Catching Rays in the Bahamas

Acoustic Detection of Ultra-high Energy Cosmic Ray Neutrinos

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http://hep.stanford.edu/neutrino/SAUND
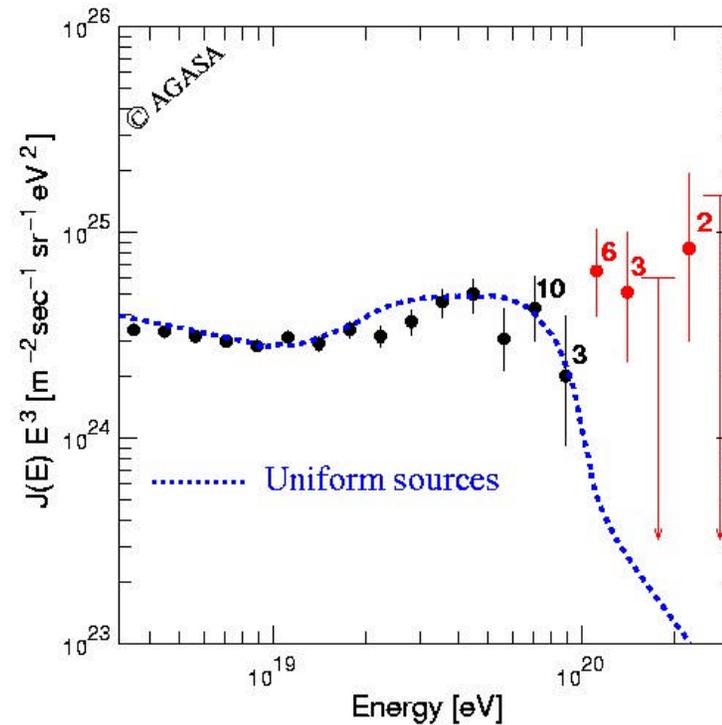
The Greisen-Zatsepin-Kuzmin (GZK) Anomaly

Theory:

$$\gamma_{CMB} + CR \ \text{-->} \ \pi$$

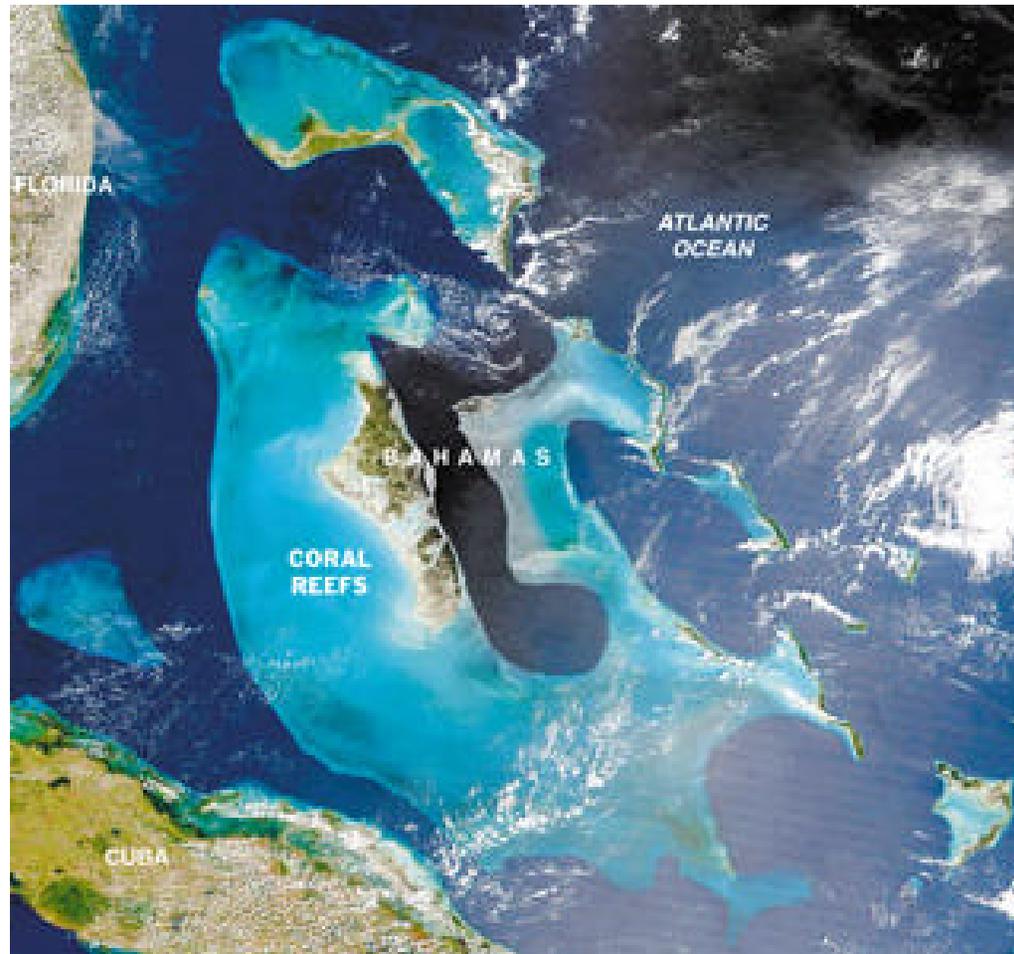$$L \sim 50 \ \text{Mpc}$$

Experiment:

Image courtesy AGASA web page

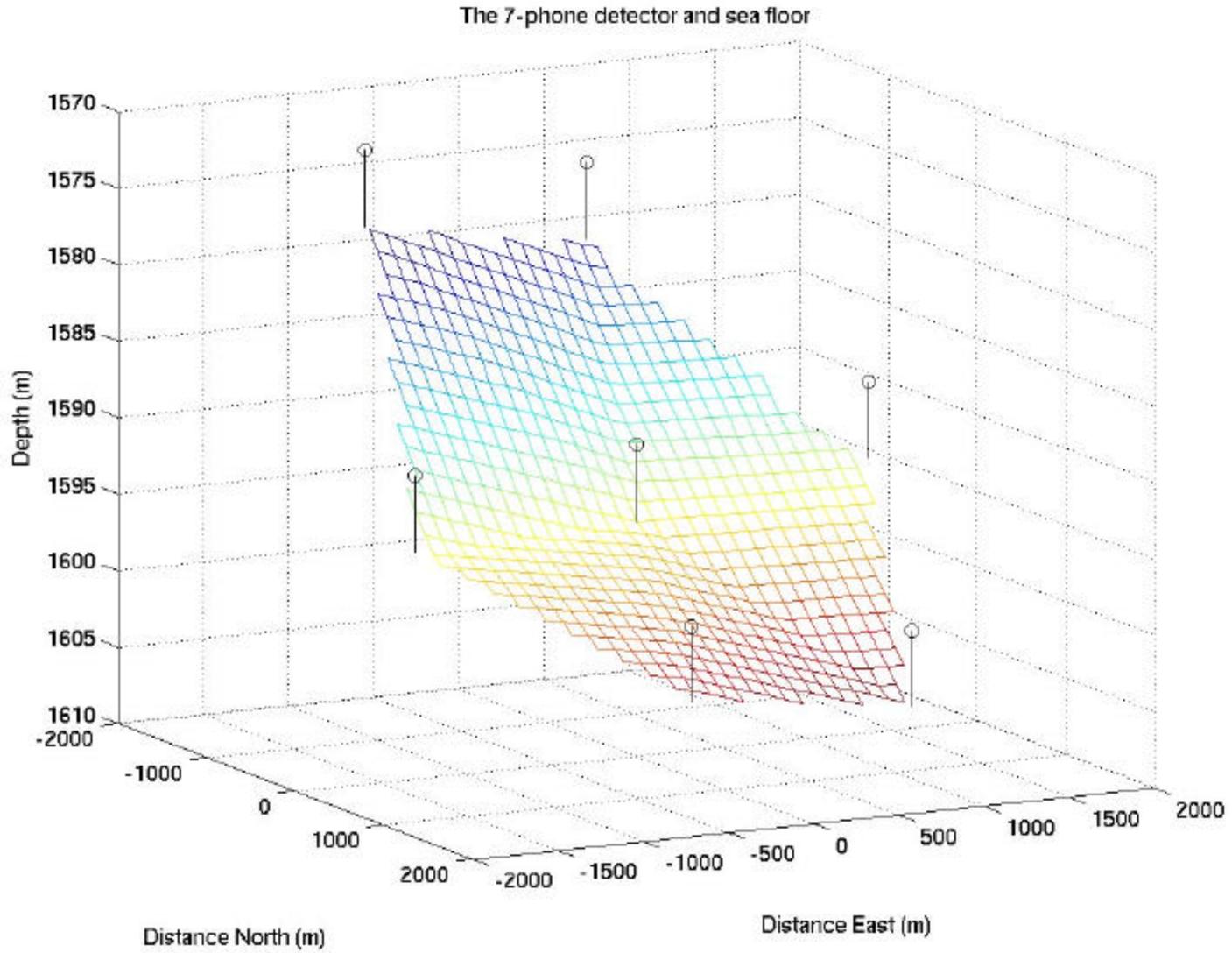Results from the Akeno Giant Air Shower Array (AGASA)

Detector Location

Tongue of the Ocean
Atlantic Undersea Test and Evaluation Center (U. S. Navy)

AUTEC Site 3

SAUND Detector

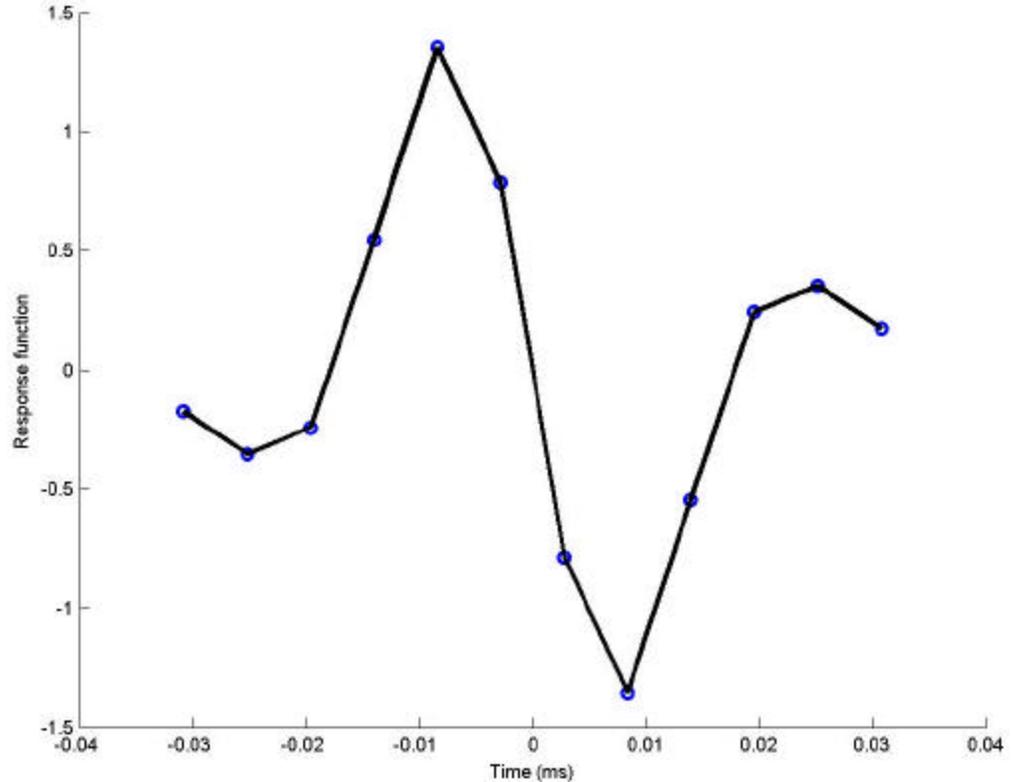
The 7-phone detector and sea floor
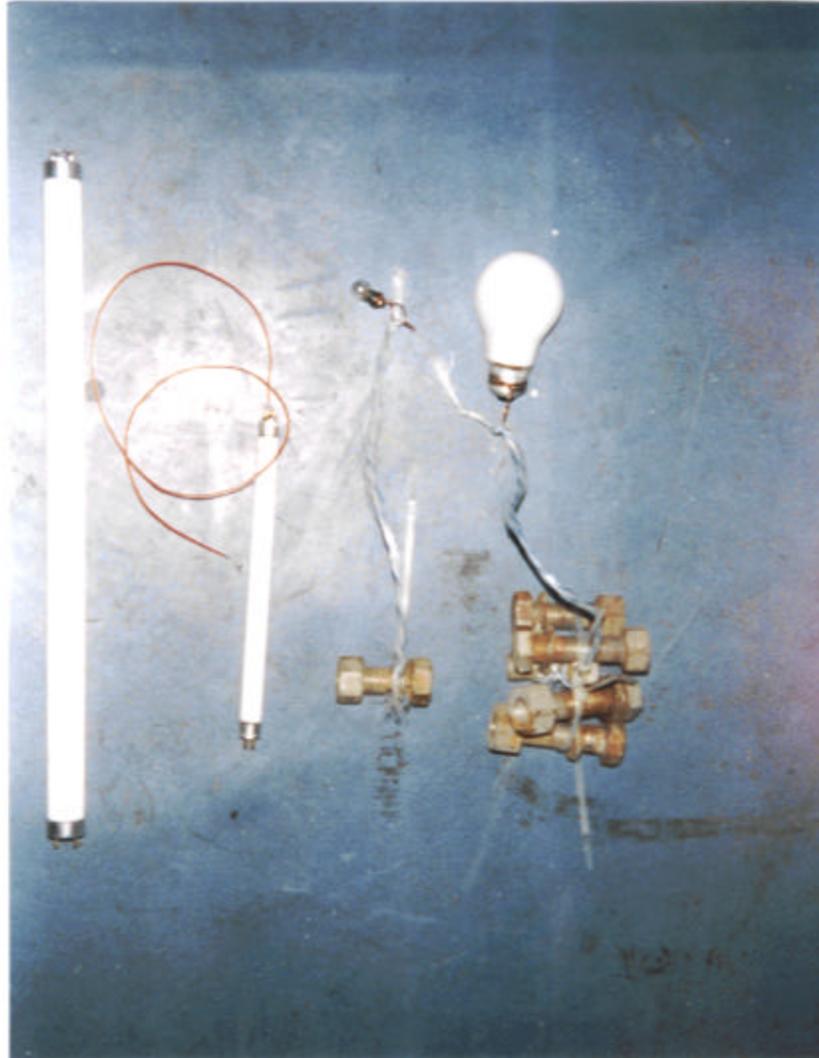
Data Acquisition

