

Forward to *A Climate Chronology*

Dr. Sean D. Birkel, Research Assistant Professor & Maine State Climatologist

Climate Change Institute

School of Earth and Climate Sciences

University of Maine

The Industrial Revolution brought unprecedented innovation, manufacturing efficiency, and human progress, ultimately shaping the energy-intensive technological world that we live in today. But for all its merits, this transformation of human economies also set the stage for looming multi-generational environmental challenges associated with pollution, energy production from fossil fuels, and the development of nuclear weapons – all on a previously unimaginable global scale.

More than a century of painstaking scientific research has shown that Earth’s atmosphere and oceans are warming as a result of human activity, primarily through the combustion of fossil fuels (*e.g.*, oil, coal, and natural gas) with the attendant atmospheric emissions of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and other greenhouse gases.* Emissions of co-pollutants, such as nitrogen oxides (NO_x), toxic metals, and volatile organic compounds, also degrade air quality and cause adverse human health impacts. Warming from greenhouse-gas emissions is amplified through feedbacks associated with water vapor, snow and sea-ice cover, and changes in atmospheric circulation. The Arctic in particular has undergone a dramatic transformation over recent decades, where temperatures have risen twice as fast as in the middle latitudes, and where late summer sea-ice extent is now on average 50% less than in the 1980s.**

We have also come to better understand natural climate variability caused by subtle changes in solar output, volcanic eruptions that eject materials that scatter sunlight, and ocean-atmosphere phenomena such as the El Niño Southern Oscillation (ENSO). Enormous strides have been made in understanding how changes in Earth’s orbital geometry and feedbacks within the climate system have periodically produced ice ages over the past two million years.

The growing body of climate science research, including sophisticated computer models of Earth’s connected atmosphere, oceanosphere, cryosphere, and biosphere, consistently indicate that climate warming driven by greenhouse-gas emissions emerged from the noisy signal of natural variability by at least the 1960s.*** Projections using these models suggest that Maine’s climate is likely to warm 2–4 °F by 2050, and up to 10 °F by 2100 depending on the trajectory of greenhouse-gas emissions controlled by humans. The warming climate also brings rising sea level, more intense storms, regional changes in precipitation and predominant weather patterns, and can facilitate the spread of vector-borne diseases. In addition to meteorological and terrestrial effects, increasing atmospheric CO₂ concentrations drive ocean acidification, which affects the function and health of marine ecosystems and fisheries.

Researchers at the Climate Change Institute and across the University of Maine community have made significant contributions to the scientific understanding of Earth’s climate and human connections – including in the fields of abrupt climate change, climate modeling, ice core proxy records, glaciology, atmospheric chemistry, acid rain, lake ecology, environmental monitoring, and anthropology in addition to effects on marine, forest, and agricultural systems. *A Climate Chronology* joins this effort by providing a comprehensive timeline of climate research, climate policy, law, and some related events in society and technology. *A Climate Chronology* also makes clear that implementation of climate solutions currently lags far behind our understanding of the situation acquired through climate science.

As highlighted in the Maine’s Climate Future reports, human-caused climate change has become the “defining environmental, economic, and social issue of the twenty-first century.”**** In keeping with the State of Maine motto, *Dirigo*, Maine has launched one of the most ambitious state plans in the nation to address both mitigation of greenhouse gas emissions and adaptation to climate change impacts already underway or expected to occur in

the foreseeable future. The newly released Climate Action Plan developed by the Maine Climate Council is to be updated every four years.**** The plan has a name that underscores the urgency of responding to climate change: MAINE WON'T WAIT.

*IPCC (Intergovernmental Panel on Climate Change). 2014a. 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. <https://www.ipcc.ch/report/ar5/syr/>

**IPCC (Intergovernmental Panel on Climate Change). 2019b. Summary for Policymakers, IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC). <https://www.ipcc.ch/srocc/>

***Maine Climate Council, [Scientific and Subcommittee report: Scientific Assessment of Climate Change and Its Effects in Maine \(2020\)](#). See Natural Variability and Human Attribution, p. 30–31.

****[Maine's Climate Future reports \(2009, 2015, 2020\)](#). Quoted text is from the 2015 report.

*****Maine Climate Council, [MAINE WON'T WAIT](#).