



SPOTLIGHT

Applying Earth Intelligence to understand humanitarian and security challenges in Ethiopia



Gain a geospatial perspective on real-world problems.

See how Maxar satellite imagery and advanced analytics can be applied to solve the world's most complex challenges.

MAXAR

MAXAR TOOLS PULL BACK THE CURTAIN ON CONFLICT IN ETHIOPIA

Ethiopia is beset with conflict and uncertainty on multiple fronts. The security situation, described by Farhan Haq, United Nations Deputy Spokesman for the Secretary-General, as “unpredictable,” is rooted in deep distrust among ethnic groups across the country. The Ethiopian government is battling the military arm of the regional government in the northwest province of Tigray, and military forces from neighboring Eritrea have been documented acting in Tigray in support of the Ethiopian government. Hundreds of thousands of civilians are internally displaced from the conflict, with more than 63,000 fleeing across the border to Sudan. Human rights abuses, including mass rape, are occurring in Tigray, in what the U.S. government and Amnesty International call an intentional ethnic cleansing campaign, according to reports received by The New York Times. Meanwhile, Sudanese forces have capitalized on Ethiopia’s internal conflict to recapture disputed land along the shared border, threatening to escalate military tension. As internal unrest continues in Ethiopia, Maxar Earth Intelligence capabilities can support humanitarian, military and government planners seeking to deliver lifesaving aid, counter violence in the north and plan for repairs wrought by conflict in Tigray.



ETHIOPIAN REFUGEES BATHE AND COLLECT WATER FROM THE TEKEZE RIVER ACROSS THE BORDER FROM SUDAN.
(NARIMAN EL-MOFTY | ASSOCIATED PRESS)

SUMMARY OF UNIQUE TOOLS & APPLICATIONS

Human Landscape is Maxar’s foundational human geography dataset, which provides rich attribution and metadata at the country scale. Leveraging Maxar’s industry-leading high-resolution satellite imagery, Human Landscape can significantly enrich thousands of publicly available and conflated data sources. Each dataset comprises more than 60 individual data layers across 13 standard human geography themes. Human Landscape datasets reduce operating costs and accelerate time-to-mission for complex geospatial analysis or geospatial taskings by providing up-to-date and analysis-ready foundational data. For this Spotlight, Human Landscape ethnicity layers reveal the social complexity in Ethiopia.

Machine learning (ML) by Maxar applies computer vision and pattern-analysis technology to geospatial problems. From producing labeled training datasets to developing, deploying and validating custom algorithms, Maxar delivers the technological and mission expertise needed to leverage machine learning for game changing results. In this analysis, ML was applied to existing roads in Ethiopia to identify additional roads that were previously unmapped on public platforms, enabling humanitarian, military and government planning.

Maxar’s **Direct Access Program** enables customers to integrate ground stations with the Maxar constellation for direct uplink and downlink. Customers can task the highest resolution and highest accuracy satellites commercially available using their own ground stations for real-time imagery acquisition and downlink to support the most demanding mission requirements. In this scenario, imagery revealed military buildup in Sudan and refugee camp destruction in Ethiopia.

ETHNIC FEDERALISM DISINTEGRATES, CONFLICT OVERTAKES NORTHERN ETHIOPIA

Reuters reports that more than 90 distinct ethnic groups inhabit nine distinct states and two self-governing administrations in Ethiopia; ethnic diversity is a hallmark of the country. It is the largest and most populated country in the Horn of Africa and the 12th most populous country in the world. Its history of pan-African support led Ethiopia to play a key role in the establishment of the African Union and the United Nations Economic Commission for Africa, both headquartered in Ethiopia's capital, Addis Ababa. Despite hosting these international institutions, which are beacons of cooperation and unity, decades-old rivalries and grudges among ethnic groups threaten to unravel the fragile peace enshrined in Ethiopia's political system of ethnic federalism.

