Spatio-Temporal Localization of Vague Spatio-Temporal Information : Natural hazards application

Mouna SNOUSSI

Laboratory of Informatics of Grenoble

mouna,.snoussi@imag.fr

In the field of Environment, it is frequent to find, in data sets describing spatial natural events, some localizations expressed through vague textual expressions, such as « nearby », « in the sector of», « towards », « north of », etc. It is the same with temporal localizations, when it comes to expressing the moment when events occur, their duration, or even the temporal relations between them: « around Christmas », « Before 1960s », « at the end of the XVIIIth century», etc. The presence of such expressions in the data sets makes them hard to be exploited or mapped. However, in order to analyze the spatio-temporal distribution of natural processes, it is important to have a visual rendering as precise as possible. Some previous works, are based on more quantitative methods or probabilistic (fuzzy logic ...) and considers the object to be located independently of the geographical context in which it operates. Yet, these approaches do not allow defining any spatio-temporal localization that takes into account their environmental context: topographic or meteorological context of the

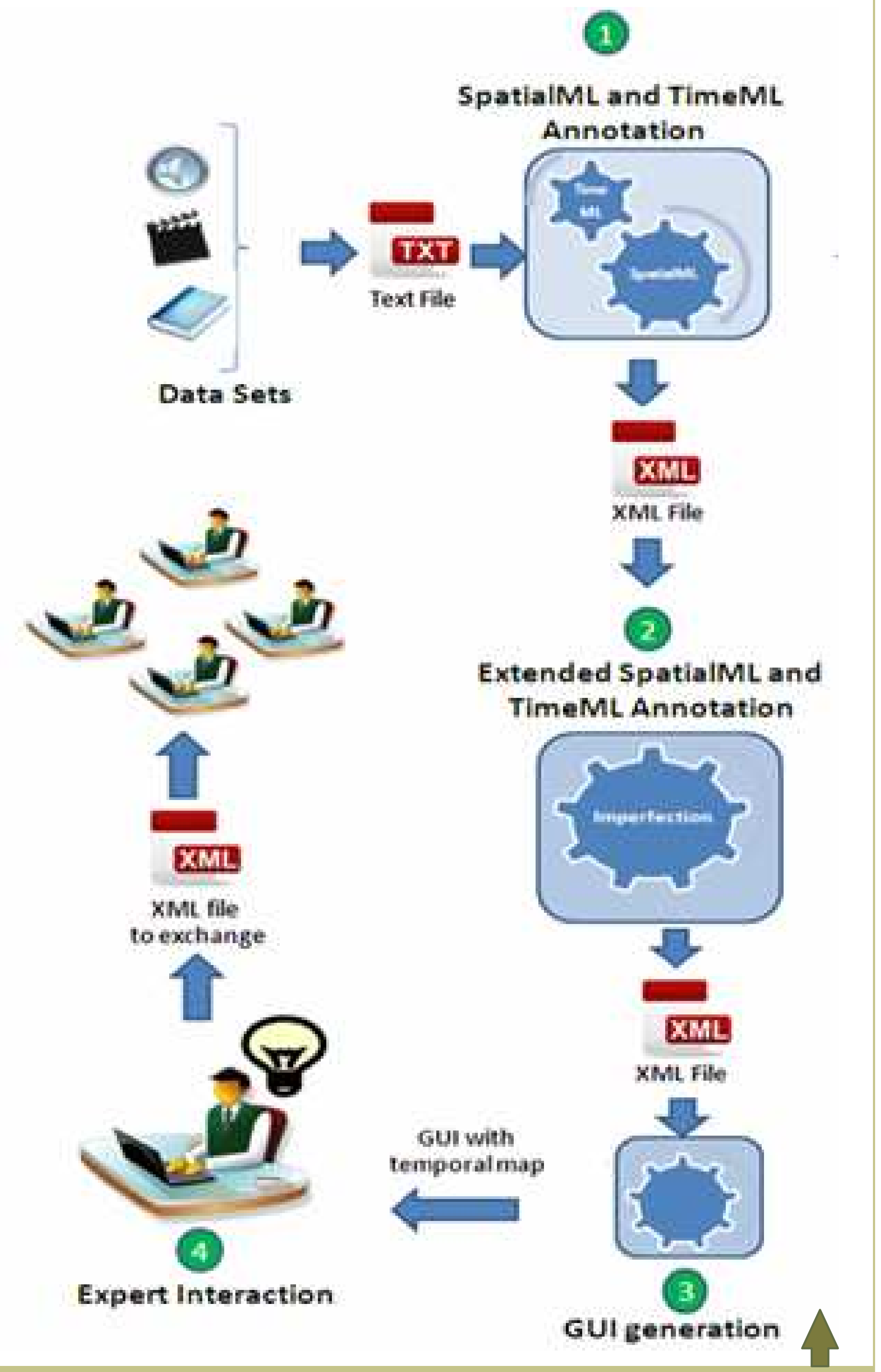

Fig. 1 Our approach

Abstract:

Natural hazards analysis uses data sets from different sources. The content of these data sets is mainly expressed using natural language describing where and when natural hazards events (eruption, avalanches, flood, etc.) took place. However, natural language contains a lot of vague expressions and especially those used to indicate places (around, near to, north of, etc.) and dates (between 1710 and 1711, at the beginning of the century, etc.). For a better exploitation and exchange of this kind of data sets, a spatial and temporal representation based on markup languages (SpatialML and TimeML) can offer a good interoperability and an easy share of such data. However, none of the existing markup languages handles the representation of imprecise and vague spatial/temporal information.

