Predictive Analytics

Confronting climate change instability

by Maj Jacob P. Jones

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When conversing about the future battlefield and challenges that may occur, many discuss the enemy the United States might face, such as nation states, non-nation states, or nefarious actors. Debates also address future Marine Corps capabilities and equipment, including artificial intelligence, body armor, or unmanned vehicles. However, one injection that receives minimal attention is climate change and the consequences it will have on the spectrum of operations to which the MAGTF may be exposed. In October 2018, the Intergovernmental Panel on Climate Change (IPCC) published *Global Warming of 1.5 Degrees Celsius,* which indicates there will be an increase in global temperature of 1.5 degrees Celsius between 2030 and 2052.[1] Based on this prediction, rising temperatures could pose significant threats to human activity. As days and nights become warmer, crop failures may surge, ocean levels may rise, and the demand for fresh water may intensify as ground water resources dry.[2] The IPCC *Synthesis Report* and Sonja Vermeulan's assessment of the IPCC *Synthesis Report,* "Climate Change, Food Security and Small-Scale Producers," mention the prospect of increasing food insecurity concerning not only agriculture but also the survival of marine species and fisheries impacted by ecosystem shifts.[3]

Climate change will define the future battlefield as areas of economic depression and resource-constrained regions—especially in islands and the littorals—become unstable, resulting in large population migrations to more resource abundant locations. Increased instability will impose significant strain on MAGTF operations, depleting Fleet Marine Force resources and elevating fiscal costs as the Marine Corps prepares for and executes security, humanitarian assistance and disaster relief, and combat missions.

The Department of Defense, recognizing this threat to U.S. security, published the *2014 Climate Change Adaptation Roadmap* (CCAR), proactively establishing measures to combat climate change. One such measure was to identify areas where "poverty, environmental degradation, political instability, and social tensions" may occur because of the stress of climate change.[4] Additionally, the CCAR emphasized the need to assess the demand for humanitarian assistance and disaster relief capabilities. Committed to meeting the mandates outlined in the CCAR, big data (BD), machine learning, and predictive analytics can be a weapon of choice. Through the collection of data ranging from social media, weather instrumentation, crop yields, and healthcare facilities, models can be created to provide descriptive analyses of past occurrences and forecast future developments concerning resources and population centers. The Marine Corps can use these models to prepare and position MAGTF resources in the most suitable locations.

The goal behind data science and predictive analytics is to take a collection of raw data, whether structured or unstructured, and produce knowledge that can influence decision making.[5] BD tools can be used to derive patterns, find relationships and associations, and make connections that are otherwise unknown.[6] These techniques can be employed on a variety of data sources to determine future behavior. Joseph and Kakade discussed how using the emergency events database from the World Health Organization can present

Unpredictable weather changes can impact terrain and trafficability. *(Photo by Sgt Tatum Vayavanada.)*

descriptive diagnostics of areas prone to disaster.[7] By clustering disasters and regions, the research demonstrated how predictive analytics can be used to ascertain future consequences. Additionally, an article published by the Institute of Electrical and Electronics Engineers, titled "Forecasting Hotspots," describes time-series and geospatial models of various healthcare data sets used to predict locations of possible medical outbreaks.[8] These examples indicate how a decision maker can use BD techniques to discover information that improves judgment and augment decisions to maximize outcomes.

The Marine Corps' employment of predictive analytics and machine learning as a weapon is a two-part process, iterative in nature, adapting as necessary to produce the most beneficial outcome. The first phase is to use BD and data science to identify regions of concern. As temperatures and sea levels rise, predictive analytics can be applied to uncover potential areas or regions where famine, drought, economic decay, resource pressure, disease, population growth, and migration may result. In partnering with academia, industry, and other government and non-government organizations, analytic findings can be verified and ensure the corroboration of forecasted solutions. The second phase is for the Marine Corps to lead a whole-of-government initiative to draw attention to areas identified as potentially unstable. Information discovered not only facilitates the ability to preemptively position MAGTF assets in areas of potential unrest but, by leveraging geographic combatant commanders in conjunction with the whole of government approach, the Marine Corps could cooperate with regional partners and potential adversaries regarding potential areas of concern. Emphasis on initiatives that foster theater support teams and collaboration with Chiefs of Mission and host-nation representatives will cultivate awareness and support action.

