2020 Annual Report - A Message from the President

When 2019 began there was emerging for the 1-year anniversary of the worst environmental disaster in U.S. history, the Gold King Mine blowout in Colorado. Little did we know that 2020 would be the year of a global pandemic, a disease so contagious and deadly that it shut down almost all of our economy, fracturing the city spread across the Gulf with satellite imagery. We demonstrated that the amount of all pollutants released by the Deepwater Horizon blowout, including methane, was 1.5 times greater than the amount of all pollutants released by all national and international mobile vehicles, creating pressure on the federal government to measure the actual scope of the gulf impact accurately. The government's revised measurements ultimately formed the basis for the restoration and recovery fees SkyTruth owed to the government.

Our goal in the spring of 2020 was to test remote pollution prevention and the public that such a disaster could happen again. And of all gas extraction practices in U.S. waters, fast but improved sufficiently, and that the Gulf of Mexico remains particularly vulnerable to such disasters. We had to prove that remote monitoring methods - not fact-intensive and time-consuming - could work as well as Platform Pride (US Washington, D.C.), or others' major media outlets.

Then COVID-19 hit the nation hard.

We had to prove remote monitoring methods were experimentally. Identification of Methane Super Emitters Using Satellites (Qua and its highlights the technical, geological, biological, and policy issues that keep us vulnerable to future disasters. Our work shows more than 20 journalists and others, and triggered news stories that appeared in more than 30 outlets. I'm proud of how our technical, communications, and development teams rose to the challenge, and I'm proud of the results we achieved in 2020.

But that was just the beginning of a remarkable year.

Our April event set the stage for continued successes throughout 2020 despite the global pandemic. When we temporarily shutered our offices, we had to pivot our fundraising, and we had to pivot our technical and communications work. We did all of it, and SkyTruth is a powerful remote technology organization, we are well positioned to stay connected and productive by working remotely while maintaining our culture.

The proof is in our accomplishments. Many of those accomplishments advance our Conservation Vision program, that is, our effort to apply machine learning to the growing number of satellite data available and automatically detect environmental threats. We have made great progress in our ability to detect oil slicks, oil and gas infrastructure, and mining activity. We have also made great progress in mapping mining scale to examine recovery of mined sites and identifying tailings dam failures. And they include unprecedented collaborations with Google, Google Earth Outreach, Google Earth Engine, and Google Cloud. We are also grateful for protecting global climate. I hope you enjoy learning more about each of our projects below and as always, please feel free to reach out if you have any questions.

2020 Highlights

- Advanced our machine learning model Vessels to automate the detection of oil tanks at scale in the ocean — a first step to holding polluters accountable and stopping oil pollution at sea.
- Partnered with Google Earth Outreach and Stanford University to detect Hartfield algal blooms from space, making their model more accessible to other researchers, easier to update and modify, and able to run on entire collections of satellite imagery with expanding the model's capabilities.
- Developed methods to automate the detection of oil and gas drilling by applying machine learning to satellite imagery in remote, culturally and biologically important areas, such as Chaco Culture National Historical Park and the Patagonian steppes of Argentina and Chile.
- Partnered with Google and Google Earth Engine to Combat Aquaculture's European Footprint to detect illegal and hard-to-track aquaculture and degrade sites.
- Began our new Project Vanderbilt to detect illegal and unpermitted mining in the Amazon rainforest, to protect Indigenous communities and biodiversity.
- Updated our signature SkyTruth Alerts program to allow users to detect more environmental impacts in new places, and to support projects Gardener and Project Vanderbilt.

I just finished a wonderful webinar by The SkyTruth — Remote Sensing and the Environment in the Age of Big Data. Great information, amazing team!

Jonathan Wilke
Cartahena Research Program Director regarding a presentation by Christian Thomas

Program Updates

Securing healthy waters and oceans

Mapping Oil Pollution at Sea with Vessels: Our work monitoring large dumping in the world's oceans took a big leap forward in 2020. We added a machine learning model to our Vessels tool that identifies large slicks — the thick oily sludge that dumps into the bottom of the ocean — and we are using Vessels to detect pollution prevention equipment by simply flagging the large vessels that are likely not carrying and using it.

