

# Chapter 120

## Discovering Geosensor Data By Means of an Event Abstraction Layer

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### ABSTRACT

*Environmental monitoring is a critical process in areas potentially affected by natural disasters. Nowadays, the distributed processing of vast amounts of heterogeneous sensor data in real time is a challenging task. Event processing tools allow creating an event abstraction layer on top of sensor data. Users can define event patterns to filter in real-time the information they are interested in and avoid irrelevant data. Extreme events are usually related to other environmental occurrences, e.g. landslides are related (among others) to precipitations and earthquakes. To be able to determine whether an occurrence could potentially lead to an extreme event, domain knowledge is necessary. Ontologies are helpful for this task, since they are able to capture a representation of knowledge as a set of concepts and relations, within a specific domain. The research presented in this chapter aims at combining event-processing tools with semantic technologies to improve the discovery of environmental data.*

### INTRODUCTION

Traditional spatial information systems hold only a single state of the real world, usually the most recent in time for which the data were captured. However, geographic phenomena involve both static and dynamic information (Galton & Wor-

boys, 2005). Although GIS are moving towards spatiotemporal information systems, some applications call for an immediate switch from a static view of our environment to a dynamic-oriented focus, e.g. environmental change monitoring, transportation, health and epidemiology, or crisis management. Besides these classical application areas, the increased use of real-time, mobile and in-situ sensors is leading to new potential applica-

DOI: 10.4018/978-1-4666-2038-4.ch120

tions for spatiotemporal data models and systems (Galton & Worboys, 2005).

Modeling geographic phenomena requires a profound understanding about the processes or events related to the phenomena. Usually, these occurrences are strongly connected, so considering just isolated snapshots of the real world is not the best approach to understand what and why is happening. We can consider each measurement, each observation of the real world as an abstraction (snapshot) of some environmental feature (taken) at a specific moment. If we want to obtain information from the continuous data flows produced by sensors, we should provide meaning to relevant fragments (patterns) of observations and analyze where and when they appear.

Environmental monitoring is a critical process in areas usually affected by natural disasters. It is aimed to ensure public safety, to set up continuous information services and to provide input for spatial decision support systems (Resch, et al., 2009). Here, the main challenge is the distributed processing of vast amounts of heterogeneous sensor data in real-time. Most current approaches use web services based on the classic request/response model. Although partly using open GIS standards, they are often unsuitable for the integration of large volumes of data on-the-fly (Resch, et al., 2009). This integration can be performed via both pull-based models and push services that send out alerts, e.g. if a certain threshold is exceeded. Thus, it requires real-time processing capabilities, such as Event Stream Processing (ESP) or Complex Event Processing (CEP). Event processing has emerged as one of the most important issues in IT today (Chandy & Schulte, 2007). Event processing tools provide methods for reading, creating, transforming or abstracting events, e.g. CEP (Luckham, 2002). It is possible to use these tools to define patterns and detect relevant events in measurement data. CEP is also able to manage abstraction layers in real-time, which could lead us to improve information integration across different communities.

## **BACKGROUND**

In this section, existing event processing technologies and eventing standards are described. Previous research on integration of landslide information is presented, as well as some literature documenting threshold-based approaches for the initiation of landslides.

### **Event Processing**

In general, one can say that event processing is working with the IT representations of events. It involves actions like creating events and reacting to events but also reading, filtering, destroying, altering, receiving and sending of events (Chandy & Schulte, 2007). A common example for the use of event processing is graphical user interfaces. They listen to user inputs, generate according event representations, and initiate further actions.

### **Complex Event Processing**

CEP is a specialization of event processing. It deals with the processing of complex events (and not the complex processing of events) (Luckham, 2002). A complex event is an event that has relations to other events like “caused by.” For instance, a wild fire event might be caused by a dry weather period event in combination with a dropped burning cigarette event. The wild fire event is complex as it consists of sub events. These sub events may themselves be complex again like the dry weather period event but also simple like the dropped cigarette event.

CEP can be used to detect certain relations between events. In the example of the wild fire event one could try to identify the cigarette that was dropped to find the source of the fire. One can also use CEP to generate new information from sets of events. In this case, one could identify that during a dry weather period a cigarette was dropped resulting in a high risk for a wild fire. A common relation used in CEP is “caused by” but any useful relation may be used such as temporal

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