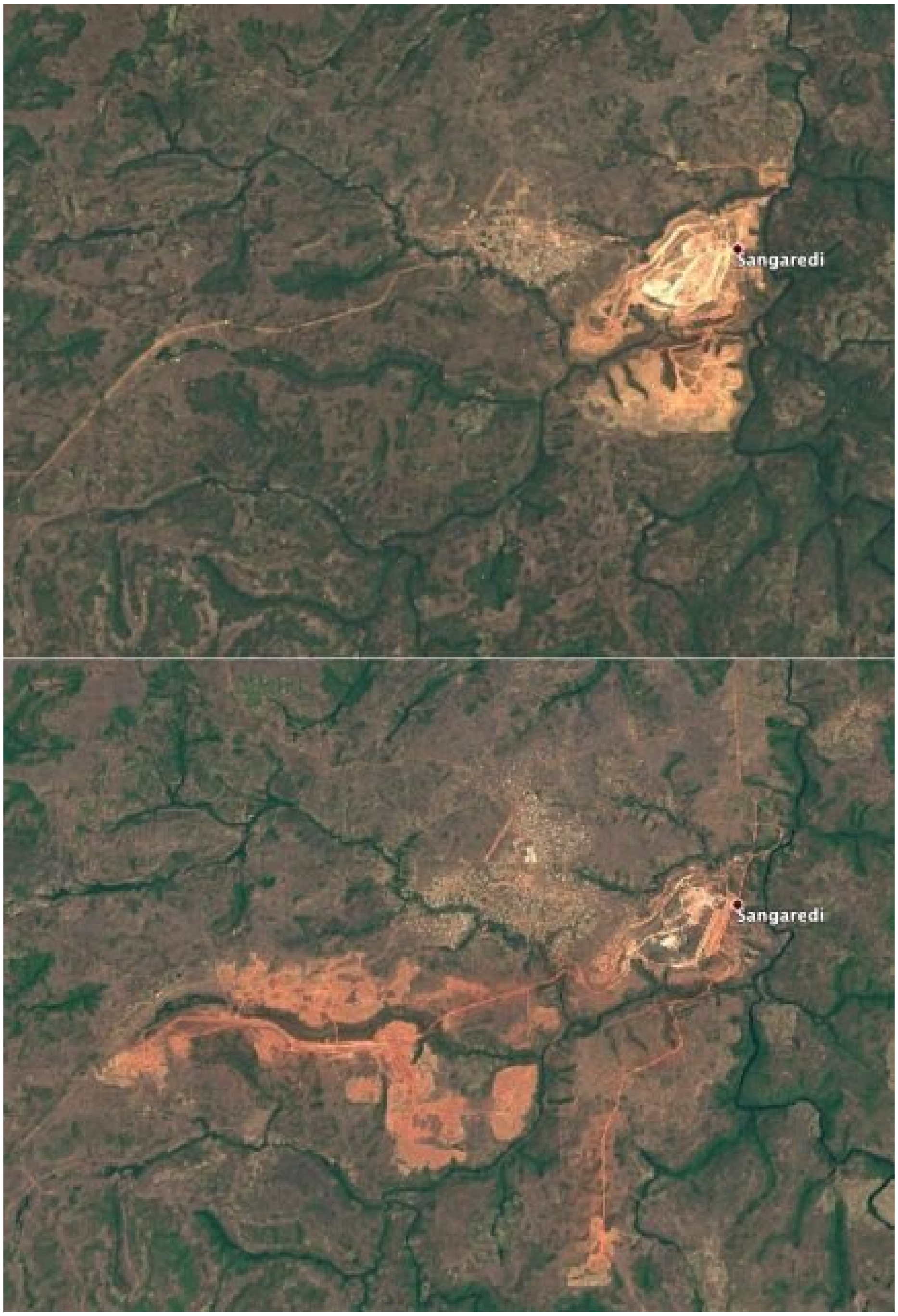
App will track harmful dust from bauxite mining in Guinea

