Color legend:

(1) Comments from Referees
(2) Author's response
(3) Author's changes in manuscript

We have revised Manuscript nhess-2019-227 in light of the editor's and reviewers' comments. Details of the changes are provided below. May we say that we found the reviewers and editor extremely helpful and constructive. We are glad to reaffirm that the manuscript has not been published or simultaneously published elsewhere. All changes suggested by the editor and reviewers have been incorporated.

Some data could not be accessed until then because of the restriction of personnel at the university. Nowadays, the covid-19 policies implies home officing for everybody. ASAP some alterations will be made.

REVIEWER 1

The article refers to an interesting and actual research topic, however I felt limitations in how the work and decisions undertaken are explained, and an orientation toward making the results (website - as promised in the title) applicable and accessible. English is pretty sound and the chapters are divided ok. Some figures need to be enhanced. But the identification and analysis of factors leading to RTS, as well as the development of the website/GIS database and app needs better clarifications.

Specific comments

I've added my direct thoughts on the paper as comments and review inserts in the pdf supplement - please download it and have a look

COMMENTS ON THE TEXT

Title

Line 1. I don't think that "website" fits good in the title, especially since there is no link to it and it is presented more a GIS app and a database, with basic analysis of how different factors correlate with RTS occurrence; please consider a slightly different title.

Re: It is a good suggest, but the title uses website because we are implementing the site. I hope it is available at the same time as the publication. The system is to be via browser (web).

Spatial database and website for reservoir triggered seismicity in Brazil

Abstract

Line 16. worldwide (Sounds a bit odd and is maybe unnecessary)

Re: Ok, We agree with the reviewer.

After confirming that impoundment of large reservoirs could cause earthquakes, studies on reservoir-triggered seismicity (RTS) have had a considerable scientific incentive.

Line 34. $1x10^{-4}$ km (Is 1X necessary and ^-4 ok (shouldn't be just 4)?

Re: Ok, we should use 10^{4}.

The reservoir volume also plays a role and it was estimated that RTS occurrence requires a limiting minimum value of $1x10^{4}$ km^{3} .

Line 38. than 10^{-3} km (Shouldn't it be ^3 instead of ^-3?)

Re: Yes, we should use 10^{3} .

The highest magnitude, 4.2, was observed for an event that occurred in a reservoir with a volume greater than 10^{3} km^{3} .

Introduction

Line 44. A reference seems needed.

Re: The reference is Marza et. al. (1999).

The reservoir-triggered seismicity (RTS) phenomenon was first observed during the filling of Lake Mead at the Hoover Reservoir (United States) in the mid-1930s,

and occurrences in the reservoirs of Hsinfenghiang (China), Kariba (Zambia), Kremasta (Greece), and Koyna (India) in the late 1960s (Marza,1999)(Figure 1).

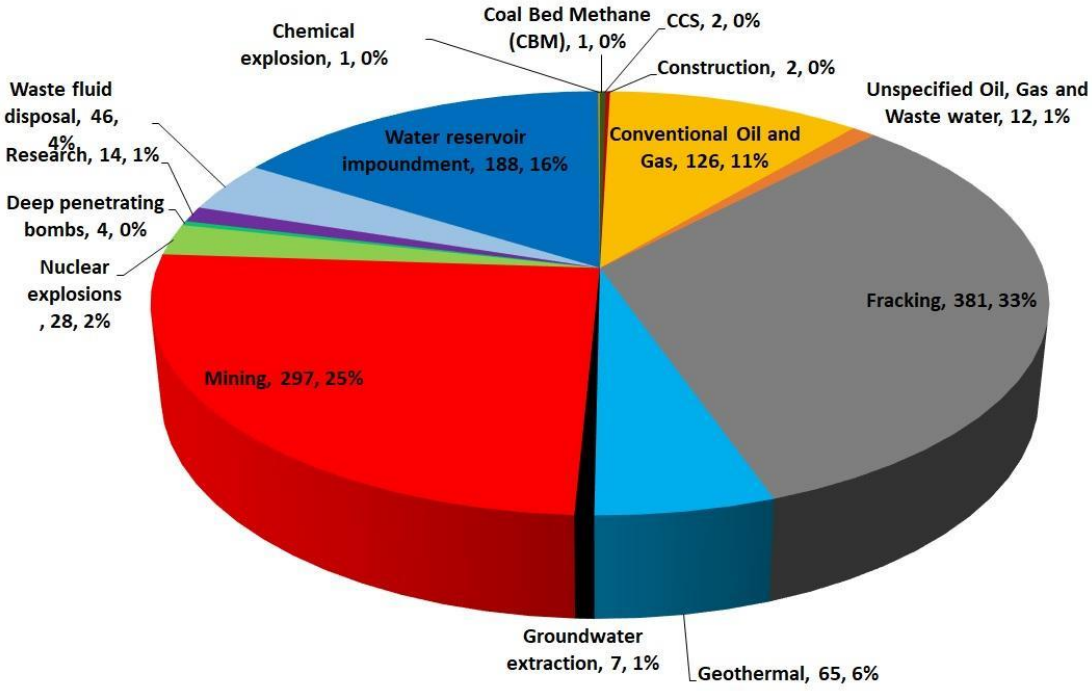
Line 45. A reference seems needed

Re: The reference is Simpson (1986).

Filling large reservoirs, mining underground mines, injecting high pressure fluids into deep wells, removing fluids during oil exploration, and the after-effects of large nuclear explosions can cause earthquakes (Simpson, 1986).

Line 50. Any damage statistics, worldwide or for some important events (such as the ones mentioned earlier)?

Re: Yes, we should cite the site (www.inducedearthquakes.org), that show that the human induced earthquake website, there are 188 cases of RST, totaling 16%.



www.inducedearthquakes.org. Last accessed 20 February 2020.

Line 54. Could you present some of the most relevant?

Re: Ok, We will insert the reference as:

There are several studies on reservoirs capable of triggering earthquakes (Assumpção et al., 2002; Ferreira et al.,2008; Veloso and Gomide., 1997), few of them, however, correlate the physical and geological information as possible agents of the triggered earthquakes.

Line 55. Could be useful to add one-two sentences explaining why is this correlation important (and is important).

Re: Yes, we agree.

There are several studies on reservoirs capable of triggering earthquakes (Assumpção et al., 2002; Ferreira et al.,2008; Veloso and Gomide., 1997), few of them, however, correlate the physical and geological information as possible agents of the triggered earthquakes. **Making this correlation expands the ability to understand this phenomenon.**

National Spatial Data Infrastructure (INDE/ NSDI)

Line 103. as shown in Figure 2 (I don't consider Figure 2 really necessary, since you already provide the text description in the text - more useful.)

