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Authors

Reid, Genevieve
Sieber, Renee

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Comparing Geospatial Ontologies with Indigenous Conceptualizations of Time

Geneviève Reid¹, Renee Sieber¹

¹McGill University, Department of Geography, Burnside Hall Building, Room 705, 805 Sherbrook Street West,
Montreal, Quebec H3A 0B9
Email: genevieve.reid@mail.mcgill.ca
renee.sieber@mcgill.ca

Abstract

The geographic domain has widely been studied in ontology research. However, integrating the conceptualization of time and temporal referencing of geographic concepts in data models is a complex task that has by no means been “solved”. Existing geospatial ontologies have adopted a space-time model that, for example, distinguishes *endurant* entities (lasting through time, e.g., fixed natural features) from *perdurant* entities (e.g., processes or events). Such a model might exclude indigenous conceptualizations of time that are far more sophisticated. We find that conventional ontologies make assumptions about time that fail to take into consideration indigenous notions including: 1. Time is not linear; 2. Nothing is completely fixed in time; 3. Time has agency; and 4. Time is not temporal but social.

1. Time and Geospatial Ontologies

In GIScience, indigenous conceptualizations of space and time have been depicted as being in direct opposition to those used to design geospatial technologies (Rundstrom 1995; Veland *et al.* 2014). Indeed, geospatial technologies emphasize a more static view of the world that is often inconsistent with indigenous perspectives on space and time. Compared with geographic features, notions of time have received less attention both in geospatial ontologies and in indigenous ontologies research. Time and temporal referencing of geographic concepts are nonetheless challenging to geospatial ontologies applied in indigenous contexts. Including indigenous conceptualizations in geospatial ontologies and in the Geospatial Semantic Web is crucial. Wellen and Sieber (2013) argue that developing an inclusive semantic interoperability is not only possible, but also critical to ensure future accessibility of geospatial technologies for indigenous communities, and minimize loss and misinterpretation of information when geospatial ontologies are used to record indigenous knowledge.

1.1 Endurant/Perdurant Model

An important contribution to the conceptualization of time in geospatial ontology development, was the distinction between *endurant* objects that endure through time and *perdurant* objects that happen in a certain time (e.g., processes or events) (Agarwal 2005). Grenon and Smith (2004) propose a spatio-temporal ontology of change and processes called SNAP/SPAN based on the duality *endurant/perdurant*.

The SNAP/SPAN model distinguishes *endurant* entities, which have spatial properties, from *perdurant* entities, which have temporal properties. Temporal intervals and instants describe *perdurant* entities through linear time. Even though the SNAP/SPAN distinction is widely adopted in geospatial ontologies (Agarwal 2005), philosophical assumptions about time behind this model can fundamentally differ from indigenous conceptualizations.

2. Indigenous Concepts of Time

2.1 Time is not linear

Indigenous conceptions of time can be more complex than a linear passage of time from the past, to the present, and towards the future. Time could be viewed as a spiral, a branch, a triangle, or a cycle. Figure 1 shows these different representations that time could take.

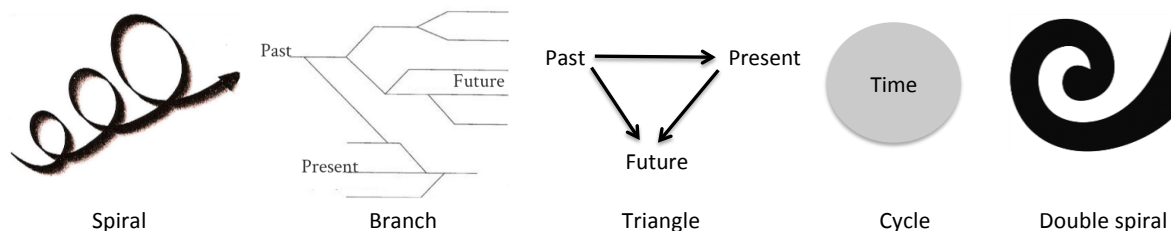


Figure 1: What is time?

In many Native American cultures, the conceptualization of cyclical time predominates (Fixico 2003). Time, as a cycle and as a circle, does not ‘go’ anywhere. Rather than following a direction, time is conceived as circular processes, including the diurnal, solar, lunar, and seasonal cycles. Events and activities are understood as part of these daily, seasonal, and annual cycles. Our research sees that Eastern Cree hunting practices are tied to the notion of cycles: cycles of returning animals, cycles of resting the land to restore animals’ habitat, and cycles of seasons affecting the animals’ behaviors and movements across the land (Berkes 2012; Preston 2002). Indigenous conceptualizations of cyclic and seasonal time are complex; many cycles are interwoven together (e.g., life cycles of plants or animals indicates life stages in other species) and linked to language and spiritual notions (e.g., cause and effects of changes) (Lantz and Turner 2003).

