Supporting Information for "Ambient Noise Imaging of Western Europe From Combining Linear SOLA Backus–Gilbert Inference and Non-Linear Probabilistic Approaches"

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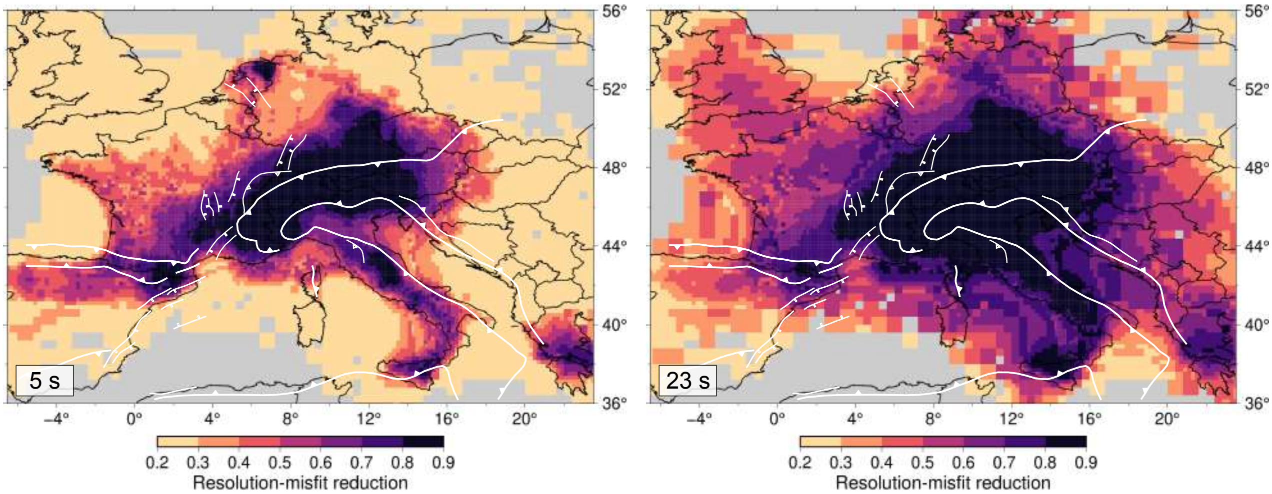

Figure 1: 2D maps of resolution-misfit reduction for periods 5 s and 23 s.

