EMODnet Thematic Lot n° 7

EMODnet Phase III

-Task report -

"Implementation of the INSPIRE Land Use Theme (LU) for EMODnet Human activities datasets"

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Executive summary

This report, is a follow-on of the work "**EMODNET human activities data models: towards compliance with INSPIRE DATA Specifications.**" published in February 2018 and available in (https://webgate.ec.europa.eu/maritimeforum/en/node/4147).

This work identified 17 different INSPIRE application schemas as potentially applicable to the 66 EMODnet human activities datasets with more or less direct alignment depending on the themes. Other issues related with uncomplete codelists and inconsistent semantic definitions were also pointed out. Consequently, the harmonisation of the EMODnet's datasets on human activities to these INSPIRE application schemas would be conceptually and technically complex and the result would probably not meet the interoperability objectives sought by INSPIRE.

However, inspired by the approach proposed in the MArSP project, consisting in using a single model from the INSPIRE Land Use theme to represent the different human activities in the maritime plans, the applicability of this approach to harmonise the EMODnet's human activities datasets has been analysed.

As a result, a great number of EMODnet's human activities datasets have been found to be assignable to INSPIRE land Use theme's models and include the compulsory information needed to comply with it. However, these datasets also include accessory information that will be left out when harmonised to INSPIRE Land Use application schemas.

Even though, the exercise of harmonising them against the INSPIRE "Sample land Use" application schema to **produce the EMODnet's INSPIRE sampled Land Use dataset**, that includes the locations of all human activities related datasets in EMODnet's human activities portal, has been performed. Besides, this dataset has been reformatted to the INSPIRE required complex feature GML format and published online. This last task has evidenced the technical difficulties still unovercome to use this format both by GIS data publishing servers and GIS application clients. Thus, although the harmonisation procedure has entailed improvements and advancements towards a convergence to a pan-European spatial data infrastructure, the encoding procedure has been difficult, time consuming and inefficient for sharing data.

Finally, some recommendations are provided to improve the current EMODnet's human activities models in order to achieve more coherence and completeness of information as well as to facilitate the updates of the newly created EMODnet's INSPIRE sampled Land Use dataset. Further observations on how the INSPIRE land Use theme could evolve to better fit the information on maritime uses are also provided in last section.

1. Background.

The analysis presented in this task report is a follow-on of the work " **EMODNET human activities data models: towards compliance with INSPIRE DATA Specifications.**", published in February 2018 and available in (https://webgate.ec.europa.eu/maritimeforum/en/node/4147).

The main conclusions of this work showed that most EMODnet human activities datasets could be thematically related to existing INSPIRE application schemas, but the alignment was more or less direct depending on the dataset analysed. Moreover, several datasets could be aligned to more than one INSPIRE application schema.

In total, seventeen INSPIRE application schemas were identified as potentially applicable to the EMODnet human activities datasets:

- Annex III: Mineral Resources model
- Annex III: Agricultural and Aquaculture Facilities Model
- Annex III: Building Base
- Annex II: Geology model
- Annex I: Protected Sites simple models.
- Annex I: Protected Sites Full
- Annex III: INSPIRE Human Health application schema
- Annex III: Area Management Restriction and Regulation Zones model
- Annex III: Statistical Units Vector
- Annex I: Water Transport Network model
- Annex III: Energy Resources Vector
- Annex I: Maritime Units
- Annex III: Common Utility Network Elements.
- Annex III: Land Use
- Annex III: Mineral Resources
- Annex III: Area Management Restriction and Regulation Zones
- Annex III: Utility and governmental Services

Apart from the thematic alignment issues, it was found that similar information concepts (i.e. date information, dimensioning attributes, etc.) were treated differently across the different INSPIRE models.

Considering these results, the harmonisation of the 66 EMODnet human activities datasets using these application schemas would be conceptually and technically complex and the result would probably not meet the interoperability objectives sought by INSPIRE.

Nevertheless an alternative strategy has recently appeared to us which is inspired by the proposal of the **"MSP INSPIRE data model", ** developed in the framework of the **Macaronesian Maritime Spatial Planning (MarSP)** project, and presented to GIS and MSP experts during the 2nd MarSP technical workshop, held in Tenerife (Spain) in March 2019.

The Maritime spatial planning EU Directive (2014/89/EU) requires Member States to establish maritime spatial plans to represent the spatial and temporal distribution of relevant existing and future activities, before 2021. Therefore, the need for a provision of harmonised digital format plans face a similar problematic that the one faced under the EMODnet's human activities project.

The strategy proposed in the MArSP project consists in using a single model to represent the different human activities in the maritime plans. The proposed model called **"MSP INSPIRE data model"** is adapted from the "**INSPIRE Planned Land Use"** application schema under the INSPIRE "Land Use" theme**. The MSP INSPIRE model** is fully described in http://www.geoportal.ulpgc.es/atom/download/MSP_INSPIRE_data_model_guidance_v1.0.pdf.

The implementation of this model by all EU maritime plans creators should ensure the comparability and a common representation of maritime spatial plans, especially relevant in cross border areas or areas where international activities coexist.

This approach seems interesting to be also applied in the context of the EMODnet human activities, as in principle, it would highly simplify the INSPIRE compliance and harmonisation process and could increase interoperability across European datasets representing human activities at sea and also in the inland-sea interaction areas.

2. Objective.

Within this work we will:

- Analyse the applicability of the "**INSPIRE Land Use"** models and the **"MSP INSPIRE data model"** to harmonise the EMODnet's human activities datasets and thus, increase interoperability among European datasets representing human activities at sea.
- Generate INSPIRE-compliant EMODNET human activities dataset(s).

3. The INSPIRE Land Use Theme

The **Land Use** INSPIRE Data Theme is defined as the "*Territory characterised according to its current and future planned functional dimension or socio economic purpose, e.g. residential, industrial, commercial, agricultural, forestry, recreational*".

This theme is different from the INSPIRE **Land Cover** theme: "Land cover" indicates the physical land type (such as forest or open water), whereas land use documents how people are using the land. Moreover, Land Use theme is included in annex III of the INSPIRE Directive, whereas Land Cover is included in Annex II. The most known map of Land Cover in Europe is the "Corine Land Cover" map.

The **INSPIRE Land Use** theme includes 5 application schemas (or data models):

- Existing Land Use (elu:) (see Figure 1)
- Sampled Land Use (selu:) (see Figure 2)
- Gridded Land Use (gelu:) (see Figure 3)

- Planned Land Use (plu:) (see Figure 4)
- Land Use Nomenclature (lunom:) (see Figure 5. **Representation of** INSPIRE Land Use Nomenclature application schema**.**

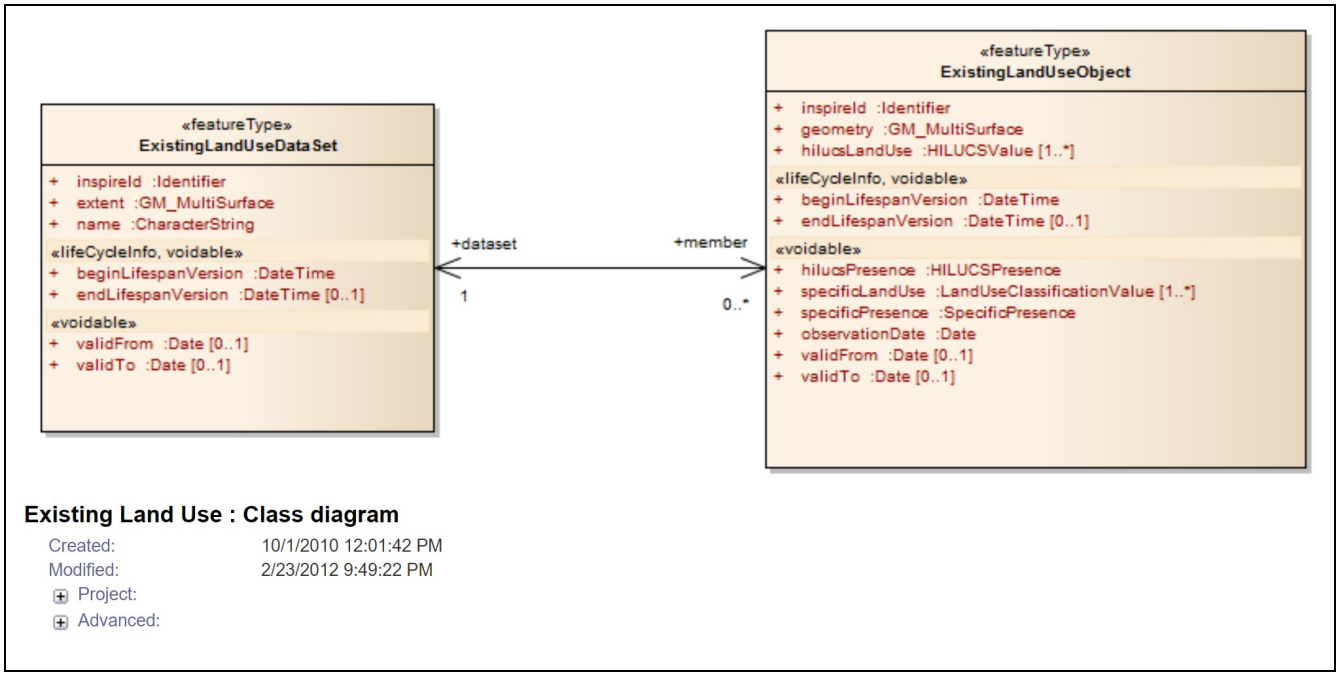


Figure 1. Representation of INSPIRE Existing Land Use application schema.

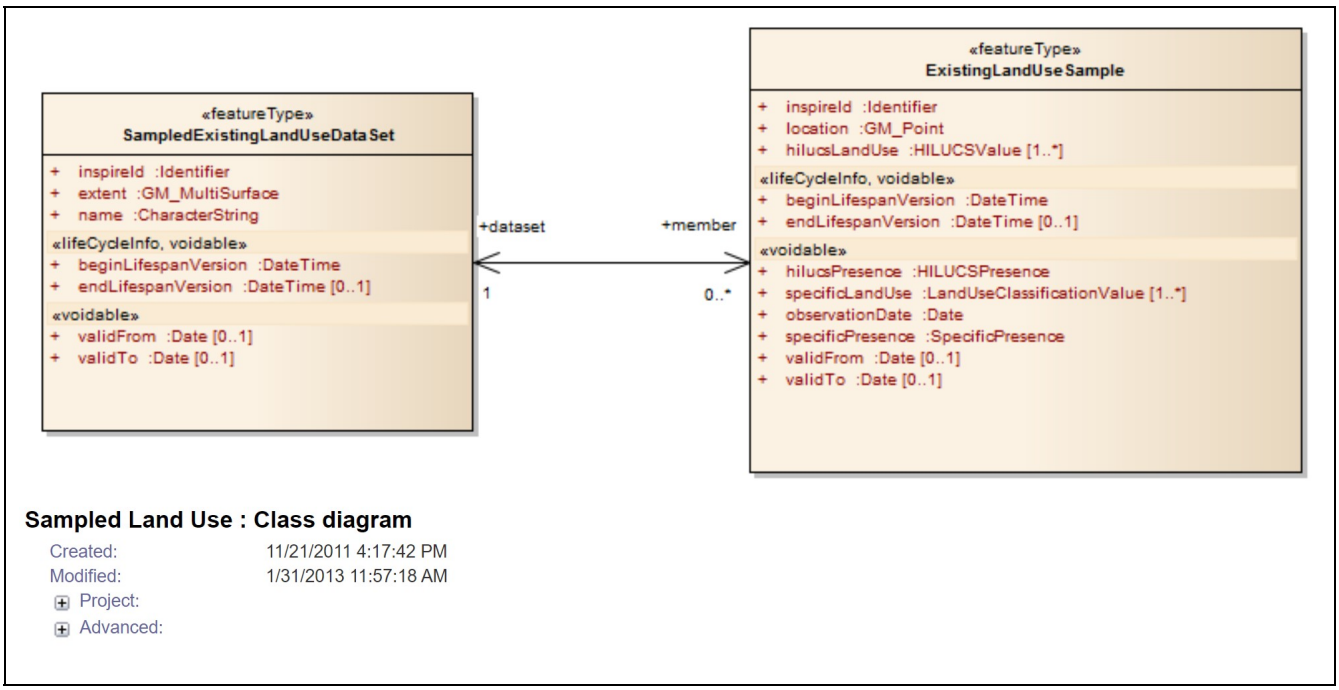


Figure 2. Representation of INSPIRE Land Use Sample application schema.

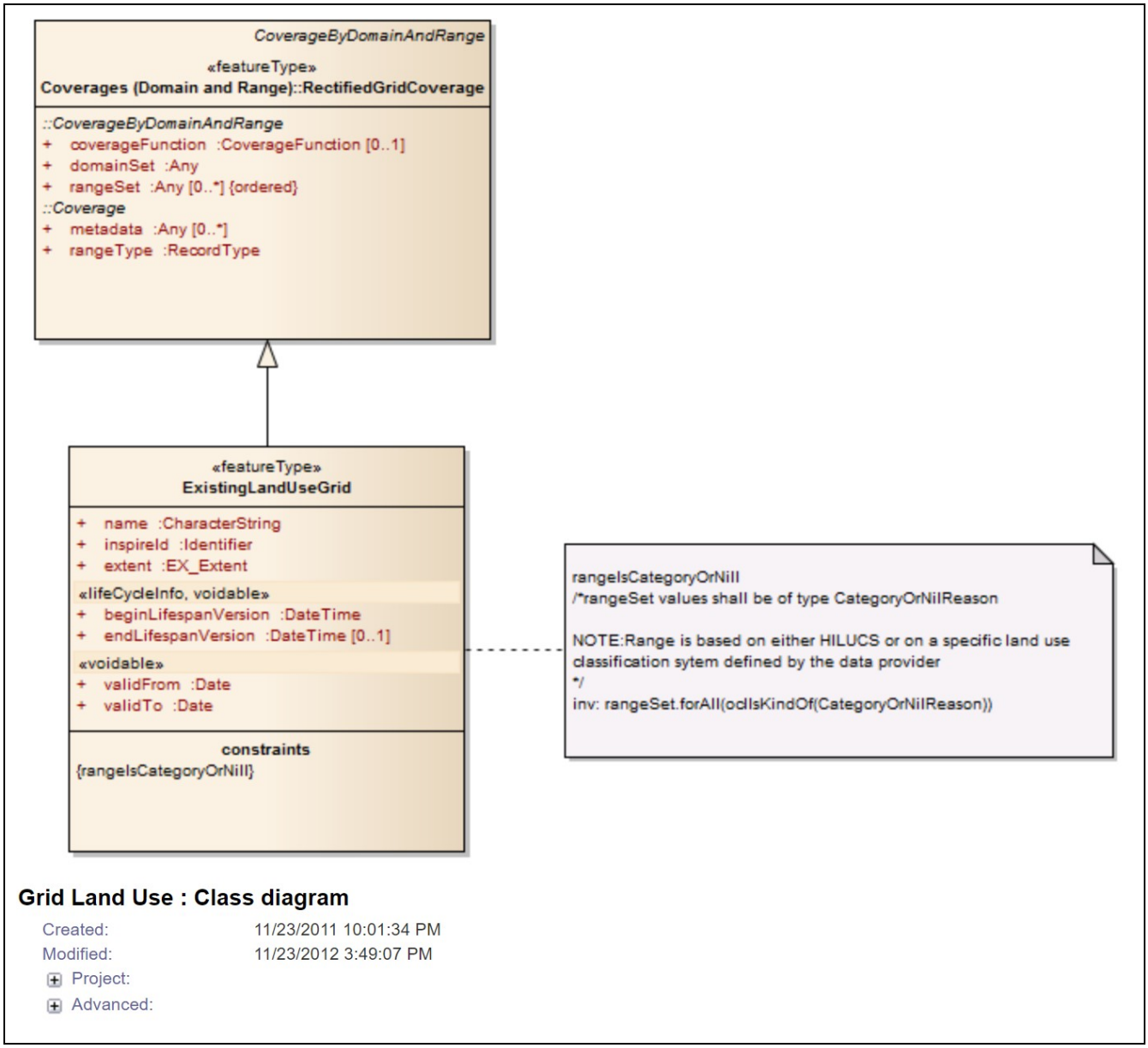


Figure 3. Representation of [INSPIRE Land Use Grid application schema].

