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Climate and National Security: Exploring the Connection

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The Marshall Institute – Science for Better Public Policy

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The change wrought by a warming planet will lead to new conflicts over refugees and resources; new suffering from drought and famine; catastrophic natural disasters; and the degradation of land across the globe.

National Security Strategy (Executive Office of the President 2010, 47)

Climate change will affect [the Department of Defense] in two broad ways. First, climate change will shape the operating environment, roles, and missions that we undertake … Second, DOD will need to adjust to the impacts of climate change on our facilities and military capabilities.

Quadrennial Defense Review (U.S. Department of Defense 2010, 84-85)

Rising sea levels, severe droughts, the melting of the polar caps, the more frequent and devastating natural disasters all raise demand for humanitarian assistance and disaster relief.

(Secretary of Defense Leon Panetta 2012)

These statements reflect how firmly entrenched climate change has become as a "national security" issue for the U.S. The *National Security Strategy* defines the Obama Administration's vision of the security interests of the United States and calls for actions designed to preserve those interests. The *Quadrennial Defense Review* identifies the strategic challenges as seen by the U.S. military. Together, through their references to climate change, both represent the culmination of a trend long in development — the institutionalization of environmentally-induced conflict as a U.S. security concern. Secretary Panetta's comments to the Environmental Defense Fund in May 2012 illustrate how deeply ingrained the issue now is, and his remarks raise important questions about how environmental issues will influence future force planning and strategic vision.

To say that environmental conditions affect U.S. national security is true, of course. George Washington exploited environmental conditions to the advantage of the Revolutionary Army. The D-Day invasion was delayed due to environmental uncertainties. But, examples such as these stand in sharp contrast to the current debate. Those examples would be chalked up as simply weather events influencing a single combat operation. The *National Security Strategy* and the *Quadrennial Defense Review* classify environmental concerns as matters exerting influence on future national power, not just temporary phenomenon of tactical importance. Anthropogenic climate change, characterized by a rise in global temperature, or, as the *Strategy* states "the change wrought by a warming planet," is expected to lead to all sorts of calamities —and those calamities are judged significant enough to negatively harm U.S. security interests.

Does a changing climate pose national security problems for the United States? This question is answered increasingly "yes." And, with that affirmative answer, strategies, programs, and budgets are changing with significant implications for the future.

Secretary Panetta's comments are most informative: they suggest that U.S. security planners envision the expanded use of the U.S. armed forces for humanitarian and disaster relief purposes. Others see expansion of Department of Defense (DOD) weather and climate monitoring capabilities as a likely response to this new security concern. The DOD's examination of its energy use and consideration of alternative fuels and electricity generation are inevitably linked with the climate debate as well. The effects are felt in more than just policy statements and speeches. Programs and budgets set courses for the purchase of new equipment and capabilities, along with the development of new systems, technologies, and research which are difficult to change or cancel.

Speculating about those factors which will shape the security environment of the United States over the course of a century is intellectually stimulating, but such forecasts are rightly considered as little more than guesses about the future. Indeed, forecasts about the character of the international security environment, made on time scales much tighter than those foreseen by climatic changes, prove frequently to be inaccurate. Even so, the conclusion that climate change affects U.S. security interests should not be accepted uncritically. Despite being reiterated by a bevy of government and non-government reports and assessments, the linkage between human-induced environmental calamity and conflict remains tenuous, and it is dependent upon assumptions concerning the present and future state of the environment, as well as the causes of conflict. Yet, the intelligence community, numerous think tanks, and retired senior military officials report with confidence that (1) climatic change will occur (2) with sufficient severity that (3) dislocations generating conflict will occur, and (4) these conflicts will negatively impact the security of the United States, and (5) therefore require mitigation strategies to address emissions of greenhouse gases and investments in new military equipment and force planning.

At its core rests the fundamental belief that environmental stresses can create conflict in the international system. A causal linkage is said to exist, and those stresses are expected to generate a host of "Dantesque" consequences (Lane 2008). Rising temperatures caused by humanity's greenhouse gas emissions will disrupt water cycles (either through droughts or floods) or generate more frequent and intense storms, disturbing food production, causing species extinction, and leading to refugee flows or competition over scarce resources. These deteriorating environmental circumstances create instability within states, causing social disorder and civil strife, creating conditions for conflict between states over resources, and weakening states internally through social disruption to allow non-state groups (including terrorists) to flourish.

Together these arguments form a seemingly logical approach, but, as will be discussed, each step involves acceptance of two separate sets of arguments, each with its own set of assumptions, theories, and variables. The arguments are sequential and additive, meaning that each action creates a response leading to another action. The overall argument weakens substantially if it can be shown that environmental stressors are not sources of intrastate instability or interstate conflict — or if temperatures do not rise as much as predicted or expected, implying that environmental conditions may not worsen enough to cause instability or conflict. Each set of arguments is examined, as

are the methods and the evidence used to support the central claims. This review shows that there are many elements of each argument which remain unknown, unmeasured, and unverified. To base national strategic goals, national security policy, and defense budgeting on such speculative conclusions is unwise.

