A Domain of Vast Proportions:
The Challenge of Maintaining A Center of Excellence

We have often stated that, from the geophysical point of view, Alaska is a giant natural laboratory in which an astounding variety of phenomena of interest to science and of importance to industry can be studied where they happen, as they happen.

But it is a big laboratory - spanning thousands of kilometers, east-west, north-south, and outwards into space. Studying geophysical phenomena under often adverse climatic conditions in a domain of such vast proportions requires a well-equipped network of observing stations and a support organization capable of satisfying the most demanding requirements in terms of logistics, transportation, communications, data handling and technical support.

The Geophysical Institute operates numerous instrumented field sites in Alaska, ranging from the Poker Flat Research Range (the only University-owned and operated rocket research facility in the world) and the Chena Valley Radio Facility (with the most powerful HF transmitter in Alaska) to a network of unmanned seismic stations.

At its headquarters at the Elvey Building on the University of Alaska-Fairbanks campus, the Geophysical Institute maintains self-supporting service centers and operates a fleet of vehicles ranging from buses to snowmobiles. Several of our microcomputers are dedicated to data handling and our Archives hold records of the earth’s magnetic field, auroral photographs, and remote sensing images.

As if all this were not enough, the Geophysical Institute also operates observatories and conducts field studies in other parts of the world. Indeed, most of the phenomena under study are of a worldwide nature and often require comparative data from other polar areas, or in some cases even from equatorial regions. Meteorological studies in the Sahara, for example, provide needed information on the spreading of the desert, but are also important in the similarities that are found with processes in other semiarid regions, including the Arctic. Just as the study of other planets is crucial to the understanding of planet Earth, the study of geophysical phenomena in other parts of the world is crucial to the understanding of what happens in Alaska. This is why the Geophysical Institute has been engaged for years in vigorous antarctic research, and occupies a prominent place in the U.S. Antarctic Research Program. The Arctic and Antarctic, while at opposite poles of the earth, have many geophysical similarities and as such provide counterpoints for comparison with one another.

Interestingly, it is less expensive for us to work in Antarctica than in our nearby Arctic although the total cost to the taxpayer is much higher in Antarctica. The cost of logistic support for antarctic research projects does not have to be included in budgets of proposals to the National Science Foundation — they provide the logistics free of charge — but the cost of logistics for work in the Arctic must be included in proposals and we must arrange for it ourselves.

And logistic support for the missions of the Geophysical Institute is costly. The high price of doing work in the Arctic and subarctic is a factor that tends to price us out of the market when we compete for funding against proposed research to be conducted at lower latitudes.

To maintain the Geophysical Institute as a center of excellence in arctic and subarctic geophysics, we must keep our network of observing stations well-equipped and our support organization well-staffed. Because of the location of our great natural laboratory, which gives us the advantage of being able to study a magnificent array of phenomena, this is a challenge we must continually meet.

Juan Roederer
Director
Field Work and Research Sites...

The Geophysical Institute, though located in the interior of Alaska at Fairbanks, conducts studies of natural phenomena and practical problems throughout the state. Our map shows the locations where research is being carried out, and the text gives a few brief examples of the various kinds of research we do, both fundamental and applied. Our intent here is to give no more than the flavor of our activities while illustrating that we are indeed a state-wide institution serving all of Alaska.

Arctic Haze and Air Pollution

Industrial pollution from Eurasia enters Alaska after having crossed the Arctic Ocean. The Institute analyzes this pollution at Barrow and Fairbanks and in cooperation with other research institutions assesses its possible effects on human health, on the tundra lichens that are the main food for caribou, and on climate.

Nome Harbor Project

The Institute is reviewing the plans for Nome's new dock and harbor and advising the Alaska Department of Transportation on safety measures to eliminate problems with sea ice. Ice override, for example is a common problem along much of the seasonally ice-covered coasts of Alaska, as shown in the photo from Barrow.

Ice Ridge at Barrow

Superstructure Icing

Sea spray freezing on the superstructure of fishing boats, ships, and oil rigs adds extra weight and instabilities and even losses of conditions that cause the ice to crack. Improved coatings which reduce strength of the ice, are being studied by Institute scientists at St.
Offshore Oil

Alaska has potentially large offshore petroleum resources, particularly along its northern coastline. The Institute's studies assess the hazards posed by permafrost under the ocean and moving sea ice to ships, drill rigs and pipelines. This research ranges from satellite data interpretation to sending divers below the sea ice to install instruments.

Permafrost Problems

Permafrost underlies three-quarters of Alaska. When the large ice masses, such as the one shown in the photo, melt because of roads or buildings on top of them, the structures may collapse. The Institute's research on permafrost includes how to detect it by geophysical methods and measures and how to avoid the problems it causes.

Geothermal Energy

Alaska has several areas where hot springs and geothermal energy could be exploited. Institute studies of Pilgrim Hot Springs on the Seward Peninsula, of the Willow area, and now of the Copper River Basin determine whether heat and energy can be extracted commercially from these sources.

Seismic Network

More than 5% of the world's most severe earthquakes occur in Alaska. That's more than in any other state including California. The Alaskan earthquake of 1964 devastated numerous coastal towns and villages, and did serious damage in Anchorage. The Institute's seismic network in the Cook Inlet/Kodiak area assesses the danger spots and may some day help predict earthquakes.
Why would scientists in Alaska study processes in the atmosphere, the oceans and the earth’s interior, as far away as Antarctica or even on other planets? Because in order to understand local processes, it is often necessary to look at the entire planet or even the solar system and the links connecting the various parts of the system. The Geophysical Institute therefore conducts research at the following major locations:

- In the Arctic:
  A chain of instrumented Institute stations stretches across Northern Canada to Greenland and Spitzbergen (Svalbard) in order to get a complete profile of the auroral regions and the geomagnetic processes of these areas. Cooperative research on these topics is also being done at several sites in northern Scandinavia.

- In the Antarctic:
  Similar observations are made cooperatively by the Institute in the south-polar regions at U.S., Soviet and Australian stations. Here also other studies, including research on winds and drifting snow, air pollution, falling ice crystals, sea ice and climate are conducted, to compare with similar processes and phenomena in the Arctic.

- In Outer Space:
  A large part of the Institute’s research effort is in outer space, using rockets and satellites to observe the earth’s magnetosphere (the magnetic field) and its interactions with the solar wind. Research projects on board NASA’s Space Shuttle and planetary studies such as one using the Galileo spacecraft to observe Jupiter’s magnetosphere will extend this work even further.

- In the Pacific Ocean:
  While the two polar regions provide a focus for the Institute’s studies of the aurora and atmospheric processes, the entire Pacific provides a focus for studies of earthquakes, volcanoes and plate tectonics. Studies from Mt. Erebus in Antarctica to the Cook Islands, Hawaii and Alaska are concerned with plate motion, terranes and the violence of the Pacific Rim of Fire (see Quarterly, Vol. 2, No. 2).