In Ethiopia, ethnic federalism provides for regional autonomy and self-determination based on ethnocultural communities as laid out in the constitution. Though the system was intended to resolve inequality in ethnic relations, it led to more violence-fueled conflict in what the African Centre for the Constructive Resolution of Disputes calls "antagonistic ethnic nationalism." Competition among ethnic groups centers on resources such as land, water and federal funds as well as religious identity. Under Ethiopia's constitution, 80 recognized ethnic groups have substantial sovereign power, magnifying the competing claims on resources and challenging the federal government's ability to exercise consistent governance across the country.



THE GREATER HORN OF AFRICA INCLUDES DJIBOUTI, ERITREA, ETHIOPIA, SOMALIA, SUDAN AND SOUTH SUDAN.

ETHIOPIA'S COMPLEX SECURITY ENVIRONMENT CHALLENGES THE GOVERNMENT

Ethnic Tigrayans make up approximately 6% of Ethiopia's population of 110 million people, and the U.S. Agency for International Development (USAID) estimates 6 million people live in Ethiopia's northwestern province of Tigray, the majority of whom are Tigrayan. Government authorities of Tigrayan ethnicity have held power in Ethiopia since 1991 and have been challenged for favoring their own ethnic group. Demanding equal representation in political decision-making, the Oromo and Amhara ethnic groups—together making up 70% of Ethiopia's population—carried out anti-government protests in 2018, resulting in the election of Prime Minister Abiy Ahmed. Abiy belongs to the Oromo ethnic group and was elected in hopes that he would reinstitute fair representation. Emphasizing unity among Ethiopia's multiethnic population, Abiy directly opposes ethnic federalism and has shifted to a territory-based governance system and consolidation of power in the federal government and his new Prosperity Party. Fearing a loss of regional autonomy, the Tigray People's Liberation Front (TPLF), the governing authority based in the Tigray province, declined to join the party, per the BBC.

In September 2020, Abiy postponed regional elections because of COVID-19 concerns. The TPLF rejected the postponement and held regional elections. In response, federal lawmakers voted to cut funding to the Tigray region, outraging Tigrayan leaders. On November 4, the armed wing of the TPLF attacked a military facility in Tigray in what it called "preemptive self-defense," claiming federal forces planned to assault Tigray, according to The New York Times. The government swiftly conducted a "law enforcement operation," paving the way for a full-scale invasion by the Ethiopian National Defense Force (ENDF). Fighting between the ENDF and TPLF ensued. The U.N. Population Fund reports that, despite the government's announcement of an official end to military operations in November 2020, months of conflict in Tigray followed. As of May 2021, hostilities were still being reported across Tigray, with some districts inaccessible to humanitarian workers, according to USAID.

What began as a political dispute over election authority quickly transformed into ethnic conflict. Abiy fortified

