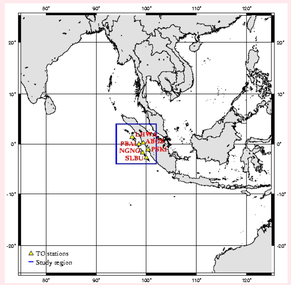
Seismicity in the Mentawai Region of Sumatra Using the Caltech Tectonic Observatory's Local Short-Period Seismic Network

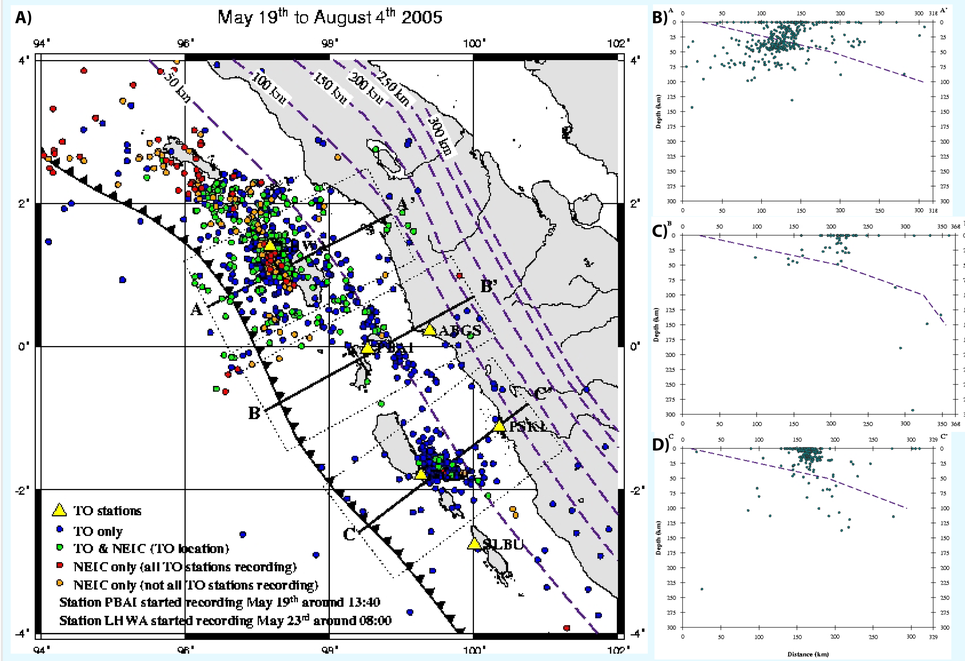
Natalia I Deligne, Robert W Clayton, Erik Hauksson
Seismological Laboratory, California Institute of Technology



OVERVIEW

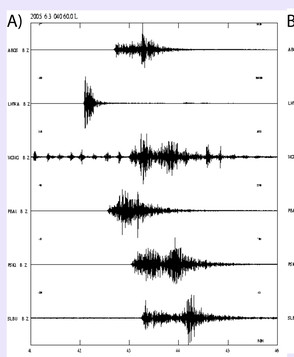
A small 6-station seismic array was installed in Sumatra by Caltech's Tectonic Observatory (TO) in May 2005. Each site, co-located with a GPS station, has an L4 1-Hz verticle seismometer recorded by a Nanometrics Taurus 24-bit logger. The data are continuously recorded on site and are retrieved every 3 to 5 months. Events are located using SEISAN. To date, 1094 earthquakes have been located for the period from May 19th - August 4th 2005. In general, for the entire study region (4N - 4S, 94E - 102E) only about 20% of the located earthquakes have also been located by the National Earthquake Information Center (NEIC), suggesting that background seismicity is far greater than previously estimated. In the region near Nyang Nyang island,the NEIC reports almost no events, but the TO stations pick up considerable activity. Most of the located earthquakes appear to be M4 - M5.

