Editors Message:

Dear Kourouklas et al.,

We have got reviews of your mansucript titled "Harmonizing Solid Earth Resources and Workflows: The HOMEROS Implementation of Open Science Data Management" We will consider publishing your artcile only when the noncerns raised and listed below are adressed properly.

With regards,

Atalay Ayele

Dear Prof. Ayele,

Thank you for handling our manuscript entitled "Harmonizing Solid Earth Resources and Workflows: The HOMEROS Implementation of Open Science Data Management" and for forwarding the reviewers' comments.

We appreciate the constructive feedback provided by the reviewers and are preparing a revised version of the manuscript that addresses all the comments in detail.

Reviewer 1

This paper describes the principles and workflows used to integrate seismological and geodetic datasets for multiple study areas across Greece. This work is of interest to anyone managing large scale multidisciplinary geophysical/geological studies on either a temporary or permanent basis. The manuscript is well written and easy to comprehend with all relevant workflows detailed in both text and figures. The paper provides an excellent example of what success looks like in the context of interoperability and management of different geophysical datasets. Additionally the paper does a good job of highlighting outstanding issues, in particular the problem of securing and maintaining long term storage solutions. I recommend this work for publication and I have listed some questions and changes below:

We sincerely thank the reviewer for the careful reading of our manuscript and for the constructive and encouraging comments. We have carefully considered all the comments and suggestions and have revised the manuscript accordingly. Our point-by-point responses are provided below, with the corresponding changes indicated in the revised manuscript.

Line 127 Two full stops

Thank you for pointing this out. The typographical error has been corrected in the revised manuscript (line 170 of the annotated copy).

Table 1 TRUST Principles / Relevance to Solid Earth resources – As you have referenced QuakeML should this not also apply to parametric data archiving?

We agree with this comment and the QuakeML versions of the published catalogs was already in preparation at the time of the manuscript submission. We have updated the repositories to now include the earthquake catalogs in the QuakeML format as well.

Figure 2 Which bulletin was used for these earthquake locations, Thessaloniki, NOA or a combination of both?

We thank the reviewer for this comment. We have revised Figure 2 to improve the visibility of the seismological and geodetic stations, with particular emphasis on the stations that are collocated within the HOMEROS project framework. In the revised figure, instrumental seismicity with magnitudes $M_w \geq 4.0$ since 2011 and all known historical earthquakes with magnitudes $M_w \geq 6.0$ are shown. The earthquake locations and instrumental seismicity presented in the map were compiled using the bulletin of Geophysics Department of the Aristotle University of Thessaloniki (https://seismo.auth.gr/en/seismicity-catalogs/).

The figure caption in the manuscript has also been revised accordingly (lines 348 – 364 of the annotated copy).

Line 273 "… communities, 'where' detailed …"

Thank you for pointing this out. The phrase has been corrected in the revised manuscript (lines 440 – 446 of the annotated copy).

Line 274 – 276 Can you give examples of these limitations? You make the case that you have fixed these issues in lines 276-278 but it would be strengthened by given definite examples of where there are issues and if possible referencing specific workflows that had these issues.

We thank the reviewer for this constructive comment. We agree that providing specific examples of the limitations encountered would strengthen the manuscript. We have therefore revised the relevant passage to clarify how HOMEROS addresses these challenges in practice. In particular, we now refer to the application of workflows aimed at improving metadata completeness, quality-control tests, and the persistent identification and publication of datasets. The corresponding text has been revised accordingly in Section 3 (lines 448 – 453 of the revised version of the manuscript).

