



Government
Office for Science

The inexorable rise of the machines: digital technology and mapping

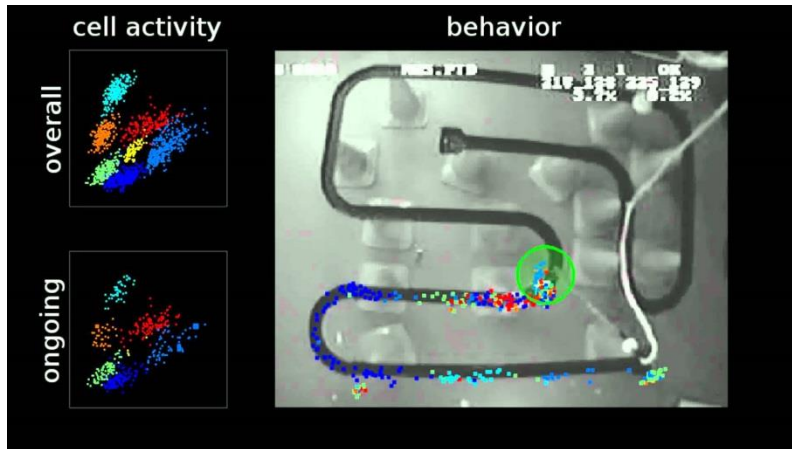
Sir Mark Walport

Chief Scientific Adviser to HM Government

Cambridge Conference, July 3rd 2017



Maps in the brain



- Place cells within the hippocampus fire in patterns, creating a cognitive map of the external environment.
- John O'Keefe discovered place cells in 1971, winning a Nobel Prize in 2014.
- The full mechanism of mental navigation is still being researched.



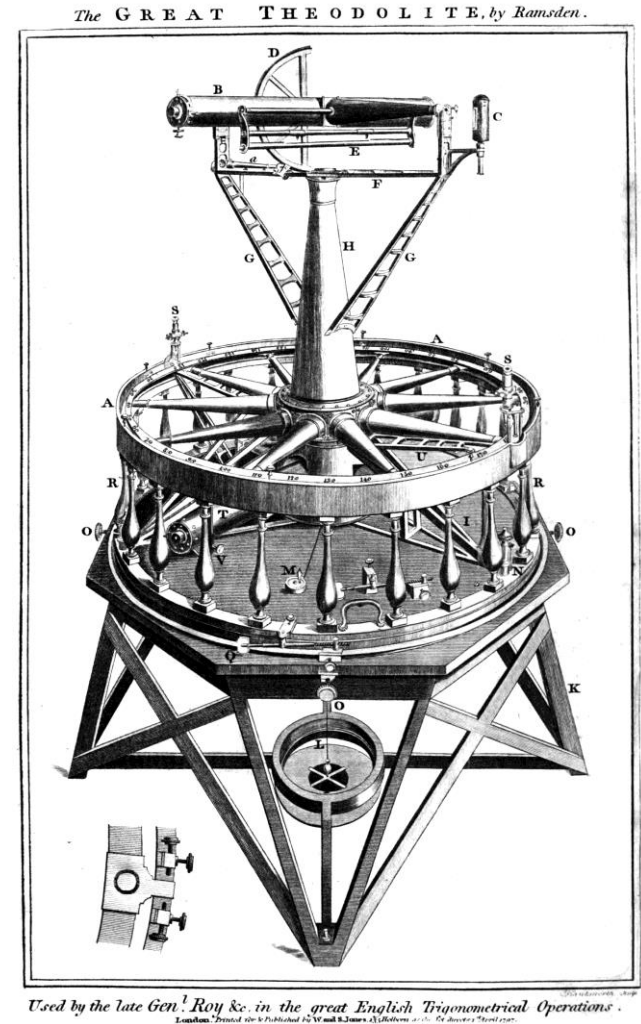
Writing maps down

- Medieval portolan charts, based on reported distances and bearings, were highly accurate for well-travelled areas like the Mediterranean coast.
- Worldwide maps were problematic until the Mercator projection was published in 1569.



