"Societal impact of improved environment and geospatial information" at the Geospatial World Forum, Rotterdam, The Netherlands, May 15, 2013.

Summary Proceedings

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Socioeconomic Benefits Community

Summary Proceedings for Geospatial World Forum user forum sessions on "Societal impact of improved environment and geospatial information", Rotterdam, The Netherlands, May 15, 2013

1. Introduction

The Geospatial World Forum is an annual event, which attracts an international audience of senior decision makers and practitioners. This year's conference in The Netherlands attracted approximately 1200 delegates and a very high caliber of speakers. The theme of the conference was Monetizing geospatial value and practice. The IEEE was invited to organize a one-day user forum as one of several parallel sessions on May 15th during the conference.

Geospatial projects are often dogged by the inability to establish a strong quantitative value proposition and are unable to sustain the attention of senior decision makers. In a tough economic climate, it is particularly important that any project that requires a significant investment can show a clear Return on Investment (ROI). Multi-disciplinary approaches involving collaboration of the physical, social and economic sciences can provide a strong foundation for formulating quantitative analyses of the value of information.

The overall objective of the user forum was therefore to share experience in using proven economic and financial methodologies from across the widest community. Case studies were selected from GIS, remote sensing and geomatics covering applications ranging from environmental and social sciences to government and utilities. Our event had excellent participation, with speakers addressing a full auditorium, with attendees coming back for multiple sessions to participate in good discussions.

2. Acknowledgements and Sponsorships

The organizations and agencies listed below are acknowledged for providing financial, organizational and/or logistical co-sponsorship of the user forum:

National Aeronautics and Space Administration (NASA)
European Commission Joint Research Center, Ispra
IEEE Committee on Earth Observations (ICEO)
Group on Earth Observation (GEO).

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3. Agenda

The final agenda is provided below.

15th May, 2013

Societal Impacts of Improved Environment & Geospatial Information

0900 – 1100 hrs **Session 1 - A foundation – Chair: Max Craglia, JRC**

Jay Pearlman Ph.D. Fellow IEEE, Chair IEEE Committee on Earth Observation, USA
A View from the Future

Richard Bernknopf, Research Professor, Department of Economics, University of New Mexico, USA
Mary Ann Stewart, Principal, Mary Ann Stewart Engineering, USA
Foundations, Methods and Case Studies for Assessing Socio-Economic Benefits

Andrew Coote, Director, ConsultingWhere, UK
Mark Noort, Founder, HCP International, The Netherlands
Communicating Impacts and Benefits

1100-1230 Coffee Break and Visit to Exhibition
1230-1330 Lunch Break

1330 – 1530 hrs **Session 2 Pointing to Benefits – Chair: Lawrence Friedl, NASA**

Massimo Craglia, European Commission, DG Joint Research Centre, Digital Earth and Reference Data Unit, Italy
INSPIRE: Delivering Societal and Economic Benefits in Europe

Maria Andrzejewska, Director, UNEP, Poland
The Role of Geoinformation in Participatory Environmental Management

Hans Roozekrans, Royal Netherlands Meteorological Institute, The Netherlands
A Cost-Benefit Analysis of Meteorological and Climatological Services

Anil Kumar, Manager Environmental Data, Environment Agency Abu Dhabi, UAE
Realizing Benefits of Geospatial Technologies in Environment Agency - Abu Dhabi

1530-1600 Coffee Break and Visit to Exhibition

1600 – 1800 hrs Session 3 Business Cases – Chair: Jay Pearlman, ICEO

Lawrence Friedl, Director, Earth Science Division's Applied Science Programme, NASA, USA
Benefits of NASA Earth Science and Earth-Observing Satellites

Tim Stonor, Managing Director, Space Syntax Limited, United Kingdom
The Use of Geographical Information in the Planning and Design of Urban Environments

Frank Hanssen, GIS Analyst and Coordinator, Norwegian Institute of Nature Research, Norway
A Least-Cost-Path (LCP) Toolbox for Optimal Routing of Power Lines

Panel discussion/Question and Answers
Participants: Max Craglia, EC JRC; Lawrence Friedl, NASA; Tim Stonnor, Space Syntax, Andrew Coote, ConsultingWhere; Hugo Degroof, EU.

Closing Remarks
Jay Pearlman

4. Summary of presentations

Session 1: A Foundation, Max Craglia chair.

A View from the Future, Jay Pearlman, IEEE.

Jay Pearlman introduced the three sessions on "Societal impacts of improved environmental and geospatial information." These fit within the theme of Monetizing geospatial information.

Jay talked briefly about several major innovations of the past hundred years. He gave the example of an automobile from 1910 -- how would one monetize its impacts on society? One viewpoint, tongue in cheek, is: "almost clean boots -- no longer stepping in horse manure." Continuing the automotive thread, paved roads led to extended communities and economic growth. Autobahn to provide high-speed travel was the real breakthrough, leading to our modern environment.

Another example is the 1960 space launch, motivated by defense. This led to the moon and eventually resulted in Landsat and GPS (which no one previously envisioned).

Jay then showed a 286 computer in 1982.The initial impact is a report without carbon paper, but without the vision then of such things as e-mail, Twitter, the cloud, the iPhone. GIS expands our data environment with streaming data, but impacts to society have not been adequately understood. The suggested approach is to Envision, Define, Quantify, and Document, thus leading to processes and methodologies that can be reused.