Line 280 The acronym DMP is not defined

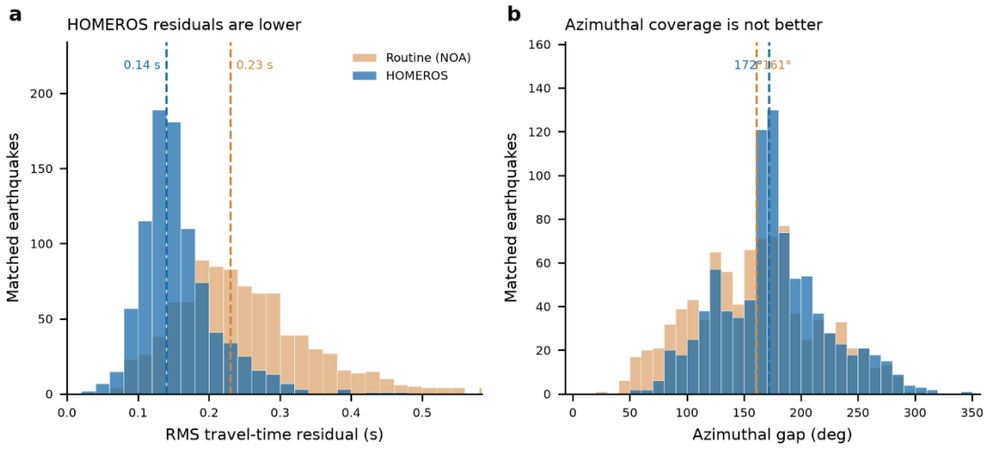
Thank you for pointing this out. The acronym of Data Management Plans (DMPs) is now defined (line 443 of the revised version of the manuscript).

Line 286-289 Can you provide a reference for this?

We thank the reviewer for this comment. This part of the manuscript is now revised, after following comments from reviewer 2 too. We now explain that HOMEROS facilitates improved downstream analyses by providing earthquake catalogs for the study area of the central Ionian Islands that include significantly more earthquakes of very low magnitudes. We also now include links to the DMPs that describe the procedure followed as well as the published catalog referenced (lines 454 – 462 & 531 – 538 of the annotated manuscript)

Line 298-300 & Figure 3 Is there a difference in the stations used for both datasets? If the HOMEROS uses more stations (thus has a better azimuthal station coverage) this may be a better explanation of the reduction in RMSE.

We thank the reviewer for raising this point, which prompted us to examine the station configuration of the two solutions explicitly. The comparison demonstrates that the reduction in travel-time residuals cannot be attributed to a larger station set or improved azimuthal coverage. For the 895 matched earthquakes, the HOMEROS solutions have a larger median azimuthal gap than the routine solutions (172° vs 161°whereas the routine solution has the smaller gap in 62 % of earthquakes) and use approximately half as many phases (median 19 vs 33 defining phases). Splitting the matched set according to which solution has the better azimuthal coverage gives the same result in both halves (median RMS 0.14 s vs 0.23 s where the HOMEROS gap is larger; 0.14 s vs 0.22 s where it is smaller or equal), confirming that the difference is not driven by coverage.



Part of the residual difference reflects the usage of a velocity model that better describes the crustal structure of our study area (Hasslinger et al., 1999). In contrast, routine catalogs are based on a generalized velocity model applied across the entire Greek region. This is now referenced in-text (lines 534 – 538 of the annotated copy). We have kept Figure 3 as-is, changing only the bin widths (as also proposed by Reviewer 2).

Line 316 missing full stop

Thank you for pointing this out. The typographical error has been corrected in the revised manuscript (line 574 of the annotated copy).

Line 337 "… extremely difficult 'if' not impossible."

Thank you for pointing this out. The typographical error has been corrected in the revised manuscript (line 605 of the annotated copy).

Line 349-351 Can you summarise in what way was the Makropoulos catalogue extended?

The earthquake catalogue of Makropoulos et al. (2012) built on earlier works from Makropoulos and Burton (1981) and Makropoulos et al. (1989), extending the catalogue with earthquakes that occurred up to 2009. By providing uniform moment magnitudes for earthquakes with $M_w \geq 4.1$ ($M_s \geq 4.0$), it became a key resource for seismic hazard studies. We updated the catalogue through 2023 using the same methods as in the 2012 study. We retrieved new event data from the ISC Bulletin (https://doi.org/10.31905/D808B830) and converted body-wave magnitudes (mb) to Ms and Mw. Unlike the original publication, our update also includes the raw post-

2009 ISC mb values. The dataset includes all earthquakes with $M_w \geq 4.1$ across all focal depths, allowing users to isolate crustal or intermediate-depth earthquakes for their specific applications. The updated catalog is openly available in our HOMEROS Zenodo repository (https://doi.org/10.5281/zenodo.18494501).

