Rijkswaterstaat
Ministerie van Infrastructuur en Waterstaat

Proof of Concept
INSPIRE
Good Practice
Coverages

Special Preview Edition

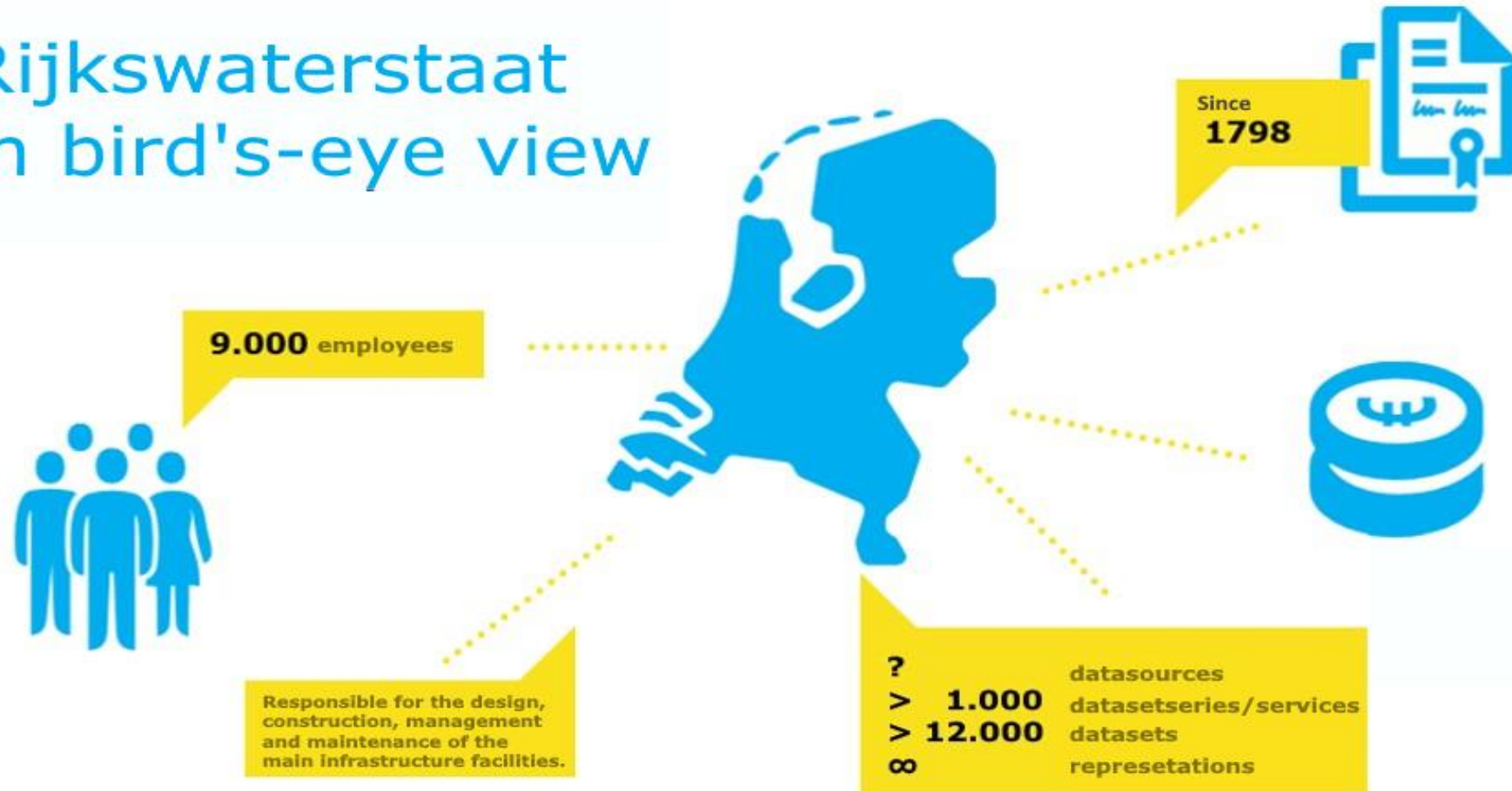November 2021

Agenda

- RWS Proof-of-Concept on INSPIRE Coverages
- Coverages in INSPIRE
- Providing Coverages
- Using Coverages

Data (use) driven

Advantage: All connected suppliers and users are available in the same process, quality and form (format) so that combining the data from different data sources is easy to perform (uniform service).

*FAIR Data: findable, accessible, interoperable, reusable*

RWS Proof-of-Concept on INSPIRE Coverages

- In the Netherlands Rijkswaterstaat has been designated to make the soil height of the Netherlands available as grids for European targets.

- In 2021 RWS has carried out a Proof of Concept of the INSPIRE Good Practice coverages (PoC) in order to gain insight into the organizational and technical barriers and to solve them where possible
  - Share the experiences
  - Collect questions and answers
  - Discuss how to use the results
  - Define actions