July 17 2020, by Jeffrey Fralick



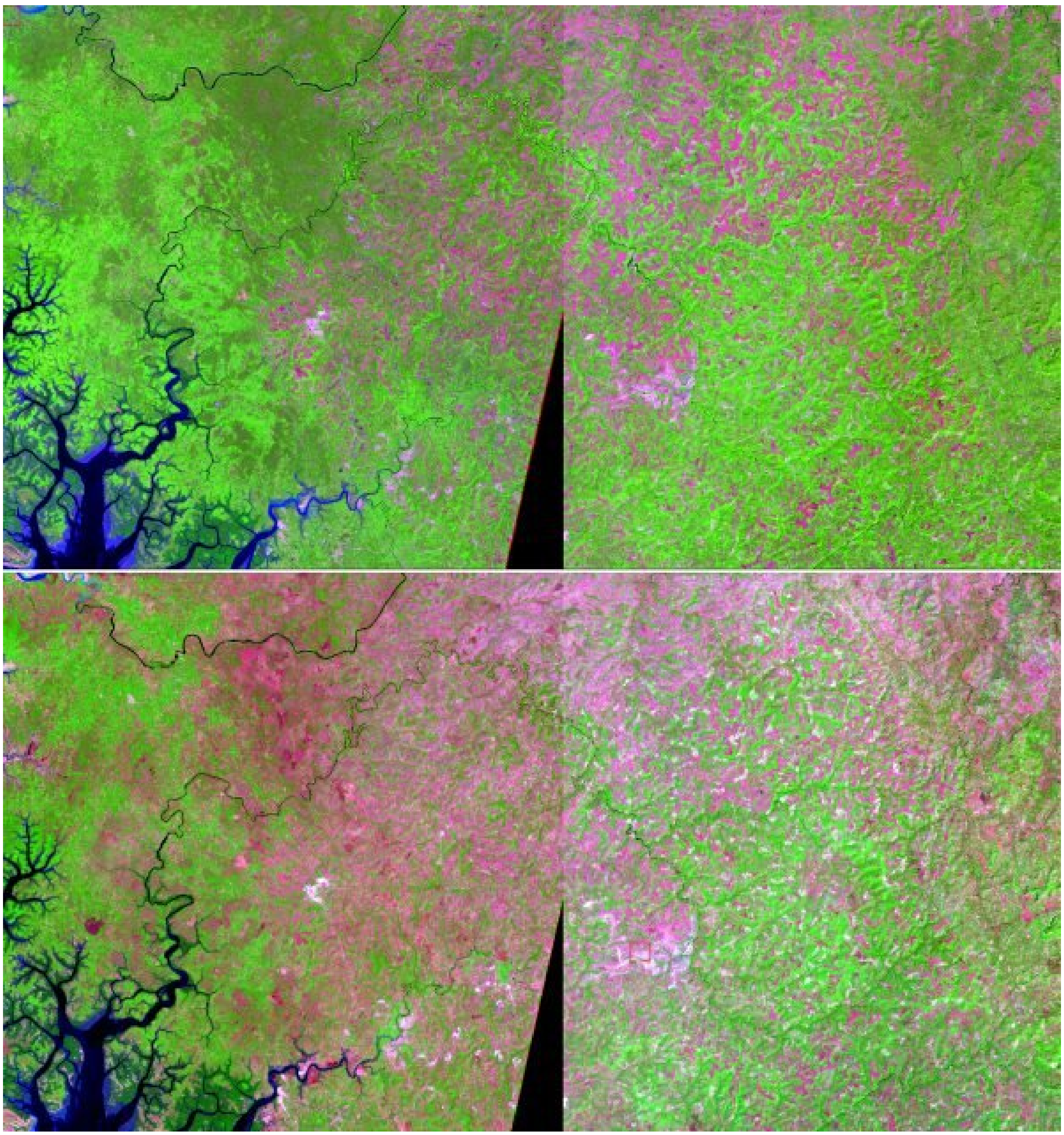
The expansion of mining operations in Sangaredi over a 20-year period. The top image is Google Earth satellite imagery from December 1996, and the bottom is from December 2016. What was a relatively centralized mining operation in 1996 has since expanded to create a broader network of mining zones connected by unpaved roads. Bauxite dust can be identified via its characteristic neon-red hue.

