ELF WP4 Geo-Tools

Presentation to: EG Technical Producers meeting 2015, Warsaw

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Date: 01-04-2015

the Competitiveness and Innovation framework Programme (CIP)
ICT Policy Support Programme (PSP) Call 6 (Grant 325140)

WP 4: Implementation of Geo-tools

- Implementation of the following Geo-tools for the use within NMCA's:
  1. Transformation
  2. Data Quality Validation
  3. Generalisation
  4. Edge Matching
  5. Visualisation
  6. Change Detection

- Provide a Geo Product Finder tool for the public

Tool demo's:

- Transformation Tools:
  - **Go Publisher by Snowflake**
  - **HALE by Delft University**
- Data Quality Validation Tools:
  - **1Validate by 1Spatial**
  - **ArcGIS Data reviewer by Esri**
  - **Pprepair by Delft University**
- Edge Matching Tools:
  - **1Integrate by 1Spatial**
  - **ArcGIS Data reviewer by Esri**
  - **Pprepair by Delft University**
- Generalisation Tools:
  - **Regional to Global by IGN-France**

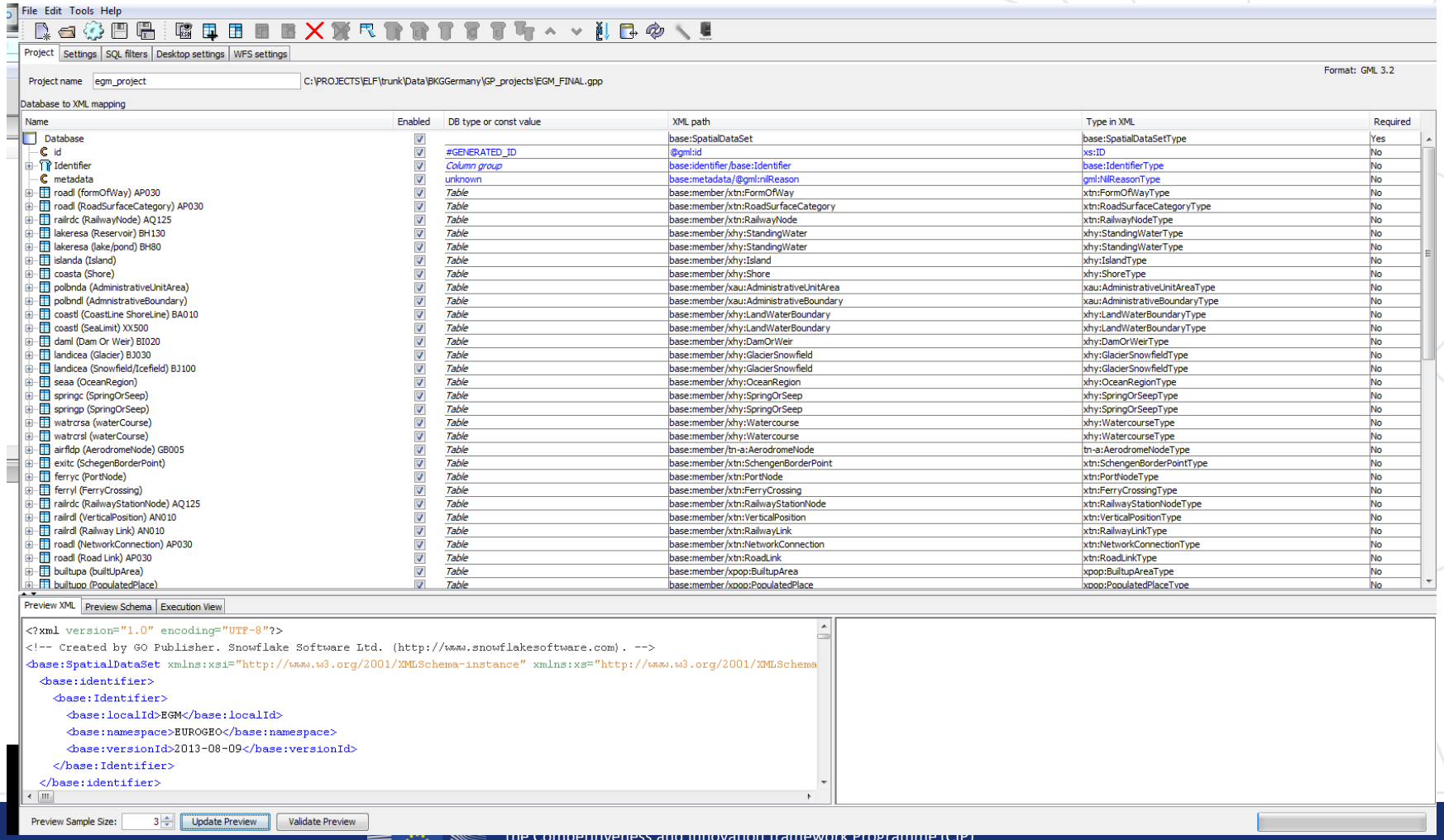
Transformation tools:

- Delivery month 12.
- The tool GO Publisher from Snowflake has been commented, tested, reviewed and delivered.
- Used by IGN France, Kadaster Netherlands, IGN Belgium and BKG.

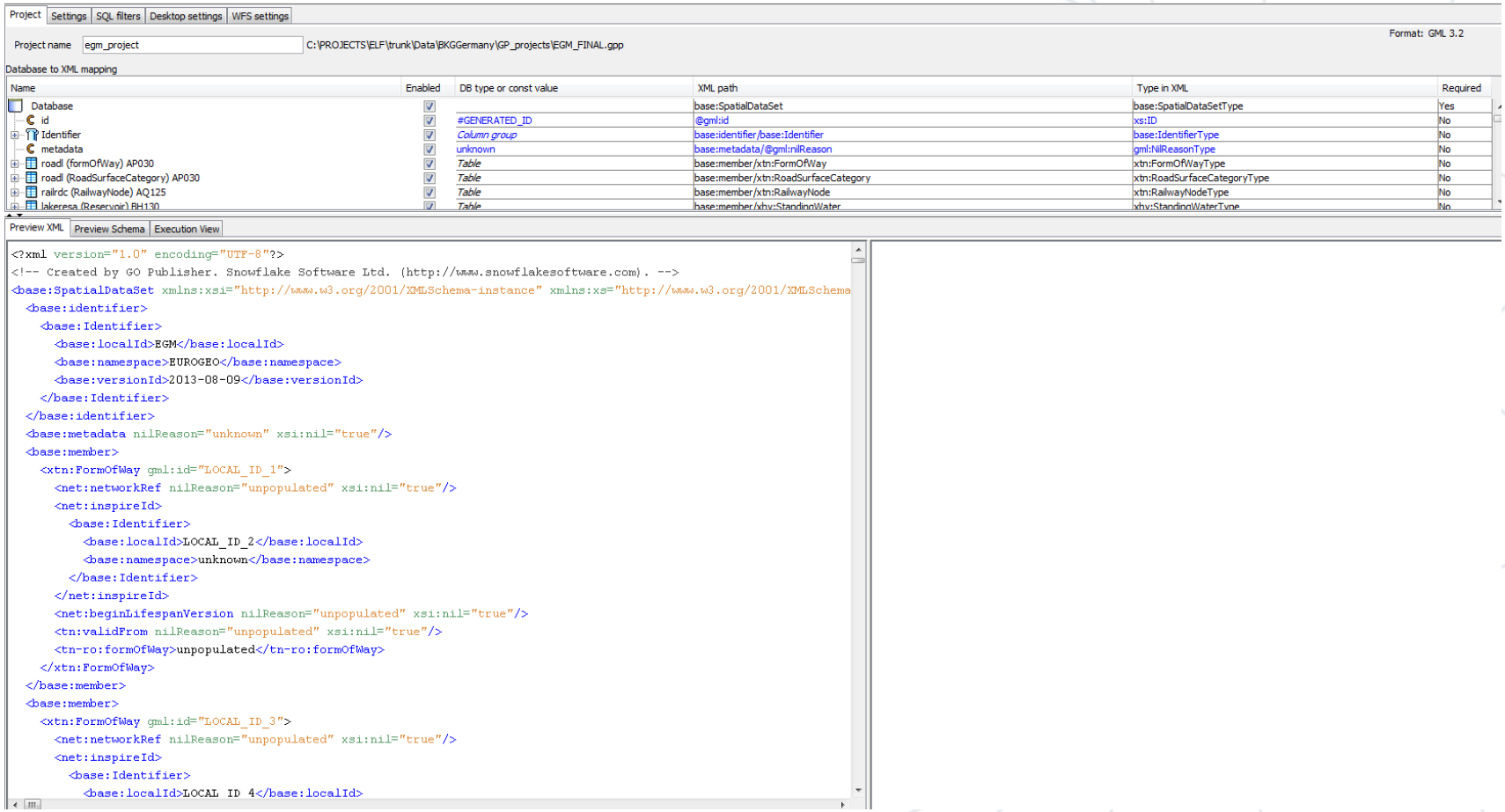
- The tool HALE has been tested and configured on ELF specifications by Delft University.

- Webinar on Transformation tools planned for May 2015.

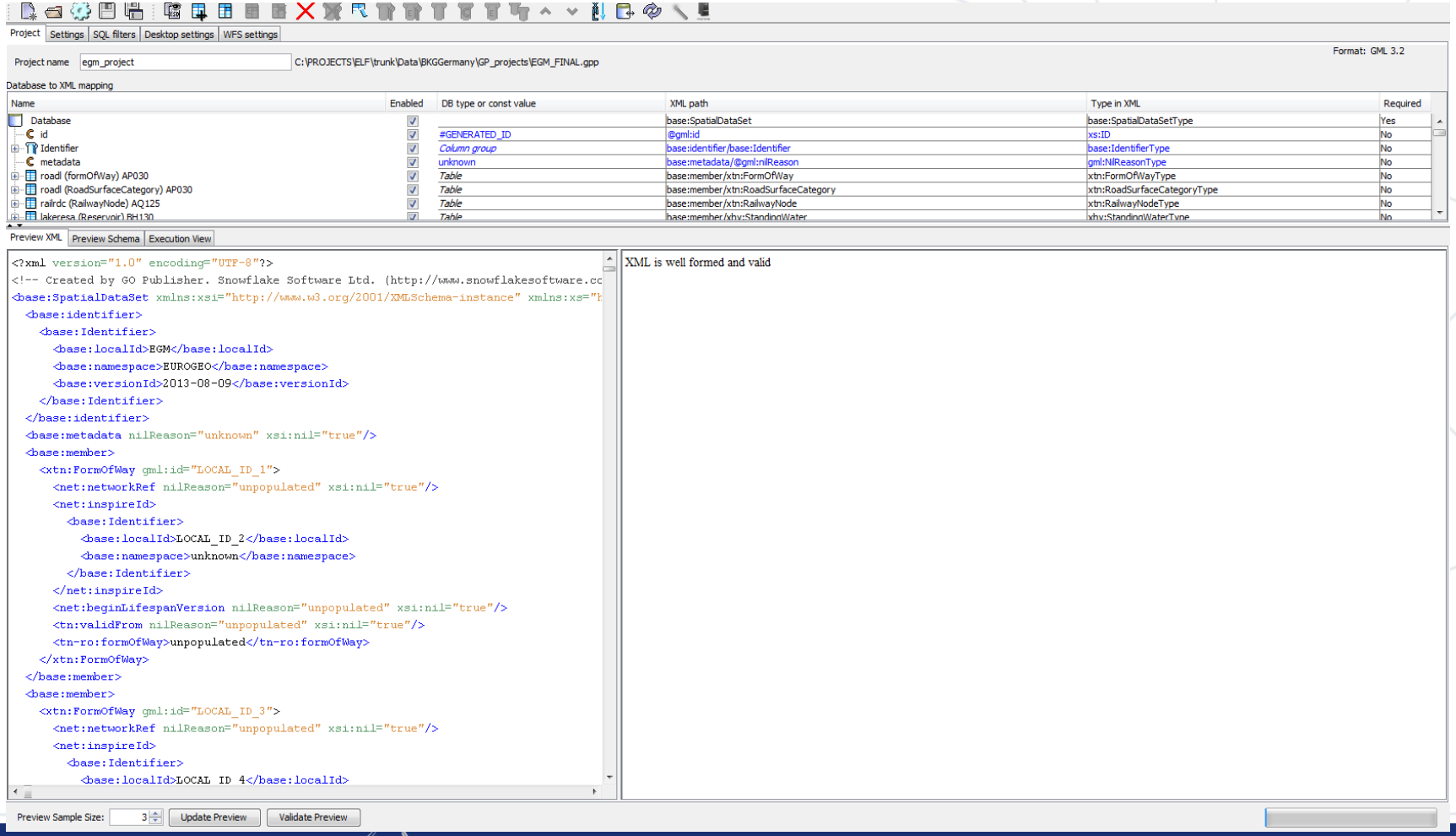
European Global Map dataset - GO Publisher Interface



