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EARTHQUAKE HAZARD ASSESSMENTS FOR BUILDING CODES

Proposal Number: M18-057

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SECTION 0: PREFACE

Our last report was given in March 2001, as a letter to Dr. David O'Brien explaining the difficulties we face due to the unfortunate hostilities in the region. The main impact on the project is the slowing down of the progress. It has to be stressed that despite political difficulties and due to the well-recognized importance of our work, we managed to make some progress as presented in this report. Due to those circumstances, this report covers more than 6 months and yet, is issued as a semi-annual report, manifesting the great efforts we put in trying to go "as normal"

SECTION I: TECHNICAL PROGRESS

A) Research objectives

The overall aim and specific objective of the project is to produce maps and charts that will provide the necessary seismological data for the implementation of building codes and regulations in Jordan, Israel and the Palestinian National Authority.

During the reported period, we have completed two major objectives:

1. Compiling a unified catalogue of earthquakes.
2. Update regionalization of seismogenic zones and assessment of their seismic capabilities.

We further concentrated our efforts in initiating a wide spectrum of activities that will lead to:

1. Quantification of the impact of different codes on the structural design.
2. Development of scaling laws of dynamic source parameters of local and regional earthquakes and attenuation of seismic energy across the region.

B) Research accomplishments

During the first half of the project we have accomplished the following research goals:

- Compilation of the geological and geophysical information in Israel and in Jordan by the Geological Survey of Israel, The Geophysical Institute of Israel and the Geology Directorate of the Natural Resources Authority in Jordan.
- In compliance with the request of the reviewers of our original proposal, Interferometric synthetic aperture radar (InSAR), the only source of information for surface deformation in the Gulf region, was used to calculate pre-, co- and post-seismic deformation interferograms. This data, integrated with source mechanism and moment distribution based on inversion of teleseismic broad band waveforms, served to constrain a 3D numerical elastic model of the mainshock rupture. The model was used to calculate synthetic interferograms and to improve the estimation static source parameters by an iterative process of minimizing the differences between the observed and the synthetic interferograms. Finally, the static stress changes induced by the main shock were calculated, showing a very good agreement with the hypocenters of major aftershocks and suggesting a mild stress increase on the fault segment to the north of the main shock rupture plane.
- Compilation of a UNIFIED earthquake catalog for the period 1900 – 1999 (including unification of the magnitude scale).

- Develop a seismogenic zone scheme for the region (see attached).
- Assessment of the frequency magnitude relationship for each of the seismogenic zones.
- Intra-national discussions with the engineering communities in the Palestinian territories (ESSE), Jordan (NRA & Association of the Eng.) and Israel (GII & the Inst. of Standards of Israel).
- First stage analysis of strong ground motions (Israeli data) has been completed.
- Choosing of the attenuation function of Boore et al. (1994) to be used for preparing the code maps. These findings are to be verified by analyzing strong motion data from stations in Jordan.
- Software for data acquisition (GII-SDA) has been implemented on the systems used in the project.
- New software for data processing of the data acquired by the project (seismograms and accelerograms) has been developed. The program named SEISPECT is currently documented.
- The acquired ARCVIEW GIS software is used to display earthquake catalog data.

C) Scientific impact of cooperation.

During the reported period we held a meeting in conjunction with the RELEMR workshop in Barcelona in May 2001. During that workshop we had a course by Dr. Robert T. Sewell (formerly with Risk Engineering, Inc.) on "Understanding and Applying Probabilistic Seismic Hazard Analysis (PSHA)".

During the workshop we also shared our project results (mainly definitions of seismogenic zones and catalogue) with our colleagues in neighboring countries. The engineering survey performed by our cooperating team from the Palestinian National Authority was discussed in details among the RELEMR participants.

D) Description of project impact

The collaborating institutions have briefed their authorities about the project and its practical impacts. The importance of the project is highly appreciated at high-level authorities.