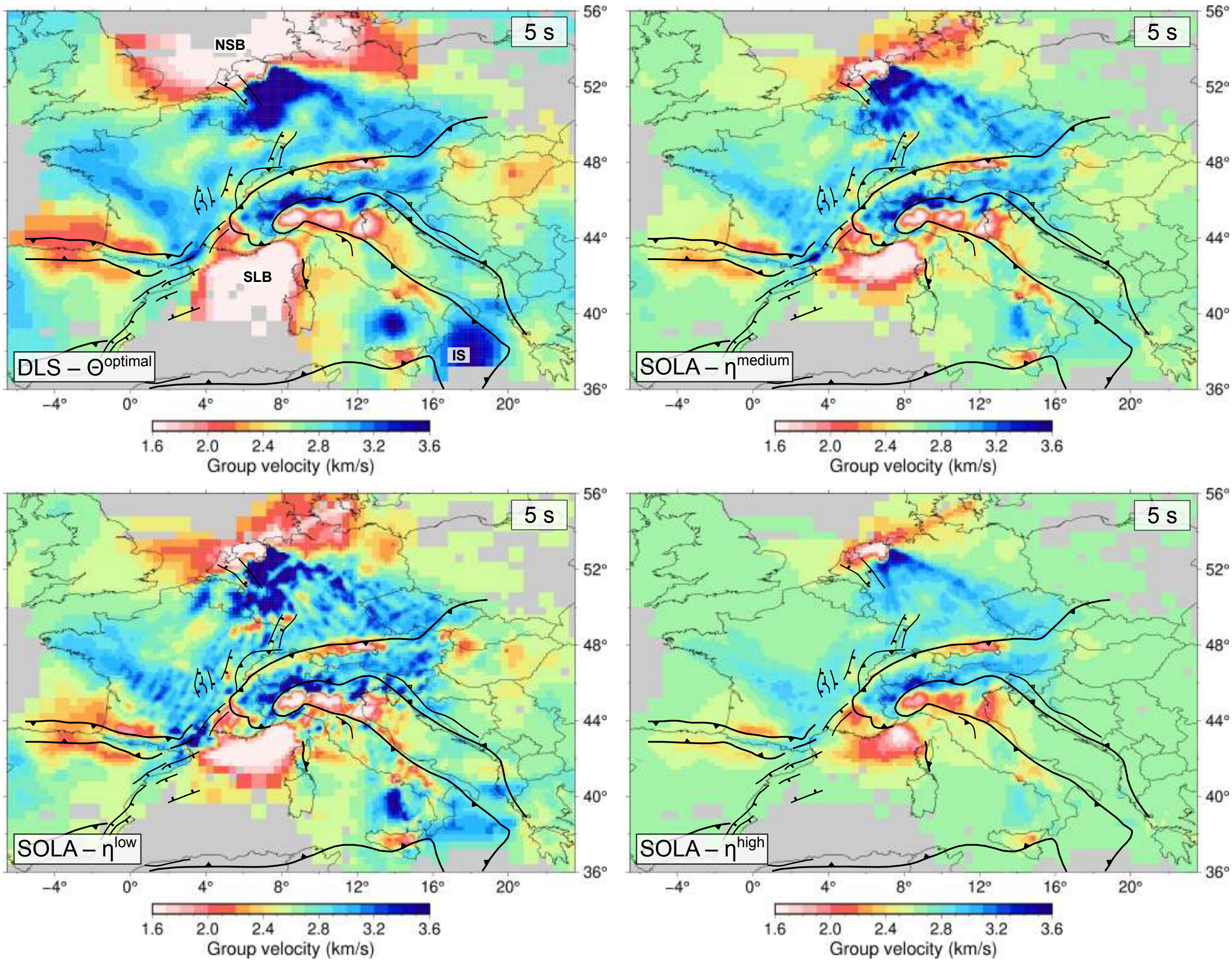

Figure 2: Comparison of 5–s group velocity maps obtained from a classical damped least squares (DLS) inversion method (Θ chosen based on the L-curve), and from SOLA–BG with different ranges for η (low η: higher noise propagation). Note the amplification/spreading of some velocity structures in the DLS solution, at the model edges, e.g., the North-Sea Basin (NSB), Southern Ligurian Basin (SLB) and Ionian Sea (IS). These areas are poorly covered by seismic rays, and the shape and magnitude of the velocity structures are strongly affected by averaging bias related to the DLS regularization. The SOLA–BG solutions do not exhibit such bias—regardless of the choice for η—since no *ad hoc* regularization constraints are directly applied on the model itself.

