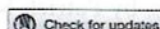


VIEWPOINT



The President's Address to the British Cartographic Society 2024

Seppe Cassettari

Being President of the British Cartographic Society affords the holder the opportunity to provide a personal view on the state of cartography. A 40-year career working with and creating all kinds of geospatial data has given me a deep insight into maps, how they are created and used, and the vital role they have as we face up to a world under threat from many directions

Prologue

Since the early 1980s, there have been dramatic changes to the way maps are created and used. While it is part of the wider societal upheaval resulting from the integration of computer technology into our lives, cartography can, in many ways, be regarded as a bellwether of that change.

Generally, change is a positive thing, but it usually comes at a cost. It is important to not forget the lessons of the past, to not waste resources on re-inventing wheels and to not enforce change where none is required.

The Start of Digital Mapping

The 1980s marked the start of the digital mapping revolution. Early on, it was clear that computers would provide a means for the mapmaking process to be radically different.

It is perhaps difficult to fully grasp what the cartographic process was like in the late 1970s, unless you were a part of it. The data used to compile a map then was still based on traditional land survey methods and photogrammetric feature extraction from aerial photography that remained mostly black and white.

In the larger mapping agencies, governmental and commercial, the main drawing offices consisted of large groups of highly skilled draughts people who worked to very detailed and quite prescriptive mapping specifications. They trained over many years to develop drawing skills for complex elements, like contours or the process of hand lettering. The map-compilation process was one of creating many layers, precisely aligned, to reflect the printing process that involved 'scribing' and 'peel coats'.

Even then, there were the first signs of what technology might offer in support of mapmaking; basic computers for calculating the geodetic parameters of a map or the 'line type' machines that replaced time-consuming lettering by hand. But these were just the precursors to the revolution that was around the corner.

There are five key aspects to this revolution, which not only changed the entire cartographic world, but which will continue to have a fundamental impact on how it evolves in the future: computing power and GIS; imagery and photomapping; data classification; accuracy, quality and confidence; and geospatial visualization.

Computing Power and GIS

Much has been written about the exponential growth in computing power over the last 40 years, our ever-increasing ability to generate and store vast quantities of data, and the incredible change in the way that we can interact with this data through a multitude of devices.

In the early days, GIS software ran on expensive minicomputers with stand-alone graphics screens. My earliest experience of using Arc/Info in my PhD research was on a VAX 11/730 and a stand-alone Tectronix terminal (Figure 1). Today, geospatial data is embedded in most of the everyday apps we have on our smartphones, tablets and laptops.

Graphics are highly computer intensive and require the best in screens or viewing devices to be effective. Furthermore, maps are often the most complex form of information graphic and the most demanding of computer power.

