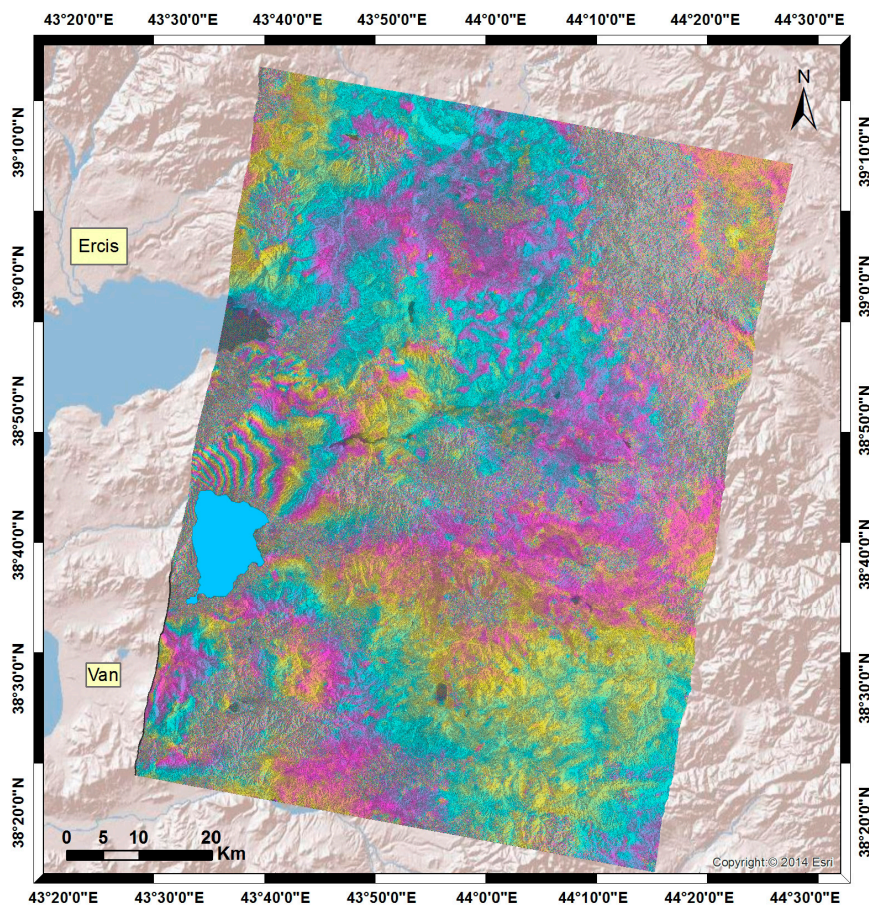


# Supplementary Materials: Deformation and Related Slip Due to the 2011 Van Earthquake (Turkey) Sequence Imaged by SAR Data and Numerical Modeling

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## Introduction

This supplementary material contains information related to data processing and models. In particular, the characteristics of all the SAR images acquired are listed in Table S1. The wrapped phase of the ASAR ENVISAT coseismic images are shown in Figures S1 and S2, while the unwrapped adjacent interferograms CSK1 (from COSMO-SkyMED) and ENV1 (from ASAR ENVISAT) are shown in Figure S3. The statistics of the non-linear inversion of the finite fault are reported in Figures S4 and S5 (1D and 2D Posterior Probability Density-PPD-distributions, respectively). Figure S6 reports the comparisons between observed data and predictions of the mean model obtained in the non-linear inversion while Figure S7 shows a full size map with all the GPS employed (data and model). In Figure S8 is shown a full size map with all the GPS employed in slip distribution computations (data and model). Figure S9 shows the slip uncertainty distribution for the post-seismic data inversions. Figure S10 reports the post-seismic interferometric data along a profile. Figure S11 shows the results for the Coulomb Failure Function (CFF) computations.



**Figure S1.** Wrapped InSAR image from ENVISAT satellite (called ENV1 in the main text). Descending orbit, 05/11/2010–31/10/2011.