Hardware

- Dell 8100 (1.7 GHz Pentium 4)
- NI analog-to-digital card (PCI-MIO-16E, interface BNC 2110)
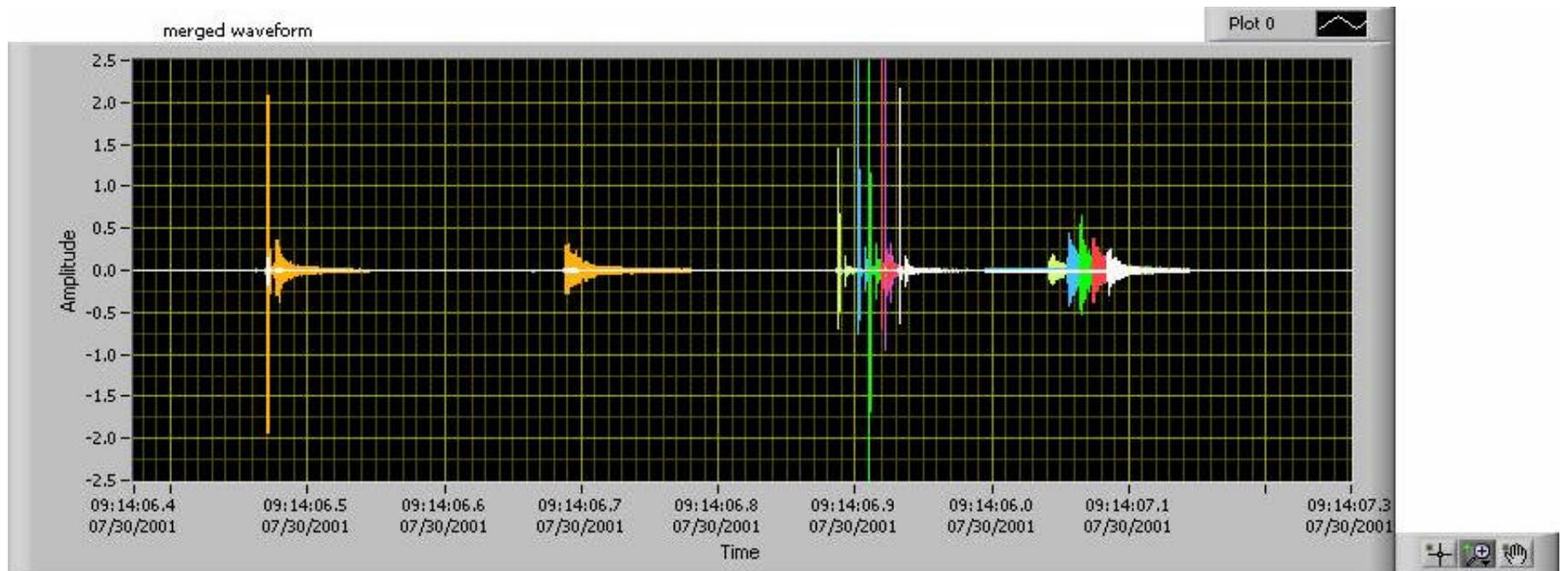- 60 GB external hard drive for data transfer

Software

- digital matched filter
- variable threshold
- 179 kHz sampling
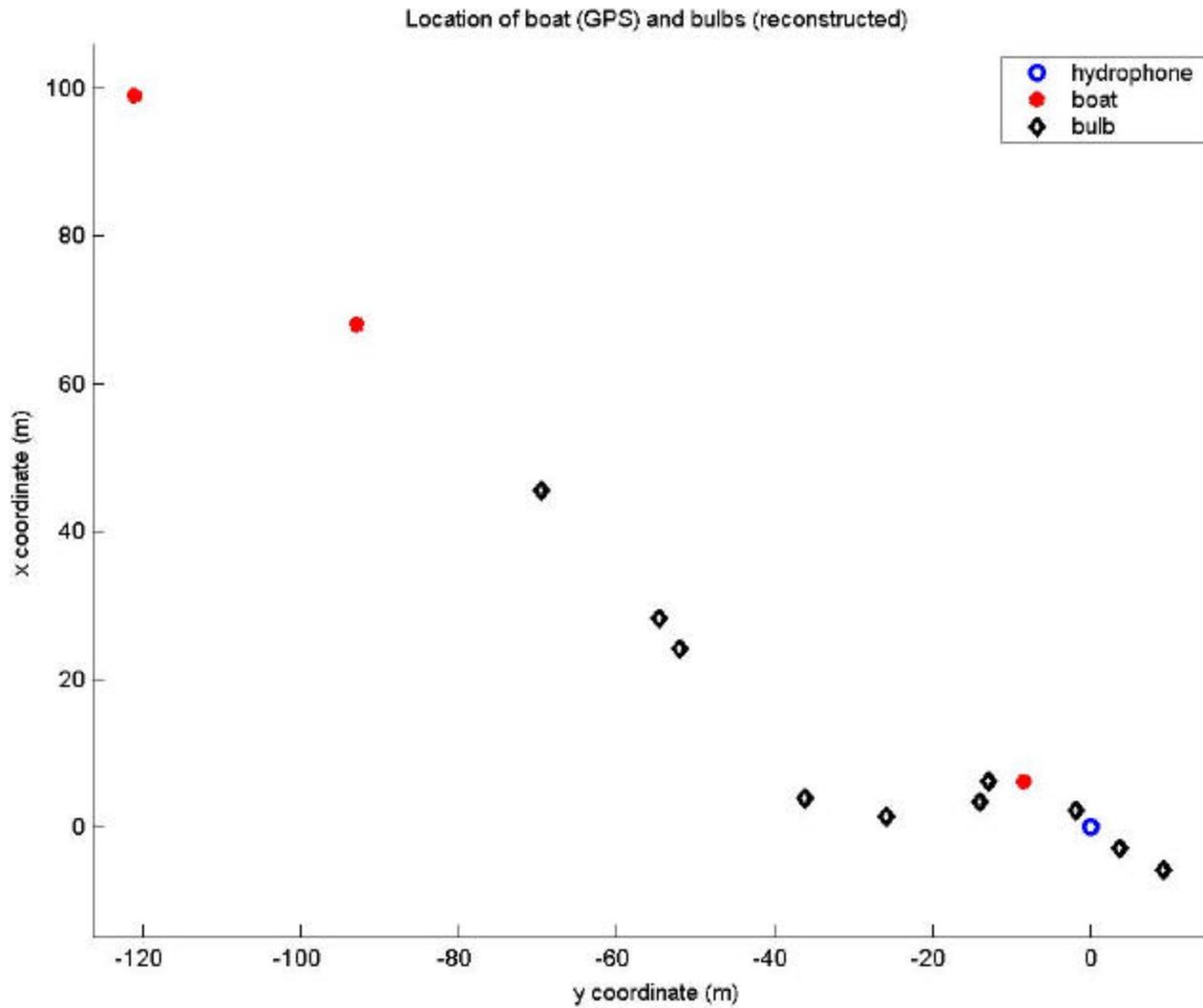- 60 events/minute target
- 1-2 GB / 24 hrs

