Tracking stewardship of resources using "Big Data"

Dr. Nigel H Wright Royal Haskoning DHV. Westminster London.UK

Introduction

Facing the immense challenges of climate change in terms of disrupting ecoservices, food supply and the population they support, demands an approach of equivalent magnitude, reach and capacity to realistically confront and manage interlinked multi-dimensional risks. The integrated decision making required is a challenge akin to n-dimensional chess. Stewardship of environmental resources, by governments as well as multinational companies, are being scrunised by cuttings edge digital technologies. The Millennium Ecosystem Assessment (2005)was a wakeup call to halt further depletion of the Earth's biological diversity and avoid seroius impacts on human future wellbeing. Biodiversity is in a critical state with extinction rates rising and key populations in decline. In parallel, the ecosystems which underpin species and diversity, undergo progressive fragmentation and gradually deteriorate. There is an urgent need, not only to extensively upgrade ability to track changes in ecosystems and biodiversity driven by human activities, but also to further our understanding the role and real value of ecoservices underpinning society.

Big Data Analytics

In the face of these threats, big data analytics has potentially a tremendous future if it can be harnessed effectively. Commercial companies have been at the fore-front of digital applications where the consistent driver is sales to "enhance society" and generate profit. Google and Amazon have amazing powers to track people's habits and behaviours to target and sell more products and effectively shape the future (Marr 2016) In order to do this, they use highly tuned data analytics requiring vast data storage which can be searched in milli second, and interrogated by the most powerful search engines which are perpetually updated. Machine learning and artificial intelligence (AI) accelerate the effective response rate of new digital dimensions -all of which areavailable at a click of a mouse. We have moved from Bytes(8 Bits)1 byte: A single character, 10 bytes: A single word to Petabytes (1 000 000 000 000 000 Bytes) 2 Petabytes= equivalent to data in all US academic research libraries).

Environmental Opportunity

The "environmental prize" of harnessing this digital revolution will ultimately be the sustainable protection of the planet's resources ,eco services , the production of sustainable forms of food (e.g. protein without the use of vast volumes of water). This is at the epicentre of environmental resource custodianship. Agencies and stakeholders could have the facility to use "Big Data" analytics to track the performance of companies in maintaining eco services under their stewardship,through dash boards of highly targetted live metrics, exploiting satellite sensors and global data analytics. The smart innovation is the selection and analysis of precise metrics surgically extracted from vast data arrays, linked to applications which deliver valued insights, with open low cost access.

Sieze the opportunity

Now is the time to drive sustainability through big data analytics. Why? because it has the global reach and capacity, while expanded open access the cost reductions associated with accessing satellite and global data have plummeted.

Global issues of climate change, biodiversity losses, disruption to food sources and threats to ecosystems, all have links into big data. Through data mining and the wizardry of analytics, these threats can be translated and distilled into meaningful metrics to support robust solutions. This, together with machine learning and artificial intelligence should be able to create a smart system to digitally fore-warn us on un-sound decisions (based on training alogorithms on globally recorded known actions and events/ scenarios, associated risk profiles and predicted outcomes from the planetary digital lake). We need supercomputer linkages and digital processes to "irreversibly learn" the "no go's ", which have the capacity to systematically edit high risk decisions ,and prevent unsustainable actions.

Solving all the United Nationals Development goals is a major task which can be linked to exploiting digital data to effectively track the rate and degree of global environment and social changes (e.g. poverty, hunger, health, clean water, sustainable cities responsible consumption, climate actions). We need to move from past-facing to future-facing decision facing decision making, using predictive data analysis. The health tracking of global resources will become real time , allowing environmental symptoms to be measured, modelling of scenarios and treatment intervention, to shape the future ,rather than a post mortem of acute or chronic loss . Furthermore, this will expand the "band width "of informed decision making and deliver traceability and transparency.

Traditional approaches to sampling are being superseded by digital data. Delivering data through pixels and mega-processing of sampling data is faster, more accurate and provides a "bigger bang for your buck" . Big data affords high throughput of data over extended time periods, allows the combination of multiple, apparently disparate data sets, in different formats and meta-analysis . This provides a potentially more accurate picture and allows deep dive analysis of the results. The spectrum of environmental analytics applications is expanding exponentially. These range from tracking of poaching in Africa ,biodiversity monitoring in tropical forests and in the USA open data initiatives have opened new opportunities to map the seafloor for biological diversity.

Emergencies

Recent events including flooding, earth quakes have exploited satellite and drone data improving the effectiveness in disaster management e.g. Hurricane Katrina . The US Geological survey collects real time earth quake data and is key to emergency response services , general public and governments providing a rapid warning system.

Pollution and Health

On a wider front, agencies are using big data to examine the interplay between air and water quality in environmental quality indices and their effects on public health. In the UK, London has introduced pollution charge measures which penalise pollution vehicles entering inner zones of London which are now recognised to directly affect the health and wellbeing of people .The World Economic Forum using big data studies on the built environment show that on average pollution reduces the life expectancy of European City dwellers by 2 years (WEF 2015).

Insights into social impacts can be derived from internet and social media data with increasing reliability. Smart ways of deciphering social changes are being formulated where ground observations are not feasible or very costly, and proxy measures can give penetrating new insights. The use analytics of big data from social media ,and links to GIS linked pharmaceutical buying, enables the early warning and tracking of disease transmittal through populations. Mobile phone use ,the tracking of light from space provides proxy measures and metrics for income, employment and links to social wellbeing.

Climate Change

Climate change is being tracked by NASA who utilize climate models with an estimated estimated 30+ petabytes of stored information for modelling purposes. The European Space Agency have the ability to log the loss of ice from glaciers . According to the ESA glaciers have lost 9 trillion tonnes of ice in the last century (ESA 2019)

Improvements in sustainability and accountability are being accelerated through hackathons , crowdfunding and resourcing and citizen science "hot housing "smart data uses .