Setting aside disagreements about how the climate is changing, the sources of those changes, and whether those changes are on the scale needed to trigger humanitarian disasters or resource wars, four features of the climate-security issue argue against it becoming anything other than an intellectual exercise in defense and security planning:

1. There is no empirical proof for the causal connections between climate change and conflict. For climate change to create security problems, a host of environmental, economic, social, and military steps must occur. The environmental conflict literature offers scant support for claims of droughts, floods, storms, or resource scarcities leading to conflict within or between states.
2. There are many alternative causes for conflict. Studies of the causes of conflict, and, indeed, the evidence offered in support of the climate-security argument, show that numerous other causal factors affect whether tension evolves into hostility, thereby confounding the explanatory power of environmental variables. Therefore, even if environmental factors were removed, conflict remains a possibility, and any security interests of the U.S. remain in jeopardy.
3. There is a mismatch of planning horizons. The scenarios depicting the impacts of climate change run 20, 30, 50, or 100 years or more before demonstrable effects are manifest. While some scholars may ponder the security interests of the U.S. or the state of world geopolitics over such spans of time, planning for budgets, programs, and strategies at such lengths offers little utility to the policymaker, the armed forces, or the program manager.
4. There is an assumption of static U.S. interests. Arguments favoring the securitization of climate change assume U.S. interests remain unchanged and further assume that the U.S. remains actively engaged and enmeshed. Over the periods considered, it is reasonable to assume that the interests of the U.S. will change. Economic realities may force a more limited international role, the American people may not support foreign interventions, other nations may adopt some of the global responsibilities previously shouldered by the U.S., or a new 'Cold War'-like balance of power may emerge to restrain interstate conflict. Any of those outcomes is theoretically plausible over a period of 20-50 years and each would suggest a redefinition of U.S. security interests. More importantly, if the climate-security argument is correct, and climate-induced conflicts and effects are evident, the U.S. likely will not respond to those future challenges in the same manner it does today.

Joining these four considerations are questions about how the climate is changing, how it will change, and what causes these changes. While these factors are only briefly considered here, the review shows that there are fundamental questions about theory, evidence, and the predictive accuracy of the models used to forecast deleterious effects of global warming. For purposes of evaluating the security implications, these

uncertainties cut against the probability of security crises rising to the level of significance suggested. Further, there is some general evidence supporting the notion that a warmer climate is more peaceful.

Of greater concern for the U.S. are the implications to be drawn from efforts to link climate with national security. The climate-security connection is used by some as justification for greenhouse gas mitigation policy. Taking action now to reduce emissions, in order to avert these terrible security consequences, is good policy, as the argument goes. Including security activities needed to respond to these challenges improves the cost-benefit ratio in favor of mitigation through the avoidance of those activities, it is claimed. Such an approach is clearly flawed. Agreeing to such logic requires one to overlook the evidentiary and methodological flaws in the arguments and accept that the consequences are so bad that action is warranted regardless of probability. Mitigation policies deserve evaluation on their own merits.

Environmental degradation is said to spark social instability and interstate conflict through its effects on economic growth. But, if the declining rate of economic growth is a key variable for triggering instability and conflict, then the greenhouse gas mitigation approach can be critiqued using the same national security arguments. Mitigating greenhouse gases requires reducing the use of fossil fuels, the principal sources of human greenhouse gas emissions, and the cheapest forms of energy. As a valuable input to the industrial process and a leading component of the consumer economy, cheap energy contributes directly to economic growth, rising standards of living, and also to improved health. Efforts to control greenhouse gas emissions by curtailing use of energy or replacing cheap energy with expensive energy reduces economic growth and worsens those very conditions that breed poverty, instability, and violence.

Another use of the climate-security argument is to justify investment in military systems and strategies designed to respond to the crises already expected to occur. Addressing climate conflicts thus becomes a new mission used by industry, politicians, and others to defend existing programs or validate new ones. In a resource-constrained environment such as that presently facing the defense sector, pressures to broaden the utility of systems and programs are high, but doing so is often wasteful, inefficient, and distracting. Systems that should be phased out may be saved or new systems begun that otherwise lack utility. For example, the Center for a New American Security (CNAS) is using the security threats of climate change to justify investments to close a capability gap they see in earth monitoring satellites. These satellites "are going dark" by 2016 "leaving a crucial information gap that will hinder national security planning" in response to environmental and climate change impacts (Parthemore and Rogers 2011). Earth monitoring satellites provide the kind of high-quality observational data necessary to evaluate how the climate is changing, but, as the CNAS paper reveals, linking these capabilities to national security objectives relies on the same methodological approach and logical leaps as does the climate-security argument. Continued investment in earth monitoring may be warranted, but that investment should be judged on the merits directly related to its contributions and not on speculative links to national security concerns that may or may not arise years from now.

The climate-national security argument also dangerously injects military and security concerns into economic and environmental issues. Long-term environmental challenges are not new to human history. Nations have struggled with internal environmental concerns and wrestled with those that cross national borders on many occasions. In many — if not most — cases, the matter is resolved through negotiation of rights and technical adaptation. Climate policy generally discounts adaptation in favor of mitigation, but investment in adaptation may be the most productive way to manage an evolving climate. Adding security concerns to the discussion may prove to be a disincentive to negotiation, as either side may now see the other as positioning for an advantage, and it injects security competition from other interest areas into what previously may have been a purely environmental or economic resource allocation discussion. If states come to view environmental issues as ones worth fighting for where they previously had not, then the climate-security argument has created the very conditions it sought to avoid.

In summary, efforts to link climate change to the deterioration of U.S. national security rely on improbable scenarios, imprecise and speculative methods, and scant empirical support. Accepting the connection can lead to the dangerous expansion of U.S. security concerns, inappropriately applied resources, and diversion of attention from more effective responses to known environmental challenges. The danger of this approach is that it offers a sense of urgency which may not be warranted, given the gaps in the current state of knowledge about climate, the known flaws in the methods used to construct the scenarios on which these security scenarios are based, and confusion over the underlying causes of those security concerns.