Re: Yes, we agree.

We removed the figure.

Line 106. dissertation (paper/article)

Re: Yes, we agree, We will change dissertation by paper.

In conceptual modeling, the object classes are grouped into categories with common functional aspect. Among the categories, the hydrography package covering the dam class is the class of interest for this paper.

Designing the Spatial Database

Line 121. Figure 3 (Figure is probably not necessary.)

Re: Yes, we agree. The description in the text is sufficient to understand the steps involved in the construction process of the project in space database system.

We removed the figure.

Third Phase: Physical Modeling

Line 150. Sounds quite obvious to be "According to..."

Re: Ok, We agree and we can change the sentence.

Database management software uses database management software (DBMS), p. e.: Medeiros (2012). For the development of the spatial database, in Linux environment, postgreSQL 9.3 with raster extension was used, PostGIS 2.4, pgAdim III and Quantum GIS (QGIS) version 3.12.

Line 153. This version is now a bit old; any comment on implementation capabilities for 3+ version?

Re: We are currently using version 3.12

Database management software uses database management software (DBMS), p. e.: Medeiros (2012). For the development of the spatial database, in Linux environment, postgreSQL 9.3 with raster extension was used, PostGIS 2.4, pgAdim III and Quantum GIS (QGIS) version 3.12.

Web viewer

Line 163. RISBRA (Reservoir Induced Seismicity in Brazil) (Is the webviewer publicly available? Where can it be found?)

Re: Yes, it is hosted on the site http://obsis.unb.br/portalsis/ in test phase.

Update of Seismicity Triggered in Brazil for the Database

Line 185. By who and with what method? Which were the detection limitations (e.g. number of stations monitoring seismicity near the dams)?

Re: Who? The catalog used was produced by the Seismology Center at the University of São Paulo and the Seismological Observatory at the University of Brasília in partnership with other reference centers in seismology in Brazil, we can access in http://www.moho.iag.usp.br/rq/ or www.obsis.unb.br. What method? In general, They used Geiger's method.

From 1966 to 2018, 626 events were classified as RTS using Geiger's method (data from the seismic bulletin of the IAG-USP and SISBRA-Brazilian bulletin cataloged by SIS-UnB), with seismic recurrence in several dams, the largest being 4.2 recorded in the dams of Porto Colombia and Volta Grande, at the border between the states of Minas Gerais and São Paulo.

Line 191. The histograms are not enough to show swarms, especially since data is for all of Brazil; maybe maps for the mentioned dams would pin-point better the swarms and the time history of events in the areas.

Re: We agree. However, we affirm about the swarms because they are known and well monitored by local networks. We can make a topic in the article to address these cases in more detail. Initially, because it is an analysis of general cases (across the country), we were not interested in addressing one or the other case due to time and objectivity limitations.

RTS

Line 217. Beside intensity, couldn't it be provided an estimation of PGA (acceleration), based on recordings or GMPE's? Could also be relevant, as also an important parameter in seismic design of structures.

Re: We thought about this possibility but due to the lack of data coverage for all or most of the reservoirs, we did not address it on paper. We are doing a detailed study for reservoirs with PGA data for another paper.

Correlation of RTS with geological characteristics

Line 243. characteristics,~~ I~~ was compared…

Re: Ok! We were correct.

In order to correlate the probability of RTS with the geotectonic characteristics, was compared the local number of reservoir-triggered seismicity cases with the local lithology (types of rocks).

Line 247. A short comparison with literature article findings explaining potential implications and correlations between rock types and RTS seems adequate.

Re: Yes, we agree,

Baecher and Keeney (1982) were among the first to propose to compare the number of cases of RTS with local lithology. The results we had with the same correlation show that igneous rocks have a higher percentage of occurrence of SDR (10.1%) than on sedimentary (8.4%) and metamorphic (8.1%) rocks. This is contrary, for example, to what Baecher and Keeney (1982) estimated for deep,

very deep or very large reservoirs (that is, height> 100 m or volume> 10 km3): sedimentary rocks are slightly more likely (16%) compared to metamorphic or igneous (about 10% each).

Dimensional physical properties and their correlations

Line 259. Dam height or reservoir depth?

Re: Dam height

Line 266. Maybe also other filters (such as geology, initial seismicity existence or swarm effects) could provide more insights to these statistics.

Re: Yes, we agree. And we can do the analyzes with the filters at the same time and not only separately, but some of them were treated in the research.

The intensity and Highest Magnitude

Line 319. Please rephrase these sentence - it's unclear.

Re: The sentence was reformulated.

Several events were not felt, or there was no micro-seismic survey to define its intensity, for these we consider Intensity I.

Conclusions

Line 332. What is the policy regarding open "easy" access to RISBRA? I don't find on google any link or in this paper.

Re: The RISBRA is hosted on no Seismological Observatory website (http://obsis.unb.br/portalsis/). Access to the website and data is free. It is currently in the testing phase.

Line 333. Should be better highlighted, not just by histograms. Also, seismic monitoring increased capabilities (not discussed) are important when referring to an increase of RTS.

Re: We agree. We can add a brief history of the coverage of Brazilian seismographic stations over the years.

From 2011 was established the Brazilian Seismographic Network (RSBR) that improved the seismic monitoring data acquisition. The RSBR, is the joint work of four different institutions: Universities of São Paulo (USP), Brasília (UnB), Rio Grande do Norte (UFRN) and National Observatory (ON). The network consists of

84 stations (in December 2017) operated by these four institutions (Bianchi et al., 2018), .

References

Lines 427, 429, 437, 440. available.

Re: Corrections have been made.

CBDB - Comitê Brasileiro de Barragens, Available at: http://www.cbdb.org.br/, last access: 23 October 2018.

Centro de Sismologia da USP – Available at: http://www.sismo.iag.usp.br/eq/bulletin/, last access: 15 October 2018.

CONCAR – Comissão Nacional de Cartografia. Plano de ação para implantação da infraestrutura nacional de dados espaciais (INDE). Rio de Janeiro, 2010. Available at: https://www.concar.gov.br/pdf/PlanoDeAcaoINDE.pdf . last access: 03 April 2018.

CONCAR – Comissão Nacional de Cartografia. Especificações técnicas para estruturação da infraestrutura nacional de dados espaciais digitais vetoriais. Edição 3.0, 2017. Available at: https://www.concar.gov.br/temp/365@ET-EDGV_versao_3.0_2018_05_20.pdf. . last access: 04 April 2018.

