

# IHME and the European

## Groundwater Body GIS Layers -

### Comparison, Applications, Synergies

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#### Legend

##### Aquifer type

- Porous - High productivity
- Porous - Low/moderate productivity
- Fissured - High productivity
- Fissured - Low/moderate productivity
- Locally aquiferous rocks
- Practically non-aquiferous rocks

Klaus Duscher

#### Legend

##### Groundwater horizon

- 1
- 2
- 3
- 4
- 5

Non WFD (CH)

(plus: Jun 12)

# Topics

- **Introduction**
- **Relation between project outlines**
- **Comparison of GIS layer contents/features**
- **GIS layer applications**
- **Potential IHME - GWB synergies**
- **Summary and Recommendations**

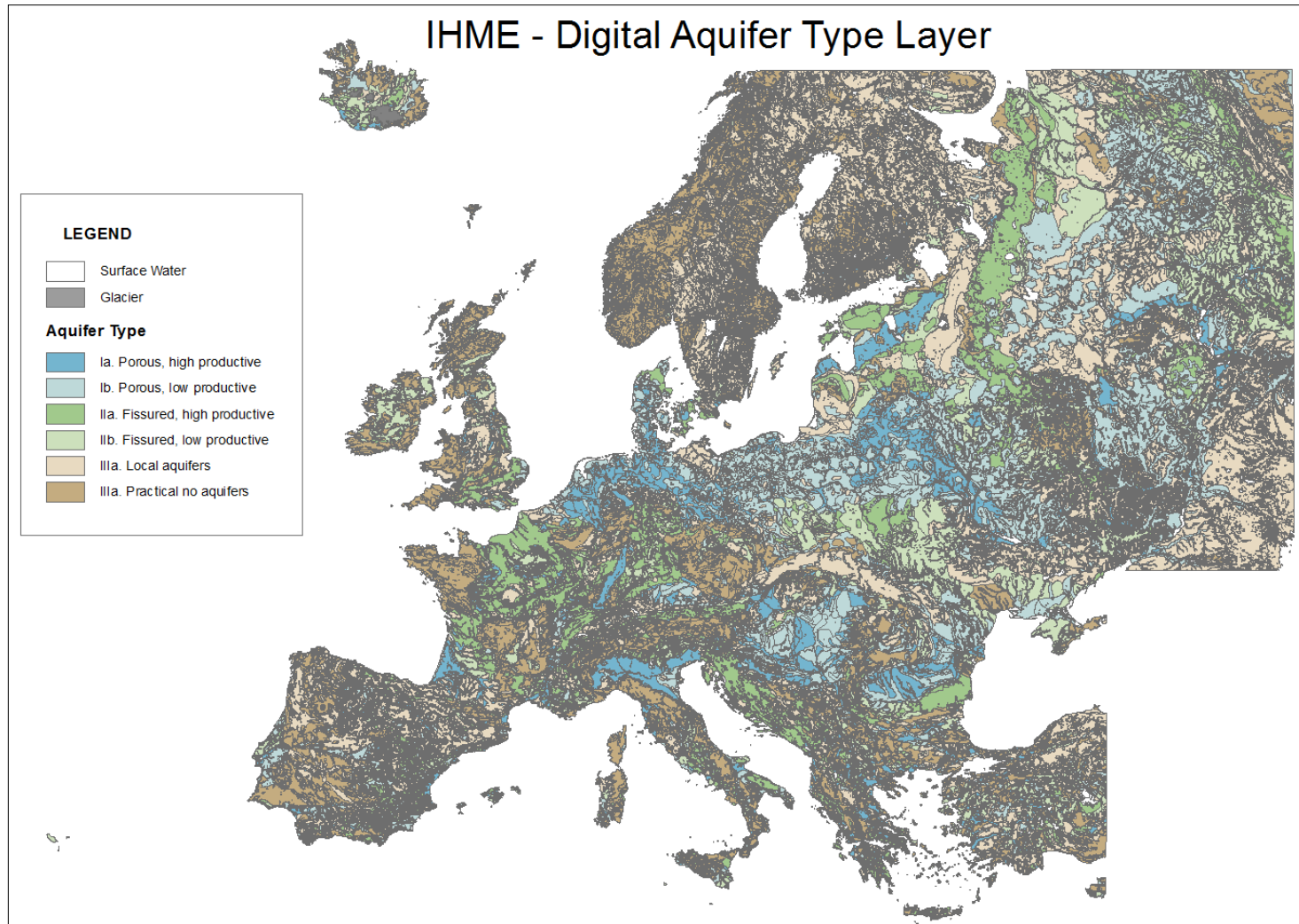
# Introduction

- BGR participates as a partner in the ETC-ICM (former ETC-W) since 2007
- The ETCs support the EEA (e.g. data handling)
- Main BGR activity is the compilation of a Groundwater Body (GWB) GIS reference layer
- In 2010 a first map of some countries and in 2012 a layer covering all EU member states was composed
- The GWB GIS layer is available for download at EEA website (<http://www.eea.europa.eu/data-and-maps/data/wise-groundwater> )