In western Guinea, near where the Tinguilinta River meets the Atlantic Ocean, a concrete jetty extends about 275 meters into the river's channel. The jetty is equipped with a conveyor belt system, which facilitates the transport of crushed and dried bauxite—the primary ore used in the production of aluminum—from pier-side stockpiles to docked ships for export. Behind the jetty, gaseous and particulate emissions pour out of a smokestack. Meanwhile, bauxite dust drifts towards the neighboring town of Kamsar, where residents link the bauxite plant's operations to health effects such as respiratory diseases. Trains rest on tracks near Kamsar's port after completing their 120-km long journey from the mining area in Sangaredi. Five to seven trains, each equipped with 120 wagons, leave that mine every day. Each wagon contains around 82 tons of bauxite ore, amounting to between 49,200 and 68,800 tons of bauxite shipped, by railway alone, daily. These are the operations of just one mining company and do not account for the truckloads of bauxite moving through the same territory each day. Several other companies have also taken up residence in western Guinea, particularly in the Boké region, in the pursuit of bauxite.

Guinea holds the world's largest reserves of bauxite. In fact, Guinea's Ministry of Mines estimates that reserves of bauxite across the country total over 40 billion tons. Since 2013, several major investment agreements have resulted in the arrival of a number of industrial players seeking to capitalize on the vast bauxite reserves located in Guinea. However, the rapid expansion of the bauxite industry has come at a cost to both humans and the environment. In an effort to fill critical on-the-ground data gaps and protect communities that are vulnerable to the impacts of bauxite mining, scientists at the Lamont-Doherty Earth Observatory and Columbia's Earth Institute, working in partnership with the Columbia Center on Sustainable Investment (CCSI) and the United Nations Development Program, are developing a mobile application that will allow community members to locate, record, and track instances of red dust generated by the extraction, transportation, and processing of bauxite. The project, led by Professor Lynnette Widder, is part of a two-year funded research project, co-sponsored by the Earth Institute's Earth Frontiers Seed Grant and the United Nations Development Program in Guinea.

The impacts of bauxite mining are not just limited to dust. Other impacts include noise pollution from extraction; water pollution from run-off; the release of minerals and other naturally occurring impurities into the environment; traffic accidents; and the destruction of native flora and fauna and resultant loss of biodiversity and ecosystem services. However, this project is focused on dust because of its impacts to livelihoods, including subsistence farming and fisheries, where red dust can accumulate on the surface of waterways and cover vegetation, in addition to its impacts on health. The World Health Organization defines 'dust' as particles in the size range of 1 to 100 micrometers. Within this range, dust particles smaller than 10 micrometers pose the greatest threat to human health. These dust particulates, when inhaled, can travel deep into the lungs and some may even get into the bloodstream, affecting both the cardiovascular and respiratory systems. Many scientific studies have linked exposure to particulate matter smaller than 10 micrometers to a variety of problems, including: premature death in people with heart or lung disease, nonfatal heart attacks, an irregular heartbeat, aggravated asthma, decreased lung function, and increases in respiratory symptoms, including the irritation of airways, coughing, or difficulty breathing. According to a report from Human Rights Watch, villagers in Guinea's most active bauxite mining regions already believe that mining activities are contributing to respiratory illnesses and express concern regarding long-term health impacts from dust exposure.

