



Informing you on ambient air quality
in the Belgian Regions

INSPIRE compliant e-reporting under the air quality directives from a member state perspective (Belgium)

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Belgian Interregional Environment Agency (IRCEL – CELINE)

Content

- Who are we (IRCEL – CELINE) and what do we do?
- What is e-reporting under the AQ-directives?
- Different approaches to e-reporting
 - Static xml (via ETL or custom script)
 - Extending a service (cf app-schema)
 - Extending a service (cf native extension of e.g. SOS)
- Reflection about the progress

IRCEL – CELINE

Intergewestelijke Cel voor het Leefmilieu (IRCEL)

Cellule Interrégionale de l'Environnement (CELINE)

Belgische Interregionale Umweltagentur (IRCEL - CELINE)

Belgian Interregional Environment Agency (IRCEL - CELINE)

Cooperation agreement between the three Belgian regions

VLAAMSE
MILIEUMAATSCHAPPIJ

(VMM)



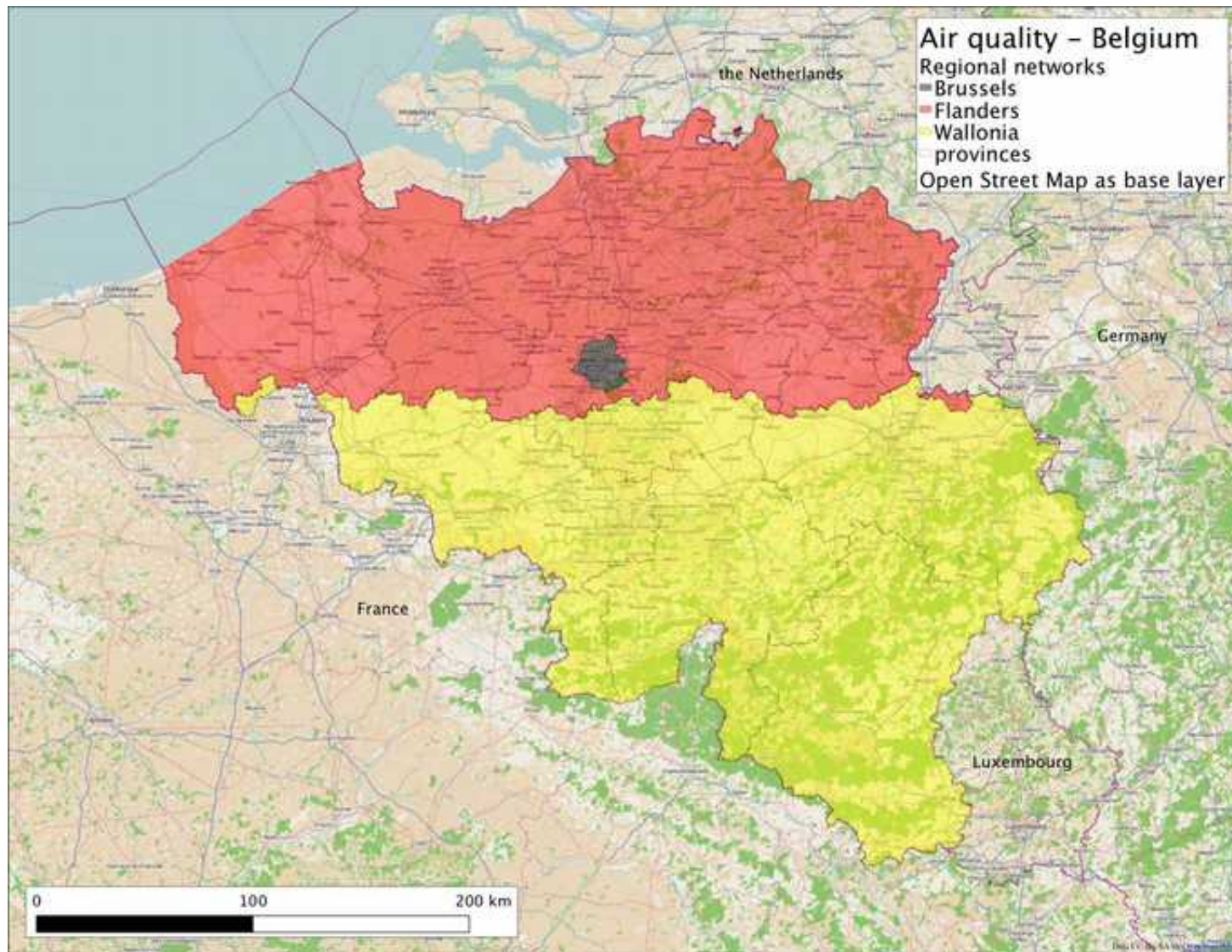
Leefmilieu Brussel -
Bruxelles Environnement



Agence wallonne de l'Air et du
Climat (AWAC)



IRCEL – CELINE



The three Belgian networks

IRCEL – CELINE



- Most important functions of IRCEL - CELINE (air quality):
 - Continuous forecasts (cf SMOG alert)
 - Informing the public on air quality (real-time and assessment)
 - National report under the air quality directive (2004/107/EC)
 - Enforcing a common scientific basis between monitoring networks
 - Interregional calibration laboratory
 - Interregional data processing centre (IDPC) - real-time database
- National Focal Point (Eionet)
- Compilation GHG inventory

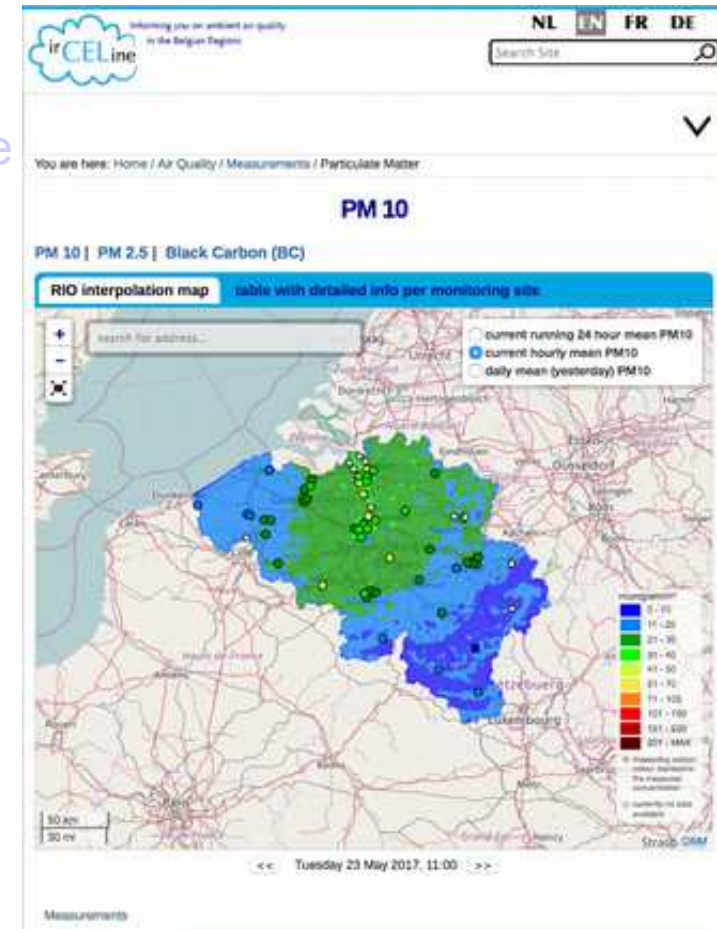
IRCEL – CELINE

<http://www.irceline.be>

- Real-time data
- All major pollutants (incl. BC)
- Forecasts
- Information about pollutants
- Publications
- etc.

