**Lesson:** "Graphing Sea-Level Trends"

https://www.jpl.nasa.gov/edu/teach/activity/graphing-sea-level-trends/

**Lesson Description**

This lesson has students use spread sheets to graph sea level trends and create trend lines for six year time spans of sea level data from 1880-2011. All of the data is included and segmented for student use, a guiding worksheet is included, and clear instructions are given on how to use these data sets with both Microsoft Excel and Google Sheets. After students have examined trend lines for the smaller six year data sets, then a trend line for the composite data set from 1880-2011 can be created.

**Student Artifacts**

**Guided recording and analysis sheet provided by the NASA lesson**

What year and month does your data set begin? June 1886

What year and month does your data set end? Nov. 1892

What is the global mean sea level (GMSL) at the beginning of your data set? -139.2

At the end? 150.1

What is the difference? 10.9

What does the GMSL indicate is happening to sea level across the span of your data?

its never consistent

•starts higher, drops, then raises then drops again

Add a trendline to your data. Does the trendline agree with your visual assessment of the data? If there is a discrepancy, why do you think that is?

It is pretty accurate, but it does not have, the drops, it just expects that it will consistently go up

How does your data set compare to the complete 130-year data set? Does your data set show the same trend as the long-term trend? If not, why do you think it is different?

They both have high points and points when they drop, but not as drastic in ours

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What year and month does your data set begin? 1945

What year and month does your data set end? 1951

What is the global mean sea level (GMSL) at the beginning of your data set? -82.7

At the end? -54.2

What is the difference? 28.5

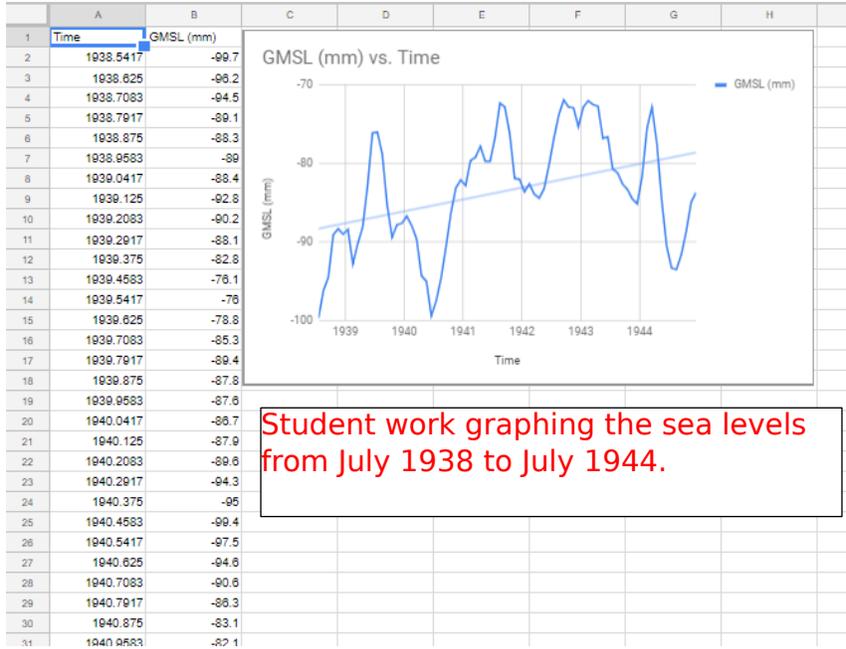What does the GMSL indicate is happening to sea level across the span of your data?

