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openLCA implementation of GIS-based regionalised LCA – practical demonstration of status and possibilities

Cristina Rodríguez, Michael Srocka

GreenDelta GmbH Berlin

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Regionalised LCIA in openLCA

1 Extended process locations

2 Regionalised LCIA methods

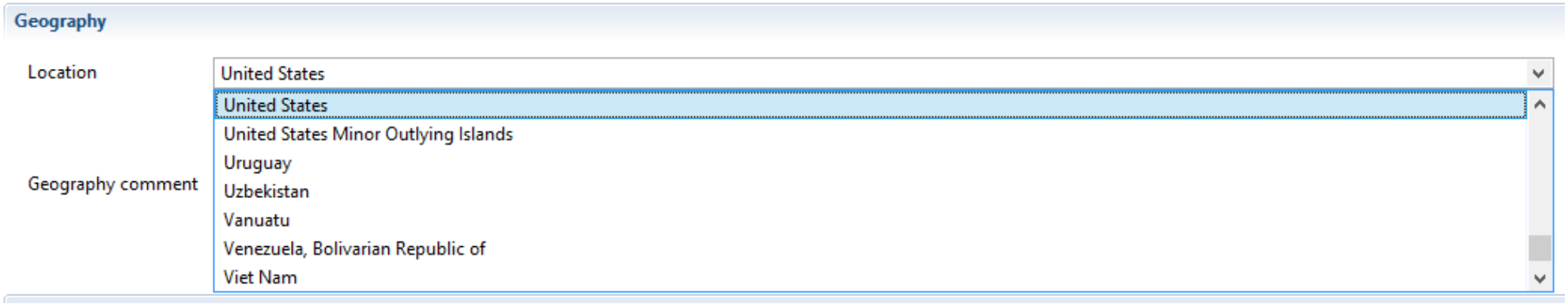
- **Parametrization**
- **Shapefiles management**

3 Calculation framework

1 Extended process locations

Traditional approach

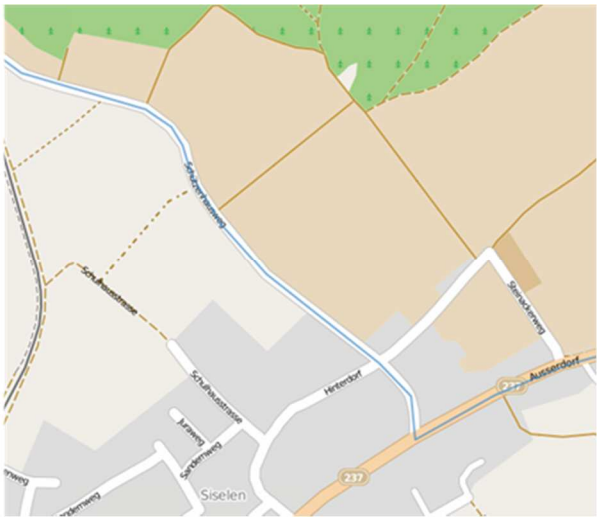
- A pre-defined list of locations could be selected:
  - Countries
  - Groups of countries, e.g. UCTE, EU, etc.
  - Global
  - (for some databases) Country's sub-divisions, e.g. states of US



New approach

Integrated KML Editor → The user can define new locations for each process

- Polygons → e.g. crop fields, countries
- Lines → e.g. transport routes
- Points → e.g. factories