TABLES

Line 551. Wouldn't be a good link also between Reservoir and temperature variations (for evaporation etc.), or Reservoir and Water release (if not reflected by hydrometric data already)?

Re: Great suggestion. We are seeing a possibility of inserting climatological data on the platform and we will do some analysis for already known cases of RTS. For water release we use hydrometry data already available and analyzed in the Response Time approach.

Table 2-

Line 552. Seismicity Cases triggered in Brazil.

What does UF stands for?

Re: Federative unit.

Area of the reservoir?

Re: Has been run to:Area of the reservoir (km^2).
Area of the reservoir (km2)

Some text appears to be missing

Re: Has been run to: Maximum reservoir water depth (m).
Maximum reservoir water depth (m).

Figures

Line 563. I don't consider Figure 2 really necessary, since you already provide the description in the text - more useful.
Re: The figure was deleted.

Line 584. I don't consider this figure necessary, since you already provide the description in the text.

Re: The figure was deleted.

Line 588. It would be useful to include all attribute names in english.

Re: Answered in next question

Line. 590. Please, use english names for the text to make the schema applicable and traceable

Re: The OMT-G and Relational Model are models made in softwares for use in the application of the physical model. It is in Portuguese because the database was developed in that language. However, we will have the English version of the page.

Line. 598. Histogram of the RTS numbers with a magnitude greater ~~than~~ 1, per year.

Re: Removed the word than.

Fig 7- Histogram of the RTS numbers with a magnitude greater 1, per year.

Line 598. Citing a datasource would be good also here (not just in the text).

Re: The correction was made.

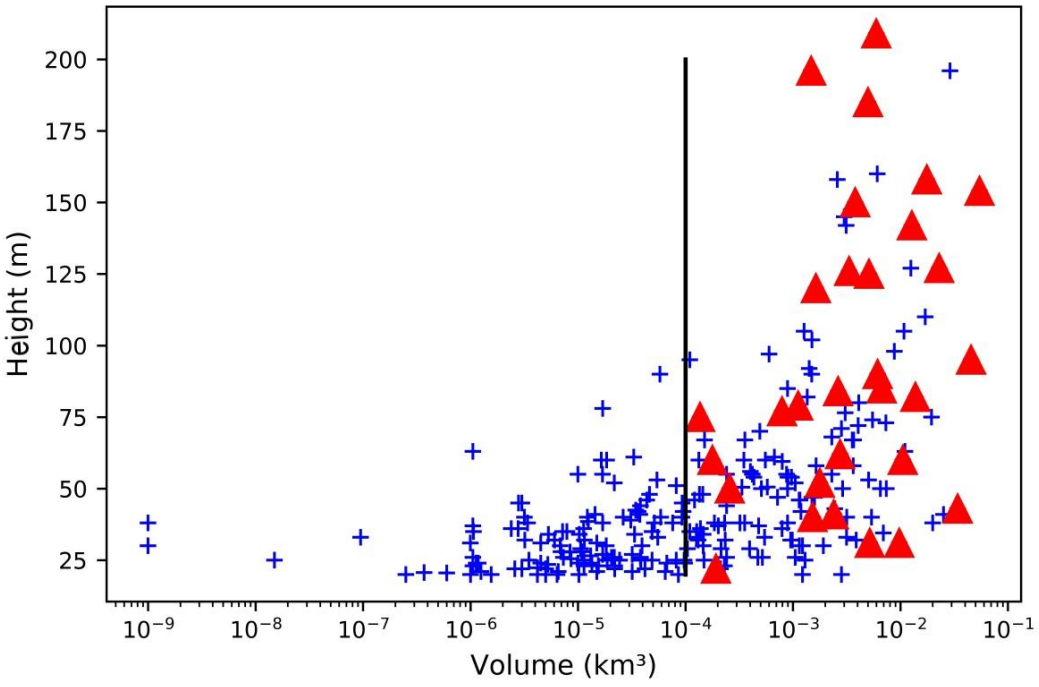
Fig 7- Histogram of the RTS numbers with a magnitude greater 1, per year (Data from the Brazilian bulletin cataloged by SIS-UnB).

Line 601. Numbers on the small circles are hard to identify. Is this data available in the webviewer - maybe make a link to the interactive version?

Re: We agree. We will put the link.

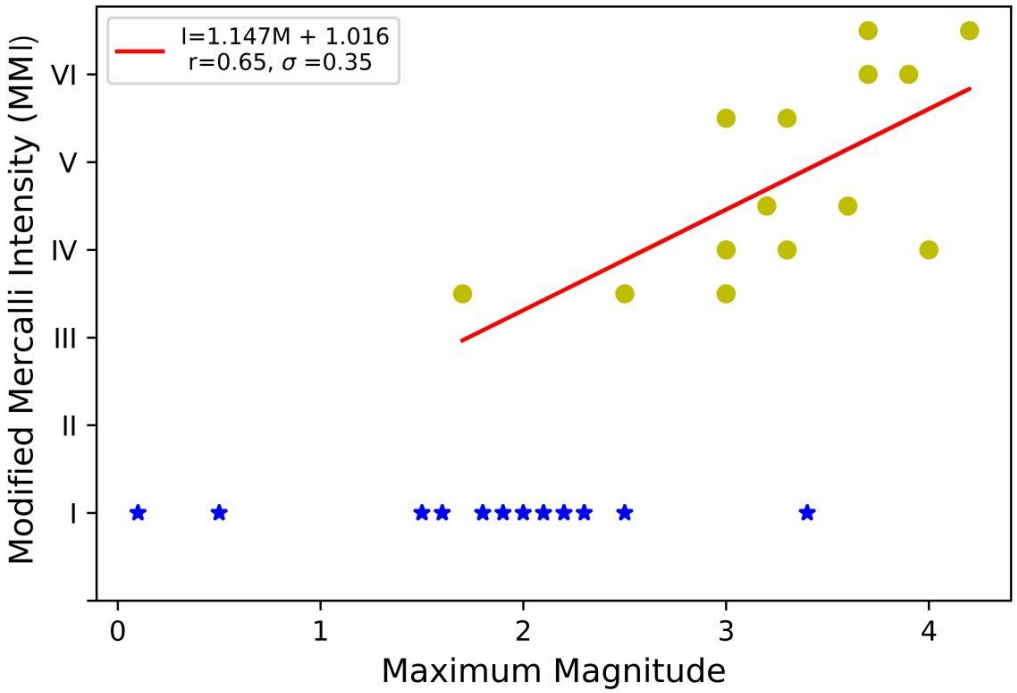
Line. 638. Height

Re: The correction was made.



