We hereafter respond to the various comments and questions addressed by Benjamin Gerard (RC1) in his review. His review is entirely reported in black, and our responses in bold blue.

The suggested revisions do not question our results and conclusions, but will clearly help improve our manuscript by clarifying our arguments and their presentation. We thank Benjamin Gerard for his positive appreciation of our work, as well as for his various comments and suggestions

General comments:

In this manuscript Habel et al. constrain the timing and quantify the amount of tectonic shortening in a part of the Western Andes in northern Chile. They processed high-resolution satellite images, field observations, updated geological and structural maps in order to confront this dataset to numerically-modeled balanced cross-sections of the study area.

As it has never been done before, results and discussions are of a great interests for the community working on the Andes. The Western Cordillera is often mentioned in the literature, but the shortening has never been quantified accurately. Results, based on the study of pluri- kilometer geological objects, partially fill the data gap regarding shortening rates and timings of (re)activation of structures in the Western Cordillera. These data allow to better frame the deformation of the Western Andes and should be taken into account in future attempts to restore Andean shortening rates.

I particularly appreciated the topic, the scientific approach and the efforts of the authors in order to reach their scientific objectives. This work is worth publishing. Results are discussed and satisfactorily confronted to the literature already published. I have detailed in the sections below a few points of science to clarify.

However, the presentation of the manuscript still needs some work. It is sometimes difficult to follow the reasoning. For instance, some parts of the results are interpretations and some interpretation sections include reporting of results. Some sentences are difficult to follow (especially figure captions). I would suggest to shorten them (please see detailed comments below). Some significant information are missing and some less relevant are available. The presentation of the supplementary document is quite different from the manuscript. I advise authors to homogenize the presentation.

I am not native English speaker but some of the vocabulary and grammar seem to be incorrect. I have indicated errors I was able to identify, but I advise authors to have the manuscript proofread by a specialized company or a native English-speaking colleague if possible.

I recommend a round of minor revision, especially to fix presentation issues.

We appreciate this various positive feedbacks on our work and will hereafter explain the modifications and corrections we propose to make our manuscript clearer and more easily readable.

Review criteria:

1. Does the paper address relevant scientific questions within the scope of SE?

♋Yes. The understanding of the timing and the quantification of deformation in the Andean Western Cordillera is of a great interest for the geological community working in the Andes. Methods, results and discussion definitely fit with the scope of Solid Earth journal.

2. Does the paper present novel concepts, ideas, tools, or data?

♋Yes, new ideas and data are presented in this manuscript.

3. Are substantial conclusions reached?

♋Yes. Results have been satisfactorily analyzed, discussed, and conceptualized. The conclusions are of importance for a better understanding of the building of the Central Andes.

4. Are the scientific methods and assumptions valid and clearly outlined?

♋Overall, yes. Some information about the cross-section restoration modeling process are missing. Please see detailed comments below.

See detailed answers hereafter

5. Are the results sufficient to support the interpretations and conclusions?

♋Yes. Results were satisfactorily exploited to support authors' statements. The limitation associated to the results were clearly discussed.

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

♋ Overall, yes. Some information about the modeling process are still missing.

See detailed answers hereafter

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

♋Yes.

8. Does the title clearly reflect the contents of the paper?

♋Yes. The title should be even more assertive by showing that the shortening of the Western Andes estimated in this study is not so negligible at the scale of the entire Andes.

We thank RC1 for this suggestion. It should be however reminded that we only clearly document a few km of shortening across our two field sites, in the Pinchal and Quebrada Blanca zones. Our proposal that shortening may not be that negligible across the whole western flank of the Andes derives from our reasoning when scaling our observations/results to the whole region - and as such may be discussed and debated. We therefore prefer to keep conservative and not too assertive or provocative in the title of the manuscript.

9. Does the abstract provide a concise and complete summary?

♋Yes, the abstract is complete.

10. Is the overall presentation well-structured and clear?

♋No, it needs a considerable amount of work, especially in the organization of the results, interpretation and discussion sections.

As further explained and detailed hereafter, we propose to re-organize slightly our manuscript to further separate field observations (in sections 4 and 5, for each one of the two field sites), structural interpretations and from there our various deductions on crustal shortening and kinematics (in section 6 - previously mixed in between sections 4-5 and 6), before proposing a discussion based on the regional up-scaling of our observations and deductions (section 7).