The Environment as a Source of Conflict

The antecedents of the climate-security argument are old. The climate change-security dialogue inserts a new causal element into a well-established school of thought in the security studies field. The notion that states compete over scarce resources — and that resource competitions could escalate into war — has existed for centuries. In the 18th century, Thomas Malthus argued that a growing population would outstrip available resources and cause social strife and discord as competition intensified. By the 1960s, a new generation of scholars picked up Malthus's mantle, claiming that population growth would put inordinate pressure on critical resources (oil, water), create famines (from consumption outstripping supply), degrade local and regional environments (from pollution, deforestation for agriculture or energy), and eventually, create refugees and conflict (Zubrin 2012). In 1968, the Club of Rome, a group of scholars, bureaucrats, and corporate leaders, gathered to sponsor a series of academic studies to prove the connections between population, environmental degradation, resource competition, and war. Their 1972 study, *Limits to Growth*, compiled statistic after statistic in support of the base prediction that the world would run out of resources and, in doing so, degrade the natural environment and sow the seeds of conflict. The 1973 OPEC oil embargo seemingly proved a powerful illustration of their claims.

Nevertheless, strategic concerns associated with superpower competition kept the notion of environmentally-induced conflict or resource war on the periphery of national

security thinking. The end of the Cold War allowed environmental issues to explode onto the security studies scene as scholars debated the next set of issues that would shape international relations following the collapse of bipolar superpower competition. Competition was said to have suppressed other sources of strife out of fear that they could escalate and risk a worldwide conflict. One review essay on the changing nature of the security studies at the time noted "During the Cold War military threats to national security dominated all others in the eyes of most security specialists. With the end of Cold War have come numerous suggestions that resources once devoted to coping with military threats now be used to deal with such nonmilitary threats as domestic poverty, educational crises, industrial competitiveness, drug trafficking, crime, international migration, environmental hazards, resource shortages, global poverty, and so on" (Baldwin 1995, 126).

The environment was once again seen as a contributing factor to intra- and interstate conflict. A new generation of security studies scholars saw the traditional conception of security as overly constraining and too limited in its recognition of the factors driving change in the international security environment. Jessica Tuchman Mathews, now the president of the Carnegie Endowment for International Peace, compared the anticipated transition in national security thinking to the recognition of the importance of economic power in the 1970s. She argued "Global developments now suggest the need for another analogous, broadening definition of national security to include resource, environmental and demographic issues." She anticipated how the climate-security argument would evolve, writing that "Environmental strains that transcend national borders are already beginning to break down the sacred boundaries of national sovereignty" (Mathews 1989). In the *State of the World*, the annual publication of the Worldwatch Institute, Lester Brown proclaimed that "threats to human security are now seen much more in environmental and economic terms and less in political ones" (Brown 1988, 182). Not surprisingly, formal government statements began reflecting this change in thinking already underway in academia.

By the mid-1990s, environmental security emerged as an element of formal U.S. national security thinking. The 1996 National Security Strategy acknowledged that "one cannot help but conclude that population growth and environmental pressures will feed into immense social unrest and make the world substantially more vulnerable to serious international frictions" (Executive Office of the President 1996). Subsequent statements by Secretary of State Warren Christopher, Vice President Gore, and other senior Clinton Administration officials reinforced the notion that U.S. foreign and national security perspectives needed to be broadened to recognize a new range of global threats. Subsequent administrations did little to arrest the expanded definition of U.S. security interests. Use of the armed forces as instruments of humanitarian assistance in Somalia and Haiti, for example, further reinforced these trends.

The end result of this line of thinking, unfortunately, is a lack of precision about what constitutes U.S. interests. The consequences are potentially dangerous, at worst, and, at best, allow the inefficient allocation of resources. The greatest danger is engaging the U.S. directly in conflicts based on weak conceptions of national interests. Such

operations risk entangling the U.S. militarily in conflicts where the objectives are unclear or shifting. Even short of actual conflict, the inability to prioritize interests distorts the allocation of resources (money, time and attention). In the absence of clear definition of national interests, resources may be applied to problems that are viewed as important simply because they garnered the most attention at the right time. For example, investment in expanded capabilities to perform humanitarian assistance operations, which Secretary Panetta suggests is possible, may result in the development of greater physical capabilities to perform these tasks at the expense of time, materials, and attention elsewhere. But, if one accepts the securitization of climate change and also agrees that the U.S. will respond to natural disasters at an increasing rate, then such investment in capability not only makes sense, but becomes an imperative.

Understanding the Climate-Security Connection

The climate-security argument is most easily understood as the combination of two sets of arguments. The first set establishes the underlying facts of climate change and its purported consequences on the global and regional environments. The second set argues that those environmental changes undermine state security and create instability and conflict.

Futurist Peter Schwartz sparked public imagination about the security consequences of climate change with a provocative 2003 report commissioned for the U.S. Department of Defense (see, for example (Townsend and Harris 2004) and (Stipp 2004)). In it, Schwartz and co-author Doug Randall argued that an abrupt climate change scenario would "potentially de-stabilize the geopolitical environment, leading to skirmishes, battles, and even war due to resource constraints," specifically food shortages, disruption of water supplies from floods and droughts, and interruption of "access to energy supplies due to extensive sea ice and storminess" (Schwartz and Randall 2003, 2). The Schwartz-Randall scenario of choice, the collapse of the thermohaline conveyor in the Atlantic Ocean, proved unsupportable. Nevertheless, efforts to directly link climate to national security concerns were well underway.