Calibration System

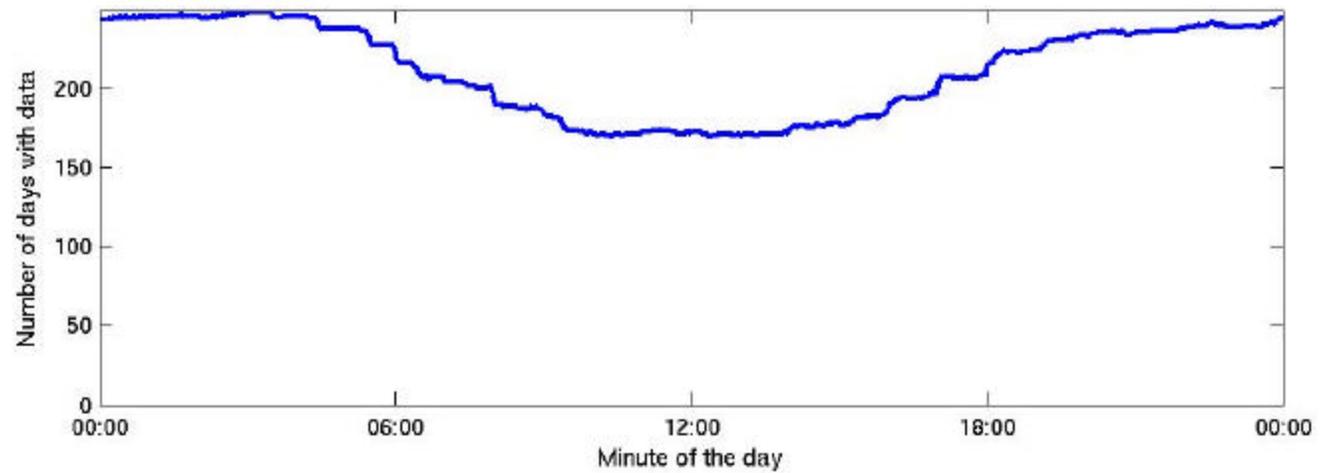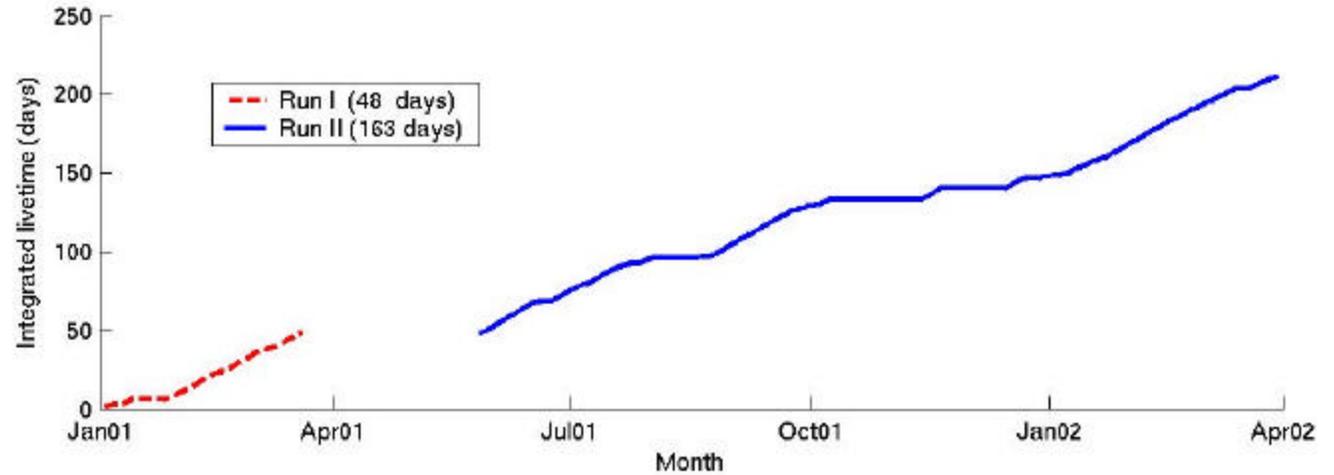# A Calibration Event

Bulb Reconstructions

Location of boat (GPS) and bulbs (reconstructed)