XML preview generated after mapping process



XML is well formed and valid

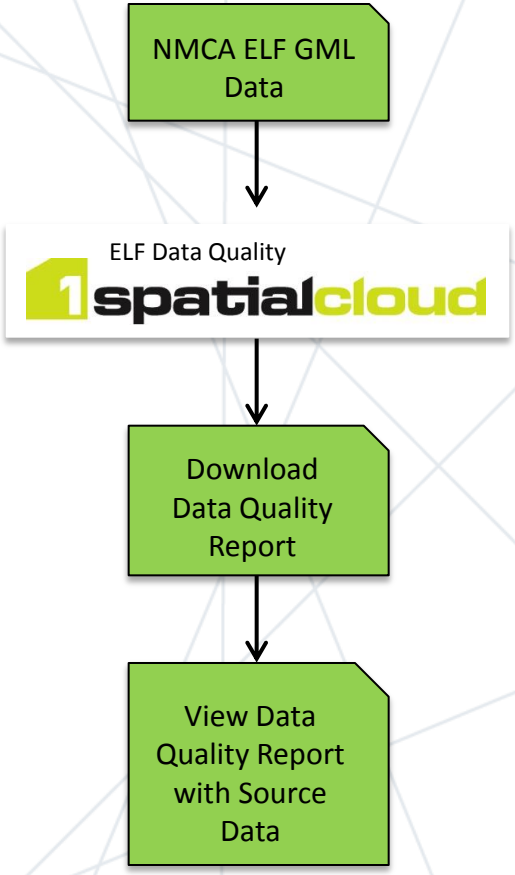


Data Quality Validation tool (1Spatial):

- 1Spatial Cloud is an easy to use Commercial Off The Shelf (COTS) application in the cloud
- Enables ELF partners to provide authoritative, accurate and harmonized data to the project
- Preconfigured data quality tool to enable users to validate and accredited their data against the ELF data quality rules
- No deployment, set-up or infrastructure costs
- Compatible with ELF geotools exchange format

4 Easy Steps to Data Quality

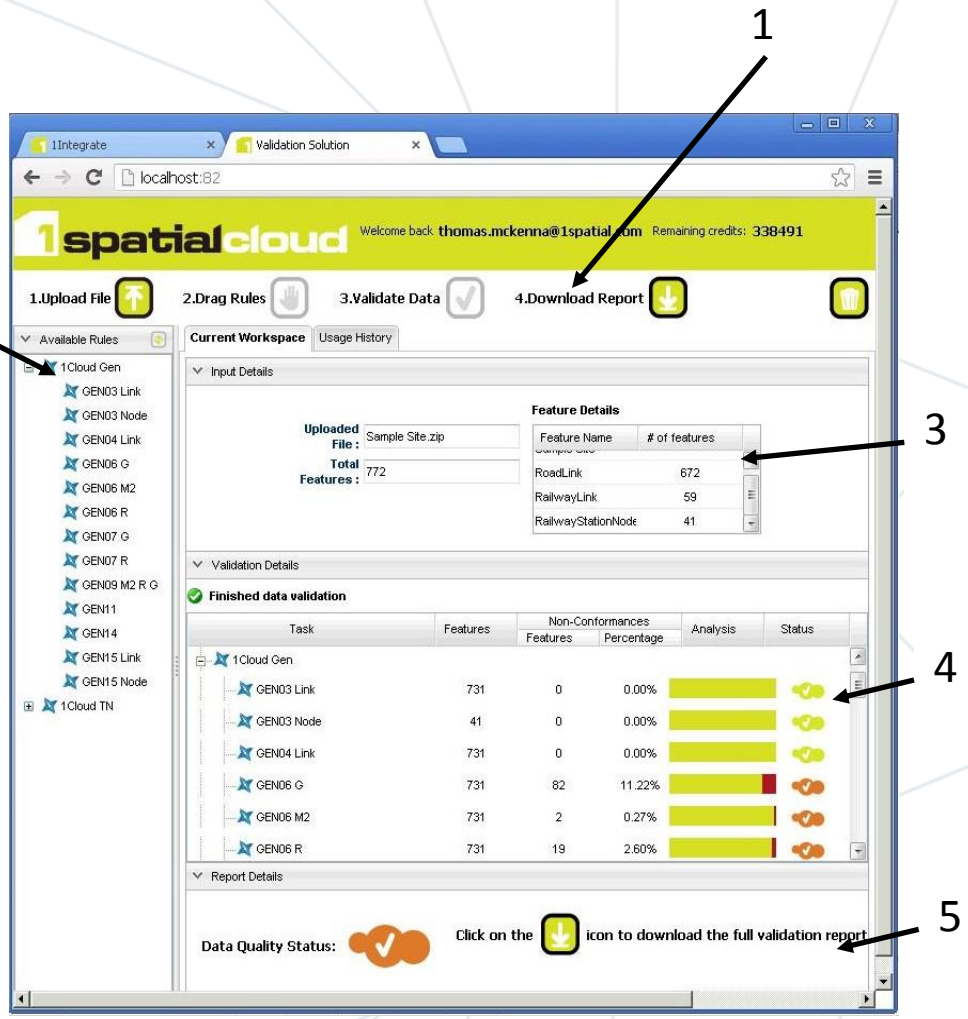
- Uploads ELF compliant GML files
  - Select the zipped GML files for importing and select upload
- Start the validation
  - Select the ELF Data Quality Rule-set and press Validate
- Review Data Quality Report
  - Quality metrics reported in progress panel
  - Data Quality report available to download
- Reviewing results using your chosen GIS editor/browser.



1SpatialCloud

★ The site has five main panels:

1. Action panel, has buttons that control the validation process
2. Available Rule panel, contains a tree of the available rules sets
3. Input Details panel, summarizes the data that is being validated
4. Progress panel, shows validation process progress and results
5. Report Details panel, allows user to download detailed results as a Shape file



Data Quality Validation tool (ESRI):

- Esri ELF software grant

- Pre-configured quality checks for INSPIRE/ELF themes
  - For ArcGIS Data Reviewer – main Esri quality tool.
  - Based on WP2 RuleSpeak.

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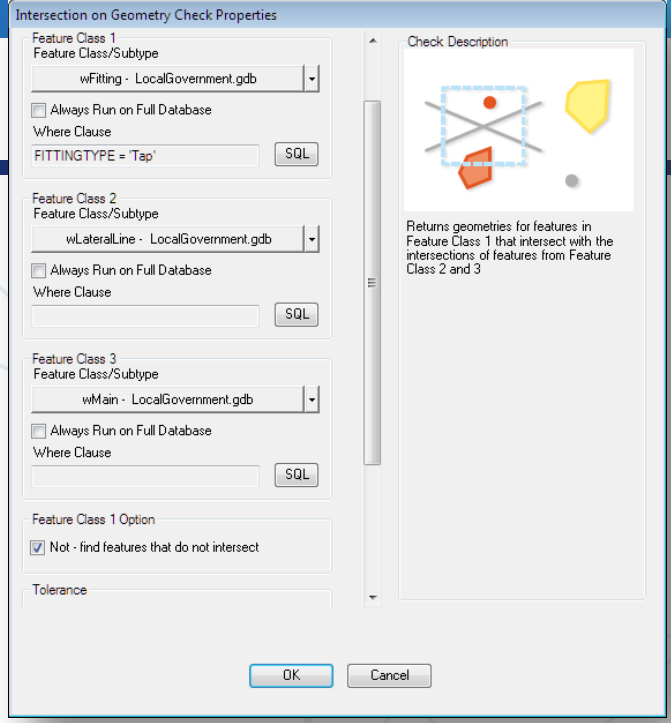
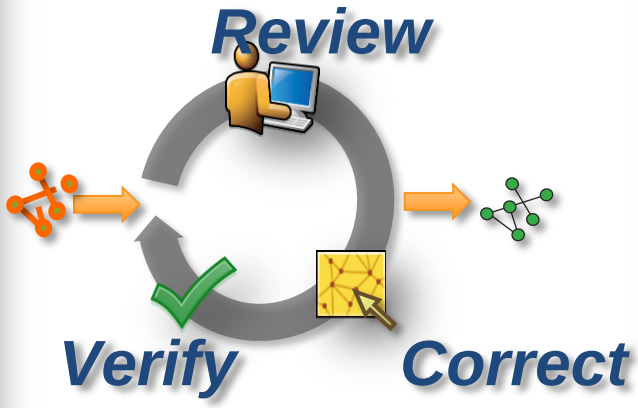
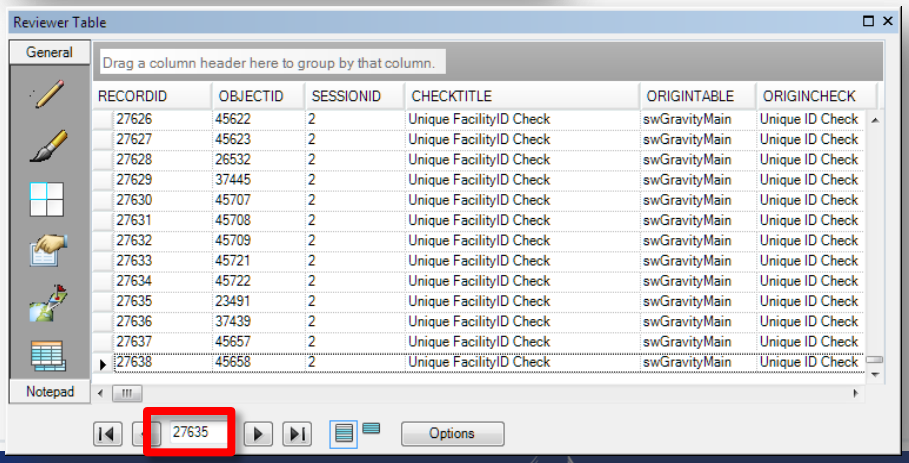
ELF EUROPEAN LOCATION FRAMEWORK

Checks configurable

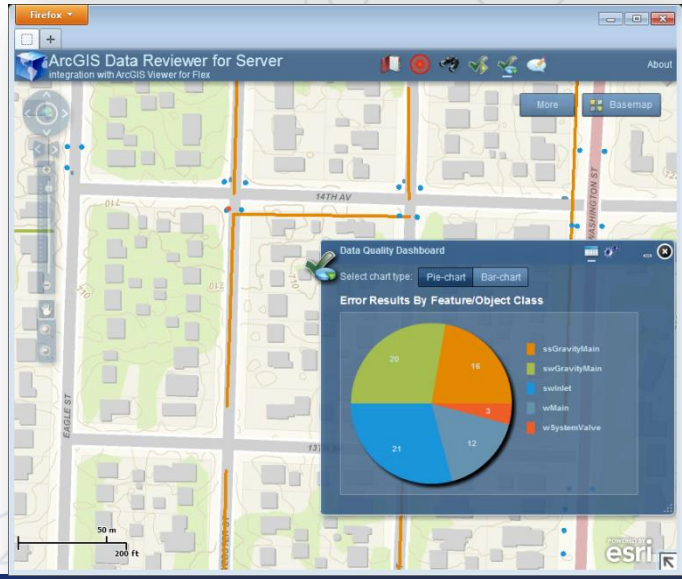


Many Automated checks





Errors table Integrated



Server Dashboard

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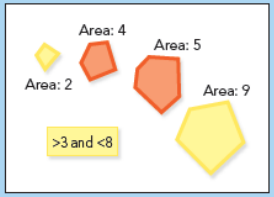
ArcGIS Data Reviewer Checks

Polygon Checks

Evaluate Polygon Perimeter and Area

Searches for polygon, part, ring, or segment features whose area or perimeter is within a specified range

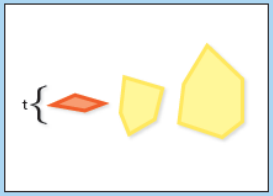


Invalid Hole Feature

Finds features that intersect polygon feature holes

Polygon Sliver

Finds polygons below a specified thinness ratio (t) and optionally whose area is within a specified threshold

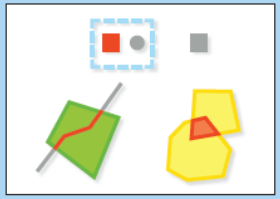


Feature on Feature Checks

Geometry on Geometry

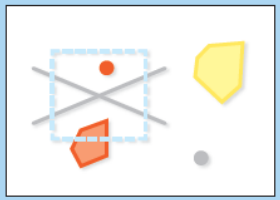
Searches for features from two different feature classes or within the same feature class that spatially interact (e.g., intersect) or are within a tolerance of each other

Comparison to Topology:
Line—Must not overlap, intersect, or overlap with
Polygon—Must not overlap, contain point, or overlap with



Intersection on Geometry

Returns geometries for features in Feature Class 1 that intersect with the intersections from features from Feature Class 2 and 3