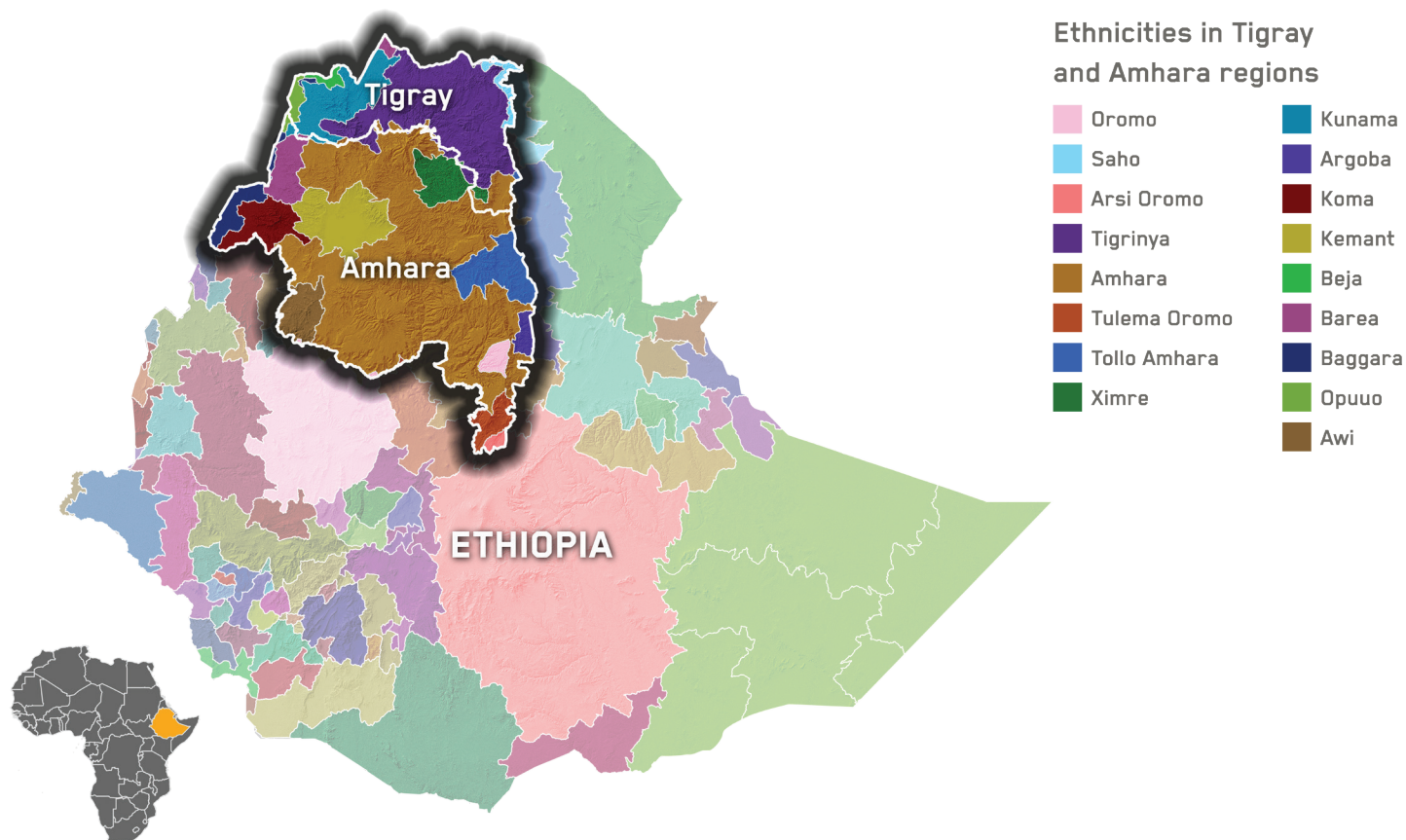
government forces with ethnic Amhara militia fighters who claim Tigray is Amhara land. Humanitarian workers reported to Foreign Policy that Amhara fighters have replaced Tigrayan ID cards and local signs to indicate it is now Amhara territory. Furthermore, Abiy has admitted allowing the Eritrean military to secure the northern border but has denied permitting Eritrean activity across Tigray, despite the widespread evidence of Eritrean troops in the province, according to the BBC. Eritrean troops operating in Tigray have been accused of human rights abuses, according to Amnesty International, which reported hundreds of witness testimonies of rape and indiscriminate killing of Tigray civilians.

ETHNIC INFIGHTING BEYOND TIGRAY

While violent conflict in Tigray has captured international attention, ethnic tensions in Ethiopia extend beyond the northern province. The New Humanitarian reports that tension along the border of the Oromia and Somali regions within Ethiopia is ever-present, as are rivalries between the Jarso and Gerri communities and between ethnic Borana and the Somali Garre clan. Ethnic Ethiopian Gedeos tried to annex Oromo land in 2018, and clashes along the provincial border between the Afar and Somali regions killed dozens in 2020. Later that year, armed Gumuz militiamen were blamed for attacking Amhara civilians in the northwest region of Benishangul-Gumuz, and at least 54 Amhara were killed in West Wellega by attackers believed to be from the Oromo Liberation Army, according to the Associated Press. Elsewhere in Ethiopia, representatives of the Raya, Wolaita and Sidama ethnic groups are seeking to form autonomous regions. The number of ethnic rivalries threatens Abiy's vision of a unified Ethiopia.

