

Answer to Review 1

Review

Title: The countrywide historical gravity dataset of Lithuanian territory

Authors: Dominykas Šlikas and colleagues

General Assessment

This manuscript presents a digitized and homogenized historical gravity dataset for the territory of Lithuania, incorporating data from mid-20th century gravity surveys and network stations. The dataset has been transformed into modern geodetic and gravimetric reference systems (ETRS89, EVRS07, IGSN71) and is made publicly available via Zenodo. This is a valuable contribution to the field, particularly for applications in regional geoid modeling and Earth gravity field studies. The manuscript should be published as soon as possible, but only after substantial revision in both its presentation and clarity to meet the standards of *Earth System Science Data*.

Thanks for nice words 😊

Major comments

Scientific contribution and novelty

The authors provide a robust and well-documented compilation of historical gravity data. The strength of the work lies in data preservation and accessibility, not in methodological innovation. The manuscript does not introduce any new methodology; data processing follows standard transformation and reduction formulas. This should be clearly acknowledged in the manuscript.

Reviewer is right. However, some practical novelties could be found in the paper, like detection the transformation parameters for coordinates and heights, which never were published before. Of course, it is not the theoretical novelty.

Use of IGSN71

The “International Gravity Standardization Net of 1971” (IGSN71) is no longer considered the most accurate or modern reference for gravity data. While still widely used for legacy compatibility (e.g., in some global gravity field models), newer systems based on absolute gravimetry and regional densifications are becoming the standard, especially in Europe. The EUREF sub-commission, which also maintains ETRS89 and EVRS, recommends the use of absolute gravity values where available, referencing new gravity campaigns to co-located absolute stations, and avoiding continued reliance on IGSN71 unless necessary for legacy data comparison.

Reviewer is right. In fact, modern gravity data of Lithuania is based on absolute gravity measurements. However historical gravity data is not of such high quality.

My suggestion: The authors should justify their use of IGSN71 and add two statements such as: “While IGSN71 is used here to harmonize legacy gravity data, future work should integrate absolute gravity stations in the European Absolute Gravity Reference Network.” “If possible, transformation offsets to newer national absolute reference values should be computed and documented.”

Thank you. Sentences are added into paper.

Clarity and structure of manuscript

The manuscript is overly long and detailed, with extended theoretical derivations (e.g., coordinate transformations, gravity reductions) that could be summarized or moved to supplementary material. Repetition occurs throughout (e.g., multiple restatements of the Potsdam to IGSN71

transformation), and the language would benefit significantly from professional editing for grammar, conciseness, and flow. At least for me, the tone is at times more instructional than scientific.

Reviewer is right. Manuscript has too many details. Some reduction is implemented.

Figures and maps – major weakness

The figures are currently a critical weak point:

- Several maps lack coordinates (e.g., Figs. 1, 2.1, 2.4, 2.8, 2.9, 2.10), scale bars, or consistent legends.
- Different map extents and projections are used without explanation (e.g., Figs. 2.2, 2.3, 2.4–2.7), making comparison difficult.
- Important metadata (e.g., color meanings, units) are missing or unclear.
- The layout and visual clarity are insufficient for a data-focused journal.

My recommendation: All figures, particularly maps, should be redesigned for standardization. Use the same geographic extent, add graticules or coordinate grids, include legends and scale bars, and clearly distinguish between data types (e.g., second/third order stations, gravity points). Figures 2.1, 2.4, and 2.10 could be consolidated or at least harmonized.

Reviewer is right. Figures are updated. Just, please, pay attention, that only fragments of maps are presented in the paper, to show total sheet of map is not possible.

Relevance and utility of the dataset

The dataset is well motivated, and its availability via a public repository is appropriate. The data will be useful for researchers in regional geoid computation, historical geophysics, and geodetic accuracy assessment.

A brief demonstration of a possible application, such as geoid height comparison or regional gravity model validation, would enhance the manuscript's impact.

Reviewer is right. Some sentences demonstrating applications are added.

Data format

The authors state (Section 3) that the dataset is published in DBF (dBASE) format, which is technically valid but increasingly outdated. While DBF is a well-documented and stable format, it lacks support for Unicode, long field names, and complex data types. It is also not readily used in modern data processing environments without conversion.

My suggestion: While DBF is functional, I encourage the authors to consider releasing the dataset in additional formats, such as CSV, GeoPackage, or NetCDF, which are more accessible, transparent, and compatible with current data processing tools. This would significantly enhance the reusability of the dataset.

Reviewer is right. Data in CSV format was added to repository.

Minor comments and suggestions

- Replace “due gravity” with “due to gravity” or simply “gravity” throughout the manuscript.
- The abstract could be made more concise.
- Section 2.2 would benefit from a table or flowchart summarizing the transformation steps.

- The DBF table (Section 3) is useful, but a sample dataset or a visual preview (e.g., GIS screenshot) would help readers better understand the structure.
- Include a graphical summary of transformation errors (e.g., histogram of residuals).
- Use SI units consistently and replace “mGal” with m/s^2 .
- References are mostly appropriate, but citation style and hyperlinks should be carefully checked and standardized.

Reviewer is right. Most corrections are implemented, but “mGal” authors would like to keep as it is the most popular unit in the geophysical literature.

Overall recommendation: Accept with major revisions.

