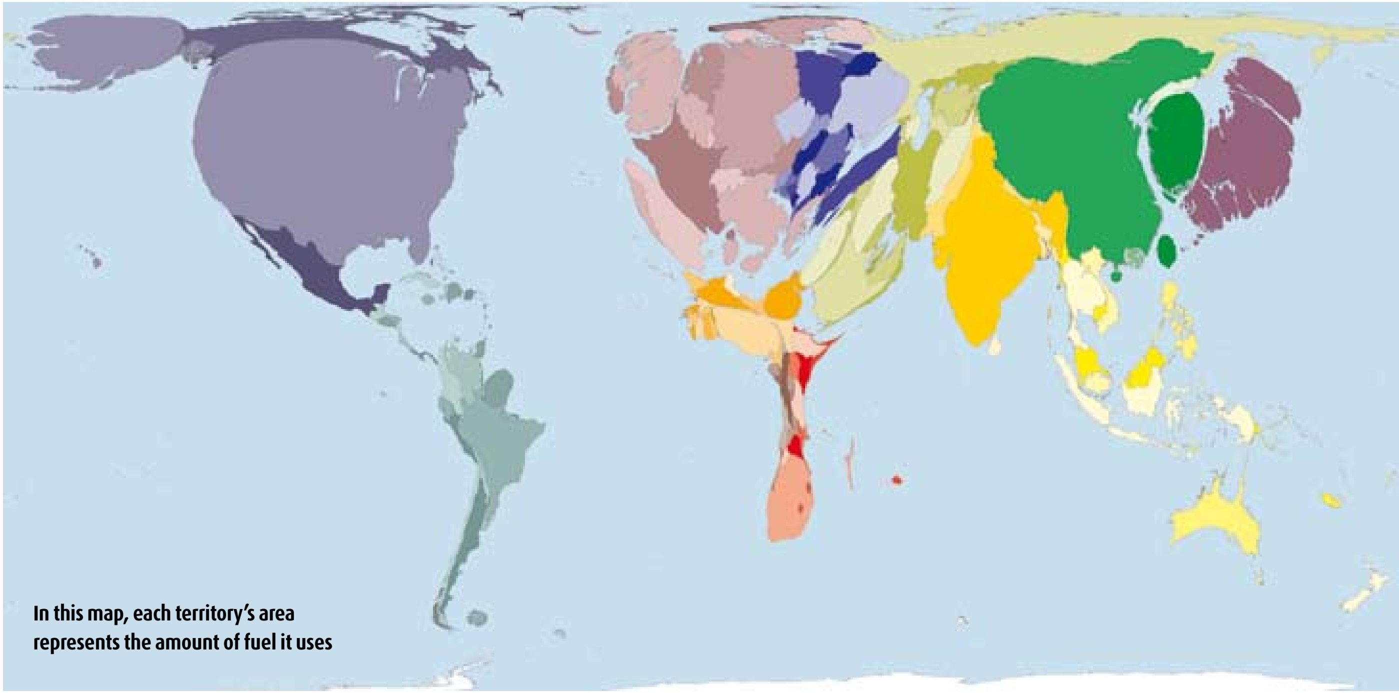


In this map, each territory's area represents the amount of fuel it uses

What's wrong with this picture?

