

Data Submitted (UTC 11): 5/16/2023 6:00:00 AM

First name: Lance

Last name: Olsen

Organization:

Title:

Comments: One such value is water temperature not only in mainstem but also and importantly in higher elevation streams

Flow volume is a closely related value, partly just because lower flow leads to increased potential for warming

Density of trees is an associated value, with studies documenting the importance of shade to water temperature, and studies on tree density as a variable affecting flow via volume of transpiration

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PNAS 2022 Vol. 119 No. 42

<https://doi.org/10.1073/pnas.2210525119>

## OPINION

Climate change and the threat to civilization

Daniel Steela, C. Tyler DesRoches<sup>b,1</sup>, and Kian Mintz-Woo<sup>c,d</sup>

1st 2 paragraphs

In a speech about climate change from April 4th of this year, UN General Secretary Antonio Guterres lambasted "the empty pledges that put us on track to an unlivable world" and warned that "we are on a fast track to climate disaster" (1). Although stark, Guterres' statements were not novel. Guterres has made similar remarks on previous occasions, as have other public figures, including Sir David Attenborough, who warned in 2018 that inaction on climate change could lead to "the collapse of our civilizations" (2). In their article, "World Scientists' Warning of a Climate Emergency 2021"-which now has more than 14,700 signatories from 158 countries-William J. Ripple and colleagues state that climate change could "cause significant disruptions to ecosystems, society, and economies, potentially making large areas of Earth uninhabitable" (3).

Because civilization cannot exist in unlivable or uninhabitable places, all of the above warnings can be understood as asserting the potential for anthropogenic climate change to cause civilization collapse (or "climate collapse") to a greater or lesser extent. Yet despite discussing many adverse impacts, climate science literature, as synthesized for instance by assessment reports of the Intergovernmental Panel on Climate Change (IPCC), has little at all to say about whether or under which conditions climate change might threaten civilization.

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The emission of greenhouse gases into Earth's atmosphere is a by-product of modern marvels such as the production of vast amounts of energy, heating and cooling inhospitable environments to be amenable to human existence, and traveling great distances faster than our saddle-sore ancestors ever dreamed possible. However, these luxuries come at a price: climate changes in the form of severe droughts, extreme precipitation and temperatures, increased frequency of flooding in coastal cities, global warming, and sea-level rise (1, 2).

This is the price we pay for the luxury of about 200 y of relatively unchecked greenhouse gas emissions.

Lasting coastal hazards from past greenhouse gas emissions

Tony E. Wong. PNAS first published November 7, 2019.

<https://doi.org/10.1073/pnas.1917051116>