Dear editors and reviewers, thank for your comments and suggestions.

Replies for anonymous referee #2 as follows:

This paper studies InSAR data collected for the 2015 Chile earthquake, in order to determine the fault geometry, the slip distribution and the related distribution of Coulomb stress change, to be compared with the aftershock distribution. The English usage is very poor along all the paper length. I found difficult to follow the description of the work made on INSAR observation, but I am not a specialists of the subject. The motivations of the study, the choice of the inverted data together with their advantages, and the impact of results are not enough discussed. Some specifications are not given for result reproducibility. Some results are not interpreted correctly.

Answer:

(1) We will make a major revision of the manuscript, including redraw Fig.2 expressed as unwrapped displacement instead of phase interferograms, redraw Fig.3 to be clear using good color scale, make another inversion based on curved fault, recalculate Coulomb stress change and redraw Fig.4, add resolution test and strengthen the analysis of the content of the discussion, and so on.

(2) We will asked for a native English speakers to modify the finally revised the manuscript text.

Scientific Significance: 3 Fair. Currently, elastic half space inversions and computation of Coulomb stress changes for planar dislocations requires almost standard techniques. Unfortunately, another paper recently provided a more resolved information about this earthquake, by jointly inverting also other kinds of data and using a more complex geometry of fault (curved surface) and elastic structure (Melgar et al. 2015doi:10.1002/2015GL067369).

Answer:

(1) Melgar et al. really made a very excellent research in this Chile's earthquake (Melgar et al. 2015doi:10.1002/2015GL067369), we have read his paper carefully. He used four kinds of data （high-rate GPS records, strong motion records, two interferograms from ascending and descending of the S1A satellite, and tide gauge records）, jointly inverted the fault slip model. They found that this earthquake produced deep and shallow two sliding zones. The "deep" asperity is well separated from the "shallow" asperity by a gap of reduced slip. The deep slip patch extends to 45 km depth, with ~10m peak slip at ~30 km depth. The shallow slip patch ruptured all the way to the trench, with ~10m peak slip at~15 km.

(2) Usually, there are some differences in the slip models constrained by different data sets, although it is necessary to use a variety of data sets to get a good slip model. In fact，dense InSAR data can provide good constrain to the near field deformation. In our paper, we used ascending and descending S1A InSAR data to get the coseismic deformation field and invert the slip model. We obtained one slip zone with maximum slip about 8m at ~10km depth, the slip depth reached 45km, while the large slip occurred in shallow portion. These results are similar to that of Melgar's, In addition to his discovery of the two slip areas. Our results are similar to those obtained by Giuseppe Solaro et al.(Giuseppe Solaro et al. 2016,doi:10.3390/rs8040323) using S1A data, which indicates our results are correct.

(3) In addition, in our manuscript, we calculated and analyzed the Coulomb Failure

Stress (CFS) changes and its relation to aftershocks. We also calculate the vertical displacement component and east–west(E-W) displacement component by using the ascending and descending data.

(4) We think these results from our study are significant for understanding the fracture behavior of the earthquake. We will improve and perfect this manuscript according to your comments and suggestions in the modified version.

Scientific Quality: 3 Fair. Results of the Coulomb stress analysis (see below) can be obtained and interpreted more correctly. However, concerning the slip distribution (the extent along dip, the shallow elongation along strike and the relative location with respect to the main-shock hypocentre) the present results are similar to the ones obtained by Melgar et al. (2015). Likely due to the "equal weight" (lines 191-192), results of the joint inversion (ascending plus descending INSAR data) do not differ significantly from those obtained using only descending data. At the same time, model residuals (Figure 2 I-L) are not discussed, so that the joint inversion is not completely justified.

Answer:

(1) We are in favor of your opinion. After reading the comments of the two reviewers, we have realized that a flat fault approximation in our inversion lead to a deviation from the aftershock, at the same time, the results of Coulomb Failure Stress (CFS) changes calculated based on the flat fault model are also affected. We will take new inversion using bending fault plane and recalculate the Coulomb Failure Stress (CFS) changes,and give more correct interpretation in the revised manuscript.

