

Meeting Summary of the Task Group "Seismic Scattering and Heterogeneity" of IASPEI Commission on "Seismological Observation and Interpretation"

During the IUGG assembly, the task group meeting was held at "Royton Sapporo" on Tuesday, July 1st, 18:30-19:30. There were 11 participants from the world. The attendances are M. Fehler, M. Korn, J. Przybilla, K. Yoshimoto, S. Matsumoto, A. Petukhin, H. Nakahara, A. Jin, J. Kawahara, Y. Murai and H. Sato. Sato chaired the group meeting on behalf of the task group leader, Rushan Wu because of his absence.

The agenda of the group meeting:

1. Scientific activity in IUGG 2003
2. Present status of the task group
3. Reports of local activities
4. Possible directions in future

We may summarize each topic as follows.

1. Scientific activity in IUGG 2003 In the afternoon of July 1 in the SS01 symposium (Convener, J. Havskov), we had a half-day session on seismic wave scattering and attenuation. Sato and Fehler (as Wu's proxy) served as chairpersons of the session. In the program there were 14 oral presentations of which four talks were cancelled. There were several presentations related to this topic in the poster session, too. Presentations include a comparison of numerical simulation of wave field in random media and the direct envelope synthesis. There was development in the use of seismic array data for the study of medium heterogeneity. The spectral range of reported studies becomes wider from surface waves of 100sec to body waves in several tens of Hz. These presentations reflect recent developments of high-power computers and accomplishment of high-density digital seismic networks. There were active discussions in the session.

2. Present status of the task group

a. At a task group meeting of IUGG in Birmingham, we started a book project as a summary of recent development in this field. Wu and Maupin are now editing a book entitled "Advances in Wave Propagation in Heterogeneous Earth". According to an e-mail from Wu, he is now contacting with some publishers for publication. Tentative table of contents is as follows:

(1) Valerie Maupin and Barbara Romanowicz: "Introduction to mode coupling methods for surface waves and free oscillations"

(2) Cervany, Klimes and Psencik: "Progress in Ray theory" (tentative) (includes: "High-frequency asymptotes for weakly anisotropic media" and "Velocity models, ray chaos and inversion")

(3) Robertson and Holliger: "Progress in finite difference modeling in visco-elastic media" (tentative)

(4) Bouchon and Chavez: "Progress in boundary integral equation modeling"

(5) Xiao-fei Chen: "Seismic wave propagation and excitation in multi-layered media with irregular interfaces"

(6) Ru-Shan Wu: "Generalized screen propagators applied to high-frequency wave propagation in complex crustal wave guides"

(7) J. Vilotte, D. Komatitsch, E. Chaljub and Y. Capdeville: "Spectral element analysis in seismology"

(8) Haruo Sato: "Synthesis of seismogram envelopes in heterogeneous media"

b. Goff and Holliger wrote a book entitled "Heterogeneity in the Crust and Upper Mantle - Nature, Scaling and Seismic Properties" (Kluwer Academic/Plenum Publishers, 2002). Sato, Fehler and Wu wrote a chapter on scattering and attenuation in the IASPEI handbook.

c. Based on the task group meeting with Wu at the IASPEI in Hanoi, we opened a web site "Scattering and Heterogeneity in the Earth" from Nov. 1, 2001: <http://www.scat.geophys.tohoku.ac.jp/index.html>. It has served as a channel for exchanging information. At present, it has following contents: information, recent publications including pdf files, lecture notes including pdf files and ppt files, references, collection of computer codes, etc.

3. Reports of local activities

a. J. Kawahara reported scientific activities in Japan. Since 1995, Japanese researchers on seismic scattering and heterogeneity have been holding workshops every financial year at Earthquake Research Institute, the University of Tokyo. The workshops have been financially supported by the "E. R. I. Cooperative Research Programs". The titles of the past workshops are "Scattering and attenuation of seismic waves" (Dec. 6-7, 1995 / Jan. 16-17, 1997, Convener: Haruo Sato), "Small-scale inhomogeneous structure and its wave-theoretical effects" (Jan. 13-14, 1998 / Jan. 12-13, 1999 / Jan. 20-21, 2000, Convener: Satoshi Matsumoto), and "Small-scale inhomogeneous structure and radiation characteristics of high-frequency seismic waves" (Dec. 11-12, 2000 / Jan. 8-9, 2002 / Dec. 16-17, 2002, Conveners: Masahiro Kosuga and Kiyoshi Yomogida). Their programs and abstracts (in Japanese) are put on the web site, <http://www.eic.eri.u-tokyo.ac.jp/viewdoc/index.html>. Through the workshops, the members have been discussing scientific issues and exchanging information and opinions. A recent remarkable achievement of this activity is a publication of a special issue: Kosuga, M. (Ed.), Special issue entitled "Small-scale heterogeneities in the lithosphere and scattering of seismic waves", Zisin (in Japanese), 54, 63-249, 2001. A new program "Toward the physical interpretation of small-scale inhomogeneous structure of the lithosphere" (convener: J. Kawahara) has just started.

b. A workshop entitled "Quantitative Prediction of Strong-Motion and the Physics of Earthquake Sources" was held at Tsukuba, Japan (Conveners: S. Kinoshita and R. J. Archuleta) in Oct. 2000. It was sponsored by IASPEI and scattering approaches to strong motion were presented. Sato and Niitsuma convened a workshop on "Seismic Waves in the Heterogeneous Earth: More Applications to Seismology and Exploration Geophysics" in Sendai, Japan on July 10, 2003 (<http://www.scat.geophys.tohoku.ac.jp/Workshop0710programE.pdf>).

4. Possible directions in future

We discussed about the possible future directions of this task group. We discussed about ideas for having a session on this subject in the next IASPEI meeting. The comments raised at this meeting are summarized as follows:

a. To encourage more study of lithospheric heterogeneity by using high density digital networks and arrays. To develop array analysis methods and theoretical methods to simulate high-frequency seismograms.

b. To put more focus on volcanic environment having strong heterogeneity and mantle heterogeneity. Heterogeneity of various scales can be revealed from analyses in various frequency bands.

c. In addition to observational and theoretical approaches, it is necessary to develop experimental approach for the study of medium heterogeneity and anisotropy.

d. It is very necessary to establish a reference scattering model of the heterogeneous earth in various scales. First, a compilation of scattered data should be done. For example, systematic analysis of scattering coefficient, coda Q, and/or spectra of medium inhomogeneity in different regions in the world.

e. To encourage writing a guide or a textbook in an easy style introducing to this field of science for new comers. It might be better to distribute codes and utilities for analyzing seismograms. The scattering web site might be useful for this purpose.

f. To maintain a constructive relation with AGU, EGS, SEG, EAGE, SSA and other regional, professional associations by co-sponsoring some symposia, workshops and training courses of common interests. Snider, Campillo, and Fehler are now proposing to have a session "Novel ways for analyzing the seismic coda" at the Fall 2003 AGU meeting.

g. To encourage more collaboration with scientists in exploration geophysics and acoustics.

h. It is the time to start to edit the next progress report of this field. First, we will ask scientists in the world to summarize recent progress in various fields related with seismic wave scattering and earth medium heterogeneity.

The task group meeting was adjourned after one hour discussion. The members will keep in touch each other and exchange ideas about the above subjects by e-mail.