

# The Cross-Linguistic Linked Data project

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# Outline

## Cross-Linguistic data – status quo ante

What is cross-linguistic data?

Cross-linguistic data on the web

How is cross-linguistic data used?

## The CLLD project

The datasets

The publication models

The technology

Linked Data

## Cross-linguistic data – status quo post

Use cases – revisited

Semantic interoperability?

# Diversity Linguistics at the MPI EVA

- ▶ The department for Linguistics at the Max Planck Institute for Evolutionary Anthropology (MPI EVA) in Leipzig studies the world's language diversity.
- ▶ As basis or result of this research, cross-linguistic datasets are collected.
- ▶ "Cross-linguistic" in this context means "massively multilingual", i.e. datasets often span hundreds of languages.
- ▶ As a corollary, studying under-resourced languages is rather the norm than the exception.

## Cross-Linguistic data

These cross-linguistic datasets typically consist of

- ▶ lexical or typological data
- ▶ on many languages (> 20)
- ▶ or on small languages.

## Examples

- ▶ wordlists (Swadesh, Leipzig-Jakarta, etc.) or dictionaries,
- ▶ phoneme inventories,
- ▶ typological surveys,
- ▶ small collections of glossed text (IGT following the Leipzig Glossing Rules) or bibliographies

## The status quo of cross-linguistic data on the Web

A lot of cross-linguistic data has been compiled/collected; many linguists have written a dictionary or a grammar or compiled a typological survey as database for their own research.

- ▶ But often it is not (anymore) freely accessible on the web ...
- ▶ ... but is hidden in books ...
- ▶ ... or – worse – in drawers.

Why?

- ▶ The traditional publication models do not work for this kind of data (databases, dictionaries on small languages, ... ).

## Cross-linguistic data on the web

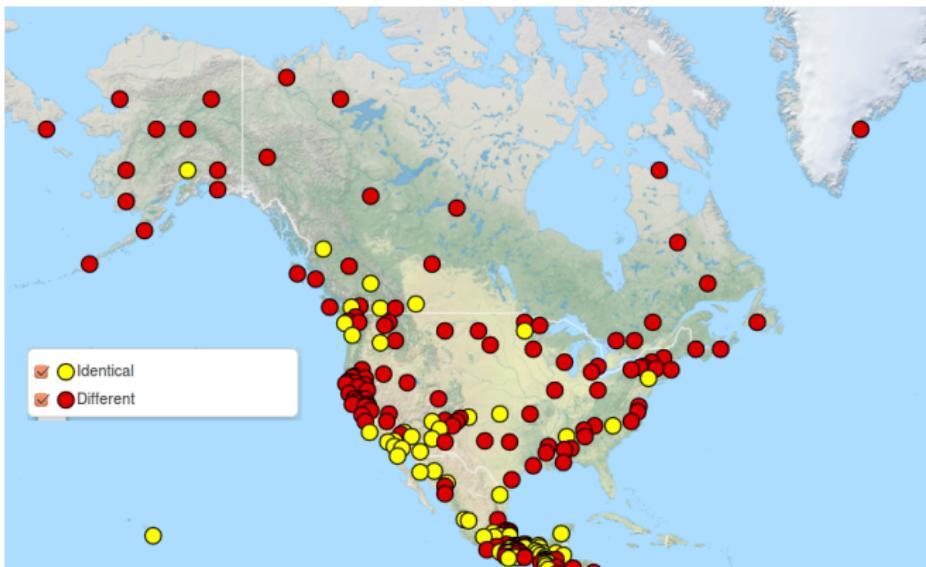
- ▶ Provided we can get cross-linguistic data on the web, how do we make sure it will stay?
- ▶ What tends to keep web resources accessible is usage!
- ▶ So bridging the gap between data creation and usage, i.e. publishing data in a usable way will solve our problem.

# Use cases for cross-linguistic data

How is cross-linguistic data used?

- ▶ Search for universals or the lack of these, i.e. documenting language diversity.
- ▶ Areal linguistics – research on areal features of languages, e.g. WALS chapter on *Hand and Arm*
- ▶ Historical linguistics – reconstruction of proto-languages, mass comparison of lexical data; e.g. ASJP, *Mapping the origin of Indo-European*
- ▶ To compute language distances/complexity/... (e.g. Gil, Dahl)

## WALS chapter – hand and arm



**Figure 1:** Cecil H. Brown. 2013. Hand and Arm. In: Dryer, Matthew S. & Haspelmath, Martin (eds.) The World Atlas of Language Structures Online.

