Climate in the Calculus Classroom

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There is a great need for scientific research on climate instability and the related energy issues, and the mathematics community can and should be involved. But we also need the mathematics community to be part of the education process since as we gain understanding of the seriousness of these problems and the need for societal changes to address them, it will be beneficial – indeed, it will be necessary – to have an educated population to appreciate and support such changes. Nearly halfway through the United Nation's decade of education for sustainable development, the mathematics community should ask itself: Are we helping in general, not just on the research side of climate instability? Are we making the impact on educating about sustainability that we should?

Consider that approximately three quarters of a million students or more take a calculus I class each year. [1] We should be looking to incorporate education about climate instability and, in general, sustainability into our calculus classes. Further, the vast majority of these students won't end up as math majors and for many of these students calculus is a terminal math course. So, not only do we have lots of students to impact in calculus I, but this may also be the last time that we can provide quantitative information about important issues facing the planet.

The question now becomes: How do we incorporate these types of issues into calculus? Given that data is much more accessible due to the internet, the basic idea is simple. We can use a spreadsheet to fit curves/functions to real data on global average temperature, oil consumption, atmospheric CO2, etc. Once we have the functions, calculus tools can be used to answer important sustainability questions. For example, given the available data, figure 1 is easy to create in *Excel* and we now have a function to work with. With a little analysis, including some calculus, we can have students compute the current rate of change of global average temperature (according to the model) and make predictions by extrapolating the curve or extrapolating the tangent line off the current year. These are standard calculus problems, but here we have added context and we can encourage discussions among students and faculty (including faculty from other disciplines) about the ramifications of these calculations. It is important to note that we don't have to cut our typical content (teaching students to do the curve-fitting takes no more than one class period), but to simply change the nature of problems and examples. This is merely one example; further examples and data sets can be found at [2].

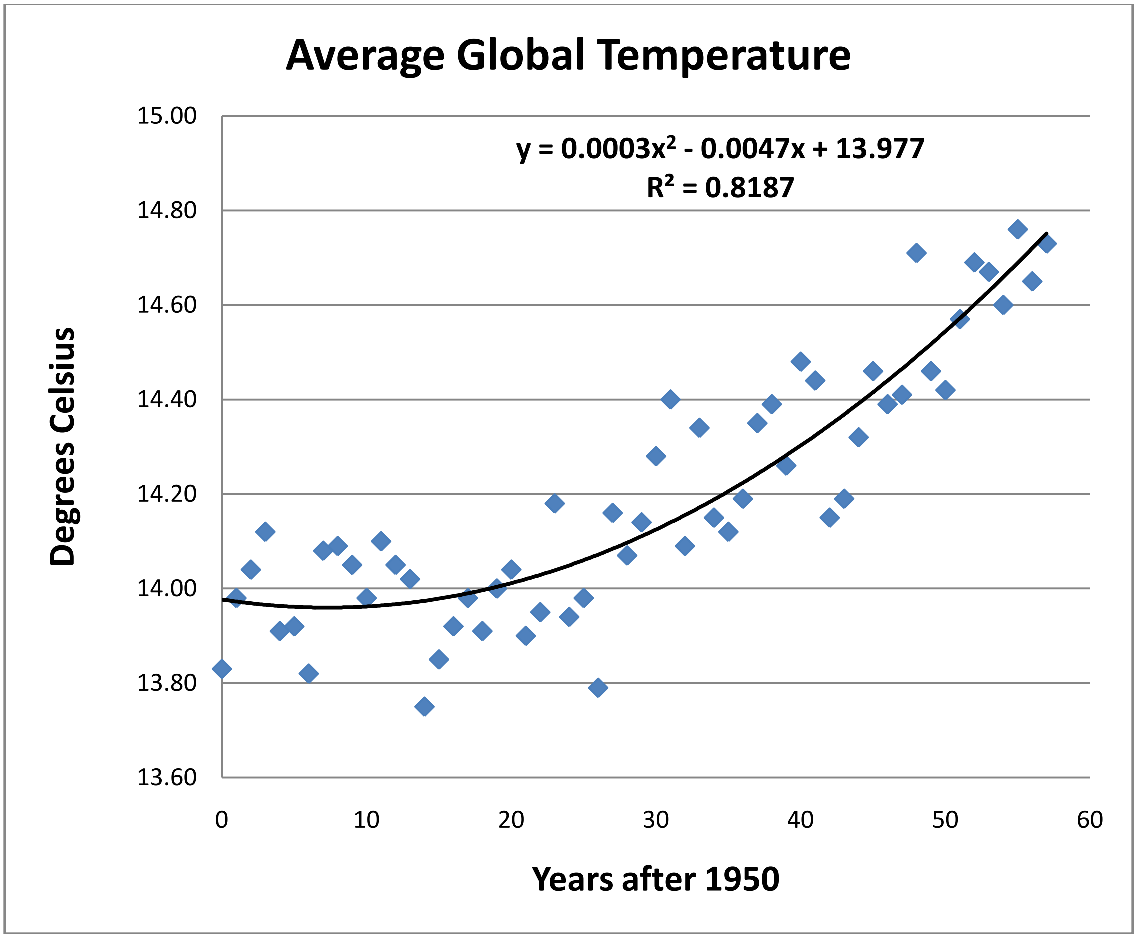

Figure 1 A scatter plot to and a quadratic fit to average global temperature data.

It is not difficult to bring concerns about climate and other issues into the calculus classroom. By incorporating these types of problems and themes into calculus, you will be supporting the goals of the decade of sustainability and helping students understand the need for change; it is quite likely that you will be engaging students in calculus more. In fact, this may encourage students to take more math courses and possibly get involved in climate research some day. As one student of mine commented anonymously "...for once a math class used real world information for their questions/problems instead of just pulling numbers out of nowhere and expecting we understand them ."

References

[1] http://www.maa.org/columns/launchings/launchings_04_07.html#no6
[2] http://www.ithaca.edu/tpfaff/sustainability.htm