Reconstructed Implosions

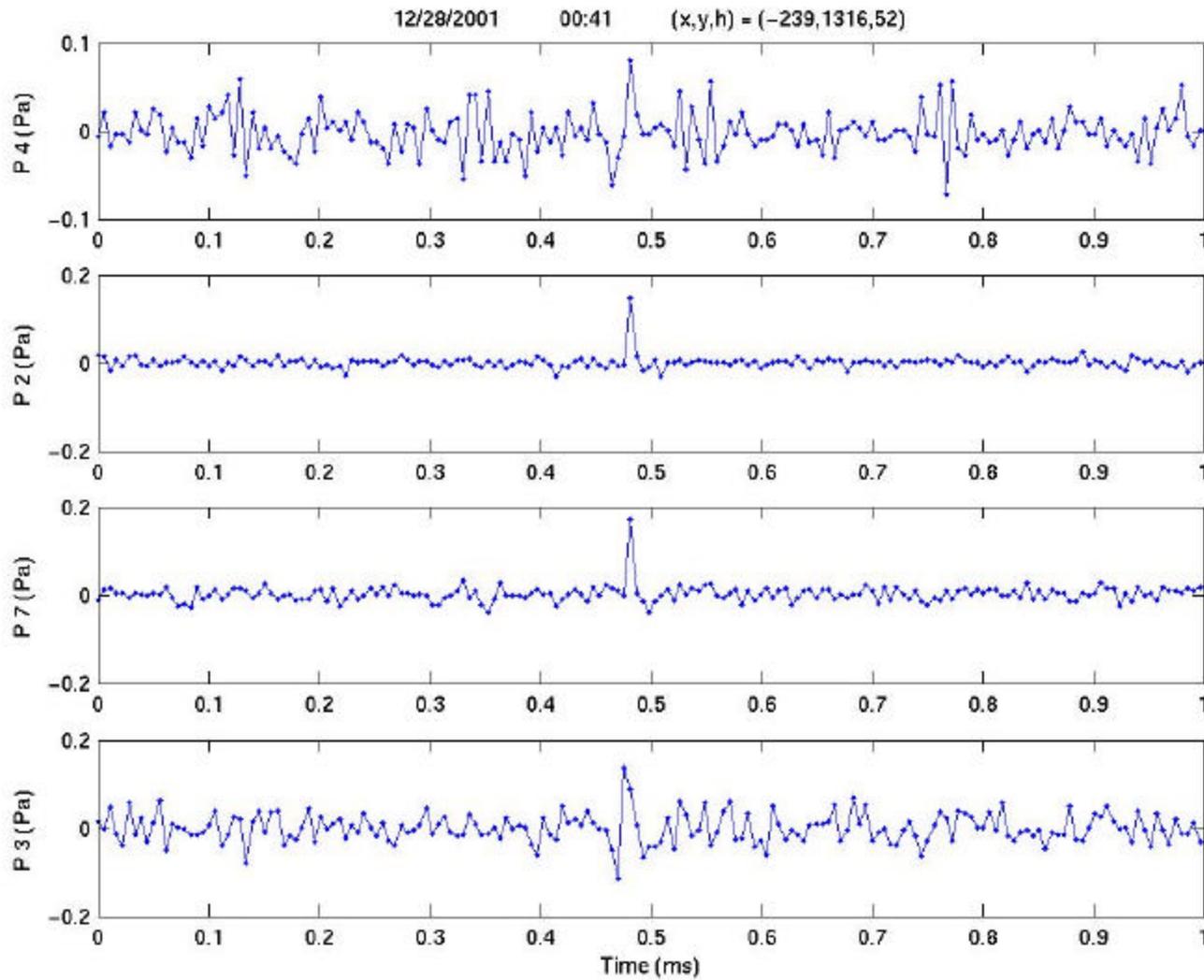| Bulb	Depth (m)	P (kPa)	E_0 (J)
1	160	1563	234
2	107	1047	157
3	139	1360	204
4	166	1626	244
5	126	1237	186
6	101	990	148
7	86	838	126
8	135	1324	199
