

Requisito BDN.01 – Modelagem de Dados – DSM – Profa. Lucineide

Banco de Dados: HypoOrbit

1. Criação do Banco de Dados

Scripts disponíveis em:

https://github.com/HypogramTechnologies/HypoOrbit/blob/develop/docs/banco_dados/hypoorbit_scripts.js

```
>_MONGOSH  
  
> use hypoorbit;  
< already on db hypoorbit  
> db.createCollection("satellite");  
< { ok: 1 }  
> db.createCollection("satellite_item_assets");  
< { ok: 1 }  
hypoorbit>
```

```

>_MONGOSH

    "type": "image/tiff; application=geotiff; profile=cloud-optimized",
    "roles": [
      "data"
    ],
    "title": "Land Cover Classification Image",
    satellite: db.satellite.findOne({ id: "LCC_L8_30_16D_STK_Cerrado-1" })._id
  },
  {
    "key": "thumbnail",
    "type": "image/png",
    "bands": {
      "red": "lcc",
      "blue": "lcc",
      "green": "lcc"
    },
    "roles": [
      "thumbnail"
    ],
    "title": "Thumbnail",
    satellite: db.satellite.findOne({ id: "LCC_L8_30_16D_STK_Cerrado-1" })._id
  }
]);
< {
  acknowledged: true,
  insertedIds: {
    '0': ObjectId('68d72cb32c75f0ebbfd8efbd'),
    '1': ObjectId('68d72cb32c75f0ebbfd8efbe'),
    '2': ObjectId('68d72cb32c75f0ebbfd8efbf'),
    '3': ObjectId('68d72cb32c75f0ebbfd8efc0'),
    '4': ObjectId('68d72cb32c75f0ebbfd8efc1'),
    '5': ObjectId('68d72cb32c75f0ebbfd8efc2'),
    '6': ObjectId('68d72cb32c75f0ebbfd8efc3'),
    '7': ObjectId('68d72cb32c75f0ebbfd8efc4'),
    '8': ObjectId('68d72cb32c75f0ebbfd8efc5'),
    '9': ObjectId('68d72cb32c75f0ebbfd8efc6')
  }
}

```

2. Modelagem de Relacionamentos

Scripts disponíveis em:

https://github.com/HypogramTechnologies/HypoOrbit/blob/develop/docs/banco_dados/hypoorbit_scripts.js

>_MONGOSH

```
> db.satellite.findOne({ id: "mosaic-cbers4a-paraiba-3m-1" });
< {
  _id: ObjectId('68d72cb32c75f0ebbfd8efba'),
  id: 'mosaic-cbers4a-paraiba-3m-1',
  type: 'Collection',
  stac_version: '1.0.0',
  stac_extensions: [
    'https://stac-extensions.github.io/version/v1.0.0/schema.json',
    'https://stac-extensions.github.io/processing/v1.0.0/schema.json',
    'https://stac-extensions.github.io/item-assets/v1.0.0/schema.json',
    'https://stac-extensions.github.io/eo/v1.0.0/schema.json'
  ],
  title: 'CBERS-4A/WFI Image Mosaic of Brazil Paraiba State - 3 Months',
  version: '1',
  deprecated: false,
  description: 'CBERS-4A/WFI image mosaic of Brazil Paraiba State with 55m of spatial resolution...',
  keywords: [
    'mosaic',
    'cbers',
    'cbers-4a',
    'wfi',
    'visible wavelengths',
    'ultraviolet wavelengths',
    'paraiba state',
    'cloud optimized geotiff',
    'cog',
    'earth observation',
    'brazil'
  ],
  providers: [
    {
      url: 'https://data.inpe.br/big/',
      name: 'National Institute for Space Research (INPE)',
      roles: [
        'host',
        'processor',
        'producer'
      ]
    }
  ],
```

```

>_MONGOSH
> db.satellite.aggregate([
  {
    $lookup: {
      from: "satellite_item_assets",
      localField: "_id",
      foreignField: "satellite",
      as: "item_assets"
    }
  }
]);
< {
  _id: ObjectId('68d72cb32c75f0ebbfd8efba'),
  id: 'mosaic-cbers4a-paraiba-3m-1',
  type: 'Collection',
  stac_version: '1.0.0',
  stac_extensions: [
    'https://stac-extensions.github.io/version/v1.0.0/schema.json',
    'https://stac-extensions.github.io/processing/v1.0.0/schema.json',
    'https://stac-extensions.github.io/item-assets/v1.0.0/schema.json',
    'https://stac-extensions.github.io/eo/v1.0.0/schema.json'
  ],
  title: 'CBERS-4A/WFI Image Mosaic of Brazil Paraíba State - 3 Months',
  version: '1',
  deprecated: false,
  description: 'CBERS-4A/WFI image mosaic of Brazil Paraíba State with 55m of spatial resolution...',
  keywords: [
    'mosaic',
    'cbers',
    'cbers-4a',
    'wfi',
    'visible wavelengths',
    'ultraviolet wavelengths',
    'paraiba state',
    'cloud optimized geotiff',
    'cog',
    'earth observation',
    'brazil'
  ],

```

Na primeira modelagem/consulta usamos **Embedding**, pois as informações principais do satélite (como properties, providers, keywords, extent) são sempre acessadas junto com o satélite. Já na segunda usamos **Referencing**, pois cada satélite pode ter muitos assets (imagens, bandas, thumbnails) que podem ser grandes e detalhados, além disso isso nos permite atualizar ou adicionar assets independentemente do satélite, sem precisar reescrever todo o documento principal.

