

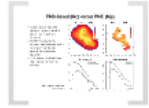
Bonus Slides

Introduction

Activities at the CSEP-EU testing center at ETH Zurich

- Model development
- Model testing
- Model validation
- Model intercomparison

CSEP Model on the Map



CSEP China

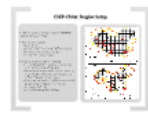
CSEP China



CSEP China (2)

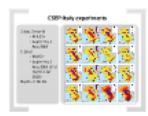


CSEP China Region Grid



CSEP Italy

CSEP Italy experiments



Status of CSEP Italy experiments

- 1st experiment (PM2.5) completed in 2014
- 2nd experiment (PM2.5) completed in 2015
- 3rd experiment (PM2.5) completed in 2016
- 4th experiment (PM2.5) completed in 2017
- 5th experiment (PM2.5) completed in 2018
- 6th experiment (PM2.5) completed in 2019
- 7th experiment (PM2.5) completed in 2020
- 8th experiment (PM2.5) completed in 2021
- 9th experiment (PM2.5) completed in 2022
- 10th experiment (PM2.5) completed in 2023

CSEP Italy monitor

- 1st monitor (PM2.5) installed in 2014
- 2nd monitor (PM2.5) installed in 2015
- 3rd monitor (PM2.5) installed in 2016
- 4th monitor (PM2.5) installed in 2017
- 5th monitor (PM2.5) installed in 2018
- 6th monitor (PM2.5) installed in 2019
- 7th monitor (PM2.5) installed in 2020
- 8th monitor (PM2.5) installed in 2021
- 9th monitor (PM2.5) installed in 2022
- 10th monitor (PM2.5) installed in 2023

CSEP Mediterranean (Europe) & Share

NERA



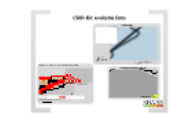
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NERA



NERA



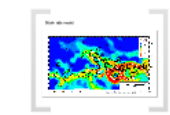
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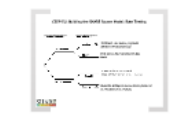
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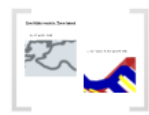
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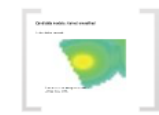
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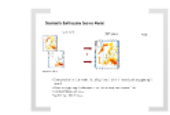
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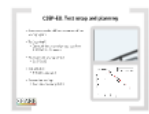
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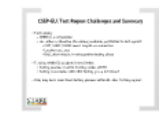
NERA



NERA



NERA



Notes

Activities at the CSEP-EU testing center at ETH Zurich

Presenter: David Eberhard

Contributions by:

Arnaud Mignan

Stefan Wiemer

Jochen Wössner

Jeremy Zechar

CSEP Europe on the Web



CSEP
Collaboratory for the Study of Earthquake Predictability

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The CSEP EU Testing Center

Welcome to the CSEP EU Testing Center

The **CSEP EU Testing Center** at **ETH Zurich** is an international collaboration of institutions with the aim to promote earthquake forecasting and predictability related research by conducting scientific experiments in a controlled environment. The CSEP EU Testing Center represents the European node of the **Collaboratory for the Study of Earthquake Predictability** (CSEP). It is funded in parts through the **EU** project **NERIES**.

CSEP is offering scientists a unique infrastructure to rigorously evaluate their scientific idea in a controlled environment. The CSEP EU Testing Center serves a number of so called testing regions within Europe. The first will be **Italy**, sponsored by the **Istituto Nazionale di Geofisica e Vulcanologia**. Please see the **Documents** and **News** sections for more information about the CSEP EU Testing Center and CSEP in general.

For more information about any of the CSEP Testing Centers, please contact **info@cseptesting.org**. For more information on the CSEP EU Testing Center, please check the resources listed below, or contact **Stefan Wiemer**.

- Further details on the EU Testing Center
- Testing regions in the EU Testing Center

Directly go to EU Testing Region:

- Italy



Testing Centers

- ERI, Japan
- ETH, Switzerland
- GNS, New Zealand
- SCEC, United States

Testing Regions

- California
- Italy
- Japan
- Northwest Pacific
- Southwest Pacific
- New Zealand
- Global

CSEP Tests

- The N(umber)-test
- The L(ikelihood)-test
- The likelihood R(atio)-test
- The Molchan-test
- The ASS-test
- The ROC-test

Contact Us

Out-of-date

Current Projects

- EU-Mediterranean
- Italy
- China
- West Pacific
- Iceland

CSEP-EU: Goals of EU-Mediterranean wide testing

- Evaluation of EU-Mediterranean wide long-term earthquake rate models that are part of the SHARE hazard model
 - Test the PSHA combined source model and single branches with CSEP-type rate testing algorithms
 - First time testing on regional scale PSHA program
- Set the test-bed for continued prospective testing
- Enhance testing algorithms to
 - Area Source-type models
- Work performed in coordination with GEM-Testing group at GFZ

What CSEP does (so far) - and what PSHA interests...

CSEP targets

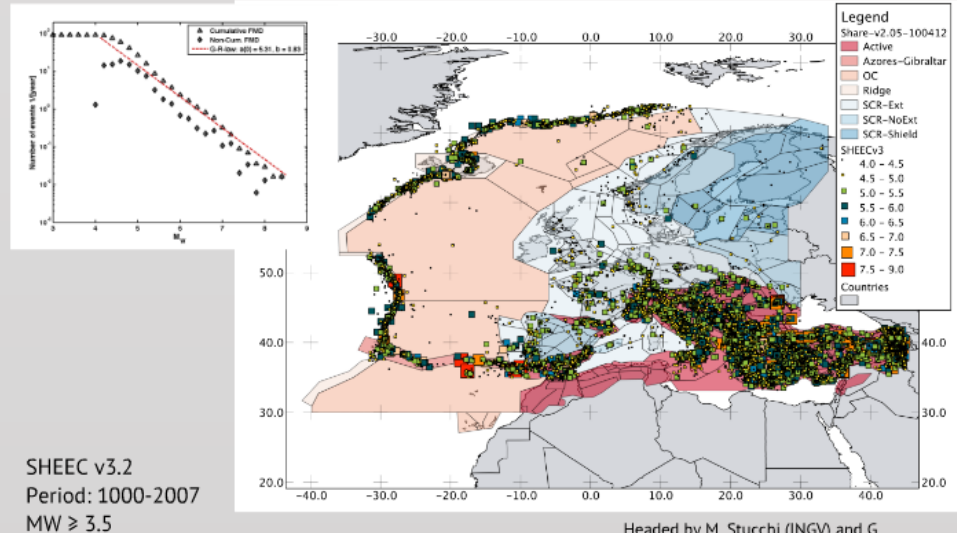
- Prospective / Retrospective earthquake rate testing
 - In seismically active regions
- Hypothesis testing in intraplate regions
 - “Recent seismicity is not a good predictor” (S. Stein)