HUMAN LANDSCAPE ENABLES ANALYSIS OF COUNTRYWIDE ETHNIC BREAKDOWN

ETHNIC DIVERSITY IN ETHIOPIA



HUMAN LANDSCAPE PROVIDED ANALYSTS WITH ETHNICITY LAYERS, LENDING INSIGHT INTO COUNTRYWIDE CONFLICT ACROSS ETHIOPIA. DIFFERENT LEVELS OF DETAIL ALLOW FOR MULTIPLE TIERS OF ANALYSIS BASED ON REQUIREMENTS.

WHAT IS HUMAN LANDSCAPE?

Human Landscape includes comprehensive geodatabases with rich attribution and metadata, detailing core human geography themes across a country, in analysis-ready format. Leveraging Maxar's high-resolution imagery significantly enriches publicly available data sources, resulting in unique surveys that enable analysts to develop responses to a wide range of complex geospatial taskings, effectively reducing operating costs and accelerating time-to-mission operations.

KEY FEATURES AND BENEFITS

Human Landscape enables intelligence agencies, humanitarian groups and commercial organizations to see global issues in context through layers of comprehensive human geography data, such as:

- Humanitarian assistance and disaster relief
- Conflict and crisis management
- Illegal trade and human trafficking
- Infrastructure improvement for growth
- Crime and socioeconomic hot spots

MAXAR IMAGERY VERIFIES GROUND REPORTS

The conflict in Tigray has killed nearly 2,000 people in more than 150 massacres perpetrated by soldiers, insurgents and paramilitaries operating in the province between November 2020 and April 2021, according to The Guardian. Mass executions of civilians are reported by Amnesty International, including one in November 2020 in which Eritrean troops deliberately shot civilians after house-to-house searches. Firsthand accounts of rapes of Tigrayan women are widespread, as are reports of the deliberate destruction of Tigrayan homes and fields. Amhara militiamen often prevent Tigrayan survivors from collecting the bodies of family members shot in the streets, reports The Guardian. Aerial bombardment and gunfire in Tigray have contributed to the exodus of Tigrayans into Sudan, with many crossing via the Tekeze River, according to Public Radio International and Reuters.

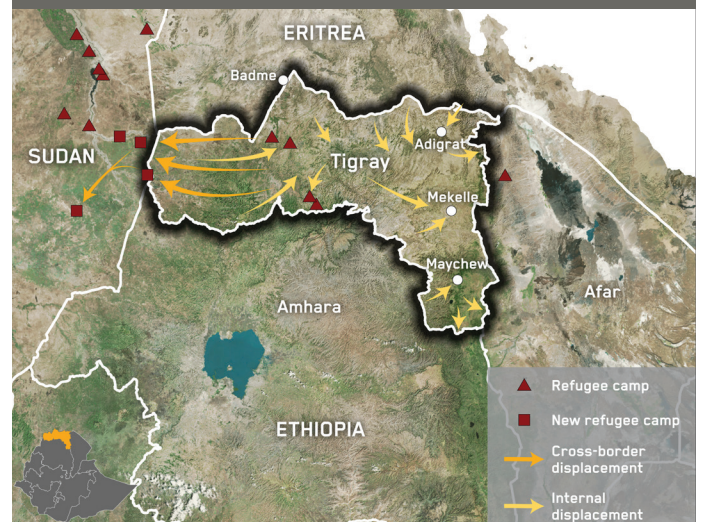
The International Organization for Migration estimates that the crisis in Tigray has displaced nearly 1.1 million people in northern Ethiopia, with 1 million internally displaced persons (IDPs) within Tigray and an additional 45,343 in the Afar region and 18,781 in the Amhara region. The U.N. High Commissioner for Refugees (UNHCR) reported that, as of April 2021, at least 63,000 Ethiopian refugees had arrived in eastern Sudan since fighting began in November 2020. Between 200 and 500 refugees arrived in Sudan daily through January 2021; by March the influx dropped to 30-50 arrivals per day, according to the UNHCR. Many refugees have been relocated to two permanent camps in Gedaref, Sudan. Others stay close to the border in Hamdayet in hopes of returning home or hearing from relatives. Between 10,000 and 12,000 Ethiopian refugees remain scattered in Hamdayet, according to Doctors Without Borders. Stuck in limbo, refugees often struggle with proper nutrition, and some risk death to cross back into Ethiopia in search of food.