9	188	1842	276
10	290	2846	427

Dataset Overview

- 16 months
- 208 days live
- 25 million events
- 350 GB
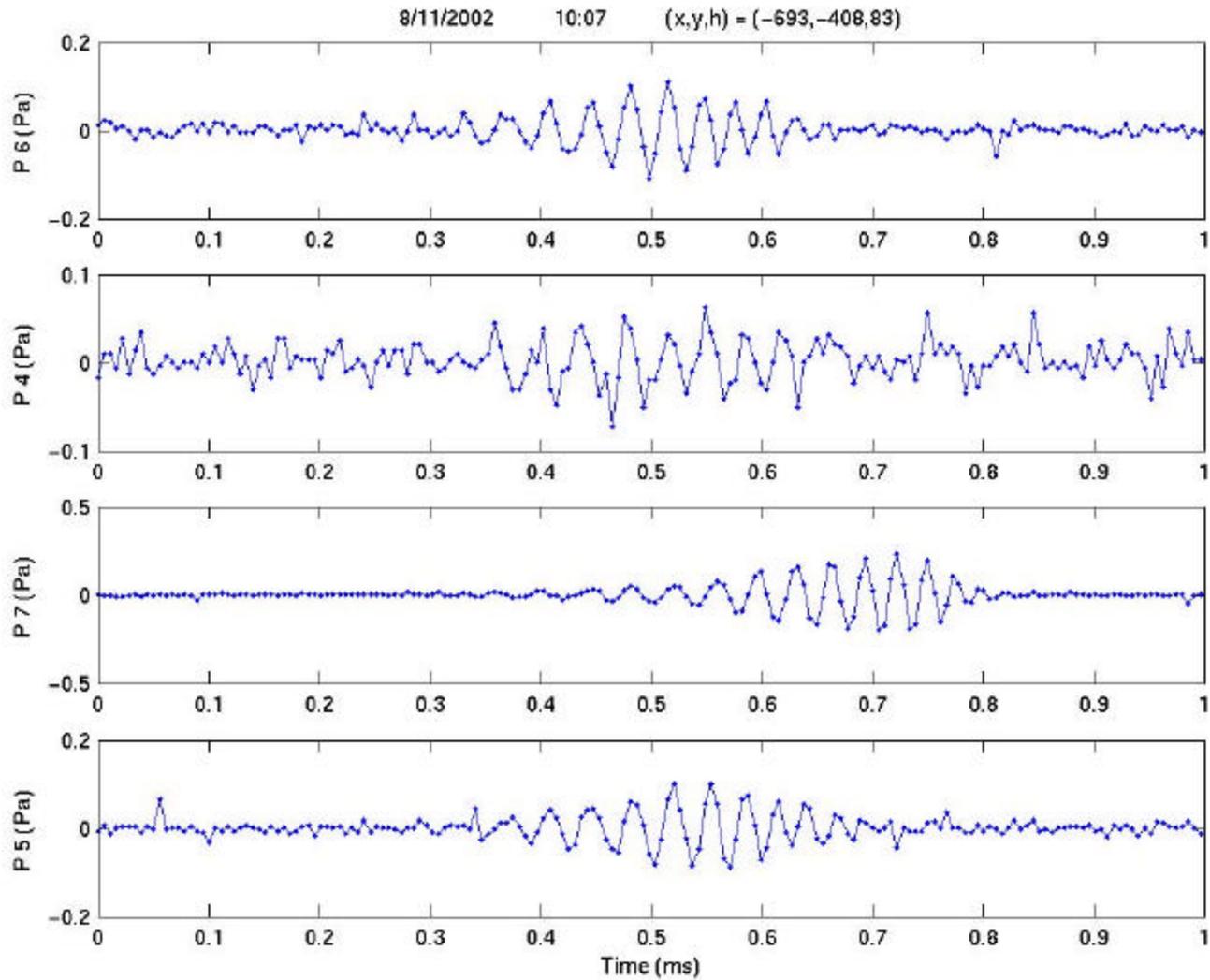
Event Depths
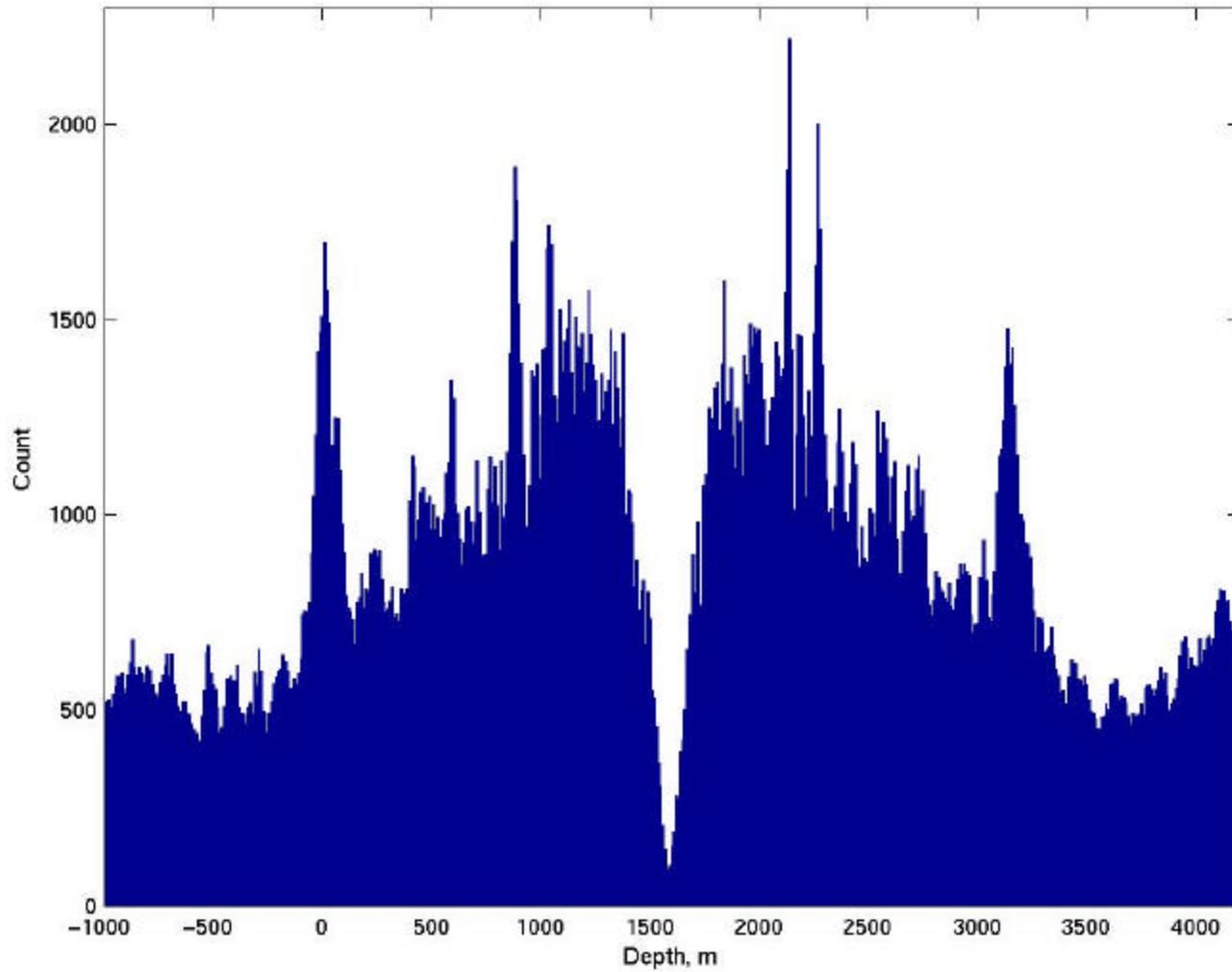
Spike Event