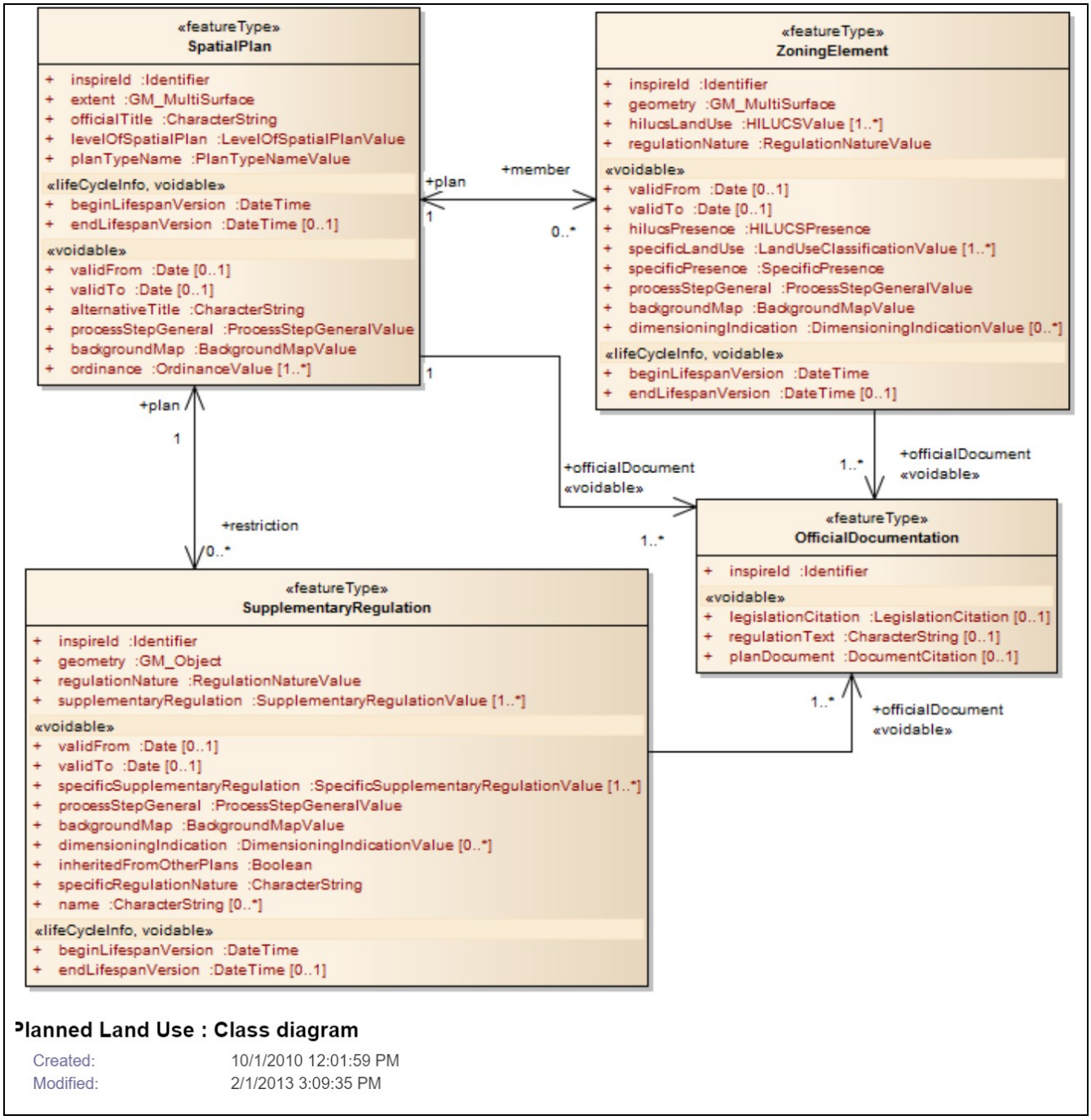


Figure 4. Representation of [INSPIRE Planned Land Use application schema].

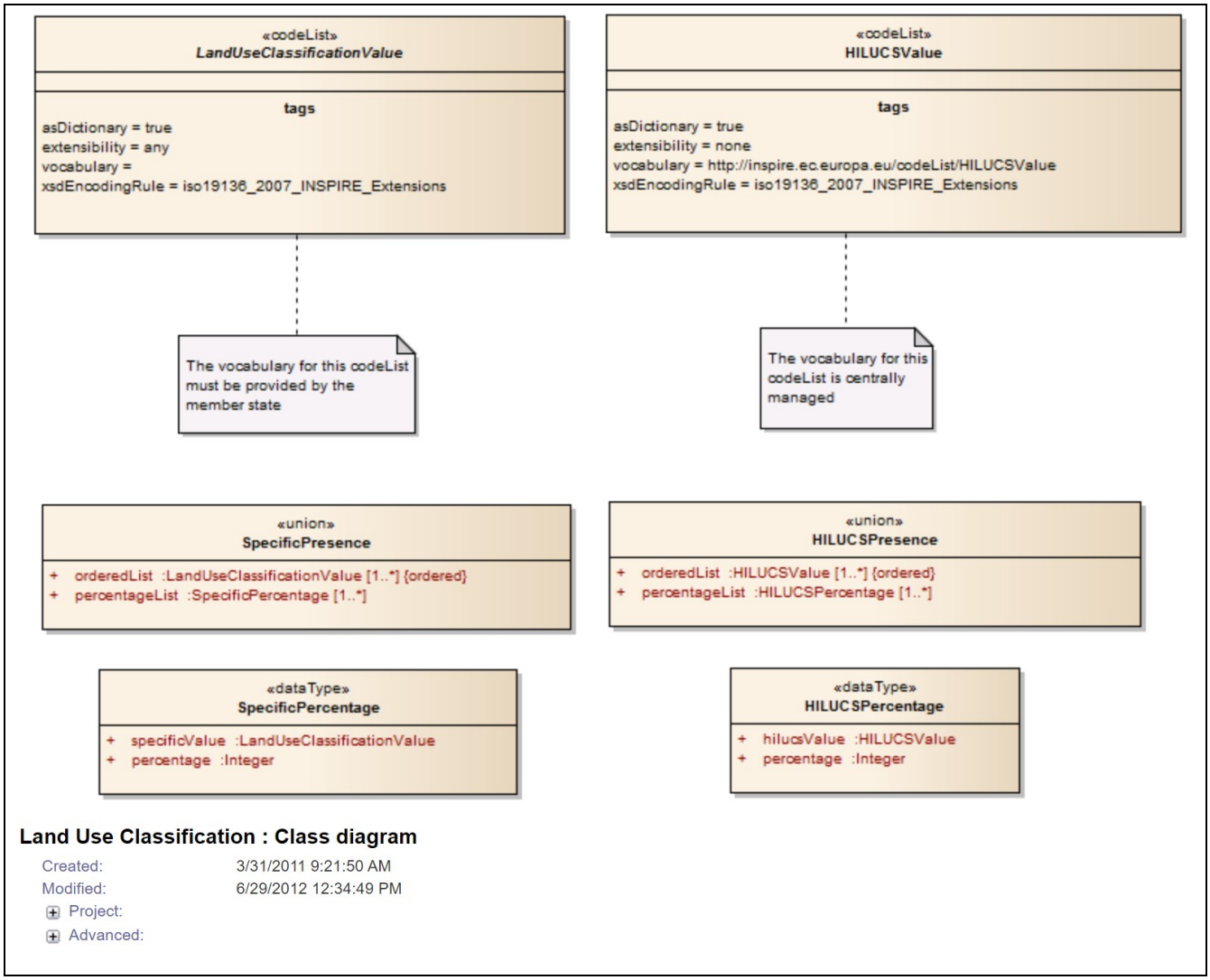


Figure 5. Representation of INSPIRE Land Use Nomenclature application schema.

THEME	Application schema	Object	Object type	Definition
Land Use Theme	Existing Land Use	Existing Land Use Object	Spatial object type	An existing land use object describes the land use of an area having a homogeneous combination of land use types.
		Existing Land Use Data Set	Spatial object type	An existing land use data set is a collection of areas for which information on existing (present or past) land uses is provided.
	Gridded Land Use	Existing Land Use Grid	Spatial object type	An existing land use grid is a collection of pixels for which information on existing (present or past) land use is provided. The HILUCS system shall be used for classification.
	Sampled Land Use	Existing Land Use Sample	Spatial object type	Description of the existing land use that is present at the specific location.
		Sampled Existing Land Use Data Set	Spatial object type	A sampled existing land use data set is a collection of locations for which information on existing (present or past) land uses is provided.
	Planned Land Use	Supplementary Regulation	Spatial object type	A spatial object (point, line or polygon) of a spatial plan that provides supplementary information and/or limitation of the use of land/water necessary for spatial planning reasons or to formalise external rules defined in legal text.
		Official Documentation	Spatial object type	The official documentation that composes the spatial plan; it may be composed of, the applicable legislation, the regulations, cartographic elements, descriptive elements that may be associated with the complete spatial plan, a zoning element or a supplementary regulation . In some Member States the actual textual regulation will be part of the data set (and can be put in the regulationText attribute), in other Member States the text will not be part of the data set and will be referenced via a reference to a document or a legal act.At least one of the three voidable values shall be provided.
		Spatial Plan	Spatial object type	A set of documents that indicates a strategic direction for the development of a given geographic area, states the policies, priorities, programmes and land allocations that will implement the strategic direction and influences the distribution of people and activities in spaces of various scales. Spatial plans may be developed for urban planning, regional planning, environmental planning, landscape planning, national spatial plans, or spatial planning at the Union level.
		Zoning Element	Spatial object type	A spatial object which is homogeneous regarding the permitted uses of land based on zoning which separate one set of land uses from another.
		Dimensioning Indication Real Value	Data type	Dimensioning indication whose value is a floating point number.
		Dimensioning Indication Measure Value	Data type	Dimensioning indication whose value is a measure.
		Background Map Value	Data type	Information regarding the map that has been used as a background in the definition of a spatial plan, a zoning element or a supplementary regulation.
		Dimensioning Indication Character Value	Data type	Dimensioning indication whose value is of type CharacterString.
		Dimensioning Indication Integer Value	Data type	Dimensioning indication whose value is of type integer.
		Ordinance Value	Data type	Reference to administrative ordinance. Ordinance is a regulation/rule that is adopted by an authority that is legally mandated to take such ordinance.
		Dimensioning Indication Value	Data type	Specifications about the dimensioning of the urban developments.
	Land Use Nomenclature	Specific Percentage	Data type	Percentage of land use object that is covered by this specific presence.
		HILUCS Percentage	Data type	Percentage of land use object that is covered by this HILUCS presence.

Table 1. Definitions of objects included in the different application schemas of INSPIRE Land Use Theme.

Clearly, the Land Use Theme conceptually differentiates between:

- The Existing Land Use, which objectively depicts the use and functions of a territory as it has been and effectively still is in real life.
- The Planned Land Use, which corresponds to spatial plans, defined by spatial planning authorities, depicting the possible utilisation of the land in the future.

Besides, the structure of the Existing Land Use models is just differentiated according to the spatial representation mode: vector points (locations), vector polygons (multi surface) and raster grids (coverages) for "*sampled land use"*, "*existing land use*" and "*gridded land use*", respectively.

In these models they are two main objects, the **"Existing Land use object"**, which *"describes the land use of an area having a homogeneous combination of land use types"* and the **"Existing Land use dataset"**, which defines *"a collection of areas for which information on existing (present or past) land uses is provided".* The attributes for each of these objects are provided in Table 2 and Table 3, respectively.

It is worth mentioning that these INSPIRE attributes are not always simple attributes. They may be complex attributes that, according to their data type, will include "sub-attributes". For example, "InspireId" datatype is composed by three attributes: "LocalId", "namespace" and "version". See Table 4 for detailed description.

All these application schemas include the **HilucsLandUse** compulsory attribute to commonly characterize the human activity being represented. This attribute must be filled in with an element (URL and title) from the "Hierarchical INSPIRE Land Use Classification System (HILUCS)" codelist.

Finally, this information should be included and published **via a GML file**, as for the moment, INSPIRE specifies in D2.7 v3.3 Annex B, a default encoding rule to specify a GML application schema for each INSPIRE application schema. The approved GML application schemas are available at http://inspire.ec.europa.eu/schemas/. Each schema uses a prefix to be used before all items within the GML file. The prefixes of the Land use application schemas are those included in brackets in the enumeration list provided at the beginning of this section. A snapshot of part of a GML file including a "plu:ZoningElement" object is presented in Figure 6.

Existing Land Use Object	
Attributes	**Characteristics**
inspire Id	**Definition:** External object identifier of the existing land use object. **Description:** An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon. **Multiplicity:** 1 **Valuetype:** Identifier
begin Lifespan Version	**Definition:** Date and time at which this version of the spatial object was inserted or changed in the spatial data set. **Multiplicity:** 1 **Stereotypes:** lifeCycleInfo **Valuetype:** DateTime
end Lifespan Version	**Definition:** Date and time at which this version of the spatial object was superseded or retired in the spatial data set. **Multiplicity:** 0...1 **Stereotypes:** lifeCycleInfo **Valuetype:** DateTime
geometry	**Definition:** Geometric representation of spatial area covered by this spatial object. **Multiplicity:** 1 **Valuetype:** GM_MultiSurface
hilucs Land Use	**Definition:** Land use HILUCS classes that are present in this existing land use object. **Description:** NOTE The Existing Land Use model enables the provision of information on land uses inside one land use object. The ExistingLandUseObject may be associated with 1 to many HILUCSLandUse that represents the Land Uses for the polygon from the economical point of view. It makes possible the assignment of more than one HILUCSLandUse existences when they cannot be managed by HILUCSPresences. **Multiplicity:** 1...* **Valuetype:** HILUCSValue
hilucs Presence	**Definition:** Actual presence of a land use category according to HILUCS within the object. **Multiplicity:** 1 **Stereotypes:** voidable **Valuetype:** HILUCSPresence
specific Land Use	**Definition:** Land Use Category according to the nomenclature specific to this data set. **Description:** Reference to an entry in the classfication that is part of the SpecificLandUseClassification. **Multiplicity:** 1...* **Stereotypes:** voidable **Valuetype:** LandUseClassificationValue
specific Presence	**Definition:** Actual presence of a land use category within the object. **Multiplicity:** 1 **Stereotypes:** voidable **Valuetype:** SpecificPresence
observation Date	**Definition:** The observation date associated to a description. **Description:** Defines the observation date of the description. It could be the date of an aerial/satellite acquisition or a field survey. The observation date allows the user to have accurate date of when the description was made in the real word. In a database, not all objects are necessarily captured at the same time. **Multiplicity:** 1 **Stereotypes:** voidable **Valuetype:** Date
valid From	**Definition:** The time when the phenomenon started to exist in the real world. **Multiplicity:** 0...1 **Stereotypes:** voidable **Valuetype:** Date
valid To	**Definition:** The time from which the phenomenon no longer exists in the real world. **Multiplicity:** 0...1 **Stereotypes:** voidable **Valuetype:** Date

Table 2. Attributes and characteristics of the "Existing Land Use Object" included in the application schemas of the Land Use theme.

Existing Land Use Dataset	
Attributes	**Characteristics**
inspire Id	**Definition:** External object identifier of the existing land use object. **Description:** An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon. **Multiplicity:** 1 **Valuetype:** Identifier
extent	**Definition:** Boundary of the geometrical union of all the instances of the spatial object type ExistingLandUseObject. **Multiplicity:** 1 **Valuetype:** GM_MultiSurface
begin Lifespan Version	**Definition:** Date and time at which this version of the spatial object was inserted or changed in the spatial data set. **Multiplicity:** 1 **Stereotypes:** lifeCycleInfo **Valuetype:** DateTime
end Lifespan Version	**Definition:** Date and time at which this version of the spatial object was superseded or retired in the spatial data set. **Multiplicity:** 0...1 **Stereotypes:** lifeCycleInfo **Valuetype:** DateTime
name	**Definition:** Human readable name of the data set. **Multiplicity:** 1 **Valuetype:** CharacterString
valid From	**Definition:** The time when the phenomenon started to exist in the real world. **Multiplicity:** 0...1 **Stereotypes:** voidable **Valuetype:** Date
valid To	**Definition:** The time from which the phenomenon no longer exists in the real world. **Multiplicity:** 0...1 **Stereotypes:** voidable **Valuetype:** Date

Table 3. Attributes and characteristics of the "Existing Land Use Dataset" included in the application schemas of the Land Use theme.

