Nagaraja Rao Harshadeep (Harsh), The World Bank Group

Spatial Agent: Reimagining Data & Analytics in an Increasingly Online World

Despite major gains in recent decades, there are pressing development challenges around the world that often seem to only get more intractable and complex with time. This is especially so when addressing extreme poverty. Most of these challenges would benefit from the use of emerging technologies that can "disrupt" traditional incremental ways of addressing them. Of particular interest is the rapidly changing world of geospatial data and related analytics. Focusing on a spatial context – be it a watershed/basin, aquifer, province, city or even a community – can help integrate traditional "siloed" perspectives of sustainable development, helping everyone quickly see and explore interconnections between issues of natural resources, transport, markets, and a range of other environmental, economic, and social factors.

To do this effectively, there is a need to visualize a range of multi-sectoral data and analyze the geospatial data with modeling tools. Traditionally, this has been done with the use of desktop or workstation tools to download appropriate data, and with the help of specialized (often expensive) GIS and modeling software installed on these machines, analyze and visualize the results. This often results in fragmented geospatial data and insights that are rarely shared, and inefficiencies related to time wasted in unnecessary analyses that have already been done. The biggest challenge is that few people have the ability to even visualize, let alone analyze, the data interactively. Furthermore, "users" must make use of highly trained analysts and their special hardware, software, and skills to both visualize and present the results, even when only minor adjustments are made. This accentuates the digital divide. Those from more developed countries have disproportionately more access to free, publicly-available data and tools than their less fortunate counterparts in the developing world.

As we look ahead at a more interconnected world with new technologies, we are rapidly approaching a situation where most of the data that we need can reside in cloud repositories, and most of the analytics and visualization can be provided by cloud services for access in various virtual and physical platforms, figure 1. Since the heavy lifting is done by cloud services rather than on a device, the "user" base could be tremendously expanded, with access even from simpler devices like ubiquitous smartphones, tablets, and low-end computers. The use of standardized Open Geospatial Consortium (OGC) standards, open APIs, and a range of both commercial and open-source software that can be freely accessed through browser or native App platforms has increased the potential for such tools to be widely used. In addition, many organizations are embracing open data initiatives in order to make their data free, more easily discoverable and consum-

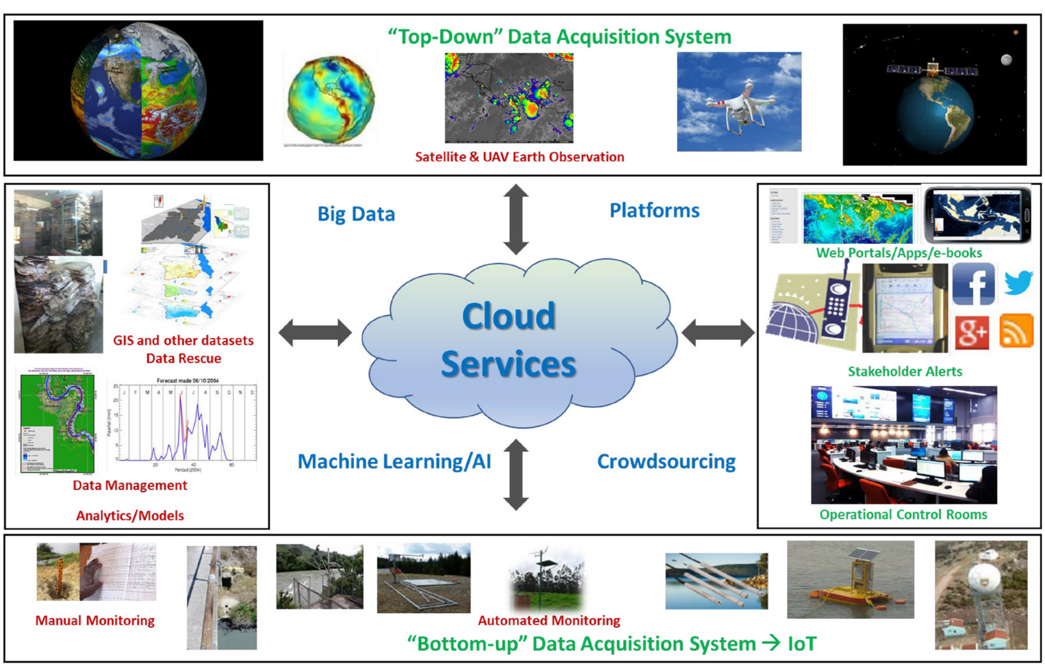

Figure 1. A Vision of Integrated Data and Analytics.

