

2nd December 2015: What can we tell from above?



Aims

This was the third meeting in the series and the three witnesses helped us to think about the kinds of data sets we can use to look at land use and land use change and links between these and policy implementation.

Witnesses

Alan Belward, the Head of the Land Resource Management Unit at the EC Joint Research Council (JRC) Institute for Environment and Sustainability (IES) came over from in Ispra, Italy. He joined **Lucas Joppa** from Microsoft Research, now based in Redmond, and **Jon Hutton**, the Director of the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) in Cambridge.

Research gaps

Alan began his introduction by highlighting the rapid advances in remote sensing technology driven by the democratization of space, increased resolution of satellite images (from 80 m to 30 cm) and free and full access to satellite data archives. These open up for new possibilities of research and mean that we have huge capability to obtain high resolution data. However, our ability to understand change on a global scale is still limited and he identified the three main gaps in our knowledge related to land use and land use change: **the nature of land cover, the nature of land use, and the nature of land ownership.**

He added after the meeting that **finding common ground between the observation and reporting standards of the three Rio Conventions** - on Biodiversity, Climate Change and Desertification - would be hugely beneficial. Identifying commonality between them will help to both determine the observations needed and to make policy links between biodiversity loss, desertification and climate change.

Lucas focused on **land ownership and difficulties associated with finding out who 'owns' a plot of land and who has rights to use it.** Very high resolution satellite image acquisitions provides some information about land use but in order to be able to understand the processes at work, physical data needs to be connected to human/ social/ institutional data. Finding ways to bring satellite data together with data from the ground, including characteristics of the land – soil type, climate, geographical features and ecology - and land tenure will provide a much more comprehensive picture of how land is being used now and in the future.

Jon gave an overview of the **challenges of collecting and interpreting remote sensing data in the specific context of biodiversity preservation.** He argued that as habitat loss is the main driver for the loss of biodiversity in all (terrestrial) biomes, an understanding of changing land uses is imperative. He stressed that even though new technology, such as the instruments being used by the Copernicus Programme's Sentinel satellites, will allow us to measure future changes, our ability to quickly and effectively measure land use change is lacking. This is both because land use change outpaces our data collection and processing but also because we do not have an efficient and holistic approach for conducting retrospective analyses.

Wicked problems and questions generated by the open discussion included:

- **So many countries and companies are launching environmental satellites that harmonising and calibrating the data between them is very challenging.** One risk is that some of the changes we are looking for are very small and calibration problems may make those changes impossible to detect.
- **A lot of the information we need to know about land use change and climate change is fairly mundane** and the cutting edge research attractive to academics (who need intellectual incentives) and companies (who need financial incentives). Who is going to do this boring but important research and who will fund it?
- **How can we make sure that that the 'haystacks' of data being collected is turned into something that can be measured or modelled,** and contributes to both into policy and action on the ground?
- **How can we enable 'cross-mapping' between different mapping projects,** such as between biodiversity mapping and land use, and ensure that data is collected consistently?
- **How do we manage large data flows** and how do we deal with the fact that many globally, existing datasets are not uniform?
- **What data are missing** and what can we do now to lay the foundations for collecting it in the future?

Witnesses

Dr Alan Belward	Head of the Land Resource Management Unit at the Institute for Environment and Sustainability, European Commission's Joint Research Center (JRC) in Ispra, Italy
Dr Jon Hutton	Director of the United Nations Environment Programme World Conservation Monitoring Centre in Cambridge
Dr Lucas Joppa	Head the Conservation Science Research Unit and a scientist in the eScience Group at Microsoft Research, based at the Microsoft Redmond Campus, USA

Dr Alan Belward

Alan Belward is leads one of eight Units within JRC, which provides information for European and International policies aiming to balance competing land-use demands whilst securing access to natural resources and maintaining ecosystem services.

He received the BSc degree in Plant Biology from the University of Newcastle upon Tyne in 1981, and MPhil and PhD degrees in remote sensing studies of vegetation, both from Cranfield University's School of Agriculture Food and Environment in 1986 and 1993 respectively. In the 1990s he co-chaired the International Geosphere Biosphere Programme's Land Cover Working Group and chaired the Committee for Earth Observing Satellites (CEOS) Working Group on Calibration and Validation. From 2002 to 2006 he chaired the Global Climate Observing System's (GCOS) Terrestrial Panel and in 2009 he was appointed to the GCOS Steering Committee. He is a member of the NASA and USGS Landsat Data Continuity Mission Science Team and the European Space Agency's Sentinel-2 Mission Advisory Group and is also a visiting lecturer at the Technical University of Vienna.

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Dr Jon Hutton

Jon Hutton received a doctorate in crocodile ecology from the University of Zimbabwe in 1984. During the next 20 years he held a number of senior management positions in that country, encompassing the government, NGO and private sectors. During the early 1990s he was one of the Zimbabwe Government's negotiators to the biodiversity-related Multilateral Environmental Agreements.

