

Report on the preparation of a Groundwater Body GIS Reference Layer

Federal Institute for Geosciences and Natural Resources (BGR), Germany
Klaus Duscher

Legend

Submission 2010
Groundwater horizon

- 1
- 2
- 3
- 4
- 5
- not specified
- Non WFD (CH)

Submission 2008
No stratification

2nd Workshop on Groundwater Bodies
15. - 16.12.2011
(Berlin)

Framework

- Since 2007 BGR participates in *ETC Water* consortium and since 2011 in successor *European Topic Center on Inland, Coastal and Marine waters* (ETC/ICM)
- BGR supports ETC/ICM in activities of policy advisory concerning groundwater issues
- Main task of BGR is the compilation and assessment of a GWB GIS Reference Layer
- First GWB layer compiled in 2010 and published in WISE
- Presentation includes update 2011, not published yet

Topics

- 1st River Basin Management Plan (RBMP) GWB Submission 2010/11
- GWB layer compilation
- Spatial data evaluation
- GWB attribute data evaluation
- Conclusions

GWB – WFD Timetable

Year	WFD Milestones
2000	GWB definition in WFD article 2 (A distinct volume of groundwater within an aquifer or aquifers)
2004 / 2005	Analysis and review of GWBs as required by WFD article 5
Dec 2009	1st River Basin Management Plan (RBMP) required by WFD article 13 (Additional mandatory horizon assignment + several optional attributes)

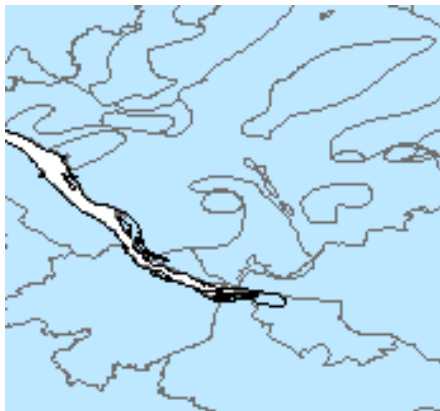
RBMP GWB – Horizon

- **Former submissions**

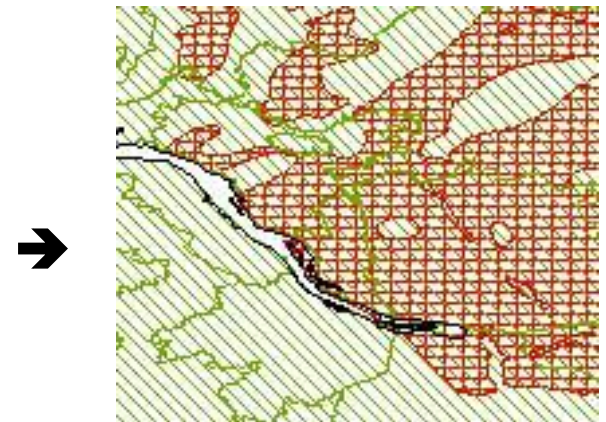
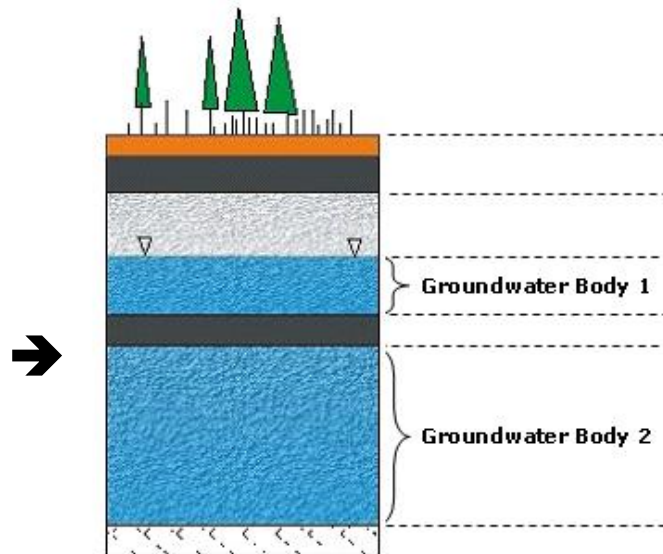
- 2-dimensional and surface-related GWB acquisition

- **RBMP / Submission 2010**

- Space-oriented and 3-dimensional formation of GWBs
- Overlaying GWB assigned to different vertical horizons



WFD article 5



WFD RBMP

RBMP GWB – Data Structure

- **Spatial data as polygon shapes with two mandatory attributes**
 - **GWB Code** (EU_CD_GW)
 - **Horizon**
 - **XML schema comprising further GWB attributes**
 - **GWB Code** (EU_CD_GW)
 - **Location of GWB** (transboundary, out of rbd, ...)
 - **Environmental links** (protected areas, surface water bodies,)
 - **GWB dimension** (average depth, average thickness,)
 - **GWB properties** (capacity, geological formation,)
- ➔ **GWB code as unique GWB identifier serves as link between spatial and attribute data**