## ASJP language tree

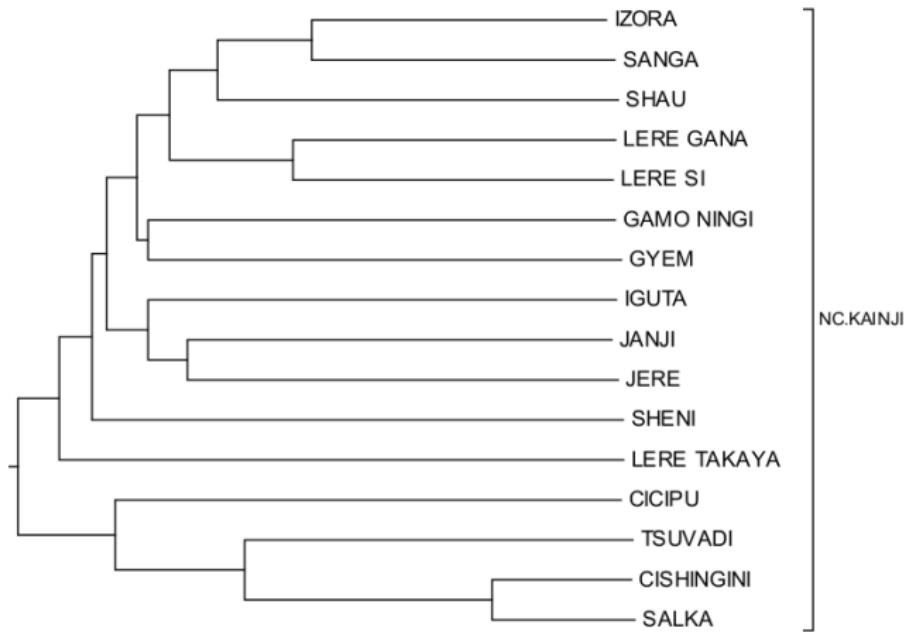
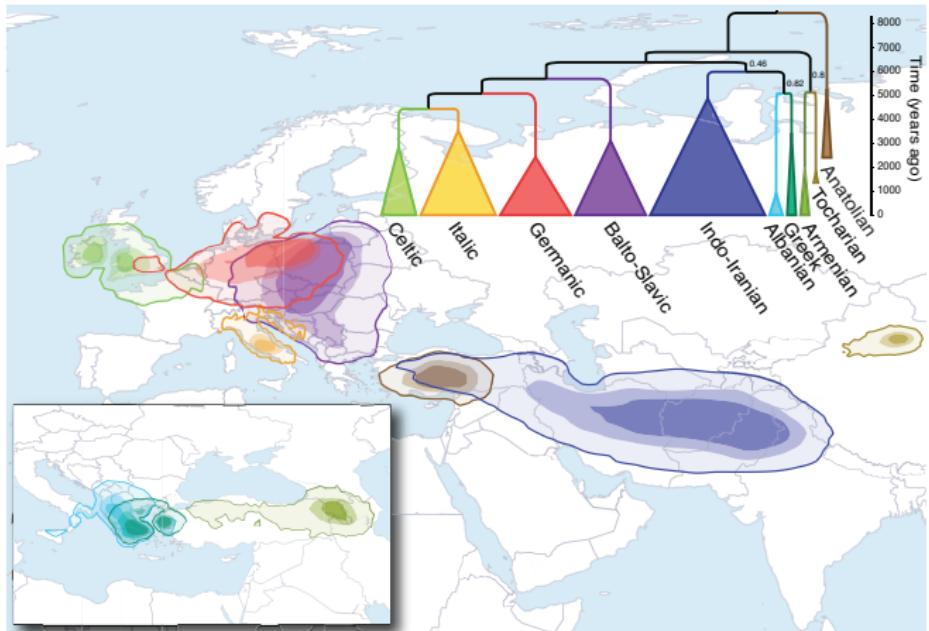


Figure 2: The ASJP Consortium. 2013. ASJP World Language Trees of Lexical Similarity: Version 4 (October 2013).

# Mapping the origin of Indo-European



**Figure 3:** Figure 2 from Bouckaert, R. et al. (2012). Mapping the origins and expansion of the Indo-European language family. *Science*, 337:957–960.

## The CLLD project

The CLLD project sets out to pick the (seemingly) low-hanging fruit – to bring existing but unpublished cross-linguistic data to the web by establishing sustainable publication infrastructure.

## CLLD – datasets

- WALS** The World Atlas of Language Structures a database of structural properties of more than 2600 languages,
- APiCS** The Atlas of Pidgin and Creole Language Structures,
- WOLD** The World Loanword Database contains vocabularies of 41 languages from around the world annotated for loanword status,
- IDS** The Intercontinental Dictionary Series (to be published in CLLD in 2014),
- ASJP** The Automated Similarity Judgement Project (to be published in 2014),
- Glottolog** A language catalog and comprehensive bibliography.

But CLLD can publish non-MPI EVA datasets as well and has done so: eWAVE, SAILS, PHOIBLE.