We have now added to the revised version of the manuscript the following (lines 631 – 641 of the annotated version of the manuscript):

"The latter catalogue was built on earlier works from (Makropoullos and Burton, 1981; Makropoulos et al., 1989), extending the catalogue with earthquakes up to 2009 (Makropoulos et al., 2012). We updated the catalogue through 2023 using the same methods as the 2012 study. We retrieved new earthquake data from the ISC Bulletin (https://doi.org/10.31905/D808B830) and converted body-wave magnitudes (m_b) to surface magnitude (M_S) and, then, M_w. Unlike the original publication, our update also includes the raw post-2009 ISC m_b values, for reproducibility purposes. The dataset includes all earthquakes with $M_w \geq 4.1$ across all focal depths, allowing users to isolate crustal or intermediate-depth seismicity for their specific applications".

Makropoulos, K. C., and P. W. Burton. 1981. "A Catalogue of Seismicity in Greece and Adjacent Areas." *Geophysical Journal International* 65, no. 3: 741–62. https://doi.org/10.1111/j.1365-246X.1981.tb04881.x.

Makropoulos, K. C., J. K. Drakopoulos, and J. B. Latousakis. 1989. "A Revised and Extended Earthquake Catalogue for Greece since 1900." *Geophysical Journal International* 98, no. 2: 391–94. https://doi.org/10.1111/j.1365-246X.1989.tb03360.x.

Makropoulos, K., G. Kaviris, and V. Kouskouna. 2012. "An Updated and Extended Earthquake Catalogue for Greece and Adjacent Areas since 1900." *Natural Hazards and Earth System Sciences* 12, no. 5: 1425–38. https://doi.org/10.5194/nhess-12-1425-2012.

Line 637 – 639 You could reference the use of international organisations to provide secondary redundant storage i.e. ISC, FDSN etc.

We thank the reviewer for this valuable suggestion. We agree that international community infrastructures can provide complementary pathways for the long-term accessibility and dissemination of seismological resources. We have therefore added a brief statement in the revised manuscript (lines 1334 – 1336 of the annotated copy) acknowledging this potential role. Since dedicated secondary redundant storage through ISC, FDSN, or similar international services is not currently implemented within HOMEROS, we have deliberately avoided presenting it as an existing project achievement. Instead, we identify such distributed infrastructures as a complementary option that could further strengthen the resilience and long-term accessibility of the resources.

Reviewer 2

This manuscript describes the results achieved with the HOMEROS project that aimed at improving FAIR and open science principles for seismological and geodetic data & products for Greece.

Overall the English is fluid and probably a bit too wordy, the manuscript could in general be shortened without loss of content or information.

My main issue with the submitted manuscript is the following: The abstract and the introduction state that the paper addresses how HOMEROS actually improved FAIR and TRUST and overall Open Science principles, but then the paper remains very theoretical and generic in the actual description of results. Interspersed are a few more or less detailed case-studies of specific data analysis / research efforts that in principle would serve well as examples how the workflows etc. developed in HOMEROS actually improved things. But I miss details about those workflows, how exactly they improved science, and where and how to access them, while the detailed scientific results & interpretations seem out of place here.

We would like to sincerely thank the reviewer for taking the time to evaluate our manuscript and for the many constructive and valuable comments provided. We have carefully considered all suggestions and have substantially revised the manuscript accordingly. In particular, the revised version clarifies the distinction between activities already implemented within the HOMEROS pilot implementations and developments that remain ongoing or are planned, while providing more explicit information on the workflows, data products, metadata, documentation, and their current accessibility. We have also reduced general and theoretical statements and strengthened the description of the concrete implementations and their relevance to FAIR, TRUST, and Open Science practices. Our point-by-point responses are provided below, with the corresponding changes indicated in the revised manuscript.

In many places the manuscript talks about improved and enhanced metadata and documentation, but also there, details are missing that would allow the reader to assess (and perhaps utilise) these improvements.

We thank the reviewer for this comment. We have revised the manuscript to provide more specific information on the metadata, documentation, and workflows developed within the HOMEROS pilot implementations. In particular, we describe the validation and structuring of seismological waveform and earthquake-catalogue resources (lines 440 – 446, 448 – 453, 454 – 462, 531 – 538, 553 – 554, 584 – 5587, 1095 – 1114 & 1489 – 1498 of the annotated manuscript), the metadata and processing information associated with GNSS datasets (lines 772 – 774, 848 – 860, 904 – 926, 1003 – 1020, 1099 – 1101 & 1185 – 1181 of the annotated manuscript), and the data structures used for selected seismic hazard products (lines 692 – 731 of the annotated manuscript).