11. Is the language fluent and precise?

♋No, Some paragraphs are difficult to follow. I advise authors to have the manuscript proofread by a native English-speaking colleague if possible and refer to technical corrections below.

We will do our best to have our revised manuscript read and corrected by a native English colleague.

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

♋Yes.

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

♋Yes. Parts of the manuscript and figures should be clarified. Please see detailed comments below. Paragraphs have to been clarified and shorten by removing redundant information.

See detailed response hereafter.

14. Are the number and quality of references appropriate?

♋Yes, the state of the art is almost complete and authors' results are satisfactorily confronted with the literature available in the discussion.

15. Is the amount and quality of supplementary material appropriate?

♋Yes. Some parts need to be clarified. Please see detailed comments hereafter.

Specific comments / Scientific questions and issues:

Manuscript

L22-24: I do not think that the authors can say that the shortening of the Western Andes is "negligible" even at the scale of the entire range. The study area only represents approximately 1/5 in width of the Western Cordillera; Authors should expect higher shortening for the Western Cordillera. Taking into account the authors' maximum shortening estimate, it could represent 15% of total shortening integrated to the entire Andes. Authors should be a bit more assertive about this important result because most of the deformation of Western Cordillera is hidden.

As already pointed out, we only clearly document a few km of shortening across the two investigated field sites. Our proposal that shortening may be up to ~20-50 km across the whole Western Andes is only a deduction when interpreting the field sites as part of a thrust system and when scaling up our results to the whole western flank of the Andes.

~20-50 km represent 6-14% of the total 360 km shortening across the whole Andes. We agree that such values are not to be considered as negligible, in particular if we consider that they were accommodated at a time when no other main structures were active. However, we prefer to keep conservative so as to avoid unnecessary debate and controversy.

The term "negligible" may sound negative, we propose to modify slightly this sentence to clarify our point.

L61-62: How much shortening has been estimated in the thrust belt framed by San Ramon fault ? Authors should add this information (if available) in order to compare it with their results. Is this tectonic shortening thick or thin-skinned, or both in Santiago de Chile area?

The San Ramon fault is the most frontal fault of the West-Andean fold and thrust belt at the latitude of Santiago (33.5°S). This structure is mostly thin-skinned and has absorbed a total of 9-15 km over the last ~20-25 Myr (Riesner et al 2017), to be compared to the total 27-42 km across the whole Andes at this latitude (Riesner et al 2018) - ie 21-55% of the total Andean shortening at 33.5°S.

However, even though this information is available in the cited references, we recall that this section of the Andes is ~1300 km southward from the sites investigated here, and is therefore not directly comparable. To avoid confusing details and keep the focus of our manuscript on the Andes at ~20-22°S, we prefer not to add these details. The reader has all needed references in case interested.

L100: The Eastern Cordillera and the Cordillera Oriental are the same... The Cordillera Oriental is not the Interandean zone. The nomenclature should be clarified here. The Interandean zone is a transition zone between the Eastern cordillera and the Subandean zone with a specific tectonic style and specific geological units involved (Kley, 1996).

We agree and thank RC1 for this correction.

L107-115: Authors should also discuss paleo-altimetry estimates in this paragraph, which is (at least partly) linked to the deformation. Please see Sundell et al. (2019) and others for instance. In this section, authors should also mentioned the Bolivian Orocline bending that affected the area, to highlight potential relationships with the migration of the deformation eastward (Müller et al., 2002; for instance).

We agree with RC1 that elevation is a indirect indication of deformation - and as such data on paleo-altimetry could be mentioned in this paragraph. We recall however that this section is only meant at providing a general overview on the various morphotectonic units of the whole Andes and on their timing of deformation, needed to later put our results and findings in the context of the Andean orogeny. Details about paleo-altimetry or even the bending of the Bolivian orocline are somehow out of the scope of this section - and of our manuscript in general. We prefer to keep our manuscript focused and not to lengthen it with unnecessary details.

L125: Why is the structural organization become more complex southward? Please consider to add a short explanation here.

One possible explanation for the lateral structural variations along the Andes relates to structural inheritance from the earlier Mesozoic Andean basins. We will add a short explanation when revising the manuscript.