In 2007, the respected Center for Naval Analyses (CNA) set the tone for future debate, both in terms of the theoretical links between slow and rapid climatic changes and security concerns and the methods used to link climate and security. CNA called climate change a "threat multiplier for instability" that "threatens to add new hostile and stressing factors" to the international security environment (Center for Naval Analyses 2007, 6). The CNA report is significant because it not only pushed the issue into the national security dialogue, it also established a methodology for identifying climate conflicts that is replicated many times by other authors, groups, and eventually official government assessments. In brief, the CNA accepts that climate change is occurring and will result in bad environmental outcomes and then asks national security experts (in their case, retired senior military officers) to comment on the implications for the U.S.

Shortly thereafter, the Brookings Institution published a book wherein a group of scholars were presented with a range of climate change scenarios and asked to surmise

the implications for the U.S. Not surprisingly, the range of scenarios were all highly troublesome and so, too, were the implications drawn for security. The book concludes: "… the United States can expect that climate changes will exacerbate already existing North-South tensions, dramatically increase global migration both inside and outside of nations (including into the United States), lead to increasingly serious public health problems, heighten interstate tension and possibly conflict over resources, collapse agricultural markets and global fisheries, challenge the institutions of global governance, cause potentially destabilizing domestic political and social repercussions, and spur unpredictable shifts in the global balance of power, particularly where China is concerned" (Campbell and Weitz 2008, 213-214).

If the musings about climate change and security remained in academia or think tanks, then the issue would have provided fodder for intellectual discussion and little else. But, it did not. The Congress held hearings on the topic, and even went so far as to order the intelligence community to provide an analysis back to them. The Central Intelligence Agency (CIA) formed a unit devoted to tracking the topic. The Director of National Intelligence commissioned a series of detailed reports. The Deputy Assistant Secretary of Defense for Strategy was tasked with helping DOD leadership to understand the implications of climate change. And, of course, the issue was incorporated into the Obama Administration's National Security Strategy and Quadrennial Defense Review.

Dr. Thomas Fingar, the Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, explained to the U.S. Congress in 2008 that "From a national security perspective, climate change has the potential to affect lives (for example, through food and water shortages, increased health problems including the spread of disease, and increased potential for conflict), property (for example through ground subsidence, flooding, coastal erosion, and extreme weather events), and other security interests" (Fingar 2008, 6).

CNA elaborates in a more recent report: "Climate change will affect both slow-onset disasters such as droughts and rapid-onset disasters such as storms and floods" (Center for Naval Analyses and Oxfam 2011, 1). They continue: "As climate change leads to increased number of disasters, economic stresses (such as loss of agricultural production and reduced access to water) and social pressures (such as migration), which tend to exacerbate tensions and produce violence, will increase, particularly in already marginal economies."

How are these predictions of doom derived? The methodologies are strikingly similar. The findings of the Intergovernmental Panel on Climate Change (IPCC) are accepted without critical review, and security experts are then asked for their opinion on what may happen under the various projections of environmental change offered. In other words, a global temperature rise, induced primarily by human activities, is assumed to be occurring and to accelerate over time. Computer climate models offer projections of the global and regional environmental effects (droughts, floods, storms) of those temperature increases. Generals, admirals, former defense, security, and intelligence

officials then consider what implications a particular set of environmental phenomena would have on a particular region. At no point are the underlying scientific relationships required to validate the anthropogenic climate change case examined in detail so as to judge probability, much less causality. Furthermore, the causal linkage between environmental changes and instability also is accepted uncritically.

Dr. Fingar offers a clear explanation of the approach in his 2008 testimony to the Congress. He noted first that the National Intelligence Assessment (NIA) "used a fundamentally different kind of analytical methodology from what is typical for an intelligence product." The justification for this departure from standard practice is lacking. Fingar explained that "our primary source for climate science was the United Nations Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report" and "we relied predominantly upon a mid-range projection from among a range of authoritative scenario trajectories provided by the IPCC." In laying out the specific findings of the NIA, Fingar further reinforced the dependency of the analysis on the IPCC assessment of how the climate is changing. He identified the connection explicitly: "In the study, we assume that the climate will change as forecast by the IPCC" (Fingar 2008, 2-3).

The government's work is hardly alone in its deference to the IPCC. Jeffrey Mazo's *Climate Conflict* "relies on the IPCC Fourth Assessment Report and reviews of scientific research published after the IPCC cut-off date for the physical science and climate projections" (Mazo 2010, 12), as does James Lee's *Climate Change and Armed Conflict* (Lee 2009, 66-67) and Cleo Paskal's *Global Warring* (Paskal 2010). The aforementioned Brookings Institution study offered three scenarios of climate change for its security experts to react to: "The general approach is to settle on three different levels of global average temperature change for each scenario, and then extract relevant projected impacts from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change and other peer reviewed scientific sources" (Gulledge 2008, 49). The first scenario accepted the temperature change projected by the A1B emissions scenario in the IPCC 4th Assessment report, which meant temperatures were expected to increase 1.3°C (2.3°F) relative to 1990 over a 30-year period. A second scenario argued that expected climate change will be more severe, assuming that "omitted positive feedbacks occur quickly and amplify warming to double that projected for emissions scenario SRES A1B" or warming of 2.6°C in a 30-year period. The third scenario extends the focus to the year 2095 and contemplates warming of 5.6°C, which "compares well with the upper end projection of a group of models that incorporated carbon cycle feedbacks and therefore simulated higher atmospheric CO_2 growth rates that did the IPCC models" (Gulledge 2008, 56-57).

This examination of the climate-security issue will proceed in two sections, mirroring the dual nature of the argument. First, a brief discussion of climate change science will provide context for weighing the probability that the climate is changing at the rate and severity predicted by the IPCC. Then, the linkages between environmental degradation and conflict will be considered.