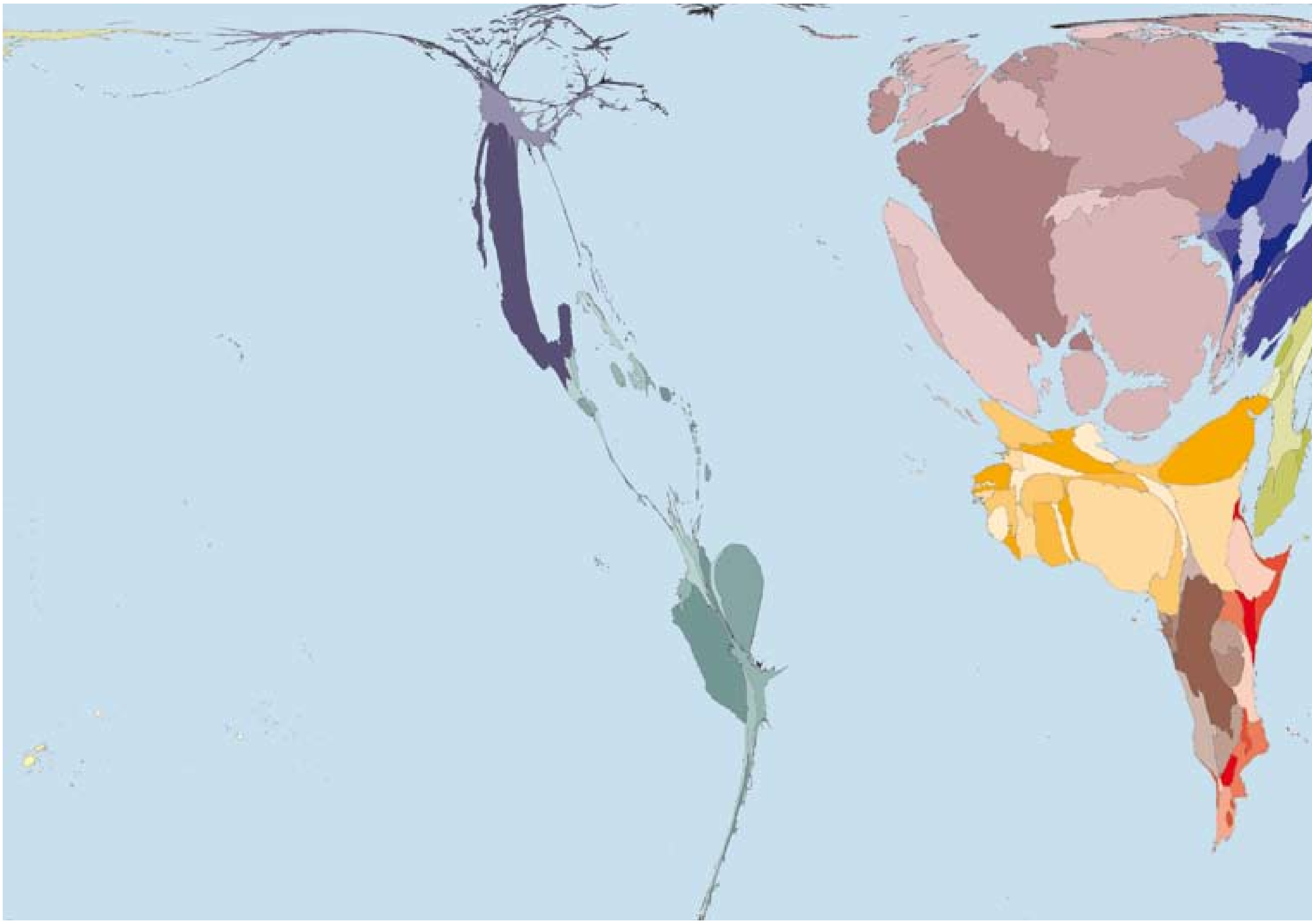
A small change of perspective can make a world of difference, say cartographers **Danny Dorling** and **Anna Barford**

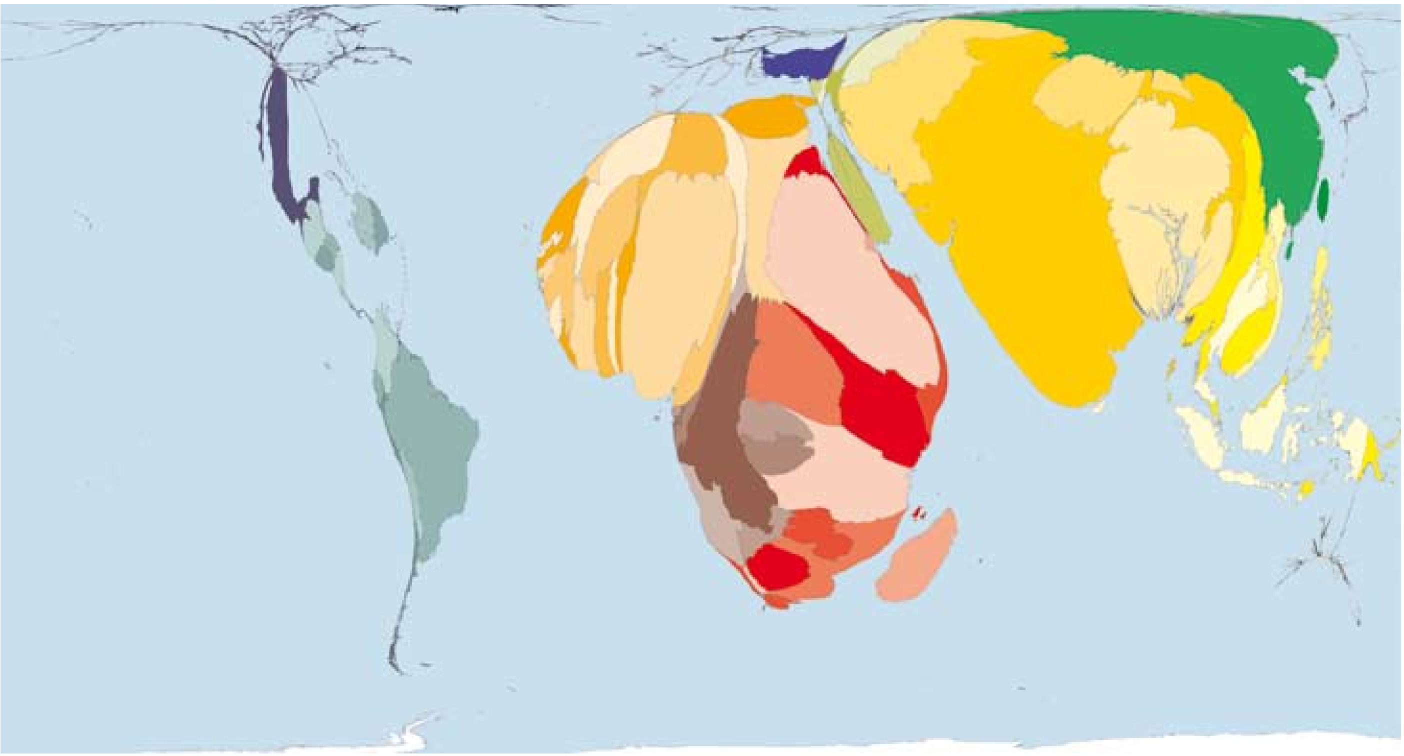
WE LOVE our maps. At first glance, people are shocked by them: the shapes look familiar, yet everything is absurdly distorted. Without even thinking, they have learned something about the world they live in.