(2) We think the reason for the difficulty in distinguishing the results of joint inversion from those obtained using only descending data is due to bad color scale. We will use an appropriate color-scale to distinguish the slip differences of different data sets to make the Fig.3 easy to read in the modified version.

(3) The residual in Figure 2 (I - L) is ~15cm, compared with the coseismic displacement more than 130cm, this residual is acceptable. The residual from inversion of ascending or descending data alone is slightly smaller than that from inversion jointly. This may be due to the slip model in joint inversion to meet both ascending and descending data at the same time.

Presentation Quality: 4 Poor. Besides the poor English usage, the LOS displacement increments shown in figure 2 are scarcely interpretable. Some of the used parameters are not specified. Aftershock hypocenter locations should be evidenced also in cross sections together with the rupture extent (Figure 4c). The same saturating values of Coulomb stress (min/max in the colour palette) should be used both in Figure 4a and4c. The two tables can be more comprehensively organized.

Answer:

(1) We will invite a native English speaker to modify the final manuscript and adjust some expressions.

(2) We will redraw Figure 2 expressed as unwrapped displacement instead of phase interferograms in order to make it easy to explain, and we will redraw Figure 4a, 4c and modify them according to reviewer's suggestion.

To be publishable, the paper should improve the presentation and compare its results with that obtained by Melgar et al (2015), with trying to interpret the differences in the light of the different resolving power of the data used and the different modelling assumption made.

Answer:

As mentioned above, we will take new inversion using bending fault plane and recalculate the Coulomb Failure Stress (CFS) changes, strengthen the content of the discussion section through the comparison with that of Melgar et al (2015).

Detailed comments:

Line 70, 212 and 218 "shear" -> "Coulomb"

Answer:

It has been modified in the revised manuscript.

Line 142: "Firstly": Before making the linear inversion for the slip distribution, authors make the nonlinear joint inversion (of both ascending and descending data) for the fault geometry (optimal model, results shown in Table 2). Unlike the inversion for the slip distribution, in the nonlinear inversion authors do not consider separately ascending and descending InSAR data.
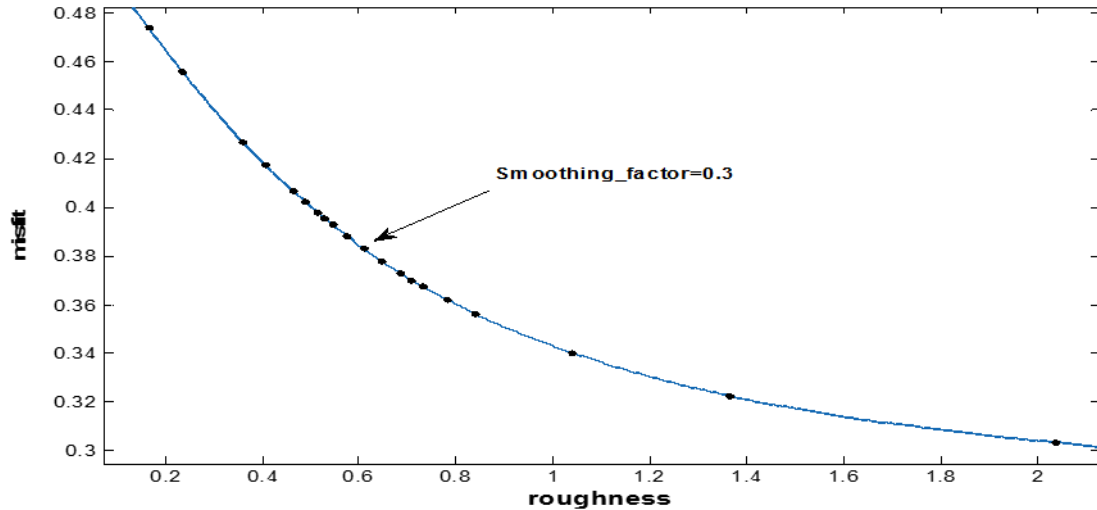
Answer:

Our fault slip inversion following two steps: firstly, we carry out a nonlinear inversion to constrain the fault geometry, then we perform a linear inversion to retrieve the fault distribution. Different data sources can get different fault geometry in the nonlinear inversion. When we make a nonlinear inversion constrained by ascending data, the obtained fault model has poor fitting to descending data, and vice versa. In order to get a general fault geometry, we use both ascending and descending data in the nonlinear joint inversion.

