Global Seismogram Plotter Focus Group
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Dr. Hilarie B. Davis, TLC Inc.
Michael Hubenthal, IRIS Consortium
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Executive Summary

Since 2005, educators and the general public have had easy access to images of seismic waveforms via the Rapid Earthquake Viewer (REV) (http://rev.seis.sc.edu). In early 2017, the REV software was retired. The IRIS Education and Public Outreach (EPO) program determined that it would be best to replace REV with a new website aligned with modern web browsers, mobile devices, and wired classrooms. This new tool, provisionally called the Global Seismogram Plotter (GSP), seeks to provide easy access for teachers and students with little experience reading seismograms, to record sections containing between 10 and 16 appropriately scaled seismograms per event, with no data drops, "weird" spikes or other noise, and usable both on screen (CPU and tablet-friendly) and in print. GSP will provide data access for two IRIS lessons, http://www.iris.edu/hq/inclass/lesson/16 and http://www.iris.edu/hq/inclass/lesson/174, as well as for other uses by the educational community.

The initial design of the GSP (Appendix A) was developed by EPO staff based on their personal experience with the previous site, informal feedback received from teachers and college faculty who used the previous site, and the staff's expertise in developing web interfaces for accessing and using data. To evaluate the design of GSP, a virtual focus group of five users of the REV website was conducted.

Based on the result of this focus group, several key recommendations were identified.
- Keep working on the name and get feedback from these and other users.
- Develop video tutorials about the content and how to use the tools at a basic level, and add more advanced ones as needed.
- Link to other IRIS resources that provide additional content, activities, and resources such as photos.
- Keep all the features being considered, but make them options that can be turned on and off, perhaps with subtle or hidden toggles so teachers can decide when to use them within the learning sequence they develop for students.
- Consider options for display and printing stations that keep the benefit of colors, but accommodate different lighting conditions for projection, and printed copy degradation.
- Make the focus group teachers beta testers when the product is minimally viable. Ask them to write sample lesson plans to put with the GSP as examples for less experienced teachers.

Background

To enable teachers and the general public to quickly and easily access seismic waveforms from recent earthquakes, the University of South Carolina, in collaboration with the IRIS Education and Public Outreach program (EPO), developed and maintained the Rapid Earthquake Viewer (REV) (http://rev.seis.sc.edu) starting in 2005. This website ran successfully for over a decade, providing thousands of teachers with images of record sections from major earthquakes (Figure 1).

While REV served its intended purpose well and had a broad user base, the interface became dated in light of modern web browsers and mobile devices. Thus, IRIS EPO has embarked on developing a replacement that includes the functionality of REV. The first phase of this functionality replacement is the development of the Global Seismogram Plotter

Figure 1: Screenshot of the REV website illustrating a record section users could obtain for noteworthy earthquakes.

(GSP). This tool seeks to provide easy access (as little as one mouse click) to teachers and students with little experience in reading seismograms, to record sections containing between 10 and 16 appropriately scaled seismograms per event, with no data drops, "weird" spikes or other noise, and useable both on screen (CPU and tablet-friendly) and in print. GSP will provide data access for two IRIS lessons, http://www.iris.edu/hq/inclass/lesson/16 or http://www.iris.edu/hq/inclass/lesson/174, as well as for other uses by the educational community. The initial design of the GSP (Appendix A) was developed by EPO staff based on their personal experience with the previous site, informal feedback received from teachers and college faculty who used the previous site, and the staff's expertise in developing web interfaces for accessing and using data. However, to further evaluate the design of GSP, an external evaluator was asked to explore this design with a focus group of users of the REV website likely to be future users of GSP.

Methods

To evaluate and refine the design of the GSP, qualitative data was collected from potential users through a focus group. A draft focus group discussion guide was generated from the feature and rationale development criteria (Appendix A). This draft was reviewed both internally by staff and by the external evaluation consultant and modified accordingly to create the final version used in the study (Appendix B). The focus group discussion guide refers to the storyboard presented as a PowerPoint slide show(e.g. slide 1, slide 2, etc.).
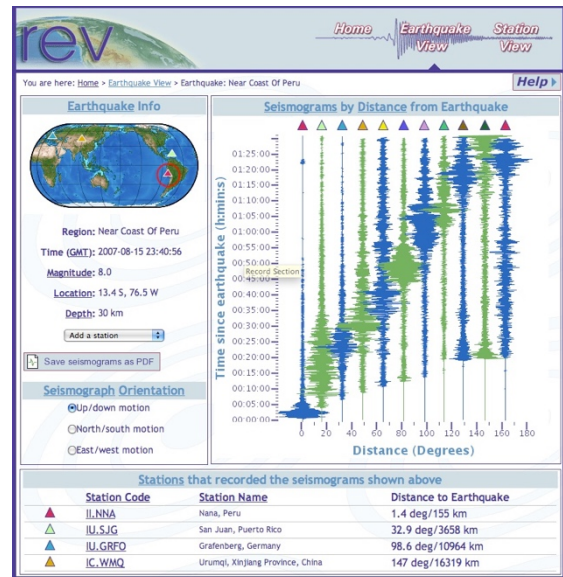
4

