Logbook for Applied Science Project, 2024-2025:

A Comparison Study of the Regional Impacts of Extreme El Niño Events on Human Societies in India and Peru in the 1788-1793 and 1982-1983 Episodes

By Eleanor Shen

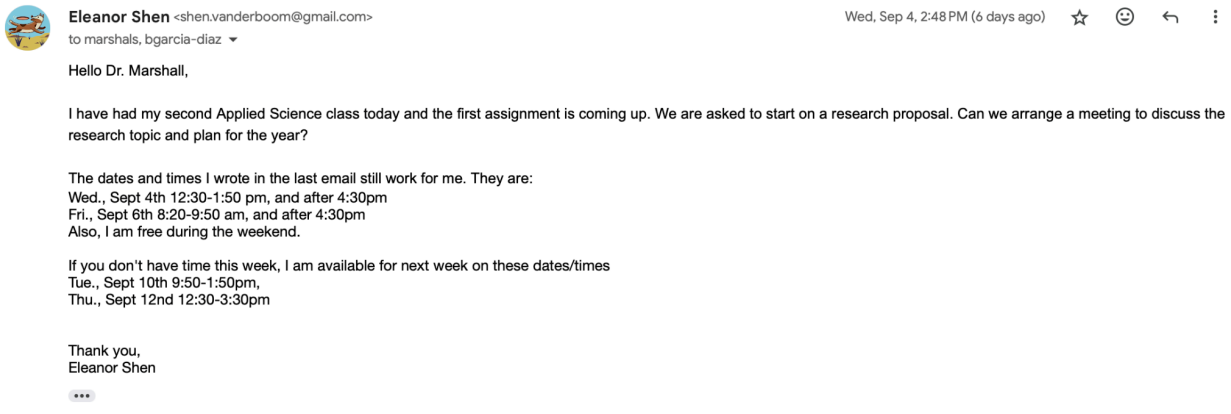
September

September 4, 2024

Lecture notes (90 min)

- Communication with the mentor:
    - Project ideas, narrow down to a research question
    - Meeting time (schedule)
    - Research Proposal, show the guideline to the mentor during meeting
- Assignment #1: Research Proposal
    - Posted in Google Classroom
    - No variables for my project
    - Ideal situation: Finished by Mid-Oct
- Learning Literature Searching Tools
    - Paperpile: organizing tool, citation in Google docs(citation styles mentioned)
    - Google Scholar, find some websites for history journals
- Logbook Form and Evaluation
    - Different tools: notions, physical notebooks and Google docs
    - Organization/Content/Calendar
    - Be specific, set tasks and due dates, update things

- An email to my mentor to schedule the first meeting



Eleanor Shen <shen.vanderboom@gmail.com> Wed, Sep 4, 2:48 PM (6 days ago)
to marshals, bgarcia-diaz

Hello Dr. Marshall,

I have had my second Applied Science class today and the first assignment is coming up. We are asked to start on a research proposal. Can we arrange a meeting to discuss the research topic and plan for the year?

The dates and times I wrote in the last email still work for me. They are:
Wed., Sept 4th 12:30-1:50 pm, and after 4:30pm
Fri., Sept 6th 8:20-9:50 am, and after 4:30pm
Also, I am free during the weekend.

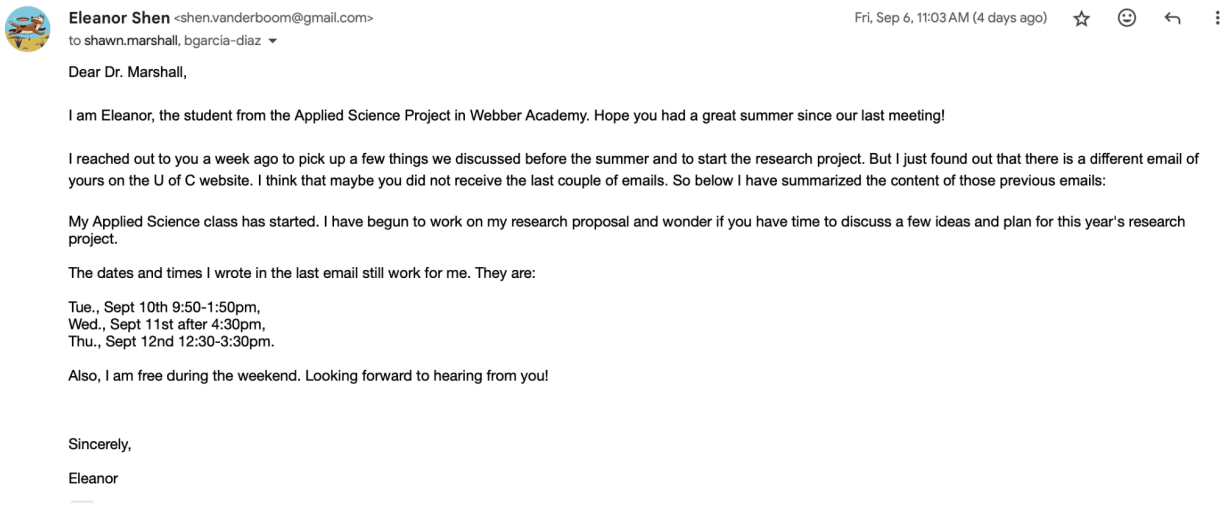
If you don't have time this week, I am available for next week on these dates/times
Tue., Sept 10th 9:50-1:50pm,
Thu., Sept 12nd 12:30-3:30pm

Thank you,
Eleanor Shen

September 6, 2024

- [x] ~~Set up and update my logbook (50 min)~~
  Decided to use Google docs, created an outline, filled in some daily notes and calendar
- [x] ~~Browse in Google Scholars to find potential project topics(20 min)~~

- [x] ~~Write another email to my mentor to schedule a meeting(10 min)~~



Eleanor Shen <shen.vanderboom@gmail.com>
to shawn.marshall, bgarcia-diaz

Fri, Sep 6, 11:03 AM (4 days ago)

Dear Dr. Marshall,

I am Eleanor, the student from the Applied Science Project in Webber Academy. Hope you had a great summer since our last meeting!

I reached out to you a week ago to pick up a few things we discussed before the summer and to start the research project. But I just found out that there is a different email of yours on the U of C website. I think that maybe you did not receive the last couple of emails. So below I have summarized the content of those previous emails:

My Applied Science class has started. I have begun to work on my research proposal and wonder if you have time to discuss a few ideas and plan for this year's research project.

The dates and times I wrote in the last email still work for me. They are:

Tue., Sept 10th 9:50-1:50pm,
Wed., Sept 11st after 4:30pm,
Thu., Sept 12nd 12:30-3:30pm.

Also, I am free during the weekend. Looking forward to hearing from you!

Sincerely,

Eleanor

- [x] ~~Decide annotation tool: digital or printed (10 min)~~

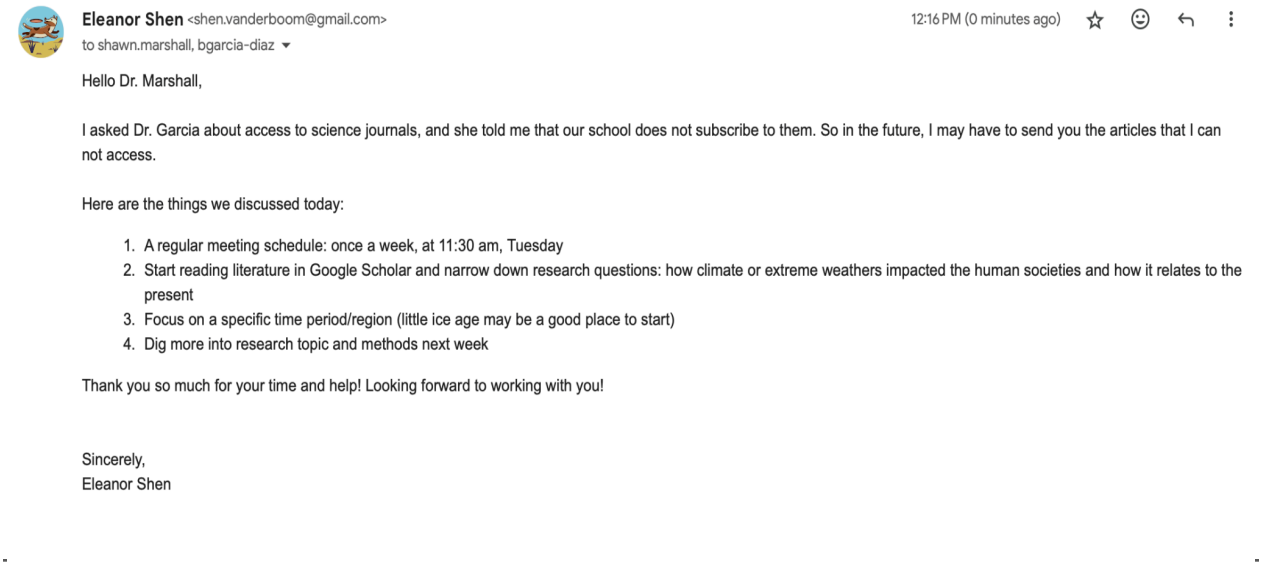
September 10, 2024

- [x] ~~Meeting with mentor(30 min)~~

Things to discuss with my mentor:

- A stable schedule to meet; or just the date for next two or three meetings
- Mention the research proposal: A topic, background research, objectives and ideology
- Assign some literature for me to read so that I can narrow down my research question

☑ ~~Write a summary of the meeting (10 min)~~



Eleanor Shen <shen.vanderboom@gmail.com> 12:16 PM (0 minutes ago)
to shawn.marshall, bgarcia-diaz

Hello Dr. Marshall,

I asked Dr. Garcia about access to science journals, and she told me that our school does not subscribe to them. So in the future, I may have to send you the articles that I can not access.

Here are the things we discussed today:

1. A regular meeting schedule: once a week, at 11:30 am, Tuesday
2. Start reading literature in Google Scholar and narrow down research questions: how climate or extreme weathers impacted the human societies and how it relates to the present
3. Focus on a specific time period/region (little ice age may be a good place to start)
4. Dig more into research topic and methods next week

Thank you so much for your time and help! Looking forward to working with you!

Sincerely,
Eleanor Shen

Meeting Summary

1. A regular meeting schedule: **once a week, at 11:30 am, Tuesday**
2. Start reading literature in Google Scholar and narrow down research questions: how climate or extreme weathers impacted the human societies and how it relates to the present
3. Focus on a specific time period/region (little ice age may be a good place to start)
4. Dig more into research topic and methods next week
5. Email to contact with mentor: **shawn.marshall@ec.gc.ca**

☑ ~~Working on the calendars in the logbook (20 min)~~
☑ ~~Decide annotation tool: digital or printed (10 min)~~

- Registered Paperpile

September 12, 2024

☑ ~~Browse for potential research topics and arrange literatures in paperpile and take notes(20 min)~~
☑ ~~Enter entry for the logbook(10 min)~~

- [x] ~~Read Literature and take notes: Improving Societal Outcomes of Extreme Weather in a Changing Climate: An Integrated Perspective, **How climate change impacted the collapse of the Ming dynasty** (50 min) See in the background research~~

- Started with the Little Ice Age that Dr. Marshall suggested
    - Better to find a case study rather than a very broad comparison
    - The collapse of the Ming Dynasty (History and climate related) https://app.paperpile.com/my-library/all

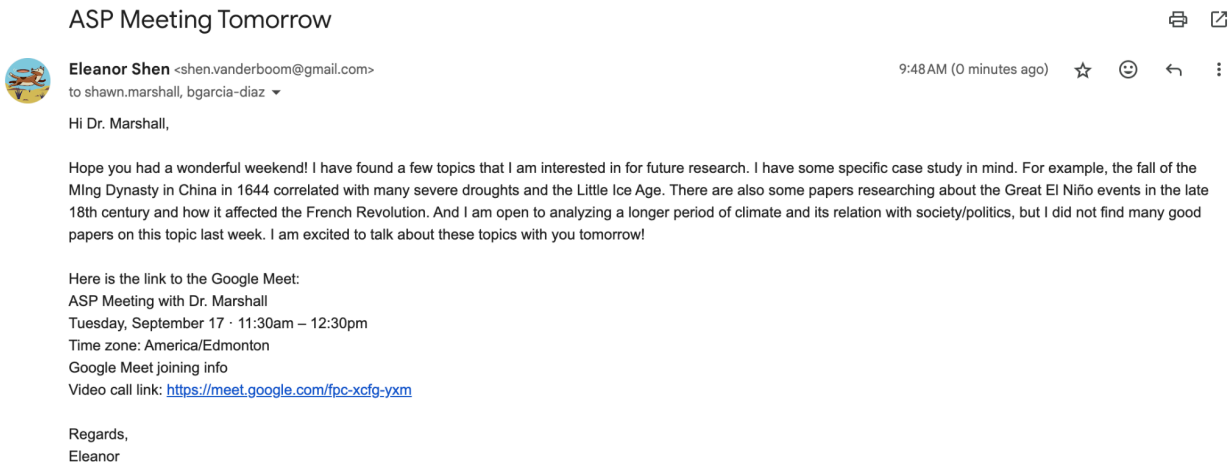
September 16, 2024

Class notes(60 min)

- Try to insert and format citation using paperpile in google docs
- https://owl.purdue.edu/owl/research_and_citation/conducting_research/index.html this website for information about citation
- Research Proposal: No Variable and Hypothesis. Introduction: Background Research/literature review

- Continued reading the literature of the collapse of the Ming Dynasty and read another general paper about how climate change impacts economy(20 min)
    - See in the background research

- An email invitation to my mentor(10 min)



ASP Meeting Tomorrow

Eleanor Shen <shen.vanderboom@gmail.com> 9:48 AM (0 minutes ago)
to shawn.marshall, bgarcia-diaz

Hi Dr. Marshall,

Hope you had a wonderful weekend! I have found a few topics that I am interested in for future research. I have some specific case study in mind. For example, the fall of the MIng Dynasty in China in 1644 correlated with many severe droughts and the Little Ice Age. There are also some papers researching about the Great El Niño events in the late 18th century and how it affected the French Revolution. And I am open to analyzing a longer period of climate and its relation with society/politics, but I did not find many good papers on this topic last week. I am excited to talk about these topics with you tomorrow!

Here is the link to the Google Meet:
ASP Meeting with Dr. Marshall
Tuesday, September 17 · 11:30am – 12:30pm
Time zone: America/Edmonton
Google Meet joining info
Video call link: https://meet.google.com/fpc-xcfg-yxm

Regards,
Eleanor

September 18, 2024

- A plan for potential meeting this week to **narrow down the research question**
    - An idea: comparative study of whether the economy and social stability is more resistant to climate change(Is it viable?)
    - Case Studies (requires more historical analysis)
        - El niño events (1789-93) in history (Global impact or specific regions)
        - The dynastic change in Chinese history and how they coincide with climate change: the collapse of the Ming Dynasty with the Little Ice Age and droughts
- Browsing, reading, and taking notes about literatures for research topics (see in the background research)
- Read literature and take notes: **The Great El Niño of 1789–93 and its global consequences: Reconstructing an extreme climate event in world environmental history**

September 20, 2024 (sick)

September 24, 2024

- Edit logbook, create tasks for every ASP class and Assignment checklist (20 min)
- Prepare for meeting with mentor (10 min)
    - Reviewing the background research notes and plan for the discussion during the meeting
- Biweekly check with Dr. Garcia(15 min):
    - Add more reading notes and tasks to calendar
- Meeting with mentor(30 min):
    - Discussion about potential research topics
    - A case study about the dynastic change in China in the mid-17th century: it coincided with the Little Ice age
    - A comparison between the impacts of extreme weather events in pre-industrial societies and industrial societies
    - Extreme weather events: droughts and floods probably have more historical evidence; temperature and precipitation change are more measurable to compare; El niño events have many data and are comparable
    - Hopefully start to write introduction this week

September 26, 2024

- Reading book chapters sent from my mentor(50 min)

    - Know better about the formation and effects of El Niños, looking for potential events to compare in my research questions
    - See in the Background Research
    - https://app.paperpile.com/my-library/Fagan-2009-pteFBOkg1AsyJLzXBHQIA2A
- Start writing an introduction for the research proposal (40 min)
    - Part 1: How climate change shapes society and its importance

September 30, 2024

- Write Introduction Part 1, Part 2, and objectives for the research proposal(90 min)

October

October 1, 2024

- Meeting with the mentor
    - Questions about how detailed I need to write for an introduction
    - A discussion of a rough methodology
    - Ask for more data about the 1789 El Niño
    - Ask for the paper that I don't have access for

    https://agupubs.onlinelibrary.wiley.com/doi/10.1002/9781119548164.ch16
    https://direct.mit.edu/books/edited-volume/1888/chapter-abstract/51991/Revolutionary-Weather-The-Climatic-and-Economic?redirectedFrom=fulltext

Meeting Summary:

1. Find more data about the magnitude of 1789 El Niño events to justify the comparative study between the 1789 and 1982 El Niño episodes
2. Introduction: to introduce some basic facts about El Niño events and how it affects climate, the importance and comparability of the 1789 and 1982 El niño events
3. General methodology: Use some potential ice core data to reconstruct the 1789 El Niño events, and find historical evidence(or data if possible) about the crop yield, grain price, and population records during the late 18th century.
4. Continue to read literature and write the research proposal this week

October 2, 2024

Class Notes (60 min)

- Logbook
    - Practice this month; use it to reflect and improve
- By the end of the week, write out research question, goals, ans an outline for introduction and show it to the mentor
- No variable and hypothesis, so marked out of 80
- Right now, in general terms, what's the method for the research?
- The significance of the study. Why are you doing it? How can your work contribute to the field of study?
- Always cite the first source and don't start Writing without citation

☑ ~~**Write out the research question and objectives in the research proposal and send to Dr. Garcia for feedback (30 min)**~~

October 4, 2024

- Class lecture on Notion and Google docs logbook(30 min)

☑ ~~**Read literature about general El Nino events and the specific 1788 El Niño to prepare for my introduction(60 min) See in the Background research**~~

- **A comparison of proxy records of El Nino/Southern Oscillation**

October 7, 2024

☑ ~~**Finish Part 2 and Part 3 introduction in the research proposal (90 min)**~~

October 8, 2024

Class notes(40 min):

- Long Range Plane till March 11(SCHOOL SCIENCE FAIR)
    - Work with mentors on long range plan
- CYSF online portal
    - Will be invited to online portal CYSF
        - Close on March 28
- If you get top 15 projects and are going to city science, the date is April 10-12
- Oral Presentation near end of February
    - Few class assignments will be due during February (research paper)

- [x] ~~Paperpile citation (Prieto and García Herrera 2009) (10 min)~~

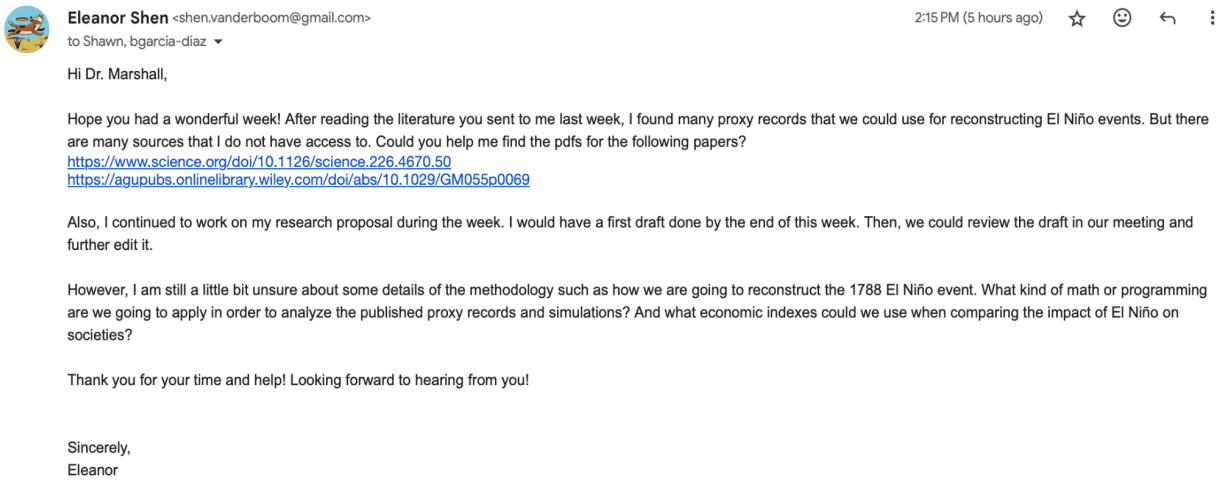
Network error contacting Google Apps Script Troubleshooting

- [x] ~~Revise the research questions and objectives based on the feedback from my mentor (10 min)~~
- [x] ~~A plan for today's meeting with mentor(10 min)~~
    - Share the research proposal with him
    - Show him the primary sources of data about El Niño events in the past centuries
    - Long range plan: a thorough understanding of the whole project by the end of February
    - Questions:
        - more specific methods on how to analyze the economic and societal effects of El Niño events
        - Are we going to use published proxy records on the strength of El Niño events

- [x] ~~Read literature A multiproxy index of the El Niño–Southern Oscillation, AD 1525–1982 to find primary resources of proxy records (See in the Background Research) (20 min)~~
- [x] ~~Biweekly check with Dr. Garcia (15 min)~~

October 9, 2024

- An email to my mentor to update my progress and ask some questions about methodology



Eleanor Shen <shen.vanderboom@gmail.com> 2:15 PM (5 hours ago)
to Shawn, bgarcia-diaz

Hi Dr. Marshall,

Hope you had a wonderful week! After reading the literature you sent to me last week, I found many proxy records that we could use for reconstructing El Niño events. But there are many sources that I do not have access to. Could you help me find the pdfs for the following papers?
https://www.science.org/doi/10.1126/science.226.4670.50
https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/GM055p0069

Also, I continued to work on my research proposal during the week. I would have a first draft done by the end of this week. Then, we could review the draft in our meeting and further edit it.

However, I am still a little bit unsure about some details of the methodology such as how we are going to reconstruct the 1788 El Niño event. What kind of math or programming are we going to apply in order to analyze the published proxy records and simulations? And what economic indexes could we use when comparing the impact of El Niño on societies?

Thank you for your time and help! Looking forward to hearing from you!

Sincerely,
Eleanor

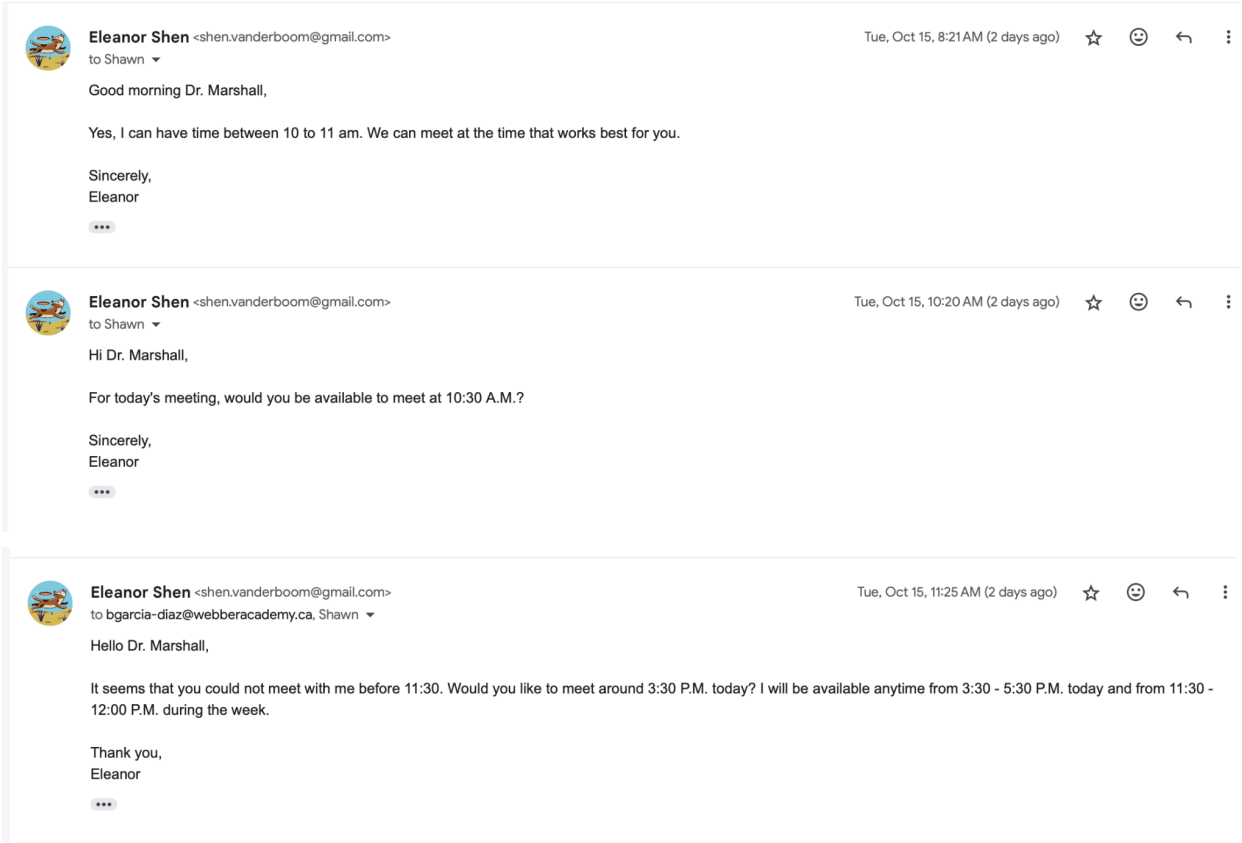
- Edited grammar and flow in the introduction of the research proposal

October 10, 2024

- [x] ~~Read A multiproxy index of the El Niño–Southern Oscillation, AD 1525–1982 See in the background research (50 min)~~
- [x] ~~Edit the introduction of the research proposal based on feedback from Dr. Garcia (30 min)~~

October 15, 2024

- [x] ~~Write the significance and a rough outline for methodology for the research proposal (50 min)~~
- [x] ~~Looking for databases that have proxy records to extract and analyze (30 min)~~
  See in the Background Research
- Emails to my mentor to confirm meeting time (10 min)



Eleanor Shen <shen.vanderboom@gmail.com> Tue, Oct 15, 8:21 AM (2 days ago)
to Shawn

Good morning Dr. Marshall,

Yes, I can have time between 10 to 11 am. We can meet at the time that works best for you.

Sincerely,
Eleanor

Eleanor Shen <shen.vanderboom@gmail.com> Tue, Oct 15, 10:20 AM (2 days ago)
to Shawn

Hi Dr. Marshall,

For today's meeting, would you be available to meet at 10:30 A.M.?

Sincerely,
Eleanor

Eleanor Shen <shen.vanderboom@gmail.com> Tue, Oct 15, 11:25 AM (2 days ago)
to bgarcia-diaz@webberacademy.ca, Shawn

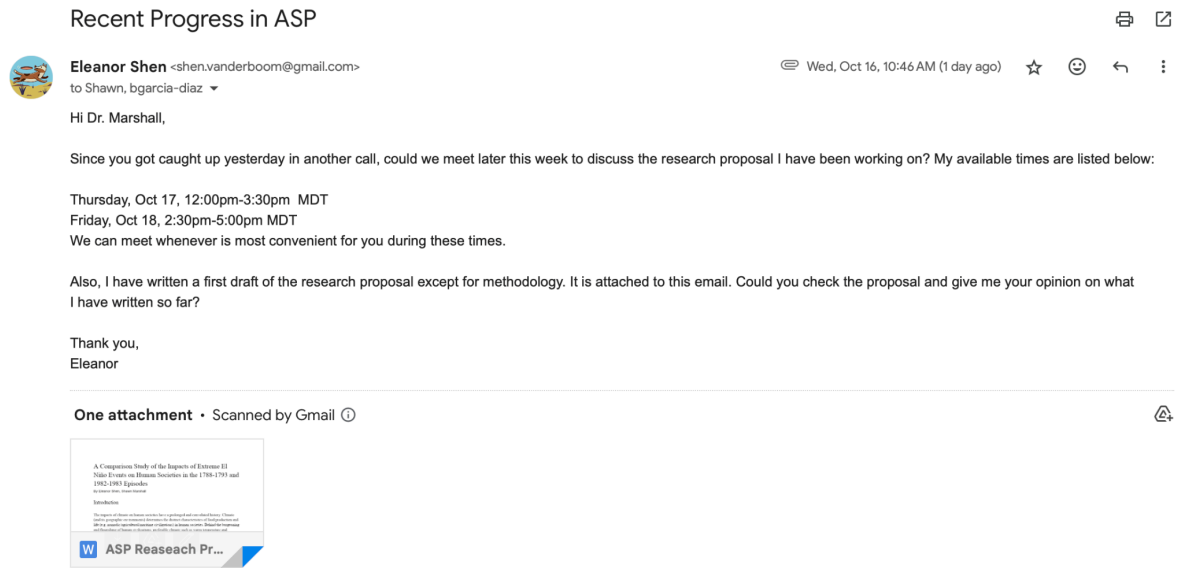
Hello Dr. Marshall,

It seems that you could not meet with me before 11:30. Would you like to meet around 3:30 P.M. today? I will be available anytime from 3:30 - 5:30 P.M. today and from 11:30 - 12:00 P.M. during the week.

Thank you,
Eleanor

October 16, 2024

- Another follow-up email to set up a meeting with Dr. Marshall and ask him to give me feedback of the research proposal



Recent Progress in ASP

Eleanor Shen <shen.vanderboom@gmail.com> Wed, Oct 16, 10:46 AM (1 day ago)
to Shawn, bgarcia-diaz

Hi Dr. Marshall,

Since you got caught up yesterday in another call, could we meet later this week to discuss the research proposal I have been working on? My available times are listed below:

Thursday, Oct 17, 12:00pm-3:30pm MDT
Friday, Oct 18, 2:30pm-5:00pm MDT
We can meet whenever is most convenient for you during these times.

Also, I have written a first draft of the research proposal except for methodology. It is attached to this email. Could you check the proposal and give me your opinion on what I have written so far?

Thank you,
Eleanor

One attachment • Scanned by Gmail

ASP Reaseach Pr...

October 17, 2024

- ☑ ~~**Biweekly check with Dr. Garcia (15 min)**~~
  - Suggestion about the introduction:
    - More description of the societal/economic structure in 1980s vs. 1790s
    - More information about the index and proxy reconstructions I would use to analyze the intensity of El Niño events
- ☑ ~~**Working on the CYSF portal (30 min)**~~
- ☑ ~~**Read The Great El Niño of 1789–93 and its global consequences: Reconstructing an extreme climate event in world environmental history and find primary documentary data that accounted for the agricultural and economic effects of 1788 El Niño (40 min)**~~

October 21, 2024

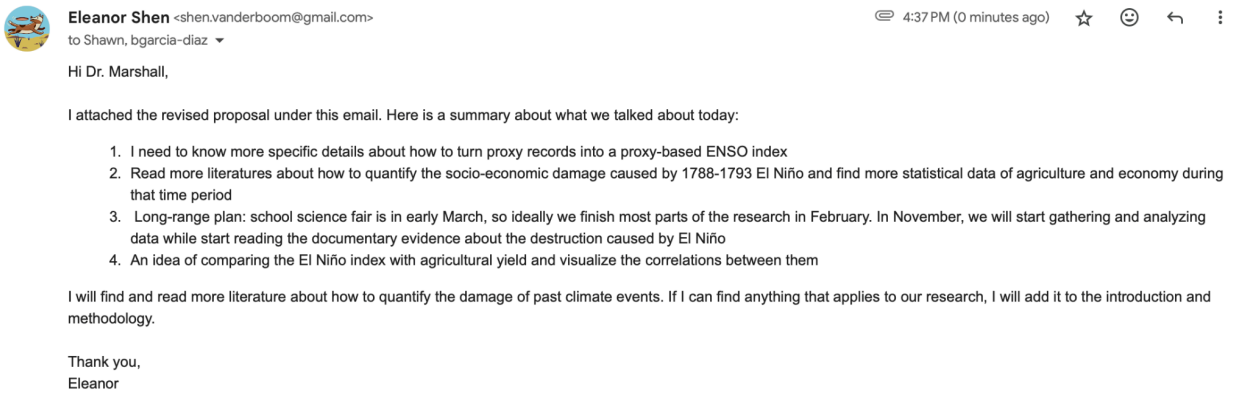
Class notes (whole block):

- Oral presentation:
  - Content (10 min): deep understanding of the project, mainly in the background research; convey what the research question is in the background research (because there is a lack of study in this field….)
  - 3+ slides for background research; 2 slides for research questions and objectives; 2-3 slides for methodology; 1 slide for significance
  - Explain the title right after the title page as background research
  - Methodology: Flow chart with bullet points

- Significance: Need and Contribution
- Clear voice, Loud, Good flow
- Edit myself
- The use of graphs and figures is crucial; Pictures need citations
- Do not overwhelm the audience with too much texts and information on one slide; make sure the picture is clear enough and the text can be read from the back of the room

October 22, 2024

- Meeting with Dr. Marshall
  - Meeting Summary:



Eleanor Shen <shen.vanderboom@gmail.com> 4:37 PM (0 minutes ago)
to Shawn, bgarcia-diaz

Hi Dr. Marshall,

I attached the revised proposal under this email. Here is a summary about what we talked about today:

1. I need to know more specific details about how to turn proxy records into a proxy-based ENSO index
2. Read more literatures about how to quantify the socio-economic damage caused by 1788-1793 El Niño and find more statistical data of agriculture and economy during that time period
3. Long-range plan: school science fair is in early March, so ideally we finish most parts of the research in February. In November, we will start gathering and analyzing data while start reading the documentary evidence about the destruction caused by El Niño
4. An idea of comparing the El Niño index with agricultural yield and visualize the correlations between them

I will find and read more literature about how to quantify the damage of past climate events. If I can find anything that applies to our research, I will add it to the introduction and methodology.

