

Micro-theories of Specialized Knowledge Representation

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Introduction

- Frame-based Terminology: cognitive approach to Terminology
 - Lexical Grammar Model (Martín-Mingorance, Faber & Mairal)
 - Frame Semantics (Fillmore)
 - Situated Cognition (Barsalou)

Context and meaning





EcoLexicon (ecolexicon.ugr.es)

- Hosted in a relational database
- Linked to a frame-based ontology
 - ***Frame***
 - representation integrating semantic generalizations about one category or a group of categories
 - ***Template***
 - representational pattern for individual members of the same category



Conceptual information

- ThinkMap conceptual networks
- Closed inventory of conceptual relations
- Images: stored images and access to Google Images
- Natural language definitions



Term information

- Grammatical category
- Term type
- Term variants
- Multilingual correspondences
- Access to corpus concordances and phraseological module

Lithosphere



Lithosphere

Search



Contextual domains

No domain

Spanish



Definition

lithosphere: hard, rocky outer layer of the Earth, consisting of the crust and the solid outermost layer of the upper mantle. It extends to a depth of about 100 km.

Terms

- lithosphere
- litosfera
- Lithosphäre
- λιτосφeρα
- lithosphère
- λιθόσφαιρα

Term information

Term: lithosphere
Language: en
Term type: main term
Part of speech: common noun

Resources

- Earth Layers
- Mineral Resources
- Lithosphere
- Litosfera oceánica
- Capas de la Tierra

Resource information

Title: Capas de la Tierra

Image:



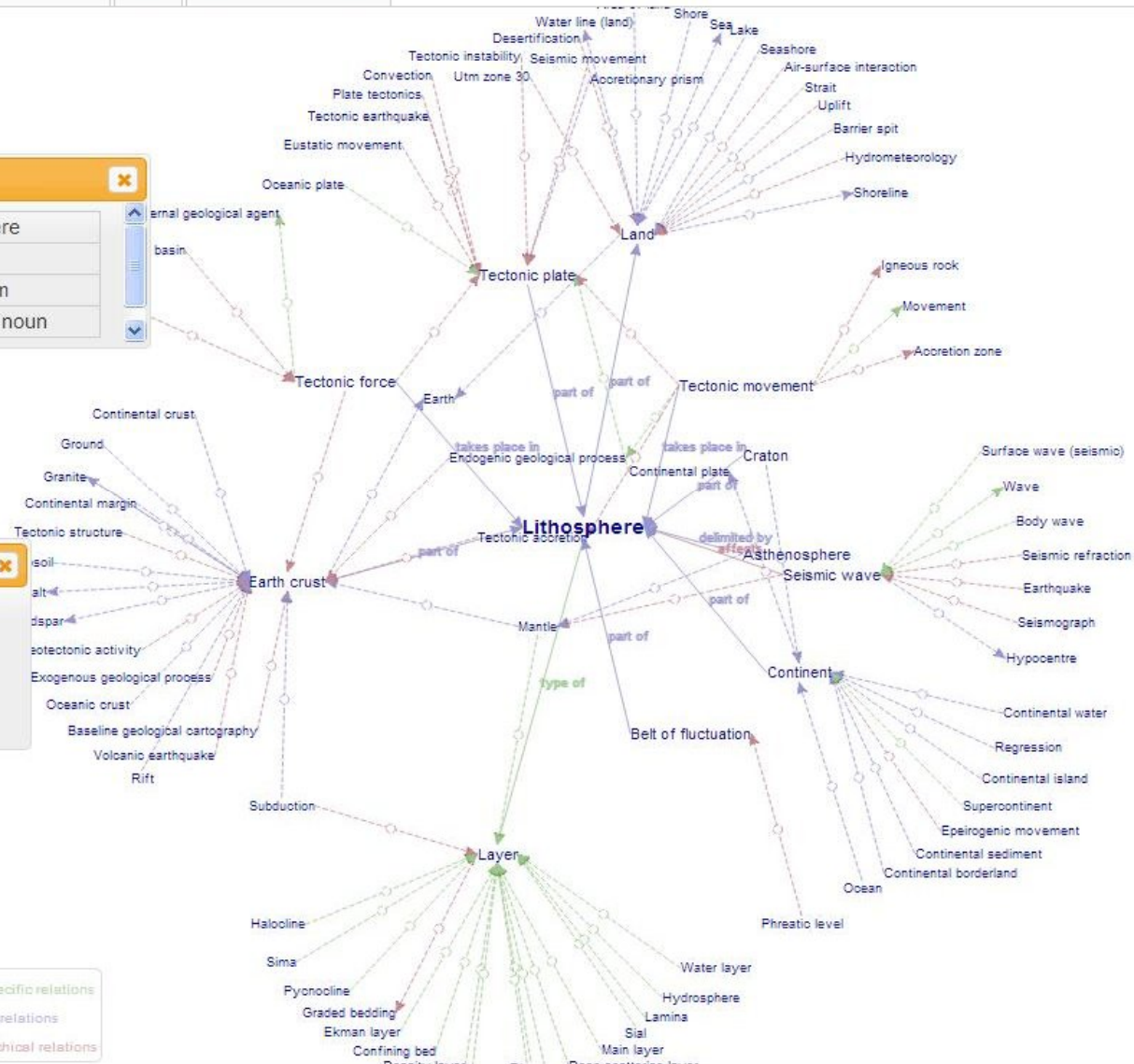
Conceptual categories

C.1.1.6.1 Part of geographic feature

Categories hierarchy

Phraseology

- Generic-specific relations
- Part-whole relations
- Non-hierarchical relations



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Contextual domains

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▼ Definition

Lithosphere: hard, rocky outer layer of the Earth, consisting of the crust and the solid outermost layer of the upper mantle. It extends to a depth of about 100 km.