Photogrammetric Engineering & Remote Sensing
Vol. 85, No. 10, October 2019,
pp. 707–711.
0099-1112/19/707–711

doi: 10.14358/PERS.85.10.707

able online. This availability ranges from data collected from in-situ measurements (e.g. climate data from the UN WMO) to remote-sensing products (e.g. from NASA and ESA) as well as model outputs (e.g. from academia, IPCC). An exciting new development is the ability to do more and more powerful analysis online – ranging from drawing a watershed at any given point, the use of powerful cloud computing platforms to do complex scenario modeling, or creating user interfaces to run these analytics online with customized parameters and visualize the results shared through appropriate data services and APIs. Many of these geospatial data are free or can be made free (e.g. with an organization absorbing the costs of development/customization, subscription, or training) to expand their use. Much of the emerging technology talent around the world can be engaged (e.g. through online learning, internships, hackathons, entrepreneurship, and employment) and tapped to contribute to developing and using such online data and analytic services to make Apps, Portals, interactive e-books, and decision support systems for the benefit of the poor and disadvantaged.

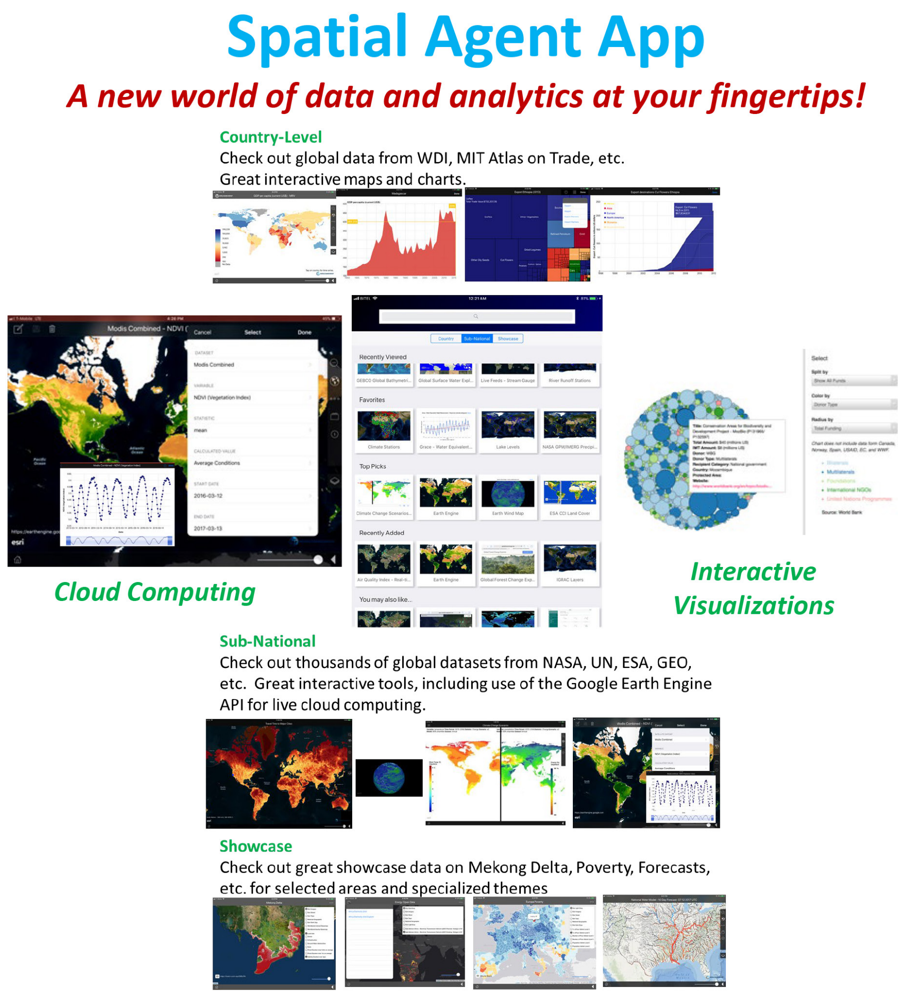

Figure 2. The World Bank Spatial Agent App.

It is useful to imagine the possibilities. Someone in a poor slum can access a world of information and analytics to determine if the flood forecast next week means they must head to higher ground with their family. A water agency in Ethiopia or Cambodia can have access to water accounting tools to better manage their basins. Any small irrigation system or check dam operator can access relevant data (e.g. soil moisture, plant growth, storage levels, etc.) based on a combination of in-situ, earth observation, and AI-leveraged cloud analytics in order to better inform their decisions and go up the data value chain of data→information→knowledgedecision support.