# Introduction

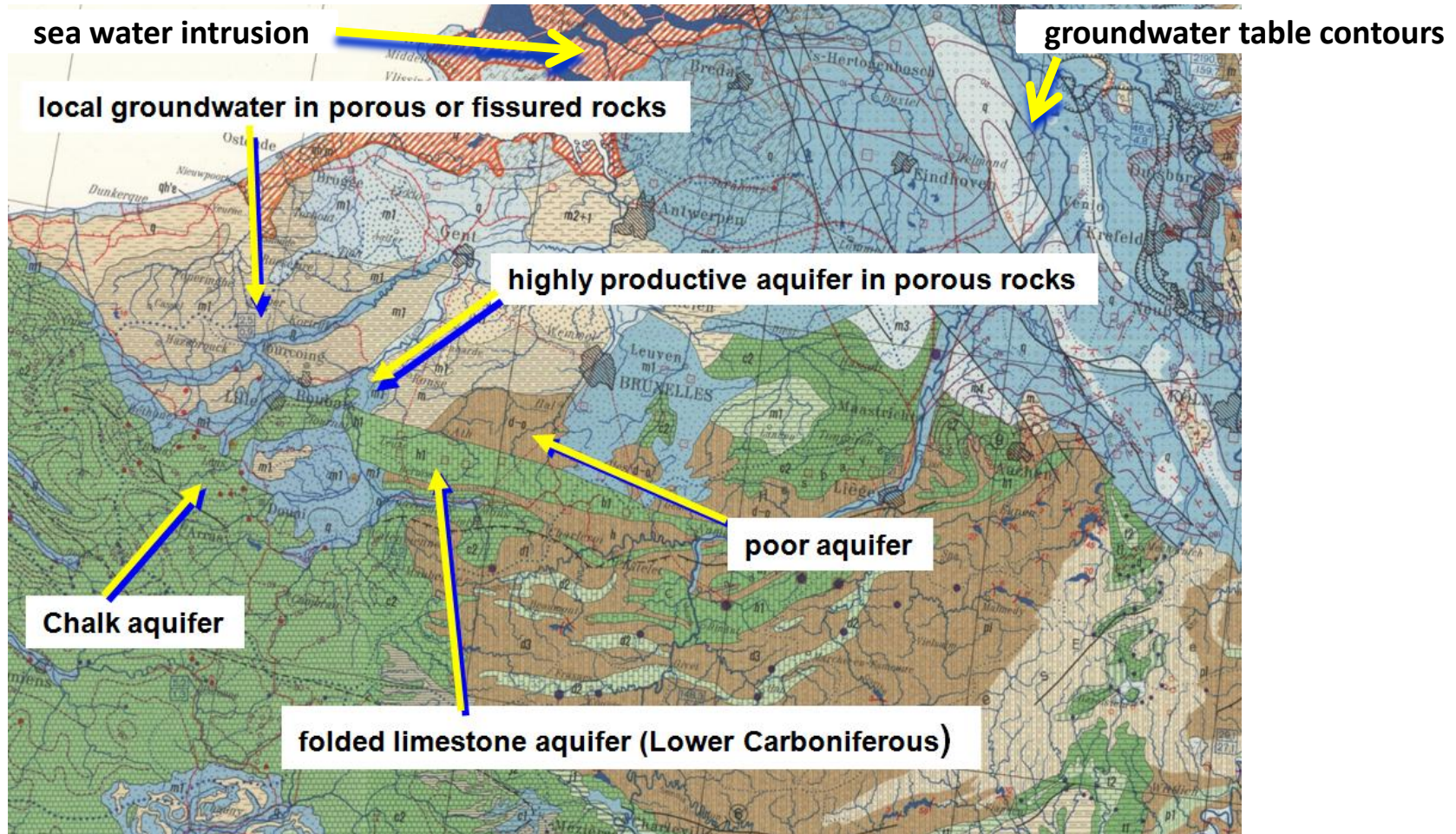
- ➔ BGR edited and published the **IHME (2013)**
- ➔ BGR compiled the **GWB GIS layer (2012)**  
merging the GWBs reported by EU MS
- ➔ Previously no authorised pan-European groundwater survey data available
- ➔ Both Layers consist of elements having different character and purpose
- ➔ **Comparative analysis of both products**

# IHME Layer – Overview Map



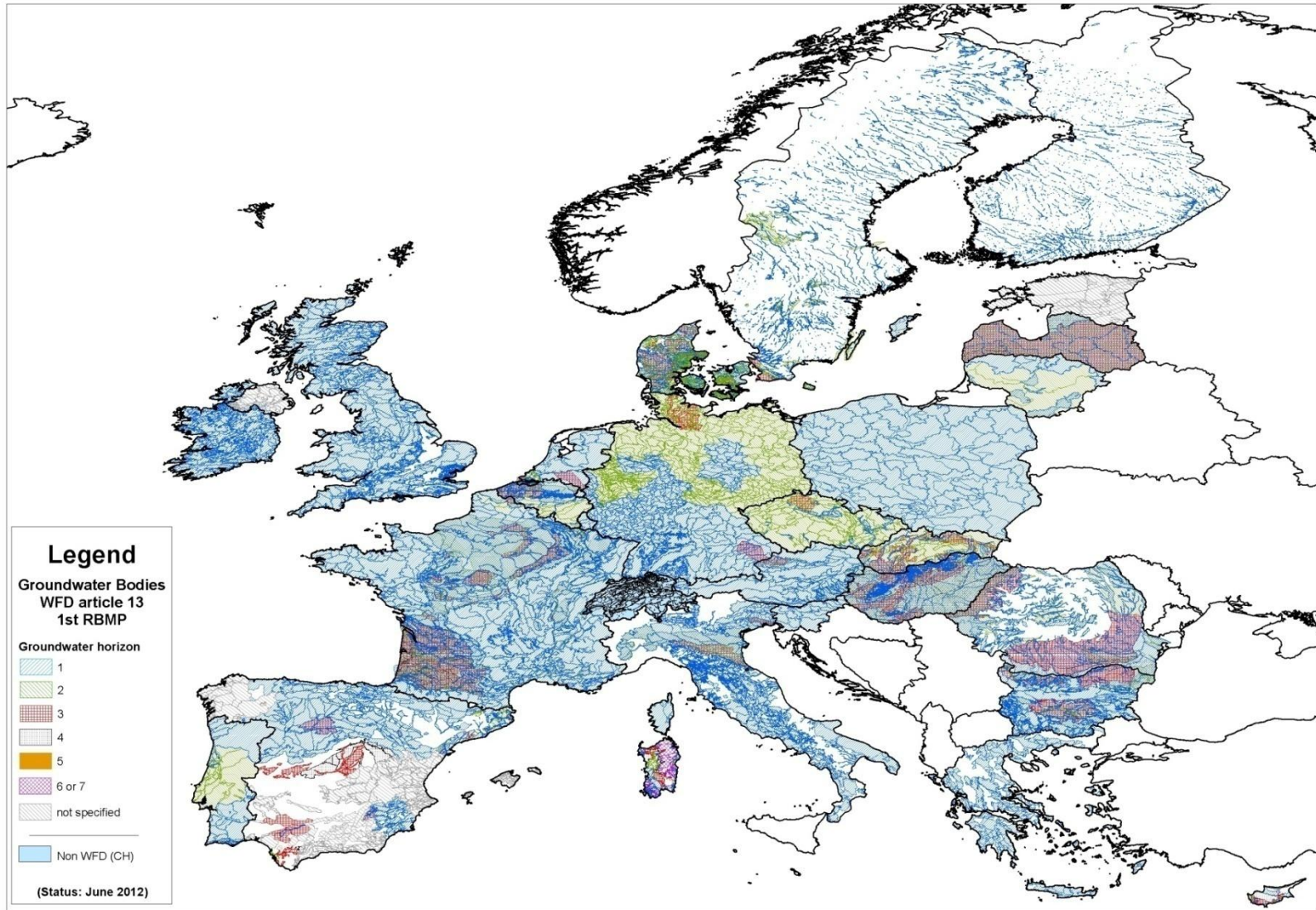
➔ No offsets or break lines ➔ Coherent visualisation