▼ Terms

lithosphere

litosfera

Lithosphäre

литосфера

lithosphère

λιθόσφαιρα

► Resources

► Conceptual categories

► Phraseology

[History](#)[Search results](#)[Path](#)[Search concordances](#)[||](#)Term: [Search concordances](#)

...phere, to make the materials that are essential to the existence of life. The other spheres are the **lithosphere**, the outer part of the earth; the atmosphere, the whole mass of air surrounding the earth; and the ...

... various paths leading to the formation of lakes and rivers. These flowing waters interact with the **lithosphere** (the outer part of the earth's crust) to dissolve chemicals as they flow to the...

...ture Distribution in the Mantle **lithosphere** 122 The **lithosphere** 122 ... Evolution 308 Were Mantle Plu...

... tectonic, crustal, and magmatic history (Fig. 1.1). For instance, only planets that recycle **lithosphere** into the mantle by subduction, as the Earth does, appear capable of generating continental crust an...

...an only be produced in a plate tectonic regime. In contrast, planets that cool by mantle plumes and **lithosphere** delamination, as perhaps Venus does today, should have widespread mafic magmas with little felsic t...

...s in thickness from about 3 km at some oceanic ridges to about 70 km in collisional orogens. 2. The **lithosphere** (50-300 km thick...

...which reacts to many stresses as a brittle solid. The asthenosphere, extending from the base of the **lithosphere** to the 660-km discontinuity, is by comparison a weak layer that readily deforms by creep. A region ...

...e upper mantle extends from the Moho to the 660-km discontinuity and includes the lower part of the **lithosphere** and the upper part of the asthenosphere. The region from the 410-km to the 660-km discontinuity is ...

... with anomalously low seismic-velocity gradients: the **lithosphere** and the D layer just above the core (Fig. 1.2). These layers coincide with steep temperature ...

...lay an important role in the cooling of the Earth. Most cooling (>90%) occurs by 4 Earth Systems **lithosphere** ASTHENOSPHERE MESOSPHERE Upper Lower Mantle Mantle LVZ Vp VS TL TW Vs 660-km discontinuity 410-km d...

...p thermal gradients in this layer may generate mantle plumes, many of which rise to the base of the **lithosphere**, thus bringing heat to the surface (<10% of the total Earth cooling). Considerable uncertainty e...

...des a mechanism for the Earth to cool. Two major premises of plate tectonics are as follows: 1. The **lithosphere** behaves as a strong, rigid substance resting on a weaker asthenosphere. 2. The ...

... behaves as a strong, rigid substance resting on a weaker **lithosphere** is broken into numerous segments or plates that are in motion with



lithosphere

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Contextual domains

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Definition

Lithosphere: hard, rocky outer layer of the Earth, consisting of the crust and the solid outermost layer of the upper mantle. It extends to a depth of about 100 km.

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Phraseology

History

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Search concordances

||



Term: lithosphere

Search concordances

... reside. Compounds of hydrogen, oxygen, carbon, nitrogen, potassium, and sulfur are cycled among the four major spheres, one of which is the biosphere, to make the materials that are essential to the existence of life. The other spheres are the **lithosphere**, the outer part of the earth; the atmosphere, the whole mass of air surrounding the earth; and the hydrosphere, the aqueous vapor of the atmosphere, sometimes defined as including the earth's bodies of water. The Water Cycle The most critical of...

...phere, to make the materials that are essential to the existence of **lithosphere**, the outer part of the earth; the atmosphere, the whole mass of air surrounding the earth; and the ...

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... thermal gradients in this layer may generate mantle plumes ... thus bringing heat to the surface (<10% of the total Earth cooling)



Micro-theories

- ☐ **Semantic micro-theory**
- ☐ **Syntactic micro-theory**
- ☐ **Pragmatic micro-theory**



- Information in term entries
- Definition formulation and semantic relations
- Multidimensionality
- Term behavior in different types of context



Semantic micro-theory: internal representation-1

- **Definitions**

- Linguistic description of the properties of a concept
- Representation of relations with other concepts
- Information sources
 - Other specialized knowledge resources
 - Corpus of specialized texts
- Format
 - Generic term + differentiating features



Semantic micro-theory: internal representation-2

WEATHERING	
decomposition	Generic term
of rocks, minerals, and soils at or below the Earth's surface	Differentiating features referring to <i>affected</i> entities and <i>location</i>
by the action of atmospheric agents, temperature changes, chemical reactions, and living organisms	Differentiating features referring to <i>agency</i>



Semantic micro-theory: internal representation-3

DECOMPOSITION	
weathering	Decomposition of rocks, minerals, and soils at or below the Earth's surface by the action of atmospheric agents, chemical reactions, and living beings
mechanical weathering	Weathering involving the breakdown of rocks and minerals by mechanical forces, caused by the action of atmospheric agents.
frost wedge	Mechanical weathering in which water freezes in a crack and exerts force on the rock causing it to further rupture.