- The information is actively managed and offered via https://github.com/codefornl/INSPIRE-coverages
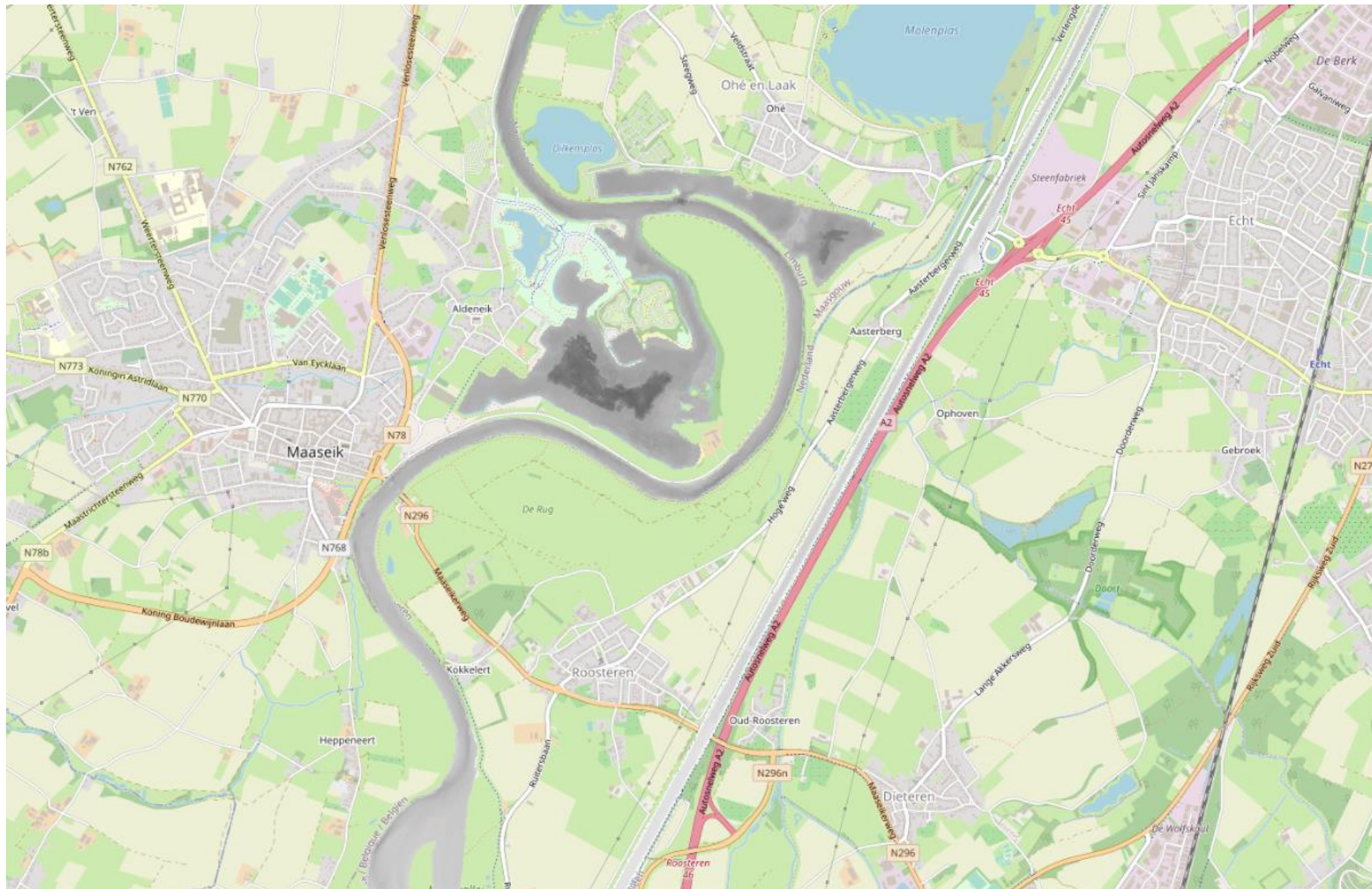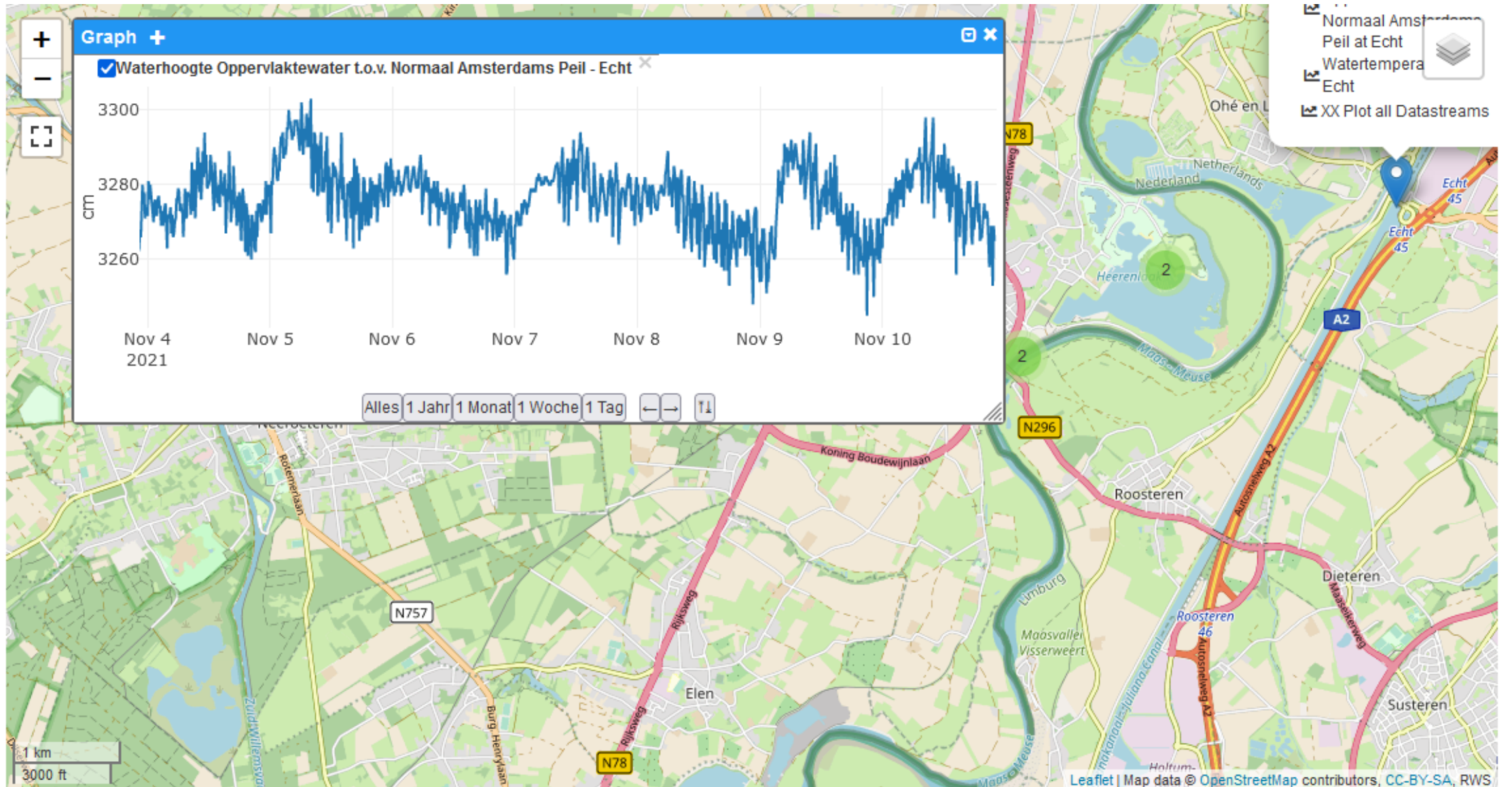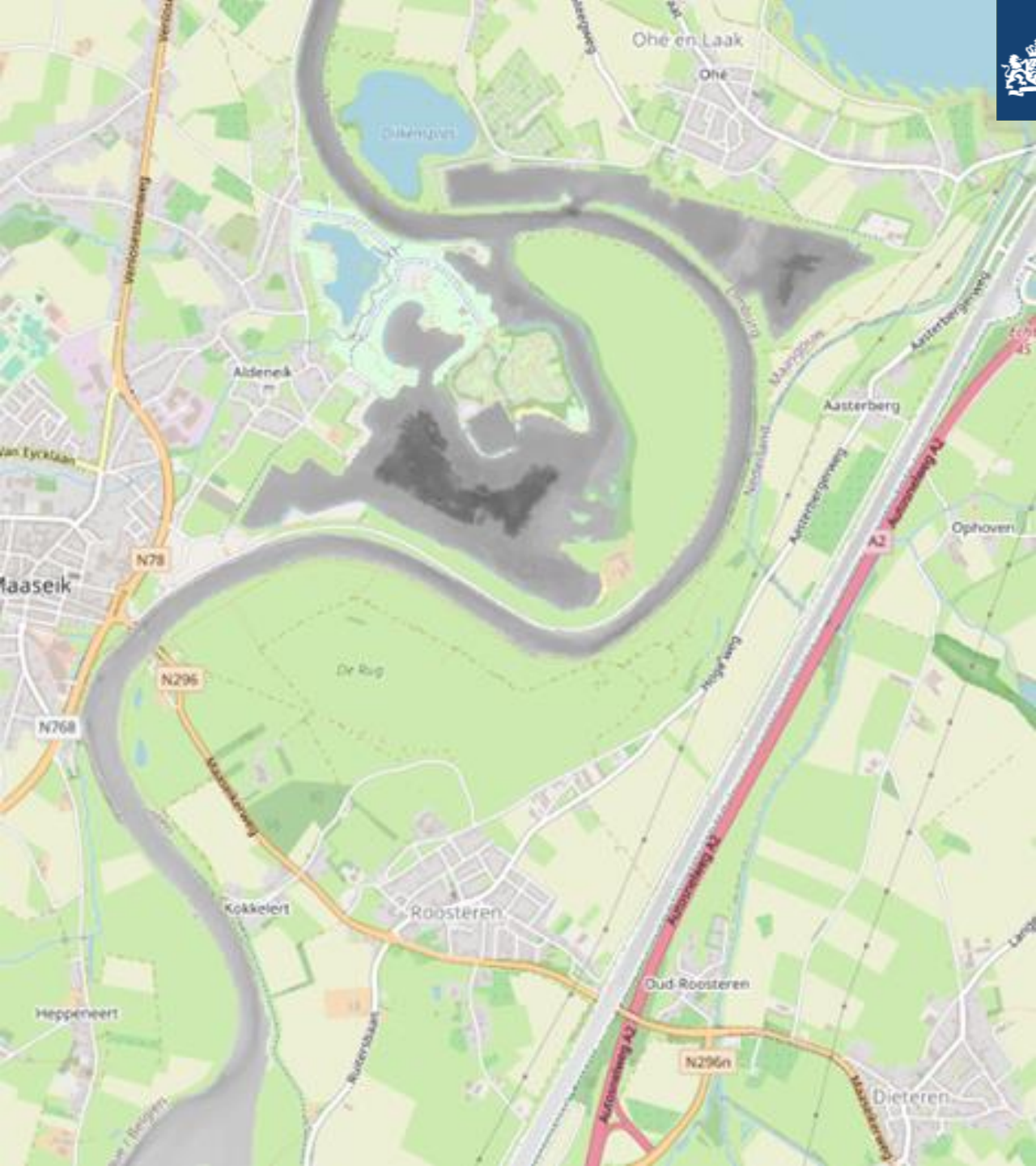
Coverages in INSPIRE

