IMPLEMENTATION OF INFRASONIC DETECTION ALGORITHMS AT I59US

Milton Garcés,[1] Claus Hetzer,[1] and Alexis Le Pichon[2]
Infrasound Laboratory, University of Hawaii, Manoa[1], Commissariat à l'Energie Atomique, Département analyse et surveillance de l'environnement[2]

ABSTRACT

Infrasound array I59US, Hawaii, started operations on May 25, 2000 and was certified into the International Monitoring System in December of 2001. In order to interpret the data, various analysis tools have been acquired, developed, and evaluated at the Infrasound Laboratory (ISLA) of the University of Hawaii. These include modified versions of Sandia National Laboratories' MatSeis, Los Alamos National Laboratory's InfraTool, STA/LTA-based automatic detectors, and the Progressive Multi-Channel Correlation (PMCC) method. Evaluation of various detection algorithms during routine analysis of the array data demonstrated that PMCC was not as vulnerable to aliasing as frequency-domain detection methods and it allowed detection of signals below the noise level, which is not possible with a STA/LTA detector. PMCC is presently used to produce automatic bulletins of detected signals. Phase names based on source identification have been devised to aid in classification. Detector results are subjected to a minimum-correlation/minimum-family-size filter, and both filtered and unfiltered bulletins are produced. The bulletins, which are not subjected to analyst review, provide Phase, Date and Time UT, Azimuth, Slowness, Correlation, Median Frequency of Detection, RMS Amplitude, and Family Size. Filtered detector results are written to CSS .arrival tables, which are subject to analyst review. Future work should concentrate on the development of an automatic, intelligent event identification algorithm that can screen the large amount of events picked by automatic detectors.

INFRASONIC SOURCE LOCATION USING THE TAU-P METHOD

Milton Garces,[1] Claus Hetzer,[1] Kent Lindquist,[2]
and Douglas Drob[3]
Infrasound Laboratory, University of Hawaii, Manoa[1], Lindquist Consulting[2],
and Naval Research Laboratory[3]

ABSTRACT

Two large bolides have been recorded by IMS infrasound stations in Hawaii and Alaska. On 25 August, 2000 at 01:12:25 UTC, DoD and DoE satellites observed an object at 14.45 North and 106.13 West, with a total visible estimated energy of 1.4 X 10^{12} joules. This object, known as the Acapulco bolide, was observed by IMS stations in Hawaii, Alaska, Bolivia, Canada, and French Guiana. On 23 April 2001 at 06:12:35 UTC, satellites also observed an object at an altitude of 28.5 km at 27.9 North and 133.89 West, with a total visible energy estimate of 4.6 X 10^{12} joules. This object was observed by IMS stations in Hawaii, Alaska, California, Canada, and Germany. We use these two ground truth events to evaluate the performance of two and three station infrasonic locations. We discuss the capabilities and limitations of source location procedures based on travel times and azimuth deviations that are derived from ray tracing formulations. A software algorithm has been developed to ingest accurate atmospheric profiles, which may be provided in near-real-time, use the tau-p method to compute the effective speed, or celerity, of specified infrasonic phases, and export these model results into the Generic Locator (genloc) module within the Antelope software platform to produce locations. This implementation is computationally efficient and allows the exploitation of CSS database structures and analysis tools.

MODELING OF MICROBAROMS FROM HURRICANE DANIEL

Milton Garcés, Claus Hetzer, Steven Businger, and Mark Willis
University of Hawaii, Manoa

ABSTRACT

Severe weather in the ocean generates infrasonic signals in the 0.1-0.5 Hz frequency band that can propagate for thousands of kilometers. The source generation mechanism for microbaroms is believed to be the same as for microseisms, and is attributed to the nonlinear interaction of surface ocean waves. We compare theoretical predictions with infrasonic observations of Hurricane Daniel in July of 2000. The nonlinear interaction of the ocean wave field is predicted to radiate sound waves only if the ocean waves are almost opposite in direction and of a near identical frequency. However, perfectly opposing wavetrains of the same frequency radiate vertically, and this acoustic energy never returns back to the earth. Only wavetrains that are slightly off line or with slightly different frequencies will result in isotropic acoustic radiation, even for highly directional ocean wave fields. The slowness of the infrasonic waves observed by IMS array IS59, or KONA, suggests that these waves were propagating close to the horizontal. The observed azimuth of the incident sound waves corresponds to the most energetic stage of Daniel's lifespan, and suggests that the acoustic signals were radiated during the interaction of surface gravity waves in the open ocean. Using the known dispersion relation for deep water waves, the median detection frequency corresponds to ocean wave speeds that are slower than the known hurricane track speed of Daniel, a condition that would encourage the nonlinear interaction.

PROGRESS IN THE DEVELOPMENT OF A GROUND TRUTH DATABASE OF INFRASONIC EVENTS

Milton Garces[1], Claus Hetzer[1], Douglas Drob[2], Robert Woodward[3], Henry Bass[4], David McCormack[5], Laslo Evers[6], Michael Hedlin[7], Alexis LePichon[8], Ludwik Liszka[9], Charles Wilson[10], Rodney Whitaker[11]

University of Hawaii, Manoa[1], Naval Research Laboratory[2], Center for Monitoring Research[3], University of Mississippi[4], Geological Observatory of Canada[5], Royal Netherlands Meteorological Institute[6], University of California, San Diego[7], Commissariat à l'Energie Atomique[8], Swedish Institute of Space Physics[9], University of Alaska, Fairbanks[10], Los Alamos National Laboratories[11]

Subjects: Ground Truth Database, Formats, Calibration, Distribution (mirrored sites), analysis tools, NSF, Newsletter. Work in progress for distribution at Workshop as CD.