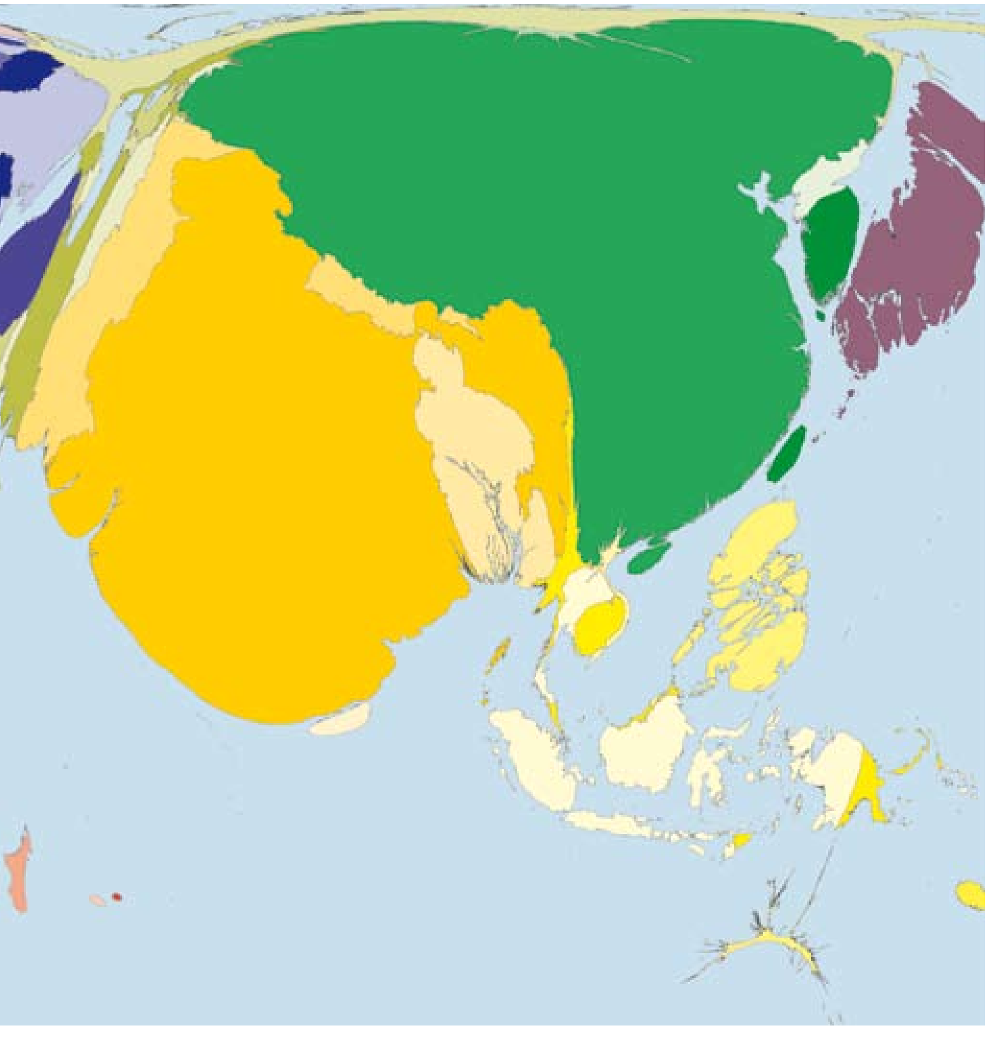
Most of our data comes from sources such as United Nations reports and is often tucked away in appendices. No one wants to look at those figures, and it would be hard to provoke any excitement by confronting someone with spreadsheets filled with numbers. But you just can't help looking at these pictures. After all, a new view of the world, rather like the famous Earthrise photo taken by Apollo astronauts, is a compelling sight.