Focus group participants were recruited via email from the ESPRIT@LISTSERV.ONEONTA.EDU and earthscience@list.nsta.org listservs, which contain primarily Earth-science teachers. A single solicitation generated 14 responses. Of those, seven met the inclusion criteria of having previously used the Determining and Measuring Earth's Layered Interior lesson (http://www.iris.edu/hq/inclass/lesson/16) and were contacted for potential participation in the group. This inclusion criterion was important because it meant that participants had prior experience using the REV website that the GSP is designed to replace. Five of the seven were able to participate at a common time and date. However, one participant dropped out of the focus group but provided written responses to the interview guide. Thus, the focus group consisted of a Michigan staff developer, an 8th grade teacher from Boulder, CO, and three high school teachers from Annapolis, MD, Bronx, NY, and Chico, CA.

The focus group was conducted virtually using the gotomeeting.com video meeting platform. Both audio and video of the meeting was recorded, and the audio was transcribed by the external evaluator. The transcript was synthesized by the external evaluator using an issue-focused analysis to illustrate both consensus where it emerged (though not required), and alternative ideas also presented.

Results

Below is a summary of the focus group result sorted by broad questions. A transcript of specific responses can be found in Appendix D.

Rapid Earthquake Viewer
Overall, the focus group participants remembered the Rapid Earthquake Viewer well and are glad to have a similar tool coming out soon. The REV allowed them to access seismograms from all over the world, both current and historical, to have students do triangulations. It provided P and S waves, plus a zoom function so you could select first arrival. It illustrated magnitude, time elapsed, and epicenter of an earthquake. They wrote it into their curricula for concepts, such as determining and measuring Earth's structure. They liked that there was some messiness to the data to help students build confidence in using real data. One person found it tricky to pick locations off the globe and suggested it might be better to be able to turn the circles on and off. For improvements to REV, they suggested the following: 1) use a circular globe instead of the Mercator projection – a globe that you could rotate and was transparent, 2) Be able to get three weeks of seismograms instead of two for comparison of quake and aftershocks.

Global Seismogram Plotter – the Name
The word "plotter" seemed problematic to everyone in the group for various reason, such as it reminded them of the machine that plots, didn't include the word "earthquake," didn't capture that the tool is more of a visualizer, a database, or an archive. Most seemed to like "visualizer" followed by analyzer and incorporating the word "earthquake." It could be called something like, "Global Earthquake Visualizer."

Efficiency or Choice?
The educators felt they wanted both because they would use them for different purposes. For example, in the middle of teaching about earthquakes, students could choose their own quakes, or the teacher could go to a recent quake as a teachable moment. Being able to choose their own quakes could be an opportunity to have students to look at different data and discuss what they are finding. With more experience, students might want to be efficient in getting seismograms for a particular region or similar types of quakes to test hypotheses.

Value of Including a Station Near You
All the educators want this an option because it is interesting to students to have data from nearby when a quake is far away. Having data from a nearby station creates a connection through discussions about magnitude, location, and human experience.

Map and Station List
The educators generally liked the map with the seismograms and station list. They did not like the great circles on the flat world projection and wanted to be able to turn them on and off. Some liked the color coding of the stations on the map and seismograms but they thought it probably would not project well or print well enough to actually be useful. They suggested having display choices such as: 1) gray scale, 2) colors, 3) alternating colors (only two, like REV).

Identifying First Arrivals
The educators felt it would be useful to have the first arrivals identified as an option, particularly for teachers without experience reading seismograms. They liked that in the REV you could click on a line and the program would give you a best guess about where the P and S waves were. Although it was not always an accurate guess, it gave the students a check on their own analysis and provided the basis for discussion. They'd like a video tutorial on how to interpret seismograms, zoom in, and identify P and S waves and first arrivals.

Messy Data
All the educators felt that messy data was good. Record sections with dead or noisy traces teaches students about the nature of science and builds their confidence in dealing with raw data. They learn to identify outliers and decide whether to ignore them or deal with them statistically. They learn how to identify sources of messy data, like another kind of disturbance near a seismometer.

Output Options
Printouts might be used when students don't have their own devices. A version that has colors or a grayscale designed to be printed and copied is important. The online option is great if you can get students online because then they can get the additional data. They can measure the data directly and can use it to determine distances and magnitudes.

The Shadow Zone

The shadow zone could be used in a natural disasters course for 12th graders, but probably not in 8th grade. It would be useful to have it as an option after students had noticed the skip and made a model for it, and/or examined the theoretical sphere model. It's important for students to identify the anomaly. Overall, the educators thought it should be an option to turn it on with the default being not showing it.