In the Māori tradition in New Zealand, the concept of time is represented in the Koru symbol of the double spiral where “each circumambulation of the spiral incorporates the past into both the present and the future and, in doing so, reconstitutes both” (Murton 2011: 82). In the Lake Titicaca area of South America, Aymara language and culture has a unique conception of time. Contrary to most conceptions, in Aymara, the past – which is known – is conceived in front of people, where it is visible; whereas the unknown future is in the back (Núñez and Sweetser 2006).

A triangle conceptualization of time emphasizes the direct relationship between past and future. The importance of that connection is often expressed by the Eastern Cree of Wemindji in Northern Quebec. When talking about future aspirations, people often directly make a connection to the past without any references to the present, as voiced by a participant: “[In the future] I want Wemindji to look like it was in the past” (Elder woman, Focus group, Wemindji 2013).

A structure with multiple branches emerging from the past to the present and branching off again towards the future represents the multiplicities of stories in the past and multiple alternate scenarios for the future. This branching time structure is an unsolved issue in computerized data models (Ott and Swiaczny 2001). To date, geospatial ontologies are ill equipped to deal with the branching time model or with other non-linear conceptualization of time such as the cycle, spiral or triangle (multidirectional) time structures.

2.2 Nothing is “endurant” or completely fixed in time

In indigenous contexts, temporally fixing elements of landscape as endurants might be problematic. Scholars have found that Australian indigenous storytelling processes about places proved the categorization of features as endurant through time to be inadequate

(Veland *et al.* 2014). For example, placenames—rather than being fixed—represent ephemeral expressions emerging through a narrative process (*ibid.*).

Creation stories are part of many indigenous cultures (McGregor 2004). These stories about how everything came to be on Earth provide an understanding of the existence of geographic features. For example, the Eastern Cree have a story of the Wolverine that was sprayed in the eyes by the Big Skunk, and walked all the way to the coast to wash up. This creation story explains how the water in the bay became salty and rivers and lakes inland remained fresh water (Preston 2002: 159-163). Other legend stories from our ongoing research in Wemindji explain how natural features, such as mountains, hills, lakes, and rivers, were formed (stories audio recorded in the community in 1984 by Luke Shashaweskum). For example, part of a longer story explains that a hill was formed and got its shape when a Giant dropped his cooking pail while being pursued and killed by a Shaman (Ronnie Georgekish, Tallyman VC22, Interview, April 23, 2016).

2.3 Time has agency

Anthropologists have widely studied the notion of agency and natural features (e.g., Cruikshank 2010; Hallowell 2002). They describe how indigenous ontologies often conceptualize the land itself and the elements constituting the land (geographic entities such as mountains, rivers, islands, trees; natural phenomena such as wind, thunder; sun, moon; animals and other spirits present on the land) as living beings, filled with spiritual powers and can all be considered as ‘persons’. Even though the notion of agency for time has been less explored, it represents nonetheless an important challenge to geospatial ontologies.

The Runa communities of Ecuador hold a notion of a ‘living future’ (Kohn 2013). Events, activities and practices of everyday life are interlinked and influenced by a future that manifests itself through relationships among humans, animals, nature, and more-than-human beings (Kohn 2013). For the Eastern Cree, the notion of a ‘living past’ is often expressed. For example, a young Cree woman activist explained in a TV interview that, for Cree people, each step one takes forward is supported by a thousand ancestors (Maitée Labrecque-Saganash in Radio Canada 2016). People in Wemindji often mention how spirits of ancestors are part of the land and guide the hunters. Furthermore, Wemindji’s Wellness & Culture Department staff often refers to the Cree Nation of Wemindji’s slogan: “A Community Where Tradition Lives On” (www.wemindji.ca). The notions of a ‘living past’ and a ‘living future’ emphasize the roles of time in actually influencing and affecting events, activities, behaviors, and relationships for humans, animals, nature, and more-than-human beings.

2.4 Time is not temporal but social

Space-time data models conceptualize *perdurant* entities (processes) as they unfold through a temporal interval (Grenon and Smith 2004). These ‘time-based’ time intervals can be problematic when the concept of time is not perceived as independent from events and objects.

Sinha *et al.* (2011) show that in Amondawa culture and language the concept ‘time’ as an abstract domain independent of the events that occur ‘in time’ does not exist. For Amondawa people, time is not based on countable units but based upon the interplay between ecological facts in the natural environment and social structures (*ibid.*). The social structure of time is based on the rhythms of working activities and the stages of life. Instead of indicating the passage of time with nominal age of people, Amondawa people change their proper names to indicate the transition in stage of life, the kinship and the role in the family or in the community. Amondawa time intervals are event-based and social, rather than ‘time-based’.

3. Conclusion

Excluding indigenous conceptualizations from geospatial ontologies and from the Geospatial Semantic Web puts indigenous communities at greater risk than they already are of losing their knowledge or having it stripped of significance (Wellen and Sieber 2013). Rather than being exclusionary, developments towards semantic interoperability can be (and ought to be) inclusive (ibid.). However, conventional geospatial ontologies fail to take into consideration indigenous conceptualizations of time. Further research should allow the integration of indigenous notions such as 1. Time is not linear; 2. Nothing is completely fixed in time; 3. Time has agency; and 4. Time is not temporal but social.

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