Polygon Overlap/ Gap Is Sliver

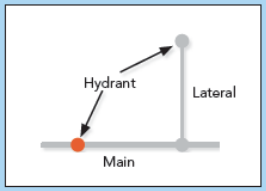
Returns overlap/gap geometries between polygon features from two feature classes that have a thinness ratio beneath a user-specified threshold; optionally requires that the overlap/gap polygons be beneath a maximum area threshold

Comparison to Topology:
Polygon must not have gaps

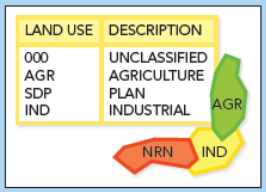
ArcGIS Data Reviewer Checks

Database Validation Checks

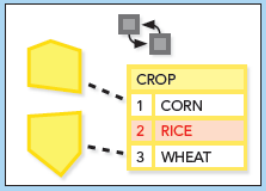
Connectivity Rules — Returns geometries for features that violate the geometric network connectivity rules



Domain — Validates coded value and range domains to ensure that all values meet domain constraints



Relationships — Searches for records that are orphans or have improper cardinality in a relationship class



Subtype — Searches for feature classes with improper or null subtypes

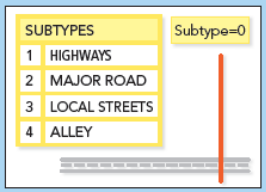
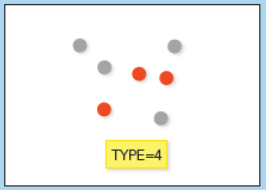


Table Checks

Execute SQL — Finds features based on a SQL query WHERE clause



Regular Expression — Finds features with attribute values that violate the regular expression

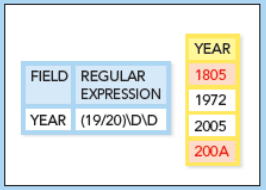
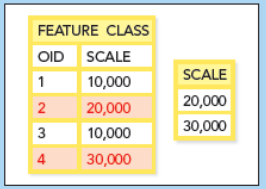
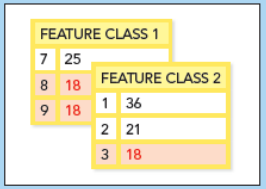


Table to Table Attribute — Returns rows whose attributes match those of a feature class or table and/or comply with a user-defined WHERE clause comparing the attributes between feature classes and/or tables



Unique ID — Checks the values of a set of fields across a set of tables and feature classes for uniqueness within a given workspace



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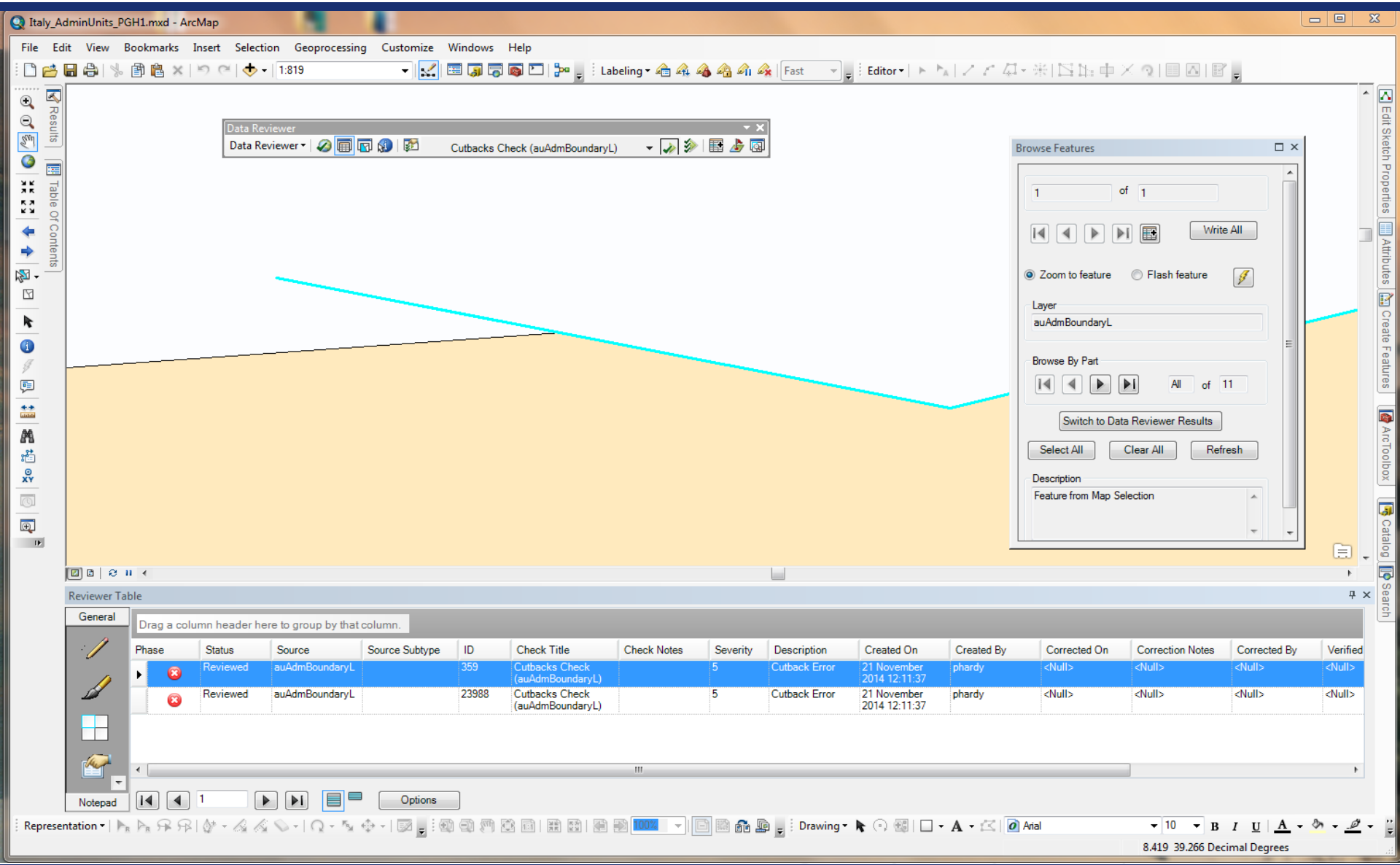
Data Reviewer – Manually trigger checks



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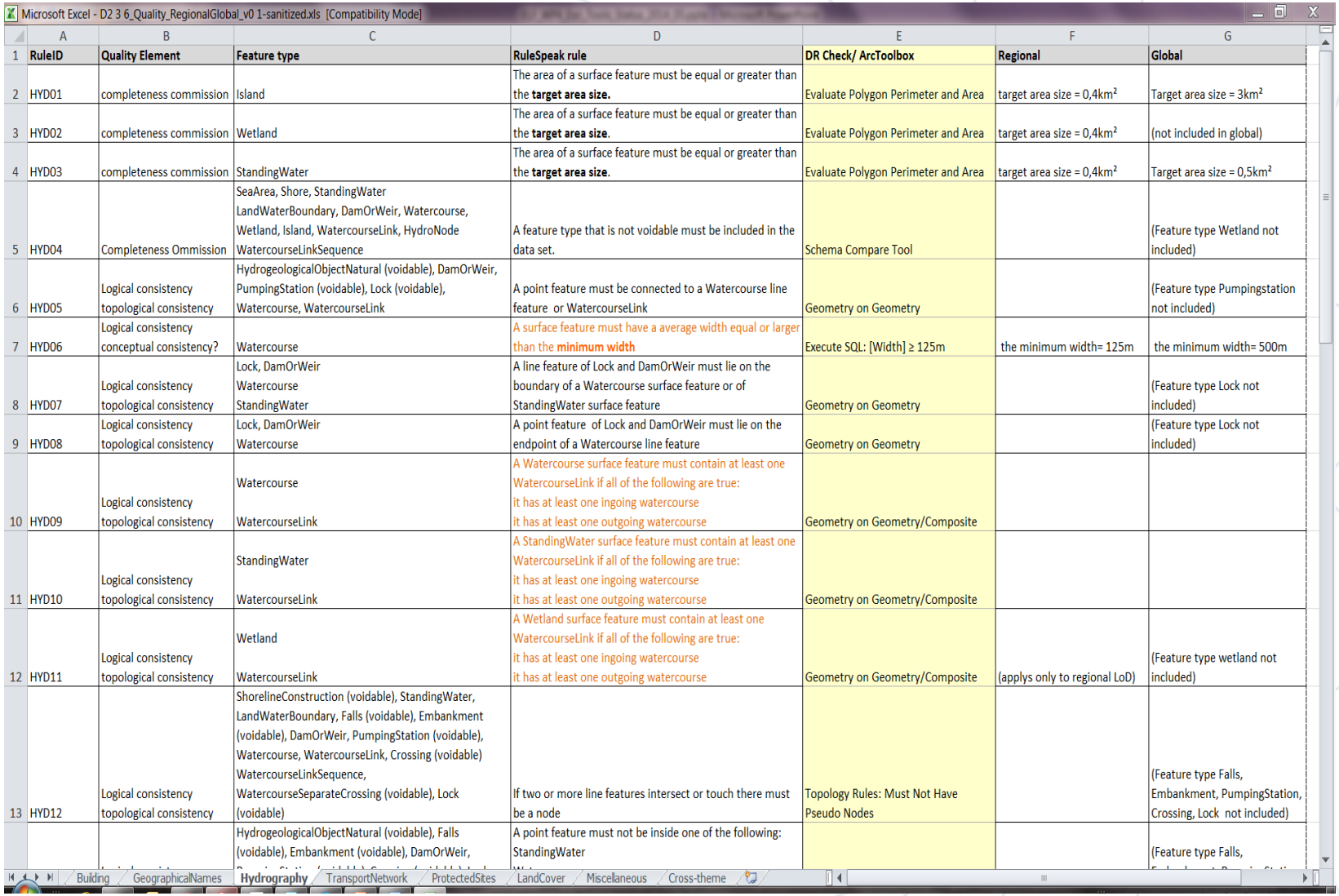
RuleSpeak to Reviewer Check



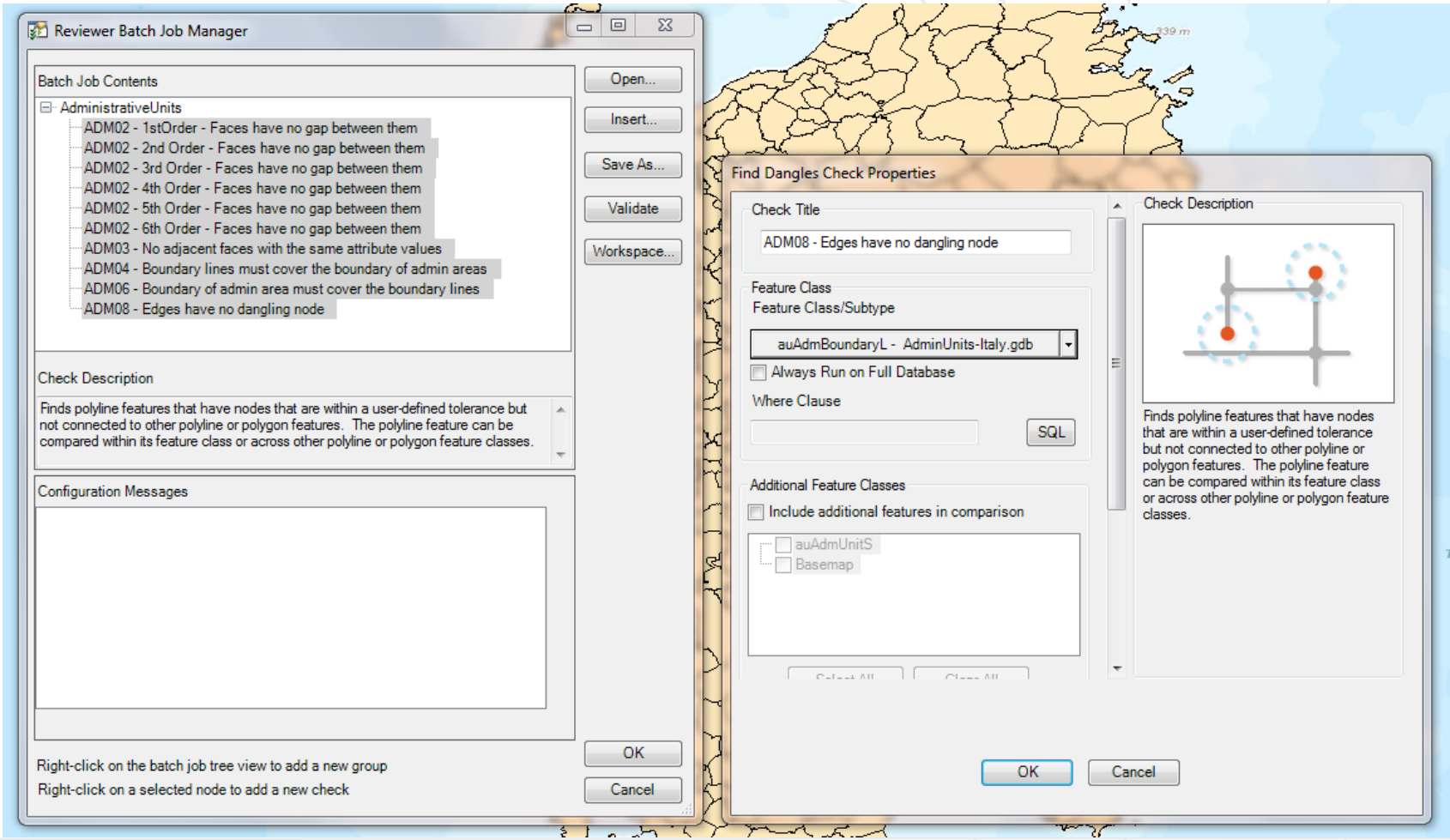
Microsoft Excel - D2 3 6_Quality_RegionalGlobal_v0 1-sanitized.xls [Compatibility Mode]