Overall

The educators liked the GSP and felt it built well on the REV. They would like additional features, such as displaying the stations on a globe that could be rotated and made transparent showing great circles and giving a more accurate picture. They would like to be able to download the map so they don't have to make their own. They would like a photo gallery with pictures or links to pictures for quakes. Expert tutorials were also on the wish list, especially video tutorials their students could use directly. They described GSP as clean, efficient, useful, engaging, and instructive.

Recommendations

Recommendation	Response*
Keep working on the name and get feedback from these and other users	*Accepted - EPO Staff will brainstorm a list of names. We note that the name for the product should not need to be too scientific (not self-revealing to users) but also can't be too generic (buries them in a google search). A short list of names will be offered to beta testers and perhaps social media followers for feedback.*
Develop video tutorials about the content and how to use the tools at a basic level, but then add more advanced ones as needed	*Accepted –* We will include links to existing resources (e.g. http://www.iris.edu/hq/inclass/animation/116) but will ultimately develop a video clip specific for use on the site.
Link to other IRIS resources that provide additional content, activities, and resources such as photos	*Accepted (but modified) – The website will include links to direct users to other IRIS resources. Also, where appropriate we will include links to the Teachable Moments slide sets for individual events.*

Keep all the features being considered but make them options that can be turned on and off, perhaps with subtle or hidden toggles so teachers could use them within their learning sequence	*Accepted (but modified) – To simplify the interface for students we will remove the following functions.*
	     - Stations: Show/Hide
	     - Shadow zone: Show/Hide
	     - Arrivals: Show/Hide
	However, we will maintain these in a second version of the site. Initially these will be an "EPO-user version" but this could become a "teacher" version.

Consider options for display and printing stations that keep the benefit of colors, but accommodate different lighting conditions for projection, and copying degradation. Perhaps consult a graphic designer for options	*Accepted – We will use a spectrum of colors for the traces as the default, but will offer a binary color option for color blind viewers and for B&W printing.*
Make these teacher beta testers when the product is minimally viable. Ask them to write sample lesson plans to put with the GSP as examples for less experienced teachers	*Accepted – As soon as the beta version is ready for testing and feedback we will contact the focus group participants to collect their thoughts and experiences. The sample lesson plans also offer great possibilities if they are willing to invest in creating them.*

*In addition to the responses above, the staff has also decided, to take the following actions in response to the focus group feedback.
- Add a front page (ahead of the map) that accommodates a two path option a) Single Click to record section of latest quake, b) Multiple click path to select your own quake from map
- Continue to use 2D maps for both event selection and station location
- Remove the great circle lines from the map on the record section page and add an icon for the event epicenter
- Explore options to include more events in the database by allowing one or two messy traces in plot while maintaining overall plot integrity

Appendix A – Feature and Rational Matrix

Version 1.3 - August 8, 2017

Goal: To provide easy access (as little as one mouse click), to record sections that contain between 10 and 16 appropriately scaled seismograms per event, with no data drops, weird spikes or other noise, suitable, both on screen (CPU and tablet-friendly) and printable, for the Earth Structure activates designed for middle and high school learners with little experience reading seismograms.

Primary audience: Teachers and students using IRIS activity
http://www.iris.edu/hq/inclass/lesson/16 or http://www.iris.edu/hq/inclass/lesson/174

Page 1 – Entrance Page

Feature	Description	Function
Title	Name of the tool	Self-revealing to tell people what the tool does.
Short description	One or two sentences	Describes what the tool does.
Button = View latest earthquake	Takes you straight to the record section for the latest quake	Allows users to get a record section quickly (e.g. one click) for the latest earthquake
Button = Let me choose an earthquake	Takes users to the map to select an earthquake from those shown.	Allows users to select an earthquake of interest based on magnitude, location, and/or when it occurred.
Link to Activity	Embedded link within the short description.	Opens the Earth Structure within InClass in a new window or tab
Image of record section	A thumbnail of a record section.	Provides users with an example of what a record section is and also links to the latest quake record section if clicked on.
Record section caption	A sentence or two.	Provides users with a simple description of what a record section is (and includes a link to an animation to illustrate)