InspireId datatype	
Attributes	**Characteristics**
localId	**Definition:** A local identifier, assigned by the data provider. The local identifier is unique within the namespace, that is no other spatial object carries the same unique identifier. **Description:** NOTE It is the responsibility of the data provider to guarantee uniqueness of the local identifier within the namespace. **Multiplicity:** 1 **Valuetype:** CharacterString
namespace	**Definition:** Namespace uniquely identifying the data source of the spatial object. **Description:** NOTE The namespace value will be owned by the data provider of the spatial object and will be registered in the INSPIRE External Object Identifier Namespaces Register. **Multiplicity:** 1 **Valuetype:** CharacterString
Version	**Definition:** Namespace uniquely identifying the data source of the spatial object. **Description:** NOTE The namespace value will be owned by the data provider of the spatial object and will be registered in the INSPIRE External Object Identifier Namespaces Register. **Multiplicity:** 1 **Valuetype:** CharacterString

Table 4. Attributes of the InspireId datatype.

```
<plu:ZoningElement gml:id="XPLAN_BP_VERKEHRSFLAECHEBESONDERERZWECKBESTIMMUNG_ab22cd45-470c-4fa2-bc7d-1ed60f26416b">
    <gml:identifier codeSpace="http://inspire.ec.europa.eu/ids">https://registry.gdi-de.org/id/de.hh/plu
        /XPLAN_BP_VERKEHRSFLAECHEBESONDERERZWECKBESTIMMUNG_ab22cd45-470c-4fa2-bc7d-1ed60f26416b</gml:identifier>
    <plu:inspireId>
        <base:Identifier>
            <base:localId>XPLAN_BP_VERKEHRSFLAECHEBESONDERERZWECKBESTIMMUNG_ab22cd45-470c-4fa2-bc7d-1ed60f26416b</base:localId>
            <base:namespace>https://registry.gdi-de.org/id/de.hh/plu</base:namespace>
        </base:Identifier>
    </plu:inspireId>
    <plu:geometry>
        <gml:MultiSurface gml:id="XPLAN_BP_VERKEHRSFLAECHEBESONDERERZWECKBESTIMMUNG_ab22cd45-470c-4fa2-bc7d-1ed60f26416b-0" srsName
            ="http://www.opengis.net/def/crs/EPSG/0/4258" srsDimension="2">
            <gml:surfaceMember>
                <gml:Surface gml:id="XPLAN_BP_VERKEHRSFLAECHEBESONDERERZWECKBESTIMMUNG_ab22cd45-470c-4fa2-bc7d-1ed60f26416b-1">
                    <gml:patches>
                        <gml:PolygonPatch>
                            <gml:exterior>
                                <gml:LinearRing>
                                    <gml:posList>53.5425293499906 9.9876671332063 53.5425114618263 9.98739718580293 53.542553055154 9
                                        .98738941590675 53.5425715825523 9.98765924263011 53.5425293499906 9.9876671332063</gml:posList>
                                </gml:LinearRing>
                            </gml:exterior>
                        </gml:PolygonPatch>
                    </gml:patches>
                </gml:Surface>
            </gml:surfaceMember>
        </gml:MultiSurface>
    </plu:geometry>
    <plu:hilucsLandUse xlink:href="http://inspire.ec.europa.eu/codelist/HILUCSValue/4_1_5_OtherTransportNetwork"/>
    <plu:beginLifespanVersion nilReason="other:unpopulated" xsi:nil="true"/>
    <plu:hilucsPresence nilReason="other:unpopulated" xsi:nil="true"/>
    <plu:specificLandUse xlink:href="http://daten-hamburg.de/inspire/codelist/LandUseClassificationValue_Extension
        .xml#3_53_4_RadFussweg"/>
    <plu:specificPresence nilReason="other:unpopulated" xsi:nil="true"/>
    <plu:regulationNature xlink:href="http://inspire.ec.europa.eu/codelist/RegulationNatureValue/generallyBinding"/>
    <plu:endLifespanVersion nilReason="other:unpopulated" xsi:nil="true"/>
    <plu:processStepGeneral xlink:href="http://inspire.ec.europa.eu/codelist/ProcessStepGeneralValue/elaboration"/>
    <plu:backgroundMap nilReason="other:unpopulated" xsi:nil="true"/>
    <plu:officialDocument xsi:nil="true"/>
    <plu:plan xlink:href="#XPLAN_BP_PLAN_24a7e067-6a06-4551-991b-171d05378d25"/>
</plu:ZoningElement>
```

Figure 6. Snapshot of part of a GML file showing the attributes for a "ZoningElement" object within the INSPIRE "Planned land use" application schema.

4. The MSP INSPIRE data model

The "MSP INSPIRE data model" basically adapts the INSPIRE "Planned Land Use" application schema to better meet the information characteristics of the maritime activities of the Maritime spatial plans. Its main modifications affect the "ZoningElement" object (see Figure 7). The rest of the objects remain invariable.

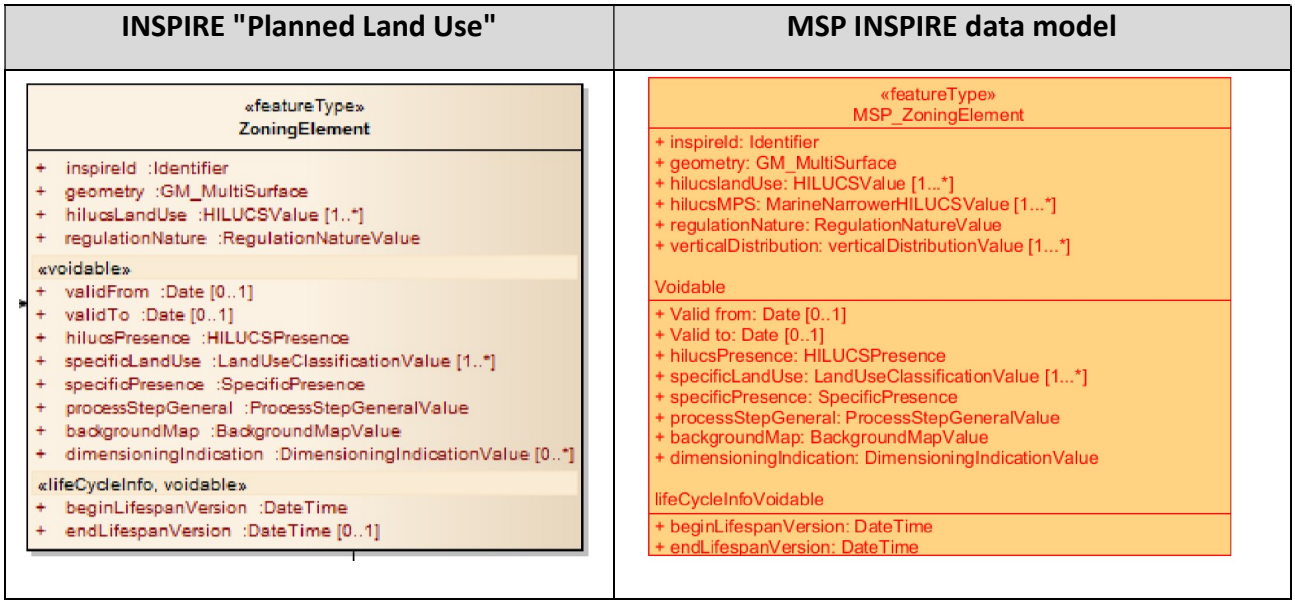


Figure 7. Comparison of the INSPIRE planned land use ZoningElement and the MSP_ZoningElement in the MSP INSPIRE model.

The modifications and proposals of the MSP data model are the following:

i. **The use of an extended HILUCs codelist as a reference source to better characterize the maritime activities.**

The "Hierarchical INSPIRE Land Use Classification System (HILUCS)", includes a three hierarchic level classification system of 98 use categories. However, this codelist provides too general, non-specific information, not closely enough to characterize all possible maritime uses.

INSPIRE "*Planned land use*" model also includes the voidable "specificLandUse" attribute to be filled in with elements from a list of land use categories agreed at a national or local level. The CodeList to be used as a reference in this attribute is empty in the INSPIRE context and must be extended by each data provider in their national codeList register. The use of this field could be useful to better specify or characterise the maritime activities, but as it is voidable and possibly used to code the activities according to internal national or local codelists, it would not serve the purposes of cross border comparability.

Therefore, the **MSP INSPIRE data model** propose the creation of a new "hilucsMPS" mandatory attribute to be filled out with the elements from an **extended HILUCs codelist** with additional hierarchical levels. This new vocabulary has been developed and published as a registry in http://www.geoportal.ulpgc.es/registro/plannedLandUse/HilucsExt/.

ii. New "VerticalDistribution" attribute added.

The vertical (Z) dimension of occurrence of some marine uses is not considered under the INSPIRE "*Planned land use*" model. Therefore, the MSP model proposes to add a new non-voidable attribute named "*verticalDistributionValue*" to characterise the vertical distribution of activities.

This attribute would use the elements of a proposed new "Vertical Distribution" codelist also available in the ECOAQUA registry (see Figure 8). This codelist includes as distinct values, all potential combinations of the three main elements defined ("*sea surface*", "*water column*", and "*sea bed*")

Figure 8. Values included in the vertical distribution codelist of the ECOAQUA vocabularies registry (www.ecoaqua.eu).

iii. Proposal of a common style file to represent the maritime uses (SLD Portrayal)

Maritime spatial planning processes require information in a cross-border context. Therefore, the representation of this information should be common in its content, structure and symbology.

Therefore, under the MARSP project, the Spanish Institute of Oceanography (IEO) has developed a Styled Layer Descriptor (SLD) file based on a set of symbols to represent all elements included in the extended HILUCS developed by ECOAQUA.

A SLD file defines an encoding to allow the users to define a symbolisation and colouring of geographic feature and coverage data. SLD is an OpenGIS® standard.

After the search and testing of existing symbologies for marine cartography, a specific and adapted SLD symbology was proposed for the MSP INSPIRE model. This symbology has been devised based on the structured Hierarchical INSPIRE Land Use Classification System (HILUCS) and its six main land use categories. A general colour or tone for each of the six main classes was assigned. With this in mind, all symbols within these categories should have a similar tone (see Figure 9). Different pattern or geometrical frame styles were assigned to the next level within the hierarchical structure (see Figure 9).

A more detailed description of this SLD can be found in the "MSP INSPIRE data model" specifications documentation, and the SLD file can be downloaded at the Tools section of the MSP platform Canaries (http://www.geoportal.ulpgc.es/marsp/).

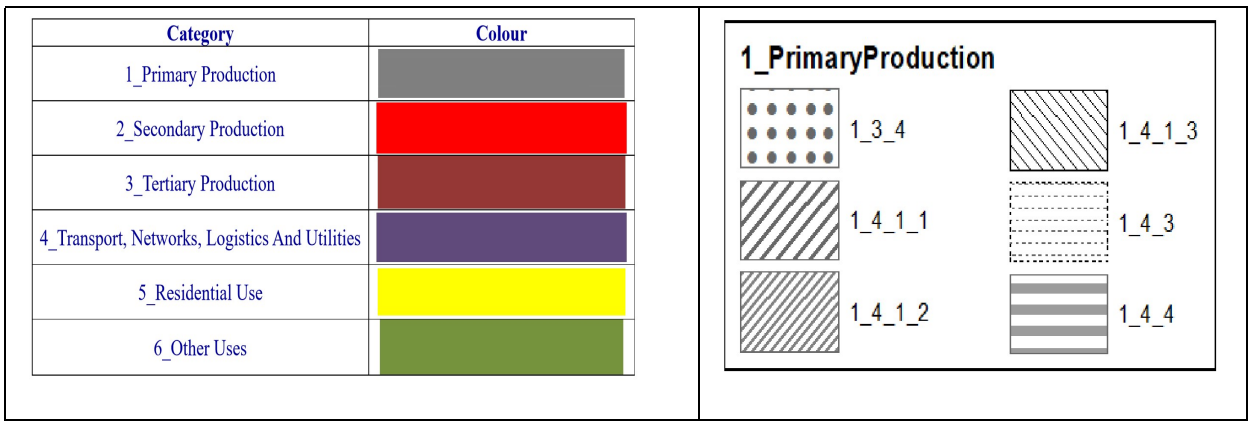


Figure 9. Examples of **Styled Layer Descriptor (**SLD) symbology created for MSP INSPIRE model.

5. Alignment and applicability of the EMODnet's Human activities to the "Land Use" and MSP application schemas.

According to the definitions provided in section 3, EMODnet human activities datasets are better conceptually aligned to the "existing" land use models than to the "planned land use" model.

EMODNET's datasets represented by locations (point vector layers) could use the "Sampled Land Use" model, whereas activities represented with areas or polygons could use the "Existing Land Use". Raster datasets should use the "Gridded Land Use". However, there is not in INSPIRE an object dedicated to polylines geometries used to represent uses such as cables or pipelines.

The differences among the Land Use models and the MSP model affect just to a limited amount of attributes (see Figure 10). Therefore, the alignment of EMODNET's datasets to Land Use models could be easily derived to the alignment to MSP model.

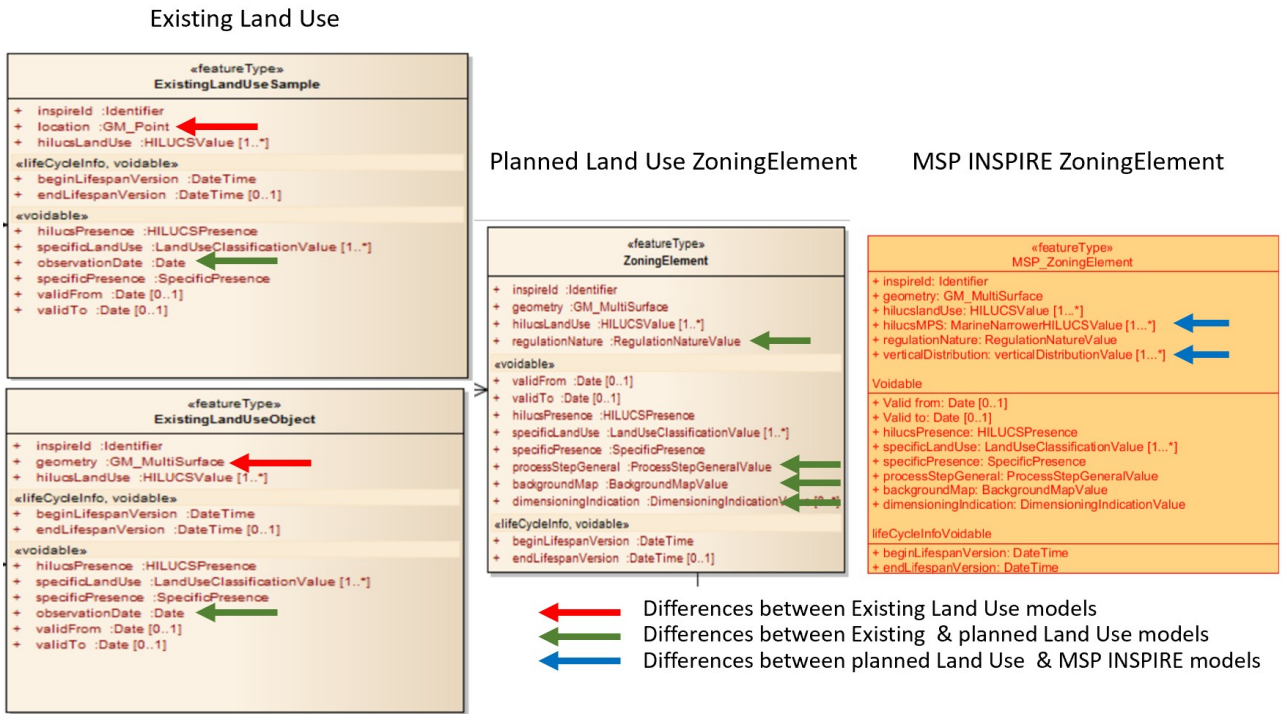


Figure 10. Differences between INSPIRE Land Use models and the MSP model.

From the full list of EMODNET's human activities datasets, those that are assignable to the INSPIRE Land Use application schemas, those that could be potentially assigned and those that are not assignable have been identified (see Table 5).

Moreover, for those that are assignable, the best fit codes from INSPIRE HILUCS and MSP extended HILUCS codelists have been identified.

As referenced in the "MSP INSPIRE data model" specifications document, the HILUCSLandUSe codelist items often are too general to characterize the features from different datasets and, although the proposed HILUCS extended vocabulary includes more specific items that are applicable in some datasets, it does not include specific items for all of them.

This first analysis shows that EMODnet's datasets already include the compulsory information needed to comply with INSPIRE Land Use schemas (location, localid and HILUCSLandUse). Besides, some EMODnet's datasets also include information required for "validfrom" and "validto" and "endlifespanversion".

However, these datasets also include accessory information that will be left out when harmonised to INSPIRE Land Use application schemas. The omission of some of this information is not crucial as may be derived by spatial analysis (I.e. distance to coast, area country, etc), but information in other attributes providing information on the activity cannot be retrieved when using the INSPIRE schema.

Based on these results, it has been decided to produce an INSPIRE compliant dataset from EMODnet's assignable datasets, to complement the catalogue of datasets provided by EMODnet human activities portal.