Considering Climate Change

The first segment of the climate-conflict hypotheses relies on a scenario-based approach predicated on the acceptance that (1) the Earth is warming at rates consistent with projections; (2) that the climate models adequately represent the interactions of physical processes; (3) that those same models accurately forecast observed climatic outcomes when actual observational data is used to test them; (4) that these models properly move from global to regional levels and (5) that the scenarios outlining economic development, industrial structures, demand for energy, and consumer behavior (among the various items that comprise the SRES scenarios) are accurate.

Summarized most extensively by the IPCC, but widely reproduced elsewhere, the argument is that emission of greenhouse gases from industrial activities, the transportation of goods, services, and individuals, and the heating/cooling of homes and other buildings traps heat from the sun in Earth's atmosphere by inciting feedbacks in clouds and other aspects of the climate system that, in turn, amplify the warming of the planet sufficiently to generate the impacts feared in the aforementioned scenarios. Computational models of climatic processes shape the understanding of these systems.

The anthropogenic climate change argument assumes human activities have become a principal forcing agent causing abnormal changes in natural patterns. To judge that statement, one must understand the nature of those natural patterns, including their timing, strength, effect, and cause. Climate varies naturally along numerous timescales. The ice ages are well known, but other cyclical changes occur more frequently than the tens of thousands of years between ice ages. The climate system varies naturally as the result of four factors:

- mathematically, the climate system exhibits "chaotic" (i.e., complex and non-linear) behavior, which means that it has limited predictability;
- important parts of the climate system exhibit oscillating behavior, e.g., the El Niño-Southern Oscillation (ENSO) cycle that repeats every 3-7 years in the tropical Pacific, and the North Atlantic Oscillation that has a cycle length of 60-80 years;
- variability in solar intensity, a key driver of the climate system, which occurs in cycles varying in length form the familiar 11-year sunspot cycle to shifts in the Earth's orbit that occur in cycles of 100,000 years; and
- the random nature of volcanic eruptions, which emit both greenhouse gases and aerosols, both of which impact the climate system. (George C. Marshall Institute 2008).

As the Committee on Global Change Research (CGCR) of the U.S. National Academy of Sciences has pointed out, understanding climate change on intermediate timescales from decades to centuries is critical to understanding the impacts of human activities on the climate system. They said:

> "Anthropogenic global change cannot be assessed without adequate understanding and documentation of natural climate variability on timescales of years to centuries — in other words, without adequate baseline understanding. This understanding encompasses solar and volcanic variability; feedbacks resulting from the interactions of water vapor, clouds, and radiation; and the massive heat fluxes associated with the motions of air and oceans and the exchanges between them …" (Committee on Global Change Research, National Research Council 1999, 127-128).

Further problems confound the use of climate science as a security planning device. Understanding natural climate variability is a function of all of the natural components of the system. Prevailing approaches use a combination of observational and proxy data along with computer modeling simulations as measures of key climatic variables. Judging the quality of the analysis, therefore, begins with a critical assessment of the quality of the data, because if the data are of poor quality or fail to adequately represent the phenomena to which they are ascribed, the resulting conclusions must be drawn into question. The data, particularly paleoclimatic data derived from proxies such as tree rings and coral reefs, are subject to error and uncertainties that limit their precision. Furthermore, estimations of the natural variability of surface temperature on decadal to centennial timescales from paleoclimatic data reveals a range significantly greater than the temperature changes observed during the 20th century.

While the IPCC and others claim great confidence in the conclusion that anthropogenic effects are driving changes in the Earth's climate, the list of key uncertainties in the knowledge base about how the climate works did not change significantly in the intervening years between publication of the third and fourth IPCC assessments, suggesting that the level of understanding of these fundamental interactions remains low. Future climatic conditions depend on the response of the climate system to anthropogenic and natural drivers. The major anthropogenic drivers are greenhouse gas and aerosol emissions and land-use changes — and these are affected by population, economic growth, technological development, and regulation, all of which are knowable as general trends but subject to significant changes in direction. Key natural drivers are solar variability, volcanic eruptions, and the Earth's orbital mechanics. Solar variability is currently poorly understood, but in concept, it can become knowable with additional study and research. Volcanic eruptions are random events, and therefore are unknowable other than as statistical averages. The Earth's orbital mechanics are well understood, but they are only a factor when projections are being made for very long periods of time.

Water vapor, aerosols, and their interactions to produce clouds are key uncertainties affecting climate change forecasts. The IPCC provided levels of scientific understanding for a number of key parameters in its last report. Several judged to have "low levels of scientific understanding" have large impacts on the climate system. Nevertheless, these parameters are estimated and incorporated into the computer models used to

forecast climate change on global and regional scales. While such an approach may provide useable insights for the environmental and climate science communities, the security analysts and force planners must recognize that these fundamental gaps in knowledge inject considerable uncertainty into the projections — and call into question the utility of the projections for planning purposes.

Comparisons of estimates of temperature variability, calculated from climate model simulations with the actual variability observed in temperature measurements for periods of up to forty years, show that that the climate models do a poor job of simulating actual variability. The IPCC's most recent assessment drew on studies with more than a dozen climate models. As we observed in our critique of that work:

> "While this is an impressive array of results, it does not overcome the basic problem with the approach: the fact that with proper tuning, a model's output can match a single set of data (such as the global average temperature of the last 150 years) without accurately representing the underlying physical processes. In such cases, the model cannot be depended upon to accurately predict future conditions" (George C. Marshall Institute 2007, 8).