A new generation of platforms is emerging that can help showcase this exciting new world of free online data and analytics at one's fingertips. At the World Bank, we are helping to develop a range of these tools – e.g. the Spatial Agent app, figure 2 (currently available in iOS and being updated on Android – more information can be found at https://olc.worldbank.org/content/spatial-agent-tutorial). Also, a range of related web-based sub-portals that are all being constantly upgraded are available at (e.g. see http://spatialagent.org/HydroInformatics/. Spatial Agent provides interactive visualizations on country-level data (e.g. GDP per capita or key imports and exports) and sub-national data (e.g. historical climate trends at any station, population distribution from many different sources, natural disasters, urban population growth projections, etc.). This is done with a combination of clickable and interactive maps and graphs, animations, swipe comparisons, showcasing external websites, and other visualizations (including the use of powerful frameworks like D3). Use of the Google Earth Engine API illustrates the power of free, powerful cloud computing tools to undertake complex analysis (e.g. to spatially and temporally analyze NDVI, rainfall, deforestation, etc.) while consuming free data. You can learn more about the data through appropriate metadata and export the visualizations to yourself on email or share on social media.

Spatial Agent is illustrative of how we can help access, analyze, and visualize data from several different online sources on the same platform. As we start getting deluged with an exponential growth in free and subscription data and analytical services, it is important that there is a way to know what is already available and curate the geospatial data for easier access. As more local, national, regional, and global institutions

continued on page 711

nese Geodetic Datum 2000 (JGD2000). The National Imagery and Mapping Agency (NIMA) reports in Technical Report 8350.2 (January, 2000) that the transformation (for Japan) from Tokyo 1918 to WGS84 is $\Delta a = 739.845$, $\Delta f \times 10^4 = 0.10037483$, $\Delta X = -148\text{m} \pm 8\text{m}$, $\Delta Y = -507\text{m} \pm 5\text{m}$, and $\Delta Z = -685\text{m} \pm 8\text{m}$.

Update

Japan now has a GPS network established with a density of about 20 km used primarily for an earthquake warning system. The new published transformation parameters from Tokyo97 Datum to ITRF94 are: $\Delta X = +147.414$ m, $\Delta Y = -507.337$ m, $\Delta Z = -680.507$ m. Thanks to Prof. Kazuo Kobayashi, "the lowest point in Japan is the middle of the Seikan Tunnel at –256.5674m. The history of Japanese Datum leveling above Mean Sea Level at Tokyo Bay at "1-chome Nagatacho, Chiyokaku, Tokyo in 1894 = 24.5000m, in 1923 = 24.4140m and in 2011 = 24.3900m."

The Geospatial Information Authority of Japan (GSI) has published extensive information on their data in English: https://www.gsi.go.jp/ENGLISH/page_e30030.html

- There is a detailed preface: https://www.gsi.go.jp/common/000001194.pdf,
- Concept of the New Japanese Geodetic System: https://www.gsi.go.jp/common/000001195.pdf,
- The new Height System of Japan: https://www.gsi.go.jp/common/000001197.pdf,
- And Development of a new Geoid: https://www.gsi.go.jp/common/000001198.pdf.

SECTORINSIGHT:.com

continued from page 708

share their data as analysis-ready data services, and as more online analytical tools are developed and made accessible for free, and more disruptive machine learning and other Artificial Intelligence (AI) approaches are leveraged, the future could be very different from the past. Simply stated, it will be much more inclusive – both in terms of the diversity of data sources and analysis techniques, and in terms of broadening the user base, including a range of non-technical users, although it will still require a great deal of technical expertise to produce the information and visualizations. These services can be made more global, providing economies of scale in development, facilitating partnerships, and expanding the user base beyond just a few with access to the data and tools to virtually anyone with a smartphone or similar device.

These kinds of platforms could move beyond being data/analytic service catalogs to become powerful customized decision support tools that leverage the services for use on any smartphone or tablet or other digital devices that even the poorest countries, institutions or people can leverage to make more information-based decisions and benefit from this rapidly-accelerating disruptive technology age.

The ASPRS community welcomes any feedback.

Author

Nagaraja Rao Harshadeep (Harsh) is a Global Lead for Disruptive Technology at the World Bank's Environment, Natural Resources & Blue Economy Global Practice. He holds a Ph.D. in Water and Environment Systems Engineering from Harvard University, a Masters in Environment and Resource Engineering from Syracuse, and a B.Tech in Civil Engineering from IIT-Madras. In over 23 years at the World Bank, he has been working on leading several activities related to environment, water resources, watersheds, and technology and is located in Washington, D.C. (harsh@worldbank.org).

Ad Index