# JAPAN CSEP Testing Center –Progress report –

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# Summary of progress

- Set up Testing Center in Japan
- Meetings and Make rules
- Model implementation in Japan Testing Center and CSEP 10.1.0 software installed
- Completeness study  $\rightarrow$  Nanjo-san
- 1<sup>st</sup> testing started
  - The first result will be reported in May 2010

# National earthquake prediction research programs in Japan

- Selected focuses of the previous program (2004–2008)
  - Forecast simulation technology
  - Understanding of physical mechanism
  - Observation
  - Other important activities
- In addition to the existing activities, a new focus of the current program (2009-2013)
  - To create earthquake forecast systems
    - Buildup testable forecast models
    - Creation of framework that can "rigorously test" such models
    - Other activities ...

### Our target: Earthquake forecast system

- Establish an earthquake forecast testing center to support activities such as
  - Refine "reference models"
    - Based on the currently available knowledge and technology, which can be used for creating null hypotheses
  - Look for a next-generation practical models
    - Based on more sophisticated physics and statistics of earthquakes
    - Based on integrating existing data and technology
  - Create a framework to objectively validate and test submitted forecast models

### Collaboratory for the Study of Earthquake Predictability (CSEP)

- ERI jointed in CSEP
- (Cyber-) Infrastructure for test environment
- Prospective forecast
- Predefined "Rules of the Game"
- Use of standardized forecast evaluation methods
- Objective test: A modeler is not equal to a tester
- Use of authorized catalog for future events
- ERI invited Danijel & Fabian and setup CSEP environment in ERI



http://www.cseptesting.org/

### Machine specifications



# **CSEP** software

- Use Simple design
- Utilize open-source software(  $\rightarrow$  low-cost)
- Put the system under test to ensure reliability and to make the system easier to change
- Language
  - Python
  - Fortran, C, Java
  - PHP
  - Matlab
  - R (for Japan CSEP)
- Parameter description
  - XML

# Preparation for the 1st earthquake forecast testing experiment for Japan

- International
  - symposium on "Toward constructing earthquake forecast systems for Japan"
    - <u>http://wwweic.eri.u-</u> tokyo.ac.jp/ZISINyosoku/
    - Invitees
      - D. Schorlemmer
      - J. Zechar
      - W. Marzochi
    - Mar 27-28, 2009

### Contests

- Mutual understanding among experiment participants
- Definition of "rules of the game"
  - Testing classes
  - Testing regions
  - And others

### **Testing classes**

- Forecast time windows
  - 1 day  $(4 \le M \le 9)$
  - 3 months ( $4 \le M \le 9$ )
  - 1 year ( $5 \le M \le 9$ )
  - 3 years  $(5 \le M \le 9)$
- Point
  - Shorter time-window lengths than the forecast time-window length (30 years) of the national seismic hazard

#### Seismiciy of Japan (left: ALL catalog, right: (H<30km)



## **Testing regions**

- All Japan (d ≤100km)
  - Grid spacing s=0.1 degree
  - Targets: Earthquakes in inland and subduction areas
- Japan's mainland ( $d \leq 30$ km)
  - *s*=0.1 degree
  - Targets: Inland earthquakes
  - Fault-based models are applicable
- Kanto (*d* ≤100km)
  - *s*=0.05 degree
  - Targets: Complicated seismicity beneath Kanto
  - Higher resolution



# Models

Testing region	Testing class				
	1 day	3 months	1 year	3 years	Total
All Japan	5	9	12	9	35
Mainland	2	7	11	7	27
Kanto	4	7	8	8	27
Total	11	23	31	24	89

- Models
  - Seismicity-based models:87
  - Seismicity-based models with Coulomb stress:2
- Submission
  - Japanese institutions:69
  - overseas institutions:20

Report on earthquake forecast models registered to the 1<sup>st</sup> CSEP experiment for Japan

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Last modified on 11 January 2009

#### Nanjo et al. (2010)

#### Snapshot images for 1-year test class



- 1. Triple-s-Japan (Zechar)
- 2. MRI (Hirose & Maeda)
- 3. Coulomb (Toda & Enescu)
- 4. MARFS (Smyth)
- 5. MARFSTA (Smyth)
- 6-9. RI (Nanjo)
- 10. PPE (Rhoades)
- 11. EEPAS (Rhoades)

## ETAS model, ogata (ISM)



Coulomb model

#### 

#### An example of Coulomb expression



http://geology.usgs.gov/postdoc/2011/opps/opp34.html

#### Modelers

- Toda (DPRI) & Enescu (NIED)
- First participation in the CSEP

## RI (Relative intensity of seismicity) model



- Modeler
  - Nanjo (ERI)
- Basics
  - Future large earthquakes are considered likely to occur at sites of higher seismic activity in the past
  - Many application examples from CA, Japan, Taiwan, China and so on

### Participation in the CSEP

- Italy (Nanjo, 2009 submitted)
- Japan

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# Special issue of EPS

- Paper submission deadline: 31 March 2010
  - Overview of the testing experiment for Japan

Earth, Planets and	E TERRAPUB
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Online ISSN 1880-5981	P Planets and Space
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-the eleventh generation" PD4 Call for Papers: Earthquake Forecast Testing	one or true every-amotheed main actor inso useder the current Japanese "Observation and Research Program for Predict of Entrahastics and Voicain: Entrahisma (2009) 2013/° is to construct forecast systems of earthquake occurrence for JaOur approach to this construction is an follows: <ul> <li>First, to develop the Testing Center, a framework that can support to assess the validity of registered earthquake for methods.</li> </ul>
Experiment for Japan (rcr)	<ul> <li>Second to comparative totaling experiments within this framework multiple times in determining which o         Final to forwark models are before further foreward accuracy         Pand, to aim at the creation and buildap of ophisticated forecast models, based on results obtained from the mat         experiments.     </li> </ul>
© Editorial Board	For this purpose, the 1st earthquake forecast testing experiment for Japan will be carried out in 2009. This research act is in collaboration with the global CSEP (Collaboratory for the Study of Earthquake Profictability) popyet that is more after the California RELM (Regional Earthquake Lickblood Models) project. In order to rewride a forum for m
Information for Contributors	understanding among participants of the 1st experiment, the international symposium "Toward Constructing Earthq Forecast Systems for Japan" was held on 27 May 2009 at Earthquark Research Institute, University of Toky, Japan Is symposium, as sho discussed to explore the possibility to create net spectration testable models. To give an overview of the experiment, we propose a special issue of Earth, Planets and Space (EPS). The publication
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