L226: Are variations in stratigraphic thicknesses have been taken into account (error computation in shortening estimates)? And if yes, how? Does it affect significantly the shortening estimates?

Variations in stratigraphic thicknesses were not taken into account in computing shortening estimates. We do not have any evidence for significant variations in the case of Quebrada Blanca (Figures 9a-b). In the case of the Pinchal zone, we cannot document any such variations if existent, in particular by comparing the two limbs of the overturned syncline as the eastern limb is highly faulted and deformed.

We simply and conservatively indicate that this is a possible limitation of our interpretations - and a classical one in structural geology.

L237-243: Authors should consider to briefly detail here what was the set of parameters explored for cross-section restoration? Even if it is available in the supplementary document. Also, what were the criteria to define the best solution of the forward modeling approach? Authors should had this significant information in this paragraph.

Our preferred solution was defined by visually comparing the modeled and interpreted structural geometries. We thank RC1 for his suggestions. We will add more information on the trishear modeling in the main text, instead of keeping all relevant information in the supplementary data. We recall here that our trishear model is a forward model (and not a backward restoration) and that our preferred model is possibly a non-unique solution. This will be further emphasized in the revised manuscript.

L574-582: This part should be in the method section. Not in the discussion. Furthermore, authors should had first-order missing information here, such as:

- Briefly describe what are parameters investigated (trishear).
- What were criteria to define the "best-fitting model". Are specific metrics used? if qualitative only, which parameters have been taken into consideration? Authors should describe a bit more the methodology.

This section (section 6) is not part of the discussion (section 7), but presents the results of our modeling and interpretation of field observations.
We recall here that our preferred model is defined from visually comparing modeled and interpreted structural geometries, and that our preferred model may not a unique solution. As such, we believe that we should refer to a "preferred model", rather than to a "best-fit model" - this will be corrected when revising our manuscript.
This will be further emphasized and clarified in the revised manuscript.

L585-586: Are there errors on cumulative shortening estimates? Did the authors test other modeling setups with similar results (or close results), which also satisfies the present-day geometry of the structures.

We tested a wide range of parameters, within the range of values considered in the literature for these parameters (see explanation in the supplementary material, to be transferred partly to the main text when revising the manuscript). Within this range of acceptable values, we did not find a wide range of possible solutions reproducing our interpreted structural geometries. Given this, we estimate that our shortening values are determined with an uncertainty of 0.1-0.2 km. We recall here that our shortening estimates mostly depend on the structural geometries to be modeled (ie as deduced from our field interpretations) rather than on the detailed model parameters.

This will be added and/or further emphasized in our revised manuscript.

L692-696: Exhumation and uplift are different. Authors should not compare it directly. I did not find the information about the amount of uplift related to the shortening modeling. Authors should explain how uplift has been computed and what is the value of uplift taken into account for comparison.

We agree with RC1.
In the case of the ABT system, these is no data on uplift, but rather on exhumation from thermochronology at the regional scale (Maksaev et al 1999, Reiners et al 2015). We compare these data to what can be deduced from our structural interpretations in the Pinchal zone. Our observations suggest >2.2 km of exhumation over the Pinchal Thrust, to erode the >2.2 km thick Mesozoic series and exhume the basement (section 4.2). Such exhumation is expected to be concomitant with overthrusting over the Pinchal thrust, as part of the ABT system. This amount of exhumation is consistent with the findings of Maksaev et al (1999) of 4-5 km of basement exhumation.
This will be rephrased and clarified in the revised manuscript, here but also in the revised section 4.2

L790-795: Authors should briefly explain hypothesis dealing about the deformation transfer from west to east in the frame of their discussion.

We do not understand the point raised here by RC1. We only aim at pointing out the fact that deformation across our field sites - and possibly across the whole Western Andean flank - seems to significantly slow down by the time deformation initiates further east (Eastern Cordillera) in the Andes. This will be tentatively rephrased if confusing.

Supporting information

Text S1: How many forward models have been run? Information partly appear in the caption of Table S1, but it has to be written in the text also (in the supplementary and in the manuscript). How was the range of parameters explored? How the authors decided to sample the range of parameters in order to cover the parameter space in the most representative way. Authors should add these information.
As already mentioned, this will be further detailed in the revised main manuscript and supplementary material.