Integration of OGC-services into website

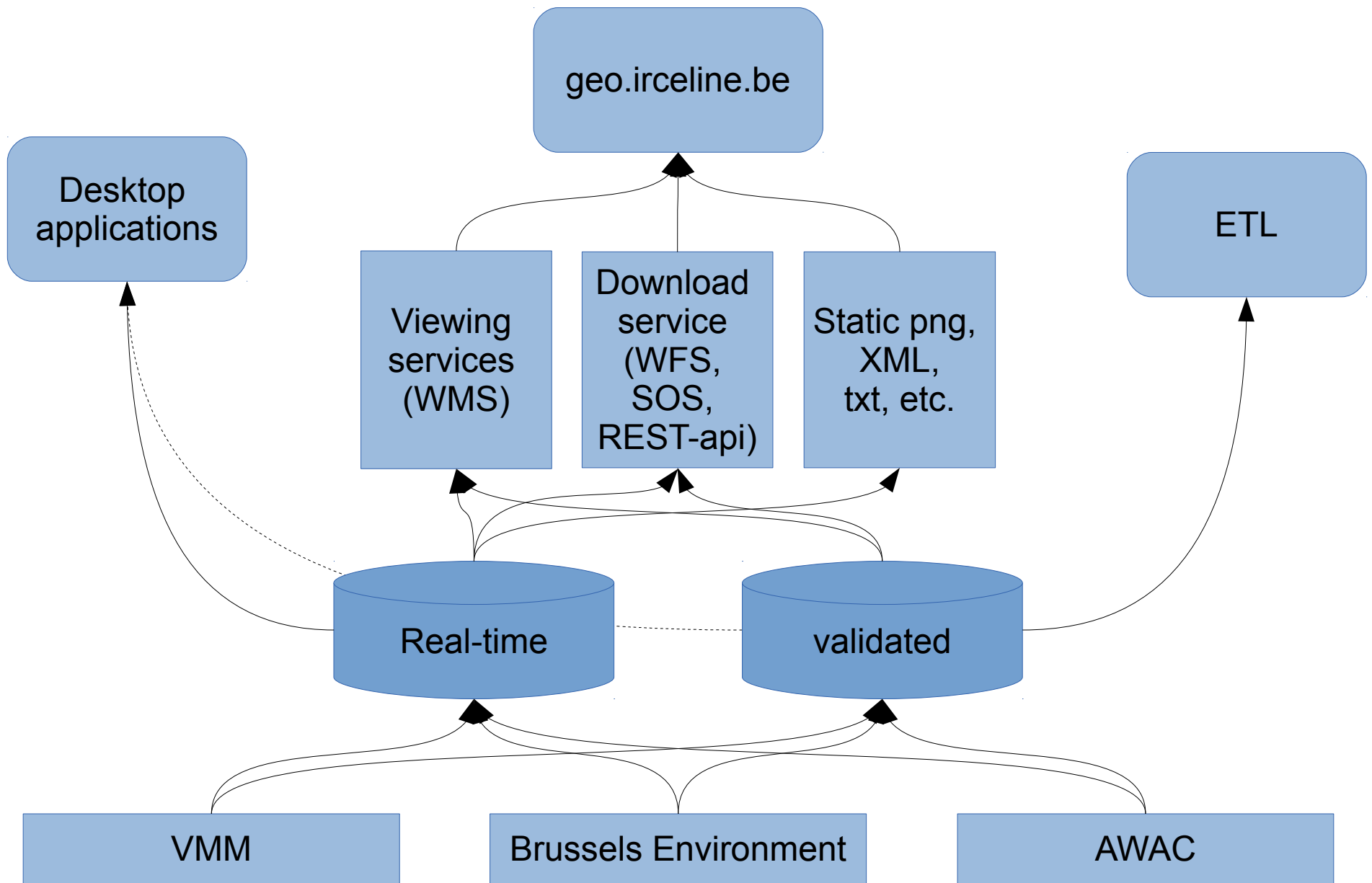
... and tables with (real-time) data:



The screenshot shows the irCELine website home page. It features the irCELine logo, navigation links (Air Quality, Documentation, About Us, Forum), and a section for 'Current Air Quality Measurements'. Below this, there are three maps showing NO2, PM2.5, and PM10 measurements. A table below the maps shows the 'The last/next week' with columns for 'weekend (Saturday/Sunday)', 'weekdays (Monday-Friday)', and 'winter (December-February)'. There is also a 'Forecast' section with three maps for NO2, PM2.5, and O3. A 'Subscribe to our mailing list' form is visible on the right side.

	weekend (Saturday/Sunday)	weekdays (Monday-Friday)	winter (December-February)
Belgium	very good - 3	very good - 3	very good - 3
Flanders	very good - 3	moderate - 5	very good - 3
Brussels	very good - 3	moderate - 5	very good - 3
Wallonia	good - 6	very good - 3	very good - 3

