How are climate data used by activists?

Marc Los Huertos

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Contents

1 Introduction

1.1 Climate and the IPCC

According the the Inter-Governmental Panel on Climate Change or IPCC, the last three decades at the Earth's surface have seen the most amount of successive warming than any decades since 1850. All in all, the averaged data for ocean surface and land temperatures combined points to a rise of 0.85 [0.65 to 1.06] degrees Celsisus from 1880 to 2012 [1] – but this global average is not evenly distributed accross the globe.

This change and causes of this change are perhaps some of the most contested environmental issues in the 50 year history of the environmental movement. So much so, that as EA students, we need to understand what the scientific conclusions are and how these conclusions were made, while understanding the potential implications.

1.1.1 What is the IPCC?

The Intergovernmental Panel on Climate Change (IPCC) is a scientific and intergovernmental body under the auspices of the United Nations, set up at the request of member governments and dedicated to the task of providing the world with an objective, scientific view of climate change and its political and economic impacts.

The IPCC was created in 1988. Initially it was set up by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) to prepare assessments on all aspects of climate change and its impacts, based on available scientific information. The goals of the IPCC is to formulate realistic response strategies.

1.1.2 IPCC's Role

The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis and risk of human-induced climate change, its potential impacts and options for adaptation and mitigation.

As an intergovernmental body, membership of the IPCC is open to all member countries of the United Nations (UN) and WMO. Currently 195 countries are Members of the IPCC.

The IPCC has published five comprehensive assessment reports reviewing the latest climate science (Table 1), as well as a number of special reports on particular topics. These reports are prepared by teams of relevant researchers

[1] IPCC, 2014: Climate Change 2014: Synthesis Report . Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Table 1: Major IPCC Reports

Assessment Report	Published
First Assessment Report (FAR)	1990
Supplementary Report	1992
Second Asessment Report (SAR)	1995
Third Assessment Report (TAR)	2001
Fourth Assessment Report (AR4)	2007
Fifth Assessment Report (AR5)	2014
Sixth Assessment Report (AR6)	2022*

selected by the Bureau[2] from government nominations.[3] Drafts of these reports are made available for comment in open review processes to which anyone may contribute.

Each assessment report is in three volumes, corresponding to Working Groups I, II, and III. Unqualified, "the IPCC report" is often used to mean the Working Group I report, which covers the basic science of climate change.

1.2 Global and Regional Average Temperature Changes

In speaking about the topic of climate change it is easy to cite a global temperature average. However, this is part of what makes climate change such a contentious issue. An average temperture increase for the globe is actually somewhat abstract and, perhaps, beyond what humans can reliably perceive. In this sense, perhaps we should evaluate how temperature (and/or rainfall) might be changing at regional scales.

Are there strategies to help us appreciate the impact of climate change on weather patterns at the regional level? Can regional level impacts help develop politically viable strategies to address the global problem? How do local activists consider regional data and do their interpretations align with currrent scientific thinking?

In other words, we are seeking to answer the question: how do activitists use regional climate change patterns?

1.3 Goals of this Document

This document is meant to be a resource and guide to you as you undertake the task of answering the question: how do activitists use regional climate data? This document contains:

1. Descriptions of the overarching goals and approaches for each assignement in the project;
2. Guidelines and resources for completing each assignment; and

[2] I am note sure what this means, but haven't had the time to sort it out! Suggestions?
[3] I'd be interested to see how this process is done in the USA.

3. Grading rubrics and descriptions of how we will evaluate the project process and products.

2 Project Description

2.1 Driving Question(s)

The driving questions for this project can be stated as follows:

- How is regional climate data being used by cliamte activists?

However, as we move along in the course and in this project you may find it worthwhile to try phrasing the questions in a number of ways – this might help you find ways to make the question more provactive and interesting, For example, instead of asking "how is the climate in my region changing?" you could ask "how does the changing climate in my region affect cloud coverage in my area and what ecological impact does that have on nearby forests/wildlife?"