Thank you,
Eleanor

October 23, 2024

- ☑ ~~**Submit the Ethics form in CYSF portal (20 min)**~~
- ☑ ~~**Create slides for the Oral Presentation (40 min)**~~
  - ☑ ~~**Including title page, two background slides introducing ENSO and El Niño events**~~
- ☑ ~~**Edit the research proposal (adding reference and sources, correction grammar and adding details in the methodology) based on Dr. Garcia's feedback (30 min)**~~

October 25, 2024

Class Notes (20 min):

- Time change: Nov 6 Oral Presentation
- Participation in the oral presentation of other classmates: 4 minimum
- ☑ ~~**Rephrase the last three paragraphs in the introduction so that it flows better and introduces El Niño events more effectively (40 min)**~~
- ☑ ~~**Create the background research slides about the impacts of El Niño events on global weather patterns and the socioeconomic damage in human societies(20 min)**~~

October 29, 2024

Class Notes (30 min):

- Format citations in google docs (With DOI)
- CYSF portal: check the inbox
- ☐ Fill out the november calendar
- ☑ ~~**Final edit on the research proposal with more research and databases on the economic structure of societies (40 min)**~~
  See in the background research

Biweekly Check with Dr. Garcia (15 min):

- Presentation slides: maybe useful to show it to Ms. Bonderud or Mr. Falk
- Plan for the meeting with my mentor today:
  - Talk about the methodology and the research proposal
  - Long Range plan: specify what we are going to do in November and general ideas for Dec, Jan, Feb

October 30, 2024

- Weekly Meeting with Dr. Marshall
  - Feedback from Dr. Marshall about the research proposal with an edited document
  - A detailed plan for November with four separated tasks:
    - Find different datasets of ENSO-sensitive proxy records from databases such as NOAA
    - Standardize the dataset using statistics
    - Create regression line that shows the correlation between
    - Reconstruct the El Niño events based on the proxy reconstruction

October 31, 2024

- ☑ ~~**Fill out the november calendar based on the information from yesterday's meeting (20 min)**~~
- ☑ ~~**Check the format of Reference List of the research proposal and examine whether these are good sources (30 min)**~~
- ☑ ~~**Create the slides for research questions and objectives (40 min)**~~

November

November 4, 2024

Class notes (30 min):

- Logbook in google docs: use tabs, separate sections into different tabs
- Calendars in the logbook:
    - Be more specific: reading papers___, working on CYSF portals, meeting with the mentor
    - A clear long range plans for the project

- ☑ ~~Edit the logbook and separate sections into tabs (10 min)~~
- ☑ ~~Create slides for methodology and significance (40 min)~~

November 6, 2024

Maria-Elise's presentation:

- Different preferences of mode of control for apps
- 1.3 billion have limitations accessing to these apps
- Different alternatives to control apps
- human-computer interaction: better experience for users
- Question: how would head tracking implement user's experience and to which group of people it applies

- ☑ ~~Oral Presentation done~~

November 8, 2024

Cole's presentation:

- Mixed Dementia
- Vascular dysfunction (Modifiable) identified via MRI
- genetic factors non modifiable: APOE, risk factor for AD
- TIAs
    - Minor strokes
    - Temporary symptoms
    - Increase risk of dementia

Lauren's presentation:

- Lung cancer Stage 3B/C:
    - Large tumors
- Non-small cell lung cancer–Locally advanced cancer

- Treatments: Chemoradiation – Immunotherapy
    - Toxicity and side effects
    - Interventions
- Scoring of multiple interventions

Coco's presentation:

- EMG: measure the electron signals created by muscle constructions
    - Electrodes planar silver wet electrodes 3m red dot planar electrode
        - Flaws motion artifacts
        - MNA new electrodes

Nina's presentation:

- Psychedelics: non-classical and classical
    - NMDA Serotonin
- How are expectations related to outcomes?

November 13, 2024

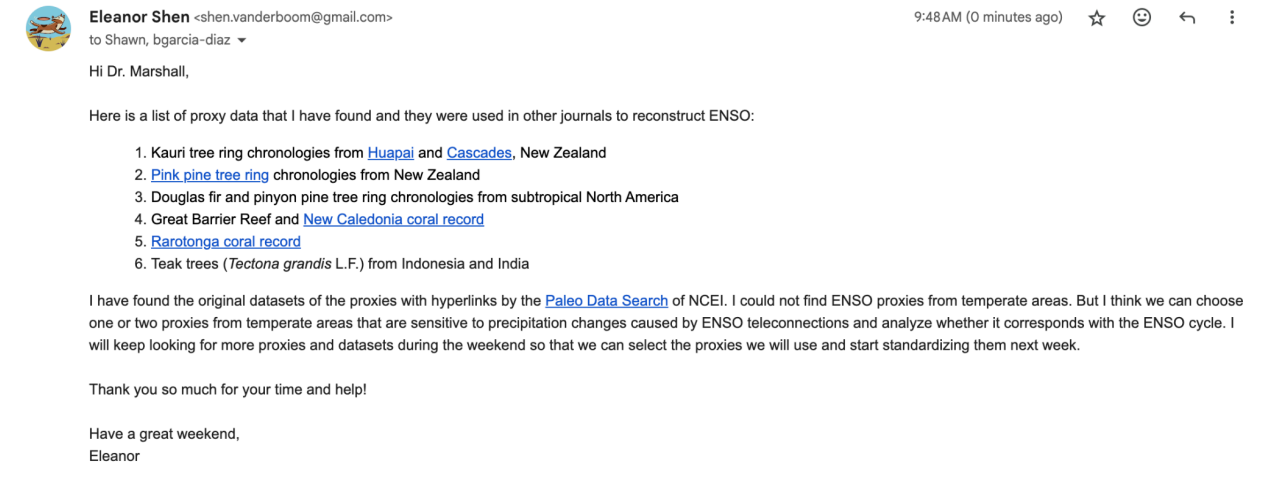
Class notes (20 min):

- A lot of works should be done in the five weeks before the winter break
    - There would not be much time to work after winter break in Jan and Feb
- Mentor's evaluation: reflect on the mark and communicate with mentor
- Paperpile and citations
- Ask Dr. Garcia if there is any questions
- CYSF

- ☑ ~~Review the literatures about El Niño proxies and take notes on the proxy records that were used (See in the background research) (60 min)~~

November 15, 2024

- [x] ~~An email to my mentor about the proxy data that I have found (20 min)~~



Eleanor Shen <shen.vanderboom@gmail.com> 9:48 AM (0 minutes ago)
to Shawn, bgarcia-diaz

Hi Dr. Marshall,

Here is a list of proxy data that I have found and they were used in other journals to reconstruct ENSO:

1. Kauri tree ring chronologies from Huapai and Cascades, New Zealand
2. Pink pine tree ring chronologies from New Zealand
3. Douglas fir and pinyon pine tree ring chronologies from subtropical North America
4. Great Barrier Reef and New Caledonia coral record
5. Rarotonga coral record
6. Teak trees (*Tectona grandis* L.F.) from Indonesia and India

I have found the original datasets of the proxies with hyperlinks by the Paleo Data Search of NCEI. I could not find ENSO proxies from temperate areas. But I think we can choose one or two proxies from temperate areas that are sensitive to precipitation changes caused by ENSO teleconnections and analyze whether it corresponds with the ENSO cycle. I will keep looking for more proxies and datasets during the weekend so that we can select the proxies we will use and start standardizing them next week.

Thank you so much for your time and help!

Have a great weekend,
Eleanor

- [x] ~~Use the Paleo Data Search to find the original data of proxies that were used in ENSO researches as I listed them in the background research in the last class (30 min) (See in the background research)~~
- [x] ~~Download the original data in .txt form (20 min)~~

November 19, 2024

Class notes (30 min):

- Move on from research proposal
- Ask questions to the mentor about the project
- A reflection on the research proposal:
    - Everything needs to have more details in the final paper
    - Read the feedback and edit the research proposal based on that
    - Reference errors: DOI and URL present, APA styles
- 4 weeks before winter break, 8 weeks in January and February
- Oral presentation skills: a punchline
- Communications with the mentor
- CYSF

- [x] ~~Updating the CYSF portal: Filling out basic project info; copy paste research, problem, method from the research proposal (20 min)~~

Plan to meet with mentor today (15 min):

- The specific way to use excel to standardize the data
    - After standardizing them, what are we going to do?
- Which data to use?

    - Multiple studies for teak trees and douglas firs
    - Tree rings: raw measurements/ thickness/ isotope
- The long range plan for December

Meeting with Dr. Marshall:

- Task for this week:
    - Using Excel to import the proxy dataset and one instrumental record (Niño3.4 or MEI)
    - Create a regression line for the proxy and instrumental record, then calculate r
- Task for next week:
    - Compare each proxy datasets' correlations with the instrumental record

November 21, 2024

- Learn how to use google sheets on youtube (40 min) https://www.youtube.com/watch?v=N2opj8XzYBY
- Import Rockies tree rings and Peruvian ice core data into the google sheets and organize the data (10 min) See in the background research
- Import the instrumental records (Nino3.4 and MEI) and find the average for each year (30 min) See in the background research

November 25, 2024

- Using the correlation function in Google Sheets to find the correlation between proxy raw measurements and the instrumental ENSO records (mainly Nino3.4 average) (50 min) See in the background research
- Implement the calculation with Nino3.4 Jan and Dec data (20 min) See in the background research

Long Range Plan (tasks to complete):

- Process the proxy data and reconstruct the 1789 El Niño (Dec)
- Gather historical data that account for the destruction of the 1789 El Niño (Dec and Jan)
- Integrate the historical data and the records of the 1982 El Niño together (Jan and Feb)
- Compare their socioeconomic effects (Feb)

November 27, 2024

- ☑ ~~Organize the November logbook (40 min)~~
- ☐ Plan for winter break:
    - Dr. Marshall has only one week off
    - I can have two weeks off with no meeting with mentor

    - During the two weeks, I can read the historical documents that accounts the 1789 El Nino
    - The meetings after winter break will be based on the midterm schedule
- ☑ ~~Create line chart for proxy data (30 min)(See in the background research)~~

November 29, 2024

- ☑ ~~Organize the November logbook and fill out the December calendar(50 min)~~
- ☑ ~~Fill out the data section in the CYSF portal with the proxies and instrumental data I have found (30 min)~~

December

December 5, 2024

Class Notes(30 min):

- The final paper:
    - Intro section due Jan 31st: read more papers to have more details and depth
    - Methods: due a month later written in past tense
        - take notes in the logbook about the specific procedures that I have done
        - DETAILS
    - Science fair:
        - Think about the poster
        - CYSF portal
- ☑ ~~Reverse the x and y axis of the scatter plots as Dr. Marshall told me during the meeting(5 min)~~
- ☑ ~~Calculate the equation of the regression line(5 min)~~
- ☑ ~~Using the equation to reconstruct Nino 3.4(20 min)~~
- ☑ ~~Create a line graph for the reconstructed Nino 3.4 and identify the points for 1789 and 1982 El Niño (30 min) (See all in the Procedures)~~

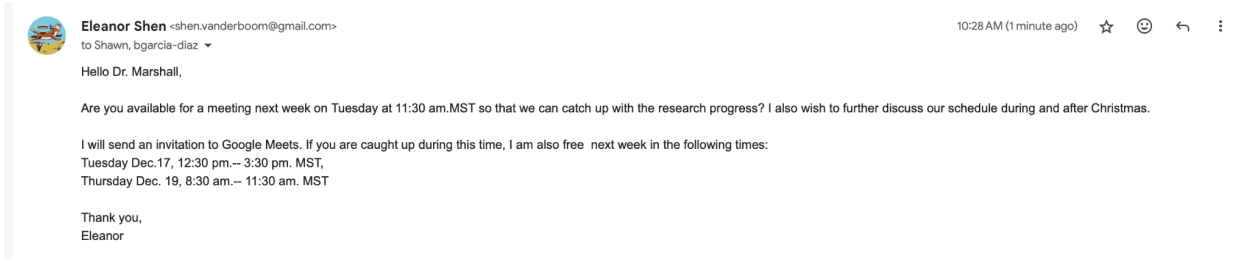
December 9, 2024

- ☑ ~~An email to update Dr. Marshall on my progress since we're not going to meet this week (10 min)~~
- ☑ ~~Fill my data collections and analysis so far into CYSF portal (problems with uploading pictures into the portal) (30 min)~~

- [x] ~~Create line graphs for the ENSO reconstructions based on proxy data (40 min)(See all in the Procedures)~~

December 11, 2024

- Email to mentor to make sure next week's meeting (10 min)



Eleanor Shen <shen.vanderboom@gmail.com> 10:28 AM (1 minute ago)
to Shawn, bgarcia-diaz

Hello Dr. Marshall,

Are you available for a meeting next week on Tuesday at 11:30 am.MST so that we can catch up with the research progress? I also wish to further discuss our schedule during and after Christmas.

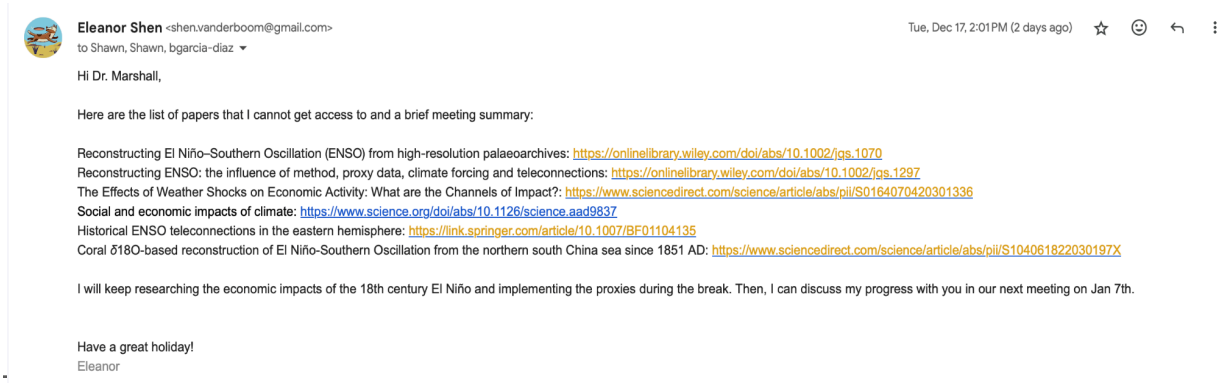
I will send an invitation to Google Meets. If you are caught up during this time, I am also free next week in the following times:
Tuesday Dec.17, 12:30 pm.-- 3:30 pm. MST,
Thursday Dec. 19, 8:30 am.-- 11:30 am. MST

Thank you,
Eleanor

- [x] ~~Look for databases and government websites that have data on the impacts of 1982 El Nino in Peru (60 min) (See in the background research)~~

December 13, 2024

- [x] ~~A meeting with Dr. Marshall and a meeting summary (30 mins)~~
  - [x] ~~Send an email to ask for access to some papers(10 min)~~



Eleanor Shen <shen.vanderboom@gmail.com> Tue, Dec 17, 2:01 PM (2 days ago)
to Shawn, Shawn, bgarcia-diaz

Hi Dr. Marshall,

Here are the list of papers that I cannot get access to and a brief meeting summary:

Reconstructing El Niño–Southern Oscillation (ENSO) from high-resolution palaeoarchives: https://onlinelibrary.wiley.com/doi/abs/10.1002/jqs.1070
Reconstructing ENSO: the influence of method, proxy data, climate forcing and teleconnections: https://onlinelibrary.wiley.com/doi/abs/10.1002/jqs.1297
The Effects of Weather Shocks on Economic Activity: What are the Channels of Impact?: https://www.sciencedirect.com/science/article/abs/pii/S0164070420301336
Social and economic impacts of climate: https://www.science.org/doi/abs/10.1126/science.aad9837
Historical ENSO teleconnections in the eastern hemisphere: https://link.springer.com/article/10.1007/BF01104135
Coral δ18O-based reconstruction of El Niño-Southern Oscillation from the northern south China sea since 1851 AD: https://www.sciencedirect.com/science/article/abs/pii/S104061822030197X

I will keep researching the economic impacts of the 18th century El Niño and implementing the proxies during the break. Then, I can discuss my progress with you in our next meeting on Jan 7th.