Line 649. MMI

Re: The correction was made.



REVIEWER 2

It is an interesting paper, data processing can add valuable information to this field of study. However the paper is not clear enough about the effort the authors have added to this work. It is not clear what they have performed and what was already ready to use as an input to their research. There is too much about the creation of the GIS database and to less about how the results were obtained (eg. Fig 11b). The structure of presenting the results is good however it is a question whether the results are in accordance with the referred papers or not. It is not clear how the authors have classified earthquakes to be linked to dams – ie. RST cases. The “research” itself is very simple only statistical assessment of the RTS events however it can be a kind of state of the art type of paper when compared to other research and results in this field. After revision it can be published. PS: I have added suggestions to the pdf file directly.

COMMENTS ON THE TEXT

Title

Line 1. ~~Website -~~ Spatial database for reservoir triggered seismicity in Brazil

Re:The title was rewritten.

Spatial database and website for reservoir triggered seismicity in Brazil.

Abstract

Line 19. of effective ~~effort~~ due to the increase in pore pressure, can modify the stress ~~regime~~ in the.

Re:Effort and regime have been replaced by force and field.

Most of the studies determined that the vertical load increase due to reservoir load, and the reduction of effective force due to the increase in pore pressure, can modify the stress field in the reservoir region, possibly triggering earthquakes.

Line 24. One of the major challenges ~~for~~ studying RTS is to identify and…

Re:“For” has been replaced by in.

One of the major challenges in studying RTS is to identify and correlate the factors in the area of influence of the reservoir, capable of influencing the RTS process itself.

Lines 25-28. To assist the research, it was created a spatial seismicity-triggered reservoir database (BDSDR) based on the specifications of the national spatial data infrastructure (INDE), for gathering data pertinent 27 to the RTS study in the area of reservoirs.

Re:The sentence was rewritten.

A spatial seismicity-triggered reservoir database was created to facilitate the research in this field, based on the specifications of the national spatial data infrastructure (INDE), assemble data pertinent to the RTS study in the area of reservoirs.

Lines 30-31. In this context, this work presents the procedures and results found in the data processing of seismotectonic factors (dam height, reservoir capacity, lithology and seismicity) and compared with the dams that triggered earthquakes and the Brazilian dam list, which was then updated from 26 to 30 cases.

Re:The sentence was rewritten.

In this context, this work presents the procedures and results found in the data processing of seismotectonic factors (dam height, reservoir capacity, lithology and seismicity) and

compared first to the dams that triggered earthquakes and secondly the Brazilian dam list. The list has been was updated with 4 more cases adding to 30 cases.

Line 36. ...of them have **a** hydraulic behavior...

Re:The correction was made.

The delayed response time of the reservoirs represents 43% of the total, that is, almost half of them have a hydraulic behavior.

Lines 37-38. The highest magnitude, 4.2, was observed for an event that occurred in a reservoir with a volume greater than 10^{-3} km^3 .

Re:The sentence was rewritten

The highest magnitude, 4.2 was observed at a reservoir with a volume greater than 10^{3} km^3 .

Introduction

Lines 43-45. The reservoir-triggered seismicity (RTS) phenomenon was first observed during the filling of Lake Mead at the Hoover Reservoir (United States) in the mid-1930s, and occurrences in the reservoirs of Hsinfenghiang (China), Kariba (Zambia), Kremasta (Greece), and Koyna (India) in the late 1960s (Figure 1).

Re:The sentence was rewritten.

The reservoir-triggered seismicity (RTS) phenomenon was first observed during the filling of Lake Mead at the Hoover Reservoir (United States) in the mid-1930s, and occurrences of RTS in case of the following reservoirs: Hsinfenghiang (China), Kariba (Zambia), Kremasta (Greece), and Koyna (India) in the late 1960s (Marza,1999) (Figure 1).

Line 52. ...intensity V-VI (MM) recorded ~~in~~ **at** the reservoir of Carmo do Cajuru...

Re:The correction was made.

In Brazil, the first STR case was a 3.7 magnitude earthquake with intensity V-VI (MM) recorded at the reservoir of Carmo do Cajuru, MG, in 1971.

Lines 54-55. please redraft.

Re:The sentence was rewritten.

There are a large number of studies on reservoirs that have SDR, however there are few studies that correlate physical and geological information, as possible causes of triggered earthquakes.

Line 56. Thus, this work ~~proposes to present~~ the procedures and results found in the data processing ~~of~~ the following …

Re:The sentence was rewritten.

Thus, this work presents the procedures and results found in the data processing concerning the following parameters (height, volume, area, geology, and local seismicity level) and comparing them with the dams that triggered earthquakes and the Brazilian dam catalog

Line 58. ~~To this end~~, a spatial …

Re:The sentence was rewritten.

Finally, a spatial database model of the reservoirs and their geological and geophysical characteristics was developed.

Line 64-66. The amount of information and probable effects ~~corroborating the RTS~~ requires ~~standardizing all information~~, which was accomplished ~~by following~~ the National Spatial Data Infrastructure (INDE).

Re:The sentence was rewritten.

The amount of information and probable effects RTS causing requires the standardization of information, which was accomplished according the National Spatial Data Infrastructure (INDE).

Database and web viewer

Lines 73-74. The Reservoir-triggered Seismicity Database (BDSDR) resulted from researching and studying the cases that happened in Brazilian Reservoirs **and the realization that the pertinent data was scattered and, most important, limited to listing the cases and the occurrence sites**. (please redraft)

Re:The sentence was rewritten.

The motivation for creating the Seismicity Database Triggered by Reservoir (BDSDR) arose from the research in the cases that occurred in Brazilian Reservoirs when observing the lack of cohesion of information, pertinent to the study, presenting only isolated cases or listing with the locations of occurrences.

Lines 76-77. ... geological and geophysical data on each reservoir, store in a standardized way while sharing and making it accessible so that the database can assist on RTS studies.

Re:The sentence was rewritten.

Geological and geophysical data on each reservoir, and to store in a standardized way while sharing and making it accessible so that the database can assist in RTS studies.

National Spatial Data Infrastructure (INDE/ NSDI)

Line 88. The spatial data infrastructure defines the standards for the data composing ~~it~~ and ~~maybe being~~ presented as a Technical Specification.

Re:The sentence was rewritten.

The spatial data infrastructure defines the standards for the data composing and can be presented as a Technical Specification.

