March, 2017

The SECURE News

Statistics of Environmental Change, Resources and Ecosystems

In this newsletter we begin by taking a look back at our Annual conference held in September 2016.
We describe the SECURE Feasibility Project Portfolio and feature one of the Feasibility projects funded on SECURE's second call. We give details of the SECURE Grand Challenge on page three.
Marian Scott, the SECURE PI reports on her recent visit to Westminster for **"Brexit: an academic conference".** Our first short article by Dr Francesco Finazzi, explains some of the interest and challenges in new forms of data being generated in this case by smartphone applications applied to environmental hazards, in this case earthquakes. Our second invited article by Professor Sarah Cleaveland touches on some of the global challenges in "***one planet, one health***". These short overviews introduce you to two areas which go straight to the aims and objectives of SECURE and hopefully will stimulate you to make connections and to think about new challenges that you can begin to address.

SECURE Annual conference

The SECURE Annual conference was held on the 20th September, 2016 at the Glasgow Science Centre. The delegates enjoyed a mixture of talks and workshops.

The day began with Marian summarising the activities of the network. This was followed by a talk by Dr Murray Lark of BGS on: "**Sample, modelling and uncertainty, statistical approaches to some environmental questions".** Throughout the day there were short talks on the feasibility projects SECURE had funded on its first call. First Dr Ben Marchant from BGS talked on **"Statistical Modelling of Groundwater Extremes (STAGE)",** which demonstrated how extreme value statistical methods could be used to predict the frequency and characteristics of groundwater droughts and floods and how they might change in a changing climate. This was followed by Dr Claire Miller from the University of Glasgow, whose project **"Statistical software to identify spatiotemporal patterns and coherence over river networks"** developed novel statistical tools, which can help to identify monitoring sites on river networks which are most influential in explaining spatiotemporal nutrient patterns. In the final feasibility project talk of the morning session, **"Abrupt changes in climate and ecosystems: automatic model selection",** Dr Rebecca Killick introduced the EnvCpt R software package which enables practitioners to fit several models with and without changepoints to their data with an indication of which model provides the best fit.

The delegates then attended one of the following two workshops: "**Communicating uncertainty"** which was chaired by Dr Murray Lark or "**Innovative applications of new data streams to environmental monitoring"** which was chaired by Dr Ruth O'Donnell.

In the second workshop the participants discussed the potential for data obtained from emerging technologies such as portable sensors and remote sensing equipment. A good example of this is the article by Dr Finazzi on page four. It was noted that there is still a lot of work to be done in the validation of data from these new sources and that current statistical approaches may need to be adapted in order to deal with rapidly increasing quantities of data in both space and time.

In the afternoon, Professor Louise Heathwaite, the Chief Scientific Adviser for Rural Affairs and the Environment provided an overview of **"Advising on scientific evidence in an uncertain world".** This was followed by the final Feasibility project talk by Dr Christine Braban on "**Feasibility testing of low-cost sensors to represent spatiotemporal variability of ambient ground-level NO_2 and O_3**. At the end of the day, Professor Richard Chandler from UCL gave an entertaining and interactive talk: **"Model calibration with uncertain inputs"** where he challenged and questioned the delegates around their experiences and knowledge concerning model calibration practices.

If this brief summary has whetted your appetite you can view the talks:
http://www.gla.ac.uk/research/az/SECURE

Feasibility Focus

In the first half of the network period, SECURE has funded the following ten feasibility projects (from 26 applications). The first five listed projects funded in the first call are now finished. An additional five projects were funded in the second call. Further details about all ten projects can be found on the website, including project reports of completed projects: http://www.gla.ac.uk/research/az/SECURE/Feasibility projects

- Statistical software to identify spatiotemporal patterns and coherence over river networks
- Feasibility testing of low-cost sensors to represent spatio-temporal variability of ambient ground-level NO_2 and O_3 concentrations
- STAGE: STAtistical modelling of Groundwater Extremes
- Getting the right spatial & social mix: improved methods for planning community Renewable Energy facilities
- Detection of abrupt changes in land and ocean ecosystems
- Improved approaches for mapping and modelling blanket peatland extent and depth
- Models of species' population trends and climate change accounting for weather-related observation bias
- Modelling Extreme Melt events On the Greenland ice sheet (MEMOG)
- Modelling and visualisation tools for water quality in the Clyde
- Efficiently modelling non-stationary in ecological spatial models

Here we showcase one of projects currently on-going:

Modelling Extreme Melt events On the Greenland ice sheet (MEMOG)