The strategic message is one that seeks to proactively forecast regions of instability and generate solutions before chaos ensues. Industry, host nations, regional partners, and the Marine Corps can collaborate on approaches best suited for each region, focusing on the population's needs to produce a sustainable future. Utilizing technology and imaginative methods to manage resources, population centers can be provided tools by whole of government initiatives to maximize resources and maintain economic security under the growing stress of climate change. Before regions become potentially inhabitable, such as islands or dry climates, host and adjacent nations must determine the best means for population migration. Additionally, economic stability needs to be resolved to support possible migration through final refugee locations.

An additional challenge concerning future behavior involves geopolitical tension and struggles for regional or global dominance. Aggression, rather than cooperation, in the management of resources may appear and produce geopolitical disruption. Nations under stress may cease to collaborate or impede cooperation. Over time this behavior may manifest itself, and this is why this process would be iterative. Frequent application of BD techniques may unearth adverse or harmful behavior, which could be coped with early before relationships or tensions become destructive.

The trends highlighted in the 2014 IPCC *Synthesis Report* and the 2018 *Global Warming of 1.5 Degrees Celsius* report both portray a future that will experience global challenges for all nations. Unfortunately, because of an already hot climate, nations in the tropic and sub-tropic regions will shoulder more burden as temperatures increase in the next few decades.[9] To strategically align with the CCAR's directive, it will benefit the Marine Corps to preemptively engage this dilemma before instability occurs. An aggressive approach will set the tone for nations to seek solutions that may not be avoided. Rather than be reactive, the Marine Corps must view climate change as a belligerent needing immediate attention. Applying data science and predictive analytics, the Marine Corps can assume an offensive posture, pooling resources from a myriad of organizations and nations to strengthen stability and minimize insecurity. Before positioning limited MAGTF assets and organizations in regions that may require humanitarian assistance and disaster relief, or more aggressive military action, the Marine Corps can use BD technology today as a weapon to fight the global enemy of tomorrow.

Notes

1. Staff, *Climate Change 2014: Synthesis Report–Summary for Policy Makers*, (Geneva, CH: Intergovernmental Panel on Climate Change, 2014).

2. Staff, *Global Warming of 1.5 Degrees Celsius*, (Geneva, CH: Intergovernmental Panel on Climate Change, 2018).

3. Ibid. See also Sonja Vermeulen, "Climate Change, Food Security and Small-Scale Producers: Analysis of Findings of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change," (Frederiksberg, DK: Climate Change Agriculture and Food Security, 2014). Additional information available at https://ccafs.cgiar.org.

4. Department of Defense, *2014 Climate Change Adaptation Roadmap*, (Washington, DC: 2014).

5. Amir Gandomi and Murtaza Haider, "Beyond the Hype: Big Data Concepts, Methods, and Analytics," *International Journal of Information Management*, (Amsterdam, NL: Elsevier, 2015).

6. Ibid.

7. C.K. Joseph and S. Kakade, "Predicting impact of natural calamities in era of big data and data science," *International Congress of Environment and Modelling and Software*, (2014), availale at https://scholarsarchive.byu.eduiemsconference/2014/Stream-G/15/.

8. Ross Maciejewski, Ryan Hafen, Stephen Rudolph, Stephen Larew, Michael Mitchell, William Cleveland, and David Ebert, "Forecasting Hotspots: A Predictive Analytics Approach," (Piscataway, NJ: IEEE Transactions on Visualization and Computer Graphics, 2011).

9. *Global Warming of 1.5 Degrees Celsius.*