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Defense community perspectives on uncertainty and confidence judgments

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Abstract In 2007, the CNA Military Advisory Board (MAB), an expert panel composed of 11 retired admirals and generals from the United States, identified climate change as a "threat multiplier" for instability in some of the most volatile regions of the world. (CNA MAB *National security and the threat of climate change* 2007)The Department of Defense reached a similar conclusion in last year's Quadrennial Defense Review–a legislatively mandated analysis of the Defense Department's strategy and priorities. This document frames the long-term course for policy decision-making at the highest levels. The reports demonstrate that climate change and energy are now mainstream elements of national security planning, and can be assessed within the frameworks used to evaluate other threats, risks, and responses. However, the exact magnitude of the threat posed by climate change is difficult to calibrate in part because the language used by scientists to predict uncertainty and the confidence levels of judgments is not sufficiently clear. The defense community has a vast amount of experience exploring and dealing with uncertainty. Scientists trying to better describe the effects of climate change may be able to draw lessons from the defense community's approach to uncertainty including how to better communicate findings to wide audiences including policy-makers.

1 The national security approach to uncertainty

Nearly all aspects of warfare are variable and uncertain, guaranteeing that decisions must be made in ambiguous environments. As the famous Prussian general and theorist Carl Von Clausewitz observed in the early 19th century, outcomes are dependent not only on observable characteristics such as the size of adversaries' forces but also on factors that are harder to quantify such as troop morale. Clausewitz referred to this uncertainty as the "fog of war."

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Nonlinear characteristics of the climate system, such as feedback loops, create conditions of uncertainty similar to the fog of war. In 2007, General Gordon Sullivan, former U.S. Army Chief of Staff and Chairman of the CNA MAB, was one of the first national security experts to call for addressing the consequences of climate change despite this uncertainty. Taking an example directly from warfare, he observed that "you have to act with incomplete information and according to the trend line .... if you wait until you have 100 percent certainty, something bad is going to happen on the battlefield. That's something we know." (CNA MAB 2007)

2 Risk management

The defense community's particular approach is to view uncertain outcomes as risks and use risk management techniques as a framework for addressing them. Conceptually, uncertainty is neither inherently positive nor negative. However, national security analysis deals in worst case scenarios; uncertainty in the national security arena can lead to catastrophic consequences—widespread death and massive property destruction. In this context, uncertainty becomes a kind of threat, and the U.S. military has extensive experience in even the most existential sort of threat.

On the strategic level, various groups of the defense community use a risk management approach that can be broken down into three components:

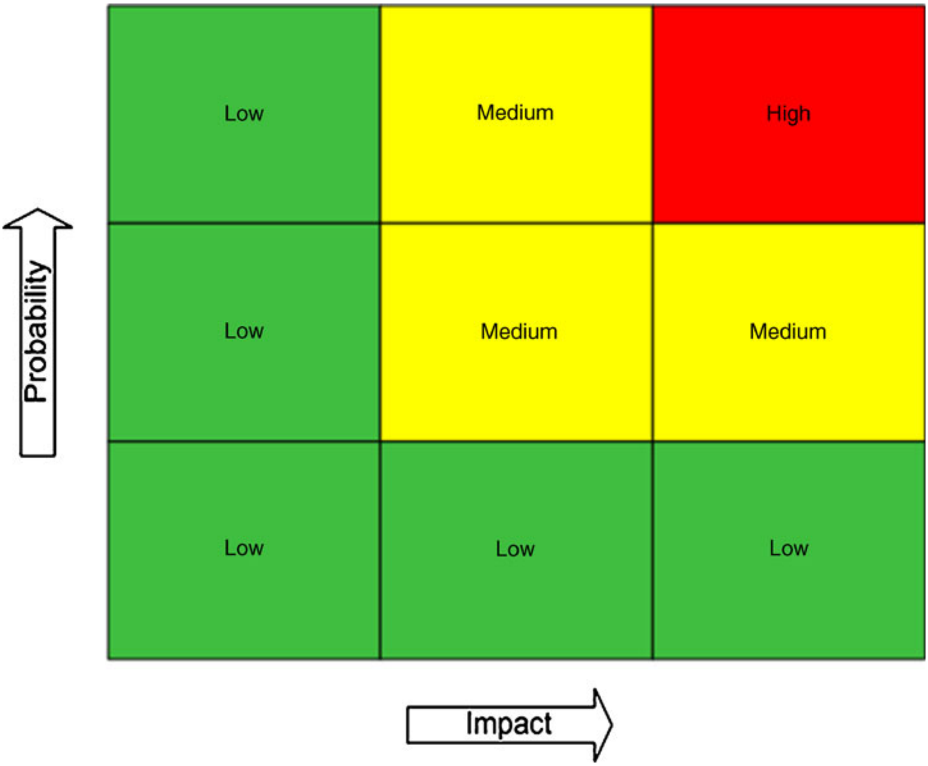
- Defining the risk
- Measuring the risk
- Making decisions about how to address the risk