RIVER BATHING | TEKEZE, SUDAN
DECEMBER 14, 2020 | WORDVIEW-3



MAXAR IMAGERY VERIFIED ON-THE-GROUND REPORTS OF TIGRAYAN REFUGEES BATHING AND WASHING CLOTHES AT THE TEKEZE RIVER ALONG THE SUDAN-ETHIOPIA BORDER. (PHOTO: TYLER HICKS | THE NEW YORK TIMES)

REFUGEE AND IDP MOVEMENT
NOVEMBER 2020 TO APRIL 2021

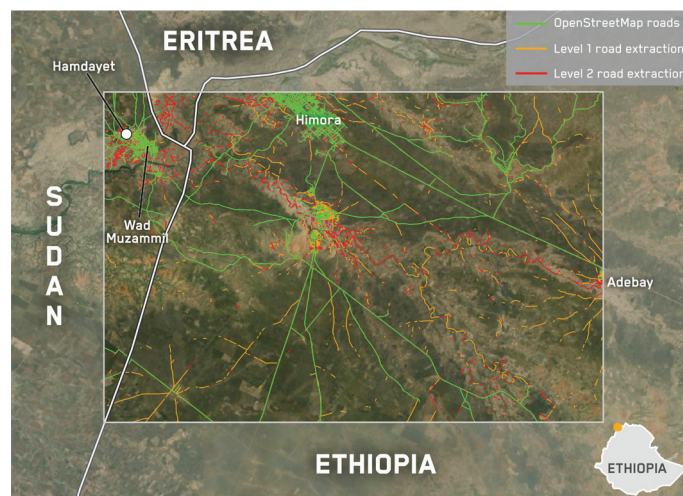


MACHINE LEARNING ENABLES HUMANITARIAN, MILITARY AND GOVERNMENT PLANNING

ML can identify objects and patterns automatically and derive meaningful insights from satellite imagery in hours—a task that previously would have required teams of analysts and months of effort. ML from Maxar relies on an archive of more than 125 petabytes of imagery dating back to 2000, the highest resolution commercial imagery on Earth. For this Spotlight, ML was applied to Maxar’s high-resolution satellite imagery to conduct object detection, identifying roads in northwest Ethiopia, many of which were previously invisible on popular mapping platforms.

Whether delivering aid, conducting military operations or planning for infrastructure development, multiple players on the ground in Tigray share the need for visibility of navigable roadways. Mainstream mapping platforms lack the ability to identify lesser-used roads and footpaths essential for predicting cross-border movement of vulnerable refugees, countering adversary military movement and calculating cost for road construction and post-conflict repair. Manual and aerial surveys can be costly and time-consuming, but Maxar’s ML capability has the power to detect roads and lesser-used footpaths, enabling time-saving analysis of urban and rural roadways. As the international community calls for “unimpeded and safe access” to Tigray, according to the U.N.’s Farhan Haq, the ability to locate and analyze navigation routes will be paramount.

ROAD EXTRACTION THROUGH MACHINE LEARNING



KNOWN ROADS ARE PUBLICLY AVAILABLE AND SHOWN HERE BY OPENSTREETMAP (GREEN) IN NORTHWEST ETHIOPIA. ML BASED ON KNOWN ROADS ALLOWED FOR DETECTION OF SIMILAR ROADS (YELLOW), AND FURTHER ALGORITHM TRAINING ALLOWED FOR ADDITIONAL FINE-TUNED PATH EXTRACTION (RED).

