

Another look at *An Inconvenient Truth*

Eric J. Steig

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Abstract The portrayal of the science of climate change in *An Inconvenient Truth* is largely correct. Some aspects of the film, such as the discussion of Hurricane Katrina, oversimplify the complex factors involved, while others conflate global warming with other environmental changes that may not be related. However it is not in question that continuing emissions of greenhouse gases by human activities will cause greater climate change in the future, and that the impacts of such change are likely to be negative. The chief message of the film—that this fact places important moral and ethical choices before society—is therefore an accurate one.

Keywords Climate change · Documentary film · Greenhouse gases · Hurricane Katrina · Ice sheets · Sea level

Introduction

There are myriad possible viewpoints that could form the basis of a debate about *An Inconvenient Truth*. Is

this also a campaign film, as asked in the *Wall Street Journal* review (Morgenstern 2006)? Was director Davis Guggenheim wise to intersperse footage of Gore giving his slide show with footage of Gore talking about his election loss to George W. Bush, or the near loss of his son to a traffic accident? Is the film fair in implying (as it strongly does) that the Bush administration misled the American public on the issue of global warming, through censorship of government scientists' work? These kinds of questions (alongside other more inane ones, such as whether Al Gore has gained weight, or whether he is a hypocrite for using air travel) are repeatedly found in reviews of the film, and endlessly discussed in the blogosphere. But none of these questions are ultimately relevant because none have any implications for the deeper question actually on the table, which is what to do (if anything) about carbon emissions.

There is a narrow question about *An Inconvenient Truth* where there is room for rational disagreement, as intended in this forum. That question—in my view the only really important question about the film—is whether it accurately portrays the science of climate change. It will come as no surprise to those who have read my review at RealClimate.org that I will answer this question in the affirmative. I stated in that review that “for the most part ... Gore gets the science right” (Steig 2006). Having now watched the film three times, I have found no reason to revise that statement. This claim does, though, warrant further exposition, because there are certainly aspects of the scientific

E. J. Steig (✉)
Quaternary Research Center & Department of Earth
and Space Sciences, University of Washington, Seattle,
WA 98195, USA
e-mail: steig@u.washington.edu

content of the film that could be improved. The issue at hand is whether making those improvements would provide sufficient grounds for reaching a different conclusion about the seriousness or urgency of addressing anthropogenic climate change.

Fundamentals are correct

First, there is no question that the film gets the fundamentals right. The increase of greenhouse gases in Earth's atmosphere, due to the combustion of fossil fuels and the burning of forests, is relentless. The direct impact of increasing greenhouse gases is to warm the planet's surface. Feedbacks—particularly water vapor and sea ice albedo—make it very likely that the amount of warming will be greater than the direct effect from greenhouse gases alone (Schlesinger 1988). All of these points are made in the film, and none of them are in contention; indeed these facts have been known for more than a century. Gore is not always as precise in his language as I would have liked. For example, his statement that we are “thickening” the atmosphere is incorrect, and one wonders why he did not choose a better way to explain that we are increasing the mixing ratios of greenhouse gas molecules in the atmosphere. Yet using more precise language would not change the essential point that *An Inconvenient Truth* is making here—that changes we make to the atmosphere create an enhanced greenhouse effect.

There are admittedly a number of factual errors in the film. Among these are images of glaciers atop Mount Kilimanjaro and of the Columbia Glacier in Alaska. While both have retreated dramatically in recent decades, in neither case is temperature change likely to be the culprit. In the case of Kilimanjaro, the best evidence is that changes in precipitation and perhaps changes in cloud cover have altered the ratio of precipitation to sublimation that determines whether Kilimanjaro's glaciers grow or shrink (Mölg and Hardy 2004). Such changes may of course be mechanistically linked to global temperature change, but it is at best confusing to present Kilimanjaro this way. Columbia Glacier is an even poorer example. This glacier has been in rapid retreat since 1980, but this is due to instabilities at the marine terminus of this tidewater glacier that are very unlikely to have anything to do with temperature change (Venteris

1999). Another example is Gore's statement that you can “see” the effect of the United States Clean Air Act in ice cores from Antarctica. In fact, one can neither see, nor even detect using sensitive chemical methods, the effect of the Clean Air Act in Antarctica. Antarctica is not significantly influenced by North American production of any of the chemicals (such as sulphur and nitrogen oxides) that the Clean Air Act reduced (Legrand and Kirchner 1990).