Overview SDI @ IRCEL - CELINE



E-reporting

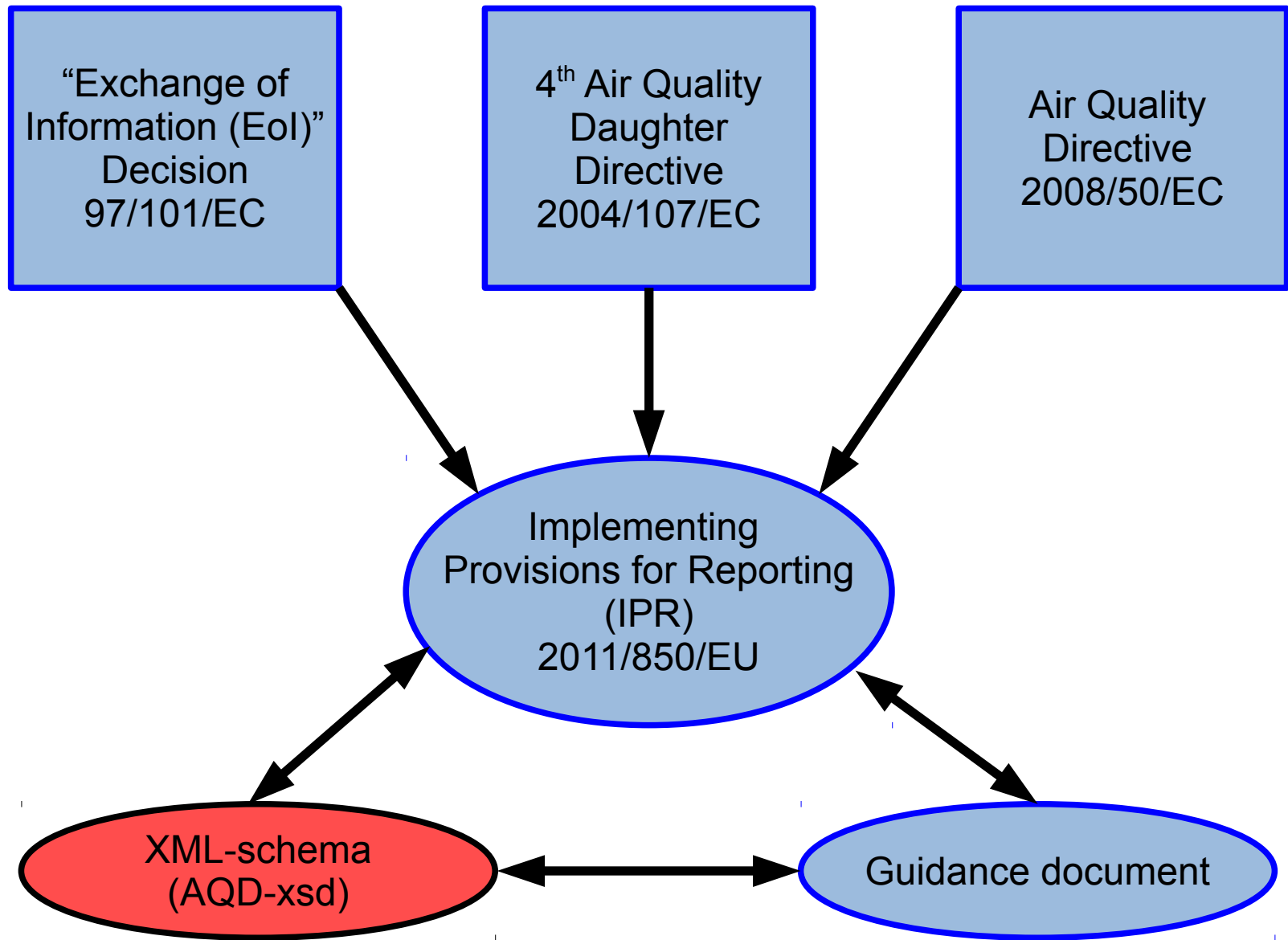
- Operational definition e-reporting:
 - Reporting by means of a standardised, machine-readable data encoding
 - Using a data model defined by a schema (cf INSPIRE data specifications)
 - (Making use of services for reporting - cf INSPIRE specifications for network services - where possible/desirable)
- New Implementing Provisions for Reporting (2011/850/EU) under the Air Quality Directives (2004/107/EC & 2008/50/EC) refer to INSPIRE (preamble, paragraph 7)
- INSPIRE refers to OGC downloading and viewing services, but there is no such thing as an “OGC reporting service”

The IPR – Decision (2011/850/EU)

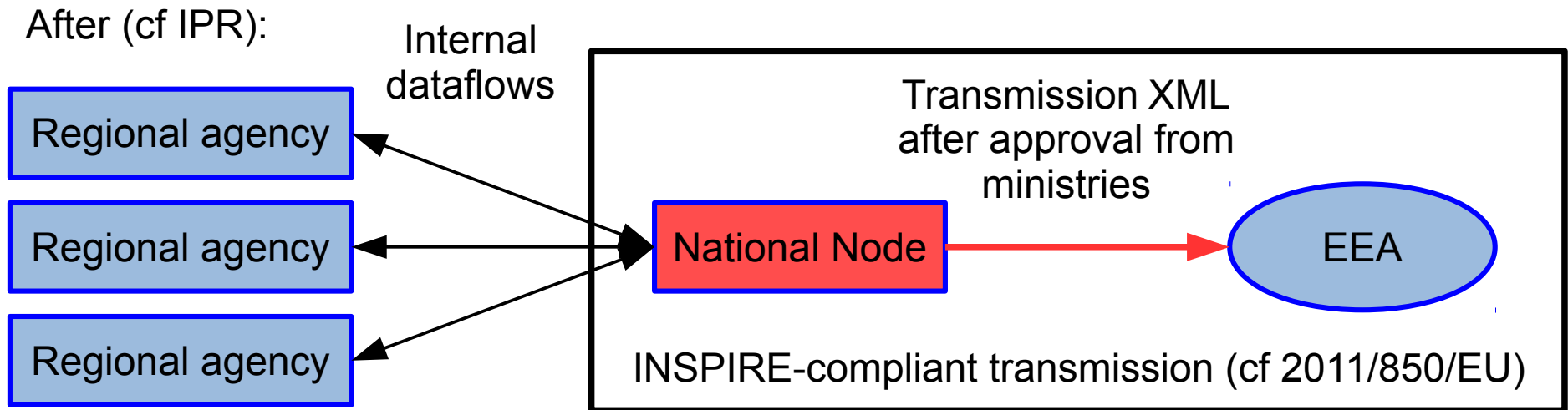
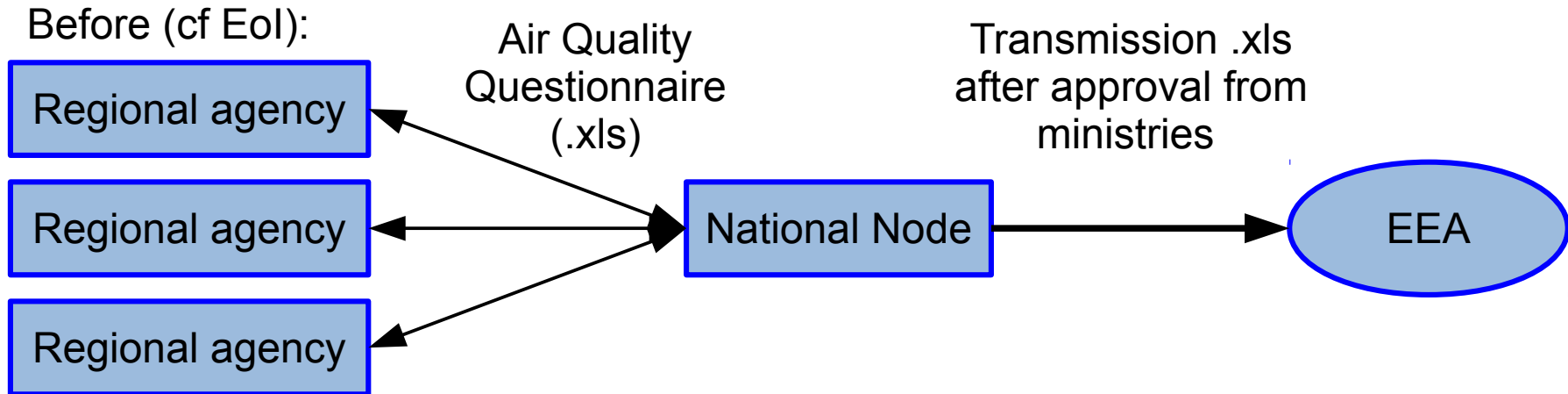
Preamble, paragraph 7 - To streamline the amount of information made available by Member States, to **maximise the usefulness** of such information and to **reduce the administrative burden**, Member States should be required to make the information available in a **standardised, machine-readable form**. The Commission, assisted by the European Environment Agency, should develop such a standardised machine-readable form **in line with the requirements of Directive 2007/2/EC** of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (**INSPIRE**) (6). It is of particular importance that the Commission carries out appropriate **consultations** during its preparatory work, including at expert level.

