# Earthquake Early Warning : Tools for system assessment

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## Strategic Goals of Earthquake Early Warning System

Issue a fast, accurated warning message in a timely manner for an earthquake

## Key Elements of Earthquake Early Warning System

1. A monitoring system composed of various sensors
2. A real-time communication link that transmits data from the sensors to a computer
3. A processing facility that converts data to information
4. A system that issues and communicates the warning

## Critical Success Factors of Earthquake Early Warning Systems

| | |
|---|---|
| Good data | : High quality stations with robust operation |
| Just-in-time data | : Reduced telemetry delays |
| Good Algorithms | : Robust estimates of earthquake parameters |
| Good System | : Well organized procesing system for rapid alerts |

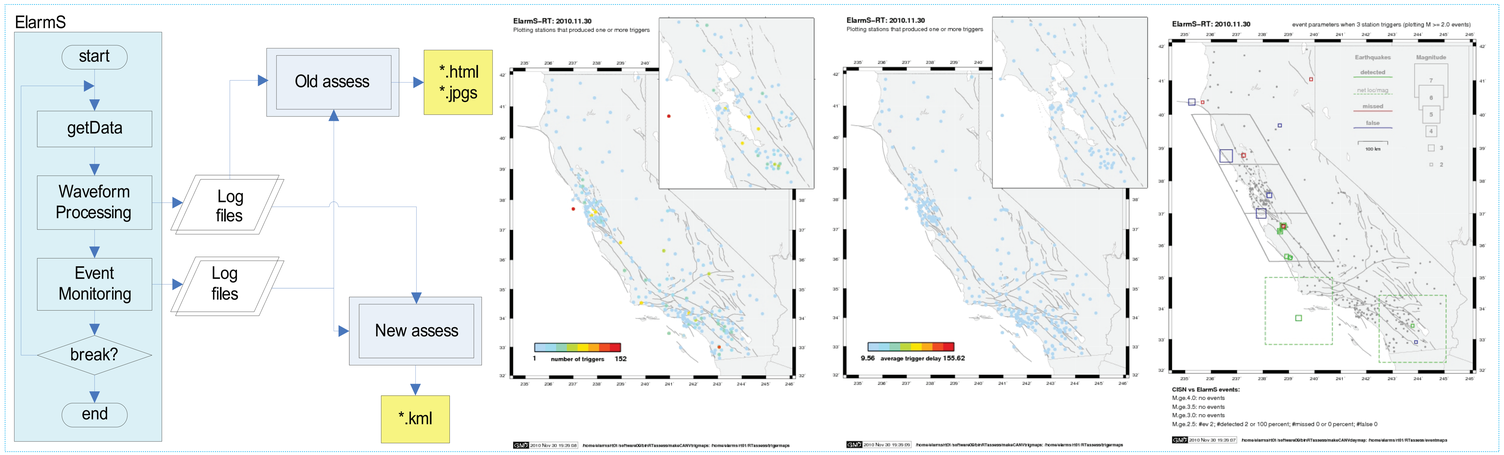
## Introduction

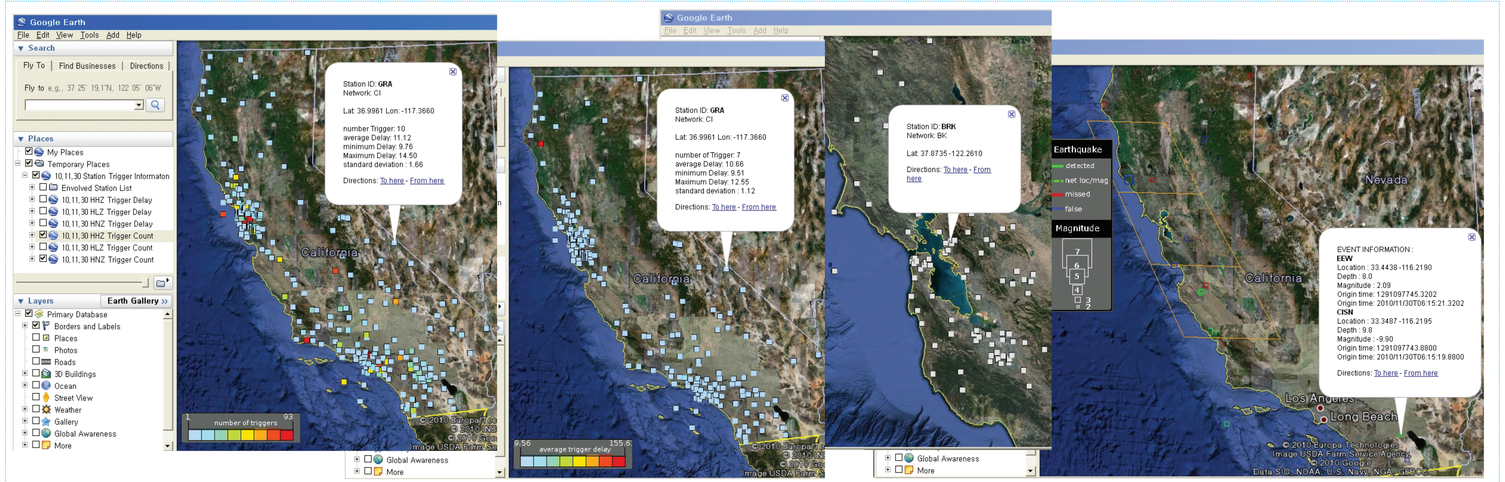
Successful earthquake early warning requires a fast, reliable network of seismic stations and a fast, accurate analysis algorithm to produce useful warnings in a timely manner. Developers and operators of earthquake early warning systems must constantly assess the health of their network and the performance of their algorithms. Hardware and telemetry of the seismic network are evaluated based on station latencies and the numbers of station P-wave triggers. Software and event processing performance can be analyzed by considering the number of successful event detections, of false alarms (alerts generated for nonexistent events), and of missed events (real events for which no alert was generated). Additional parameters for evaluation are the speed of delivery of the alerts and accuracy of magnitude, location and ground shaking estimates.

For rapid assessment of system performance, it is useful to provide automatically prepared summaries for review. We present new tools for viewing and assessing performance of the earthquake early warning system from data collection through telemetry to alert delivery in a graphical, intuitive format. The data is collected into a KMZ file for easy viewing in Google Earth.

## What is KML?

Keyhole Markup Language (KML) is an XML schema for expressing geographic annotation and visualization within Internet-based, two-dimensional maps and three-dimensional Earth browsers : such as Google Earth, Google Maps, and Google Maps for mobile.
The KML is an international standard maintained by the Open Geospatial Consortium, Inc. (OGC).
A KMZ file consists of a main KML file and zero or more supporting files that are packaged using a Zip utility into one unit.




## Conclusion

KML (Keyhole Markup Language) is a good solution for assessing the performance of not only EEW but also the other application.
Operator and developer can check the result interactvely and easily based on Google Earth with tiny network load(5K vs. 124K).
There are some limitations to KML, most notably some content cannot be displyed using Google Maps and Google Earth must be used instead.
Using these, we will continue to improve automatic procedures for CISN(California Integrated Seismic Network) ShakeAlert system.