Have a great holiday!
Eleanor

- [x] ~~Continue to look for databases for the economic data in India (40 min)(See in the background research)~~

December 17, 2024

- [x] ~~look for databases for the economic data in New Zealand (20 min) (See in the background research)~~
- [x] ~~Collect the economic data in New Zealand in 1980s from Stats NZ and download it into a separate google sheet(See in Procedures) (50 min)~~

December 19, 2024

- Relaxing before the winter break
- Study for math test tomorrow

January

January 6, 2025

- Study for midterm

January 8, 2025

- Study for midterm

January 22, 2025

Class Notes(70 min):

- Make a plan and be specific about it
- Next five weeks: Focus on ASP
    - Data Analysis/Collection
    - Preparation for Science Fair: Understanding the results
    - Introduction Paper: finish with research questions and goals
- CYSF portal due March 21
- Oral Presentation by the end of February
    - Posters or Slides
    - Data Collection done by Feb 20 (hopefully)
- What if data is not completed?
    - By Feb 27, work with what you have
    - Back up the research with more background research
- Science Fair Rubric explanation:
    - Big messages and big takeaway; not so much about details

- Read paper **Reconstructing El Nino–Southern Oscillation (ENSO) from high-resolution palaeoarchives (see in the Background Research)(20 min)**

January 24, 2025

- [x] ~~Gather the data of Peru's sectoral GDP, total GDP and consumer price index from Central Reserve Bank of Peru (BCRP) and sort them into google sheets(see in the Procedures)(90 min)~~

January 28, 2025

Biweekly meeting with Dr. Garcia (20 min):

- An extension of the introduction paper till Feb 7th
- A clear plan for the next five weeks
- Cut off time: Feb 21st
- The oral presentation in class by the end of February
- Marks are locked for Term 2 report card around March 1st

- [x] ~~Gather the economic data of India and download into google sheets (40 min) (See in the Procedure)~~
- [x] ~~Fill the February calendar and revise my January calendar based on what has been done (40 min)~~

January 30, 2025

- [x] ~~Formatting the reference list for my Introduction and Procedure paper (30 min)~~
- [x] ~~Find the correlation between the economic data and instrumental records of ENSO (See in the procedures) (50 min)~~

February

February 3, 2025

Class Notes(30 min):

- ChatGPT helps to find sources for statements in the final paper
- Methodology check: went through all the methods
- Data collection and analysis needs to be in a separate section in the logbook, not in daily notes
- Tasks need to be specific and dated

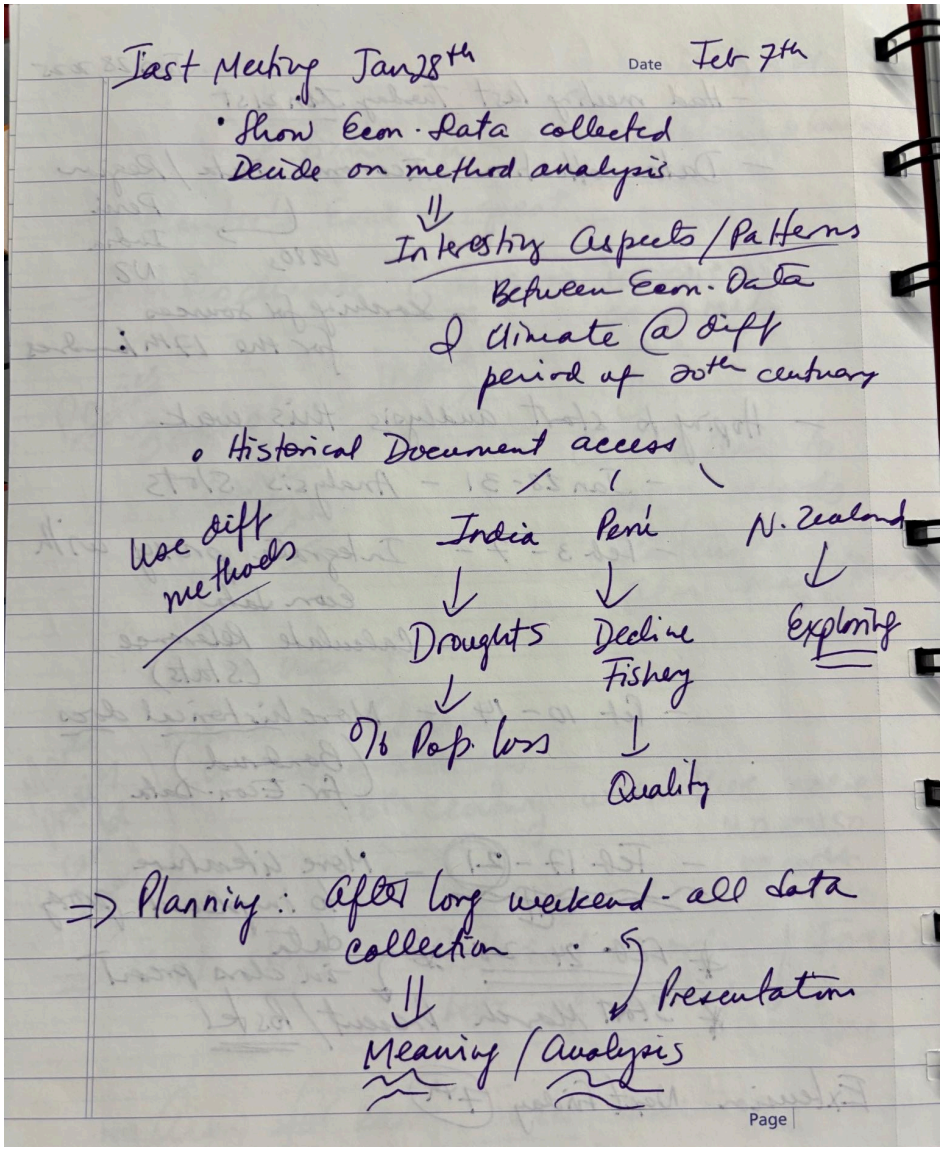
- [x] ~~Calculate the correlation between Peruvian economic data and ENSO and identify trends in those correlations (See in Procedures) (50 min)~~

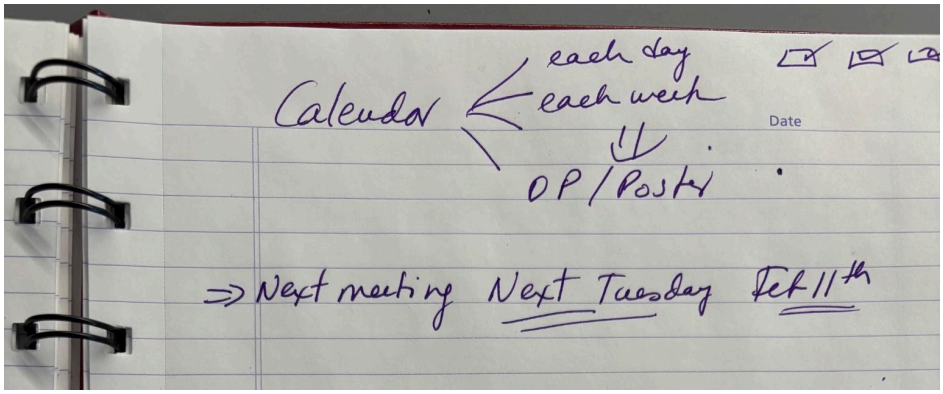
February 5, 2025

- [x] ~~Edit the introduction paper based on Dr. Marshall's feedback yesterday and hand in the paper(40 min)~~
- [x] ~~Calculate the correlation between India's economic data and ENSO and identify trends in those correlations (See in Procedures) (40 min)~~

February 7, 2025

Biweekly Meeting with Dr. Garcia(15 min):





- ☑ ~~Write the first part of procedures paper on reconstructing ENSO (70 min)~~

February 11, 2025

- February Assembly(85 min)

February 13, 2025

Class note (40 min):

- CYSF portal filled before March 21st
    - Problems section: not just research questions, needs a little bit background
    - Citation can be put in its own section not after each section
    - Acknowledgements: make it short and write down the institutions
- Science Fair: Originality and self-driven shown in the presentation
    - Use the rubric of CYSF
    - Sources of errors: Science Fair likes to see this
- The last day of class in February: 27th
    - Oral presentation and logbook due
    - Marks are locked the next day, so must be handed in
- Methods paper and data analysis is the number 1 priority
    - Logbook and Oral presentation is second priority
    - Then work on the poster for the SF
- ☑ ~~Write the second part of the procedures paper on measuring the regional impacts of El Niño in India and Peru (50 min)~~

February 19, 2025

Class note (40 min):

- Results Paper due April 14
    - Results alone without explanations and analysis
    - Figures and graphs
        - Figure title, legend and descriptions under the figures

    - Deadline of asking for help: at least three days before Apr 14
- Analysis/Discussion Paper due May 1
    - Explain/Provide alternative explanations
    - Put the results in the context of the current understanding in the field of studies
    - Get back to the research questions
    - Significance and future direction
- Final Paper due May 30th

- ☑ ~~Edit the Procedures Paper based on the suggestions Dr. Marshall sent to me this morning (30 min)~~
- ☑ ~~Create the background information slides for the oral presentation (20 min)~~

February 21, 2025

- ☑ ~~Add the procedure paper to the CYSF portal (10 min)~~
- ☑ ~~Create significance, methods, RQs, and results slides (80 min)~~

February 23, 2025 (Sunday)

- ☑ ~~Finish the presentation slides including analysis and editing~~
- ☑ ~~Practice the presentation~~

February 25, 2025

- Participation for oral presentation
    - Maddux and Merrit
    - Arth
    - Antara
        - Question asked
    - Nina
        - Questions asked
- Presentation done
    - 12+5 min
    - Trim down the background, methods, RQs
    - Explain the results and graphs in more details, time control
    - Conclusions need to be clear
    - Good punchline, if more rehearsed, it can take less time
    - Different from presenting with a poster, clearer logic flow for poster
    - Have to start making poster/tri-fold now

February 27, 2025

- Participation for oral presentations(40 min)
    - Cole
        - Question asked
    - Amber
        - Question asked

☑ ~~Check and edit the February logbook(20 min)~~

☑ ~~Design the layout for the science fair tri-fold (30 min)~~

March

March 3, 2025

Class Notes(50 min):

- Poster has to be more comprehensive
    - Go back and forth with different sections of the poster
- Logical flow in the slides is important
- Punchline for presentation

☑ ~~Finish the background, significance, RQs and methods on the poster(70 min)~~

March 5, 2025

☑ ~~Finish the results, analysis and conclusion part of the poster (90 min)~~

March 7, 2025

☑ ~~Finish acknowledgement and reference for the poster and some final edits (60 min)~~

☑ ~~Plan and practice the speech for science fair (30 min)~~

March 13, 2025

☑ ~~Reflect on the school science fair and look for parts that can be improved~~

☑ ~~Finish the methods section for CYSF portal~~

March 17, 2025

- ☑ ~~Finish the data and conclusion section for CYSF portal (90 min)~~

March 19, 2025

- ☑ ~~Finish the presentation and attachment section for CYSF portal (60 min)~~
- ☑ ~~Collect the data for global temperature from 1850 to present (50 min)~~

Calendar

September

Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
Sept 1	Sept 2	Sept 3	Sept 4 ASP class Second email to schedule meetings	Sept 5	Sept 6 ASP class Another email to schedule meetings	Sept 7
Sept 8	Sept 9	Sept 10 ASP class Meeting with mentor Plan set for the year	Sept 11	Sept 12 ASP class Start to explore potential research topics	Sept 13	Sept 14
Sept 15	Sept 16 ASP class Read literatures and find a few events/ periods in history	Sept 17 Meeting with mentor (missed)	Sept 18 ASP class Read literature and search for useful data	Sept 19	Sept 20 ASP class(missed)	Sept 21
Sept 22	Sept 23	Sept 24 ASP class Meeting with mentor Determine the	Sept 25	Sept 26 ASP class Read literature for background research and	Sept 27	Sept 28

		final research question		start writing introduction Part 1		
Sept 29	Sept 30 ASP class Finish introduction Part 1 and start Part 2					

October

Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
		Oct 1 Meeting with mentor Discuss the introduction and methodology of the research proposal	Oct 2 ASP class Finish research questions and objectives	Oct 3	Oct 4 ASP class Read a paper on the primary data for El nino reconstruction and finish introduction part 2	Oct 5
Oct 6	Oct 7	Oct 8 ASP class Meeting with mentor (Canceled) Finish Part 3 introduction	Oct 9	Oct 10 ASP class Finish significance and read literature about the multiproxy reconstruction of El Nino	Oct 11	Oct 12
Oct 13	Oct 14	Oct 15 ASP class Meeting with mentor (Canceled) Modify the research proposal based on Dr. Garcia's feedback	Oct 16 Emailed my first draft to Dr. Marshall	Oct 17 ASP class	Oct 18	Oct 19

Oct 20	Oct 21 ASP class Class Lecture(90 min)	Oct 22 Meeting with mentor Discuss Long Range Plan and methodology	Oct 23 ASP class: Create slides on background information about ENSO for oral presentation	Oct 24	Oct 25 ASP class: Create slides about the impacts of El Niño events on human societies	Oct 26
Oct 27	Oct 28	Oct 29 ASP class Final edit on the research proposal with more research on the economic structure of societies	Oct 30 Meeting with mentor Feedback of the research Proposal and a more detailed plan for Nov/Dec	Oct 31 ASP class **Research Proposal Due** **Logbook Check** Create slides of the research questions and objectives		

November

Sun	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Sat**
					Nov 1	Nov 2
Nov 3	Nov 4 ASP class Finish the methodology and significance slides	Nov 5	Nov 6 ASP class **Oral Presentation and Participation in others presentations** Meeting with my mentor (canceled)	Nov 7	Nov 8 ASP class **Participation in others presentations**	Nov 9

Nov 10	Nov 11	Nov 12 Meeting with my mentor Look for raw proxy dataset and discuss the standardizing method	Nov 13 ASP class Read literature on the proxy reconstruction of ENSO and select proxy records	Nov 14	Nov 15 ASP class Searching and downloading the original proxy data in databases	Nov 16
Nov 17	Nov 18	Nov 19 ASP class Work on the basic project info, problems, research in CYSF portal Meeting with my mentor Learn about the details of standardizing data	Nov 20	Nov 21 ASP class Import and organize the proxies and instrumental data into Google Sheets	Nov 22	Nov 23
Nov 24	Nov 25 ASP class Calculate the correlation between the proxies and instrumental record	Nov 26 Meeting with my mentor Show Dr. Marshall my results of correlations, discuss plan for winter break	Nov 27 ASP class Create line charts for the proxies that show statistically significant correlation	Nov 28	Nov 29 ASP class **Logbook Due** Work on the logbook calendar and fill the data section in CYSF portal	Nov 30

December

Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
Dec 1	Dec 2	Dec 3 ASP class (President Breakfast) Meeting with mentor Show Dr. Marshall the graphs that I have made and learn to reconstruct El Nino	Dec 4	Dec 5 ASP class Put different proxies into one table and create line graphs	Dec 6	Dec 7

Dec 8	Dec 9 ASP class Put these proxies into one line graph and make a regression line	Dec 10 Meeting with mentor Show Dr. Marshall my multi-proxy graphs and ask for the resources about 1982 El Nino	Dec 11 ASP class Look for databases and government websites that have data on the impacts of 1982 El Nino in Peru	Dec 12	Dec 13 ASP class Continue to look for databases for the economic data in India and New Zealand	Dec 14
Dec 15	Dec 16	Dec 17 ASP class Collect New Zealand economic data in 1980s Meeting with mentor Confirm the date for the meeting after winter break	Dec 18	Dec 19 ASP class Study for the math test on Friday	Dec 20	Dec 21 Winter break
Dec 22 Winter break	Dec 23 Winter break	Dec 24 Winter break	Dec 25 Winter break	Dec 26 Winter break	Dec 27 Winter break	Dec 28 Winter break
Dec 29 Winter break	Dec 30 Winter break	Dec 31 Winter break				

January

Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
			Jan 1 Winter break	Jan 2 Winter break	Jan 3 Winter break	Jan 4 Winter break
Jan 5 Winter break	Jan 6 ASP class Study for Midterms	Jan 7 Meeting with mentor Set up a plan for Jan and Feb, arrange the meeting after the midterm	Jan 8 ASP class Study for Midterms	Jan 9	Jan 10 Midterm	Jan 11 Midterm
Jan 12	Jan 13	Jan 14	Jan 15	Jan 16	Jan 17	Jan 18

Midterm	Midterm	Midterm	Midterm	Midterm	Midterm	Midterm
Jan 19 Midterm	Jan 20 Midterm	Jan 21 Meeting with mentor Goal for the week: statistics on economic impacts of 19	Jan 22 ASP class Lecture; read a paper about the multiproxy reconstruction of El Niño to implement the introduction paper	Jan 23	Jan 24 ASP class Gather the economic data of Peru and sort it into Google Sheets	Jan 25
Jan 26	Jan 27	Jan 28 ASP class Check and catch up with the logbook; Biweekly check with Dr. Garcia Meeting with mentor Ask for feedback on the draft of the introduction paper and discuss the analysis of economic data	Jan 29	Jan 30 ASP class Analyze the correlation between the economic data collected and the proxy reconstruction **Dec/Jan Logbook Due**	Jan 31	

