

CLDERA: Developing a Novel Foundational Approach for Attributing Localized Source Forcings in the Climate

Diana Bull[†], Kara Peterson[†], Irina Tezaur^{*}, Lyndsay Shand[†], and Laura Swiler[†]

^{*} Sandia National Laboratories
P.O. Box 969, MS 9060, Livermore, CA 94551 USA
e-mail: ikalash@sandia.gov, web page: <https://www.sandia.gov/ikalash>

[†] Sandia National Laboratories
P.O. Box 5800, Albuquerque, NM 87123 USA

ABSTRACT

The ability to distinguish the impacts of intervention, anthropogenic climate change, and natural variability, as well as to quantify the proportion of impacts attributable to each, will become increasingly important as the effects of climate change compound and decision-makers must plan for future mitigation and adaptation scenarios. Due to the innate complexity of the climate, enough data must be available to overcome large sources of variability and uncover complex, often nonlinear, correlations [1]. This is an underlying hurdle to the successful discovery of source-impact relationships. Addressing this challenging problem requires integrating foundational research to improve the intelligibility of Earth System Models (ESMs) and fusing disparate observational data sources in order to bridge the gap between observations and models and enable reliable attribution. In this talk, we will provide an overview of the CLDERA (CLImage impact: Determining Etiology through pathways) project at Sandia National Laboratories, which aims to develop methods to enable the discovery of pathways between sources and impacts in simulated and observational data. The uncovered pathways elucidate connective relationships, enabling a deeper understanding of cause and effect in the climate, and offer much needed constraints for the inverse attribution problem. Using the 1991 eruption of Mt. Pinatubo, a Stratospheric Aerosol Injection (SAI) event, as an exemplar, we are developing novel computational modeling techniques using version 2 of the U.S. Department of Energy's Energy Exascale Earth System Model (E3SM) [2] in combination with multivariate statistical techniques applied to large-scale observational data in order to provide constraints for the attribution of impacts from the eruption. A brief overview of the aims of CLDERA along with descriptions of analytical techniques we are pursuing and some early results will be provided.

REFERENCES

- [1] I.P.C.C. . Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. P'ean, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekci, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.
- [2] J.C. Golaz et al. The DOE E3SM Model Version 2: Overview of the physical model. J Earth and Space Science Open Archive, 2022. doi:10.1002/essoar.10511174.2.