Line 151-152 I agree with referee 1: the criterion used to choose the smoothing factor (beta) and its chosen value should be declared.

Answer:

We select the smoothing factor through trade-off curve model between roughness and misfit which are mutually restricted. When the smooth factor value increase, the misfit value will increase, while the roughness will decrease. By using a trade-off curve (Figure S1.), we find best fitting smoothing factor 0.3 for descending data inversion. Taking into account the degree of constraint by smooth factor in fault slip inversion is similar, the smoothing factor is all set to 0.3 in our three kinds of inversion.

124

Figure S1. The trade-off curve between roughness and misfit

Line 160 "is to the surface" -> "is put at the surface of the elastic half-space".
Answer:
It has been modified in revised manuscript.

Table 2 misses the average value of slip and rake assumed or estimated. Parameters fixed or estimated should be distinguishable in Table 2. In Table 2, rather than in Table 3, I would suggest the authors to compare the results of the optimal model with evidences from USGS and GCMT.
Answer:
We will add the corresponding contents to table 2 and table3 according to your opinion in our revised manuscript.

Table 3: it is necessary to declare the shear modulus (or rigidity) value used to estimate the seismic moment, as reported in the last three rows. On the contrary, here reporting the same data concerning dip and strike as in Table 2 is unnecessary. Reporting the maximum slip together with the depth of the down-dip edge of the rupture, according to the different data sets, should help readers in understanding how the inferred results depend on the particular data set. Please check the rake angle estimated with descending data which is declared as 110 at line 177.
Answer:
We set the shear modulus 3.0×10^{6}MPa in our fault slip inversion. We will modify table 2 and table 3 to add the corresponding contents mentioned above in the revised manuscript

Lines 178, 185 and 194. I am surprised that the "fitting degree" (not defined) is so high, giving the results shown in Figure 2 I-L.
Answer:
(1) The fitting degree is defined as follows:

155

$$Corr = \frac{\sum_{n=1}^{N} O_n \cdot P_n}{\sqrt{\sum_{n=1}^{N} O_n^2 \cdot \sum_{n=1}^{N} P_n^2}}$$

156 '*Corr*' is the fitting degree, 'n' is the data points index, 'N' is the total sampled points
157 in our inversion. 'O' is the observation data. 'P' is the prediction data. When $O_n \approx P_n$,
158 Corr≈1.
159 (2) The residual error of the observed value minus the model is about 15cm (Figure2 I-
160 L), compared with the coseismic displacement more than 130cm, this residual is small
161 and acceptable, so the "fitting degree" is high.
162 (3) We will redraw the Fig.2 to make the residual value easy to identify.
163
164 Line 181. What is the "scope" of the slip magnitude? Concerning the lower slip values or
165 seismic moment estimated with ascending data, referee 1 gives an interpretation more
166 articulated and convincing, than the one given by the authors. The displacement observed at a
167 GPS station is a useful constraint to solve for the true displacement observed in the LOS
168 direction.
169 **Answer:**
170 (1) Here the "scope" of the slip magnitude means the range of the slip area coverage on
171 fault plane. We will improve the English expression in revised version.
172 (2) We agree with you. We are aware of the two question after reading the review
173 comments. On the one hand, the much smaller slip value in ascending data inversion is
174 likely to be related to the unwrapping, on the other hand, the color scale we used is not
175 appropriate, so that distinction is not clear. We will seriously examine and revise these
176 issues in order to improve the clarity and quality of the map in the revised manuscript.
177 (3) As you said, it is very good to use the displacement observed at a GPS station as
178 constraint to solve for the true displacement observed in the LOS direction. In the
179 observation of coseismic deformation, We usually take the far field without deformation
180 fringes as reference when the GPS is not available in the region of interferogram. That's
181 what we did in this manuscript. We will check and improve the process of unwrapping
182 in the new version.
183
184 Line 211. Stain->Stein. I agree with referee 1: likely aftershocks appear below the fault, because
185 the true fault curvature is neglected. Often, the distribution of the seismicity hypocentres,
186 possibly relocated, in a vertical cross section, allows us to delineate the true dip of the
187 mainshock fault.
188 **Answer:**
189 (1) "Stain" has been modified to "Stein" in the revised manuscript.
190 (2) We agree with the comments of the reviewers. We have realized that a flat fault
191 approximation in our inversion does lead to a deviation from the aftershocks. The dip
192 angle of the seismogenic fault may be greater in the deeper part. So we will take new
193 inversion using bending fault plane in the revised manuscript, which will improve our
194 interpretation.

