

Canada's approach to integrating socio-economic and environmental statistics with geospatial information

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Abstract: Statistics Canada produces a wealth of socio-economic and environmental statistics that are made available to Canadians. Traditionally, such statistics consisted mainly in tables. In Canada, statistical data were combined with national mapping and surveying activity conducted in Natural Resources Canada (and its forerunner departments) to produce national atlases which help guide the exploration and subsequent economic, social and political development of Canada. The integration of mapping and statistics are some early examples of integrated geospatial analysis – which is undergoing a rediscovery, driven in large part by new technological advances and an insatiable quest for evidence to address some of the world's most intractable challenges. This presentation outlines how two of Canada's leading data institutions – Statistics Canada and Natural Resources Canada – are addressing new opportunities.

1 Introduction

In an increasingly interconnected world, where opinions and ideas encircle the planet at a mere click of a button, the quality and relevance of data and statistics are constantly challenged. Some argue that in an environment of rampant opinion and suspect data there is an ever greater need for official facts or statistics. Others argue, contrarily, that large governmental institutions provide facts and evidence to sustain a narrative which necessitates the need (and the rise) for new sources of information and data that challenge governmental orthodoxy.

Regardless of perspective, there is a growing use of new data sources and a recognition that new ways of presenting evidence and facts may provide an opportunity to establish common ground: to help provide context and visual representation of what is occurring at any given place on the planet. It used to be that such visual representations often took the form of paper maps combined with official statistical data. These processes were very time consuming as in both cases – surveying and mapping the land, and surveying and tabulating results in a national census often required boots on the ground – taking years to complete. Today however new technologies have reduced the time taken to make maps from years to hours, and new forms of satellite data are enabling the capture and generation of information in days as opposed to years.

In the United Nations, among member states, and across trans-national organizations there is a growing embrace of combining statistical and geospatial data. In 2013, following 4 years of work, the United Nations Statistical Commission pushed for developing a statistical spatial framework in national statistical systems (UNSC, 2013).

Activities in the field of geospatial information have a long history - they were a natural evolution for the geographic sciences - but it was only recently that these have been paralleled by related efforts in an organized international and multilateral setting, leading to the high-level forum on Global Geospatial Management Information (UN-GGIM) in 2011 and continuing thereafter.

In parallel, the emergence of the fields related to big data and the Internet of Things quickly created linkages and opportunities for geospatial information and technologies, as was discussed at the United Nations Statistical Commission (UNSC, 2014) and with regards to Australia (Tam and Clarke, 2015).

Recently the United Nations Economic Commission for Europe called for an in –depth review of developing geospatial information services based on official statistics, as presented in 2016 at the meeting of the Bureau of the Conference of European Statisticians (UNECE-CES, 2016). It discussed new frameworks that allow geospatial information to be integrated with statistical information, stressing the pressing need to link information to its geolocation. It also emphasized that as part of their modernization efforts, National Statistical Offices ought to consider geospatial information, techniques and technologies.

In Canada, Statistics Canada regularly uses and studies remote sensing data (Earth imagery) for quality assessment purposes, but in 2016 they were also used to modernize and replace the crop yield survey (Bédard and Reichert, 2013). The Canadian Centre For Mapping and Earth Observation at the department of Natural Resources has developed solid expertise in Earth observation and satellite imagery and has been an active international player since the inception of the UN-GGIM (Prashant, 2011). The work to expand and integrate our geospatial and statistical activities continues, and this paper provides a quick overview of recent developments.

2 Statistics Canada

Statistics Canada produces data that help Canadians better understand their country—its population, resources, economy, society and culture. Its mission is to serve Canada with high-quality statistical information that matters. The agency promotes the quality and coherence of Canada's statistics through collaboration with international organizations, federal departments and agencies, and the provinces and territories. As a member of the United Nations Statistical Commission, the agency endorses the fundamental principles of official statistics which help define what constitutes a good system of official statistics and what role that system should play in national governments (Statistics Canada, 2017).

Statistics Canada has three main programs, one for economic and environmental statistics, one for social statistics and one for the census. These are complemented by a statistical infrastructure program that includes geographic and geospatial activities and related support to the other programs.