Mapping technology

- Accuracy over land terrain required high-quality surveying equipment, developed in Britain in the 18th century.
- The next big change was microwave-based surveying in the 1950s, soon followed by satellite positioning (GNSS).



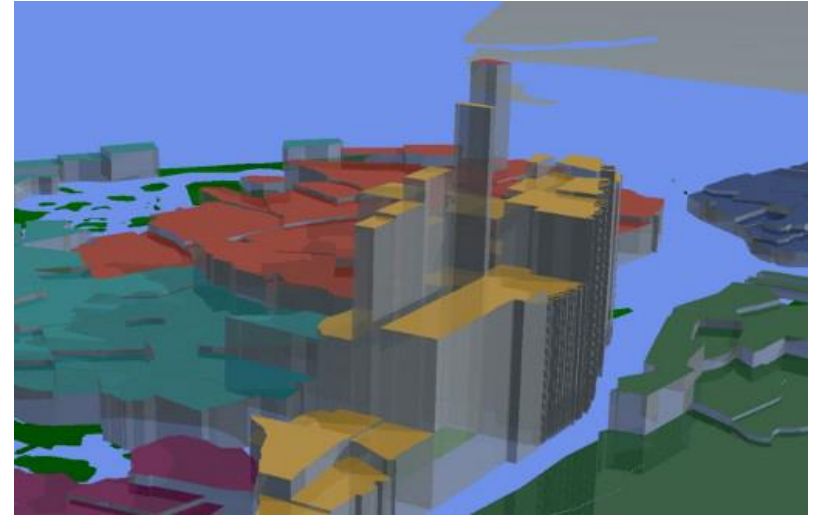


Digital maps

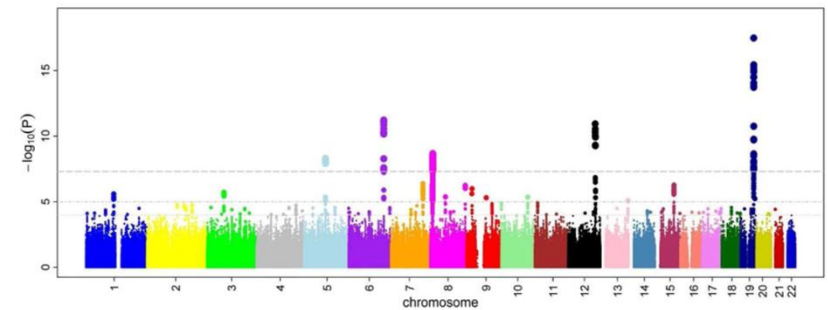


New kinds of map

- Early digital maps were just paper maps on a screen.
- But improved computing power allows much more sophisticated mapping.
- Maps today can be 3D and/or real-time, and can depict “place” in a more conceptual sense.



