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Global Geodetic Strain Rate Model

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Slides based on C. Kreemer presentation - GEM Joint Meeting – February 2011
Principal investigators / Leading Institutions
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Project duration
18 months
Main Products

• A high-resolution stain rate model for the entire globe
• GPS velocity field uploading tool
INTRODUCTION

Why strain rate is useful?
• The geodetic strain rate field provides a deformation reference level with which any hazard estimate needs/shoulds to be consistent
• (for some areas) Strain rate fields can directly be derived from the output of the GEM’s Active Faulting group, and compared with geodetic model
• Similarly, expected moment rates from earthquake occurrence rates should be consistent with geodetic moment rates
• Ultimately, the methodology presented here can be used to directly include fault slip rate data and seismicity distribution in the inversion of GPS data
WORK PLAN

Analyze data of 4000+ continuous GPS stations worldwide and determine secular horizontal velocities (="core solution")
• Add to the core solution published velocities from mainly campaign-style observations (100+ studies)
• Use new GPS velocity database to update the Global Strain Rate Model (GSRM) of 2004
• Use earthquake focal mechanisms for additional constraints on the style of the modeled strain rate tensor field, and active fault traces to add constraints on distribution of strain
• Compared to 2004 version, decrease model grid spacing from 0.5o to 0.2o (where feasible), and allow some plate interiors to deform (Europe, North America)
• Archive all results on public website, provide kmz versions of strain model, and allow results to be displaced on visual tool
PREVIOUS EXPERIENCE
DATA AVAILABILITY

Geodetic Velocities

Normalized Seismic Moment Tensors (≤40 km)

Quaternary Fault Location, Style (and rate)

Kostrov's Summation

Style and Direction of Seismic Strain Rates

Geologic Strain Rates

Kostrov's Summation

Bi-Cubic Bessel Spline Interpolation

Strain Rate Field

Velocity Field

Least-Squares Fit to Data

Angular Velocities

Rotation Rates

A priori covariance tensor

GEM

GEOCENTRAL

GLOBAL ENVIRONMENTAL MONITORING
CONCLUSIONS AND WAYS FORWARD

How does all of this help GEM?
The main contribution of the regional components can mainly be in helping making GPS data/velocities available. In return, they can receive preliminary strain rate models that may aid their other investigations.

The geodetic signal from slip along subduction megathrusts is distributed in the overriding plate. To correct for this, while still being able to identify long-term strain in the overriding plate, requires an iterative approach.

We will determine uncertainties in our models, but the best approach to quantify these will be an active component of our task, and is not yet established.