Technical corrections:

Manuscript

L12/L14/L45: "western Andes" should be written "Western Andes" with a capital letter (w). Authors should check it in the entire manuscript.

L14-15: "Our results [...] regional data". Authors should consider to rework this sentence that is difficult to follow. I think the part "once our [...] regional data" is not necessary.

L45: Authors should consider to add a reference (e.g. Jaillard et al., 2000; Jaillard & Soler, 1996) to justify Andean mountain-building initiation.

L47-49: Authors should considered to cite only 2 or 3 articles here, in order to focus on the most relevant papers that deal with Andean deformation migration. Some of the papers cited here do not deal exclusively with this topic.

L49-53: This sentence is too long and difficult to follow. I suggest to shorten it.

These above corrections will be easily implemented in the revised manuscript.

L50-51: To justify previous studies in the "various cordilleras to the east" authors should consider to cite Gérard et al. (2021) to support their statements.

Although this contribution is undoubtedly interesting, we prefer not to mention it in our manuscript. Indeed, it is rather a local study in Peru, and if we were to cite this work, we should also cite any other work on the Altiplano-Puna... in contradiction with the simplification requested in our citations (see penultimate comment by RC1).

L57: "locations" instead of "localities" maybe?

L67: "onset" instead of "start" maybe?

L69: Authors should refer to Figure 1 to help the reader. "blanketing Cenozoic deposits and volcanics".

L73: Authors should briefly describe here what kind of quantitative data have been processed.

These above corrections will be implemented in the revised manuscript.

L86-115: This state of the art is quite complete but, it is too difficult to follow. In order to be clearer, I would suggest to start the geological framework from the full Andes' scale and then to focus on the study area. That is to say, to keep L86-90 as it is. Then to put L97-115 in a row and next, focusing on the study area (L90-96).

We do not really get the point raised by RC1. Indeed the first part (lines 86-90) refers to the overall Andean margin, then the second one (lines 90-96) to the proper Andes and their various units at the large-scale, before indicating the temporal evolution of deformation of these various units from the literature (lines 97-115). As such we already follow the recommendation of RC1 by progressively zooming into our study area. It would make no sense to indicate the temporal evolution of Andean morphotectonics units (lines 97-115) before even defining these units (lines 90-96).
We propose to slightly modify this section, so as to mention the topographic characteristics of the Andes, their crustal thickening and shortening after first defining the Andes along the Andean margin.

L91-92: "elevation" instead of "altitude". Please check throughout the manuscript.

L95-96: Merge "Figure 1" into the bracket located before. For instance: (...Atacama Bench; Figure 1). Please check throughout the manuscript.

L98: Authors do not need to quote "following here the terminology of ..." I would suggest just to cite the literature. It will be easier to read.

These above corrections will be implemented in the revised manuscript.

L118-119: Authors usually described units from west to east before. Here it is reversed. I suggest to keep this west-east logic, it will be easier for the reader.

We agree with RC1. The logic has been to describe morpho-structural units from west to east before, ie from the subduction trench to the South American continent. We have tried in our earlier versions of the manuscript to keep this geographic logic, but found it to be difficult as it supposes to describe stratigraphic units from the youngest to the oldest, ie the

reverse of what is usually done. To keep a stratigraphic (ie temporal) logic from the oldest units to the youngest ones, here but also later in the manuscript when providing the detailed stratigraphy of the investigated field sites, we need to keep describing from east to west our region of interest. We will explain this logic briefly in the revised manuscript.

L124: Please add the city of Calama on Figure 1.

This correction cannot be implemented, as the city of Calama is out of the map of Figure 1. This is why we indicate its latitude in the main text.

L149-153: These sentences are confusing. Please consider to rework this section. There are too many comas.

This correction will be implemented in the revised manuscript.

L150: Where are located these Sierras on Figure 1? Sierra del Medio and Sierra de Moreno? Authors should consider to add these information on Figure 1.

These sierras are also slightly south of the map of Figure 1, except for part of the Sierra Moreno where the Pinchal zone is located. We will simplify and delete this part of the sentence mentioning local and unnecessary features.

L189: Authors should add a reference for "European Pléiades satellites images".

Rather than adding a reference, we will add the corresponding web site of the spatial program (https://earth.esa.int/eogateway/missions/pleiades) in the data availability statement.

