2005 SCEC REPORT

SRCMOD: A DATABASE OF FINITE-SOURCE RUPTURE MODELS

http//:www.seismo.ethz.ch/srcmod

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Summary

Over the past two decades, near-source strong motion data, teleseismic waveforms and geodetic measurements have been used to infer the detailed distribution of slip on the rupture plane. The resulting finite-source images of earthquake rupture show that fault slip is spatially variable at all resolvable scales. The rupture complexity inferred from these slip distribution has important implications for the dynamics of the earthquake source, and hence for the resulting near-field ground motion. Detailed information about slip on the fault plane is also critical for studies on stress-triggering, for the scaling of the earthquake source and may help to shed light on the physics of rupture nucleation, propagation and arrest. A self-consistent dataset of finite-source rupture model is also needed to study the scaling of and relationships between dynamic source parameters.

In June 2004 we launched an Internet-accessible database of finite-source rupture models; the details of the file organization and structure of the database and the available information were described in the 2004 report, and are also available when browsing through the website. The experience and feedback from the first year of the website being online has been very positive and encouraging. From comments of users, but also from references to this web-site in papers and talks it is obvious that there is a large demand of such a compilation of earthquake rupture models. In general, the end-users accepted and liked the current data format and structure of the website, but requested minor additions and improvements.

The following report briefly summarizes the activities related to the source-model database in the past year, and gives some information to upcoming improvements. No accompanying proposal is submitted since we still have funds from the previous year and only minor changes and modifications are expected for the upcoming funding period.

Data Inconsistencies

For several source-rupture models there was apparently incorrect information given on the website, partly due to transformation errors from our side, partly also because data/parameters in the electronic files sent by the source-modeler were inconsistent with what has been published in the literature. In case of transformation errors, we have tried to weed out all mistakes as rigorously as possible, but some errors go perhaps still unnoticed. These will be corrected as they become know. The latter cases are difficult to handle since any researcher will first rely on the information given in the corresponding publication, and not necessarily trust in the online-resource of the data. On the other hand, there are also several instances where the source-modeling team changed/improved/updated their rupture model after the actual publication of the paper. In these cases we always refer to the latest version of a given rupture model. This will be accounted for in the upcoming update of the database by means of adding a time-stamp of "model-submission" such that it is clear whether a particular model has been modified after the actual publication of the work

Additional source-rupture models for recent events

When launching this website we had hoped that source-modelers will "quickly" and independently submit their rupture models to this web resource in order to make it available to the public. This is not the case, yet, and is due to the fact that many researchers/institutions maintain their own web-page of "recent earthquakes of interest" where in most cases images of some source-rupture model are displayed. Only in selected cases the actual digital data of the rupture model can be downloaded from a site. The obvious reason is that "intermediate" or "preliminary" source-rupture models are not intended to be widely disseminated, and the research groups rather wait with releasing the models until papers have been published. The downside is that many rupture models available online from event-pages will actually never make into a full publication (or only years later).

However, to at least provide some information on the latest source rupture models, we have included a link-section to new events, which takes the user to the respective websites of different researchers/institutions. This section is updated infrequently as of now, but will soon be more up-to-date and more visible.

Nevertheless, we have collected and compiled several new rupture models: for the 2004 Parkfield earthquake (M = 5.9), the 2004 Sumatra earthquake (M = 9.3), the 2005 Sumatra rupture (M = 8.7) and an additional slip-solution for the 2000 Tottori earthquake (M = 6.9). The data-files for these rupture models, however, have not been made available on the SRCMOD website because the relevant papers have not yet been published and certain information was not provided or could not be verified. These models, along with other slip solutions, will be made available online as soon as possible.

Additional source-rupture models from past earthquakes in Japan

Our 2005 proposals states that we plan to incorporate source-models from Japan that had been published in the largely inaccessible Japanese seismological literature in the past 2-3 decades. During a visit of M. Mai at University of Tokyo (ERI and EPS), S. Ide and in particular

K. Koketsu and co-workers were enthusiastic about this plan, since they had already started compiling a similar earthquake catalogue. Unfortunately, the interaction on this topic has slowed down considerable in the beginning of 2005, obviously because of the immense additional workload due to the Sumatra events in Dec 2004 and March 2005 (among other large earthquakes). We hope that a recent extended stay of S. Jónsson at ERI Tokyo (Oct/Nov 2005) refreshes the cooperation to the extent that we soon will be able to include the Japanese rupture models in the SRCMOD database.