## CLLD – publication models

CLLD provides three publication models for cross-linguistic datasets:

- ▶ Standalone databases following an "edited series" model, like WALS, WOLD, ....
- ▶ Two journals for cross-linguistic datasets,
  - ▶ *Dictionaria* a journal for dictionaries,
  - ▶ *The Journal for Cross-linguistic Datasets* for typological surveys and simila datasets.
- ▶ Self-hosting using the `clld` software.

These models are explicitly based on examples from the traditional publishing world.

## CLLD – publication models

- ▶ Incentivize data publication through recognition – following traditional models.
- ▶ Favor expert submission and editorial control over crowdsourcing
  - ▶ for easier quality control,
  - ▶ easier provenance assessment,
  - ▶ and because we have the experts at hand.

## CLLD – the software

The datasets are hosted as web applications built on the `cldd` python package,

- ▶ a CMS tailored towards cross-linguistic data,
- ▶ provides a common data model which
  - ▶ includes the generally accepted practice of basing all "measurements" on sources,
  - ▶ fits typological and lexical data,
  - ▶ is customizable per application.
- ▶ Each `cldd` app has full control over its output.
- ▶ So we have a lot of datasets served by software fully under our control – time to think about standards!

## CLLD – the software

- ▶ Trying to "standardize" on the software – i.e. making things interoperable by putting all on the same technology stack – has been tried before.
- ▶ Taking the second step – i.e. using common specifications, protocols is essential.
- ▶ Still, being able to put a nice interface browsable by humans on your database goes a long way in attracting data submissions.

## cldd data model

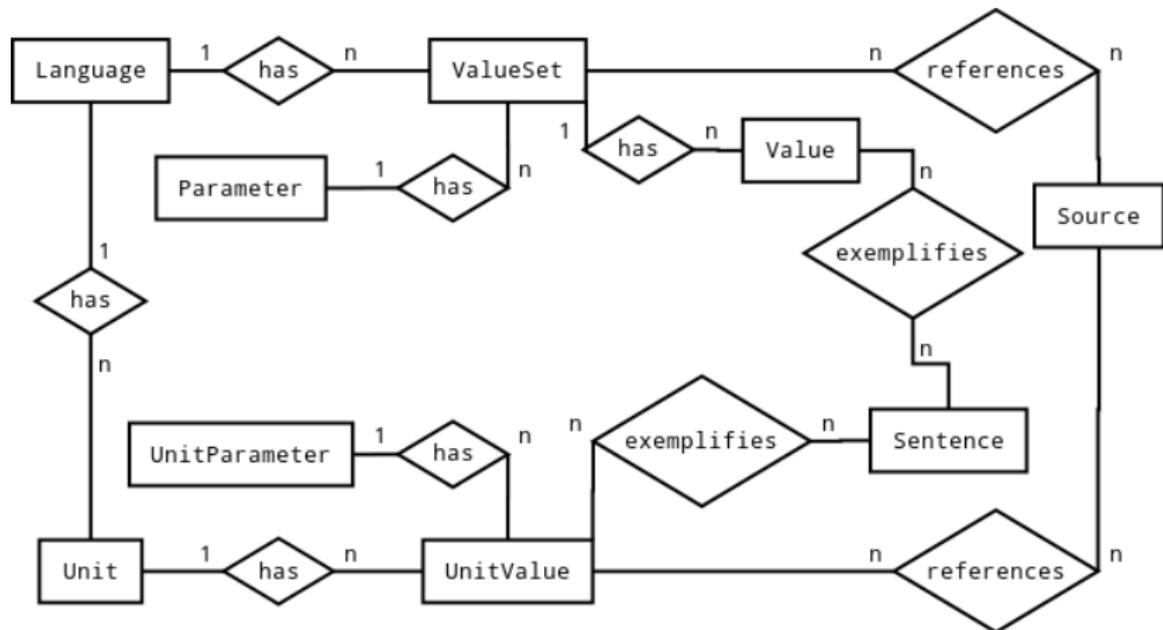


Figure 4: The default cldd data model.