Title	App Schem	HILUCS_Value	HILUCS_MSP_Value
Aggregate Extraction Areas	ELU	1_3_3_OtherMiningAndQuarrying	
Ocean Energy - Test Sites	ELU	2_4_4_RenewableEnergyProduction	2_4_4_4_RenewableEnergyProductionWave
Wind Farms (Polygons)	ELU	2_4_4_RenewableEnergyProduction	2_4_4_1_RenewableEnergyProductionWind
BSH CONTIS Cables	ELU	3_2_3_InformationAndCommunicationServices	
maltacables	ELU	3_2_3_InformationAndCommunicationServices	4_3_5_2_SubmarineCableTelecom *
SIGCables Submarine Cables Ro	ELU	3_2_3_InformationAndCommunicationServices	4_3_5_2_SubmarineCableTelecom *
Telecommunication Cables (sch	ELU	3_2_3_InformationAndCommunicationServices	4_3_5_2_SubmarineCableTelecom *
Pipelines	ELU	4_3_Utilities	4_3_1_2_OilLine *,4_3_1_2_GasLine *
Dredge Spoil Dumping (Polygon	ELU	4_3_3_WasteTreatment	4_3_3_1_SolidWasteTreatment.html
Dumped Munitions (Polygons)	ELU	4_3_3_WasteTreatment	4_3_3_1_SolidWasteTreatment.html
Aggregate Extraction	SLU	1_3_3_OtherMiningAndQuarrying	
Dredging	SLU	1_3_3_OtherMiningAndQuarrying	
Finfish Production	SLU	1_4_1_Aquaculture	1_4_1_1_AquacultureSeaWater *
Freshwater Production	SLU	1_4_1_Aquaculture	1_4_1_1_AquacultureFreshWater *
Shellfish Production	SLU	1_4_1_Aquaculture	1_4_1_1_AquacultureSeaWater
Macroalgae (seaweeds)	SLU	1_5_OtherPrimaryProduction	1_4_3_SeaweedCultivation *
Microalgae	SLU	1_5_OtherPrimaryProduction	1_4_3_SeaweedCultivation *
nuclear	SLU	2_4_1_NuclearBasedEnergyProduction	
Active Licences	ELU	2_4_2_FossilFuelBasedEnergyProduction	
Boreholes	SLU	2_4_2_FossilFuelBasedEnergyProduction	
Offshore Installations	SLU	2_4_2_FossilFuelBasedEnergyProduction	
Wind Farms (Points)	SLU	2_4_4_RenewableEnergyProduction	2_4_4_1_RenewableEnergyProductionWind
Cables - Landing Stations	SLU	3_2_3_InformationAndCommunicationServices	4_3_5_2_SubmarineCableTelecom *
Lighthouses	SLU	3_4_1_CulturalServices	
State of Bathing Waters	SLU	3_4_4_OpenAirRecreationalAreas	3_4_6_MaritimeServices */3_4_6_2_Beach
Main Ports (Locations Only)	SLU	4_1_4_WaterTransport	
Dredge Spoil Dumping (Points)	SLU	4_3_3_WasteTreatment	4_3_3_1_SolidWasteTreatment.html
Dumped Munitions (Points)	SLU	4_3_3_WasteTreatment	4_3_3_1_SolidWasteTreatment.html
UWWTD Treatment plants	SLU	4_3_3_WasteTreatment	
UWWTD Discharge points	SLU	4_3_3_WasteTreatment	
Vessel traffic	GELU	4_1_4_WaterTransport	
Fish Catches by FAO Fishery Statistical Areas (Division Area)	SLU/su-vector/AM?	1_4_2_ProfessionalFishing	
Fish Catches by FAO Fishery Statistical Areas (Major Area)	SLU/su-vector/AM?	1_4_2_ProfessionalFishing	
Fish Catches by FAO Fishery Statistical Areas (Sub-area	SLU/su-vector/AM?	1_4_2_ProfessionalFishing	
Fish Catches by FAO Fishery Statistical Areas (Sub-division	SLU/su-vector/AM?	1_4_2_ProfessionalFishing	
Fish Catches by FAO Fishery Statistical Areas (Sub-unit	SLU/su-vector/AM?	1_4_2_ProfessionalFishing	
Ocean Energy - Project Location	SLU/PLU	2_4_4_RenewableEnergyProduction	2_4_4_4_RenewableEnergyProductionWav
wrecks	SLU/PS	3_4_1_CulturalServices	3_4_7_UnderwaterCulturalHeritage
Main Ports (Goods Traffic)	SLU/SU-VECTOR	4_1_4_WaterTransport	4_1_4_2_CommercialPort *
Main Ports (Passengers Traffic)	SLU/SU-VECTOR	4_1_4_WaterTransport	4_1_4_3_CruisesFerriesPort *
Main Ports (Vessles Traffic)	SLU/SU-VECTOR	4_1_4_WaterTransport	
Waste at Ports	SLU/SU-VECTOR	4_3_3_WasteTreatment	4_3_3_1_SolidWasteTreatment, 4_3_3_4_MarineOilDischarge
Advisory Councils (Aquaculture)	AM		
Advisory Councils (Baltic)	AM		
Advisory Councils (Black Sea)	AM		
Advisory Councils (Long Distanc	AM		
Advisory Councils (Market)	AM		
Advisory Councils (Mediterrane	AM		
Advisory Councils (North Sea)	AM		
Advisory Councils (North Weste	AM		
Advisory Councils (Outermost R	AM		
Advisory Councils (Pelagic Stock	AM		
Advisory Councils (Southwester	AM		
Barcelona Convention	AM		
Bucharest Convention	AM		
Exclusive Economic Zone	AM		
HELCOM Maritime Area	AM		
ICES Statistical Areas	AM		
Maritime Boundaries	AM		
OSPAR Maritime Area	AM		
reportingunits	AM		
cddaareas	PS		
Nationally Designated Areas	PS		
Natura 2000	PS		
natura2000areas	PS		
First Sales of Fish	SU-VECTOR		

Table 5. List of EMODnet's Human activities datasets and identification of those potentially assignable INSPIRE Land Use application schemas with applicable HILUCS and MSP extended HILUCS codes. Green cells: assignable, Yellow cells: potentially assignable, Red cells: Not assignable. ELU: Existing Land Use, SLU: Sampled Land Use, GELU: Gridded Land Use, AM: Areas Management & RestrictionZones, PS: Protected Sites, SU-VECTOR: Statistical Units Areas vector.

6. Harmonisation of EMODNET's human activities datasets and generation of INSPIRE Land Use compliant GML files

The original EMODNET layers identified as assignable to INSPIRE land use theme have been harmonised to the INSPIRE "Sampled Land Use" model.

This model, applicable for point geometries, has been chosen because most datasets in EMODnet human activities are point layers. Just a few of them are polygon-type or polyline-type. Moreover, datasets represented with polygons often are complementary to another layer of the same theme whose geometries are represented with points (I.e. dredged spoil dumping points and dredged spoil dumping polygons). Vessel traffic dataset, being of raster type, has not been included in this harmonisation process.

The harmonisation process involves several changes and amendments made to original EMODnet's human activities datasets downloaded from the EMODnet's WFS Service link (http://77.246.172.208/geoserver/emodnet/wfs?VERSION=1.1.0) and stored in disk as shapefiles.

The main changes include:

1. Geometrical transformations to points: centroids have been extracted from polygon datasets and vertices from polyline datasets.
2. Creation of new fields to include INSPIRE attribute values and transfer the mapped information from original datasets. In this step, "localid" and "specificlanduse" attributes have been filled in with values concatenating several original attributes with important information to minimize the loss of information from original datasets. Nevertheless, this approach is rather artificial and has followed subjective criteria that may be revised or discarded. Table 6 shows the criteria set to fulfil these INSPIRE attributes.
3. Whenever available in the original dataset, "validfrom" and "validto" have been fulfilled with information on starting and ending activity dates. In the original datasets these dates are shown as characters with different formats ('2020', '2019-01-07',02/03/2015, etc). Thus, these characters have been transformed to dates before inserting them in the INSPIRE date attributes. When only the year information was available the date was considered as the 1st of January if start date and as 31st of December if end date.
4. In some datasets the information of last update date was included. This information has been included in the INSPIRE "endlifespanversion" attribute. The same kind of transformations made for "validto" and "validfrom" attributes have been done for this one.
5. Select and add HILUCSLandUse from the INSPIRE HILUCSLandUse codelist.
6. The "specificLandUse" attribute has been filled in with MSP HILUCS extended codelist if a specific enough item was found. If not, a "specific land use" value was created to clearly identify the record and add important information from original fields (cf. **Table 6**).

EMODNE's HA Layer name	geometric processing	localid	HILUCS_Value	SpecificlandUse
Aggregate Extraction Areas	polygons Centroids,	concat("country" ,'/', "areaid")	1_3_3_OtherMiningAndQuarrying	concat('Marine sediments extraction for' "end_use")
Aggregate Extraction			1_3_3_OtherMiningAndQuarrying	
Dredging		concat("country" ,'/', "areaid")	1_3_3_OtherMiningAndQuarrying	concat("extraction_type" ,'/end_use: ', "end_use")
Dredge Spoil Dumping (Polygons)	polygon centroids		4_3_3_WasteTreatment	
Dredge Spoil Dumping (Points)		concat("country" ,'/', "objectid")	4_3_3_WasteTreatment	concat('dredge dumping site: ', "status").
Dumped Munitions (Points)	polygons Centroids,	to_string($id).	4_3_3_WasteTreatment	concat('munition dumping site: munition type: ', "munition_typ
Dumped Munitions (Polygons)		to_string($id).	4_3_3_WasteTreatment	concat('munition dumping site: munition type: ', "munition_typ
Main Ports (Locations Only)	Merge points and	"port_id"	4_1_4_WaterTransport	4_1_4_3_CruisesFerriesPort and/or 4_1_4_2_CommercialPort
Main Ports (Goods Traffic)				4_1_4_2_CommercialPort
Main Ports (Passengers Traffic)				4_1_4_3_CruisesFerriesPort
Waste at Ports				4_1_4_3_CruisesFerriesPort and/or 4_1_4_2_CommercialPort
Pipelines	polyline vertices	concat("country" ,'/', "operator" ,'/', "status",'/',"objectid")	4_3_Utilities	concat('Pipeline/',"medium")
BSH CONTIS Cables	polyline vertices	concat('Submarine cables/ BSH_contis_cables /',$id)	3_2_3_InformationAndCommunicationServ	4_3_5_2_SubmarineCableTelecom *
maltacables		concat('Submarine cables/Malta cables/',$id)	3_2_3_InformationAndCommunicationServ	4_3_5_2_SubmarineCableTelecom *
SIGCables Submarine Cables		concat('Submarine cables/SIG_cables/',$id)	3_2_3_InformationAndCommunicationServ	4_3_5_2_SubmarineCableTelecom *
Telecommunication Cables		concat('Submarine cables schematic/ Telegeography /',"owners",'/',"id")	3_2_3_InformationAndCommunicationServ	4_3_5_2_SubmarineCableTelecom *
Cables - Landing Stations		concat('Submarine cables landing stations/,"source",'/',$id)	3_2_3_InformationAndCommunicationServ	4_3_5_2_SubmarineCableTelecom *
Wind Farms (Points)		concat("country" ,'/', "status" ,'/', "power_mw" ,'mw/', format_number("dist_coast" /1000,	2_4_4_RenewableEnergyProduction	2_4_4_1_RenewableEnergyProductionWind *
Ocean Energy - Test Sites		concat("country" ,'/', "status" ,'/', "capacitykw" ,'kw/', "testsite")	2_4_4_RenewableEnergyProduction	2_4_4_4_RenewableEnergyProductionWave", "2_4_4_1_RenewableEnergyProductionWind", or "2_4_4_5_RenewableEnergyProductionTidal"
Ocean Energy - Project Locations		concat("country" ,'/', "status" ,'/', "project_ca" ,'kw/', "facid")	2_4_4_RenewableEnergyProduction	
Boreholes		concat("country" ,'/', "status" ,'/', "purpose",'/',"code")	2_4_2_FossilFuelBasedEnergyProduction	"Hydrocarbon"
Active Licences		concat("country" ,'/', "operator" ,'/', "type",'/',"code")	2_4_2_FossilFuelBasedEnergyProduction	'Active licences for hydrocarbons'
Offshore Installations		concat("country" ,'/', "operator" ,'/', "type",'/',"code")	2_4_2_FossilFuelBasedEnergyProduction	concat('Offshore_installation/',"function" ,'/', "primary_pr")
nuclear		concat("country" ,'/', "reactor_nm" ,'/',"operator",'/',"status",'/',"the_cap_mw_tot",'mw')	2_4_1_NuclearBasedEnergyProduction	concat('nuclear energy production/',"model",'/',"type",'/',"fuel'
Finfish Production		concat("country" ,'/', "owner_name" ,'/', "status",'/',"finid")	1_4_1_Aquaculture	concat('finfish/', "species_detailed" ,'/', "production_meth" ,'/
Shellfish Production		concat("country" ,'/', "owner" ,'/', "status",'/',"site_id")	1_4_1_Aquaculture	concat('shellfish/', "species" ,'/', "prod_method" ,'/', "purpose
Macroalgae (seaweeds)		concat("country" ,'/', "owner_name")	1_5_OtherPrimaryProduction	concat('macroalgae/', "prod_meth")
Microalgae		concat("country" ,'/', "owner_name")	1_5_OtherPrimaryProduction	concat('microalgae/', "prod_meth")
State of Bathing Waters		concat("country" ,'/', "bwname",'/'."objectid").	3_4_4_OpenAirRecreationalAreas	concat('Bathing waters/state:', "class").
Lighthouses		concat("country" ,'/', "arlhs_number").	3_4_1_CulturalServices	concat('Lighthouses/status:', "status")
UWWTD_Treatment_Plants		"uwwCode"	4_3_3_WasteTreatment	concat('Urban waste treatment plant/',"treatment",'/capacity:',
UWWTD_Discharge_points		"uwwCode"	4_3_3_WasteTreatment	concat('Urban waste discharge point/', "dcpWBType" , '/',"dcpS

Table 6. Criteria used to fill in the INSPIRE sampled land use localid, HILUCSValue and SpecificLandUse attributes from original EMODnet's human activities related datasets.

7. Once transformed, all harmonised layers have been merged into a single EMODnet's INSPIRE sampled Land Use dataset ready to be published online via INSPIRE compliant web services.

8. To encode this shapefile as a complex feature GML file, as required by INSPIRE, GEOSERVER and its App-schema plugin have been used. A mapping xml file that will transform this shapefile in an INSPIRE compliant complex feature GML generated by the GEOSERVER WFS Web service has been created. Details of this process are provided in annexes B and C.

9. This attempt has also been made from the dataset in geopackage format, but it has been found that app schema plugin did not work for transformation of this format.

   In any case, shapefile format has also some inconveniences for the harmonisation process to INSPIRE. In particular, its field name limitation to 10 characters avoids using the full names of INSPIRE models that often are longer that 10 characters. The recently arose **OGC GeoPackage (GPKG)** format has very interesting characteristics as an easy to use file format for GIS data. shows the pros and cons of geopackage and shapefile formats (cf. Table 7)

Geopackage	**ESRI Shapefile**
Pros: ✓ OPEN ✓ OGC standard ✓ Broadly implemented (GDAL, QGIS, R, Python, Esri, …) ✓ More lightweight than a real geodatabase, but as fast as a geodatabase ✓ Everything is contained in a single file -> easier file management with GeoPackage than with Esri Shapefile ✓ Faster work-flow than with Shapefiles. ✓ There are nearly no limitations *Cons*: ⚠ Relatively young (Encoding Standard (1.0) adopted by OGC in 2014). (But honestly, that's not a	*Pros:* ✓ It is a defacto standard and well established ✓ It's iconic (Shapefiles Twitter) *Cons:* ⚠ It is proprietary (closed and controlled by Esri) ⚠ It is relatively sluggish ⚠ It is a multifile format (.shp,.dbf.,.shx,.prj, encoding, other indexes, etc.) (everybody knows the problem with GIS newbies sending you solely the .shp…) ⚠ Attribute names are limited to 10 characters ⚠ No ability to store topologies in the files ⚠ Uses Esris WKT. Can result in

real con…) ⚠ Raster support is relatively limited (personal experiences in QGIS)	inconsistencies ⚠ File size is restricted to 2 GB ⚠ It can only contain one geometry type per file. ⚠ No real 3D support

Table 7. Pros and cons of geopackage and shapefile formats for GIS data storage. Source: https://www.gis-blog.com/geopackage-vs-shapefile/.

10. This GML has been validated with the online INSPIRE ETF validator (see annex D). The analysis report throws a unique error related with the absence of validTo or validFrom values. As the original datasets do not include this information, subsanation of this error is not possible.

11. Nevertheless, the service of the INSPIRE layers produced in Geoserver takes a lot more server resources (time and memory) to be served correctly, whereas the same dataset published in the same server in pre-INSPIRE shapefile or geopackage data sources are served much more efficiently.

12. All the resources created during this work have been published online along with a [web map](#) showing the created dataset, served (in its pre-INSPIRE format) through a Geoserver node (cf. Figure 11).