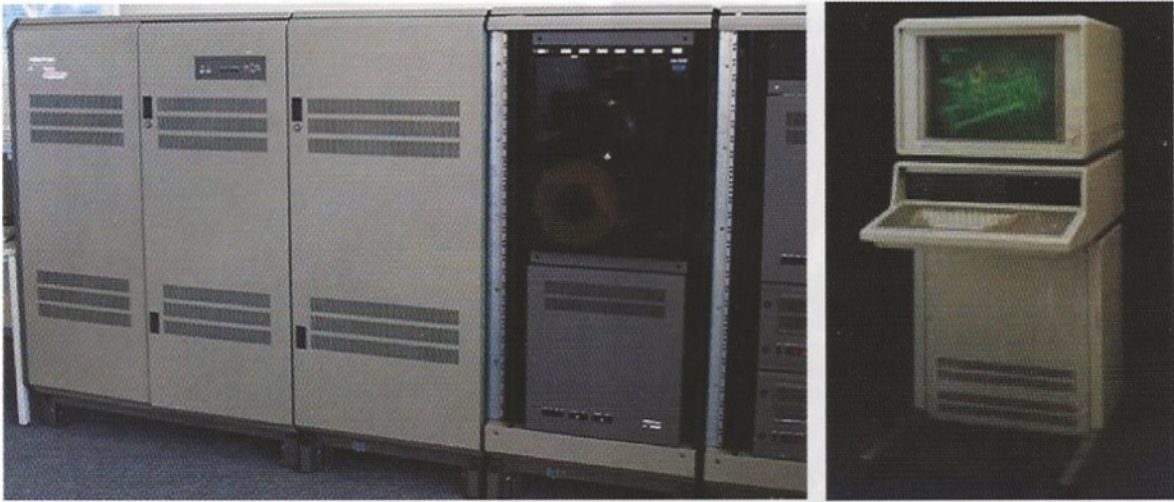


Figure 1. A typical VAX 11/730 Minicomputer configuration together with a Tectronix colour graphics terminal, as used in the Southeast Regional Research Laboratory (SERRL), Birbeck College, University of London in the 1980s.

Over the last 40 years, cartography has always been at the forefront of those pushing for more, faster, better. The nature of geospatial data means it is ever more ravenous for computer power, and, as an aside, is becoming one of the largest users of energy-intensive storage, potentially to the detriment of the planet.

Suffice to say, the direction of travel will continue and hence provide greater opportunities for the creation and use of even more innovative and effective geospatial information. We will continue to see new tools to help manage and display geospatial data that is made available to us. The command-line GIS of the 1980s is long gone, to be replaced by ever-more sophisticated, AI-driven, data manipulation display tools that are simpler to use, even for the non-expert. However, although technology has made mapmaking tools universally accessible, it also needs to ensure that maps are made to the right quality and accuracy – a theme I return to later in this paper.

Imagery and Photomapping

The use of aerial imagery in various forms had become well established after its introduction during the First World War. By the 1970s, the mathematical processes by which map-accurate data could be extracted using pre-sortie ground control and highly sophisticated photogrammetric plotters was well understood. It was an accurate, but lengthy and complex, process. Maling (1973) and Kilford (1973) are good examples of textbooks laying out our understanding of mapping principles at the time.

The early 1990s saw the first computer-based aerial imagery products. Users such as local authorities were embracing colour rather than black-and-white imagery, and companies such as JAS Phot (later to become Geonex UK) worked on developing a method for converting contact prints into a searchable digital file (Cassettari, 1991; 1992).

We should bear in mind that when the first digital aerial imagery products emerged in 1992, the only 24-bit colour screens that were widely available on the personal computer market were Apple Macs. But things were changing fast; with the launch of Google Earth at the turn of the century, digital aerial imagery moved from being solely a tool of the professional to an easily accessible geospatial product for everyone.

The biggest challenge in the conversion of aerial survey prints to digital form was data volumes. Over time, the increasing capacity of data storage devices and more latterly the move to cloud-based solutions has barely kept pace with demand.

As an example, the very first Cities Revealed dataset to be published in 1994 was of Central London. It used 24-bit colour imagery created by scanning film diapositives. The resolution was 25 cm, the area covered was 160 sq. km and the data was stored, uncompressed, on a CD-ROM (Figure 2). This was very innovative at the time, with each disc storing 650 megabytes.

The current national digital aerial database created for the UK Government by Bluesky International covers all 240,000 sq. km of Great Britain at a resolution of 12.5 cm. It requires 45 terabytes of storage and from 2024 is being updated on a 2-yearly cycle.

While aerial imagery was converting from hard copy to digital, satellite-based Earth observation data collection was also moving on from the early Landsat series I–III with a resolution of 80 m (ignoring the advances in military technology that drove much of this change). These early Earth observation satellites brought new opportunities