Page 2- Map

Feature	Description	Function
World Map	Interactive map of the world	Orients users with where earthquakes *available to be plotted* have occurred.
Color of circles on map	Outlines of circles plotted on the map using 3 colors. Color 1 = Most recent	Shows where earthquakes occurred, which earthquakes have occurred within the last two weeks, and which

	earthquakes (past two weeks?) with record section available. Color 2 = Earthquake more than 2 weeks old with record section available.(quakes more than 12 months old will be dropped from the map unless they are M9+) Color 3 = Great earthquakes (M9.0+) with record section available	earthquakes were M9.0.
Diameter of circle will illustrate the magnitude of the quakes	Indicates the magnitude of each earthquake	Allows users to select earthquakes based on magnitudes. Range of magnitude will be between 8.0 and 10.
Navigation	Pan map with grab and pull +/- Symbols on map and mouse wheel for zoom	Provides users with the ability to Zooming to a more regional or local view. Allows users to move the map to locate an earthquake of interest
Hovering mouse over circle	Hovering over a circle provide info via tool tip.	Provides user with info about the quake including location, magnitude, time.
Click on a circle	Opens a dialog box that provides basic details of each earthquake (Mag/Date/Time/Region) and also offers two options to view record sections… Option 1: View record section (takes you straight to the record section) Option 2: View record section with the closest station near me included in the record section (has a space for you to enter your zip code and then takes you to a record section with the closest good station to you included)	Provides users with info on each earthquake shown Provides users with access to the record section for an earthquake, either with or without a station "near" them included in the record section.

Page 3 – Record Section

Feature	Description	Function
Clicking on a trace	Highlights trace and station on map at the bottom of the screen by bouncing it a few times.	Allows users to quickly find the station code matched with each seismogram for the purposes of deleting the trace
Tool tip for traces	Shows time since quake and station location from source at any point on the trace.	Allows users to use their mouse to determine when the first seismic waves arrived at each station to complete the activity online.
Zooming in on trace	Dragging down and releasing zooms in on all the seismograms in the record section (displays less time and distance on screen).	Allows users to more carefully analyze each trace when picking first arrivals.
Triangles at the top of each seismogram.	Clicking shows/hides trace from record section	Allows users to remove stations from the record section if they are "bad" or messy traces
Zoom out on trace	Clicking on "Reset Zoom" on bottom of the page	Allows users to reset their view of the seismograms back to the original.
IRIS Logo	Clicking takes users to IRIS home page Russ does:	Provides users with a path to the "rest" of the IRIS content.
Button = First Arrivals	Shows/hides flags of first arrivals on each seismogram in the record section.	Provides teachers (and potentially students) with a way check/confirm what segment of the seismograms they should select in the activity.
Button = Shadow zone	Shows/hides a flag of the shadow zone region on the record section	Provides teachers (and potentially students) with a way check/confirm where the shadow zone is located. OK
Button = Add station near me	Takes user back to add station via map location/zip code dialog	Allows user to add local station after seeing plot and realizing a local station would be useful
Button = More/Fewer stations	Creates a new plot with smaller or larger station spacing	Allows user to increase or decrease the number of stations to provide more detail or is simpler with few stations to pick.

Title	Name of the event and includes Location/Date/Time/Magnitude of the event	Provides an easy way for users to get the basic information about the earthquake shown on the page (especially important if direct links to the record section are supported).
Button = Print menu	Offers two options. The first generates a print a version of the record section optimized for color printing. The second offers a print a version of the record section optimized for black and white printing.	Provides teachers with an option to have students complete the activity from a hardcopy record section.
Map with triangles for stations	Color-coded triangles match the seismograms.	To visually illustrate where the stations are located.
Hovering over stations on the map"	Highlights that station on the plot above	Allows users to illustrate which trace corresponds to which station.
Concentric rings on map	Symbol for epicenter location	Illustrates on the map where the epicenter was located.
Great Circle lines on map.	Lines on map from each station to the epicenter	Help users visualize the distances to each station from the epicenter".

Appendix B - Focus Group Flow

Collect participants mailing address and we will send a "Thank you" slinky and exploring the earth poster for participation.

1. Introduction
   - Topic and purpose - Discussion of your ideas and opinions on a new tool to provide access to record sections (a plot of seismograms from a single earthquake, but recorded at various distances).
   - Facilitator introduction
     a. Role as researcher to facilitate a discussion
     b. After today's session, you are welcome to ask questions about the evaluation and our discussion
     c. You have been invited because you are an Earth science teacher with experience using record sections in your instruction with the IRIS activity "Determining and Measuring Earth's Layered Interior"
   - Review procedure/rules for focus groups
     a. You should speak freely
     b. Your opinions are important
     c. There are no right or wrong answers; we are interested in both positive and negative comments
     d. Don't worry about building consensus among the group
     e. Don't worry about being on the right track
     f. Please don't talk all at the same time; allow others to speak
   - Note audio recording
     a. Ensures I don't miss important aspects of the conversation.
     b. Data will be confidential and results will be presented anonymously.
     c. Following analysis and final reporting, recordings will be destroyed.