Lines 98-103. MapTopoPE is divided into 14 categories: ~~Energy and Communications (ENC), Economic Structure (ECO)~~, Hydrography (HID), etc ~~Boundaries/Limits and Localities (DML), Reference Points (PTO), Relief (REL), Basic Sanitation (SAB), Vegetation (VEG), Transport System (TRA), Transport System/Airport Subsystem (AER), Transport System/Duct Subsystem (DUT), Transport System/Rail Subsystem (FER), Transport System/Hydro Subsystem (HDV), and Transportation System/Road Subsystem (ROD),~~ as shown in Figure 2. (you may list one or two but it is not necessary so far there is the Fig.2)

Re:Figure 2 was removed, keeping only the text.

Line 106. dissertation (paper/article)

Re: We did the dissertation substitution for paper.

Among the categories, the hydrography package covering the dam class is the class of interest for this paper.

Lines 128-132. From the studies on the metadata of the archives of the seismological data, it was initially defined a model consisting of 20 entities: Stress Regime, Fault Orientation, Fault Mechanism, Chronostratigraphy, Structure, Lithology, Reservoir, Dam, UF, Municipality, Hydrometry, Magnetometry, Electromagnetometry, Gravimetry, Pluviometry, Regional Stress Regime, Hydrography, Crustal Thickness, Seismic Event, and Seismographic Station. (determined by the authors of this paper ?)

Re:Yes, the entities that make up the database were determined by the authors of this paper based on the research conducted.

Lines 140-142. At this stage, key attributes such as imposing relational integrity, creating unique indexes, attributing data types, and the height of the fields to store information are defined and identified.

Re:Yes, this step is performed based on the objectives of using the database. It is one of the most important steps because it involves multiple search options and access to the bank's data.

Third Phase: Physical Modeling

Line 145. The last phase of the database design consists of creating a physical schematics, which depends on the Database Management System (DBMS) ~~used~~ (Cardoso and Cardoso, 2012).

Re:The sentence was rewritten.

The last phase of the database design consists of creating a physical schematics, which depends on the used Database Management System (DBMS) (Cardoso and Cardoso, 2012).

Web viewer

Line 163. The web viewer, named RISBRA (Reservoir Induced Seismicity in Brazil), was created using the leaflet, Node.js and Redis libraries. (by authors of this paper ?)

Re:Yes, the name was created by the authors.

Line 179. Update of Seismicity Triggered in Brazil for the Database (Please redraft)

Re:The topic was adjusted according to the suggestion.

Reservoir-Triggered Seismicity List updated for the database.

Line 203. Table 2 is based on the work of Marza et al. (1999), to which we added other data such as area of reservoirs,...
(you should indicate also at the title of the table that is based on marza et al).

Re:The correction was made.

Marza et al. (1999).

RTS

Line 214. In general, from the total of 348 reservoirs, only 8.6% of those presented RTS, ~~among them~~, only two events with a maximum magnitude...

Re:The sentence was rewritten.

In general, from the total of 348 reservoirs, only 8.6% of those presented RTS, and only two events with a maximum magnitude greater than or equal to 4.0 (Table 3 and Figures 9 and 10).

Line 223. However, compared to the number of reservoirs in Northeast, 17.8% of the reservoirs show RTS that although there are fewer cases in the region, the relative value is comparatively higher. (of the total number of earthquakes or number of what?)

Re:Compared to the number of RTS with number of reservoirs in the northeast region.

The sentence was rewritten.

However, compared to the number of RTS, 17.8% of the total number of Reservoirs in the Northeast shows that although there are fewer cases in the region, the relative value is comparatively higher.

Line 225. ….although there are fewer cases in the region, the relative ~~value~~ is comparatively higher.

Re:Value has been replaced by number.

However, compared to the number of reservoirs, 17.8% in the Northeast shows that although there are fewer cases in the region, the relative number is comparatively higher.

Correlation of RTS with geological characteristics

Line 232. Despite the laboratory ~~studies on~~ these properties, little progress has been made, especially due…

Re:The sentence was rewritten.

Despite the laboratory test determining these properties, little progress has been made, especially due to the great practical difficulties to map the huge number of rocks below and in the vicinity of a reservoir in terms of porosity, permeability, existence of faults, cracks, etc. (Assumpção et al., 2002).

Line 239. ...low resistance to rupture, facilitates liquid penetration all the way to the deepest and most…

Re:The sentence was rewritten.

The existence of fractures and faults, besides generating a weakness zone due to the low resistance to rupture, it also facilitates liquid penetration all the way to the deepest and most distant reservoir zones, increasing the pressure in the pores.

Line 243. characteristics,~~ I~~ was compared…

Re: Ok! We were correct.

In order to correlate the probability of RTS with the geotectonic characteristics, was compared the local number of reservoir-triggered seismicity cases with the local lithology (types of rocks):

Dimensional physical properties and their correlations

Line 265. ...more likely to trigger earthquakes, ~~corroborating~~ Simpson (1986) findings.

Re:Corroborating has been replaced by confirming.

Thus, in Brazil, the comparison between the RTS cases and the dam heights indicates that dams smaller than 50 m are only 2% likely to trigger seismicity while those higher than 100 m are approximately 54% (Figure 13a) more likely to trigger earthquakes, confirming Simpson (1986) findings.

Line 272. you are determining initial type later -maybe this is something you should mention there

Re: The type of seismicity is one of the items in Table 2. We do not understand.

Line 274. We observed that the height is not limitant, which is the height of the largest dam. (Please redraft)

Re:The sentence was rewritten.

We observe that the height does not have a limit between 20m and 209m, which is the height of the largest dam.

Response Time

Line 284-286. Cases of state initial or delayed response seismicity occur at a certain time after the filling/impoundment when the steady-state is reached and presents a more lasting associated seismicity. (If you want to describe to different behaviour than please redraft the sentence.)

Re:The description was for the steady state.The sentence was rewritten.

Cases of steady state or delayed response seismicity occur at a certain time after the filling/impoundment when the steady-state is reached and presents a more lasting associated seismicity.

Line 294. ~~O~~f the 30 RTS cases, only 4 were considered as a delayed response while 17 cases had only an initial response (Figure 15).

Re:Changing the suggested phrase would change the meaning.

Line 299. The delayed response cases represent 43% in total, that is, almost half of them have hydraulic behavior.

(Is this accordance with you have described in row 280-289?)

Re: We insert to the paragraph (280-289) the nomenclature hydraulic and mechanical behavior.

These different responses may correspond to two fundamental mechanisms by which a reservoir can modify the force in the crust - one related to the rapid increase of elastic stress due to the reservoir load (mechanical behavior) and the other to the more gradual diffusion of water from the reservoir to hypocentral depths (hydraulic behavior) .

Highest Magnitude

Line 303. It is known that in large reservoirs, the chances of pressure in the rock pores to affect the existing...

