

In 2010, we introduced Google Earth Engine at the COP16 International Climate Conference. It was the world's first cloud-native, planetary-scale geospatial data analytics platform, designed from the ground-up to democratize access to earth observation data and help accelerate the transformation of "pixels to knowledge" for societal benefit. Looking back, while nothing like it had existed before (e.g., analysis-ready EO data, petapixel-scale processing, easily-accessible from any web browser), it seems almost inevitable that such a platform would be invented. A set of factors had converged in that moment to shift the dominant paradigm of remote sensing from the desktop to the cloud - the release by USGS/NASA of Landsat data for free (millions of scenes and petabytes of data, sitting on tapes going back to 1972), the advent of large-scale publicly-available cloud computing such as the Google cloud, and the urgent need for accessible, timely, accurate information about the state of the planet and how it was changing, to support better decision-making and action on critical environmental and humanitarian issues.

In particular, the initial impetus for the Google Earth Engine project came from Brazilian geoscientists in 2008/9, who asked us if Google could help them stop the loss of more than a million acres of Amazon rainforest annually. They had already developed the remote sensing techniques to derive valuable information from daily-updating satellite data, but were struggling to manage and process the "brutal" amount of EO data in a timely manner on their desktop computers. Further consultation with leading remote sensing scientists convinced us that this was a ubiquitous challenge as well as a "Google-scale" one, and so we set off to build Earth Engine in close collaboration with the remote sensing community.

Our first step was to partner with the USGS EROS Data Center team in bringing the entire multi-petabyte, multi-decadal Landsat data archive off tapes, and online, for the first time. It took three years to create this online "mirror" for Landsat, but it was worth it. This novel co-location of big Earth observation data in analysis-ready form with hundreds of thousands of CPUs for processing created new possibilities for characterizing our changing planet. Scientists began developing Earth Engine-powered methodologies which mapped, measured and monitored global landscape change and environmental phenomena at unprecedented resolution, speed and scale. Early applications included tracking and reducing global deforestation, mapping global surface water resources over time, estimating global crop yields to enhance food security, mapping and mitigating the risks of extreme weather events such as floods and drought, forecasting future risks of vector-borne diseases such as malaria, and even predicting where chimpanzees were likely to build their nests.

Since those early days, it's been exciting to witness and support the Earth Engine user community as it has grown and thrived, now including more than half a million individuals and organizations worldwide. This diverse community of scientists, academics, non-profits, governments and industries has become increasingly-impactful across a range of disciplines, advancing both the "state of the science" as well as the practical, real-world application of global environmental remote sensing. To date, the GEE community has collectively (and creatively) applied Earth Engine to author more than 20,000 scientific publications in journals such as Nature, Science and Remote Sensing of Environment. They've also developed numerous high-impact environmental monitoring applications, including Global Forest Watch, Global

Fishing Watch, OpenET, Climate Engine, MapBiomass, SDG661.app, Restor.eco, EarthMap, TraceMark and more. Every year, we've grown the scale of cloud-computation that we serve to support the amazing work of this community, and today Earth Engine provides more than 500M CPU hours per year (i.e. more than half a billion CPU hours!)

With our announcement last year that Earth Engine is available through Google Cloud Platform as an enterprise-grade service, governments and businesses are now relying upon GEE for mission-critical purposes, such as sustainable natural resource management, climate and disaster risk resilience, and sustainable sourcing of commodities to meet zero-deforestation commitments. In addition, new startups are now applying GEE technology to transform science and EO data into innovative sustainability-focused ideas and enterprises.

So, I am **tremendously excited about this book**, which has come at the perfect time. With Earth Engine's maturation into such a powerful and flexible environmental monitoring platform, the demand for geospatial data scientists with fluency and expertise in Earth Engine is skyrocketing. We're seeing universities all over the world creating curricula and teaching courses based on Earth Engine. While prior texts for teaching remote sensing reflect the old (desktop) paradigm, modern teachers, learners and practitioners need a new textbook that is written in the language of cloud computing. A textbook that embeds familiar technical concepts of data structures, image processing and remote sensing in the context and machinery of cloud infrastructure, with its unique ability to process massive, multi-sensor, near real-time datasets at unprecedented speed and scale.

**Cloud-Based Remote Sensing with Google Earth Engine: Fundamentals and Applications** is exactly the textbook that we need: comprehensive, authoritative and also enjoyable! It deftly and thoroughly covers the fundamental content and material required to go from zero-to-sixty on Earth Engine. The variety of applications represented can help jump-start and inspire the reader in so many wonderful directions. The associated code samples ensure that you can get hands-on and productive, immediately and throughout.

I'm especially delighted that this book was authored by such a diverse, accomplished group of Earth Engine experts, spanning backgrounds, disciplines, geographies and career-stage (including undergrads to full professors), who voluntarily joined together in a common mission to create this much-needed Earth Engine reference text. They've made a tremendous contribution to our entire global community, aligned with our founding Earth Engine mission to support the greater good, and I am forever grateful.

Looking ahead, this is a time of innovation and evolution in the field of cloud-powered environmental remote-sensing, with new satellites and sensors continually launching, producing new types of data (e.g., global atmospheric methane concentrations), while also improving spatial, spectral and temporal resolution of existing data sources. Meanwhile, the classical remote sensing machine learning toolkit is now expanding to include modern deep learning/AI-based techniques. At Google, and together with the GEE community, we're continuing to push this envelope by advancing Earth Engine's fundamental capabilities and

applications. For example, the recent launch of Dynamic World together with WRI introduced the first near real-time, probabilistic, 10m global landcover mapping dataset based on deep learning/AI techniques, with which the GEE community is already driving further downstream innovations.

It's never been a more exciting, important and relevant time to join this field and contribute to generating new knowledge about our changing planet. Policy-makers and project implementers worldwide are seeking timely, accurate, science-based and data-driven information to guide wiser decision-making and action on critical environmental and humanitarian issues. I hope that this book will turbo-charge your interest and ability to become proficient in Earth Engine, and that you will join our growing community of people around the world dedicated to making it a better place, now and for generations to come. Enjoy!

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