Questions we would like answers to…

Part I – What were the strengths and weakness of REV?
Let's begin with something you all are familiar with… the Rapid Earthquake Viewer or REV
Show the work flow through REV from images (can't show actual site because it is no longer being served) - (**Slides 1 – 4**).
- Describe in a few words what you think REV did?
- What did you like about using REV to access record sections?
- What did you not like about using REV to access record sections?
- What could be improved to make REV, and the output it provided, more useful to you and your students? What is your wish?

Part II – What is in a name?

Since REV is no longer available, IRIS is building a replacement.
The working name for the new product is the Global Seismogram Plotter or GSP **(Slide 5).** As a teacher, is this self-revealing? Why or why not? Do you think the name matters? What suggestions do you have?

Now let's take a look at current mockups.

Part III – Which is preferred, Efficiency vs Choice of Quake
Show **Slide 6**
We are considering two paths to obtain the record sections.
- The first path, #1, would take you directly to the record section for the latest large earthquake in one mouse click **(Slide 7)**
- The second path, #2, requires multiple mouse clicks but would allow you to choose the large earthquake you get the record section for **(Slide 8)**

When getting data to run this activity with your students, which path do you think you might choose to use and why? If the second path, what information or factors would you consider when choosing a quake?

Part IV – Is there value to including "a station near you?" If so, to what degree?
When generating the record section, a station near your location (or some point of interest) could be included, if that location were specified. Depending on where you lived the station might be in your hometown or within a few hundred kilometers.

To what degree would you as the instructor find value in a record section that included a station nearby a specified location (e.g. nearby your hometown)?

To what degree would you think your students would find value in a record section that included a station nearby a specified location (e.g. nearby their hometown)?

Show **Slide 9** after initial discussion and expand discussion

Part V – Does the map and station list make sense to users and do they find it useful? (Slide 10)
Are there connections between the record section plot and the map? If so, what connections do you see? What do you think the colored lines on the map represent? How useful is the map? Why do think this?

Part VI – How much "answer" support do teacher need?
Slide 11 - How confident do you feel about your ability to assist students in identifying the first arrivals on this record section?

Slide 12 - Would it be helpful if the direct first arrivals were flagged on each record section? Are there other things that the tool could provide that would make you more confident?

Part VII – What is teachers' threshold for messy data and how would they handle it?
If you were presented with a record section that had one or more dead or noisy traces in it **(Slide 13),** how problematic would this be for you and your students? Would you edit the plot to remove the bad traces is you could, or would you be more likely to go back a step and select another quake anticipating that it would make it cleaner looking.

Part VIII – Are the output options satisfactory for teacher and student needs?
We intend to offer two output options for the activity.
1) Online **(Slide 14).** Using the mouse students could "detect" the arrival time any point along a seismogram. The mouse over will also provide the distance the station is from the epicenter.
2) Download as (pdf, png, jpeg, etc) for printing. These can be printed **(Slide 15)** in color or black and white

Which of these two output options would you be most likely to use? Why? If you were to use the online option, what strengths and weaknesses do you see for students? Would you use tables or other screens? If you were to use the print options, what strengths and weaknesses do you see for students?

Part IX – Do teachers value the shadow zone flagged on the record section? If so, in what ways and to what degree?
Would you find any value, for you or your students from having the shadow zone flagged on the record section as illustrated? **(Slide 16)**

Part X – Summing it up!
What is your impression of the product? (Use a numeric or favorable scale) What specific features did you see that impressed you or you were excited about? What features (or lack of) disappointed you? What three words would you use to describe the product?

Appendix C – Transcript of focus group responses

PART I – The Rapid Earthquake Viewer or REV (review slides 2-5 to refresh your memory)

1. Describe in a few words what you think REV did?
    *   *The REV allowed me and my students to be able to access seismograms from all over the world and compare them.*
    *   *It allowed me to view seismograms from recent and historical large earthquakes. I would download the record sections and give them to my students to have students do triangulations. I still do that with my students – I have them to do it by hand and then compare it with the computer output.*
    *   *I think the REV was a tool to access records of earthquakes at various time intervals with analytical support by providing P and S waves, allowing zooming so you could select first arrival. I used it for PD, for determining and measuring Earth's structure. Also with triangulation activity. I also wrote it into some of the curriculum that we provided for Earth science teachers.*
    *   *Illustrates magnitude, time elapsed, and epicenter of earthquake. It also showed historical data (like Ring of Fire activity) around Pacific Ocean basin.*

2. What did you like about using REV to access record sections?
    *   *I liked how when you looked at the record, the alternating colors made it easy to distinguish the different stations.*
    *   *I liked that it had a little messiness to it, because you have to make choices about what data to use because I think that builds student confidence over time- the confidence they would need to deal with real data.*
    *   *I liked the zooming feature.*
    *   *I liked that you could download a pdf.*
    *   *Use of seismograms to determine location. Also, differences and that tells us about the internal earth structure to some degree.*