Dr Pearlman envisioned today as the first two courses of a four-course meal. The remainder will be served in Florence, Italy, on June 23-24, 2013, within the context of an INSPIRE pre-event workshop.

Foundations Methods and Case Studies for Assessing Socio-Economic Benefits, Richard Bernknopf, University of New-Mexico, and Mary Ann Stewart, Mary Ann Stewart Engineering/

Rich Bernknopf

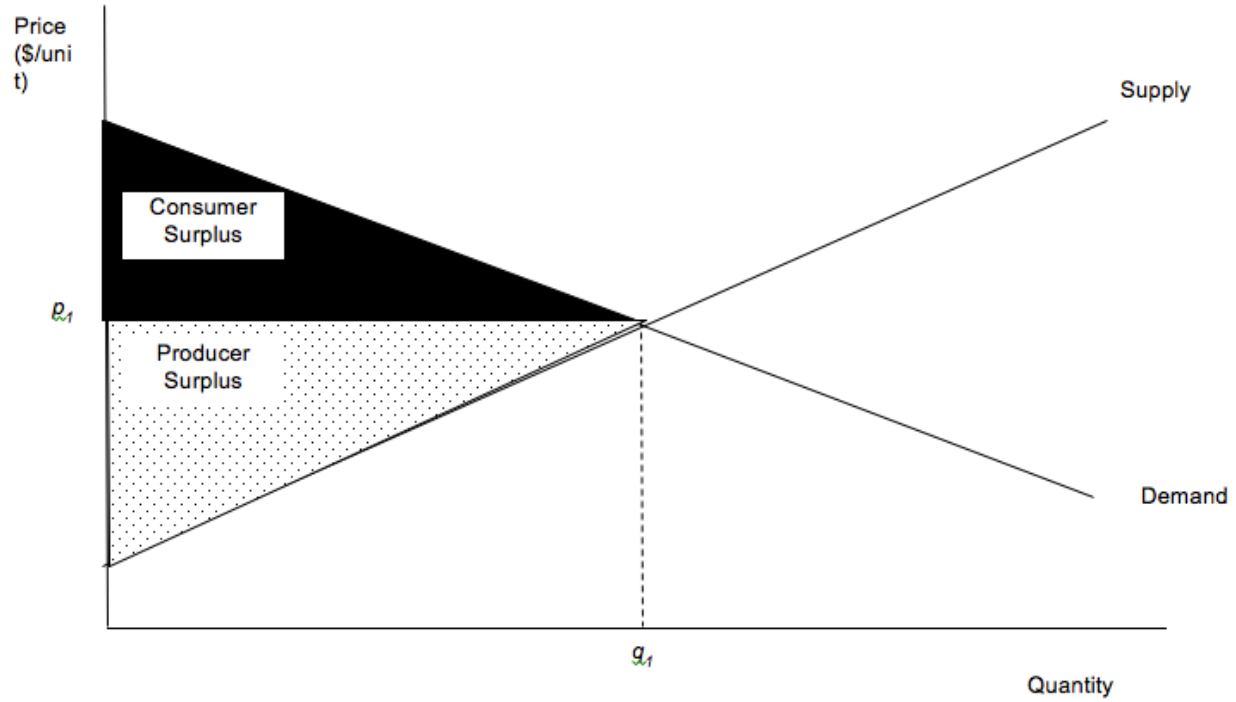
Dr. Bernknopf presented the economics foundation for the economic analysis of geospatial information and its application in a case study of the value of earth observation information. Dr. Bernknopf began with a definition for geospatial information. It is an intermediate good. It is a fundamental input to reducing uncertainty in economic and policy decisions. It is composed of spatial and spatiotemporal social, scientific and technical data. It comes in many forms and, for specific data sets, provides a long-term archive. Its value in use requires demonstration of why and how the data is a component in a decision.

What is “value of information” (VOI)? VOI is a concept accompanied by a suite of methods for evaluating the usefulness of information for many types of decisions. VOI demonstrates why and how geospatial information and technology can inform economic and resource development decisions.

The following questions can be used for conducting an analysis:

- What are the pros (benefits) and cons (costs) of investing in geospatial information?
- What are the rules for a valid evaluation?
- Does the investment demonstrate an increase in the efficiency of the allocation of resources?

Rich then addressed the economic analysis of a market good, with demand and supply curves using the following figure:



(Source: Raunikar)

Here the price of a product is the point on the graph where supply equals demand. If the price is other than this level, the consumer or the producer will have an advantage over the other. Unlike a market for a private good, most geospatial data is public information and is supplied, in large part, free or for the cost of reproduction. Public geospatial information is a public good because it is neither consumable (one individual cannot stop another from using the good) nor excludable (one individual cannot keep another from access to the good). Thus a market for most types of geospatial data does not exist and the product is distributed by the public sector.

There are multiple approaches to analysis. These can be qualitative or quantitative, using revealed preference (market data), versus stated preference (Willingness to Pay surveys), retrospective (ex post) and prospective (ex ante). Economic impact analysis may include macroeconomic models, simulations, industry impact analysis, or microeconomic analysis and case studies. Today we will look at microeconomic analysis and case studies, considering for these two factors:

- Cost Benefit Analysis (CBA)
- Return on Investment (ROI).