February

Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
						Feb 1
Feb 2	Feb 3 ASP class Continue to analyze the economic data for 1982 El Niño	Feb 4 Meeting with mentor Present my result to Dr. Marshall and ask him for help on the historical records on 1789 El Niño	Feb 5 ASP class Final edits on the Introduction paper and	Feb 6	Feb 7 ASP class Final edit on the introduction paper and finish the first part of the procedures paper **INTRODUCTION Paper Due**	Feb 8

Feb 9	Feb 10	Feb 11 ASP class Assembly Meeting with mentor Share the historical data collected in the past week	Feb 12	Feb 13 ASP class Write the second part of the procedures paper and send it to Dr. Marshall	Feb 14	Feb 15
Feb 16	Feb 17	Feb 18 Meeting with mentor Ask for feedback on the procedure paper and discuss the result from the analysis of historical data	Feb 19 ASP class Final edit on the procedure paper and create background slides for the presentation **PROCEDURE Paper Due**	Feb 20	Feb 21 ASP class Create significance, method and results slides for the in class presentation	Feb 22
Feb 23	Feb 24	Feb 25 ASP class **In Class Presentation** Meeting with mentor Discuss the interpretation of our results on the proxy reconstruction and economic data	Feb 26	Feb 27 ASP class Check the logbook and design the layout of the poster **Feb Logbook Due**	Feb 28	

March

Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
						Mar 1
Mar 2	Mar 3 ASP class Finish the background, significance, RQs and methods on the poster	Mar 4 Meeting with mentor	Mar 5 ASP class Finish the results, analysis and conclusion part of the poster	Mar 6	Mar 7 ASP class Refine the details of the poster and practice the science fair presentation	Mar 8

Mar 9	Mar 10	Mar 11 School Science Fair	Mar 12	Mar 13 ASP class Fill in the data and conclusion sections for CYSF portal	Mar 14	Mar 15
Mar 16	Mar 17 ASP class Citations, Acknowledgement, Presentation parts to be done in PYSF portal	Mar 18	Mar 19 ASP class Start writing the reconstruction part of the results paper	Mar 20	Mar 21 ASP class Finish the reconstruction part of the results paper **CYSF Online Portal Due**	Mar 22 Spring Break
Mar 23 Spring Break	Mar 24 Spring Break	Mar 25 Spring Break	Mar 26 Spring Break	Mar 27 Spring Break	Mar 28 Spring Break	Mar 29 Spring Break
Mar 30 Spring Break	Mar 31 Spring Break					

April

Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
		Apr 1 Spring Break	Apr 2 Spring Break	Apr 3 Spring Break	Apr 4 Spring Break	Apr 5 Spring Break
Apr 6 Spring Break	Apr 7	Apr 8 ASP class	Apr 9	Apr 10 ASP class City Science Fair	Apr 11 City Science Fair	Apr 12 City Science Fair
Apr 13	Apr 14 ASP class **RESULTS Paper Due**	Apr 15	Apr 16 ASP class	Apr 17	Apr 18	Apr 19
Apr 20	Apr 21 ASP class	Apr 22	Apr 23 ASP class	Apr 24	Apr 25 ASP class	Apr 26

Apr 27	Apr 28	Apr 29 ASP class	Apr 30			

Assignment Checklist

- ☑ ~~Research Proposal (Deadline October 31)~~
- ☑ ~~Introduction~~
  - ☑ ~~Part 1: A brief summary of how climate influenced human societies in the past and the significance to analyze how society responds to extreme climate events in global warming (backed by the various research papers I have read during the selection of research question)~~
  - ☑ ~~Part 2: Introduce the basic facts of El Niño events (the duration, cycle, and its formation) and its effects on the weather in the tropics area. (Started)~~
  - ☑ ~~Part 3: Summarize the previous research on the 1788 El Niño event, and introduce my comparison research on the difference of impacts of the same weather events in different historical period~~
- ☑ ~~Objectives~~
  - ☑ ~~Short term goals: To analyze the impacts of El Niño events on the past and contemporary societies~~
  - ☑ ~~Long term goals: To analyze the degrees of the resilience of human societies when encountering extreme weather events~~
- ☑ ~~Research Questions~~
- ☑ ~~Methodology~~
  - ☑ ~~To further discuss with my mentor on Oct 1~~
- ☑ ~~Significance~~

- ☑ ~~Oral Presentation of the Research Proposal (Deadline Nov 4)~~

- 10 mins presentation, 5 mins questions
- 15 slides TOP

- ☑ ~~Background Research (3+ slides)~~
  - ☑ ~~General Definition of ENSO and El Niño events~~
  - ☑ ~~Its impacts on human society~~

- [x] ~~The significance of this study: how it addresses the lack of study in this field~~

- [x] ~~Research Questions (1 slide)~~
- [x] ~~Objectives (2 slide)~~
- [x] ~~Methodology (2 slides)~~
- [x] ~~Significance (1 slide)~~

- [x] ~~Proxy Data Collection and Analysis~~ ~~(Deadline Dec 10)~~
  - [x] ~~Import and organize the proxy data~~
  - [x] ~~Import the instrumental records (NINO3.4 and MEI)~~
  - [x] ~~Using correlation function to determine which proxy data to use~~
  - [x] ~~Create a graph of selected proxies and circle out the 1789 and 1982 El Niño~~
  - [x] ~~Create a regression line for the suitable proxies~~

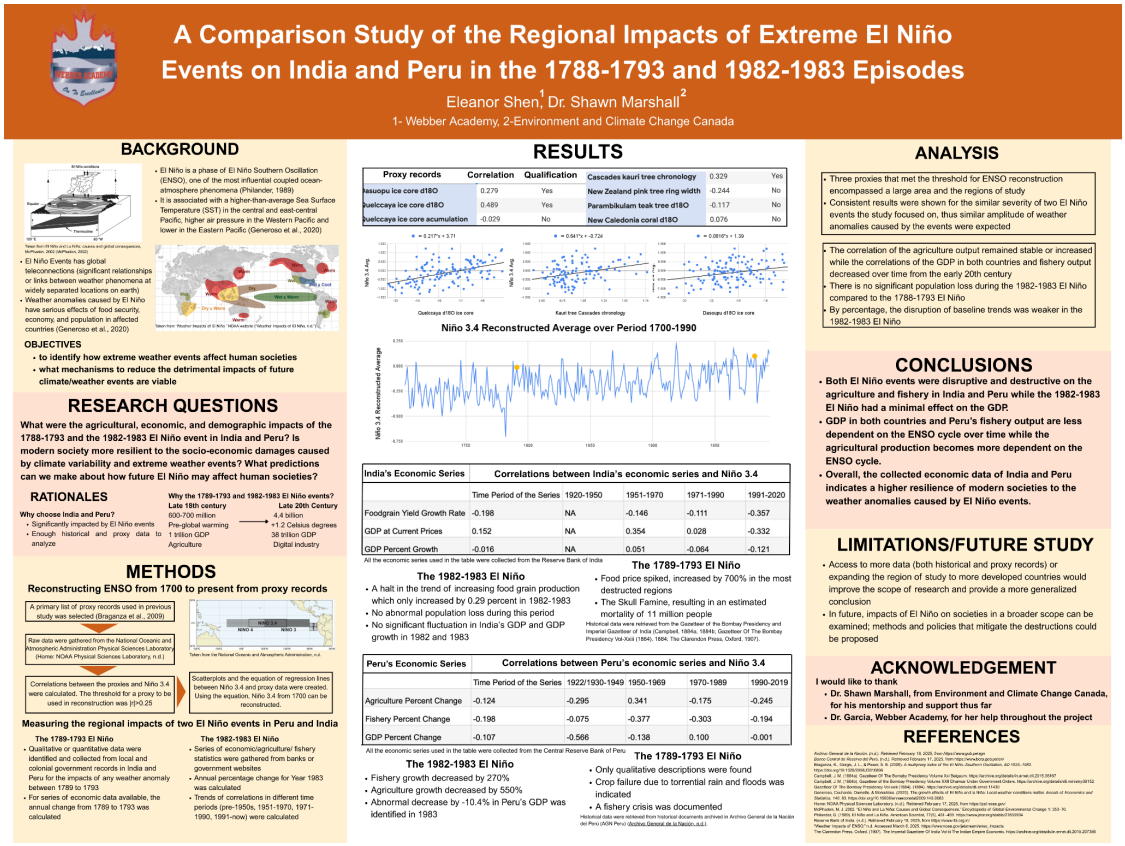
- [x] ~~Introduction Section Paper~~ ~~(Deadline Jan 30)~~
  - [x] ~~Copy paste the Introduction section of the research proposal~~
    - [x] ~~Resolve the feedback from Dr. Garcia~~
  - [x] ~~Add the research questions, goal, and significance~~
  - [x] ~~Refine and implement the content~~
  - [ ] Edit based on the feedback from Dr. Marshall
  - [x] ~~Submit to the CYSF portal~~

- [x] ~~Procedures Section Paper~~ ~~(Deadline Feb 19)~~
  - [x] ~~Copy paste the Methodology from the research proposal~~
    - [x] ~~Resolve the feedback from Dr. Garcia~~
  - [x] ~~Add more details and procedures used in the research~~
  - [x] ~~Edit based on the feedback from Dr. Marshall~~
  - [x] ~~Submit to the CYSF portal~~

- [x] ~~Oral Presentation for Science Fair~~ ~~(Deadline Feb 25)~~
  - [x] ~~Background information~~
  - [x] ~~Significance~~
  - [x] ~~RQs~~

- [x] ~~Methods~~
- [x] ~~Results (graphs)~~
- [x] ~~Analysis~~
- [x] ~~Practice presentation with the slides~~

- [x] ~~Poster for Science Fair (Deadline Mar 7)~~



A Comparison Study of the Regional Impacts of Extreme El Niño Events on India and Peru in the 1788-1793 and 1982-1983 Episodes

Eleanor Shen,[1] Dr. Shawn Marshall[2]
1- Webber Academy, 2-Environment and Climate Change Canada

BACKGROUND

- El Niño is a phase of El Niño Southern Oscillation (ENSO), one of the most influential coupled ocean-atmosphere phenomena (Philander, 1989)
- It is associated with a higher-than-average Sea Surface Temperature (SST) in the central and east-central Pacific, higher air pressure in the Western Pacific and lower in the Eastern Pacific (Generoso et al., 2020)

- El Niño Events has global teleconnections (significant relationships or links between weather phenomena at widely separated locations on earth)
- Weather anomalies caused by El Niño have serious effects of food security, economy, and population in affected countries (Generoso et al., 2020)

OBJECTIVES
- **to identify how extreme weather events affect human societies**
- **what mechanisms to reduce the detrimental impacts of future climate/weather events are viable**

RESEARCH QUESTIONS

What were the agricultural, economic, and demographic impacts of the 1788-1793 and the 1982-1983 El Niño event in India and Peru? Is modern society more resilient to the socio-economic damages caused by climate variability and extreme weather events? What predictions can we make about how future El Niño may affect human societies?

RATIONALES

Why choose India and Peru?
- Significantly impacted by El Niño events
- Enough historical and proxy data to analyze

Why the 1789-1793 and 1982-1983 El Niño events?

Late 18th century		Late 20th Century
600-700 million		4.4 billion
Pre-global warming	→	+1.2 Celsius degrees
1 trillion GDP		38 trillion GDP
Agriculture		Digital industry

METHODS

Reconstructing ENSO from 1700 to present from proxy records

A primary list of proxy records used in previous study was selected (Braganza et al., 2009)

Raw data were gathered from the National Oceanic and Atmospheric Administration Physical Sciences Laboratory (Home: NOAA Physical Sciences Laboratory, n.d.)

Correlations between the proxies and Niño 3.4 were calculated. The threshold for a proxy to be used in reconstruction was |r|>0.25

Scatterplots and the equation of regression lines between Niño 3.4 and proxy data were created. Using the equation, Niño 3.4 from 1700 can be reconstructed.

Measuring the regional impacts of two El Niño events in Peru and India

The 1789-1793 El Niño
- Qualitative or quantitative data were identified and collected from local and colonial government records in India and Peru for the impacts of any weather anomaly between 1789 to 1793
- For series of economic data available, the annual change from 1789 to 1793 was calculated

The 1982-1983 El Niño
- Series of economic/agriculture/ fishery statistics were gathered from banks or government websites
- Annual percentage change for Year 1983 was calculated
- Trends of correlations in different time periods (pre-1950s, 1951-1970, 1971-1990, 1991-now) were calculated

RESULTS

Proxy records	Correlation	Qualification	Cascades kauri tree chronology	0.329	Yes
Isaupu ice core d18O	0.279	Yes	New Zealand pink tree ring width	-0.244	No
Quelccaya ice core d18O	0.489	Yes	Parambikulam teak tree d18O	-0.117	No
Quelccaya ice core acumulation	-0.029	No	New Caledonia coral d18O	0.076	No

Niño 3.4 Reconstructed Average over Period 1700-1990

India's Economic Series	Correlations between India's economic series and Niño 3.4			
	Time Period of the Series	1920-1950	1951-1970	1971-1990	1991-2020
Foodgrain Yield Growth Rate	-0.198	NA	-0.146	-0.111	-0.357
GDP at Current Prices	0.152	NA	0.354	0.028	-0.332
GDP Percent Growth	-0.016	NA	0.051	-0.064	-0.121

All the economic series used in the table were collected from the Reserve Bank of India

The 1982-1983 El Niño
- A halt in the trend of increasing food grain production which only increased by 0.29 percent in 1982-1983
- No abnormal population loss during this period
- No significant fluctuation in India's GDP and GDP growth in 1982 and 1983

The 1789-1793 El Niño
- Food price spiked, increased by 700% in the most destructed regions
- The Skull Famine, resulting in an estimated mortality of 11 million people

Historical data were retrieved from the Gazetteer of the Bombay Presidency and Imperial Gazetteer of India (Campbell, 1884a, 1884b; *Gazetteer Of The Bombay Presidency Vol-XxII* (1884), 1884; The Clarendon Press, Oxford, 1907).

Peru's Economic Series	Correlations between Peru's economic series and Niño 3.4				
	Time Period of the Series	1922/1930-1949	1950-1969	1970-1989	1990-2019
Agriculture Percent Change	-0.124	-0.295	0.341	-0.175	-0.245
Fishery Percent Change	-0.198	-0.075	-0.377	-0.303	-0.194
GDP Percent Change	-0.107	-0.566	-0.138	0.100	-0.001

All the economic series used in the table were collected from the Central Reserve Bank of Peru

The 1982-1983 El Niño
- Fishery growth decreased by 270%
- Agriculture growth decreased by 550%
- Abnormal decrease by -10.4% in Peru's GDP was identified in 1983

The 1789-1793 El Niño
- Only qualitative descriptions were found
- Crop failure due to torrential rain and floods was indicated
- A fishery crisis was documented

Historical data were retrieved from historical documents archived in Archivo General de la Nación del Perú (AGN Peru) (Archivo General de la Nación, n.d.).

ANALYSIS

- Three proxies that met the threshold for ENSO reconstruction encompassed a large area and the regions of study
- Consistent results were shown for the similar severity of two El Niño events the study focused on, thus similar amplitude of weather anomalies caused by the events were expected

- The correlation of the agriculture output remained stable or increased while the correlations of the GDP in both countries and fishery output decreased over time from the early 20th century
- There is no significant population loss during the 1982-1983 El Niño compared to the 1788-1793 El Niño
- By percentage, the disruption of baseline trends was weaker in the 1982-1983 El Niño

CONCLUSIONS

- **Both El Niño events were disruptive and destructive on the agriculture and fishery in India and Peru while the 1982-1983 El Niño had a minimal effect on the GDP.**
- **GDP in both countries and Peru's fishery output are less dependent on the ENSO cycle over time while the agricultural production becomes more dependent on the ENSO cycle.**
- **Overall, the collected economic data of India and Peru indicates a higher resilience of modern societies to the weather anomalies caused by El Niño events.**

LIMITATIONS/FUTURE STUDY

- Access to more data (both historical and proxy records) or expanding the region of study to more developed countries would improve the scope of research and provide a more generalized conclusion
- In future, impacts of El Niño on societies in a broader scope can be examined; methods and policies that mitigate the destructions could be proposed

ACKNOWLEDGEMENT

I would like to thank
- **Dr. Shawn Marshall, from Environment and Climate Change Canada, for his mentorship and support thus far**
- **Dr. Garcia, Webber Academy, for her help throughout the project**

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- [ ] Results Section Paper (Deadline Apr 14)

- [ ] Analysis/Discussion Section Paper (Deadline May 1)

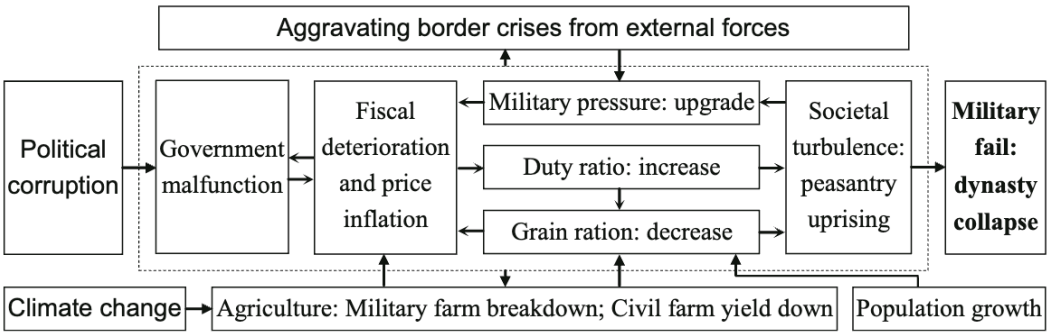
- [ ] Final Paper (Deadline May 30)

Background Research

Sept 12

1. Improving Societal Outcomes of Extreme Weather in a Changing Climate: An Integrated Perspective
    - temperature extremes (heat and cold waves), precipitation extremes (including floods and droughts), and storms and severe weather (including tropical cyclones).
    - The potential climate events for my research
    - how social vulnerability, coping, and adaptation shape the societal impacts of extreme weather.
    - It is not that related to my research question, so only minimum notes were taken.
    - However, the introduction of the paper can support the Part 1 introduction for my research paper.

