Upgrading the Philippines National Seismic Network

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Abstract

During January to March this year (2000) the Philippine national seismic network was significantly upgraded by the installation of digital seismic recording systems, telephone communications and a near real-time automated earthquake location and alarm generation system.

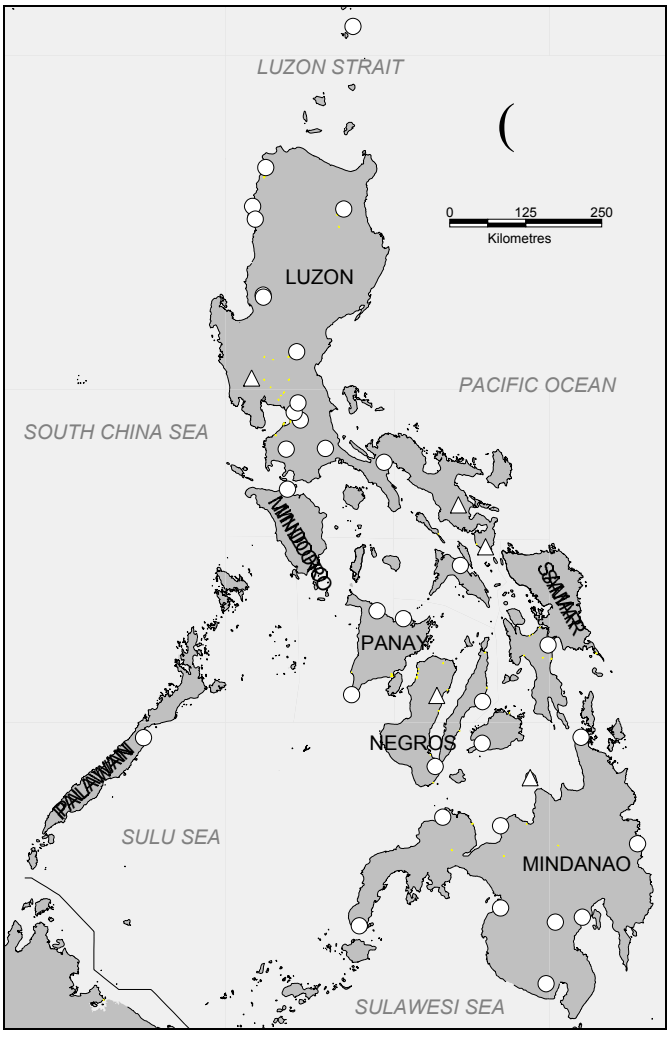
The software at each field station performs automatic P arrival picking and sends this information via FTP to the head office. There, all arrivals are automatically placed in a database and event association performed. An initial location and magnitude are computed automatically. Any location may be improved at a later time with additional data received via radio or other means. Location information may be transmitted to interested parties via a worldwide web page, email or via pager.

The automated system should provide assistance in responding to the significant hazard caused by earthquakes, volcanoes and tsunami in the Philippines.