L191: A space is missing between "2" and "m".

This correction will be implemented in the revised manuscript.

L249-251: This is a paragraph for a discussion. Authors should consider to put this section in the interpretation/discussion section and not in the result section.

We understand this comment by RC1. However, because the stratigraphic order observed in the field is the reverse of that published in the earlier geological map of the area (Skarmeta and Marinovic, 1981), with implications in terms of the sense of local structures (syncline instead of anticline) and in terms of regional stratigraphy with the possibility of Trias units, we prefer to mention this particular context early in our presentation of the Pinchal area. In contrast, in the case of the Quebrada Blanca area, we rely on earlier stratigraphic and geologic work.

L254-255: "The first order [...] units". Authors do not need to introduce figures like in a book chapter or in a thesis or report. Just to smoothly integrate it in the text to argue their points. This observation is valid for other sections in the manuscript.

This correction will be implemented in the revised manuscript.

L255-256: To my opinion, and this is valid for the entire manuscript, it would be easier for the reader if authors should refer to the exact figures in the supplementary document (in line with their statements; Figure S1 for instance) instead of just reporting that there is supplementary material here and there.

We do not understand this comment by RC1... as this is what we exactly do by refering to the exact figure to be found in the supplementary material. We will verify that this is done throughout the whole text.

L314-315: Authors should not introduce figures at the beginning of sections, just integrate it in the text, according to their statements. It will be easier to read.

This correction will be implemented in the revised manuscript.

L395: The section 4.1.3 is an interpretation section. Authors must not merged results and interpretation this way. 4.1.3 part has to appear later in the manuscript. Authors should consider to had this section in the Discussion/Interpretation section.

We understand this comment by RC1. However, we believe that we need to discuss our field observations in the Pinchal zone in light of existing geological maps and regional stratigraphic knowledge, in particular because these are in contradiction with previous published work, before presenting anything about the Quebrada Blanca. As we present two different field sites with various degrees of confidence in previous work in light of our field observations, we find it confusing to strictly follow the classical manuscript organisation "data-results-interpretations-discussion" that would imply repetitions in going back and forth between the two field sites. At some point we need to discuss the strength of our field observations before presenting our interpretations, and this for each site, before combining our results together at the regional scale and discussing them. We therefore prefer to keep here this discussion on the strength of our stratigraphic considerations, before getting into the resulting structural interpretations.

L416: Same comment as above. Authors cannot present results and interpretations from Pinchal area and then present results and interpretations from Quebrada Blanca. The organization of the sections has to be reviewed. Authors should present all observations, stratigraphic, tectonic and modeling results for both area; and then interpret and discuss it later in the manuscript. Parts of section 4.2 has to be transferred in a distinct interpretation section (section 6 for instance, with new sub-sections for Quebrada Blanca and for Pinchal).

As the Pinchal and Quebrada Blanca zones are quite different in terms of scale, stratigraphy or structure, in particular with respect to previous works, we preferred to present observations and interpretations for each zone, separately, for clarity purposes and to avoid otherwise inevitable repetitions.

We understand the recommendations of RC1, but for these previous reasons, we would like to keep presenting and discussing the two zones separately, one after the other, at least where it comes to observations. However, following these suggestions, we propose to revise the structure of the manuscript as follows:

1) first present stratigraphic and structural observations of Pinchal (present sections 4.1.1 to 4.1.3) and Quebrada Blanca (present sections 5.1 and 5.2) zones in two separate sections (sections 4 and 5),

then 2) present all structural and kinematic interpretations of both zones in section 6 (including present sections 4.2, 5.3 into present section 6),

before 3) a general discussion (section 7) where our results and interpretations are up-scaled to the whole western Andean flank.

L417-418: In order to get straight to the point, these introductory sentences are not necessary. It makes the reading difficult with unnecessary information. Authors should simply refer to figures and tables to support their statements.

This correction will be implemented in the revised manuscript.

L418: There is an issue in results presentation. Authors should not refer to table 1 (presenting shortening values computed from cross-section restoration) before figures presenting cross-sections restoration/line-length balancing (Figure 11). It is very difficult to follow.

When revising the structure of the manuscript as proposed a few lines above, any reference to Table 1 would appear later in the manuscript, in section 6. This issue should then be solved.