In 1999, he moved to Europe to work as the Executive Director of Resource Africa and Fauna & Flora International's Director for Africa before joining UNEP. Jon has produced over 50 papers, books and conference proceedings covering issues such as conservation policy; wildlife management; protected area management; community-based natural resource management; the sustainable use of natural resources; and the relationship between conservation and poverty. In recognition of his academic interests he was appointed a Senior Member of Hughes Hall College, Cambridge in 2004 and Honorary Professor of Sustainable Resource Management at the University of Kent in 2007.

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Dr Lucas Joppa

Lucas Joppa's research combines science, policy, and tools & technology. This ranges from quantifying the impacts of conservation actions to unraveling the complexities of species interactions and mapping where species are being discovered - and going extinct. He embraces the challenge of predicting outcomes for ecological communities under an increasingly uncertain environment, and unite robust ecological theory, social considerations, and innovative distributed data collection systems to achieve effective environmental conservation.

He completed his PhD in Ecology from Duke University's Nicholas School of the Environment. He is currently an Honorary Research Fellow at the University of Kent's Durrell Institute for Conservation and Ecology (DICE) and an Honorary Conservation Fellow at the Zoological Society of London (ZSL). In 2013, he received the Society for Conservation Biology's 'Early Career Award'.

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Setting the scene

Alan Belward, the Head of the Land Resource Management Unit at the EC Joint Research Council, is one of the other witnesses and he was particularly interested in land use change and remote sensing in Africa. He sent us two papers. Paper 1 is an article from *The Biologist* about how satellites can help monitor the latest threat to life on Earth: a lack of space. Paper 2 was published online this year in an open source journal that outlines the satellites under civilian and/or commercial control with the potential to gather global land-cover observations.

Lucas Joppa from Microsoft Research, now based in Redmond, was keen to talk about who owns what land and for what purpose, particularly looking forward, the agricultural 'land grab' or land rush that's being driven by foreign investors buying up farmland in developing countries. He sent us Paper 3 about 'the global land rush' that focuses on how foreign investors are buying up farmland in developing countries. He also recommended we look at the Land Matrix, an open web-tool for collecting and visualising information about large-scale land acquisitions and contains some fascinating infographics and maps.

They were joined by **Jon Hutton**, the Director of the United Nations Environment Programme World Conservation Monitoring Centre who is interested in both the data sets themselves and in how to link them to policy at a national and inter-governmental level.

Background papers

Belward, A.S. & Skøien, J. O. (2014). Who launched what, when and why; trends in global land-cover observation capacity from civilian earth observation satellites. *LSPRS Journal of Photogrammetry and Remote Sensing*, published online: <http://www.sciencedirect.com/science/article/pii/S0924271614000720>

Belward, A.S. (2014). Running out of land. *The Biologist*, 61,3, 28-32

Arezki, R., Deininger, K. & Harris, S. (2012) *The Global Land Rush*. *Finance and Development*, 49, 46-49.

The land matrix website: <http://www.landmatrix.org/en/>

Extra paper: from Lucas

Lucas mentioned a paper about satellite accumulation around the world, and how we are missing conservation priorities with high res images. Seeing this figured updated would be amazing!

Loarie, S. R., **Joppa, L.N.** & Pimm, S. L. 2008. Satellites miss environmental priorities. *Trends in Ecology & Evolution*, 23, 183-184.

Introductions by the witnesses

Alan Belward (Notes by Therese Rudebeck)

Introduction: Dr Belward initiated his presentation by highlighting that land is finite, non-renewable, and scarce. On this basis, he identified the three main gaps in knowledge that we currently have in regards to land: the nature of land cover, the nature of land use, and the nature of land ownership.

Leading one unit within the IRC, which provide information for European and international policies aiming to balance competing land-use demands whilst securing access to natural resources and maintaining ecosystem services, Dr Belward and his team uses remote sensing to fill these gaps of knowledge. Accentuating how remote sensing is an area that has changed rapidly in the past decades, Dr Belward noted three processes in particular which have changed the field:

1. **The democratization of space.** This realm used to be only in the hands of the US, which later extended to Russia, India, China and EU. More and more countries are now participating in this field of research.
2. **The resolution of satellite images.** This has changed from 80 m to 30 cm, opening up for new possibilities of research.
3. **Full free and access to archives.** All the satellite data was made available full, free, and open in 2008, enabling access to vast amounts of new data, which in turn enabled the development of new projects

He feels that the main challenges currently facing the community working with remote sensing are:

1. How can we make sure that that the data is turned into something that can be measured or modelled, and turn it into knowledge?
2. How can we enable 'Cross-mapping' between different mapping projects? E.g. between biodiversity mapping and land use?
3. How do we manage the large data flows?
4. How do we deal with the fact that globally, the data is not uniform?