it's rising, it peaks and then falls, it slowly works it's way back up

Add a trendline to your data. Does the trendline agree with your visual assessment of the data? If there is a discrepancy, why do you think that is?
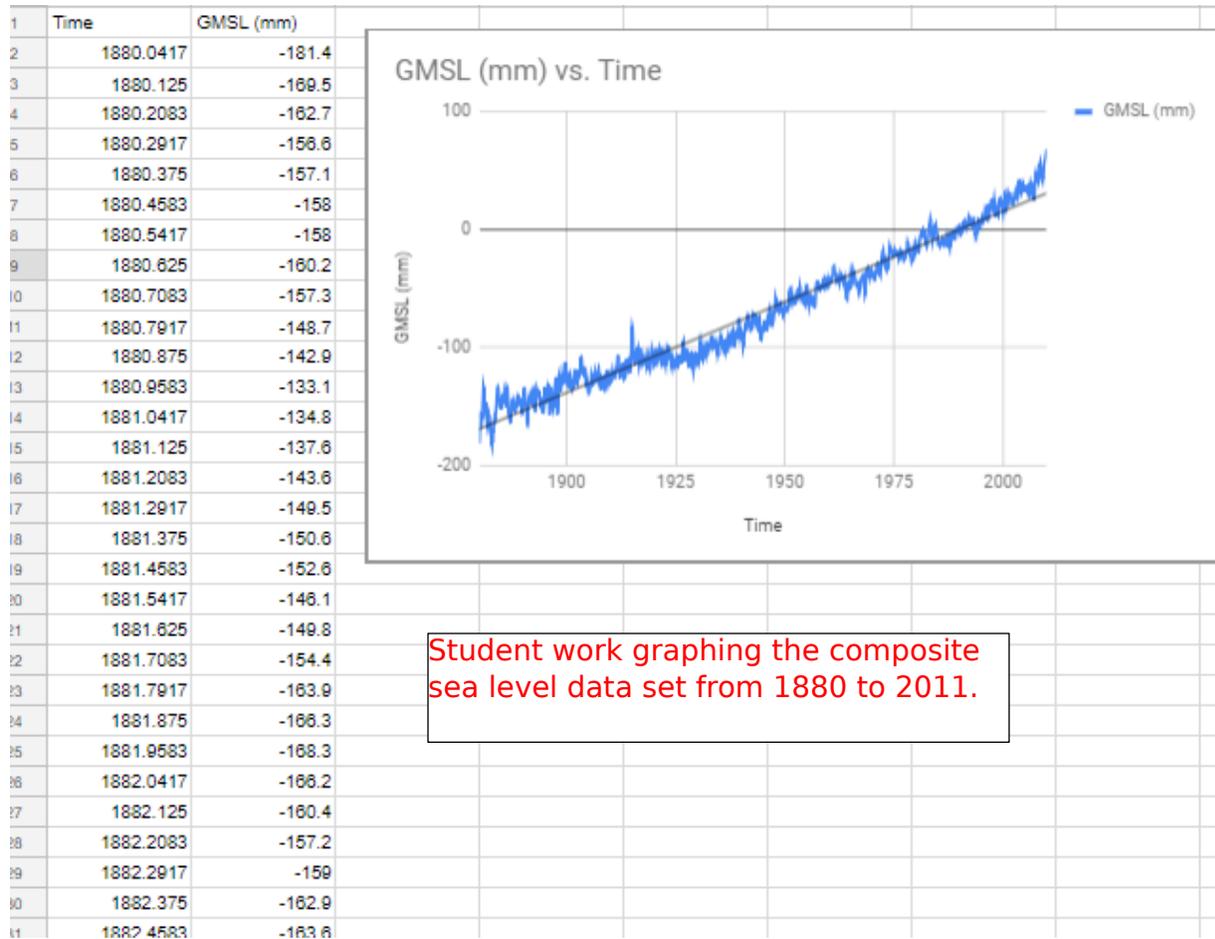
yes, but the data isn't constantly rising

How does your data set compare to the complete 130-year data set? Does your data set show the same trend as the long-term trend? If not, why do you think it is different?

yes, because it starts and ends above the trend line but the middle is below. Yes, they both rise slowly

## First spreadsheet

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Time | GMSL (mm) | | | | | | |
| 2 | 1938.5417 | -99.7 | | | | | | |
| 3 | 1938.625 | -96.2 | | | | | | |
| 4 | 1938.7083 | -94.5 | | | | | | |
| 5 | 1938.7917 | -89.1 | | | | | | |
| 6 | 1938.875 | -88.3 | | | | | | |
| 7 | 1938.9583 | -89 | | | | | | |
| 8 | 1939.0417 | -88.4 | | | | | | |
| 9 | 1939.125 | -92.8 | | | | | | |
| 10 | 1939.2083 | -90.2 | | | | | | |
| 11 | 1939.2917 | -88.1 | | | | | | |
| 12 | 1939.375 | -82.8 | | | | | | |
| 13 | 1939.4583 | -76.1 | | | | | | |
| 14 | 1939.5417 | -76 | | | | | | |
| 15 | 1939.625 | -78.8 | | | | | | |
| 16 | 1939.7083 | -85.3 | | | | | | |
| 17 | 1939.7917 | -89.4 | | | | | | |
| 18 | 1939.875 | -87.8 | | | | | | |
| 19 | 1939.9583 | -87.6 | | | | | | |
| 20 | 1940.0417 | -86.7 | | | | | | |
| 21 | 1940.125 | -87.9 | | | | | | |
| 22 | 1940.2083 | -89.6 | | | | | | |
| 23 | 1940.2917 | -94.3 | | | | | | |
| 24 | 1940.375 | -95 | | | | | | |
| 25 | 1940.4583 | -99.4 | | | | | | |
| 26 | 1940.5417 | -97.5 | | | | | | |
| 27 | 1940.625 | -94.6 | | | | | | |
| 28 | 1940.7083 | -90.6 | | | | | | |
| 29 | 1940.7917 | -86.3 | | | | | | |
| 30 | 1940.875 | -83.1 | | | | | | |
| 31 | 1940.9583 | -82.1 | | | | | | |



GMSL (mm) vs. Time

Student work graphing the sea levels from July 1938 to July 1944.

