Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02680, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02680
EGU General Assembly 2008

GPS-based inversion: A sensitivity analysis and application to past and possible events

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It is one of the goals of the German Indonesian Tsunami Early Warning System (GITEWS) to provide reliable information about expected arrival times, wave heights and inundation as quickly as possible to local warning centers in order to save lives and protect infrastructure. This is rendered difficult by the geomorphological settings in Indonesia: the trench is located closely to the coast, and the bathymetry is complex, including islands either protecting the main land or trapping tsunami energy in the forearc basin in case of a deep earthquake. Traditionally used tsunami source models based on epicenter and magnitude are not first choice: The epicenter does not necessarily coincide with the position of slip maximum, slip heterogeneities play an important role in the near-field, and the magnitude of large earthquakes is often underestimated during the first minutes. Thus, some events might not be recognized as being dangerous while at the same time the number of false alarms would be prohibitively high. These problems can be overcome using GPS, which is ideally suited for local Tsunami early warning.

In this study, we first use the tools 'RuptGen' to generate a set of realistic earthquake scenarios offshore Indonesia of varying size including displacements at GPS stations, and 'TsunAwi' to compute the corresponding tide gauge measurements. We then analyze the resolving power of different GPS array configurations in respect to earthquake size and noise levels. The same inversion technique is applied to recent Sumatra events. Finally, we present a possible scenario for the region of Padang and how well it could be detected.