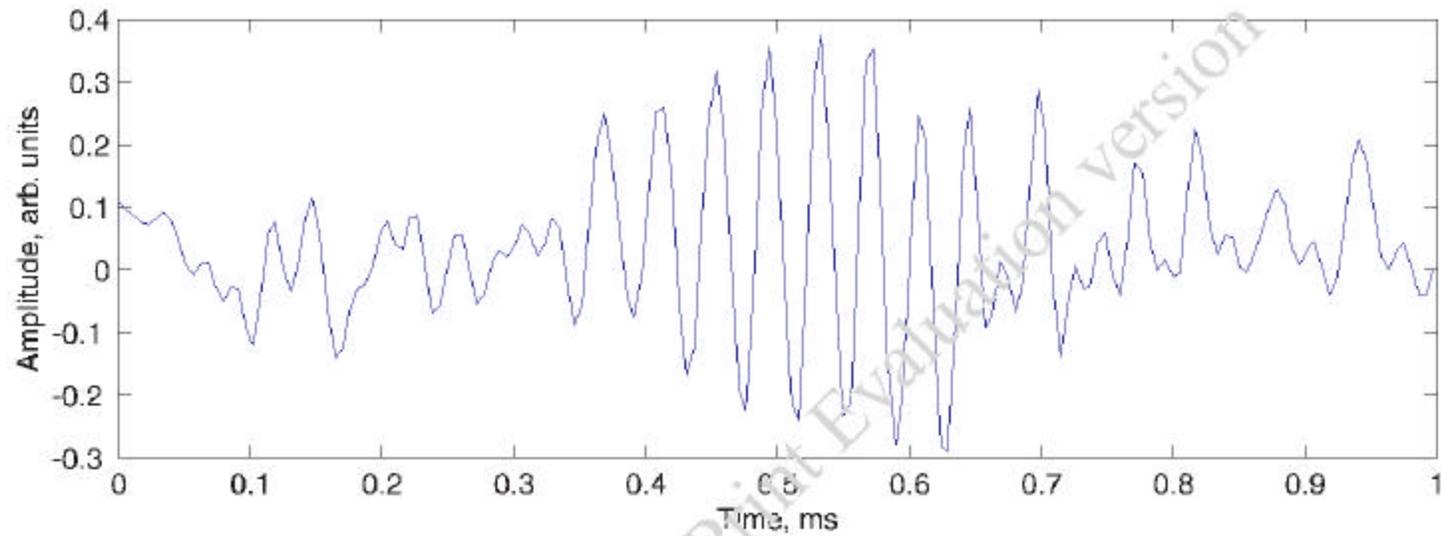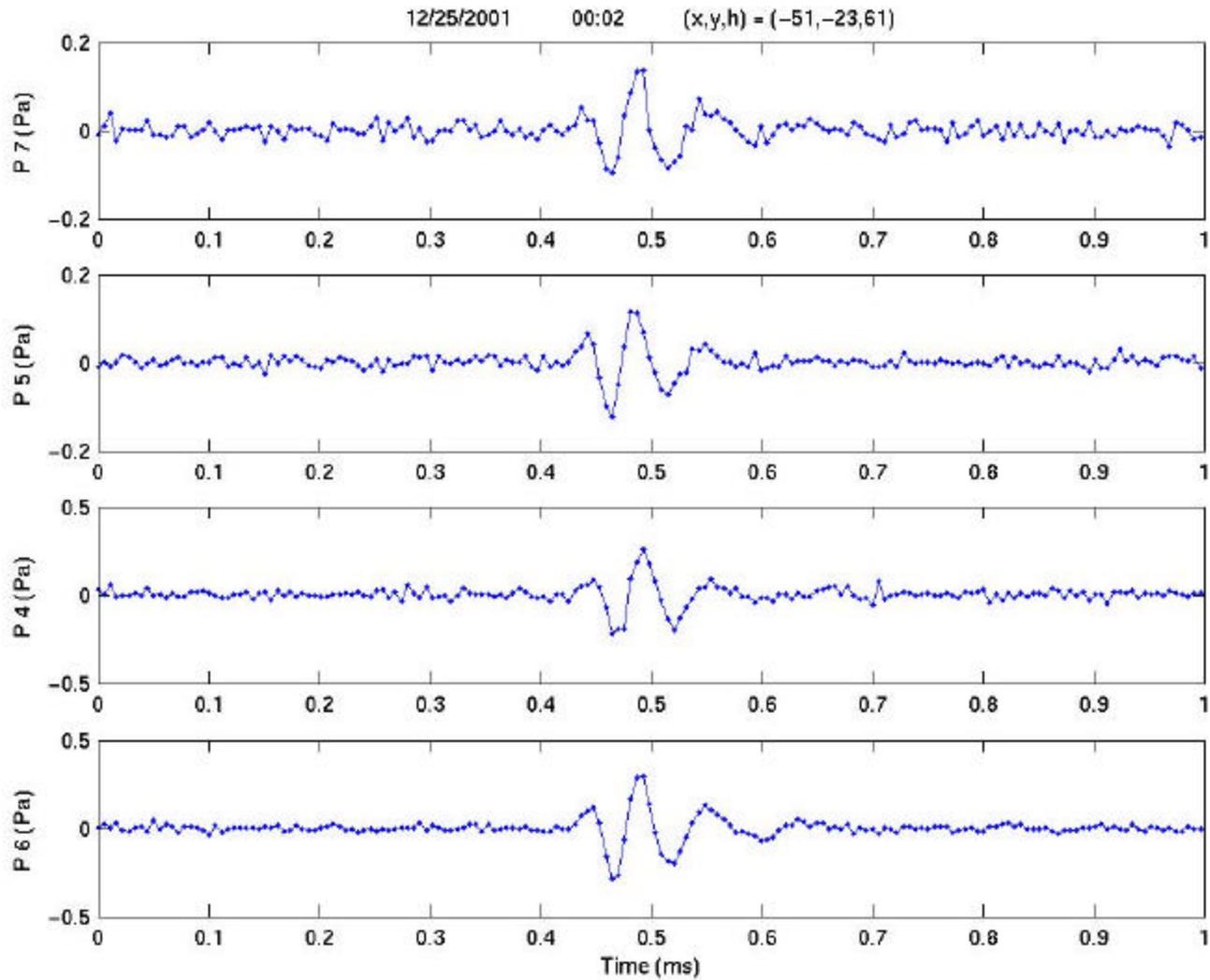# Ping Event
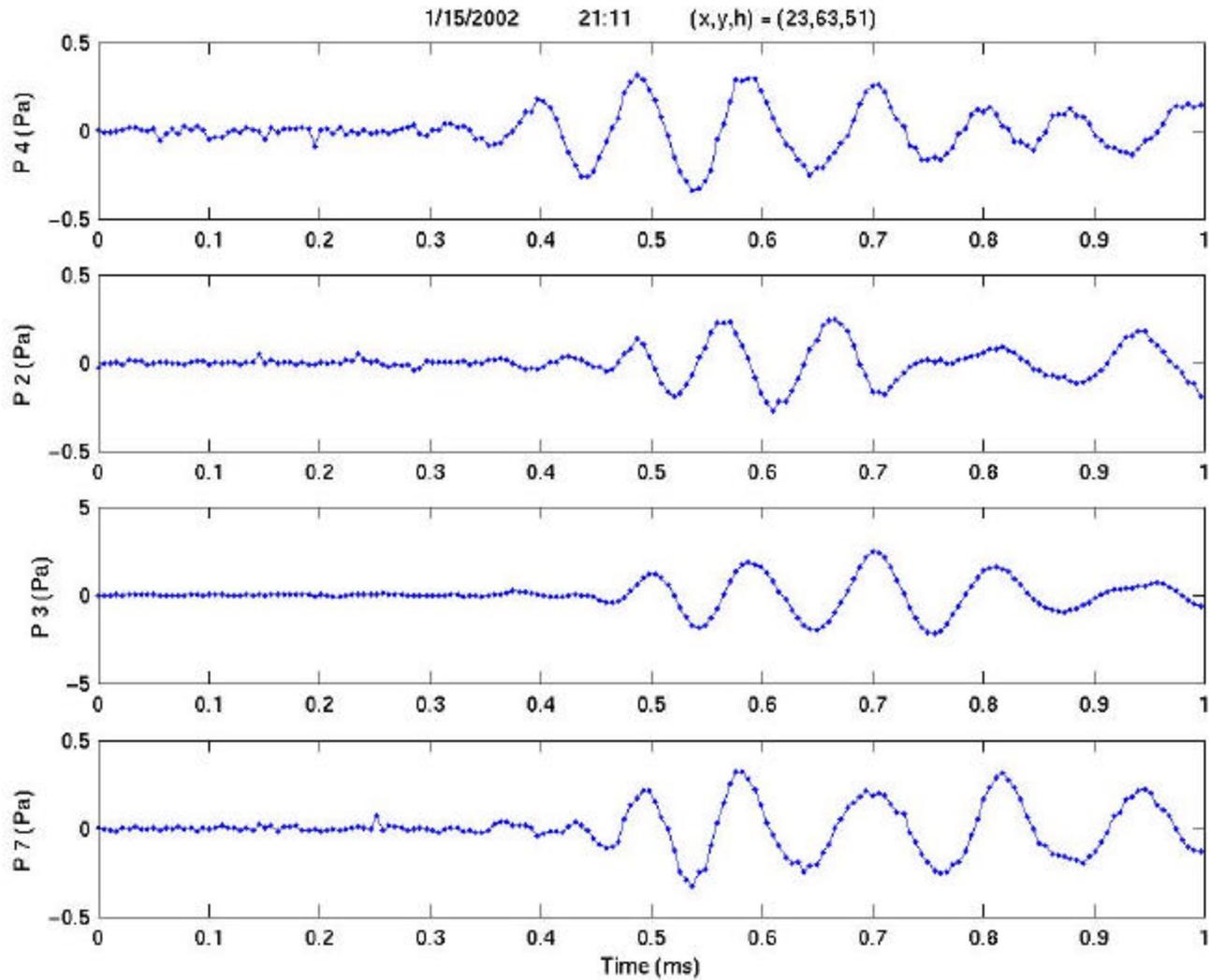
Diamond Event