3. What did you <u>not</u> like about using REV to access record sections?
    *   *One thing that was tricky was picking earthquakes off the globe. It might be better to pick a point.*
    *   *I understand the circles show different magnitude, but points would be better.*
    *   *I didn't find anything I didn't like. I never did look at the North Pole or South Pole button.*

4. What could be improved to make REV, and the output it provided, more useful to you and your students? What would you like to see?
    *   *From a visual perspective, the circles are nice, it would be best to be able to turn on and off the circles.*
    *   *It would be nice to have a circular globe that I could actually rotate. There are benefits to a flattened earth, but it would be nice to have a globe.*
    *   *Yes, who wouldn't like that (they all liked this idea)*
    *   *Improvements: check on specifics and get three weeks of seismograms instead of just 2 for comparison of quake and aftershocks.*

PART II - What is in a name?

Since REV is no longer available, IRIS is building a replacement. The working name for the new product is the **Global Seismogram Plotter** or GSP. As a teacher, is this name self-revealing? Why or why not? Do you think the name matters? What suggestions do you have for a name?

- *I think it is self-revealing. It says what it does. The name doesn't not matter to me or my students. What it does and the information available is the focus. The name might include the word "earthquake" for more general audiences. Most know the word earthquake but most aren't familiar with the word seismograph.*
- *Are you plotting? Or are you uploading?*
  I don't like Plotter. Plotter reminds me of a machine. I have an issue with the word.
- *We have a plotter to print things out. If were moving things around, or putting in our own data, maybe plotter would work, but since you are using your data, maybe viewer? Sounds better than REV. I like that we are looking at seismograms.*
- *I like visualizer.*
- *I was thinking database or archive. You could download historical seismograms; it wasn't just current stuff.*
- *Maybe it's a library – Global Seismogram Library (others say that is ok)*
- *I think visualizer is the best since that is a big part of what we do with it. (others agreed that was good option)*
- *Maybe "analyzer"*

PART III - Which is preferred, Efficiency or Choice of Quake

IRIS is considering **two paths** to obtain the record sections. **Slide 9**

   Path #1 - take you directly to the record section for the latest large earthquake in one mouse click.

   Path #2 - requires multiple mouse clicks but would allow you to choose the large earthquake you get the record section for.

When getting data to run this activity with your students, which path do you think you might choose to use and why? If you would choose the **second** path, what information or factors would you consider when choosing a quake?

- *I think it would just depend on what my point was at the time. If I was in the middle of teaching this, and my students had already gone through this, I would probably just choose the latest earthquake. I could bring up the Mexico City earthquake as a teachable moment. But a lot of times, I want my students to choose a location they are interested in.*
- *I would say the same thing. Most of the time when I'm students deal with real time data like this, I don't want all the kids looking at the same things, so I will tell the kids to choose something they thought was interesting.*
- *I also think that with more experience, students would gravitate toward being more efficient. The graphical interface builds their visualizing skills and curiosity. The more data you can use, the better the model gets developed. A single record is too limited, it leads to a sparse model. Students could ask, "Where do I want more records? What kind of earthquake might produce that?" I think this might cause them to think strategically and look visually at the globe and think about size and location, or famous earthquakes, or obscure ones. That's one of the cool things about it, if you build that model from earthquakes all over the globe, it's still the same model. So, I would go for the visual one first for those reasons.*
- *I would use the latest earthquake data for classroom purposes, while my students would choose an earthquake pathway. Historical earthquakes, depths, seismograms-it's all there.*

PART IV - Is there value to including "a station near you?" If so, to what degree?
When generating the record section, a station near your location (or some point of interest) could be included, if that location were specified. Depending on where you lived the station might be in your hometown or within a few hundred kilometers. **Slide 13**

To what degree would you as the instructor find that valuable? Please explain. To what degree would you think your students would find that valuable? Please explain.
- *If we're just saying we want it as an option, yes, it's an interesting thing. Having a nearby station identified, makes a different sort of connection for them, regardless of where the earthquake is. It could be interesting.*
- *I think it's a good thing to include. Not include it all the time, but better to have it than not.*
- *I think it would be curious to kids. Being in the Midwest, kids don't have a much of a relationship to earthquakes, so the idea that there could be a station nearby that could pick up and an earthquake in Mexico City and somehow contribute the analysis model – it's kind of bewildering, "What do you mean, that's get all the way over here!"*
- *It builds in relevancy for the kids as something local being part of a global network, it's that appreciation and awe, "Wow, right near us is this data that matters!" It builds in relevancy for them and increases appreciation for their studies.*
- *I think it's valuable. Most earthquakes nearby are not felt here, so there is a connection between magnitude, location, and human experience. It's interesting for students to have real data to verify their own personal experience.*