Investigators: Amber Leeson[1], Emma Eastoe[2], Xavier Fettweis[3].
[1]*Lancaster Environment Centre / Data Science Institute.* [2]*Maths and Statistics, Lancaster University.* [3]*Laboratoire de Climatologie et Topoclimatologie, University of Liege.*

Since 2010, the rate of ice loss from Greenland has increased and the ice sheet has experienced episodes of rare and extreme surface melt. Melting on Greenland is typically predicted using physically based Regional Climate Models (RCM), which are optimised against low amplitude/frequency signals such as mean annual values (measured at weather stations) or total ice loss from the ice sheet (measured by gravity-measuring satellites). Because of this, they may not resolve features of small spatial scale, short temporal duration or high variability. Extreme melt events for example, typically only last for a day or so and thus their effects are potentially omitted from RCM estimates of future ice sheet change.

In the MEMOG project we are using statistical (extreme value) analysis to 1) better understand the past distribution of extreme temperature events on the Greenland ice sheet, how they contribute to ice melting and what the associated implications for global sea level might be and 2) to assess the ability of regional climate models to simulate these events.

Preliminary results suggest that while regional climate models capture the frequency and duration of extreme events well, they typically underestimate their magnitude (i.e. temperature). Ongoing analysis is quantifying the degree to which this results in an underestimate of melting and investigating the role of physical drivers of weather patterns that produce temperature extremes (for example the Greenland Blocking Index).

Glacier Moulin: a conduit between the ice surface and its interior, bored through the ice by the passage of meltwater

Photograph: Amber Leeson

SECURE Grand Challenge

A major aim of the network is to forge new partnerships. Therefore instead of a conventional final feasibility call SECURE has launched its ***"Grand Challenge"***

SECURE has invited our non-academic partners, for example, the British Geological Survey, Environment Agency, HPS, SEPA, and Transport Scotland, to define and describe a challenge for the statistical community.

A one day event will be held by SECURE in May 2017 where the selected challenges will be presented. The attendees will work in groups (one for each challenge) for the rest of the day to develop a plan/solution detailing how to practically address the challenges. Each group will include at least one individual from the partner proposing the challenge. At the end of the day, there will be a presentation on the discussion in each challenge area and the SECURE Network will produce a short report summarising the discussions. The participants will then frame a feasibility project around the challenge (there would be up to five funded projects at £15K per project available). Applicants will have one month to submit the feasibility project proposal. The call to attend the event will be in March 2017; details will be posted on the website.

SECURE Feasibility Project: Jan. 16 – June 16

STAGE: STAtistical modelling of Groundwater Extremes

Dr Ben Marchant, British Geological Survey

SECURE at Westminster: Marian Scott - SECURE PI

Earlier in November, I attended an academic event at Westminster, "Brexit: an academic conference". The conference brought together parliamentary researchers from both Houses and academics to consider some of the key policy areas affected by the UK's decision to leave the EU. This gave an opportunity to discuss the effect of Brexit on different policy areas and help researchers and academics share expertise and ideas. I was part of the RCUK exhibition, and had prepared a short presentation on some of the key environmental topics that we are involved in, including air and water quality and the water-energy-food nexus - I was able to showcase some of the SECURE projects and what we were doing in our network (although I used a video poster). The advice had been very clear - keep the message simple. Several times I was asked what I thought the implications of Brexit would be for our environment. Our environmental regulations come from Europe, and the big questions is how will this change in the future, for example, will we still adhere to the standards and limits for NO_2, or comply with the water framework directive? So there may be some interesting work to derive from this.

There were approximately 110 parliamentary researchers who attended. This included Westminster staff based in the Libraries and Select Committees of both Houses, and staff from the Parliamentary Office of Science and Technology (POST), so the event was very busy with a lot of discussion (although some of it quite short). There were also some very short plenary presentations.

What did I learn? The main message I took away was that there is considerable amount of research being done in Westminster linked to questions from parliamentarians. The staff can find it a challenge to keep abreast of the diverse research activities across the UK, but that as academics we can help with that. A secondary message for me was that when communicating our findings we need to be brief and to the point. Busy people need the headlines. I thoroughly enjoyed the experience and I would recommend taking opportunities like this as they come up.

New technologies provide a challenge for statistical modelling and data analysis by Dr Francesco Finazzi.

As statisticians, we are happy when our space-time dataset comes in a matrix form, where rows and columns are the temporal and spatial indexes about when and where data have been collected. This kind of data usually arise from classic monitoring networks, where data are collected at fixed spatial locations and regular time steps. Even when the sampling scheme is more complex (i.e. remote sensing), data are provided in matrix form since they are much easier to store, visualise and analyse.