(6) OJ L 108, 25.4.2007, p. 1.

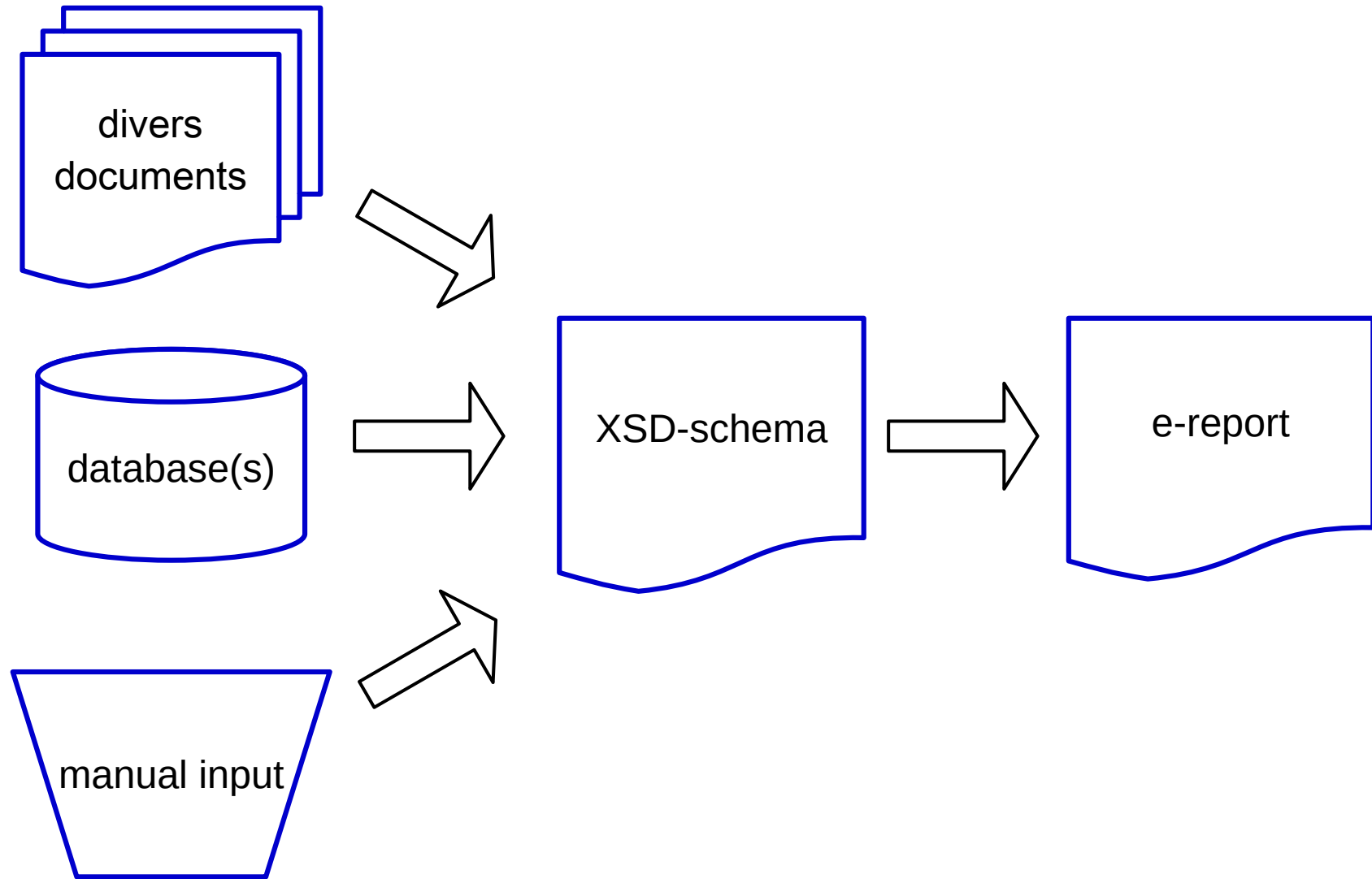
E-reporting and Air Quality



E-reporting under the IPR



E-reporting – schematic representation



E-reporting: the data flows involved

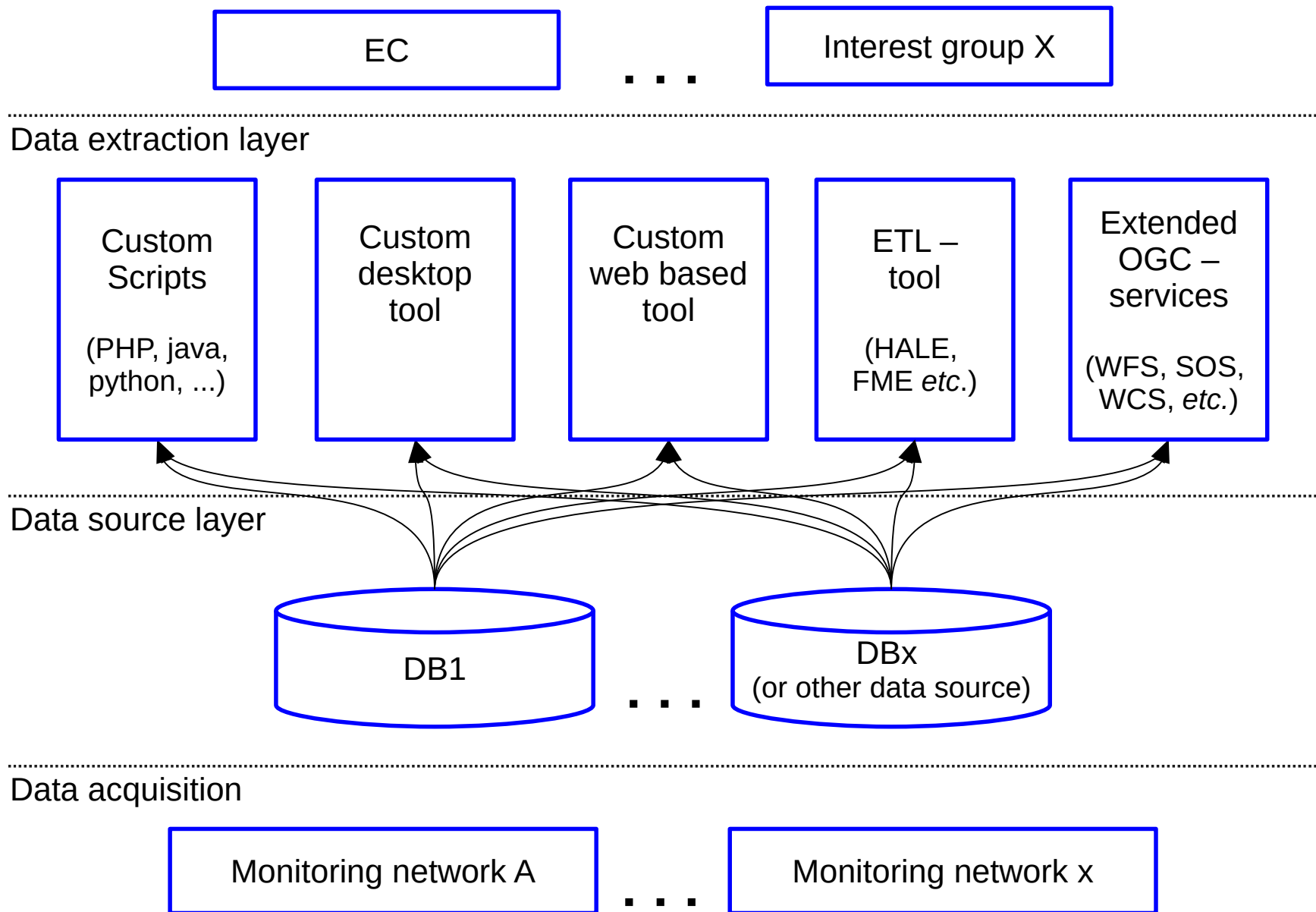
(cf Implementing Provisions for Reporting (IPR) 2011/850/EU)