# IHME Print Map - Detail



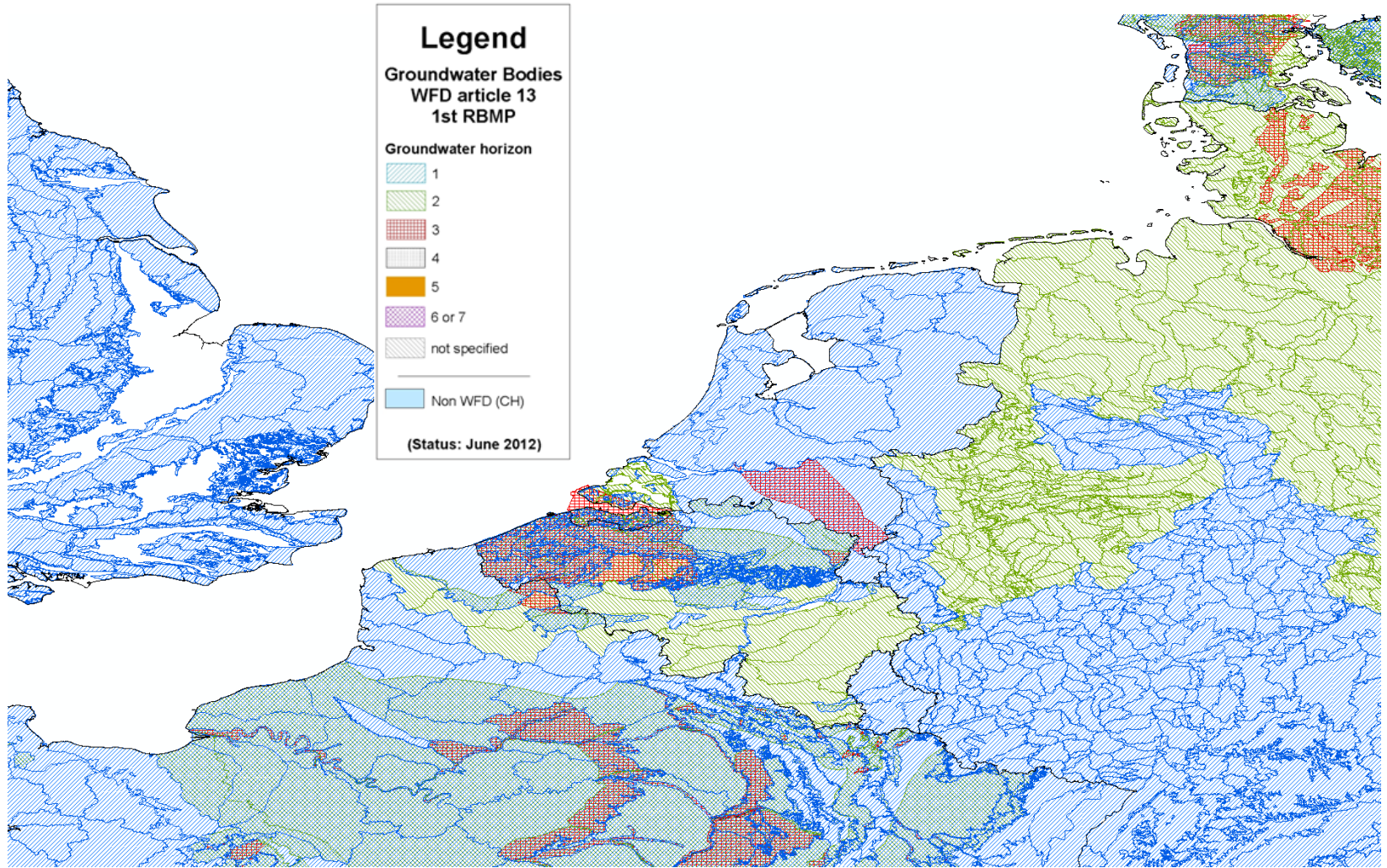
➔ Several map features as folded strata, artificial features or groundwater table have not been digitised

# GWB Layer - Overview



➔ Several groundwater horizons

# GWB Layer – Detail Map



➔ Inconsistencies: Horizon assignment / GWB size



# Project Outline

	<b>IHME</b>	<b>GWB</b>
Basis	UNESCO funded cooperation, coordinated/published by BGR	EU legislation, reporting of MS partly obligatory (not polygons)
Period	About 50 a	About 10 a
Spatial extension	European-wide with gaps in peripheries	EU member states and currently three EEA partner countries
Elements	Hydrogeological units	Water management units
Format	25 map sheets Mostly analogous and subsequent digitisation / 4 digitally prepared sheets	Processing of digital data, reported by EU member states (MS)
Vertical	No information	Vertically overlaying horizons, but without depth reference
Dynamics	Hydraulic contours mapped in some areas, but not digitised	Partly considered as a criteria used for GWB delineation

# Project Features / Elements

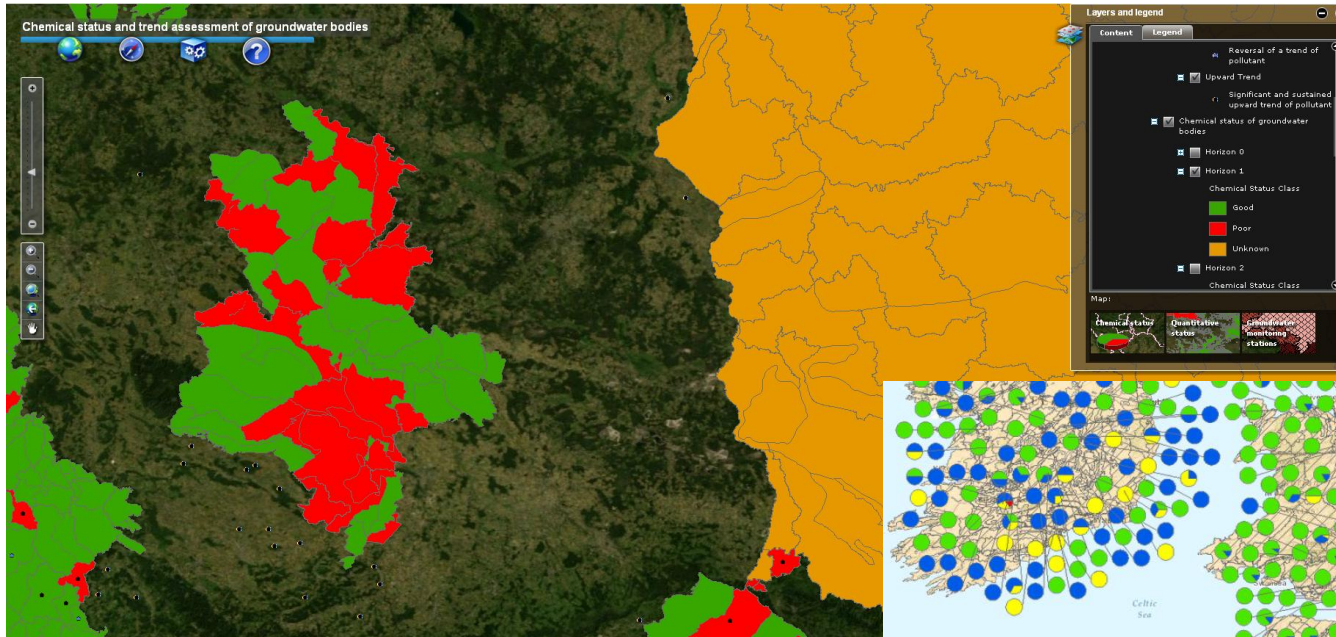
		IHME	GWB
General		Static data, some updates	Dynamic data in progression, container for attributes
Spatial data		42303 distinct aquifers with originally given lithology, 23597 distinct aquifers not considering lithology	13335 polygons / 12964 GWBs (→ Some GWBs consist of several polygons in horizontal and/or vertical extension)
Attribute data	Hydrogeological	Aquifer type, productivity, lithology, sea water intrusion	Variable list of attributes according WFD reporting scheme, currently 10 hydrogeological attributes
	Time dependency	No information	Qualitative and quantitative status, trend, interaction
Consistency		Consistent dataset, several lithology aggregation levels	Inconsistencies: GWB ID, spatial / topological aspects and content → e.g. vertical horizon assignment

