CCSM Volcanic Eruptions Use Case

Compiled Mar. 2022 by Model Data RCN team

Summary Weighted rubric score - 61 Category - Preserve selected simulation workflow outputs

- Use Case Description
 - High-level overview of the use case
 - Using volcanic sulfur dioxide emissions in an aerosol-climate model, the researchers derived a time series of global-mean volcanic effective radiative forcing (ERF) from 1979 to 2015.
 - This project continues a previous paper and describes development for new simulation capabilities of volcanic eruptions in the WACCM model. The insertion of new emission data of SO2 allows for deeper understanding of chemical processes which ultimately helps understand cooling and heating.
 - Published journal link:
 - <u>https://doi.org/10.1029/2018JD028776</u>
 - NCAR data repository link:
 - <u>https://doi.org/10.5065/D6C53JPS</u>
 - Science goals and basic workflow
 - The goal is to try to quantify how much volcanic eruptions impact climate. The project used new capabilities of WACCM to understand mechanisms by which volcanoes can affect climate.
 - The two files in the repository are from two different simulations, one with volcanic emissions included, and one without such emissions.
- What use-case specific additional materials were preserved and shared?
 - Data
 - Inputs to model
 - Used standard datasets already in the model. Collected emissions data and made into a model-readable file, which is also publicly available:
 - Two versions available:
 - NCAR has model readable format (4D emissions file)
 - Simple version hosted in UK database of volcanic eruptions. (Created by Ryan Neely, Anja Schmidt, named VolcanEESM.)

- Sources for volcanic mass of SO₂ and volcanic plume heights for eruptions came from the following (note, these are not listed in the data repository, but are listed in the paper):
- Publicly archived
 - Total Ozone Mapping Spectrometer (TOMS),
 - Ozone Monitoring Instrument (OMI),
 - Ozone Mapping Profile Suite (OMPS),
 - Infrared Atmospheric Sounding Interferometer (IASI),
 - Global Ozone Monitoring Experiment (GOME/2),
 - Atmospheric Infrared Sounder (AIRS),
 - Microwave Limb Sounder (MLS),
 - Michelson Interferometer for Passive
 - Atmospheric Sounding (MIPAS),
 - and ground-based remote sensing or petrological methods.
- Plume height data:
 - based on published estimates of the eruption source parameters and reports from the Smithsonian Global Volcanism Program (http://volcano.si.edu/),
 - National Aeronautics and Space Administration (NASA)s Global Sulfur Dioxide Monitoring website (http://so2.gsfc.nasa.gov/),
 - Support to Aviation Control Service (http://sacs.aeronomie.be/)
- Raw model output
 - N/A
- Processed model output
 - Total data volume preserved in a repository by the PI
 - Model output uploaded to repository
 - Two files, around 73 MB each.
 - One simulation file includes volcanic sulfur dioxide emissions within parameterization while the other does not.
 - Each contains a large number of atmospheric variables, as well as latitude, longitude, and time.
 - Monthly averages were created, however the files in this data set contain global averages.
 - Total data volume not preserved in a repository? (might be retained on PI's local working storage)
 - The researchers generated monthly atmospheric output and reduced those files by average lat/long. The simulations included all atmospheric output, as well as

some components that were not included in the data repository:

- Additional surface model variables
- Nudged to observe temperature and wind-small fraction of output
- The original simulations included 10-day averages and daily average outputs
- Software
 - Model configuration
 - CESM1 (WACCM)
 - The version of WACCM used for this project was an intermediate version/iteration that is not publicly released, but is the basis for WACCM6.
 - It is sometimes labeled "WACCM5" as an unofficial name, but this was never an official WACCM release.
 - Preprocessing code
 - N/A
 - Model code
 - Even though the model code was not an official public release, the code has been located by other researchers and used for other studies.
 - Postprocessing code
 - The postprocessing code was not made publicly available, but was used for:
 - \circ $\;$ Averaging of variables for latitude and longitude zones.
 - Processing of flux data.
 - COMMENTARY NOTE BY RCN TEAM: According to RCN project guidance PIs should archive and provide access to pre- and post-processing codes. We acknowledge, however, the practical and funding challenges in packaging, presenting, and archiving these codes publicly.
- Other
 - Documentation
 - No additional documentation files are included in the repository.
 - The published paper is the main documentation for the data.
 - Visualizations or images
 - No visualizations were produced for this project beyond what is shown in the paper.
 - A previous paper which informed this research and data included animations which gained notoriety inside and outside the domain.
- Why were these things preserved and shared?
 - General
 - To satisfy requirements of journals to make data available.

- Researcher considered the works as generally useful data for the community and publishing allows for easier dissemination
- Reasons why the things listed above are important
 - Expected/intended audience and what they expect/need
 - Are there specific people who will be using the data downstream?
 - Broader community of climate scientists interested in volcanic impacts.
 - The paper includes a "Plain Language Summary"--maybe this could be a data repository requirement also?
 - Possible/aspirational users?
 - **N/A**
 - Note any temporal considerations, such as particular products that become more/less useful over time
 - N/A
- Broader Impacts:
 - How will output from this project be used by stakeholders?
 - Not discussed
 - How were stakeholders involved in the data curation decision-making?
 - Not discussed
 - How will stakeholders be compensated for their participation in the data curation decision-making process?
 - Not discussed
- Do you have any concerns about misuse of your data or software? If so, what concerns do you have, and what are the reasons for those concerns?
 - The researcher notes that this work falls under the broader climate change topic.
 - The researcher understands that this data contributes and affirms volcanic activity providing evidence of climate cooling. The researcher notes that conversations and thoughts of humans retooling volcanic activity to offset climate change impacts. This is a controversial topic among the climate science domain. This data could be used in a way that the researcher did not intend to affirm and support the controversial topic of retooling volcanic activity.