INPIRE Data Theme	Content
III.11.AM	Dataset B – "zones and agglomerations"
III.11.AM	Dataset C – "assessment regime"
III.11.AM	Dataset D – "assessment methods"
III.7. EF	Dataset E1a – "primary validated assessment data – measurements"
III.13 AC	Dataset E1b – "primary validated assessment data – modelled"
III.7. EF	Dataset E2a – "primary up-to-date assessment data – measurements"
III.13 AC	Dataset E2b – "primary up-to-date assessment data – modelled"
III.7. EF	Dataset F1a – "aggregated data - primary validated measurements"
III.13 AC	Dataset F1b – "aggregated data - primary validated modelled"
III.7. EF	Dataset F2 – "aggregated data - primary up-to-date measurements"
III.11.AM	Dataset G – "attainment of environmental objectives"
III.11.AM	Dataset H – "air quality plans"
III.11.AM	Dataset I – "source apportionment"
III.11.AM	Dataset J – "scenario for the attainment year"
III.11.AM	Dataset K – "measures"

+ a header transmitted with every separate submission

colours represent similar data types

E-reporting: plenty of ways to skin a cat

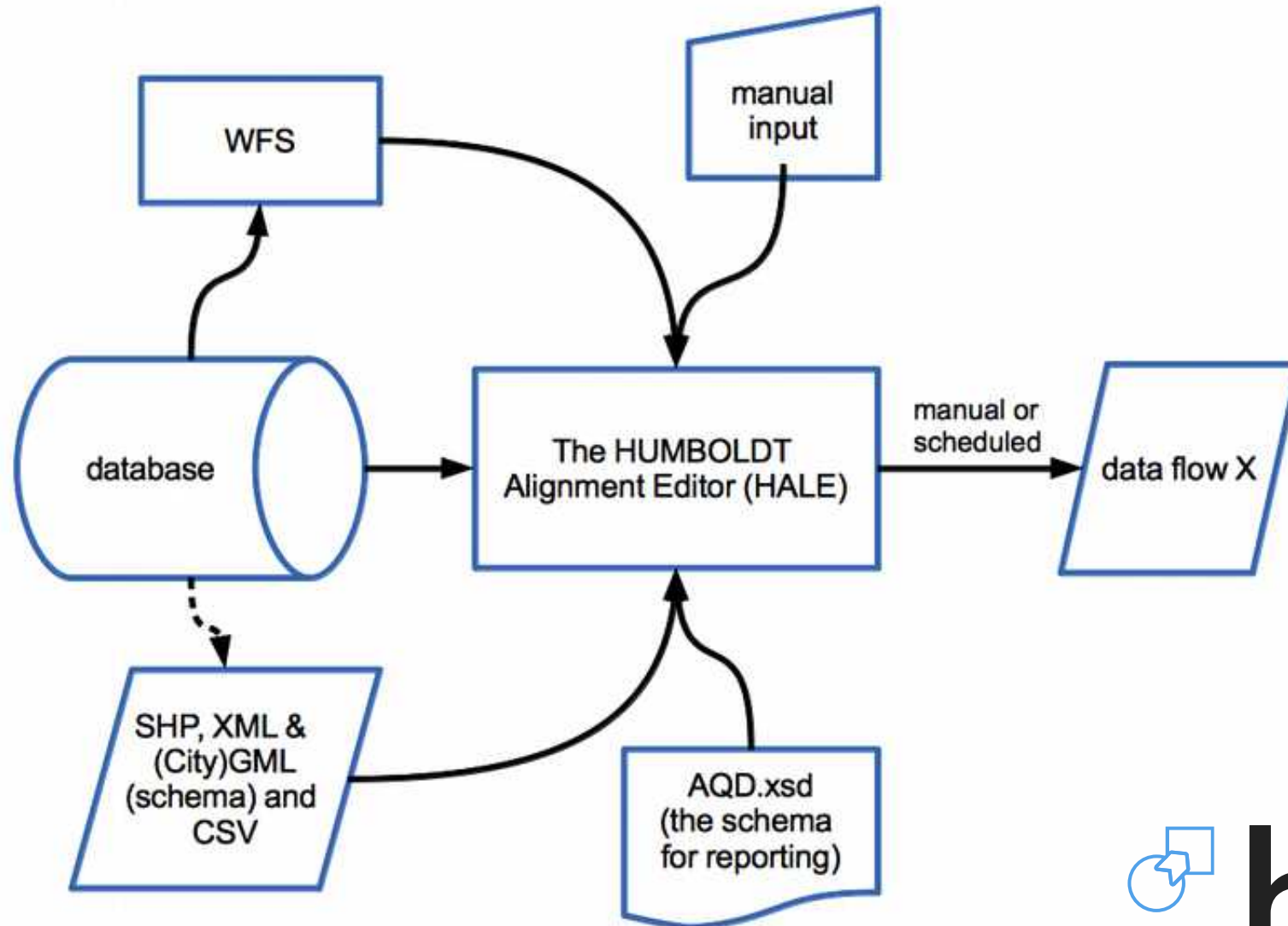


Different approaches to e-reporting

- Making use of an ETL-tool is probably the most generically applicable method + this can be used as basis for a service
- Custom scripts require specialised skills but produces fast results
- Extending an OGC-service (e.g. SOS or WFS) is most durable solution within a multifunctional Service Oriented Architecture → a queryable dataset

Generic approach via ETL (using HALE)

ETL = Extract, Transform and Load



HUMBOLDT Alignment Editor - the GUI



The screenshot displays the HUMBOLDT Alignment Editor interface, which is divided into several main sections:

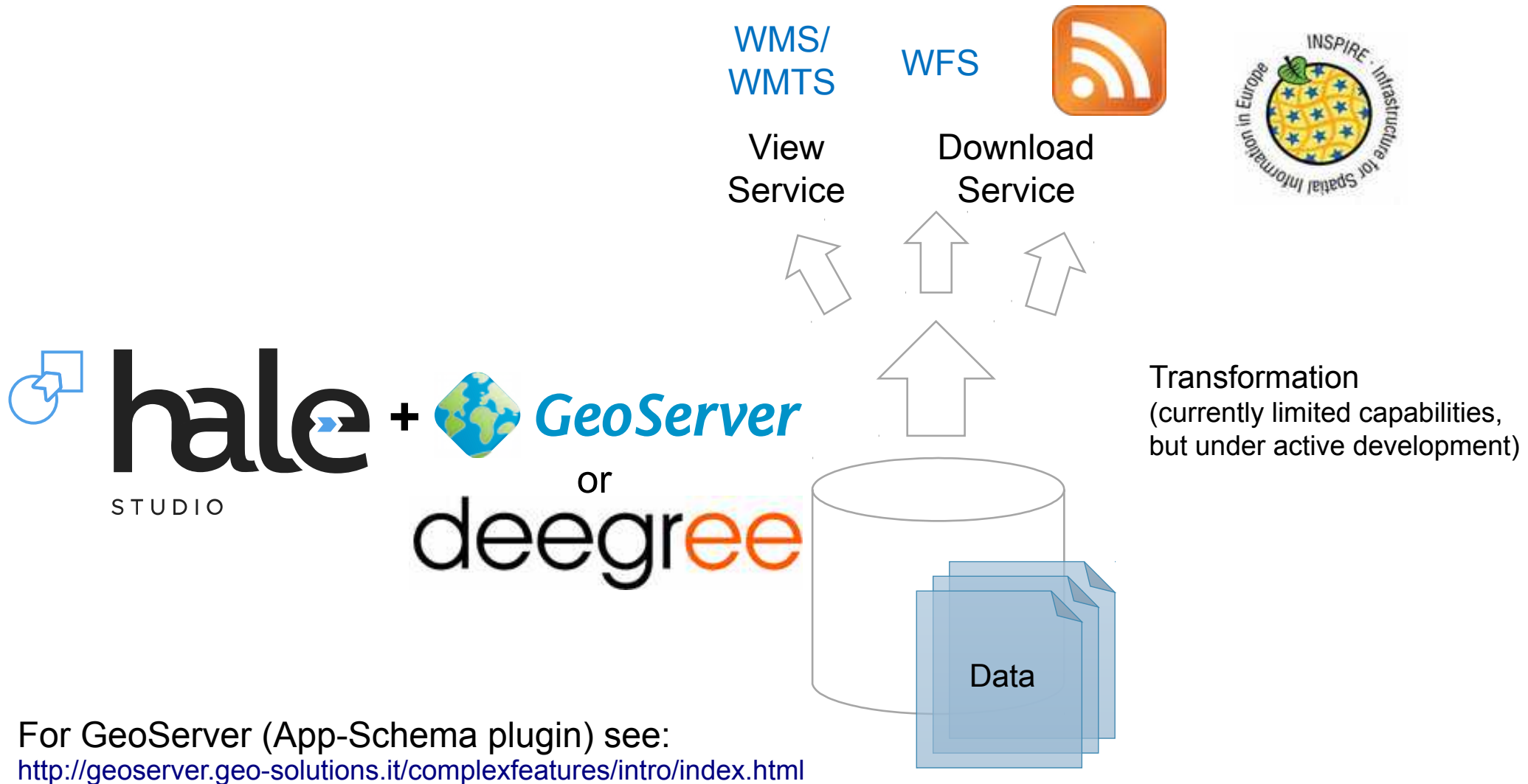
- Sources:** A list of source data elements on the left, including 'dataflow_B_prelim_2016' and various attributes like 'location', 'name', 'ab_code', 'aqd_address_street', etc.
- Target:** A list of target data elements on the right, including 'OrientableSurface', 'Point', 'Polygon', 'PolyhedralSurface', 'RectifiedGrid', 'TriangulatedSurface', 'priorityLocation', 'content', 'delete', 'id', 'inspireId', 'metaDataProperty', 'reportingAuthority', 'reportingPeriod', 'ADD_Zone', 'component_code', 'competentAuthority', 'designationPeriod', 'geometry', 'id', 'inspireId', 'localId', 'versionId', 'LAU', 'legalBasis', 'metaDataProperty', 'plan', and 'predecessor'.
- Data preview of sources & target:** A table view showing a side-by-side comparison of source and target data for a specific record. The table has columns for source and target values for various attributes.
- Alignment:** A diagram showing the mapping between source and target elements. Lines connect source elements to target elements, and a 'Merge' button is visible.
- Edit mapping:** A context menu for editing the mapping, with options like 'Set Priority Level', 'Replace with', 'Edit...', 'Delete', and 'Properties'.
- Execution log:** A log window at the bottom right showing the execution progress, including steps like 'Instance validation', 'Instance transformation', 'Load data into database', 'GML file import', and 'XML schema import'.

HUMBOLDT Alignment Editor (HALE)

- Intuitive GUI for mapping data from different sources to the schema
- You can execute HALE from the command line (meaning you can do a crontab on Linux), e.g.:
 - `[hale@hale ~]$ HALE -nosplash -application de.fhg.igd.hale.fme.app.exec -project <URI-to-project> -source <URI-to-source-data> -out <Path-to-target-file>`
- Optional parameters:
 - `reportsOut <Path-to-report-file>` (Write report of transformation to a file)
 - `validate` (Enable XML validation)
 - `format <format>` (Its either 'GML' or 'XML', with 'GML' set as default)
 - `root <root-element-name>` (The name of the root element to use when using 'XML' as format)
 - `root-ns <root-element-namespace>` (The namespace of the root element to use if using 'XML' as format)
- HALE can be used as an XSLT-editor
- Can be used to convert a transformation to service (e.g. using GeoServer and the App-Schema or XSLT-plugin)



From HALE-alignment to (reporting) service



For GeoServer (App-Schema plugin) see:
<http://geoserver.geo-solutions.it/complexfeatures/intro/index.html>

For more information on HALE studio see:
<https://www.wetransform.to/>



HALE transformation can alternatively also be exported to JDBC database (incl. SpatiaLite, PostgreSQL etc.)