New technologies and modern problems, however, call for new forms of data and they open new challenges in statistical modelling and data analysis. An example is given by the smartphone revolution and the need to extract useful information from data collected by smartphone networks.

With respect to classic monitoring networks, data coming from a smartphone network are far more complex. First of all, the network is dynamic, with the number of nodes and node spatial locations continuously changing over time. This implies that, at any given time, the network state is known with uncertainty. Additionally, data arrive at random times when the smartphone is able to collect them or when Internet becomes available. All these issues are partially mitigated by the fact that a smartphone network may include thousands or even millions of smartphones, and the signal may be strong even if the data coming from a single smartphone have a high degree of uncertainty. Nonetheless, it is clear that the convenient matrix form has to be abandoned in favour of a less appealing form, where space and time are not indexes but, rather, they are themselves variables observed with uncertainty.

If you are wondering how a smartphone network operates and how it can be exploited to solve new and interesting problems, take a look at the Earthquake Network project (www.earthquakenetwork.it). The project develops a crowdsourced smartphone-based Earthquake Early Warning system on a global scale. People join the network by simply installing an Android app and the smartphones are used to sense the earthquake waves in real time. When an earthquake is detected, a warning is issued and the population living away from the epicenter is alerted many seconds in advance. In this particular context, a new statistical approach has been developed to detect real earthquakes while controlling the probability of false alarms. Thanks to thousands of citizen scientists, the network has so far detected more than 370 strong earthquakes all over the world and it is now an instrument of earthquake risk mitigation.

Data from the users of the Earthquake Network app.
The map shows the mobile phone locations of the app users in Italy

One Health or Planetary Health?
Let's not get distracted by definitions, let's get on with the science
By Professor Sarah Cleaveland

It is increasingly recognized that international and interdisciplinary approaches are required to tackle the many complex health challenges facing the planet. In 2004, these ideas were articulated through the concept of One Health and laid out in twelve Manhattan principles (http://www.oneworldonehealth.org). These principles include recognition of the links between human, domestic animal and wildlife health and the critical importance of biodiversity and ecosystem integrity in providing the foundational support for provisioning and sustaining all life.

Although the One Health concept embraces a wide range of issues relating to global health, the reality is that One Health research has tended to focus on infectious diseases, often in the context of the emergence and spread of zoonotic diseases with pandemic potential, such as the highly pathogenic avian influenza, SARS, Ebola virus disease and MERS. For example in articles published in 2016 in a leading One Health journal, EcoHealth, 63 of 67 original contributions related to the eco-epidemiology of specific pathogens or diseases, with only four addressing broader issues of ecological health.

Perhaps this is no surprise. The broad 'umbrella' of potential disciplines that might be embraced by One Health (see figure below) is undoubtedly challenging for researchers trained in disciplinary silos. Until recently, research funding has not been available for the ambitious type of interdisciplinary research that is needed. And even when funding has been available interdisciplinary research proposals have often suffered lower funding success than proposals addressing questions that have a clear focus and from a single discipline perspective.

But it is clear that the health challenges that One Health sets out to address are increasingly relevant and the need for solutions ever more urgent. Planetary Health is now emerging as the discipline poised to take up these challenges – in principle no different to One Health, but the scope perhaps more intentionally ambitious at the outset.

Will a re-branding of the discipline help us tackle global challenges more effectively? Perhaps. One reason is that Planetary Health has more powerful support and advocates from within human health, which tends to carry greater political weight than the veterinary sector, which has been the driving force behind the One Health agenda. But issues of definition, ownership or influence must not be a distraction. What matters is that we are able to bring together disciplinary expertise in novel ways that will allow us to carry out interesting and important research to improve the health of our planet and the diversity of life which depends on it.