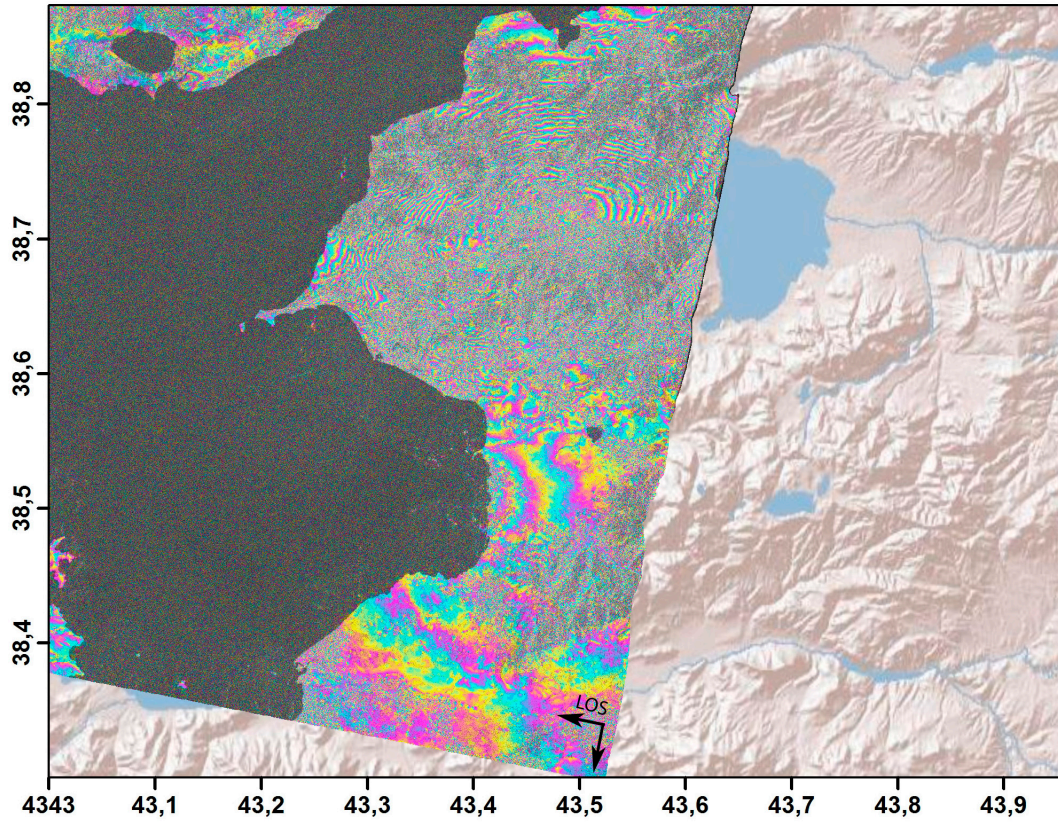


Figure S2. Wrapped InSAR image from ENVISAT satellite (called ENV2 in the main text). Descending orbit, 22/07/2011–19/11/2011.