Sensor observation services (SOS)

... an INSPIRE compliant downloading service

<http://sos.irceline.be>

- Efficient transmission of time series

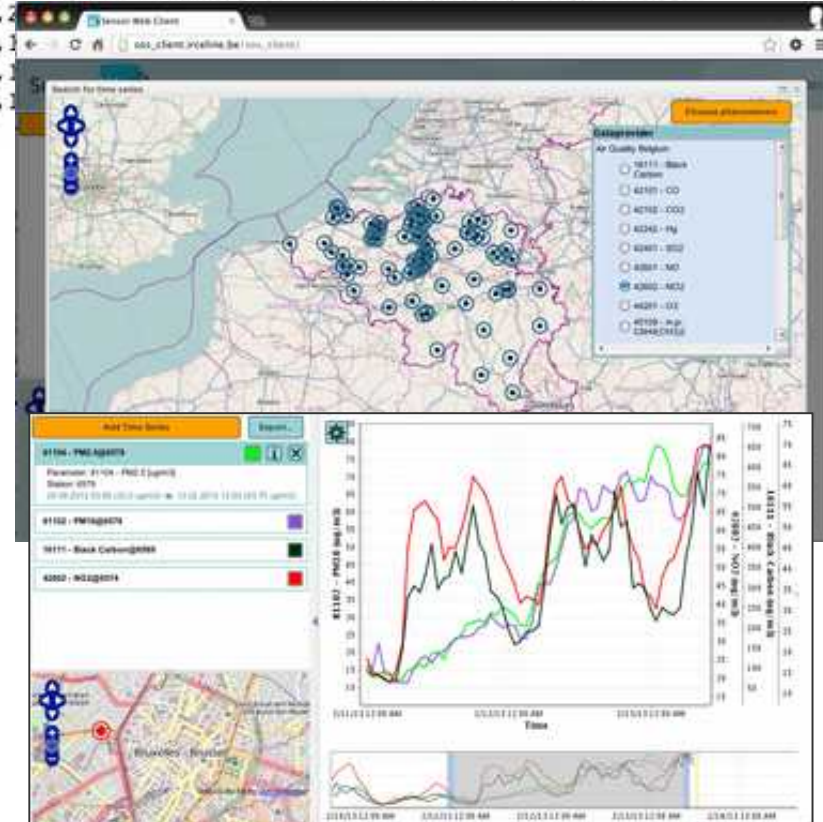
Geographic position

Timestamp & measured concentrations (e.g. 24 hours)

```
<swe:encoding>
  <swe:TextBlock decimalSeparator="." tokenSeparator="," blockSeparator=";"/>
</swe:encoding>
<swe:values>
  2013-02-12T12:00:00.000+01:00,19.0;2013-02-12T13:00:00.000+01:00,24.0;2013-02-
  12T14:00:00.000+01:00,28.0;2013-02-12T15:00:00.000+01:00,23.0;2013-02-
  12T16:00:00.000+01:00,21.0;2013-02-12T17:00:00.000+01:00,19.0;2013-02-
  12T18:00:00.000+01:00,18.0;2013-02-12T19:00:00.000+01:00,22.0;2013-02-
  12T20:00:00.000+01:00,14.0;2013-02-12T21:00:00.000+01:00,21.0;2013-02-
  12T22:00:00.000+01:00,21.0;2013-02-12T23:00:00.000+01:00,21.0;2013-02-
  13T00:00:00.000+01:00,20.0;2013-02-13T01:00:00.000+01:00,23.0;2013-02-
  13T02:00:00.000+01:00,18.0;2013-02-13T03:00:00.000+01:00,11.0;2013-02-
  13T04:00:00.000+01:00,2
  13T06:00:00.000+01:00,1
  13T08:00:00.000+01:00,1
  13T10:00:00.000+01:00,1.5;
</swe:values>
```

- queryable:

Extended for e-reporting since version 4.3.x



SOS and the IPR (and INSPIRE)

- The IPR data model expects some extra elements
 - startTime and endTime
 - Validity and verification flag
 - The IPR header
- More convenient to have IPR specific interpretation of standard SOS elements
 - e.g. URI's as pollutant names (also solved with flexible identifiers)
- INSPIRE specifications for downloading services
 - Service has to be able to handle multilingual
 - Return geometry in multiple coordinate systems
 - Some extra metadata elements (extended getCapabilities)


See: https://ies-svn.jrc.ec.europa.eu/projects/download-services-tg/wiki/ARE3NA_SOS_study

SOS and the IPR (and INSPIRE)

Home **Client** Documentation Admin

52°North SOS Test Client

Choose a request from the examples or write your own to test the SOS.



Examples

NOTE: Requests use example values and are not dynamically generated from values in this SOS. Construct valid requests by changing request values to match values in the Capabilities response.

NOTE: For security reasons, the transactional SOS operations are disabled by default and the *Transactional Security* is activated by default with allowed IPs *127.0.0.1*. The transactional operations can be activated in the [Operations settings](#) and the *Transactional Security* can be deactivated in the [Transactional Security tab of the settings](#).

