



BOOK REVIEWS

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Unsettled: What Climate Science Tells Us, What It Doesn't, and Why It Matters. Steven R. Koonin. 320 pp. BenBella Books, 2021. ISBN 1-950-665-79-8. (Nadir Jeevanjee, Reviewer.)

There is a skeptical streak in the physics community regarding climate science. Decorated physicists, such as Princeton's Will Happer and the late Freeman Dyson, have declared in op-eds and interviews that climate change is not a serious problem.¹ Berkeley's Richard Muller grew so concerned over the potential mistreatment of temperature station data (i.e., "Climategate"²) that he and collaborators performed their own temperature reconstructions, which are now a standard dataset in climate science.³ When the American Physical Society (APS) set out to revise their statement on climate change in 2014, controversy erupted when the drafting committee gave equal weight to skeptical and mainstream voices in the drafting process. Higher-ups in the APS subsequently took control of the statement, revising it to better reflect the consensus as embodied in the 2013 IPCC report, and the original drafting committee head resigned.⁴

That drafting committee head was Steven R. Koonin, an established Caltech nuclear physicist with extensive real-world credentials, having served on the JASON advisory panel, as BP's chief scientist, and as deputy undersecretary for energy in the Obama administration. After resigning from the APS panel, Koonin wrote a 2014 Wall Street Journal op-ed arguing that climate science is not as settled as it might appear to be.⁵ Koonin's recent book, *Unsettled*, is an extension and elaboration of those arguments.

Unsettled covers a lot of ground, but a recurring argument is that historical observations of climate and weather phenomena are too noisy and uncertain to make definitive statements about human influence. Yet, such definitive statements can be found in the mass media and even some government reports, thus exaggerating both the impacts of climate change and the urgency of mitigating it. Given his physicist's penchant for data, Koonin takes a deep dive into a few examples of such distortion, including:

- (1) *Heat waves.* Koonin pushes back on claims that heat waves in the U.S. are becoming more frequent, because such claims often neglect the time period before 1950. That period includes the many heat waves during the Dust Bowl, and including these older records makes a long term trend in U.S. heat waves less evident.
- (2) *Sea level rise and glacier melt.* Koonin points out that there is significant variability in the *rate* of sea level rise over the last century, which does not seem to correlate with human influence. He doubled down on this claim in a recent op-ed,⁶ noting that today's large rates of Greenland ice loss are actually comparable to those from

80 years ago, when greenhouse gas concentrations were much lower.

- (3) *Tropical cyclones.* Koonin notes that a prominent U.S. climate change report portrays tropical cyclone activity as trending upwards. But this is only true since 1960, and (again) including older records reveals no strong long-term trend.

On these points, and others like them, Koonin is largely correct. Signal-to-noise issues, as well as poor data availability, often confound attempts to detect trends and attribute them to global warming. The dust bowl indeed complicates the U.S. temperature record, and even the summary figure in the latest IPCC report (AR6WG1 Fig. SPM.3, reproduced here as Fig. 1) shows essentially no long term trend in heat waves in the central and eastern U.S. Similarly, there is indeed substantial variability in the rates of sea-level rise and ice-sheet melt, which go underemphasized in government reports. Koonin is correct that the statistics of tropical cyclones are noisy and multi-faceted, and that metrics which measure tropical cyclone frequency (rather than intensity) tend not to show a global warming signal.

These facts will likely surprise most readers. Such nuances often do not survive the long game of telephone among the scientific literature, government reports, and associated media coverage. Public perception on these issues can indeed stray from the science, and Koonin does us a service by emphasizing the need for accuracy and integrity in climate communication.

Yet, by focusing on these narrow issues, Koonin downplays the bigger picture, in ways that can mislead the reader. An excellent example of this is Fig. 1, which shows that while most of the U.S. does not exhibit a significant trend in heat waves, *every other region of the globe does* (besides the Congo and Patagonia where data are limited). Furthermore, these trends can be attributed to human influence. These facts go unmentioned in *Unsettled*. Similarly, while it is true that Greenland mass loss rates have significant natural variability, these loss rates have nonetheless remained strongly positive throughout the 20th century, but were close to zero prior to that, broadly consistent with global warming.⁷

By focusing almost entirely on our limited observational records, Koonin also misses out on the perspective which emerges when one looks beyond historical datasets. Our understanding of sea level rise and extreme weather stems not just from records of past variations but also from climate model projections of *future* warming, which tell us unambiguously that heat waves will increase, sea level rise will accelerate, and hurricanes will intensify on a warmer planet. Koonin, however, ignores such model projections entirely. He argues that because climate models require empirical adjustments known as "tuning," and because their quantitative predictions often span a wide range, they cannot be

a) Synthesis of assessment of observed change in **hot extremes** and confidence in human contribution to the observed changes in the world's regions

