28th Workshop of the International School of Geophysics

5th International Workshop on Statistical Seismology: Physical and Stochastic Modelling of Earthquake Occurrence and Forecasting

(EMFCSC, Erice, Sicily, 31 May - 6 June, 2007)

INITIAL ANNOUNCEMENT AND CALL FOR MAILING LIST REGISTRATION

Workshop Motivation

The area of Statistical Seismology is evolving rapidly, in part because of several recently funded large-scale projects on testing, forecasting and time dependent hazard (NERIES - Network of Research Infrastructures for European Seismology & SAFER - Seismic Early Warning for Europe in the EU, CSEP - Collaboratory for the Study of Earthquake Predictability in California). It is also evolving as new models and ideas are developed in the community. Statisticians dealing with seismology are making more and more use of physical modelling, and seismologists dealing with physical processes are making more and more use of statistical tools. The Statsei workshops are opportunities for the community to reflect on the current state of the art and define future directions and needs. Statsei V will bring together statisticians interested in earthquakes and seismologists with backgrounds in seismicity analysis and modelling. The workshop will focus on •creating and testing of earthquake forecast models, •the need for community supported testing centres and software developments, •time-dependent earthquake hazard assessment, •the study of earthquake predictability and •the need for a system-level science approach.

Workshop Format

The workshop will feature both thematic sessions, each of which introduced by keynote speakers, and workshop style meetings of the international CSEP community and the NERIES-JRA2 and SAFER WP5 communities.
Ample time will be allocated to open and/or panel discussions. Poster sessions could be organized, along with very brief overviews from contributors.
Half day will be left free or devoted to a guided excursion.

Venue and Dates

The workshop will be held at the "Ettore Majorana" Foundation and Centre for Scientific Culture (EMFCSC) in Erice (Sicily), Italy from Thursday, May 31 to Wednesday, June 6, 2007 (http://www.ccsem.infn.it/). The Erice site is quite special and, together with the target audience of ~80 attendees, very conducive to making connections and forming creative new collaborations.

Co-ordinator: Prof. E. Boschi
Department of Physics, Università di Bologna,
& President, Istituto Nazionale di Geofisica e
Vulcanologia, (INGV), Rome, Italy

Programming Committee: Prof. E. Boschi, INGV, Rome, Italy
Prof. R. Console, INGV, Rome, Italy
Dr. M. Cocco, INGV, Rome, Italy
Dr. S. Wiemer, ETH, Zürich, Switzerland

Advisory Board: Dr. M. Cocco, INGV, Rome, Italy
Prof. R. Console, INGV, Rome, Italy

Dr. W. Marzocchi, INGV, Bologna, Italy
Prof. Y. Ogata, Institute of Statistical Mathematics, Tokyo, Japan
Prof. D. Schorlemmer, USC, Los Angeles, CA, USA
Prof. D. Vere-Jones, Victoria University of Wellington, New Zealand
Dr. S. Wiemer, ETH, Zürich, Switzerland

Sponsors and Collaborations:

- Istituto Nazionale di Geofisica e Vulcanologia (INGV), Rome, Italy
- Institute of Statistical Mathematics (ISM), Tokyo, Japan
- Swiss Seismological Service, Institute of Geophysics (ETH), Zürich, Switzerland

Thematic Sessions

1. THE NATURE OF EARTHQUAKE OCCURRENCE PROCESS AND PHYSICAL CONSTRAINTS ON ITS PREDICTABILITY

Earthquakes have been often classified as organized criticality processes. What degree of predictability have phenomena of this kind and earthquakes in particular? Do long, intermediate and short-term precursors have a meaning and a role in this kind of classification? Moreover, one of the key issues of forecasting is the need to fit some modelling or interpretation of past data for the region under study. Can this be done without the intervention of a statistical model and, if a statistical model is needed, what form might it take if the underlying process has a chaotic/complex behavior? Some complex models imply that a constant background seismic activity cannot exist, while many forecasting models require it; empirical analyses have shown that the seismicity rate is in some cases continuously changing and is conditioned by the past earthquake occurrence. Is the constant background rate a real physical concept? In this case, how is it possible to estimate it in an objective way?