You can modify these questions to develop the project that you might find compelling.

2.2 Public Products

Science is a social project. From the questions we ask, to the results and their presentation, science is usually embedded in a culture of norms (such as research journals, reports, documentaries, etc.). To frame our science within these norms of communication, each of us will publish a series of blogs utilizing our findings to answer our driving question.

In addition, each student will write and submit an Op-Ed piece to a regional newspaper that frames regional climate issues into a newsworthy item.

3 Directed Practice

3.1 Learning Goals

For this project, you will obtain weather records to answer the driving questions. However, the exact way you decide to answer the question is largely up to you. Nevertheless, specific skills and knowledges will be required to successfully address the question:

Skills

- Ability to obtain and process weather long-term weather records;[4]
- evaluate temporal trends in weather data;
- research the environmental impacts on human or non-human communities; and

[4] I advise students to find stations with atleast 50 years of data.

- communicate conclusions to the public with special attention to guide how data misinterpretations should be considered.
- determine how data are used by activists.

Knowledge

- Understand how data climate data is currated;
- Analyze climate impacts from around the world.

Throughout this project, we will co-develop the strategies and skills to address this question and help you make some conclusions and present the results to the public.

3.2 Resources

Students will have the following tools available:

- Servers where stored weather data can be downloaded;
- R Studio Server with some scripts & libraries to help develop analyses;
- Github to store project codes and as a platform to make the product public;
- Lectures, reports, and presentations on climate change science, the social and ecological implications of climate change, and public policy and politics of climate change;
- Random numbers for student submissions; and
- Shiny app templates that might be used as a container for interactive content.[5]

3.2.1 Software Guides

Much of the environmental data collected has become electronic. Using software requires certain skills, which requires students to appreciate that different types of software exist.

In particular, I am constantly thinking critically about what software I advise students to use and learn. For my "developmental thinking" on this issue, I suggest you read the following draft white paper: Open Source and Liberation.

Since climate data rely on large time series datasets, we need to rely on software to access to and process these data, we need use tools to access, pre-process, and analyze these data. Below are resources that we have developed to assist you in this class (Table 2).

3.2.2 Data Processing and Analysis Tools

Much of the environmental data collected has become electronic. Thus, to access to and process these data, we need use tools to access, pre-process, and analyze these data using computer software.

[5] Currently under-development – We will likely skip this application since I not confident in using this particular tool.

Table 2: Software guides developed for EA30. These SOPs have been developed by students and faculty over the years and are loaded on the github.com/SOPs repository.

SOP #	Description
06	An Introduction to Rstudio and Github
06b	Introduction to Markdown–Html
06c	Introduction to Markdown–Word
06d	Visual Display of Data using R

Below are resources that we have developed to assist you in this class (Table 3).

Table 3: Resources to obtain, pre-process, and analyze NOAA climate data.

Step #	Title
1	Obtaining Climate Records
2	Using NOAA climate Records
3	Evaluating Monthly Trends using CHCN-Daily

These SOPs can be found in the Rproject/Github Respistory –Climate Change Narratives and in the 'Analysis_SOPs' directory.

The analysis of trend data can range from simple to complex. For a brief introduction, read an introduction on the Trend Analysis on the Climate Data Guide website.

3.2.3 Readings and Other Climate Change Resources

I have put these readings in the syllabus schedule, since these readings are more background material.

3.2.4 Contested Science and Critical Thinking

- "The Rhetorical Tools of Logical Fallacies"
- "Critical Thinking in EA"

3.2.5 Communication Resources

We will learn and practice our skills to communicate using written and oral media.

Scientific writing is a skill that takes years to develop. Although there are many types of readings, scientific writing does have some unique characteristics that will seem a bit awkward. However, you might be surprised about how much you already know about technical writing. We have selected key resources that we think will help you further develop and improve your writing skills.

