

UK election cartography

Kenneth Field^a and Danny Dorling^b

^aCartographic Research and Development, Esri Inc, Redlands, USA; ^bSchool of Geography and the Environment, University of Oxford, Oxford, UK

ABSTRACT

In this paper, we explore the history of the cartography of UK elections; we illustrate how it has changed as a result of technological change and also due to the changing demands of electoral map consumers. We then focus on the way in which maps were used (and possibly also abused) across many of the various media outlets that reported the 2015 General Election in the United Kingdom. The review reveals a fascinating consensus in terms of map type, style and functionality though, naturally, the extent to which various maps were useful varies. However, what is most interesting is seeing their form coalesce towards a common format. A new default appears to be emerging.

We then offer two alternative maps of the UK 2015 General Election, which contribute to the development of modified symbology for thematic cartography. In the first, we demonstrate how an artistic representation can have benefits in displaying what are essentially very messy data. In the second, we create a new 3D hexagonal cartogram. In summary, we suggest that despite the apparent coalescing it might be too early in the cartography of elections to think that a final form has now been reached as our experiments show.

RÉSUMÉ

Dans ce papier, nous explorons l'histoire de la cartographie électorale au Royaume-Uni ; nous illustrons comment cette cartographie a changé non seulement en raison des changements technologiques mais aussi en raison des changements des attentes des consommateurs de cartes électorales. Puis nous analysons la façon dont étaient utilisées - voire éventuellement abusées- ces cartes au travers de nombreux médias qui ont couvert les élections générales en 2015 au Royaume-Uni. Notre étude révèle un consensus fascinant quant aux types de carte, de légendes et de fonctionnalités bien que, naturellement, toutes les cartes ne répondent pas aux besoins de façon équivalente. Pourtant, le plus intéressant est que ces cartes se fondent dans une forme identique. Un nouveau défaut semble ainsi émerger.

Nous proposons alors deux cartes alternatives pour les élections générales du Royaume-Uni de 2015. Ces cartes contribuent au développement de nouvelles symbolisations pour la cartographie thématique. Dans la première carte, nous démontrons que les représentations artistiques peuvent être avantageuses lorsqu'il s'agit de représenter des données particulièrement peu

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ordonnées. Pour le deuxième type, nous créons des nouveaux cartogrammes à base de formes hexagonales 3D. En résumé nous suggérons que, malgré un consensus apparent, il est peut-être trop tôt dans l'histoire de la cartographie électorale pour penser qu'un type définitif ait été atteint, comme le montre nos propositions cartographiques.

Introduction

Elections are fascinating events. Of course, the serious business of democratically electing a candidate to represent you in government is at the heart of the event, but for many of us, there also exists a fascinating sideshow in seeing how the results will be presented this time round. The media and pollsters expend a terrific amount of energy in the impossible task of trying to predict individual winners in marginal seats, and then overall outcomes when the polling shows the result will be close. With nothing to report until the results are announced, the media are in an unenviable position of having to publish or broadcast extensive coverage of an event they have very little actual content for. At best, they can draw upon historical information and develop a commentary on what has happened in the past and on how this relates to the various polls – polls which (at some times) can appear little better than a badly informed guess and which have as much chance of being right as they do of being utterly wrong when it comes to a knife edge outcome. In the UK in 2001 and 2005 the polls appeared to be much more accurate, but that too could have been partly chance (Dorling, 2008). The UK general election of 2010 was too close and complex to call, resulting in a coalition government. The polls then predicted the wrong outcome in both the 2015 election result and the subsequent 2016 Brexit referendum. Mapping actual outcomes becomes both more important and more interesting when they are unpredictable.

For cartographers, there's interest in how maps are used in the run-up to an election, on the results night itself, and in how the result is reported post-election. Maps take centre stage because they give us a trusted mechanism with which to illustrate the past and, to put it most simply, people like maps, particularly colourful ones that reflect political affiliations with political party colours. They are tangible objects that add stature to debates and poll results, giving them a sense of realism where perhaps one should not be presumed to yet exist. Maps also give newspapers, web and broadcast media (as well as political commentators) a way to flex their technological and design muscles in a game of carto-one-up-manship. They are a battleground in their own right as organisations vie with one another to seek to produce ever more impressive graphics with which to lure viewers to rely on their coverage and not that of the other channel or newspaper. With so much need to captivate an audience, and so little of much substance to say until the actual results are released, maps become an important tool in the armoury of broadcasters.

In this paper we present a view of the past, present and future of election mapping using the United Kingdom as an example and with specific reference to the General Election of 7th May 2015. We review how UK election mapping has historically been designed and has developed before focusing on the way in which different media organisations used maps to augment their coverage of the 2015 General Election.

This review of the current state-of-the-art is then further developed as we report on two new maps we've produced that challenge what could be seen as conventional electoral cartography and use these as a springboard to think how election maps may change in the future. In particular, we explore the potential for artistic symbology to act as a metaphor for the uncertainty and convoluted process of electioneering and the reporting of results beyond merely showing the winners. We also explore the value of 3D thematic mapping as a way to encode the results using multivariate symbology and show how new technologies overcome some of the limitations of static 3D views. We assert that both of these methods offer something new and interesting to the presentation of election results as well as further developing the realm of new possibilities in thematic cartography.

The past

Possibly the first attempt to making a map of election results that disregarded conventional physical geography was a cartogram published in *The Times* newspaper in 1895 (Figure 1), although earlier maps may have been drawn in mainland Europe. The development of the cartogram as a technique for thematic mapping can be traced back to early nineteenth Century atlases in the United States (Nusrat & Kobourov, 2016) but cartograms were not described as such until 1870 (Tobler, 2004). The *Times*' cartogram was referred to as the copyrighted 'simplex chart', which showed the various parliamentary geographies represented as tessellating squares of equal size. Additional internal symbology and a black/white distinction gave rise to the use multivariate symbol to show whether any particular seat was an urban borough, a metropolitan borough, or a university seat (members of certain universities got to vote twice in 1895 all the way through to 1945 after which the university seats were abolished).

Cartograms have become a popular mechanism for portraying elections from that of 1895 onwards, not just in the UK but in many other countries. Cartograms have routinely been used in German election mapping since at least 1903 (Fabrikant, 2003) and in US election reporting by the *New York Times* for the last decade and almost certainly earlier (Nusrat & Kobourov, 2016). Concentrating on the UK, cartograms have traditionally been most popular when the Conservative and/or Unionist parties have been least popular. In both 1964 and 1966 a topologically correct cartogram of the UK (now without most of Ireland) appeared (Figure 2). Both were created by Hollingsworth (1964, 1966) and would have taken many days, if not weeks, of work to produce by hand. These are all early evidence of the desire to equalize our geographical view of the world to present the relative importance of political units.

Political boundaries in the UK are periodically redrawn to try to take into account changes in the distribution of the electorate. One such redrawing occurred for the 1970 general election, meaning that Hollingsworth's 1964 and 1966 cartogram, based upon seats first contested in 1959, had become useless and would need to be redrawn again. That was never done and so the 1970, two 1974 and 1979 elections were never properly mapped. However, following yet another redrawing of the boundaries, for the 1983 general election, and the advent of microcomputers, electoral cartography suddenly became far easier in the 1980s. Figure 3 shows ten general elections being mapped on a cartogram base that slowly changes over time as the electorate changes, as the



Figure 1. Result of general election by the times 1895.

parties change and as new seats are introduced while those in areas of declining population are removed.

Once microcomputers could be used to draw maps the opportunities for depicting more and more information about elections blossomed. For example the cartogram in Figure 4 has seats coloured by the share of the vote gained by the three main parties in 1987. It was a very early and crude example of trivariate mapping. Areas coloured blue represented seats where the Conservatives gained most votes; red, Labour; purple,

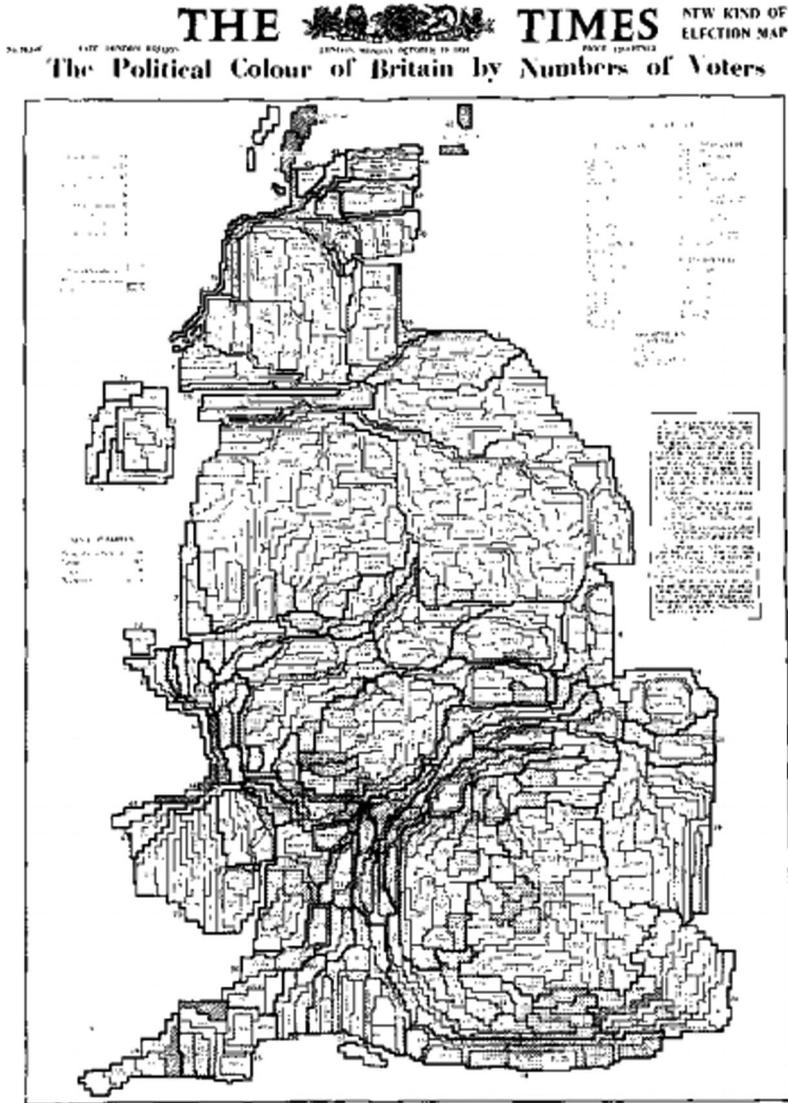


Figure 2. The political colour of Britain by numbers of voters by Hollingsworth, 1964.