The IPCC modeling approach simulates the global climate of the past 150 years using both natural and human drivers of climate change. A determination of the relative importance of natural and human drivers, or forcings, is the result of these assessments. For this technique to work, both the climate models and the input data on drivers of climate change must be reliable. Also, the comparison has to be made against a reliable record of global climate for the past 150 years. Unfortunately, none of these conditions are met. The models have systematic flaws, the input data is unreliable prior to 1970 at the earliest, and the historical record of climate is incomplete and flawed.

None of the climate models used by the IPCC have been independently validated. In the latest IPCC report model, validation was not even discussed. Instead, models were considered using a less demanding term: evaluation (Working Group I 2007). By its own assessment, the IPCC concludes that evaluation shows that major problems exist in the design of climate models. Among the problems listed are:

- Systematic biases in simulation of the Southern Ocean, which is important for the transfer of heat between the atmosphere and oceans;
- Ongoing problems in simulating the El Niño — Southern Oscillation (ENSO) cycle, which is a major factor in the Earth's climates;
- Poor simulations of precipitation events: "In general, models tend to produce too many days with weak precipitation (< 10 millimeters/day, <0.4 inches/day) and too little precipitation overall in intense events (>10 millimeters/day, >0.4 inches/day)"; and
- Substantial uncertainty in the simulation of feedbacks from sea-ice, which are coupled with polar cloud formation and transport of heat through the polar oceans (Working Group I 2007, 3-6).

The IPCC's final report contains an even franker assessment of the shortcomings of models:

> Nevertheless, models still show significant errors. Although these are generally greater at smaller scales, important large-scale problems also remain. For example, deficiencies remain in the simulation of tropical precipitation, the El Niño-Southern Oscillation and Madden-Julian Oscillation (an observed variation in tropical winds and rainfall with a scale of 30 to 90 days). The ultimate source of most such errors is that many important small-scale processes cannot be represented explicitly in models, and so must be included in approximate form as they interact with large-scale features. This is partly due to limitations in computing power, but also the results from limitation in scientific understanding or in the availability of detailed observations of some physical processes. Significant uncertainties, in particular are associated with the representation of clouds, and in the resulting cloud response to climate change. Consequently, models continue to display a substantial range of global temperature change in response to specified greenhouse gas forcing" (Solomon et al. 2007, 601).

As noted, models will respond differently to the same forcing. This occurs because climate models use very different mathematical representations of the same climate processes. Disagreement about the physics of some key climate processes, such as cloud formation or rates of climate sensitivity, explain the differences. As an example, the greenhouse warming theory is critically dependent on the positive response of clouds and other so-called feedbacks to increasing levels of CO_2. Typically, clouds are viewed as a positive feedback, meaning that rising temperatures produce more clouds which trap more heat, and, indeed, this relationship carries over into most leading climate models. An examination of precipitation and cloud patterns in the tropics indicates the existence of a negative feedback mechanism instead (Spencer 2007). The quality of climate models cannot improve until there is a both a better understanding of these key climate processes and better observational data.

Nevertheless, climate models are used widely, and their results are interpreted as accurate approximations of how climate will change. Some climate models have been adjusted, or calibrated, to the point where they provide a reasonable simulation of some aspects of climate. These simulations are then used to claim that model outputs are a valid representation of the climate system. They are not. The difference between *calibration* and *validation* of models is critical. Climate models are routinely calibrated, or adjusted, to make their output look more like the real world. However, calibrating a model to produce a realistic simulation of current climate conditions does not ensure that it will provide realistic projections of future climate conditions. Realistic representations of current climate or projections of future climate require a model that is both validated and has an accurate set of inputs. Validation requires that the model be developed using one set of data, then its output shown to match an independent set of data. At this time, no climate model has been validated (George C. Marshall Institute 2008).

Even with these basic concerns about how the climate is changing, estimating the impacts of a warming climate adds even more complexity to an already questionable foundation. Faced with an inability to predict future human emissions, climate scientists use the scenario approach. The IPCC defines a scenario as "an image of the future" and a set of scenarios as alternate images of the future. Currently, the most widely used set of emissions scenarios for projecting future climate are the so-called SRES scenarios published by the IPCC in 2000 in its *Special Report on Emissions Scenarios.* This report presented emissions projections for thirty-five scenarios and recommended that climate modelers use a sub-set of six "marker" scenarios for climate projections.

Projections of the future impacts of climate change are based on assumptions about future climate change that are largely qualitative in their approach, meaning they are based on the simple assumption that, if it gets warmer, there will be a continuation in the changes in natural systems observed over the last century. These findings are derived from a four step approach:

1. The IPCC's SRES scenarios were used as input to a climate model.
2. The output from the climate model was used as a prediction of future climate.
3. The predicted future climate was used as input to an empirical impact model, e.g., river run-off as a function of rainfall and temperature.
4. The difference between the output of the impact model and current conditions was assumed to be the impact of climate change. (George C. Marshall Institute 2007)

Our 2007 review of this approach concludes simply that: "Each of these steps is so fraught with uncertainty or unrealistic assumptions that the outputs of exercise are meaningless," (George C. Marshall Institute 2007, 5). For example, the SRES scenarios assume the same suite of technologies is used throughout the scenario. Of course, such an assumption is unrealistic. New technologies and production practices are adopted regularly — improving productivity, and affecting energy use and emissions patterns, as well as consumer behavior. No modeling approach can reliably capture the variability of those trends over the timescales estimated by climate impact models. Further complicating the predictive capabilities of the SRES approach are uncertainties about the economic development and energy pathways which the developing world will follow. A related critique of the impact modeling approach is that it does not adequately represent adaptation to changing climatic conditions which would lessen the negative impacts of those changes. Use of drought-resistant crops and improved irrigation practices, for example, would dramatically increase agricultural productivity and overall yields in the developing world, while simultaneously reducing vulnerability to certain climate changes.