The U.S. Army applies a more refined five step risk assessment process applicable to decision-making on the tactical level:

- Identify hazards
- Assess hazards
- Develop controls and make risk decisions
- Implement controls
- Supervise and evaluate (U.S. Army 1996)

The first two steps in each of the above processes are the most relevant to the reporting of the Intergovernmental Panel on Climate Change (IPCC) working group. National security and scientific analysis are similar in the sense that they can both employ risk assessment and intelligence analysis methods that can better define and assess problems. However, making decisions about how to address these problems is the policy-makers' responsibility.

The following diagram illustrates a basic risk categorization technique.



Source: “Eight to Late” Blog, accessed 24 Feb 2011 at http://eight2late.wordpress.com

Once a risk is defined or identified, the defense community can then apply a basic analysis. The risk is plotted on a probability/impact axis with the probability on the X axis and impact on the Y axis. So probability multiplied by impact equals risk. The most urgent threats are the high-probability, high-impact events found in the upper right quadrant of the matrix.

This device has also been used in relation to climate change impacts. In a 2009 report on climate risk management, the New York City Panel on Climate Change used a similar two dimensional matrix to categorize levels of risk to infrastructure and to determine whether adaptation strategies were necessary. (Rosenzweig and Solecki 2009)

3 Intelligence analysis and uncertainty

Intelligence analysis is another tool used by sectors of the defense community to explore, quantify, and reduce uncertainty. The key endeavor of intelligence analysis is to find likely outcomes of working with ambiguous evidence.

Within the defense community, it has long been suggested that the reporting of intelligence findings can benefit from the use of more analytically precise terminology. Dr. Sherman Kent, the seminal figure who founded the Central Intelligence Agency's Office of National Estimates in the 1950s, is given credit for formalizing analytical tradecraft and methodologies. These methods have informed current national estimates, such as a 2008 National Intelligence Assessment of the National Security Implications of Global Climate Change to 2030. Kent was the champion for using precise "words of estimative probability" where percentages could be applied to descriptive phrases. For example, an "almost certain" outcome equated to a 93% probability, give or take about 8%. (Kent 1964) Although the use of quantitative probability estimates has not necessarily prevailed within the entire intelligence community, lessons can be drawn from Kent's attempt. Members of the IPCC working group communicating the impacts of climate change may consider applying this sort of quantitative rigor to framing and communicating uncertainty and confidence judgments. A core writing team has developed guidance on consistent treatment of uncertainties for Lead Authors of the IPCC Fifth Assessment Report that calls for such use of calibrated language to communicate at the appropriate level of precision.

4 Deterrence and the Soviet nuclear threat

The prospect of nuclear annihilation during the Cold War was a threat that was easy to define but difficult to measure using the risk management processes we have described. Nuclear deterrence is based on uncertainty about the opponent's possible capabilities and actions. Mutual uncertainty about the severity of the opponent's reaction to a nuclear buildup may have prevented suicidal offensive action but it also encouraged preparation for the worst possible outcome.

