

EOSC114: Volcanoes homework (see footnote for copyright information¹)

Instructions. REVIEW THESE CAREFULLY; DON'T MAKE GUESSES ABOUT YOUR TASKS

Several different types of readings will be assigned later in the course.

- 1) First skim all questions to find out what to expect
- 2) Find the articles online at <https://www.usgs.gov/natural-hazards/volcano-hazards/volcanoes-can-affect-climate>, <https://phys.org/news/2021-08-climate-cooling-effects-volcanic-eruptions.html>, and <https://www.scientificamerican.com/article/get-ready-for-more-volcanic-eruptions-as-the-planet-warms/#>.
- 3) Complete the worksheet during or after reading the article
- 4) THEN, after you have completed the worksheet, go online to our course website to submit your work.
 - a) Time available for online submission is limited. Do the reading & worksheet BEFORE going online.
 - b) Online questions are automatically gradable versions of SOME of these worksheet questions.
 - c) Each student will get a different sub-set of these questions.
- 5) Important notes
 - a) **Regarding older versions of eos114 exercises:** This homework exercise AND its online data entry questions are different from earlier versions of eos114 homework.
 - b) THE MOST COMMON ERROR is not reading ONLINE questions carefully. Their order may differ from the worksheet, answer options are randomized, AND each student gets a different subset of questions. **Please work online carefully, with your worksheet beside you.**
 - c) Working with colleagues on homework is OK but copying the work of others is cheating and will not help you succeed. See the Code of Conduct on our course's Canvas website and UBC's strict rules regarding academic integrity at <http://www.calendar.ubc.ca/vancouver/?tree=3,54,111,959.1>
 - d) Note there may be one or more questions about this assignment in future tests, quizzes, or exams.
 - e) Questions have boxes instead of numbers to avoid confusion with different numbering online.
 - f) Please recall this course has 1st yr students in non-science disciplines, 4th yr science students, and everyone in between. Some tasks may seem "easy" for some students but will be challenging for others.

Part 1: Follow this link and use this webpage to answer the following questions:

<https://www.usgs.gov/natural-hazards/volcano-hazards/volcanoes-can-affect-climate>

- Refer to paragraph 1. Which of the following statements about the effects of volcanic gases on the atmosphere is correct?
 - Sulfur dioxide and carbon dioxide cause global cooling
 - Sulfur dioxide causes global warming, and carbon dioxide causes global cooling
 - Sulfur dioxide causes global cooling, and carbon dioxide causes global warming
 - Both sulfur dioxide and carbon dioxide cause global warming
- Look at the figure in the top right corner of the webpage. Which of the following is not a gas produced by volcanic eruptions?
 - SO₂
 - HF
 - CO₂
 - N₂O₅

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- How many kg of sulfur dioxide did the eruption of Mount Pinatubo on June 15, 1991, inject into the stratosphere? Enter your value as a number without units or words.
- How many kg of carbon dioxide did climactic eruption of Mount Pinatubo on June 15, 1991, inject into the stratosphere?
- How many Pinatubo-equivalent eruptions would equal the 2010 global anthropogenic CO₂ emissions?
- How many Mount St. Helens-equivalent eruptions would equal the 2010 global anthropogenic CO₂ emissions?
- How much sulfur dioxide did the 1783-1784 Laki fissure eruption in Iceland release, in Kg?
- How much more sulfur dioxide did the Laki fissure eruption release than Mount Pinatubo?
- What is the **average** annual global CO₂ emissions for all degassing subaerial (on land) and submarine volcanoes, in gigatons? Give your answer to 3 significant figures.
- According to the webpage, how many gigatons of anthropogenic CO₂ were released from fuel combustion 2015? Give your answer to 3 significant figures.
- How many days did it take in 2015 for the anthropogenic CO₂ released from fuel combustion to match the average CO₂ produced volcanoes in a year? Give your answer to 3 significant figures.
- How many times larger was the anthropogenic CO₂ released from fuel combustion 2015 than the average global CO₂ emission rate for all degassing subaerial (on land) and submarine volcanoes? Enter your value as a number without units or words.
- Given these values, if a volcanic eruption of a similar scale to the June 15, 1991 eruption of Mount Pinatubo occurred today, would it have a significant effect on the rate of global warming?
 - No
 - Yes
 - It is impossible to know

Part 2: Follow this link and answer the questions below.

<https://phys.org/news/2021-08-climate-cooling-effects-volcanic-eruptions.html>

Read the article carefully before attempting the following questions.

- According to the article, by what percent could the cooling effect of small and medium sized eruptions shrink as the climate warms? Enter your value as a number without units or words.
- Fill in the blanks. The effects of volcanic aerosols lasts for _____, while the effects of anthropogenic greenhouse gases lasts for _____ .