- Themes

- Grids

- Services

- Issues

- WCS Guidelines

- Good Practice

Coverages in INSPIRE

INSPIRE Themes with Coverage Models:

Elevation (EL)

Geology (GE)

Land cover (LC)

Land use (LU)

Natural risk zones (NZ)

Orthoimagery (OI)

Soil (SO)

Energy resources (ER)

Species distribution (SD) – App. schema deprecated

Coverages in INSPIRE

Don't forget Annex I **Geographical Grid Systems**, specifies:

- **Equal Area Grid**:
  - based on the ETRS89 Lambert Azimuthal Equal Area (**ETRS89-LAEA**)
  - centre of the projection at the point 52o N, 10o E
    - false easting: x0 = 4321000 m
    - false northing: y0 = 3210000 m
  - hierarchical, with resolutions of 1m, 10m, 100m, 1000m, 10000m and 100000m

Coverages in INSPIRE

Providing Coverages:

- Too "Heavy" for WFS (100s MB)

- Web Coverage Service (WCS) allows for subsetting

- Web Coverage Processing Service (WCPS) adds server side processing

- Guidance:

  - [Technical Guidance for the implementation of INSPIRE Download Services using Web Coverage Services (WCS)](#)
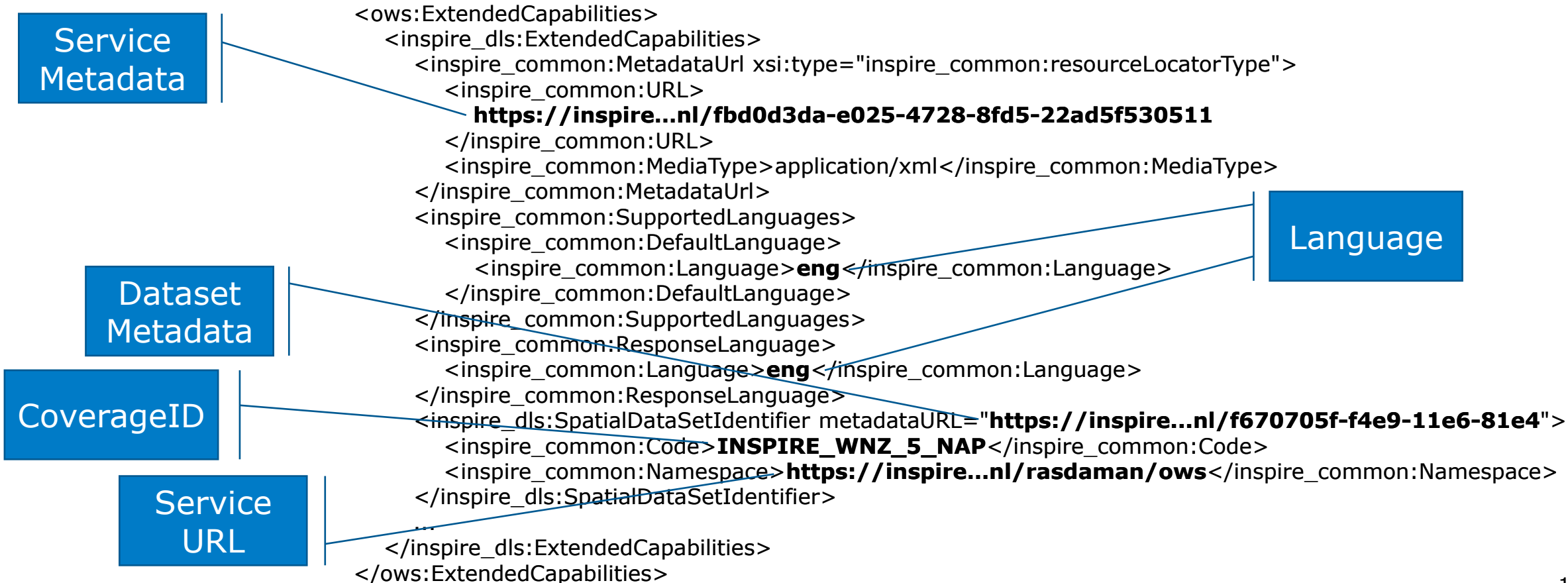
Coverages in INSPIRE

Issues:

- INSPIRE Download Service requires additional information in the service capabilities response

   → GeoSolutions (GeoServer) and Rasdaman are implementing the required extensions based on WCS Guidance