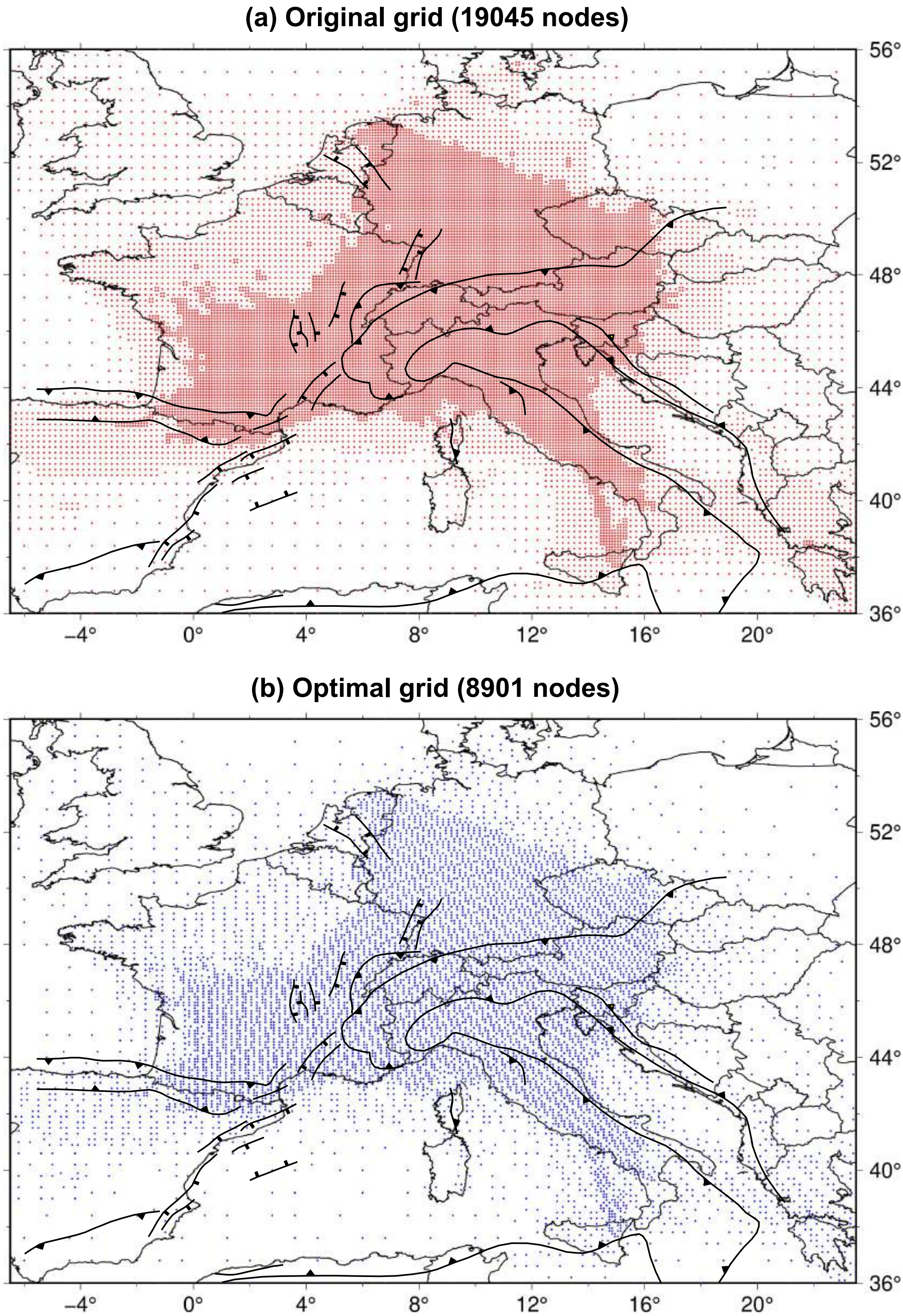

Figure 3: (a) Original grid used in the SOLA-BG inversion. (b) Optimal set of nodes used in the depth inversion.