Yet the general points Gore is trying to make in these examples are not in dispute. Mountain glaciers *are* in retreat worldwide, and in the vast majority of cases this is due to temperature change. And indeed, there are many other photos of retreating glaciers shown in the film that serve as accurate illustrations of this fact. Nor is this a trivial fact. The loss of mountain glaciers is the largest contributor to sea level rise after the thermal expansion of the oceans (Meier et al. 2007). Likewise, the effects of changes in U.S. atmospheric pollution may not show up in Antarctica, but they are clearly recorded in ice core records from Greenland (Mayewski et al. 1990). The point here is that humans are capable of making huge changes in the composition of the atmosphere, and we are also capable of reversing those changes. While Gore and his team perhaps should have thought of a better way to illustrate this, the point remains entirely valid.

A matter of style

In summary, *An Inconvenient Truth* gets the fundamentals right, and the factual errors that do creep into the movie are inconsequential. That leaves only one area for serious criticism, which is that the style in which the facts are presented is misleading. The most obvious case to consider is the lengthy use of Hurricane Katrina, which Gore strongly implies is due to global warming. As scientists are fond of pointing out, no single weather event can be attributed to global climate change; it is only the statistics—the likelihood of such events occurring—that can be meaningfully related to global warming. To state that Katrina was a disaster that would have been avoided if it were not for human-induced climate change would therefore be quite irresponsible. However, Gore does not say this. What he does say, in the supplemental material supplied with the DVD of the film, is that “There is no scientific

consensus linking the absolute number of hurricanes to global warming.... But ... global warming makes them stronger.” This is an entirely accurate representation of the current state of the science (put precisely, the potential intensity of storms depends strongly on the sea surface temperature) (Emanuel 2000). Furthermore, while the most disastrous effects of Katrina can be largely attributed to engineering and planning failures, it remains a fact that Katrina resulted in the highest storm surge ever observed in North America (McCallum and Heming 2006). Katrina is thus an entirely valid example of the kind of event that we have reason to be concerned about in a future, warmer world.

Another topic that has been singled out for criticism is the treatment of sea level rise. Gore states in the film that sea level may rise 20 feet if the West Antarctic or Greenland ice sheets should collapse. This is accurate (Alley et al. 2005). What is not accurate is that such a huge sea level rise—which would be truly catastrophic if it occurred quickly—is likely to occur in relatively near future (say, over the next century). Gore should have made it clear that conventional wisdom holds that the timescale for such changes is hundreds to thousands of years. Yet he could also have pointed out that such changes are virtually certain to occur, if global temperatures are maintained at more than a few degrees Celsius above their 20th century values, as will be most assuredly be the case under business-as-usual global carbon emissions. Furthermore, we do not really know how quickly such changes may occur, and there is in fact serious concern in the scientific community that recent changes in Greenland’s glaciers may result in collapse of that ice sheet in a much shorter time than previously thought. It now appears likely that, at the very least, Greenland’s contribution to sea level rise will continue to increase rapidly in the near future (Dowdeswell 2006).