# Application of GWB Layer

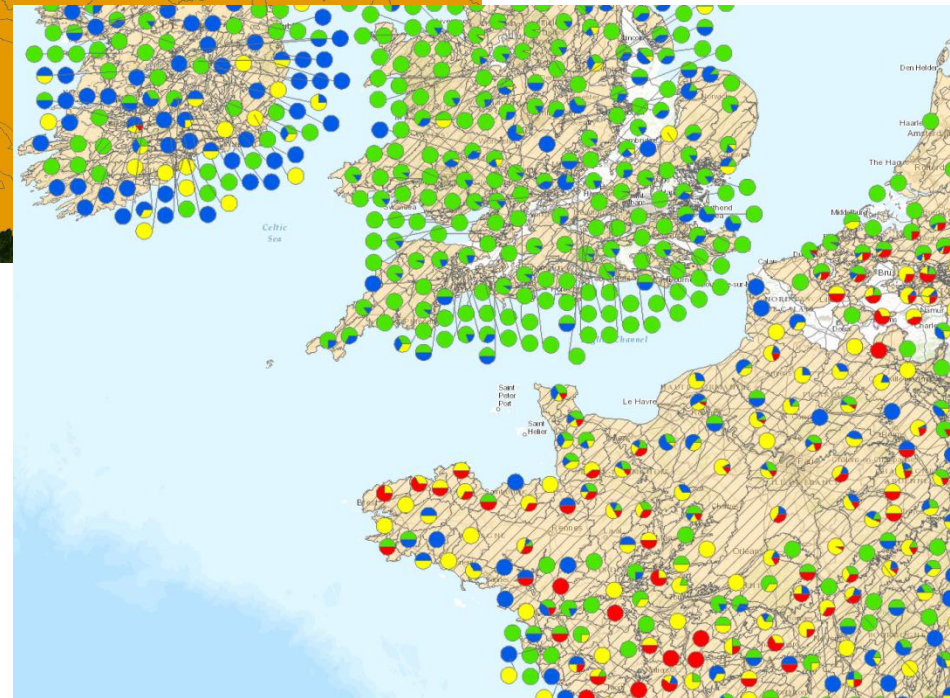
- Visualisation of WFD related characteristics
    - Chemical status
    - Quantitative status
    - Trend
    - Transboundary
    - .....
  - Geoprocessing with water management factors (climatic data, population density...)
- Agreement between member states to harmonize the methodologies is essential**

# GWB Viewer

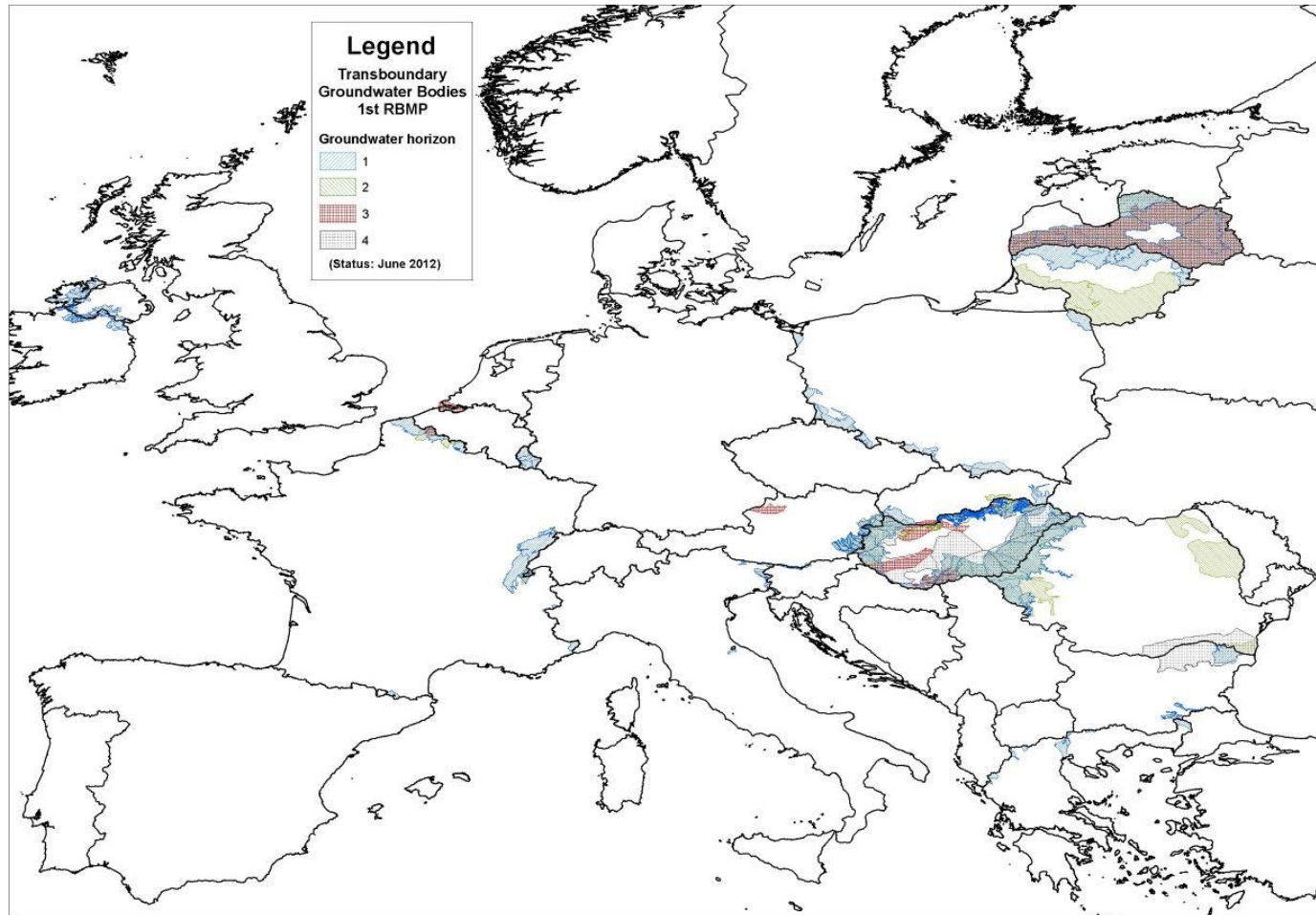
Visualisation  
of GWB  
chemical  
status