The Statistical Registers and Geography Division is the area that maintains and develops statistical frames and conducts geographical activities. Through registers, its main role has been to support census and survey programs, geographical delineation, collection, processing and dissemination activities.

Geography and geospatial activities are not exclusive to that unit. They are an encouraged and taking place in many programs. For example remote sensing has been used in the Agriculture Crop yield survey program. Conceptualized in the Canada Centre for Remote Sensing and further refined and developed by Agriculture Canada and Statistics Canada, Canadians now benefit from an approach that uses satellite data to remotely develop and forecast agricultural yields. This approach holds tremendous promise and efforts are currently underway to identify processes to account for national infrastructure; develop approaches to measuring the value of environmental goods, and most importantly in the international context – develop a means to monitor progress towards global sustainable development goals.

Statistics Canada is increasing its international participation in the field of geospatial information by getting involved in the works of the various international and regional GGIM and by chairing the Task Team on Satellite Imagery and Geo-spatial statistics that is under the Global working group on big data.

Statistics Canada has now embraced a modernization agenda that will strengthen its alignment to users and to enhance their experience; to use more modern tools and approaches; to be a stronger enabler in data uses; and to transform its partnership model with its collaborators and stakeholders. The increase use of Geo-spatial information is a natural component of this modernization effort.

3 Natural Resources Canada

Natural Resources Canada (NRCan) seeks to enhance the responsible development and use of Canada's natural resources and the competitiveness of Canada's natural resources products. It is an established leader in science and technology in the fields of energy, forests, and minerals and metals and uses its expertise in earth sciences to build and maintain an up-to-date knowledge base of the Canadian land mass.

Its vision is to improve the quality of life of Canadians by creating a sustainable resource advantage. To achieve this, NRCan develops policies and programs and runs innovative science facilities across Canada to generate ideas and transfer technologies.

Part of this mission is rooted in its organizational antecedents. At the time of Canada's founding – the Department of Lands and Interior was responsible to survey and map Canada's sovereign territory and a foundation of economic development. Over time traditional survey approaches expanded to sensors mounted on aerial or space based platforms and today include sensors embedded on the surface of the planet. All of these data sources and technologies provide new ways of analysing the earth.

The deployment of these technologies and data feeds across many departments is coordinated through the Federal Committee on Geomatics and Earth Observations (FCGEO), which is responsible for:

- i) providing proactive, whole-of-government leadership in establishing priorities for geomatics and their application in support of government priorities, decision-making, and Canada's competitive advantage; and
- ii) collectively enhancing the responsiveness, efficiency and sustainability of the federal geomatics and Earth observation infrastructure.

In 2014, the FCGEO launched the Federal Geospatial Platform (FGP) and its public face, Open Maps; these tools now provide a catalogue of available federal geospatial data, services, and applications integrated with an intuitive data viewer. This has helped federal public servants and Canadians to better access the government's most relevant information and to leverage it for analysis, enhancing decision-making on government priorities, fostering innovation and ensuring better service for Canadians.

Internationally, NRCAN has been a regular contributor to the efforts of the United Nations Group of Experts on Geographical Names (UNGEGN) and the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM).

4 Joining forces: The StatCan – NRCAN Partnership

Statistics Canada's expertise in gathering and providing vast store of data that matters intuitively couples with NRCAN's expertise in geospatial data technologies and applications. Undertaking this work will build on years of collaboration in other areas.

Under the Open Government Implementation Plan (OGIP), which ensures that the Government of Canada implements digital data transparency (Government of Canada, 2015), the Treasury Board of Canada Secretariat engaged Statistics Canada to build and maintain a new version of Canada's Open Data Portal. NRCAN provided the Open Maps facet of the Portal, and the two agencies are well positioned to explore and exploit new data integration possibilities together.

The geospatial partnership has already started. In March 2017, statistical information on human activity and the environment was published on the Federal Geospatial Platform, thereby opening a new area of dissemination partnership between StatCan and NRCAN.

The plans are to explore new domains where statistical data could be loaded onto the FGP to enhance the analytical possibilities and availability of various layers of information.