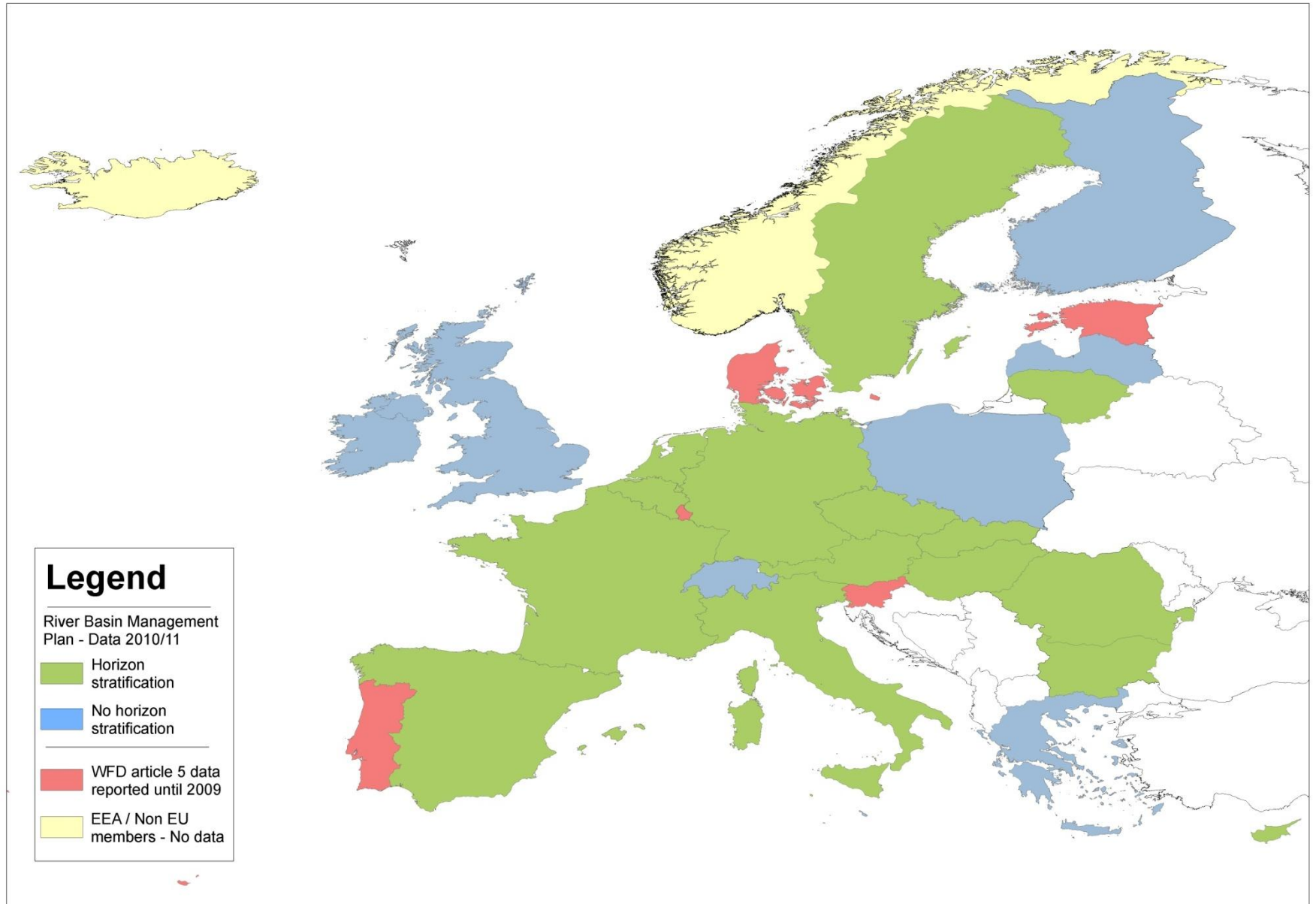
GWB – Available Data 2011

Country	GIS data RBMP	GIS Data Article 5	XML data	Submission status November 2010
Austria	X		X	Finalised
Belgium	X		X	Draft
Bulgaria	X		X	Draft
Cyprus	X		X	Finalised
Czech Republic	X		X	Finalised
Denmark		X		
Estonia		X	X	
Finland	X		X	Finalised
France	X		X	Finalised
Germany	X		X	Finalised
Greece	X		X	Finalised
Hungary	X		X	Finalised
Ireland	X		X	Draft
Italy	X		X	Draft
Lithuania	X		X	Finalised
Latvia	X		X	Draft
Luxembourg		X	X	
Malta	X		X	Draft
Netherlands	X		X	Finalised
Poland	X		X	Draft
Portugal		X		
Romania	X		X	Finalised
Slovakia	X		X	Draft
Slovenia		x		
Spain	X		X	Draft
Sweden	X		X	Finalised
United Kingdom	X		X	Finalised

- RBMP spatial data by all 27 MS besides DK, EE, LU, SI and PT, but data from WFD article 5 available
- CY and MT first spatial data 2011
- No XML data from DK, PT and SI
- Status Finalized 13 MS / Draft 9 MS

- **RBMP data - 22 MS**
 - RBMP data with horizons - 15 MS
 - RBMP data without horizons - 7 MS
- **WFD article 5 data - 5 MS → No quality assessment**

