**Comments to Reviewers.**

We thank the reviewers for their insightful and helpful comments on our manuscript. The topic is complicated with many different variables and consecutive correction schemes. Therefore, we appreciate that you have found inconsistencies and helped making the manuscript better and easier to read.

1. Due to your comments we have applied many minor changes to the text:
   - Revising the abstract and making sure to stay within the 200 word limit.
   - Reorganising the introduction
   - Restructuring the methods to be consistent with the abstract
   - Wordings have been adapted in the results section, according to comments of reviewers
   - The discussion and conclusion paragraphs have been enhanced and rearranged to fit comments from the editor. We now give numbers as quantification for the errors and when we believe a correction is warranted and have included a last figure.
2. Two new tables (Table 2,3) have been added, that explain the different rotation-corrected rotation and acceleration time series. The table in the Supplementary materials has been deleted.
3. Upon reading your revision comments and rearanging the equations, we noticed that there was an inconsistency of using the variable Psi. Therefore the equations 1,4,6,7 were all changed to use the convention of either Psi^{euler}, Psi^{spin} or Psi^{signal} instead of just \Psi and \Psi_{signal}. These stand for:
   - Psi^{euler} : only the attitude correction turning the obserevd angles to euler angles
   - Psi^{spin}: only the Earth's spin correction
   - Psi^{signal}: both corrections combined
   - They are also noted in the new Table 2, where all the different angle notations are explained in detail. In latex it is not possible to highlight equations, for this reason these equations have not been highlighted.
4. We noticed that we defined the same matrix twice, once as T and once as R. This was now rectified and we only use T. The matrix R that was used in Section 3.4 is now used as T.
5. The figures that had weak colors, were changed to now include more vivid colors. These are Figures 3 and 5.
6. We also made sure that the 'rot.' is now consistent in all timeseries names, instead of using both 'rot' and 'rot.'.
7. Upon revision we realized that using the wording of "misorientation of rotations" is unneccessary, as we could simply use the more common wording of "attitude error". As is common in the navigation community. We also wanted to make sure, that seismologists don't misunderstand the attitude error, which is dynamic, from a statically misoriented sensor due to wrong installation. So this change should now make the correction schemes clear for both the navigation and seismology community.

Detailed answers to all your comments have been added below:

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**Reviewer C:**

1. The authors calculated the errors from (1) the sensor misorientation and (2) the Earth spin leakage in records of rotation, displacement, and acceleration. According to the results shown in Figure 5, the Earth spin leakage is important for smaller rotation angles. However, as shown in Figure 4, for some components of records, the correction for the Earth spin leakage deteriorates the record. I'd like to know the reason. And I also would like to know what to do with the case.

The error due to the earth spin leakage is low and independent of the amplitude of motion. Figure 4 shows only the error in percent to the original rotation timeseries 'rot'. This error is really small (ca 0.001% for high frequencies and 0.2% for low frequencies), which is why we also state that this error is negligible. The earthquake Mw 7.4 shows an error of 1% for the low frequencies, showing that the error might be larger for specific events. We propose to apply the rotation correction in the case were a total angle of more than 10^-2 rad and 5*10^-5 rad for high and low frequencies respectively are observed. We mention this in the last paragraph of the dicussion section, which is now newly accompanied with a summary figure.

1. In Figure 8, the authors estimated displacements by making the corrections of the effects of (1) the sensor misorientation and (2) the Earth spin leakage. These corrections are better in this case because the corrected records are flat. However, I would like to know if the authors can confirm that the estimated displacement offsets are consistent with independent geodetic observations like GNSS or InSAR.
   Unfortunately, we do not have access to GNSS and INSAR from this region, so we cannot compare the estimated displacements. We agree that this would have been valuable.

1. page 5, lines 136-138 The authors mentioned that the y-axis in the body system is perfectly aligned with the North axis of the local system when \dot{\Psi}_{e} and \dot {\Psi}_{z} equal zero. But I think that an additional relation of \Psi_{e}=0 seems necessary according to equations (1) and (2).
   That is correct, the initial angles of Psi_e and Psi_z also have to be zero. In hindsight we believe this sentence not to be necessary and have deleted it.