Semantic micro-theory: internal representation-4

WEATHERING	
[Environmental Science]	<i>Decomposition</i> of rocks, minerals, and soils at or below the Earth's surface by the action of atmospheric agents, chemical reactions, and living beings.
[Architecture]	Slight <i>inclination</i> given to horizontal surfaces, especially in masonry to prevent water from lodging on them
[Construction]	<i>Process</i> of simulating wear and tear on a model



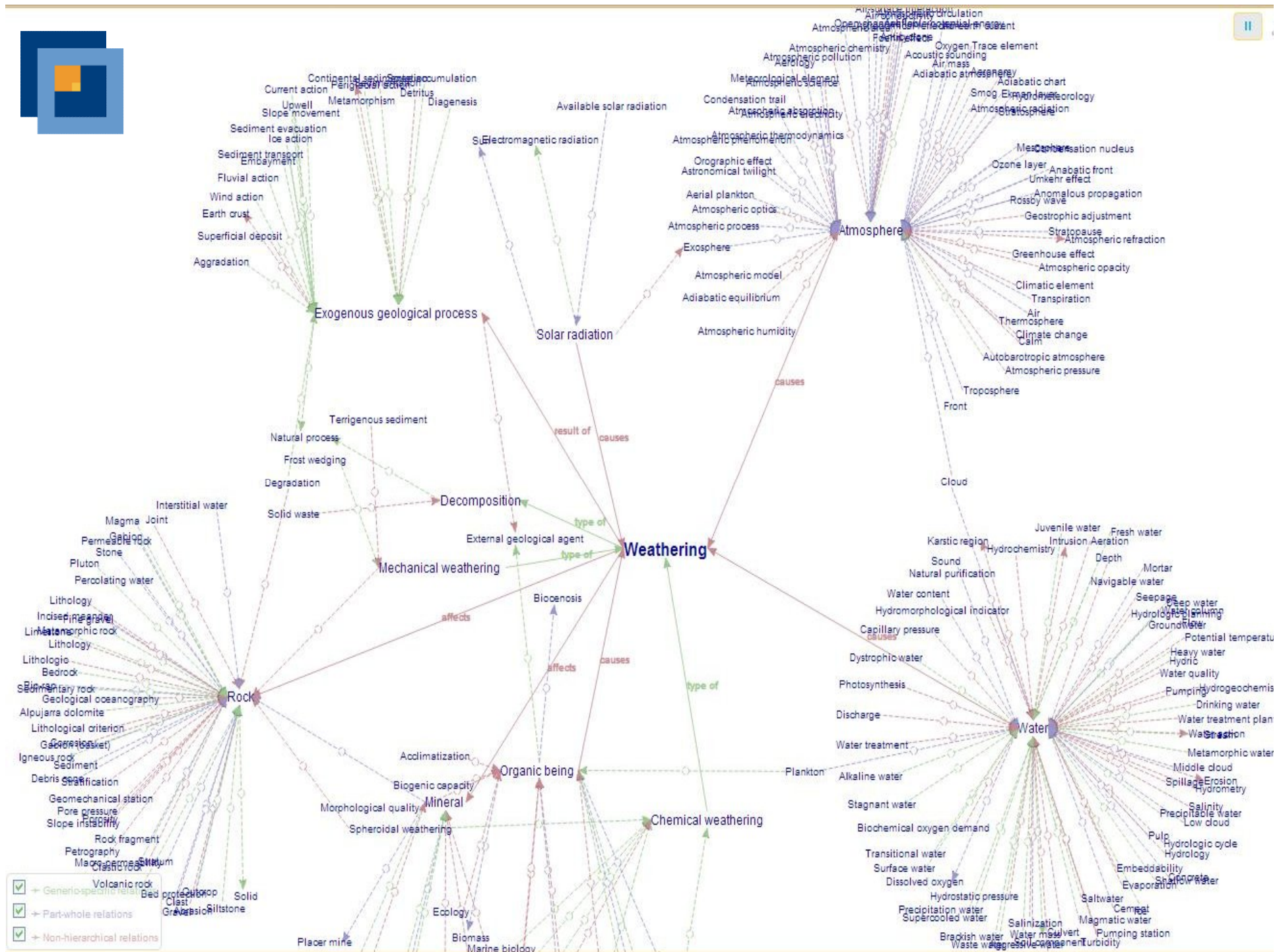
Semantic micro-theory: external representation