# cld default data model – with a twist

Home    Languoids    Langdoc

Search    Families    Languages    Languoids information    Glottocode: abdi1241 | ISO 639-3: cld | 2023-03-15

**Abadi** ⓘ

Austronesian ⓘ

- Nuclear Austronesian
- Malayo-Polynesian
  - Central-Eastern Malayo-Polynesian
  - Eastern Malayo-Polynesian
    - Oceanic
      - Western Oceanic linkage
      - Papuan Tip linkage
      - Peripheral Papuan Tip
        - Central Papuan
        - West Central Papuan linkage
        - Abadi ⓘ
- Motu
- Nuclear West Central Papuan

Map

Port Moresby

Links

Alternative names

References

Showing 1 to 19 of 19 entries

– Previous 1 Next – ⓘ

Details	Name	Title	Year	Author	Doctype	Provider
<a href="#">more</a>	W. M. Strong 1912	Note on the Language of Kabadi, British New Guinea	1912	W. M. Strong	wordlist	hh
<a href="#">more</a>	Andrew Pawley 1975	The relationship of the Austronesian languages of Papua: A preliminary study	1975	Andrew Pawley	comparative, overview	hh
<a href="#">more</a>	n.a. 2005	Ega vanoda maoradada	2005			sil16
<a href="#">more</a>	n.a. 2005	Mara'una agonanai	2005			sil16
<a href="#">more</a>	n.a. 2005	Ega mauri avaida	2005			sil16
<a href="#">more</a>	n.a. 2005	Mekauda mai vanoda maoradada	2005			sil16

Figure 5: Glottolog page for Icelandic, listing genealogy and sources.

# cld data model for structural data

THE WORLD ATLAS OF LANGUAGE STRUCTURES  
ONLINE



Home Features Chapters Languages References Authors

Family: Indo-European / Genus: Germanic

GlottoCode: icel247 ISO 639-3: ISL

## Language Icelandic

Showing 1 to 77 of 77 entries

Fid	Value	Feature	Source	Area
14A	Initial	Fixed Stress Locations	Árnasonar 1980	Phonology
15A	Fixed stress (no weight-sensitivity)	Weight-Sensitive Stress	Árnasonar 1980	Phonology
16A	No weight	Weight Factors in Weight-Sensitive Stress Systems	Árnasonar 1980	Phonology
17A	Trochaic	Rhythm Types	Árnasonar 1980	Phonology
23A	Dependent marking	Locus of Marking in the Clause	Kress 1982; Einarsson 1945	Morphology
24A	Dependent marking	Locus of Marking in Possessive Noun Phrases	Einarsson 1945; Kress 1982	Morphology
25A	Dependent-marking	Locus of Marking: Whole-language Typology	Kress 1982; Einarsson 1945	Morphology
25B	Non-zero marking	Zero Marking of A and P Arguments	Kress 1982; Einarsson 1945	Morphology
26A	Strongly suffixing	Prefixing vs. Suffixing in Inflectional Morphology	Einarsson 1945; passim; Þráinsson 1994; passim; Jonsson 1927; passim	Morphology
30A	Three	Number of Genders	Jonsson 1927	Nominal Categories
31A	Sex-based	Sex-based and Non-sex-based Gender Systems	Jonsson 1927	Nominal Categories
32A	Semantic and formal	Systems of Gender Assignment	Jonsson 1927	Nominal Categories
33A	Plural suffix	Coding of Nominal Plurality	Jonsson 1927; 14-20	Nominal Categories
34A	All nouns, always obligatory	Occurrence of Nominal Plurality	Þráinsson 1994	Nominal Categories

Coordinates: WGS84 65°N, 17°W 65.00, -17.00

Spoken in: Iceland



### Alternative names

Ruhlen: Icelandic  
Ethnologue: Icelandic

### Sources

**Einarsson 1945**  
Icelandic: Grammar, Texts, Glossary  
**Einarsson 1949**  
Icelandic grammar, text, glossary  
[Info at Google Books](#)

**Glendening 1966**

Figure 6: WALS page for Icelandic, listing properties and sources.

## c11d data model for lexical data

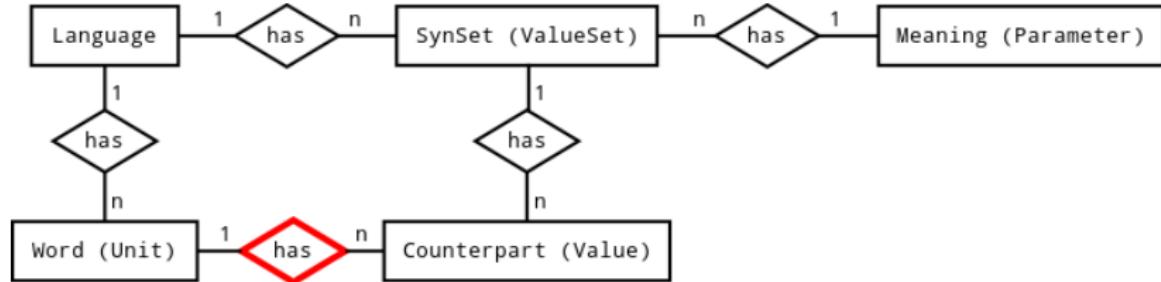


Figure 7: The WOLD instantiation of the data model.

- ▶ Additional relation in custom data model,
- ▶ lexical data model can be mapped to *lemon* (*Counterpart* maps to *LexicalSense*).