PSHA interests

- T&E procedures for
 - Zonation models
 - Seismicity on faults
- T&E procedures for
 - Fault models
- T&E procedures for Strain Rate Models
- T&E procedures for
 - Ground Motion Prediction Equations
 - Site-Amplification Factors
 - Intensity fields

CSEP-EU: Available Data

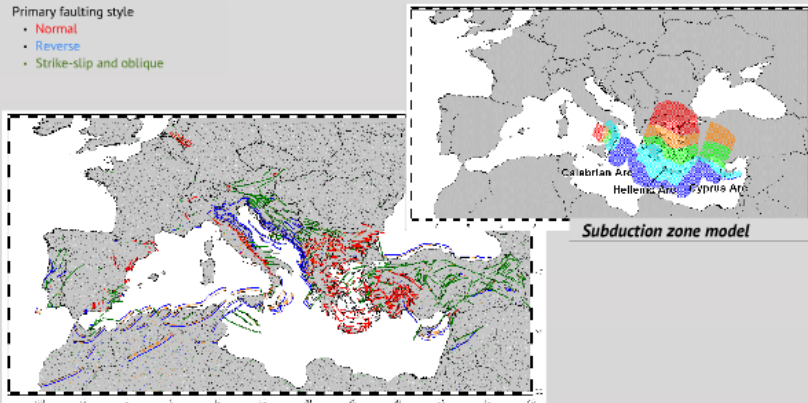
Catalog data



Headed by M. Stucchi (INGV) and G. Grünthal (GFZ)

Fault Sources: Homogeneously parameterized for PSHA

- Primary faulting style
- Normal
 - Reverse
 - Strike-slip and oblique



Project start - June 2009:

- 98 data records,
- ~8500 km of faults

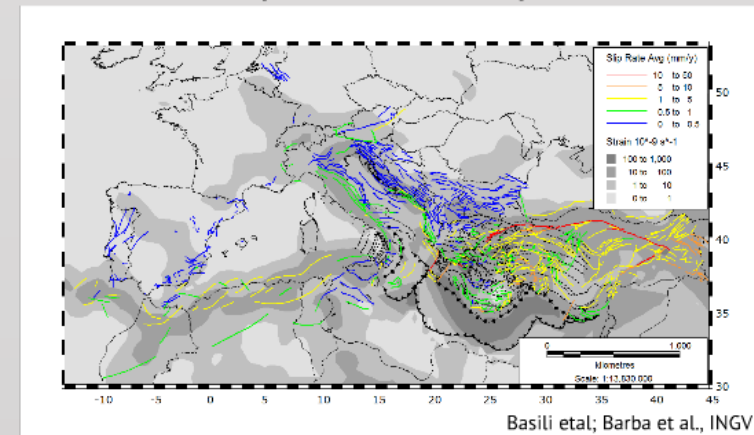
(Basili et al., 2008, Tectonophysics)

Today:

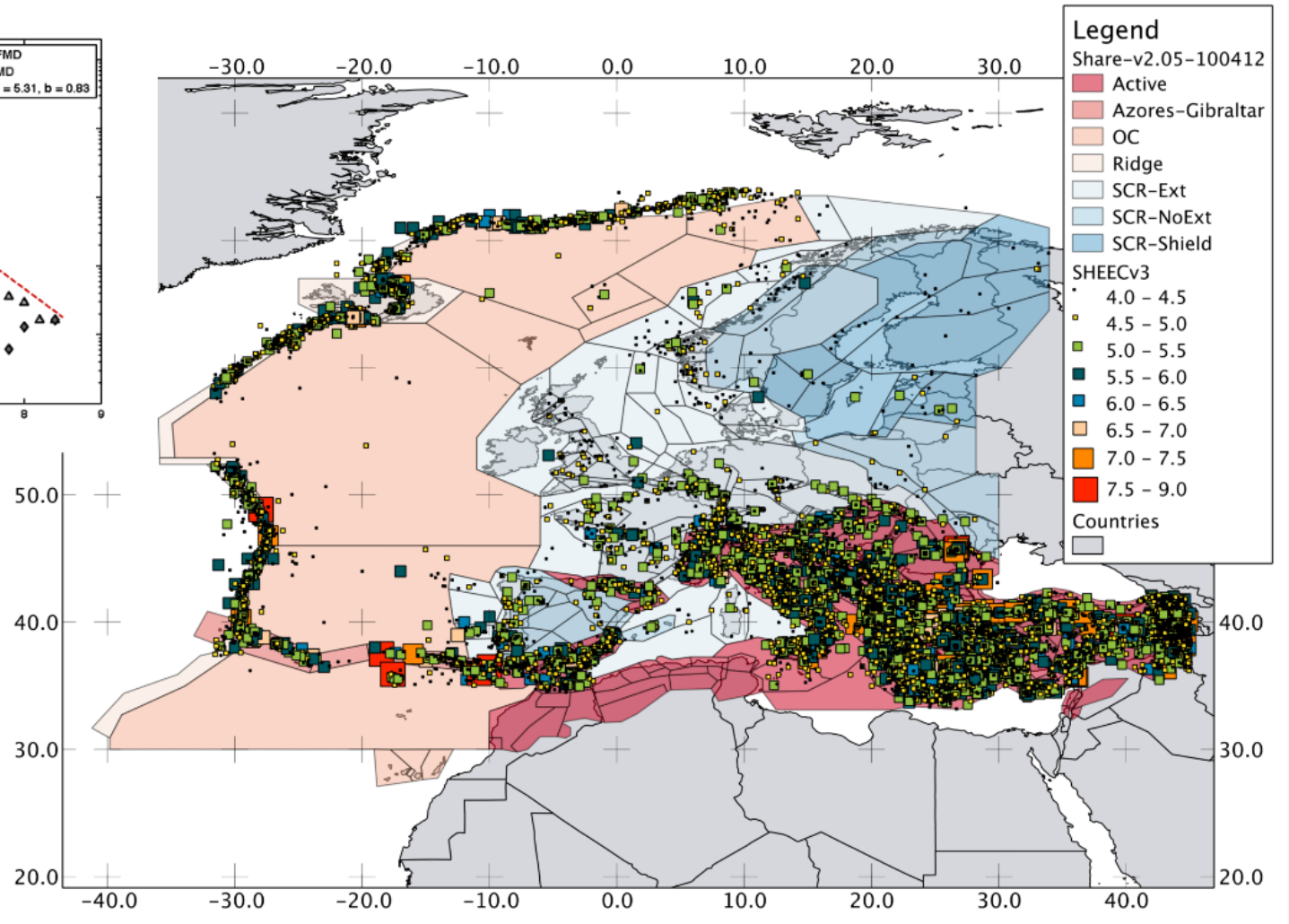
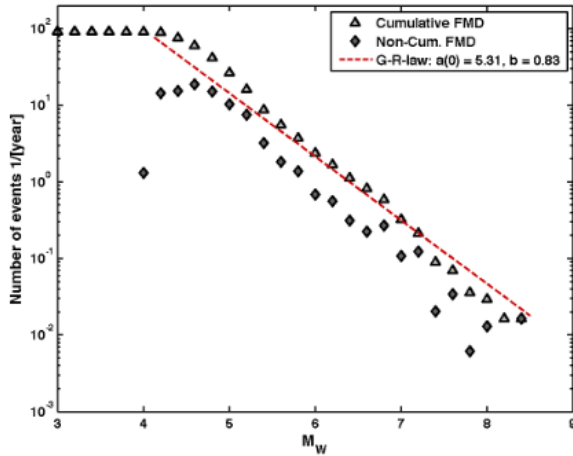
- 1128 data records
- ~64000 km of faults