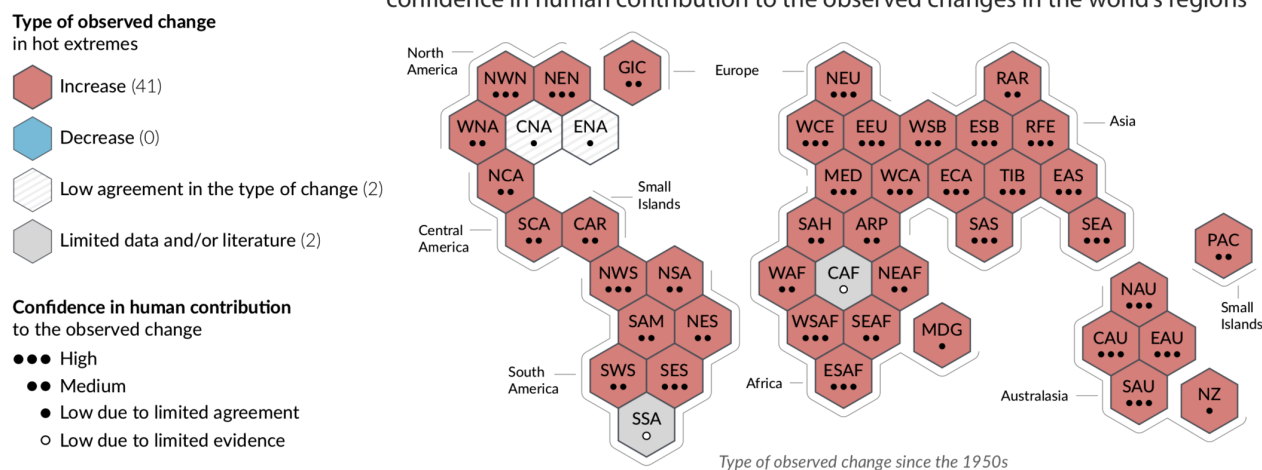


Fig. 1. IPCC 2021 assessment of trends in heat extremes. While signal-to-noise issues confound trend identification in the central and eastern U.S., virtually every other region of the globe shows a statistically significant positive trend which can be attributed in large part to global warming. Taken from Fig SPM.3 of Masson-Delmotte *et al.*, “IPCC, 2021: Summary for policymakers. in: Climate change 2021: The physical science basis. contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change.”

trusted to tell us anything at all. However, as a veteran modeler himself, Koonin surely knows that any model will be fit for some purposes and not for others. Admittedly, today's climate models do not provide robust predictions of certain key aspects of global warming, such as regional climate change (especially hydroclimate changes). To some degree, this is because certain processes, such as thunderstorms, cannot be resolved by models' coarse discretizations of Earth's atmosphere, so must be represented in a more *ad hoc* manner. However, other phenomena, such as heat waves and tropical cyclones, are reasonably well represented by models, and consistently intensify under global warming. This intensification also comports with our physical understanding, in that an overall shift to higher temperatures will naturally lead to more frequent and intense heat waves, and a warmer atmosphere contains more water vapor which then fuels more intense hurricanes. There are, thus, many aspects of global warming for which climate models are fit for purpose, based on consistency across models as well as basic physics.

Koonin's critiques of climate science and how it is communicated have some merit. The subtle science of our complex Earth system is particularly ill-suited for headlines and sound bites. Modeling results are sometimes received too credulously, rather than with an appropriately sized grain of salt. However, these critiques do not add up to an indictment of climate science. Furthermore, in dismissing the entire field of climate modeling, and in quibbling about historical data sets, Koonin ends up misleading readers and missing the larger predicament we are in: Our models and the laws of physics paint a picture of the world to come, and the data are telling us that this world is around the corner, and in some ways has already arrived.

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Note: This paper is part of the special issue on Teaching about the environment, sustainability, and climate change.

¹See, for instance, the op-ed by Will Happer, “Global warming models are wrong again,” *Wall Street Journal*, March 27, 2012 <<https://www.wsj.com/articles/SB10001424052702304636404577291352882984274>>; or the cover story on Freeman Dyson by Nicholas Dawidoff, “The Civic Heretic,” *New York Times Magazine*, March 25, 2009 <<https://www.nytimes.com/2009/03/29/magazine/29Dyson-t.html>>.

²See, e.g., F. Pearce, *The Climate Files: The Battle for the Truth About Global Warming* (Guardian Faber Publishing, London, 2010).

³Berkeleyearth.org.

⁴See this account from Gayathri Vaidyanathan, “Physicists battle over the meaning of ‘incontrovertible’ in global warming fight,” *Scientific American*, April 14, 2015. <<https://www.scientificamerican.com/article/physicists-battle-over-the-meaning-of-incontrovertible-in-global-warming-fight/>>.

⁵See “Climate science is not settled,” *Wall Street Journal*, September 19, 2014 <<https://www.wsj.com/articles/climate-science-is-not-settled-1411143565>>.

⁶See “Greenland's melting ice is no cause for climate-change panic,” *Wall Street Journal*, February 17, 2022. <https://www.wsj.com/articles/greenland-melting-ice-panic-sheets-global-warming-variance-seal-level-rise-climate-change-carbon-fossil-fuel-11645131739?mod=article_inline>.

⁷See Kenneth D. Mankoff *et al.*, “Greenland ice sheet mass balance from 1840 through next week,” *Earth System Science Data* 13.10 (2021), pp. 5001–5025, as well as the rebuttal to Koonin's op-ed by Mankoff and others, “Disputing Koonin on Greenland's melting ice,” *Wall Street Journal*, February 27, 2022. <<https://www.wsj.com/articles/koonin-greenland-ice-loss-melting-climate-change-11645828198>>.