We have also added direct links to representative repository records and associated resources, including datasets and workflows available through the HOMEROS Zenodo community (https://zenodo.org/communities/homeros/records?q=&l=list&p=1&s=10&sort=newest) and GNSS datasets repository (https://hardmin.heal-link.gr/dataset/79c13cef-bb0b-496e-98ca-ea024d6e2a12; https://hardmin.heal-link.gr/dataset/7e497c83-1b13-47cb-8bc9-a7ac732cc68e; https://hardmin.heal-link.gr/dataset/eygiros-gnss-rinex-data-2026) published through the HARDMIN repository. These links allow readers to inspect the deposited resources, along with their available documentation and metadata, and to access the data products for potential reuse.

In addition, the revised manuscript provides a detailed description of the proposed PSHA data model in Appendix A (lines 1582 – 1590 of the annotated manuscript), including the fields used to describe hazard outputs and their associated metadata. We also provide the link to the HOMEROS Data Management Plans (DMPs) (https://dmp.heal-link.gr/explore-descriptions), where available, to provide further information on the corresponding data-management practices.

In parts the text seems to be a (more or less close) rewording of the HOMEROS project proposal to OSCARS (I was one of the reviewers), and quite often it is not clear whether the text describes an achieved result or ongoing work (e.g. when referring to the inclusion of HOMEROS results in EIDA, EPOS or EOSC).

We thank the reviewer for highlighting this important issue. We have substantially revised the manuscript to distinguish more clearly between practices and resources implemented or tested within the HOMEROS pilot implementations and activities that remain under development or depend on broader institutional or European uptake. The revised manuscript explicitly describes the work as a set of selected pilot

implementations and demonstrator workflows rather than as a full-scale operational harmonization of national resources (lines 204 – 240 of the annotated copy).

Particularly, we have revised the sections discussing the relationship of HOMEROS resources with EPOS, EIDA, GNSS Data and Product Services, M³G, and EOSC to avoid presenting planned or prospective integration as completed project outcomes. Where appropriate, we now distinguish between currently available resources and pilot activities, such as the available GNSS dissemination pathways and datasets and the discussion of interoperability with EPOS and EIDA (lines 835 – 847 & 1090 – 1101 of the annotated manuscript) and the EOSC-related demonstrator activities (lines 897 – 900 of the annotated manuscript). Broader relationships with European infrastructures, including M³G, are presented as integration pathways and wider infrastructure contexts rather than as completed HOMEROS integrations (lines 1346 – 1364 of the annotated manuscript).

We have also reduced general and proposal-oriented descriptions and replaced them, where appropriate, with descriptions of the current implementation status, available data products, workflows, and pilot applications. The revised manuscript therefore focuses more explicitly on what was implemented or tested within HOMEROS, while identifying broader institutional and European integration as ongoing or future developments where this is the current status.

The HOMEROS repository on zenodo https://zenodo.org/communities/homeros/ includes a recent paper by Bitharis et al (HOMEROS Open Science: Integrated Seismological and Geodetic Ecosystems, doi.org/10.31577/congeo.2026.56.2.2) that to a considerable extent seems to overlap with the content of this manuscript (and has basically the same authors as this paper), while providing a more exhaustive discussion on scientific results from the seismological and geodetic studies undertaken in the context of the project.

We sincerely thank the Reviewer for pointing out the publication of Bitharis et al. (2026). While both papers originate from the HOMEROS project and share authors, they have distinct scopes and scientific contributions. Bitharis et al. (2026) focuses primarily on describing the seismological and geodetic networks and their associated scientific outcomes. The present manuscript serves as a methodological study on Open Science implementation, FAIR/TRUST data stewardship, and metadata alignment within Greek solid Earth infrastructures. Our manuscript introduces entirely new datasets and case studies not present in Bitharis et al. (2026), including the 2025 Santorini volcano unrest, a newly compiled 2024 manually picked earthquake catalog for the central Ionian Islands (~5,400 earthquakes vs. ~290 routinely analyzed earthquakes) with an original RMS error quality comparison and a proposed standardized and simplified data structure for communicating seismic hazard outputs to cross-domain users (e.g., researchers from other hazard and risk topics).