He therefore concluded that remote sensing is an area that shows great promise, and that it is an exciting field in which progress is made daily, but that there are still challenges ahead, particularly in filling the gaps of knowledge in regards to land. Furthermore, emphasizing the notion of land ownership as an example, he highlighted the importance in marrying the view from the sky with a perspective from the ground in order to fill these knowledge gaps.

As part of the follow-up after the meeting, he added:

I suspect there are many areas of overlap. Your forum could certainly provide guidance on synergies between the observation/reporting standards for the three Rio Conventions. This is a sadly neglected area. Finding common ground among them would be hugely beneficial - if we can identify commonality we may even end up with the observations needed... it would certainly help anyone trying to make policy links between biodiversity loss, desertification and climate change.

The land tenure / land cover story isn't closed either. Who 'owns' the land (or has rights of use) is extremely important - the very high resolution satellite image acquisitions may help, but won't provide a complete picture. We need to refine the questions asked of any cadaster. And we only really just scratched the surface of the woodfuel/charcoalhydro//habitat-loss story...

Jon Hutton (Notes by Elena Kazamia)

Introduction: Jon gave an overview of the challenges of collecting and interpreting remote sensing data in the specific context of biodiversity preservation. He highlighted that since habitat loss is the main driver for the loss of biodiversity in all (terrestrial) biomes, an understanding of changing land uses is imperative. He stressed that our ability to quickly and effectively measure land use change is lacking. This is both because land use change outpaces our data collection and processing but also because we do not have an efficient and holistic approach for conducting retrospective analyses. Jon explained that in the specific context of trying to understand changes to biodiversity, a tailored product is required, and whilst many have been developed (e.g. GlobCover 2005, 2009), none answer satisfactorily to our needs.

Key points people took away from the witnesses in the Original Forum

All of the points people e-mailed me after the meeting related to availability and collection of remote sensing data.

- We have a lot of big data at our finger-tips, yet seemingly simple information that would help support land-use decision making isn't there. However, easy access to details of ownership can be a controversial issue. I guess a culture of open knowledge can be introduced over time in the sense that in the UK if you buy land there is now the expectation/condition that this will be publicly available knowledge. But as Lucas raised, should his friends know what his mortgage is by searching online?
- There is huge capability to obtain high resolution data, yet our ability to understand change on a global scale is limited. This was interesting information to reflect on. So, we have the capacity for this knowledge, but there does not appear to be enough incentive to invest in gaining it. I guess that raises the question - in terms of longer term planning (and aims such as the UN's Development Goals), what data that we currently don't have be of most use?
- I was struck by the sense that we are collecting so much data in ever more sophisticated ways but still don't know so much. The lack of consistency in the ways in which data are collected, but more surprising, the apparent inability to join it up over time to show what has been happening. The, less surprising to me but problematic, difficulties in linking the physical data to human/ social/ institutional data in order to begin to understand more about the processes at work. The need for some sort of structure, perhaps something like land systems, that can provide a basis within which the available information can be linked, both the physical and institutional and social. This will sometimes be comprehensive, but often from samples and models of representative units.
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- The need for some sort of structure, perhaps something like land systems, that can provide a basis within which the available information can be linked, both the physical and institutional and social. This will sometimes be comprehensive, but often from samples and models of representative units.
- Satellite data is now synoptic almost in real time, revisits are frequent and precision is getting very high; we're on the verge of getting real time information (ie analysed data) at most scales on ecological, social and economic conditions of real importance to policy makers. However, we won't have trend data, historical comparability for some time to come in many areas. This provides opportunities for improving policy decision making, especially in the context of fully informed democratic debate. It also opens up less benign possibilities ranging from personal loss of privacy and commercial confidentiality through to support for neo-colonialism, land grabbing or worse. The history of mapping is substantially a military and colonising history; maps provide power but not always to the right people.
- Jon highlighted that one of the reasons we have not interpreted historic data on land use is that the type of work required would *not* involve using cutting-edge technology, which is off-putting to prospective researchers. Manual archival work is both expensive, laborious, time intensive and would not necessarily constitute a type of project that lends itself to doctoral training. I found this point particularly interesting as it is rarely considered. In our rush for better technology, retrospective analyses are... unappealing!
- Elena Kazamia was surprised to hear that data from products such as GlobCover 2005 and 2009 were impossible to compare. Jon implied that there was fundamental technological challenges that meant that any attempts would constitute bad science. Of course this raises a number of "why" questions. Why is there a lack of consistency and can no amount of data correction overcome the stumbling blocks?
- It was disheartening to hear (and have confirmed) that our technological capabilities are outpacing our needs but also our rational thinking. We are collecting haystacks of data that we do not need, struggle to interpret, without asking constructive scientific questions. I was left contemplating the scale of effort and communication required to improve on this?

There was no Parallel Forum related to this meeting.