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EDITORIAL

Will Printed Journals Continue?

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As one librarian has noted, AGU decided that printed journals would cease when AGU declared that from 2002 the electronic journal was the version of record. Indeed, the printed journal increasingly differs from the 'real thing' as more and more authors take advantage of the electronic medium to publish animations, videos, and other dynamic material—features not possible with the printed version. Authors are also electing to save the cost of printing color by using color figures only in the online version. The usefulness of the electronic journal can only grow as the issues back to volume 1, issue 1 are added to the AGU digital library and linked to the current literature.

The 'market' is now weighing in with its vote. Members were early adopters of the electronic format for their personal subscriptions. Now, institutions are routinely replacing print subscriptions with electronic-only subscriptions. As a result, there are significantly fewer subscribers to bear the added costs of producing the printed copies. Institutional subscribers choosing electronic access pay their fair share of the costs of review, copyediting, and file conversion; they also pay for costs related to posting and maintaining the online version. They are not asked to bear the added costs of producing print; just as print subscribers are not asked to cover the cost of electronic distribution.

As a result of setting subscription rates to reflect the costs of the service being provided, print prices increased in 2006 and electronic prices declined. For 2007, the print prices have marked increases of between 9% and 26% over 2006 rates. Even with these increases, there is still a gap between anticipated revenue from print subscriptions and the appropriate price based on costs. More increases can be expected each year for print. The size of the increase will depend heavily on the decline in the number of institutions choosing print. Member print subscription prices are increasing because many of the costs related to print, such as postage and paper, rise faster than general inflation,. There will come a time when print will not be economically feasible, and that time may be sooner than some expect.

One printed journal product will disappear next year. The member-only JGR subsets (i.e. topically oriented parts of the Space Physics, Solid Earth, and Atmospheres sections of JGR) will be offered only in electronic form in 2007. There were simply too few members subscribing to the print versions to cover the costs of producing the subsets in that format.

Prices of electronic subscriptions have generally stayed the same as in 2006, when there was a 10% decrease in price for all but a few AGU journals. For two journals, there are additional decreases in 2007 for the electronic version. Increases in electronic subscription rates were only necessary where significant increases in the amount of material to be published are anticipated.

I hope this brief discussion of prices will help you be better prepared to make your own subscription decisions and to advise your institution. The 2007 subscription rates and terms can be found by going to http://www.agu.org/pubs/pubs.html and clicking on 'Members' or 'Institutions' at the top of the page.

Several AGU journals began as electronic-only. The Publications Committee and AGU staff clearly see the day when the electronic format will be the only one for all AGU journals.

—JUDY C. HOLOVIAK, AGU Director of Publications

Real-Time Underwater Sounds From the Southern Ocean

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Marine sound, natural or anthropogenic, has long fascinated scientists, mariners, and the general public. The haunting songs of humpback whales and the pings of antisubmarine sonar, among other sounds from the oceans, convey allure and suspense.

Recently, that suspense has moved from television screens to courtrooms, where navies, scientists, and environmentalists have clashed over the effects of anthropogenic sound on marine mammals [*Malakoff*, 2002]. Triggered by atypical mass strandings of primarily beaked whales in concordance with naval sonar exercises off Greece in 1996 and the Bahamas in 2000, substantial efforts to obtain baseline data to understand the possible effects of anthropogenic sound on marine mammals have commenced. Recent advances include dive and vocalization records of beaked whales [*Johnson et al.*, 2004] and detailed observations of the behavioral response of sperm whales on seismic signals [*Jochens et al.*, 2006].

Among the data necessary to determine the contingent impact of noise, estimates of whale abundances resolved at regional, seasonal, and species levels are needed. These estimates may be used to adjust hydroacoustic operations in order to minimally interfere with the whales. However, the Antarctic climate renders a systematic acquisition of abundance data, which usually is obtained by visual surveys, difficult. The passive acoustic recording of marine mammal vocalizations offers a unique opportunity of year-round observations at selected sites—presuming that the animals vocalize.

Long-term acoustic recordings from the Southern Ocean previously have been obtained by moored recorders along the Antarctic Peninsula [*Sirovic et al.*, 2004]. Limited storage capacity only allowed for the detection of low-frequency calls from mysticetes (baleen whales), while vocalizations from odontocetes (toothed whales) and

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pinnipeds (seals and sea lions) lay outside the recorded spectral range.