Proportion of monitoring  
stations within nitrate  
concentration classes  
for each GWB



# Transboundary GWBs



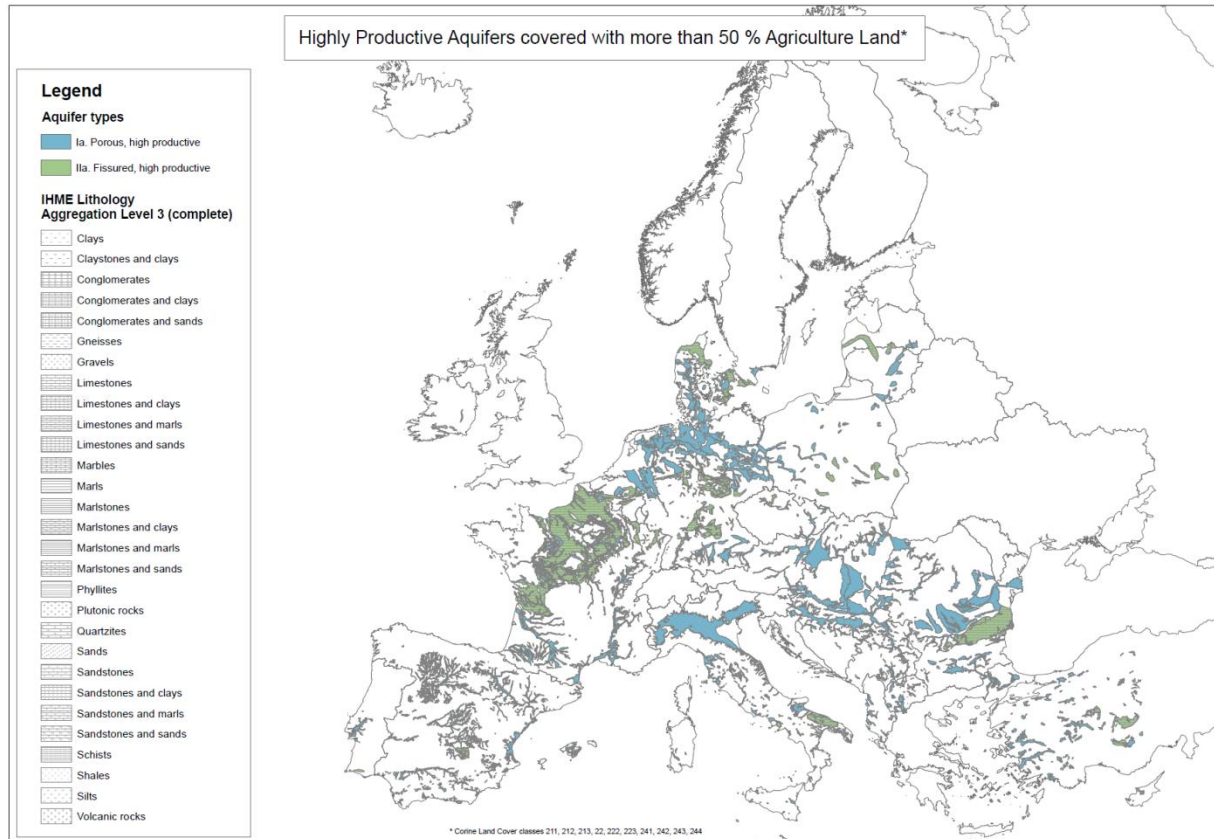
➔ **Inconsistent distribution, because only on certain borders and/or not on both sides of a border**

# Application of IHME Layer

- Cross border hydrogeological enquiries through
    - Selection
    - Aggregation
    - Geoprocessing and
    - Interpretationof data
  - Models covering Europe or several European countries
- Further aquifer characteristics, e. g. depth related information required**