	A	B	C	D	E	F	G
1	**RuleID**	**Quality Element**	**Feature type**	**RuleSpeak rule**	**DR Check/ ArcToolbox**	**Regional**	**Global**
2	HYD01	completeness commission	Island	The area of a surface feature must be equal or greater than the **target area size.**	Evaluate Polygon Perimeter and Area	target area size = 0,4km²	Target area size = 3km²
3	HYD02	completeness commission	Wetland	The area of a surface feature must be equal or greater than the **target area size.**	Evaluate Polygon Perimeter and Area	target area size = 0,4km²	(not included in global)
4	HYD03	completeness commission	StandingWater	The area of a surface feature must be equal or greater than the **target area size.**	Evaluate Polygon Perimeter and Area	target area size = 0,4km²	Target area size = 0,5km²
5	HYD04	Completeness Ommission	SeaArea, Shore, StandingWater LandWaterBoundary, DamOrWeir, Watercourse, Wetland, Island, WatercourseLink, HydroNode WatercourseLinkSequence	A feature type that is not voidable must be included in the data set.	Schema Compare Tool		(Feature type Wetland not included)
6	HYD05	Logical consistency topological consistency	HydrogeologicalObjectNatural (voidable), DamOrWeir, PumpingStation (voidable), Lock (voidable), Watercourse, WatercourseLink	A point feature must be connected to a Watercourse line feature or WatercourseLink	Geometry on Geometry		(Feature type Pumpingstation not included)
7	HYD06	Logical consistency conceptual consistency?	Watercourse	A surface feature must have a average width equal or larger than the **minimum width**	Execute SQL: [Width] ≥ 125m	the minimum width= 125m	the minimum width= 500m
8	HYD07	Logical consistency topological consistency	Lock, DamOrWeir Watercourse StandingWater	A line feature of Lock and DamOrWeir must lie on the boundary of a Watercourse surface feature or of StandingWater surface feature	Geometry on Geometry		(Feature type Lock not included)
9	HYD08	Logical consistency topological consistency	Lock, DamOrWeir Watercourse	A point feature of Lock and DamOrWeir must lie on the endpoint of a Watercourse line feature	Geometry on Geometry		(Feature type Lock not included)
10	HYD09	Logical consistency topological consistency	Watercourse WatercourseLink	A Watercourse surface feature must contain at least one WatercourseLink if all of the following are true: it has at least one ingoing watercourse it has at least one outgoing watercourse	Geometry on Geometry/Composite		
11	HYD10	Logical consistency topological consistency	StandingWater WatercourseLink	A StandingWater surface feature must contain at least one WatercourseLink if all of the following are true: it has at least one ingoing watercourse it has at least one outgoing watercourse	Geometry on Geometry/Composite		
12	HYD11	Logical consistency topological consistency	Wetland WatercourseLink	A Wetland surface feature must contain at least one WatercourseLink if all of the following are true: it has at least one ingoing watercourse it has at least one outgoing watercourse	Geometry on Geometry/Composite	(applys only to regional LoD)	(Feature type wetland not included)
13	HYD12	Logical consistency topological consistency	ShorelineConstruction (voidable), StandingWater, LandWaterBoundary, Falls (voidable), Embankment (voidable), DamOrWeir, PumpingStation (voidable), Watercourse, WatercourseLink, Crossing (voidable) WatercourseLinkSequence, WatercourseSeparateCrossing (voidable), Lock (voidable)	If two or more line features intersect or touch there must be a node	Topology Rules: Must Not Have Pseudo Nodes		(Feature type Falls, Embankment, PumpingStation, Crossing, Lock not included)
			HydrogeologicalObjectNatural (voidable), Falls (voidable), Embankment (voidable), DamOrWeir,	A point feature must not be inside one of the following: StandingWater			(Feature type Falls,

Building | GeographicalNames | Hydrography | TransportNetwork | ProtectedSites | LandCover | Miscellaneous | Cross-theme

Data Reviewer - Batch Job Manager

- ★ Design Batch Jobs in Batch Job Manager
- ★ Run job manually or automatically



More information

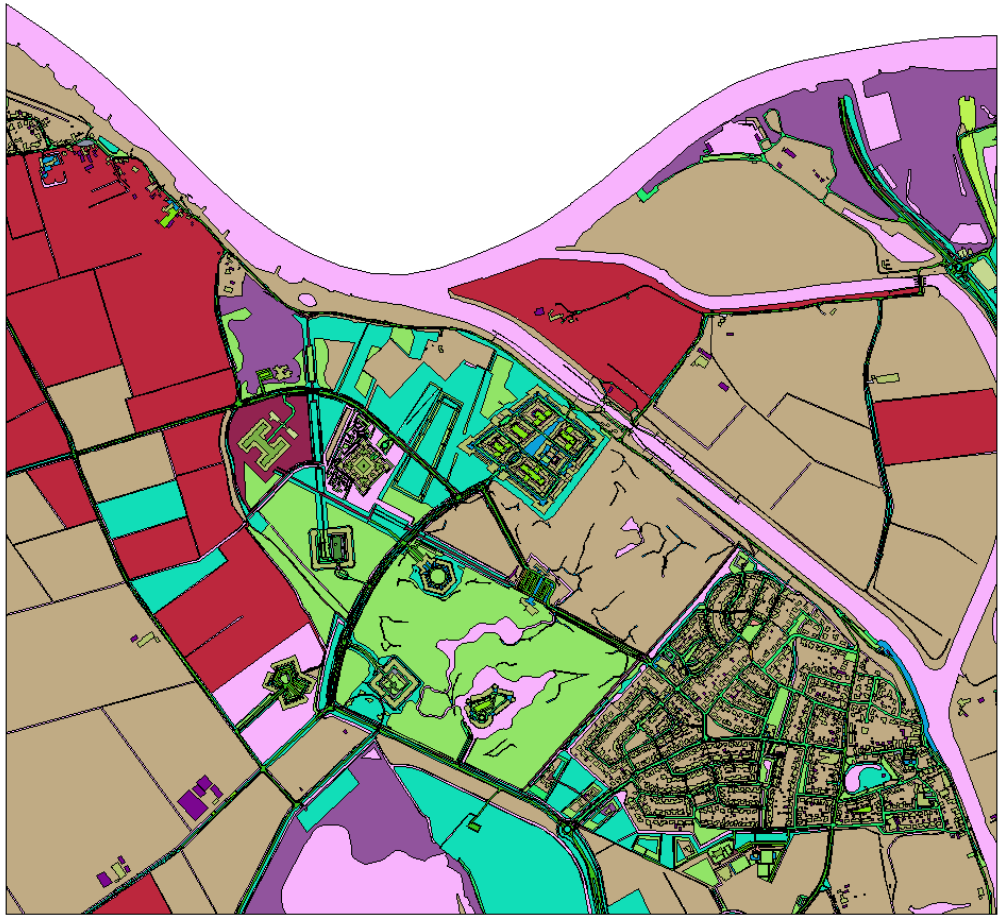
- ArcGIS Data Reviewer pages
- http://www.esri.com/software/arcgis/extensions/arcgis-data-reviewer
- http://www.esri.com/software/arcgis/extensions/arcgis-data-reviewer/key-features
- http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/data-reviewer/what-is-data-reviewer.htm
- http://desktop.arcgis.com/en/desktop/latest/guide-books/extensions/data-reviewer/a-quick-tour-of-data-reviewer.htm
- To take up the ELF Esri software grant, email Nick Land nland@esri.com.

PPrepair:
Geometric data quality & edge-matching

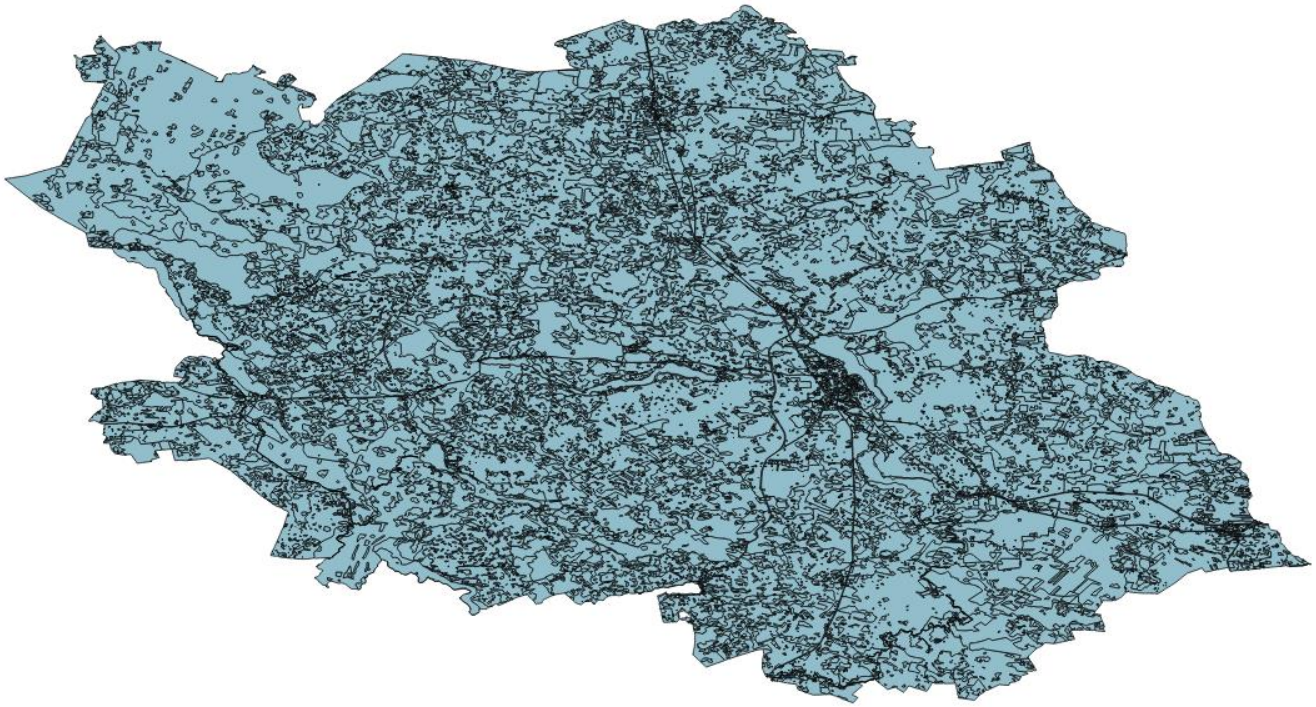
Technische Universiteit Delft

What does it do?