I believe that a comprehensive publication on the results of HOMEROS about improving FAIR, TRUST, and Open Science in general, should be very useful, also to foster the uptake of relevant results in the community (and at least make the community aware of the HOMEROS achievements). As it is, this manuscript does not really serve that purpose.

We thank the reviewer for this important observation. We agree that the main purpose of the manuscript should be to document the Open Science, FAIR, and TRUST-related implementation of HOMEROS, rather than to provide an extensive account of the scientific results obtained from the project.

Accordingly, we have substantially revised the manuscript to strengthen and clarify this focus. We have reduced general scientific background and detailed scientific interpretation where these do not directly support the discussion of data management and Open Science practices (lines 204 – 240 of the annotated copy). At the same time, we have expanded the description of selected pilot implementations to show more explicitly how data products, workflows, metadata, quality-control procedures, documentation, and repository-based dissemination were applied in practice. The revised manuscript also provides direct references to representative datasets, workflows, notebooks, repositories, and Data Management Plans, allowing readers to inspect the resources associated with the described implementations We have further clarified the current status of these resources and distinguish between practices implemented or tested within HOMEROS and broader developments that remain ongoing or are planned for future integration (lines 440 – 453, 454 – 462, 565 – 568, 652 – 673 of the annotated manuscript).

Finally, we have revised the scope of the manuscript to avoid implying that HOMEROS has already established harmonized practices across the entire Greek seismological and geodetic community. Instead, the manuscript

presents the selected HOMEROS pilot implementations as practical examples of Open Science-oriented data stewardship and discusses their potential for broader uptake and integration.

A revised manuscript could start with the introduction of the goals of HOMEROS (less wordy than at the moment), then describe (in more detail than currently) the improved workflows for seismological and geodetic data & products together with the enhanced metadata & documentation (and reference where they are accessible in machine-actionable form), based on the mentioned 'pilot implementations'. As HOMEROS claims to set improved standards for the whole Greek seismological & geodetic community (at least that's what I understand), the paper could then provide more detail about interaction with other Greek institutions and concrete examples (or plans) of how HOMEROS results are taken up by other institutions.

We thank the reviewer for this constructive recommendation regarding the structure and focus of the revised manuscript. We have addressed this suggestion by restructuring and refocusing the manuscript on the practical implementation of Open Science, FAIR, and TRUST-oriented practices within the HOMEROS pilot implementations.

The Introduction has been shortened and refocused on the motivation, objectives, and scope of HOMEROS, with general background and proposal-oriented descriptions reduced where they did not directly support the main purpose of the manuscript.

The revised manuscript now places greater emphasis on selected pilot implementations for seismological and geodetic data and products. These include earthquake-catalogue compilation and quality control, the PSHA data model and associated notebooks, GNSS data and station documentation, and the organisation and dissemination of InSAR-related products. For these examples, we have expanded the description of the associated workflows, data products, metadata, documentation, provenance, and quality-control aspects, and provide references to the relevant repositories and resources where they are currently accessible.

We have also clarified the distinction between resources that are already available and activities that remain under development or are planned. In particular, references to integration with European infrastructures and broader community services have been revised so that prospective developments are not presented as completed HOMEROS outcomes. Where appropriate, we now indicate the current status of the relevant resources and access mechanisms.

Regarding interaction with other Greek institutions and broader uptake, we have also revised the manuscript to avoid implying that HOMEROS has already established harmonized standards or practices across the entire Greek seismological and geodetic community. Instead, we present the HOMEROS activities as selected pilot implementations that demonstrate practical approaches to Open Science-oriented data stewardship. Their broader adoption, integration with other institutional resources, and alignment with community-level infrastructures are described as ongoing or future developments where this is applicable.

Overall, these changes have shifted the manuscript from a predominantly conceptual description of the HOMEROS objectives toward a more implementation-oriented account of the practices, workflows, and research objects that were actually tested or made available within the project.

I have annotated the pdf manuscript (attached), overall, I believe a major rework of the manuscript as indicated above would make it a useful contribution.

We thank the reviewer for the detailed annotations provided in the pdf file. We have carefully considered all the comments and suggestions included in the annotated manuscript and have incorporated the proposed changes throughout the revised version.