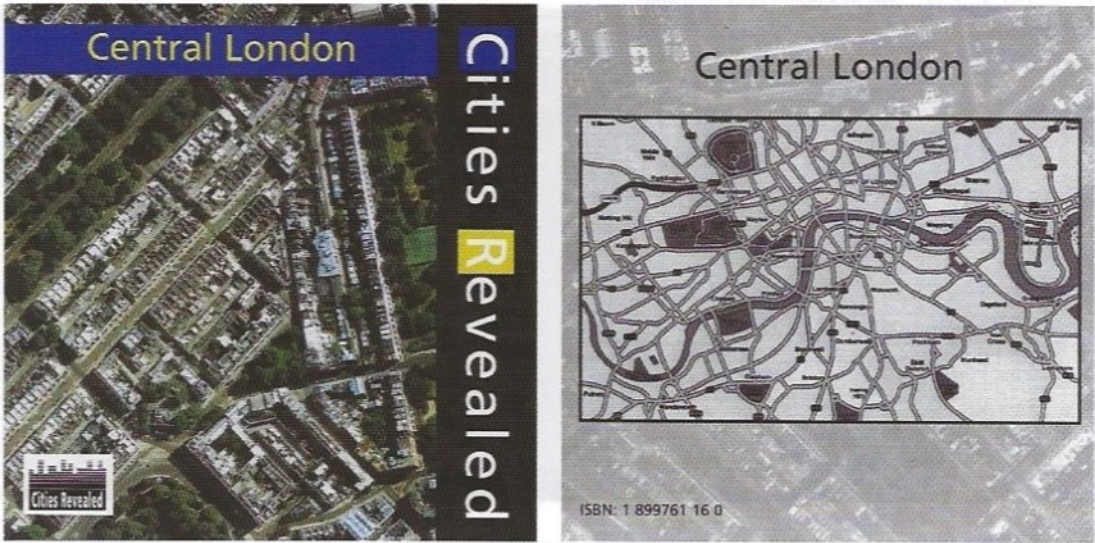


Figure 2. CD-ROM case cover for the first Cities Revealed digital aerial database covering central London and published in 1994 by Longman GeoInformation.

for landscape characterization and monitoring. Landsat IV (launched 1982), Landsat V (launched 1985) with a resolution of 30 m and so it went on. More and more images, with better and better resolution.

By the time the Planet Labs RapidEye constellation was retired in 2020, it had resolutions of up to 1 m. In total, the suite of satellites orbited the Earth 305,000 times, covering 13,422,000,000 km, taking 660,000 images that covered 15 billion sq. km (Van Ryswyk, 2020). The Union of Concerned Scientists publishes a Satellite Database. As of February 2024, it listed 7,560 satellites, of which 1,259 had a role in Earth observation (UCS, 2024).

Now there is commercially available satellite imagery for not just the visible wavelengths but also infrared and near infrared, multispectral, as well as thermal and radar imaging, with some commercially available Earth observation data at 30 cm resolution. At the same time, imaging from aerial survey has moved on to regularly capture data at 5–10 cm.

Then came the drones. The rapid rise in their use for all sorts of survey, mapping and data gathering processes has been extraordinary. A recent survey of a Cambridgeshire village, extending over 2 sq. km, was undertaken using a Wingtra drone. It took 3 hours to capture and a further 3 days to process the data into a rectified format with a pixel resolution of 3 cm, which allows individual tiles on a roof or pavements on a drive to be counted (Figure 3). The total data volume exceeded 167 gigabytes.

There is a continuing drive for higher resolution, more rapidly capture and processing. It is easy to foresee that satellite imagery at resolutions better than 20 cm will become the norm in due course.

Wide-area coverage drone surveys will become more common at resolutions of about 3 cm (with a general acceptance of the privacy implications) and it is not too far-fetched to see national drone surveys managed from a central control room being undertaken on a continual basis to feed our ever-growing geospatial databases (Cassettari, 2020).



Figure 3. Image extracts from a survey flown in 2022 using a Wingtra drone processed to give a 3-cm pixel resolution (Copyright GeoInforma Ltd).

A Hexagon blog in 2021 described 'a data deluge', much of it geospatial (Alisch, 2021). Our problem is the enormous growth in data collection without the accompanying strategies for creating knowledge from it. Perhaps AI will be part of the solution.