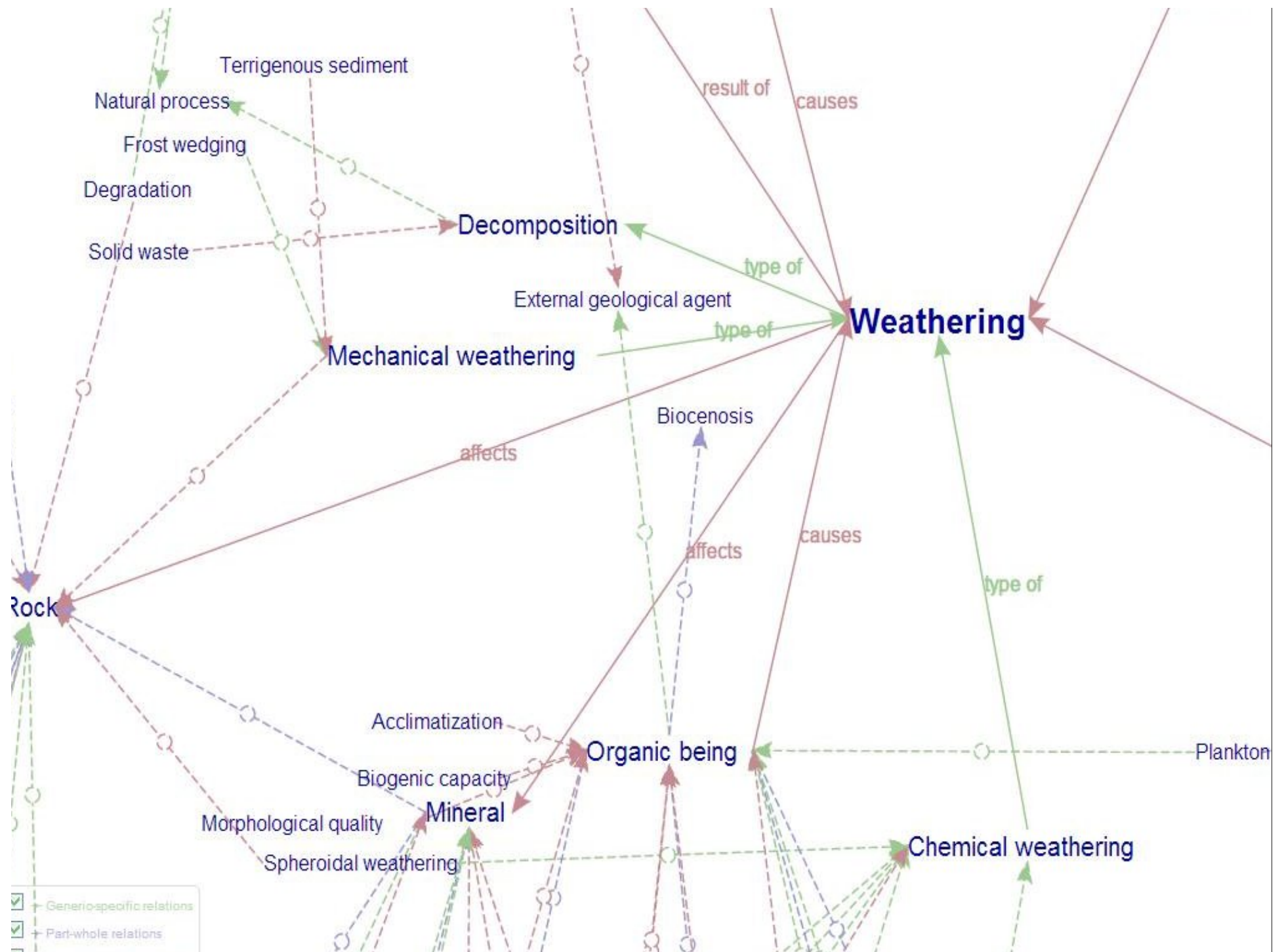
- Relations between concepts
- Linguistically-based ontology based on corpus data and definitional structure
- **Top-level concepts:**
 - **Object** (geographic landforms, water bodies, constructions, etc.)
 - **Process** (weathering, erosion, deposition, etc.)
 - **Attribute** (terrestrial, atmospheric, etc.)
 - **Relation** (*type_of, part_of, effected_by, affected, located_at*, etc.)



Semantic micro-theory: external representation

WEATHERING	
<i>Type_of</i>	decomposition
<i>Affects</i>	rocks, minerals, and soils [THEME]
<i>Location_of</i>	at or below the Earth's surface [LOCATION]
<i>Caused_by</i>	atmospheric agents (wind, water, solar radiation, temperature changes), chemical reactions, and living organisms [AGENT]