Background

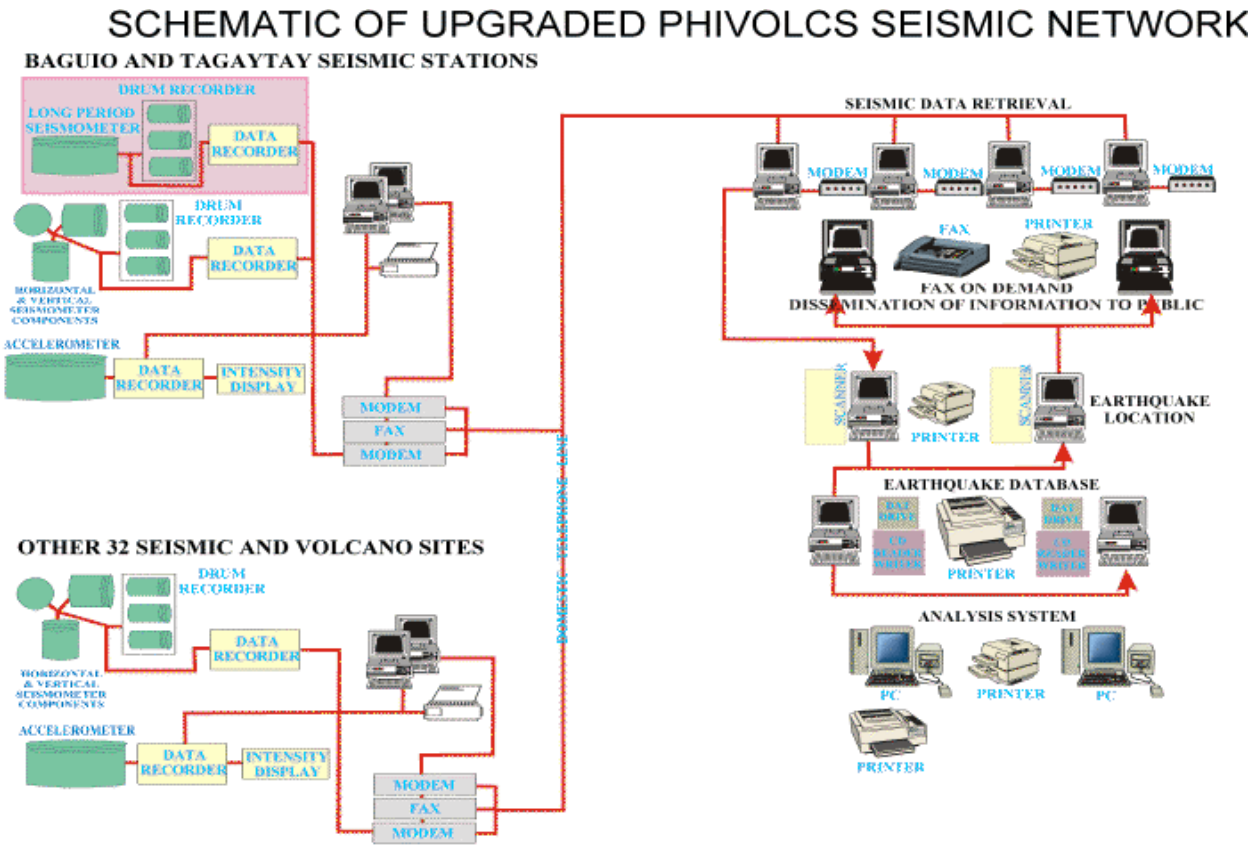
Following the catastrophic eruption of Mt Pinatubo in 1991 the Philippine Institute of Volcanology and Seismology (PHIVOLCS) applied to the Japanese International Cooperation Agency (JICA) for funding to upgrade the volcano and seismic monitoring capability of the Philippines. This application was ultimately successful.

PHIVOLCS had been running the national seismic and volcano monitoring networks in the Philippines under various names since 1952. This network consisted of approximately 35 seismic monitoring stations spread across the 1500km length of the country. Most stations used single component short period seismometers recording on helical drum recorders. A few stations had digital recorders provided for special projects. Communication with the head office in Manila was by a short wave radio network.



The perceived need was for a more modern digital seismic network with multi-channel recording and an automated system running in Manila for automatic determination of earthquake epicentres and magnitudes. The telecommunications infrastructure of the country and budget of the relevant department precluded continuous telemetry from each station. Therefore, an event based system using dial-up communications was proposed by the Japan Weather Association (JWA), the technical consultants for the project.

The project was put out to tender in early 1999. Mitsubishi Corporation was the successful bidder. They used a largely Australian consortium including the Australian Bureau of Meteorology (BoM), the Australian Geological Survey Organisation (AGSO), SRC/Mindata Australia and Delairco. The tender was let in August 1999 with all equipment to be supplied and installation complete by March 2000.



System Overview

The system specified in the tender was for the upgrading of 33 regional stations, the station in Quezon City, Manila and the installation of an automated analysis system in Manila.