(As the pressure in the rock pores increases affects existing seismic structures below a dam, so the chance of RST also increases. This is what you suggested? Please redraft)

Re:We cannot say that. Our results point out the majority of cases in the initial response reservoir, that is, related to the rapid increase in elastic effort due to the reservoir load.

Line 312. ~~For~~ Klose (2013), the reservoir volume showed a small tendency to generate higher magnitude events compatible with the affected area of the reservoir, depending on its dimensions

Re:The sentence was rewritten.

Based on Klose (2013), the reservoir volume showed a small tendency to generate higher magnitude events compatible with the affected area of the reservoir, depending on its dimensions.

Lines 314-316. Figure 17 shows that most of the events occur in reservoirs with volumes greater than 10-3 and 4.2 ~~maximum magnitude and that~~, for the most part, events between 3 and 4 magnitudes occur in dams ~~up to~~ 100 m tall. (Is this in agreement with that you have referred from literature (row 257- Simpsons)?

Re:Yes, confirming Simpson (1986) findings.

The sentence was rewritten.

Figure 17 shows that most of the events occur in reservoirs with volumes greater than 10^{3} and with a magnitude of 4.2 in most cases, events between 3 and 4 magnitudes occur in dams lower than 100 ml.

The intensity and Highest Magnitude

Lines 318-319. Several events were either not felt or there was no micro-seismic survey defining its intensity, they were considered Intensity I ~~here~~.

Re:The sentence was rewritten.

Several events were either not felt or there was no micro-seismic survey defining its intensity, they were considered Intensity in this study.

Line 323. Have such equations published previously? You might need to say that this is only applicable for dams in the investigated area.

Re:These equations have not been published previously. We will inform in the text that the equation is applicable only to the dams investigated in this study.

Conclusions

Line 331. The created web viewer, RISBRA, presents ~~as~~ an interactive platform with easy access and great potential to improve knowledge on the RTS in Brazil.

Re:Fixed.

The created web viewer, RISBRA, presents an interactive platform with easy access and great potential to improve knowledge on the RTS in Brazil.

Line 338. Despite having a small number of RTS, the Northeastern region has comparatively higher relative value compared to other regions. (What Value?)

Re:Compared to the number of RTS, 17.8% in the Northeast shows that although there are fewer cases in the region, the relative value is comparatively higher. The sentence was rewritten.

Despite having a small number of RTS, 5 cases, the Northeast region has a comparatively higher relative value of RTS compared to other regions.

Line 339. Although the results show a small trend for igneous rocks (rock type) and sedimentary basins (geological provinces) being more prone to RTS, there is no way to state the trend of these parameters with the current available data.

Re:The sentence was rewritten.

Although the results show a trend with higher number of RTS in case of igneous rocks (rock type) and sedimentary basins (geological provinces) being more prone to RTS, however trends cannot be backed up with the currently available data.

Lines 344-346. The dam height has been confirmed as one of the main indicators of the dam capability of triggering earthquakes. Dams less than 50 m high are only 2% likely to cause seismicity while those more than 100 m high are about 54% more likely to cause an earthquake. (based on data obtained from, or based on evaluated data- these are your results?

Re:Yes, these are our results. Based on the evaluated data.

Line 352. The relationship between Intensity and highest magnitude is described by the equation "I = 1.147M + 1.016 (+ -0.35)", where I is the estimated intensity and M is the determined magnitude.

Re:The sentence was rewritten.

An equation "I = 1.147M + 1.016 (+ -0.35)" has been determined to describe the relationship between Intensity and highest magnitude. Where “I” is the estimated intensity and “M” is the determined magnitude.

Line 355-357. The evaluation of a reservoir seismic risk is hampered by the practical difficulty of mapping a large volume of rocks located below the reservoir and, therefore, of knowing key parameters such as local stresses, rock mass permeability, and fracture system geometry.

Re:The sentence was rewritten.

Practical difficulty of mapping soil layers below the dams hinders the evaluation of the seismic risk of an reservoir and, therefore, it is essential to obtain key parameters such as local stresses, rock mass permeability, and fracture system geometry.

Lines 360-361. Most importantly, this work shows that the possibility of RTS occurrence in Brazil cannot be overlooked while highlighting the importance of continuous monitoring, before, during and after the construction of the dam.

Re:The sentence was rewritten.

Most importantly, this work shows that the possibility of RTS occurrence in Brazil cannot be neglected while highlights the importance of continuous monitoring, before, during and after the construction of a dam.

Data and Resources

Line 363. The data used in this article was extracted the seismic bulletin and SISBRA, data and information from the SISBRA can be downloaded from the Seismological Observatory of the University of Brasília (SIS / UnB), Center of Seismology of the University of São Paulo (USP): www.obsis.unb.br; www.sismo.iag.usp.br; (last accessed December 2018).

Re:The sentence was rewritten.

The data used in this article was extracted from the seismic bulletin and SISBRA. Data and information from the SISBRA can be downloaded from the Seismological Observatory of the University of Brasília (SIS / UnB), Center of Seismology of the University of São Paulo (USP): www.obsis.unb.br; www.sismo.iag.usp.br; (last accessed December 2018).

TABLES

Line 550. It should be more dense to fit one page.

Re:We agree. We will make the change.

Relacionamento	Descrição
Litologia e Estrutura	A estrutura é a característica da falha que está associada à litologia.
Litologia e Cronoestratigrafia	A litologia (tipo de rocha) possui um ou mais dados de cronoestratigrafia.
Reservatório e Litologia	Na área do reservatório temos um ou mais tipos de litologia.
Estrutura e Regime de Esforço (*Stress*)	O regime de esforço atua sobre as estruturas.
Estrutura e Orientação da Falha	Orientação da falha diz respeito a informações de mergulho, direção e inclinação da estrutura (falha).

Estrutura e Mecanismo da Falha	Mecanismo de falha refere-se a informação das características da estrutura.
Reservatório e Espessura Crustal	Na área do reservatório possui informações da espessura Crustal.
Reservatório e Evento Sísmico	Evento sísmico pode ocorrer na área de influência do reservatório.
Evento Sísmico e Estação Sismográfica	A estação sismográfica detecta evento sísmico.
Hidrometria e Reservatório	Os reservatórios possuem informações diárias de hidrometria.
Reservatório e Magnetometria	O reservatório possui informações de magnetometria em sua área de influência.
Reservatório e Eletromagnetometria	O reservatório possui informações de Eletromagnetometria em sua área de influência.
Reservatório e Gravimetria	O reservatório possui informações de gravimetria em sua área de influência.
Reservatório e Regime de Esforço da Região	Na área de influência do reservatório existem forças atuantes do regime de esforço.
Reservatório e Hidrografia	O reservatório faz parte da hidrografia.