Today, national security analysts widely perceive Cold War estimates of the Soviet's nuclear arsenal's size and corresponding threat level to have been exaggerated given information available today. It should be noted that Sovietologists also disagreed about the magnitude of the risk at the time. And while Sovietologists disagreed about measuring the probability or severity of the risk, it was an abundance-of-caution approach that dictated the decision to pursue a massive defense buildup.

5 Counterterrorism

Before 9/11, national security analysts almost universally considered mass casualty or so called "spectacular" terrorist strikes to be low probability, high-impact events. Again, the risk of future attacks is well defined but difficult to measure. The exact odds of large scale strikes against U.S. targets are hard to calculate. The defense community's current approach to dealing with the uncertain risk of terrorism is not only to prepare for low probability/ high-impact events but also to prepare for all dangers from terrorism across the threat spectrum. As is the case with scientific inquiry, deliberation within the intelligence community about defining and measuring risks can be healthy because it can lead to more accurate quantification and articulation of the threat. The bottom line is that terrorist strikes of any magnitude are unacceptable outcomes requiring extreme vigilance and preparation regardless of the exact probability of occurrence.

6 Nuclear proliferation

One of the most salient international security issues is the possibility of nations such as Iran taking advantage of dual-use nuclear power technology to develop a nuclear weapons program. In this case the intelligence thus far has been murky so it is difficult to identify the likelihood of this outcome. The U.S. government is continuing to develop policy responses to address the risk even as the efficacy of these policies—such as sanctions— is uncertain.

Many, but not all, of America's most significant national security challenges such as spectacular terrorism fall into the category of low-probability high-impact events. The threat of climate change may present a different challenge altogether. Although they will not necessarily occur in the United States, some of the impacts of climate change identified as likely outcomes by the 2007 Summary for Policymakers of Working Group Two's contribution to the IPCC's Fourth Assessment Report (AR4) fall into the category of high-probability high impact events. The impacts may have second and third order consequences by creating instability in nations that are of concern to U.S. national security interests. For example, the summary indicates that by 2020, between 75 million and 250 million people in Africa are projected to be exposed to increased water stress due to climate change and that if this exposure is coupled with increased demand it will adversely affect livelihoods. (Parry et al. 2007) However, the most severe impacts of climate change such as extreme sea-level rise may be low probability high-impact events. The low probability of occurrence does not mean that they should be ignored.

The above IPCC projection of water stress in Africa can be used to illustrate how the defense community or intelligence approach could be applied for more effective communication to policymakers. First, the language here would benefit from more exact words of estimative probability such as those recommended by Kent for intelligence analysis. The phrase states that Africans are projected to suffer from increased water stress and this coupled with increased demand could lead to an adverse effect on livelihoods. Phrases like "could lead" are manifestly imprecise. It would also be useful for the writer to provide some context by explaining possible causes of the increase in water demand, such as population growth, and express this possibility to the policymaker in the most precise language possible.

Second, to suit the needs of the policymaker, the writer might also look at the projected effect of water scarcity on Africans' livelihoods and highlight possible second and third order outcomes including those "at the tails" of the probability curve. One such outcome could be large-scale disruptive migration. So use of methods such a closer examination of causal linkages, more precise language, and consideration of second and third order can provide policymakers better context for understanding how water scarcity can become a "risk multiplier" for instability on the African Continent.

7 Defense community and scientific approaches to uncertainty

The defense or intelligence community approach and mainstream scientific approaches to uncertainty analysis vary in certain key respects that are worth noting. Intelligence analysis, particularly at the strategic level, tends to be prescriptive because it is designed for use by decision-makers at the highest levels of government. Generally, scientific analysis is tailored for further consideration of the academic community. The IPCC impacts assessments Summaries for Policymakers are a notable exception because they are tailored for that audience.