From a cartographic perspective, there may be something we can learn from the past. The Directorate of Overseas Surveys, along with other mapping agencies, utilized the concept of photomapping as a method of creating maps more rapidly than by traditional means. The technique was used by the Ordnance Survey of Great Britain in a series created immediately after the Second World War for areas where regeneration planning was a high priority (Figure 4).

Photomapping creates particular challenges for the cartographer, in as much as the base imagery cannot be easily simplified (within reason) and there is less of the usual 'white space' for symbology, names, and so on. But as has been shown with the availability of imagery layers in online mapping services, there is interest in – and the ability to – interpret this form of geospatial information.

The future is bound to see the greater use of imagery as a base for a wide variety of cartographic products in both two and three dimensions, primarily online. This means researching into new ways to represent detail that needs to be highlighted, how to achieve visually compelling transitions between places, view angles, imagery sources and data types, as well as creating more dynamic temporal visualizations (Figure 5).

Data Classifications

The pre-GIS era had a focus on the creation of high-quality topographic mapping in all its various scales and forms. Nevertheless, there was also plenty of thematic mapping published. National atlases were common at one point and many different types of land classifications were developed, not least geological, soils and land use (Figure 6).



Figure 4. Sheet 42/00 SE from the Ordnance Survey orthophoto map series. Publication date not stated, but source imagery is dated October 1945.

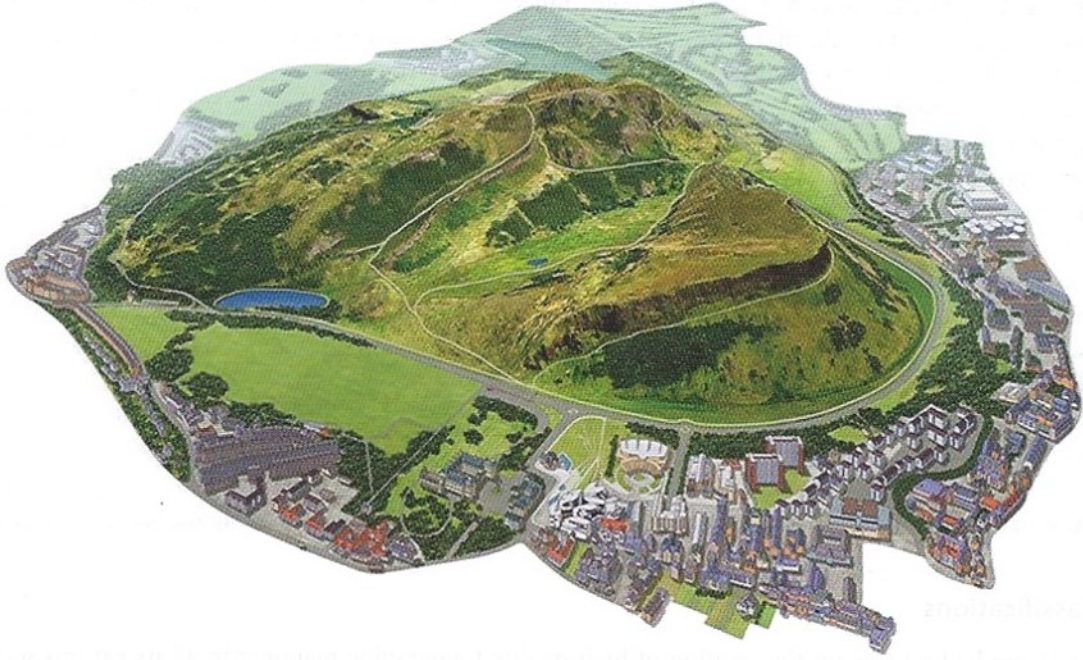


Figure 5. An illustrated map of Holyrood Park, Edinburgh, from a blog by Lovell Johns (Keyworth, 2020).