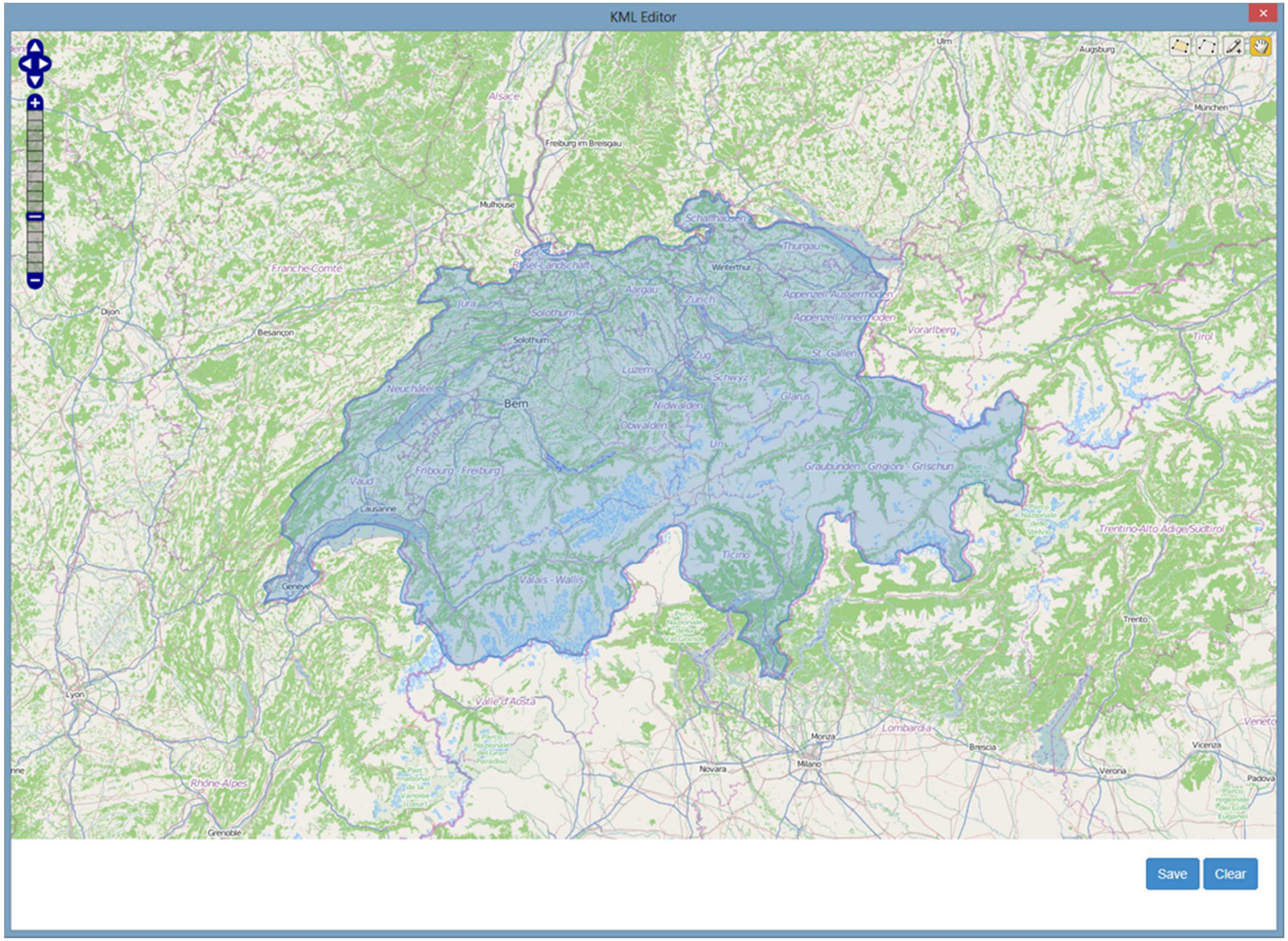


KML Editor

- XML data can be easily edited

- KML data included in the Ecospold2 format

KML Editor



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2 Regionalised LCIA methods

Parameterization of LCIA methods

- Formulas for calculating the characterisation factors (CFs) can be defined

  → Input and dependent parameters can be used as in the process datasets

Impact factors

Impact category: Land use

Flow	Category	Flow property	Unit	Factor	Uncertainty
Occupation, arable	resource/land	Area*time	m2*a	(0.60*ratio_biom)/SA_CF	lognormal: gmean=1.36 g...
Occupation, construction site	resource/land	Area*time	m2*a	(0.44*ratio_biom)/SA_CF	lognormal: gmean=1.00 g...
Occupation, forest, intensive	resource/land	Area*time	m2*a	(0.04*ratio_biom)/SA_CF	lognormal: gmean=9.09E-...
Occupation, forest, intensive, clear-c...	resource/land	Area*time	m2*a	(0.18*ratio_biom)/SA_CF	lognormal: gmean=0.41 g...