2. SETTING UP EARTHQUAKE FORECASTING MODELS

2.1 Statistical earthquake forecasting models

ETAS model is the most diffuse time-dependent statistical model that has been used in earthquake forecasting. Are there alternative statistical models to it? Do large and small earthquakes have the same distribution? If they do not, what is the range of applicability of any distribution? What is the physical meaning of the ETAS parameters?

2.2 The role of faults interaction and nucleation into forecasting models

Fault interaction through stress redistribution and earthquake nucleation and triggering through physically-based models are currently adopted to model seismicity patterns and the changes in the rate of earthquake production. These models have been proved to reproduce the seismicity rate changes in different tectonic areas worldwide. Are they useful to compute earthquake probabilities? Are they suitable for earthquake forecasting? Should they be validated with real-time applications? Moreover, if any earthquake can trigger other seismic events, are these physically-based models able to catch the changes in seismicity rates?
Source scaling relationships have been proposed and provide useful statistical tools. Is the earthquake process self-similar and in what magnitude range? Is the magnitude of a future earthquake predictable? Is a large earthquake the union of many aftershocks occurring in a time window that is too short for

the resolution of our observation means, and does it evolve in a common aftershock sequence?

2.3 The use of synthetic simulators

Simulators like cellular automata have been developed and proved to generate detailed space-time earthquake distributions that resemble quite accurately real catalogs, including foreshocks, mainshock and aftershocks series, spatial migration, seismic gaps, etc. Do they prove that real earthquakes behave in this way and are they applicable in prospective way?

3. VALIDATION OF EARTHQUAKE FORECASTING MODELS

3.1 Validation of space-time modelling

Several methods for validating earthquake forecasts have been proposed: probability gain, likelihood ratio, binary ROC, Molchan diagrams, etc. Prerequisites of validation are fully specified natural laboratories, including data streams, forecasts, rule sets, and testing procedures. Tests need to be carried out in truly prospective way. The definition of null hypothesis models for different classes of forecast models is also critical. Do we distinguish between forecasts and predictions?

3.2 Validation of the Gutenberg-Richter model

The G-R distribution is one of the most common hypothesis assumed in earthquake statistics. Nevertheless the range of validity of this law has very well-known limits, both in the low and in the high magnitude ranges. The characteristic earthquake hypothesis is clearly in conflict with the G-R law in the high magnitude range and the concept of self-similarity of earthquakes in general. Other questions concerning the G-R law are possible spatial and temporal variations of the b-value. In particular, time variations of the b-value have been considered as precursors of large magnitude earthquakes. Recently, new interest has been devoted on the old question of Bath-law, and whether this law reflects some physical property of the seismicity, or it is just a consequence of the G-R law and of the parameter "alpha" characterizing the aftershock productivity.

3.3 Data, computing power, and software: future needs of the community

The emergence of testing centres has highlighted the need for quality controlled and authoritative data streams (e.g. earthquake catalogs), standardization in data exchange procedures (e.g. XML-based standards), community supported, interoperable and open-source software developments and documentation, and access to high performance computing resources. In many large-scale projects, new software tools are deliverables and the notion that these tools should be available under open source licenses has been accepted in general. How can we as a community coordinate developments and ensure interoperability? How can we ensure the best possible usage of available resources? What tools are missing and how can we achieve their development?

4. LIVING IN AN UNCERTAIN WORLD: INTERFACES STATISTICAL SEISMOLOGY WITH OTHER SCIENCES AND SOCIETY

Seismology is moving towards increasingly complex forecast models, which are inherently probabilistic. This is true, for example, for probabilistic seismic hazard assessment, time-dependent hazard assessment, rapid damage and loss assessment or earthquake early warning. The increasing importance of

statistical seismology is partially due to the needs of seismologists to contribute to decisions of high societal importance, based on highly uncertain models. We need to address, as a community, several key issues: How do we evaluate and validate such complex models and communicate them to other scientists, decision makers and the public? How can we find the sustained funding to support the long-term efforts in testing, model development and maintenance? How do we network ongoing experiments in earthquake early warning, forecasting and validation worldwide and who does interface them with society? How can we contribute to a system level science approach, centred on selected natural laboratories?

Deadline for mailing list registration: 30 November 2006

To receive our forthcoming first circular with a finalized list of speakers and detailed information in December 2006, we kindly ask you to send an email message to: silvia.nardi@ingv.it by 30 November 2006, specifying your name, institution, country, and e-mail address.