# cld data model for lexical data

## Meaning 1.1: the world

Description:

Typical context: The Amazon is the longest river in the world.

Semantic field: The physical world

Semantic category: Noun

Borrowed score 0: 0.40

Age score 0: 0.64

Simplicity score 0: 0.86

## Counterpart words in the World Loanword Database

Map List

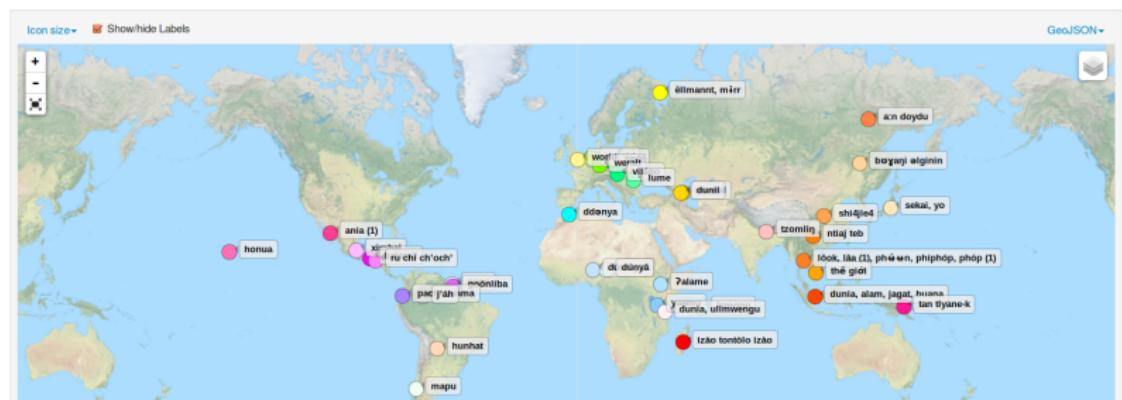


Figure 8: WOLD page for comparison meaning "World".

# cld data model for lexical data

The screenshot shows the Tsammalex website interface for the species "Lion".

**Header:** Tsammalex

**Breadcrumbs:** Home - Languages - Species

**Search Results:** Family: Felidae - Species: Panthera leo

**Content Area:**

- Lion:** A large image of two lions in a grassy enclosure.
- Information:** Source: own work, Date: 2008-10-05, Place: Zoo Leipzig, Germany, Author: Christfried Naumann, Permission: public domain, Comments: "Angola lion", P. l. angolensis = P. l. bleyenberghi?
- Lion:** A close-up image of a lion's head and mane.
- Information:** Source: own work, Date: 2008-10-05, Place: Zoo Leipzig, Germany, Author: Christfried Naumann, Permission: public domain.

**Names:** Shows a map of southern Africa with various names for "lion" in different languages. Labels include: xām (Xhosa), għu-njuhrikxō (Maltese), nħai, nħau, għu (ka), xar (Xhosa), nħai, ġie npur (Maltese), leeu (Afrikaans), Löwe (Deutsch), qā bēt għo (Hoan), nħaj (Hoan), tsónámē (Hoan), nħai (Jufhoansi), nħau (Jufhoansi), għiū (ka) (Jufhoansi), and oħlu-njuhrikxō (Urši).

**Table:** Shows 19 entries for the word "lion" across various languages. The table includes columns for Language, Word, and References.

Language	Word	References
Afrikaans	leeu	wikipedia
Deutsch	Löwe	
Hoan	qā bēt għo	
Hoan	nħaj	
Hoan	tsónámē	Berthold, Falko and Linda Gerlach 2011
Jufhoansi	nħai	
Jufhoansi	nħau	
Jufhoansi	għiū (ka)	
Jufhoansi	oħlu-njuhrikxō (Urši)	

Figure 9: Tsammalex page for species "Lion".

## CLLD and Linked Data

So, with this publication platform and lots of datasets at our hands, what to do?

- ▶ We regard Linked Data principles as rules of best practice for publishing data on the web.

## Linked Data – the first star

Publish data on the web with an open license!

- ▶ Most CLLD datasets are published under CC-BY licenses.
- ▶ Implies using HTTP URLs as names,
- ▶ which forces you to think about the things you want to describe and at which level of granularity,
- ▶ enables distributed development of data and the basis for merging via globally unique identifiers,
- ▶ puts coarse provenance information in each identifier.