Thematic maps are, by their nature, data intensive. The ‘Big Data’ revolution and the advances in GIS have provided the source and the tools for many more thematic maps and products to be created, often in a timelier manner.

There has been the development of new data classifications, such as the UK’s National land use database (NLUD), but there is still much to do to implement these in a consistent and effective way. NLUD version 4.4 was published in 2006 (HMG, 2006) and has never systematically been applied at a national level.

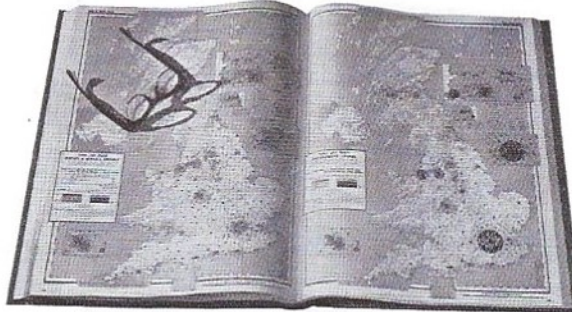
To some extent, we are seeing collaboration between governmental agencies and commercial data collectors to develop new and effective hybrid data products. The recent partnership between Ordnance Survey and Verisk Inc.

Announcing the ATLAS OF BRITAIN

THE ATLAS OF BRITAIN & NORTHERN IRELAND is a statement, on a geographical basis, of modern Britain’s resources, physical, economic and industrial — a complete and ordered portrait of this country from the rocks beneath to the industry above. Its two hundred pages of maps are so planned that all these material aspects of Britain can be seen and studied in relation to each other, within the covers of one great folio volume.

Many other countries have their national atlases, usually published with official support as a necessary part of a country’s equipment today. The lack of such an authoritative single source of information for Britain has been seriously felt. Now that it is here it will be essential to three fields of activity: that is, to industry and commerce, to public service and administration, and to universities, schools, and learned and professional bodies.

This is emphatically a book to be seen and examined. No prospectus can do more than indicate its qualities.



Published by the Oxford University Press. Size 20½×15½ in. Quarter-leather and buckram binding. Price 25 guineas net

Figure 6. Flyer announcing the Atlas of Britain, published in 1963 (Oxford University Press, 1962).

on UK building age is a good example (Ordnance Survey, 2024). This is a much-upgraded version of the UKBuildings Database first published by The GeoInformation Group in the early 2000s and shows how long some of these developments take to become mainstream.

Based on all this, there is a huge opportunity for cartography to develop new and creative thematic map styles that help users make sense of the 'data deluge'. But this also presents the cartographer with challenges. As mapmakers move away from the use of standard specifications, any thematic cartographic representation must be interpretable by the user. There is an increasing opportunity for maps to be the source of misinformation.

In his excellent exploration of the thematic mapping process, Field (2022) said:

Every map is a product of its maker and its reader, and maps are rarely right or wrong but simply different versions of the truth. The meaning you see in a map can reinforce or challenge your understanding of the theme it represents [...] *Thematic Mapping* examines the innovative and fascinating alternative ways of making maps of data which you can use in your own work.

Accuracy, Quality and Confidence

This leads on to one of the key concerns that cartographers will need to address going forward. That is, how we provide the user with clear and concise information on the quality of the map they are looking at.

Geography lessons in the pre-GIS era emphasized the importance of marginalia on a map. It should provide the map user with information about the currency of the information they are looking at, projection details, sources used and overall accuracy. In other words, it gives the user a sense of the overall quality of the cartographic product and the accuracy of the underlying source data.

Today, we rarely include these details in a way that is accessible to the casual user, even if they could understand them. Many people consider maps as authoritative sources – their contents having the status of 'known fact' – even if they are produced for propaganda or misinformation purposes.

Early work in the 1990s introduced standards for metadata (data about the data). This led to the creation of international standards, such as that produced by the Federal Geographic Data Committee (FGDC) and the International Standards Organization (ISO) series on metadata, such as ISO 19115/-1 (FGDC, n.d.).