The SRES assumes the developing world will use large amounts of fossil fuels, which is likely true in the near term (20-30 years from today). But, the approach fails to account for improved efficiencies or the introduction of new practices that may lessen

the rate of growth in fuel use or reduce the emissions from that use which would accompany the rising standards of living in the developing world. Rising standards of living in the developing world greatly expand the adaptive capacity of those populations (Goklany 2011). The finding has profound implications for the impact modeling approach. Goklany explains:

> "Therefore, even if one assumes that there will be no secular technological change — that is, no new or improved technologies will become available between the 1990s and 2100 — developing countries' adaptive capacity should on average far exceed that of the United States today. Therefore, although claims that developing countries will be unable to cope with future climate change may have been true for the world of 1990 (the base year), they are simply inconsistent with the assumptions built into the IPCC scenarios…" (Goklany 2011).

By failing to account for the positive effects of prosperity, the impact modeling approach used by the IPCC, and subsequently relied upon by the climate-security literature, is guaranteed to produce overly pessimistic outcomes. It is another example of the deterministic approach that pervades the climate-security discourse.

A more recent IPCC assessment reveals that "projected changes in climate extremes under different emissions scenarios generally do not strongly diverge in the coming two to three decades, but these signals are relatively small compared to natural climate variability over this time frame. Even the sign of projected changes in some climate extremes over this time frame is uncertain" (Intergovernmental Panel on Climate Change 2011, 9). The statement is significant for two reasons. First, it is an admission that natural forces will exert dominant influence over "climate extremes" over the period of 10-20 years and that, in some instances, the models are unable to state definitely whether the purported human impact is positive or negative. Second, and most important for questions of security planning, the uncertainty over the 10-20 year is very telling for defense planners. Looking beyond two decades to judge the security threats and challenges to the U.S. (or any other state, for that matter) may be intellectually stimulating, but it offers little insight into strategy, program development, or budgeting.

Even if all of these concerns about the fundamental scientific understanding of the drivers of climate change, the interactions of climatic variables, the modeling approaches, and the impact scenario methodology are set aside, the climate-security argument faces a final problem. The Earth's temperature simply is not responding in the manner predicted by the IPCC. In its Fourth Assessment Report, the IPCC used the full range of emissions scenarios — and seven different climate models — to project temperature in 2100. This exercise yielded a projection of 1.1 – 6.4°C (2.0 – 11.5°F) temperature rise between 1990 and 2100. This range of uncertainty is larger than reported by IPCC in its Third Assessment Report because a wider range of models was used, and because a significant new source of uncertainty was added: climate-carbon feedback.

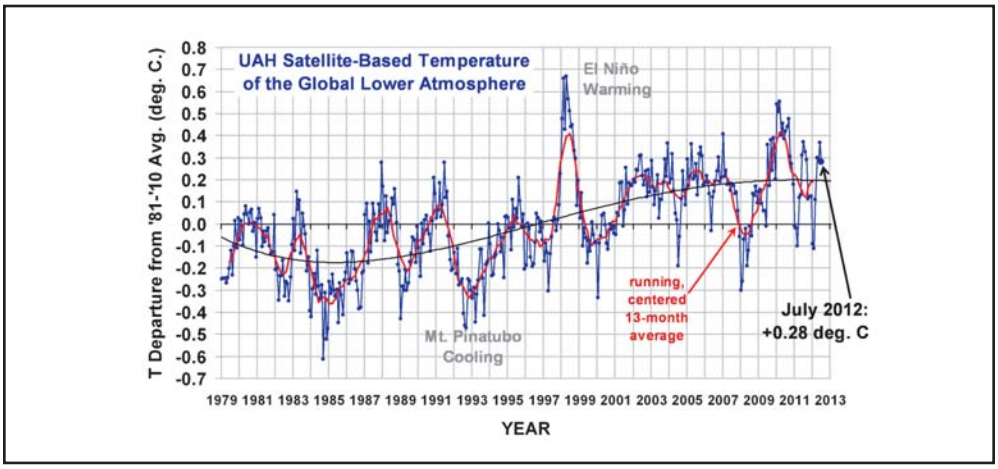
The surface temperature data base has several limitations, including:

- uneven geographic coverage — most of the data are for industrialized nations, with sparse coverage over much of the developing world (Lindzen and Giannitsis 2002);
- sea surface temperature measurements that are more scattered and require more adjustment than the land-based measurements (J.T. Houghton et al 2001, 110-112); and
- numerous possible errors created by instrument calibration and siting problems (Balling 2005).

Measurements of actual surface temperature prove more complicated to compile than one might imagine. Three techniques are used: surface thermometers, weather balloons, and satellites. Each method requires adjustments and calibrations to correct for known factors that distort the accuracy of the measurements. For instance, the readings from a surface thermometer once in a rural location but now in a residential or commercial area due to development, will require adjustments to compensate for the urban heat island effect. How those adjustments are made and the assumptions that drive the changes are the subject of much debate and study. Satellite temperature trends show little warming from 1979 to 1997 after which an El Nino causes a large jump in temperature followed by a generally rising trend (see (R. Spencer 2012).

Generally considered the most accurate way to measure temperature trends, the satellite record reveals generally less warming in comparison to the surface record. In the post El Niño period, roughly 2000 to the present, temperatures have risen steadily. Even so, in 2012, the trend deviates 0.2°C from the mean temperature over the period 1981-2010 and shows signs of leveling off. Recall that the impact scenarios began registering impacts in 2030 when temperatures rose 1.3°C from 1990 temperatures. Since 1990, the satellite record shows an increase of 0.3°C. Given these trends, the prospect of a 1°C increase in the next 15 years seems low.