Additional source-rupture models from published "images"

For many source-rupture models in the literature, digital data are not available anymore since the authors either lost their data or are not able to read them off old storage media. For such rupture models, only images are available. In contrast, some of the "rapid-response" source models released at certain websites are presented only as image-files, and the actual digital data cannot be accessed. We therefore proposed in our 2005 proposals to also include source models for which no digital source-representation is available by means of digitizing such source models. In these cases, the published source images will be scanned (or image-files downloaded) and, depending on the information contained in these images, subjected to different processing methods to extract the slip information. We tested this procedure for a few selected models of the 2003 Bam earthquake (Figure 1 shows a case study where we digitized a source model based on the plotted slip vectors), showing that this method is accurate to within about 10-20% for each subfault, while the overall moment is matched very closely. If contour plots of slip have been published, the source properties of interest can be extracted by digitizing the contour lines and then performing a two-dimensional bi-cubic interpolation of the field onto the desired grid points.

For the time frame Nov 2005 – Jan 2006 we have now found a student who will be working for us on digitizing a number of prominent source models from the literature, testing also different data-processing approaches to optimally extract the desired source properties. We expect that this undertaking will significantly augment the database of digital earthquake source information that otherwise would not be available to the public.

Update and maintenance of SRCMOD website

In its current implementation, the website is maintained through a number of data-files that contain the source-rupture information, and additional text files that hold entries on the "bulk" source properties (like seismic moment, location etc pp). The actual event-pages are then created from these data-files in an automated fashion based on several MATLAB-routines.

While this approach worked fine in the beginning, it turns out that it does not allow the desired flexibility in actually bringing the database online, updating model-specific information, or adding a set of recently published events. We therefore plan to move to a XML-based webpage development. To that end, we searched for (and found) a student who will be dedicating 4 months (Dec 2005 – April 2006) to develop the XML-based database, including also some additional meta-data into the source representation (e.g. sub-fault specific latitude-longitude-depth coordinates). We expect that this change in the data organization and preparation for web-publishing will further improve the SRCMOD database.

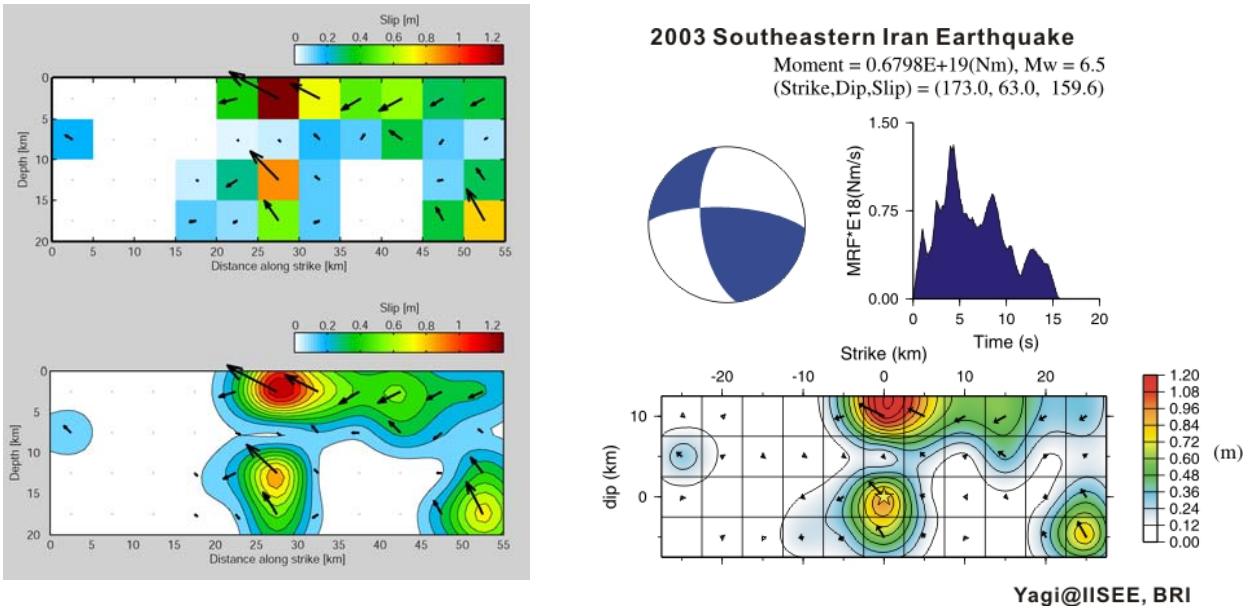

Figure 1 Top left: Slip distribution based on the digitized slip-map using the length of the slip vector (shown in the bottom right; this model is an online source model of the Bam earthquake on Dec. 26, 2003, as published by Y. Yagi). The figure at the bottom left displays a contour plot similar to the original slip map, indicating that this digitizing approach works very well.