BORDER RECEPTION CENTER | HAMDAYET, SUDAN | MARCH 25, 2021 | WORLDVIEW-3



IDPS IN ETHIOPIA MAKE THEIR WAY WEST TOWARD THE SUDANESE BORDER, WHERE THEY REGISTER AS REFUGEES IN HAMDAYET.

SUDAN CAPITALIZES ON UNREST IN TIGRAY BY REENTERING CONTESTED AREA

Sudan has capitalized on the unrest in Tigray by reentering the disputed al-Fashaga region at the border of Sudan and western Ethiopia. Called by Abiy to fight in Tigray, ethnic Amhara farmers in al-Fashaga left the region, creating a void filled quickly by Sudanese military. In December 2020, the Sudanese military reported several casualties on the Sudanese side of the border after an “ambush” by Ethiopian forces. In response, Sudan fortified multiple military outposts in al-Fashaga as revealed by Maxar imagery, and in January 2021 Sudan’s acting Foreign Minister Omar Gamer El Din announced that the military had begun placing physical markers every two kilometers to demarcate the territory. According to Ethiopia’s ambassador in Sudan, Yibeltal Aemero, when Ethiopians returned to al-Fashaga after fighting in Tigray, they found Sudanese army personnel looting property and burning camps. According to The Institute for Security Studies, the resulting skirmishes threaten to plunge Sudan and Ethiopia into a border war, which could further destabilize the entire region.

**SUDANESE MILITARY OUTPOSTS | UMM SETEIBA, SUDAN
FEBRUARY 22, 2021 | WORLDVIEW-3**



IMAGERY CAPTURED BY MAXAR SATELLITES SHOWS SUDANESE MILITARY OUTPOSTS JUST UNDER 8.5 MILES WEST OF THE SUDAN-ETHIOPIA BORDER. AN EXTENDED TRENCH IS GUARDED BY PICKUP TRUCKS FACING THE ETHIOPIAN BORDER.