Access at <http://diss.rm.ingv.it/diss/>
Courtesy of R. Basili / G. Valensise

Fault parameterization: Slip rate



Catalog data



SHEEC v3.2
Period: 1000-2007
 $M_w \geq 3.5$

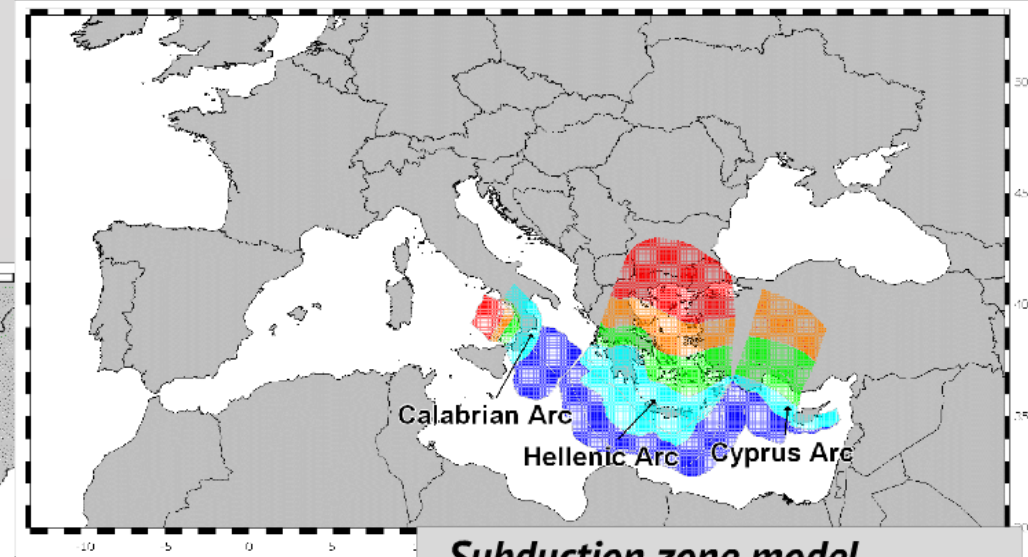
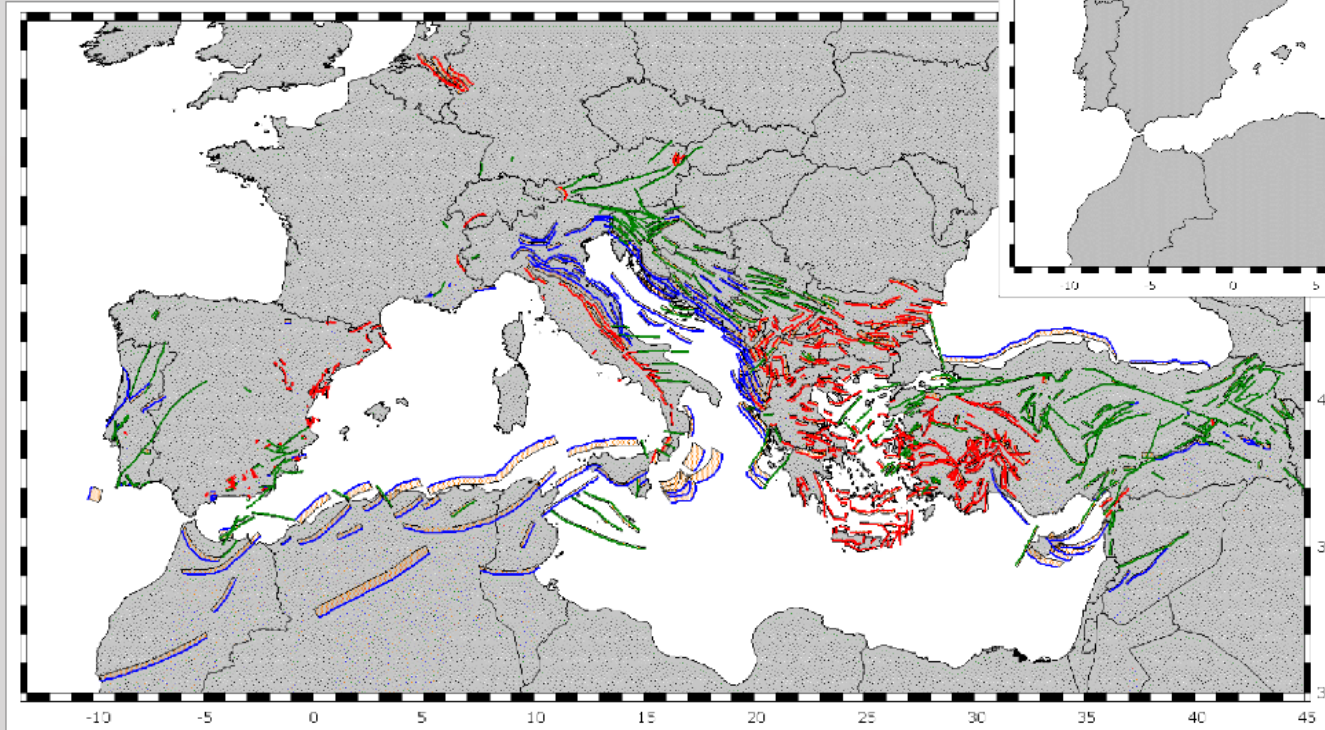
Headed by M. Stucchi (INGV) and G. Grünthal (GFZ)