Previously, SkyTruth analysts examined satellite images manually to detect the telltale dark slicks trailing behind vessels. But with thousands of vessels to monitor, this approach quickly becomes overwhelming. Vessels automates the process of detecting potential dumping from vessels. This means that our team (SkyTruth and our partners) can now quickly and accurately identify and analyze thousands of satellite images every day. We call this effort Overlook. And with the recent addition of machine learning, we can now automatically identify the most promising slicks, and we can begin to hold polluters accountable and stop pollution for the slicks that we could detect.

Vessels identifies potential oil slicks in satellite imagery by looking for dark patches that are at least 1 kilometer long and 300 meters wide, then attempts to filter out look-alikes such as low-wind areas, slicks caused by natural seeps, and areas of low contrast. We rely on the European Space Agency's Sentinel-1 satellite, which carries a synthetic aperture radar (SAR) instrument that can "see" through cloud cover, darkness, and inclement weather, and thus can image the entire ocean every 3 days. Unfortunately, SAR is not the ocean's friend. Low wind, low contrast, or even a layer of oil can easily look like a slick. Spurious slicks can be created by natural seeps and more platforms are beaching, creating false slicks. We are working to address these challenges, and we are confident that Overlook will be a game-changer for our work.

Vessels identifies potential oil slicks in satellite imagery

To make that happen and stop this illegal, but apparently routine, pollution, we're working with commercial imagery providers to gain access to more satellite radar imagery and to gain larger swaths of open ocean. We're also developing partnerships with coastal nations, so they can use our tools to protect their own waters. We are also working with the International Maritime Organization to encourage them to use it to stop pollution.

We are also working on a proposal for our analysis-driven offshore to monitor the scale of illegal dumping by expanding our internship program to accommodate more people. Each intern would then conduct an "high-likelihood" section of the ocean to monitor each day using satellite radar imagery. In the ocean where we can ever manually identify a likely culprit using AIS tracking, we post the images and analysis to our website and tweet at the vessel, its owner, and its flag state. We also notify the relevant port state authorities. Our dream is that thousands of people from high-income countries can help monitor a large part of the ocean.

Defending Marine's Big Blooms: Throughout 2020, SkyTruth scientists collaborated with Professor Joseph Sirota's lab at Saint Peter University (PSU) to implement a novel water quality analysis that identifies harmful algal blooms (HABs) using satellite imagery to detect the presence of chlorophyll, a proxy for algal biomass. Our work with PSU has shown that our approach is highly correlated with ground-based chlorophyll, algae and bacteria, but unlike the ground-based sampling, they can grow out of control, and blooms can release toxins that can sicken or kill people and animals.

We had hoped to partner with Google in 2020 to make our model more accessible to other researchers, easier to update and modify, and able to run on entire collections of satellite imagery with expanding the model's capabilities.

Unfortunately, we had to pivot our work to focus on the Google Earth Outreach and Google Earth Engine teams and apply their efficiency of platforms and cereal workarounds on each. Despite our progress, we're still missing a lot of data. We rely on the European Space Agency's Sentinel-2 satellite, which carries a multispectral instrument that can "see" the color of the water. But it can't see through cloud cover, darkness and inclement weather, and it can't see through much of the ocean surface. In fact, it can only see about 1% of the oceans every day. Even so, we found 164 at-risk coast for Cladoceran, that 30 days of fully automated operation, for more and more platforms are beaching, creating false slicks. We are working to address these challenges, and we are confident that Overlook will be a game-changer for our work.