Gaps and overlaps in GIS datasets are detected and automatically repaired



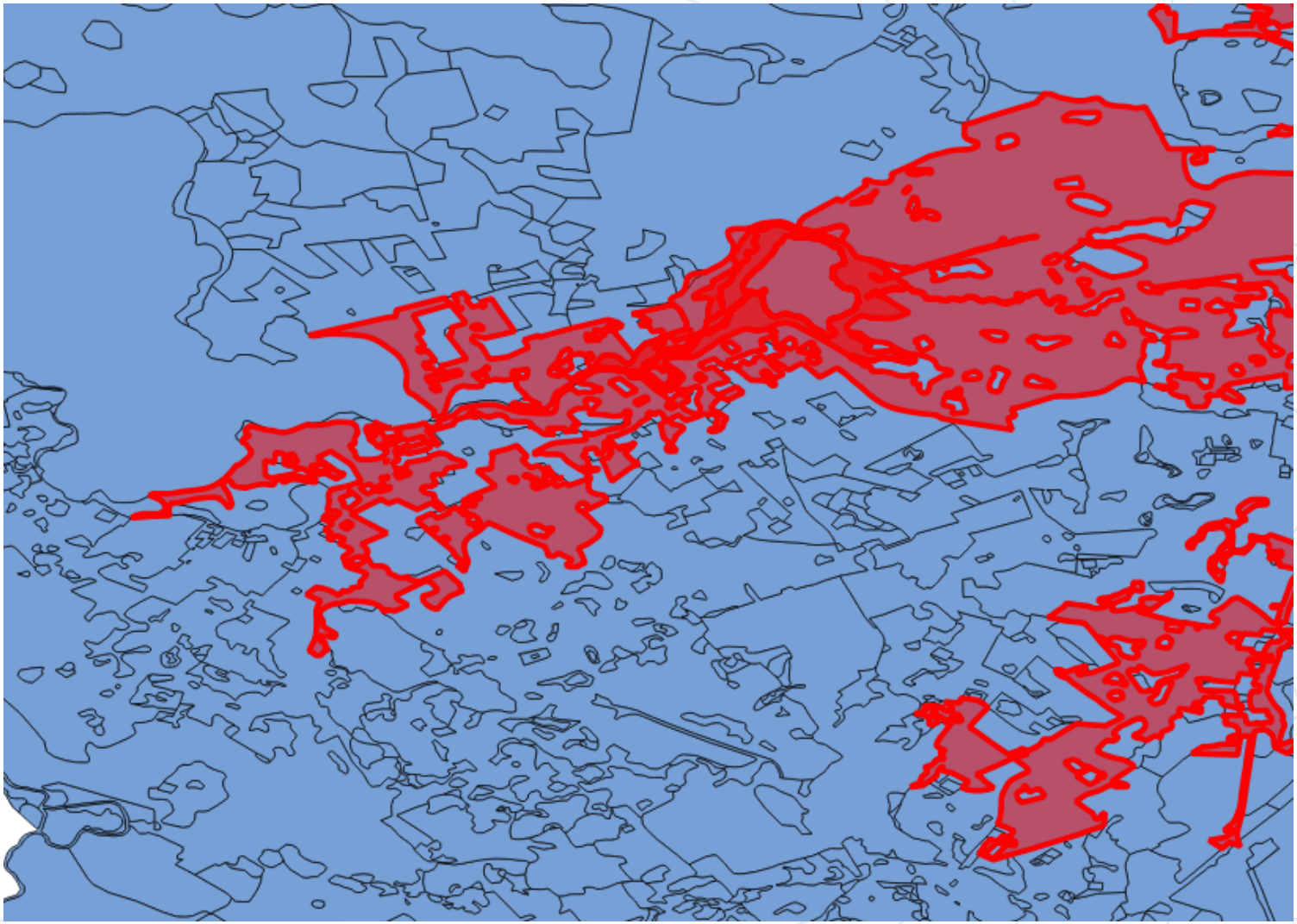
Tested with ELF dataset



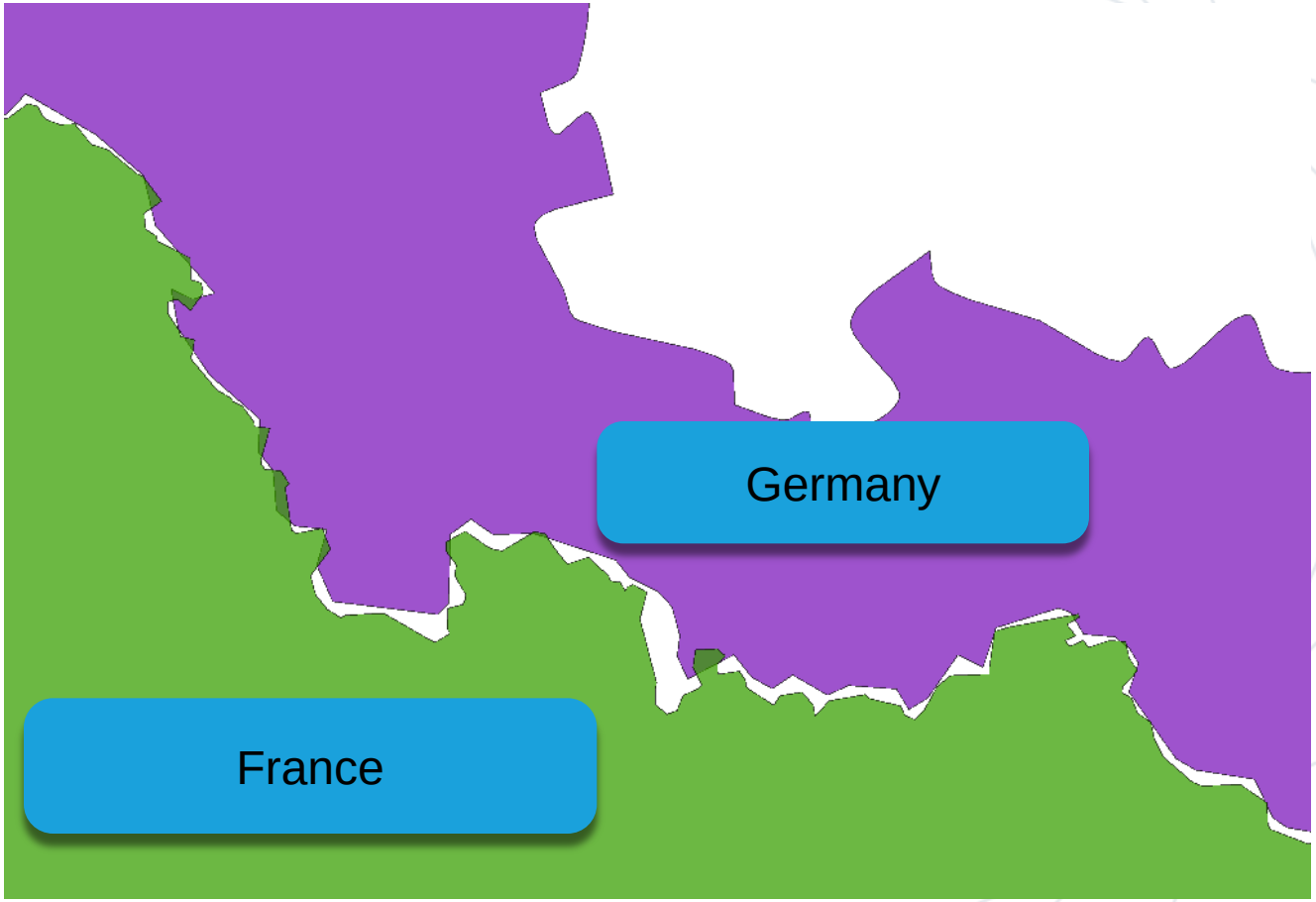
Tested with ELF dataset

red = overlap between polygons

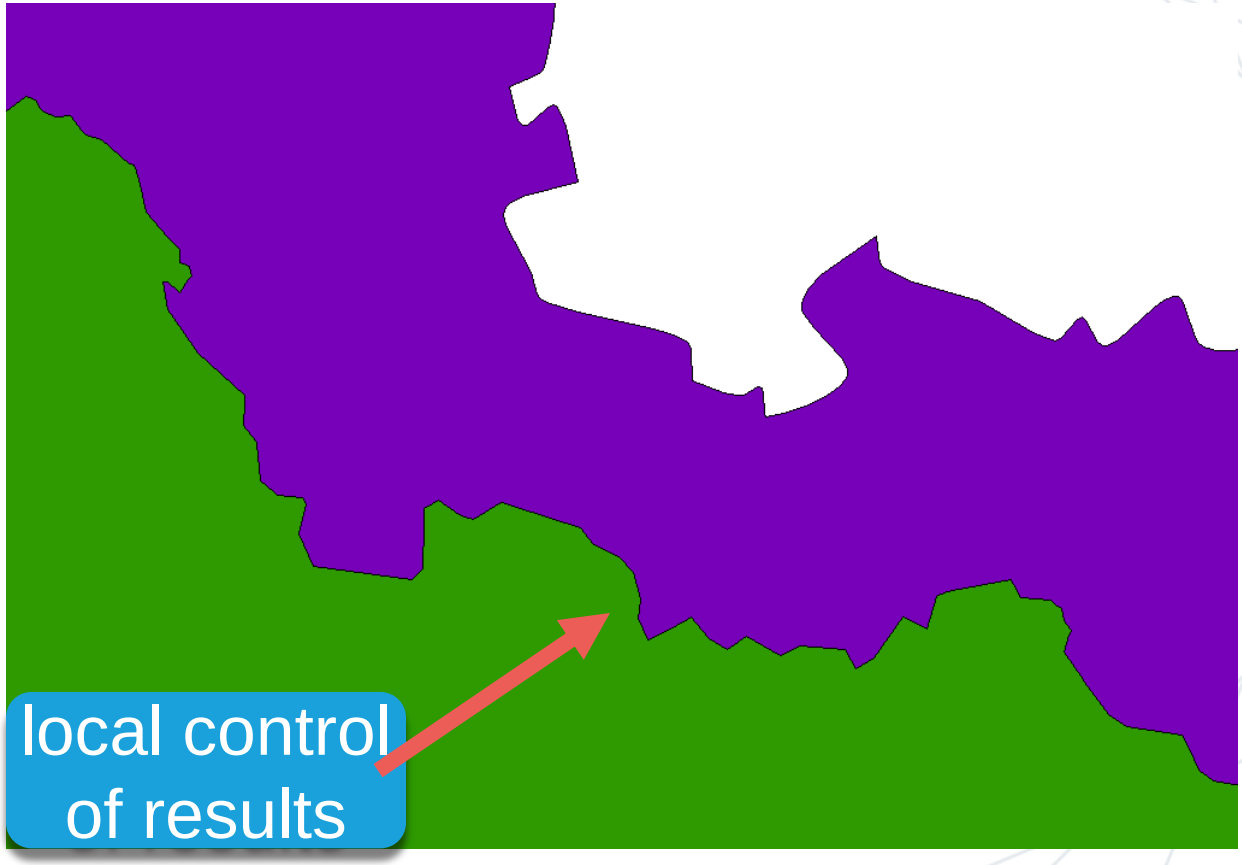
Tested with ELF dataset



Edge-matching uses same principle



Edge-matching uses same principle



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More information and download PPrepair?

https://github.com/tudelft3d/pprepair

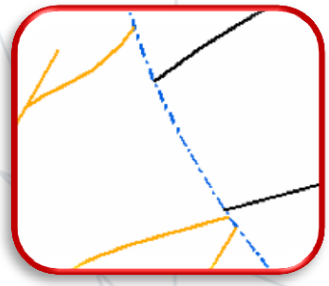
It is free and open-source software (GPLv3 licence)

- ★ Works with *shapefiles* and GML input (ELF data need more testing)
- ★ Windows app will be released soon (only Mac/Linux at this moment)

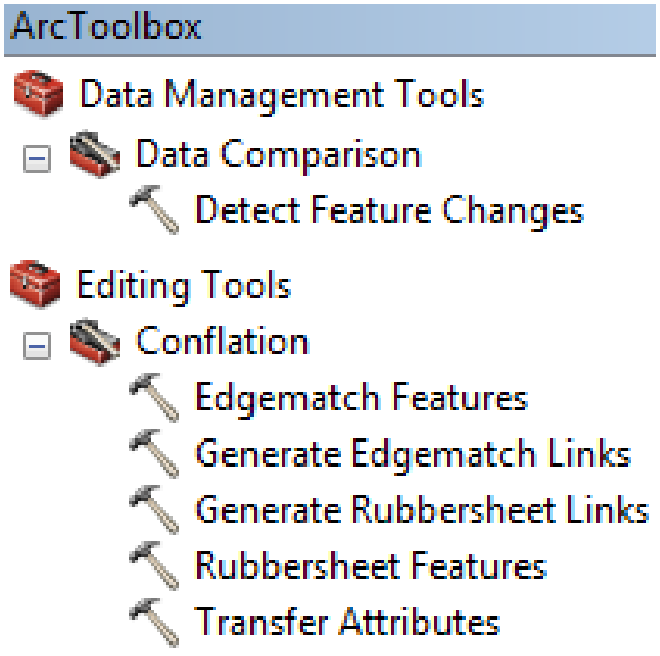
Edge matching tool

(ESRI)

ESRI Conflation Tools for ELF



- Conflation and edgematch toolset
  - New in ArcGIS 10.2.1 – better in 10.3 (now out)
  - Tools match two datasets
- Edgematch tools
  - Will move one or both ends
  - Currently line features only