Parameters

Global parameters

Input parameters

Name	Value	Uncertainty	Description
ratio_biom	1.0	uniform: min=0.21 max=1.97	from shapefile: ecoregions_with_biome_ratio
SA_CF	0.44	none	Settlement Area Characterization Factor
SA_EF	300.0	none	Settlement Area Ecofactor

Shapefiles containing regional characteristics

- Regional characteristics affecting the CFs can be defined with parameters

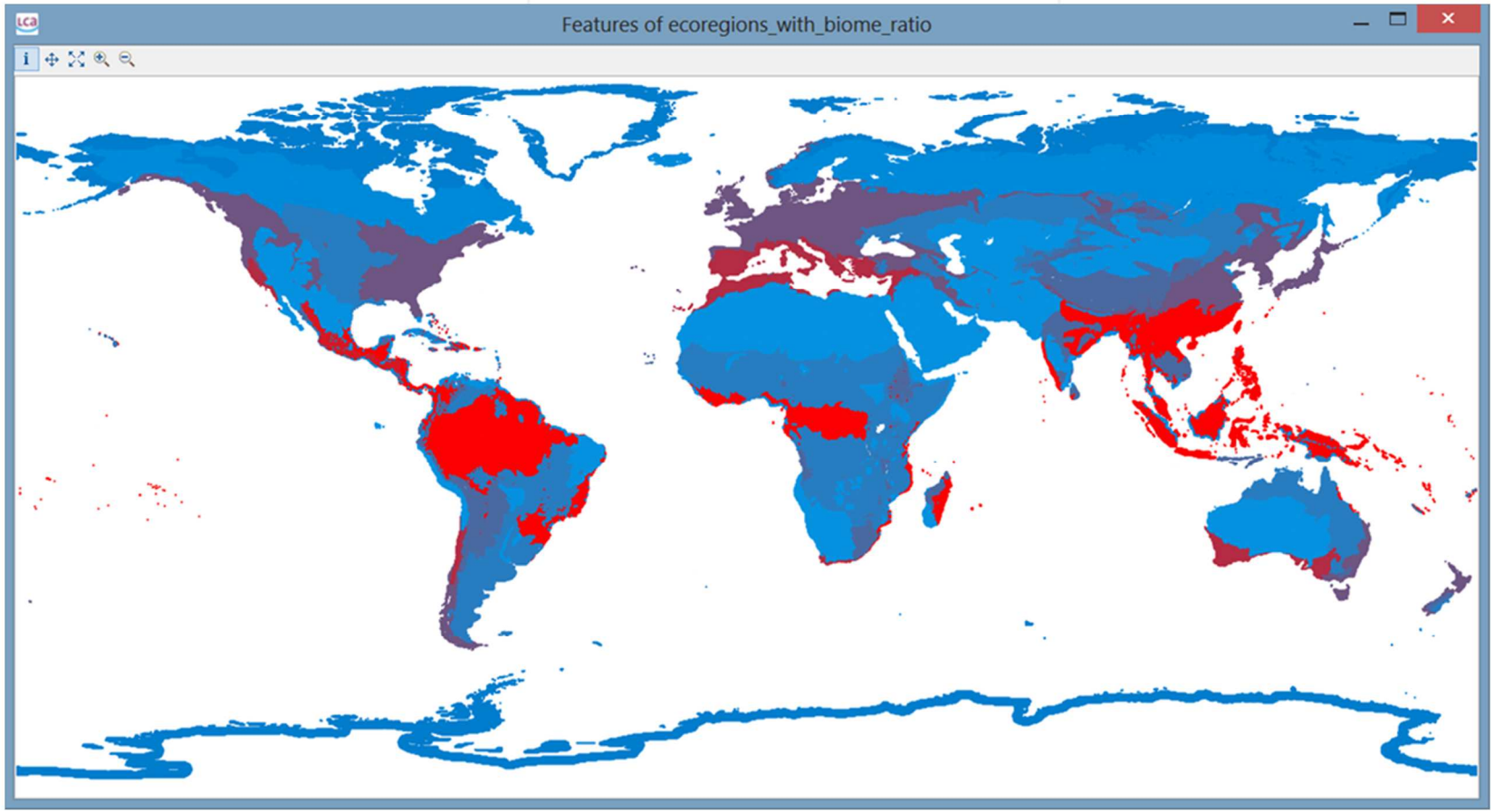
    e.g. population density, precipitation variability,etc.