L425: For this assumption, authors should consider to add a reference to support their point.

This will be corrected in the revised manuscript, with references to classical papers by J. Suppe for instance.

L453: Results for Quebrada Blanca area should appear before interpretations from Pinchal area.

L525: Similar comment from above. Parts of this section are interpretations, and it should appear in a distinct and independent section later in the manuscript to avoid merging results and interpretation in the same section.

See previous answer about the proposed revision of the manuscript structure. Our proposed revision follows in its main lines this particular recommendation.

L554: It is not necessary to refer to previous sections: "section 4.1". Authors should remove this information.

This correction will be implemented in the revised manuscript.

L567: Section 6.2 is a mix between trishear method, results, interpretation and discussion. Results should appear earlier in the manuscript. Authors should review the structure of the manuscript.

Trishear results cannot appear earlier in the manuscript, as we need to present first the structural interpretations of our field sites before modeling them.
We agree that part of the text is here a repetition of the trishear method. This can be easily corrected by complementing section 3.4 (method) and by focusing only here on the model implementation and results. Some points need however to remain discussed here - such as the different spatial scales of the two sites, the meaning of these results with respect to our structural interpretations - so as to keep the discussion section (section 7) focused on up-scaling our results and interpretations and discussing their regional implications.

L574-582: This part should be in the method section. Not in the discussion. Furthermore, authors should had first-order missing information here, such as: - Briefly describe what are parameters investigated (trishear). - What were criteria to define the "best-fitting model". Are specific metrics used? if qualitative only, which parameters have been taken into consideration? Authors should describe a bit more the methodology.

As stated previously, we agree with RC1 and part of the text will be moved to the method section (section 3.4). Also to complement what is written about the model implementation, we will move to this section some key information initially provided in the supplementary material: what parameters investigated, range of values, etc. Finally, as proposed previously, the "best-fitting model" should be rather referred as the "preferred model" as we do a visual fit between model and structural section, and not a mathematical fit of the two geometries.

L617: "elevation" instead of "altitude".

L797-802: There are too many information here. Authors should consider to shorten this part to focus on first-order information.

L798: Authors may add "Chilean" before "Andes" to help the reader.

L855: The bibliography is not homogeneous. Some titles are in capital letters, typos are present. Please fix issues.

These above corrections will be implemented in the revised manuscript.

Figures

Figure 1: The text in the figure caption is not very clear. Authors should consider to rework the caption with smallest sentences. Authors should consider to add the topographic cross-section location on the geological map. Authors should consider to add major tectonic features location on the topographic cross-section to identify potential relationships between faults and topography. Cordillera Domeyko appears in the caption but does not appear on the geological map. Please add it. To simplify the caption, authors should remove abbreviation explanation for ABT, WAT, WATS, Cz, Mz, Px-Pc as it is already written in the figure. Or delete the abbreviation in the figure et keep it in the caption. In the inset, authors should consider to add an arrow to show the direction of convergence (Nazca vs. South American plate).

The suggested corrections will be implemented.

Figure 2: Labels "a" and "b" are on the figure but not in the caption. What is the difference between the two pictures ? Authors should mayve select one picture to avoir repetition of information. Figures 2 and 3 could be merged.

We thank RC1 for these suggested corrections, which will be implemented in the revised manuscript.

As of merging figures 2 and 3, we do not agree with this idea as these two figures are quite different: one represents a landscape view (Figure 2), and the other the simplified stratigraphic column of the site (Figure 3).

Figure 3: Approximative thicknesses of units should be indicated on the figure. Even if the log is not scaled. In the caption: "By analogy to regional description". Please cite the literature here.

We already tried to report the thicknesses of the units, but because the log is not scaled this is not easy to implement for readability purposes. All thicknesses are reported in the text. Instead of citing the literature corresponding to regional stratigraphic descriptions, we rather refer to the text to avoid lengthening unnecessarily the caption.

Figure 4: It would be maybe better to call figure 4 before. At the beginning of section 4, to better organize this section. Authors do not need to add information twice (in the figure + in the caption). Field picture locations for instance.

The structural map of Figure 4 cannot be called before the structural descriptions, ie not before section 4.1.2. The stratigraphic description of section 4.1.1 is not related to this map but rather to Figure 3.