2. The Collapse of Ming Dynasty in 1644 and its correlations with the Little Ice Age (A potential research topic)
    A. **How climate change impacted the collapse of the Ming dynasty**
    B. **These research papers are for determining whether the topic of the collapse of the Ming Dynasty is suitable for my research. So I just read the introductions and methodologies used.**
    C. **Advantage as a research topic: Very Specific research question, Climate – drought – bad crop yield (with abundant historical evidence such as official documents of agricultural production and taxation)– famine/ fiscal crisis/ weak military defense/peasant revolts (factors to look in to in case study)– the rise of Manchu power**



    D. **Challenge: A thorough understanding of Chinese history during 1630-1644 is needed. There is a lot of historical evidence but data collection and analysis would be hard.**

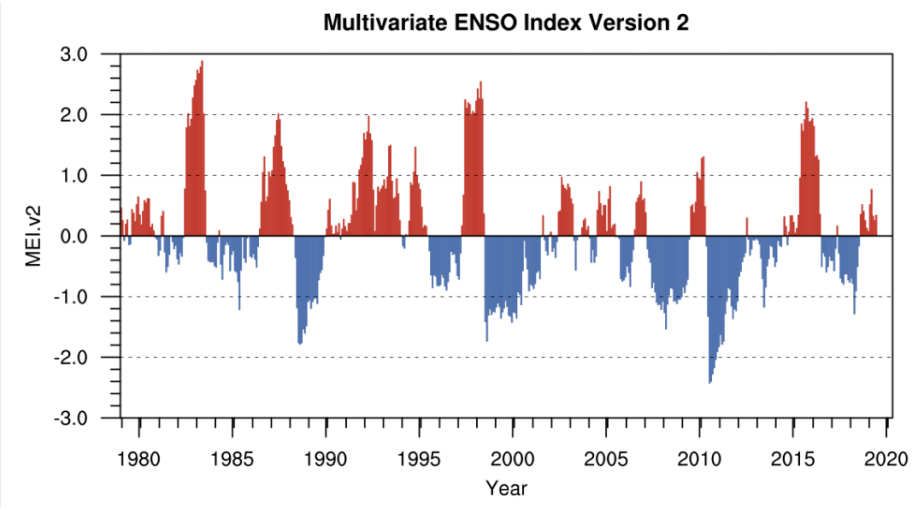
Sept 16

1. The economic impacts of climate change
    a. I first thought it was about how to measure the economic impacts of climate such as how crop yields influence the domestic economy. However, it is about the general estimations about the impact of global warming to world economy, and it is not very useful for my research
2. How climate change impacted the collapse of the Ming dynasty
    a. Methodology used in this study:
        i. used high-resolution reconstructions of temperature and dry-wet index in China for the past 1000 years
        ii. Specific data on provincial population, cropland area, grain productivity, grain price, uprests and wars, and peasant uprisings
        iii. Along with some historical literature. For example, *Ming Shilu*

Sept 18

1. El Niño Events in 1789-93 and its global impact (A potential research topic)
    a. The Great El Niño of 1789–93 and its global consequences: Reconstructing an extreme climate event in world environmental history
    b. A rough description of the El Niño event of 1789-93 and its impacts on the societies in the globe
    c. Features: It caused severe droughts and famine in South Asia, Europe and Americas and the aftermath of revolts. Because tropic area such as India, South America, Southeast Asia are most influenced by El Niño episodes, they're ideal regions for my research
    d. Challenge: Hard to find data or simulation about the 1788 El Niño episodes
    e. An idea: compare the response of pre industrial civilizations and industrial civilizations to extreme weather events like El Niño–would be more climatology and modeling related
2. Some basic facts about El Niño-Southern Oscillations from Google
    a. **El Niño–Southern Oscillation** (**ENSO**) is a global climate phenomenon that emerges from variations in winds and sea surface temperatures over the tropical Pacific Ocean.
    b. The warming phase of the sea surface temperature is known as "**El Niño**"
    c. The occurrence of ENSO is not predictable
    d. El Niño is associated with higher than normal air sea level pressure over Indonesia, Australia and across the Indian Ocean to the Atlantic.
3. A website that provides data of El Niño episodes from 1980 to 2020
    a. https://climatedataguide.ucar.edu/climate-data/multivariate-enso-index
    b. Indicate the intensity of each El Niño events

c. Able to compare contemporary El Niño episodes with episodes in other time periods

d. 

Sept 26

1. Floods, Famines, and Emperors: El Niño and the Fate of Civilizations (the book is not available without payment so I bought it on Amazon)
    - Chapter 3 ENSO (El Niño Southern-Oscillations): effects of El Niño events.
    - As sea temperatures peak during El Niño events, the temperatures over most of the tropics increase almost by 1 degree, significantly affecting the average global temperature
    - And strong El Niño events cause catastrophic droughts in tropical regions such as Central America, India, Australia, West Africa and China. But the effect was not restrained to tropical regions, even Siberia has disastrous harvests in strong El Niño years
    - Global fish catches declined significantly
    - El Niño events also shifts the pattern and intensity of storms in the central Pacific and Atlantic
    - Chapter 4 the Northern Atlantic Oscillations
    - When the Northern Atlantic Oscillation is strong, in Europe, there would be strong westerlies bringing wet storms. The strong westerlies also cause relatively mild temperature during winter, which could produce dry conditions in the southern Europe
    - In contrast, a lower index would mean shallower pressure gradients, weaker westerlies, a colder winter in the continental Europe

Oct 4

1. **A comparison of proxy records of El Nino/Southern Oscillation**
    a. The paper referenced to many primary sources that contain tree ring and ice core reconstructions of El Niño events and many documentary records
        i. tree-ring chronologies from southwestern United States and northwestern Mexico (Drew 1976; Michaelsen 1989); ice-cores from Quelccaya ice cap in Peru (Thompson et al. 1984, 1985, 1986, 1988; Thompson and Mosley-Thompson 1989; Thomp- son et al. 1992, this volume);
        ii. The highlighted references are the study conducted using proxy records to create ENSO indices that can be used to reconstruct El Niño events
        iii. and documentary records (Quinn et al. 1987)
        iv. Tasks for next class: check this paper **El Niño occurrences over the past four and a half centuries**(Quinn et al. 1987) for useful documentary records

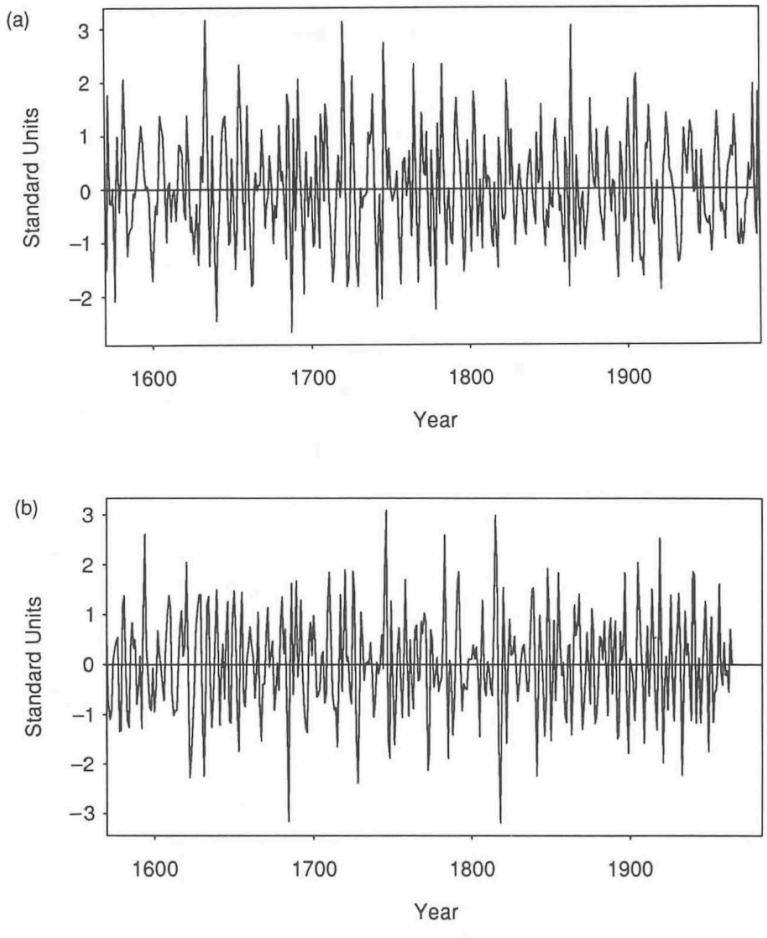


Fig. 17.1 Reconstructions of sea surface temperatures based on (a) the $\delta^{18}O$ record, and (b) the tree-ring record. Units in standard deviations.

        v.

Oct 8

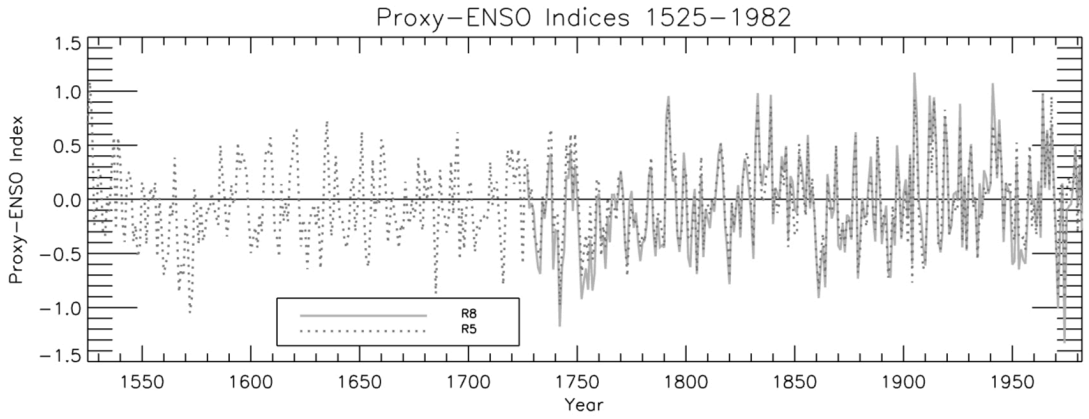
1. **El Niño occurrences over the past four and a half centuries**
    a. It is based primarily on evidence obtained from the west coast region of northern South America and its adjacent Pacific Ocean waters. The region that is suitable for my research of El Niño occurrences and impacts
    b. Both 1788 and 1982 El Niño were classified as VS (very strong); it can be used in my introduction to indicate that 1788 and 1982 El Niño events are comparable

Oct 10

1. **A multiproxy index of the El Niño–Southern Oscillation, AD 1525–1982**
    a. This is a great outline for how to write my methodology
    b. First the selection of proxies, must be ENSO sensitive
    c. Since ENSO is a both oceanic and atmospheric climate phenomenon, so it needs to select multiple proxies that address the two aspects
    d. Data then needs to be processed to minimize the noise in the proxy records
    e. And then the data needs to be calibrated (adjusted) to the instrumental El Niño data recorded in the 20th century— This step is to make sure that the processed data actually reflects the ENSO cycle

Oct 15

1. The figure from **A multiproxy index of the El Niño–Southern Oscillation, AD 1525–1982**



    a. It can be used to showcase the similar intensity of the 1788 El Niño and 1982 El Niño

    b. I would need to explain where the data comes from and how the data is compiled and changed into the index
2. From **A multiproxy index of the El Niño–Southern Oscillation, AD 1525–1982** a useful meteorological database with proxy records and historical data is mentioned.
    a. National Oceanic and Atmospheric Administration, World Data System https://www.ncei.noaa.gov/services/world-data-system

Oct 17

1. The primary historical data in **The Great El Niño of 1789–93 and its global consequences: Reconstructing an extreme climate event in world environmental history**
    a. Logbooks from the English East India Company voyages digitized in keyed format from 1789 to 1834 https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ncdc:C00785
    b. The log of HMS"bounty", 1787-1789 https://www.genesis-publications.com/book/0904351009/the-log-of-hms-bounty-1787-1789

Oct 29

1. The economic and historical databases that have reconstructions of world GDP/ population in the late-eighteenth century.
    a. Maddison Project Database 2023: this one also includes an estimation of world populations in the late 18th century https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2023?lang=en#:~:text=The%20Maddison%20Project%20Database%20provides,the%20period%20up%20to%202022.
    b. UN World Population Prospects https://population.un.org/wpp/Download/Standard/MostUsed/
    c. US Census International Database https://www.census.gov/data-tools/demo/idb/#/dashboard?COUNTRY_YEAR=2024&COUNTRY_YR_ANIM=2024&CCODE_SINGLE=**&CCODE=**

Dec 11

1. National resources of Peru:
    a. Government website: Instituto Nacional de Estadística e Informática (INEI)

https://www.gob.pe/inei/
    b. Central Reserve Bank of Peru (BCRP) https://www.bcrp.gob.pe/en/
2. International organizations:
    a. IMF and World Bank
    b. UN portal
3. The economic data in 1980s that I am looking for:
    a. Usually called series
    b. GDP growth in percentage which diminishes the overall trend
    c. Sectoral GDP percentage such as agriculture and fishery

Dec 13

1. Institutions that could have economic statistics for India:
    a. Ministry of Statistics and Programme Implementation https://www.mospi.gov.in/
    b. Reserve Bank of India https://www.rbi.org.in/
    c. Indian Council of Agricultural Research https://www.icar.org.in
2. International databases found in Dec 11

Dec 17

1. Economic database for New Zealand:
    a. Infoshare, Stats NZ https://www.stats.govt.nz/tools/stats-infoshare/
    b. Reserve Bank of New Zealand https://www.rbnz.govt.nz/
2. International databases found in Dec 11

Jan 22

1. From **Reconstructing El Nino–Southern Oscillation (ENSO) from high-resolution palaeoarchives**,
    a. Things to implement for my Introduction
        i. Rationale for using multiproxy reconstruction for El Niño events (highlighted in the paper)
        ii. Rewrite the definition of ENSO
    b. Potential improvements for my reconstruction if time allows
        i. Using the indice that accounts for the atmospheric component of ENSO such as SOI

Procedures

Nov 13

1. Paleo Data Search: https://www.ncei.noaa.gov/access/paleo-search/?dataTypeId=18

2. A list of potential proxy data
    a. From **A multiproxy index of the El Niño–Southern Oscillation, AD 1525–1982**
        i. Kauri tree ring chronologies from Huapai and Cascades, New Zealand by Fowler
        ii. pink pine tree ring chronologies from New Zealand (western Pacific, Southern Hemisphere)
        iii. The Douglas fir and pinyon pine tree ring chronologies from subtropical North America
        iv. the Great Barrier Reef and New Caledonia coral record (western Pacific)
        v. the Rarotonga coral record (central Pacific)
    b. teak trees (*Tectona grandis* L.F.) from Indonesia, Thailand, Java and India

Nov 15

1. Find the raw data of proxy records mentioned in Nov 13 in Paleo Data Search and download them as .txt
    a. Kauri tree ring chronologies from Huapai and Cascades, New Zealand
    b. Pink pine tree ring chronologies from New Zealand
    c. Douglas fir and pinyon pine tree ring chronologies from subtropical North America
    d. Great Barrier Reef and New Caledonia coral record
    e. Rarotonga coral record
    f. Teak trees (Tectona grandis L.F.) from Indonesia and India
2. For the teak trees and Douglas fir, there are too many NOAA studies. I don't know which one is the best to use. So I downloaded multiple files to see which one best correlates with ENSO instrumental records.