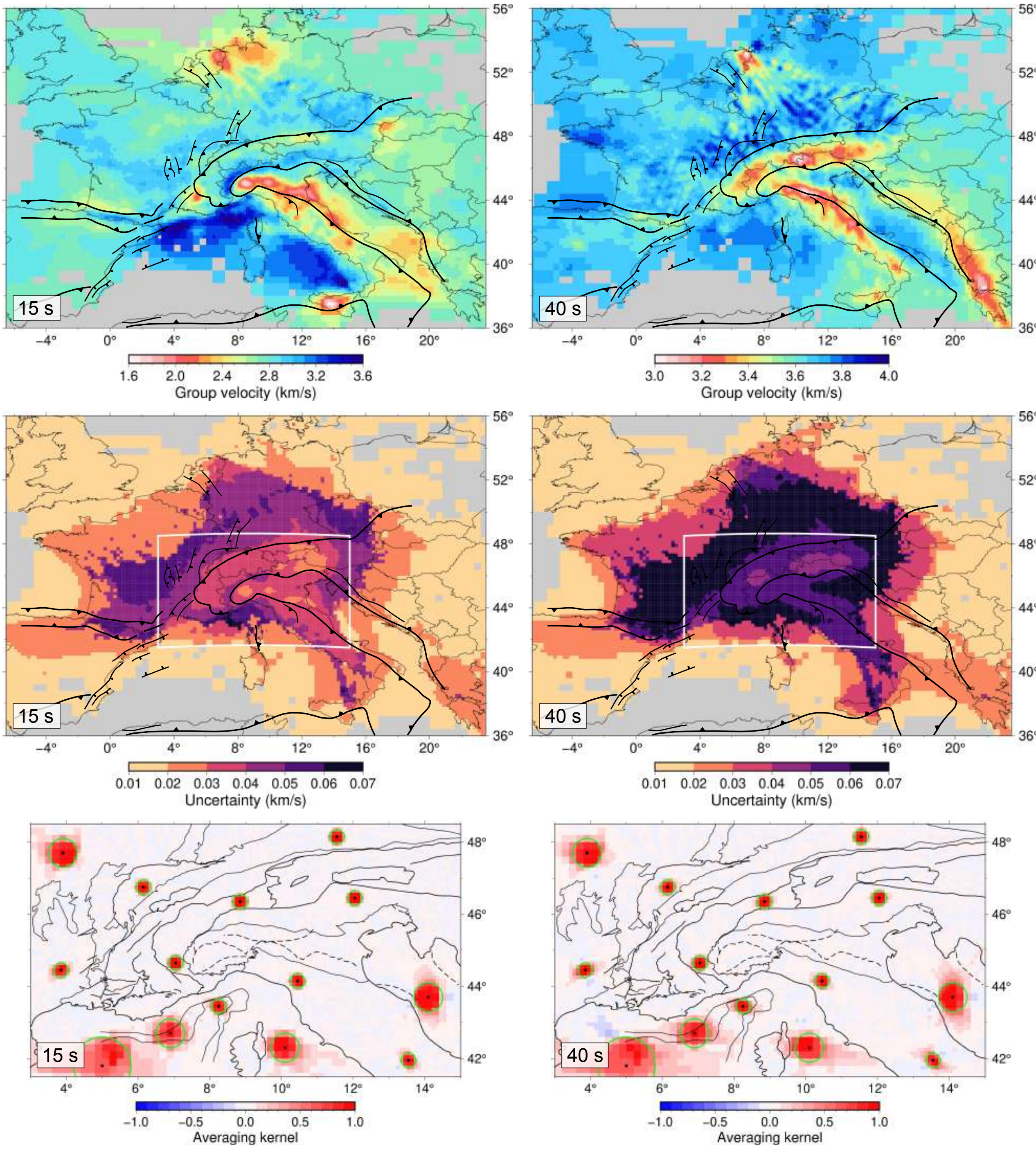

Figure 4: Group velocity maps with their uncertainty and resolution estimates. The green circles denote shapes of some SOLA target resolving kernels.

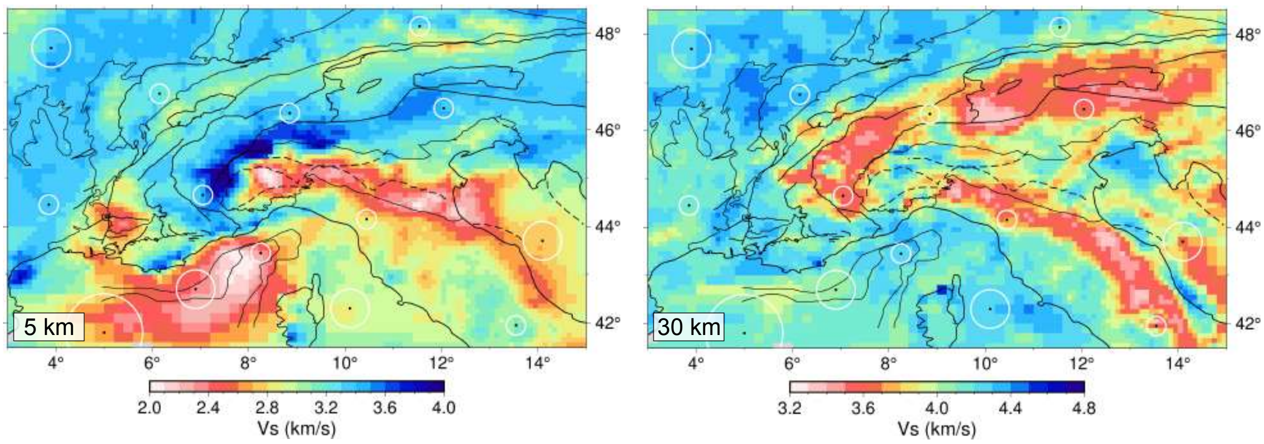

Figure 5: Depth slices in the V_s model (focus on the Alpine region). White circles: shapes of some SOLA target resolving kernels.

