In 2017, the United States dropped the GBU-43/B MOAB on an ISIS-held cave system in Syria. The “Mother of All Bombs,” as it is known, is the largest non-nuclear bomb in the U.S. arsenal, weighing in at 21,600 pounds. Perhaps it is because the People’s Liberation Army (PLA) DF-21 “Carrier Killer” missile is over 10,000 pounds heavier than the MOAB that its unveiling has been termed a “Sputnik Moment” for the PLA Navy. Whatever the case, the Carrier Killer is a culmination of decades of investment by the PLA in anti-access and area-denial capabilities.

It is this anti-access and area-denial capability that the Marine Corps’ Expeditionary Advanced Base Operations (EABO) seeks to contravene. The EABO concept pushes the Marine Corps to operate within and disrupt the pacing threat’s weapon engagement zone, which will set conditions for the Navy to safely project power. It is an eerie repeat of the Island-Hopping Campaign against the Japanese Imperial Army.

As the Marine Corps prepares to operate stealthily in our adversaries’ backyards, signature management is now in vogue. The June 2020 Signature Management Camouflage SOP elaborates that “to be detected is to be targeted is to be killed [and therefore] units must ruthlessly reduce their signature.” The urgency to reduce operational signatures has permeated training at all levels, but a better appreciation for the sophistication of observation and signature collection techniques available to a modernized adversary is still needed. Indeed, such an understanding may prompt novel ways of improving signature management. In this article, I argue that the proliferation of low-orbit satellites and geospatial imaging systems in conjunction with advancements in machine learning pose a unique challenge to the EABO concept.

Regarding satellites, it is clear that after a several-decade break in the action, the space race is back on. In 2019 the United States established the Space Force—the first new branch of the military since the Air Force’s introduction in 1947. In the years since, the need for a Space Force has been evinced time and time again. In 2021, a Chinese spacecraft reached the moon. Some estimates suggest that between 2019 and 2021 the number of active satellites more than doubled to 4,877. Domestically, the private sector has thrown its hat in the ring. Jeff Bezos and Elon Musk have vied for NASA’s contracts, and each has their eyes set on Mars. While many satellites exist purely to enable communications, others have geographic information system (GIS) imaging capabilities. The earthly consequences of advanced GIS are already being felt. A litany of crimes has been solved thanks to Google Earth. Satellites are only one GIS asset class; UAS also increase their owner’s situational awareness and are also proliferating in their number and power.

Significantly, denial of these GIS assets to an adversary in the present operating environment is a steep ask. The technology driving GIS follows Moore’s Law. The equipment keeps halving in size, halving in price, and doubling in power. Furthermore, satellites occupy the vastness of space, making them dubious targets. Shooting down satellites in the name of signature management may strike policymakers as asymmetric. As GIS assets proliferate, so too does the data they generate. Gone are the days when Google’s lone GIS satellite gradually stitched together granular images of the Earth’s surface. Particularly in contentious areas of Earth (think: the Spratly Islands), the 21st century has heralded near-continuous geospatial surveillance of the planet’s surface.

Paired with the data created by GIS assets, advances in machine learning (ML) may be ruinous for EABO’s signature management ambitions. The black box of advanced ML can detect signatures that transcend human comprehension. Already, we have examples of predictive algorithms, which can efficiently key in on relatively traditional signatures. Algorithms trained on ...
Google trends’ geographic search data were able to better predict the spread of COVID-19 than models trained on epidemiological data. In medicine, ML promises to bring the precision of big data to diagnostic and prognostic processes. In advertising, ML has rapidly become ubiquitous, being the impetus for the targeted ads we all receive nowadays. The human experience with ML over the past decade suggests that it ought to be able to, with devastating efficiency, complete the relatively simple task of identifying concealed troops and military installations via satellite imagery. Marines executing EABO may be imperceptible to human detection but avoiding detection by ML is an entirely different matter.

There are two prerequisites to developing effective anti-EABO diagnostic tools with GIS and ML. First, our adversaries require robust, ongoing inputs. That is, to take advantage of the hypothetical detective capabilities of ML, current GIS images are needed. To meet this requirement, our adversaries will need to maintain surveillance of the area of operations, with satellites or drones always on site. Second, our adversaries require training data. Before ML can diagnose cancer, it needs human input on thousands and thousands of PET scans, tagging each as showing a cancer or not showing a cancer. So long as the human inputs are generally correct, ML can build arcane strategies to detect cancer, keying off signatures incomprehensible to the human mind and yielding much greater accuracy. ML used to diagnose the presence of an expeditionary advanced base from an image taken by a low orbit satellite requires a training data set of past images of such bases, with the disposition of EABs identified by humans. In peacetime, there is little we can do to prevent our adversaries from collecting satellite imagery on our equipment and training exercises. It is likely that our adversaries have rooms upon rooms of analysts parsing images of training exercises identifying what U.S. military equipment looks like from low orbit. These images will be used to train ML that can be employed in the decisive moment to locate expeditionary advanced bases.

Taken as a given that the enemy will have access to these tools, there are a few ways to limit this advantage and enable EABO. First, there is the notion of attacking the dataset. The United States could build similar algorithms and then through experimentation identify markers that fool the ML—telling the AI that the piece of equipment is not, in fact, itself. A HIMAR covered in ferns and painted green may still be identified as a HIMAR, but perhaps if the HIMAR’s signature to the human eye, but dispersed on islands thousands of miles apart, the ability of a human to identify the HIMAR from the deck is much less significant than that of detection from above.

Being able to beat the ML has the added benefit of creating absolute surprise. If the enemy puts faith in ML to detect our presence and said ML informs the enemy that there is no U.S. presence on a given island, despite the existence of a FARP or an EAB, then the ultimate condition will be more favorable to the United States than if the enemy never evaluated the island. Rather than identifying the island as potentially containing U.S. forces, the island will be deemed to be free of U.S. forces, granting an added layer of stealth.

Second, denying the enemy continuous data for the ML to evaluate (i.e., knocking GIS satellites and assets out of the sky) will cripple ML assets trained on GIS data. In a hot war, this will be the last on a laundry list of reasons to target enemy satellites. It is in the build up to conflict and in cold wars where the enemies’ GIS satellites will continuously prod and observe, evaluating our positions and inhibiting the ability of the Corps to begin emplacing concealed EABs.

The word of the day is signature management, but without an adequate understanding of the ability of the enemy to observe signatures, efforts to reduce our signature will be misguided. In the modern Pacific theatre, signatures will be collected by low orbit satellites and evaluated by ML as often as they are collected by the human eye and evaluated by the human mind. If EABO is to succeed, Marines across the board should need to accept, understand, and address the GIS plus ML reality, else it spells a death knell for EABO.