Nov 19

1. The Peruvian ice core thickness data sent by Dr. Marshall does not correlate well with the instrumental data of ENSO. The d18O data correlates well; however, it only goes back to 1900.
    a. Alternative peru ice core found in NCEI with d18O data that goes back to 488 C.E.: https://www.ncei.noaa.gov/access/paleo-search/study/2447
    b. Tibetan ice core d18O found in NCEI:

i. Dasuopu Ice Core 1000 Year d18O, Dust, Anion and Accumulation Data

YearAD	d18O per mil	Dust/mL 0.63–20um diameter	Chloride (ppb)	Nitrate (ppb)	Sulfate (ppb)
1996	−17.8	51424	11.3	147.3	66
1995	−18.79	45538	10	120.5	61.8
1994	−16.49	203768	38.8	168.5	116
1993	−14.62	89872	11.7	127.2	83.9
1992	−16.99	97933	25.8	197.5	102.3
1991	−16.27	147695	22.1	189	116.4
1990	−18.94	56493	17.9	106.3	80.4
1989	−17.64	37853	15	94.9	46.4
1988	−20.78	74943	55.5	102.2	44
1987	−15.91	74569	12.5	135.6	62.8
1986	−20.15	54150	12	79.2	45.7
1985	−21.89	34880	8.9	59.1	28.1
1984	−19.7	59313	8.5	80.3	33.4
1983	−18.04	77163	9	84	37.9
1982	−14.74	119158	21.7	170	89.6
1981	−17.74	81729	12.5	83.8	49.8
1980	−19.18	60055	8	83.1	37.5
1979	−14.28	116235	18.3	123.9	62.6
1978	−20.2	110581	23.5	105.8	80.5
1977	−17.3	49234	8.2	88.2	39.7
1976	−15.38	117544	17.5	139.8	90.7
1975	−19.82	58012	12.2	87.5	41.8
1974	−18.61	60235	8.5	100.3	30.5
1973	−16.35	175500	20.6	135.9	67.7
1972	−17.58	73298	14.9	108	43.4
1971	−18.16	57336	11.5	95.8	41.2
1970	−18.97	95460	11.3	88.4	44.6
1969	−19.35	88196	14.2	110.7	50.5
1968	−17.84	82777	13.4	87.5	39
1967	−16.65	121561	16.4	107.4	52.5
1966	−17.06	82545	12.8	97.7	40.8
1965	−15.35	85692	11.5	102.4	47.2
1964	−20.55	48509	10.6	67	27.8
1963	−17.46	41880	14.8	83.1	43.5
1962	−18.49	42225	7.5	71.6	29.5

Nov 21

1. Nino 3.4 instrumental records downloaded from: https://psl.noaa.gov/gcos_wgsp/Timeseries/Nino34/
   Annual average is calculated for data analysis

Nino3.4 SST

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1871	-0.25	-0.58	-0.43	-0.5	-0.7	-0.53	-0.6	-0.33	-0.24	-0.33	-0.31	-0.58	-0.448
1872	-0.72	-0.62	-0.5	-0.77	-0.62	-0.52	-0.32	-0.85	-1.02	-0.94	-0.79	-0.88	-0.713
1873	-0.78	-1.01	-1.31	-0.67	-0.53	-0.48	-0.58	-0.39	-0.34	-0.78	-0.77	-0.7	-0.695
1874	-0.93	-1.06	-1.4	-0.94	-0.86	-0.72	-1	-1.05	-1.13	-1.25	-1.33	-1.14	-1.068
1875	-0.71	-0.37	-0.59	-0.87	-1.09	-0.76	-0.85	-0.81	-0.91	-0.83	-0.64	-0.75	-0.765
1876	-0.95	-1.2	-1.13	-1.18	-1.08	-0.43	-0.34	-0.16	-0.02	0.11	0.15	0.23	-0.500
1877	0.35	0.46	0.52	0.5	0.76	0.98	1.42	1.54	1.75	1.95	2.08	2.49	1.233
1878	2.41	2.43	1.31	0.92	0.82	0.92	0.25	-0.11	-0.32	-0.53	-0.7	-0.75	0.554
1879	-0.55	-0.18	-0.24	-0.37	-0.83	-0.67	-0.77	-0.69	-0.83	-0.93	-1.14	-1.02	-0.685
1880	-1	-0.73	-0.62	-0.57	-0.71	-0.61	-0.53	-0.24	-0.03	0.17	0.24	0.18	-0.371
1881	0.29	0.23	0.32	0.41	0.16	0.23	-0.26	-0.17	-0.33	-0.43	-0.59	-0.37	-0.043
1882	-0.45	-0.55	-0.53	0.1	0.01	-0.4	-0.57	-0.33	-0.51	-0.65	-0.92	-0.75	-0.463
1883	-0.46	-0.49	-0.4	-0.23	-0.38	-0.21	-0.01	-0.03	-0.17	-0.42	-0.22	-0.14	-0.263
1884	-0.11	-0.01	0	0.26	0.4	-0.13	0.28	0.2	0.18	0.29	0.3	0.35	0.168
1885	0.12	0.27	0.12	-0.02	0.44	0.17	0.08	0.34	0.52	0.72	0.81	1.02	0.383
1886	0.17	-0.1	-0.11	-0.37	-0.85	-0.9	-0.97	-1.03	-1.21	-1.14	-1.34	-1.44	-0.774
1887	-0.68	-1.02	-1.17	-1.18	-1.14	-0.56	-0.55	-0.62	-0.34	-0.12	0.04	0.15	-0.599
1888	0.15	0.66	0.4	0.3	0.47	0.4	0.56	0.93	0.58	1.42	2.21	1.67	0.813
1889	1.98	1.47	0.83	0.46	0.32	0.09	-0.76	-0.99	-0.92	-1.31	-1.08	-1.25	-0.097

2. Proxy data files in text form are imported into the sheets and split into columns as shown in the screenshot below.

DATA:

1. Dasuopu Core 3 Annual averages of oxygen isotopes, dust concentration and major ions (1450-1996 AD)

YearAD	d18O per mil	Dust/mL 0.63-20um diameter	Chloride (ppb)	Nitrate (ppb)	Sulfate
1450	-21.12	33537	12	74	35.5
1451	-19.56	59803	9.1	69.9	27.9
1452	-18.79	52600	5.9	57.1	21.8
1453	-19.59	51820	5.1	53.4	20.8
1454	-20.28	39452	4.6	49.9	15.7
1455	-21.06	52793	5.2	40	19.8
1456	-20.63	57960	10	60.3	28.1
1457	-20.28	67050	6.7	47	21.6
1458	-20.25	40480	5	45.9	22.5
1459	-20.82	24256	4.9	45.6	22.8
1460	-21.3	26250	4.2	39.1	17.7
1461	-20.5	105320	6.4	54.5	25.9
1462	-20.26	24340	5.6	47.8	20.7
1463	-20.97	20270	3.8	37.3	13.7
1464	-21.39	28277	4.8	35.4	14.9
1465	-20.94	42587	8	55.9	26.6
1466	-19.57	37547	6.3	42.1	17.5
1467	-22.37	34467	4.1	31.1	14.8
1468	-20.47	48620	6.6	57.6	26.7
1469	-19.91	24345	2.9	39.8	17.8
1470	-20.06	25293	3	35.9	15.2
1471	-20.06	47780	8.2	65.4	24.2
1472	-21.64	36520	4.9	51.7	21.7
1473	-20.03	33080	5.5	47.2	19.1
1474	-21.4	37425	5.8	47.4	22.3
1475	-20.51	27570	4.6	41.3	16.1

Nov 25

1. Using the function =CORREL in Google Sheets, I calculated the r(correlation) between the proxy data and the annual average of Nino3.4 (for some proxies I also calculated its

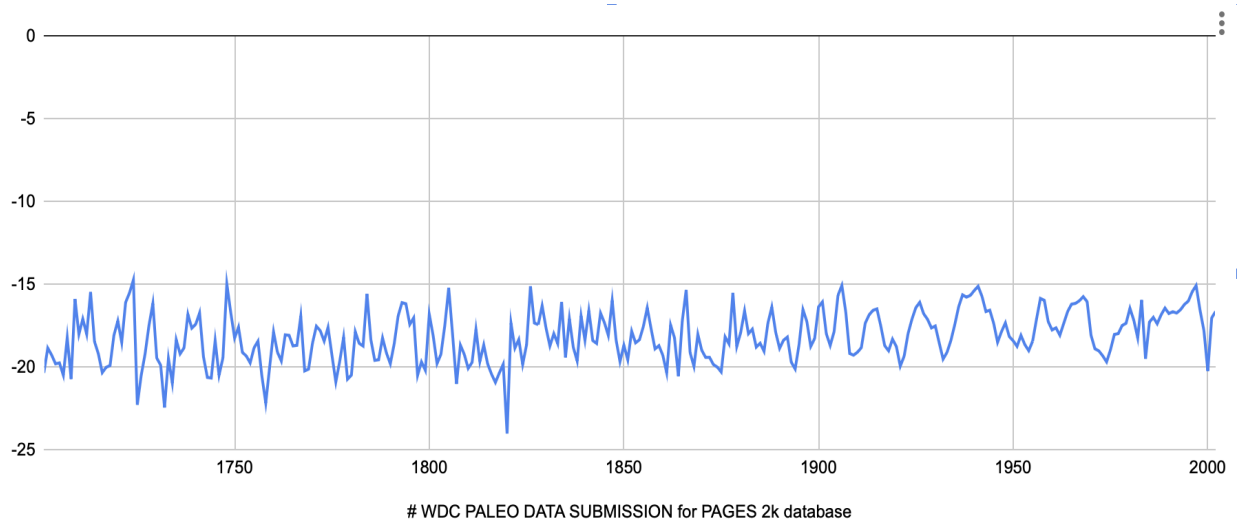
correlation with Nino3.4 Jan and Dec)

1870	-19	NINO3.4 avg		NINO3.4 Dec		NINO3.4 Jan	
1871	-19.4325	-0.448	0.4891025307	-0.58	0.3136973534	-0.25	0.3964646071
1872	-19.4275	-0.713		-0.88		-0.72	
1873	-19.8675	-0.695	calculated r	-0.7		-0.78	
1874	-20.0175	-1.068		-1.14		-0.93	
1875	-20.31	-0.765		-0.75		-0.71	
1876	-18.19	-0.500		0.23		-0.95	
1877	-18.615	1.233		2.49		0.35	
1878	-15.53	0.554		-0.75		2.41	
1879	-18.77	-0.685		-1.02		-0.55	
1880	-17.9375	-0.371		0.18		-1	
1881	-16.6125	-0.043		-0.37		0.29	
1882	-18	-0.463		-0.75		-0.45	
1883	-17.7275	-0.263		-0.14		-0.46	
1884	-18.8075	0.168		0.35		-0.11	
1885	-18.575	0.383		1.02		0.12	
1886	-19.0625	-0.774		-1.44		0.17	
1887	-17.3575	-0.599		0.15		-0.68	
1888	-16.39	0.813		1.67		0.15	
1889	-17.9175	-0.097		-1.25		1.98	
1890	-18.885	-1.279		-0.68		-2.49	
1891	-18.3925	-0.007		0.01		-0.45	
1892	-18.2025	-0.835		-1.18		-0.5	
1893	-19.7225	-1.249		-1		-1.23	
1894	-20.135	-0.920		-0.48		-1.09	
1895	-18.6575	-0.023		0.48		-0.73	
1896	-16.5425	0.568		1.55		0.16	
1897	-17.26	0.072		-0.4		1.49	
1898	-18.7675	-0.558		-0.78		-0.51	
1899	-18.295	0.211		1.51		-0.75	
1900	-16.3775	0.742		0.6		1.41	
1901	-16.08	-0.121		-0.35		0.82	
1902	-18.0025	0.736		1.39		-0.5	

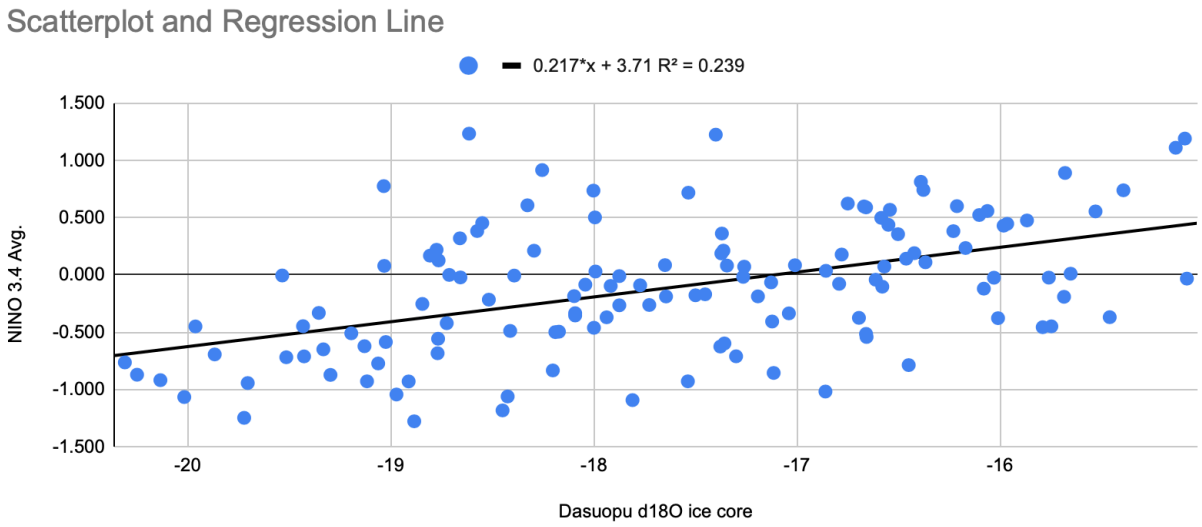
2. Proxies with statistically significant correlation (|r|>0.2): Pink pine tree ring in New Zealand; Kauri tree ring chronology in Cascades, New Zealand; Quelccaya ice core d18O in Peru; Dasuopu ice core d18O in Tibetan Plateau

Nov 27

1. Create line charts for the proxies with statistically significant correlations: The two peaks for the 1982 and 1789 El Nino have similar heights, which indicates similar intensity.



Dec 5

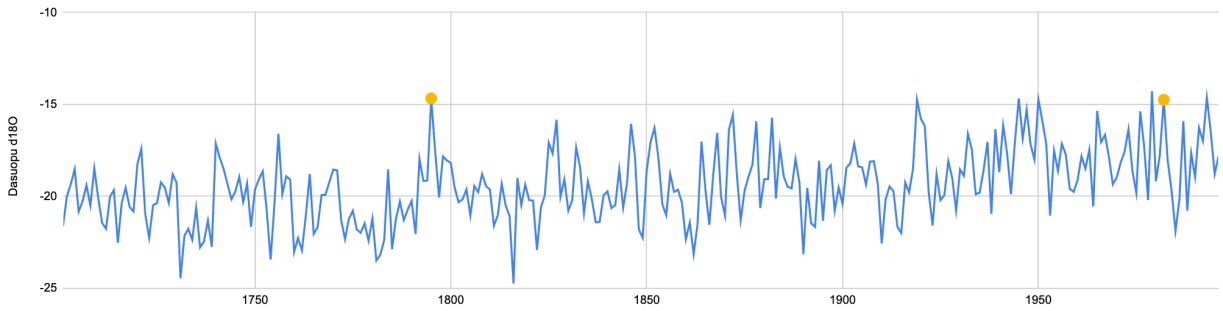


1. Switch the axis in order to put the proxy data as the x values of the regression line and output the reconstructed NINO 3.4
2. Use the function in Google Sheets to calculate the reconstructed NINO 3.4 index
3. Create a line graph (example below) for the reconstructed NINO 3.4 index