There is one area where I think Gore does overstate his case, and that is in conflating global warming with other environmental problems that may be largely unrelated. Gore’s illustration of Lake Chad, an African lake that is drying up largely due to land use changes (though also because of changes in precipitation patterns) is one oft-cited example of this. More concerning, though, is the discussion of infectious diseases in *An Inconvenient Truth*. This particular issue has provided a very easy target for

detractors, who have used it to imply that doing something about global warming is somehow to ignore other more urgent humanitarian crises. Although Gore does not outright say this, the film strongly implies by the juxtaposition of images and ideas that global warming has already played a significant role in the spread of diseases such as West Nile virus in the United States. I very much doubt that the increased prevalence of West Nile or malaria—another example given in the film—can be clearly linked to global warming. This is not to say warmer temperatures will not increase the prevalence of such diseases, but there are so many other things at play (population and land use changes, in particular) that it would be exceedingly difficult to demonstrate. Nor is addressing climate change likely to be the most effective way to combat such diseases. This point was nicely summarized in a 1997 opinion piece in *Science*: “public health measures will inevitably outweigh effects of climate” (Taubes 1997). I have seen nothing since that convinces me that this basic conclusion has changed.

To those who would take the examples such as I have given above to try to discredit the film, I would point out that there are many areas where Gore could have spent more time emphasizing the probable negative consequences of climate change. The truly worrisome impact of carbon emissions on the world’s oceans—through the dissolution of carbon dioxide, resulting in surface ocean acidification (Feely et al. 2004)—barely gets a mention, though there is a brief section on it in the DVD’s supplemental material. More emphasis could also have been placed on the significant effects of sea level rise in some areas (such as Bangladesh or the Netherlands) even under the very conservative IPCC predictions of only about one half meter of sea level rise over the next century (IPCC 2007). And the film could have used the dramatic 2003 heat wave in Europe to much better effect. What Gore says in reference to this event is that “we have already seen some of the heat waves that are similar to what scientists are saying are going to be a lot more common”, which repeats the scientist’s mantra that no specific event can be attributed to global warming. Yet ironically, this event is perhaps the only one that could justifiably be used to flaunt this rule. The statistics of this event show that human influence has at least doubled the risk of heat waves such as that experienced in 2003

(Stott et al. 2005). Finally, Gore could have made much use of the fact that the uncertainties in our projections of future climate change nearly all tend to line up in the direction of greater—not smaller—change, than indicated in the IPCC report (Roe and Baker 2007).

The first time I saw *An Inconvenient Truth* was with a group of fellow scientists from the University of Washington, most of them more senior than I and with greater expertise in atmospheric physics, the fundamental basis of the science of global warming. I was struck, in discussing the film with them immediately afterwards, how little they found wrong with it in their initial viewing. Indeed, the chief criticism I remember was over Gore's handling of the relationship between temperature and carbon dioxide in the long ice core records. This is the scene in which Gore is raised up above the stage to point out the high levels that carbon dioxide concentrations will reach in the next 50 years. Because the temperature history from the ice core records is shown alongside the carbon dioxide concentrations, this bit of theater has the effect of implying that the temperature change will be much larger than is in fact projected. The problem is that only about one third of the magnitude of temperature variations recorded over tens of thousands of years in the ice cores can be attributed to greenhouse gases. Yet Gore could have used a more complete explanation of the ice core data to make a stronger point, which is that these data—when insolation and albedo are accounted for—provide an independent test of climate sensitivity, which gives a result in excellent agreement with results from computer models of climate (Lorius et al. 1990).

Conclusion

An Inconvenient Truth rests on a solid scientific foundation. But its chief role is not a scientific one, as the Nobel Committee clearly recognized when they awarded the 2007 Peace Prize not only to Al Gore, but also to the Intergovernmental Panel on Climate Change. How alarmed we should be that the Greenland ice sheet is likely to disappear depends on a value judgment about our responsibility to future generations. How alarmed we should be about near term changes depends in large part on our concern

about the developing world, or (more selfishly) about how problems elsewhere may affect us indirectly, through a flood of environmental refugees. These are the chief messages of *An Inconvenient Truth*, and they are accurate ones. How alarmed we should be about global warming is no longer a scientific question so much as it is a question of values.

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