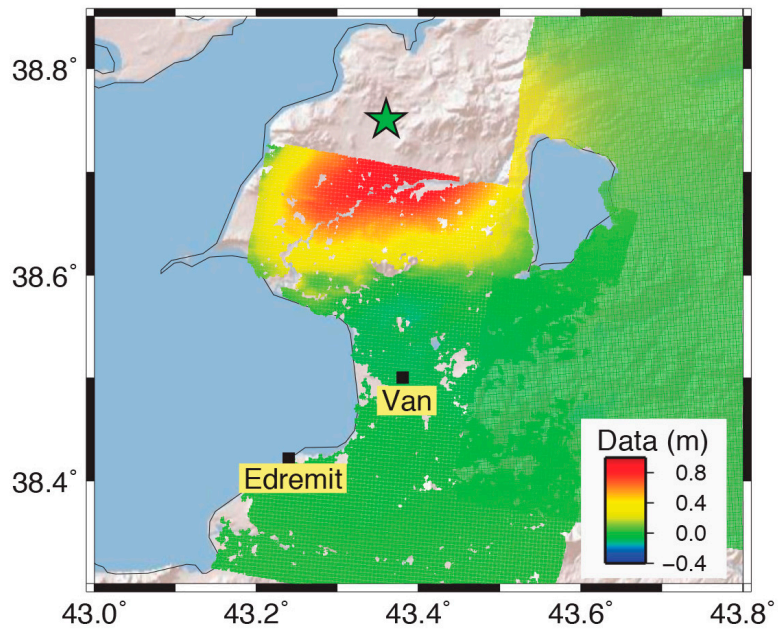
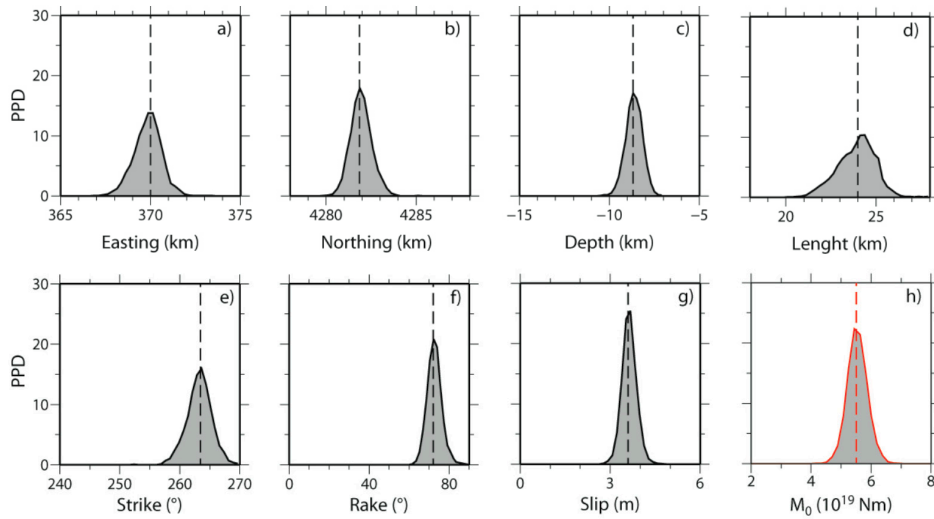
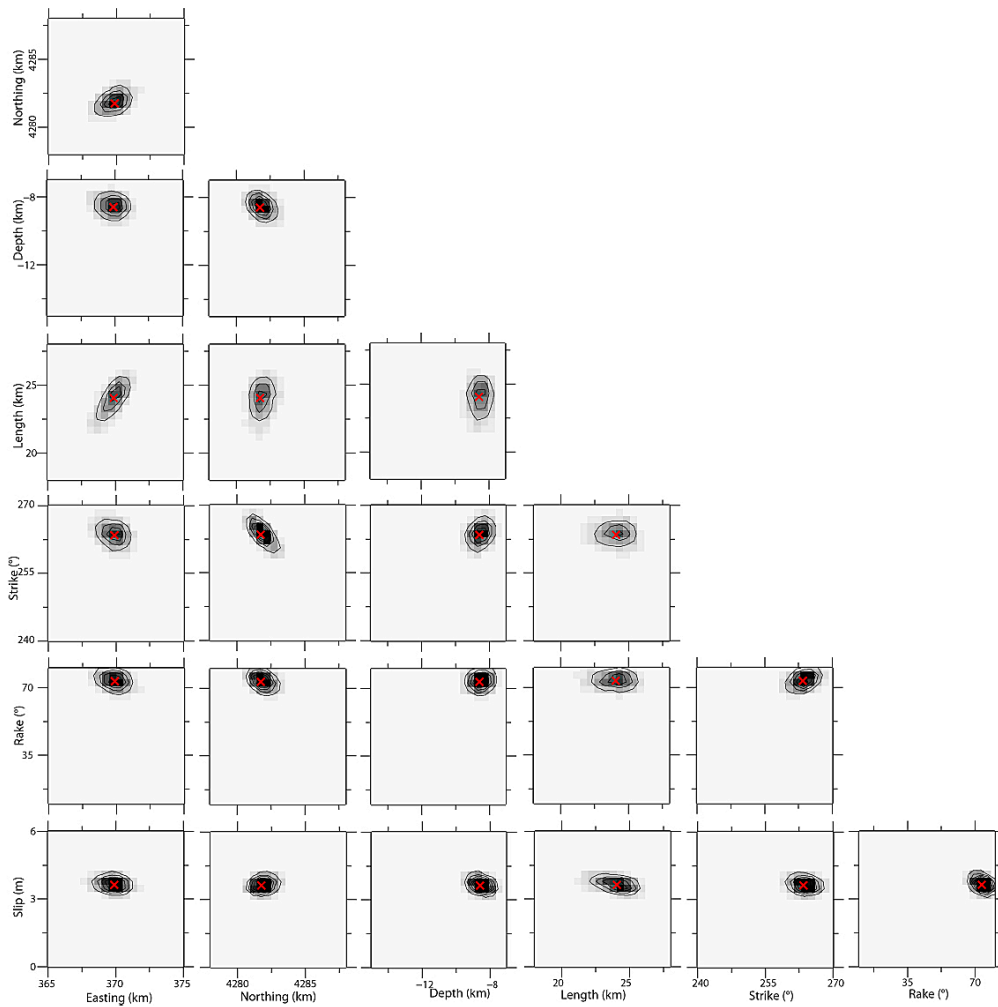


Figure S3. Unwrapped interferograms CSK1 and ENV1 of the coseismic phase.

