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Towards higher Resolution Tomography at the global and regional Scales

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Some of the most relevant questions debated in recent years by students of the global Earth are perhaps the origin of hotspots, the fate of subducted slabs, the properties of the core-mantle boundary region and the nature of the Earth's inner core and its presumed differential rotation. In all those contexts, global tomography plays a central role as the most powerful available instrument to sample the Earth's deep interor. At the same time, it became apparent that global tomography will not provide definite answers to such specific questions, until its achieved resolution is enhanced. The data coverage must be augmented, collecting and processing increasing amounts of seismic records, and deploying stations in previously undersampled regions. Model parameterization has to be made accordingly denser, or the regularization scheme applied to inversion algorithms appropriately tuned. Last, the relationship between recorded data and seismic velocities to be mapped is generally based on approximate theoretical formulations that necessarily introduce inaccuracies, and must also be refined. These aspects cannot be treated separately: the number of model parameters that one can constrain is a function of data quality and coverage; even in the presence of a perfect data coverage, an error will be introduced in tomographic images by inaccuracies in the theoretical formulations; on the other hand, a perfect theoretical formulation will not provide an accurate solution, if the data are inadequate.

We have recently updated a global database of surface wave dispersion measurements, focusing on Europe and the Mediterranean, where we have processed a large number of records, from regional stations neglected in earlier global, multi-resolution studies by Boschi and Ekstrom. The new database provides unprecedentedly high regional-scale resolution. We derive new tomographic maps from it, both in the ray-theoretical and finite-frequency (analytical and numerical) approaches. We estimate its optimal

parameterization via information criteria (Akaike or Bayesian). We evaluate quantitatively the improvement in model quality and resolution achieved jointly and separately by all these different strategies.