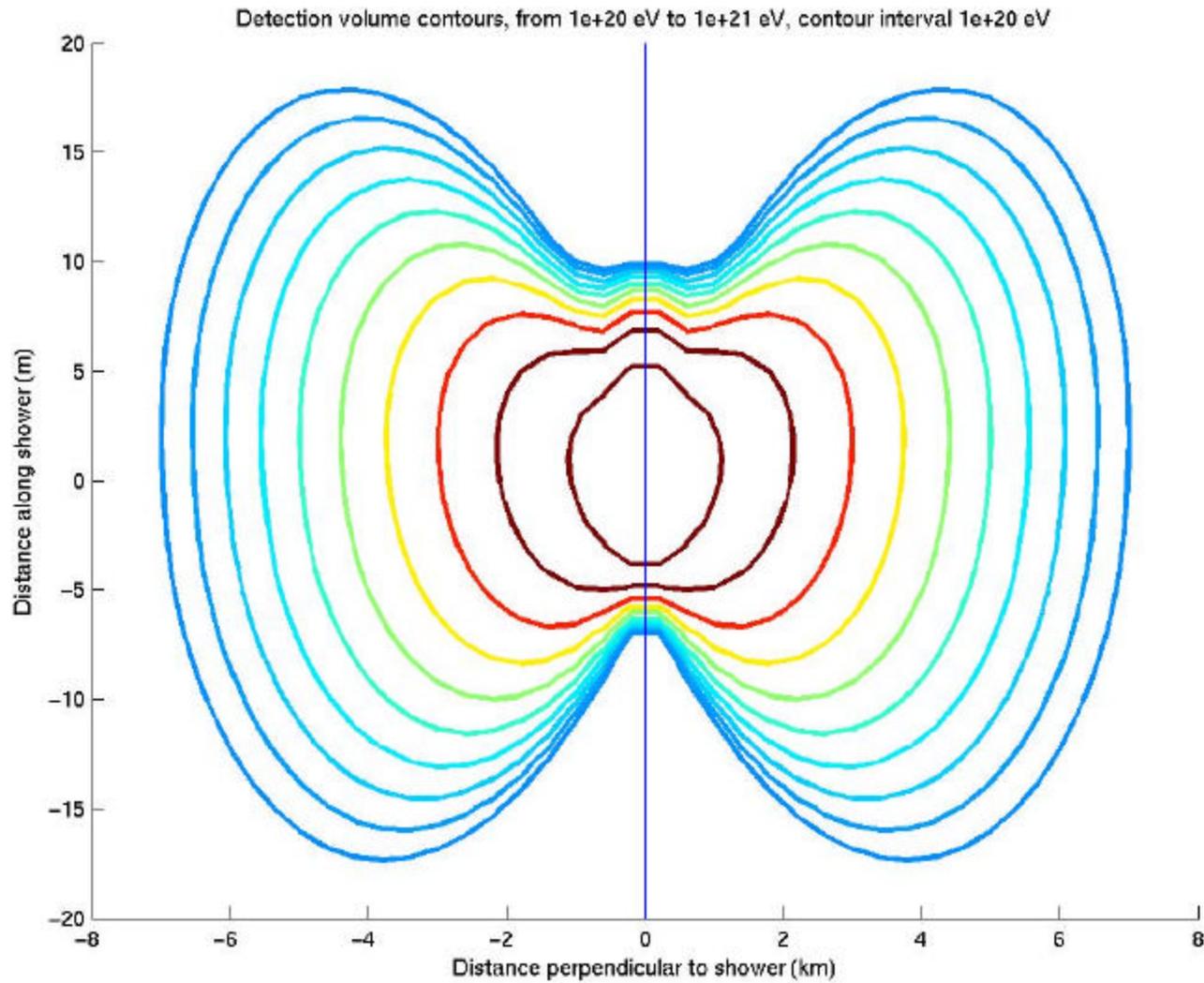# Examples of dolphin signals recorded by AUTEC personnel
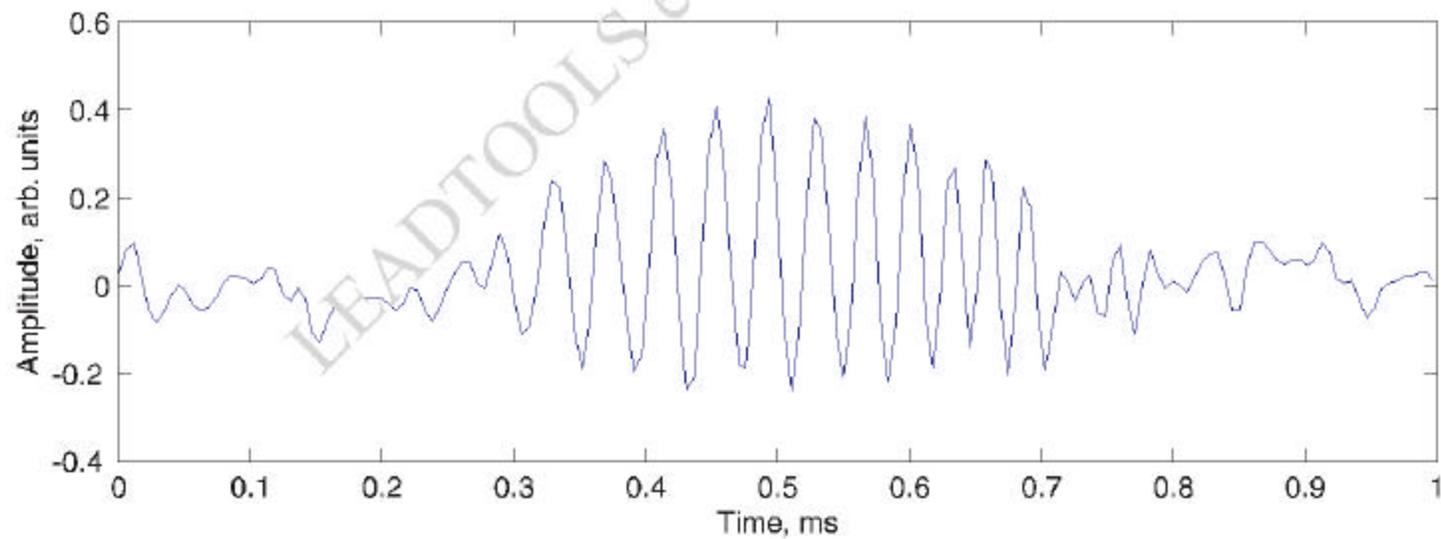
Candidate Event

Radiation / Detection Contours

Detection volume contours, from 1e+20 eV to 1e+21 eV, contour interval 1e+20 eV

Acceptance

Flux Limits