However, specific genres require specific adjustments in our writing style. Please use the following to help in your writing process:[6]

- "Scientific Writing and Climate Narratives"
- "Op-Ed Guidelines"
- "Scientific Blog Guidelines"
- "Visual Presentation of Data using R"
- "Citing References in EA30"
- "Peer review writing – Dos and Don'ts"

Oral presentations will also be part of this project and course. Students will use Rpres for their presentations and here is a short tutorial for this tool:

- "Using Rpres to Develop Oral Presentations"
- "Guide for Oral Presentations"
- "Guide to Make Effective Video Presentations for Covid-19" Coming soon! ☺

Below is my list of key areas to be cognizant to improve our capacity to communicate science:

Clarity, Forthrightness, and Economical

Accuracy and Precision Accuracy and precision occurs at several scales in writing, word choice, sentence level, paragraph, and essay level.

Critical Thinking

Cited Evidence

4 Project Milestones

To complete the project in a timely fashion, we will be adhering to a rather strick schedule (Table 4).

5 Op Ed #1: Scientific Values and Climate Activists

5.1 Rationale

Climate change may be the most controversial environmental issue in history. However, compared to other issues, this history is relatively short. Fueled by opposing political parties and industry goals, the conclusions of scientists is

[6] I have used various emails and conversations to produce the resources below, but they are still rough around the edges. I usually hire students to improve these resources after I get them started – let me know if this is something you might be interested in doing after the semester ends.

Table 4: Project Deliverables, milestones and point distribution. *I encourage students to continue to improve their blogs (and their grades) even after they are published.

Deliverable	Launch	Due Date	Points
Op-Ed #1	Aug 28	Sep 12	10
Draft Regional Analysis	Sep 1	Sep 12	20
Climate Science Expert Team Video	Sep 1	Sep 12	20
Regional Climate Literature Review	Sep 1	Sep 19	20
Climate Science – Forum	Sep 1	Sep 19	15
Blog Draft	Sep 1	Sep 26	50
Blog – Peer Review	Sep 1	Oct 3	10
Published Blog*	Sep 1	Oct 10	50
Op Ed #2 Submission	Sep 1	Oct 10	25

a fundamental source of conflict – thus, science itself has become extremely politicized.

Nevertheless, how and where science and scientists became embroiled became a battle ground negotiating the appropriate level of regulation (regulatory reach), economic and industrial *Laissez-faire*, and environmental risks. Environmental issues are almost always controversial and in the case of climate change, few dominate the political agenda like climate change.

Nevertheless, in a pandemic and election year, the political states may be higher than normal. The role of activism in the US (and world) has changed in recent years with a higher reliance on social media. Of course, with the current requirements for Covid-19 social distance, social media might be the primary source of information for many.

In this context, we need to determine the role of and changes in activism and it's role in climate science. Moreover, we need to evaluate the how activist are using scientific information, especially climate records as they promote their agendas.

5.2 Assignment

Write an Op-Ed piece that describe the role of activism in climate change, their use of climate data during a pandemic and election year. Spend sometime deciding what is currently in the news that you consider a compelling issue to your audience.

5.3 Submission Format and Naming Convention

Submit your Op-Ed as a pdf via `Sakai`, using the following naming convention:

Op-Ed_1_XXXXX.pdf,

using one of your 5 digit random numbers for the Xs. See `https://github.com/marclos/Climate_Change_Narratives/raw/master/Admin/RandomNumbers.pdf` to get the list of assigned random numbers.

5.4 Grading

The Op-Ed will be graded using several criteria. First, the topic must be compelling – connecting current affairs to the historical issues of climate. Second, the Op-Ed should rely on several sources of evidence and citations, while creating fluid prose that compel the reader to continue reading. If the reader gets stuck in statistics or technical jargon, it can be like wading in mud – but without some "numbers" the argument may become glittering generalities without a sense of a gritty reality. Again, your job is to find a compelling balance. Finally, you want the read to jump out of their seat and "do something". Thus, the Op-Ed should compel the reader into action, see assignment handout for more information.