Below, we provide responses to several of the comments raised in the annotated PDF that require further clarification or explanation:

- *L356: “where? on the zenodo homeros repo? there is a psha notebook(s) already”*

The notebook was released after submission of the article. We have changed the text to reflect this and added links to find the frozen version (at Zenodo) and the live repository at GitHub (lines 625 – 628 of the annotated manuscript).

- *L358: “you basically define a new data model for hazard map outputs (not much different from the openQuake standard – just specifically including the IMT and unit). But on the HOMEROS repo you (only) use that data model*

for the csv-files with the PGA values (grids) for your 2 study sites. If the data model should be useful for others, it should be described as such (and e.g. encoded in xml, similar to the openQuake 'standards' on their github)."

We now have updated the proposed data model to a more comprehensive and informative structure, which is applied to hazard map, UHS and hazard curve outputs. It includes three main logical groupings (node – for spatial definitions; hazard – for properties related to hazard calculations; meta - for metadata). Our main intention for this is to provide the seismic hazard information within its wider context to a simplified and easily readable format, intentionally avoiding more complete, yet much more complex, formats (e.g., XML). Now, other than simply the grid and hazard values, the file provides information such as source and ground motion models used, DOIs for the respective publication and the dataset itself. We have changed the relevant text segment accordingly (lines 666 – 673 of the annotated manuscript) and added Appendix A which describes each field in detail (lines 1582 – 1590 of the annotated manuscript).

While we agree with the reviewer that OpenQuake offers an excellent model for seismic hazard experts, our intention is to provide this information in a simplified format, which is easier to be read by non-PSHA experts. Researchers who may not be familiar with OpenQuake or XML may use general purpose tools (e.g., GIS software, simple Python scripts with Pandas, scripts written in R). Therefore, in line with HOMEROS's objective of supporting accessible, multi-hazard data, the proposed solution aims to achieve a balance between simplicity and informational richness.

Moreover, each Zenodo record of the PSHA datasets now contains a Frictionless Data Package (FDP) file to offer the necessary metadata context of each data collection. This provides standardized, machine-actionable JSON descriptions of our data (fields, data types, metadata).

- *L383: "isn't that counter-productive, to introduce a new 'HOMEROS' style (data format) for seismic hazard products, instead of remaining with the OpenQuake 'de-facto' community standard?"*

As stated in the previous answer, our intention is to introduce a model suitable for sharing PSHA outputs with experts of other fields who may not be familiar with OpenQuake and XML files.

- *L504:" I am not an InSAR expert, but that seems a very standard pipeline for InSAR processing – nothing HOMEROS specific / special?"*

We agree that the underlying PSI processing chain is based on established InSAR methodology and was not intended to be presented as a methodological innovation of HOMEROS. We have revised the text (lines 941 – 958 of the annotated copy) to clarify that the contribution lies into the implementation of a harmonized workflow that couples standardized processing with automatic metadata generation, systematic provenance tracking, versioning, and open dissemination.

In addition to addressing the specific points raised in the annotations, we have undertaken the broader restructuring and reworking of the manuscript described above.

Further specific comments:

Figures:

Fig 2 – looks like a copy/paste from HOMEROS proposal ? reword caption as relevant for the current status

Thank you for the comment. We thank the reviewer for this comment. We have revised Figure 2 to improve the visibility of the seismological and geodetic stations, with particular emphasis on the stations that are collocated within the HOMEROS project framework. In the revised figure, instrumental seismicity with magnitudes $M_w \geq 4.0$ since 2011 and all known historical earthquakes with magnitudes $M_w \geq 6.0$ are shown. The earthquake locations and instrumental seismicity presented in the map were compiled using the bulletin of Geophysics Department of the Aristotle University of Thessaloniki (https://seismo.auth.gr/en/seismicity-catalogs/).

The figure caption in the manuscript has also been revised accordingly (lines 348 – 364 of the annotated copy).

Fig 3 – please use same bin width for both datasets

Thank you for this comment. The bin widths for the two earthquake datasets are now the same.

References:

missing: Jacobsen et al., 2020 (line 108); Lin et al, 2020 (line 109); Gutenberg & Richter, 1944 (line 354); Wiemer & Wyss, 2000 (line 355)

Thank you for pointing this out. All missing references are now added in the references list section (lines 1451 – 1459, 1502 – 1505, 1448 – 1550 & 1558 – 1560 of the annotated copy, respectively).