SUPPLEMENTARY MATERIAL OF

How do Local earthquake tomography and inverted dataset affect earthquake locations? The case study of High Agri Valley (southern Italy).

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Introduction

Here, the captions of the figures referred in the main text as “supplementary material” are provided.

Figure S1. Modified Wadati diagram of dataset A. A Vp/Vs value equal to 1.90 is retrieved.

Figure S2. Figure 4. Derivative weighted sum (S waves) for different model parameterizations relative to dataset A. Each parameterization has a 2 km spacing in the vertical direction up to 10 km depth and 3 km spacing for greater depths. Horizontal plane views are shown for 2 and 4 km depths. These are the model slices characterized by highest values of diagonal elements of resolution matrix. The crosses mark positions of nodes of the tomographic grid. a) Irregular grid spacing: in the central part of the tomographic grid the node spacing is 5 km and 8 km in the two horizontal directions (x and y), respectively. b) Regular grid spacing: the horizontal grid spacing is 5 km. c) Irregular grid spacing: only in the central part of the grid, the node spacing is 3 km in both horizontal directions. The coarser parameterization, a), allows to retrieve a more homogeneous ray coverage in a wider volume with respect to finer parameterizations. For each parameterization, at a single node a much greater DWS value than remaining nodes is observed. It is due to Pertusillo artificial lake seismicity cluster, where most of the earthquakes of our dataset is located.

Figure S3. Checkerboard tests (S waves) relative to dataset A. Left panel of each row represents the actual checkerboard structure, whereas the central and the right panels show the recovered structure after inversion of synthetic travel time data at two different depths, 2 km and 4 km (that are the slices of the tomographic grid characterized by highest values of diagonal element of resolution matrix). a) Irregular grid spacing: in the central part of the tomographic grid, the node spacing is 5 km and 8 km in the two horizontal directions (x and y), respectively. b) Regular grid spacing: the horizontal grid spacing is 5 km. c) Irregular grid spacing: only in the central part of the grid, the node spacing is 3 km in both horizontal directions. The best recovery of the checkerboard structure is clearly obtained with the coarser parameterization a).

Figure S4. Derivative weighted sum (S waves) for different model parameterizations relative to dataset B. Each parameterization has a 2 km spacing in the vertical direction up to 10 km depth and 3 km spacing for greater depths. Horizontal plane views are shown for 2 and 4 km depths. These are the model slices characterized by highest values of diagonal elements of resolution matrix. The crosses mark positions of nodes of the tomographic grid. a) Irregular grid spacing: in the central part of the tomographic grid the node spacing is 5 km and 8 km in the two horizontal directions (x and y), respectively. b) Regular grid spacing: the horizontal grid spacing is 5 km. c) Irregular grid spacing: only in the central part of the grid, the node spacing is 3 km in both horizontal directions. The coarser parameterization, a), still allows to retrieve an homogeneous ray coverage in a wider volume with respect to finer parameterizations. For each parameterization, at a single node (or at very few nodes) a much greater DWS value than remaining nodes is observed. It is due to Pertusillo artificial lake seismicity cluster, where most of the earthquakes of our dataset is located.

Figure S5. Checkerboard tests relative (S waves) to dataset B. Left panel of each row represents the

actual checkerboard structure, whereas the central and the right panels show the recovered structure after inversion of synthetic travel time data at two different depths, 2 km and 4 km (that are the that are the slices of the tomographic grid characterized by highest values of diagonal element of resolution matrix). a) Irregular grid spacing: in the central part of the tomographic grid, the node spacing is 5 km and 8 km in the two horizontal directions (x and y), respectively. b) Regular grid spacing: the horizontal grid spacing is 5 km. c) Irregular grid spacing: only in the central part of the grid, the node spacing is 3 km in both horizontal directions. The best recovery of the checkerboard structure is clearly obtained with the coarser parameterization. In spite of the increase in the number of data, the small scale anomalies still remain not recovered.

Figure S6. Recursive procedure adopted for the estimation of regularization parameters of the tomographic inversion for dataset A in the horizontal parameterization 5 km x 8 km. a) Trade-off curve between the variance of residuals and variance of the model. Several one-step inversions have been carried out by fixing the damping parameters for Vp/Vs and the maximum Vp/Vs adjustment allowed per iteration to 50 and 0.2, respectively. Each curve in the plot represents a different fixed maximum Vp adjustment. Each point identifies a different damping value. The chosen damping parameter is dampVp=60 (highlighted in bold character). The chosen maximum Vp adjustment for iteration is Dvp=1.0 km/s (purple line) . b) Trade-off curve between residuals variance and model roughness. These have been obtained by fixing the damping of Vp parameter to the one retrieved at the previous step. Each curve represents represents a different fixed maximum Vp/Vs adjustment. At this step of the procedure, the combination Dvp/vs=0.15 and dampVp/Vs=60 has been chosen. The chosen damping parameter is highlighted in bold character. c) Analogously to the procedure adopted at the first step, a trade-off curve between residuals variance and model variance has been retrieved. The regularization parameters relative to Vp/Vs part of the inverions have been fixed to the values retrieved at the previous step. The chosen damping parameter is dampVp=60. The chosen maximum Vp adjustment for iteration is dvp=1.0. Since the chosen combination is equal to the one retrieved at the first step of the iterative procedure, no further iterations have been necessary. Therefore, the final combination of regularization parameters is dampVp=60, dVp=1.0,dampVp/Vs=60, dVp/Vs=0.15.

Figure S7. Summary of synthetic checkerboard tests. On each map the black contour defines the well resolved area, as defined by the chosen SF threshold value. The grey crosses represent the position of grid nodes. The color scale, both for Vp and Vp/Vs models checkerboard tests are reported on the bottom of the figure. a) Results of checkerboard tests carried out for P-wave velocity model retrieved from the inversion of dataset A. b) Results of checkerboard tests carried out for Vp/Vs model retrieved from the inversion of dataset A. c) Results of checkerboard tests carried out for P-wave velocity model retrieved from the inversion of dataset B. d) Results of checkerboard tests carried out for Vp/Vs model retrieved from the inversion of dataset B.