Geophysical Research Abstracts, Vol. 8, 05281, 2006
SRef-ID: 1607-7962/gra/EGU06-A-05281

Thoughts on a European Seismic Reference Model: The role of surface waves from earthquakes and ambient noise

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A seismic model, as constructed by a single scientist or a small group of collaborators, typically is intended for purely scientific purposes: to explore poorly understood regions of Earth's interior, to test hypotheses, or to express the scientific understanding or prejudice of its creator(s). It tends to be used predominantly or exclusively by its creators, to predict the data that were used in its construction, and does not have uncertainty information. A Reference Model is different. It needs to express the understanding of a much larger community, it exists to be used by a still larger community, it must be able to predict a wide variety of data and be vetted against them, and must contain within itself information about its own quality (e.g., uncertainties) and the quantities to be predicted from it. A principal challenge in constructing a seismic Reference Model over a region as large as Europe is to develop information homogeneously distributed over the entire area with uncertainty information. Surface waves are particularly useful in constructing a large-scale Reference Model as they sample large regions with fair uniformity and the inverse problem is naturally suited to using model-space sampling methods such as Monte Carlo that generate uncertainty information. We discuss a shear velocity model of the crust and uppermost mantle based on broad-band surface wave dispersion using earthquake sources that was constructed as a reference model for Eurasia and present one test of the model – a relocation experiment of "Ground Truth" events. Traditional teleseismic surface wave studies, however, have several significant limitations: they present information

predominantly about shear wave speeds and distant earthquake sources present data depleted in periods shorter than about 20 sec and, therefore, provide poor resolution in the crust and only large-scale information laterally. The use of ambient noise in surface wave tomography provides more information about the crust and much better lateral resolution in regions of good station coverage. We present preliminary results of surface wave tomography across Europe using data available from the IRIS DMC. Better station coverage (e.g., from the emerging Virtual European Array) will improve the resolution and the spatial extent of the surface wave dispersion information needed for a European Reference Model.