6 Developing Specialized Knowledge

To develop expertise, we will rely on teams of students to develop and evaluate various aspect of climate data. Each of us form an essential component for the effort. Organized as teams and expert groups, we will disassemble the project into chunks that each of us will contribute in specific and effective ways. This expertise will be used to develop our Q & A sessions, as well as, to help us develop and write our op-ed and blogs. The experts should include areas of contravery and how scientists and non-scientists wressle over the data.

6.1 Topics of Expertise

We will will create expert groups on to present the following topics:

1. Radiative Gases – What are they and what do they do?
   List the major compounds categorized as radiative gases and describe how various processes determine their role as GHGs. Provide detail on how different wavelengths of light interact with the gases. Finally, a discussion of water is key, since it is one of the main sources of controversy.
2. GHG Emission Trends and Sources – Carbon Dioxide (CO_2), Nitrous Oxide (N_2O), and Methane (CH_4).
   Describe how carbon dioxide and other GHGs are emitted and remain in the atmosphere. Distinguish between natural and anthropogenic sources and why that distinction might be important. Desribe various type of sources and how these might be linked to certain types of economic development and activities. In addition, describe the role of vegetation and other forms of carbon sequestration. Describe the sources of uncertainty

and the common arguments that are used to discount the role of greenhouse gases (e.g. carbon dioxide is natural and can't be a pollutant, humans exhale carbon dioxide, carbon has been higher in the past, etc).

3. Role of Water and Other Feedbacks
   Climate change feedback is important in the understanding of global warming because feedback processes may amplify or diminish the effect of each climate forcing, and so play an important part in determining the climate sensitivity and future climate state. Feedback in general is the process in which changing one quantity changes a second quantity, and the change in the second quantity in turn changes the first. Positive feedback amplifies the change in the first quantity while negative feedback reduces it. Be sure to include the following feedbacks: Clouds, gas release (Methane is a big one), ice-albedo, carbon, and water vapor. Describe the uncertainties and how some of these have become politicized.
4. Terrestrial Surface Temperature Records
   The instrumental temperature record provides the temperature of Earth's climate system from the historical network of in situ measurements of surface air temperatures and ocean surface temperatures. Data are collected at thousands of meteorological stations, buoys and ships around the globe. The longest-running temperature record is the Central England temperature data series, that starts in 1659. The longest-running quasi-global record starts in 1850.
5. Ocean Temperatures and Sea Level
   In recent decades more extensive sampling of ocean temperatures at various depths have begun allowing estimates of ocean heat content but these do not form part of the global surface temperature datasets. Describe how ocean temperatures have been measured over time and how these have lead to a range of interpretations of the results. Discuss how the thermal expansion of water may influence sea leval rise. Discuss how sea temperature change may affect different parts of the world differently. Describe the methods to distinguish sea level rise and coastal elevation changes, including how satellites work to collect these data. Describe the areas of uncertainty and how various groups frame these uncertainties.
6. Satellite-based Temperature Measures
   Satellites can be used to measure outgoing radiation. However, each atmospheric layer has different properties and is impacted by GHGs in differing ways. Describe how the satelite data has been used, how these instruments have changed and why there are several different methods to evalaute satellite data. Because satellite data has result results, describe how these methods have been used to support or limit our confidence in climate change. Describe sources of uncertainty and how various groups have used the uncertainties to make arguments for and against anthropogenic climate change.
7. Weather Extremes Trends Explained
   Weather and climate extremes such as hurricanes, tornadoes, heavy downpours, heat waves, and droughts affect all sectors of the economy and the

environment, impacting people where they live and work. As usual some claim that more extreme weather has been caused climate change, while others claim that there has been a reduction in extreme events. Please describe why the analyses have not developed into a clear conclusion.

