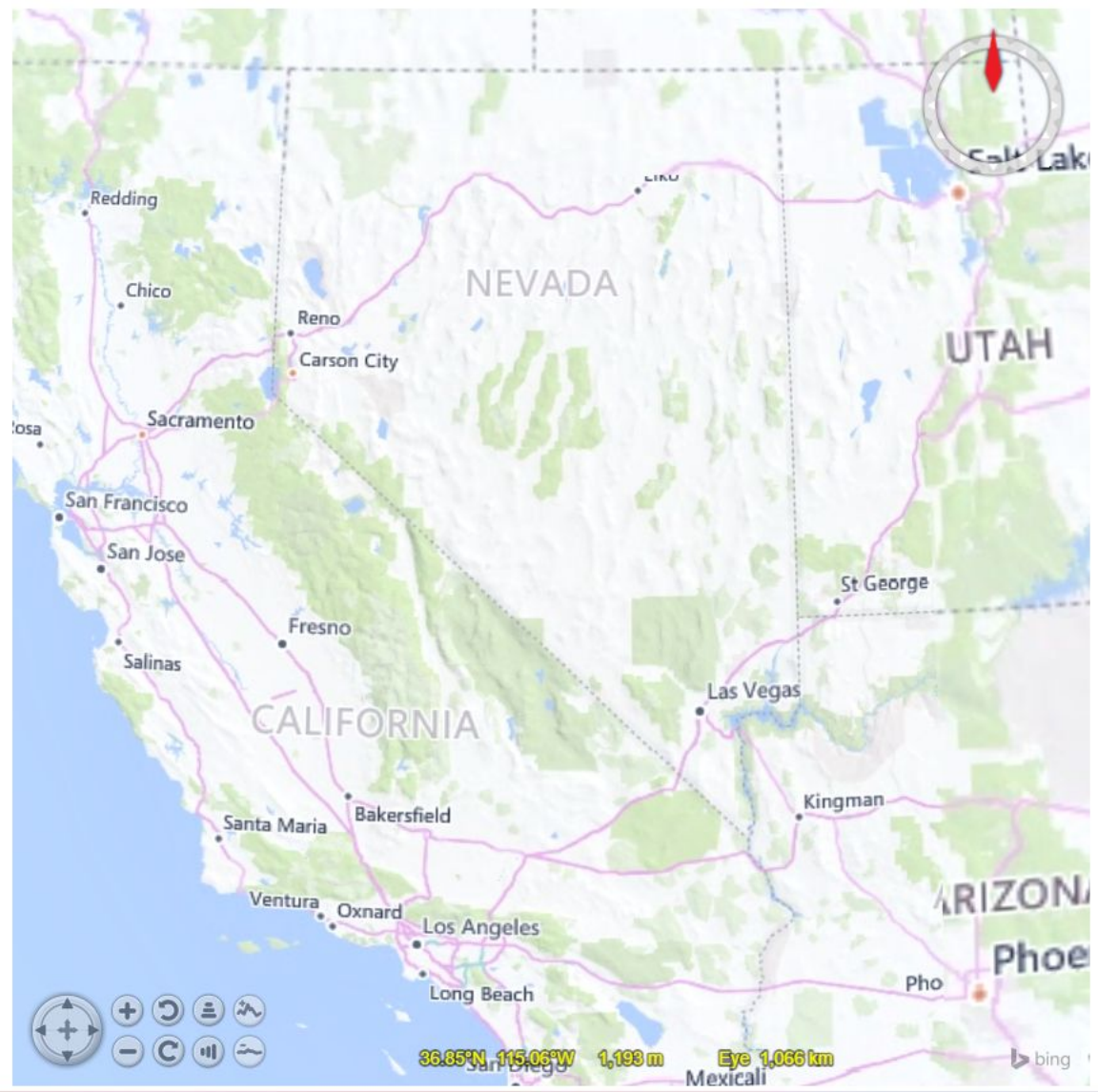
3D

Layers

- Blue Marble
- Blue Marble & Landsat
- Bing Aerial
- Bing Aerial with Labels**
- Bing Roads
- Atmosphere
- Compass
- Coordinates
- View Controls

Destination

GoTo



EXPLORER

- NASA
  - images
  - node\_modules
  - index.html
  - NASA.js
  - package-lock.json
  - package.json