Search



Contextual
domains

No domain



Spanish



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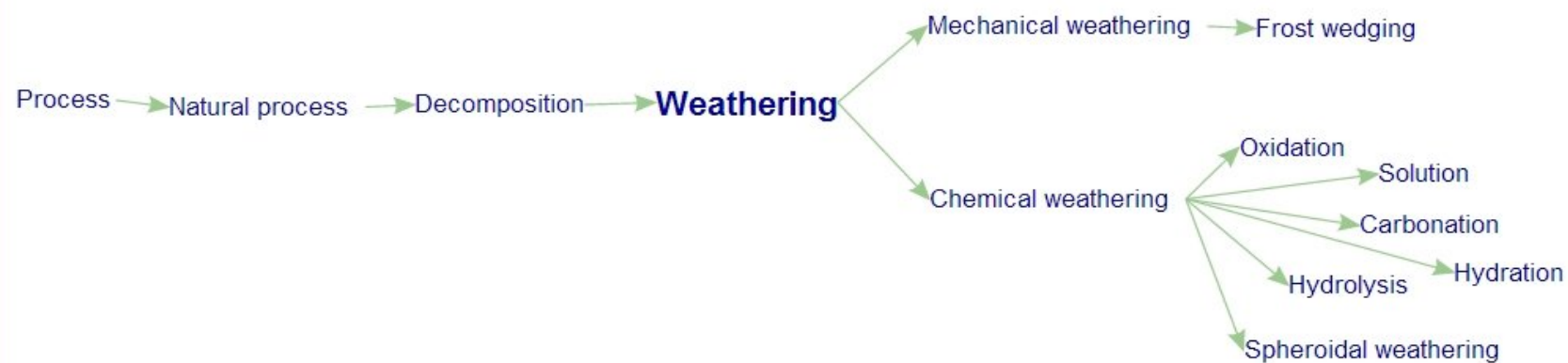
History

Search results

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Search concordances



- ☒ → Generic-specific relations
- ☒ → Part-whole relations
- ☒ → Non-hierarchical relations



Syntactic micro-theory: term internal

- **Interpretation of multi-word terminological units**
 - Slot-filling mechanism: modifier inserted into a slot in the head-noun schema
 - Schema corresponds to the underspecified meaning of head
- Ex. *Energy* <agent-of>
 - wave energy, wind energy, solar energy, etc.
- Ex. *Sediment* <location-of>
 - intertidal zone sediment, streambed sediment, aquifer sediment, etc.



Syntactic microtheory: term external

- Recurrent structural patterns in which the term or terminological phraseme participates
- “Semantic” syntax: codification of predicate-argument structure





Valency

- Predicates (e.g. verbs) open slots that are filled by other lexical units.
- Valence of a predicate depends on its meaning since arguments are the participants which are required for the activity or state described.



Verbs in Terminology



- Important role: position in a lexical domain and degree of semantic specificity of a verb in direct relation to its number and type of arguments
- Arguments are terms that transform the meaning of the verb, depending on the context of activation.



Dissipate

DISSIPATE (x)agent (y)theme

- 1.to break up and drive off (as a crowd)
 - 2.to cause to spread thin or scatter and gradually vanish
 - 3.to lose (as heat or electricity) irrecoverably
 - 4.to spend or use up wastefully or foolishly
- (Merriam-Webster)*



Dissipate (general language)

- to cause to spread thin or scatter and gradually vanish
 - TEMPERATURE (e.g. *warmth, heat*)
 - METEOROLOGICAL PHENOMENA (e.g. *storm, fog, mist*)
 - VISUAL/OLFACTORY PERCEPTION (e.g. *mirage, smell*)
 - EMOTIONS/FEELINGS (e.g. *fear, anxiety*)
- to spend or use up wastefully or foolishly
 - VALUABLE POSSESSIONS (e.g. *wealth, resources*)



Dissipate (specialized language)

Concordances	Pred-arg structure
ENERGY (<i>energy</i>)	
The wave <i>energy</i> has been dissipated by wave <i>breaking</i> and <i>bottom friction</i> .	DISSIPATE (wave breaking & bottom friction) _{agent} (energy) _{theme}
Part of the <i>energy</i> is dissipated by <i>breaking processes</i> .	DISSIPATE (breaking processes) _{agent} (energy) _{theme}
X is the fraction of <i>energy</i> dissipated by the <i>falling sand grains</i> .	DISSIPATE (falling sand grains) _{agent} (energy) _{theme}
Part of the wave <i>energy</i> is dissipated by the <i>uprushing water body</i>	DISSIPATE (uprushing water body) _{agent} (energy) _{theme}



Dissipate (specialized language)

Concordances	Pred-arg structure
METEOROLOGICAL PHENOMENON (e.g. <i>cyclone</i> , <i>hurricane</i> , <i>tornado</i>)	
Only if the <i>tropical cyclone</i> dissipates with just a tropical disturbance remaining with...	DISSIPATE (\emptyset) _{agent} (<i>tropical cyclone</i>) _{theme}
<i>Hurricanes</i> dissipate when their energy supply is substantially reduced	DISSIPATE (\emptyset) _{agent} (<i>hurricane</i>) _{theme}
Even though the <i>tornado</i> is dissipating , the tornado is still capable of causing damage.	DISSIPATE (\emptyset) _{agent} (<i>tornado</i>) _{theme}



Remodeled definition

The meaning of *dissipate* is changed by the dissipated entity (*energy*) and dissipating agent (*friction, breaking, falling, uprushing*)



Specialized definition

To cause (energy) to be lost through its conversion to heat.

Definition

hurricane: tropical cyclone with sustained winds of 118 km per hour or greater in the North Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and in the eastern North Pacific Ocean, and which is called a typhoon in the western Pacific and a cyclone in the Indian Ocean.