However, comparable data were unavailable for the Weddell Sea, a major basin of the Southern Ocean. To obtain data from this remote region, an acoustic listening station, the Perennial Acoustic Observatory in the Antarctic Ocean (PALAOA, also the Hawaiian word for 'whale') was constructed in austral summer of 2005–2006 on the Ekström ice shelf 15 kilometers north of Germany's Neumayer Base (Figure 1). PALAOA's design was guided by demanding prerequisites: perennial, 365-day, 24-hour, autonomous operation; real-time data access; and full frequency and dynamic coverage.

Station Location

How can perennial, real-time access be gained to the Antarctic coastal ocean? Hydrophone deployments over the ice shelf edge or through the sea ice are threatened by passing icebergs or iceberg calving. Bottom-moored recorders do not provide real-time access. Consequently, PALAOA had to be located on the ice shelf proper. Airborne radio echo sounding data suggested an ice thickness of between 80 and 200 meters for the ice shelf north of Neumayer Base, while interferometric imagery indicated little shear (Figure 1, bottom inset) within the northernmost protrusion of the ice shelf, favorable conditions for its long-term stability.

To optimize the reception of high-frequency vocalizations from marine mammals, PALAOA needed to be located as close as possible to the ice shelf edge while observing a sufficient safety distance from the edge, because the shelf ice advances and breaks off by about 100–150 meters each year. Balancing these requirements, PALAOA was positioned at 70°31'S, 8°13'W at 1.5–3 kilometer distance from the ice shelf edge, with the Southern Ocean to the north and Atka Bay to the east (Figure 1).

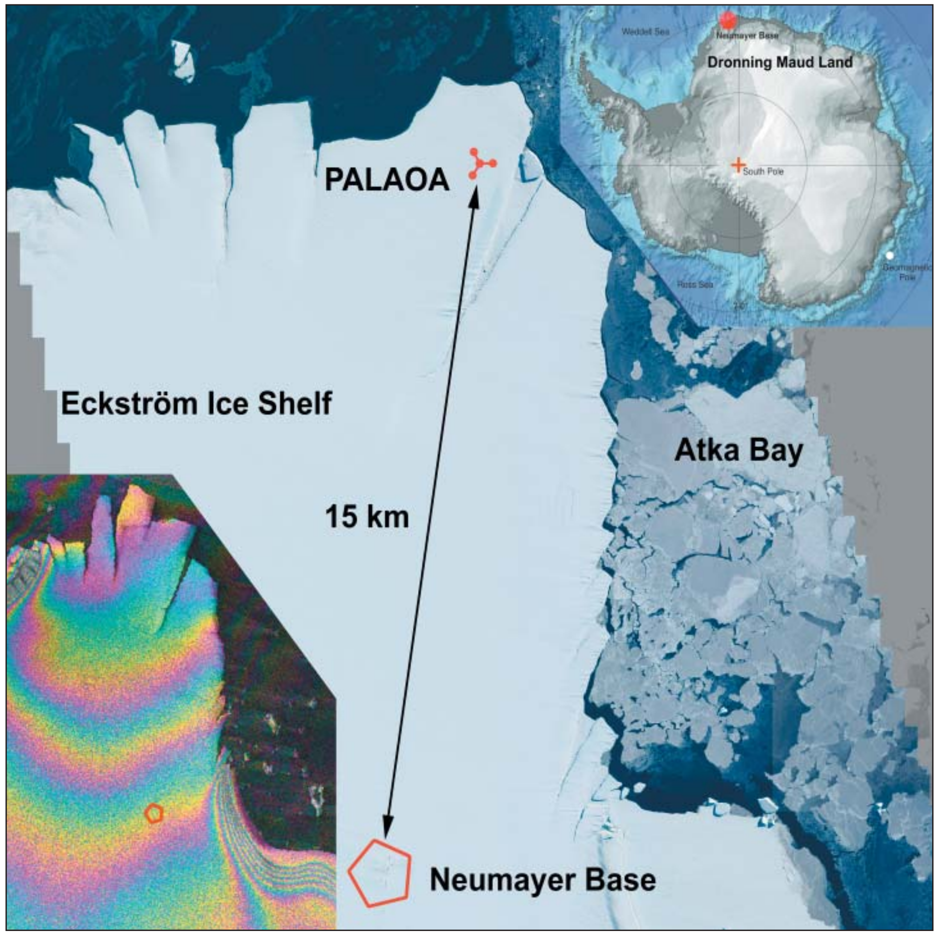

Fig. 1. IKONOS-2 satellite image from March 2004, with locations of the Neumayer Base and PALAOA. (top inset) Antarctica with the location of PALAOA indicated by a red dot. (bottom inset) ERS-1/2 Single Aperture Radar interferogram from October 1995, showing the changed outline of the ice shelf border along with information of the movement of the glacier. Equal colors indicate identical flow rates of the ice, roughly 150 meters per year at Neumayer Base.