**BEFORE ARMORY SHED ATTACK | TIGRAY, ETHIOPIA
MAY 28, 2020 | GEOEYE-1**



**AFTER ARMORY SHED ATTACK | TIGRAY, ETHIOPIA
MARCH 19, 2021 | WORLDVIEW-3**

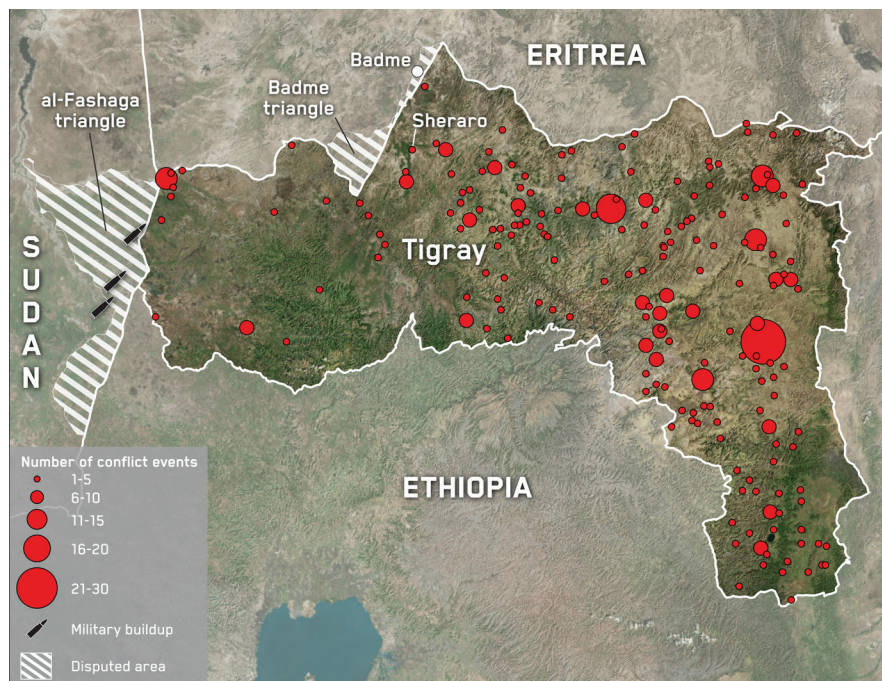


HISTORICAL CONFLICT OVER THE AL-FASHAGA TRIANGLE

Claimed by both Ethiopia and Sudan, the rich farmland of the al-Fashaga triangle is inhabited by Ethiopian farmers of the Amhara ethnicity who have been present in the region since 1993, as explained by Cameron Hudson, senior fellow with the Atlantic Council. Since 2008, Sudan has granted farming rights to those living in the triangle but since January 2021 has expressed the desire to remove Ethiopian farmers from the territory, according to The National. The Sudanese government cites a 1902 British colonial border demarcation as the authority for ownership of the land; Ethiopia rejects this border, arguing that Ethiopians have historically lived in al-Fashaga. Sudan’s top general, Abdel Fattah Al Burhan, expressed his refusal to sit in silence as Ethiopian farmers occupy al-Fashaga, vowing to defend to the death Sudan’s right to the territory.

IMAGERY REVEALS MILITARY BUILDUP ON SUDANESE BORDER

CONFLICT IN TIGRAY, ETHIOPIA



Military buildup sites in Sudan were identified using high-resolution imagery. Overlooking the Sudan-Ethiopia border, these outposts enable Sudanese security forces to monitor activity in the contested al-Fashaga territory. For this map, conflict density is symbolized from data starting at the beginning of the conflict in November 2020 through April 2021. Data breakdown for event type—including battles and violence against civilians—is also available.

BADME DISPUTE CONTINUES

Eritrea's interest in northern Tigray has its roots in an unresolved conflict with Ethiopia over a segment of land around the town of Badme on the shared border between the two countries. Eritrea desires to reclaim Badme and drive out Ethiopian inhabitants but faces difficulty working with the TPLF, which has stated that Eritrea is interfering with Ethiopia's internal affairs. The Institute for Security Studies notes that the TPLF is facing pressure from Eritrea, which may unintentionally complement Abiy's campaign against the TPLF in Tigray.

- 1998-2000: War between Ethiopia and Eritrea over Badme
- 2002: Territory awarded to Eritrea by U.N.
- 2003-2018: Cold war between Ethiopia and Eritrea
- 2018: Peace agreement between Ethiopia and Eritrea—Ethiopia announces withdrawal in Badme but does not withdraw
- 2020: International Crisis Group reports Badme reoccupied by Eritrean troops
- 2021: Dispute unresolved as Eritrean troops remain in Tigray as of May

BRIDGE CONSTRUCTION | SUDANESE BORDER MARCH 11, 2021 | WORLDVIEW-2



MAXAR IMAGERY SHOWS BRIDGE CONSTRUCTION 5.5 MILES WEST OF THE SUDANESE BORDER WITH ETHIOPIA.

MAXAR IMAGERY REVEALS EXTENSIVE DAMAGE TO HUMANITARIAN SITES

Maxar's Direct Access Program can be used to monitor refugee camp and humanitarian building footprints on a regular basis to assess expansion and quantify damage. For example, Maxar imagery captured two weeks apart revealed extensive damage to the Shimelba refugee camp. Confirmed as destroyed by the UNHCR, the camp housed Eritrean refugees, unspoken victims

of conflict in Tigray. To terrorize ethnic Tigrayan civilians and drive out aid workers, militants victims claim were Amhara destroyed a key U.N. humanitarian building in Hitsats, according to U.N. News. As shelters for IDPs and refugees are destroyed, thousands are further displaced, with many seeking refuge in neighboring Sudan.