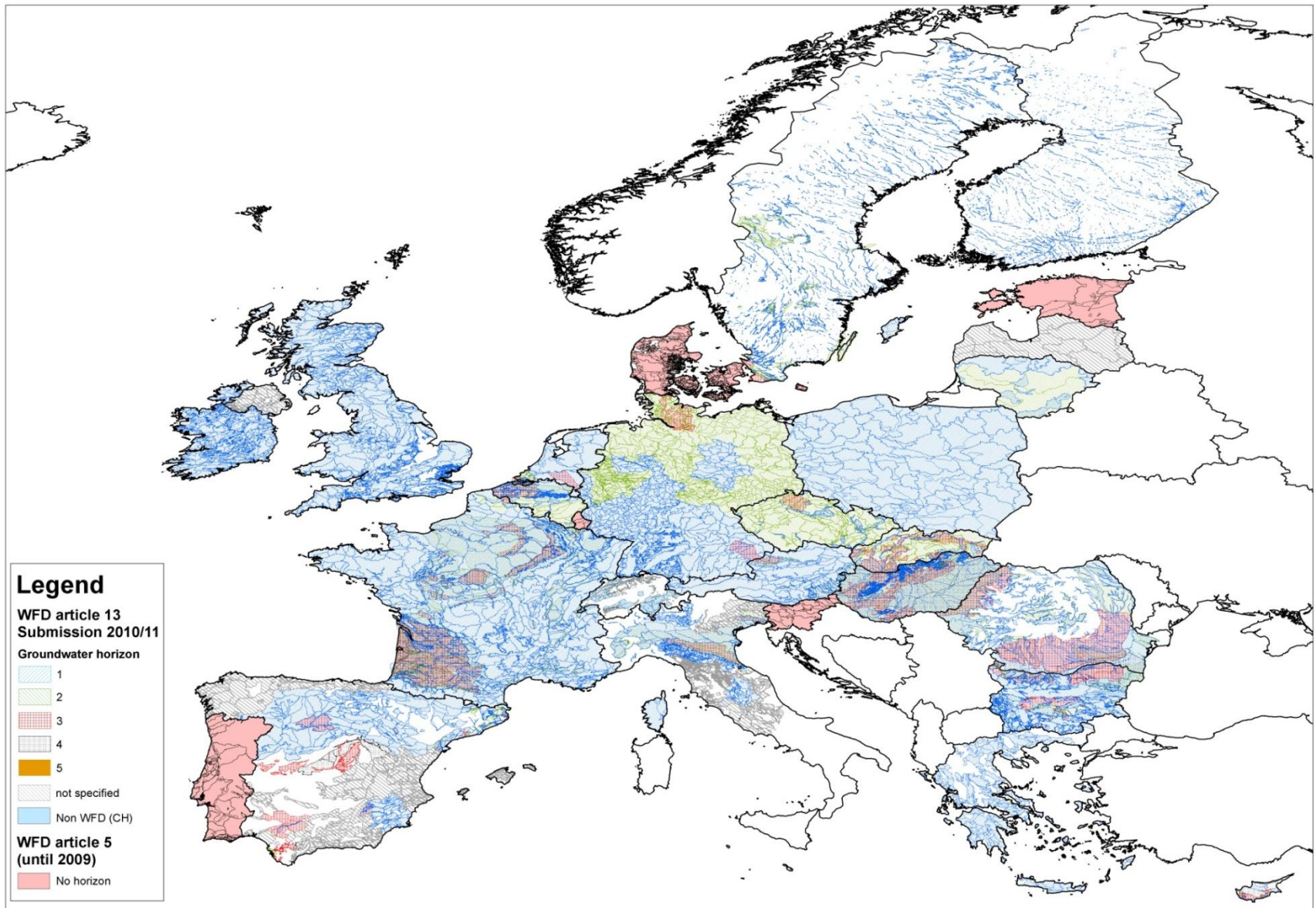
GWB Data until 2011 – Horizon



GWB Layer Compilation - Methodology

- 12590 polygons from RBMP data merged to one shape for each horizon 1 to 5 plus one shape of polygons without allocated horizons
 - ➔ 6 shapes with attributes **GWB key** and **Horizon**
- Merge of 531 polygons of countries providing only WFD article 5 data without vertical stratification
 - ➔ 1 shape with **GWB key**
- 29 polygons of Non MS (CH) assigned to horizon 1
 - ➔ 1 shape with **GWB key**
 - ➔ **Compilation of 8 individually portrayable layers**

GWB Reference Layer – Survey Map



Remark: Data evaluation will comprise exclusively WFD article 13 data of EU member states

GWB – Structural Inconsistencies

- **230 GWBs consist of several polygons**
- **GWBs extend over several horizons**
- **Overlying GWBs within same horizon**

→ Assessment complications

Spatial Data - GWB Size

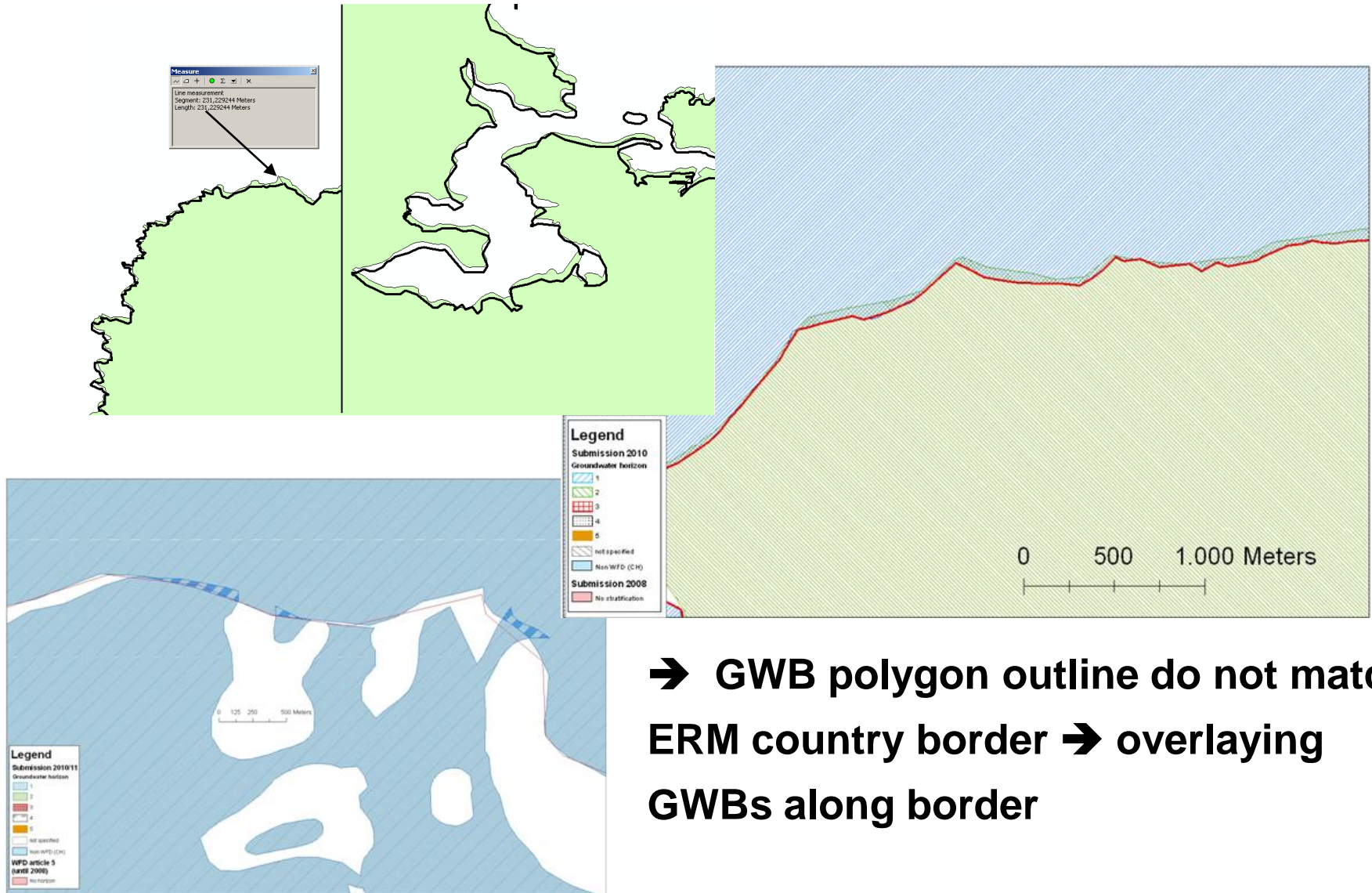
Country	Amount of polygons	Min polygon (km ²)	Max polygon (km ²)
AT	136	12.06	9569.29
BE	80	0.00002 (21.23)	6049.67
BG	127	101.21	13043.29
CY	20	1.99	2391.15
CZ	173	12.47	5833.39
DE	989	0.01	5574.51
ES	712	2.54	7788.9
FI	3616	0.05	97.39
FR	890	0.22 (1.85)	53453.7 (60940.39)
GR	235	4.12	3536.73
HU	176	114.88	13601.70
IE	756	0.02	1866.23
IT	481	0.001 (4.12)	9028.89 (9190.6)
LT	20	332.31	19824
LV	16	327.93	10173.23
MT	1	220.4	220.4
NL	23	26.32	6277.55
PL	161	24.62	8931.2
RO	142	21.76	42493.29
SE	3023	0.002	5153.46
SK	90	109.83	6680.89
UK	723	1.88	4066.88



