



## A case study on the use of event bushes as a formal representation for Computer Supported Collaborative Work in the GeoSciences

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It is almost impossible nowadays to imagine a scientist working in isolation, as would a stereotyped character of a nineteenth-century novel do. On the contrary, researchers work together, group in communities, share information and also collaboratively develop theories or demolish them.

Whatever be the method of collaborative work: a face-to-face meeting, an email exchange or more advanced tools of e-communication, it is very helpful to have a map of what is in the heads of the partners.

This is the way to describe (or sometimes create) the common space, in which they move, to make this motion tractable and navigable.

The kind, level and details of formalization of the representation of this space is determined, first of all, by the Nature itself, i.e. the properties of addressed phenomenon or environment (Pshenichny and Kanzheleva, in press). Still, the formalization is also strongly dependent on the personal preferences and backgrounds of involved researchers. Living in different paradigms (Kuhn 1962, Lakatos 1970) they far from always can easily understand each other and therefore have difficulties in building a shared conceptual space.

However, even if by different courses, they all do navigate in the same space characterized by such information objects as those geo-scientists are used to observe. For instance, regardless of scientific school, genetic and other concepts followed, any geomorphologist looking at a river basin would recognize the pieces of information (visual, textual, whatever) that express water flows, river beds, islands and deltas, solid rock material being eroded/denudated/washed out/removed and so on and so forth. This intellectual space filled with those objects, even though defined and understood in diverse ways, does create a shared “geography” which needs to be projected on a map.

This map, not forcing the traveller to one specific route (Suchman 1987), but allowing multiple concurrent journeys, can become the place where a collaborative work can take place.

A specific class of well-structured network-shaped graphic conceptualizations that has proved to be efficient in mapping of models of reasoning is the event bush (Pshenichny et al., 2009). It formalizes a domain of knowledge through relations of cause and effect. The variety of these relations is handled by a set of specific conjunctions, like in logic. Importantly, these cause-effect relations are just postulated as observed or imagined facts, but not elucidated – e.g., “if something explodes, it falls into fragments”, without an explanation.

Application of event bushes as a formal representation for mapping collaborative work was already envisaged by Diviacco & Pshenichny (2009). We propose here a practical web-based implementation in which the eruptive behaviour of Mt. Etna is modeled by means of the event bush.

Retrospective analysis of these events shows that they were likely caused by the very same sets of premises and starting conditions as “normal” eruptions, yet combined in an unexpected, and probably unique, way (Behncke & Pshenichny 2009).

Importantly, the event bushes constructed for different eruptions from similar source all fall within one general bush (which can be modified by some rules if something happens that it fails to express). The bushes corresponding to particular eruptions can be understood (i) *a posteriori*, as data supporting the knowledge (the general bush), and *a priori*, as (ii) standpoints of experts on future course of events provided they all agree on the general knowledge, and (iii) points to address by a collaborative work to find stronger evidence for some scenarios, especially in the parts that occur in several particular bushes.

Hazard scenarios can be not only imagined but also quantified by means of applying a Bayesian Belief Network to the bush. The weights of this Bayesian network need to be discussed collaboratively by all partners based, again, on particular bushes and the data collected by an event-bush-based collaborative work.

The event bush model draws the map of the collaborative space. Every node of the bush/map may refer and be

referred to by various pieces of information (files, documents, images, videos) regarding a specific entity. This data space may be shared via the web by a group of researchers working on this specific issue so that all of them can access the same information in the same way. The work of each researcher is made public to the others via the messaging facility of the portal so that the team can converge on the weights to assign to each node so that eventually a hazard estimation can be derived.

References:

Boris Behncke, Cyril A. Pshenichny, Modeling unusual eruptive behavior of Mt. Etna, Italy, by means of event bush, *Journal of Volcanology and Geothermal Research*, Volume 185, Issue 3, 20 August 2009, Pages 157-171, ISSN 0377-0273, DOI: 10.1016/j.jvolgeores.2009.04.020

Diviacco, P., and Pshenichny, C.A., 2010. Concept-referenced spaces in Computer-supported Collaborative Work. European Geosciences Union (EGU) 5th General Assembly, Vienna (Austria), April 2010, *Geophysical Research Abstracts*, Vol. 12, EGU2010-6258.

Kuhn, T.S. (1962) 'The Structure of Scientific Revolutions', University of Chicago Press, 1962.

Lakatos, I. (1970): 'Falsification and the Methodology of Scientific Research Programmes', in 'Criticism and the Growth of Knowledge', eds. Lakatos and Musgrave, Cambridge University Press, 1970

Pshenichny,C.A.et al. (2009) 'The event Bush as a Semantic-based Numerical Approach to Natural hazard Assessment (exemplified by Volcanology) 2009, *Computer and GeoSciences*, Vol 35, Issue 5, May 2009, Pages 1017-1034

Suchman, L. A. (1987) 'Plans and Situated Actions: The problem of human-Machine Communication', Cambridge Univ. Press