SEISMIC NETWORK OPERATIONS IN ALASKA

Annual Project Summary

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Program Element II. Research on Earthquake Occurrence and Effects

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Non-Technical Summary

AEIC and AVO jointly operate, record and analyze data from 600 channels of seismic data throughout Alaska. Part of the operation and maintenance of the network is supported by USGS/NEHRP. The network contains numerous short-period seismic stations, 14 accelerometers,. 20 broadband stations, and the associated receiving and telemetry systems. Many of these stations are in remote areas with extreme climatic conditions and can only be reached by helicopter, after the snow has melted. The major thrust of this work is to provide continued operation of the south Alaska seismic network together with the routine analysis of the combined network data.

Investigations Undertaken

The Alaska Earthquake Information Center (AEIC) and Alaska Volcano Observatory (AVO) jointly operate, record and analyze data from several networks comprising about 300 channels of seismic data throughout Alaska. Part of the operation and maintenance of the network is supported by USGS/NEHRP.

The USGS/NEHRP funded network contains numerous short-period (SP) seismic stations, 14 Strong motion accelerometers (SMA) and the associated receiving and telemetry systems. Many of

these stations are in very remote areas with extreme climatic conditions and can only be reached by helicopter, late in the summer after the snow has melted.

The SMAs are designed with a two-year routine site visit schedule, they were serviced in summer of 2000. The SP stations have varying maintenance schedules from two to five years or more depending upon power source, and equipment failures. Throughout the contract period, all sites were serviced to repair improperly functioning equipment.

We now have a total of 20 broadband digital stations operating in Alaska. Three of these are IRIS stations, one AVO, three ATWC, and the rest installed by AEIC.

Seismicity

For the period from Oct. 1, 1999 to Sept. 30, 2000 the AEIC located nearly 6,000 earthquakes within the combined seismic network. A plot of these events is shown in Figure 1 illustrating the magnitude and depth distribution for the central parts of Alaska. The abrupt decline in seismicity to the southwest toward the Alaska Peninsula and to the southeast is primarily due to the lack of seismic stations. Such areas are supplemented by teleseismic locations in cooperation with the NEIC.

During the contract period, the Alaska Earthquake Information Center has released the following documents and publications on a regular basis:

Weekly Seismicity Reports

Weekly releases include summary listings of all located earthquakes in or near Alaska for the previous week (usually 100 to 120 events), with date and time of origin, latitude, longitude and hypocentral depth, magnitude, solution quality parameters and a brief comment regarding approximate region, alternate magnitudes and any felt information. Each weekly listing also includes an epicenter map of the whole state (including the Aleutian Islands), a close-up map focusing on the central and south-central part of the state which is most heavily populated, and a brief verbal summary of largest or most significant earthquakes to have occurred during the week. The seismicity maps and earthquake summary are available over the Worldwide Web, updated on a weekly basis.

Monthly Earthquake Catalogs

Approximately seven months after the end of each month, AEIC issues "Earthquakes in Alaska," a monthly catalog of earthquakes in and near Alaska. The catalogs include full-state seismicity maps, central/ south-central seismicity maps, cross-sections through the two Wadati- Benioff Zones which exist beneath Alaska, a comprehensive listing of the month's earthquakes with additions from the National Earthquake Information Center, the Alaska Tsunami Warning Center, and data from the Geological Survey of Canada where appropriate. A "Highlights" section discusses in detail several of the month's most interesting or significant earthquakes, each of which is presented with an individual map and, when available, its focal mechanism. Detected and located mine and quarry blasts are also itemized in the monthly catalogs.

Information Releases

As a part of the 24-hour earthquake monitoring carried out by AEIC, any earthquake whose magnitude is large enough to be considered significant, or an earthquake which was felt by locals, will have a formal "Information Release" issued. The Information release is sent out in two forms: electronic mail is broadcast to a suite of recipients, with a text message providing location, magnitude and any other pertinent information; also, a FAX release is transmitted which includes all the above information as well as a map illustrating the epicenter of the earthquake. These email and FAX releases are sent to numerous state, local and federal government agencies, news media, utilities, other seismic observatories and interested parties. In addition, all Information Releases are now available on the Web.

Monthly Newspaper Map

A seismicity map of the state of Alaska is printed each month in the Fairbanks Newspaper, showing the previous month's seismic activity throughout the state. Accompanying this map is a short column discussing the activity and enlarging on some aspect of seismology for the public's information.

Finger Quake

The widely used finger quake utility (finger quake@giseis.alaska.edu) is available on our machines for anyone to view the most recent 100 events located by AEIC analysts. This utility is typically updated on a daily basis.

CNSS Catalog contribution

We have implemented regular submission of our earthquake catalogs to the Council of the National Seismic System. Catalogs are submitted several days after completion of each month. In addition, we have retroactively submitted all catalogs from July 1988 until present, meaning that the catalogs from the full period of this grant have been submitted to the CNSS.

