Monitoring of Earthquake and Volcanic Hazards

The goal of earthquake prediction is to give warning of potentially damaging earthquakes early enough to allow appropriate response to the disaster, enabling people to minimize loss of life and property. A primary goal of earthquake research is to increase the reliability of earthquake probability estimates. Ultimately, scientists would like to be able to specify a high probability for a specific earthquake on a particular fault within a particular year. Scientists today estimate earthquake probabilities in two ways: by studying the history of large earthquakes in a specific area and the rate at which strain accumulates in the rock.
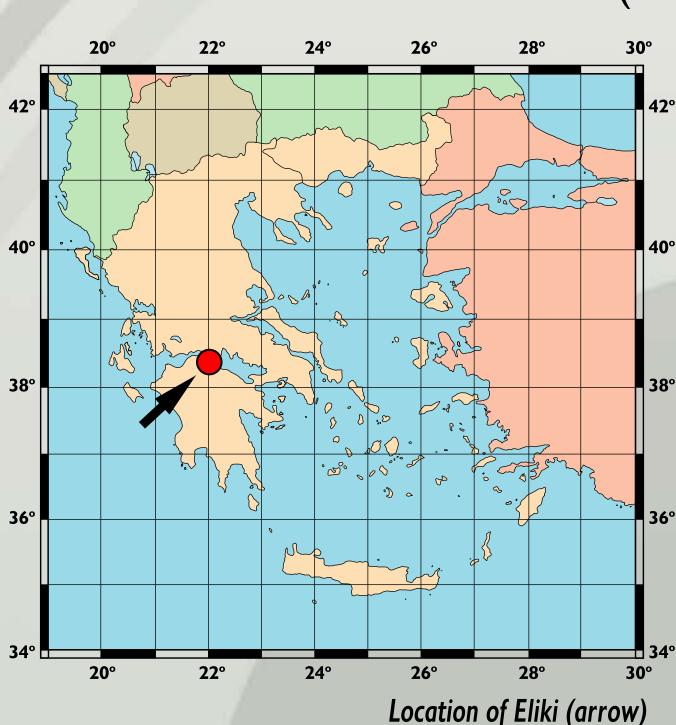
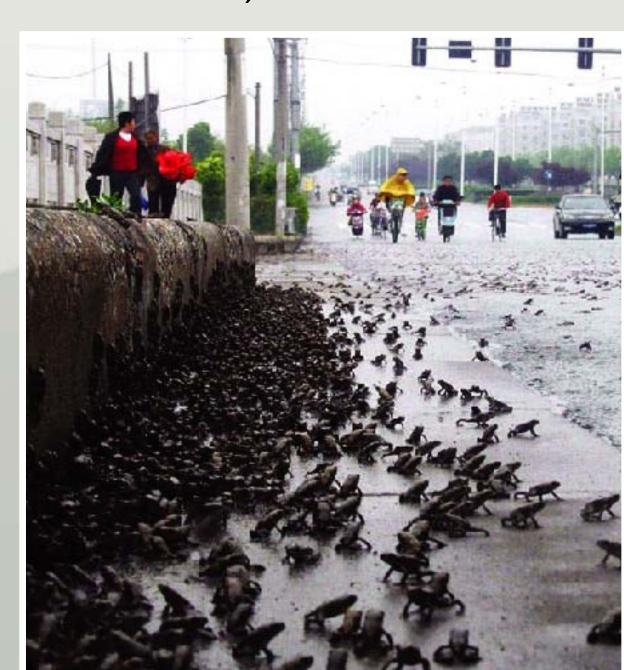## Can scientists predict earthquakes?

There's currently no organization or government or scientist capable of successfully predicting the time, place, and magnitude of the future earthquake. Scientists have tried many different ways over the decades of predicting earthquakes, but none have been successful.

However, on any particular fault, scientists know if there will be another earthquake sometime in the future, but they have no way of telling when it will happen. They can on the other hand say more general things about earthquake hazards and earthquake risks related to these faults. Using that information, we can improve building codes, do land use planning, avoid buildings next to faults that are hazardous. So we can forecast in the long term where the earthquake hazard is likely to happen.

The first seismoscope was developed in China in 132 A.D. by philosopher Chang Heng.