The steps in cost-benefit analysis are as follows: decide whose benefits and costs count and select alternative geospatial data and information; catalogue potential impacts and select measurement indicators; predict the quantitative impacts over the lifetime of the project; monetize all impacts at a discount rate to estimate the net present value of the benefits of the project; sum the benefits and costs and perform sensitivity analysis.

The presentation went on to explain the mathematics of VOI. It is based on the characterization of the descriptive attributes of the data that comprise the elements of the information (an information structure). The informativeness of a geospatial information structure can be evaluated using CBA and ROI analysis and has two steps: (1) determine the VOI – the benefit is estimated as the difference in value between solving a problem with geospatial information and without it, and (2) the benefit of the geospatial information must be greater than the cost of implementation to demonstrate that a decision is more informed than without it.

Three case studies of economic value with/without geospatial information were considered in this discussion:

1. Should Landsat be an operational land imaging system? (‘Operational’ means routine use of imagery for decisions.) Regional resource management can be improved and public health maintained by coupling Medium Resolution Land Imagery (MRLI) with agricultural, geospatial, and hydrogeologic models.

2. What is the potential return on investment (ROI) for leveraging a municipal geospatially-based emergency management system for province-wide use? Analysis of public health and organizational benefits of reverse 911 emergency notification technology.

3. Can use of topographic contours derived from LiDAR data better inform decision making for flood response? More accurate forecasts of flood levels result in reduced property damage, faster restoration of services, increased government benefits to affected property owners.

Case study 1: an environmental regulatory application using Landsat archives to project risk of contaminated drinking water given nitrate contamination potential.

The investment issue is stated as follows: does Medium Resolution Land Imaging (MLRI) provide economic benefits to society? The objective is to maximize agricultural production without decreasing groundwater quality. The implementation steps include:

(1) Use MRLI monitoring data from a spatially explicit archive of land use information as a baseline for analysis;

(2) Apply spatiotemporal statistical information to convey time-dependent nitrate accumulation;

(3) Apply nitrate data in a regulatory decision to evaluate the impacts of intensive and extensive agricultural land use on groundwater quality.

In the study, the authors measured the contribution of MRLI as an input to revising regional land use to maximize the value of agricultural production and preserve potable groundwater resources. They looked at the dynamic nitrogen loading and transport at specified distances from specific sites (wells) for 35 Iowa counties and two aquifers. They assessed the impact of MRLI for the management of the major land uses in the region (production of corn and soybeans) and their effects on groundwater quality.

Within the decision framework, MRLI assists in the management of corn and soybean crops and the impact on soils and groundwater by monitoring agricultural production to meet the EPA maximum contaminant level of nitrates. It also assists in identifying places for types of agricultural production that may require nitrogen fertilizer, which can contaminate groundwater. When coupled with earth science process models, it enables decisions about land uses and their impacts on natural resources. Producer and regulator choices and monetized benefits are based on the relative market value of crops and an environmental health standard.

In summary, over a 10-year period of analysis in Northeast Iowa some groundwater wells are threatened by nitrate contamination and could fail to maintain drinking-water quality as contrasted with other locations where the topography, soils, well characteristics (such as depth and operations), and surface geology are less likely to transport the contaminant to the water supply in the future. The estimated VOI for MRLI is an annualized $858M ± $197M / yr (in $2010) and has a net present value of $38.1B ± $8.8B for northeastern Iowa.

Mary Ann Stewart

Ms. Stewart presented the second and third case studies. The second case study, entitled PRISM 911, involves a citizen notification project using return on investment methodology developed by a consortium of GITA (Geospatial Information Technology Association), FGDC (US Federal Geospatial Data Committee), GeoConnections of Canada, and the American Water Works Association Research Foundation. This bottom-up approach focuses on metrics collected in interviews with technology practitioners. The six steps of the return of investment (ROI) methodology were used: define the investment; calculate costs; calculate tangible benefits; schedule cash flow; perform financial analysis; prepare strategic analysis.

PRISM 911 is a web-based reverse-dial emergency response notification application linked to the municipal GIS of Quinte West, Ontario. The study used three years of detailed records on adoption of the technology. The majority of notifications were boil water advisories. The results for the 5-year retrospective study are summarized in spreadsheet format.

In this study, public benefits dominate – 65% are to the public for reduced risk of water borne illness and reduced time boiling water when no longer necessary. Public benefits led to high annualized Return on Investment. Analysis of benefits within only municipal organization showed a significantly lower ROI.

Health research conducted externally to this study was leveraged to estimate the cost of water borne illness. Census metrics and public health records for Ontario were also used. Analysis extended to Huron County, which leased PRISM from Quinte West, using one year’s notification records. Projections were made for potential benefits of extending PRISM to entire province.

The third case study looked at the benefits of using statewide LiDAR in place of preliminary field surveying.