Terms

- hurricane
- huracán
- Hurikan
- Tropensturm
- υπαραν
- ouragan
- τυφώνας
- τροπικός κυκλώνας

Resources

Conceptual categories

Phraseology

drown2
spawn
originate
evolve
originate from

Term information

Term: hurricane
Language: en
Term type: main term
Part of speech: common noun

ACTION

to_come_against_sth_with_sudden_force batter blast3 hit strike

CHANGE

to_cause_to_change_for_the_worse affect damage demolish destroy devastate injure ravage sweep away wreck

EXISTENCE

to_begin_to_exist blow up burst2 develop evolve form originate start2

to_begin_to_exist_becoming_sth_else develop into evolve into

View phraseology

Phraseology

Lexical domain ACTION

Frame to_come_against_sth_with_sudden_force

Frame definition NATURAL FORCE comes against PATIENT with sudden force, affecting it negatively.

Verbs hit batter strike blast3

Lexical domain CHANGE

Frame to_cause_to_change_for_the_worse

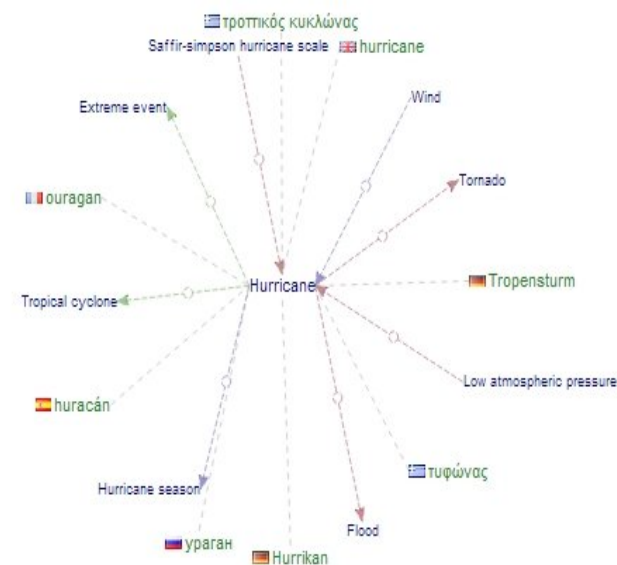
Frame definition NATURAL DISASTER causes a PATIENT to change for the worse.

Verbs affect damage demolish destroy devastate injure sweep away wreck ravage

Lexical domain EXISTENCE

Frame to_begin_to_exist_becoming_sth_else

Phraseology





Pragmatic Micro-theory

- Terms as pointers to larger situational, linguistic, and cultural contexts
 - User-based parameters: geographic, temporal or social
 - Usage-based parameters: field, tenor, and channel
 - Interlinguistic parameters
 - Cognitive parameters



Variational complexity

Pier: structure built on posts extending from land out over water, used as a landing place for ships, an entertainment area, or a strolling place

- Pier = *jetty* (Great Lakes)
- *Jetty* = structure that prevents shoaling (except in BrE, where it is synonymous with *wharf*)
- Pier = *Dock* (AmE)
- *Dock* (BrE) = area of water used for loading or unloading cargo (= *port* (AmE))

Conceptual modeling: PLEASURE_PIER, LOADING_PIER, ANTI-SHOALING_PIER



Domain-specific pragmatic contexts

- Description of specialized entities constrained by contextual variation across disciplines, cultures, communicative situations
- Recontextualization makes representation more meaningful