both Labour and the Conservatives and so on. Furthermore, each seat was drawn as an arrow where the length of the area was proportional to the amount of swing between the two elections and the direction of that swing. Seats in the south of England were much more likely to swing towards the Conservatives in the 1980s. People living in Scottish, Welsh and Northern English seats almost all shifted leftwards and downwards in their voting – away from the Alliance and the Conservatives. One of the authors of this paper was involved in developing these 1980s cartograms, but very soon electoral graphics became more the preserve of media organizations again, once they had become used to the new technologies.

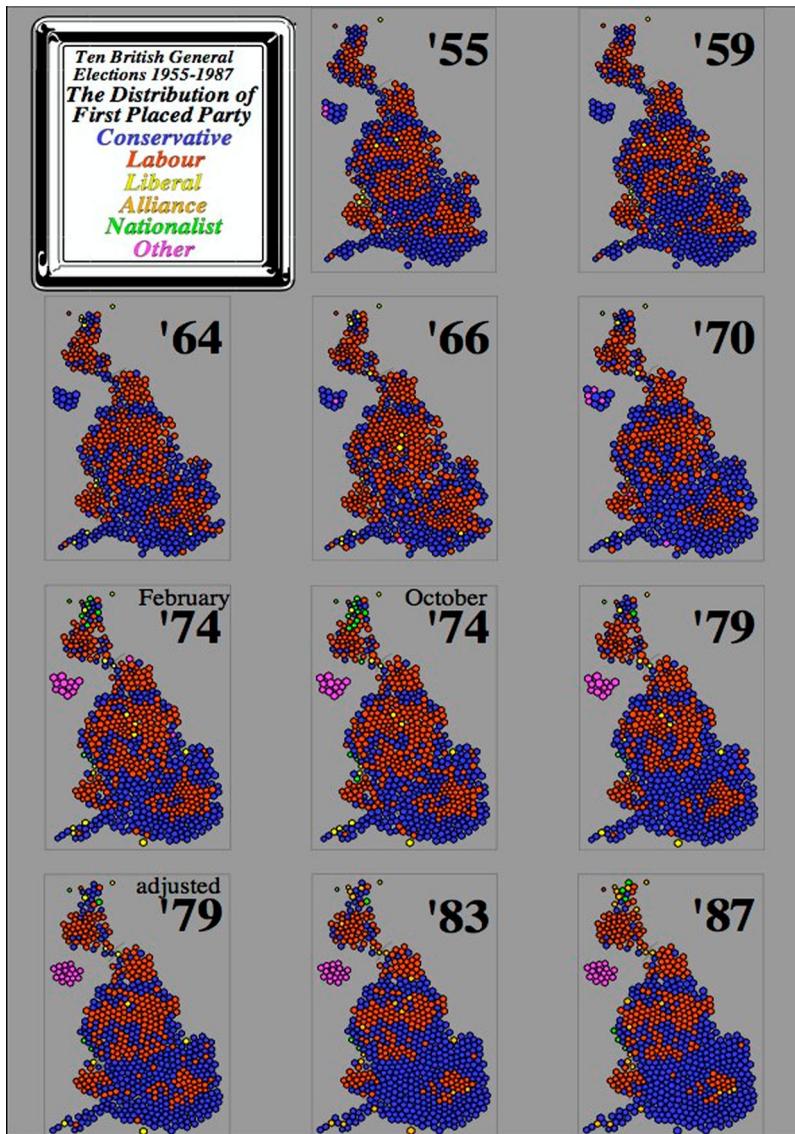


Figure 3. Ten British general elections 1955–1987. (Dorling, 2012 used with permission).

During the 1990s election, graphics became more and more adventurous. On the BBC the traditional swingometer was replaced with a digital version that became progressively more sophisticated, although it never coped with the growing importance of three-party politics, let alone with the halting rise of a fourth party, the Scottish Nationalists, who now control the third largest number of seats in the House of Commons.

Animations were used more and more to try to depict the growing complexity of British politics in the 1990s. The 1997 general election was a near landslide and suggested a swing had occurred which was as unpredictably large as was that of 1945 (Cornford, Dorling, & Tether, 1995). Labour, albeit in a 'New' format, were back in power and cartograms became more popular again as having maps that appeared mostly blue, while

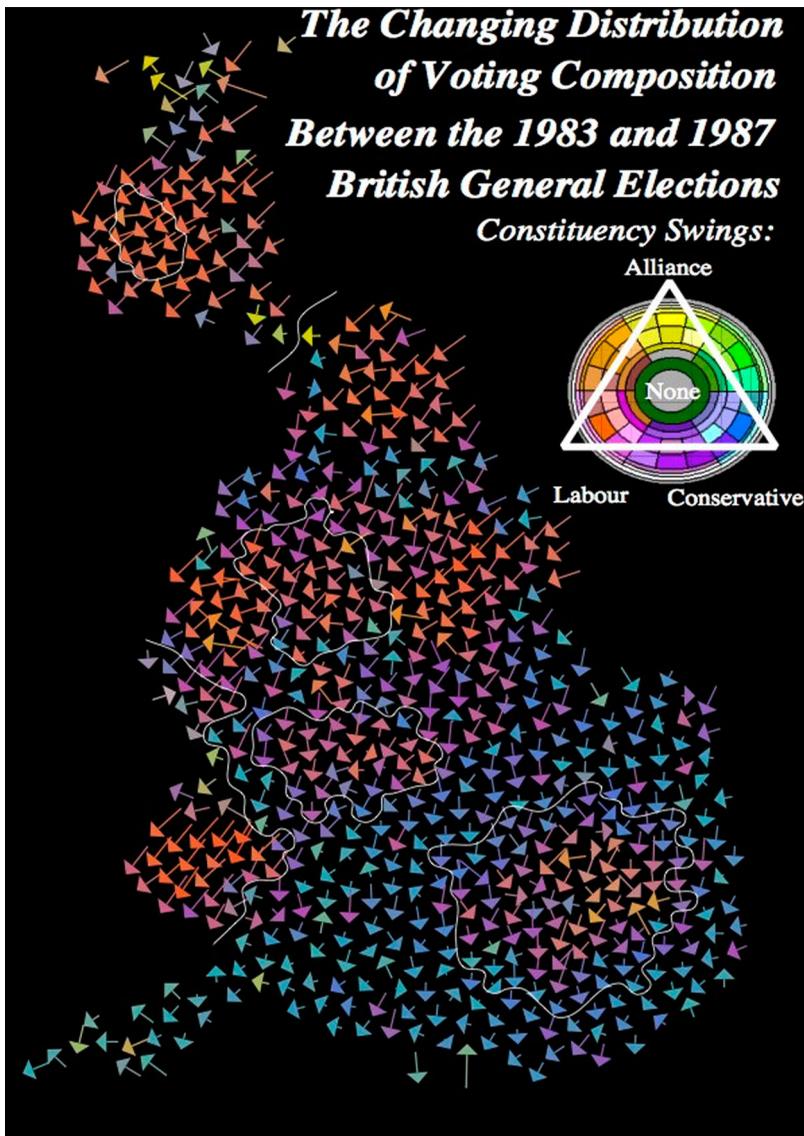


Figure 4. The changing distribution of voting composition between the 1983 and 1987 British general elections. (Dorling, 2012 used with permission).

the Conservatives lost elections in 1997, 2001 and 2005, appeared very odd. But slowly simple equal land area maps did re-merge again – not least because the new ubiquity of GIS made them so easy to produce.

It is possible that the availability of cheaper mapping software, reduced budgets in the media as advertising revenue collapsed after 2008, and the weakening of the Labour majority led to sloppier cartographic work again by 2010. The actual result of the 2010 general election, the formation of the UK's first serious coalition government (not just a 'pack') led to more headaches for both pollsters and cartographers. Parties which had been painted as fighting each other in early May 2010 were best buddies come late

May. And the traditional equal land area map appeared to be a fair representation of the actual election result as it made the Liberals look far bigger than they actual seat tally (they did win a higher proportion of votes than seats). Liberal MPs entered the cabinet and, as the Daily Mail commented at the time, unlike other Liberal MPs almost all those who entered cabinet were millionaires (Owen, 2010). But as yet none was mapping the characteristics of MPs such as the variance in their personal wealth.