- INSPIRE Coverage based data models not suited to provision via WCS

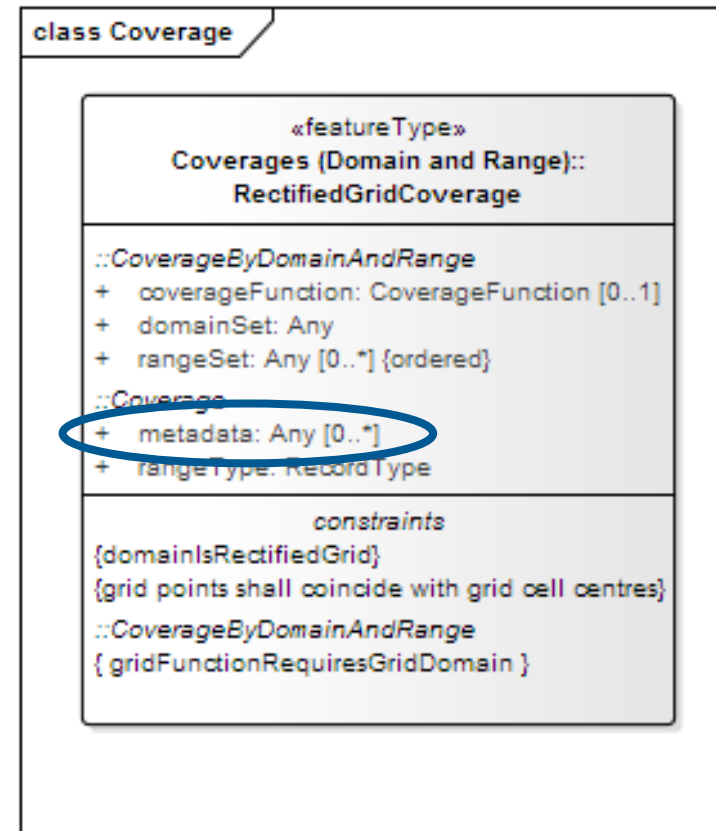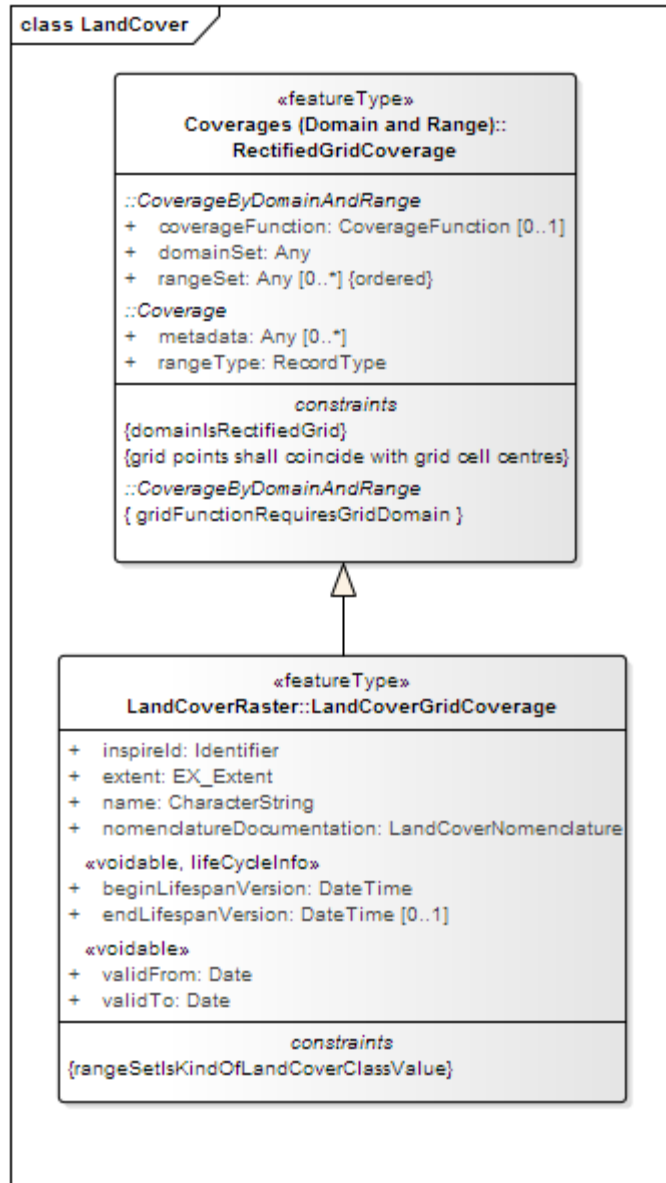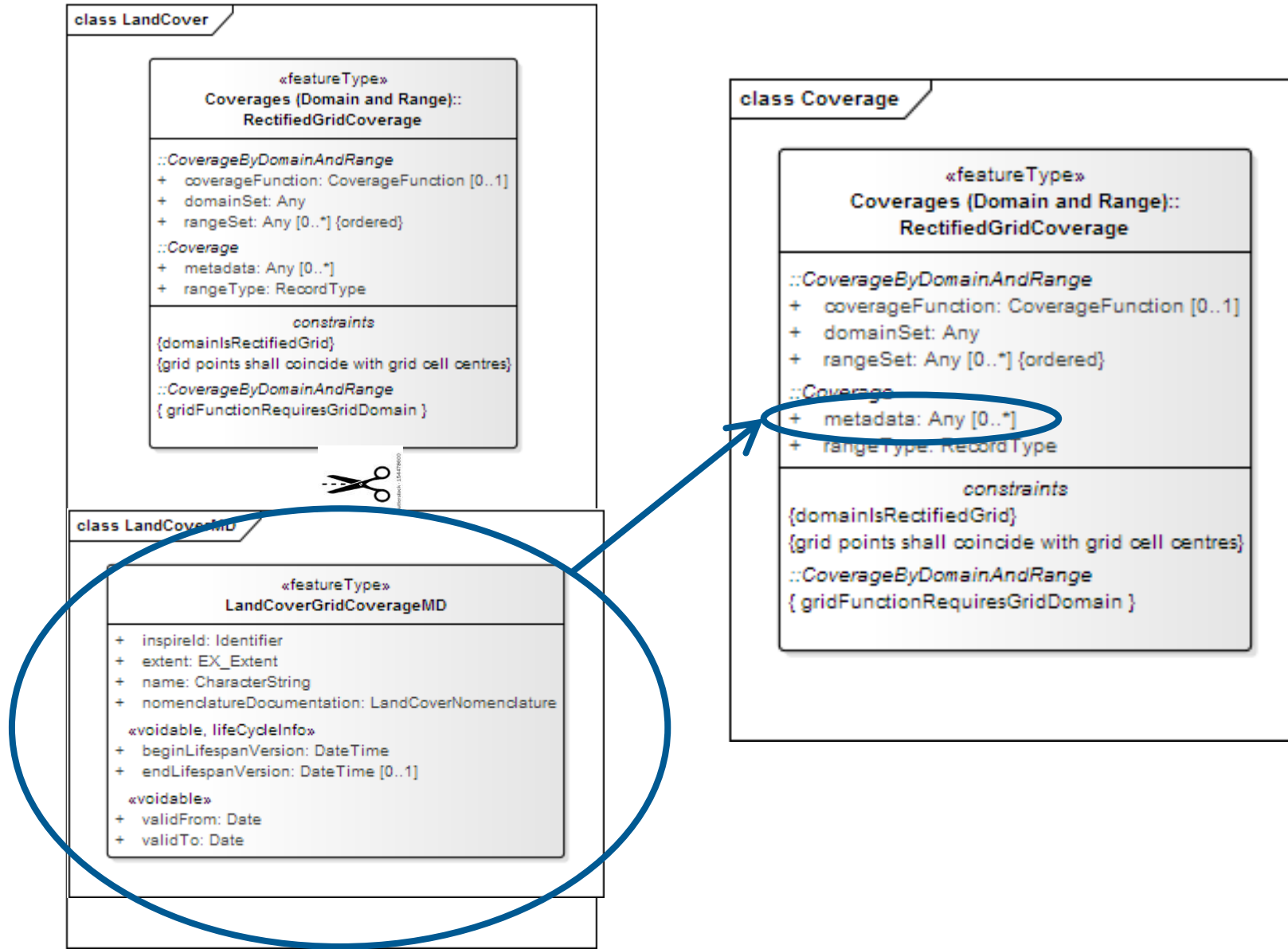   → INSPIRE Good Practice on Coverage