MS having GWBs with several polygons
polygon area (GWB area)

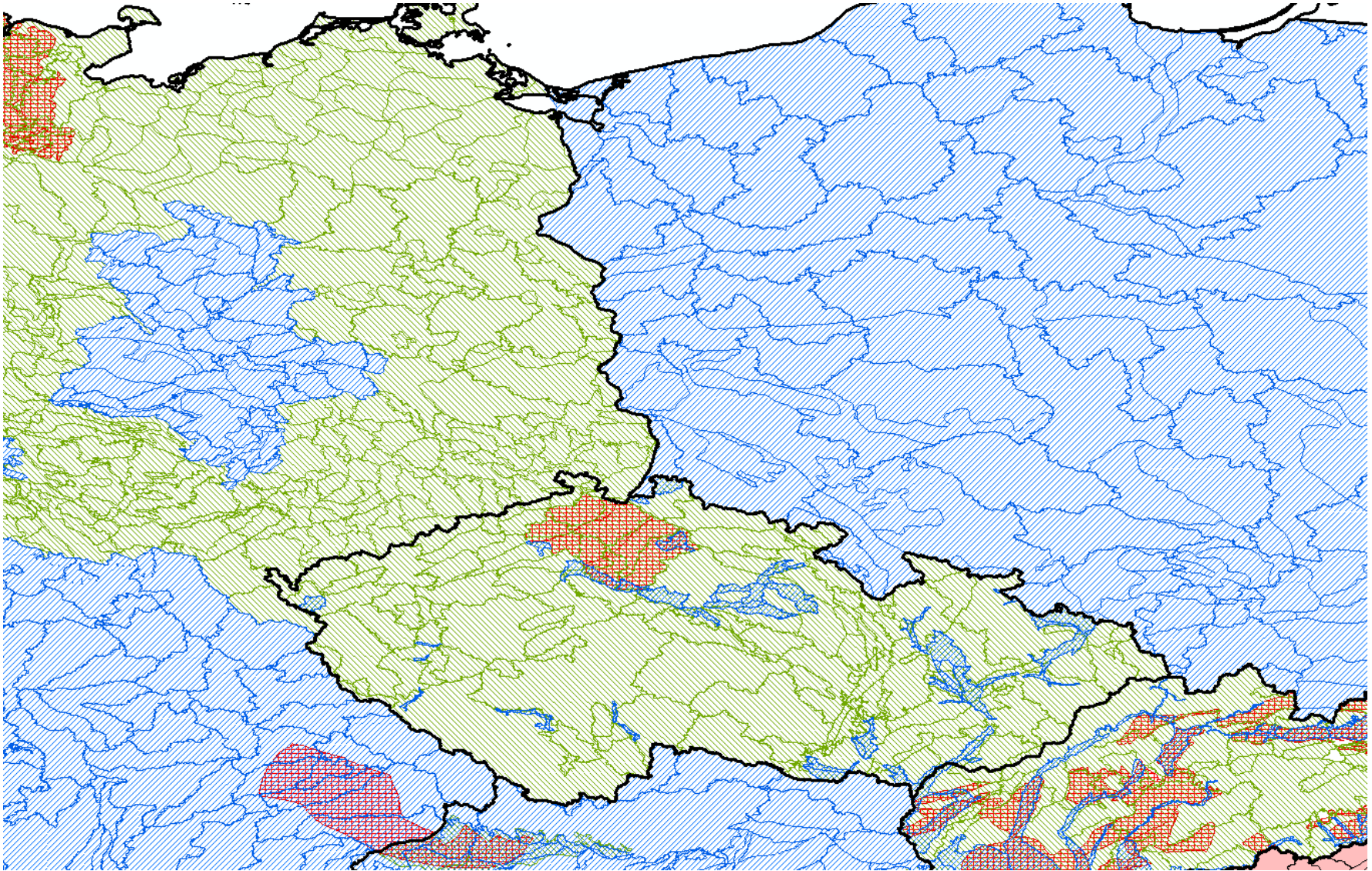
- Widely varying number of GWBs/ polygons in the MS (1 to 3616 - FI and SE half of total amount)
 - Many MS report either large and very small GWBs/polygons
 - 46% of all polygons (total number about 5831) less than 5 km² (5424 in FI or SE)
 - 20% of all polygons (total number about 2500) less than 1 km² (2314 in FI or SE)
- ➔ Feasibility of monitoring a large amount of small GWBs?

Spatial Data – Border Topology



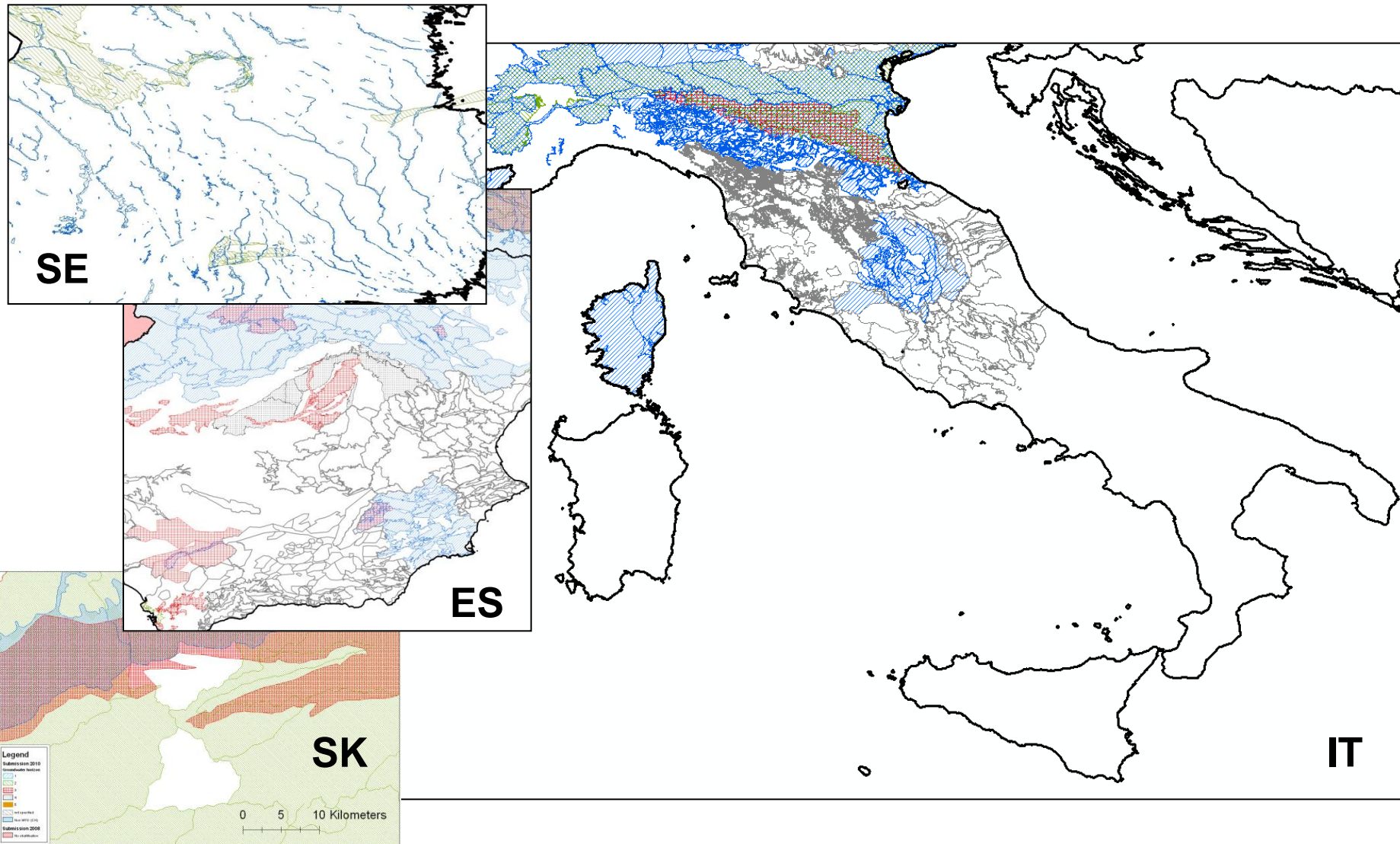
➔ **GWB polygon outline do not match ERM country border ➔ overlaying GWBs along border**