Service URL

Request

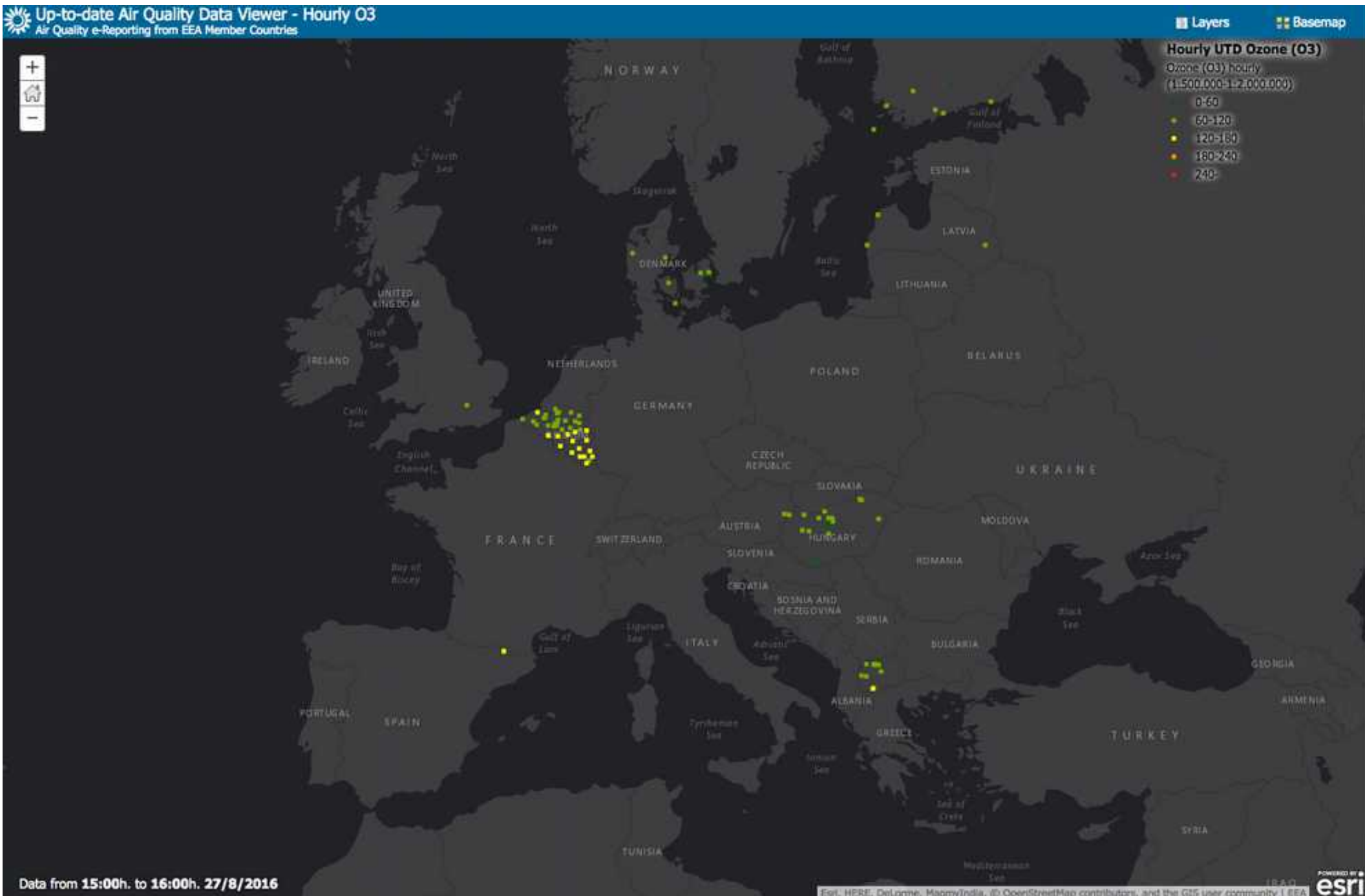
<http://geo.irceline.be/sos/client>

Documentation

- General documentation SOS server
 - <https://wiki.52north.org/bin/view/SensorWeb/SensorObservationServiceIVDocumentation>
- INSPIRE Download Service extension
 - https://wiki.52north.org/bin/view/SensorWeb/SensorObservationServiceIVDocumentation#INSPIRE_Download_Service_extensi
- About the additional elements/functionalities for e-reporting
 - <https://wiki.52north.org/bin/view/SensorWeb/AqdEReporting>
- Flexible identifiers
 - <https://wiki.52north.org/bin/view/SensorWeb/FlexibleIdentifier>

Viewer of EU up-to-date data

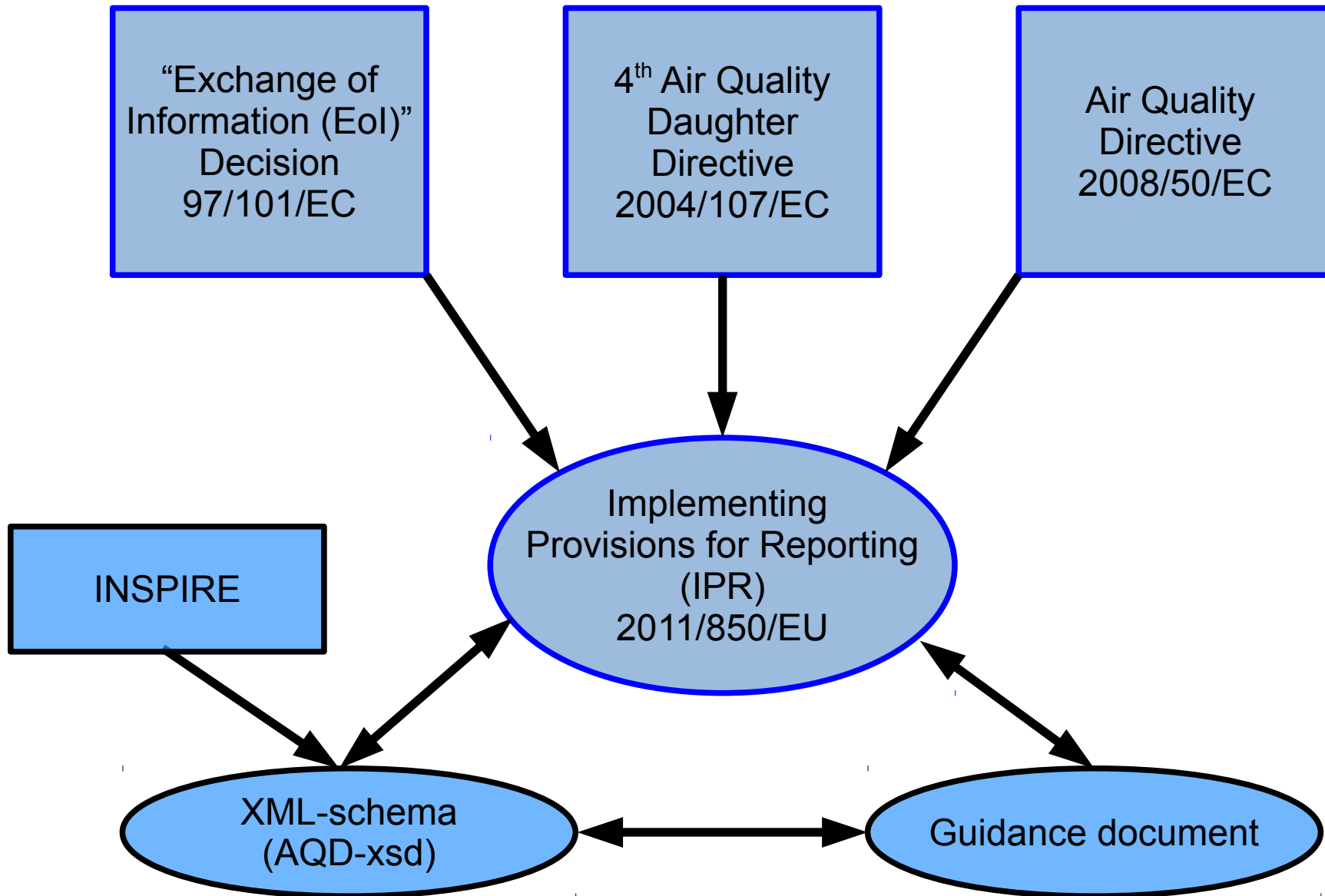
Data availability during summer-SMOG episode August 2016



Air Pollution in Europe: Real-time Air Quality Index Visual Map



Where did we go wrong?



Where did we go wrong?

- The guidance document added a lot of complexity
- INSPIRE view services are performant enough (but left outside the scope of e-reporting)
- INSPIRE downloading service are often not performant enough for big data sets (even if the guidance document would have been less demanding)
- Complexity of the schema for e-reporting under the air quality directives is often blamed on INSPIRE, but this is not entirely fair (cf guidance document & lack of pragmatism during schema design)
- Since a “pull” e-reporting was seen as not in line with legal requirements this possibility was neglected early on in the process → a missed opportunity for leveraging the potential of e-reporting becoming a driver for establishing new SDI’s

Lesson learned

- Be pragmatic during development schema for reporting
- Think about push versus pull mechanism from the start
- INSPIRE vs open data vs reporting obligations
- Think of alternatives to SOAP/XML (e.g. REST/json)
- XML is very versatile, but not the most efficient data encoding for bigger data sets
- Having a “reporting service” (or OGC download service) for e-reporting creates a queryable, multifunctional dataset
- Progress on data availability can be painstakingly slow (Complications implementing complex data model? Lack of political will?)
- Establish services capable of multiple encodings with focus on efficiency of the data transmission



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Thank you!

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