Addionaly, none of the existing GIS tools can handle the representation of this kind of data. For this purpose, firstly we propose to extend the SpatialML and TimeML mark-up languages to explicitly integrate the representation of imperfect spatio-temporal information. Secondly, we propose some graphical and cartographical components to improve the localization and the cartographic representation of vague spatio-temporal information.

studied ground, nature and characteristics of the observed phenomenon, etc. For this, we propose an approach (see fig. 1) that intends to improve the localization and the cartographic representation of vague spatio-temporal information. The spatio-temporal information expressed in natural language is represented in a semi-structured format relying on the SpatialML schema and TimeML schema (Step 1), that we have extended allowing the representation of the vagueness imperfection (step 2) (see fig. 2). With this extension graphic and cartographic components are associated whose goal is to display an initial localization zone of the spatio-temporal information qualified as vague (step 3). It is through these components (see fig. 3) used during step 4 that the expert can propose a re-localization aiming at reducing the initial set of possible localizations. A representation, in a curved graph of the Fuzzy Membership Function (MF) is proposed to the expert, so that she/he can select, by modifying the appearance of this latter, the values sub-set and their belonging degree. The same approach has been adapted to the example related to the vague temporal information. At the figure 3 at the bottom, we present an application example. In this examples, two categories of relations are identified: spatial relation based on direction and metric “50m north of” and temporal relation “before 1960”.

Before 1960, the lava flowed 50m north of the Piton de la Fournaise.

<SIGNAL> **before** </SIGNAL>
<TIMEX3 tid="t1" type="YEAR" Value="1960"> ***1960***</TIMEX3>
…
<PLACE id=1 type="PPLC" country="RE" form="NAM">Piton de la Fournaise</PLACE>
<SIGNAL id=2 type="DISTANCE">1 miles</SIGNAL>
<SIGNAL id=3 type="DIRECTION">north</SIGNAL>
<PLACE id=4/>
…
<IMPERFECTION id="5" Type= "VAGUENESS" tagType="PLACE" tagID="4" ImperfectionValues="" uncertaintyValuesDegrees= ""/>
<IMPERFECTION id="1" Type= "VAGUENESS" tagType="TIMEX3" tagID="t1" ImperfectionValues="" uncertaintyValuesDegrees=""/>

Fig. 2 Representation of vague spatio-temporal information using SpatialML and TimeML extension