## Second spreadsheet

| | Time | GMSL (mm) |
|---|---|---|
| 1 | Time | GMSL (mm) |
| 2 | 1880.0417 | -181.4 |
| 3 | 1880.125 | -169.5 |
| 4 | 1880.2083 | -162.7 |
| 5 | 1880.2917 | -156.6 |
| 6 | 1880.375 | -157.1 |
| 7 | 1880.4583 | -158 |
| 8 | 1880.5417 | -158 |
| 9 | 1880.625 | -160.2 |
| 10 | 1880.7083 | -157.3 |
| 11 | 1880.7917 | -148.7 |
| 12 | 1880.875 | -142.9 |
| 13 | 1880.9583 | -133.1 |
| 14 | 1881.0417 | -134.8 |
| 15 | 1881.125 | -137.6 |
| 16 | 1881.2083 | -143.6 |
| 17 | 1881.2917 | -149.5 |
| 18 | 1881.375 | -150.6 |
| 19 | 1881.4583 | -152.6 |
| 20 | 1881.5417 | -146.1 |
| 21 | 1881.625 | -149.8 |
| 22 | 1881.7083 | -154.4 |
| 23 | 1881.7917 | -163.9 |
| 24 | 1881.875 | -166.3 |
| 25 | 1881.9583 | -168.3 |
| 26 | 1882.0417 | -166.2 |
| 27 | 1882.125 | -160.4 |
| 28 | 1882.2083 | -157.2 |
| 29 | 1882.2917 | -159 |
| 30 | 1882.375 | -162.9 |
| 31 | 1882.4583 | -163.6 |



GMSL (mm) vs. Time

Student work graphing the composite sea level data set from 1880 to 2011.

## <u>Summary of Experience</u>

This lesson was delivered in an 11<sup>th</sup> grade Algebra 2 course after the completion of a lesson on developing linear, quadratic, and exponential regression models.  I was very pleased with how easy it was to share this lesson with my students with minimal modification needed on my part.  We began the lesson with a brief discussion about what students knew about sea levels and tides.  As a math teacher it was very fun to hear what students have learned in previous science courses.  It was also eye opening to see how many of my students had misconceptions about tides.  Being that I teach in Minnesota, this is an understandable gap in knowledge because students do not have personal experience with tides unless they have visited the ocean.

After our introductory discussion we practiced finding which year and month the data sets ended on and then students worked in partners to graph the data sets and create trend lines.  I teach in a 1:1 Chromebook school so I had posted the data sets in Google Classroom for students to access.  Unfortunately, we had a brief technological difficulty with trying to get the data to copy and paste from the NASA file format into Google Sheets.  Thankfully, with the brain power of the class, we were quickly able to resolve this issue and the lesson got back on track.  Students spent the majority of the class graphing their data sets, completing their guided worksheet, and then graphing the composite 130 year data set.

Almost all students were surprised to see the drastic differences in the six year data sets when compared with the 130 year data set.  Within the six year data sets sometimes no trend was clearly visible, or a negative trend was visible.  At the end of the lesson when students graphed the 130 year data set, it was entertaining to see and hear surprised exclamations of how clearly the data showed that sea levels have indeed been rising for the last 130 years and how different the graph looked in comparison to the smaller data sets.  From a mathematical perspective this

generated an excellent discussion on how important it is to critically analyze the way data is presented as well as the data that is being presented.  Does the data actually show what the author wants it to, or is its appearance being manipulated?

One of the largest challenges I always encounter with using authentic data in my classes is that students often feel overwhelmed with its complexity.  One aspect I very much appreciated about this lesson is that the data was scaffolded into manageable pieces, and clear directions, written at the level of the student, were given on how to interpret and analyze the data.  To be honest, this is the first NASA lesson I have used where the authentic data has been accessible to my students without me needing to significantly scaffold or modify.

My only suggestion for improvement would be to add some more scaffolding or directions to the guided worksheet.  Students struggled with calculating the year and month that the data set began and having an example of that process on the worksheet as a quick reference would have been helpful for them.  It may also have been helpful to have some key bullet pointed information about GMSL at the top of the worksheet.  We did discuss this as a class, but many students forgot key parts because we did not take formal notes.  Overall, this lesson was very easy to follow and implement!