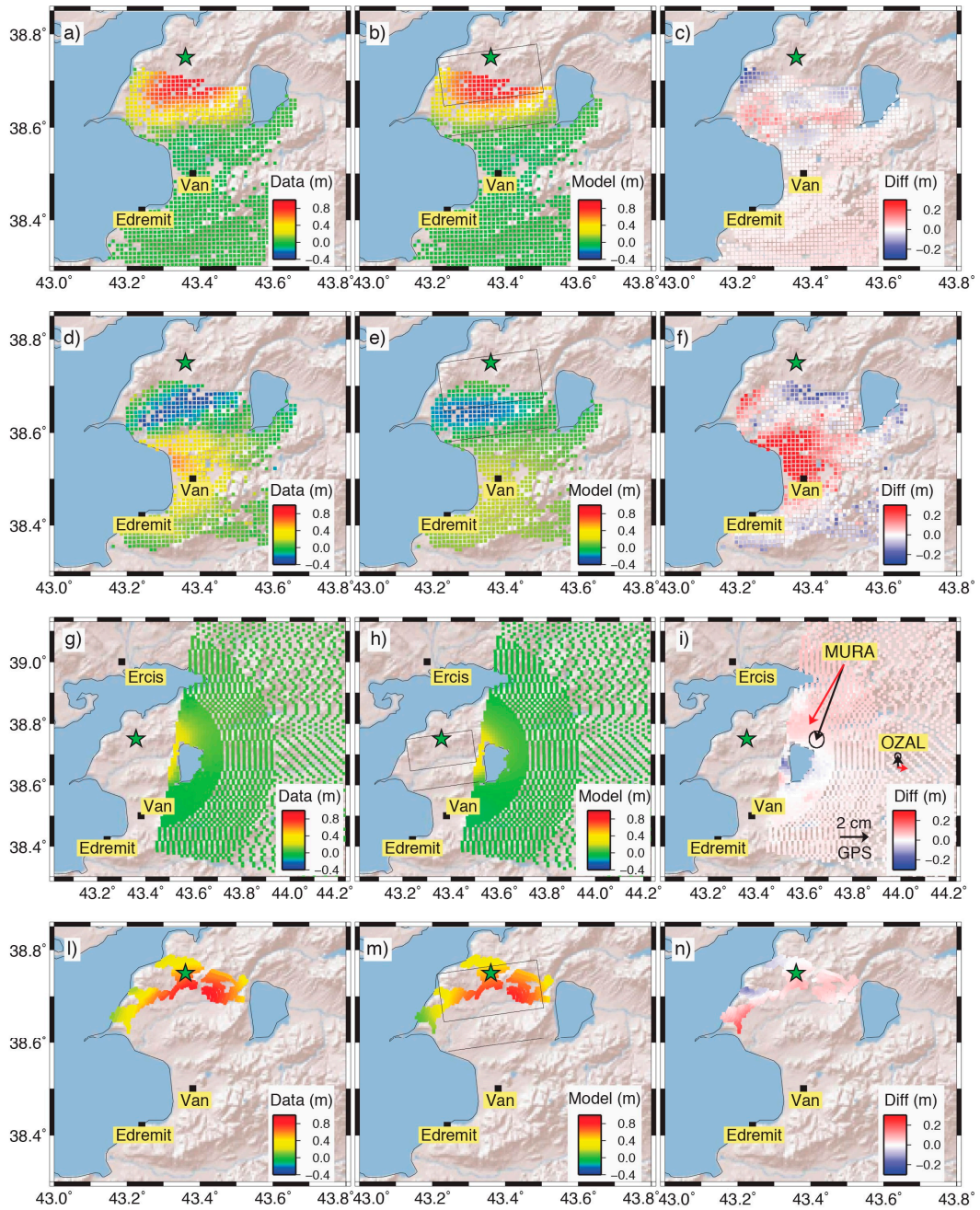


**Figure S4.** (a–g) PPD obtained by the non-linear fault inversion. Easting and Northing are in UTM-WGS84 projection (zone 38), and together with the depth are referred to the fault top left corner; (h) PPD of the geodetic moment. Note that this parameter is not actually inverted but is computed from the PPDs of the length and slip parameters, using a width equal to 18 km and an average rigidity of 35 GPa. The dashed line is the mean model while the parameters’ uncertainty is the half width of the PPD distribution.