Edgematching of adjacent datasets

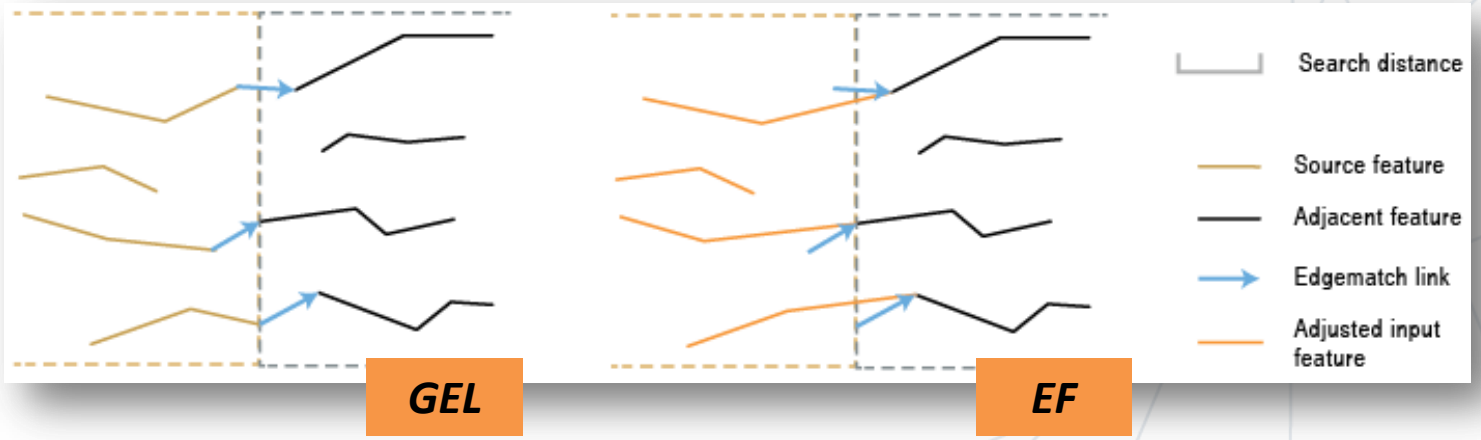
★ Based on proximity, topology, and continuity analysis, as well as attributes

Generate Edgematch Links (GEL)

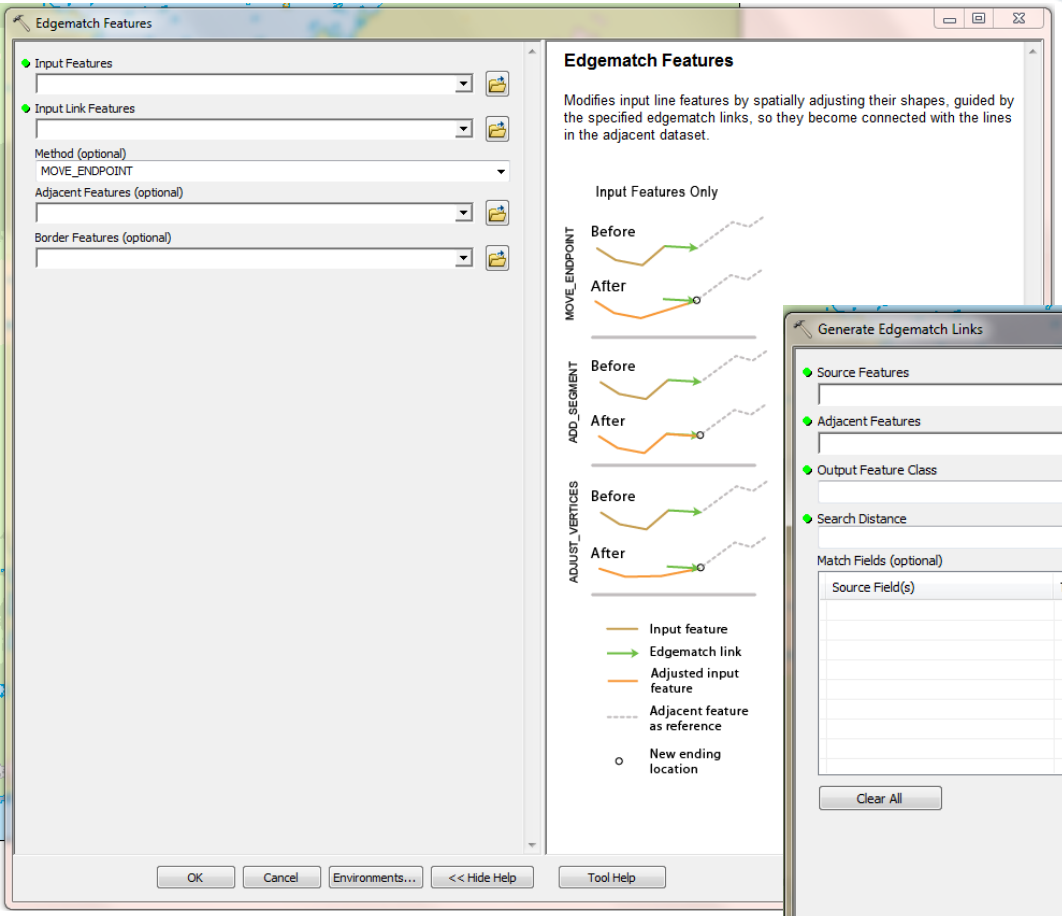
- **From source features to adjacent features**

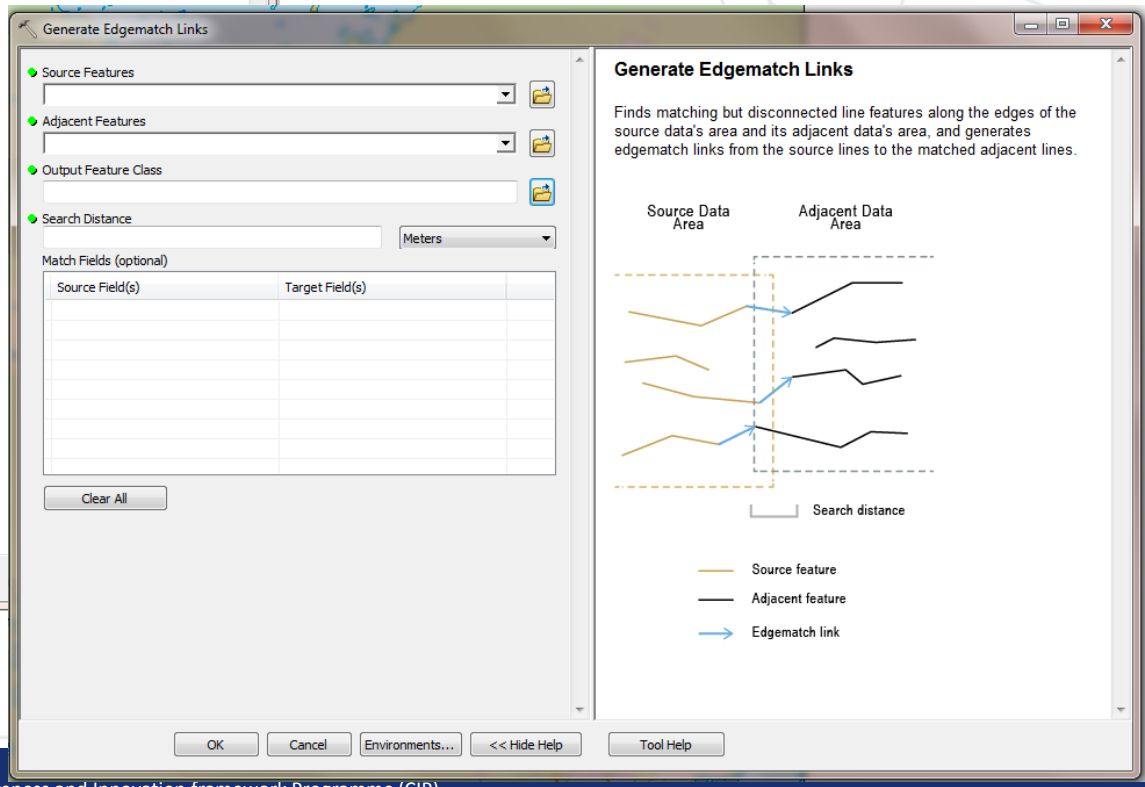
Followed by Edgematch Features (EF)

- **Connects features guided by the established links**



Edgematch geoprocessing tools





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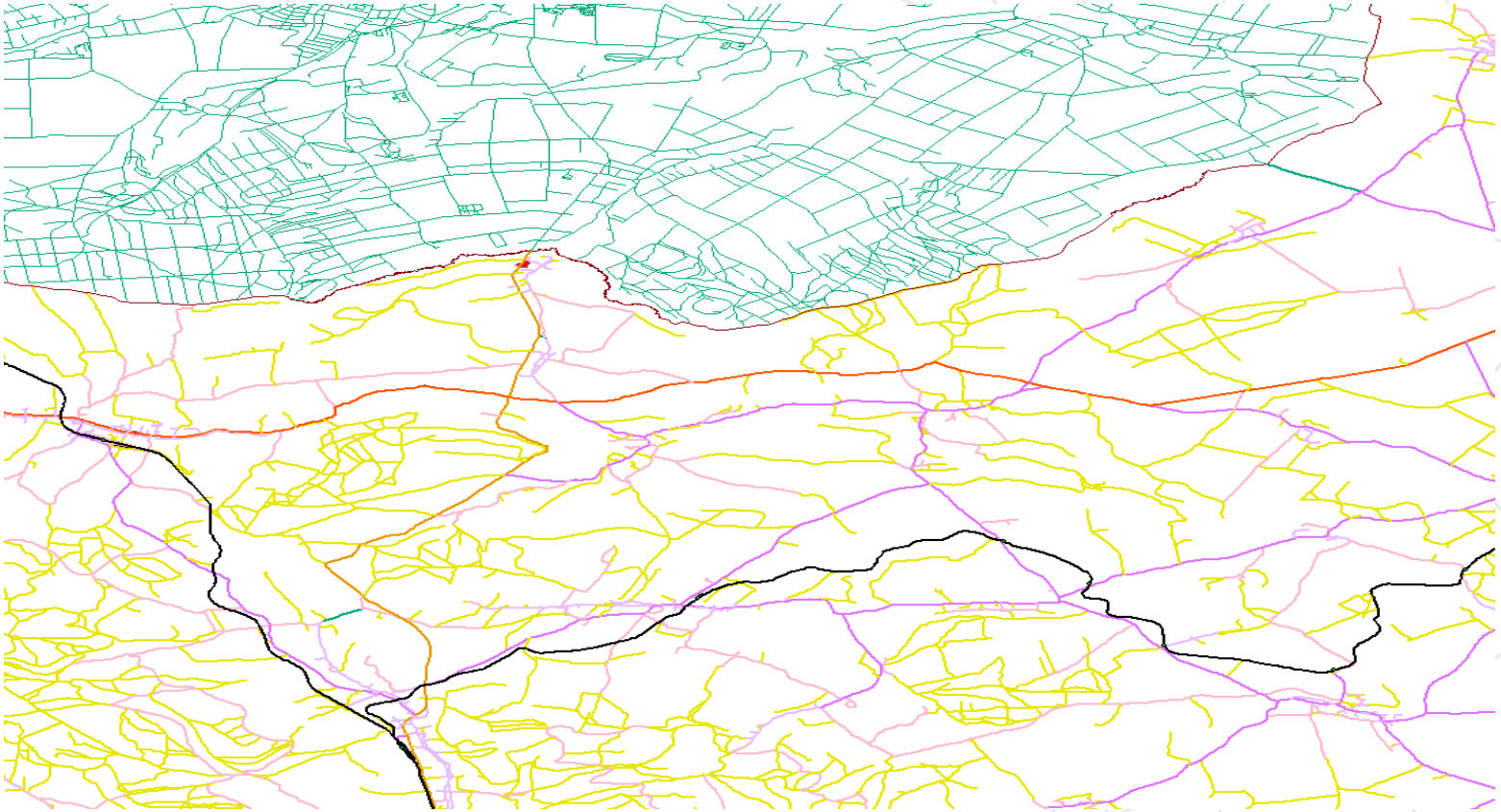
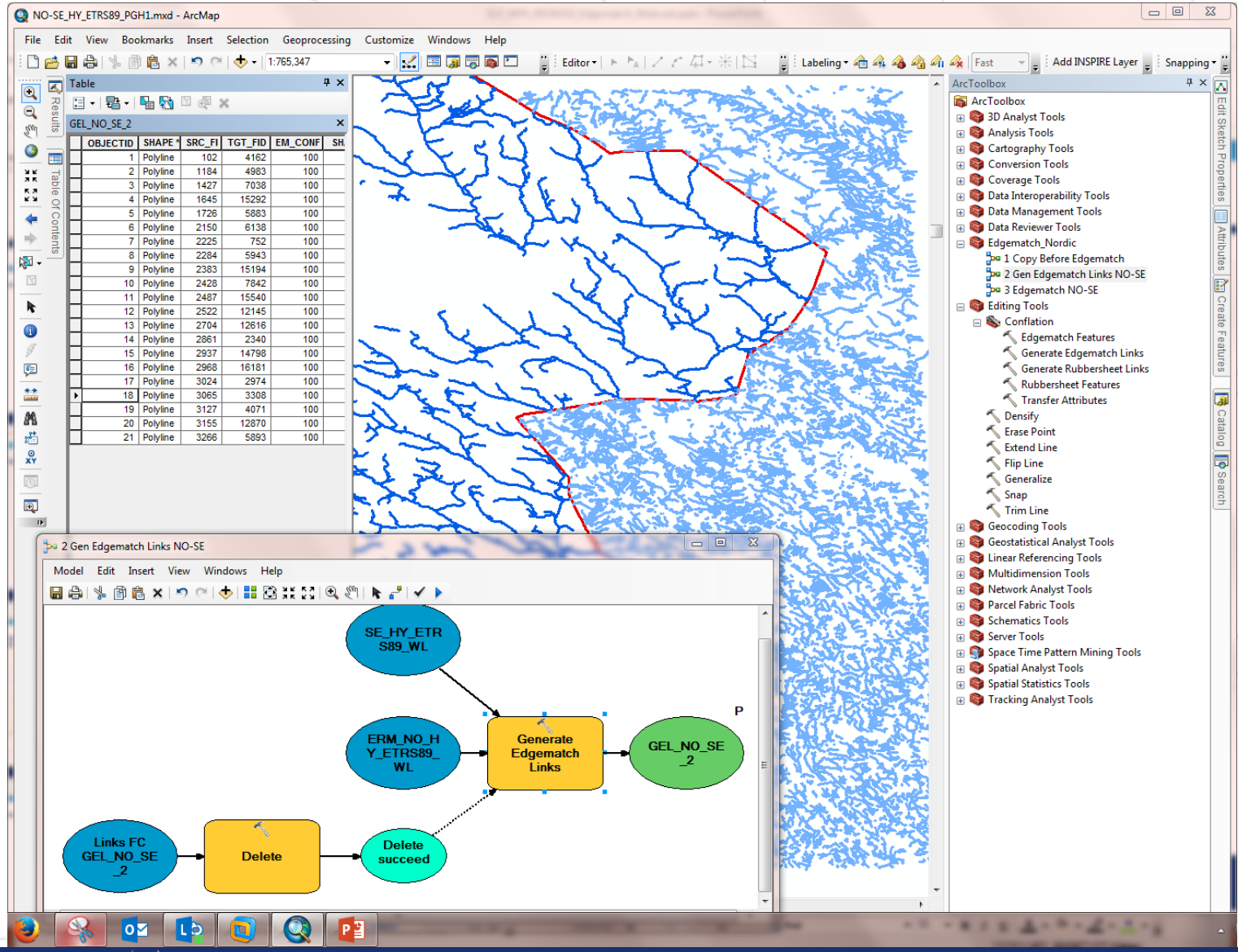
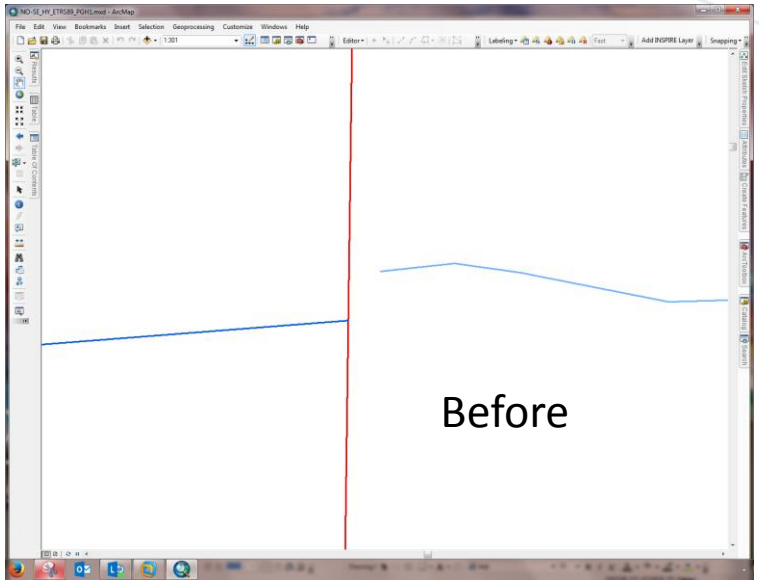
Initial Poland-Czech transport theme test