The UK's first past the post Westminster election voting system has many failings but one benefit is that it makes electoral mapping simpler. In the run up to the most recent May 2015 general election the 'battleground' could be drawn using the political colours of the current victor in each area, and the degree of marginality could then be shown some other way. Next came the polls and so in this story we are now up to the present and one of the most exciting elections in recent British history. Cartographically the 2010 UK general election had been disappointing, but that was hopefully the end of an era.

The present

From a cartographic perspective, the 2015 UK General Election didn't disappoint as a multitude of different maps were developed that seemed to focus on the cartogram as the main graphical device. In 2010, at the previous UK General Election, most news agencies went with a standard geographic map showing the results by colour of the winning party (Figure 5).

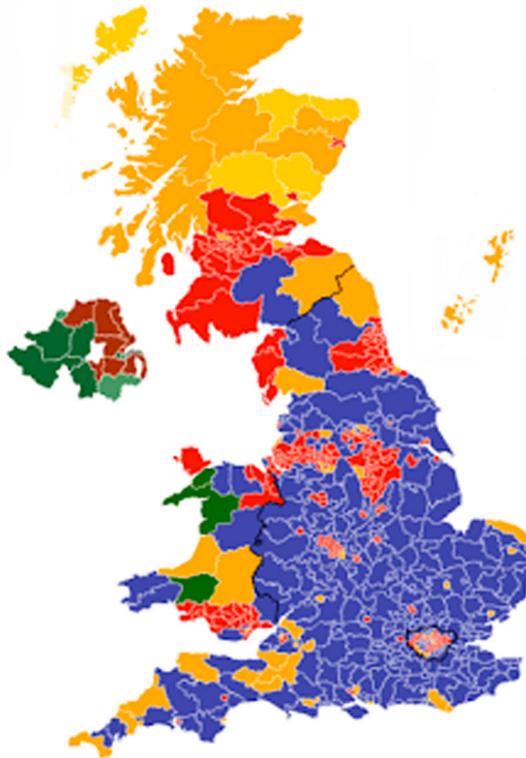


Figure 5. A typical geographical map of the 2010 UK general election (author).

The difficulty with this approach is that larger constituencies dominate the map in visual terms. Smaller, inner city constituencies can hardly be seen on a national map like this. That traditional map greatly distorts the way we see the election results. On this map there's a lot of blue (Conservative) and a fair bit of yellow (Scottish Nationalist) and gold (Liberal), but not much red (Labour) and just one speck of Green (ironically in an urban seat).

At this point it is perhaps worth inserting a note for US readers. The United States is one of the few countries in the world to use the political colours 'red' and blue' the opposite way round to what has become a convention elsewhere. This is a product of the interesting political history of the US where the two parties swapped political positions over time and the current blue for Democrat and red for Republican was not completely cemented until the Bush vs Gore election in 2000 (Enda, 2012). If you are from the US and not familiar with the international conventions what you need to know is that red – in the rest of the world – is used for the party of the workers (the socialists, social democrats and communists), blue for the bosses and liberal (gold) means 'in the middle' in European politics, not on the edge. There are also green parties in Europe (a bit like successful Ralph Naders) and many other groups – especially where there is proportional representation, which is almost everywhere else in Europe apart from the UK, and in almost every other election held in the UK apart from very local ones!

As we've set out in the previous section, cartograms offer a form of thematic mapping that accommodates the difference in the original land size of areas. There are plenty of alternatives. The Gastner-Newman population density equalizing cartogram (Gastner & Newman, 2004) tries to preserve some sense of geography, preserving all topology while squeezing and stretching shapes. It appears a little odd to some people (Nusrat & Kobourov, 2016). The DeMers uses squares, the Dorling uses circles; both perfectly good shapes and then ... there's the hexagon that offers a form of mosaiced cartogram, perhaps best described as a tessellating version of the Dorling cartogram. Here's the 2010 results again, this time mapped with equally sized hexagons (Figure 6).

The colours on Figure 6 reflect which party won the most Westminster seats. Each hexagon is now equal sized in terms of the area each occupies on the map reflecting the equal voting power of each MP in parliament. The gold and yellow in the large Scottish constituencies have receded. The blue has also been shifted in visual importance as many far smaller constituencies that elected a Labour MP (red) are now visible (smaller by land area note, not electorate). As there was a hung parliament in 2010 the Conservatives (blue) had to do a deal with the Liberal Democrats (gold) to get over the 326 seats needed to form a coalition government. But Labour working alongside the Liberals and some other minor parties could have also made up that number. Many of the minor parties are in Northern Ireland, which has almost as many political colours as the mainland does. The map in this form is a much more useful mechanism for communicating the results for this specific data, showing the nuances but also putting everything into political perspective. It tells the story far more effectively than a traditional geographic map.

Hexagons have been used as a framework for thematic mapping since at least 1895 (O'Brien, 2013). They were also promoted by one of the authors of this paper in the 1980s as a method for mapping election results because they are close to circular (and

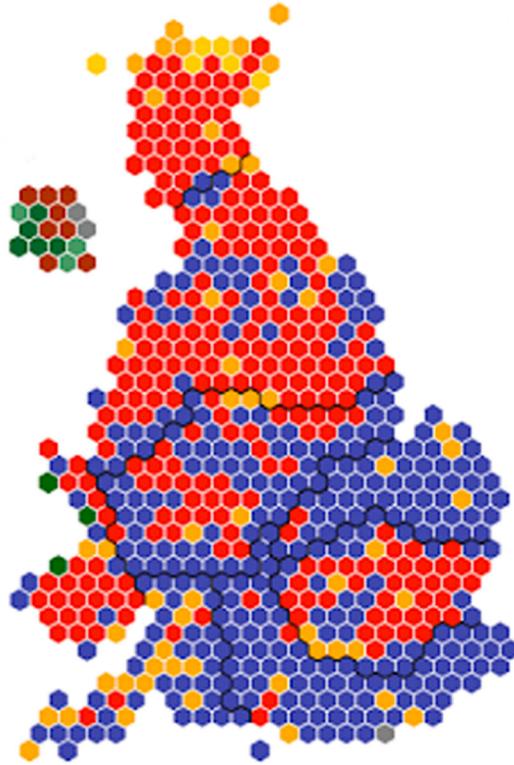


Figure 6. A typical hexagonal cartogram of the 2010 UK general election (author).



Figure 7. BBC piazza election map (from broadcast television coverage).

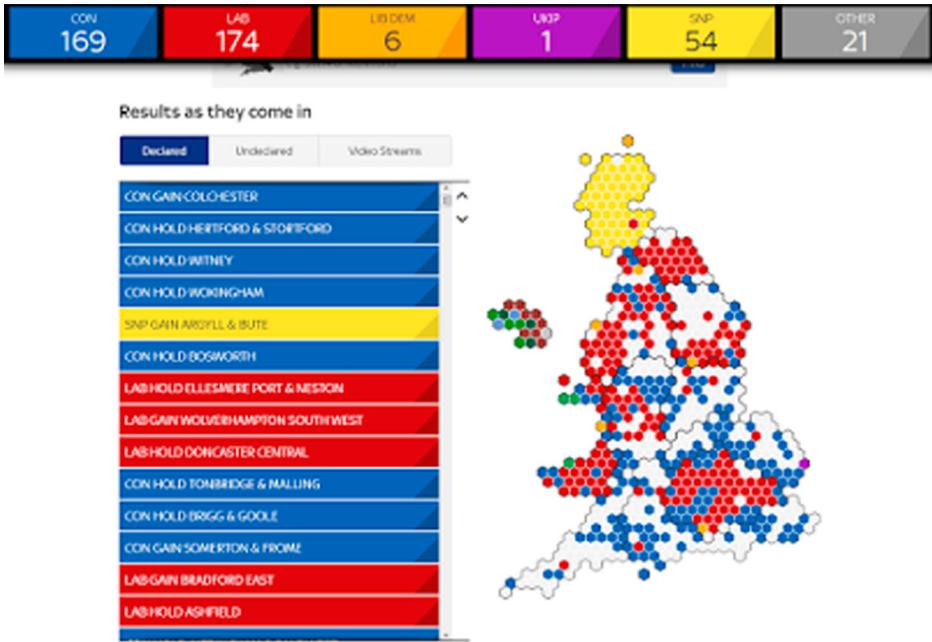


Figure 8. The Telegraph election web map.

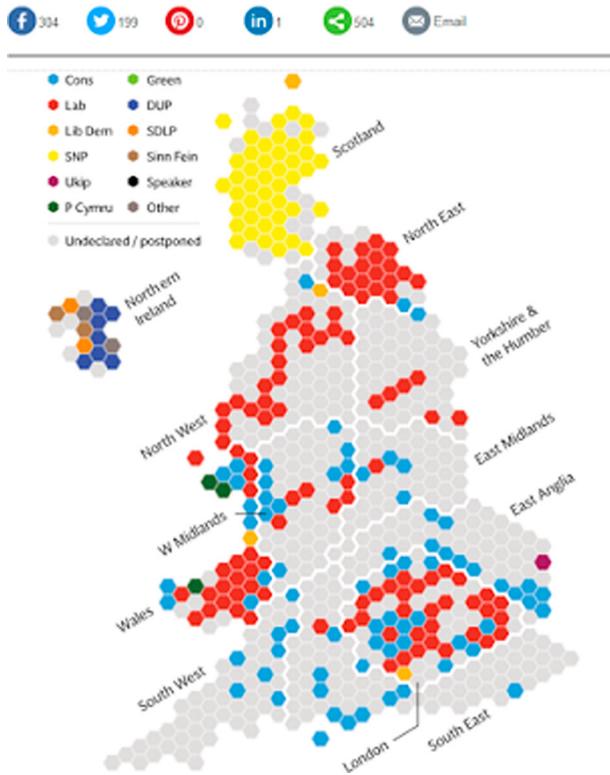


Figure 9. Sky News election map (Sky News, 2015).