The works required at each station included:

- Supply of new mains electricity cable from outside power pole, power distribution board with lightning protection and so on. Provision of new power points for all equipment.
- A power rack with battery chargers and sealed lead acid batteries.
- A seismic rack with two digital recorders, three drum recorders and an Intensity display.
- A set of tri-axial short period seismometers and a tri-axial accelerometer
- Two desks and chairs
- Two PC's for data analysis and storage
- Two modems and a facsimile for communication with head office
- Two printers for printing out seismic waveforms and general use
- A UPS for each station
- All associated cabling
- Consumables for two years

For the head office in Manila, a complete computer based analysis and archiving system was required. This included:

- Approximately twelve computers and associated network cabling and switches. A UPS for each computer
- A number of printers and facsimile machines and four modems for dial-in data reception
- Software for automatic reception of data, automatic location of events and storage in a database
- Interactive programs for displaying seismic waveforms, event location and database browsing
- A GIS system for displaying maps of earthquakes and other information

Installation

The seismic equipment was completed at the beginning of January 2000 and shipped to the Philippines. Installation commenced in the middle of January. The first "demonstration" installation was performed at Tagaytay, about an hour or two south of Manila. This initial installation took three days with various members of SRC/Mindata performing the installation. It was watched by personnel from PHIVOLCS, JWA, Mitsubishi, AGSO and BoM. This was a stressful time for all concerned. It was stressful for PHIVOLCS staff because up until this time, they did not really know what sort of a system they were going to get. It was stressful for the Australian consortium because due to time constraints this was the first time they had been able to put all of the pieces of the system together, and it was being performed in a confined area overseen by up to thirty observers.

Once this installation was complete, SRC/Mindata used five teams to perform the installation at the remaining twenty eight sites. Five sites in Mindanao were considered by the Japanese consulate to be unsafe for foreigners. Each of the five teams consisted of one SRC/Mindata engineer and one or more PHIVOLCS staff member. The PHIVOLCS person was given on-site training so that they would be able to install the remaining five sites.

An AGSO staff member visited each site after installation was complete to check that all systems were installed and operating satisfactorily. They were also accompanied by a PHIVOLCS employee.

Overall, twenty nine stations were installed by the five teams in a seven week period. Including travel, this amounts to about five days per station. It was quite a difficult logistical exercise to support this installation work. We had between two and four people in Manila supporting the installation work.

Before the installation started in the field, the computer systems and their network had been installed in head office. This involved organising the desks, physically unpacking all the computers, printers, UPS's etc., running hundreds of metres of networking cable around the room, configuration of the computers, switches and so on. This took a couple of person weeks in total.

The seismic analysis system then had to be installed and set up on the various computers. This was about another person's week of effort.

Overall, the partners in the project are very pleased to have been able to install the system within the very tight time frame imposed by the Japanese financial system and end of Japanese financial year.

Operation

The system has been in operation to a lesser or greater extent since mid March 2000. Over that time hundreds of earthquakes have occurred within the Philippines and been detected by the system, including a magnitude 6.2 event in July this year just off northern Luzon.

It is fair to say that a number of problems have been encountered, as you would expect of a project such as this. Of the 33 remote stations 22 have standard land line telephones installed. Of these, two have lines of such poor quality that they cannot be used for modem based communications. This leaves only 20 of the sites to automatically dial in information following an earthquake. Of these a number are poorly sited being close to main roads or a similar source of significant cultural noise. This makes the system less reliable than it would otherwise be in automatically detecting or locating earthquakes.

There have been some equipment problems, particularly with the seismic sensors, but also with the seismic recording equipment and computers. It seems that the computers (particularly their hard discs) do not like operating in the hot humid conditions present in the Philippines. One or two sites have suffered lightning damage to the seismic equipment in the first six months of operation.

The seismic analysis software has undergone some fine tuning to adapt it to the conditions in the Philippines and the way in which PHIVOLCS wish to operate it. This has involved many discussions between PHIVOLCS staff and the various members of the Australian consortium.

PHIVOLCS now has a modern digital seismic network installed which is recording high quality multi-component continuous digital data which can be used for a range of seismic and related studies within the Philippines and surrounding areas. This will also facilitate communication of data between the Philippines and neighbouring seismic observatories.