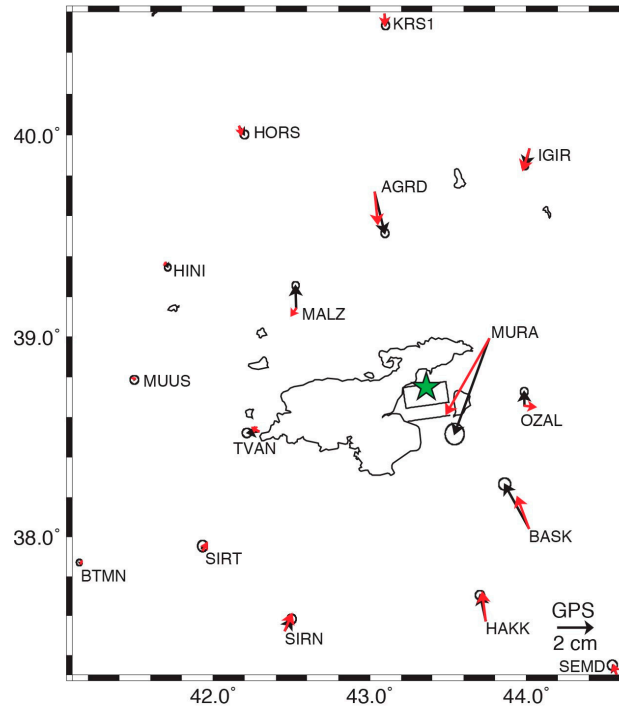
**Figure S5.** Two-dimensional PPD distributions. Each panel represents the 2D distribution of the inverted parameters. Contour lines every 20% confidence. The red cross is the mean model.



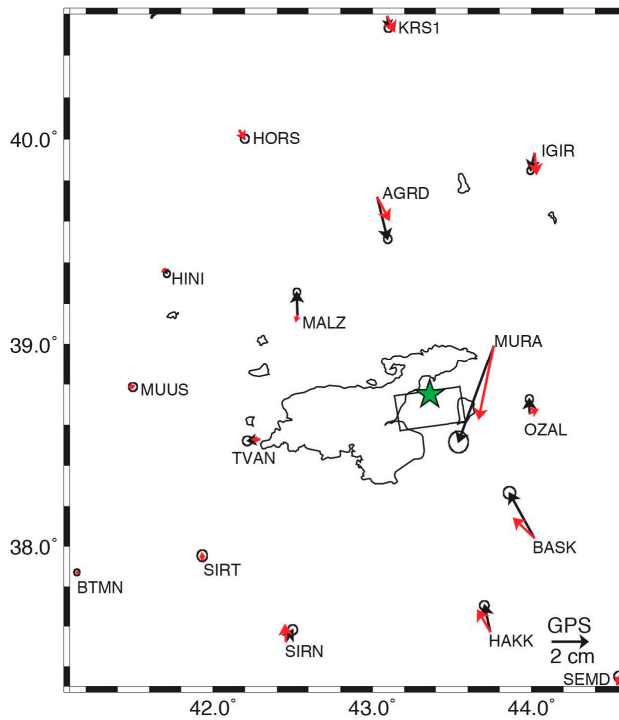


**Figure S6.** Comparisons between observed data (first column) and predictions (second column) for the coseismic displacements of the Van earthquake in the non-linear inversion. The residuals are observed minus modeled data (third column). (a–c) CSK1; (d–f) offset tracking azimuth data; (g–i) ENV1; near field GPS displacement vectors are also reported (black, observed; red, computed); (j–l) ENV2. The green star is the hypocenter while the fault constrained by the non-linear inversion is indicated in black.

