Big Spatial Data and Climate Risk Management

Canadians can rightly take pride as the birthplace of Geospatial Analytics. Roger Tomlinson (1933-2014)
a British emigre to Canada, is generally regarded as the "Father of Geographic Information Systems". Tomlinson invented GIS in the 1960s while working at the Federal Department of Forestry and Rural Development in Ottawa. Dr. Tomlinson connected what now seem like obvious dots; Canada has a massive landmass and the only practical way to store information on all of it was to harness the power of the newly-invented electronic computer. Old-timers will remember clunky old-school tape drives and punch cards – all of that to digitize and store mapped data – outrageous. Cumbersome and tedious but it worked and Canada had the word's first functional GIS, to address, "its immense problem in both understanding and guiding the development of its land, water, and human resources" . Tomlinson was duly recognized as an Officer of the Order of Canada for changing the face of geography as a discipline.

At a community level GIS faltered however, and well into the 21st century GIS was regarded as a nice idea, but not practical because either the data was too hard to collect and enter or, once entered too complicated to manage. Fortunately, that perspective is waning as GIS is proving its value as the foundation for modern municipal asset management. Many communities now rely on GIS for routine management of municipal assets such as water distribution, sanitary collection, roads, sidewalks, forests, and buildings. The benefits of systematic, spatial organization of data are too great to ignore as we live in a world defined by the x, y and z coordinates of everything and "big" spatial data is now everywhere.

The next frontier in municipal asset management is harnessing the power of big data and high performance computing for climate risk management and investment attraction; LiDAR and its applications are a great example. LiDAR originated about the same time as GIS but in a much different context – as a technology for military targeting with key advances made by Canadian Allan Carswell at York University. The word LiDAR is a portmanteau of "light" and "radar" and conveys the essence of how it

works: an object's location is determined by shooting a laser beam and calculating the object's distance from the time delay before the reflected signal is detected. The physics and signal processing power that make this technology work are truly impressive and continually improving. Once military-spec only, very high accuracy elevation mapping using LiDAR is now accessible to almost every municipality in Canada. Buying LiDAR in bulk from aerial survey companies by flying larger areas drives costs down. Recognizing the value of LiDAR for municipal flood risk management, the Province of Manitoba invested heavily in acquiring LiDAR.

Most municipalities in Manitoba now have access to LiDAR ranging from 5m to 1m resolution. Sub-meter, even centimetre resolution LiDAR can be acquired from lower flying drones. Having access to the data and its effective use are two different things, however, and even GIS-savvy municipalities can have difficulty processing these terabyte to petabyte-sized datasets. Natural Resources Canada has published flood mapping guidelines encouraging LiDAR acquisition to accurately estimate flood depths and asset risk at municipal scale. The data management and computing power required for actually doing the analysis however challenges municipalities, engineering firms and government departments while the insurance industry grows impatient. In March 2020, Reuters quoted, Craig Stewart, vice president of federal affairs for the Insurance Bureau of Canada: "Flooding is by far the single greatest peril facing Canadians as a result of climate change…. we can't take a decade to complete flood maps for this country". Stewart believes that comprehensive national flood mapping could be done within three years if the government collaborates with the private sector. We agree and believe the answer to the challenge of accurate, large-scale flood risk mapping lies in harnessing near infinite and very low cost modern cloud computing.

The importance of getting this right and quickly should not be under-estimated as investors have taken note. In July 2020, the Globe and Mail ran an article describing the new field of "spatial finance" – the use of earth observation data; LiDAR, satellite imagery, and climate modelling data to pinpoint assets and regions at climate risk (particularly flood risk) for investment and dis-investment planning. A big part of municipal government has always been concerned with investment attraction to ensure that the local tax base matches expenditures. The new game in town is proving to

would-be investors that your municipality understands its climate risk, has modelled it accurately, and is making efficient infrastructure investments to ensure that existing and new assets are effectively de-risked.

Climate risk is undeniably growing but so is our analytic and engineering capability. SCC is committed to bringing the data and the required compute power together, empowering municipalities in Western Canada with the analysis and the options needed for effective climate risk management that builds on a uniquely Canadian pedigree of geospatial innovation.