Glaciology and Bathymetry

Ice shelf thickness and seafloor bathymetry were obtained by a local reflection seismic survey. A small Seismic Impulse Source System (SISSY) [*Buness et al.*, 2000] was used to obtain seismic recordings via a chain of 24 geophones. Best results were obtained by placing the shot point 100 meters away from the middle of the geophone chain, thus balancing signal strength, travel time, and pulse duration. With sound speeds of 3770 meters per second [*Kohnen*, 1974] (the speed of *P*-waves in ice) and of 1440 meters per second (the speed of *P*-waves in water), the first estimates of the thicknesses of the ice shelf (105–120 meters) and underlying water column (150 and 170 meters) were obtained for the proposed drill sites. The subsequent hot-water drilling, needed for positioning the hydrophones in the waters beneath the ice shelf indicated slightly thinner (10 meters) ice than estimated. The estimated and actual ice thicknesses match when assuming a root-mean-square in-ice velocity of 3550 meters per second, resulting in estimates of 160 meters of water column below the ice at all drilling sites and a seafloor depth of 240–250 meters.

Hot-Water Drilling and Hydrophone Arrangement

A total of four ice shelf penetrating boreholes of about 100-meter depth were melted through solid ice, located at the edges and the center of a 500-meter-baseline triangle, using high pressure hot-water drilling equipment (Figure 2) capable of advancing at a rate of up to 40 meters per hour.

After completion of each borehole, the respective hydrophone and conductivity-temperature-depth (CTD) recorder were placed about midway (for best separation of signal and reflections) in the water column at a depth of about 155 meters (i.e., 70 meters below the ice shelf bottom and 90 meters above the seafloor). The central hydrophone was placed 20 meters below this level, resulting in a long baseline array arranged as an oblate tetrahedron (Figure 1), which allows for locating sources of acoustic emissions from time of arrival differences at the four sites with an angular resolution of about 1°, and a two-dimensional resolution of about 20 meters for sources near the shelf ice border. The central hydrophone allows for reception as well as emission of sound to recalibrate the system and estimate the influence of currents on the array geometry.

Energy Supply and Data Streams

PALAOA consumes about 53 watts of electric power, provided by solar panels, a wind generator, and a methanol fuel cell, backed-up by a bank of rechargeable batteries. The audio hardware is capable of resolving the 10-hertz (blue whale calls) to 80-kilohertz (beaked whale clicks) frequency band, while the dynamic range covers levels from well below sea-state zero to significant amplitudes, such as iceberg calving events. The four hydrophone channels are digitally recorded in professional audio quality (24-bit/192 kilohertz) and continuously transferred to Neumayer Base through a wireless local area network. A compressed mono-audio stream is transmitted in near real time to the Alfred Wegener Institute (AWI), Bremerhaven, Germany, via the Neumayer Base's leased satellite line, where it is made accessible to the public (see http://www.awi.de/acoustics/livestream).

Expected and First Results

On 23 December 2005 at 1400 GMT, PALAOA recorded its first sound. Occasional calving and crack formation generate the dominant signals by far [*Dyer*, 1987]. Known noises from sea ice are rarely detected [*Waddell and Farmer*, 1988], whereas hitherto unreported sequences of overlapping down- and upsweeping sounds—i.e., tones sliding from high to low or low to high frequencies, respectively—feature prominently (Figure 3). Their likely source is sea ice motion during breakup, as their occurrence decreased drastically with vanishing sea ice coverage. The loudest event so far was generated by the collision of two icebergs on 19 April 2006, roughly 40 kilometers offshore. Sound levels exceeded by far the dynamic range of the hydrophones for more than ten minutes, implying a source level well above 205 decibels relative to a reference pressure of one micropascal, when calculated for a nominal distance of one meter from the source. To our knowledge, this is the first broadband recording of a nearby iceberg collision, providing an important reference value of underwater noise levels in the Antarctic coastal ocean. In addition, vocalizations of minke whales, orcas, leopard seals and especially Weddell seals pervade the records.

The large amount of acoustic data will be processed using pattern recognition algorithms to obtain a data set directly suitable for interpretation in biological and climatological contexts.