The original 2007-08 study of a statewide Iowa data sharing project included benefits of open access to elevation contours derived from LiDAR data. Typical counties were estimated to save 20 crew days/year at $150/hour = $24K annual savings based on interviews with field survey chiefs. Given 99 counties in the state, statewide savings would amount to over $2M annually. A study of 2008 Iowa flood response showed diverse benefits from on-the-fly innovation using LiDAR-based elevation contours. Real time data combined with contours and modeling resulted in optimized sandbag placement to minimize property damage. Over $166M of avoided damage were estimated for the University of Iowa. Smaller municipalities benefited similarly, at a reduced scale given less property at risk.

LiDAR contours were used in place of FEMA digital flood maps, which were not available at the time of the flood for many affected counties. Iowa GIS managers provided maps with property ownership records to FEMA community relations staff, resulting in faster service to affected residents and greater payouts of recovery funds to residents. For a single county, estimated benefit ranged from $4M to $7.5M. One county avoided evacuation of its jail through correct modeling of water level and sandbag placement, contrasted with the adjacent county’s negative experience with flooding and forced evacuation.

Communicating Impacts and Benefit, Andrew Coote, ConsultingWhere and Mark Noort, HCP International

Andew Coote - It is important to speak the right language -- don't use the G word (geospatial) or raster.

Political language is about popular opinion (votes), gross domestic product, trade, tax revenues, and new jobs created. Corporate language is about ROI, shareholder value, and media reaction.

The elevator pitch goes beyond the pain statement, and focuses on how the proposition meets needs. A successful pitch meets four tests: 1) It is succinct – two minutes or less; 2) produces a lot of efficiencies; 3) Is understandable by your grandmother and your grandkids; 4) Is irrefutable. Don't leave your audience with more questions than answers.

Andrew proposed an elevator pitch exercise to the attendees. It is a learning method for presenting your business case and provides a straightforward way to get on a level playing field with sophisticated financial analysis. Creating an elevator pitch helps identify the true value of your project and optimize it. Use it to tell your best possible story.

Mark Noort

Mr. Noort started from the elevator pitch for GEONETCAB: Earth Observation helps you to save money, save lives, and save the environment.

But Mark hates elevator pitches because the real goal is to establish long-term relationships with partners. A better approach is the customer value proposition, which is the value of products and services as seen by the customer. Mark contrasted a consultative selling approach, which is needed here, versus transactional selling. It is a seduction rather than an assault!

A framework for a successful communication strategy was discussed (source Matt Hirschland from NCAR - workshop on socio-economic benefits in June 2012). The framework steps are:

1) Articulate key priorities and imperatives;

2) Define and understand key audiences;

3) Select and build distinctive messages (Story telling);

4) Deliver messages through the right channels at the right time;

5) Assess impact of the message;

6) Continuously refine the approach.

A Case Study about Earth observation applications was presented with focus on reaching new user communities, and finding out how to involve them. The marketing needs include promotion and capacity building. There is still a lack of awareness on what can be achieved by Earth Observation. What can be done about awareness raising? Initiating a dialogue with promising end-user communities; demonstrating successful applications; gaining more knowledge about “weakest link aspects” for each particular country or region; stimulating demand through a mix of workshops, success stories and quick-win projects. These should be supported by marketing toolkits and a web facility for capacity building.

From a communications standpoint, it is important to understand your audience, as there may be different audiences to reach (CEOs, advisors, politicians, etc). For example, a CEO has many competing priorities, such as external factors (PESTLE influences), organization's agenda, personal agenda. The timeframe should be considered as well. Most CEOs last less than three years in one position and long-term corporate projects often fail. CEOs are concerned with corporate social responsibility, and media image.

Policy Advisors are professional thinkers, employed by Governments, think tanks, lobbying organizations or economic analysts. You may want to go to them to instead of politicians. Their role is to think up new policy ideas. They are more likely than politicians to read proposals or research papers. They are

generally interested in numbers (statistics, financial results etc.). However, your new idea needs to fit with their frame of reference.

Politicians: what's in it for me? Politics is about power. Decision of a single person can affect millions of people. There is generally no theoretical underpinning for their decisions that are based primarily on judgment. They have little time to think and may be there to implement policy views of their political party. They react to media and opposition pressure. Politicians are human beings, but rarely scientists.

Here is an example of political engagement. The dialogue started: What is your problem? Why should I care (popular, reputation, power, how many lives improved)? What do you want me to do about it? I've got another meeting in 10 minutes.

Andrew stressed the power of storytelling. He gave several examples: the election-day map showing red and blue voters; the crime and deprivation riots in England, which were based on areas of deprivation though politicians were blaming undereducated rioters.

Timing is everything. Develop your presentations, including rehearsals. There will also be occasional event driven opportunities. Christ Church earthquake in NZ showed lack of data infrastructure. In all cases, repeat until achieved. Rome wasn't built in a day.

Session 2: Pointing to Benefits, Lawrence Friedl chair.

INSPIRE: Delivering Societal and Economic Benefits in Europe, Massimo Craglia, EC JRC.

INSPIRE is a long 11 year story, reading like a soap opera. The INSPIRE Directive is an EU directive requiring 27 nations to set up structure to be compatible for data sharing. Building the structure is a challenge -- different map projections, sea levels, 23 languages. Consensus was reached regarding the need to arrive at harmonized data with 34 themes re infrastructure for the environment. This decentralized approach is built on the infrastructures for spatial information established and operated by the Member States. INSPIREs ‘ aim is to provide access to spatial data via network services according to a harmonized data specification to achieve **i**nteroperability**.** There is a great variety of SDIs among the member states. For example, Germany has 16 SDI at the state level, and 1 at the federal level; by comparison, there are only three in Belgium. In most countries, an SDI just needs a catalogue, but in Europe you actually need harmonized data.