- Data for those characteristics is contained in shapefiles, which can be imported to openLCA
- Parameters are extracted during the shapefile import
- Shapefiles are stored in the database

Shapefiles containing regional characteristics

Parameters of ecoregions_with_biome_ratio

Name	Minimum	Maximum
f_x CLS_CODE	0.0	1144.0
f_x ECO_ID_U	10000.0	17109.0
f_x ECO_NUM	1.0	99.0
f_x ratio_biom	0.20929077	1.96750671



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Binding of shapefiles parameters

- Parameters of shapefiles can be bound to input parameters with a default value
- Default value is used for normal calculations and formula evaluation
- In regionalized assessment the parameter value derived from the shapefile is used for the formula evaluation

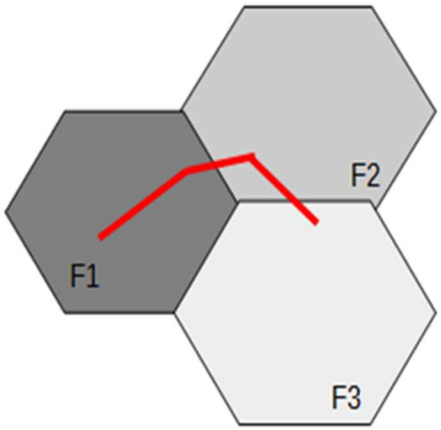
3 Calculation framework

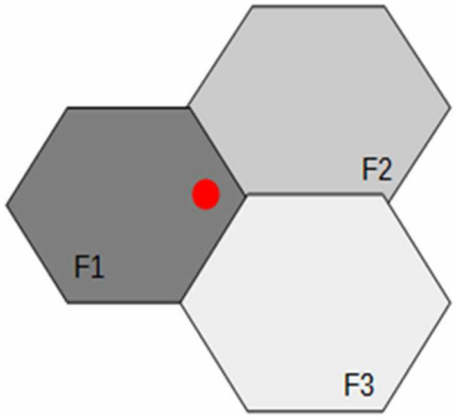
Linking inventory locations and LCIA methods spatial units

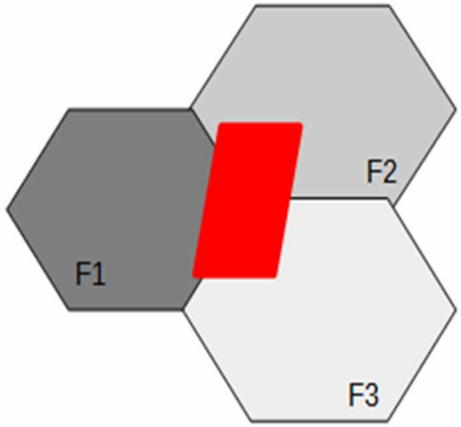
- GeoTools libraries integrated in openLCA

  → Calculate the shapefiles features intersected by the process geometries

  → A weighted mean calculated for each regional parameter







$(p(F_1)*L(F_1) + p(F_2)*L(F_2) \ldots) / L$ $p(F_1)$ $(p(F_1)*A(F_1) + p(F_2)*A(F_2) \ldots) / A$

Regionalised LCIA calculation

- Creation of a regionalised result matrix for the inventory (GR)
- Creation of a regionalised LCIA matrix (CR)
- Creation of the regionalised LCIA result (RR)

$$RR = CR * GR$$

Regionalised LCIA calculation

Result map

Flows: tap water, at user - water supply/production -

Impact categories: Land use

Impact contributions

Impact category: Land use Cut-off: 2 %

Contribution	Process	Amount	Unit
66.67%	sugar beets IP, at farm - Aarberg (Field 1) - CH	0.45301	UBP
33.33%	sugar beets IP, at farm - Aarberg (Field 2) - CH	0.22651	UBP

4 Conclusions and Outlook

Conclusions and Outlook

- The new advanced regionalised features developed in a project supported by USDA
- They will be included in openLCA 1.4 (currently beta version, final release in next weeks)
- Multipolygon geometries will need further work → adaptation of GeoTools libraries
- Refinement of the regionalised LCIA approach implemented possible → suggestions welcome

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Thank you!

Contact: Cristina Rodríguez

GreenDelta GmbH

Müllerstrasse 135, 13349 Berlin, Germany

rodriguez@greendelta.com

www.greendelta.com