Any redondant information between figure and caption will be removed. In the case of located field pictures, the associated number still needs to be explained as the figure to which it refers.

Figure 5: Authors should not repeat three times "Figure 4" in the caption. It represents a repetition of the same information. It is difficult to read... I suggest to find a way to shorten these sentences. There are some French words in the figure: "Cisaillement, Schisosité". Please translate it.

Repetitions will be corrected in the revised manuscript.

As of the French word "Cisaillement-Schistosité".. well, this is in fact the technical word used even in English (which explains the "C-S" abbreviation used for the fabric), as some other structural words such as "décollement", etc.

Figure 7: L385/389: In the caption, the word “violet” should be replaced by “purple”? Authors should indicate dip marks of strata on the pictures to help the reader.

The word "violet" will be corrected.
We will also implement some dip marks, but will mostly try not to load too much the figure to keep it readable.

Figure 10: This figure is not well structured. Authors should add a symbol (on the figure) to show the relationship between picture a and b. Authors should also find a way to remove blank space at bottom right of the figure.

We will modify the figure so as to balance the blank space in the lower right corner of the figure (ex: moving lower panel to the middle), and so as to better illustrate the link between figures a and b (ex: adding an arrow).

Figure 11: This Figure and associated results have to be presented before in the result section. Not in an interpretation part. L596-603: This text is not needed in the figure caption and should be written in the main text, otherwise the caption is too hard to follow. Parts of the caption are already displayed on the figure. To shorten the caption, authors should consider to remove duplicate information.

We do not agree with RC1. This figure can only appear with section 6 as it presents and uses results from trishear modeling, together with geological time constraints. Therefore it must be in an interpretation section, even though this interpretation integrates modeling results. We recognize that time benchmarks, which provide key time constraints for our kinematic interpretation, are already explained in the main text. We will simplify the caption, but prefer to clarify and explain the key time lines that appear in the figure as these are important for our conclusions - and to understand the figure.

Supporting information

The style of the supplementary document is quite different from the manuscript. I advise authors to homogenize the presentation. English has to be proofread. In the manuscript, authors should refer to the exact figure label to clarify the text. Generally, figure captions should be shorten in order to optimize them.

We will homogenize the format of the supplementary material with that of the main text. We recall here that there is no indication of a specific format to be followed for supplementary material in the author guidelines of Solid Earth.

English will be verified. As of referring to the exact figures in the main text, this was already the case in the initially submitted manuscript.

Section (1)

Figure S14 appears before Figure S13 in the text. Authors should check the order.

This will be verified after revision of our manuscript, we thank RC1 for pointing this.

Figures S15 and S16 are not introduced. Authors should consider to add this information.

Figure S4: Aguilef et al. 2019 citation in the caption is not referenced in the bibliography at the end of the supplementary document.

Figure S11: In the figure, authors should correct “bancs” into “bed” or “strata”. And “Calcareous” into “Limestone”.

Figure S14: I do not see “view directions” on the map. “Field picture” information appears twice in the legend and in the caption. To help the reader, authors should remove one of this information. “Quebrada” is not only Chilean but used in all the Andes. Authors should write “Spanish word for...”. This latest observation is also valid for Figure 4.

The above suggestions will be implemented in the revised manuscript.

Text S1: Some of the information presented here have to be written in the method section of the manuscript to help the reader. Please see detailed comments above.

See previous responses about moving details on the trishear modeling from supplementary material to the main text.

Table S1: This table should be in the method section of the main manuscript. In the caption, authors should remove unnecessary parts (Best results [...] Allmendinger, 2002) and add them instead in the text S1, or even in the manuscript.

We agree with RC1 that this information is important, however not crucial for the main message conveyed in our manuscript. To avoid unnecessarily lengthening the manuscript, we'd rather keep this table in the supplementary material.

Data Set S1: Parts of this text (although nice) are not appropriate for publication in a scientific journal. Although I love to imagine geologists in the field under a beautiful starry night, this is not required here. Authors must remain factual.

We liked the idea of letting the authors free for a couple words of fantasy - in the supplementary material and not in the scientific argumentation presented in the main text. Anyway, if asked by the editor, we will remove it - but we sincerely hope that the editor will let us keep this slight departure with strict uses since it has no consequence on the science.

Benjamin Gérard

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