OUTLINE

TIMELINE

```

index.html > html > body
1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4 <meta charset="utf-8">
5 </head>
6 <body>
7 <canvas id="canvasOne" width="1024" height="768">
8 Your browser does not support HTML5 Canvas.
9 </canvas>
10 <script
11 src="https://files.worldwind.arc.nasa.gov/artifactory/web/0.9.0/worldwind.min.js"
12 type="text/javascript"></script>
13 <script src="NASA.js" type="text/javascript">
14 </script>
15 </body>
16 </html>

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

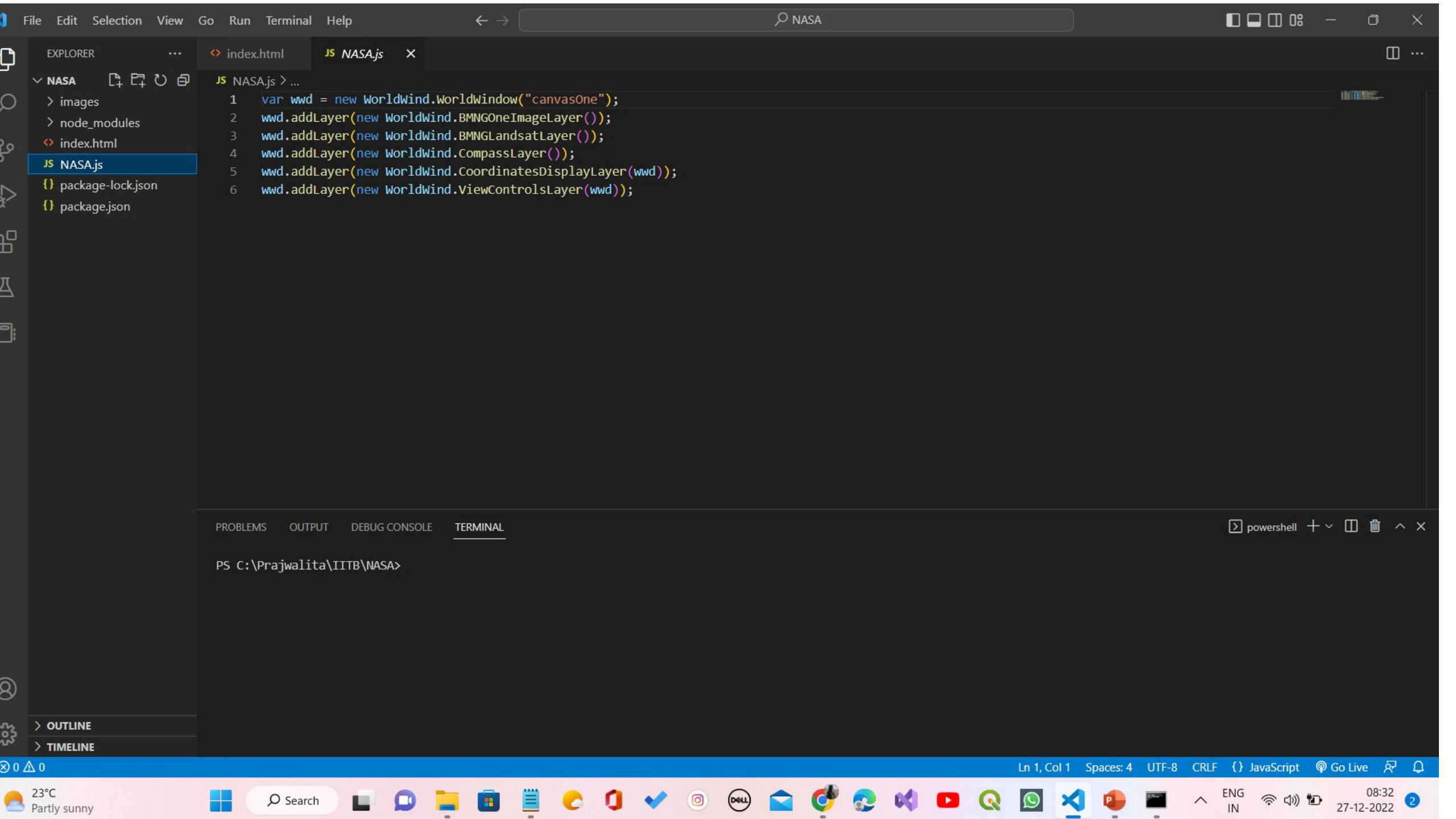
powershell

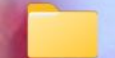
```

PS C:\Prajwalita\IITB\NASA>

```







OGC



n

```
Command Prompt - python -m http.server
Microsoft Windows [Version 10.0.22000.1335]
(c) Microsoft Corporation. All rights reserved.

C:\Users\prajw>cd..

C:\Users>cd..

C:\>cd prajwalita/iitb/nasa

C:\Prajwalita\IITB\NASA>python -m http.server
Serving HTTP on :: port 8000 (http://[::]:8000/) ...
::1 - - [27/Dec/2022 08:30:42] "GET / HTTP/1.1" 304 -
::1 - - [27/Dec/2022 08:30:42] "GET /NASA.js HTTP/1.1" 304 -
::1 - - [27/Dec/2022 08:30:42] code 404, message File not found
::1 - - [27/Dec/2022 08:30:42] "GET /favicon.ico HTTP/1.1" 404 -
```



Recycle Bin



Eye 17,739 km

# THANK YOU!

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#OGCAPI