Outreach and Education

During the contract period, seismologists provided an average of two invited lectures each month to various audiences including University departments, community organizations such as the Rotary and Kiwanis clubs, meetings of engineers and public safety officials as well as guest lectures at area elementary and high schools. Among these were two heavily attended (200 people) lectures given in Fairbanks and Anchorage as part of the annual “Science for Everyone” public lecture series, and one as a regular part of the State Division of Emergency Services continuing education class for teachers, “Quake and Shake.” Several television news appearances and taped radio interviews were made during the year. AEIC participated in Earth Day activities with an earthquake booth, providing educational demonstrations and materials on earthquakes and earthquake preparedness. An earthquake and seismology booth was set up and maintained during the Tanana Valley State

Fair; this was heavily attended and much literature was disbursed regarding earthquakes and earthquake preparedness.

Tours are routinely conducted in the seismology laboratory; on average, two groups per week are provided with lab tours and talks; these groups range from emergency providers and visiting professionals to tourists and school children.

AEIC routinely exchanges e-mail with citizens worldwide who are seeking information about Alaska earthquakes, or seismology in general, and has provided verbiage and graphics for engineering reports, newspaper articles and school textbooks this year. Public Radio International's "Earth and Sky" series has contacted us on three occasions for help in crafting responses to their listeners' questions about earthquakes.

Public schools throughout the state of Alaska are beginning to incorporate seismology into their science curriculum through their access to our data via the Internet. Further, we are working closely with selected schools to maintain seismic instruments at their location and encourage hands-on participation among students and teachers in the routine scanning and transfer of seismic data; our efforts are modeled on our participation with the Princeton Earth Physics Project (PEPP) approach for bringing schools into the seismic network both as a means to enhance science and mathematics education, as well as to augment our own network coverage and capabilities.

We have a Web page for the Seismology group at the Geophysical Institute that incorporates the activities of the ASN and the SEIC. Within this web site are descriptions of personnel, network topology, network processing, earthquake occurrence, research activities, and links to a variety of related sites. Examples of related links include the USGS Alaska Hazard Maps, publications on hazard preparedness, and a customized version of the Community Internet Intensity Map (CIIM) incollaboration with David Wald. In addition, we have dowloaded the QDDS system and intend to merge it with our Antelope system for supplying near-real-time earthquake information to both the CIIm and the web based seismicity maps as developed by the northern and southern California networks. This will complement the existing notification maps produced by Antelope and Iceworm.

The Kodiak Island, Alaska, M_W7 Earthquake of December 6, 1999

A M_W7 earthquake occurred on December 6, 1999 at 2:12 p.m. AKST in the Kodiak Island region of Alaska. This event was felt strongly in the towns of Kodiak and Old Harbor, as well as surrounding communities. It caused some minor damage, including power and phone outages in Kodiak. Felt reports were received from as far as Fairbanks, 900 km away. The earthquake was located by the Alaska Earthquake Information Center (AEIC) at 57.51°N and 154.67°W at 45.8 km depth. Aftershocks of M_L 5.4 and M_W 6.4 followed the main shock by ten minutes and one hour, respectively. Aftershock activity decreased rapidly from about 25 events per hour in the first few hours after the main shock to 5 events a day 10 days later. It appears that the main shock triggered a swarm of earthquakes in the Katmai volcano field that subsided in a few hours (Power et al., 2000).

Convergence of the Pacific and North American plates dominates the tectonic framework of the Kodiak region. The plate boundary lies along the Aleutian trench about 100 km seaward of Kodiak Island. A typical volcanic arc accompanying subduction is located on the Alaska Peninsula and the

west coast of Cook Inlet. Most of the seismic energy in southern Alaska is released in major earthquakes that rupture the shallow part of the megathrust. The Great 1964 Prince William Sound earthquake (M_W 9.2) ruptured a 800-km-long portion of the megathrust, including the Kodiak Island segment (Christensen and Beck, 21994). In 1938, an M_W 8.2 earthquake ruptured the segment of the boundary south of Kodiak Island. Recent GPS studies of the deformation processes near Kodiak showed that the down-dip width of the locked portion of the megathrust can be as much as 1.58 km (Savage et al., 1999).

A number of significant earthquakes occurred beneath the Kodiak Island region in the 1900's, including seven earthquakes with magnitude 6.8 or larger. While the majority of these shocks are associated with the megathrust ruptures, two earthquakes an m_b 7.3 and an m_b 6.9, in 1912 occurred at a depth of 90 km within a 20 km radius of the 1999 Kodiak Island earthquake. Allowing for some uncertainty in their locations, it is safe to suggest that both earthquakes occurred within the subducting plate. Therefore, strong earthquakes in the Kodiak region are known to be originated inside the subducting plate, not only on the interplate contact.