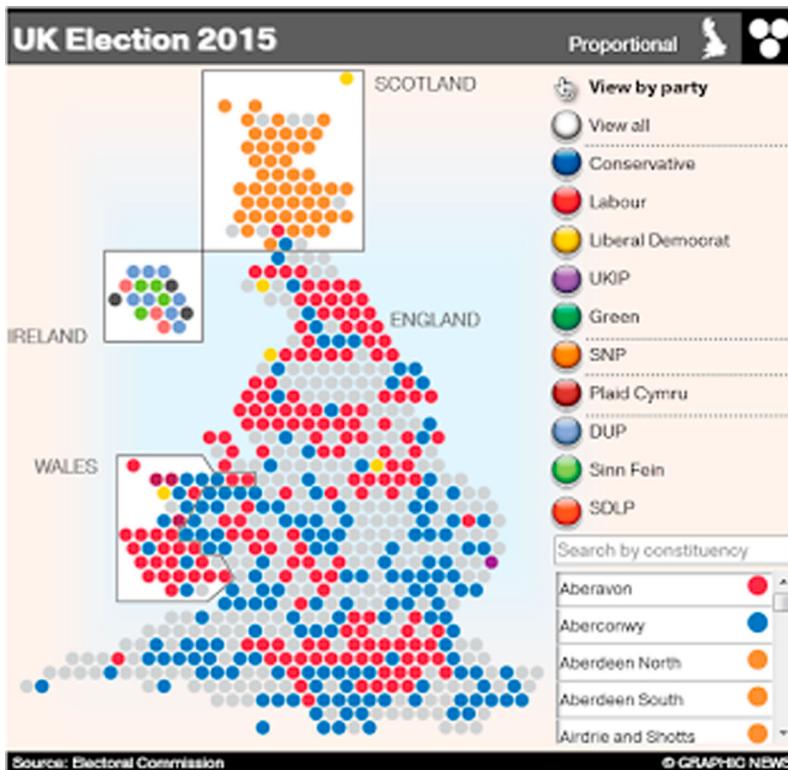


Figure 10. The Independent web map (The Independent, 2015).

thus pleasing on the eye) and they tessellate well, providing flexibility and six shared boundaries each. This was and remains a pretty good fit for UK political geography. The average parliamentary constituency in the UK has just under 6 neighbours.

Sporadically, news agencies have used hexagons, but just before the 2015 UK General Election the hexagonal cartogram 'went viral'. Virtually everyone used them. In fact, you'd be hard pushed to find a news agency or media outlet that didn't. Andy Kirk even proposed a new name – the elecagon map which struck us as a fun way to refer to them in this context (Kirk, 2015).

The BBC got the 6-sided ball rolling with a giant physical map they built in the piazza at the entrance to their main central London Television Centre (Figure 7). This was a map you could walk on. A map that had tiles added throughout the night as results came in. It was a map that was used for short interviews and which was largely under-used in comparison to what might have been possible. Apart from any more serious use it was large enough for Vince Cable, a prominent Liberal Democrat MP and award-winning ballroom dancer to show his dancing skills off on. He did this while also demonstrating how it became possible to traverse from Land's End to the Mouth of the Humber, tiptoeing only on blue tiles due to this party's poor showing. Numerous other possibilities can be dreamed up for next time.

The BBC web site (in this and in many of their other digital mapping offerings) curiously did not go for hexagons, which they had used successfully in 2010 (BBC, 2015a). An odd



Figure 12. The transition state of Bloomberg's web map (Burgess et al., 2015).

2015), as did Sky News (Figure 9), a TV channel closely connected with the Times, Sunday Times and Sun newspapers (Sky News, 2015).

The Independent went with a hexagonal cartogram too (Figure 10), but the web page opens with the equal electorate version and there was an option to switch to an equal land area version if you wished.

Figure 11 shows that in their print media, The Independent (newspaper) preferred an equal land area view and they also offered a slider comparative view comparing the 2010 with the 2015 results, again using a geographic map (Indy100, 2015).

Bloomberg (Burgess, Migliozi, Pearce, & Cannon, 2015) also gave visitors to their web site the option of an equal land area map or a hexagonal cartogram (Figure 12). What we particularly liked in this example was the way that the map transitioned between traditional geographic shapes and hexagons through animated proportional hex symbols. Largely meaningless, they did however provide a subtle visual link between the abstract hexagons and the real geography. Using a transition gives the eye something to follow and it's arguable that it aids our interpretation of where places are in relation to one another.

Bloomberg also had a fun animated map which used a blank canvas with no boundaries of any form, across which splodges of colour were fired (Burgess & Pearce, 2015). The results were animated so a map of colour builds during the 25 seconds that the animation plays. It's a piece of visual data art and one of the more interesting approaches to

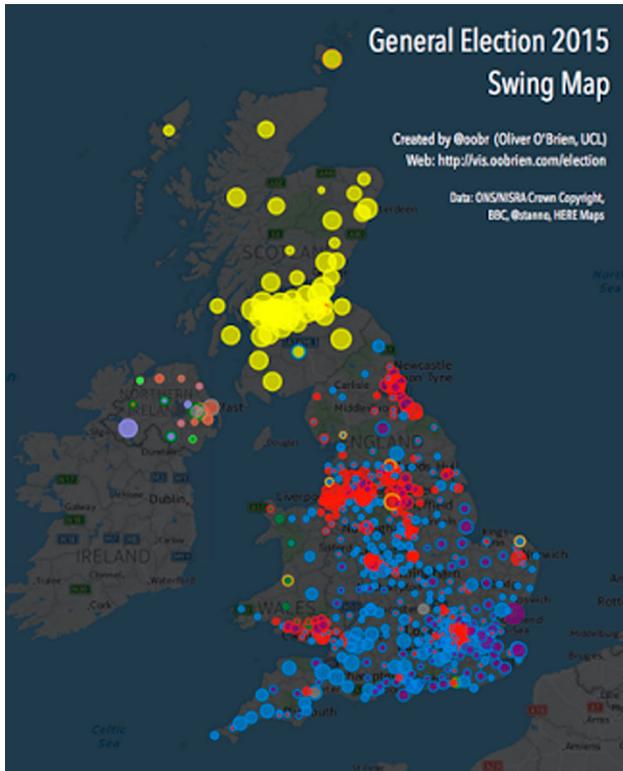


Figure 13. General election 2015 Swing Map (O'Brien, 2015).

mapping the data. There's no way you can recover the results from the final image produced or explore the data, but that's not the point. It exists because they had a good idea. It works.

London-based cartographer Ollie O'Brien produced a live map for election night that updated the results using his DataShine mapping engine. He has since made a few post-election maps showing various metrics such as swing in share of vote, turnout. Ollie went for a geographical view of the results and multivariate proportional symbols (Figure 13).

Oxford's Ben Hennig went with the option of providing three versions on his maps of the results to showcase how the alternatives modify your view (Figure 14). He illustrates the geographic, hexagonal cartogram and a gridded population-equalizing cartogram side-by-side. You get three maps for the price of one and it's a good way to show the different trade-offs between map type.

In our opinion, The Guardian provided the most compelling and complete cartographic service on the night itself with a map that was coloured in as results came in and that auto-zoomed and panned to a constituency you could search for or click on. The live election headlines scrolled next to the map and they too were geographically enabled so clicking on the headline brought up the results for that place (Osborn, Clarke, Franklin, & Straumann, 2015).

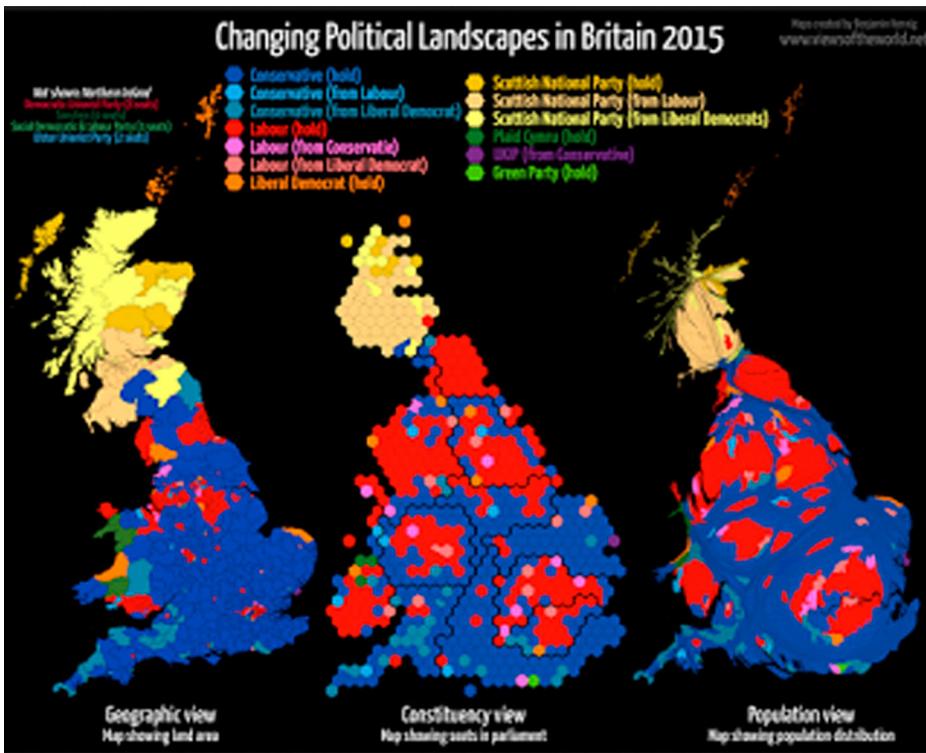


Figure 14. Changing political landscapes in Britain 2015 (Hennig, 2015).