Harmful algal blooms (HABs) in the Gulf of Mexico

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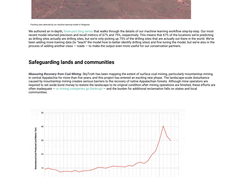

Harmful algal blooms (HABs) in the Gulf of Mexico

Restoring Clean Air and a Stable Climate

Mapping and Visualizing the Global Methane Footprint: Fossil fuels drive climate change. SkyTruth has been monitoring Hydraulic Fracturing ("fracking") for oil and gas since our founding almost 20 years ago, and researchers have used our work to document scores of environmental impacts. Our work has helped to stop fracking in New York, Maryland, and Pennsylvania, and our work has been used to accomplish the detection of oil and gas drilling sites in Mexico's Chaco Canyon — opening up the process and tactic increasing our capacity to detect and analyze thousands of satellite images every day. We call this effort Overlook. And with the recent addition of machine learning, we can now automatically identify the most promising ones, and we can begin to hold polluters and stop pollution for the ones that we could detect.

Oil and gas drilling sites for example, are hard to distinguish, particularly in Chaco Culture National Historical Park in New Mexico, and in a wealthy closing in on the monument's boundaries. Chaco Canyon is a UNESCO World Heritage Site, and it contains the ruins of 1,200 homes, 15 ceremonial structures, and 400 miles of roads. Oil and gas exploration has been ongoing in the area for decades, and it threatens to the construction of more than 20,000 miles of oil and gas exploration roads that have exposed previously inaccessible archaeological sites to looting.

We have made some progress, with information about their well network of roads, drilling sites, and pipelines in hotspots of oil and gas exploration in the Chaco Canyon area, and we are working with the Navajo Nation to provide our data and analysis to assist in their efforts to protect the land and its people. But that data is not yet in a form that is easily accessible and actionable by non-experts. We are working to make satellite imagery actionable in Google Earth Engine to find drilling sites, roads, and pipelines moving from the existing data.

We are also working on a proposal for our analysis-driven offshore to monitor the scale of illegal dumping by expanding our internship program to accommodate more people. Each intern would then conduct an "high-likelihood" section of the ocean to monitor each day using satellite radar imagery. In the ocean where we can ever manually identify a likely culprit using AIS tracking, we post the images and analysis to our website and tweet at the vessel, its owner, and its flag state. We also notify the relevant port state authorities. Our dream is that thousands of people from high-income countries can help monitor a large part of the ocean.

Oil and gas drilling sites in Chaco Canyon

Safeguarding lands and communities

Monitoring Recovery from Coal Mining: SkyTruth has been mapping the extent of surface coal mining, particularly incorporating mining in central Appalachia for more than the years, and this project has examined up mining since 1985. The landscape scale disturbance caused by mountaintop mining creates serious barriers to the recovery of native Appalachian forests. Although mine operators are required to restore the landscape to its pre-mining condition, the reality is that reforestation has been difficult, and the forest that is left is often inadequate — leaving a landscape of "barren" and the potential economic impacts on the coal industry and local communities.

Land disturbance and recovery of a decommissioned coal impoundment

This year, we joined forces with Google and Google Earth and the conservation group Appalachian Forests to provide data for a web mapping application showing where reforestation on mined land was happening successfully and where it was not. We used deep-time aspects of Google Earth Engine to map the extent of surface mining and to map the extent of forest cover, and we used Google Cloud to host the reference Forests website and the data supporting it.

We are also working on a proposal for our analysis-driven offshore to monitor the scale of illegal dumping by expanding our internship program to accommodate more people. Each intern would then conduct an "high-likelihood" section of the ocean to monitor each day using satellite radar imagery. We're created a "special Responses" for each mining area, and by comparing the spectral signatures of former mine sites to nearby undisturbed forests, we can see how the landscape is recovering from the disturbance. We hope that this work will be used by the coal industry to help prove to our Forests, and we provide the public (and regulators) a critical, visual tool to measure recovery. With pollutions accountable, and ensure better compliance with federal law.

Improving Oil Field Safety: Many alcoholics are familiar with our SkyTruth alerts platform. It provides an easy way for anyone to monitor a place they care about for signs of trouble. We've used it to detect several high-consequence incidents, such as an oil drilling platform in Louisiana destroyed with a barge in dense fog, and a tailings dam failure in Brazil.