Line 214. In general, the distribution of aftershock is not used to choose the "receiver fault mechanism". If the concern are aftershocks, the best thing to do is considering their focal mechanism in order to determine the" mechanism of the receiver fault". As said, aftershock alignments suggest the geometry of the "source fault" (where the mainshock occurred), therefore choosing this geometry for the "receiver fault" coincides with assuming that aftershocks occurred on faults with the same fault mechanism as the source fault. We cannot state that the authors chose this last strategy because in this paper the source fault does not have the same dip as inferred from aftershock alignments.

Answer:
After reading the comments of two reviewers, we have noticed this deviation caused by the flat plane fault approximation in our inversion. The aftershock distribution should reflect the geometry of the main fault. That is to say the dip angle of the seismic fault becomes larger in the deeper portion (about 20 km below). The flat fault model leads to inappropriate interpretation. In the revised manuscript, we will take new inversion using bending fault plane and compare with the old one, and give more reasonable interpretation.

Line 218-222: The following two statements are scarcely supported by Figure 4 results:
1) "(we) find aftershocks (depth in 20km-30km) locations correlate well with the area shaving increased Coulomb stress", 2) "most areas with increased Coulomb stress appeared beneath the main shock fault plane, which is consistent with the location where aftershocks took place."

Answer:
We agree with you. The statements in our initial manuscript are really inappropriate due to the deviation from the plane fault approximation. We will make a new inversion using bending fault and recalculate the Coulomb Failure Stress (CFS) changes, redraw the Fig.4, we will add aftershocks to Fig.4C to make the relationship between the CFS changes and the aftershock distribution more clear and easy to judge in our revised manuscript.

1) Actually in Figure 4a the majority of aftershocks seems to be shadowed (negative coulomb stress change) by the main rupture. This suggest that the 30 km of depth of the map view is above the down-dip edge of the rupture at least close to line B-B' (as also stated at lines 19, 278, 295). If this is true, the positive Coulomb stress values within the horizontal projection of the fault rupture likely are not due to the slip distribution, given the absence of asperities (regions of no slip) within the rupture surface, as evident from Figure 3c. In obtaining this result, a role may have the change in the receiver dip with respect to the source dip (see last point), or numerical problems due to fault discretization near the fault plane, evident mainly in cross sections (Figure 4c).

Answer:
Under the guidance of the referee's opinions, We do realize that the results shown in Fig.4 and corresponding explanation are not appropriate. Maybe the flat fault model with low dip angle(18.3°) used in our initial manuscript leads to the deviation of the source fault from the distribution of the aftershock, and the inappropriate location

settings of the receiver fault. These issues will be all modified in the revised manuscript by making new inversion based on curved fault and recalculating CFS.

2) In Figure 4c, below the fault plane, the most reliable positive feature is the off-fault lobe of Coulomb stress, which is located at a distance of about 200 km. It is due to tensile stress changes caused by the main rupture (the so-called antithetic lobe).However few of the aftershocks reported in Figure 4b seem to locate there.

Answer:

The off-fault lobe of Coulomb stress with positive value appears in the deep near the trench (Figure 4c), We think there may be several factors that can lead to this phenomenon: for example, aseismic slip and low initial stress accumulation in the area. In our revised manuscript, we will give a more reasonable explanation based on new CFS calculation results and relevant referencs.

Lines 273-275 Sentence to be rewritten for clarity.

Answer:

We will carefully revise these sentences in the revised manuscript.