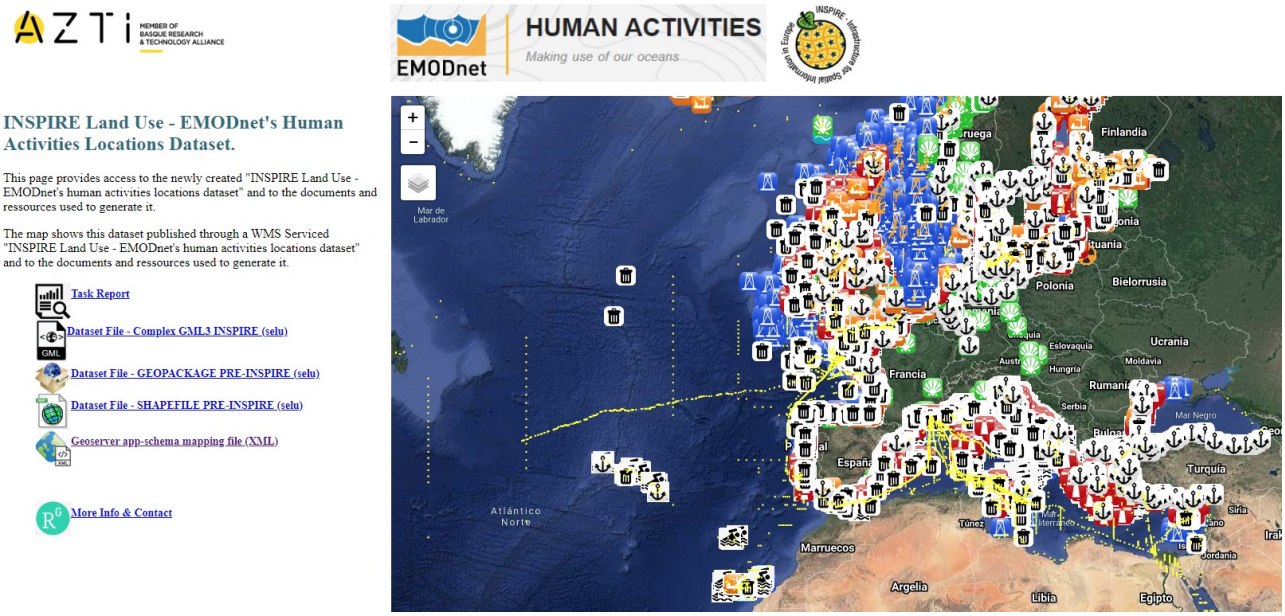


Figure 11. Web page publishing all resources generated during this work.

7. Recommendations and conclusions.

The main conclusions from this work are that the approach tested in this work, consisting in harmonising the EMODnet human activities datasets to the INSPIRE "Sampled Land Use" model is feasible and much more practical than harmonising these datasets to the several specific INSPIRE themes identified in our previous work.

However, some information from EMODnet's datasets is lost when applying the Land Use model due to the lack of INSPIRE attributes to include associated activity information to each location.

Moreover, the characterisation of the Uses or Activities by the "HILUCSLanduse" codelist remains too general to well identify the activities represented.

The harmonisation to the MSP model proposed by MARSP would partially overcome the activities identification problem by using the "HILUCS extended" vocabulary, but not totally. Using this model would also add the advantage of identifying the vertical realm of the activity locations, which can be considered useful but not crucial.

An advantage found in this process is that common information from all human activities' datasets in EMODnet has been harmonised and gathered. However, the encoding phase to achieve INSPIRE encoding requirements has been found complex and not efficient at all.

Finally, this work has been useful to identify issues that could be improved both in EMODnet's and INSPIRE current models to make data more coherent, comprehensive, and useful. The description of these issues and the recommendations for improvement are provided hereafter.

a. EMODnet's datasets.

I. **Definition and usage of common field names, field types and formats** for the concepts "Activity Start Date", "Activity End Date", "Date of first version of the dataset" and "Date of last update of the dataset".

   Presently different names are provided for this information in different datasets, and not all of them have this information. Moreover, when available, these fields are string type fields filled in with different formats (I.e. 2003,08-2008,08-07-2010, etc.)

   Our recommendation is to add these fields to ALL EMODnet's datasets as shown in Table 8.

Concept	Field Name	Field Type	Compulsory/Voidable
Activity Start Date	validfrom	Date	Voidable but highly recommended*.
Activity Start Date	validto	Date	Voidable but highly recommended*.
Date of first version of the dataset	beginlifespan	DateTime	Voidable
Date of last update of the dataset	endlifespan	DateTime	Compulsory

Table 8. Proposal for field harmonisation in EMODnet human activities datasets. (*)These fields may be used to give information on activity status (active, past, planned)

II. Create a common ID field implementing common coding criteria across al EMODnet's human activities datasets.

This **ID** field should include a unique identifier code for each record in one EMODnet dataset and remain unique across all the EMODnet datasets. Ideally, this code should allow traceability of each record between the original source and the possible derived datasets.

Source data (Id) → *EMODnet Dataset(Id)* → *Derived datasets(Id)*

In the **Table 9** below some possible examples are provided:

Coding criteria	Examples
ORIGINAL_ID (from source data I.e IHO Port ID, EEA waterbodyId, UWWCode)	ESBIO (ports)
DATASET_CODE/ORIGINAL_ID	EMODNET_HA_PORTS/ESBIO DOI{EMODNET_HA_DREDG}/ DOI{EMODNET_HA_BATHING}/
EMODNET_HA/DATASET_CODE/COUNTRY/ORIGINAL_ID	EMODNET_HA/PORTS/ES/ESBIO

Table 9. Examples of criterio for unique identifiers in EMODnet human activities datasets.

III. Get a DOI for each EMODnet human activity dataset.

Concerning the traceability of datasets, a good option could be to get a DOI identifier for each dataset in order to allow citing the EMODnet datasets when used and being referenced when derived datasets or studies are generated from them.

Presently there are several platforms providing DOIs for datasets (Datacite, Researchgate, zenodo, ArXiv…).

IV. Use common codes for "country" and other fields using codelists.

Some EMODnet datasets use country names and some country codes and names. A common criterion across all datasets is recommended. INSPIRE recommendations for country codes is the following: https://op.europa.eu/en/web/eu-vocabularies/at-dataset/-/resource/dataset/country .

Other fields in EMODnet's human activities datasets use codes that do not formally belong to published/registered codelists. The existence of formally defined (and even published codelists) is advisable especially in fields that appear in different datasets (I.e Status), where different terms are included for similar concepts.

V. Fields with geographical information (I.e. Latitude, Longitude, Area, Distance to coast):

Although the information of these fields can be easily extracted from the datasets by users using GIS, there inclusion is justified for users that only "view" these data and do not want to download and analyse it.

Nevertheless, it is highly advisable that these fields share the same field name and field type. Units should be common across datasets and may be expressed in the fieldname (i.e. Area_sqkm, Lat_dd, dist_coast_km, Botdepth_m…).

b. INSPIRE Land Use application schemas

I. Develop and extend the HILUCSLandUse codelist.

During this work, the same conclusion that the one presented in the MarSP project's work has been achieved: The current version of HILUCSLandUse codelist is too broad to characterise many maritime uses. As a result, several distinct EMODnet human activities datasets share the same HILUCs codes and cannot be properly identified.

The MarSP project proposes a new nonvoidable HILUCSext field to include more specific items from an extended version of HILUCSLandUse codelist, probably motivated by the difficulties (mainly procedural) to formally extend the official HILUCSLandUse codelist. Nevertheless, this extended HILUCS codelist is still not specific enough for some uses included in the EMODnet human activities datasets.

Consequently, a flexibilization of the procedures to extend the official HILUCSLandUse codelist is highly recommend and it should be extended to cope with uses in the marine realm in order to better converge to INSPIRE compliance rather that applying a pseudo-INSPIRE model. The extended HILUCS land Use proposed by MarSP could be a good starting point for it.

II. New Encoding formats or tools to convert templates in common file formats to INSPIRE GMLs.

From our gained experience in this work, the encoding phase to complex feature GML has been by far the most complicated and time consuming one.

The reasons for this include the unsuitability of many commonly used tools to properly handle this format, the unfriendly reference documentation and the scarcity and scattered availability of concrete examples implementing INSPIRE models from real-world datasets.

Moreover, the performance of commonly used OGC web services provider to serve data in this complex GMLs is worse than the performance to server data in other more commonly used formats.

Thus, from our perspective it would make much sense to convert complex features models to simple features models, and to be able to encode them in the most used formats used by data providers and managers.

Moreover templates for INSPIRE models in these formats would highly help to harmonise existing datasets to INSPIRE models and consequently, converge more rapidly to a pan-European spatial data infrastructure, that at the moment, is taking much time and efforts to be achieved due to its technical complexity.

III. INSPIRE Models information scope.

Another issue encountered in this and the preceding work made in EMODnet human activities project related to INSPIRE, concerns the alignment of the information included in the EMODnet datasets against the INSPIRE proposed models.

In both studies it was observed that it is difficult, even impossible, to find a direct alignment from EMODnet's dataset to a single INSPIRE model.

In this work, the harmonization of most EMODnet's human activities location information to the "INSPIRE sampled existing land Use model" has been achieved, but still much information included in the EMODnet human activities has had to be discarded in the INSPIRE-compliant dataset (even if some of this has been artificially inserted in fields like "localid" and "specificlandUse" fields).

To overcome this difficulty, some alternatives are proposed below:

- The possibility of mixing features and attributes from different application schemas. This is already partially done with features from base models. In our case, this would mean to add to the land Use models attributes, attributes from other thematic models (cf. example Figure 12 below).

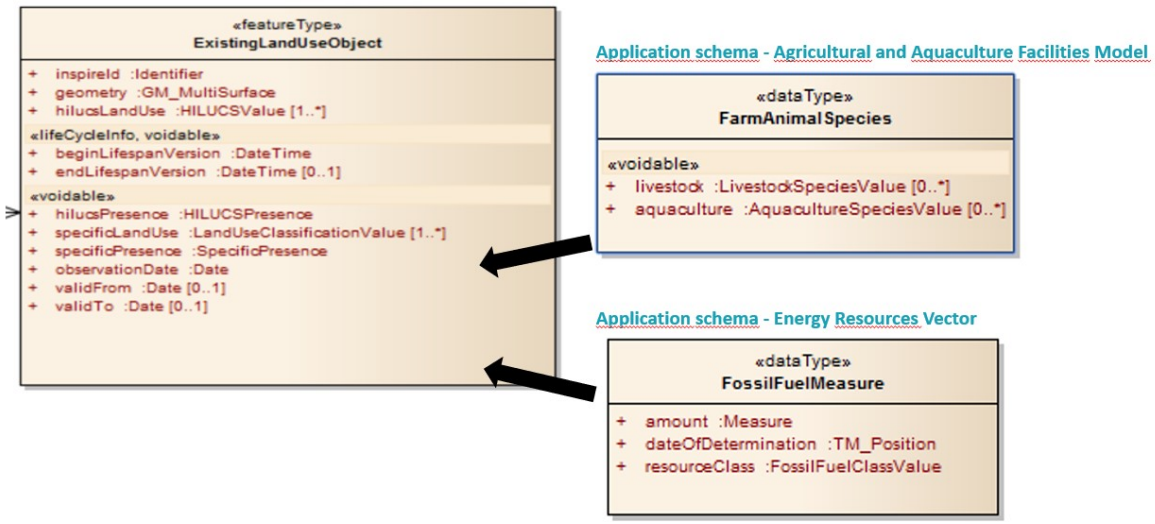
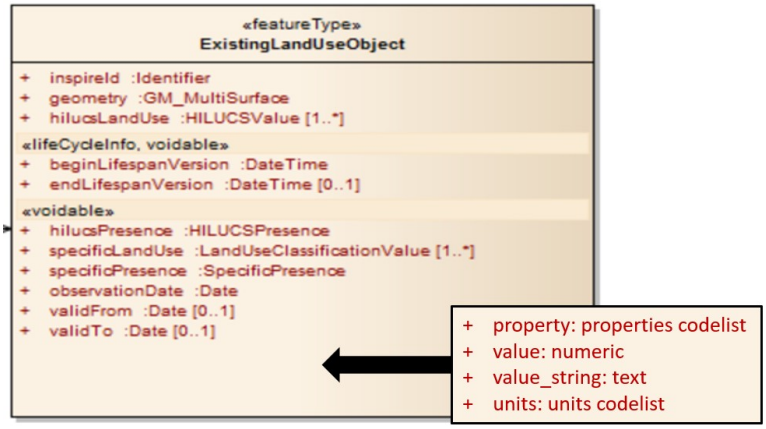


Figure 12. Example figure representing the possibility of mixing attributes from different features in different INSPIRE application schemas to hold information from original datasets.

- The possibility of model extension with user defined attributes that allow completeness of information available by data producer.

  This is the approach followed by the MSP-INSPIRE proposed model in MARSP, that proposes some extended attributes to cope with the needed information for maritime spatial plans (cf. Figure 7)

- The possibility of model extension with INSPIRE approved unspecific attributes to hold properties related to the geometric object (cf. as example Figure 13 below). This approach could be used in other INSPIRE themes and models too.



Examples:

Properties	value	value_string	units
Capacity	1000		KW
Material	NULL	sand	
Species	NULL	Oyster	
Production	1000	NULL	tonnes_per_ye
Discharge	200	NULL	litres_per_day
Water_quality	NULL	Good	

...

Figure 13.Example figure representing the possibility of extending Land use features with general or unspecific attributes.

From the EMODnet human activities project perspective, the last approach would be the recommended, as the first alternative is difficult to implement in a coherent manner, the second one could be suitable but would not be synergic to the INSPIRE principle as it would mean to multiplicate models schemas, and thus restrict interoperability across themes.

This last alternative would provide the simplicity and flexibility needed to add all the information available for each human activity geometry. For that, most of the effort should be devoted to select applicable codelists for "properties", "units" and "value_string" elements.

IV. Models for different vector geometry types.

Land Use Theme include distinct models for existing uses represented by points or polygons, lacking a model for uses represented by polylines. A unique model for all type of vector geometries with a geometry attribute including the binary geometries representing the spatial object could be more coherent.

ANNEX A. Field mapping analysis

In this annex the changes and amendments made to original EMODnet's human activities datasets, downloaded from the EMODnet's WFS Service link (http://77.246.172.208/geoserver/emodnet/wfs?VERSION=1.1.0) and stored in disk as shapefiles, are provided.

These changes include:

- Geometrical transformations to points if needed: centroids have been extracted from polygon datasets and vertices from polyline datasets.
- Creation of new fields for INSPIRE attributes and transfer the mapped information from original datasets and from the HILUCSLandUse and HILUCS extended codelists.
- Merge all harmonised single layers to a single EMODnet's INSPIRE Sampled Land Use dataset ready to be published online via INSPIRE compliant web services.

The descriptions of changes made include tables illustrating the mapping criteria used to associate original fields and Land Use INSPIRE attributes. These mapping tables include a field with an evaluation of conservation/loss of information from original datasets expressed with the keys shown in Table 10.

	Field whose values are reflected in any of the INSPIRE Land use model attributes.
	Field whose values won't be reflected in the new INSPIRE attributes but its omission does not necessarily imply loss of information, as this info can be extracted through spatial analysis.
	Field with no correspondence and not deductible, thus implies a loss of information when INSPIRE dataset will be generated.

Table 10. Keys used in mapping tables between EMODnet's original datasets and INSPIRE Land Use to evaluate information conservation/loss.

A. Aggregate Extraction

EMODnet's human activities include two datasets for aggregate extraction: one including locations (point layer) and the second one including polygons. Both layers include different attributes. These are the steps followed to be converted to INSPIRE compliant dataset:

- Centroids of polygons have been extracted to convert polygon's dataset to points layer.

- Then each dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (see Table 11 and Table 12).
- The new localid has been set concatenating information from various fields with the qgis formula: *concat("country" ,'/', "areaid")*.
- Hilucslanduse value has been set to "1_3_3_OtherMiningAndQuarrying". SpecificlandUse has been set to values from the formula: *concat ('Marine sediments extraction for' "end_use")* as no specific items were found in HILUCS extended vocabulary.
- Then both datasets have been merged and duplicate records (with duplicate values in all source fields) have been removed.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	code	560-BA	Identifier/localId
✓	material	Sand and gravel	specificlanduse
✓	country	Denmark	Identifier/localId
✓	year_start	2015	ValidFrom
✓	year_end	2025	ValidTo
✗	notes	Common areas (Fællesområder)	
✗	sourcetype	web page	
✗	sourcedeta	The Danish Environmental Protection Agency (Råstofindvinding på havet)	
✗	service	Shapefile	
✗	sourcelink	http://miljoegis.mim.dk/cbkort?profile=miljoegis-raastofferhavet	
✓	lastaccess	2019-06-03Z	endLifespanVersio
✗	metadavail	No	
✗	metalink	N/A	
!	seabasin	Baltic Sea	
!	x_centroid	12.13062881	
!	y_centroid	54.47784934	
!	coast_dist	13814	
✓	id	935	Identifier/localId
✗	site_type	Extraction area (in use)	
✗	status	Active	

Table 11. Mapping table between EMODnet's aggregate extraction polygons layer and INSPIRE land Use attributes.

Status	Field_name	Data example	INSPIRE LU attribute
!	id	255	
!	lat	54.899879	
!	long	12.048324	
✗	position_i	Original	
✓	country	Denmark	Identifier/localId
!	sea_basin	Greater North Sea	
!	distance	945	
✓	areaid	A-DK1896	Identifier/localId
✗	extraction_area	Grønsund	
✗	area_of_activity_km2	N/A	
✓	year_	2011	ValidFrom,validTo
✗	permitted_amount_m3	N/A	
✗	permitted_amount_t	N/A	
✗	requested_amount_m3	N/A	
✗	requested_amount_t	N/A	
✗	extracted_amount_m3	25937	
✗	extracted_amount_t	N/A	
✗	extraction_type	Marine sediment extraction	
✗	purpose	N/A	
✓	end_use	N/A	specificlanduse
✗	notes		
✗	source_type	web page	
✗	source_details	HELCOM Map and Data service - HELCOM HOLAS II Dataset: Extraction of sand and gravel (2017)	
✗	service_or_data_available	shapefile	
✗	link_to_web_sources	http://maps.helcom.fi/website/mapservice/index.html	
✓	date_of_last_access	43630	endLifespanVersion
✗	metadata_available	Yes	
✗	metadata_link	http://metadata.helcom.fi/geonetwork/srv/eng/catalog.search#/metadata/683224c3-2fb9-4f2f-b748-bf5ad712d708	

Table 12. Mapping table between EMODnet's aggregate extraction points' layer and INSPIRE land Use attributes.

