

# Module Capstone Project:

## Toba-like eruption in 2020



An 1888 lithograph of the 1883 eruption of Krakatoa.  
from: "The Eruption of Krakatoa and Subsequent Phenomena", published 1888  
<https://archive.org/details/eruptionkrakato00whipgoog>

**Learning objectives:** students will:

- design a conceptual model to estimate the climatic and societal implication of a large Toba-type volcanic eruption in the year 2020;
- compare and contrast the similarities and differences between the expected climatic effects of a Toba-sized eruption and the climatic effects possible from anthropogenically induced global warming;
- communicate research findings, conceptual model, and compare and contrast exercise in a written summary.

### ***1. Investigate Mt. Toba eruption.***

The super-eruption of Mt Toba is thought to be one of the most significant events of the past 100,000 years. Utilizing the same research techniques you used in Part A, write a brief summary of the Toba event (150 word minimum).

### ***2. Develop a conceptual model to explore the climatic and societal effects of a Toba-like eruption occurring in the year 2020.***

Use the information from your Toba summary, relevant data relating volcanic eruption events to global and regional temperature changes, and your understanding of energy exchanges within the climate system to develop a conceptual model designed to explore the possible consequences of a Toba-sized eruption occurring in the year 2020. (note: it is estimated that the probability of such an event is very rare, less than once every million years, see [Self 2006](#))

In your conceptual model you will estimate the magnitude and duration of all effects associated with this eruption scenario. Make sure to include a concept map and/or a concept sketch of your model, and use a system diagram to describe at least one relevant feedback process.

Your conceptual model should include a discussion of:

- The effects of the eruption on Earth's atmosphere.
- The effects of the eruption on Earth's energy balance.
- How changes in Earth's energy balance will affect atmospheric and ocean circulation.
- Differences in effects on a regional and global scale.
- Possible impacts on local, regional, and/or global economy, changes in public policy, effects on human health and mortality.
- The magnitude and the duration of all effects associated with this eruption scenario.

The written summary of your conceptual model and the implications of a large modern day volcanic eruption should be at least 400 words and should include four references. At least two of these must come from scientific journals.

To gain additional perspective, write 150 word summary to compare and contrast the similarities and differences between the expected climate related effects of a Toba-sized eruption and those possible from anthropogenically induced global warming throughout this century. Identify and discuss at least two features that they would likely have in common and two features that are quite different. For example, it may be useful to think about ideas related to possible mitigation strategies, adaptation strategies, public policy before and/or after the event, socio-economic classes most affected, required changes in infrastructure before or after the event, and spatial coverage and duration of the climatic effects of each event.

You may work alone or in a team with up to 2 other people. If you choose to work in a team, a paragraph describing the responsibilities of each team member is required. (*The Appendix has some useful resources related to conceptual model development*)

**References cited:**

For journals or magazine articles references should include:

Author, publication date, Title of article, Journal name, volume, number, and page number.

For books the reference should include:

Author, Title of book, Chapter, page number(s), publisher with city, publication date

For World Wide Web sites the reference should include:

Title, author, affiliation, complete URL address, retrieval date.

**\*Examples of Acceptable Scientific Journals (a good source of scholarly papers is <https://scholar.google.com/> .**

Nature

Science

Journal of Climate

Journal of Geophysical Research

Earth and Planetary Science Letters

Geology

Geophysical Research Letters

American Geophysical Union EOS

Bulletin of the American Meteorology Society

## Rubric: Module Capstone Project: Toba-like Eruption.

(created from <http://rubistar.4teachers.org/> )

CATEGORY	85 to 100%	70 to 85%	50 to 70%	0 to 50 %
<b>Organization (3 pts)</b>	Information is very organized with well-constructed paragraphs and subheadings.	Information is organized with well-constructed paragraphs.	Information is organized, but paragraphs are not well-constructed.	The information appears to be disorganized. 8)
<b>Amount of Information 3 pts)</b>	All topics are addressed and all questions answered with at least 2 sentences about each.	All topics are addressed and most questions answered with at least 2 sentences about each.	All topics are addressed, and most questions answered with 1 sentence about each.	One or more topics were not addressed.
<b>Quality of Information (8 pts)</b>	Information clearly relates to the main topic. It includes several supporting details and/or examples.	Information clearly relates to the main topic. It provides 1-2 supporting details and/or examples.	Information clearly relates to the main topic. No details and/or examples are given.	Information has little or nothing to do with the main topic.
<b>Concept Map, concept sketch, and system diagrams (7 pts)</b>	A clear and organized concept map (or sketch) is presented and discussed and a system diagram is used to explain a feedback process relevant to your conceptual model	A complete concept map (or sketch) is presented and discussed and a system diagram is used to explain a feedback process relevant to your conceptual model.	A complete concept map (or sketch) is presented and discussed.	No concept map (sketch) or causal loop diagram is included
<b>Mechanics (2 pts)</b>	No grammatical, spelling or punctuation errors. Achieved word count.	Almost no grammatical, spelling or punctuation errors. Achieved word count.	A few grammatical spelling, or punctuation errors. Less than stated word count.	Many grammatical, spelling, or punctuation errors. Less than stated word count.
<b>Sources (2 pts)</b>	All sources (information and graphics) are accurately documented in the desired format.	All sources (information and graphics) are accurately documented, but a few are not in the desired format.	All sources (information and graphics) are accurately documented, but many are not in the desired format.	Some sources are not accurately documented.

*This assignment is worth 25 points total.*

## **Appendix I. Some useful resources for conceptual model development.**

The effects and consequences of very large explosive volcanic eruptions. S Self. Philosophical Transactions A, The Royal Society Publishing. Published 15 August 2006. Access at:  
<http://rsta.royalsocietypublishing.org/content/364/1845/2073>

Conceptual Model: <http://serc.carleton.edu/introgeo/models/WhatIsAModel.html>

Concept Maps: <http://serc.carleton.edu/introgeo/assessment/conceptmaps.html>

Concept sketches: See Figure 1. From “The Atmospheric Effect of the Pinatubo Eruption”  
<http://www.nuclear.lu.se/fileadmin/nuclear/Undervisning/Atmosfaerskurs/P04.pdf>  
and

<http://serc.carleton.edu/NAGTWorkshops/careerdev/AcademicCareerTeach2013/march.html>

Causal loop Diagrams: <http://serc.carleton.edu/resources/14127.html>

[Power Point Review for this assignment used in class.](#)