Spatial Data – Horizon



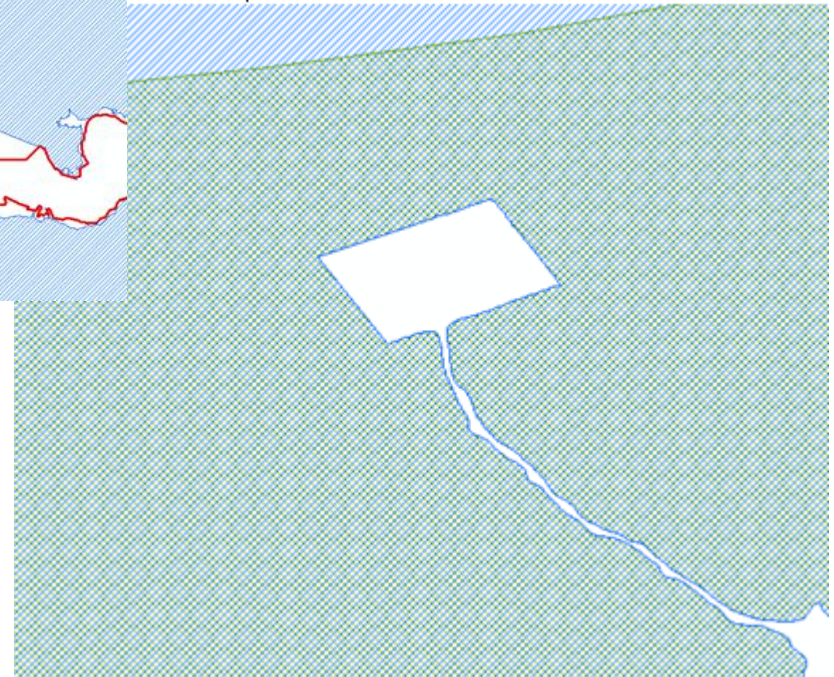
→ Horizon assignment depend on editors

Spatial Data – Uncovered Areas



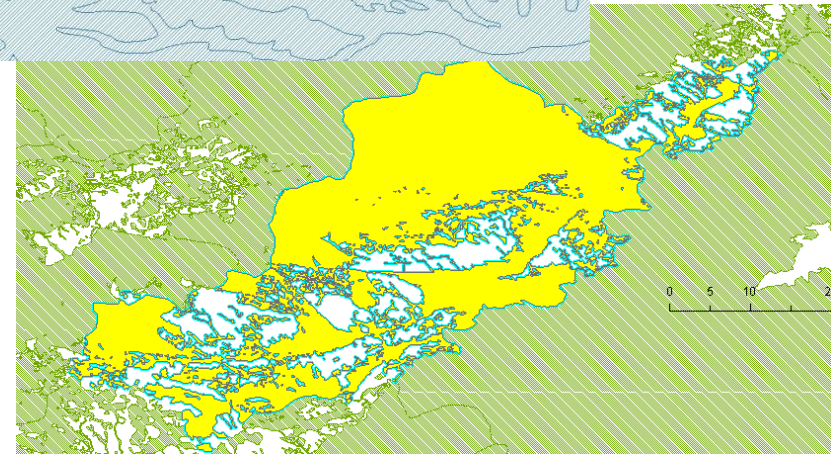
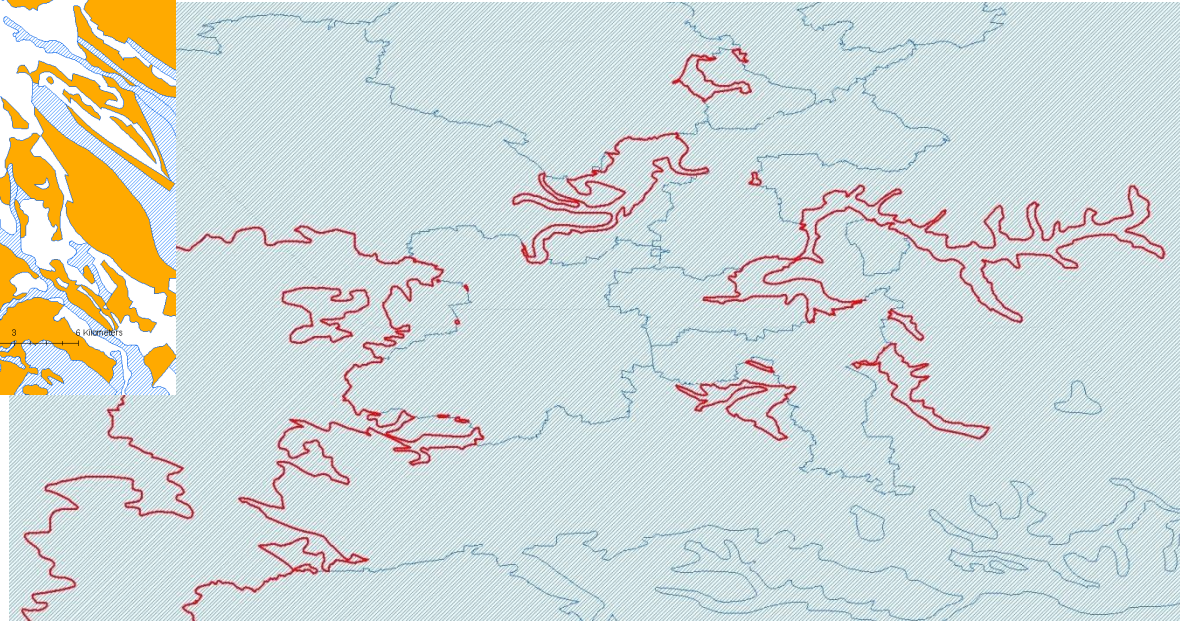
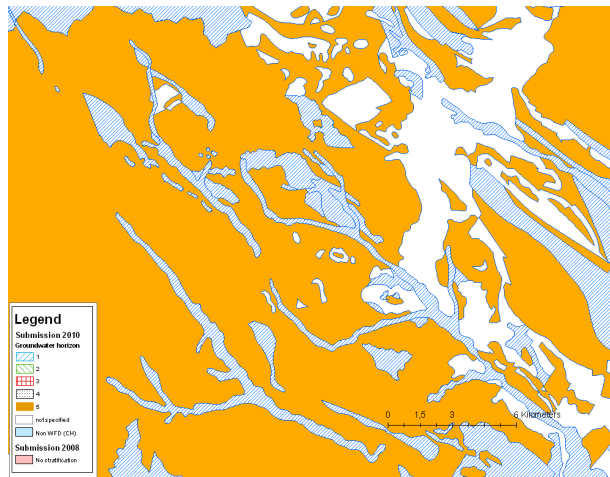
➔ GWBs do not cover entire territory