Dust can be generated throughout the entire bauxite mining process. The first step of bauxite mining consists of land clearing and the removal of topsoil and trees. This removal of native vegetation increases the rate at which the wind can erode soils during the dry season while also making the same land more susceptible to mudslides during the rainy season. Next, bauxite is extracted by digging, ripping, and blasting, all of which creates dust plumes. Following extraction, bauxite is trucked along haul roads to stockpiles where it is then loaded onto trains, or in some cases larger trucks, for transport to port facilities for further processing—washing, crushing, and drying—and shipping.



These are false color composite images of the Boké region in Guinea. Vegetation appears in green, bare soil in pink/magenta, and mining sites and ports are easily identified as the bright light pink spots. The black triangle on each image corresponds to missing data. The top image depicts satellite imagery from November 2019 (beginning of the dry season in Guinea), while the bottom shows imagery from February 2020 (end of the dry season). As the dry season unfolds, vegetation dies off, exposing more bare soil. This seasonality represents a challenge for the identification of bauxite dust emitted by mining activities using satellite imagery. Credit: Marguerite Obolensky

Because mining locations and truck routes may change over time without notice, improving the ability to monitor dust propagation at a larger, regional scale is necessary to ensure that mining companies are taking measures to reduce the dust they generate. That's why the mobile application—currently in development by Quadrant 2, a company not affiliated with Columbia that specializes in app development for social good—will be loaded with satellite images that show dust hot spots to the user. These hot spots may be located close to a mine, at stockpile locations, along railways or other major transportation arteries, and/or by the port. Users would then be able to travel to these regions and take a series of photographs to verify the presence of bauxite dust. Their reports, once uploaded to the app platform, will also be visible to other users of the app. Through this mobile application, communities will have the ability to track and record instances of dust in an effort to hold mining companies accountable for their actions.

Once dust and its source are located, there are a multitude of management strategies that companies can use to minimize dust loss, though they are not legally required to do so under Guinean environmental codes. According to the International Aluminum

Institute's "Sustainable Bauxite Mining Guidelines," dust management strategies include lowering speed limits; checking load limits and mandating covered load from mining operations to port facilities; constructing roads using appropriate materials to minimize the creation of dust; using dust suppression sprays on stockpiles; covering conveyor systems and equipping them with water sprays at transfer points; ensuring that the loading, transfer, and discharge of bauxite occurs with a minimum height of fall and is shielded against the wind; and revegetating exposed soils and other erodible materials. In addition to these management strategies, mining companies and government agencies should provide for real-time monitoring of fugitive dust and specific, enforceable standards for air quality findings.

This project would not have been possible without the collective work of its various partners. The team at CCSI—led by Perrine Toledano, in collaboration with Columbia law student Laure Dupain, and supported by CCSI's Martin Dietrich Bauch and Solina Kennedy—conducted a legal review of the current environmental and political framework for regulating the mining industry in Guinea. Additionally, CCSI evaluated a handful of case studies from other countries across the globe regarding best-practices for community monitoring. Chris Small, a research professor at Lamont, is supervising the processing of satellite imagery to identify mining dust hot spots where the mobile application would be most beneficial. Marguerite Obolensky, a current PhD student at Columbia's Sustainable Development program, is assisting Chris Small with the satellite imagery analysis and is working to identify key distinctions of satellite reflectivity between soil, which is naturally red, and bauxite residue. Lex van Geen, a research professor and geochemist at Lamont, is providing additional technical support to the app. He brings with him years of citizen-science expertise stemming from his own work with community-based monitoring of arsenic in groundwater in Bangladesh, as well as lead in soil in Peru. Jeff Fralick, a recent graduate of Columbia's Sustainability Science program, has served as

Professor Widder's research assistant since the launch of the project in January.

The project also received support from one of the Earth Institute's Masters of Sustainability Management Spring Capstone teams. The 10 students, led by Professor Widder, conducted a semester-long stakeholder mapping and scenario-planning study. The team also worked on identifying potential on-the-ground partners to help with the roll-out and implementation of the project. The project is currently on track to field test the app in Guinea's bauxite rich Boké region in fall 2020.

Provided by State of the Planet

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