

## **Summary of Break-out Group Discussions for**

### **Group 2: The 2004 Sumatra Tsunami and Non-Traditional Observations**

**and**

### **Group 5: Tsunami Warning Systems and Outreach**

It was decided right from the beginning that these two groups would merge, largely because we were meeting in the same room anyways but also because group 5 was quite small and there was considerable overlap in topics.

There were two themes in our discussion. One was the notion of using hydroacoustics (hydrophone arrays moored in the sound channel) to monitor landslide activity, in a similar fashion to the way seismic arrays are used to monitor earthquake activity. Landslides are the second most common source of tsunamis, often accompany large earthquakes, and play a role in the tsunamigenic behavior of earthquakes. Hydrophone arrays for T-phase studies are common place, and observe earthquake events about 2-3 magnitudes less than land-based seismic networks. Some basic research is still required since we still do not know the landslide "signature" on hydrophones in the sound channel. Some useful background information could be available for the 17 July, 1998 Java landslide from the Wake Island hydrophones, for the 28-29 July, 2006 Kamchatka tsunami, and for Hawaiian Bench Failures (Caplan-Auerbach).

The second theme was small tsunamis. The focus of warning systems is to detect and alert the public of large, potentially catastrophic tsunami events. Since these are relatively rare, tsunami research based on large events is sporadic with the most readily available funding immediately after a catastrophic event. Small tsunamis from small earthquakes and small landslides occur much more often and could be a useful resource in studying the physics of tsunamis in general. Research based on small tsunamis would be more amenable to steady funding.

Although we did not have time to prioritize them, the following is a list of potentially interesting and useful research topics:

- 1) The CTBT arrays in the Indian Ocean will continue to provide useful hydroacoustic data for studies similar to those by Salzberg and de Groot-Hedlin (see their posters). Research into the hydroacoustic signals from the 2004 Sumatran event and the March 2005 is encouraged.
- 2) Newman suggested that with existing satellite technology it should be possible to permanently survey an ocean basin for sea surface height and hence directly observe tsunamis. This would require geostationary satellites rather than the transit satellites, TOPEX and Jason-1, that observed the Sumatran event.
- 3) Tanioka-sama recommended further studies of ionospheric disturbances building on the work of Artru, Kanamori and others (e.g., *Geophysical Journal*, 2005, v160, p840).

- 4) Our group commends the efforts of the ORION group to install tsunamimeters, broadband seismometers and horizontal acoustic arrays on the global and regional permanent seafloor observatories (Titov). Okal mentioned that the 2033GMT July 23 2001 Peru tsunami could be observed on the prototype seafloor observatory at H2O. It would also be worth checking any existing tide gauge records for a tsunami generated by the 14 May, 1955 controlled source test (Wigwam).
- 5) Okal and Newman suggested using the GPS positioning data for the DART buoys to check for the relatively large horizontal motion (10-20m) of a passing tsunami in the deep ocean.
- 6) Titov recommended studying small tsunamis.
- 7) Salzberg and Newman recommended piggy-backing mid-ocean hydrophones and/or seafloor tiltmeters on the DART buoys.
- 8) It was recognized that the Gulf of Mexico (GOM) is an under-studied geographical region with potentially significant landslides and associated tsunamis. It would be relatively easy to add hydrophones near the sound channel axis on deep water (2000m) oil platforms. Ekstrom and Nettles have reported slow earthquakes occurring near the GOM that could possibly be associated with landslides. Salzberg mentioned that his company, SAIC, has at least land installations around the GOM that could provide infrastructure support.
- 9) Everyone is reminded that the USGS has up to 5 OBS's on stand-by for use in a "rapid response" mode (ten Brink). Of course ship time would also need to be arranged.
- 10) There are plans for extensive broadband OBS installations off Japan that could include tsunamimeters. These will provide terrific data sets for tsunami studies, but they would be even more useful if moored hydrophones were included in the network. Contacts include Hino-sama at Tohoku University, Kanazawa-sama and Koshimura-sama at the Earthquake Research Institute and Araki-sama at JAMSTEC.