Environmental impact assessments have been required in Europe since 1985. An Impact Assessment was conducted from 2004 to 2007 for INSPIRE. The approach relied on expert knowledge and case studies, and was based on a set of assumptions, which were generous regarding cost, and conservative as far as benefits. The assessment addressed environmental, societal, and economic issues. The

estimated costs were approximately one billion Euros over 10 years, and the benefits were expected to be 7 to 10 times that.

We are now 8 years later. A workshop was conducted on cost/benefit analysis and ROI, looking at the best practices on assessing the impact of SDIs in Europe and North America. Investment cost estimation was possible, but hard to value, as it is a proportion of governments’ expenditures in the GI sector. In general, it was hard to estimate the benefits without understanding who the users were. Costs were incurred in the short term, while benefits accumulated in the long term, so political favor was not guaranteed.

A regional study was done to determine if estimates were correct. This regional study was for Catalonia in 2007, with a similar study around Milan in 2009. Max showed a table that summarized the investments; most costs were at the local level. Savings of 10 to 15% were experienced.

Most of the studies discussed so far were focused on the public sector. Max now turned toward a survey of Small and Medium Enterprises (SMEs) conducted by JRC. 150 European companies doing environmental assessments and strategic environmental assessments for land planning were included. An average study costs 30,000 to 50,000 Euros with 24,000 national studies done per year. The resulting cost is one billion Euros/year for the sector. If the 15% increase in cost associated with data access and quality problems were tackled, annual savings could be €150 to 200 million.

Studies show that assumptions made for INSPIRE were generally correct, with the note that it is unusual to have verification studies.

The role of geoinformation in participatory environmental management, Maria Andrejewska, UNEP Warsaw

Maria opened her presentation by mentioning that she is looking forward to getting help from the group on how to quantify public benefits. The UNEP/GRID Program has 7 or 8 centers around the globe. Maria is director of the Warsaw center. The primary mission of the centers is to support public units in sustainable environmental management, promote use of spatial information in decision-making, and raise ecological awareness through environmental education.

Wide access to spatial data and geoinformation technology brought about by INSPIRE significantly changed the methodologies used in the practice of environmental management. New opportunities generate new requirements such as data harmonization, and capacity building. Geoparticipatory environmental management is both an opportunity and a challenge. Environmental management supported by public participation is indisputably beneficial for the environment and for the authorities responsible for the management of protected areas.

At Natura 2000 sites, a certain level of economic activities is permitted. Management plans should engage a wide range of stakeholders. The case of the Dolina Rospuda Valley deals with a valuable area of natural peat bogs. It has been a Special Protection Area since 2004. An issue arose on how to plan a large highway bridge across the valley? The project began in 1992, and was stopped completely in 2007, as only consultations within the range specified by law, were conducted. The budget was exceeded, and the schedule not met. Starting at the end of 2007, a new approach made use of round tables with a place for different institutions. A new project is being developed, hopefully to be completed in 2020. What is the cost of lack of public participation at onset?

What could make this better? Maria stressed the need for active participation of stakeholders resulting in access to information about arguments of different stakeholders; understanding interests of different parties and rethinking of all available materials. GIS collaborative tools facilitate discussion and communication leading to decisions. Benefits include increased transparency, access to information, trust and social capital. Emotional factors are minimized and the community is inspired for future involvement. People feel that their voice matters.

Maria concluded by quoting Confucius: “Tell me, I forget. Show me, I remember. Involve me, I understand.” It's better to prevent than to cure.
Max Craglia commented that Natura 2000 covers 17% of European land mass, with its projects having great potential benefits.

A Cost-Benefit Analysis of Meteorological and Climatological Services, Hans Roozekrans, KNMI.

Meteorological and climatological information are important for governments, businesses and individuals. Based on international research, an initial estimate can be obtained of the possible value for the Dutch society. Climate and weather information in the Netherlands is provided by the national meteorological service, KNMI, and private companies (e.g. MeteoConsult). Hans introduced the results of study by a Dutch consultancy, Rebel. The Dutch meteorological (met for short) service, KNMI is 100% public institute and needs to show its public value. Privatization of KNMI has been a threat until recently.

The KNMI is the most important supplier, in cooperation with organizations in neighbouring countries, as it comes to basic (source) data, public weather forecasting and aviation weather services. The total production (turnover) of the KNMI in 2012 amounted to almost € 50 million. The size of the private met sector in the Netherlands is about € 20 million.

In national studies from Europe, Australia and the United States, the value of weather and climate information has been estimated. Studies show differences in methodology, considering sectors and accuracy. Nevertheless, the results show a uniform picture: the benefits of weather and climate information outweigh the costs by far. The benefit-cost ratios for weather and climate services are

exceptionally high.

Often analyzed sectors are transport, agriculture and construction industry. The public sector benefits as well from good weather services. Value is created primarily by avoiding harm to people and goods and by achieving efficiency gains. Furthermore, users and private households experience large gains in the daily use of weather information. Finally, savings can be achieved by adjusting to climate change better.