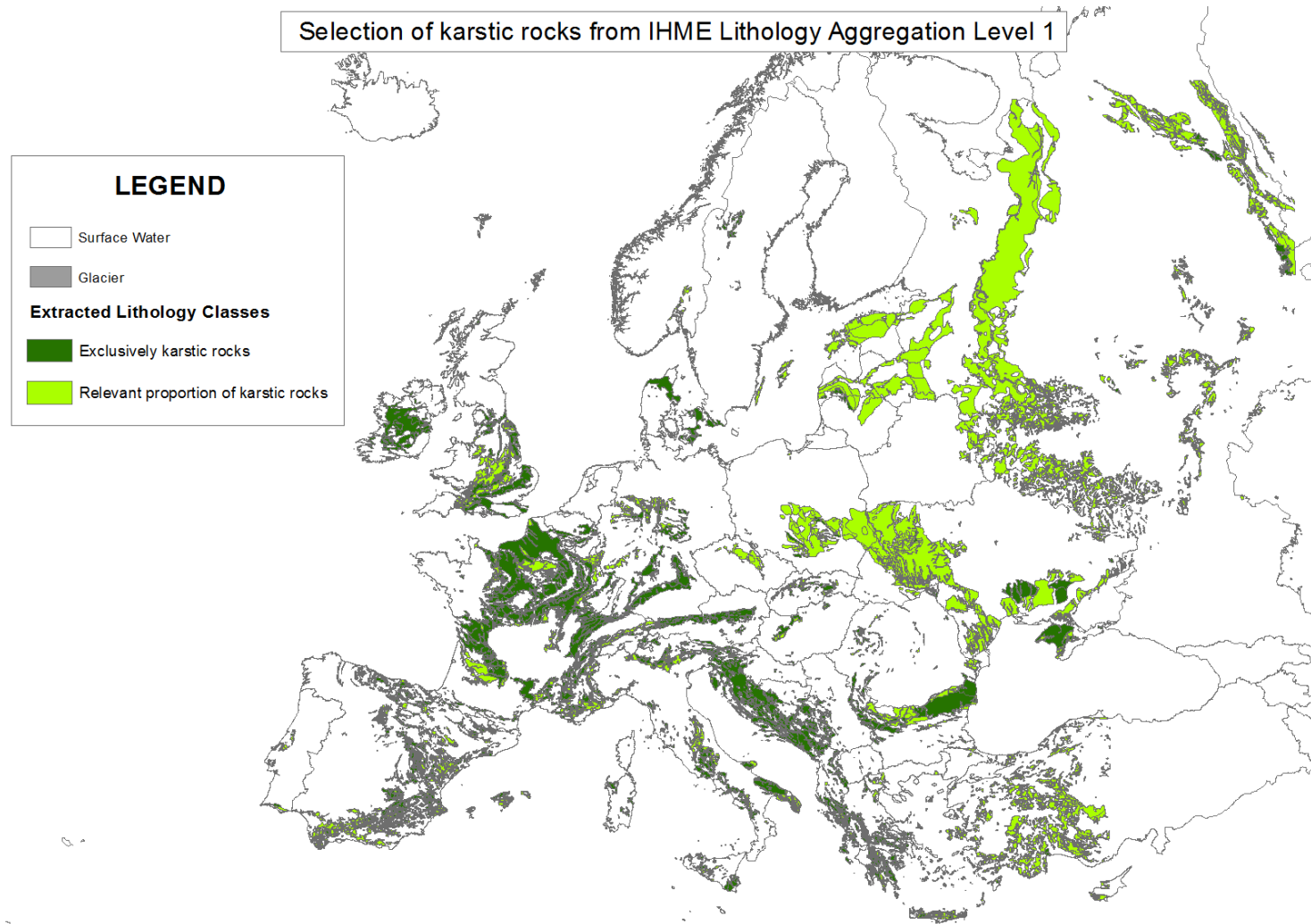
# IHME – Risk Assessment

## Geoprocessing of IHME – highly productive aquifers and CORINE LAND COVER (CLC)



➔ Indication of areas with risk of relevant groundwater pollution by nitrate and pesticides

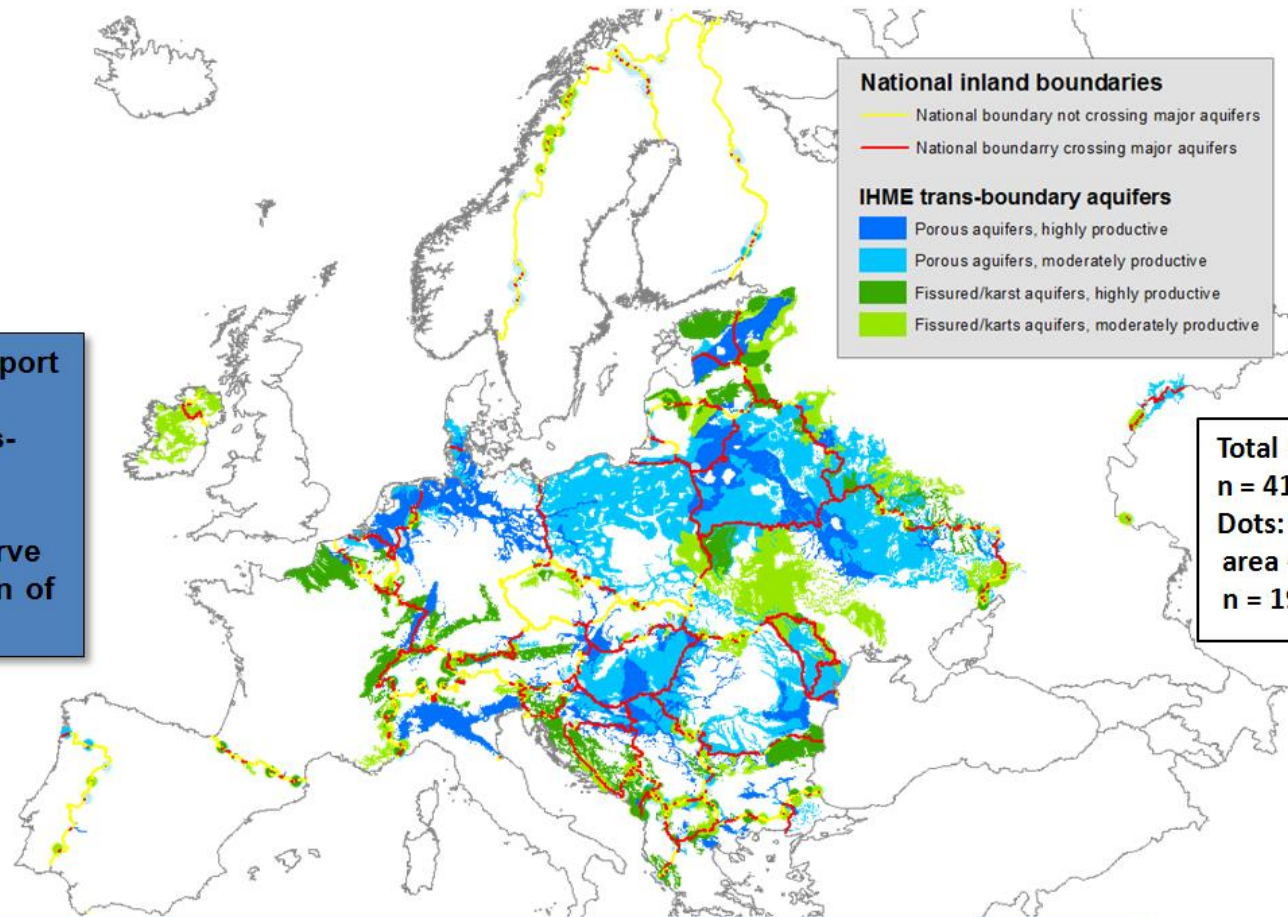
# IHME Application – Lithology Assessment



➔ **Lithological analysis to address specific issues,  
e. g. outcrop of karstic aquifers**



# IHME – Transboundary Aquifers



Total number TBA:  
n = 418  
Dots: Aquifers with  
area < 200 km<sup>2</sup>  
n = 197

➤ IHME 1500 can support a synoptic spatial delineation of trans-boundary aquifer systems across Europe and can serve for the identification of priority regions

➤ For a better geographic assessment, constraints on aquifer sizes and border separations have to be formulated

➤ Additional IHME information (lithology, GW divides, isolines, springs etc.) can allow for a more specific characterization of trans-boundary aquifers