Fault parameterization: Slip rate

Fault Sources: Homogeneously parameterized for PSHA

Primary faulting style

- Normal
- Reverse
- Strike-slip and oblique



Subduction zone model

Project start - June 2009:

- 98 data records,
- ~8500 km of faults

(Basili et al., 2008, Tectonophysics)

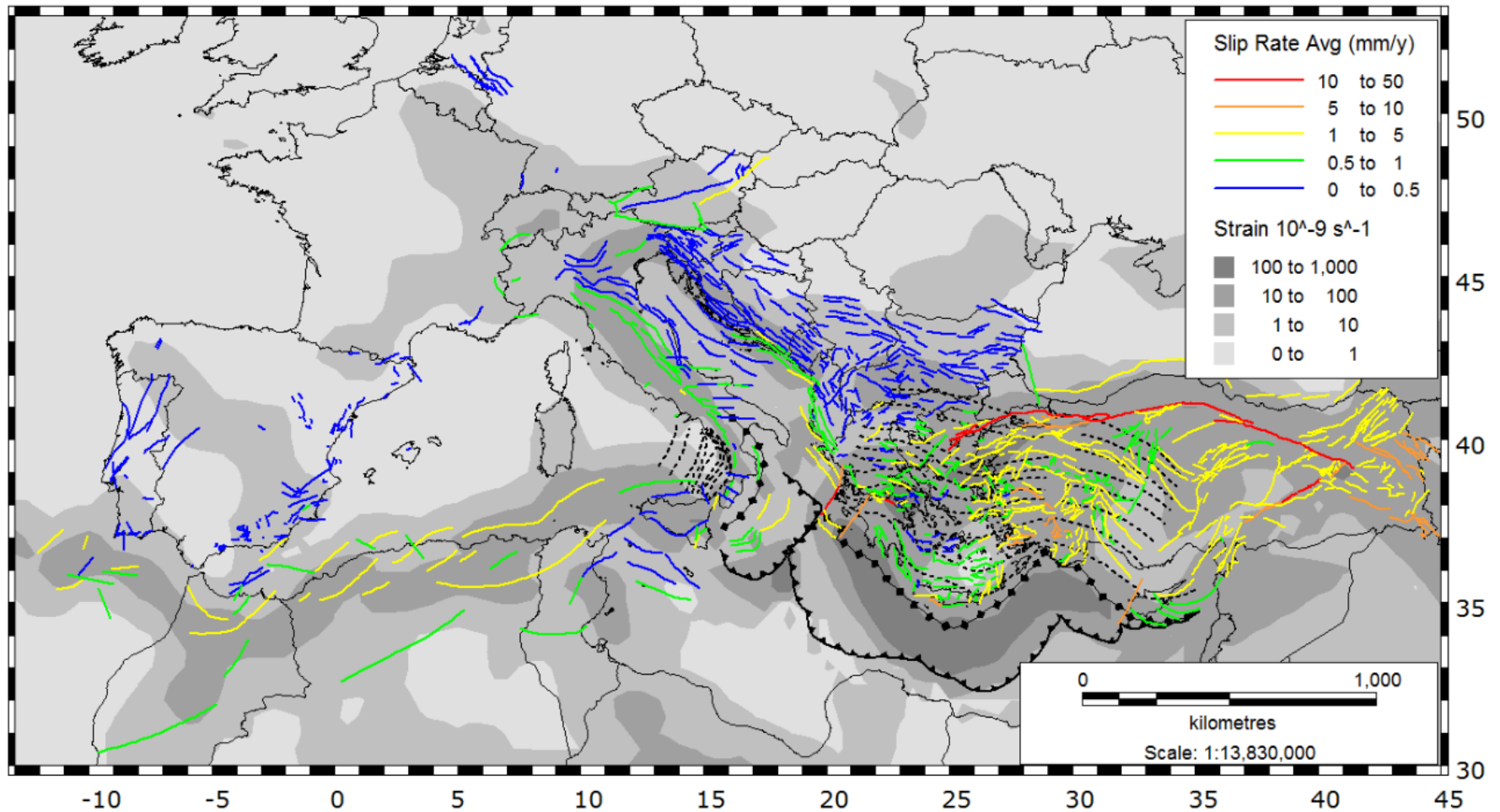


Today:

- 1128 data records
- ~64000 km of faults

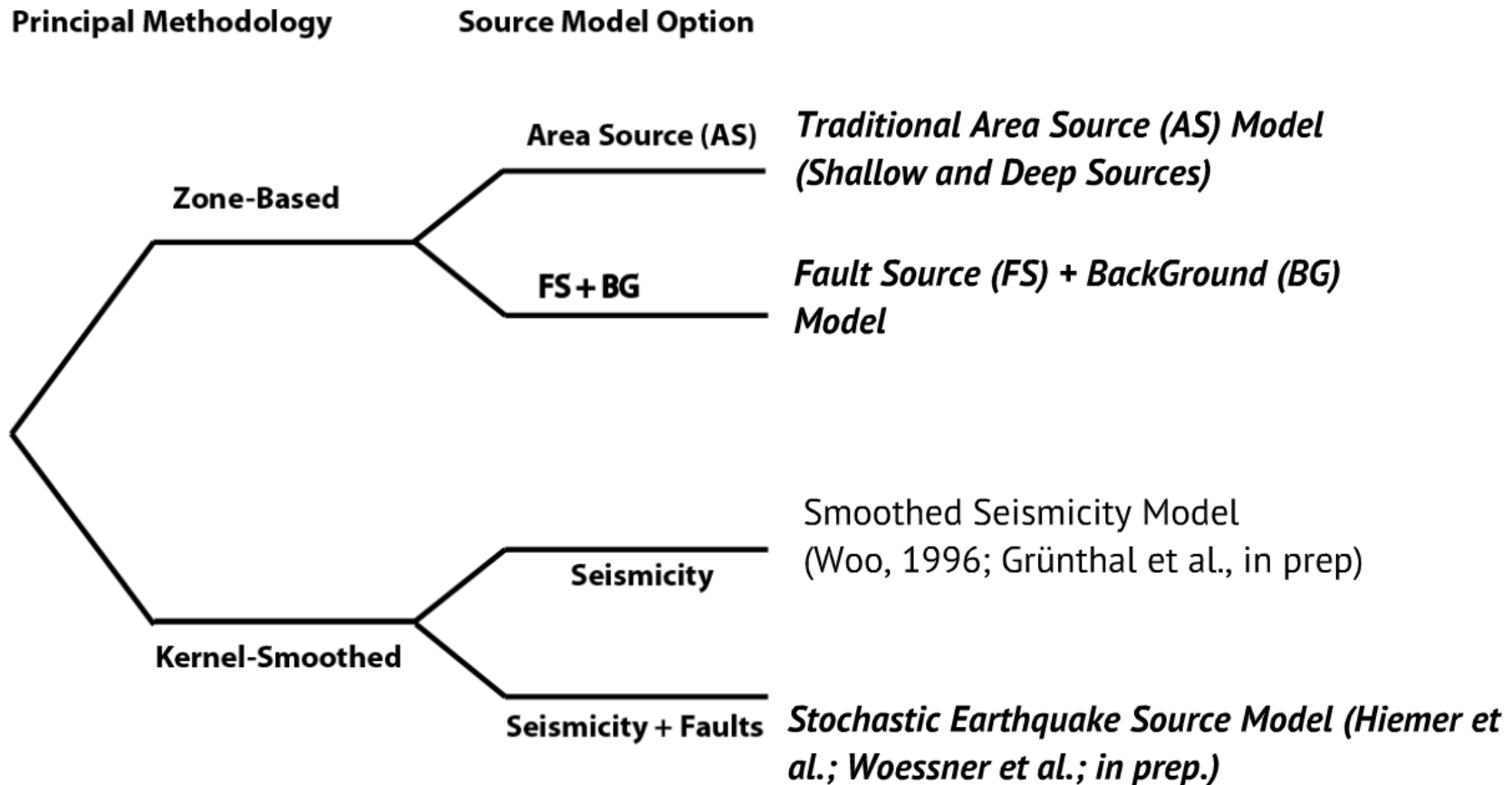
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Courtesy of R. Basili / G. Valensise

Fault parameterization: Slip rate



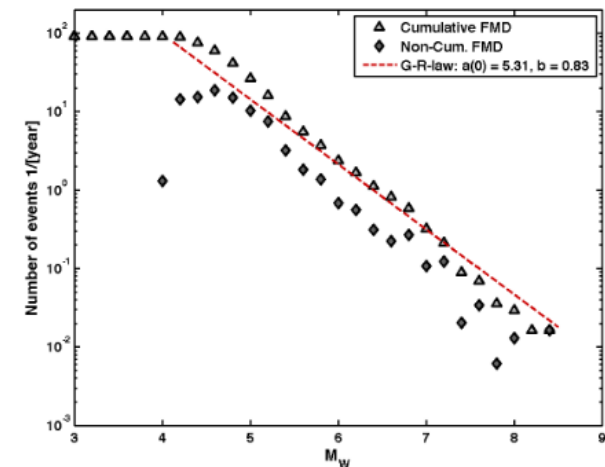
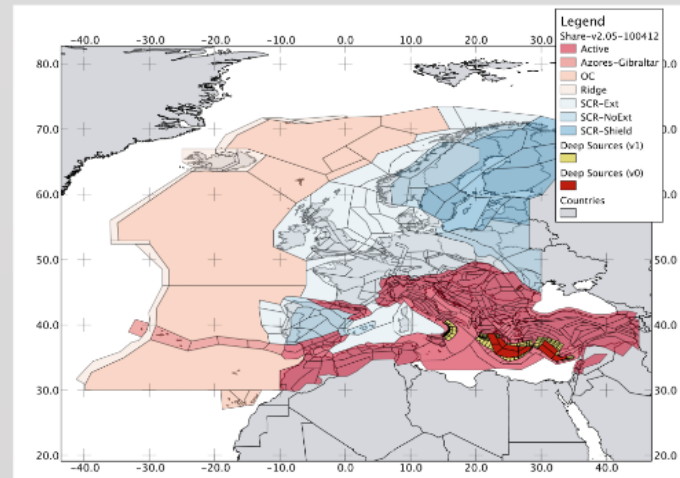
Basili et al.; Barba et al., INGV

CSEP-EU: Building the SHARE Source Model: Rate Testing



CSEP-EU: Test setup and planning

- Area source model defines the extent of the testing region
- Testing $M_w \geq 5$
 - Expected declustered annual rate from SHEECv3.2: ~30 events
- Retrospective testing period
 - 2007-2012
- End of 2012:
 - 8 Models available
- Prospective testing:
 - Start possible early 2013



CSEP-EU: Test Region Challenges and Summary

- Test catalog:
 - SHEEC is a compilation
 - No unified authoritative Mw catalog available, possibilities to test against:
 - CMT / NEIC / EMSC needs magnitude conversion
 - Location accuracy
 - Evaluation needed in retrospective testing phase
- Funding within EU-projects is very limited
 - Testing planned in at EU-Testing center at ETH
 - Testing coordinated with GEM Testing group in Potsdam
- Only long-term main shock testing planned within EU-Med. Testing regions