# URLs as names – example

<http://wals.info/valuesets/62A-ice>

The screenshot shows a single datapoint on the WALS website. The URL is <http://wals.info/valuesets/62A-ice>. The page title is "Datapoint Icelandic / Action Nominal Constructions". It includes metadata: Language: Icelandic, Feature: Action Nominal Constructions by Maria Koptjevskaja-Tamm, and Value: Other. There are buttons for "cite" and "comment". A sidebar on the right shows "No comments have been posted." and a "History" section with the entry "2008-04-21 Other". Below the main title, there's a section for "Examples" with a sentence from the GIG-2671 corpus: "dráp íð veiðimannanna á birninum". The sentence is analyzed with parts of speech: dráp (verb), íð (adjective), veiðimannanna (noun), á (preposition), and birninum (noun). The analysis notes: kill.an (verb), def (adjective), hunter.det.gen.pi (noun), on (preposition), bear.def.dat.sg (noun). The full sentence translation is "'the killing of the bear by the hunters'".

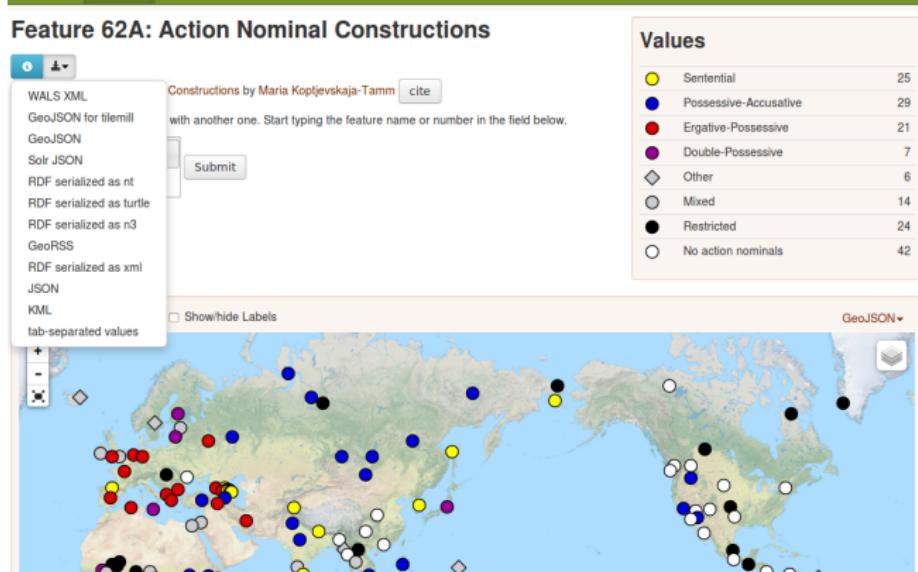
Figure 10: The level of granularity of the WALS data allows to link comments, history and examples to datapoints.

## Linked Data – 3-out-of-5 stars

Generally, the usefulness of “3-out-of-5 stars” Linked Data has to be stressed:

- ▶ Linked Data as uniform data access API (following the “crawler” paradigm)
- ▶ enables distributed databases,
- ▶ allows follow-your-nose API discovery (cf. REST),
- ▶ plays well with the web at large (Internet archive, bookmarking, google, etc.),
- ▶ allows easy hosting (thus helps with sustainability, and is attractive for developers/administrators as well) – which cannot be said about SPARQL endpoints.

# Machine readable data – example



**Figure 11:** The data of a WALS feature can be serialized in various formats. As soon as specifications for JSON-LD and GeoJSON-LD stabilize, these will be added. Note that the map on the page is created by calling the WALS API to retrieve the GeoJSON representation.

## Linked Data as API and storage format

Publishing Linked Data can be as easy as putting a bunch of files on a web server.

- ▶ clld apps will be able to fall back to that, i.e.
  - ▶ dumping the resources they serve as static files
  - ▶ by enumerating their URL space.
- ▶ This allows for a graceful degradation of service:
  - ▶ When served from the app, resources will point to a canonical URI using the appropriate HTTP Link header.
  - ▶ These URIs will still resolve in the static-files-on-webserver scenario.
  - ▶ So when served as static files from a plain HTTP server, most things will still work – at least as far as non-human user agents are concerned; googlebot does not care too much about content types.

## Linked Data – the 4th star

That being said, for common domains RDF models are useful, e.g. to describe provenance and links between resources.

- ▶ All CLLD datasets have editors (are)edited.
- ▶ VoID is used to convey basic provenance and license information.
- ▶ Typically all statements of linguistic interest (i.e. value assignments) are linked to sources.

## Linked Data – the 4th star

- ▶ Our publication platform does spit out RDF.
- ▶ The RDF model for a particular cld app can be completely customized.
- ▶ But should it?
- ▶ Balance between
  - ▶ uniform access across CLLD apps and
  - ▶ semantic interoperability with existing infrastructure.
  - ▶ Is it more useful to model resources as having multiple types or provide mappings?
- ▶ Example: Model lexical data using *lemon*?
- ▶ Generally, in terms of user-friendliness, the problem is not a choice of RDF models but csv, Newick, ...

## Linked Data – the 5th star

Linking with other resources . . .