Figures 15–18 show different static states of the interactive maps in *The Guardian*. The hexagons showed regional boundaries and constituency boundaries, hover the mouse and you got some basic detail. Click and you get more. More than that, you could switch between the overall map showing the winning party (using the traditional colours) to a map that showed majority, turnout, and vote share by party. While still using the basic cartogram, these maps used transparency (as an unclassed choropleth) and proportional symbols (arrows) well to convey the message of the different election metrics. Lots to interest both the casual reader and those more interested in digging a little deeper. Supporting graphs and tabulated results as well as subtle labels added to the overall approach and usability.

Of course, it is the serious cartographic efforts that we inevitably focus on in this paper, though there were a few frivolous and humorous maps that were also worthy of attention.

It soon became clear that the Scottish National Party were sweeping up wins across almost all of Scotland with a swathe of yellow constituencies regardless of the cartographic method used. With much of the rest of England and Wales being coloured blue or red, the comparisons with Maggie Simpson began proliferating social media feeds (Figure 19).

Roderick (2015) compared the final map with a quick sketch of traditional coal mining areas of the UK (Figure 20). These traditional industrial heartlands are staunch Labour areas and so the visual correlation between the red of the map with areas of strong support for the centre-left party are a natural fit. The approach gives context though and helps to lift

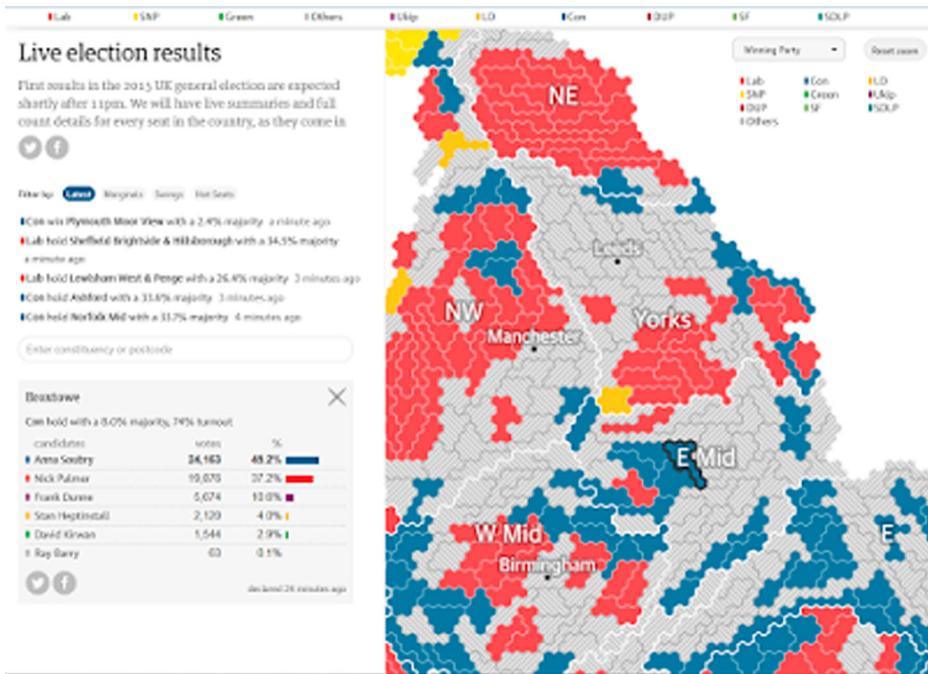


Figure 15. The Guardian general web map (Osborn et al., 2015).

the lid on why the map is coloured as it is. Of course, voting behaviour is far more complex, but this was a useful way of reflecting on some of the historical and geographical reasons for the patterns.

Combining a cartogram with the beauty of a hand-made ‘physical’ map, Figure 21 shows a cross-stitched version by Tom Katsumi, adding a stitch as the results came in to colour in his cartogram based on squares (BBC, 2015b).

Our alternatives

There are, of course, many ways to map the election results and once the results were all counted we devised a couple of alternatives with the intent to explore modified symbolism and ways to represent some of the details of the results that the first past the post maps fail to deliver.

Firstly a map entitled ‘Election Pollocks’ riffs off the notion that elections are messy affairs as political parties and candidates slog it out to persuade people that their ideologies are a better bet than their opponents’. The UK political scene used to be dominated by two (three if we’re generous) political parties but the landscape has changed. Many more have come to the fore and despite the first past the post system, the political map is now an altogether more colourful affair. So this example paints the resulting political colour of the UK as a Jackson Pollock inspired piece of modern art (Figure 22). The title’s play on words and the visual result provides a metaphor for the frantic electioneering that culminated with the usual hysteria of election results night. Instead of a map showing just the results of the winners, this map illustrates the complex patterns of

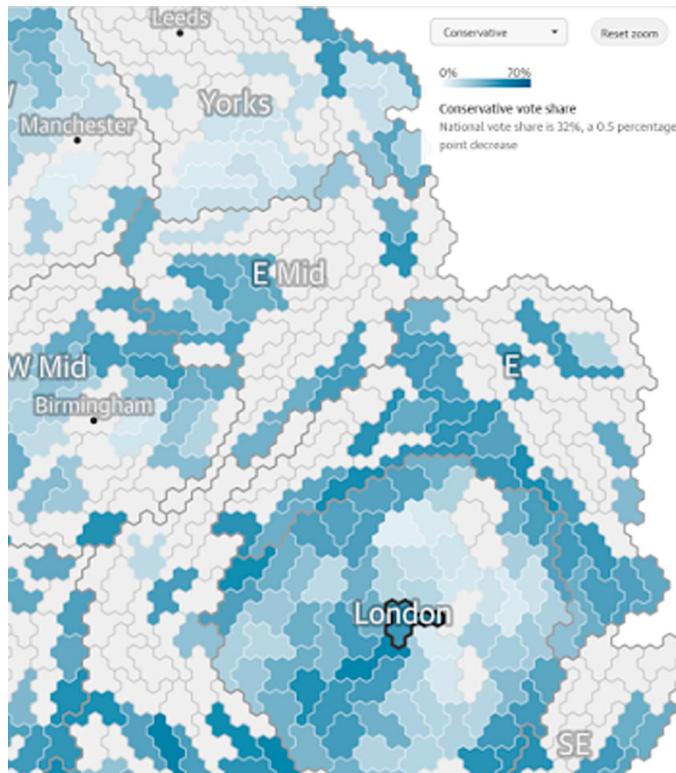


Figure 16. The Guardian vote share for Conservatives web map (Osborn et al., 2015).

voting as abstract art, using paint to create a fascinating impression of political colour across the UK.

The map was constructed using Esri's ArcGIS Pro with a few key technical steps required. The 650 constituency level election results were prepared and four layers of point features representing the winners, runners-up, third place and others created in an ArcGIS Pro project. A 'paint splat' symbol for each political party was designed using Adobe Illustrator, using party colours and saved as PNG files. The point feature for each constituency is then symbolized by its relevant paint splat, sized according to the number of votes received to create a proportional symbol map with abstract symbols. This process was repeated for the remaining layers to build up layers of 'paint' on the map with random rotation and offsets being applied. The map was published to ArcGIS Online as a web map and can be viewed at <http://arcg.is/1ji2tDx>.

The different sized and coloured symbols and their pseudo-random application give the map a less structured appearance, much like a Jackson Pollock painting. This allows the paint to mix, to give winners visual prominence, but also to incorporate a visual impression of the wider voting profile of each constituency (Figure 23).

More paint is applied to the map in areas with small, urban constituencies and larger populations. Larger, predominantly rural constituencies appear less splattered, which highlights the disparities in the population distribution of the electorate. The map deliberately does not show constituency boundaries to reduce clutter. It's not meant to be a

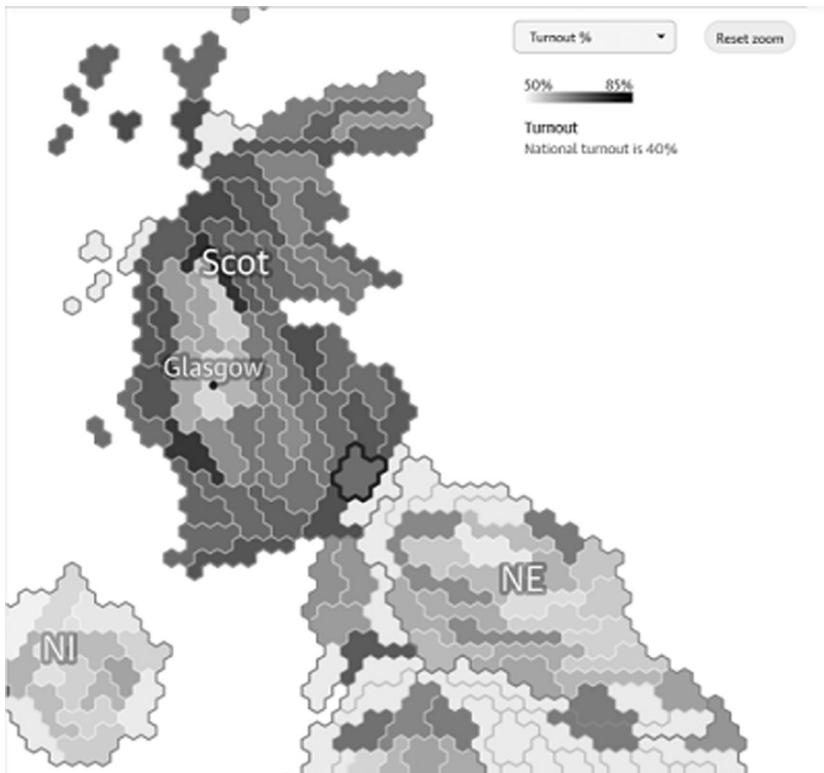


Figure 17. The Guardian turnout web map (Osborn et al., 2015).

map that supports accurate visual processing of the results by area. It's a proportional splat symbol map that paints a colourful picture of the complex and messy geography of elections.