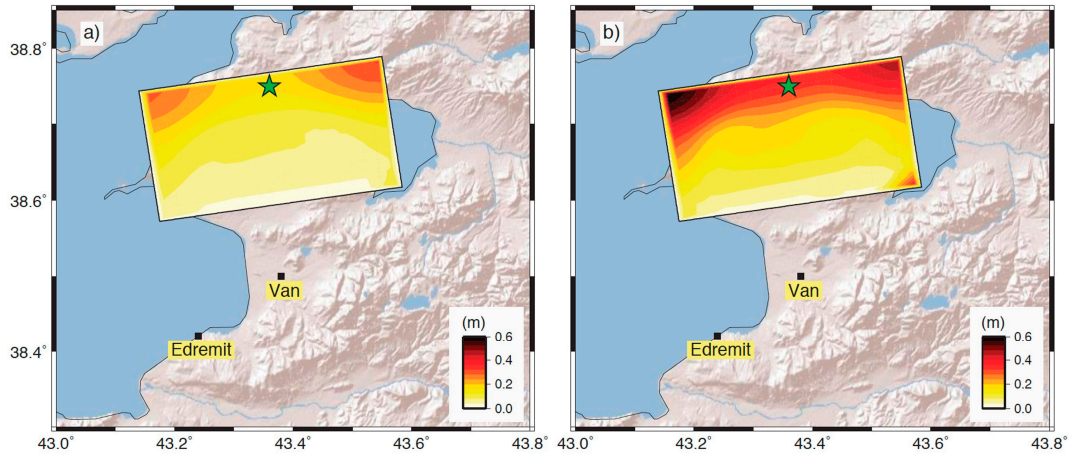




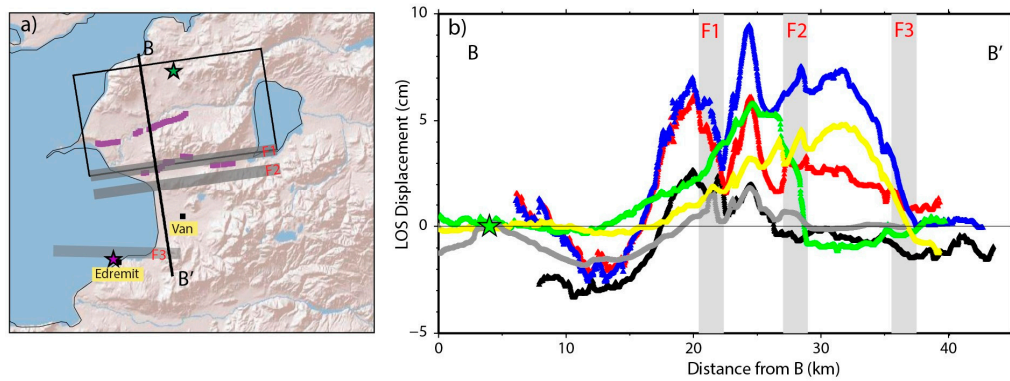
**Figure S7.** Full-scale map containing GPS data (black); and model (red) as computed in the non-linear inversion. The green star is the hypocenter; the fault plane and trace are indicated.



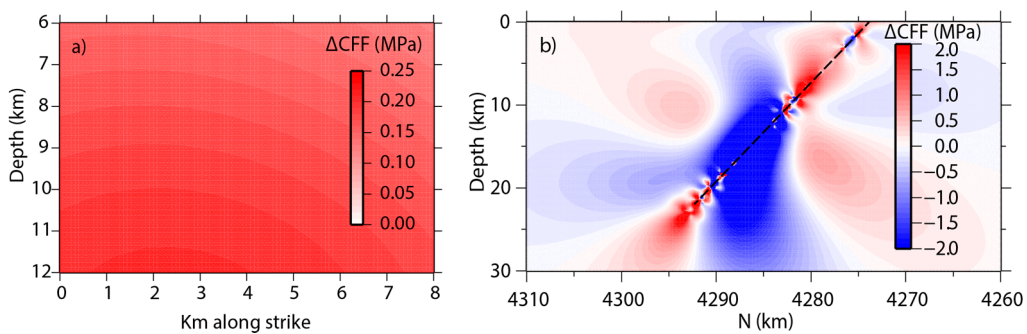
**Figure S8.** Full-scale map containing GPS data (black); and model (red) as computed in the linear inversion. The green star is the hypocenter; the fault plane is reported.