- ▶ Glottolog as hub in the CLLD LOD cloud:
  - ▶ language catalog (linking in turn to lexvo, dbpedia, etc.), iso639-3 is often not sufficient.
  - ▶ shared bibliography
- ▶ WOLD as catalog for comparison meanings (cf Leipzig-Jakarta list) – a *concepticon*, or an *ontology*.
- ▶ PHOIBLE may play such a role for phonological segments, e.g. as reference for transcriptions.

## Linked Data – the 5th star

... and vocabularies

- ▶ we stick with rather generic or focused vocabularies by default: dcterms, skos, foaf;
- ▶ and aim at semantic interoperability by default only for stable interpretations across apps: bibliographical data, provenance data, metadata: VoID, bibo, ...
- ▶ Creation of a CLLD ontology might be warranted – but this may be putting the cart before the horse.

# Glottolog – linking languages to descriptions

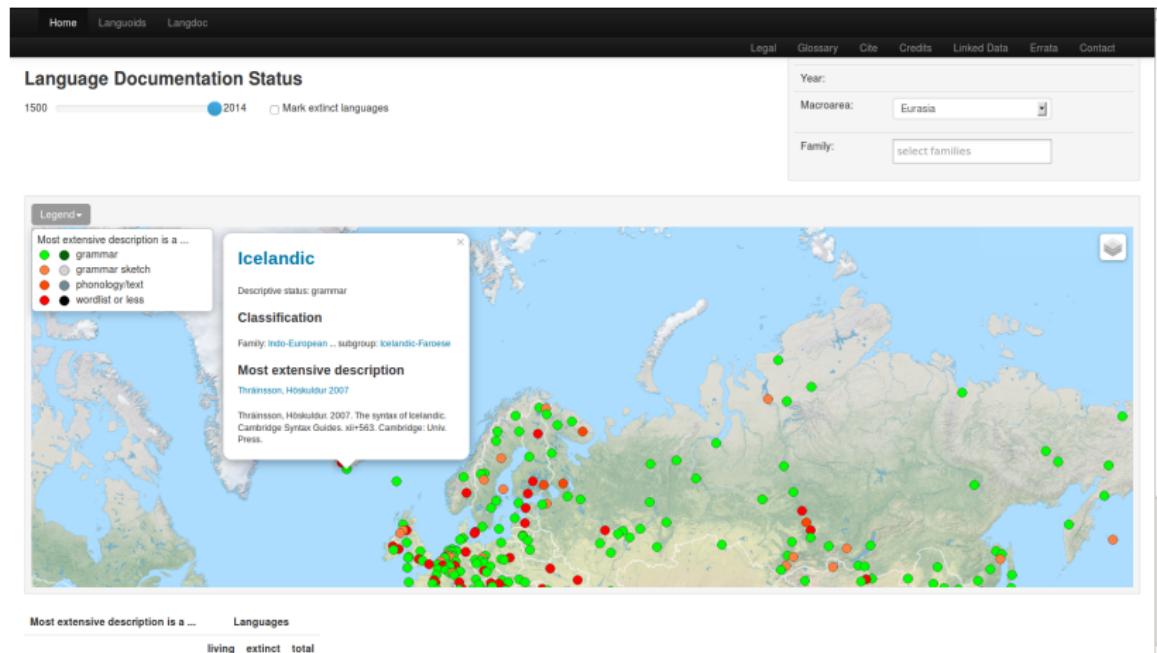


Figure 12: Glottolog description status browser – the LRE map for language descriptions.

## Use cases – revisited

How does CLLD help with our use cases and how does Linked Data benefit cross-linguistic research?

- ▶ Clearly all use cases will benefit from more and better data, e.g.
  - ▶ constructing language phylogenies with a time-depth of more than a couple thousands of years is thought to be more accurate with structural than with lexical data,
  - ▶ the WALS language–feature matrix is still pretty sparse.
- ▶ Many of the listed datasets have been available in some digital form before, being able to access them in a unified way could help grow a unified toolset.

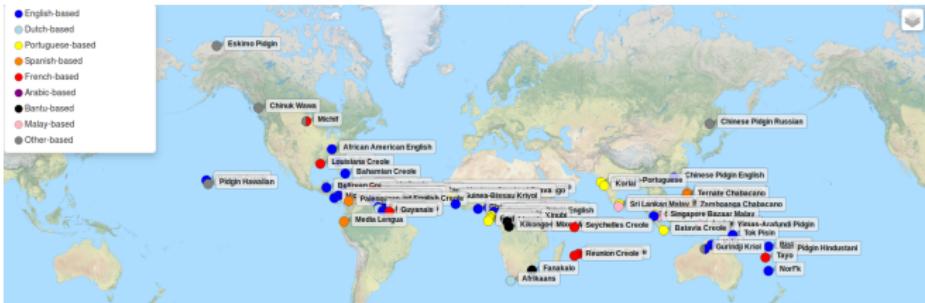
## A workflow for research based on CLLD data

1. Identify suitable datasets.
  2. Aggregate the data in a triple store (crawling/importing dumps).
  3. Filter data in the triple store (using provenance information, etc.).
  4. Export data to suitable format for analysis.
- CLLD and Linked Data will mainly play a role during aggregation of raw data.