Part V - Does the map and station list make sense to you and your students? Do you find it useful?
Are there connections between the record section plot and the map? YES, NO If so, what connections do you see? What do you think the colored lines on the map represent? How useful is the map? Why do think it is useful or not so useful? What would make it more useful?
- *If I wanted to have my students understand distance, I would like them to see the great circles on a globe rather than having them try to figure out an additional level of information about why that line is curved.*
- *Because then you are almost looking at a ground trace of a satellite orbiting the Earth and it's hard to pull that 3D information out of a 2D map. To see the connection around the globe or through it, is very meaningful. Like in Earthquake Browser, seeing through 3D views is great.*
- *I don't see what the great circles contribute here, and imposing them on a Mercator projection here is confusing. If a globe is too difficult, then maybe the wedge view. What is the value added here?*
- *I would want to see the great circles at a visual distance, like 4000 miles away, I'd want them.*
- *The first time I saw it, I thought it would be confusing – students might think it was the path of the earthquake took to the station.*
- *I see the color coding of the stations, but I liked the greed and blue on the REV. Some of the lines are more dominant than others… I guess it's better than coding them, like SR3.*
- *I like the colors*
- *Me too – that they match the stations. But maybe be able to toggle it because on a projector in your room with a lot of light would make some of the colors hard to see.*
- *I think the colors make the connection between the map and the plot – toggling would be best.*
- *That might be a problem too for printing.*

- *Yes, there are connections. You can see distances from epicenter to station, also least distance path or Great Circle distance. Because shows not just distances, but infers what is in the middle of earth as well.*

Part VI – How much "answer" support do you want or need?

How confident do you feel about your ability to assist students in identifying the first arrivals on this record section? (Not at all confident, Somewhat, Confident, Very confident, Extremely confident) Would it be helpful if the direct first arrivals were flagged on each record section? Are there other things that the tool could provide that would make you more confident?

- *I work with teachers who don't have a lot of Earth science background. Because it's real data, it's not always clear what it is, so I teach some seismology here. Look at those P waves where you think they should be S waves. In the REV, you would click on a line, and the program would make a best guess about where the P and the S waves were, and that was super helpful. It didn't always guess well. As an option, it would be helpful for teachers and students.*
- *I agree it would be helpful as an option for teachers who don't have the experience reading seismograms.*
- *I would agree, I'm a meteorologist by training, so the first seismogram I saw was when I was teaching it. It would depend on the situation. Sometimes, I'd have kids try to figure out what they thought was going on before they saw the answer. At other times, I'd want to give them to labels to get the ambiguity out of the way to make sure that your data is a little bit more accurate.*
- *I would always present the REV, with there is the option of having the computer model guess P and S wave locations. I would use the fact that it wasn't always accurate to my advantage by saying to my students, "Hey, you're training to be a seismologist, so you need to be as accurate as possible. You take your measurements first, then turn that on and see how accurate you were." It gave them a boost in confidence if they chose the right area.*
- *The default should be to NOT have them on. Should have zoom in feature that lays out a station horizontally so you could see the time scale, looking one at time (in REV). Would it be possible to take a few cases, and have a video tutorial on how to interpret them? Get Michael Humbenthal or somebody, give a how to on how to zoom in and how we simplify things, but you can look at the complicated vibrations that are reflecting and refracting off of features, and they make things really messy. In determining the Earth's interior, students have to select the most accurate arrival times they can, and if they aren't confident, they won't be able to select one.*
- *This is first arrival of P waves, could there also be arrival times in S waves? The first arrival of P waves can be difficult enough to identify. If you are looking at S and surface waves, it can get confusing. If you trying to do triangulation, you need that difference to be as easily identifiable as possible. Being able to find that next one – that's really difficult. (others agree since they are all using it for triangulation).*
- *I feel somewhat confident. I think the first arrival info is very helpful. Students might also benefit by having markers on PP and S waves, or the option to turn them on or off.*

Part VII – What is your threshold for messy data and how would you handle it?

If you were presented with a record section that had one or more dead or noisy traces in it, how problematic would this be for you and your students? Would you edit the plot to remove the bad traces if you could **OR** would you be more likely to go back a step and select another quake anticipating that it would look cleaner? (remove bad traces, go back a step and select another quake). Please explain.

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- *No, I think having messy data is the nature of science. Having those bad traces in there creates another point of discussion. What's bad about it? What's your problem with it?*
- *I would second that. Leave that mess in there.*
- *If something is an outlier, should you ignore it, or deal with it statistically? That's a question across the sciences.*
- *I had a seismologist once say that the gain might have been turned up on the seismometer. Maybe the instrument is next to a railroad. Some video or a help menu, tutorials with more background on these concepts would be really helpful here.*
- *I teach my students to look at patterns in any dataset. They look at the trace as well the pattern they see, so they would observe at least two noisy traces. I would remove the bad traces. Many quakes will have some noise. I expect it. SO, to look for another quake that might be cleaner doesn't take this into account. There might not be any quakes that are "clean." Noise is something that is real and I think it is better to learn how to work with it.*

Part VIII – Are the output options satisfactory for teacher and student needs?