B. Dredging

EMODnet's dredging human activities dataset includes a point's layer whose attributes are shown in Table 13. These are the steps followed to be converted to INSPIRE compliant dataset:

- Each dataset's attribute table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (see Table 13).
- The new localid has been set concatenating information from various fields with the formula: *concat ("country" ,'/', "areaid").*
- Hilucslanduse value has been set to "1_3_3_OtherMiningAndQuarrying". SpecificlandUse has been set to values from the formula: *concat ("extraction_type" ,'/end_use: ', "end_use")* as no specific items were found in HILUCS extended vocabulary.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✗	id	1	
!	lat	57.591943	
!	long	10.428084	
✗	position_i	Original	
✓	country	Denmark	inspireid/localid
!	sea_basin	Greater North Sea	
✓	areaid	D-DK106	inspireid/localid
✗	extraction_area	Ålbæk Harbour	
✓	year	1999	validfrom
✗	permitted_amount_m3		
✗	permitted_amount_t		
✗	extracted_amount_m3		
✗	extracted_amount_t	8100	
✓	extraction_type	Estuary dredging	specificlanduse
✗	purpose	N/A	
✓	end_use	Sea disposal	specificlanduse
✗	notes		
✗	source_type	web page	
✗	source_details	OSPAR (Dumping of Wastes or Other	
✗	service_or_data_availa	Database	
✗	link_to_web_sources	N/A	
✓	date_of_last_access	31/03/2015	endlifespan
✗	metadata_available	No	
✗	metadata_link	N/A	

Table 13. Mapping table between EMODnet's dredging point layer and INSPIRE land Use attributes.

C. Dredge spoil dumping

EMODnet's dredging spoil dumping includes a polygon and a point layer. Both datasets include the attributes shown in Table 14. These are the steps followed to be converted to INSPIRE compliant dataset:

- Each dataset's attribute table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (see Table 14).
- The new localid has been set concatenating information from various fields with the formula: *concat("country" ,'/', "objectid")*.
- Hilucslanduse value has been set to "4_3_3_WasteTreatment". SpecificlandUse has been set to values from the formula: *concat('dredge dumping site: ', "status")*. In HILUCS extended vocabulary the item "4_3_3_1_SolidWasteTreatment.html" could be used but still not specific enough. Thus we have filled in this attribute with the following formula: *concat('dredge dumping site: ', "status")*.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	objectid	810	inspireid/localid
✓	country	Germany	inspireid/localid
!	oscom_code		
!	depth__m_		
✓	status		specificlanduse
!	dist_coast	1583.15	
✓	updateyear	2007	endlifespan
✓	year_opera		validfrom

Table 14. Mapping table between EMODnet's dredge spoil dumping point and polygon layers and INSPIRE land Use attributes.

D. Dumping munitions

There are two layers for dumped munitions in EMODnet Human activities, one with polygons and another one for points. Both have the same attributes shown in Table 15. These are the steps followed to be converted to INSPIRE compliant dataset:

- Extract the centroids from the polygon's layer, merge the centroids with the points layer and remove duplicated points.
- The attribute table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (see Table 15).

- The new localid has been newly defined as no attribute from the source layers give identification information. Thus, the new localid has been newly generated with the qgis formula: *to_string($id)*.
- Hilucslanduse value has been set to "4_3_3_WasteTreatment". SpecificlandUse has been set to values from the formula: *concat ('munition dumping site: munition type: ', "munition_type")*. In HILUCS extended vocabulary the item "4_3_3_1_SolidWasteTreatment.html" could be used but still not specific enough. Thus the formula *concat ('munition dumping site: munition type: ', "munition_type")*, has been used to fill in this attribute.
- Resulting records have been appended to EMODNET_HA shapefile.

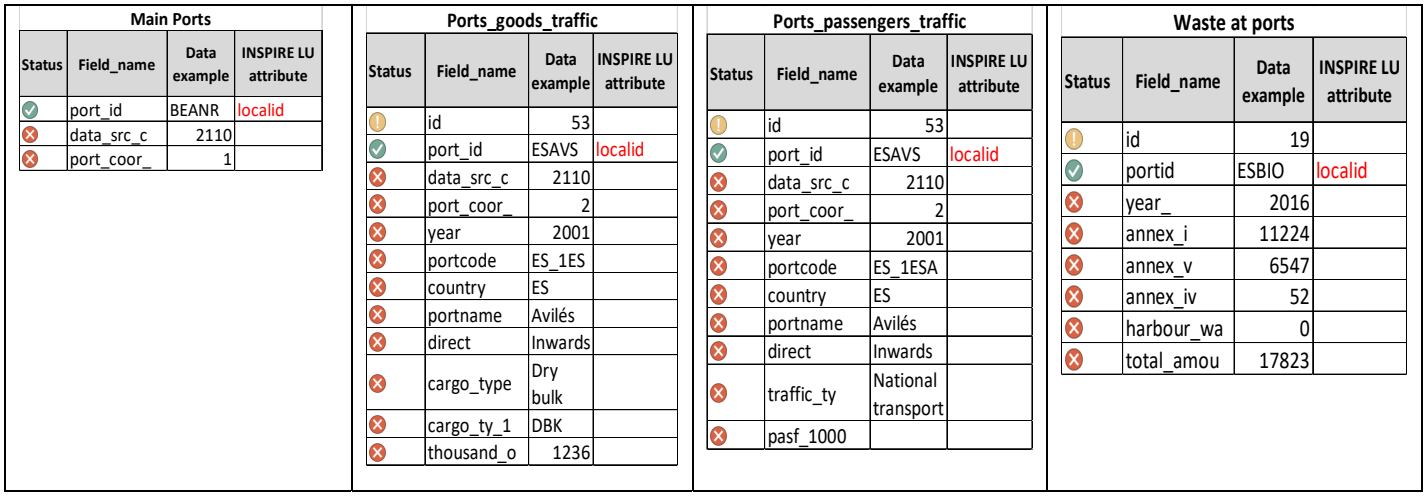
Status	Field_name	Data example	INSPIRE LU attribute
✗	dist_coast	140622.047	
✓	munition_type	Chemical	specificlandUse

Table 15. Mapping table between EMODnet's dumping munitions layers and INSPIRE land Use attributes.

E. Ports

EMODnet Human activities includes 4 point layers with port information including main ports locations, statistics of vessel, goods and passengers traffic and information of waste produced in some ports. The attributes included in these layers are shown in Table 16. The steps to be converted to INSPIRE compliant dataset are the following:

- Merge all layers to a single one in order to compile all port locations whatever their associated information. Eliminate duplicated geometries.
- The attribute tables have been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (see Table 16).
- In this case only "port_id" field has been retained to define the localid attribute.
- Hilucslanduse value has been set to "4_1_4_WaterTransport". SpecificlandUse has been used for those locations where vessels, goods and passenger traffic information was available. In these cases, specificlanduse has been filled in with the HILUCS extended items: "4_1_4_3_CruisesFerriesPort" and/or "4_1_4_2_CommercialPort"
- Resulting records have been appended to EMODNET_HA shapefile.



Main Ports

Status	Field_name	Data example	INSPIRE LU attribute
✓	port_id	BEANR	localid
✗	data_src_c	2110	
✗	port_coor_	1	

Ports_goods_traffic

Status	Field_name	Data example	INSPIRE LU attribute
!	id	53	
✓	port_id	ESAVS	localid
✗	data_src_c	2110	
✗	port_coor_	2	
✗	year	2001	
✗	portcode	ES_1ES	
✗	country	ES	
✗	portname	Avilés	
✗	direct	Inwards	
✗	cargo_type	Dry bulk	
✗	cargo_ty_1	DBK	
✗	thousand_o	1236	

Ports_passengers_traffic

Status	Field_name	Data example	INSPIRE LU attribute
!	id	53	
✓	port_id	ESAVS	localid
✗	data_src_c	2110	
✗	port_coor_	2	
✗	year	2001	
✗	portcode	ES_1ESA	
✗	country	ES	
✗	portname	Avilés	
✗	direct	Inwards	
✗	traffic_ty	National transport	
✗	pasf_1000		

Waste at ports

Status	Field_name	Data example	INSPIRE LU attribute
!	id	19	
✓	portid	ESBIO	localid
✗	year_	2016	
✗	annex_i	11224	
✗	annex_v	6547	
✗	annex_iv	52	
✗	harbour_wa	0	
✗	total_amou	17823	

Table 16. Mapping table between EMODnet's Ports layers and INSPIRE land Use attributes.

F. Pipelines

EMODnet Human activities pipelines layer is a polyline layer whose attributes are shown in Table 17. The steps to be converted to INSPIRE compliant dataset are the following:

- Extract lines vertices.
- The attribute tables have been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (see Table 17).
- In this case the localid attribute has been created with the formula: *concat("country" ,'/', "operator" ,'/', "status",'/',"objectid")*.
- Hilucslanduse value has been set to "4_3_Utilities". SpecificlandUse has been set with the formula *concat('Pipeline/',"medium")* due to the fact that in HILUCS extended vocabulary there are specific terms such as "4_3_1_2_OilLine", "4_3_1_2_GasLine", but this layer also includes pipelines for other substances like sewage water, chemicals, etc. that are not referenced.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	objectid	20	inspire/localId
!	id		
✓	status	Active	inspire/localId
✓	medium	Gas	specificlanduse
✓	operator	INAgip	inspire/localId
✗	size_in	18	
!	length_m	45300	
✓	year	2006	validFrom
!	from_loc	IVANA K	
!	to_loc	PULA	
!	country_co	HR	
✓	country	Croatia	inspire/localId
✗	notes		

Table 17. Mapping table between EMODnet's Pipelines layer and INSPIRE land Use attributes.

G. Cables

EMODnet Human activities includes 4 polyline layers with cables information plus a point layer including cables landing stations. The attributes included in these layers are shown in Table 19. The steps to be converted to INSPIRE compliant gml are the following:

- Merge all polyline layers to a single one in order to compile all cables whatever their associated information.
- The attribute tables from resulting merged layer and landing stations point layer have been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (see Table 19).
- The localid attribute has been set using slightly different formulas for records issued from original layers (cf. Table 18).

Original layer	Localid formula	Example
telecommunication cables schematic lines	concat('Submarine cables schematic/ Telegeography /',"owners",'/',"id")	Submarine cables schematic/Telegeography/Global Cloud Xchange/1027
SIG cables	concat('Submarine cables/SIG_cables/',$id)	Submarine cables/SIG_cables/1
malta_cables	concat('Submarine cables/Malta cables/',$id)	Submarine cables/Malta cables/0
bsh_contis_cables	concat('Submarine cables/ BSH_contis_cables /',$id)	Submarine cables/BSH_contis_cables/103
cables_landing_stations	concat('Submarine cables landing stations/,"source",'/',$id)	Submarine cables landing stations/Telegeography/0

Table 18. Formulas to define localid values for EMODNET's cables layers

- Hilucslanduse value has been set to " 3_2_3_InformationAndCommunicationServices". SpecificlandUse has been set to the HILUCS extended item "4_3_5_2_SubmarineCableTelecom"
- Resulting records have been appended to EMODNET_HA shapefile.

telecommunication cables schematic lines

Status	Field_name	Data example	INSPIRE LU attribute
✓	id	1199	localId
✓	owners	TeliaSonera, Orange Polska, TDC, Telenor, Slovak	localId
!	landing_po	Gedser, Denmark; Kolobrzeg, Poland;	
!	lenght_km	4.37E+02	
✓	rfs	March 1997	Validfrom
✗	source	Telegeography	
✗	url_1	http://www.telecompaper.com/news/baltica-cable-system-to-start-up--	
✗	url_2		
✗	capacity_g	60	
✗	capacity	60	

SIG cables

Status	Field_name	Data example	INSPIRE LU attribute
✓	objectid	1	localID
✗	sgc_id	8	
✗	status	1	
✓	inst_year	01/05/1995	ValidFrom
✓	dism_year		ValidTo
!	length	295.222	

bsh_contis_cables

Status	Field_name	Data example	INSPIRE LU attribute
✗	featuretyp	3	
✗	featurespe	0	
✗	status	6	

malta_cables

Status	Field_name	Data example	INSPIRE LU attribute
✓	FID	5	localID

cables_landing_stations

Status	Field_name	Data example	INSPIRE LU attribute
✓	source	Telegeography	localid

Table 19. Mapping table between EMODnet's cables layers and INSPIRE land Use attributes.

H. Wind Farms

EMODnet's wind farms dataset includes a point and a polygon layer including the attributes shown in Table 20. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 20). As no unique identifier is included a new *"localid"* has been set concatenating information from various fields with the formula: *concat("country" ,'/', "status" ,'/', "power_mw" ,'mw/', format_number("dist_coast" /1000,2),'km')*.
- Hilucslanduse value has been set to "2_4_4_RenewableEnergyProduction" and specificlandUse to "2_4_4_1_RenewableEnergyProductionWind"
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	country	France	inspireid/localid
✗	n_turbines		
✓	start	2015	ValidTo
✓	status	Production	inspireid/localid
✓	dist_coast	10363.1502	inspireid/localid
!	ljstatus	production	
✓	power_mw	8	inspireid/localid

Table 20. Mapping table between EMODnet's wind farms point layer and INSPIRE land Use attributes.

I. Ocean energy test sites

EMODnet's ocean energy sites dataset is a polygon layer whose attributes are shown in Table 21.

These are the steps followed to be converted to INSPIRE compliant dataset:

- Centroids for each polygon have been extracted.
- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 21).
- As no unique identifier is included a new localid has been set concatenating information from various fields with the formula: *concat("country" ,'/', "status" ,'/', "capacitykw" ,'kw/', "testsite")*.

- Hilucslanduse value has been set to "2_4_4_RenewableEnergyProduction", and specificlandUse to "2_4_4_4_RenewableEnergyProductionWave", "2_4_4_1_RenewableEnergyProductionWind", or "2_4_4_5_RenewableEnergyProductionTidal" from the MSP hilucs extended vocabulary.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✗	id_ts	TS_16	
✓	testsite	Scapa Flow	inspireid/localid
✓	country	United Kingdom	inspireid/localid
!	seabasin	Greater North Sea	
!	coast_dist	904	
✓	resource	Wave	specificlanduse
✓	startyear	2011	ValidFrom
✓	endyear	0	ValidTo
✗	lease_stat	Lease	
✓	status	Operational	inspireid/localid
✓	capacitykw	0	inspireid/localid
!	depth_m	21	
!	area_km2	0	
✗	gridconnec	No	
✗	no_berths	1	
✗	developer	EMEC Limited	
✗	web_page	http://www.emec.org.uk/	
✗	source	web page	
✗	service	Map App/shapefile	
✗	sourcelink	http://www.emec.org.uk/facilities/; https://www.thecrownestate.co.uk/en-gb/resources/maps-and-gis-data/	
✗	sourcedeta	EMEC Orkney; The Crown Estate	
✓	lastaccess	20190626	endLifespanVersion
✗	metadavail	Yes	
✗	metalink	http://www.thecrownestate.co.uk/energy-and-infrastructure/downloads/maps-and-gis-data/	
✗	otherlinks	http://tethys.pnnl.gov/map-viewer-marine-energy	
✗	notes	Depth: 21-25 m	
✗	posinfo	Original	
✗	possource	http://www.thecrownestate.co.uk/energy-and-infrastructure/downloads/maps-and-gis-data/	
✗	eia	Yes	
✗	eialink	https://tethys.pnnl.gov/sites/default/files/publications/EMEC-Scapa-Flow-Environmental-Description-2011.pdf	

Table 21. Mapping table between EMODnet's ocean test sites polygon layer and INSPIRE land Use attributes.

J. Ocean energy Project locations

EMODnet's ocean energy project locations dataset is a point layer whose attributes are shown in Table 22. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 22).
- As no unique identifier is included a new localid has been set concatenating information from various fields with the formula: *concat("country" ,'/', "status" ,'/', "project_ca" ,'kw/', "facid")*.
- Hilucslanduse value has been set to "2_4_4_RenewableEnergyProduction", and specificlandUse to "2_4_4_4_RenewableEnergyProductionWave", "2_4_4_1_RenewableEnergyProductionWind", or "2_4_4_5_RenewableEnergyProductionTidal" from the MSP hilucs extended vocabulary.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
!	id	1	inspire/localId
!	lat	41.46861	
!	long_	-8.84722	
✗	position_i	Original	
✓	country	Portugal	inspire/localId
!	sea_basin	Bay of Biscay and Iberian Coast	
✗	location1	Aguçadoura	
!	coast_dist	5723	
✓	facid	OE-PT06	inspire/localId
✓	start_year	2004	ValidFrom
✓	end_year	2004	validTo
✓	resource	Wave	specificlandUse
✗	technology	Submerged Pressure Differential	
✗	device	AWS-Mk1	
✗	device_sca	Full scale	
✗	project_sc	Sea testing	
✓	status	Completed	inspire/localId
✗	project_ca	2000	
✗	project_pr	Teamwork Technology	
✓	web_page	http://www.teamwork.nl	
!	source	web page	
!	service_or	Map viewer	
!	link_to_so	http://sowfia.hidromod.com/PivotMapViewer/ViewData/Index	
✓	source_det	SOWFIA Project Database	
✓	date_of_la	24/06/2019	endlifespan
✗	metadata_a	No	
✗	metadata_l	N/A	
✗	otherlinks	N/A	

Table 22. Mapping table between EMODnet's ocean project location point layer and INSPIRE land Use attributes.