House prices around Manhattan

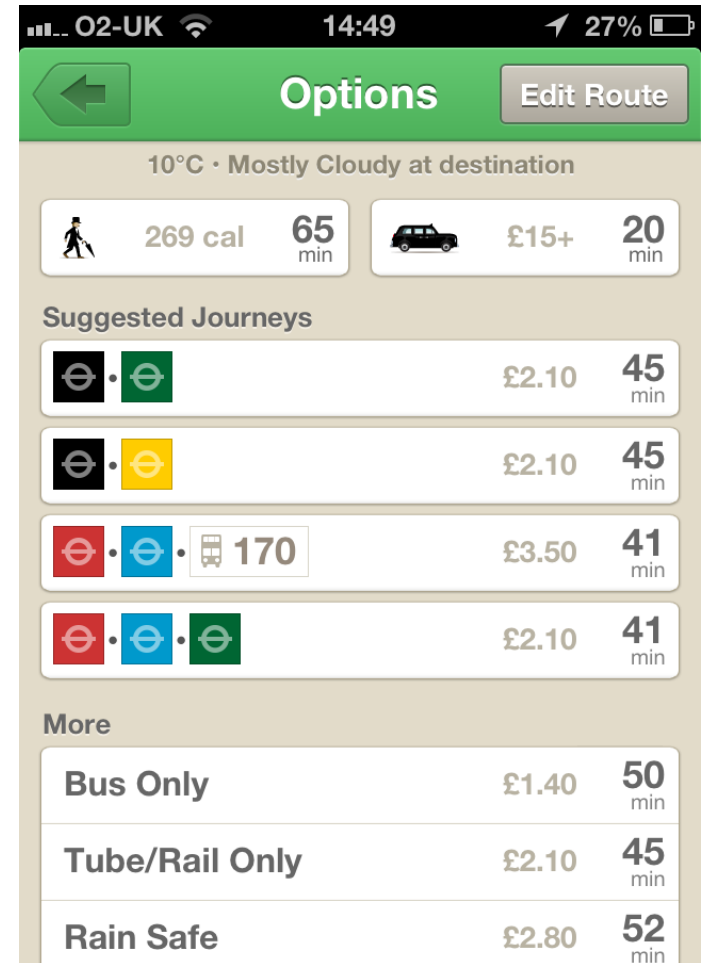


“Manhattan” plot of a genome study



Layered maps – in the city

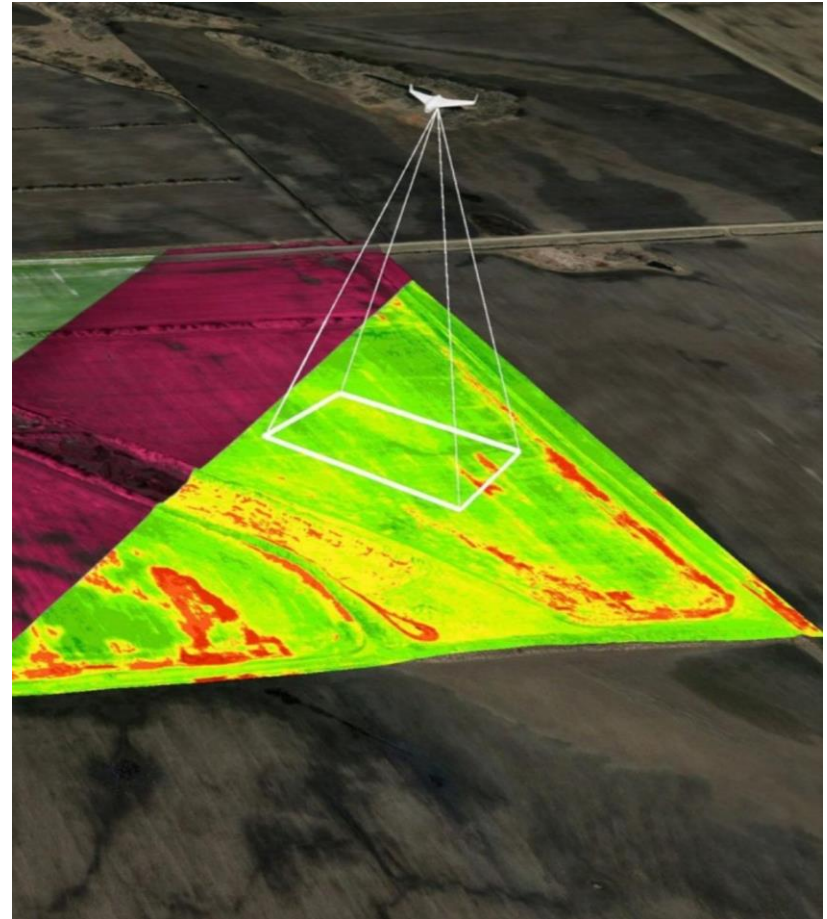
- Citymapper is one of many urban navigation apps, which combine maps with real-time transport and weather data.
- Some can plan personalised routes, taking account of sightseeing or exercise preferences.