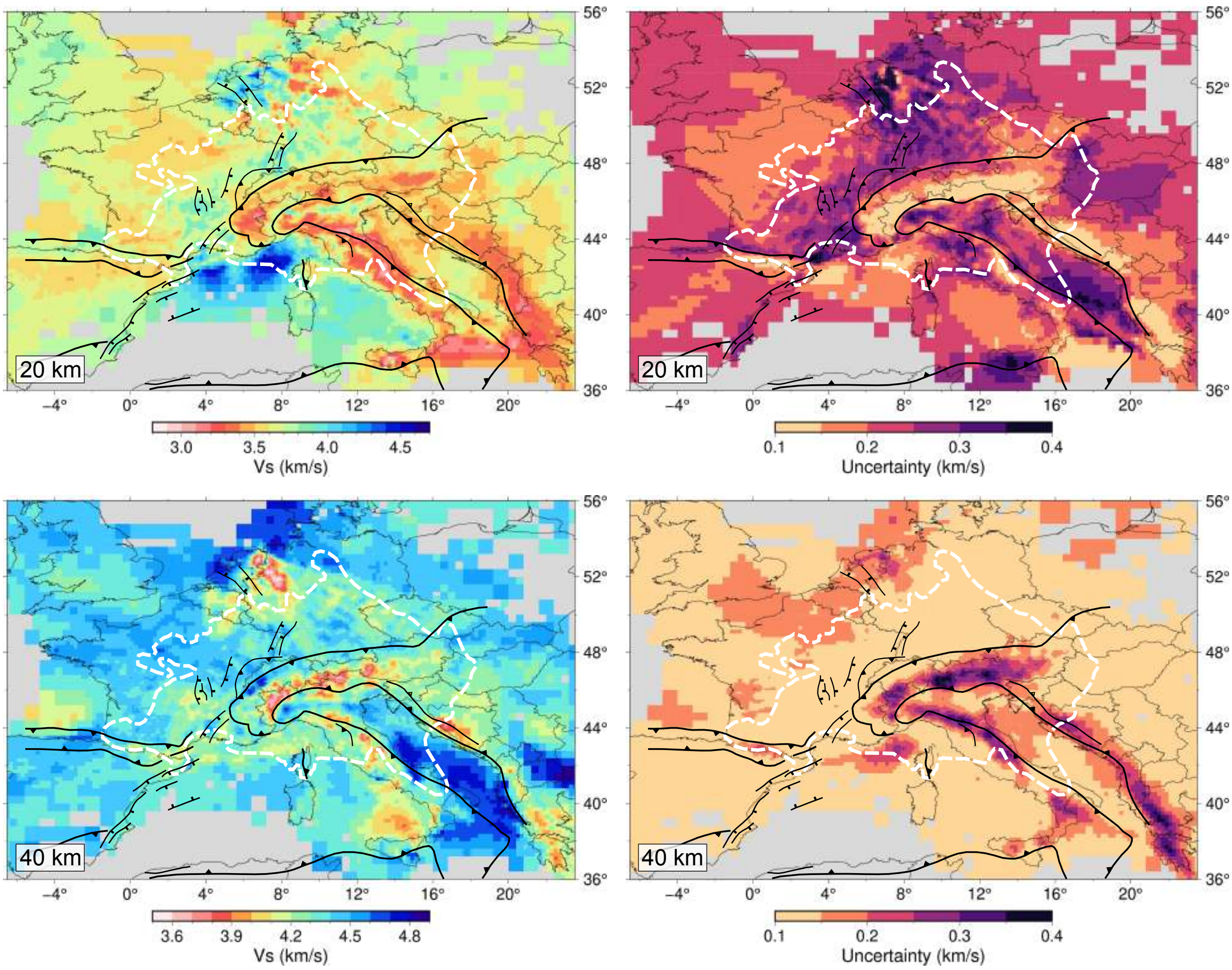

Figure 6: Depth slices in the V_s model and their uncertainty estimates.