Based on of cost-benefit ratios from individual country studies and the total output (say € 70 million) a rough estimation of benefits of weather and climate information in the Netherlands is made: a bandwidth ranging from at least € 338 million to nearly € 3,000 million. The size of the benefits is largely determined by the considered value drivers.

EUMETSAT is the European organization for exploitation of weather satellites, comprised of 26 member states and is located in Darmstadt, Germany. The European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading, UK, provides forecasts for all of Europe. In 25 years this European Meteorological Infrastructure has resulted in an improvement of the 80% forecasting skill by two days ahead. Value drivers for meteorological services include casualties avoided/lives saved, property damage avoided, social and environmental benefits, and efficiency savings (especially in aviation). In a British survey 3000 UK people have been interviewed regarding the value of the UK Met Office outputs. The British results were used to translate to KNMI’s benefit figures. Results for Netherlands range from 1:5 cost/benefits up to 1:42.

Why benefits will increase in the future? -- accuracy of forecasts is likely to increase; relevance of warnings will increase as public and authorities make better use for decision making; more frequent high-impact weather events are expected due to climate change; as a result, hunger for weather information will increase.

Economic value of met data in the US appears to be much higher than in Europe. The gross receipts of commercial meteorology businesses in the US are much higher than in Europe. A probable reason is that US met data are free of charge while EU agencies and most national met services in Europe charge fees for data use by commercial services. This is a really big issue for the European Commission to change this. Therefore, KNMI has now changed to an open data policy and puts pressure on EUMETSAT and ECMWF to do the same. It was noted that the public TV in the Netherlands uses US model data, which is free, rather than the model data from ECMWF, which is not free.

Regarding the effect of the study on decision makers, having at least a 5 to 1 benefit/cost ratio was helpful. Safety must remain in public domain, especially regarding airline safety (the transportation radar covers all of Netherland). It was noted that the TV in the Netherlands uses US data, which is free, rather than Dutch data.

Realizing the Benefits of Geospatial Technologies Environmental Agency, Anil Kumar, Environment agency, Abu Dhabi

How can we put a value on protecting a species from extinction? The agency is the custodian of the environment of Abu Dubai. UAE has a very high environmental footprint. His agency is looking at ways to reduce this. They are doing research on falcon and habara (which are migrating species), putting together material to facilitate better informed decision-making. They have started tracking these species, then added flamingos and ospreys, and then dugongs, which are like manatees.

Regarding protected areas management, GIS is an integral part of the decision support system. Another example focused on analysis for decision support: which forest areas are providing value, relative to possible removal of some forest areas? The organization has been using remote sensing since 1972. It is currently used for mapping soil information. Currently, satellite images are used every 2 years. An environmental portal with 150 layers of data is available to the public. (See www.uaesis.ae). Another area of work is marine water quality, where both public health and ecological monitoring are being addressed. In his conclusion, Anil Kumar noted the tension between development and environmental protection.

A question regarding eye-on-earth was raised from the audience. The next eye-on-earth conference will be in 2014, and include 7 initiatives.

Session 3: Business Cases, chaired by Jay Pearlman

Benefits of NASA Earth Science and Earth-Observing Satellites, Lawrence Friedl, NASA.

Internationally, multiple organizations are placing greater emphasis on the societal benefits that governments, businesses, and NGOs can derive from applications of Earth-observing satellite observations, research, and models. A growing set of qualitative, anecdotal examples on the uses of Earth observations across a range of sectors can be complemented by the quantitative substantiation of the socioeconomic benefits. In turn, the expanding breadth of environmental data available and the awareness of their beneficial applications to inform decisions can support new products and services by companies, agencies, and civil society. There are, however, significant efforts needed to bridge the Earth sciences and social and economic sciences fields to build capacity, develop case studies, and refine analytic techniques in quantifying socioeconomic benefits from the use of Earth observations.

NASA currently has 17 Earth-observing environmental satellites examining the Earth system, providing data on precipitation, soil moisture, ocean salinity, air quality, and hundreds of other parameters. 14 of those satellites are past their 3-5 year design life.

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NASA's Applied Sciences Program specifically pursues innovative uses and practical benefits of NASA's Earth-observing satellites and new research knowledge. Applied Sciences pursues partnerships with public- and private sector organizations to test and apply satellite data in their decision-making activities. In recent years, the Program has initiated activities to quantify socioeconomic benefits from uses of Earth observations. The Program has developed impact analysis reports, sponsored workshops, developed a primer, and pursued other activities to advance analytic methodologies and build capacity.

This talk focuses on efforts to substantiate socioeconomic benefits associated with the use of NASA's Earth-observing satellite observations in policy and management decisions. Lawrence presented case studies on socioeconomic impact analyses of applications in several areas. He gave the example of the US drought monitor. NASA has GRACE satellites looking at gravity anomalies on the earth and has funded a project to look at how to integrate data from GRACE with the drought monitor. Another example is related to determining global crop conditions from satellite and identifying crop anomalies.