Reservatório e Pluviometria	Na área do reservatório temos a influência da pluviometria.
Reservatório e Barragem	Reservatório possui barragem
Município e UF	Cada município está contido na UF

Line 552. This table should be cut in to more tables each containing headings to be able to process.

Re:We agree. We will make the change.

													Maiores Eventos						
N°	Nome	UF	Altura(m)	Volume (km3)	Profundidade máx. de água do reservatório (m)	Área (km2)	Início do confinamento	Província Geológica	Tipo de Sismicidade	Hora (HH:MM:SS)	Data (AA/MM/DD)	Magnitude	Tipo de	Io (MMI)	ΔT(ano)	Localização	Referências
1	Acu	RN	41	2,400	55,0	195,0	1985	Faixa de cavalgamentos e dobramentos	Atrasada	01:31:47	1994/08/26	3,0	mR	IV*	9.5	Dentro	Do Nascimento (2002)
2	Balb	AM	31	9,75	51,0	2,36	10/1987	Bacia	Inicial	--	1990/03/2-	3,4	mb	I	2.5	Margem	Assumpção et al. (200
3	Barra	RS	185	5,000	-	93,40	12/1999	Bacia	Inicial Atrasada	--	2005/10/10	2,5	ML	I	0.01	Margem Dentro	Ribotta et al. (2008) e Ribotta et
4	Batalha	MG/GO	52	1,781	800,0	138,13	2014	Faixa de cavalgamentos e dobramentos	Inicial	--	2015-08-01	2,1	mD	I	-	Margem	Chimpliganond et al. (2015)
5	Carmo	MG	22	0,192	749,7	2,30	1954	Cráton	Atrasada	30:35:10	1972/01/23	3,7	mb	VI	18	Margem	Veloso et al. (1987) e Viotti
6	Campo	SC	196	1,477	-	34,60	10/2005	Bacia	Inicial Atrasa-	--	2005/10/12	1,8	ML	I	0.01	Dentro	Ribotta et al. (2010)
7	Capi	PR/	60	10,5	-	576,	01/1976	Bacia	Inicial A-	--	1979/03/27	3,7	mb	VI-VII	~3	Margem	Assumpção et.al (199
8	Capivari-	PR/SP	60	0,178	-	13,10	07/1970	Faixa de cavalgamentos e dobramentos	Inicial	16:00:00	1971/05/21	3,9	ML	VI	~1	-	Berrocal et. al.(1984) e Mioto et.al. (1991)

21	20	19	18	17	16	15	14	13	12	11	10	9	N°	
Miranda	Marimbon	Machadinh	Lajeado	Jirau	Jaguari	Itapebi	Itá	Irapé	Furnas	Funil	Emborca	Castanhã	Nome	
MG	MG/SP	RS/SC	TO	RO	SP	BA	RS/SC	MG	MG	MG	GO/MG	CE	UF	
79	90	126	31	62	77	120	125	209	127	50	158	85	Altura(m)	
1,120	6,150	3,339	5,190	2,746	0,793	1,633	5,100	5,964	22,950	0,258	17,588	6,700	Volume (km3)	
-	-	-	212,3	90,0	-	-	370,0	470,8	-	808,0	653,0	100,0	Profundidade máx. de água do reservatório (m)	
70,0	438,0	79,0	630,0	361,6	56,0	61,58	141,00	137,00	1,44	33,46	473,00	458,00	Área (km2)	
08/1981	1975	2001/09/08	2002	2014	12/1969	12/2002	12/1999	12/2005	1963	2002	08/1981	2003	Início do confinamento	
Bacia	Bacia	Bacia	Bacia	Bacia	Faixa de cavalgamentos e dobramentos	Cráton	Bacia	Faixa de cavalgamentos e dobramentos	Faixa de cavalgamentos e dobramentos	Cráton	Faixa de cavalgamentos e dobramentos	Faixa de cavalgamentos e dobramentos	Província Geológica	
Inicial Atrasada	Inicial	Inicial Atrasada	Inicial Atrasada	Inicial	Atrasada	Inicial	Inicial Atrasada	Inicial	Inicial *	Atrasada	Inicial	Inicial	Tipo de Sismicidade	
--	--	--	--	--	--	15:44:16	--	14:07:46	08:00:00	--	--	09:29:25	Hora (HH:MM:SS)	
2000-05-06	1978/07/25	2001/09/08	2012/04/01	2014/11/07	1985/12/17	2003/08/03	1999/12/15	2006/05/14	1966/11/15	2011/08/14	1982/05/20	2007/08/07	Data (AA/MM/DD)	Maiores Eventos
3,3	2,0	1,8	2,2	3,2	3,0	1,5	2,5	3,0	3,2	3,2	1,6	2,3	Magnitude	
mR	ML	ML	mD	mR	ML	M_D	ML	mR	mI	mR	ML	mD	Tipo de	
V-VI	I	I	I	IV-V	V-VI	I	III-IV	III-IV	IV-V	IV-V	I	I	Io (MMI)	
2.7	~3	0.01	10	0.8	16	~0.01	0.01	0.01	~1?	8	~1	1?	ΔT(ano)	
Margem	Margem	Dentro Margem	Margem	Dentro	Margem	Dentro Marge	Margem Dentro	Dentro	-	Margem	Dentro	Inicial Atrasada	Localização	
Barros e Caixeta (2003) e Assumpção et al	Veloso et al. (1987)	Ribotta et al. (2006a) e	Relatório Técnico do Observatório	Barros et.al (2015)	Veloso et al. (1987)	Barros (2008)	Ribotta et al. (2006b,2010,2017)	França et al.(2010)	Berrocal et al. (1984) e Barros et al	Barros et al. (2014)	Viotti et al. (1997,1995)	Ferreira et. al. (2008)	Referências	