Intelligence analysis and scientific analysis can be differentiated by their respective methodologies. Intelligence analysis follows prescribed methodologies but it often informs decisions that must be made under urgent deadlines. Scientific inquiry generally operates under longer timeframes. The scientific method follows a deliberate, predictable pattern that includes rules for concept formation, conduct of observations and validation of hypothesis through experimentation. This peer review process is intrinsic to rigorous scientific inquiry. The scientific community tends to withhold judgment and proscribing action until the method has been carefully applied and consensus exists.

As we have noted, defense community assessments give significant treatment to low probability/high-impact events. Due to a consensus-driven review process and other institutional factors inherent in their exploration of uncertainty, the scientific community biases against identifying and communicating high severity impact low probability outcomes.

8 Unanticipated consequences and innovation

The myriad of contemporary and emergent international threats ensure that national security decision-makers will be obligated to make bold decisions in the face of uncertainty. It will be important to provide decision-makers with the most “actionable” information about the climate possible.

In addition to meeting the essential goal of safeguarding national security, bold actions by the defense community supported by solid planning have generated other unanticipated, benefits. In 1957, the Soviet’s surprise launch of Sputnik 1 raised doubts about the military’s ability to defend the nation. The ensuing civilian space program, which had its roots in military research, sparked the space race that came to characterize the Cold War. The space program inspired a great sense of national pride but also led to a raft of inventions that carried larger benefits to society.

The establishment of a robust military industrial base to address the Soviet threat was one factor leading to U.S. victory in the Cold War. This buildup also carried positive secondary effects such as sparking the growth of spin-off industries. The military tradition of planning for contingencies and hedging against high risk threats has helped nurture a culture of innovation producing inventions such as the internet, global positioning systems, advanced jet engines, and nuclear power. Optimism in the face of uncertainty is a major factor that has also catalyzed private sector entrepreneurialism.

Powering America’s Economy, Energy Innovation at the Crossroads of National Security Challenges, the most recent report by the CNA MAB states that because of its size, the considerable amount of energy it consumes, and its extensive experience in technological innovation, the Department of Defense is uniquely positioned to spur innovation in the area of clean energy. (CNA MAB 2010) Clean energy technologies such as advanced biofuels can play a key role in mitigating climate change.

Technological innovation carries other benefits. It can be a key to strengthening the national education system. Mastering new technologies demands better academic and professional preparation. New infrastructure is required to manufacture and operationalize these technologies. These developments will serve to increase U.S. competitiveness during troubling economic times.

Developing clean energy options that mitigate climate change even while there is some uncertainty about its magnitude may not only cool the planet but it could also have positive consequences for the U.S. education system, technology infrastructure, and global competitiveness.

9 Clearing the fog

The defense community's experience dealing with uncertainty leads us to three conclusions:

- First, developing and considering worst-case scenarios is intrinsic to the national security risk assessment process. The IPCC (AR5) impacts assessment working group may benefit from giving more treatment to worst-case scenarios rather than to the most likely outcomes when quantifying and communicating risks associated with climate change. Decision makers should be able to consider the higher risk, lower probability global changes that could occur from climate change.
- Second, the IPCC (AR5) impacts assessment working group may consider emulating Sherman Kent's approach to confidence judgments by applying more quantitative rigor to descriptive terms. This approach could lead to more robust conclusions that provide a better tool for decision-making under accelerated timeframes. Indeed, legal standards have long conveyed probabilities. For example, "More likely than not," is considered to be slightly more than 50% probability of an event occurring, whereas "Beyond a reasonable doubt," the standard for a criminal conviction, is considered to require over 90% certainty by the juror that the defendant committed the act.
- Finally, although the AR 5 process is significantly underway, the IPCC may consider including national security analysts in the interdisciplinary group of authors and reviewers and incorporating climate impacts assessments reports produced by national security organization into their findings.

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