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Comments based on joint research with a number individuals and groups, but I alone bear the responsibility for errors. For relevant old projects

http://www.globalsystemdynamics.eu and www.gsdp.eu

http://www.futurict.eu

A report is available on best practice in www.gsdp.eu

Two current EPSRC funded projects one on complexity science with other UCL departments (see ENFOLDing and Alan Wilson) and the other on big Data with Tobias Preis and Suzy Moat at Warwick Business School.

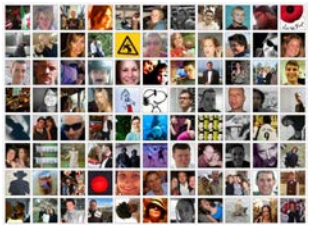
A new EC funded project called CIMPLEX (see http://cimplex-project.eu which should come on line soon)

Societal risk: the role of modelling to create scientific narratives

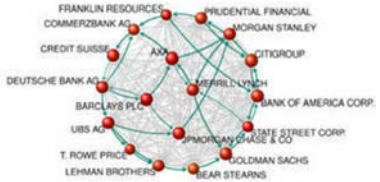
Summary

1. Risk of interconnected systems
2. Big data providing new evidence
3. Example of modelling riots
4. New narratives to aid decision making

1. Challenges, threats and opportunities



- We face global challenges
- Information technology has changed our world
- *We* have *created* complex, global networks
- Nonlinear interactions exist between policy domains



Threat: 'hyper-connected' networks are a challenge for governance. Actions may lead to unintended consequences

Opportunity: If we can understand the behaviour of such networks then we can manage them better and, what is more, profit from a collective power

2. Data:

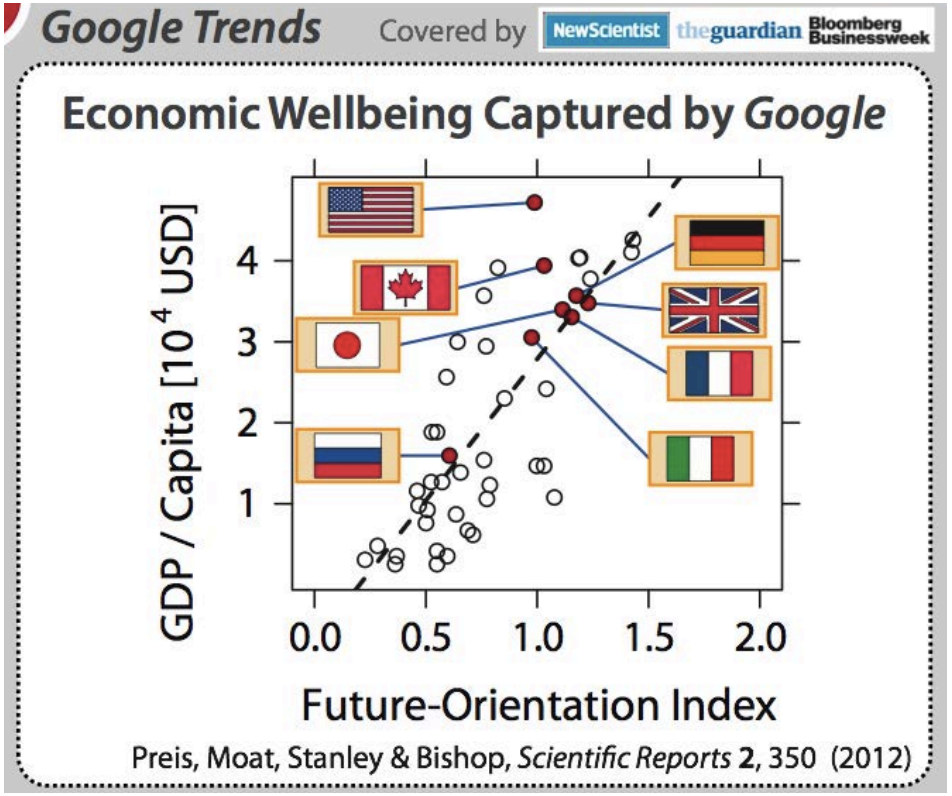
Big Data (meaning vast amounts of data from a variety of sources arriving in real-time i.e. with rapid velocity) can release new data and hence new information.