IRIS intends to offer **two output options** for the activity:
Option 1: Online - Using the mouse students could "detect" the arrival time any point along a seismogram. The mouse over will also provide the distance the station is from the epicenter.
Option 2: Download as (pdf, png, jpeg, etc) for printing. These can be printed in color or black and white.

Which of these two output options would you be most likely to use? Why? If you were to use the online option, what strengths and weaknesses do you see for students? Would you use tables or other screens? If so, how? If you were to use the print options, what strengths and weaknesses do you see for students?
- *My experience is that some schools don't have access for each student to online resources so they would use printouts. Both options are necessary. Most wouldn't print them if they didn't have to.*
- *With the shades of gray, it would be better alternating since some of those lighter shades might not show up. The copier would wash out the lighter colors too.*
- *Without the globe, those colors don't make sense so just go with alternating colors.*
- *I would love to be able to download the map and the seismograms. I create my own map so a download would probably be more accurate.*
- *I would use the online option more often for me and my classes. It tells what we want to know about each seismic event. It displays the time lag, and amplitude to help with magnitude and epicenter location. IT gives more information-students don't need to figure out those things but they could with download version. I would have students determine those things outlined in #2 directly above. They can work directly on it. They can measure the data directly and can use it to determine distances and magnitudes. It does require that the student have more skills than the online version.*

Part IX – Would you value the shadow zone flagged on the record section? If so, in what ways and to what degree?

Would you find any value, for you or your students from having the shadow zone flagged on the record section as illustrated? Why or why not?
- *It would depend on the level. 12th grade natural disaster course would look at the shadow zone. At 8th grade, not so important.*

- *I think it's better to have it than not. Best to be able to turn it on and off. Probably I would use it for discussions about what's the shadow zone, here's what it looks like, where it is, and why it exists.*
- *For determining and measuring Earth's interior structure, the shadow zone is the discovery they make when they look at the skip in the seismological model and compare it to the homogeneous theoretical sphere model. That skip has to be noticed and interpreted. You want students to have this discussion over where the real data matches the theoretical model. If you do enough study, the skip shows up. There's something slowing down the seismic wave – the core. They make a new physical model and create a wedge where the skip is. I wouldn't want it to be a default or a distraction. In that activity, you want them to make sense of the two lines that are distinctly different. (others agreed)*
- *No, it's important for the data to show an "anomaly". Students ask the question, "why are they different", that leads to use of IRIS's "Determining Earth's Layered Interior" activity because students asked about it. Plus, it's important to keep the data "real" and not cleaned up.*

Part X – Summing it up!
1. What three words would you use to describe the product?
   - *It's about time!*
   - *Clean, efficient, useful*
   - *Thank you! I'm happening that this is happening.*
   - *Yay it's back*
   - *Helpful, engaging, instructive*

2. What is your overall impression of the product?
   Not very good   Okay   Pretty good   Very good=1   **Excellent=4**

3. What specific features did you see that impressed you or you were excited about?
   - *There are things that I liked about the REV: accessed an archive and I had control of what seismograms would be presented.*
   - *Flagging the times of first arrival for P, S and surface waves*
   - *I like the color coding of the lines to the stations*
   - *I like the layout, the use of comparisons of graphs or pictures on one PowerPoint slide, useful information in a popup, markers to help wade through the less-than-textbook data, and the choice to observe earthquakes.*

4. What features (or lack of) disappointed you?
   - *None-it's more build-on what was a good starting point (the REV)*
   - *I want a sphere, instead of the Mercator projection map (all want it)*
   - *In REV, you could click on a single record and it came up horizontally and you could zoom in on it to look at the nature of the wiggles.*
   - *When you are looking at the distance seismograms, and you want to see the times, could the time illuminate to the vertical axis, or pop up to get a precise time.*
   - *Love to see the S waves like in REV – but make it transparent how it was done*
   - *Depending on style of map you have for the locations of the stations, if it is a 2D projection, I would love to be able to download that.*
   - *I think some tutorial stuff - some things in the Earthquake Browser were inspired by Alan Jones' seismic waves. One of the things that was great about that was the help menu which was like an*

encyclopedia. It had content. I think there is an opportunity to bundle that in here with animations with video tutorials with basic seismogram tutorial.

- *What about a photo gallery? USGS or National Geophysical Data Center had 3 CD ROMS with thousands of images from all over. It was public domain. It was a way to seeing more, but I also realize that it might overlap with other parts of IRIS. Too many functions can overwhelm teachers and students. In some states, there are not enough Earth science teachers, so Earth science classes are being assigned to teachers trained in other disciplines. There is big need for helping teachers with a tool like this that is for them rather than seismologists.*