The ultimate question is how to assess the socioeconomic benefits of earth observation? One approach is to measure outcomes with and without access to earth information. What is your theory of change, and your value proposition? Sometimes it is useful to monetize impacts, other times not, depending on audience and the issue being addressed. There are, for example, difference when determining prospective analysis versus retrospective analysis. Lawrence described an example that addresses volcanic ash advisories. Ash can cause damage to aircraft parts, resulting in issues with passenger safety. Thus airlines will reroute and delay flights in order to avoid ash. Aura/OMI data enables reliable detection of volcanic ash clouds using sulfur dioxide data. The eruption in April 2010 in Iceland provides a good illustration. Retrospective Impact Analysis shows that additional information could have avoided revenue losses. Aura data reduced uncertainty about level of ash threat. Counterfactual cases should also be examined -- what would have happened if earth observations were not available? Either flight routes would be reopened more slowly or flights would be continued at risk. The impact metrics include avoided revenue losses and avoided aircraft damages. The probability of an incident using data for 1996-2010 historical frequencies of aircraft damage from volcanic ash, showed that the probability of aircraft experiencing damage is reduced by 12% using Earth Observation. A revenue loss of $450 Million (M) was reported by April 18. This was used as a maximum in the analysis. Regarding avoided damages, Boeing metrics for repairing engine with foreign object damage amounted to a maximum of $1.6M for repair or $10M for replacement. A second source ranged from $3-8 M for replacement. The study used average values. The scenario of opening more rapidly (high risk) resulted in $1M damages and $24M revenue loss. The scenario of reopening more slowly (low risk) resulted in no damages, a revenue loss of $48M on April 19 , and $24M on April 20, with additional $138M damages from the start of eruption. Statistically over a number of years results show $10M avoided costs. In establishing a baseline case, one may have to make assumptions regarding what would have happened without the EO data.

Lawrence cited a number of relevant publications including the following reports: Restructuring Federal Climate Research; USGCRP Strategic Plan; Planet Under Pressure: State of the Planet Declaration. There is a need for terminology transfer in interdisciplinary work. For this purpose, Socioeconomic Impacts: A Primer was released in 2013 (a number of copies were available to sessions attendees).

Looking at the future, new satellites in 2014 include (US) SMAP: Soil Moisture Satellite; (EU) GPM: Global Precipitation. NASA is setting up an early adopters program for getting early access to data and providing feedback. Current US appetite for macro studies is not all that high so NASA favors micro approach.

Create space: Create Value -- Using geographical information to plan and design urban environments
Tim Stonor, Space Syntax Limited.

Tim Stonor’s clients want to: keep people safe, maximize rental income/property value, create jobs, or get reelected. But very few try to put economics into the picture.

Architects are terrible scientists. Architecture is not a strong evidence based practice. Financial backers aren't in it for the long term. UK has a legacy of failed housing, failed new towns. Ability to forecast has been largely inaccurate. Stories from China report unoccupied new cities. This means politicians are hesitant to make decisions about development. There's the problem.

Tim's only weakness is fatal optimism. Most cities today look like traffic jams. That can't be the goal of advanced civilization. It’s all going to get worse unless we do something about it. Especially regarding population growth. At the same time cities are wonderful crucibles of culture where science happens. We've always made cities, benefitting from their intensifications.

Urban designers are building a transaction machine in which people come together to trade. Cities are a natural asset, capitalizing on our natural inclination to come together and interact. Cities are patterns of streets, street networks. Grid is something to do with how our brains work, aids memory.

Urban challenge #1: Fast highways replacing “main street”. Main streets allow for mixing of global and local movements, resulting in movement economy. Resulting good urban design can bring value. Fast highways lead to separation of global and local movements, suppressing movement economy.

Urban challenge #2: The rise of fragmenting urban design. Filling neighborhoods with parks, which erodes tight connectivity. How do people interact?

Urban challenge #3: We're turning inwards.

What we need are metrics, measuring urban performances, and making the invisible visible. If you show people colors rather than spreadsheets and they will respond better. Spatial network analysis, looking at spatial accessibility can forecast pedestrian and traffic patterns. It is a revolutionary method -- really simple and light versus complex traffic models. One can predict where land uses will be; for example in London, 80% of the retail businesses are located on 20% of the most spatially accessible streets. Accessibility can influence crime and safety (the example was Perth, Australia)-- criminals know where to go, quiet streets with very little movement. It is possible to predict likelihood of crime on a street and to monetize the value of a design.

All cities have a play between radial (bring in people) and orbital (help move around) configurations with boulevard as connector. Use the technology to plan the city. See in advance what ideas will achieve.

Tim gave the example of monetizing two alternative designs, one integrated and one disconnected. Thee net present value of the integrated alternative was 335 Million British Pounds greater than the disconnected one. Tim gave the examples of connecting the London Olympic Park to the City. He recommended transforming decisions through evidence based processes: observe, explain, forecast, and deliver. Making bold decisions is how cities have always grown; now it’s possible with reduced risk.