# IHME Model Application

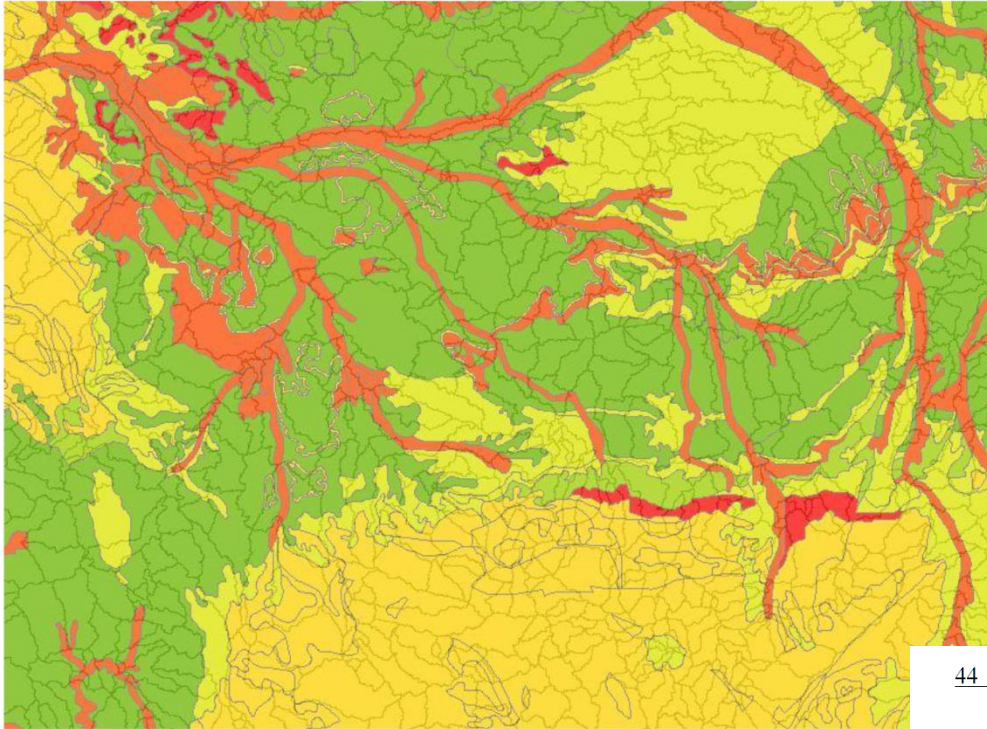


Figure 23 Groundwater aquifer and ECRINS FECs (in grey)

Source: Le Gall, G. & Crouzet, P.: Water Accounting Implementation over Europe - ECRINS V1 and Water Balance Calculations; EEA report (Version 1); p. 34; 15.02.2011

**Calculation of EU-wide water accounts**

(Presentation Alberto L. Alonso, Theme 5)

**Filling the gap of harmonised EU-wide or cross border groundwater information**

**MONERIS - Substance flow modelling in cross border regions**

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*I.5 MONERIS model structure*

Hydrogeology

Table I.5.12: Hydrogeology

Category	Sub- Category	Specification	Units
HYDRO-GEOLOGY	Unconsolidated soil	Shallow groundwater	km <sup>2</sup>
	Unconsolidated soil	Deep groundwater	km <sup>2</sup>
	Consolidated	High porosity	km <sup>2</sup>
	Consolidated	Impermeable	km <sup>2</sup>

For further information about the Hydrogeology data consult Chapter I.3.3.1.

Source: Behrendt et al.: The model system MONERIS – User Manual (Version 2); Leibniz Institute of Freshwater Ecology and Inland Fisheries; Berlin; p. 44; July 2007

# IHME - GWB layer synergies

- Harmonisation of GWB outlines and horizon assignment comparing GWB and aquifer delineation
- Selection of objects querying certain characteristics of the other layer
- Geoprocessing and database functions enable to create and save information



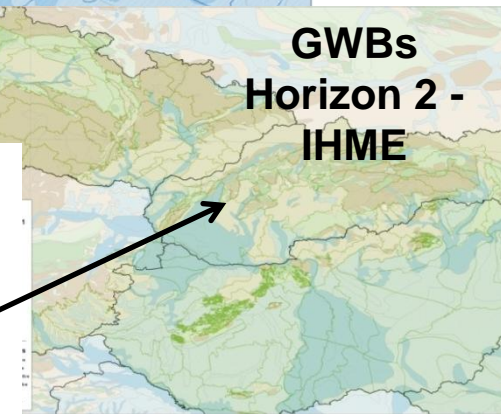
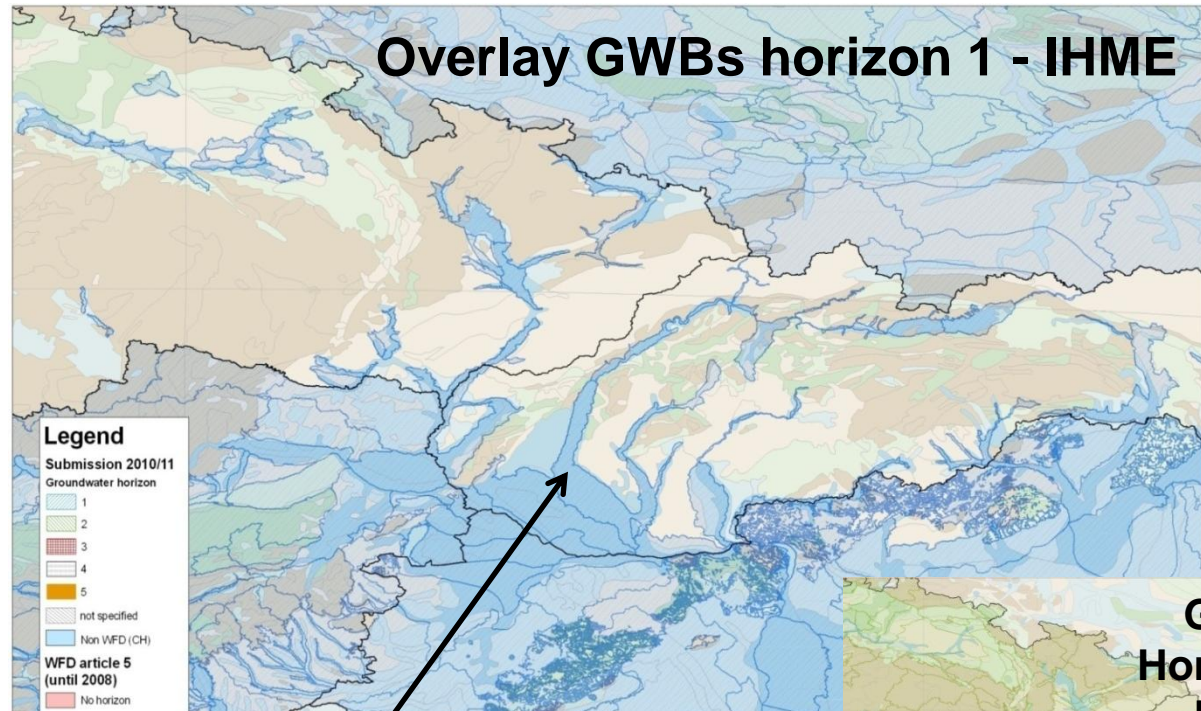
Generating new / replenish existing information



Reference between single- and multilayer?