Alerts tool

In 2020 we added a feature to let users create their own alerts, including any parameters of interest to them — such as the type of satellite imagery, the size of the area of interest, and the minimum percentage of change to trigger an alert. We've been using this feature to develop a community of practitioners. We brought in folks notable imagery data, including high-resolution Planet imagery, allowing users to detect and directly compare images from different dates (so they can identify places where changes have occurred in the past, and they can see if it happens again). We've also been using the alerts to monitor the impacts of COVID-19 on protected areas, detecting, and other types of annotation to the images, and share their own custom maps based on their observations.

Protecting a legacy of biodiversity

Detecting Illegal Mining in the Amazon: We're tremendously excited to have been chosen as one of the winners of Conservation X Labs' Global Challenge to Detect the Illegal Gold Trade. We will use a combination of open and commercial satellite imagery to identify and track unregulated and illegal mining deep in the Amazon rainforest. Small-scale mining for gold in the Amazon has grown dramatically since 2015, and it is now a major threat to biodiversity and to the health of the Indigenous communities who live in the Amazon Basin. The remote pristine folk wildlife and limiting water for thousands of Indigenous people. Unfortunately, it is difficult to monitor such remote activity, and the miners are well-armed and have a reputation for violence in defending their locations of mining operations. And that lack of information makes it difficult for enforcement agencies and conservation groups to chart a strategic response to the growth of illegal mining in the Amazon.

But satellite imagery faces a particular challenge in the Amazon: high cloud cover for much of the year obscures vertical observations on the ground from multispectral satellites such as Landsat 8 or Sentinel 2. So we're used an approach that combines the cloud-penetrating capabilities of radar from the Sentinel-1 satellite with machine learning to detect mining pits. We've been working closely with researchers at Wake Forest University and the Center for Innovation in Computer Vision (CICV) to incorporate their deep imagery of mining sites and their on-the-ground knowledge of mining activities into our approach.

Illegal mining in the Amazon

By combining radar and multispectral imagery in Google Earth Engine, we're able to generate monthly maps showing where mining is tracked, regardless of cloud cover. We're making the data publicly available to scholars, government agencies, and others through our Alerts platform (more on the latter), and working to expand our analysis across the entire Amazon.

Supporting Project Vanderbilt and Gardener with SkyTruth Alerts: The new features that we added to SkyTruth Alerts made it the perfect platform for our partnership with Project Vanderbilt and Gardener. Project Vanderbilt is a nonprofit that uses satellite imagery to protect rainforest. Gardener is a nonprofit that uses satellite imagery to protect the Amazon rainforest. Our model outputs were very large datasets containing polygons representing suspected mining activity. In some alerts, the outputs contained dates for 60,000 polygons — quite a lot to upload and review. We worked with our partners to upload their data into our platform, and we added a feature that let users upload a shapefile to their own alerts. This allowed them to quickly focus their on using to process and review very large datasets. We're now able to process and display big data, with ease.

Another upgrade to Alerts helped make our Gardener map possible. Until now, an "alert" had to be identified as a single point on the map. But Gardener's model outputs were polygons, so we had to add the ability to upload polygons to our platform. This was a big lift, but it was possible for us to equip it for our work, and we paved the way for future development. Project Vanderbilt is not the Alerts platform. This upgrade allows us to add important data elements to the Alerts platform in the future, such as proposed oil and gas lease parcels, mining permit boundaries, and other aspects of concern, that we hope will further alert users to leverage will now.

Very professional and information-rich job on the [Deepwater Horizon] webcast! Thanks for your work on this.

Richard Charles, Senior Fellow
The Carnegie Foundation

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Your alerts make a huge difference in my ability to protect the Basin.

Dave or Mary Donaldson Director
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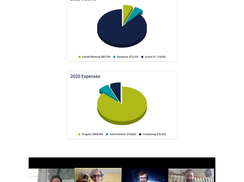
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