New Data: Future Orientation Index

Google searches in 2012
for something with 2013
or 2011 in the search box
so
…. 2013 or …. 2011

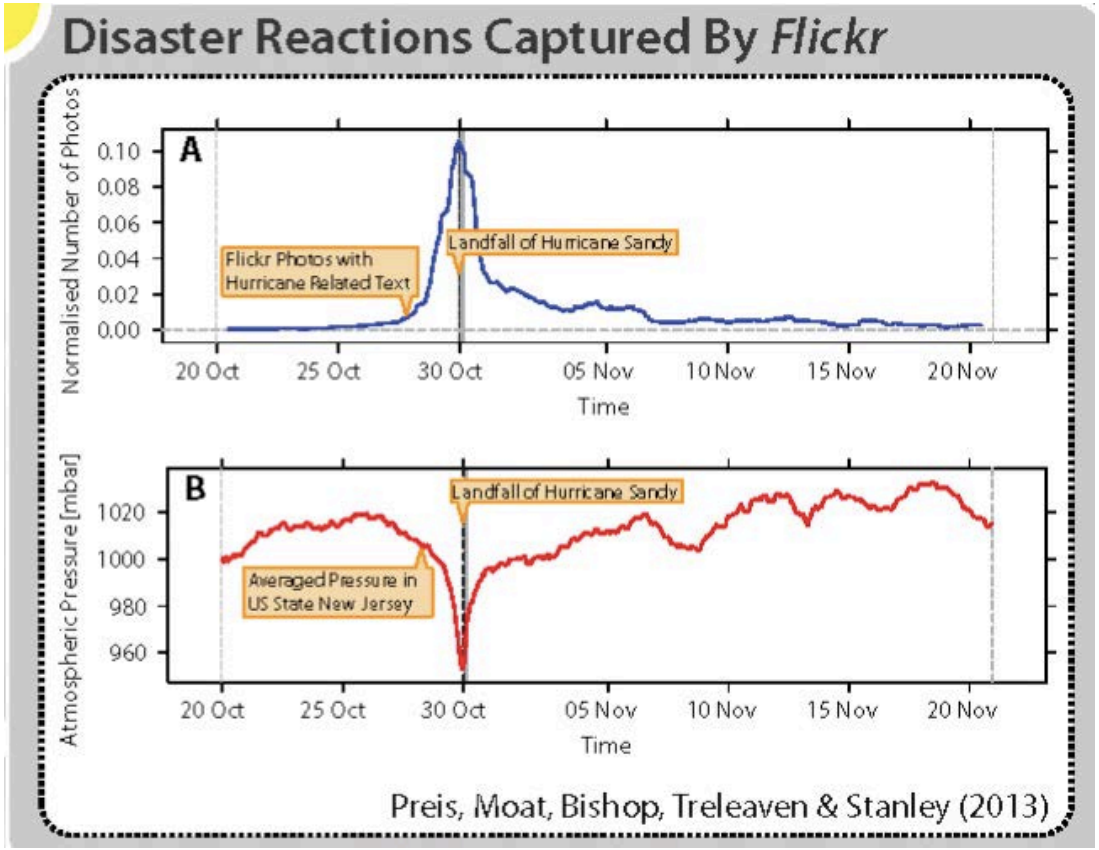
45 countries

based on 1 billion
searches in each country
so 45 billion bits of data



There is a question of how to use this information and understand its cause, but it is at the least, interesting

New Data: Flickr as a social barometer



a nice paper that uses mobile phone data as a proxy for travel is
Source: Wesolowski A, Buckee CO, Bengtsson L, Wetter E, Lu X, Tatem AJ. Commentary: Containing the Ebola Outbreak the Potential and Challenge of Mobile Network Data. PLOS Currents Outbreaks. 2014 Sep 29. Edition 1. doi: 10.1371/currents.outbreaks.0177e7fcf52217b8b634376e2f3efc5e.

New Data: Citizen Science

Projects driven by the Internet and social media with citizen participation of teams of scientists, often globally dispersed, in the gathering of information and knowledge which:

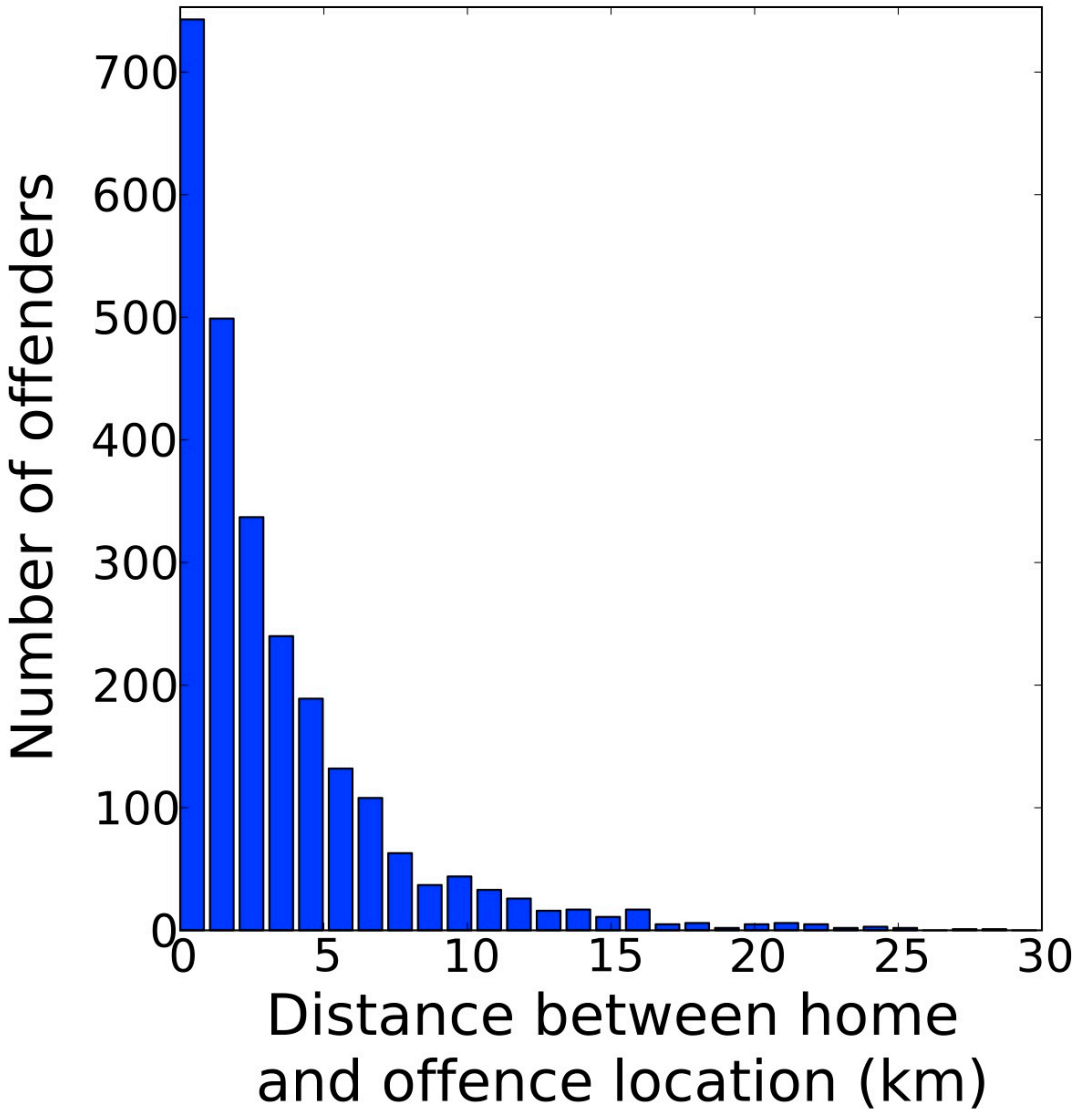
- engages non-scientists
- utilise citizens as sensors
- feedback information to users

The way in which we obtain knowledge and make decisions becomes open

3. Main benefits of a model

- Open to scrutiny
- Exploratory experiments to forecast the future beyond existing data
- Perform ‘what if’ scenarios to explore the impacts of potential policy changes

Data from London riots: Distance to riot



Example: Modelling London riots

- Sites chosen by rioters can be adequately modelled by retail shopping models

- Disease or contagion models used for interaction between rioters

- Predator-prey models and game theory used for interaction with police

Davies, T., Fry, H., Wilson, A.G. and Bishop, S.R. (2013) A mathematical model of the London riots and their policing, *Nature Scientific Reports*. Sci. Rep., **3**, 1303; doi:10.1038/srep01303.
http://www.nature.com/srep/2013/130221/srep01303/full/srep01303.html

Modelling rioting

Combining these can help us understand how this riot spread, but some things have not been included in the model:

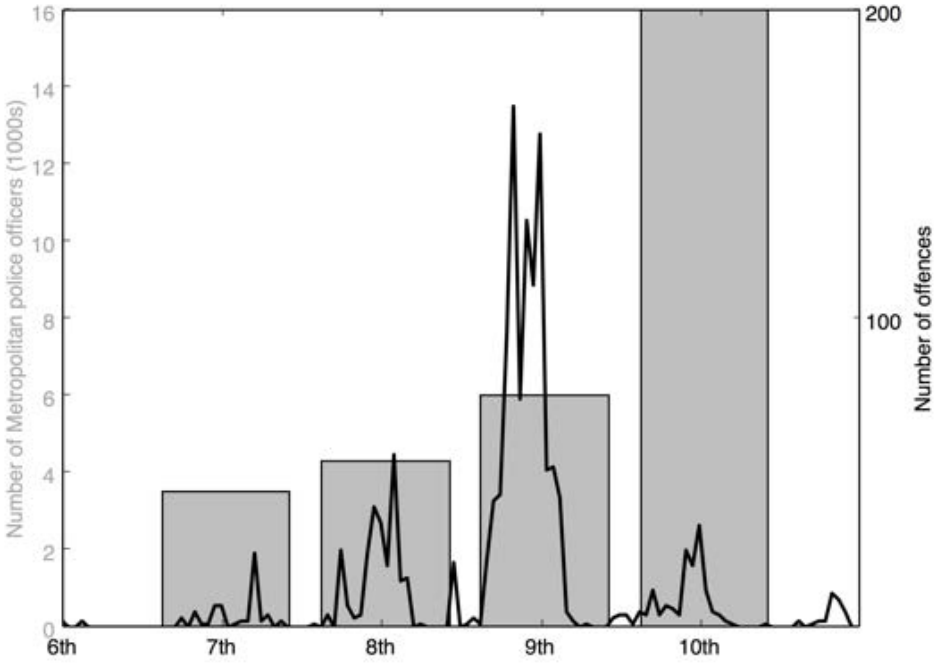
- Decision by an individual to riot

- Role played by social media
- Political stability
- Weather

- Social deprivation
- ……

Policy questions

- Is kettling an effective policing strategy?
- What is the role of social media?
- Is there a threshold for police numbers to prevent rioting from spreading?



4. Scientific narratives

Mathematical models form narratives

Models and data

- Models useful to understand behaviour and forecast future outcomes
- Connections across systems can lead to unintended outcomes
- Models need to be validated against data for evidence-based policy decisions to have social legitimacy

Models and data

But beware

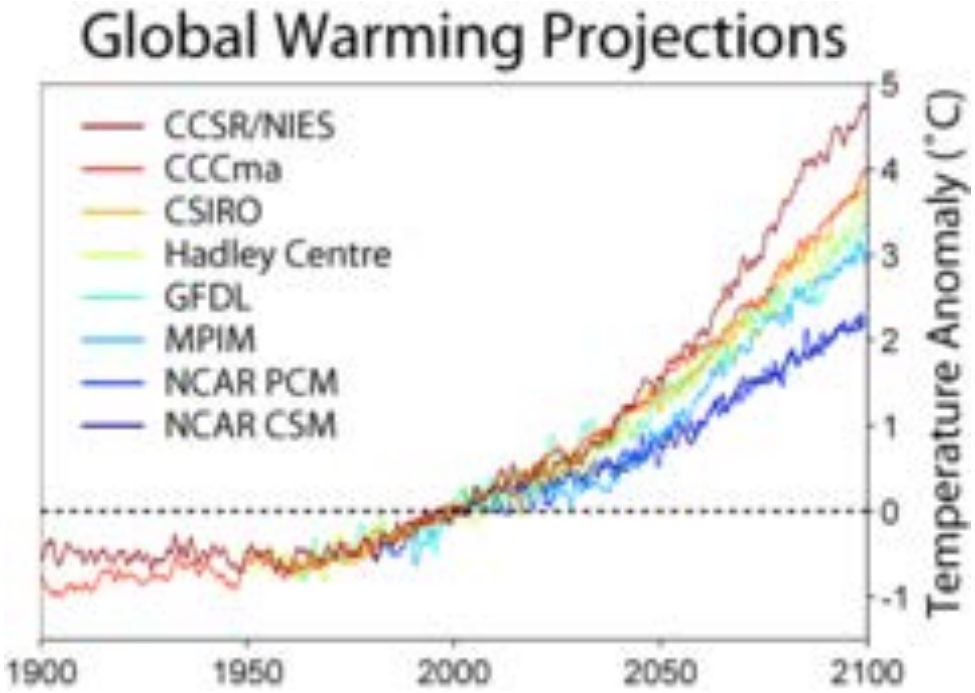
A model can produce a perfectly good fit to data but be wrong

Models can be wrong but yet people still use them to determine how they will react

Linear models based on past data may give misleading information about future events

Pluralistic approach

I suggest that a pluralistic approach (as now used routinely in the climate change debate) with several models used to tackle the same problem is needed to provided legitimacy of the results.



Dreamer

www.ucl.ac.uk/maths/steven-bishop