Animals and Earthquakes

It is true that animals sometimes can behave unusual prior to earthquakes. The earliest reference we have is from Greece in 373 BC. Rats, weasels, snakes, and centipedes reportedly left their homes and headed for safety several days before the Eliki earthquake (estimated magnitude 7) that caused the total destruction of the ancient cities of Eliki and Voura (Gulf of Corinth).
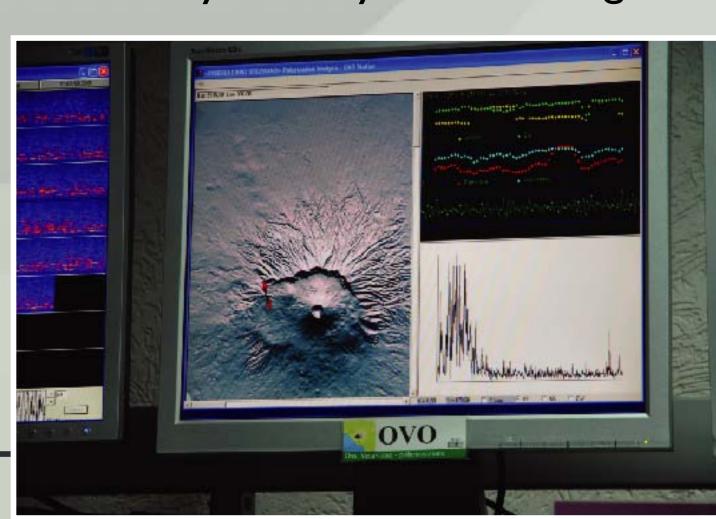

Location of Eliki (arrow)

Frogs and reptiles are more sensitive in earthquakes

Volcanic monitoring

The magma moving toward the surface can cause swarms of earthquakes, ground deformations, cracking of the volcano's flanks, changes in the amount or types of emitted gases, and clear changes in volcano behavior that can be precursors of an eruption. Volcanoes monitoring detects these changes allowing scientists to predict with varying degrees of certainty, the style and timing of an eruption. The continuous information about the volcano state updates, are crucial for public officials and people at risk to develop strategies that can reduce the impact of an eruption.
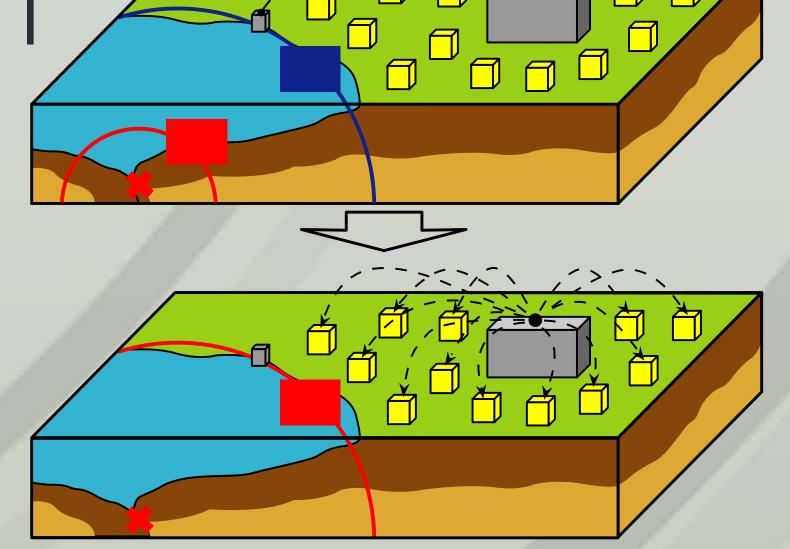

Vesuvius monitoring system

The story of the unique successful prediction: Haicheng earthquake, China (1975 February, 04 11:36 UTC, Magnitude 7.0)

The earthquake caused more than 2,000 fatalities and many injuries. Chinese officials ordered the evacuation of Haicheng (population about 1 million) the day before the earthquake. In the preceding months, changes in land elevation and in ground water levels, and widespread reports of peculiar animal behavior had been reported. The increase in foreshock activity triggered the evacuation warning. It was estimated that the number of fatalities and injuries would have exceeded 150,000 if no earthquake prediction and evacuation had been made. All these observations took place during a larger Chinese project, that failed however to predict other earthquakes that happened within the studying area.
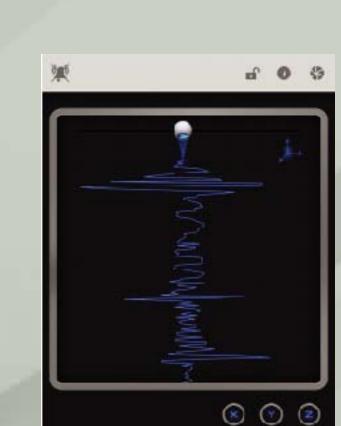
Early warning system

With this system, the instant a large earthquake is recorded sensors in the ground transmit a signal to receiving stations throughout the area. You're taking advantage of the idea that once an earthquake occurs and it's detected, you can essentially out-race the seismic waves that are propagating through the ground by sending a radio signal ahead, and so the farther away you are, the more time of warning that you have.

The actual time saved by such a system might only amount to 10 or 20 seconds, but this could be long enough to divert or temporarily immobilize public transportation systems or to simply warn people to take cover and possibly save their lives.

Earthquake Early Warning in Japan: When two or more Seismometers detect **P-waves** (upper), the **Japan Meteorological** Agency immediately analyzes the readings and distributes the warning information to advanced users, such as broadcasting stations and **mobile phone** companies, before the arrival of **S-waves** (lower).

In our days, modern mobile phone or tablet industry offers many opportunities through the various applications developed, to use our new generation devices either as seismometers that could record earthquakes or as early warning systems that can receive instantaneous warning messages.