6.2 Expert Teams

Although most of the work will be individual, we will also work in pair for the presentation. Using this Google Sheet, sign up for a topic and as the slots are filled, I will update this document.

The following students have been assigned to the teams below:

Topic	Team_Members	Presentation_Date
1	1 , 8 , 15	09/19/20
2	2 , 9 , 16	09/19/20
3	3 , 10 , 17	09/19/20
4	4 , 11 , 18	9/19/20
5	5 , 12 , 19	09/19/20
6	6 , 13 , 20	09/19/20
7	7 , 14 , 21	09/19/20

6.3 Climate Science Review Presentation

6.3.1 Rational

Climate change science is complex and requires a tacit understanding of a range of scientific disciplines. Instead of trying to learn all about them, we will hear presentations from our peers on various topics based on their own research.

Following the adage, 'the best way to learn is to teach', is an appropriate way to think about this assignment.

6.3.2 Assignment

Create a 10-12 minute presentation where each team member should limit their presentation to 3-4 minutes each. Tem minutes goes quickly, so I suggest you practice a few times to ensure that you don't lose unnecessary points. Longer presentations will be penalized.
Assignment:

- Describe the historical development of the scinece/topic.
- Describe how data are collected and used to develop conclusions.
- Describe areas of uncertainty.
- Make an organized presentation that effectively communicates how various scientific arguments have been distorted and politicized;
- Identify how conventional scientific standards have been comprimised; and

- Use the allotted time (10-12 min) effectively. I suggest you practice, 10 mintues can go very quickly when presenting complext scientific data.[7]

6.3.3 Submission Format and Naming Convention

I have created a link on vidgrid for you to create the video.[8] Please submit and name the vido using the following naming convention:
Y_Topic_Title,

where "Y" is the topic number enumerated in the previous section.

6.3.4 Presentation Grading Criteria

The Climate Science Presentation will be grading using the criteria in Table 5.

Table 5: Presentation Grading Criteria

Standard	Percent	Criteria
Accuracy	20%	Was the information accurate?
Completeness	20%	Were important issues not addressed? Or important aspects left out?
Clarity	20%	Was the presentation clear and logically constructed?
Timeliness	20%	Was the presentation completed within the alotted time?
Use of Technology	20%	Was technology used effectively?

6.4 Climate Science Presentation Forums

6.4.1 Rational

Communicating about climate sciene is fraught with potential stumbling blocks. First, it's hard to hit the audience knowledge level correctly. Second, many readers have biases, which means that readers have filters that we might not be able to appreciate. Finally, since we are not climate scientists, we are working to translate the science into a languages that others can understand – back to first point!

By using peer reveiw, we can develop methods that might reduce this stumbling blocks, where your peers will be able to read and evaluate if the text is clear, accurate, and comprehendable.

6.4.2 Assignment

Watch each presentation and take careful notes. After watching the presentation, post a forum on the topic commenting in the following ways, if appropiriate:

[7] If your group needs extra time, please send a note on the Slack Channel and we'll decided how to proceed.

[8] I need to figure out if you can do a group video – so I'll be checking on that soon!

1. Describe specific components of the video that you thought were helpful and describe why.
2. Identify some concepts that you might use in your blog
3. Ask questions from the authors that you would like more information on or areas that be a source of confusion.
4. Suggest additional informatin that might be useful for other students.

7 Regional Climate Analysis

Each of us will select a region of interest. Perhaps, somewhere that you have spent a compelling time in or that you wish to know more about. Please select a region that has not been done by previous classes.

7.1 Analysis of Regional Data

7.1.1 Rationale

Learning to analyze data requires a range of skills that include collecting, analyzing, and interpreting data. For our purposes, this portion of the class is what might traditionally understood as "doing science." We will learn how to test a hypothesis and what it means if we reject the null hypothesis. We will create figures that can be used to communicate our results and finally, we interpret the results.

Ultimately, this analysis will be used a template for our blogs and inform our second Opinion Editorials.