A Least Cost Path Toolbox for Optimal Routing of Power Lines - Frank Hanssen, NINA

Optimal routing of power lines is important to avoid environmental and societal impacts, and must be considered in relation to the modern societal needs for a stable and secure power infrastructure. What is optimal routing of power lines? The shortest route? The most bird friendly route? A corridor to accumulate impacts? The most maintenance friendly route? Identifying the “optimal route” or an “acceptable” routing-corridor for a new power line is highly challenging. The great complexity of formal and informal stakeholder interests at different geographical levels must be identified, organized and handled through standardized impact assessments. Also legal, technological and economic criteria have to be analyzed prior to the final routing decision. All stakeholder interests are unified into least cost path, with the ultimate goal a safe and secure power supply. To aid decision makers and developers, the Norwegian Institute for Nature Research (NINA) is now developing a GIS-based Least-Cost-Path (LCP) toolbox for environmentally-friendly routing of power lines based on ecological, social, economic and technological criteria. NINA started this work in January 2011 and will finalize it in December 2013. An important part of our project is to achieve consensus among relevant stakeholders through dialogue. The stakeholders were guided through an intensive dialogue process (spring 2012) in order to establish a high degree of consensus on themes deemed relevant for power line routing and their map-based criteria, values and weights to be used in the LCP-toolbox. A pilot version of the LCP- toolbox was validated through a local case study from 2001/2002 and was presented for the stakeholders during the dialogue process in order to demonstrate the capabilities of LCP. The final LCP-toolbox (to be launched in December 2013) will be an efficient and supportive tool in handling the multi-criteria complexity of impact assessments and planning of power line routing. Frank used the Hardanger case, biggest national conflict regarding power line routing and potential for ruining the landscape, to illustrate the approach. Visual disturbance by power lines on ridges is a very big deal in Norway. A conflict map is created with red showing high problem, and green no problem. Often things are not completely acceptable or unacceptable. A measure of disagreement is used to create a consensus map. The result is the optimal corridor.

They plan is to use the Least-Cost-Path (LCP) toolbox for optimal routing of power lines for an upcoming 1200-1300 km of new power lines, affecting 100 communities, thus with high potential for conflict. Current practices will be highly challenged. Challenges will include human landscape perception, and domestic reindeer herding. Land use dynamics are difficult to model.

Summary Proceedings for Geospatial World Forum user forum sessions on "Societal impact of improved environment and geospatial information", Rotterdam, The Netherlands, May 15, 2013

Panel Discussion: Massimo Craglia, JRC; Lawrence Friedl, NASA; Tim Stonor, Space Syntax Limited; Andy Coote, ConsultingWhere; and Hugo DegGoof, EC. The panel was moderated by Jay Pearlman, IEEE.

The discussion took place between the panel and the audience. The first point of discussion was citizen participation in planning and decisions.

Max - We haven't addressed citizen participation in today's presentations. This would make for a form of bottom-up feedback and participation. Also, this would provide a way of using tag sites for people who won't attend public meetings.

Lawrence (question to the audience) - Are you finding public participation emerging as a dominant issue or are you more looking for tools to quantify benefits?

Fraser Taylor - You bring up a dangerous issue with significant implications. In northern Canada we have given full power to the community. To give people voice, you must start by changing your attitude and increase your flexibility.

Andy: Using an open Twitter feed changes the demographic to ages 10 to 30 versus gray hair.

Lawrence - Is geospatial technology an end or a mean? Aren't we trying to improve public health and the like?

Jay - Monetizing may be only part of the issue.

Susan Ancel (Epcor) asked a question about water quality related to Tim's presentation.

Tim - Cities must be part of the solution to human behavior. We need better modeling so as to generate human change (drive less, cycle more, use public transport).

Rich - Consider the difference between individual preferences and social preferences. How best to reconcile these two?

Someone in the audience asked a question concerning carbon emissions.

Hugo - Create tools that have a financial incentive regarding carbon footprint activity.

Andy – The incentive could come from gaming. Waze awards community points for contributing information, resulting in behavioral change.

Hugo - Risk communication is not just about making people afraid. Trading in green points would be more interesting.

Max - Always we come back to NIMBY (Not In My Back Yard). To resolve individual differences in democracies, politicians must resolve conflicts. Your study can show great ROI but never get funded because its conclusions are politically unacceptable.

Jay - Human factors are important. How do we bring in social scientists?

Tim - Geospatial information is typically highly visual. Don’t underestimate this quality. His company originated from providing support to fight development in a neighborhood. Don’t just bring in professionals; also bring in slum dwellers.

Fraser Taylor - This would contribute to bringing in multiple disciplines..

The Moderator, Dr. Pearlman, summarized the discussion and presentations earlier in the session. There is movement toward quantifying impacts and benefits of geospatial information, whether from satellites or ground data collection. Some items are more easily quantifiable - for example, those that are in the commercial environment and impact sales or productivity. A good example was provided by L. Friedl of the cost impacts of volcanic eruptions on airline operations. Other areas in the social impact/economic sphere – power line routings, water contamination or preserving nature areas are harder to quantify. A study by R Bernknopf of well water contamination using Landsat clearly illustrated the impact of land use assessments on water quality in wells. T Stonor addressed the impacts in the urban environment illustrating the economic impacts of planning for better community interactions. Understanding means

to quantify social decisions in the government/social domain need further discussion on how to assess impacts.

There was a common theme of community participation in some of the presentations. In this case, community can be broad or narrow depending on the issue at hand. Projects that ignore community tend to have a higher risk for cost overruns or even completion. The means for community engagement were considered and further discussions – including approaches for effective communication with the broader array of citizen and decision makers – will be addressed in Florence workshop June 23-24 29013, as a pre-event to the INSPIRE conference.