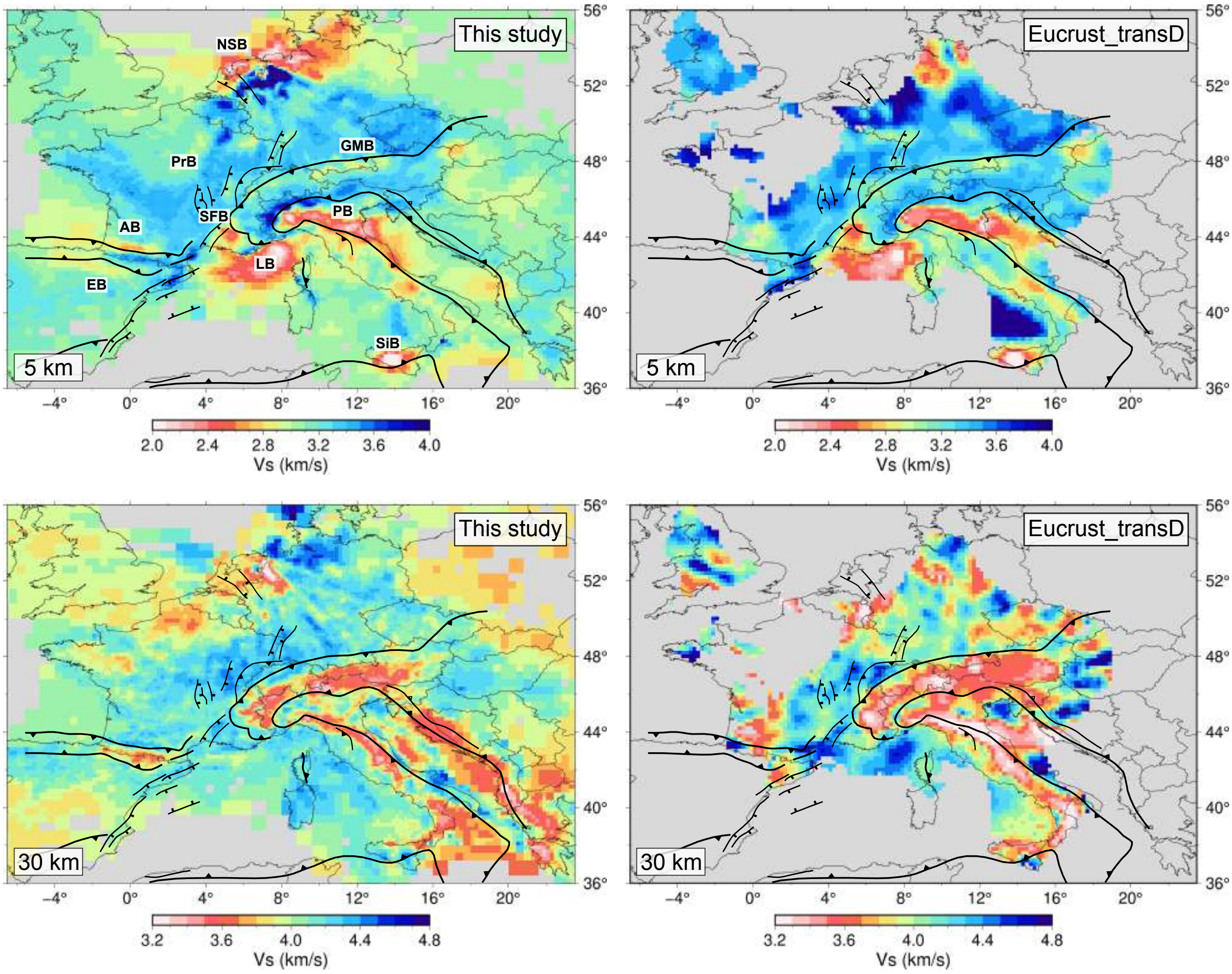

Figure 7: Depth slices in the V_s model obtained in this study (left) and in the *Eucrust_transD* V_s model (right), derived using 2D rj-McMC and 1D probabilistic inversions (Nouibat et al., 2022a). The new model covers a larger area, as it was developed based on a more comprehensive noise database, enhanced by permanent broadband stations located on the periphery of the greater Alpine region. Overall, the two models agree and display similar patterns correlated with the main geologic structures. The velocity structures appear overall finer and more localized in the new model, which is probably due to a better control of the local resolution, achieved with SOLA. However, discrepancies in their magnitude are mainly attributed to the different inversion schemes.