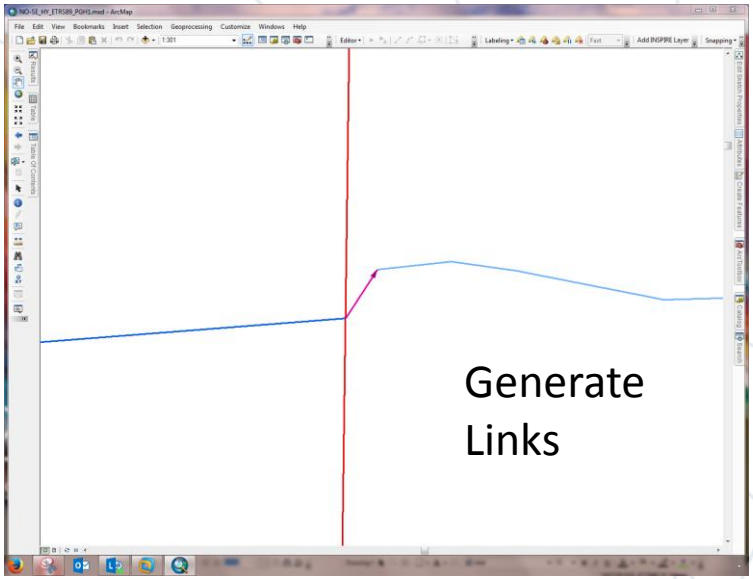


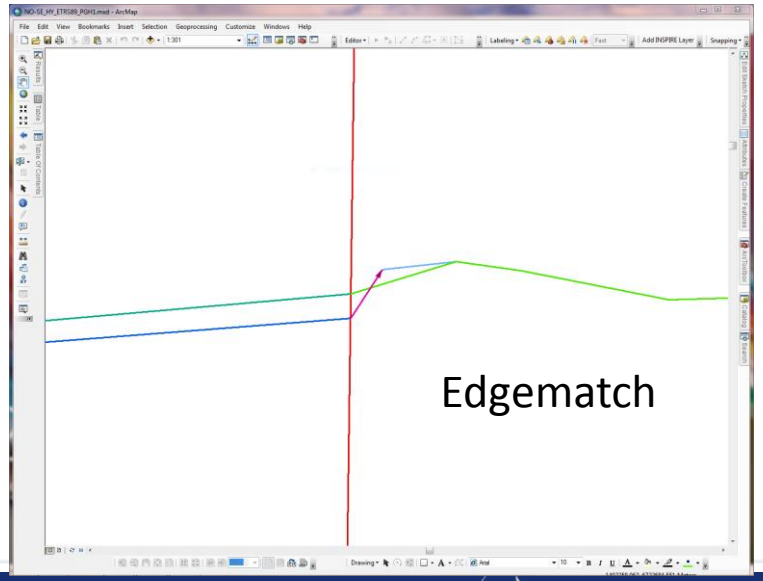
Norway-Sweden Tests

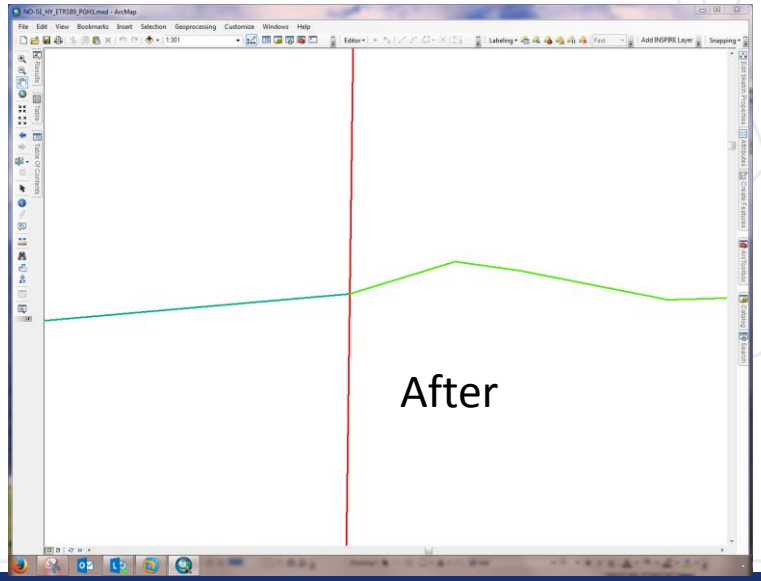


Norway-Sweden Tests









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More information

- https://pro.arcgis.com/en/pro-app/tool-reference/editing/an-overview-of-the-conflation-toolset.htm
- https://pro.arcgis.com/en/pro-app/tool-reference/editing/about-edgematching.htm
- https://pro.arcgis.com/en/pro-app/tool-reference/editing/edgematch-features.htm

- To take up the ELF Esri software grant, email Nick Land nland@esri.com.

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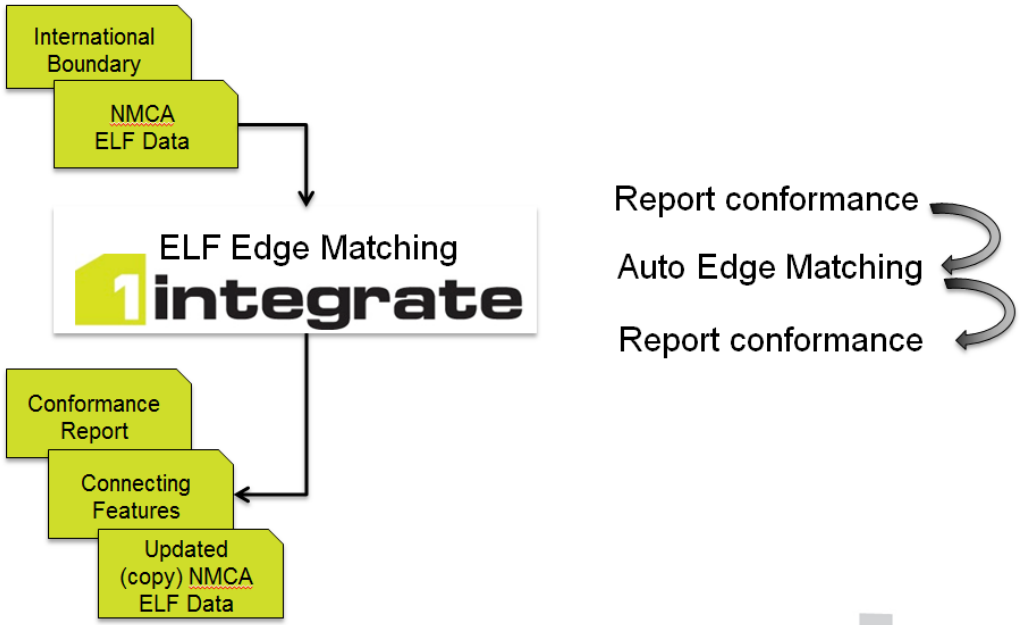
Edge Matching tool (1Spatial)

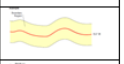
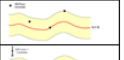
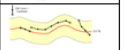
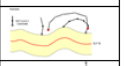
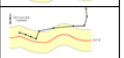
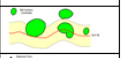
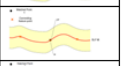
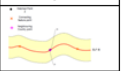
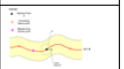
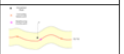
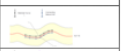
- 1Spatial ELF Edge-Matching is provided via 1Integrate
- 1Integrate is a Commercial Off The Shelf (COTS) product designed for automatic change update, data engineering, data migration or data transformation tasks.
- Preconfigured ELF ruleset for each of the three edge-matching scenarios



Edge-Matching Rulesets

- Preconfigured rules sets
- The Edge-Matching evaluation rules check the conformance of the data along the international boundary
- The ELF actions will automatically edge-match data and automatically create/modify the connecting features as defined in the requirements.