K. Boreholes (Oil and Gas)

EMODnet's Boreholes dataset is a point layer whose attributes are shown in Table 23. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 23).
- The new localid has been set concatenating information from various fields with the formula: *concat("country" ,'/', "status" ,'/', "purpose",'/',"code")*.
- Hilucslanduse value has been set to " 2_4_2_FossilFuelBasedEnergyProduction", and specificlandUse includes the values from "Hydrocarbon" source field as no adapted item is included in HILUCS neither in MSP HILUCS extended vocabularies.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	status	Active	inspireid/localid
✓	country	Norway	inspireid/localid
✓	code	8145	inspireid/localid
✓	year	2017	validfrom
✗	purpose	Exploitation	inspireid/localid
✓	hydrocarbon	Crude Oil	specificlandUse
✗	operator	Wintershall Norge AS	
✗	company	DEEPSEA STAVANGER	
!	distance	139896.7076	
!	depth	304	

Table 23. Mapping table between EMODnet's boreholes point layer and INSPIRE land Use attributes.

L. Active licenses (Oil and Gas)

EMODnet's active licenses dataset is a polygon layer whose attributes are shown in Table 24. These are the steps followed to be converted to INSPIRE compliant dataset:

- Centroids for each polygon have been extracted.
- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 24).

- The new localid has been set concatenating information from various fields with the formula: *concat("country",'/', "operator",'/', "type",'/',"code")*.
- Hilucslanduse value has been set to "2_4_2_FossilFuelBasedEnergyProduction". specificlandUse has been set to 'Active licences for hydrocarbons' as no more specific information nor codelist items have been found for this information.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	country	Netherlands	inspireid/localid
✓	code	L11a	inspireid/localid
✓	type	Exploitation	inspireid/localid
✗	round		
!	area_sqkm	1.85E+02	inspireid/localid
✓	operator	Neptune Energy Netherlands B.V.	inspireid/localid
✓	year_start	1971	ValidFrom
✓	year_end	2025	ValidTo
✗	area_info	Original	

Table 24. Mapping table between EMODnet's Active licenses layer and INSPIRE land Use attributes.

M. Offshore installations (Oil and Gas)

EMODnet's offshore installations dataset is a point layer whose attributes are shown in Table 25. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 25).
- The new localid has been set concatenating information from various fields with the formula: *concat("country",'/', "operator",'/', "type",'/',"code")*.
- Hilucslanduse value has been set to "2_4_2_FossilFuelBasedEnergyProduction". specificlandUse has been set to *concat('Offshore_installation/',"function" ,'/', "primary_pr")* as no more specific information nor codelist items have been found for this information.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	platformid	168	inspireid/localid
✓	country	Italy	inspireid/localid
✗	location_blocks	ZB	
!	latitude	42.20129395	
!	longitude	14.93908691	
!	water_depth	74	
✓	operator	EDISON	inspireid/localid
✓	production_start	2012	validfrom
✓	current_status	Operational	inspireid/localid
!	primary_production	Oil	specificlandUse
✗	category	Floating steel	
✓	function	Above water storage and production	specificlandUse
✗	weight_sub	0	
✗	weight_top	0	
✗	remarks	Licence B.C 8.LF - FSO (Floating Storage Offloading) vessel, operating with platforms ROSPO MARE A, ROSPO MARE B and ROSPO MARE C	
!	coast_dist	18686.67888	
✓	class	Operational	

Table 25. Mapping table between EMODnet's Active licenses layer and INSPIRE land Use attributes.

N. Nuclear (Nuclear Energy Production)

EMODnet's "nuclear" dataset is a point layer whose attributes are shown in Table 26. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 26).
- The new localid has been set concatenating information from various fields with the formula: *concat("country" ,'/', "reactor_nm" ,'/', "operator",'/',"status",'/',"the_cap_mw_tot",'mw')*.
- Hilucslanduse value has been set to "2_4_1_NuclearBasedEnergyProduction". specificlandUse has been set to values from the formula: *concat('nuclear energy production/',"model",'/',"type",'/',"fuel")* as no codelist item have been found for this information.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
⚠	id	3	
⚠	lat	53.89176	
⚠	long	9.20256	
✗	code	DE02	
✓	country	Germany	inspire/localid
✓	status	Permanently shut down	inspire/localid
✗	reactors_n	1	
✓	the_cap_mw_tot	2292	inspire/localid
✗	grs_cap_mw_tot	806	
✗	net_cap_mw_tot	771	
✗	water_src	Elbe River	
✓	reactor_nm	BRUNSBUETTEL	
✓	reactorstatus	Permanently shut down	
✓	type	Boiling Water	specificlandUse
✓	model	BWR-69	specificlandUse
✓	fuel	N/A	
✓	the_cap_mw	2292	
✗	grs_cap_mw	806	
✗	net_cap_mw	771	
✗	operator	KKB	
✗	nsss	KWU	
✓	start_yr	1970	ValidFrom
✓	start_mth	4	ValidFrom
✗	critic_yr	1976	
✗	critic_mth	6	
✗	grid_yr	1976	
✗	grid_mth	7	
✓	shdn_yr	2011	ValidTo
✓	shdn_mth	8	ValidTo

Table 26. Mapping table between EMODnet's nuclear layer and INSPIRE land Use attributes.

O. Finfish production (aquaculture& fishing)

EMODnet's "finfish production" dataset is a point layer whose attributes are shown in Table 27. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 27).
- The new localid has been set concatenating information from various fields with the formula: *concat("country",'/', "owner_name",'/', "status",'/',"finid")*.

- Hilucslanduse value has been set to "1_4_1_Aquaculture". SpecificlandUse has been set to values from the formula: *concat('finfish/', "species_detailed" ,'/', "production_meth" ,'/', "production")*. Even if in HILUCS extended there is an item "1_4_1_1_AquacultureSeaWater", we estimate that the term is still too broad and decided to add in this field some more specific information from source attributes.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	country	United Kingdom	inspireid/localid
✓	owner_name	Grieg Seafood Shetland Ltd	inspireid/localid
✓	production	Grow out for human consumption, Other	specificlandUse
✗	purpose	n.a.	
✓	species_detailed	Wrasse, Atlantic Salmon, Lumpsucker	specificlandUse
✓	finid	UK_0121	inspireid/localid
!	distance_to_coast_m	182.86944	
!	position_coastline	At sea	
✓	status	Active	inspireid/localid
✗	point_info	Original	
✗	cod	No	
✗	halibut	No	
✗	lumpfish	Yes	
✗	eel	No	
✗	salmon	Yes	
✗	seabass	No	
✗	seabream	No	
✗	trout	No	
✗	tuna	No	
✗	tubot	No	
✗	sole	No	
✗	other_species	Yes	
✗	farm_type	Salmon	
✓	production_meth	Sea cages	specificlandUse

Table 27. Mapping table between EMODnet's finfish production layer and INSPIRE land Use attributes.

P. Shellfish production (aquaculture& fishing)

EMODnet's "shellfish production" dataset is a point layer whose attributes are shown in Table 28. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 28).
- The new localid has been set concatenating information from various fields with the formula: *concat("country" ,'/', "owner" ,'/', "status",'/',"site_id")*.
- Hilucslanduse value has been set to "1_4_1_Aquaculture". specificlandUse has been set to values from the formula: *concat('shellfish/', "species" ,'/', "prod_method" ,'/', "purpose")*. Even if in HILUCS extended there is an item "1_4_1_1_AquacultureSeaWater", we estimate that the term is still too broad and decided to add in this field some more specific information from source attributes.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	site_id	FR_0044	inspireId/localId
✓	country	France	inspireId/localId
✓	owner	n.a.	inspireId/localId
✗	area_name	Oulme	
✓	status	n.a.	inspireId/localId
✗	farmtype	Oysters	
✓	prod_method	n.a.	specificLandUse
✗	prod_stage	n.a.	
✓	purpose	n.a.	specificLandUse
✓	species	Oysters	specificLandUse
!	position_info	Polygon centroid	
!	point_def	Production area	
!	distance_to_shore_m	98.34557556	
!	costal_inland	Within the coastline	

Table 28. Mapping table between EMODnet's shellfish production layer and INSPIRE land Use attributes.

Q. Macroalgae (aquaculture& fishing)

EMODnet's "macroalgae" dataset is a point layer whose attributes are shown in Table 29. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 29).

- The new localid has been set concatenating information from various fields with the formula: *concat("country" ,'/', "owner_name").* When the same owner has several sites in the same country, an integer suffix has been added manually to the localid records to avoid duplicated values.
- Hilucslanduse value has been set to "1_4_1_Aquaculture". SpecificlandUse has been set to values from the formula: *concat('macroalgae/', "prod_meth")*. Even if in HILUCS extended there is an item "1_4_1_1_AquacultureSeaWater", we estimate that the term is still too broad and decided to add in this field some more specific information from source attributes.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
	owner_name	Nordisk Tang	inspire/localid
	country	Denmark	inspire/localid
	lat	56.421895	
	long_	10.886575	
	org_group	Macroalgae	specifuclanduse
	prod_meth	Harvesting	specifuclanduse
	imta	No	
	pos_info	Estimated	

Table 29. Mapping table between EMODnet's macroalgae layer and INSPIRE land Use attributes.

R. Microalgae (aquaculture& fishing)

EMODnet's "microalgae" dataset is a point layer whose attributes are shown in Table 30. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 30).
- The new localid has been set concatenating information from various fields with the formula: *concat("country" ,'/', "owner_name").* When the same owner has several sites in the same country an integer suffix has been added manually to the localid records to avoid duplicated values.
- Hilucslanduse value has been set to "1_4_1_Aquaculture". specificlandUse has been set to values from the formula: *concat('microalgae/', "prod_meth")*. Even if in HILUCS

extended there is an item "1_4_1_1_AquacultureSeaWater", we estimate that the term is still too broad and decided to add in this field some more specific information from source attributes.

- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	owner_name	Ecoduna	inspire/localid
✓	country	Austria	inspire/localid
!	lat	48.034771	
!	long_	16.815236	
✓	org_group	Microalgae	specifuclanduse
✓	prod_meth	Photobioreactors	specifuclanduse
✗	pos_info	Estimated	

Table 30. Mapping table between EMODnet's microalgae layer and INSPIRE land Use attributes.

S. Bathing waters (Environment)

EMODnet's "Bathing waters" dataset is a point layer whose attributes are shown in Table 31. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 31).
- The new localid has been set concatenating information from various fields with the formula: *concat("country" ,'/', "bwname",'/'."objectid").*
- Hilucslanduse value has been set to "3_4_4_OpenAirRecreationalAreas". SpecificlandUse has been set to values from the formula: *concat('Bathing waters/state:', "class")*. Even if in HILUCS extended there is an item "3_4_6_MaritimeServices */3_4_6_2_Beaches", we estimate that the term is still too broad and decided to add in this field some more specific information from source attributes.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✗	cc	PT	
✓	country	Portugal	Identifier/localId
✓	objectid	PTCH8M	Identifier/localId
✓	bwname	TONEL	Identifier/localId
✗	bwatercat	CW - Coastal water body	
✗	waterbodyid	PTCOST14	
✗	url	http://www.apambiente.pt/index.php?ref=19&subref=906&sub2ref=910	
!	latitude	37.007	
!	longitude	-8.9484	
✓	class	Excellent	specificlanduse
!	monitoring	PTCH8M	

Table 31. Mapping table between EMODnet's bathing waters layer and INSPIRE land Use attributes.

T. Lighthouses (Cultural heritage)

EMODnet's "lighthouses" dataset is a point layer whose attributes are shown in Table 32. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 32).
- The new localid has been set concatenating information from various fields with the formula: *concat("country",'/', "arlhs_number").*
- Hilucslanduse value has been set to "3_4_1_CulturalServices". SpecificlandUse has been set to values from the formula: *concat('Lighthouses/status:', "status")*, as no more specific item has been found in HILUCS extended codelist.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✓	arlhs_number	FRA 133	inspireId/localId
✓	country	France	inspireId/localId
✓	status	Removed, relocated or destroyed	specificlanduse
✗	gridsquare	IN95jq	
!	distance_to_shore_m	224.037203	
!	position_coastline	Within the coastline	
✓	ljstatus	0	specificlanduse

Table 32. Mapping table between EMODnet's lighthouses layer and INSPIRE land Use attributes.

U. UWWTD Treatment Plants (Waste disposal)

EMODnet's "UWWTD Treatment Plants" dataset is a point layer whose attributes are shown in Table 33. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 33).
- The new localid takes the code included in "uwwCode" field.
- Hilucslanduse value has been set to "4_3_3_WasteTreatment". SpecificlandUse has been set to values from the formula: *concat('Urban waste treatment plant/',"treatment",'/capacity:',"capacit_pe")*, as no specific enough item has been found in HILUCS extended codelist. Although "4_3_3_WasteTreatment" includes child elements such as "solid waste treatment o disposal location", "water waste treatment", "marine Litter Location", "oil discharge (accidental spills, illegal discharges) location" or "offshore (other than oil) discharge location", these have not been considered specific enough to be selected.
- The dataset version date included in the downloadable dataset filename has been included as the endlifespanversion INSPIRE attribute.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
!	Country_ID	UK	
!	Country	United Kingdom	
✓	uwwCode	UKWAWA_WW_TP000084	localid
✗	uwwName	LLANFAGLAN STW	
✓	Year	2014	validfrom
✓	Capacit_pe	5500	specificla
✓	Treatment	secondary	specificla
✗	BOD5_TP	pass	
✗	COD_TP	pass	
✗	Ntot_TP		
✗	Ptot_TP		
✗	More_info	https://tableau.discomap.eea.europa.eu/t/Wateronline/views/UWWTP/UWWTP?:embed=y&:sho	
!	uwwLatitud	53.11	
!	uwwLongitu	-4.28881	

Table 33. Mapping table between EMODnet's UWWTD Treatment Plants layer and INSPIRE land Use attributes.

V. UWWTD Discharge points (Waste disposal)

EMODnet's "UWWTD discharge points" dataset is a point layer whose attributes are shown in Table 34. These are the steps followed to be converted to INSPIRE compliant dataset:

- The dataset's attributes table has been modified to include the INSPIRE attributes and correspondent information has been transferred from original fields to these new ones (cf. Table 34).
- The new localid takes the code included in "uwwCode" field.
- Hilucslanduse value has been set to "4_3_3_WasteTreatment". SpecificlandUse has been set to values from the formula: *concat('Urban waste discharge point/', "dcpWBType" , '/',"dcpState")*, as no specific enough item has been found in HILUCS extended codelist. Although "4_3_3_WasteTreatment" includes child elements such as "solid waste treatment o disposal location", "water waste treatment", "marine Litter Location", "oil discharge (accidental spills, illegal discharges) location" or "offshore (other than oil) discharge location", these have not been considered specific enough to be selected.
- The dataset version date included in the downloadable dataset filename has been included as the endlifespanversion INSPIRE attribute.
- Resulting records have been appended to EMODNET_HA shapefile.

Status	Field_name	Data example	INSPIRE LU attribute
✗	dcpDischar	2256543	
✓	dcpState	Active	specificla
!	COUNTRY	Germany	
✓	uwwCode	DETP_SH1000	localid
✗	dcpCode	DEDP_SH1000	
✗	dcpName	Flensburg	
✗	dcpNuts	DEF01	
!	dcpLatitud	54.8049	
!	dcpLongitu	9.446056	
✓	dcpWBType	discharge into coastal water	specificla
✗	dcpTypeRCA	Art. 5(4) area	
✗	rcaCode	DE	
✗	dcpWBID	DE_CW_B2.9610.07.01	
✗	dcpWFDRBD	DE9610	

Table 34. Mapping table between EMODnet's UWWTD discharges points layer and INSPIRE land Use attributes.

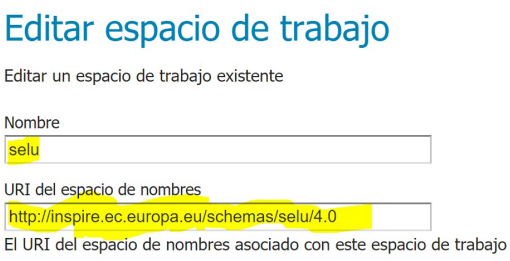
ANNEX B. Steps to apply INSPIRE schemas in GEOSERVER.