Coverages in INSPIRE

Service capabilities response

Service Metadata

Language

Dataset Metadata

CoverageID

Service URL

```
<ows:ExtendedCapabilities>
    <inspire_dls:ExtendedCapabilities>
        <inspire_common:MetadataUrl xsi:type="inspire_common:resourceLocatorType">
            <inspire_common:URL>
                https://inspire...nl/fbd0d3da-e025-4728-8fd5-22ad5f530511
            </inspire_common:URL>
            <inspire_common:MediaType>application/xml</inspire_common:MediaType>
        </inspire_common:MetadataUrl>
        <inspire_common:SupportedLanguages>
            <inspire_common:DefaultLanguage>
                <inspire_common:Language>eng</inspire_common:Language>
            </inspire_common:DefaultLanguage>
        </inspire_common:SupportedLanguages>
        <inspire_common:ResponseLanguage>
            <inspire_common:Language>eng</inspire_common:Language>
        </inspire_common:ResponseLanguage>
        <inspire_dls:SpatialDataSetIdentifier metadataURL="https://inspire...nl/f670705f-f4e9-11e6-81e4">
            <inspire_common:Code>INSPIRE_WNZ_5_NAP</inspire_common:Code>
            <inspire_common:Namespace>https://inspire...nl/rasdaman/ows</inspire_common:Namespace>
        </inspire_dls:SpatialDataSetIdentifier>
        ...
    </inspire_dls:ExtendedCapabilities>
</ows:ExtendedCapabilities>
```
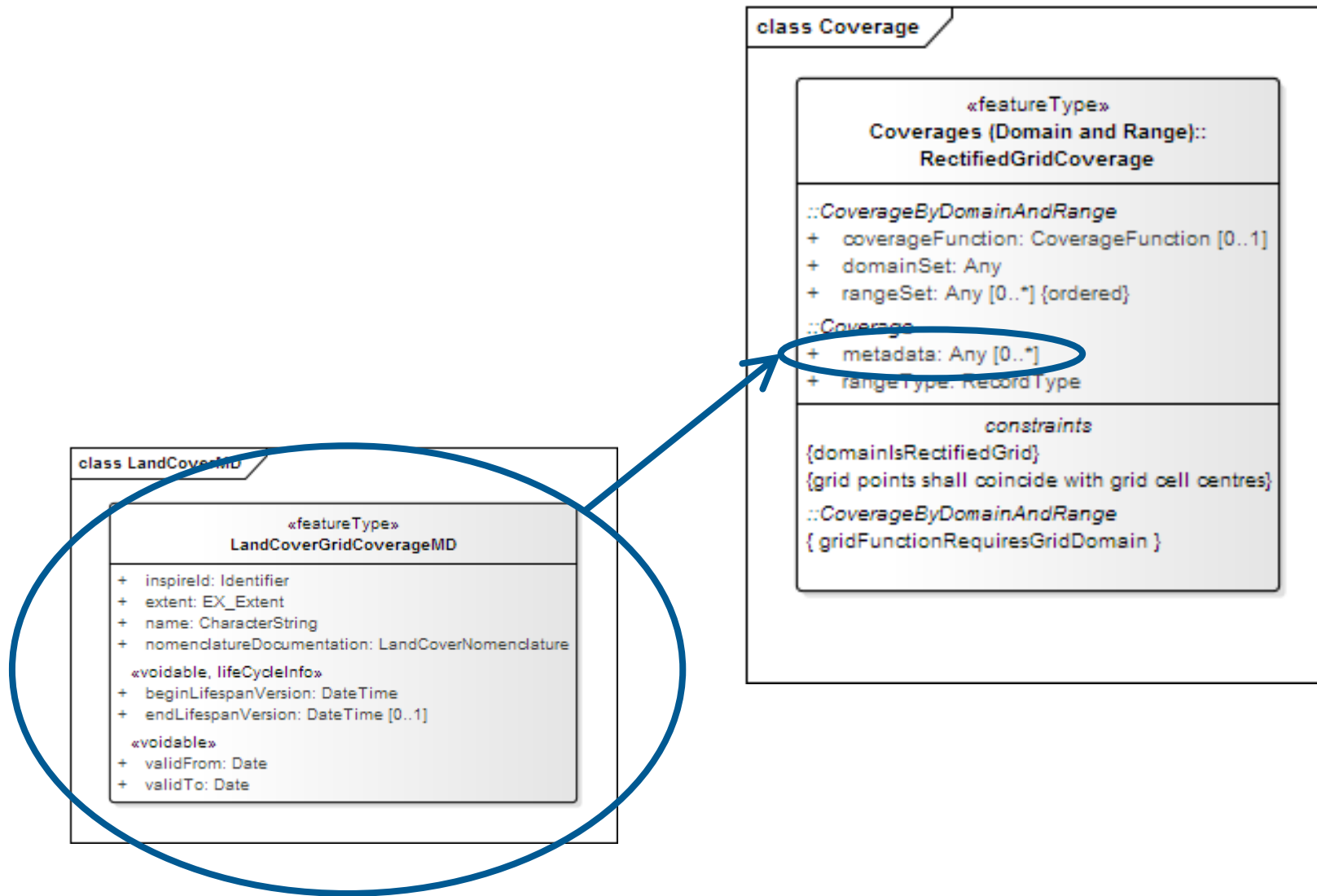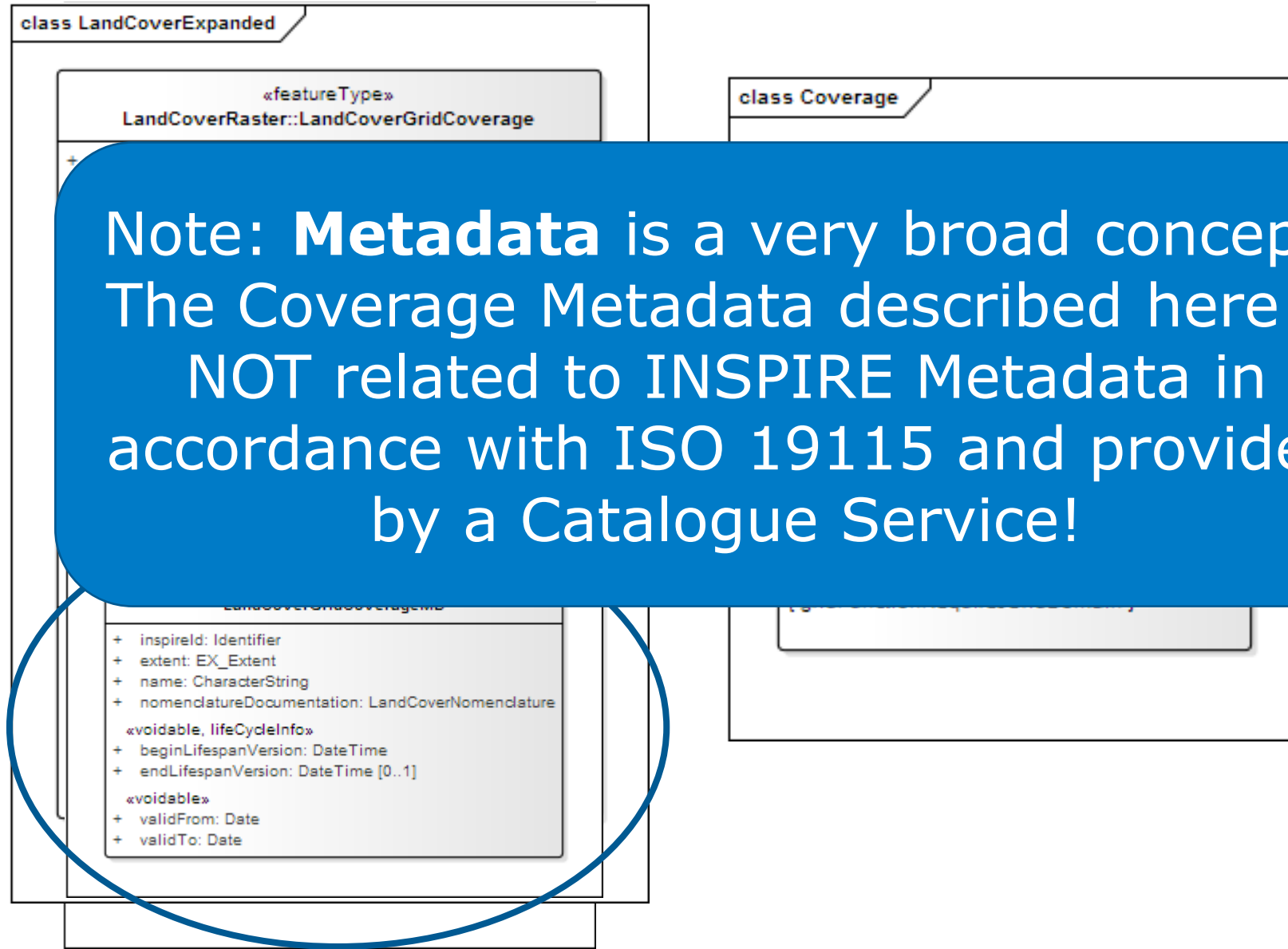
INSPIRE Good Practice Coverages