**Figure S9.** Post-seismic slip uncertainty distributions for InSAR data of (a) CSK2 (3-days temporal baseline); and (b) CSK3-TSX2 (17-days temporal baseline). The green star is the mainshock epicenter.



**Figure S10.** (a) Map of the BB' profile across the traces of the main fault (F1), the supposed splay fault (F2) according to Dogan *et al.* (2014) and the presumed Edremit-Van fault (F3); (b) LOS displacements of the post-seismic interferograms across the BB' profile. The colors are: CSK2, black; CSK3, blue; TSX1, grey; TSX2, yellow; TSX3, green; the difference between CSK3 and TSX2 in red. The stars are the epicenters of the Van (green) and Edremit-Van (purple) earthquakes.



**Figure S11.** (a) CFF projected on the presumed Edremit-Van earthquake fault, considering the stress changes due to coseismic and post-seismic slip (17-days temporal baseline) of the mainshock and a friction of 0.4. The Edremit-Van fault is oriented E-W (38.45°N) and extends 8 km × 5.75 km (Wells and Coppersmith, 1994); (b) CFF projected on a plane perpendicular to the main fault (AA' section as indicated in Figures 2 and 4), considering the stress changes due to coseismic and post-seismic slip (17-days temporal baseline). The fault line is dashed.



**Table S1.** Characteristics of the SAR images acquired (CSK, COSMO-SkyMed; ENV, ASAR ENVISAT; TSX, TERRASAR-X). The images used to produce coseismic and post-seismic interferograms are in boldface.

Sensor	Orbit	Track\Beam	Date	Incidence Angle
CSK	Descending	03	08/06/2011	29.3
CSK	Descending	03	16/06/2011	29.3
CSK	Descending	03	02/07/2011	29.3
CSK	Descending	03	10/07/2011	29.3
CSK	Descending	03	18/07/2011	29.3
CSK	Descending	03	19/07/2011	29.3
CSK	Descending	03	19/08/2011	29.3
CSK	Descending	03	20/08/2011	29.3
CSK	Descending	03	23/08/2011	29.3
CSK	Descending	03	08/09/2011	29.3
CSK	Descending	03	28/09/2011	29.3
<b>CSK</b>	<b>Descending</b>	<b>03</b>	<b>10/10/2011</b>	<b>29.3</b>
CSK	Descending	03	27/11/2011	29.3
<b>CSK</b>	<b>Descending</b>	<b>03</b>	<b>23/10/2011</b>	<b>29.3</b>
<b>CSK</b>	<b>Descending</b>	<b>03</b>	<b>26/10/2011</b>	<b>29.3</b>
<b>CSK</b>	<b>Descending</b>	<b>03</b>	<b>15/11/2011</b>	<b>29.3</b>
<b>ENV</b>	<b>Descending</b>	<b>394</b>	<b>22/07/2011</b>	<b>40.8</b>
<b>ENV</b>	<b>Descending</b>	<b>394</b>	<b>19/11/2011</b>	<b>40.8</b>
<b>ENV</b>	<b>Descending</b>	<b>121</b>	<b>05/11/2011</b>	<b>40.8</b>
<b>ENV</b>	<b>Descending</b>	<b>121</b>	<b>31/10/2011</b>	<b>40.8</b>
<b>TSX</b>	<b>Descending</b>	<b>31945</b>	<b>29/10/2011</b>	<b>26.3</b>
<b>TSX</b>	<b>Descending</b>	<b>31945</b>	<b>09/11/2011</b>	<b>26.3</b>
<b>TSX</b>	<b>Descending</b>	<b>31945</b>	<b>20/11/2011</b>	<b>26.3</b>
TSX	Descending	31945	01/12/2011	26.3
TSX	Descending	31945	12/12/2011	26.3
TSX	Descending	31945	03/01/2012	26.3
TSX	Descending	31945	14/01/2012	26.3
TSX	Descending	31945	25/01/2012	26.3
<b>TSX</b>	<b>Ascending</b>	<b>145704</b>	<b>31/10/2011</b>	<b>33.2</b>
<b>TSX</b>	<b>Ascending</b>	<b>145704</b>	<b>11/11/2011</b>	<b>33.2</b>
TSX	Ascending	145704	14/12/2011	33.2
TSX	Ascending	145704	25/12/2011	33.2