CSEP-Italy experiments

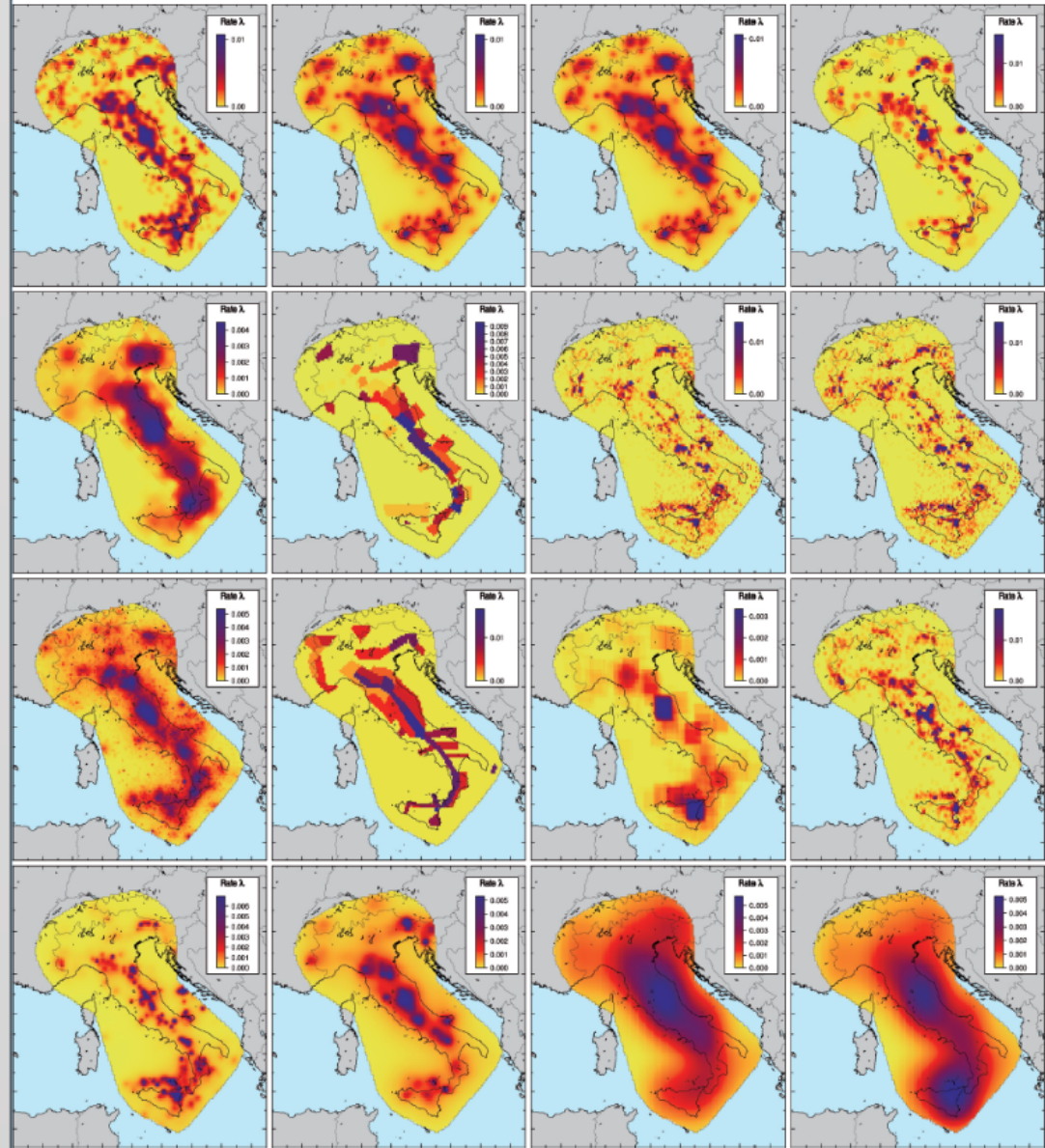
1 day, 3 month

- M 4.95+
- beginning 1 Aug 2009

5/10 yr

- M4.95+
- beginning 1 Aug 2009 (2nd round 1 Jan 2010)

Depth \leq 30 km



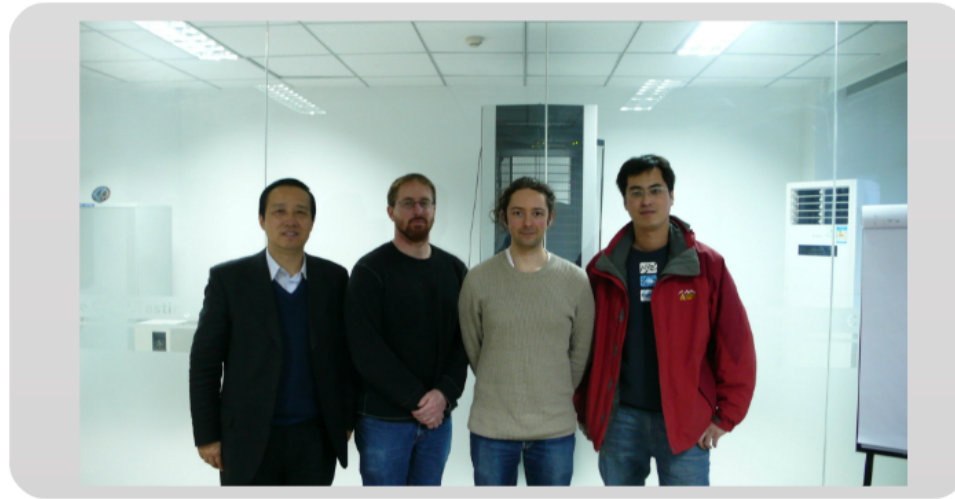
Status of CSEP-Italy experiments

- Due to “resource stretch,” experiments are not yet running in testing center, to begin this summer
- Official catalog only available up to 15 September 2011
- Through that date, 26 M3.95+ events, 0 M4.95+
- Through today, roughly ~90 M3.95+, 7 M4.95+, more likely

CSEP-Italy reminder

- 11 models for 5/10 yr experiment (16 static forecasts)
- 3 models for 1 day, 3 models for 3 month experiments (5 codes)
- Special issue of Annals of Geophysics (analogous to RELM special issue of Seismological Research Letters)
 - Details on completeness assessment
 - Details on models
 - Retrospective evaluation of time-invariant forecasts (Werner et al. 2010)