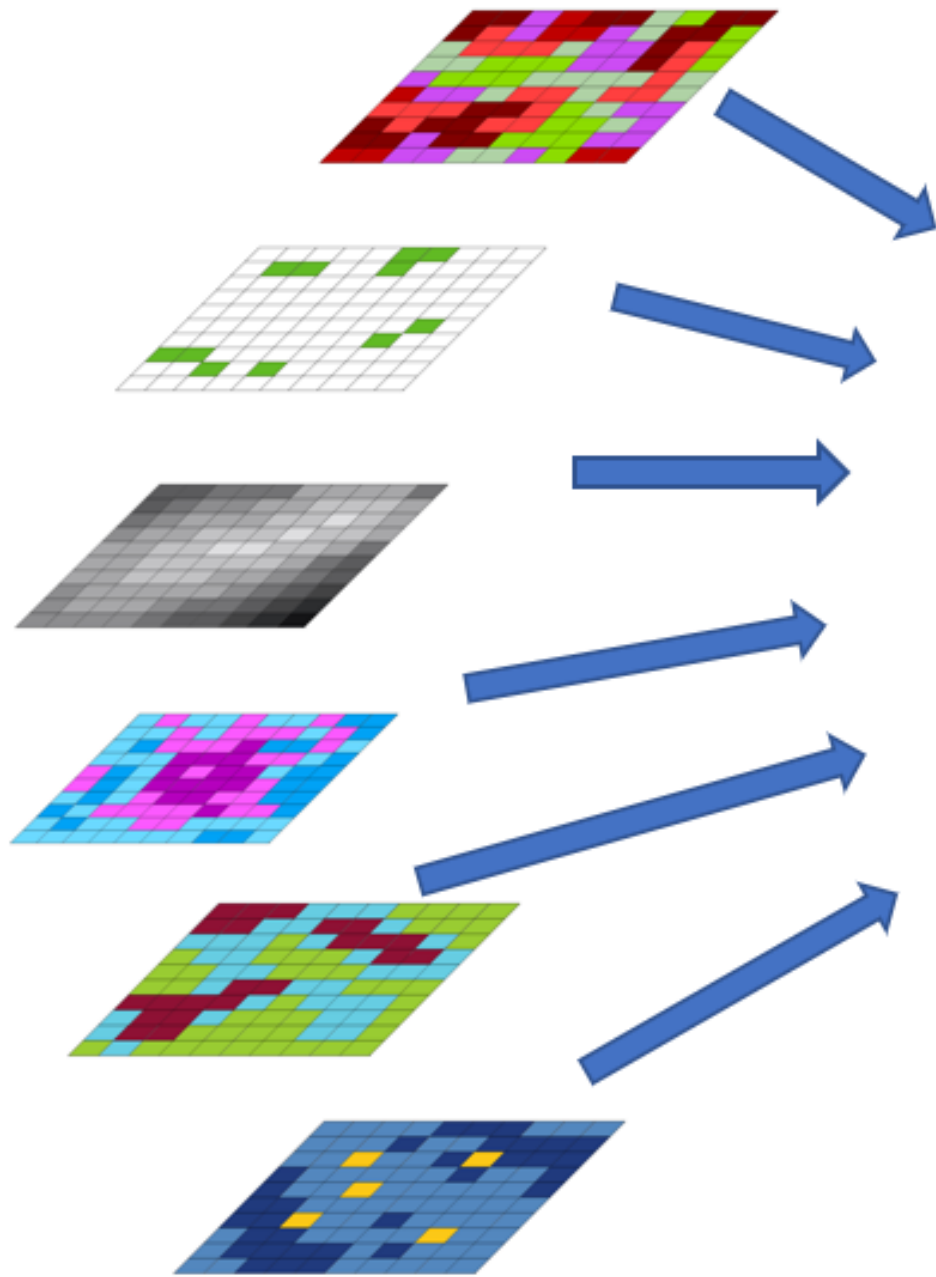# INSPIRE Good Practice Coverages

INSPIRE Good Practice Coverages

class Coverage

«featureType»
Coverages (Domain and Range)::
RectifiedGridCoverage

::CoverageByDomainAndRange
+ coverageFunction: CoverageFunction [0..1]
+ domainSet: Any
+ rangeSet: Any [0..*] {ordered}

::Coverage
+ metadata: Any [0..*]
+ rangeType: RecordType

constraints
{domainIsRectifiedGrid}
{grid points shall coincide with grid cell centres}
::CoverageByDomainAndRange
{ gridFunctionRequiresGridDomain }

class LandCoverMD

«featureType»
LandCoverGridCoverageMD

+ inspireId: Identifier
+ extent: EX_Extent
+ name: CharacterString
+ nomenclatureDocumentation: LandCoverNomenclature

«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]

«voidable»
+ validFrom: Date
+ validTo: Date

INSPIRE Good Practice Coverages

INSPIRE Good Practice Coverages

- Information on the Good Practice:
  - https://inspire.ec.europa.eu/good-practice/ogc-compliant-inspire-coverage-data-and-service-implementation
- Schema Files:
  - https://schema.datacove.eu/ElevationGridCoverageMetadata.xsd
  - https://schema.datacove.eu/OrthoimageryMetadata.xsd
  - http://test.datacove.eu/LandCoverRasterMDExt.xsd

Providing Coverages

- Data Sources
- Providing Data

Data Sources

- Source data often point/vector based
  - Must first be transformed to grid
- Grid should align to ETRS89-LAEA
  - Resolutions of 1m, 10m, 100m, 1000m, 10000m and 100000m
  - https://epsg.io/3035
- GeoTIFF useful format
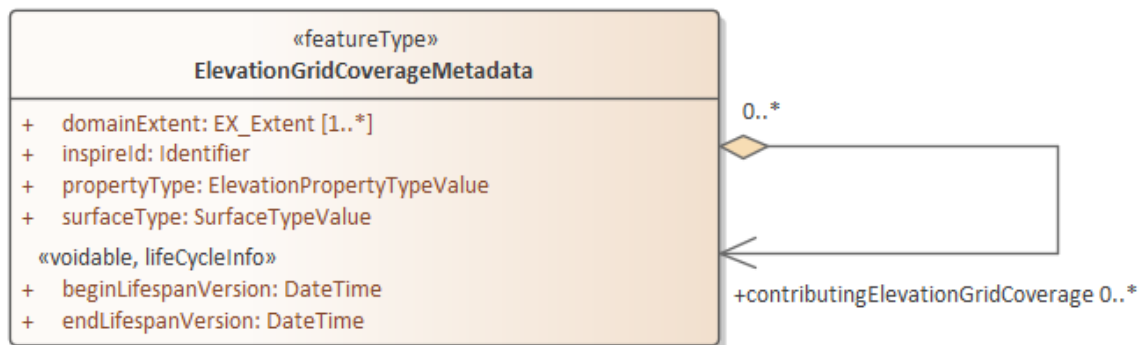
Providing data

- Gridded data rapidly becomes unmanageable due to size
  - Subset into tiles for transfer and import
  - WCS can import multiple input grids, merge to one coverage
  - Gdal library very useful
  - Ideally transform to ETRS89-LAEA close to source
    - While can also be transformed later, reduces accuracy
- XML Snippets must be created for the additional INSPIRE attributes

Providing data

XML Snippet for EL

class Elevation Metadata Example

«featureType»
ElevationGridCoverageMetadata

+ domainExtent: EX_Extent [1..*]
+ inspireId: Identifier
+ propertyType: ElevationPropertyTypeValue
+ surfaceType: SurfaceTypeValue

«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime

0..*

+contributingElevationGridCoverage 0..*

```xml
<?xml version="1.0" encoding="UTF-8"?>
<el-covmd-ks:ElevationGridCoverageMetadata xmlns:el-covmd-ks="http://ins
    <el-covmd-ks:beginLifespanVersion>2021-04-09T00:00:00+01:00</
    <el-covmd-ks:domainExtent>
        <gmd:EX_Extent>
            <gmd:geographicElement>
                <gmd:EX_GeographicBoundingBox>
                    <gmd:westBoundLongitude><gco:Decimal>3.9632793</gc
                    <gmd:eastBoundLongitude><gco:Decimal>4.8789582</gc
                    <gmd:southBoundLatitude><gco:Decimal>51.8526434</g
                    <gmd:northBoundLatitude><gco:Decimal>52.0129335</g
                </gmd:EX_GeographicBoundingBox>
            </gmd:geographicElement>
        </gmd:EX_Extent>
    </el-covmd-ks:domainExtent>
    <el-covmd-ks:inspireId>
        <base:Identifier>
            <base:localId>INSPIRE_WNZ_5_NAP</base:localId>
            <base:namespace>https://www.rijkswaterstaat.nl</base:nam
        </base:Identifier>
    </el-covmd-ks:inspireId>
    <el-covmd-ks:propertyType>depth</el-covmd-ks:propertyType>
    <el-covmd-ks:surfaceType>DTM</el-covmd-ks:surfaceType>
</el-covmd-ks:ElevationGridCoverageMetadata>
```

Providing data

Putting it all together, you need:

- Coverage ID
- Gridded data, e.g. Tif
  - Can be multiple files
- XML Snippet
- Language (usually default English)
- Metadata URLS for
  - Service Metadata (ISO 19119)
  - Dataset Metadata (ISO 19115)

Providing data

- Importing to rasdaman:
- Import configuration done with the help of a "recipe" file. In this JSON file, you provide:
  - Coverage ID
  - Path to gridded data files, e.g. Tif
  - Location of file with XML Snippet
  - Metadata URLS for
    - Service Metadata
    - Dataset Metadata

Using Coverages

- Some Endpoints
- Issues

Some Endpoints

Elevation WCS

- NL Elevation: https://coverage-demo.wetransform.eu/rasdaman/ows#/services

- BE Elevation Mirror: http://sandbox.datacove.eu:8080/rasdaman/ows

To make things more interesting, we've also added OGC SensorThings API*
to the mix with water level data:

- https://ogc-demo.k8s.ilt-dmz.iosb.fraunhofer.de/v1.1/

- Viewer: https://api4inspire.k8s.ilt-dmz.iosb.fraunhofer.de/servlet/is/196/

*SensorThings is also an INSPIRE Good Practice

Some Endpoints

OGC Web Coverage Service (WCS) | OGC Web Map Service (WMS) | Admin

GetCapabilities | DescribeCoverage | GetCoverage | ProcessCoverages

🌐 INSPIRE_WNZ_5_NAP   **Describe Coverage**

Coverage **INSPIRE_WNZ_5_NAP** is of type **RectifiedGridCoverage** with **2** axes:

Axis name	Type	Geo Extent	Grid Extent	Resolution	UoM
Y	Regular Axis	[3077582, 3180858]	[0, 103275]	-1	metre
X	Regular Axis	[4008022, 4058088]	[-5945, 44120]	1	metre

with range type:

Field name	Null Values	UoM code
Elevation	1000000	10^0

with native format: **application/octet-stream**

with Coordinate Reference System: **http://localhost:8080/def/crs/EPSG/0/3035**

with size: **20.68 GB**

Footprint of geo-referenced coverage   ❯

Coverage metadata   ⌄

```
                    <el-covmd-ks:ElevationGridCoverageMetadata xmlns:base="http://inspire.ec.europa.eu/schemas/base/3.3" xmlns:base2="http://
        inspire.ec.europa.eu/schemas/base2/2.0" xmlns:el-covmd-ks="http://inspire.ec.europa.eu/schemas/el-covmd/4.0" xmlns:gco="http://www.isotc2
        11.org/2005/gco" xmlns:gmd="http://www.isotc211.org/2005/gmd" xsi:schemaLocation="http://inspire.ec.europa.eu/schemas/el-covmd/4.0 http
        s://schema.datacove.eu/ElevationGridCoverageMetadata.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
                        <el-covmd-ks:beginLifespanVersion>2021-02-25T00:00:00+01:00</el-covmd-ks:beginLifespanVersion>
                        <el-covmd-ks:domainExtent>
                            <gmd:EX_Extent>
 5.                             <gmd:geographicElement>
                                    <gmd:EX_GeographicBoundingBox>
                                        <gmd:westBoundLongitude>