BEFORE REFUGEE CAMP DESTRUCTION
SHIMELBA, ETHIOPIA | JANUARY 13, 2021 | WORLDVIEW-2



AFTER REFUGEE CAMP DESTRUCTION
SHIMELBA, ETHIOPIA | JANUARY 27, 2021 | WORLDVIEW-3



BEFORE HUMANITARIAN BUILDING DESTRUCTION
HITSATS, ETHIOPIA | JANUARY 5, 2021 | WORLDVIEW-2



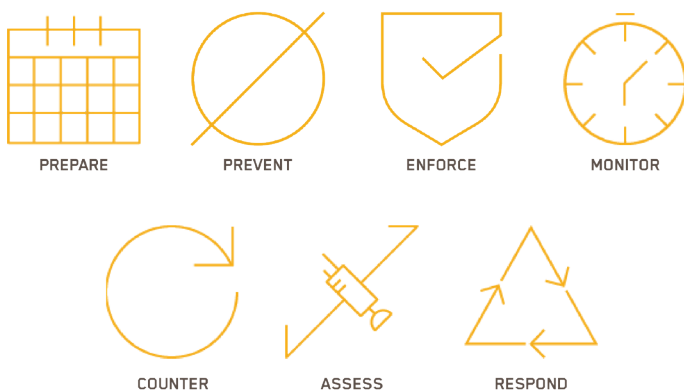
AFTER HUMANITARIAN BUILDING DESTRUCTION
HITSATS, ETHIOPIA | MARCH 19, 2021 | WORLDVIEW-3



DYNAMIC PROBLEMS REQUIRE DYNAMIC SOLUTIONS

Closely monitor key sites for change by ordering regular collects over key areas of interest. Maxar's Direct Access Program establishes a trusted alliance with select defense, intelligence and commercial customers to provide dynamic access to the industry's highest resolution, most accurate and spectrally diverse constellation of satellites. Through an emphasis on security, a high level of service and Maxar's fastest available throughput from collection to product, the Direct Access Program gives customers the ability to integrate the Maxar constellation with their existing source architecture without the cost or resource burden associated with satellite ownership. Sales of Direct Access Facilities are contingent on U.S. government review and approval.

DIRECT ACCESS PROGRAM



KEY FEATURES AND BENEFITS

- Humanitarian assistance and disaster relief
- On-demand tasking according to customer timing and mission requirements
- Priority access for ten best-in-class Earth observation satellites
- Adaptability allowing changes up to 15 minutes before image acquisition
- Satellite access window imagery processed and delivered 15 minutes after acquisition
- Secure, easy-to-use web portal for order management, collection requests and receiving imagery products

“They have destroyed Tigray, literally.”

- MULUGETA GEBREHIWOT | SENIOR FELLOW | WORLD PEACE FOUNDATION
CORRESPONDENCE FROM TIGRAY | JANUARY 27, 2021

CONCLUSION

At a news conference in Geneva, Switzerland, in May 2021, Director-General of the World Health Organization and ethnic Tigrayan Tedros Adhanom Ghebreyesus described the situation in Tigray as “horrific.” In April 2021, U.S. Ambassador to the United Nations Linda Thomas-Greenfield presented the Tigray crisis at a meeting of the U.N. Security Council, warning of the deteriorating humanitarian situation. In an article published in March 2021 by Just Security at New York University School of Law, the Atlantic Council’s Cameron Hudson summarized the international community’s hope for a long-term solution in Tigray with five goals: “a cessation of hostilities, unfettered humanitarian access, the removal of foreign troops, a process of justice and accountability for crimes committed, and for political reconciliation to occur.” As humanitarian, military and government planners look to deliver aid, counter violence and repair what the Ethiopian government estimates to be over \$1 billion in damages in Tigray due to the conflict, Maxar Earth Intelligence capabilities provide valuable insight to key decision-makers.



FOR A BETTER WORLD

Maxar is a trusted partner and innovator in Earth Intelligence and Space Infrastructure. We deliver disruptive value to government and commercial customers to help them monitor, understand and navigate our changing planet; deliver global broadband communications; and explore and advance the use of space.

Our unique approach combines decades of deep mission understanding and a proven foundation of commercial technology to deliver solutions with unrivaled speed, scale and cost-effectiveness.

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