Election Pollocks was designed as a piece of art. As art it will not be to everyone's taste, but it challenges cartographic practice and the way in which we consider election cartography to be possible. The use of a messy symbolization to express a somewhat messy subject matter provides an interesting cartographic solution and a counter to the geometric certainty that the ubiquitous cartogram has come to represent. It also offers a way of presenting multivariate data (four pieces of information per constituency) in a way that might not otherwise be legible across a map with such varying geographically sized areas. A more detailed technical description of the map's construction can be found at <http://arcg.is/2cU6rog>.

For the second map we wanted to develop the two-dimensional hexagonal cartogram and explore the way in which we might use three-dimensional space. There's also a natural metaphor with the Giant's Causeway in Ireland and part of the inspiration for the second map was this picture of (ex-prime minister) David Cameron taken in 2015 (Figure 24). Could a hexagonal cartogram be extruded to make use of vertical space? The second map is called Political Causeway.

In two-dimensional space the creation of equal area tessellated hexagons is relatively simple. Creating hexagons that curve across a surface is more complicated due to the



Figure 18. The Guardian swing (here, to SNP) web map (Osborn et al., 2015).

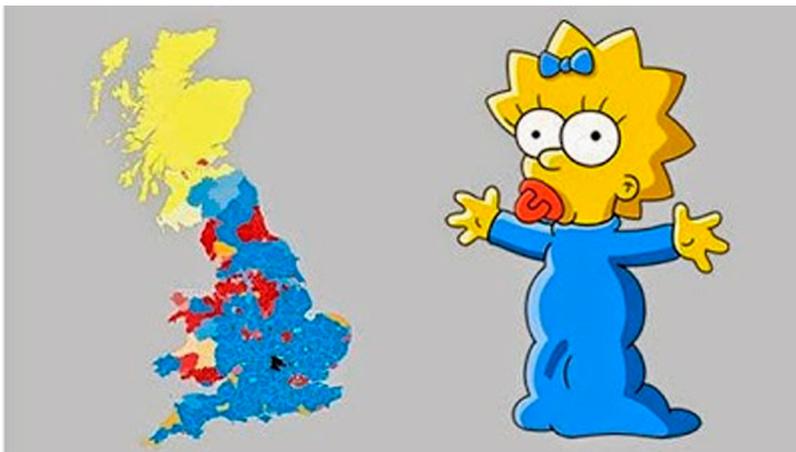


Figure 19. Maggie Simpson and the UK General Election (McLaughlan, 2015).

geometry involved. The initial challenge was to build a set of hexagonal regions that partition the Earth's surface. This was achieved computationally by creating an icosahedral discrete global grid using ArcGIS Pro. A number of grids of different resolutions were built and used in different ways in the final map.

Once general grids had been developed, a grid of 650 tessellating hexagons, one for each political constituency was constructed. The position of the hexagons optimized the real adjacency characteristics as far as possible while maintaining some sense of the

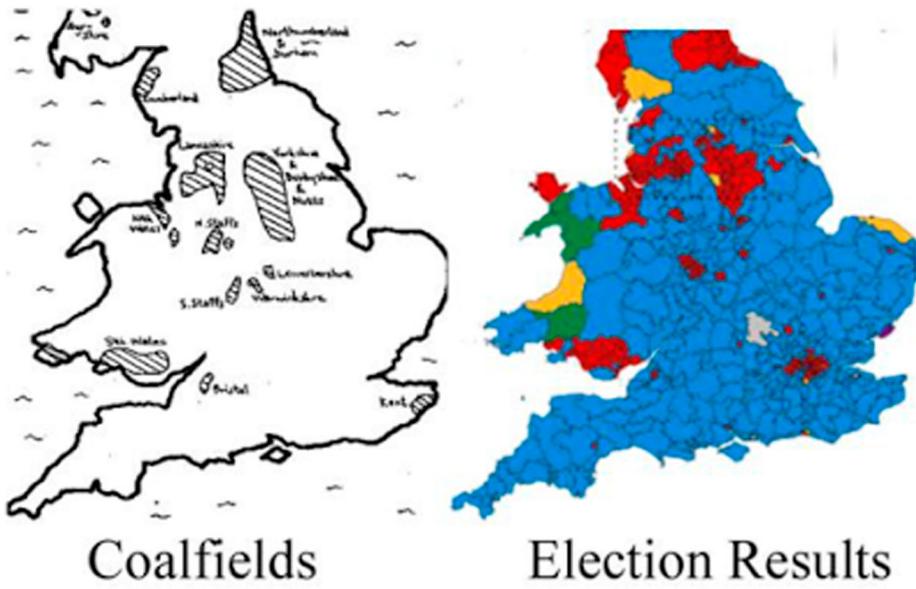


Figure 20. Distribution of Labour seats compared to England and Wales coalfields.

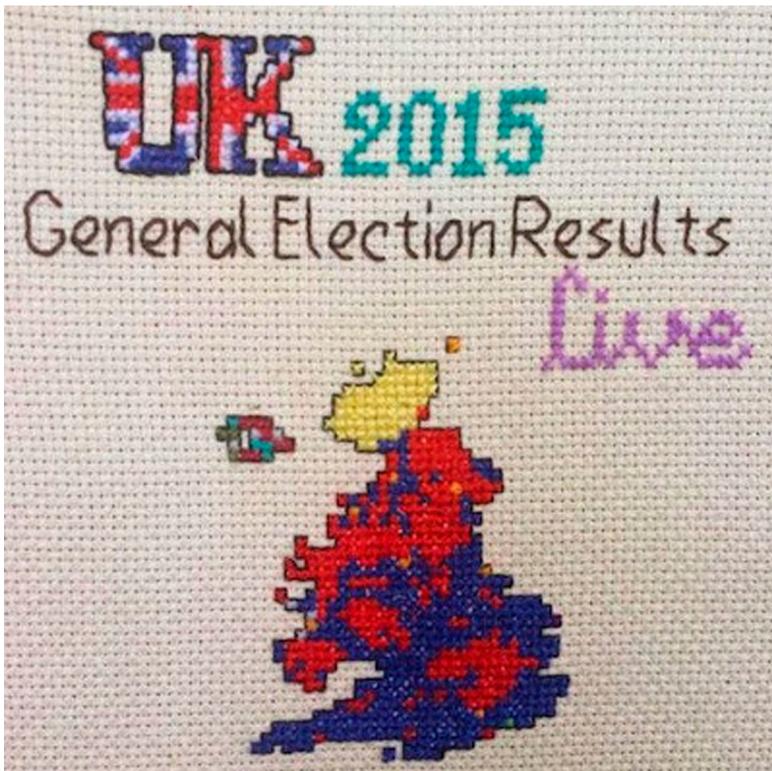


Figure 21. Cross-stitching the general election (BBC, 2015b).

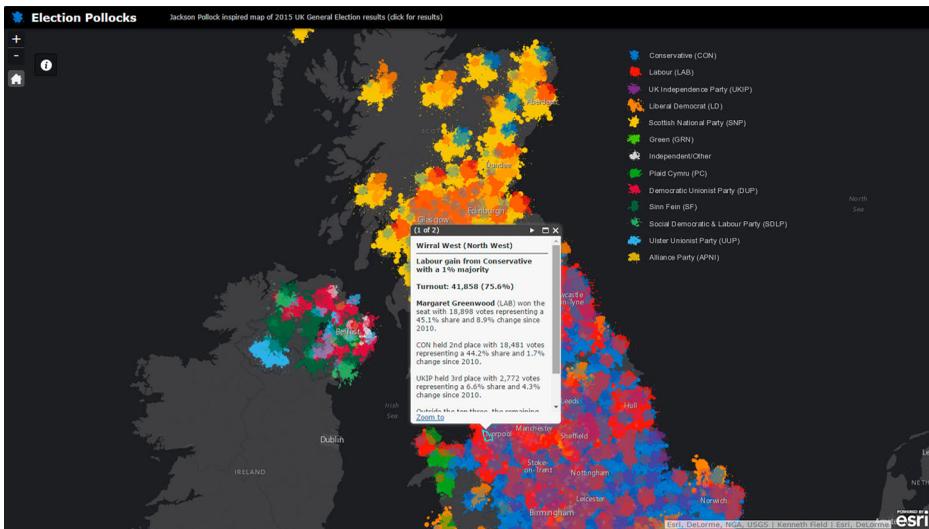


Figure 22. Election Pollocks overview (Field, 2015a).