3. Scripts MongoDB

Scripts disponíveis em:

https://github.com/HypogramTechnologies/HypoOrbit/blob/develop/docs/banco_dados/hypoorbit_scripts.js

>_MONGOSH

```
> db.satellite.updateMany(
  { "properties.created": { $type: "string" } },
  [
    {
      $set: {
        "properties.created": {
          $dateFromString: { dateString: "$properties.created" }
        }
      }
    }
  ]
);
< {
  acknowledged: true,
  insertedId: null,
  matchedCount: 2,
  modifiedCount: 2,
  upsertedCount: 0
}
```

>_MONGOSH

```
> db.satellite.find(
  {},
  {
    title: 1,
    "providers.processing:parameters.spectralIndices": 1,
    _id: 0
  }
);
< {
  title: 'CBERS-4A/WFI Image Mosaic of Brazil Paraíba State - 3 Months',
  providers: [
    {}
  ]
}
{
  title: 'AMAZONIA-1/WFI - Level-4-SR - Cloud Optimized GeoTIFF',
  providers: [
    {}
  ]
}
{
  title: 'LCC - Cerrado - LC8 30m 16D STK',
  providers: [
    {
      'processing:parameters': {
        spectralIndices: [
          'NDVI',
          'EVI'
        ]
      }
    }
  ]
}
}
```

>_MONGOSH

```
> db.satellite.find({
  $and: [
    { "properties.created": { $gte: ISODate("2025-01-01T00:00:00Z") } },
    { "properties.created": { $lte: ISODate("2025-12-31T23:59:59Z") } }
  ]
}, {
  id: 1,
  title: 1,
  "properties.created": 1,
  "properties.updated": 1,
  _id: 0
});
< {
  id: 'LCC_L8_30_16D_STK_Cerrado-1',
  title: 'LCC - Cerrado - LC8 30m 16D STK',
  properties: {
    created: 2025-01-31T16:38:01.400Z,
    updated: '2025-01-31T16:38:01.400312Z'
  }
}
```

>_MONGOSH

```
> db.satellite.find({
  $and: [
    { "properties.created": { $gte: ISODate("2025-01-01T00:00:00Z") } },
    { "properties.created": { $lte: ISODate("2025-12-31T23:59:59Z") } }
  ]
}, {
  id: 1,
  title: 1,
  "properties.created": 1,
  "properties.updated": 1,
  _id: 0
});
< {
  id: 'LCC_L8_30_16D_STK_Cerrado-1',
  title: 'LCC - Cerrado - LC8 30m 16D STK',
  properties: {
    created: 2025-01-31T16:38:01.400Z,
    updated: '2025-01-31T16:38:01.400312Z'
  }
}
```

```

>_MONGOSH

> db.satellite.find(
  {
    $and: [
      {
        $or: [
          { id: "mosaic-cbers4a-paraiba-3m-1" },
          { id: "AMZ1-WFI-L4-SR-1" }
        ]
      },
      { "properties.updated": { $type: "date" } }
    ]
  },
  {
    id: 1,
    title: 1,
    "properties.created": 1,
    "properties.updated": 1,
    _id: 0
  }
);
< {
  id: 'mosaic-cbers4a-paraiba-3m-1',
  title: 'CBERS-4A/WFI Image Mosaic of Brazil Paraíba State - 3 Months',
  properties: {
    created: 2024-05-03T17:58:15.432Z,
    updated: 2024-05-03T17:58:15.432Z
  }
}

```

4. Comparação com SQL (PostgreSQL)

Scripts disponíveis em:

https://github.com/HypogramTechnologies/HypoOrbit/blob/develop/docs/banco_dado/s/hypoorbit_scripts.sql

Query		Query History	
1	SELECT	id, title, created, updated	
2	FROM	satellite	
3	WHERE	created >= '2025-01-01T00:00:00Z'	
4	AND	created <= '2025-12-31T23:59:59Z';	

Data Output		Messages		Notifications	
id	title	created	updated		
[PK] text	text	timestamp with time zone	timestamp with time zone		
1	LCC_L8_30_16D_STK_Cerrado-1	LCC - Cerrado - LC8 30m 16D STK	2025-01-31 13:38:01.400305-03	2025-01-31 13:38:01.400312-03	

Query		Query History		Scratch Pad	
1	SELECT	s.id, s.title, sia.key, sia.type, sia.roles, sia.title AS asset_title			
2	FROM	satellite s			
3	LEFT JOIN	satellite_item_assets sia ON sia.satellite_id = s.id;			

Data Output		Messages		Notifications	
id	title	key	type	roles	asset_title
text	text	text	text	text[]	text
1	LCC_L8_30_16D_STK_Cerrado-1	LCC - Cerrado - LC8 30m 16D STK	lcc	image/tiff, application-geotiff, profile=cloud-optimized	Land Cover Classification Image
2	LCC_L8_30_16D_STK_Cerrado-1	LCC - Cerrado - LC8 30m 16D STK	thumbnail	image/png	Thumbnail

- **Tabela `satellite`:** armazena os metadados principais (id, título, datas de criação/atualização, descrição etc.).
- **Tabela `satellite_provider`:** armazena os provedores de cada satélite, vinculados pela chave estrangeira `satellite_id`.
- **Tabela `satellite_processing_parameters`:** armazena os parâmetros técnicos (bands, índices espectrais, etc.) de cada provider.
- **Tabela `satellite_item_assets`:** armazena os assets vinculados ao satélite.