Spatial Data – Blanked Areas



➔ Details may not be blanked

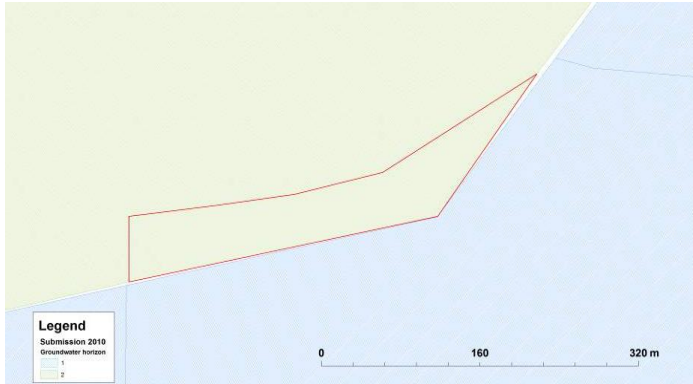
Spatial Data – Segmented GWB



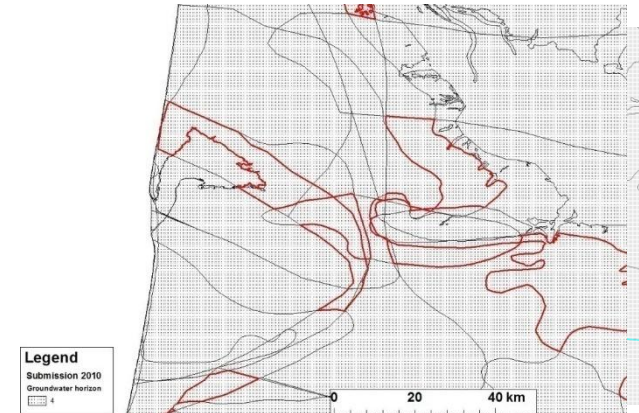
GWBs saved as single multipart polygons with several spatially separated areas

→ Fragmented GWB pattern

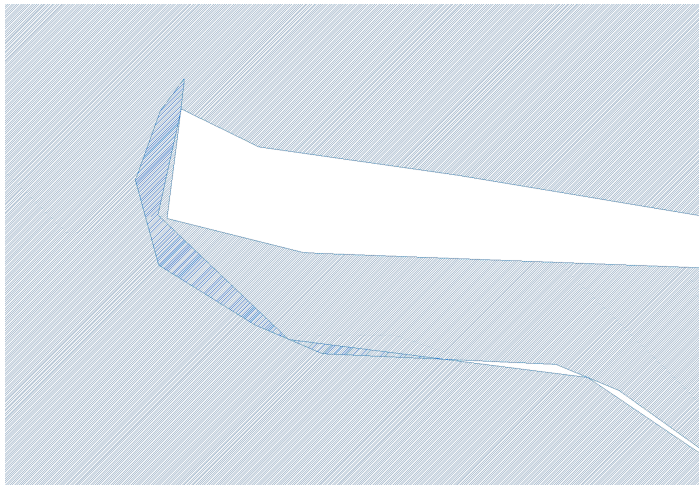
Spatial Data – Technical Deficits



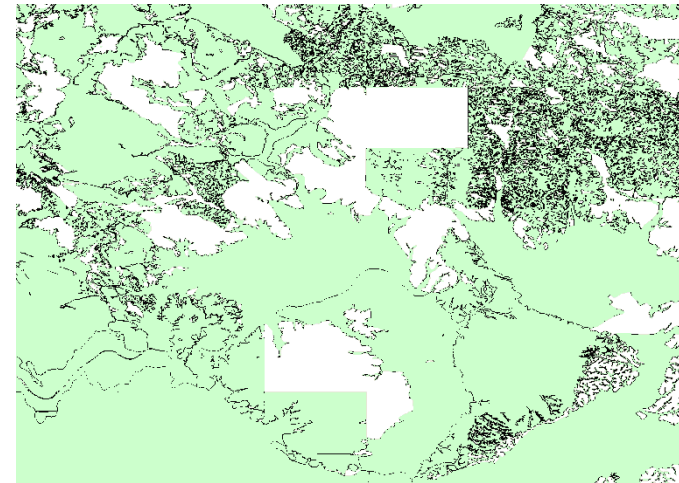
→ Fractional GWB



→ Multiple fractional GWBs



→ Topological error



→ Geometrical error

Polygon quality is not appropriate for use as reference layer

Alignment XML – Spatial Data

MS	GWB spatial data	GWB XML data	Match spatial data - GWB data
AT	136	136	136
BE	76	42	38
BG	127	177	126
CY	20	20	20
CZ	173	173	173
DE	989	989	989
ES	712	644	644
FI	3616	3804	3603
FR	574	574	574
GR	235	236	235
HU	176	185	176
IE	756	756	756
IT	341	680	284
LT	20	20	20
LV	16	16	16
MT	1	15	1
NL	23	23	23
PL	161	161	161
RO	142	142	142
SE	3023	3021	3021
SK	90	101	90
UK	723	723	723
Total	12130	12638	11951