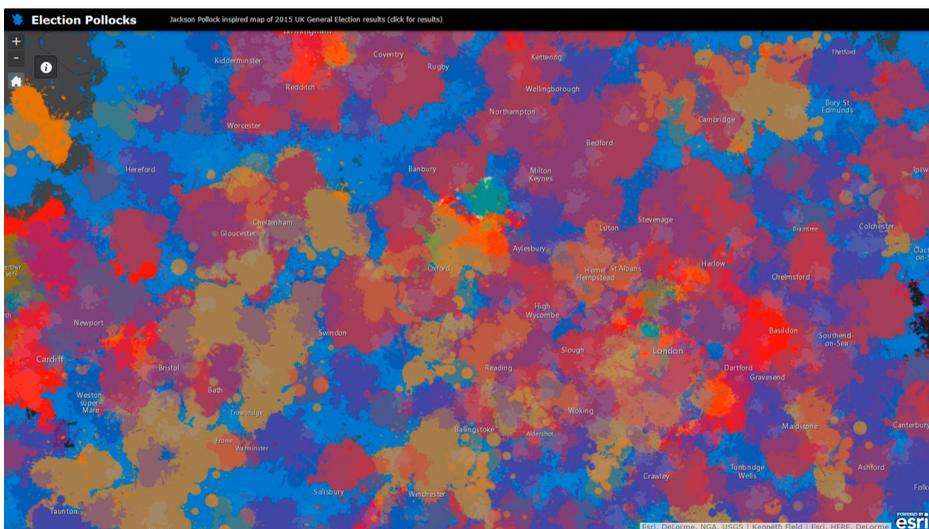


Figure 23. Election Pollocks symbology (Field, 2015a).

shape of Great Britain and Northern Ireland. Obviously, the Scottish hexagons appear to cover a smaller area than their true geographical counterparts, which is inevitable and desirable since this is an equalizing approach to cartography.

The technical steps to constructing the map began by joining the election results to the hexagon features and into four different layers. The two-dimensional features were extruded into hexagonal blocks using the total vote for that party. The base layer represents all votes for those other than the top three. The second to bottom layer represents the third place result, again extruded by number of votes and positioned such that its base sits atop the previous layer. The next layer in the stack represents the second place



Figure 24. David Cameron visits the Giant Causeway (credit: Harrison Photography).



Figure 25. Political Causeway: UK Election Results 2015 (Field, 2015b).

and, finally, the winners layer sits on the top. We refer to these building blocks as hexstones such that when stacked they show something of the stratigraphy of the result. Since each hexstone in each layer was extruded proportionally to the candidate's number of votes giving a causeway-like 3D surface and built with volumetric blocks. Each layer sits relative to the layer beneath to build up the final three-dimensional political causeway. The model ultimately looks like a way of viewing the structure of the election results a little like we might cut away layers of geological structure to see beneath. This further supports the causeway metaphor beyond simply the hexagonal shapes though, of course, the basalt columns of the Giant's Causeway don't have a stratigraphic structure

(Figure 25). The final 3D map can be viewed at <http://arcg.is/2c93tLD>. A more detailed technical description of the map's construction can be found at <http://arcg.is/2cHj4zY>.

Of course, this is really just a prism map and one of the limitations of any three-dimensional map of prisms (of whatever shape) is the inability to look 'inside'. Modern interactive web maps allow us to go beyond the possibilities afforded by their static predecessors as we can cut away different layers in the map to see the detail inside. The problem of not seeing inside can also be overcome by creating a nested proportional symbol to sit atop each hexagonal column. We refer to this as a capstone which shows the share of vote for the same four layers of results but in a single layer. This provides a way of seeing the political pattern of voting across all candidates across the top of the hexstones and works well when the viewing angle is set to above. It allows the map to reveal more than just the winners (Figure 26).

A range of supporting datasets (a custom 2D base map, 3D leader lines, 3D labels, a 3D legend and popups) were produced to support the final map and to provide an appropriate amount of marginalia to support the map reading task (Field, 2015b).

Party colours across the map give a recognisable link to the political affiliations. The undulating nature of the hexstones shows total voter turnout across the map ... a small but subtle illustration of where the electorate were motivated to vote to a greater or lesser extent.

A layer of labels can be added to the map. These are scale dependent so as you zoom in, pan and rotate the globe they update to give a reasonable amount of labelling in the immediate view atop the causeway. Simply adding all labels at once would swamp the map. More are revealed as you zoom in' vertical leader lines anchor the labels to each constituency hexstone/capstone and popups can be revealed by clicking the label. This gives detailed results for each constituency and reveals the full statistical make-up of the results (Figures 27–28).



Figure 26. Political Causeway: UK Election Results 2015 (Field, 2015b).



Figure 27. Labelling the Political Causeway (Field, 2015b).

A legend is viewable, again built from 3D hexstones that shows the party affiliated colours (to aid map interpretation), this time proportionally scaled in height by the total number of constituencies each party gained. Legend labels can be queried to get further details of the map and the overall results (Figure 29).

The map is fully interactive so you can zoom, pan and rotate. This gives the map user an ability to zoom across the landscape and position the view camera to any desired location and angle. This overcomes the limitation of a static 3D map that some features are inevitably occluded and foreshortened. Some pre-fixed positions are available to provide quick navigation. The fact that the UK displays limited curvature on a virtual globe due to its

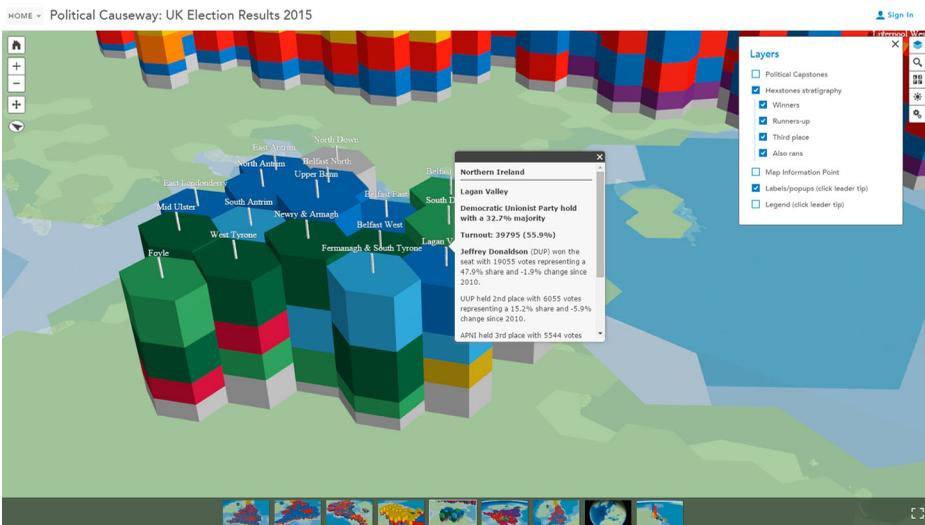


Figure 28. Mining the results for the Political Causeway (Field, 2015b).

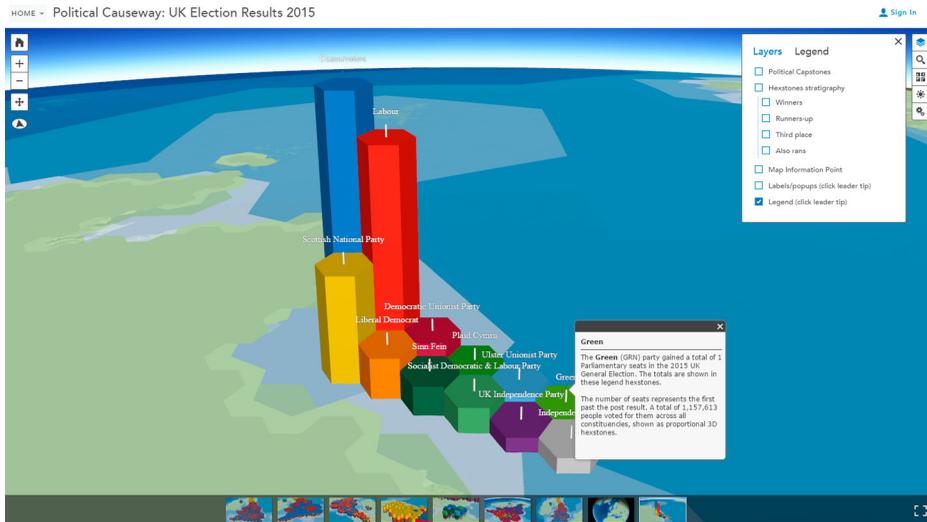


Figure 29. Legend detail for the Political Causeway (Field, 2015b).

relatively small size (in global terms) means the problem of prisms pointing upwards in different directions is overcome. Similarly, because voter turnout was relatively similar across most of the country, there are no overly tall or short columns by comparison, meaning the perceptual difficulties arising from differences in scale are minimal.

The future

The Election Pollocks map explored a more artistic approach to cartographic depiction of the results which allowed a messy metaphor to be made. It's difficult to see clear patterns but that's perhaps the very reason it evokes a desire to explore colour mixing. It's clearly a style and approach that won't be used by many media agencies for whom simple graphic clarity is the principal requirement for a news map yet it demonstrates the flexibility of cartography to offer something new and different, perhaps as a way to better capture attention than provide clarity of outcome. There's certainly scope to explore other ways of using such an artistic approach for other data, perhaps to represent uncertainty or to evoke feelings more associated with artistic movements in general.