E) Strengthening of ME institutions

1. The strong motion accelerographs (ETNA manufactured by Kinnemetrics, California) were delivered to ESSE and to NRA and are in operation. No strong enough earthquake has occurred to trigger these systems.
2. Following the NRA's requirements for upgrading its national seismic network, GII has provided a PC based data acquisition system (GII-SDA) that acquires data from the national seismic network. GII has added new software for reformatting of the data to facilitate routine data processing by different s/w including the SEISAN. The system is in operation and provides seismic data.
3. As mentioned above, we had a course on probabilistic hazard assessments. Several ME institutions participated in the course.

F) Future work

The turmoil events in the Middle East disrupted our operations. As agreed between the participants and approved by the MERC program, we modified the project program and re-arranged some of the activities as follows:

1. Most of the interaction and communication will be made over the Internet. GII will build a site that will become a virtual meeting room for exchanging data and information and for presenting results and reports.
2. A detailed manual will be written for using the GII-SDA system and operating manual will be written for SEISPECT.
3. We have compiled enough data and information to start computing a seismic hazard code map that presents the PGA for 10% probability within 50 years exposure time. Drafts will be presented to the engineering communities for comments, during Summer 2001.

SECTION II : Project Management and Cooperation

A) Managerial Issues

1. Thanks to the active participation of Dr. Walter Hays, the project is fairly well integrated into the RELEMR activities. RELEMR activities are integrated in the project but are NOT financed by the project.
2. During 20 – 25 of May 2001, using the event of the RELEMR meeting, we met in Barcelona, Spain for discussions and exchange of reports and information.
3. In June/July 2001, our working group on engineering lead by Dr. J. Dabbeek will meet in Amman, Jordan.
Our working group on unifying an earthquake catalog, lead by Eng. A-Q Abdallah is preparing a map of epicenters for the period 1900-1999.

B) Special Concerns

We are very much concerned about the political situation in the region. We shall use any “window of opportunity” to complete the transfer of equipment and technical training.

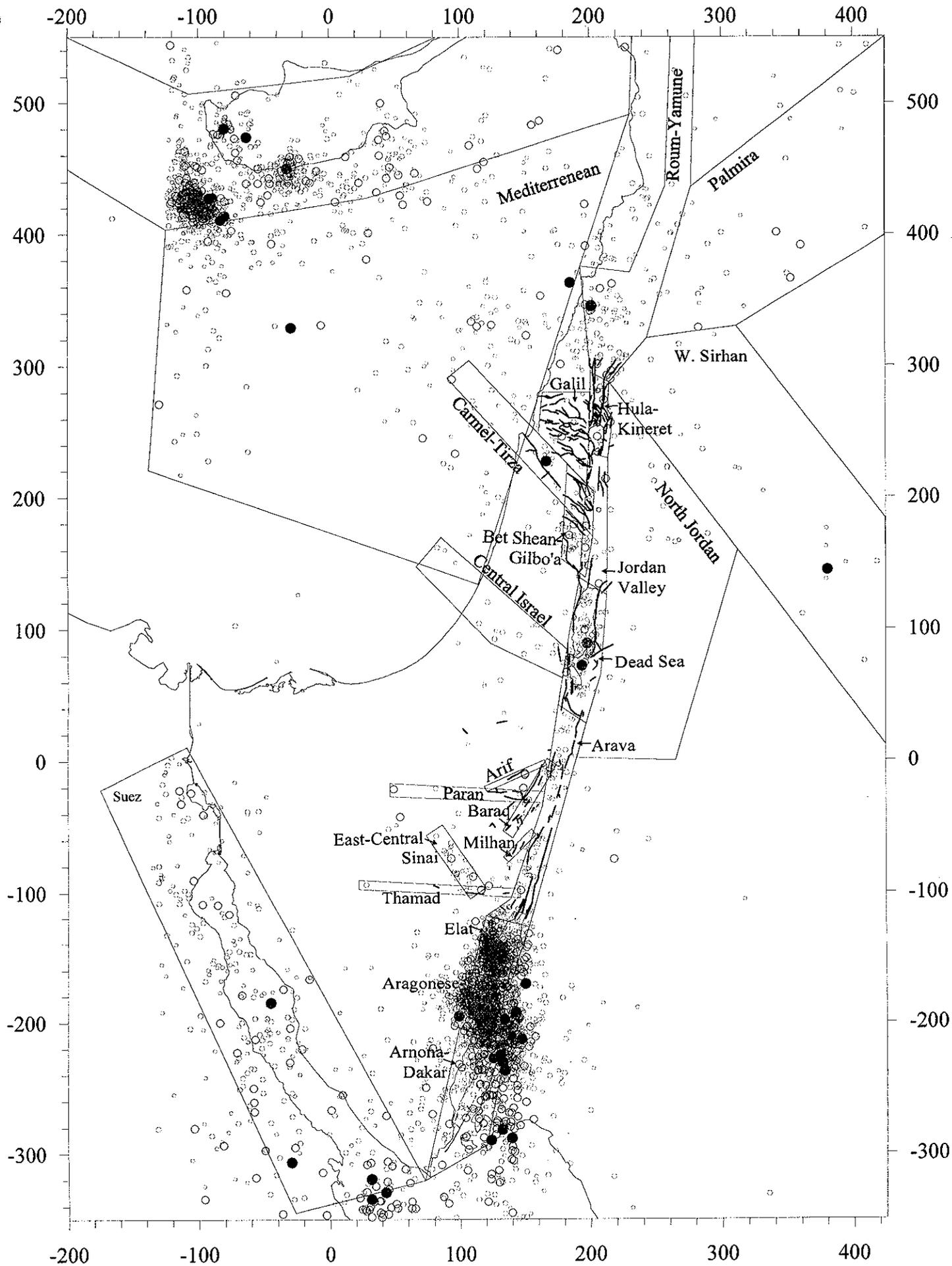
C) Cooperation, Travel, Training & publications:

Scientific results associated with the project are presented in the following publications:

- Shapira A., 2001. Hazard assessment practice in the Middle East and application to building codes. Abstract in RELEMR Workshop, Barcelona, May 2001.
- Hofstetter, A., 2001. New developments in seismic source zoning along the Dead Sea transform. Abstract in RELEMR Workshop, Barcelona, May 2001.
- Al-Dabbeek J. and A-H Jawhari, 2001. Palestinian common building and variations in building codes. Abstract in RELEMR Workshop, Barcelona, May 2001.
- Zaslavsky, Y., A. Shapira and J. Leonov, 2001. Insitu measurements of site effects at strong motion accelerograph station of Israel. Abstracts of Annual Meeting of the Israel Geological Society, Eilat
- Shamir, G., Y. Bartov., A. Sneh., L. Fleisher., V. Arad., and M. Rosensaft, 2001. Preliminary seismic zonation in Israel. GSI Rept. 12/2001 and GII No. 550/95/01(1).
- Leonov, J., Y. Zaslavsky and A. Shapira, 2001. In searching of suitable attenuation law for the region of Israel. Abstract in the RELEMR Workshop, May, 2001, Barcelona, Spain.
- Baer, G., D. Sandwell, S. Williams, Y. Bock, and G. Shamir. 1999. Coseismic deformation associated with the November 1995, Mw=7.1 Nuweiba earthquake, Gulf of Elat (Aqaba), detected by synthetic aperture radar interferometry, J. Geophys. Res., 104, 25221-25232, 1999.
- Baer, G., G. Shamir, D. Sandwell, and Y. Bock, Coseismic and postseismic deformation associated with the November 1995, Mw=7.1 Nuweiba earthquake, Gulf of Elat (Aqaba), analyzed by Interferometric Synthetic Aperture Radar (InSAR) and elastic modeling, in 27th General Assembly of the European Seismological Commission, p. 37, Lisbon, 2000.

- Baer, G., G. Shamir, D. Sandwell, and Y. Bock, Crustal Deformation During 6 Years Spanning the $M_w=7.2$ 1995 Nuweiba Earthquake, analyzed by Interferometric Synthetic Aperture Radar (InSAR), Submitted to Isr. J. Earth Sci.

D) Request for USAID actions
No requests



Shamir et al., Preliminary Seismic Zonation in Israel, GII Rep. No. 550/95/01(1), 2001