To obtain marine mammal abundances, the ambiguity between multiple calls of a single animal and individual calls of multiple animals needs to be resolved. Project scientists plan to use PALAOA's capability of source location and the differentiation between overlapping vocalizations to address this issue. Furthermore, PALAOA will be used to determine the long-term noise budget for a pristine location, and to identify and quantify the various physical acoustic sources in coastal waters. The signals' seasonality, diurnal patterns, locations, and correlations with weather and tidal data will be used to explain their respective origins.

This project will provide marine mammal abundances from this remote region resolved at seasonal and species levels, the ocean noise budget and trends from an undisturbed environment, and unique opportunities for public eavesdropping into the Antarctic underwater soundscape. Project scientists particularly encourage the use of the data in the context of educational programs at all levels, for which it is freely available.

Fig. 2. Hot-water drill rig setup for hydrophone deployment. Pictured left rear to right front are a snow-cat, the black meltwater basin with snow, a pressure hose and drill winch, six hot-water pressure washers on the drill platform, and fuel supplies in barrels. The actual borehole is at the bottom of the snow hole in the front. Penetrating the 100-meter-thick ice shelf with 700 kilowatts heating power took about 12 hours for each of the four holes. PALAOA's central instrumentation container is visible in the distant background.

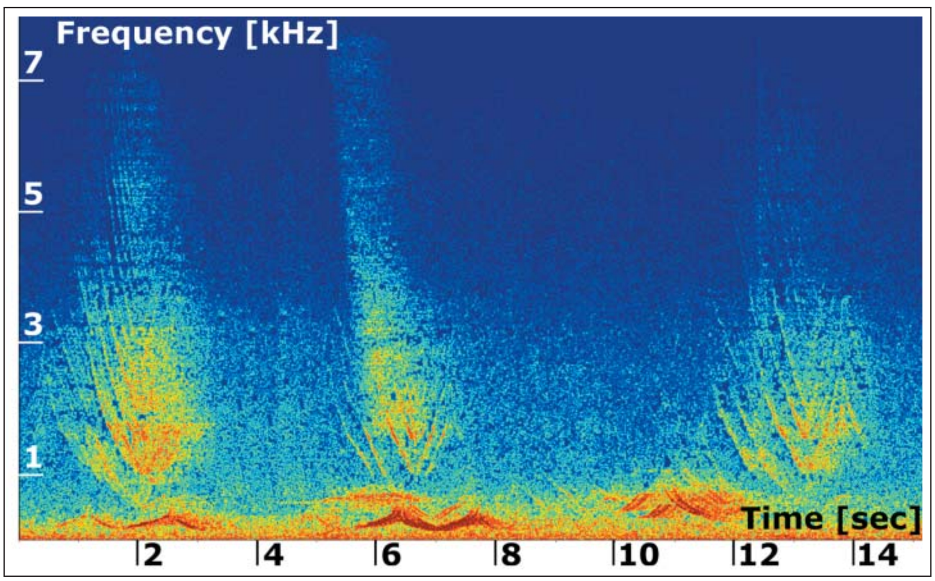

Fig. 3. Spectrogram or 'voiceprint' of an underwater recording from 19 January 2006, 1241 GMT. The image depicts, similar to a musical score, the temporal development of the frequency content. Here, the triple repetition of low-frequency (about 500 hertz) and high frequency (1–7 kilohertz) down- and upsweeping sounds are clearly discernable, probably generated by sea ice movements. Warm colors indicate high intensities; blue indicates the low intensity background noise.

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Advanced National Seismic System Delivers Improved Information

PAGES 365–366

The Advanced National Seismic System (ANSS), an initiative begun in 1998 to integrate, expand, and modernize seismic monitoring nationwide, is providing improvements in earthquake monitoring and in the development, production, and delivery of earthquake data, information, and science. The ANSS initiative is an element of the Earthquake Hazard Program (EHP) of the U. S. Geological Survey (USGS).

The USGS National Earthquake Information Center (NEIC), an integral part of ANSS, has incorporated into its routine operations many of the developments in data processing and data products supported by the ANSS. The four principal elements of ANSS monitoring operations are, in sequence: data collection, data processing, generation of data products, and product dissemination. This article describes the current status and new developments in each of these elements, and how they have affected NEIC capabilities.