The 3D hexagonal cartogram exhibits technical and conceptual innovation. It has pushed our ability to develop 3D thematic products that support ease of use, clarity and interpretation. In some sense it also pushes election mapping and the use of hexagonal cartograms as a way of representing and reporting results. It develops a rationale for taking advantage of vertical space by creating stacked layers for results. The winners-on-top idea works for the final map but layers can be stripped away to reveal the detail of each constituency as well as the pattern across the landscape. The key to the map is interactivity so people can truly explore the different layers and views of the data.

This approach has potential for other uses if we consider vertical space not as separate facets of the same event but as a place to encode the temporal dimension. Creating a 3D hexagonal space-time cube could be an excellent way to display the results from past

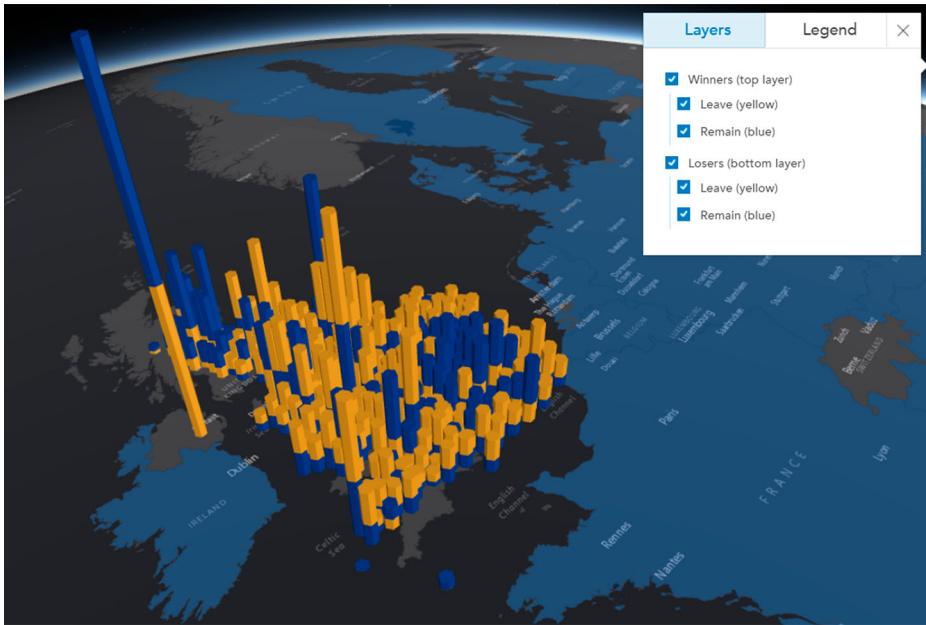


Figure 30. Brexitogram (Field, 2016).

elections in a single application. Each layer could represent the results of an election and so the columns themselves would paint a fascinating picture, in one view, of how political support has changed over time locally and nationally. Indeed, the same approach has more recently been used to map the 2016 Brexit result (Figure 30; Field, 2016).

In some respects, cartography tends to follow fashion as in many different design-led fields. It's part of the purpose of map-makers to experiment and to push the boundaries of cartographic taste and sensibility. By creating the two examples reported here, we've experimented with modified symbology and sought to harness 3D in a meaningful way to encode the complexity of an election in enticing ways. It may be the case that such maps retain a short-lived popularity in the modern world of short attention spans; alternatively, they may pique interest and emerge as a method that gains some traction. Much of that is down to whether people see the maps, recognize value in them and are able to replicate them. The maps we have presented may be a stretch for media organisations to accept as they are better suited to interactive exploration but, clearly, there remains considerable scope to invent new ways of presenting thematic information, which is important to drive cartographic research forward. Whether such maps replace the tried and tested new defaults remains to be seen as familiarity is also a key aspect of cartographic design. Cartograms are still somewhat divisive and yet they have been used on and off for the best part of 150 years to map elections. We've likely some way to go before the maps reported here become ubiquitous. It may be that their value is not in the immediate reporting of results but in the aftermath of an election where people are perhaps more interested in maps that give them an opportunity to explore and pore over the nuance of a result; perhaps the history or the detail.

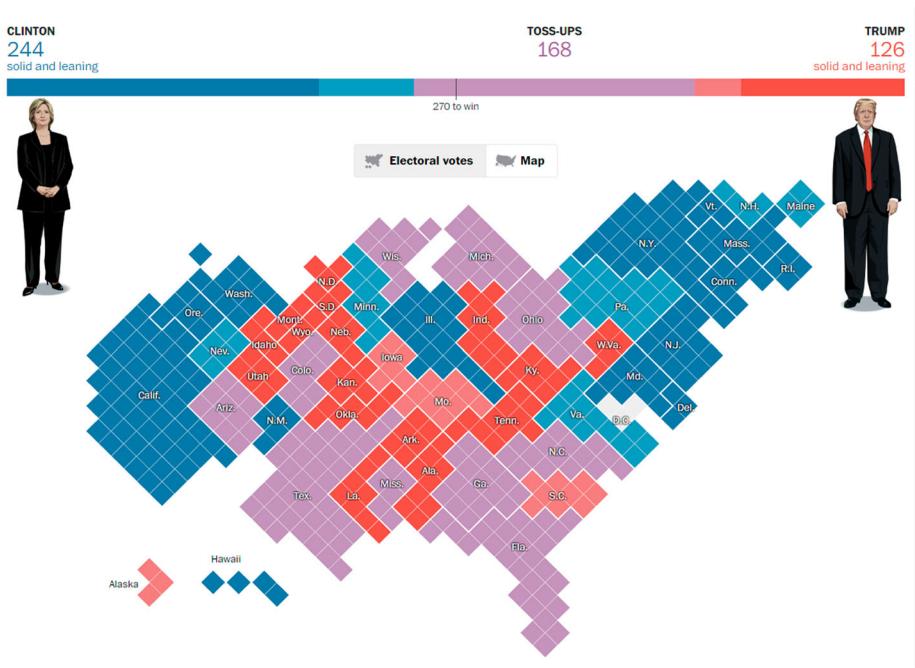


Figure 31. Redrawing the electoral map (Gamio & Cameron, 2016).

The 2015 UK General Election was both unusual and politically intriguing (Hennig & Dorling, 2016). The cartography of the election was perhaps even more fascinating, as long as you're interested in maps. But 2020, if the political mandate lasts that long, could well be even more exciting a contest. It will now almost certainly be held on redrawn constituencies (the proposed boundaries of which were first released in September 2016) with different boundaries and so a whole series of new base maps will have to be created as well as new techniques developed to cope with the growing number of effective political parties in the UK. Only 1 in 4 of the electorate voted for the Conservatives, the party that won a majority of seats in 2015. The next election is likely to be both close and highly unpredictable, and this prediction comes despite Labour currently doing so badly in the polls. As we write, the Conservative party top leadership have all just been replaced due to the Brexit referendum result. The Labour opposition has been similarly changed beyond all recognition from that which went to the polls in May 2015. The liberals have a new leader as soon will UKIP. One wonders what developments we'll see next in the mapping of votes and how that manifests as part of the reporting of the 2020 General election. Before then, though there's the small matter of the US Presidential election in late 2016. This is a fertile battleground for red/blue maps and we wonder whether the United Kingdom's appetite for hexagonal cartograms will be equalled in the reporting of the autumn 2016 US election. Indeed, the Washington Post has perhaps set the ball rolling by using a diamond-shaped cartogram in their pre-election reporting (Figure 31; Gamio & Cameron, 2016). This is the first time the authors have seen this type of shape used in electoral cartograms and it's also interesting that the article itself is titled

'redrawing the electoral map', which hints at an attempt to persuade readers not only of a new look to American politics but also to a new look for the map itself.

As former British Prime Minister Harold Wilson is famously attributed to have said: 'a week is a long time in politics'. The same might be said about the style and fashion of electoral cartography.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Dr Kenneth Field is a self-confessed cartoner. After 20 years in UK academia, he now works at Esri in cartographic research and development for the Mapping Systems team. He researches, writes, teaches and blogs about map design, is Immediate Past-Editor of *The Cartographic Journal* (and current Assistant Editor), co-founder of the *Journal of Maps* and is on the advisory board of the *International Journal of Cartography*. He is Chair of the ICA Map Design Commission, a Fellow of both the British Cartographic Society and Royal Geographic Society and a Chartered Geographer (GIS). He has written and published widely, presented and given keynotes internationally and won numerous awards for his mapping and also for pedagogy in cartographic education. He plays the drums. He rides a snowboard. He supports Nottingham Forest. Ken tweets at @kennethfield and his blog is available at www.cartoner.com.

Professor Danny Dorling has lived all his life in England. To try to counter his myopic world view, in 2006, Danny started working with a group of researchers on a project to remap the world (www.worldmapper.org). He has published with many colleagues more than a dozen books on issues related to social inequalities in Britain and several hundred journal papers. His work concerns issues of housing, health, employment, education and poverty. Danny was employed as a play-worker in children's summer play-schemes. He learnt the ethos of pre-school education, where the underlying rationale was that playing is learning for living. He tries not to forget this. He is an Academician of the Academy of the Learned Societies in the Social Sciences, Honorary President of the Society of Cartographers and a patron of Roadpeace, the national charity for road crash victims. Danny tweets at @dannydorling and many of his publications can be found at www.dannydorling.org

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