The complexity of the metadata required to meet the standards often leads to organizations ignoring the requirement for metadata, or at best, paying lip service to its collection. Governmental agencies will often adopt such standards, but many users are not provided with accessible information on how to interpret the map at the point of viewing. Professionals with the background knowledge to interpret the metadata when this is missing are left with a significant gap in their understanding of the information they are working with. And there are many people who do not have the background knowledge to even appreciate that they should be looking for metadata. This has the potential to impact the confidence of map users.

Consequently, this means that decisions being made using geospatial data will not consider the overall quality of the map. Issues related to currency, especially at the detailed level, positional and classification accuracy, consistency and the sources used are not considered by the map user.

When we buy food, increasingly we want to know more about where it comes from, what it contains and how good or otherwise it is for us. We need something similar for mapping and we need to ensure map users know what the implications are of ignoring these aspects of their geospatial data.

Geospatial Visualization

All this leads on to probably the biggest challenge for cartography going forward. With so much data being collected, including imagery as well as the surge in statistical data with geospatial referencing, new thematic classifications and the importance of ensuring the specific qualities of a map are recorded and communicated to the user, we need new and innovative data visualizations.

Historically, maps have been complex, very detailed information graphics. They take time and skill to interpret. Many still are, but we are also seeing an increasing amount of automated simplification and interpretation based on user-specific questions. Increasingly, maps are often integrated into other forms of data and information handling. It is common to have the same data represented in descriptive, tabular and map form as a way of emphasizing a message.

The technology of the future will no doubt provide methods for presenting geospatial data in different ways, effectively redefining the concept of the map. Those who design maps and consider how to make complex spatial interactions accessible to users through new interactive, time-limited views, have a real challenge.

The mapmaking of the future will be about flexibility, customization and immersive experiences. The way geospatial data is classified, quality-assessed and presented will determine the ultimate value of a map in the context of a wider decision-making process.

To this end, the British Cartographic Society launched its GeoViz initiative in 2024, with a view to stimulating discussion, training and experimentation into the ways that geospatial data could be visualized in the future.

Final Thoughts

Although, traditionally, mapmakers have been highly skilled specialists, that is not so true anymore. Anyone can make a map, but we know that not everyone can make a good one.

A map is about the information it contains and the way it is presented. A great map embraces high-quality design based on the best available content that is customized to serve the expected use in the best way.

There will always be a need for specialists in mapmaking, but most of us will have basic tools and lots of data at our fingertips. Whereas we can all be cartographers, we can't all become good ones.

The International Map Industry Association (IMIA), in collaboration with the British Cartographic Society, has been running a series of seminars on the theme of 'trust in cartography'. How can anyone be sure that the map they are looking at is a true and trustworthy representation of the geography they are interested in? This is a huge subject that needs addressing if we are to ensure users do not lose faith in maps as a reliable and verifiable source of information.

There was a school of thought in the early days of GIS that said the role of cartographic design would be sidelined by the use of automated systems and easily reproduceable standards. Today, with the increasing volume of data and information and better interpretative tools (including AI), there is a growing demand for better ways to visualize increasingly complex representations of our world. Data visualization is at the core of the geospatial evolution.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Notes on the Contributor

Sepp Cassettari's career started in 1979 with the UK's Ministry of Defence, where he was involved in mapmaking, operational analysis and geospatial information gathering. After a PhD in the emerging subject of GIS at Birkbeck College under Prof. David Rhind, he went on to set up the UK's first undergraduate and HND (Higher National Diploma) programmes in GIS at Kingston University. In the 1990s, he became Managing Director at Longman GeoInformation, part of Pearson Plc, and set up The GeoInformation Group with Dr Alun Jones. This created some hugely successful and innovative digital aerial databases, land and building classifications, and the award-winning UKMap large-scale topographic database. The business was sold to Verisk Inc. in 2016, and Dr Cassettari retired in 2019 only to take on the role of BCS President for the second time.

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