In order to provide a concrete framework for this work, StatCan and NRCan have entered into a bilateral agreement that specifically makes Statistics Canada a partner in the FGP. This agreement includes provisions to collaborate on the development of the national road network file, and to see if the application of geomatics tools and technologies can assist the work on the Sustainable Development Goals (SDG) indicators. The agreement also describes further exploration of statistical data integration in the areas of agriculture and population.

The two departments are also exploring new ideas related to the use of Earth observation imagery and satellite-based detection: in the area of green energy, accurately detecting solar panels from space can now lead to better information on the Canadian energy profile; in transportation, satellite and/or sensor information can now be used to better track key infrastructure such as bridges, to better estimate their individual rate of depreciation, structural changes and need for repair.

Collaboration could also support key goals for the North and the circumpolar area, which include linking statistical information to geomatics, and help to add value to the building of map products and the country's Atlas.

5 Challenges / Opportunities

Joint work between Statistics Canada and Natural Resources Canada still present a number of challenges. They are not necessarily barriers to going forward, but rather new or expanded views of approaches, methods and directives that have not yet been generalized enough for the foreseen data integration. Below is a non-exhaustive list.

Sharing of data: How to share and make data available between the two department and with other user needs a complete re-thinking of currently established processes. Each of information management perspectives, IT approaches to solutions as well as legal instruments and their interpretation must be considered.

Breadth of collaboration: So far, most of the collaboration has concentrated on new dissemination approaches and avenues. However, integration of statistical and geospatial information can also take place at the data acquisition level, at the processing level and at the analysis level. These will open up multiple possibilities.

Knowledge sharing: Those involved in production of statistical information will immensely benefit from an increase understanding of the complete geospatial process. That is not simply acquisition of satellite data ready for combination with statistical information, but also the mechanism for information acquisition by satellites, the architecture, format and shape of satellite information, the interpretation of images, temperature and other data, the transformation and classification of these information and the algorithms necessary to code and interpret them. Conversely, experts in geospatial

information shall benefit from increased knowledge of survey data collection, processing, editing, estimation, classification, analysis and confidentiality procedure. When this knowledge is shared in both directions, new capacities will very likely lead to innovative ideas.

Survey paradigm: Statistical office have (and are almost still exclusively) functioned under the paradigm of gathering information towards a pre-determined objective by means of surveys. From that standpoint, geospatial information comes as a new source of auxiliary information that can be used in a variety of ways. However, this paradigm is being (positively and constructively) challenged by the richness of the sources of available data. Integrating data no longer narrowly means augmenting the survey, but rather finding new practical and theoretical frames to combine survey with admin with satellite information and with many other types of data. How this should be accomplished has yet to be fully formulated. And so, standards such as the General Statistical Business Process Model (GSBPM) are general enough to find a niche for geospatial information, but at the same time may not be completely open to all emerging possibilities. For example, how to further integrate with various types of GPS data, with crowdsourcing activities and with web scraping remains to be fully developed. The resulting framework will likely include new quality measures and ways to ground truth processes.

Confidentiality: More integration combined with increased openness will result in new needs of disclosure protection approaches. On the one hand, traditional confidentiality protection methods will have to be expanded to situations for which they had not initially been conceived, but on the other hand how privacy rules are formulated and interpreted will have to be renovated. The challenge is great because at the same time society want more information and privacy. It is all about compromises that must be gaged against specific societal contexts.

HR impact: As statistical and geospatial data integration increase, the nature of the work of those involve will change and the skill set needed will evolve. Going farther and faster into the digital world this has obviously significant human impacts on producers and users. For producers, this will change hiring requirements as well as training and re-training of staff in place. And so either the enterprise culture will change on its own, or will be guided to change.

6 Conclusion

Statistics Canada and Natural Resources Canada both share a rich history of information provision to Canadians. While they have worked together on some projects, the still new developing field of integration of statistical information and geospatial information offers a wide array of opportunities.

The two department see themselves as a team of experts looking forward to be at the forefront in this journey to enrich the information that is made available to Canadians.

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