1. In equations (6), \Psi is updated with time. I wonder about the initial conditions for \Psi.
   The initial Psi is zero. We now mention this in line 156.

1. What is the rotation rate in Figure 3 (b)? Is that band-pass filtered? If so, what about frequency-band widths?
   The values in figure 3b are derived from translations from Clinton and Heaton 2002 and span a broad frequency range on the x-axis. There is no filter applied. Also 3a and 3c are unfiltered timeseries, that have been demeaned. A comment has been added in the figure caption.

1. In equations, functions like max, sin, and cos should be written in Roman, not in Italic.
   This has been implemented.

1. Elements of vectors Psi and Theta are explicitly shown in equation (6), but that should be made in equation (1).
   The vectors are now already shown in equation 1.

1. Page 5, line 134 Euler angles should be Euler angle rates.
   This has been changed, thank you for realising the mistake.

1. Table 1: The title of the table should be at the top.
   The location of the title is automatically placed in the seismica template. However, we will let the editors know of your comment and let them decide.

Recommendation: Revisions Required

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Editor Review:

The field of rotational seismology is developing at a fast pace, with new sensors becoming available, leading to new applications and understanding of the seismic wave field. Rossi et al. have set out to characterise and quantify some of the errors in rotation measurements, which may impact also traditional translational observations. Although I am not an expert in this field, I recognise the importance of this work, especially given the developments in rotational seismology.

I have a number of comments, primarily related to the structure of the manuscript, which are listed here in order of appearance. I also attach an annotated PDF with small changes.

- **Structure of the introduction:** A large part of the introduction describes different errors in rotational measurements. Before discussing many of these lines 41-57) and then different sensors that exist, the authors state they only consider two of them (lines 37-40). It would make more sense to first introduce all the equipment and possible errors, and then to discuss why the authors focus on the two errors (along the lines of the text in lines 65-77).
  Thank you for this comment. To ensure a more logical structure, the mentioning of the two rotation correction were deleted in lines 37-40 and instead the last paragraph in the introduction has been expanded.

- **Introducing the data:** The two data sets are introduced in lines 81-83, but immediately again in line 85. This appears repetitive or at least in need of restructuring. Perhap include the structure of the paper with lines 78-83?
  We believe that introducing the two datasts in the introduction is important, as these are unique datasets. As far as we know these are the only datasets that have near field recordings of large earthquakes (> Mw5). For this reason we did not change the structure concerning the data.

- **Structure of the Method**: Lines 114-116 summarise the two errors that are considered, which is then expanded upon in the two bullet points, but again in Section 3.1 and 3.2. There is quite some duplicate information in this text, e.g. lines 130-136 about the rotation of the coordinate system is also mentioned in point 2 (lines 120-128). In addition, the order of the two corrections changes, bullet point 2 relates to Section 3.1 and bullet point 1 relates to Section 3.2.
  Thank you for mentioning the repetition and inconsistency with the numbering of section and bullet points. The bullet points have been switched. Part of the misorientation (now attitude) bullet point (now 1) was deleted and part was put in the section 3.1.

- Amplitude is used to refer to event magnitude and also the amplitude of the rotation (I think). When referring to event amplitudes, use magnitude instead to make the distinction clearer.
  In fact, we were only refering to ground motion amplitude when using amplitude. In the result part this has been adapted to not only write amplitude but ground-motion amplitude when it sounded unclear.

- Line 247: the error of the misorientation increases with the amplitudes – is this theoretically expected? If so, mention this, if not, how do you explain it? Similar for line 265 – is this expected to be independent from the latitude?

Yes both trends are expected. The more the sensor is tilted away from the original position, the larger the attitude error will get. As this error entirely derives from the body system not being aligned to the local system. The attitude error is not dependent on the earth's rotation rate, so therefore independent of the latitude.
We wrote a comment in both instances mentioning that this is as expected. Line 243: In contrast, the attitude error in percent increases when the amplitudes are increased, which is as expected. Line 259: In Figure 6a one can see that the attitude error is not affected, as it is not influenced by the Earth's spin, so the error stays the same independent of latitude.