1spatial
YOUR WORLD SMARTER

Evaluation Rules		Image
EM.Evaluation.1	A Boundary Region must be computed as a surface around the ELF IB with the following buffer width: Master LoD: 10 m, Regional LoD: 25 m.	
EM.Evaluation.2	An EM Point Feature must be considered an 'EM Point Candidate' if it intersects the Boundary Region.	
EM.Evaluation.3.1	An EM Curve Feature L must be considered an 'EM Curve 1 Candidate' if L is within the Boundary Region.	
EM.Evaluation.3.2	An EM Curve Feature L must be considered an 'EM Curve 2 Candidate' if all the following are true: The boundary of L intersects the Boundary Region The interior of L does not intersect the Boundary Region.	
EM.Evaluation.3.3	An EM Curve Feature L must be considered an 'EM Curve Split Candidate' if all the following are true: L intersects the Boundary Region, L is not an EM Curve 1 Candidate, L is not an EM Curve 2 Candidate.	
EM.Evaluation.4	An EM Surface Feature must be considered an 'EM Surface Candidate' if it intersects the Boundary Region.	
EM.Evaluation.5.1	An EM Point Candidate P must be considered a 'Matched Point 1' if all the following are true: P intersects a connecting feature point CP, CP.featureType contains the feature type of P.	
EM.Evaluation.5.2	An EM Point Candidate P must be considered a 'Matched Point 2' if all the following are true: P is not a Matched Point 1, P intersects the ELF IB, P intersects a Neighbouring Country point feature Q, Q has the same feature type as P.	
EM.Evaluation.5.3	An EM Point Candidate P must be considered a 'Matched Point 3' if all the following are true: P is not a Matched Point 1, P is not a Matched Point 2, P intersects the ELF IB, There is no Neighbouring Country point feature Q such that all the following are true: Q is within the following distance of P: Master LoD: 20 m, Regional LoD: 50 m. Q has the same type as P.	
EM.Evaluation.5.4	An EM Point Candidate P must be considered an 'Unmatched Point' if all the following are true: P is not a Matched Point 1, P is not a Matched Point 2, P is not a Matched Point 3.	
EM.Evaluation.6.1	An EM Curve 1 Candidate L must be considered a 'Matched Curve 1' if all the following are true: The geometry of L coincides with the geometry of a connecting feature line CL CL.featureType contains the feature type of L.	
EM.Evaluation.6.2	An EM Curve 1 Candidate L must be considered a 'Matched Curve 2' if all the following are true: L is not a Matched Curve 1, L is within the ELF IB, The geometry of L coincides with the geometry of a Neighbouring Country curve feature Q, Q has the same feature type as L.	
EM.Evaluation.6.3	An EM Curve 1 Candidate L must be considered a 'Matched Curve 3' if all the following are true: L is not a Matched Curve 1, L is not a Matched Curve 2,	

Generalisation tools:

- Delivery month 24.
- Generalisation rules (together with WP 2) have been finished and configured in the tools.
- Generalisation tool for Regional to Global has been developed by IGN France.
- Generalisation tools for Master level 1 to 2 have been developed by Esri/Kadaster Netherlands and 1Spatial.
- A cartographic generalisation tool has been developed by Delft University called Varioscale.

- 1spatial has developed the tool 1Generalise.
- Esri/Kadaster Netherlands have developed their Generalistion tool based on ArcGIS.

- First versions of the Generalisation tools have been delivered. Next versions will follow after tests and use within NMCA's.

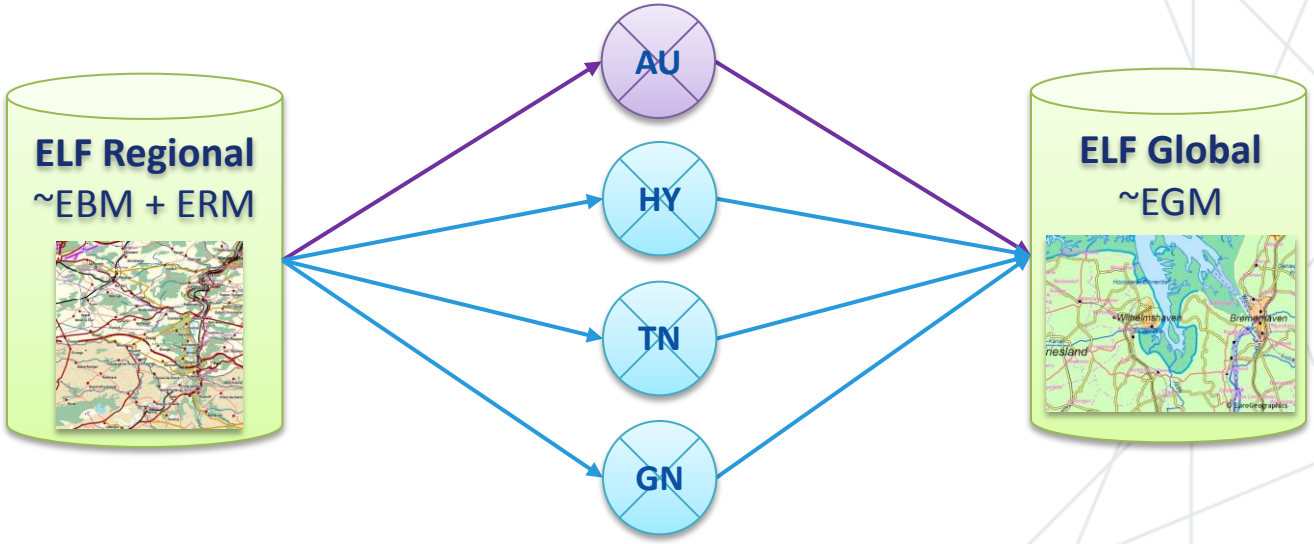
- Webinars on Generalisation tools have to be planned.

Regional → Global generalization tool (IGN France)

★ **Purpose**: automatically generalize data from ELF Regional to Global level for:

- Administrative units
- Hydrography
- Transport network
- Geographical names (settlements)

★ One sub-tool for each theme:



Only the ELF feature/data types which correspond to existing EGM data are covered by the tools.

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Technical characteristics of the tools for each theme

	AU tool	HY, TN and GN tools
Input/output data format	Shapefiles 	PostgreSQL database 
Implementation language	Python with ArcGis 	C++ with internal IGNF libraries 
Constraint	Only input data in a **flattened structure** can be processed. The output data model will also be flat. Complex GML data cannot be used nor created.	

NB: the difference in data formats and languages is due to the fact that the work in ELF was based on existing tools which had to answer to different technical constraints.

Overview of the generalization process

- Parameters can be defined country by country for each of the 4 tools via xml or text files

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  </SELECTION_SQL>
  <SELECTION_SQL_2>
    <SQL_2>rrc = 16 and exs != 6</SQL_2>
  </SELECTION_SQL_2>
  <SELECTION_SQL_3>
    <SQL_3>tfc != 32 and tfc != 33 and tuc != 25</SQL_3>
  </SELECTION_SQL_3>
  <SELECTION_LENGTH>
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  </SELECTION_LENGTH>
  <SELECTION_GEOM_CONTINUITY>
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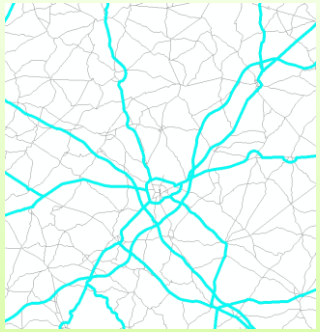
  </SELECTION_NUMBER_OF_INHABITANTS>
</COUNTRY>
```

- The tools for each theme follow the same main steps.

Step 1: Selection

- Semantic selection
- Geometric selection
- Topological criteria
- Network continuity within and between countries



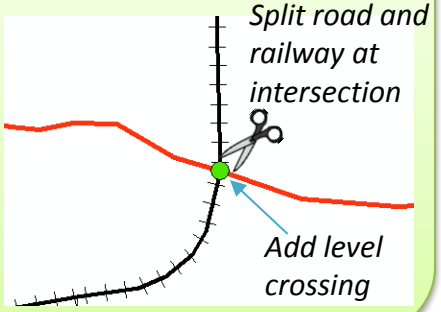
Step 2: Model conversion

- Change of geometry type

- Attribute modifications

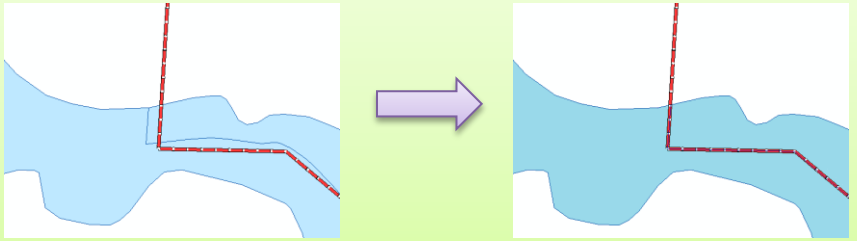
Step 3: Intra-theme consistency

- Ensure consistency between feature types from the same theme
- Add new feature types where needed



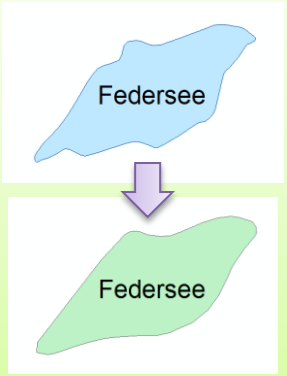
Step 4: Edge-matching

Ensure consistency of the selected (regional) data with the international boundaries from the target (global) dataset.



Step 5: Simplification

- Smaller objects merged with neighbours (attribute generalization)
- Geometrical simplification based on Douglas-Peucker algorithm with topological constraints.



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Main functionalities proposed by the tools

- ★ Fully automated generalization process from Regional to Global levels
- ★ Extensive library of generalization-related functions, used within the different steps
  - Graph manipulation
  - Itinerary calculations and network continuity
  - Basic and advanced geometric functionalities
  - Advanced selection methods
  - Advanced edge-matching procedures with and without connecting features
  - Context-aware simplification tools (topological relationships between objects are preserved)
  - Etc.
- ★ Production follow-up for the user
  - Actions, errors, warnings, processing times are recorded in log files
  - Copies of the data are kept after each step for user checks
  - Production monitoring system to ensure that no step is processed without the previous ones having been successfully concluded.

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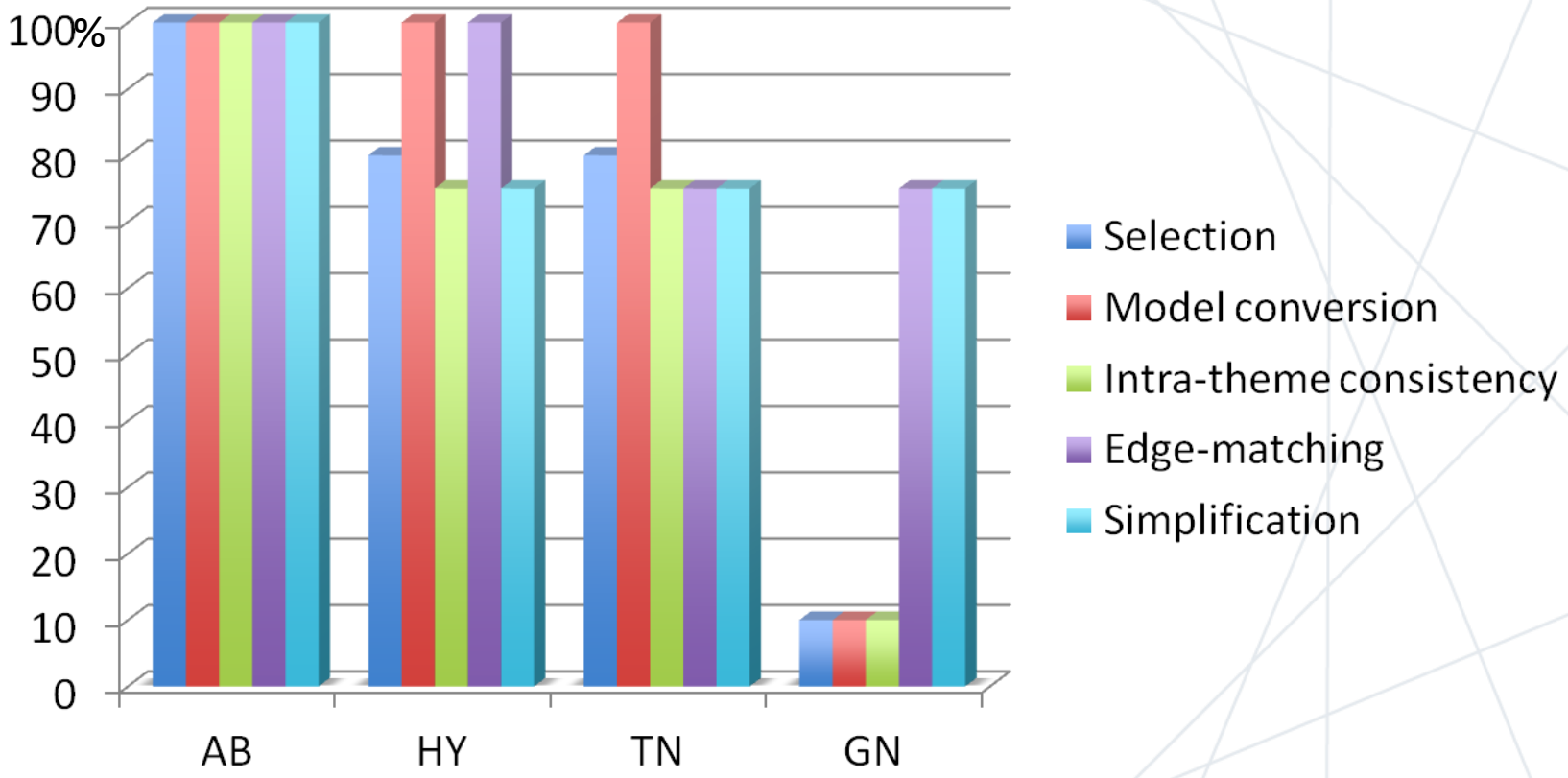
Progress report



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