# IHME – Horizon Assignment

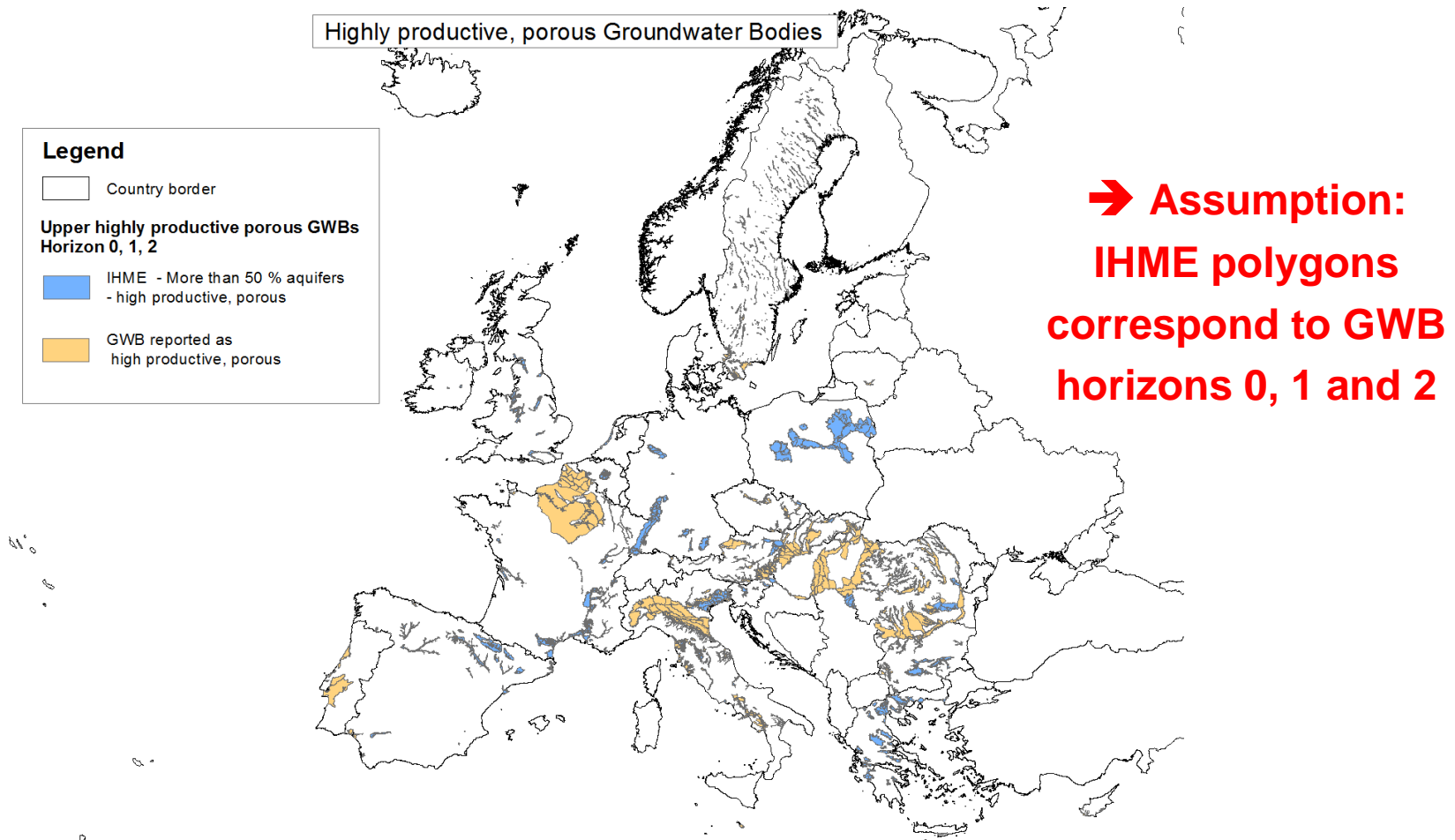
**IHME may serve as an instrument for harmonisation of GWB outlines and/or delineation of new GWBs**



Code of horizon name	Name of horizon	Brief description
UP	upper	Alluvial deposits, locally delineated
M	main	Different geological age of GWBs including quarternary sediments, in principle the entire area of RBD/country
D1	deep	Locally delineated Cretaceous sediments (Turon and Cenoman)
TH	thermal water	Locally delineated thermal waters

# IHME – GWB Aquifer Analysis

GWB attribute ‚Geological Formation‘ analogous IHME ‚Aquifer Type‘





→ Supplement of lacking data „Geological Formation“

# IHME – GWB Lithology Analysis

Upper Groundwater Bodies mainly consisting of coarse sediments

## Legend

-  country
-  GWBs of horizons 0, 1 and 2 consisting of more than 50 % of coarse sediments deduced from IHME lithology level 4

**→ Assumption:  
IHME polygons  
correspond to GWB  
horizons 0, 1 and 2**

EU_CD_GW	IHME Lithology LEVEL4	Area sqkm	Area %
ATGK100001	Calcareous rocks	7,912023715	25,42
ATGK100001	Clastic rocks	13,96880826	44,88
ATGK100001	Coarse sediments	9,240659746	29,69
ATGK100002	Calcareous rocks	30,6135941	13,74
ATGK100002	Clastic rocks	33,70607889	15,13
ATGK100002	Clastic rocks and fine sediments	0,499258873	0,22
ATGK100002	Coarse sediments	130,420682	58,56
ATGK100002	Magmatic rocks	5,972057846	2,68
ATGK100002	Metamorphic rocks	21,51458075	9,66
ATGK100003	Clastic rocks and fine sediments	651,2010175	71,08
ATGK100003	Coarse sediments	264,9412785	28,92
ATGK100004	Calcareous rocks	31,12634167	64,25
ATGK100004	Calcareous rocks and coarse sediments	1,585664845	3,27
ATGK100004	Calcareous rocks and fine sediments	15,73236424	32,48
ATGK100005	Calcareous rocks	11,15374822	19,81
ATGK100005	Clastic rocks	13,40364243	23,81
ATGK100005	Coarse sediments	31,73854397	56,38
ATGK100006	Calcareous rocks	35,55036422	19,59
ATGK100006	Calcareous rocks and coarse sediments	13,04092118	7,19
ATGK100006	Clastic rocks and fine sediments	0,38640337	0,21
ATGK100006	Coarse sediments	130,2391599	71,76
ATGK100006	Fine sediments	2,270202013	1,25

**→ Creating new GWB information**

# Summary

- **The IHME and GWB GIS layers constitute two new hydrogeological datasets of different structure and elements**
- **IHME presents for the first time coherent and quality assured European-wide spatial groundwater data**
- **Spatial data of GWB offer vertical distinct elements and serve as container for a wide range of attributes, but spatial and attribute data is not consistent**
- **Draft examples of several applications for data analysis and to achieve new information have been presented**

# Recommendations

- **Review of IHME concerning updates / areas not mapped**
- **Review of GWB layer for spatial and attribute data quality improvement as a long-term iterative process**
- **Data extracted from IHME may serve as attributes for GWB layer**
- **IHME spatial data may support a range of international assessment issues like transboundary aquifers**
- **Potential application of IHME lithological data not only for hydrogeological enquiries (e.g. superficial deposits / landslides)**



# Thank You!