											Maiores Eventos						
N°	**Nome**	**UF**	**Altura(m)**	**Volume (km3)**	**Profundidade máx. de água do reservatório (m)**	**Área (km2)**	**Início do confinamento**	**Província Geológica**	**Tipo de Sismicidade**	**Hora (HH:MM:SS)**	**Data (AA/MM/DD)**	**Magnitude**	**Tipo de**	**Io (MMI)**	**ΔT(ano)**	**Localização**	**Referências**
22	Nova	MG	142	12,79	-	443,0	10/19 93	Bacia	Inicia l	--	1998/ 05/22	4,0	mR	VI		Marg em	Chim pliga nond (2002)
23	Paraibun	SP	84 /105	2,636	-	177,0	1974 /1976	Faixa de cavalga mentos e dobrame ntos	Inicial	23:20:00	1977-11-16	3,3	mb	IV	~1	Dentro	Mendigu ren (1980) e Ribotta (1989)
24	Porto	MG/SP	40 / 55	1,525 /	-	143,00/	04/1973 -	Bacia	Inicial	31:94:0 0	1974/02 /24	4,2	mD	VI-VII	~1	Margem ?	Berroca l et al. (1984), Veloso (1992a)
25	Serra da	GO	154	54,400	-	1,78	10/1996	Faixa de cavalgame ntos e dobrament os	Inicial	--	1999/06/1 3	2.2	mD	I	~3	Margem	Veloso et al. (1987) e Assumpçã o et al
26	Sobr	BA	43	34,1	-	4,12	1977	Crát on	Inici al	--	1979 /07/0 5	1,9	ML	I	~2	Dent ro	Berr ocal e Fern ande
27	Qu	SC	75	0,1	549 ,0	5,6	200 2	Bac ia	Inic ial	--	200 3/0 3/0	0,1	mD	I	-	-	Rel atór io Téc nic
28	Três	SP	82	13,800	-	785,0	1990	Bacia	Inicial	--	1990/11/0 1	0,5	mD	I	~0.1	-	Relatório Técnico do Observató rio
29	Tucuruí	PA	95	45,500	-	2,43	Set/198 4	Cráton	Inicial Atrasad	06:26:5 1	1998/03 /02	3,6	-	IV-V	14	Dentro	Assump ção et. al (2002)e Veloso
30	Xingó	AL/SE	150	3,800	-	60,0	06/1984	Faixa de cavalgam entos e dobramen tos	Inicial	--	1994/07/2 0	1,7	ML	III-IV	~0.1	Margem	Berrocal e Fernande s (1996)

Figures.

Line 560. Reference?

Re: (data from the www.inducedearthquakes.org. Last accessed 20 February 2020)

Line 562. Not readable blurry.

Re: This figure was removed.

Line 584. Too big compared to other figures . Reference?

Re: This figure was removed.

Line 589 and 590. Reference? Not readable

Re: The OMT-G and Relational Model are models made in softwares for use in the application of the physical model. It is in Portuguese because the database was developed in that language. We will make it readable

Line 595. Reference?

Re: We do not put the website address because we are implementing it. I hope it will be available at the same time as the publication.

Line 601. Reference

Re: Data from the bulletin of the IAG IAG-USP and SISBRA (Brazilian bulletin cataloged by SIS-UnB.

Data from the bulletin of the IAG IAG-USP and SISBRA (Brazilian bulletin cataloged by SIS-UnB.

Line 602. Figure 9 has been compiled by the authors of this paper?

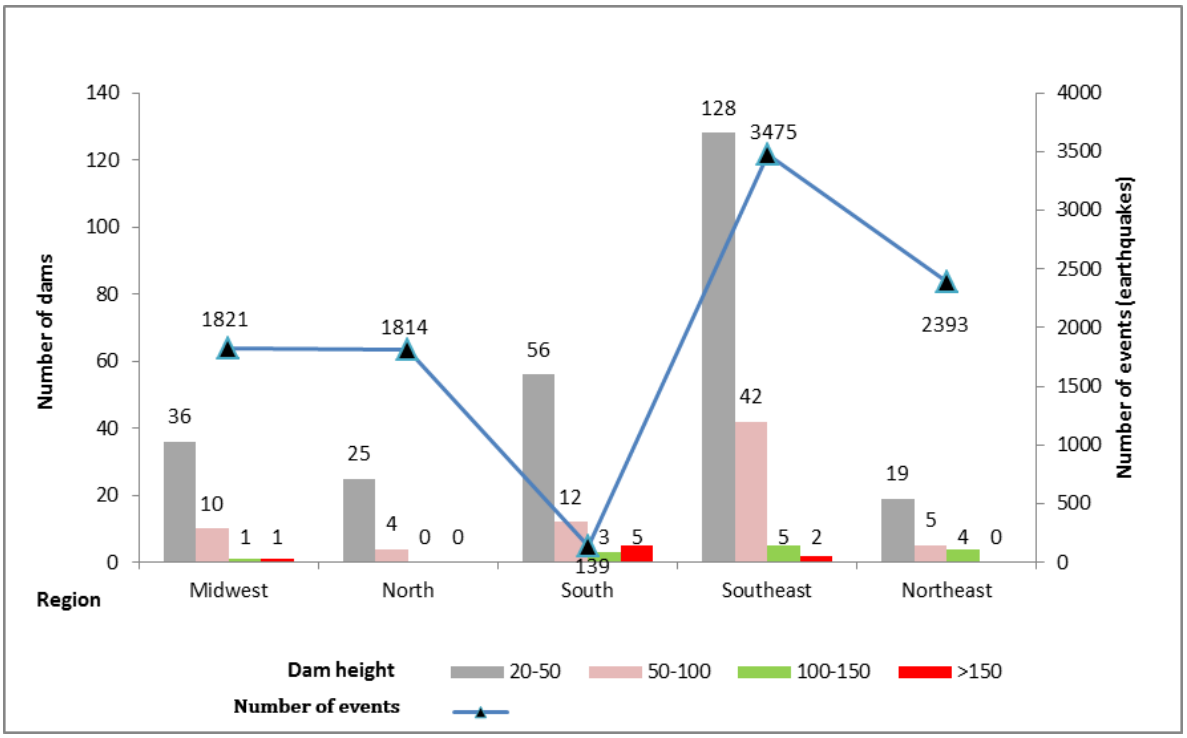
Meaning of the blue line?

Magnitude of earthquake can be represented in this figure ? It would be great to see.

Re: Figure 9 was created by the authors.

The blue line represents the number of events (earthquakes) by region.

We can place events of greater magnitude in which region.



Line 608. Reference?

Re:Data from the Brazilian Committee on Dam.

Data from the Brazilian Committee on Dam.

Line 615. Figure 11 has been compiled by the authors of this paper?

Re:Figure 11 was created by the authors.

Line 625. Reference?

Re:Datas from the Brazilian Committee on Dams-2018 and CPRM Mineral Resources Research Company.

Datas from the Brazilian Committee on Dams-2018 and CPRM Mineral Resources Research Company.

Line 631. Figure 13-18 has been compiled by the authors of this paper?

Re:Figures 13 to 18 are the authors' creations.

Line 641. Blurry

Re:The figure has been redone for better clarity.