Assessing environmental risks

Environmental analytics is valuable in assessing environmental risks. The World Resources Institute has developed "Aqueduct" -an free on line interactive water-risk mapping tool that monitors and calculates water risk anywhere in the world (based on parameters of water's quantity, quality and other changing regulatory requirement. The insurance industry is keen to utilize big data to understand the dimensions of key risks ,assess financial exposure and develop early warning metrics for departures from predicted changes. It also allows brokers to assess claims,precisely target premiums and edit the risk coverage.

Global digital mapping and monitoring of environmental resources (forestry, mangroves, crops etc.) allows changes and losses to be calculated ,and if combined with eco-resource values , the dollar value eco-resources can be entered on the on asset balance sheet. Losses in the event of poor land management, a major pollution event or natural disaster (loss of coral reefs, fisheries, mangroves, forestry fires illegal logging) can then be tracked in monetary terms giving focus to decision makers.

Management from Space

Sentinel satellite missions could be key to global ecosystem function monitoring. They include a range of sensors (land, ocean and atmospheric monitoring; provide the only global, open-access radar imagery (Sentinel 1) and gather data at both high temporal (5 days) and spatial resolutions (5–10 m).

Future spaceborne multispectral sensor missions are geared to interrogating and mapping surface chemistry and structure, chemical composition of foliage, mapping of burned areas and measurements of ecosystem methane emissions . Monitoring of biomass (using Lidar /Landsat/Modis data) are being more sophisticated and image fusion techniques facilitate characterisation of data .

Future technology

Solar powered HighAltitude Pseudo Satellites (HAPS) are planned to fly at up to 67,000ft for 90 days at a time, without needing to land (CNBC 2019). Boeing plan to build Orca Unmanned Undersea Vehicles which will operate in blue water environments autonomous navigation systems with a range of 12,038 km (You Tube).

Eco-services Accounting

The use of use of ecosystem accounting has been gathering momentum. This accounting approach will measure changes in the stock of natural capital at a variety of scales and integrate the value of ecosystem services into accounting and reporting systems

An integrated system for natural capital and ecosystem services accounting is currently being formuated by the European Union (DG ENV 2015) to account for the range of ecosystem services in monetary terms the benefits of investing in nature and the sustainable management of resources. It will allow assessment of ecosystems' economic importance and value, which can be linked to national accounts.

Corporate Social Responsibility (CSR)- Finance Sustainability Driver

In the world of finance and investment, Corporate Social Responsibility has become a sustainability driver. Corporations are keen to claim ownership of corporate social responsibility (CSR) and "environmental guardianship" of the planet's resources. Within portfolios of companies, ESG opportunities and risks have material impacts which are examined under due diligence processes. UN Sustainable Development goals have changed the expectations of private equity firms and multinational companies, which today play a significant role in shaping the environmental guardianship of the earth's resources. Scientifically sound corporate reporting including the eco services balance sheet (with defined debt and profit) need to be standardised, in order to be truly valuable in responsible decision making .Responsible investment credentials are used as a competitive edge, but how is this independently accounted for across global asset portfolios?

In the financial market's sustainability indices include a wide range of elements e.g. Dow Jones Sustainability. The United Nations Principles of Responsible Investment has been a drive in Environmental, Social and Governance adoption. CSR and ESG data is compiled globally and companies including Bloomberg and the CSR hub and develop sophisticated metrics which are then and is used in part to predict the financial performance/ stock price of companies. The expansion of sensors and the data they deliver will be highly valuable to insurers to screen out higher risk elements of portfolios or indeed increase premiums The multiple dimensions and vast data analysis requirements to provide meaningful insights demands a radical re-think of our approach.

Big Data Challenges

Methods for capturing data, storage capacity, data analysis, data searching and transfer, visualization are being developed and are at the leading edge of technology. Data security, privacy issues and the sources of storage remain issues, highlighted in recent announcement of data breaches. While there has been improvement in open access data there is still a large amount of data held privately (research and commercial) with limited or no access.

“Big data” mining will unlock new opportunities to remotely scrutinise environmental resources (including energy) over wide geographic areas. Integration of remote sensing technologies, artificial intelligence and analytics, linked to GIS data bases, can provide a powerful platform to map and evaluate change in value of ecoservices. New dimensions of CSR, including social impact, can be tracked through focused big data analytics

Future “live” metrics of stewardship of national resources and CSR will ultimately feature on the balance sheet of environmental due diligence, the bottom line and corporate global reputation. This will stimulate competitions in a league table of corporations vying to be the leader in responsible and sustainable business.

References

CNBC 2019 https://www.cnbc.com/2019/02/13/solar-powered-pseudo-satellite-to-map-earth-for-90-days-at-a-time.htmlEuropean Union (DG ENV 2015) European Environment Agency .www.eea.europa.eu

Millennium Ecosystem Assessment 2005. Ecosystems and Human Well-being: Synthesis. Wa MilleniumEcosystemAssessmenthttps: //www.millenniumassessment.org/ documents/document.50.aspx.pdfwashington, DC: Island Press.

ESA 2019 http://www.esa.int/Our_Activities/Observing_the_Earth/Glaciers_lose_nine_trillion_tonnes_of_ice_in_half_a_century

Marr ,B (2016) Big Data in Practice: How 45 Successful Companies Used Big Data Analytics to Deliver Extraordinary Results.Wiley pub.

World Economic Forum Global Risks 2015

United Nations Principles for Responsible Investment: https://www.unpri.org

You Tube (http://youtubez7ij4QBfPG4)