HOW TO GET FACTUAL DATA AND ARTICLES

SURVIVING IN TODAY'S ONLINE WORLD

By Simon Boxall

As oceanographers, as scientists, we learn from an early stage in our careers that science is apolitical: the outcomes are what they are regardless of what we or others would like them to be. Our role is to gather and interpret data, with significant peer review prior to publishing and with our data open to full scrutiny. In this area, access to primary data is a must. We are taught to only put our best work forward, satisfied that it is true as far as the data we have used allows, and a credit to us, our institutions, and our profession. To achieve a full scientific understanding of our subject, we research and study for decades, and we are often the most critical of our own work. Until recently, we have not taken it much beyond that. The education of our students has very much followed that credence for generations.

This was all fine until online "experts" started offering their own "facts" after spending a few minutes reading around a subject. For example, there are people who genuinely believe the Earth is flat—and they have great debates about it online, blind to any actual evidence. How can you debate nonsense? A YouGov poll in 2018 found that 4% of Americans and 3% of British people thought the world was flat. That grew (!) in 2022 to over 10% in the United States—I have no figures for the UK (a true scientist sticking to evidence), but I would suspect a similar rise. Something like 40% of Americans think humans and dinosaurs roamed the Earth together. To scientists, these are silly concepts, but their growth and uptake ignore all solid scientific evidence.

Falsehoods become more damaging when they cross over into biasing our students' views on what is true and what is false. We have seen the dangerous impact of false information on vaccines—the science that eradicated smallpox and almost eradicated polio and measles has had a public backlash, with over 20% of the UK population believing that inoculations are harmful. Another growing movement is against any evidence of climate change, with a third of British citizens over 55 dismissing it as not being an issue.

More of a concern is the growing number of scientists who are ignoring the unwritten ethos of honesty in science. There is a rise in the publication of sham science papers written by those who desperately need scientific publications for promotion or salary consideration. It appears that there are organizations—"paper mills"—that supply fabricated work for publication that sometimes slips through the net of peer review. A study published in *Nature* showed that in 2013 there were just over 1,000 retractions of papers that were proven to be false post-publication. In 2022 it was 4,000, and in 2024 over 10,000. I know of one case firsthand where a colleague was sent a paper to review that looked familiar—and it turned out to be a direct copy of a paper published four years earlier and co-authored by this person. We also see dubious papers on oceanographic subjects published in journals that focus on religion and are unlikely to have a critical editorial board or a wealth of expert reviewers, and so papers get published. It is a growing trend and one that is driven by pressures on scientists to publish results at a high output rate.

What has this to do with education in oceanography? There are three key areas here, the first being access to primary data. NOAA and NASA have without a doubt provided the best resources for students globally to access a plethora of data online and free of charge. There is also a relatively new European resource that brings both observational data and global models together, and of course a number of sites that offer live Argo float data can be viewed and downloaded. I use these platforms regularly for teaching exercises and for student research projects: Have hurricanes increased as a result of a warming ocean? Do hurricanes and tropical storms enhance vertical mixing and supply of nutrients for productivity? How have El Niño-Southern Oscillation (ENSO) events changed in character over the past 30 years? You get the idea, and the primary data for topics like these, which once would have involved a major task to gather, can now be accessed in minutes. Importantly, we know that these data are from reliable and trustworthy sources.

The second area is that today we need to teach students to be skeptical of articles that appear in newspapers, on social media, and increasingly in peer-reviewed journals. If it doesn't seem to make sense, it probably isn't right. I raised this issue about who and what to trust a few years ago in this journal along with suggesting ways of getting students to question everything they find. Over the past couple of years, this approach has become even more critical. What was the journal? Does it have a good reputation in your field of study? Is it clear when it was submitted and then finally accepted for publication? If these dates are only days apart, it is either the paper of the decade with groundbreaking science or more likely

pushed through without proper review. The one problem in the good old-fashioned library access is that once a paper is on the shelf, the retraction doesn't take it off the shelf. Although I encourage students to avoid too much online web searching, one big advantage of using something like Google Scholar is that it does give access to any retraction alongside a peer-reviewed article on the publisher's website, or the article may even have been removed.

What is of interest is that, for now at least, ChatGPT seems to give a balanced and accurate view of the science background to a number of key questions. For the sake of this article, on September 1, 2025, I asked ChatGPT three questions: What impact does CO_2 have on the globe? Is the ocean being affected by climate change? And, controversially, "Is Simon Boxall any good at writing articles"? The answers I got for the first two were word perfect and accurate and didn't hold back on the issues—an article for the future on AI in education! The last one stated: "His articles benefit from deep scientific knowledge, but he communicates them clearly and accessibly to a general audience. Coverage of pressing environmental issues suggests he can translate complex concepts into engaging, understandable prose." I guess it is not always right, but I could save the cost of having an agent and just employ ChatGPT.

The third area is that we need to reinforce the ethics of being a scientist—to report in a truthful and honest way, backed up by evidence regardless of what the desired outcome might have been (we used to call it testing a hypothesis). To emphasize this, we provide all our first-year students with a booklet on plagiarism and academic integrity. Getting the "wrong" outcome is called experimentation; it is often said research is 95% sweat and tears and 5% success. Forcing the outcome to be "correct" shows a lack of integrity and has no place in scientific endeavor. As an educator, I do very occasionally see poor examples of academic integrity—a project written by a postgrad for an undergraduate, direct copying of another student's work, use of the dreaded AI to write an essay word for word. In the first case, it is obvious when drafts of work are poor but then suddenly appear as outstanding bits of research a week later. With plagiarism, online submission tools search the web for phrases from both literature and other student submissions going back a few years. While AI can be a lazy way of essay writing, posing the same question often gives the same text, so if more than one student resorts to it for an essay, then they are sunk. On that basis, I'm off to see if ChatGPT still overinflates my ego.

AUTHOR

Simon Boxall (srb2@noc.soton.ac.uk), University of Southampton, National Oceanography Centre, Southampton, UK.

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