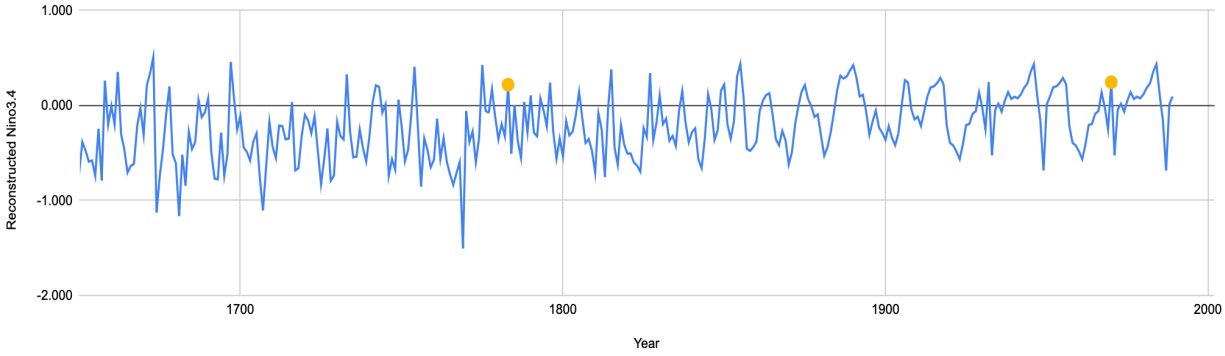
Dec 9

1. Create line graphs for the ENSO reconstructions based on proxy data

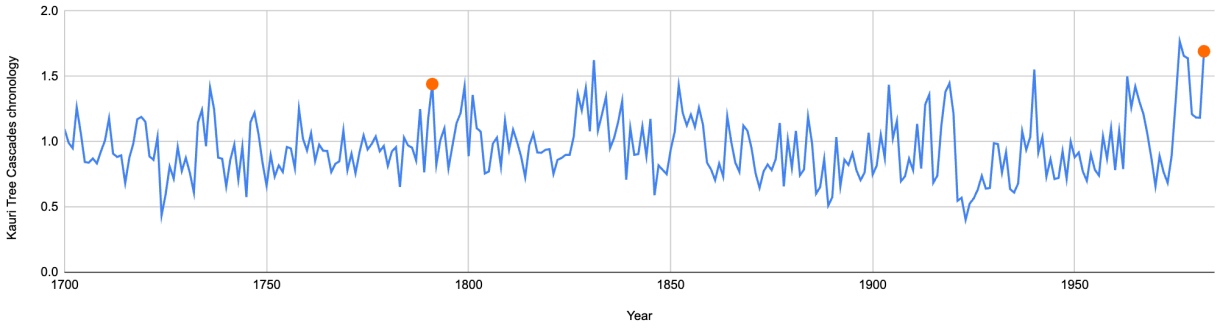
Dasuopu d18O ice core



NINO3.4 Reconstruction based on Quelccaya d18O



Kauri tree ring chronology, Cascade



Dec 17

1. Collect the economic data of New Zealand in 1980s and sort them into google sheets from Stats NZ https://www.stats.govt.nz/

	A	B	C	D	E	F
	DP(P), Nominal, Actual, Total (An					
	Gross Domestic Product - production measure					
	1972	6,855				
	1973	7,872				
	1974	9,201				
	1975	10,110				
	1976	11,388				
	1977	13,964				
	1978	15,643				
	1979	17,730				
	1980	20,696				
	1981	24,086				
	1982	29,328				
	1983	33,178				
	1984	36,989				
	1985	41,785				
	1986	48,249				
	1987	57,953				
	1988	65,228				
	1989	70,137				
	1990	74,212				
	1991	76,127				
	1992	75,967				
	1993	78,335				

Nominal GDP

2. In Stats NZ there is many kinds of economic indicators that may be useful
    a. Could check out whether they are better than GDP if time allows

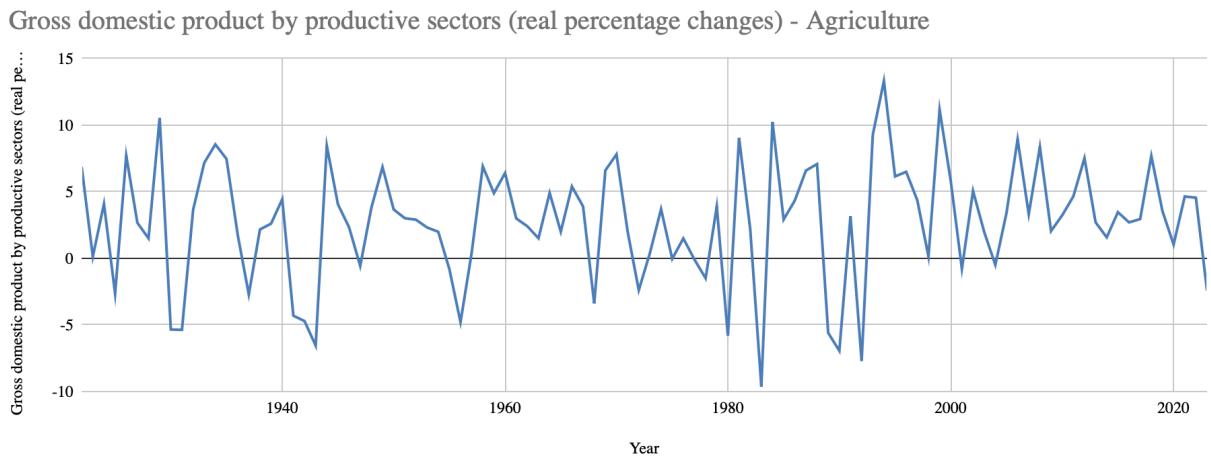
Jan 24

1. Collect Peruvian economy data from [the Central Reserve Bank of Peru] and sort them into [google sheets]

	A	B
1		PD39552DA
2		PBI Sectorial - PBI (Var.%)
3	1922	5.072965616
4	1923	4.490749925
5	1924	8.901884538
6	1925	3.145034191
7	1926	9.381447407
8	1927	3.06884367
9	1928	5.371289806
10	1929	12.59019161
11	1930	-9.49378572
12	1931	-6.605734841
13	1932	-3.25061969
14	1933	10.76017854
15	1934	12.70408137
16	1935	8.852326048
17	1936	4.814349961
18	1937	1.937918289
19	1938	2.005978738
20	1939	0.8182938648
21	1940	2.468357745
22	1941	0.8506975875
23	1942	-1.034167293
24	1943	1.749576209
25	1944	8.054971442
26	1945	3.428571563
27	1946	4.013205831
28	1947	3.459135391
29	1948	3.754899687
30	1949	7.771534062
31	1950	8.021895739
32	1951	9.264418377
33	1952	5.895640894
34	1953	5.78283735
35	1954	5.344913647

Agriculture | Fishery | Consumer Price Index | GDP(percentage change)

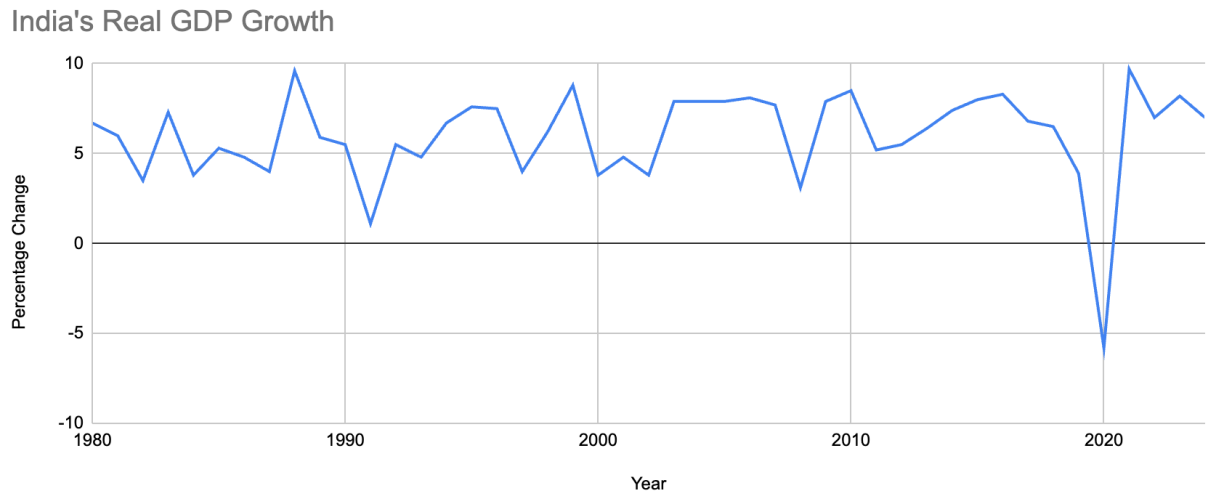
2. Visualize the change in data by creating line graphs



Jan 28

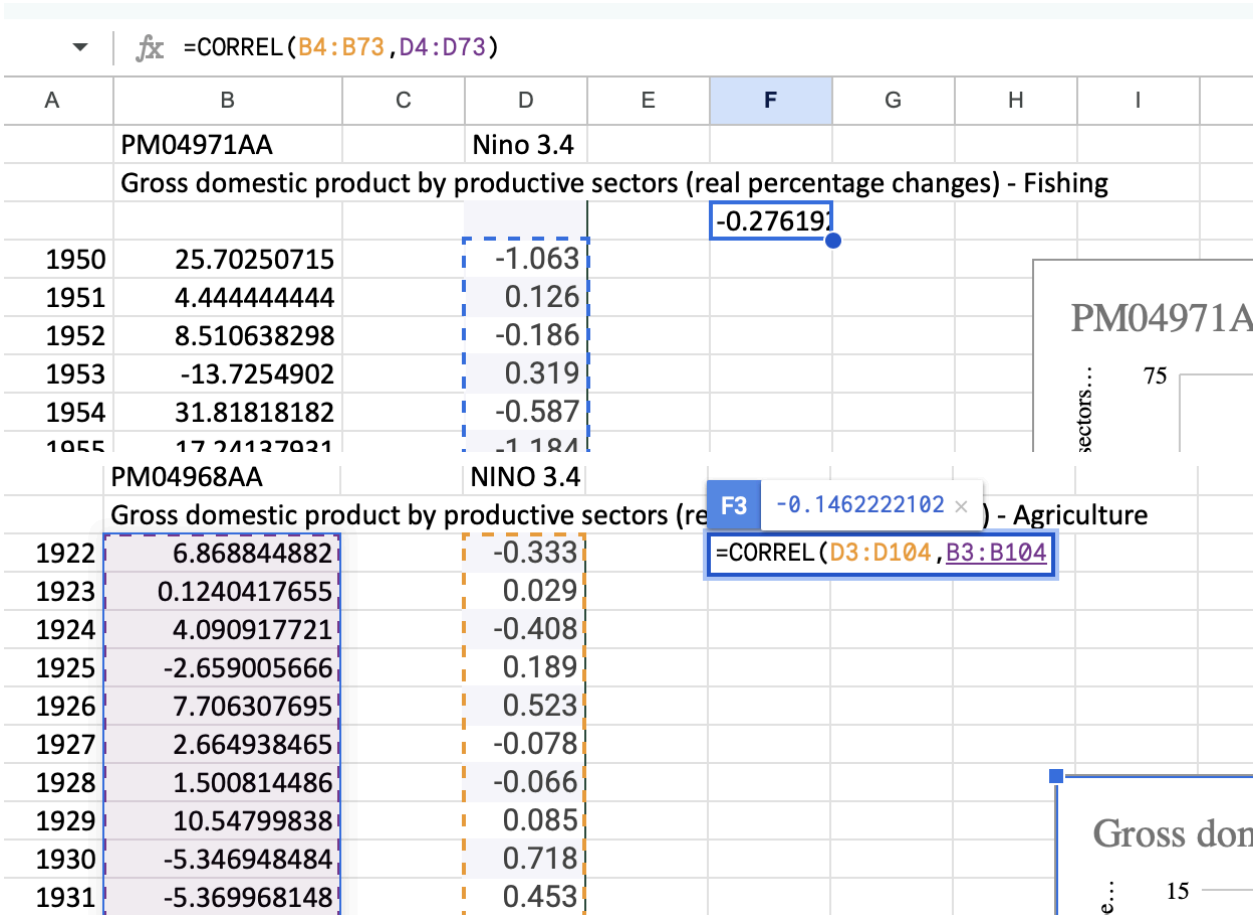
1. Collect data on India's GDP growth and agricultural production from IMF (International Monetary Fund) and Reserve Bank of India into google sheets

2. Visualize the change in data by creating line graphs



Jan 30

1. Calculate the correlation between Nino 3.4 and the Peruvian economic data

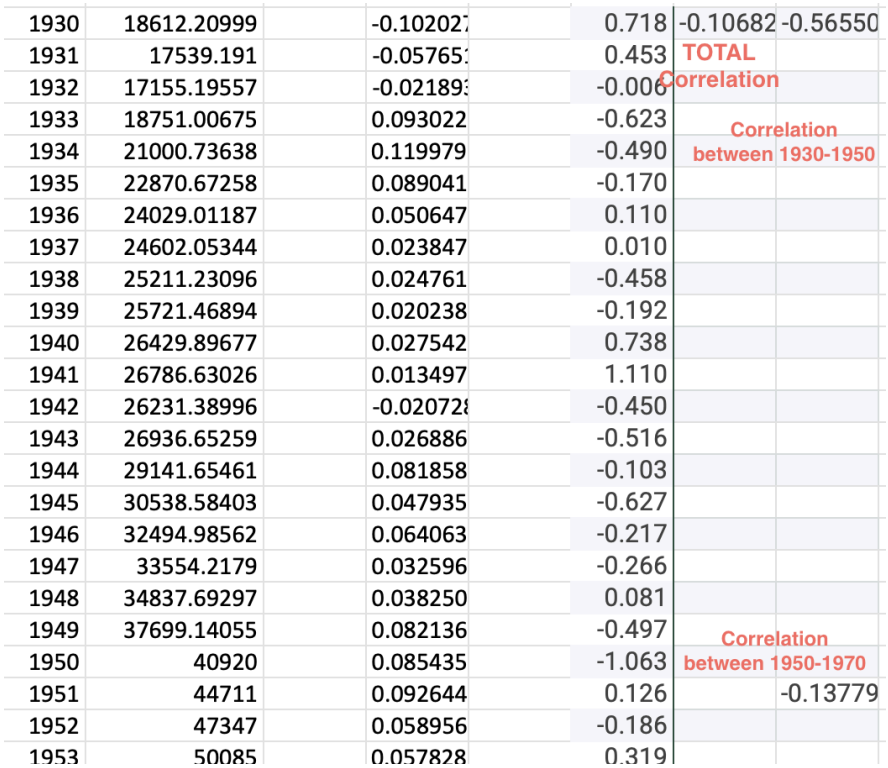


The correlation is not ideal even when anomalies caused by Covid and WW2 are deleted.

2. Choosing different instrumental records
    a. For Peru, Nino 1,2,3 that is closer to Peru's coast may generate more correlation
    b. Or use indices such as MEI that measures more than just the sea surface temperature

Feb 3

1. Calculate the correlations between Peruvian economic data(GDP, fishery and agriculture) and ENSO in different time periods: 1930-1950, 1950-1970, 1970-1990, 1990-present
2. The correlation between Peru's GDP and fishery steadily declines



1930	18612.20999	-0.10202	0.718	-0.10682	-0.56550
1931	17539.191	-0.05765	0.453	TOTAL	
1932	17155.19557	-0.02189	-0.006	Correlation	
1933	18751.00675	0.093022	-0.623		
1934	21000.73638	0.119979	-0.490	Correlation between 1930-1950	
1935	22870.67258	0.089041	-0.170		
1936	24029.01187	0.050647	0.110		
1937	24602.05344	0.023847	0.010		
1938	25211.23096	0.024761	-0.458		
1939	25721.46894	0.020238	-0.192		
1940	26429.89677	0.027542	0.738		
1941	26786.63026	0.013497	1.110		
1942	26231.38996	-0.02072	-0.450		
1943	26936.65259	0.026886	-0.516		
1944	29141.65461	0.081858	-0.103		
1945	30538.58403	0.047935	-0.627		
1946	32494.98562	0.064063	-0.217		
1947	33554.2179	0.032596	-0.266		
1948	34837.69297	0.038250	0.081		
1949	37699.14055	0.082136	-0.497		
1950	40920	0.085435	-1.063	Correlation between 1950-1970	
1951	44711	0.092644	0.126		-0.13779
1952	47347	0.058956	-0.186		
1953	50085	0.057828	0.319		

Feb 5

1. Calculate the correlation between Indian economic data and ENSO in different time periods: 1950-1970, 1970-1990, 1990-present
2. Interesting trend detected: the correlation between india's foodgrain production and ENSO spiked after 1990

1971-72	858	-1.605504587	-0.931	
1972-73	813	-5.244755245	0.775	-0.1113093521
1973-74	827	1.72201722	-0.651	
1974-75	824	-0.3627569528	-0.945	Correlation between 1970-1990
1975-76	944	14.5631068	-1.045	
1976-77	894	-5.296610169	-0.086	
1977-78	991	10.85011186	0.502	
1978-79	1,022	3.12815338	-0.178	
1979-80	876	-14.28571429	0.187	
1980-81	1,023	16.78082192	0.141	
1981-82	1,032	0.8797653959	-0.188	
1982-83	1,035	0.2906976744	0.915	
1983-84	1,162	12.2705314	0.446	
1984-85	1,149	-1.118760757	-0.720	
1985-86	1,175	2.26283725	-0.712	
1986-87	1,128	-4	0.084	
1987-88	1,173	3.989361702	1.224	
1988-89	1,331	13.46973572	-1.019	
1989-90	1,349	1.352366642	-0.788	
1990-91	1,380	2.297998517	0.178	
1991-92	1,382	0.1449275362	0.598	-0.356633027
1992-93	1,457	5.426917511	0.623	Correlation between 1990-2020
1993-94	1,501	3.019903912	0.437	
1994-95	1,546	2.998001332	0.382	
1995-96	1,491	-3.557567917	-0.025	
1996-97	1,614	8.249496982	-0.370	