• Match of spatial and XML data

green - match

blue - mostly match

red – often mismatch (mostly

higher number of XML datasets)

→ Mismatch mostly results from higher number of XML datasets

Reporting finalised

→ Provisional data evaluation

Completeness of GWB Attribute Entries

MS	Total	%	AT	BE	BG	CY	CZ	DE	ES	FI	FR	GR	HU	IE	IT	LT	LV	MT	NL	PL	RO	SE	SK	UK
GWB_MS_CD	11951	100.00	136	38	126	20	173	989	644	3603	574	235	176	756	284	20	16	1	23	161	142	3021	90	723
Quantitative StatusValues	11951	100.00	136	38	126	20	173	989	644	3603	574	235	176	756	284	20	16	1	23	161	142	3021	90	723
Chemical StatusValue	11951	100.00	136	38	126	20	173	989	644	3603	574	235	176	756	284	20	16	1	23	161	142	3021	90	723
UpwardTrend	11951	100.00	136	38	126	20	173	989	644	3603	574	235	176	756	284	20	16	1	23	161	142	3021	90	723
TrendReversal	11951	100.00	136	38	126	20	173	989	644	3603	574	235	176	756	284	20	16	1	23	161	142	3021	90	723
Associated_Protected_Area	11951	100.00	136	38	126	20	173	989	644	3603	574	235	176	756	284	20	16	1	23	161	142	3021	90	723
Area	11345	94.93	136	38	125	20	173	989	150	3603	574	192	176	756	283	20	16	1	23	161	142	3021	90	656
Layered	10082	84.36	0	38	125	20	173	989	150	3603	97	0	176	756	267	20	16	1	23	161	142	3021	0	304
Geological Formation	8737	73.11	136	0	63	20	170	0	21	3603	71	0	176	756	283	20	3	1	0	161	142	3021	90	0
Out of RBD	8178	68.43	136	0	126	20	173	989	439	3603	574	235	176	756	217	20	16	1	23	161	142	0	0	371
Transboundary Scale	7346	61.47	136	38	126	20	173	0	457	3603	574	235	176	756	228	20	16	1	23	161	142	0	90	371
Scale	6503	54.41	136	0	61	20	173	989	108	0	113	192	176	756	255	20	16	1	23	0	142	3018	0	304
LinkSurface WaterBodies	5440	45.52	0	0	91	20	173	0	57	0	285	192	176	756	238	20	16	1	0	0	0	3021	90	304
LinkTerrestrial Ecosystems	5044	42.21	0	0	125	20	173	0	21	0	286	192	176	756	214	20	16	1	23	0	0	3021	0	0
DepthRange	3829	32.04	54	38	35	20	0	4	20	0	71	0	176	0	209	20	0	0	0	161	0	3021	0	0
Vertical Orientation	3589	30.03	0	37	36	20	0	0	0	0	53	0	176	0	209	20	16	1	0	0	0	3021	0	0
AverageDepth	3507	29.34	58	0	27	7	0	0	2	0	0	0	165	0	179	20	16	0	11	1	0	3021	0	0
Average Thickness	3550	29.70	69	0	48	2	0	0	0	0	7	0	165	0	170	20	15	0	23	10	0	3021	0	0
Capacity	3242	27.13	0	0	0	19	0	0	0	0	5	104	0	0	54	0	16	0	23	0	0	3021	0	0
OtherPressure Description	300	2.51	0	0	0	0	33	0	0	0	5	0	85	0	11	0	1	0	0	0	0	165	0	0
OtherImpactDescription	176	1.47	3	0	0	0	0	0	43	0	0	0	85	0	0	0	3	1	0	0	0	0	0	41

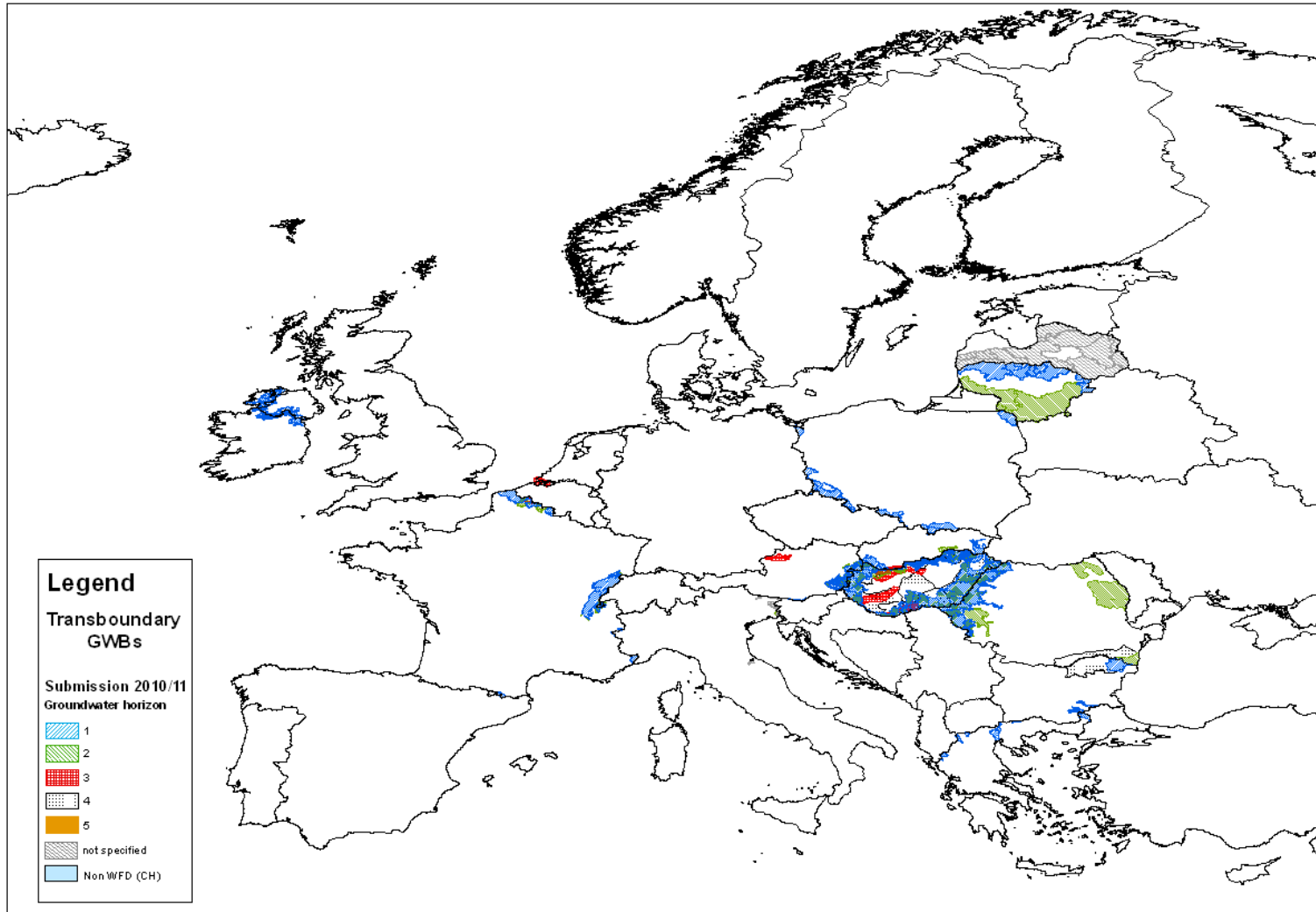
 Six mandatory attributes marked as blue rows, reporting of 15 remaining characteristics related to GWBs is optional