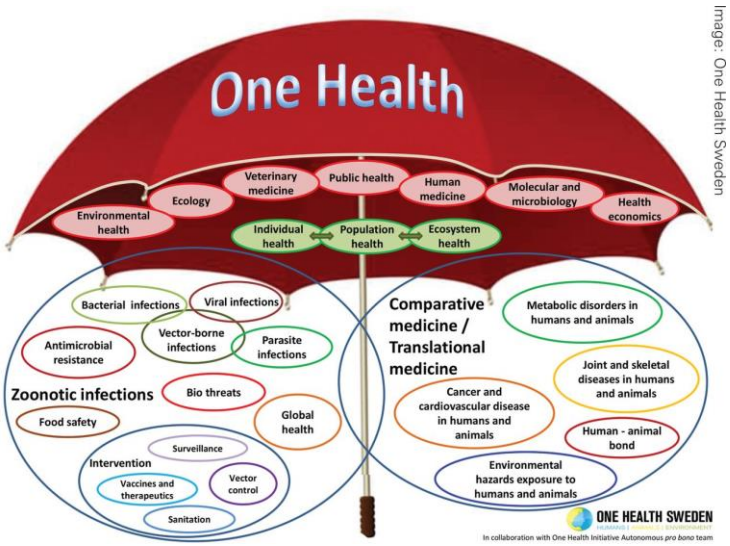

Image: One Health Sweden

Here at the University of Glasgow, we are well positioned to take up this challenge. Over the past decade, we have already established strong platforms for interdisciplinary research in Tanzania that have included infectious and zoonotic diseases, but also embrace broader themes, relating to the planetary health agenda – ecosystem health and biodiversity conservation, land-use change, resilience, social justice and health equity. In our most recent research, funded through the DfID-RCUK research initiative on Zoonoses and Emerging Livestock Systems (www.http://livestocklivelihoodsandhealth.org), our team comprise of physicists, ecologists, infectious disease physicians, human and physical geographers, anthropologists, economists, mathematicians and veterinarians.
We are starting to understand how best to make interdisciplinary research work effectively in practice. While we embarked on this research with a focus on livestock zoonoses, we are increasingly aware of the intersection with broader planetary health issues, and the potential for our interdisciplinary teams to conduct this type of research. The scope of planetary health can seem intimidating - but is never been more urgent to take on these challenges together.

Research project exploring zoonoses in Tanzania which seeks to increase our understanding of: The social, environmental and economic factors causing disease in livestock and people

Additional Reading

Gibbs E.P.J. (2014) The evolution of One Health: a decade of progress and challenges for future Veterinary Record 174:85-91, doi:10.1136/vr.g143

Whitmee S et al. (2015) Safeguarding Human Health in the Anthropocene Epoch: Report of The Rockefeller Foundation-Lancet Commission on Planetary Health. The Lancet 386: 1973-2028: DPI: http://dx.doi.org/10.1016/S0140-6736(15)6090-1.

Horton R. (2016) Planetary health – gains and challenges. The Lancet 388:2462. DOI:http://dx.doi.org/10.1016/S0140-6736(16)32215-2

News from our Partner Living with Environmental Change (LwEC) Networks.

CliMathNet

CliMathNet Conference 2017 Meeting Announcement

The 2017 CliMathNet Conference will take place at the University of Reading from 29th August to 1st September 2017.
Further details to follow at www.climathnet.org/. Please save the dates if you can.
For further information contact:
Dr Emily Paremain;mailto:E.Paremain@exeter.ac.uk

Maths Foresees

Environmental Modelling in Industry study group
3rd-6th April 2017
Isaac Newton Institute, Cambridge

Following the successful event in 2015, registration is now open for the second Maths Foresees Network study group. The aim of the study group is to bring together researchers working in relevant areas of the mathematical and environmental sciences with end-users of environmental research to develop innovative solutions and insights relevant to industry. Further details, including outlines of four of the challenges, and a registration link are available on the event webpage. (Full descriptions of these and additional challenges will be made available shortly.)
Accommodation, catering and reasonable travel costs within the UK will be covered for network members. Network membership is inclusive and free – please contact us for details. Registration is currently open only to those who can attend the whole event; if you wish to attend but cannot commit to the full four days please get in touch before attempting to register.
For further information contact:
Onno Bokhove (O.Bokhove@leeds.ac.uk)
Maths Foresees Principal Investigator

SECURE Funding Opportunities

Conference funding is available to members of SECURE where you are presenting (oral or poster). ***A maximum of £400 is available for a UK conference*** *and £1,000 for an international conference. Details on how to apply and how to become a member are available at:*

www.gla.ac.uk/research/az/SECURE/Funding

TIES 2017 conference: July 24 – 26

The International Environmetrics Society 27th Annual conference will be held in the University of Bergamo. SECURE will sponsor a session at the conference. For further details visit the website:

http://meetings2.sis-statistica.org/index.php/graspa2017/tiesgraspa2017

EVENT CALENDAR 2017

April 3rd-6th: Maths Foresees study group; Isaac Newton Institute, Cambridge

May 23rd: SECURE Grand Challenge Event, Teacher Building, Glasgow

July 24th-26th: TIES Annual Conference, University of Bergamo

29th Aug.- 1st Sept.: CliMathNet Annual Conference, University of Reading

Sept. wk beginning 18th: SECURE Annual Conference


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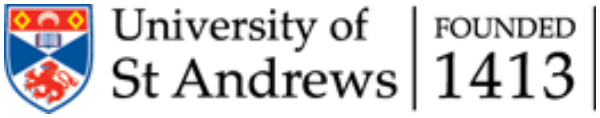
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