- Why are the events with 90 degree latitude so different for the Z component (Figure 6)? It seems to be only at 90 degrees, there is no trend with latitude. Is this the same for 85 degrees?
  The trend comes from sine and cosine in the matrix T. For example the North and East components are more sensitive to earth's spin error at 90°, because in theory they shouldn't see any there but even a small rotation will suddenly leak Earth's spin into that component. The Z-component on the other hand will only be sensitive to it at the Equator. The figure has been revised to also plot 5° and 85° so that it is better visible, that it is a trend over all latitude.

- Fig 7 and equivalent figures in the SOM – the difference is so small, why not show this (perhaps with a 10x amplification)?
  Figure 4 shows the difference in percent between the original rotation and the corrected rotation versions. The top three panels of Figure 7 are the equivalent time series. We believe that the real error in percent is shown in enough detail in Figures 5, 9 and 10, so that we can take the chance in Figure 7 to show that this small percentage is actually negligible when compariong the timeseries.

- Line 306-308 – this seems to ignore the fact that the errors in the displacement at lower frequencies are up to 20 or 300 %. Do the authors discard these entirely? If this is the case, this should be made clearer in lines 284-287.
  These lines were rewritten, as the meaning was not clear enough. The rotation correction does have a large influence 20 – 300 %. We wanted to write that it doesn't matter if we use the original rotations 'rot' or any of the rotation corrected rotations like 'attitude error rc.', 'rot + spin rc.' or 'attitude error + spin rc.'. So the rotation induced errors on the rotations are small enough not to impact the rotation correction of the accelerometer. The errors in the displacements are due to rotation correction, but again it doesn't matter if we use the corrected or uncorrected rotation angles. This paragraph has been revised to explain this more clearly.

- The authors state in the abstract and introduction that they provide guidance for assessing the need for these corrections, but this is not done explicitly. I would include a more explicit discussion on this in Section 5. Perhaps include the second half of the Conclusions, especially the part where referring to the Github.here as well, as this is not suited to the Conclusions.
  Thank you for this comment, we revised the discussions and conclusion, to be more specific about our guidance and give concrete numbers when we propose to apply the rotation correction. Additionally we added a Figure 11, that now summarises the findings in a more simply visual way.

Minor comments / style edits:

- Consider changing the first sentences of the abstract, you make it sound like it is only important to know the full wave field for understanding the errors.
  The sentence specifically has been changed. Due to comments noted directly in the pdf, we then had to revise the whole abstract to still stay within 200 words.

- Be consistent in the use of the tense, e.g. it changes from past to present tense in lines 85-96.
  The section 'Data' has been revised for tenses.

- Include equations once they are referred to, rather than all together at the end of each paragraph or section (this holds for section 3.1, 3.2, 3.4 etc).
  This has been adapted. Equations are now located when referred to.

- Be consistent in the naming of the corrections (e.g. rot vs rot.) and include them in Table S1 to refer to all the named corrections from Section 3.3 and 3.5. Strongly encourage you to move this to the main text.
  The naming has been unified across the whole manuscript. Sections 3.3 and 3.5 now each have a table explaining the naming notations, inlcuding the variable used in the Equations. The table in the supplementary material has been deleted. We also changed the naming of misorientation of rotations to attitude error, to be consisent with the terms used in navigation and seismology community.

- Be consistent in the use of hyphens, e.g. "rotation-induced" vs rotation induced
  This has been checked to be consistent as well as rotation-correction.

- Check the opening quotes when referring to the different coordinate systems and correction names
  Quotes have been adapted.

- There is probably no need to use the full event timing in UTC in the text (e.g. line 210-211. Also be consistent, as it is only listed for one event. In figure captions, you may want to include this, but again, be consistent
  UTC is now only mentioned in the figure captions and no longer in the main text.

- Lines 226-227: the authors mention the error is the same order of magnitude, but it is 0.2 % vs 0.05 %?
  Correct, this error has been rectified to stating simply they are both small.

- When printed out, the figures are very faint – consider making the lines more vivid in colour.
  The color of the figures has been changed to more vivid ones.

- Make sure to cite the networks that have provided seismic data in your references, it is not sufficient to acknowledge them.
  The hawaii network has been added. The data from Taiwan is in a zenodo folder.

Recommendation: Revisions Required