Data Collection

Incoming data are the foundation of ANSS operations at the NEIC. The NEIC receives over 3000 channels of digital waveform data in real time from approximately 700 seismic stations worldwide. Dedicated satellite circuits and public and private Internet links transmit data to the NEIC, to regional data centers, and to the Incorporated Research Institutions for Seismology (IRIS) Data Management System. Most of these data are from field seismograph systems with large amplitude range and broad frequency response, ensuring that the data generated have the span and fidelity to produce reliable earthquake parameters and characterizations.

Data Processing

With ANSS support, the NEIC is involved in a major revision and upgrading of its data processing software and systems. The new seismic data processing system, called Hydra, is operational and will fully replace the old system in 2006. Hydra is designed as a 'human-guided' rather than a human-centric system.

A human-guided system is founded on processes that allow continuous revision of results based on new input data; the results are available to people at any time in various formats and displays. Applied to earthquake processing, this concept allows for a seamless data processing environment within which earthquake parameters are continuously accessible to a seismic analyst, and updated as new data become available. The analyst can guide earthquake data processing by issuing commands that will be applied to future revisions of an event.

For flexibility, a 'state based' automated processing structure has been adopted. This allows a complex sequence of algorithms to be applied to each processing pass of each earthquake, and it allows the sequence to

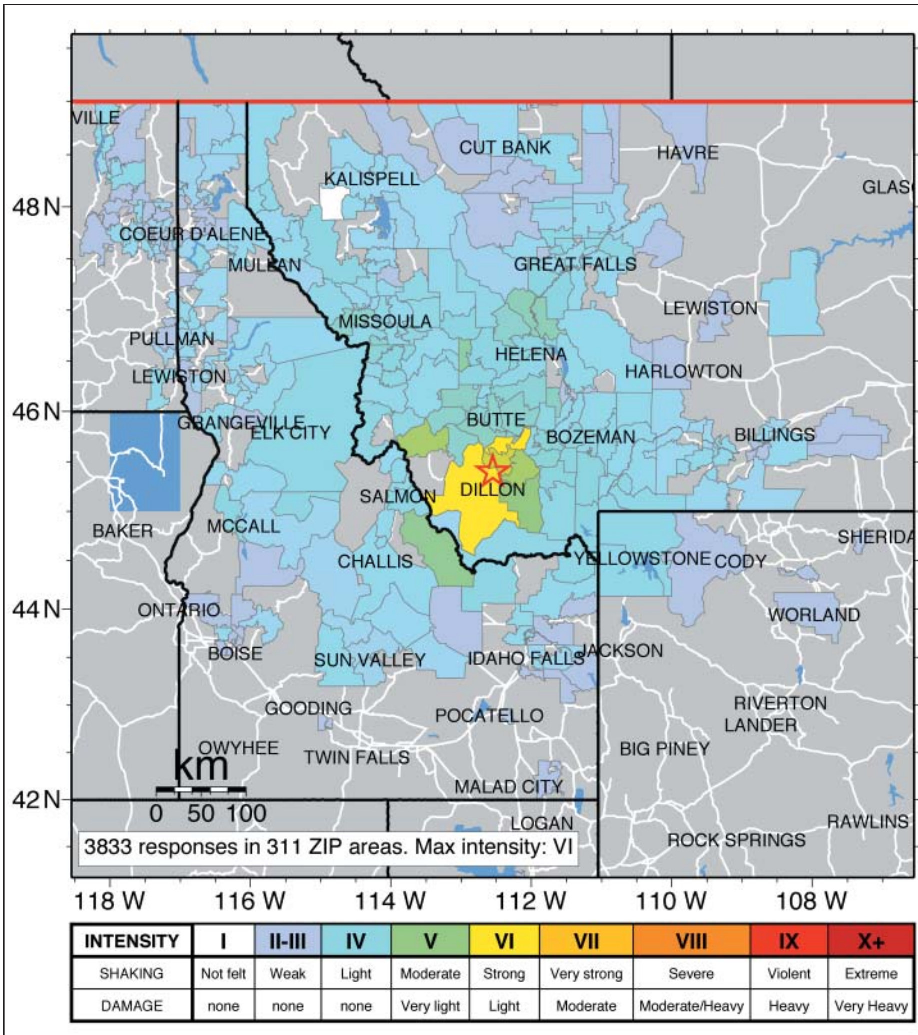

Fig. 1. Community Internet Intensity Map ("Did you feel it?") for the 26 July 2005 magnitude 5.6 earthquake in western Montana. As of 18 January 2006, 3829 responses from 311 ZIP codes, with a maximum modified Mercalli intensity of VI, had been received at the National Earthquake Information Center.

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