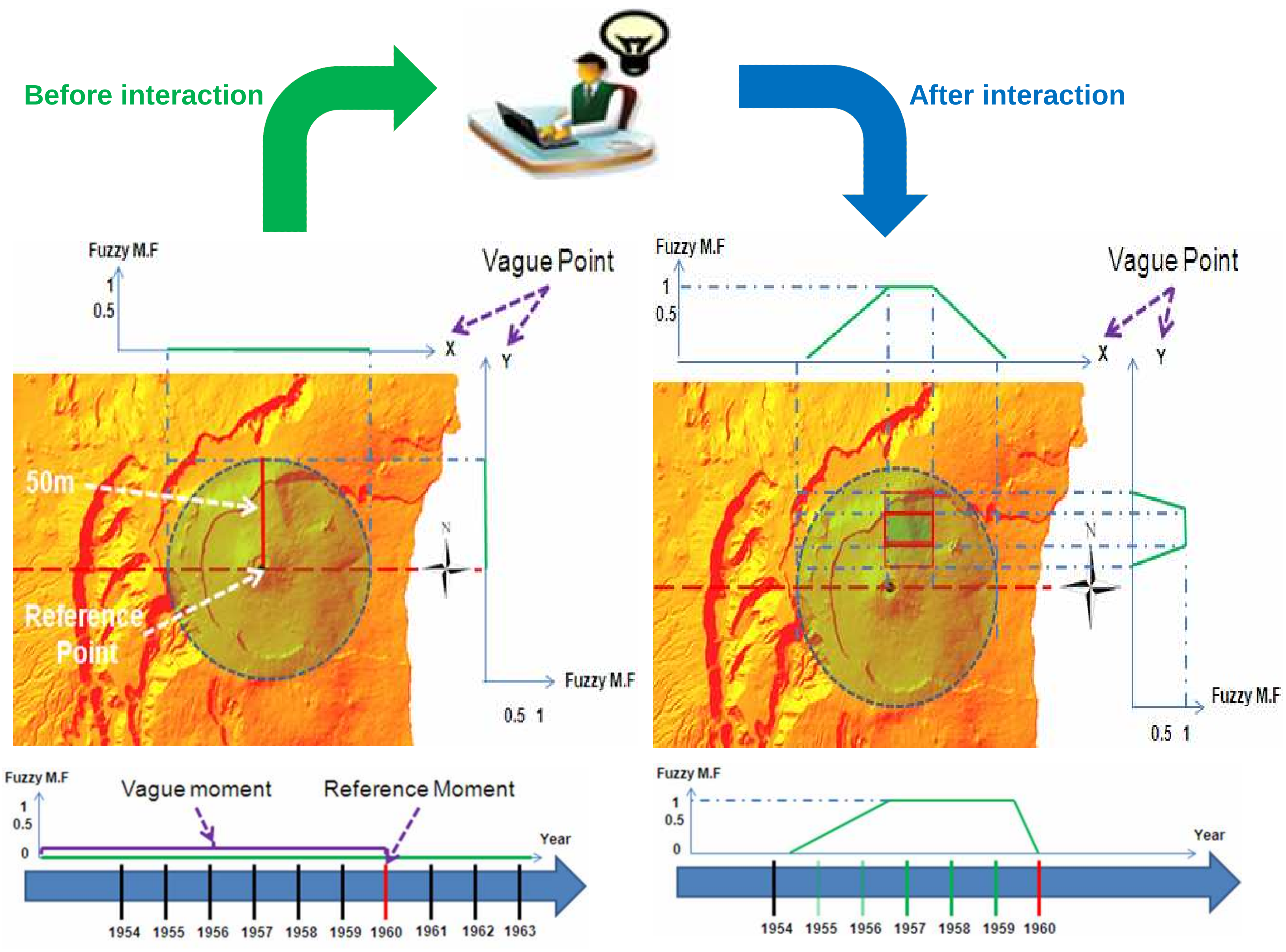

Fig. 3 Our graphic and cartographic representation of vague spatio-temporal information