7.1.2 Assignment

Using the resources supplied, it will be up to you to download, pre-process, and analyze a trend analysis using R – where the slope, r^2, and probability are calculated[9] and explained.

Using R studio, analyze a long-term climate record, create 3-4 figures that will be used to communicate these climate records, e.g. 100-year temperature **and** precipitation record for a specific region. Be sure to include language about the "null" hypothesis for your trend analysis.

7.1.3 Submission Format and Naming Convention

As specified by the milestones (Table 4), submit the draft analysis and results using Rstudio.

The Rmd file (and the compiled html) should be saved the the 'student_submissions' directory using the following naming convention:

[9] We will have to learn what these are to be able to explain our results! Be sure to ask lots of questions about the statistics so you appreciate this important topic that nearly every scientific field relies!

Region_XXXXX.Rmd and **Region_XXXXX.html**

where XXXXX refer to one of your random numbers.

NOTE: Be sure the file still compiles. For example, you may need to change the path to the Data directory.

Since the regional analysis has been down within Rstudio, you will use the version control procedures to commit and push your analysis onto the Github repository. Thus, be sure to commit and push your files so I have access to the files.

7.1.4 Data Analysis Grading

The Data Analysis html files will be grading using the criteria in Table 6.

Table 6: Summary of Data Analysis grading standards.

Criteria	Standard	Percent
Records	Compelling, e.g. Over 60 years	10%
Knowledge of Data	Limitations and Methods of Collection	10%
Analysis	p-values and R^2 reported	20%
Analysis	Validated Model	20%
Interpretation	Accurate, e.g. rejected null	10%
Graphics	Publishable Quality	20%
Accessible	Pushed and named correctly	10%

7.2 Regional Climate Impacts – Literature Review

7.2.1 Rationale

By using peer reviewed literature, we can assess our regional analysis to determine if the are trends that have been predicted that align or possibly contradict our analysis.

This assignment is designed to help you put create a blog and have compelling information.

7.2.2 Assignment

Review regionally relative results and conclusions from peer reviewed climate science. See this document as a resource.

Evaluate peer-reviewed articles to determine potential ecological, economic, and sociological implications of climate patterns.

Summarize these papers into a stand-alone paper.

7.2.3 Submission Format and Naming Convention

The paper should be double-space, 12 point font, and less than 5 pages (excluding citations). As a pdf, the paper should be submitted via Sakai with the following naming convention:

RegionalImpacts_F20_XXXXX.pdf

where the XXXXX refer to one set of the assigned random numbers.

7.2.4 Grading of the Regional Impacts Summary

The regional impacts review will be grading using the criteria in Table 7.

Table 7: Summary of Data Analysis grading standards.

Criteria	Standard	Percent
Sources	Compelling, e.g. Over 5 peer reviewed papers; correctly cited	15%
Ecological	Knowns and unknowns	20%
Economic	costs and benefits	20%
Social	e.g. Social Justice	20%
Communication	Accurate, e.g. rejected null	25%

8 Communicating Science

8.1 Analyzing Prior Communication Edeavors

8.2 Writing a Scientific Blog

Coming soon! ☺

8.3 Peer Review Blogs

Coming soon! ☺

8.4 Publishing Revised Blog

Coming soon! ☺

8.5 Op-Ed 2

Coming soon! ☺

8.6 DRAFT Blog – Peer Evaluation

Evaluator: _____

Presenter: _____

1. Describe two items you learned.

2. Describe one concept or fact you would like to learn in more detail.

Table 8: Please circle the best response, where one is inadequate and five is outstanding—i.e. should be teaching the topic!

How clear was the presentation?	1	2	3	4	5
Suggestions:					
Did the analysis seem valid?	1	2	3	4	5
Suggestions:					
Was information complete enough?	1	2	3	4	5
Suggestions:					
To what extent could you use this example in climate discussions?	1	2	3	4	5
Suggestions:					