CSEP-China



- Testing center hardware and CSEP software version 11.1 operational--noactive experiment
- 2010-2012 project funded by the Sino Swiss Science & Technology Cooperation Program
- Principal Investigators:
 - ETH: A. Mignan, J. D. Zechar, S. Wiemer
 - CEA: C. Jiang, Z. Wu
- Collaborative visits in February and October 2011
- Setup of the CSEP-China collection and testing regions based on Mc analysis
- Paper by Mignan et al. in revision at BSSA

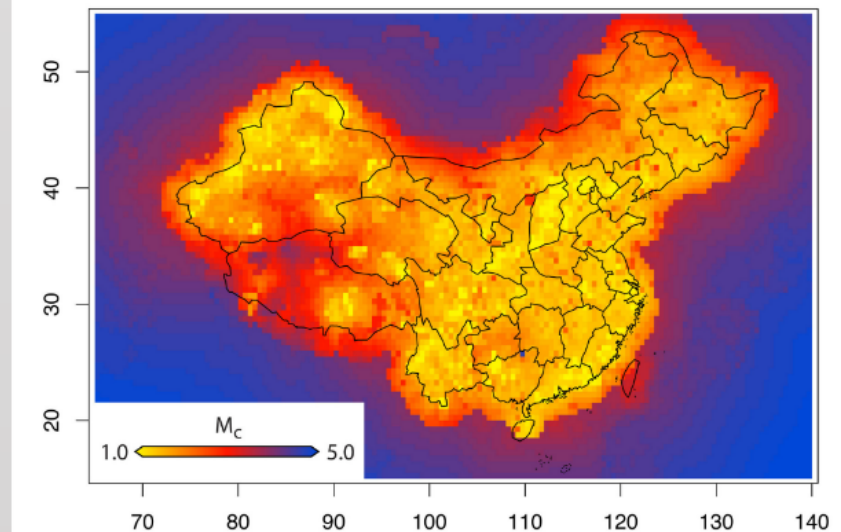
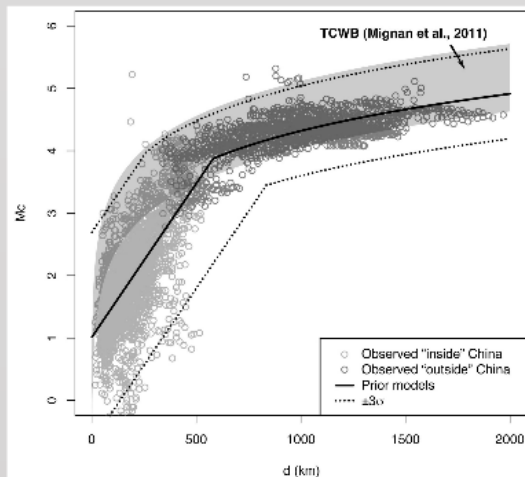
CSEP-China: BMC

Bayesian Magnitude of Completeness (BMC) method (Mignan et al., BSSA2011)

- Avoids shortcomings of previous FMD-based mapping methods: (1) no gap in space, (2) no arbitrary definition of the M_c spatial resolution
- Still FMD-based (in contrast with PMC), thus consistent with subsequent forecast models based on the validity of the GR law
- Application to Mainland China using the China Earthquake Network Center (CENC) catalog