Layered maps – in the country

- Need for farming to become ever more efficient, both for economic and food security reasons.
- Precision agriculture uses multiple data sources: satellites, drones, IoT sensors and apps.
- Global market to reach nearly \$50bn by 2025.





Building-level mapping

- Building Information Modelling: a single coherent model of an engineering project, rather than the traditional sets of drawings.
- Allows a far more holistic and dynamic view of the local environment, enabling project rehearsals and virtual testing.





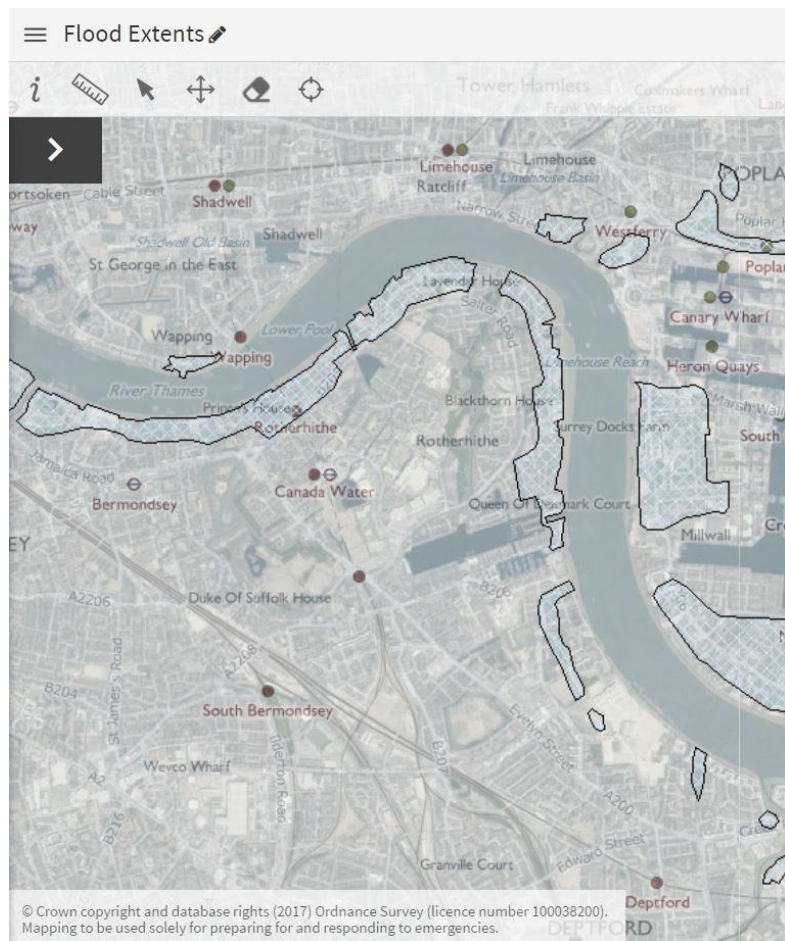
Object-level mapping




- RFID: Identification tags passively reflect radio waves from a scanner. Used in Oyster and contactless cards.
- Also very useful for micro-mapping. Ubisense uses RFID to monitor each tool in a factory in real time.
- Filtering algorithms can avoid data deluge.



Specialist mapping for government



- Resilience Direct: a tool whose development was catalysed by GO-Science, in response to flooding and ash cloud emergencies.
- Not just a map, but an online private network for both emergency responders and strategic planners.