- What evidence was used by the Cambridge study to determine the effect of a warming climate on the distribution of volcanic aerosols?
 - Analysis of volcanic deposits from around the world
 - Global climate and volcanic plume models
 - Dendrochronology of trees
 - No evidence was used for the article

- How will climate change affect the transport rate of volcanic sulfate aerosols?
 - It will decrease the rate of transport
 - It will increase the rate of transport

- Why might the cooling effect of large eruptions, such as Mount Pinatubo, be amplified by climate change?
 - The plumes will rise higher, and the aerosols spread faster over the globe
 - More sulfur dioxide will be released by volcanic eruptions
 - More ash will be released by volcanic eruptions
 - All of the above

- Why might the cooling effect of small and medium sized eruptions be reduced with climate change?
 - Less aerosols will be released in a warmer climate
 - The height of the stratosphere will decrease
 - More CO₂ will be released by volcanic eruptions in a warmer climate
 - The aerosols will be confined to the troposphere

- What is the name of the boundary between the troposphere and the stratosphere?
 - Thermopause
 - Mesopause
 - Stratopause
 - Tropopause

- How will climate change affect the boundary between the troposphere and the stratosphere?
 - It will get lower
 - It will become more variable
 - It will get higher
 - It will become less variable

- Fill in the blanks: Volcanic plumes that do not reach the stratosphere will affect a _____ area, and their climatic effects will be _____.

Information about any field of expertise can be obtained from many sources, with various degrees of reliability. In this section we consider the author's intentions, the types of sources used to support their arguments or "story", and how evidence was used in those arguments. Please Review "primary", "secondary" and "tertiary" sources at: <http://scwrl.ubc.ca/student-resources/finding-identifying-and-citing-sources/identifying-different-types-of-sources/>.

For each "characteristic" of the article we've read select either true or false. (During online submission, watch carefully to ensure you are answering each question correctly - they may be offered in a different order.)

- Our article was written by the author(s) mainly to present their own previously unpublished new developments or discoveries. True / False
- The central message of the article was based predominantly on work already presented in earlier publications or other forms of communication. True / False
- Our reading is mainly targeting a general non-scientific audience. True / False
- The content in our reading is presented in a non-technical manner, without presenting a complete "chain of evidence" using formal references and citations? True / False
- This article is published in a peer reviewed journal (disregarding comments from an editor). True /False
- The main purpose or context for this reading is to ... (Hint: consider where or how it was published.)
 - offer social commentary to any reader
 - provide new scientific developments to the general public
 - provide information for a person or organization who requested it
 - present and discuss recommendations about scientific priorities in the peer-reviewed literature
 - communicate new scientific methods, procedures or discoveries to experts in the subject
- Now, based on your previous answers and the summary about source types referred to above, what kind of reference is our article best described as?
 - Primary
 - Secondary
 - Tertiary

Part 3: Follow this link and answer the questions below:

<https://www.scientificamerican.com/article/get-ready-for-more-volcanic-eruptions-as-the-planet-warms/#>

Read the article carefully before attempting the following questions.

- 5500 to 4500 years ago, what happened to the number of volcanic eruptions in Iceland?
 - They became more frequent and larger
 - They became more frequent
 - They became more powerful
 - They became less frequent and smaller
- What is suggested as the cause for the change in the number of volcanic eruptions in Iceland?
 - An increase in pressure reduces magma flow and the volume of magma stored in the crust
 - The decrease in temperature cools the magma and so does not erupt
 - Water from glaciers mixes with the magma to make the eruptions more violent
 - No cause is suggested for this change
- Fill in the blank. The time lag between ice melt and the change in eruptions is _____ the time lag between ice growth the change in eruptions.
 - Longer than
 - Shorter than
 - The same as
- Why is Iceland suggested as potentially more vulnerable to the ice effect?
 - It is very cold
 - It is very volcanically active
 - It is an island
 - It is always glaciated

- Why was Iceland chosen as the study area for the research discussed in this article?
 - It is very volcanically active
 - It experiences periodic glaciation through time
 - Records of its eruptions are well preserved
 - All of the above

- Which location is **not** suggested as an area which may experience enhanced volcanic activity with climate change?
 - U.S. Pacific Northwest
 - Northern Europe
 - Southern South America
 - Antarctica

- Which of the following was not evidence used to determine the effect of glaciation on volcanic eruptions?
 - The Icelandic eruption record
 - The volcanic ash record in peat bogs and lakes across Europe
 - The glacial coverage in mainland Europe through time
 - Glacial coverage in Iceland through time

- Based on the article, can you say for sure that enhanced volcanic activity will occur with climate change?
 - Yes
 - No
 - It is not possible to say for sure

- How did the research discussed in this article build on existing knowledge about the link between volcanic eruptions and changing climate?
 - It focused on small scale changes in climate
 - It focused just on Iceland
 - It focused on both large- and small-scale changes in climate
 - It focused on global changes in climate

- Which one of these statements most clearly articulates the main claim of this article?
 - Scientists of many types are working hard individually and collaboratively to understand the link between volcanic eruptions and modern-day climate change
 - Small-scale climatic changes can affect volcanic activity
 - Only large-scale climatic changes will affect volcanic activity
 - We do not yet know enough about the link between volcanic eruptions and modern-day climate change

- What kind of data are each of the following? Choose an option to fill the blank
 - a quantity or quantities that were measured with instruments of some sort
 - information that was observed – i.e., seen or noticed, not measured with instruments
 - data that was simulated, modelled, or calculated
 - information collected from people, archives, records etc.
 - not really data at all

- The occurrence of volcanic ash beds within peat bogs across the European continent is best described as _____.
- Historical written accounts of volcanic eruptions in Iceland are best described as _____.
- The “600-year lag between when glaciers advanced and volcanic activity diminished” is best described as _____.