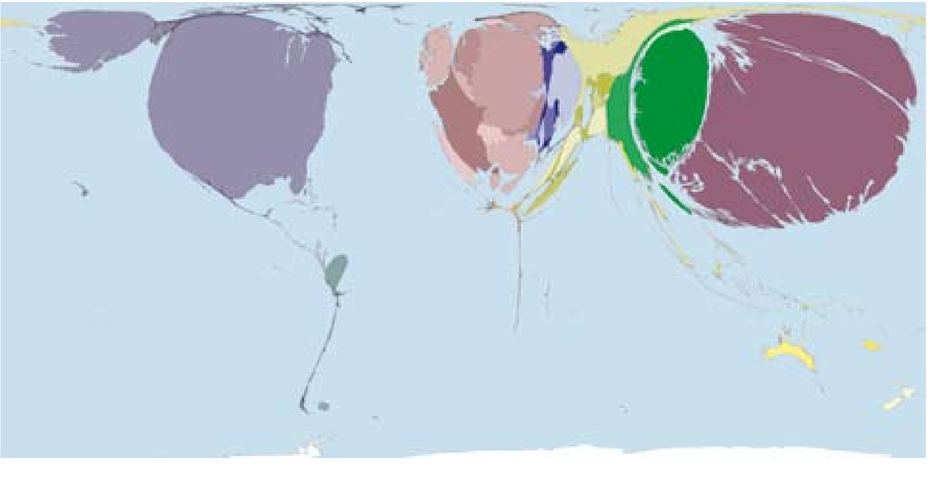
Perhaps it is the sheer audacious distortion that draws the eye. Distortion is not a new thing in maps, of course: some kind of distortion in area, shape, direction or distance is inevitable in mapping. The famous Peters projection is perhaps one of the least distorted maps around in that it at least represents areas accurately, but while that projection made an important contribution to perceptions of the shape of the world, and it is undeniably beneficial to have a general understanding of how spacious various parts of the world are, there are things far more interesting than land area. After all, how many people are more interested in how many hectares a country has than how many nuclear weapons it contains?

People have traditionally represented such information by colour, but the result is not as visually intuitive as simply changing the area. Early attempts to do this represented countries with simple rectangular blocks, ▶









These maps turn statistics into images that are strangely intuitive. Clockwise from top: wealth in the year 1500; patents granted per year; number of working tractors; children aged 10-14 in the workforce

but thanks to an algorithm developed by Michael Gastner and Mark Newman of the University of Michigan in Ann Arbor, we now have a method that maintains the recognisable shapes of territories.

To understand how these new cartograms are generated, take the example of population. The algorithm allocates each country its actual population, and then lets population flow from high-density to lower-density areas – just as a gas will flow from high-pressure to low-pressure areas – by allowing the borders to swell or contract. That is why the maps look like they do: shrunken areas are like balloons that have had some air let out, and expanded areas are like balloons that have been inflated.

Changing territories

The end result is that the same amount of space in any territory represents the same number of people. In other words, the density of population is equal everywhere, and the final size of the territory will immediately indicate the proportion of the worldwide population living there. And just as pre-shaped children's balloons take on an exaggerated yet recognisable version of their former shape (or a sorry-looking deflated version) when their volume changes, so do the territories on our maps. As a result, you can still recognise which country is which.

Newman derived his algorithm to do this from the physics of heat transfer, molecular mixing and a mathematical tool called the fast Fourier transform. It makes these projections feasible with only modest computing power, but the other long-awaited vital ingredient is highly detailed data. The UN Millennium Development Goals, a collection of grand blueprints for improving education, halting HIV, reducing poverty and so on, have created the need for large amounts of data of this type in order to monitor progress. Its collection has also made much more comprehensive world mapping possible. And that's what we and our colleagues at the University of Sheffield, UK, and the University of Michigan are attempting to do. Our plan is to produce at least 365 maps this year, all made available through the Worldmapper website. Visit www.worldmapper.org and have a look around. It will change your world. ●

Danny Dorling and Anna Barford are part of the Worldmapper project at the University of Sheffield, UK. The maps accompanying this article will shortly be available on the Worldmapper website

Further reading: "Diffusion-based method for producing density equalizing maps" by Michael T. Gastner and M. E. J. Newman, *Proceedings of the National Academy of Sciences*, vol 101, p 7499