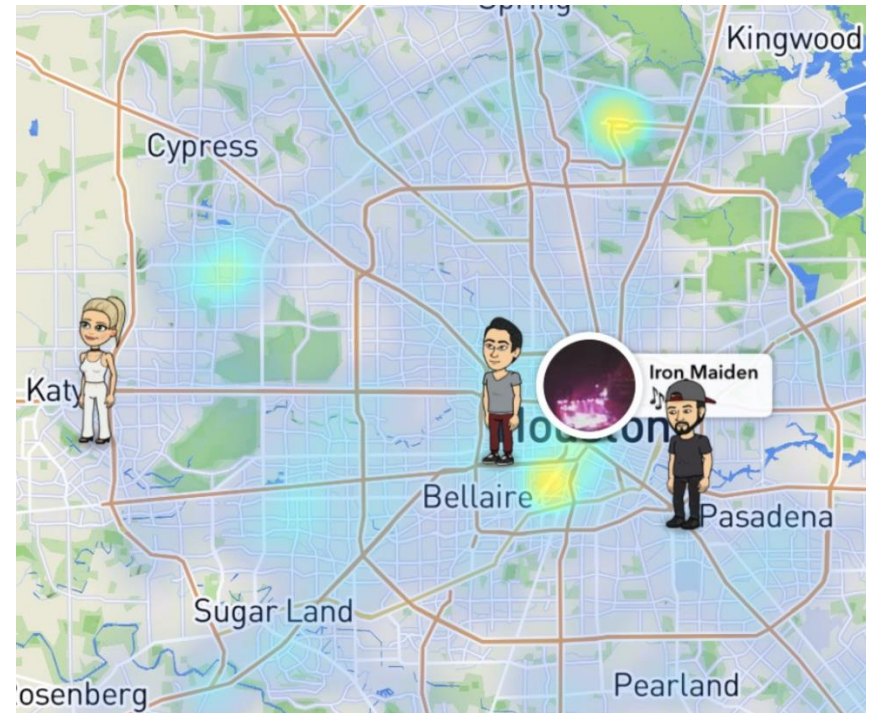
A lush tropical jungle scene with a small stream flowing through dense vegetation. The stream is in the foreground, surrounded by rocks and green plants. The background is filled with various tropical trees and ferns, creating a dense canopy. The text "Problems with mapping tech" is overlaid in the center of the image.

Problems with mapping tech



Personal location data raises ethical issues

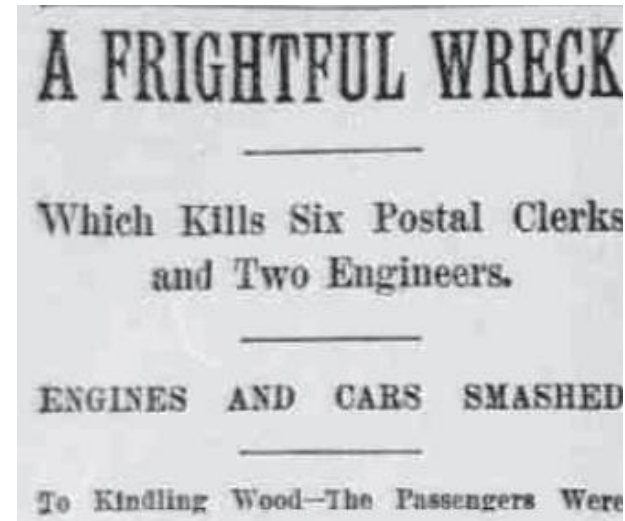
- Snapchat has just added a “map where your friends are” feature.
- It’s the first such app where location tracking is on by default.
- Concerns raised about stalking, child safety, and accidental reveals of embarrassing information.





All sources of data must stay synchronised

- Great Kipton Train Wreck, Ohio, 1891. Caused by an engineer's pocket watch being four minutes slow, having been dropped in the mud.
- Led to stringent timekeeping standards across the rail industry. Data synchronisation is even more important now.





Overreliance on technology can lead to loss of vital skills



- UCL research (*Nature*, 2017) suggests the brain's navigational capability goes dormant if not used.
- Many driving disasters have been caused by over-reliance on GPS.
- There is a human behaviour aspect to many location-based tasks.



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