Geography

alluvial fan Search Contextual domains 2.1 Geography Spanish

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alluvial fan

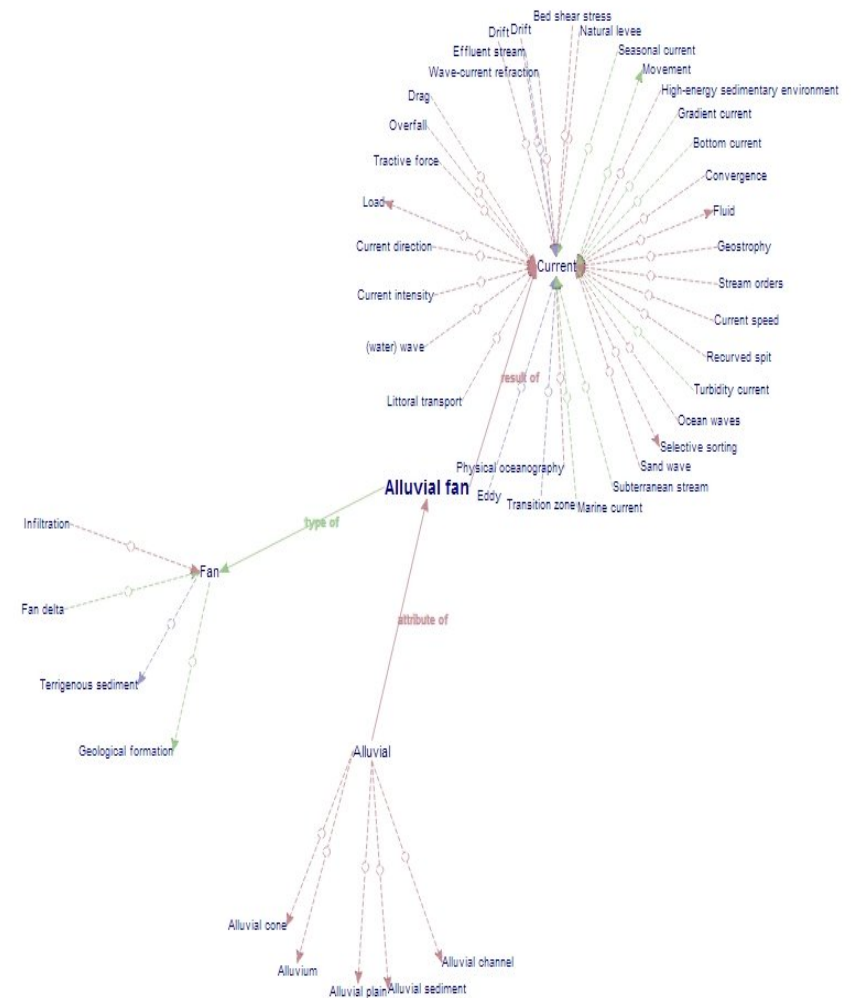


Geology

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alluvial fan





Single Information Space in Europe (SISE)

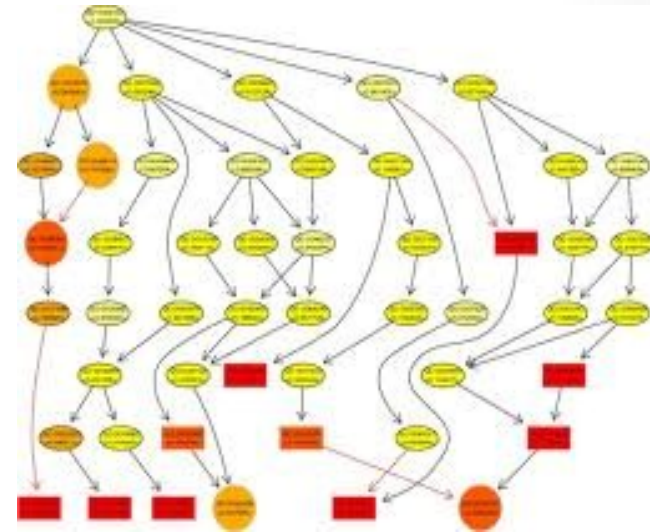
- **Barriers:**
 - Multilingualism
 - Multi-culturalism
- **Priorities:**
 - Controlled vocabularies
 - Thesauri
 - Ontologies
 - Semantic Web technologies





Ontology localization

- Process of adapting an ontology to a certain language, cultural or geo-political community
- Need of a context-sensitive representation framework
 - Translation relations
 - Degrees of equivalence





Multilingual knowledge representation-1

- Knowledge more complex than thesaurus-like structure
- Ontologies with *rdf:labels* are not really multilingual





Multilingual knowledge representation-2

- Need to adapt conceptualizations
- Inclusion of terminological and linguistic information in the description of classes and properties (e.g. *lemon*)





Multilingual environmental term bases

- General Multilingual Environmental Thesaurus (GEMET)

<http://www.eionet.europa.eu/gemet/>

- AgroVoc

<http://aims.fao.org/standards/agrovoc>

- EcoLexicon

<http://ecolexicon.ugr.es>



Problems

- **GEMET**

- Definitions extracted from other sources and do not reflect conceptual hierarchy
- Semantic relations based on SKOS, and do not distinguish between generic-specific and part-whole relations.

- **AgroVoc**

- Its conceptual representations reflect a certain degree of monolingual and multilingual incoherence



Contamination?

- **GEMET**

- *pollution* = broader term for *contamination*

- **AGROVOC**

- *pollution* = broader term for *contamination*
- *pollution* = synonym of *environmental contamination, pollution of agriculture, immision*

Definition

Contamination: presence of a substance in the environment that because of its chemical composition or quantity prevents the functioning of natural processes and produces undesirable environmental and health effects.