## Semantic interoperability I

- ▶ Being able to evaluate provenance data during the aggregation of a dataset is useful (e.g. in the ASJP project, some sources of wordlists are regarded as less trustworthy than others).
- ▶ Unambiguous identification of languages is required; Glottolog will help with that.
  - ▶ Being able to answer the question “which data do we have on a selected sample of languages?” as well as
  - ▶ “what sample of languages can we investigate given we need a certain selection of data (lexical, structural, etc.)?”
- ▶ For lexical data *lemon* can help to interpret the raw data, i.e. matching senses across languages (cf. Moran and Brümmer 2013).
- ▶ The requirements of statistical methods may lead to a standardisation of structural language parameters (features in the WALS sense), but we are not there yet.

# Language identification



The languages described in APiCS and eWAVE show that iso639-3 is insufficient for language identification.

## Semantic interoperability II

- ▶ Often cultures are identified with language codes, e.g. iso639-3; being able to link to anthropological data about these would be very valuable. Quoting from the WALS chapter on *Hand and Arm*:

*Another potentially fruitful investigatory strategy would be to cross-tabulate values against the tailoring technologies of peoples who speak each of the 620 languages of the sample - an enormous research effort this author must leave to future investigators.*

## Semantic interoperability III – limits

- ▶ Generally, useful data formats will be dictated by the needs of the analysis tools (e.g. phylogenetic software),
- ▶ so doing analyses directly on the RDF model can not be expected.
- ▶ Computing language phylogenies: Construction of the dataset on which to base analyses is part of the intellectual research effort.
- ▶ Example APiCS: Interoperability of typological resources is hampered by the difficulty of cross-linguistic categories.

## Semantic interoperability – APiCS and WALS

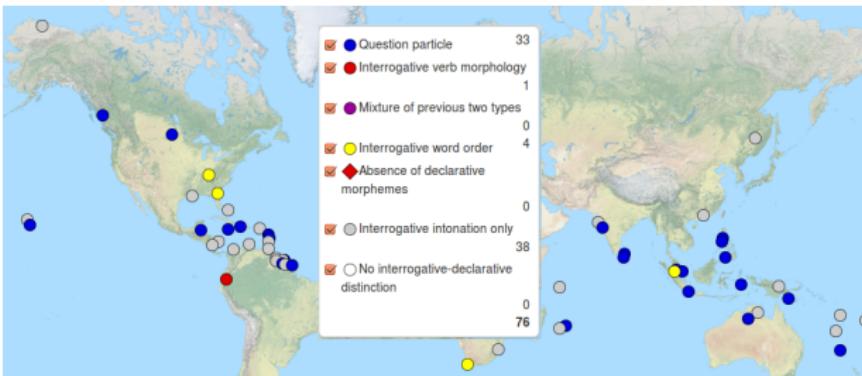
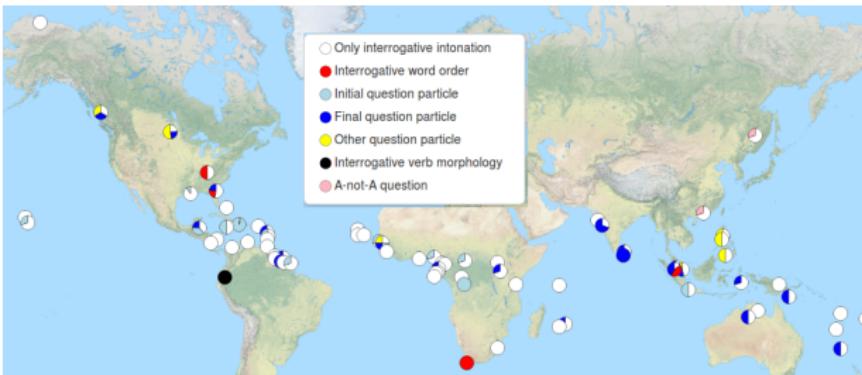


Figure 13: APiCS feature *Polar questions* – original and WALSified.

## Final remarks:

- ▶ If you are a linguist and have unpublished cross-linguistic datasets, get in touch!
- ▶ If you have a research question that might be possible to answer using the kind of data we have, get in touch!
- ▶ If you are a Linked Data specialist with ideas how to model cross-linguistic data in RDF, let us know!

<http://clld.org>

Thank you!