Thank you for careful review of our manuscript 😊

Answer to Review 2

This article presents re-processed historical gravity data for Lithuania. Updating the data is a logical step that will make the Lithuanian gravity database more accessible and useful. The process of transforming the dataset to modern coordinate systems and gravity datums involved several steps:

1. Determining normal heights, which were not available for all data points
2. Transforming latitude, longitude and elevation to a modern, European datum (ETRS89 and EVRS07)
3. Converting gravity values to a modern international reference system (IGSN71)

The manuscript outlines the challenges in re-processing this dataset, namely the need to digitise data from paper records and dealing with data points that do not have normal heights associated with them. Despite these challenges, a valuable new dataset has been developed and made available to the community.

Below I provide the following responses to the ESSD review criteria. I have also uploaded an annotated pdf of the article with further comments and suggestions for edits.

Thank you very much for annotated pdf file. In fact, all remarks were accepted by authors and valuable improvements implemented.

Are the data and methods presented new? Whilst the data is not strictly new, they have been re-processed to bring them up to modern standards.

Reviewer is right. Data set consists of historical gravity data.

Is there any potential of the data being useful in the future? Yes. Anyone planning to use the data for a range of applications (geoid modelling to geological interpretation) will appreciate having access to a this revised and improved dataset.

Are methods and materials described in sufficient detail? Yes. The steps applied to re-process the data are laid out well and include examples of calculations at each step.

Are any references/citations to other data sets or articles missing or inappropriate? Not that I am aware of. It may be possible to include additional details of some cited publications.

Reviewer is right. Reference list is slightly improved according to annotated pdf file. By authors heads, all references could be easily find on the web.

Is the article itself appropriate to support the publication of a data set? Yes. The article describes the processing steps applied to the data.

Is the data set accessible via the given identifier? Yes. I successfully downloaded the data from the Zenodo DOI link provided. I had no trouble using the downloaded dataset to grid the data and generate maps of free-air and Bouguer anomalies.

Is the data set complete? Yes, the data provided is sufficient. Whilst some equivalent datasets in other parts of the world might provide additional data (e.g. spherical cap Bouguer corrections, terrain corrections), this dataset is a good basis for further work.

Are error estimates and sources of errors given (and discussed in the article)? Yes. Sources of error are discussed in the article and estimates of the error are mentioned in the article and included as a column in the downloaded data.

Are the accuracy, calibration, processing, etc. state of the art? Are common standards used for comparison? The dataset uses acceptable formulae for transforming coordinates and gravity data between outdated and modern datums, and for calculating gravity anomalies. Whilst a basic Bouguer correction (infinite slab) has been used and no terrain corrections are provided, these are things that users of the dataset should be able to apply themselves (or perhaps the authors will assist in that process?).

Is the data set significant – unique, useful, and complete? Yes. See introductory comments above.

Article and data set: are there any inconsistencies within these, implausible assertions or data, or noticeable problems which would suggest the data are erroneous (or worse). If possible, apply tests (e.g. statistics). The article and the dataset are consistent and there are no implausible assertions. However, I do feel that there perhaps needs to be some more discussion of the quality of the final dataset. After I downloaded the data and gridded it, I noticed that there are artefacts in the gridded data (see file of Bouguer anomalies uploaded, 0.5' cell size). Whilst I only quickly gridded the data (using GMT) without much thought as to ideal parameters, I think it would be important to include a map in the article that shows gridded free-air and Bouguer anomalies and, with reference to those maps, a short discussion of those artefacts, their likely source, some suggestions as to how to overcome them, and some comments on the limitations that these artefacts impose when interpreting the data. I think it is important to make clear to readers and/or potential users of the dataset that the dataset is not perfect.

Is the data set itself of high quality? Yes, the dataset is of the best quality possible for data collected several decades ago that is partly missing some of the critical information needed for re-processing (e.g. missing station elevations, only paper maps available).

Is the data set usable in its current format and size? Yes. The datafiles downloaded from Zenodo are small in size and readily convertible to a desired format.

Are the formal metadata appropriate? The downloaded data comes with a README file, but this is quite brief. I'm not sure if the journal expects a formal, more detailed metadata file to be included with the dataset, but all the relevant information that a user would need is included in the article.

Reviewer is right. However, by authors heads, README file should be very general, and reader could find all necessary information from the paper.

Is the length of the article appropriate? Yes. It is compact and presents the key elements of the reprocessing steps.

Is the overall structure of the article well structured and clear? Is the language consistent and precise? Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes. The article is readable and the structure is logical (description of the historical dataset and its deficiencies, details of the processing steps applied to coordinates, elevations and gravity measurements to modernise the dataset). As noted above, I suggest a useful addition would be a

short section presenting the gridded data and a discussion of the deficiencies in the dataset (that are of course largely unavoidable given the age of the data and the missing information for large parts of the historical dataset). The language is understandable and the mathematical formulae and symbols are adequately presented and described (though I have noted a few minor points below). In some places, more specific mention of the units of the gravity data (mGal) could be added. I have provided some suggested language edits (and comments) in the uploaded pdf.

Are figures and tables correct and of high quality? I think some of the figures could be improved. For example, the maps in figures 1, 2, 5 and 9 would be better as proper maps with axes, coordinate labels and, where necessary, a legend. See also my comment above about including a figure with maps showing gridded free-air and Bouguer data.

Reviewer is right. Figures were improved slightly, and the Bouguer anomaly map was added.

Is the data set publication, as submitted, of high quality? Yes. The dataset downloaded is accessible and contains the information needed by potential users.

Thank you very much for number of “Yes”. Your remarks are very professional and let us to improve a manuscript significantly.