The 1999 M_W 7 event and its aftershocks recorded by the regional seismic network were relocated using the Joint Hypocenter Determination (JHD) method. Regional broadband data has been used to calculate moment tensors for the main shock and its largest aftershock. An SRL article (Jan. 2001) will concentrate on discusing the aftershock distribution of the M_W7 event and its source mechanism.

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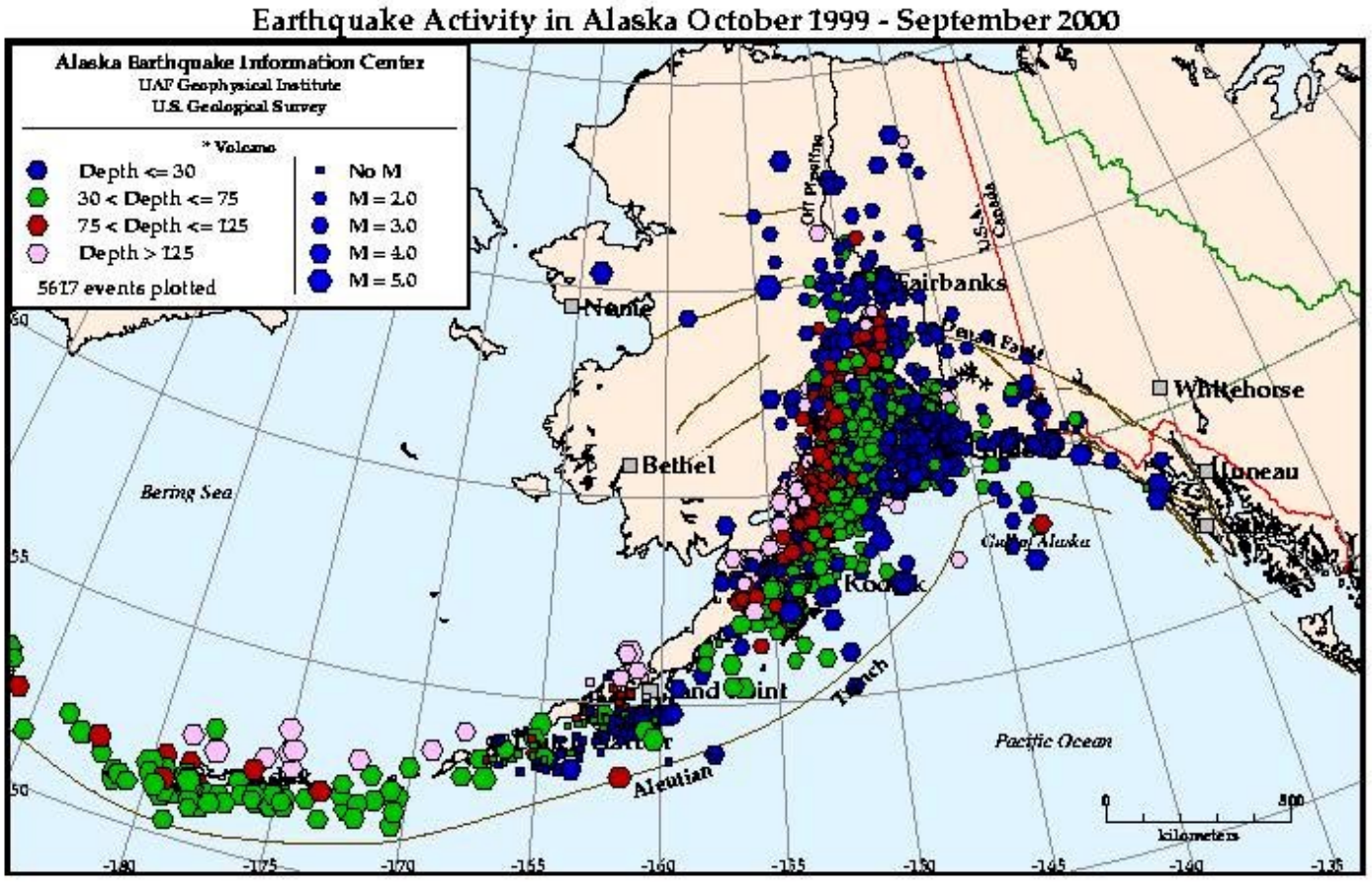
Earthquake Activity in Alaska October 1999 - September 2000
Alaska Earthquake Information Center
UAF Geophysical Institute
U.S. Geological Survey
* Volcano
Depth <= 30
30 < Depth <= 75
75 < Depth <= 125
Depth > 125
5617 events plotted
No M
M = 2.0
M = 3.0
M = 4.0
M = 5.0
Nome
Fairbanks
Whitehorse
Bethel
Juneau
Bering Sea
Pacific Ocean
Aleutian
Trench
kilometers

Figure 1