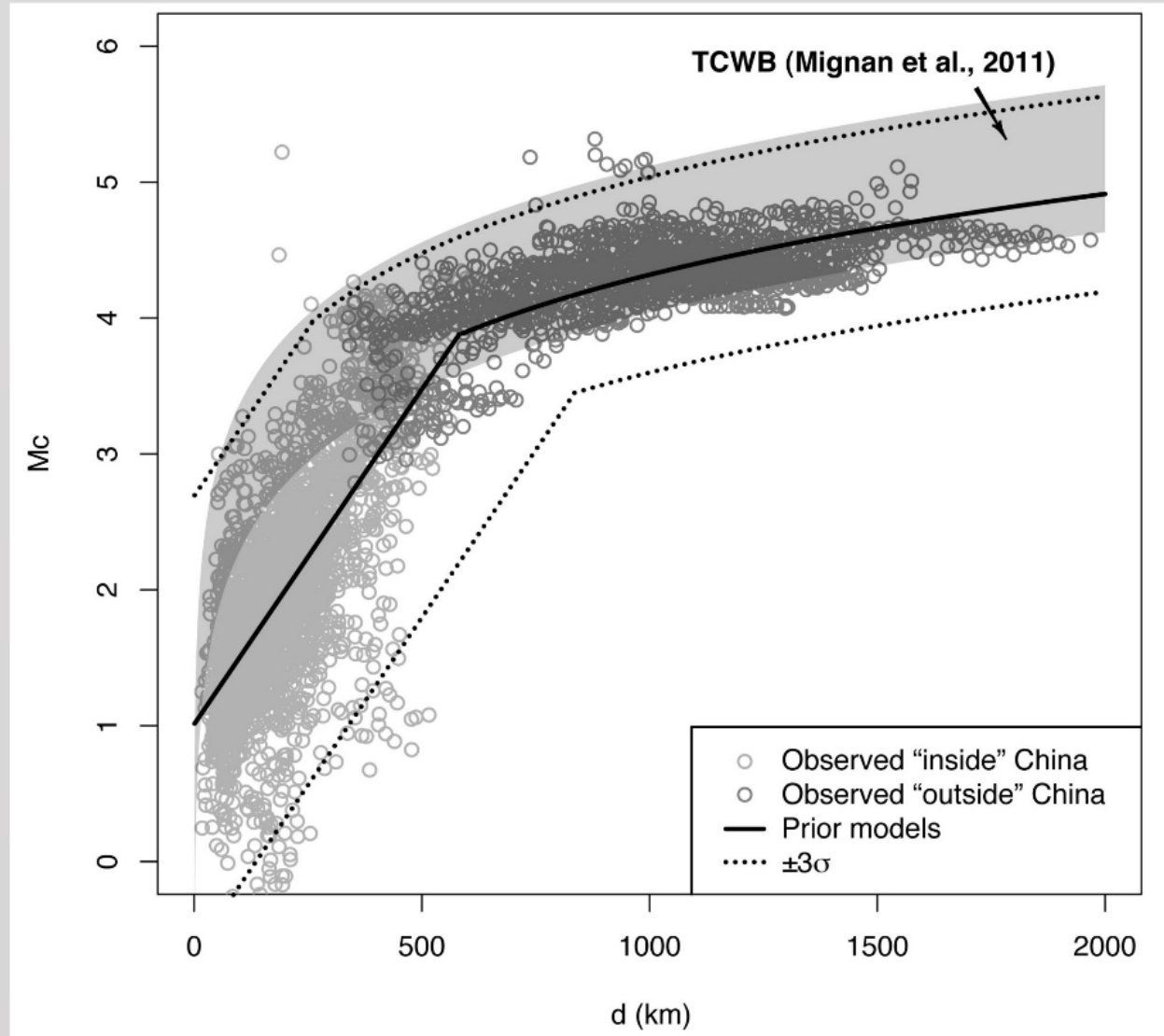
BMC method

- Prior model based on relationship between M_c and distance d to 4th seismic station (~density of seismic stations)
- Bayes' Theorem to combine prior M_c and observed M_c
- BMC map = Posterior M_c map (+ uncertainty map)



BMC method

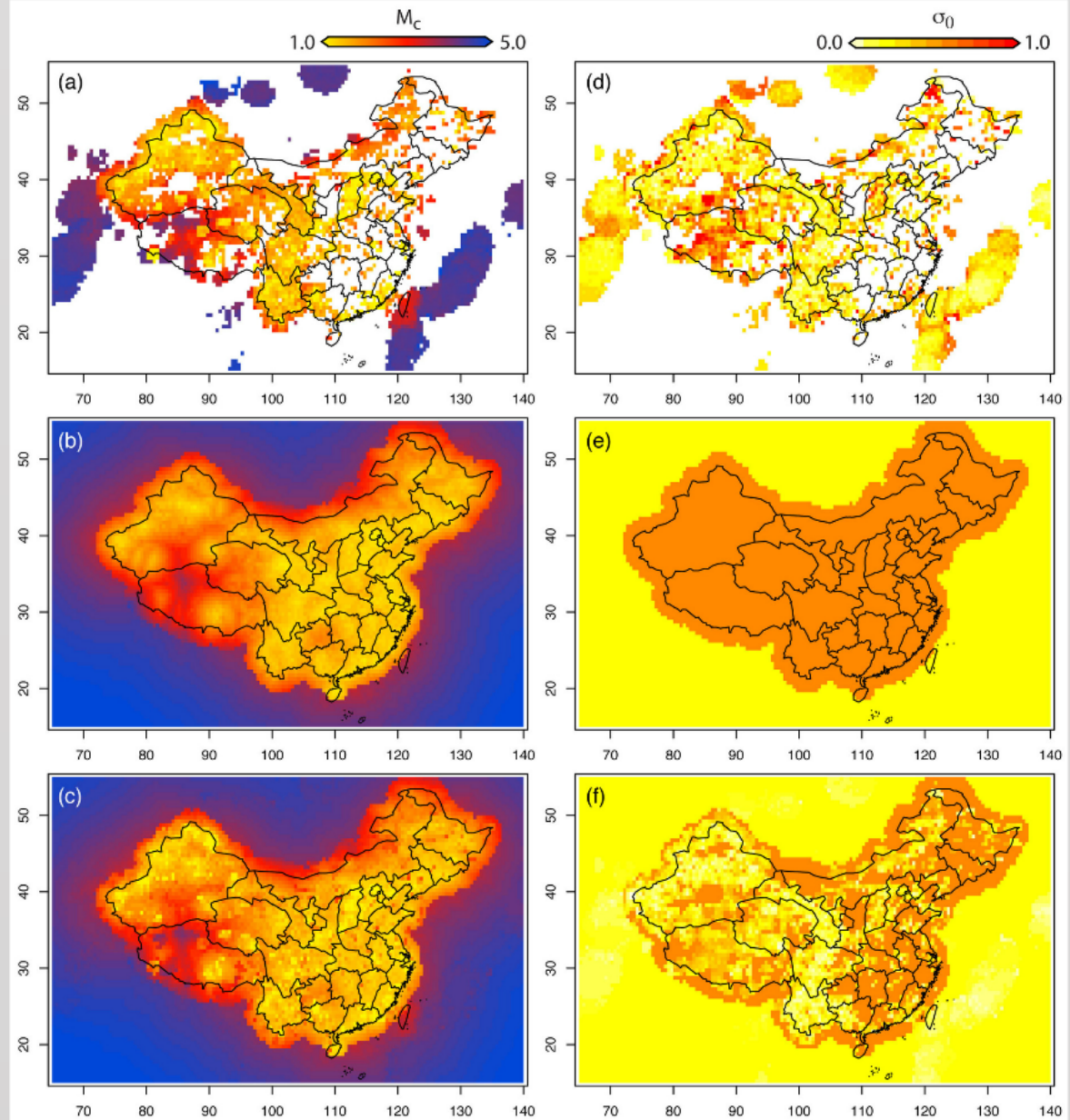
- Prior model based on relationship between M_c and distance d to 4th seismic station (~density of seismic stations)
- Bayes' Theorem to combine prior M_c and observed M_c
- BMC map = Posterior M_c map (+ uncertainty map)



CSEP-China: BMC results

- BMC results:

- (a) Observed M_c
- (b) Predicted M_c (prior)
- (c) Posterior M_c
- (d,e,f) standard dev.



CSEP-China: Region Setup

- Different regions proposed based on $M_c(\text{BMC})+n$ (conservative estimates)
- Potential testing areas:
 - A: All China
 - B: North-South Seismic Belt (official region)
 - C: Northern Xinjiang Seismic Belt
 - D: North China Seismic Belt
- Ongoing / Next steps (at ETH & CEA):
 - TripleS forecast with negative binomial rate distribution (instead of Poisson)
 - Retrospective analysis of seismicity preceding the 2008 $M_w=7.9$ Sichuan earthquake using different forecasting techniques
 - Strain rate map combining GPS and seismicity? (ongoing work in Western US, method applicable to China)
 - + STEP forecast (at GNS & CEA)