                                            <gco:Decimal>5.56256995087</gco:Decimal>
                                        </gmd:westBoundLongitude>
 10.                                    <gmd:eastBoundLongitude>
                                            <gco:Decimal>6.19900732304</gco:Decimal>
                                        </gmd:eastBoundLongitude>
                                        <gmd:southBoundLatitude>
                                            <gco:Decimal>50.7472049152</gco:Decimal>
```
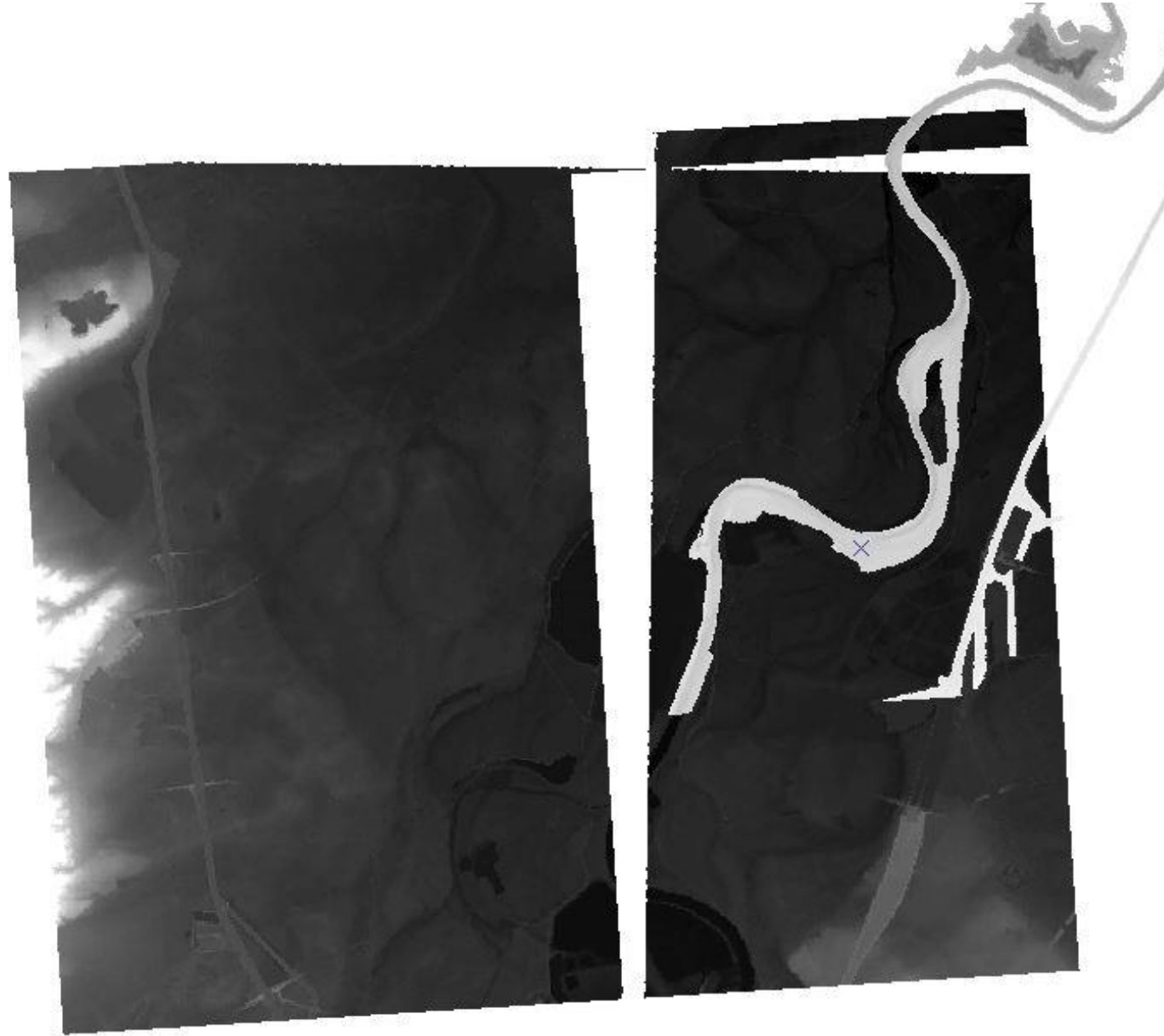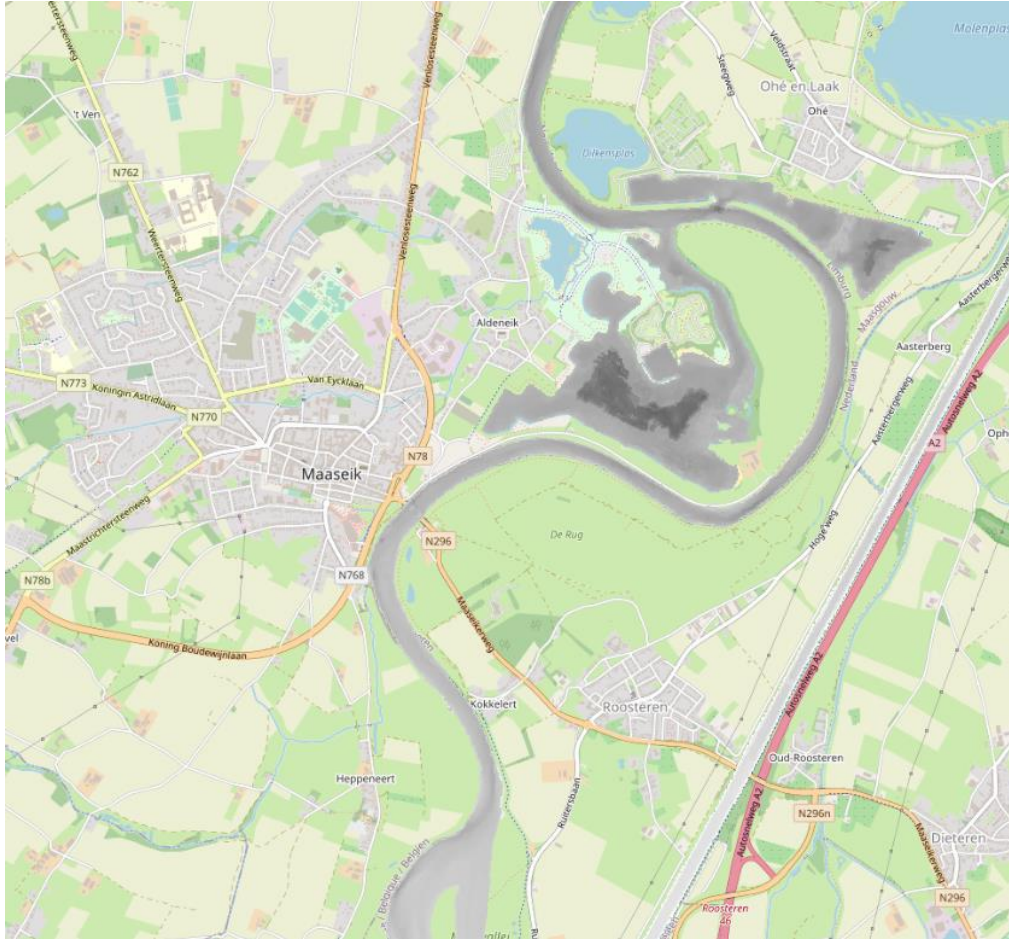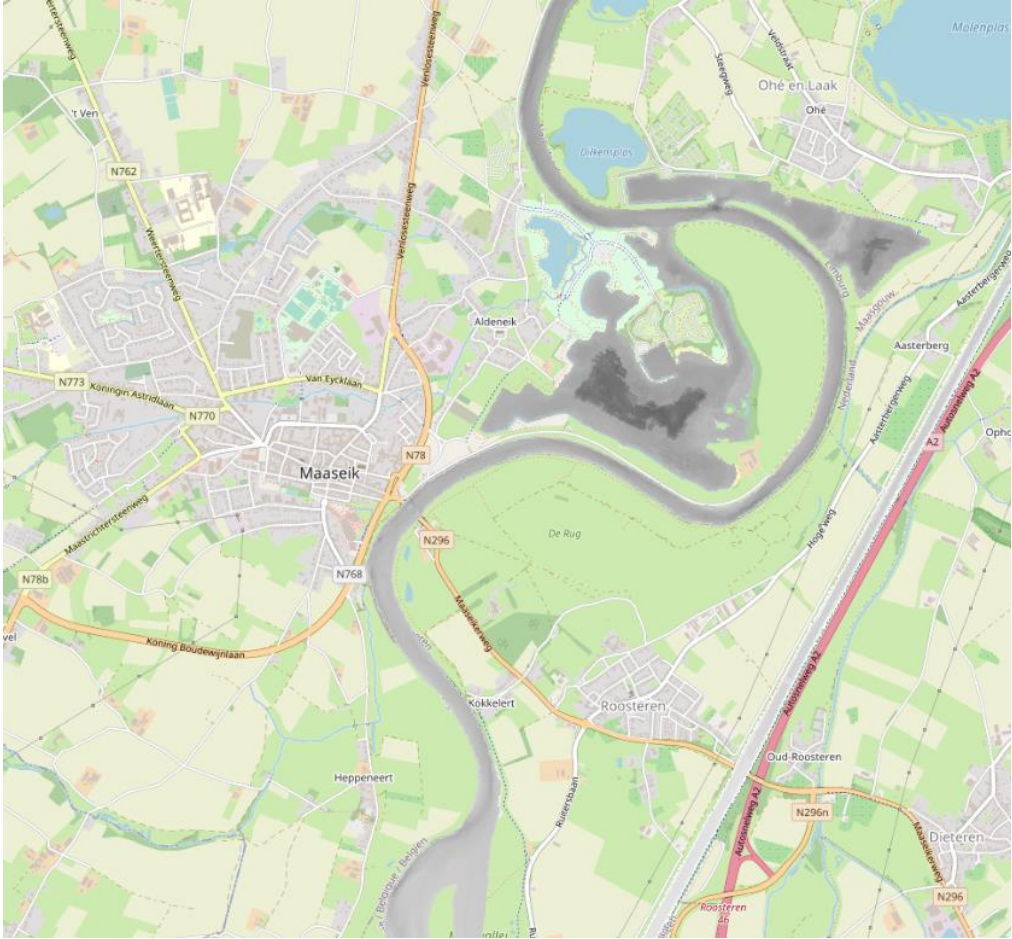
Coverage Reality Bites!
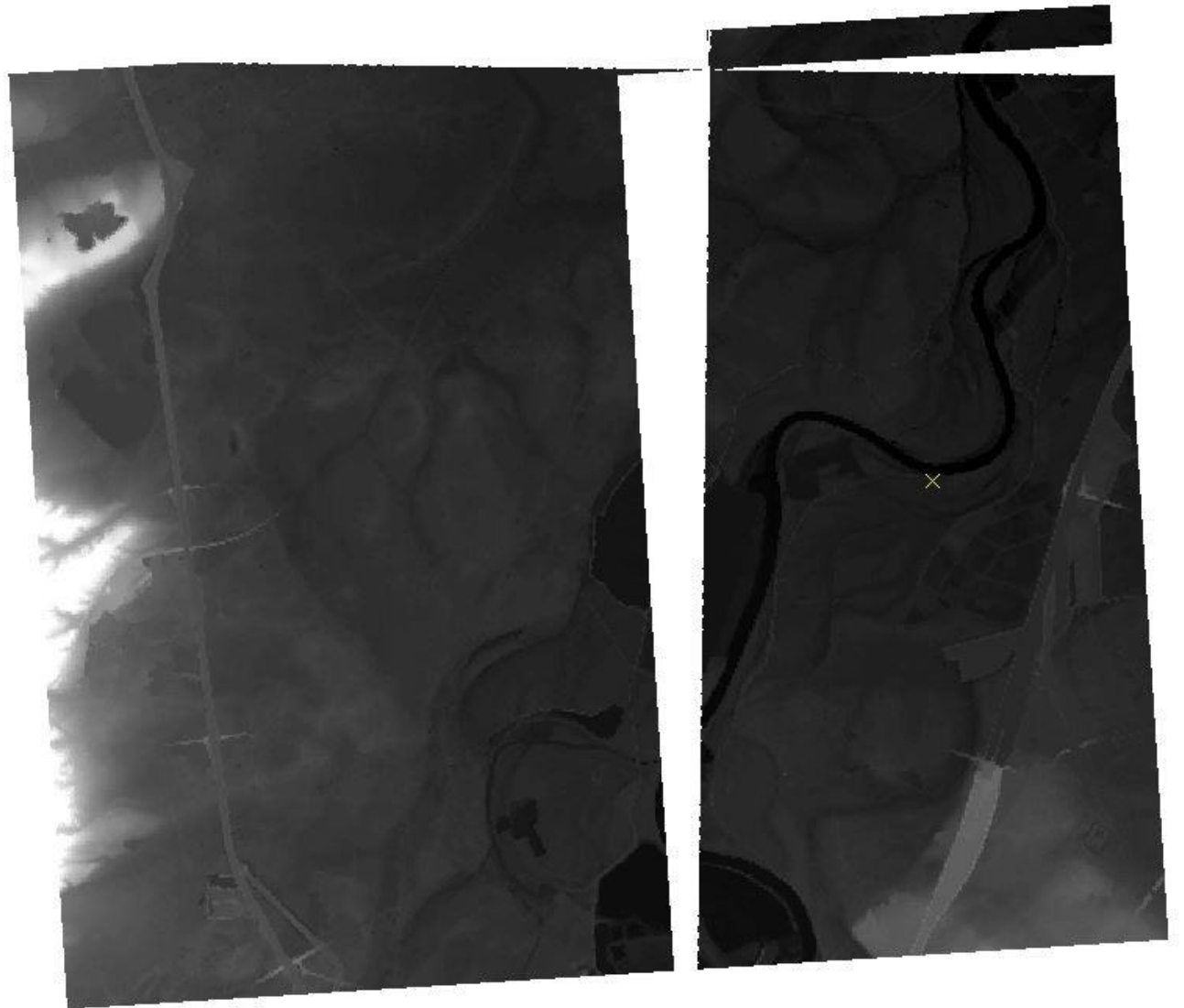
Coverage Reality Bites!

Coverage Reality Bites!

Issues

- XML Snippet Schema must be formalized
  - Will be submitted to the INSPIRE Coverage Good Practice
- Conversion to ETRS89-LAEA
  - GDAL can be very useful
- What values to provide where canals cross?
- Relative sea levels
  - While vertical CRS exist, not being utilized, conversion tools missing
- GIS Tools cannot access WCS 2
  - Download TIF via GetCoverage from a browser

Questions?

INSPIRE services RWS
- *DataCove*
- wetransform - Data modelling and transformation
- *Engineering consultancy Sweco*
- *Rijkswaterstaat*

November 2021