SEISMICITY LOCATION



A) All located earthquakes in the study region (4N - 4S, 94E - 102E) for the period from May 19th - August 4th 2005, with the locations for crosssections for figure parts B, C, and D indicated. TO stations are shown as yellow triangles. Events were located from TO waveforms using SEISAN, and a minimum of four stations had a signal for an event to be located. Events in blue are only located by the TO, green events are located by both the TO and the NEIC, while red and orange events have only been located by the NEIC. For most such events, however, at least one or two TO stations picked up the signal. Slab contours are based on global seismicity (Gudmundsson and Sambridge, 1998).
B) Cross-section across the northern portion of the study region. For this and the other cross-sections, only TO-located earthquakes are shown (i.e. blue and green events on location map).
C) Cross-section across the central region. Note the linear feature occuring about 200 km from the trench, going to a depth of 50 km. Although focal mechanism have not yet be done, such a linear feature suggests strike slip motion. Earthquakes not along this feature seem to match the suggested slab location pretty well.
D) Cross-section across the southern portion of the study region. There is a lot of activity at shallow depth above the presumed slab location. This region was selected fo the double difference relocation study (see below)

SAMPLE WAVEFORM DATA

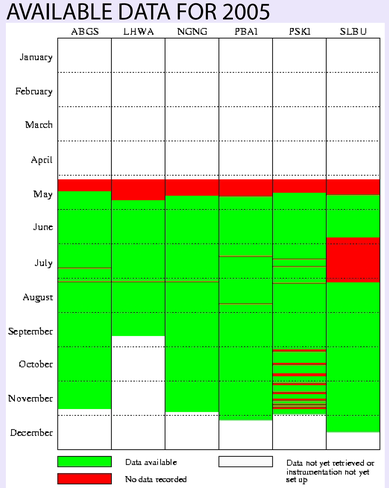


A) Example of event with high-quality signal. The NEIC reports this earthquake as having a magnitude of 5.8; the epicenter we obtained for this event is 1.579 N, 96.845 E with a depth of 19.3 km (the NEIC reports location / depth of 1.46 N, 97.15 E, 24 km). Note the regular spikes at station NGNG corresponding to the surf.
B) Example of typical data. This event was not located as less than 4 stations recorded a signal. Note the noise at station LHWA, the extreme noise at station SLBU (this is what most of the data from station SLBU looks like), and the regular spikes at station NGNG corresponding to the surf.

DATA QUALITY

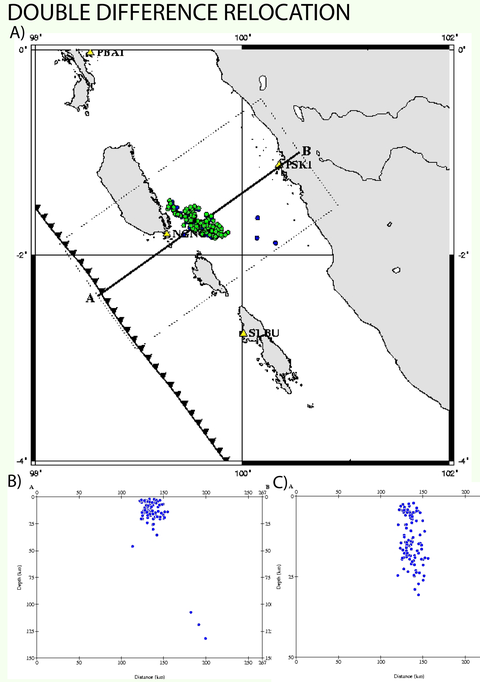
The two land-based stations (ABGS and PSKI) have the clearest signal. Proximity of an earthquake also strongly influences clarity of signal at a given station. Station PBAI has the clearest island-based signal. Station LHWA has a relatively good signal, and records numerous events, presumably to the north of the array, that are not recored by any other staions. Station NGNG records the surf at a nearby beach, while station SLBU is exceedingly noisy.

AVAILABLE DATA FOR 2005



White indicates there is no data available either because instrumentation was not yet set up or because data has yet to be retrieved, green indicates that there is data, and red indicates that the instrument was not recording.

DOUBLE DIFFERENCE RELOCATION



A) Earthquakes selected for the double difference relocation study. Blue circles correspond to the original SEISAN-based TO location, and the green circles correspond to the re-located epicenter. TO stations are yellow triangles, and the cross-section profile is indicated.
B) SEISAN-based location cross-section. The three deeper earthquakes are the three earthquakes outside of the main cluster on the location map.
C) Re-located events. Note the strong linear feature; although we do not yet have focal mechanism, this feature suggests strike-slip motion. If this activity is indeed strike slip motion, this would imply that the Great Sumatran Fault does not take up all the strike-slip motion along the Sunda arc; there is a component taken off shore closer to the trench.

FUTURE WORK

In the future, we plan to :
1) Update the current 1D velocity model, with the aim of eventually developing a 3D velocity model
2) Calibrate the amplitude from the stations to be able to determine earthquake magnitude.