➔ Insufficient entries for evaluation of several attributes (< 50 % of total datasets - red coloured)

Attribute Data Evaluation

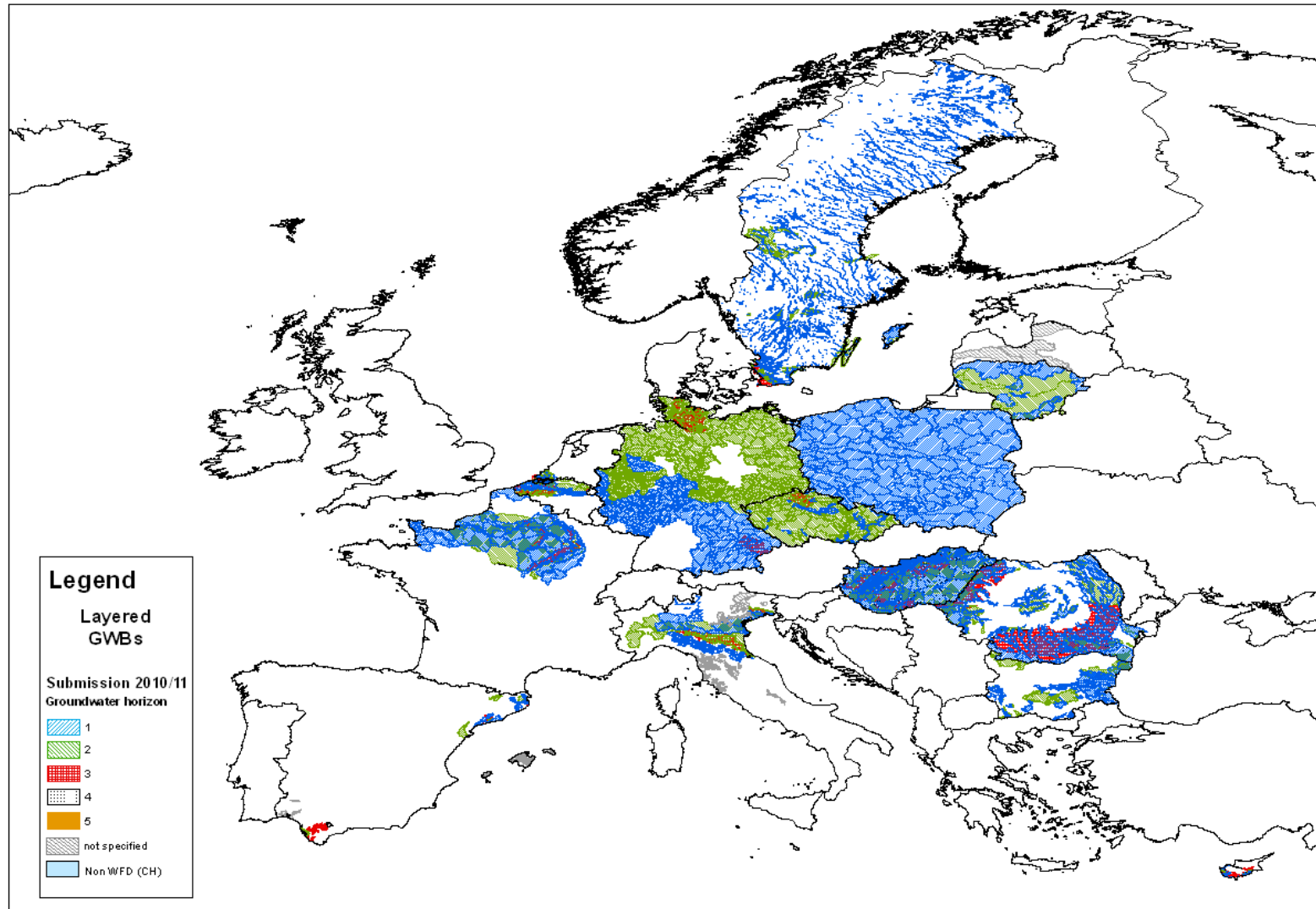
- **Data availability improved with update 2011**
- ***GWB code, chemical/quantitative status and trend* fully displayed in WISE**
- **Boolean (Yes/no) columns may partially be filled by default values**
- **Inconsistent entries in regard to content**

Transboundary GWBs



➔ **Inconsistent, because occurrence only on certain borders and in some cases only on one side of a border**

Layered GWBs



→ GWBs reported as Layered mismatch pattern of overlying GWBs (default values?)

2010 GWB Reference Layer – Conclusions

- **WFD article 13 reporting not complete**
 - Missing data of MS
 - Lack of entries for XML attributes
- **Data inconsistency**
 - Spatial data → e.g. Topological and geometric errors
 - Attribute data → e. g. Transboundary GWBs
 - Mismatch of spatial (polygons) and attribute (XML) data
- **Demand of coordination between MS**
 - Harmonisation of GWB delineation methodology (e. g. Horizon)

**→ Replenishment and review of data for further
GWB Layer developments is required**