Terms

contamination

contaminación

Kontamination

Umweltverschmutzung

загрязнение

ρύπανση

μόλυνση

Resources

Conceptual categories

Phraseology

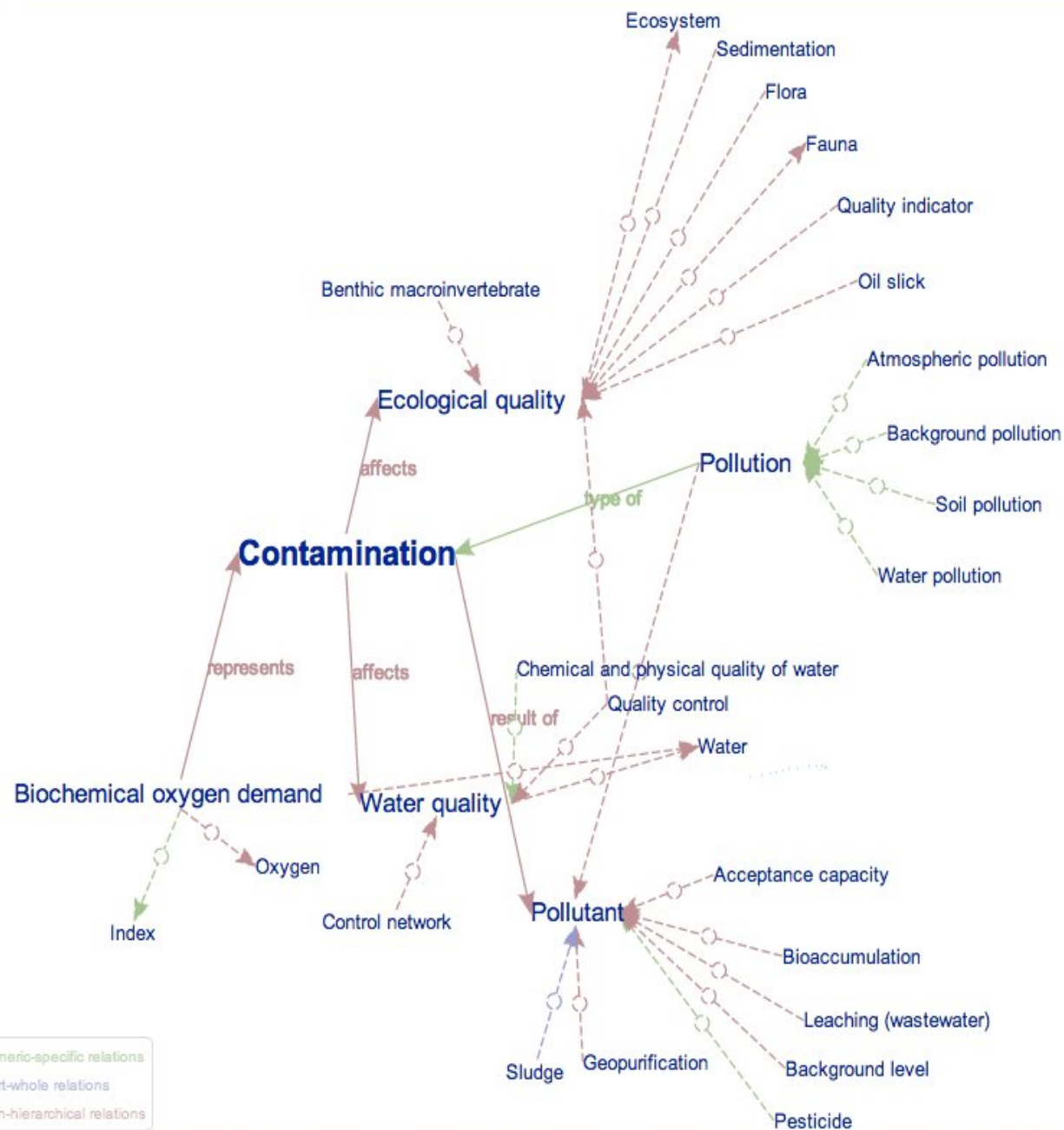
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Cross-lingual problems-1

- **The entity exists in both cultures BUT:**
 - The term for it in one of the languages is more general/specific.
Ex. contamination/contaminación vs. pollution/polución
 - Only one of the languages has a term for it.
Ex. boule in the domain of Solar Energy



Cross-lingual problems-2

- **The entity exists in both cultures BUT:**
 - The terms in each language highlight different facets of the object.
Ex. wind turbine/aerogenerador
 - The entity is more extensively lexicalized in one culture than the other.
Ex. turbine blades/álabe, pala, aspa



Cross-lingual problems-3

- **The entity exists in both cultures BUT:**
 - Its role is different in each culture.
Ex. transmission towers/hydro towers.
 - A term from one culture has been recycled to refer to a different concept in the other.
Ex. playa (Eng.) = dry lake/salar
 - The term in one culture only refers to part of the object and thus may be ambiguous.
Ex. groyne/escollera.



Cross-lingual problems-4

- **The entity only exists in one of the cultures AND:**

- Its name has been adopted in the other culture to refer only to the foreign, culture-specific object.

Ex. billabong, dambo, muskeg

- The entity is totally unknown in the other culture without any designation.

Ex. pejerrey



Solutions: expanded classification of translation types

- Types corresponding to SKOS categories
 - Canonical translation
 - Generic \leftrightarrow Specific translation
 - Extensional translation



New translation categories-1

- Communicative translation (user-related or discipline-related registers)
- Functional translation (deculturalization of original term)
- Cultural translation (adaptation of term to target culture)



New translation categories-2

- Descriptive translation (specification of certain semantic features, depending on user context and needs).
- Non-translation (the term is not translated and the same form is used in both languages).
- Metonymic translation (adaptation of term to target culture) (translation of part as holistic concept).



Expansion of SKOS

- For SISE to be a reality, linguistic and cultural barriers need to be overcome.
- Ontology localization contemplating the multicultural variation in environmental terms
- Need for expanded classification of translation correspondences



Conclusion

- **Semantic micro-theory:** based on internal and external representations
- **Syntactic micro-theory:** domain events mapped as the interaction between predicate meaning and the semantic features of the prototypical arguments.
- **Pragmatic micro-theory:** parametrization of different types situational, linguistic, and cultural contexts

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