These are the steps followed to generate the INSPIRE compliant GML files from a source shapefile using GEOSERVER and its App-schema plugin.

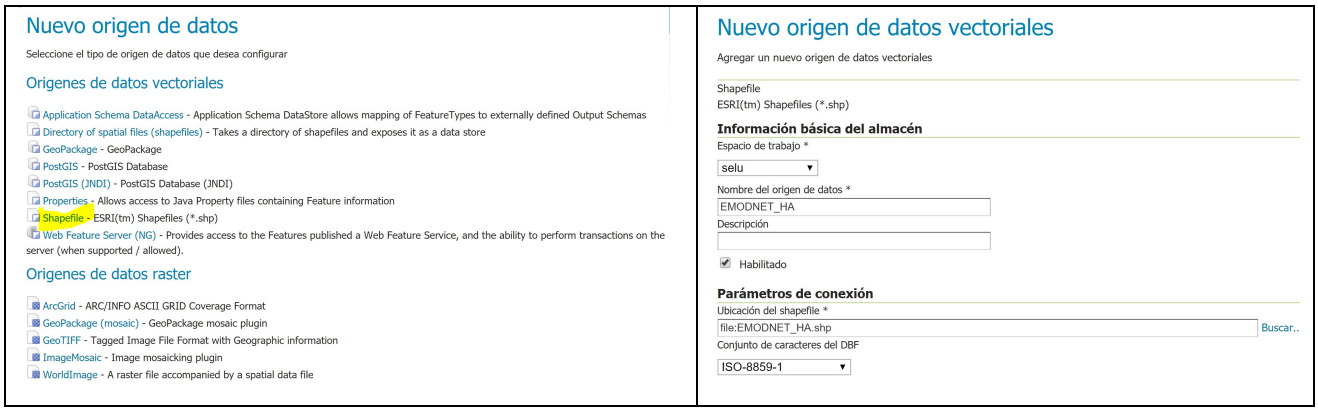
More examples explaining this procedure for other application schemas can be found in the following links:

http://www.onegeology.org/wmsCookbook/6_4_2_1.html
https://onegeology-docs.readthedocs.io/en/latest/providingdata.html#complex-feature-wfs
https://github.com/e-gov/kem-inspire/tree/reporting/src/data

1. Create a new "Workspace" for the INSPIRE application to be implemented (in this case the sampledExistinglandUse). Name it as the application schema prefix (selu) and include the application schema URI.



2. Add a new "data store" selecting the data type of the source dataset (in this case a shapefile), assign it to the workspace created and provide the path of the file. Once loaded, do not publish the layer(s) of the data store.



3. Stop geoserver.

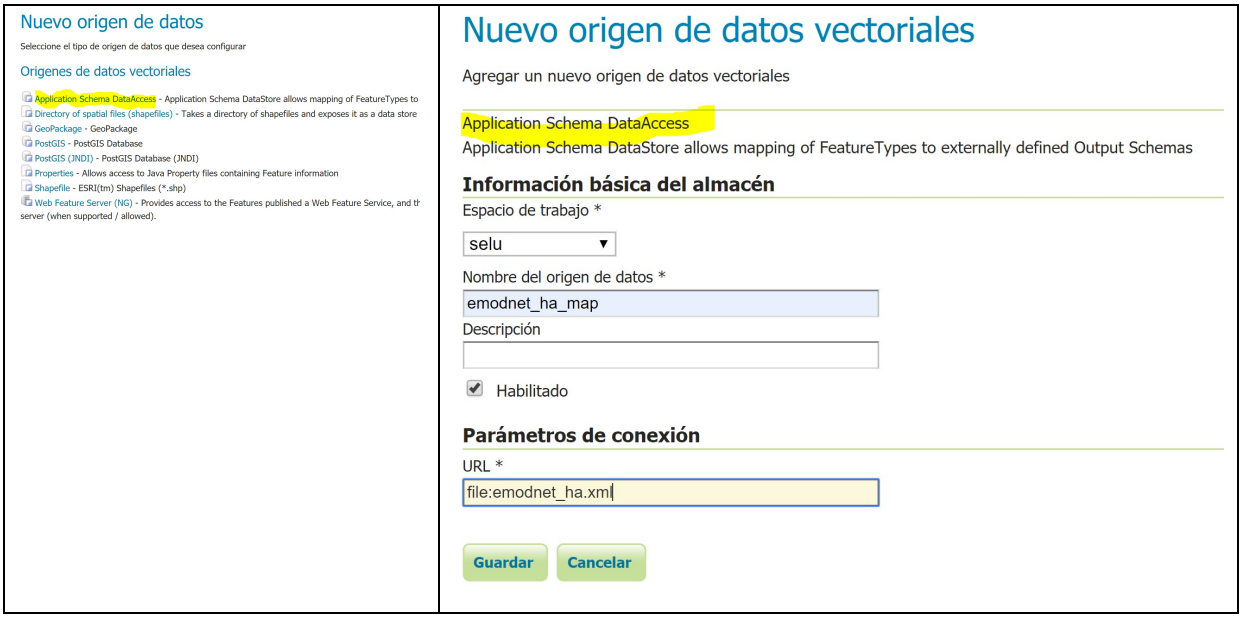
4. In file explorer go to the directory created for the datastore created (C:\Program Files (x86)\Apache Software Foundation\Tomcat

8.5\webapps\geoserver\data\workspaces\selu\EMODNET_HA) and edit the datastore.xml file, change the connection parameters to point to an app-schema type and to the mapping file (in our case emodnet_ha.xml)

```
<dataStore>
  <id>DataStoreInfoImpl--7243a0f5:1713eb54dc9:-7ffd</id>
  <name>EMODNET_HA</name>
  <type>Shapefile</type>
  <enabled>true</enabled>
  <workspace>
    <id>WorkspaceInfoImpl--7243a0f5:1713eb54dc9:-7fff</id>
  </workspace>
  <connectionParameters>
    <entry key="charset">ISO-8859-1</entry>
    <entry key="filetype">shapefile</entry>
    <entry key="create spatial index">true</entry>
    <entry key="memory mapped buffer">false</entry>
    <entry key="timezone">Europe/Paris</entry>
    <entry key="enable spatial index">true</entry>
    <entry key="namespace">https://inspire.ec.europa.eu/schemas/selu/4.0</entry>
    <entry key="cache and reuse memory maps">true</entry>
    <entry key="url">file:EMODNET_HA.shp</entry>
    <entry key="fstype">shape</entry>
  </connectionParameters>
  <__default>false</__default>
</dataStore>
```

```
<dataStore>
  <id>DataStoreInfoImpl-69a7133:1713ebde74e:-7fff</id>
  <name>EMODNET_HA</name>
  <type>Shapefile</type>
  <enabled>true</enabled>
  <workspace>
    <id>WorkspaceInfoImpl--7243a0f5:1713eb54dc9:-7fff</id>
  </workspace>
  <connectionParameters>
    <entry key="dbtype">app-schema</entry>
    <entry key="namespace">http://inspire.ec.europa.eu/schemas/selu/4.0</entry>

    <entry key="url">file:emodnet_ha.xml</entry>

  </connectionParameters>
  <__default>false</__default>
</dataStore>
```

5. Start geoserver.
6. Add a new "Data store" of type "application schema datastore" and include the mapping xml file as source URL. Then save it and publish the resulting layer.

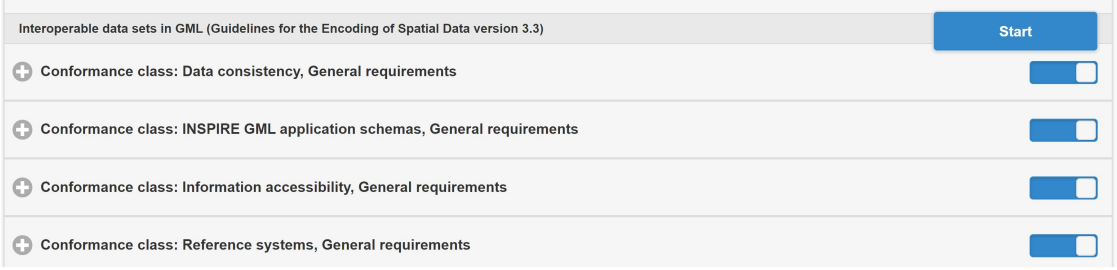


7. Publish the newly generated layer.
8. In the "Preview layers" it is possible to visualize (WMS and WFS) the new INSPIRE compliant layer and download it the layer in GML format:

This is the same as downloading the published layer in the following URL:

http://localhost:8080/geoserver/selu/ows?service=WFS&version=1.1.0&request=GetFeature&typeName=selu%3AExistingLandUseSample&outputFormat=gml32

9. This file can undergo the INSPIRE validation tests for GML inteoperability included in the ETF Validator tool (http://inspire.ec.europa.eu/validator/)



ANNEX C. Mapping xml file to be used in Geoserver.

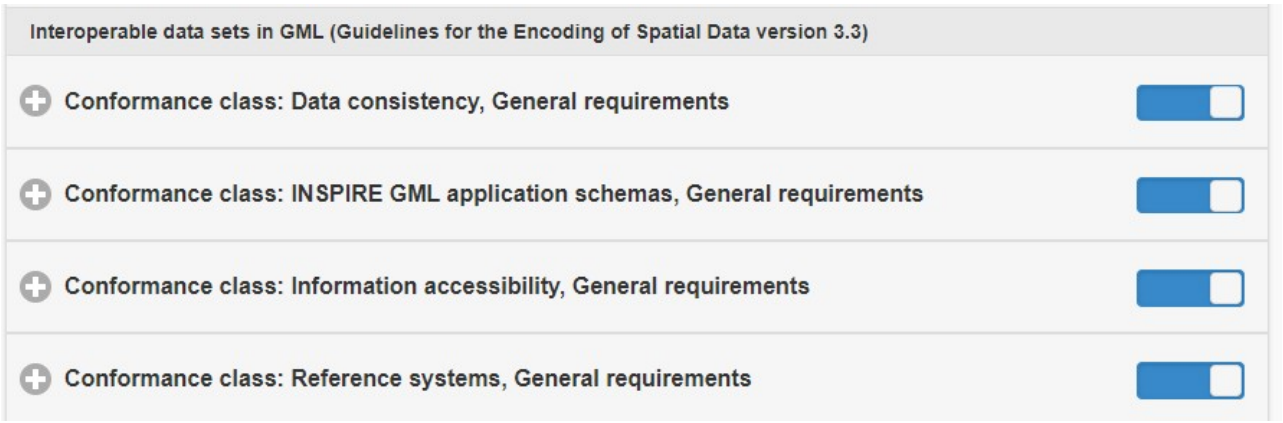
```
<?xml version="1.0" encoding="UTF-8"?>
<as:AppSchemaDataAccess xmlns:as="http://www.geotools.org/app-schema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.geotools.org/app-schema AppSchemaDataAccess.xsd">

<namespaces>
<Namespace><prefix>gml</prefix><uri>http://www.opengis.net/gml/3.2</uri></Namespace>
<Namespace><prefix>base</prefix><uri>http://inspire.ec.europa.eu/schemas/base/3.3</uri></Namespace>
<Namespace><prefix>selu</prefix><uri>http://inspire.ec.europa.eu/schemas/selu/4.0</uri></Namespace>
<Namespace><prefix>xlink</prefix><uri>http://www.w3.org/1999/xlink</uri></Namespace>
<Namespace><prefix>xsi</prefix><uri>http://www.w3.org/2001/XMLSchema-instance</uri></Namespace>
</namespaces>

<sourceDataStores><DataStore>
        <id>shapefile</id>
        <parameters><Parameter>
        <name>url</name>
        <value>file:EMODNET_HA.shp</value>
        </Parameter></parameters>
</DataStore></sourceDataStores>

<targetTypes>
        <FeatureType><schemaUri>http://inspire.ec.europa.eu/schemas/selu/4.0/SampledExistingLandUse.xsd </schemaUri></FeatureType>
</targetTypes>

<typeMappings><FeatureTypeMapping>
                <sourceDataStore>shapefile</sourceDataStore>
                <sourceType>EMODNET_HA</sourceType>
        <targetElement>selu:ExistingLandUseSample</targetElement>
<attributeMappings>
    <AttributeMapping>
        <targetAttribute>selu:inspireId/base:Identifier/base:localId</targetAttribute>
        <sourceExpression>
                <OCQL>localid</OCQL>
        </sourceExpression>
    </AttributeMapping>
    <AttributeMapping>
<targetAttribute>selu:inspireId/base:Identifier/base:namespace</targetAttribute>
        <sourceExpression>
                <OCQL>'EMODNET HA NOTATION'</OCQL>
        </sourceExpression>
    </AttributeMapping>
    <AttributeMapping>
        <targetAttribute>selu:hilucsLandUse</targetAttribute>
        <ClientProperty><name>xlink:href</name><value>hilucshref</value></ClientProperty>
        <ClientProperty><name>xlink:title</name><value>hilucstitl</value></ClientProperty>
     </AttributeMapping>
     <AttributeMapping>
        <targetAttribute>selu:location</targetAttribute>
        <sourceExpression>
                <OCQL>the_geom</OCQL>
        </sourceExpression>
   </AttributeMapping>
   <AttributeMapping>
        <targetAttribute>selu:hilucsPresence</targetAttribute>
        <sourceExpression>
                <OCQL>hilucspres</OCQL>
        </sourceExpression>
    </AttributeMapping>
    <AttributeMapping>
        <targetAttribute>selu:specificLandUse</targetAttribute>
        <sourceExpression>
                <OCQL>specificla</OCQL>
        </sourceExpression>
    </AttributeMapping>
    <AttributeMapping>
        <targetAttribute>selu:specificPresence</targetAttribute>
        <sourceExpression>
```

```
                        <OCQL>specificpr</OCQL>
                </sourceExpression>
        </AttributeMapping>

        <AttributeMapping>
                <targetAttribute>selu:validTo</targetAttribute>
                 <sourceExpression>
                        <OCQL>validto</OCQL>
                </sourceExpression>
        </AttributeMapping>
        <AttributeMapping>
                <targetAttribute>selu:validFrom</targetAttribute>
                 <sourceExpression>
                        <OCQL>validfrom</OCQL>
                 </sourceExpression>
        </AttributeMapping>
        <AttributeMapping>
                <targetAttribute>selu:beginLifespanVersion</targetAttribute>
                <sourceExpression>
                        <OCQL>beginlifes</OCQL>
                </sourceExpression>
        </AttributeMapping>
        <AttributeMapping>
                <targetAttribute>selu:observationDate</targetAttribute>
                <sourceExpression>
                        <OCQL>observatio</OCQL>
                </sourceExpression>
        </AttributeMapping>
        <AttributeMapping>
                <targetAttribute>selu:endLifespanVersion</targetAttribute>
                <sourceExpression>
                        <OCQL>endlifespa</OCQL>
                </sourceExpression>
        </AttributeMapping>

</attributeMappings></FeatureTypeMapping>
</typeMappings></as:AppSchemaDataAccess>
```

ANNEX D. ETF Validation report.

To validate the GML produced by the Geoserver's app schema, we have used the online INSPIRE ETF validator: http://inspire.ec.europa.eu/validator/

The tests runned have been those dealing with the INSPIR GML conformance:



The resulting report snapshot is provided hereafter. One single error was reported dealing with the unavailability of information either in ValidTo and ValidFrom fields. As this information is not available in the original data, no actions have been made to overcome it.

Conformance class: INSPIRE GML encoding 1

Conformance class: Data consistency, General requirements Failed: 1 / 2

This test suite examines a data set against the basic requirements related to the consistency of the data. This test suite only examines requirements that are not specific to a data theme. Additional test cases will be defined per data theme, where needed.

This is a draft version. It has limitations and is expected to contain errors. Please report any issues or problems in GitHub.

Known limitations are documented in the description of the applicable test case or test assertion. There is a general limitation in all assertions that extensions in additional application schemas are only supported, if the unqualified name of the feature type in the extension is the same as the name of the feature type in the INSPIRE application schema.

Source: Conformance Class 'Data consistency'

Pre-requisite conformance classes:

- Conformance Class 'INSPIRE GML application schemas'

Status Failed
Duration 0.002 s
Version 0.2.1

Version consistency 3

Temporal consistency Failed: 1 / 1

Verify that the temporal validity of the real-world entity is consistent.

Status Failed
Duration 0.001 s

dc.b.1: Valid time plausible

For all features verify that either

- validFrom or validTo are missing or nil or
- validTo is not before the value of validFrom.

Relevant requirements:

- IR Requirement Article 12 (3): Other Requirements and Rules. Where the attributes validFrom and validTo are used, the value of validTo shall not be before the value of validFrom.

Source: Abstract Test Case 'Temporal consistency', INSPIRE Data Specification Template, A.3.4

Status Failed
Duration 0.001 s

Messages

```
System error in the Executable Test Suite. Please contact a system administrator. Error information:
[err:FORG0001] Wrong xs:dateTime format: '2011-12-31Z' (try e.g. '2000-12-31T23:59:59.999').
(609/153)
```

Conformance class: INSPIRE GML application schemas, General requirements 6

Conformance class: Information accessibility, General requirements 1

Conformance class: Reference systems, General requirements 2