Figure 1 – Satellite Temperature Trends, 1979-2012

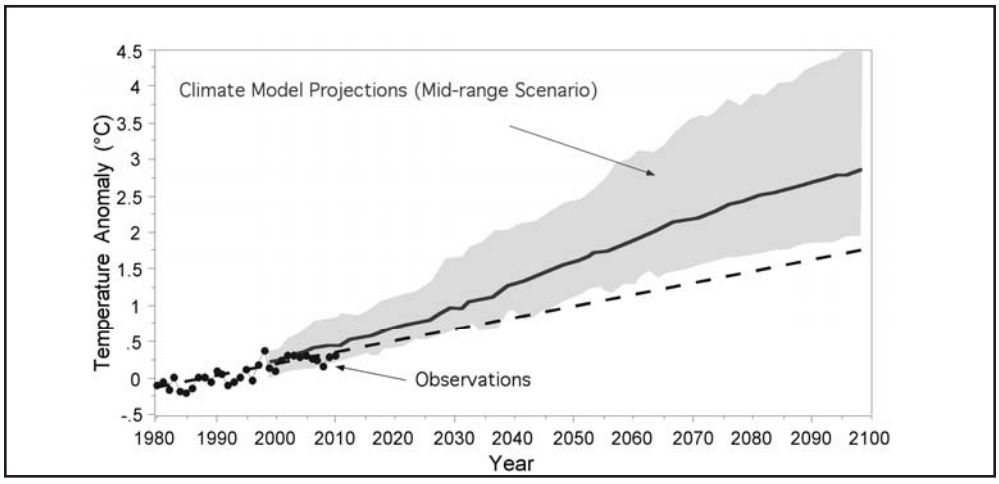


http://www.drroyspencer.com/wp-content/uploads/UAH_LT_1979_thru_July_2012.png

Even with those errors in the data-collection process overlooked, temperature still is not rising at rates consistent with the IPCC models or sufficiently large enough to trigger the catastrophic changes envisioned in the climate-security literature. Figure 2 shows temperature projections given in the IPCC Fourth Assessment Report for its collection of climate models run under the mid-range emissions scenario (SRES A1B) for 2000-2100, along with observations from the U.K. Hadley Centre (dark points) from 1980-2010. The range of climate model projections is indicated by the gray-shaded area, and the model ensemble average is indicated by the solid line. The observations have been adjusted to the 1980-1999 mean in order to match the projections.

Figure 2 presents an observed (i.e., actual) temperature change of approximately 0.25°C between 1980-2010, with virtually no observed increase in the 2000-2010 period. The observed trends are less than half the rise in surface temperature projected by the IPCC's midrange scenario and fall outside the range of model projections.

Figure 2 – Observed Temperature Trends in Comparison to IPCC Projections



Courtesy of Dr. Patrick Michaels, Cato Institute.

Writing in the *Wall Street Journal*, Marshall Institute Chairman and Princeton physics professor Dr. William Happer and several colleagues summarize the current state of climate science:

> "The lack of warming for more than a decade—indeed, the smaller-than-predicted warming over the 22 years since the U.N.'s Intergovernmental Panel on Climate Change (IPCC) began issuing projections—suggests that computer models have greatly exaggerated how much warming additional CO_2 can cause. Faced with this embarrassment, those promoting alarm have shifted their drumbeat from warming to weather extremes, to enable anything unusual that happens in our chaotic climate to be ascribed to CO_2" (Happer 2012).

Examining the Climate-Security Connection

The second part of the climate-security argument connects these environmental analyses to security concerns through case studies, conjecture, and expert opinion. A typical case study approach is provided by the International Institute for Strategic Studies' Jeff Mazo when he summarizes thousands of years of human history to create the connection between environmental collapse and civilization failure (Mazo 2010, 43-72). Mazo then uses the case of Darfur to illustrate his sweeping conclusions, calling it the "first modern climate change conflict." Most analyses follow a complementary approach that first identifies an area of ongoing or expected strife and then identifies environmental variables seen as contributing to or potentially inciting greater conflict or insecurity. Paskal claims that "by combining the clear trends in environmental change with the clear trends in geopolitics we start to see the broadstrokes of what may lie ahead." One trend she sees is that "the changing environmental condition could exacerbate the potential for conflict in areas where new geopolitical realities already chafe" (Paskal 2010, 18).

The CNA, Brookings Institution, and the various U.S. government reports follow similar approaches. They enlisted regional or security affairs experts to comment on a presented set of environmental scenarios. This approach makes verification of the proof for their claims problematic. At their foundation, they are the opinions, albeit the informed opinions, of those presenting them. These assessments rest on the pre-conceived notions, judgments, and experiences of those asked to comment. While those views are not discountable, they certainly should not be accepted solely at face value. Furthermore, the methods used risk becoming circular. The proofs used to validate the expert opinions are the case studies which inform the expert opinions. Empirical and statistical analysis ought to validate the case studies and opinions supporting climate-conflict hypothesis. If it does not, then additional questions about the validity of the linkage between climate change and conflict comes into question.

The climate-conflict hypothesis is an argument linked together in a chain. Each link in the chain must be accepted as true for the entirety of the argument to be valid. The argument is a causal set of events occuring in a sequence to produce an impact on security interests. The calamity could be a drought, a flood, a hurricane, a famine, refugees, or the like. These conditions give rise to decreased economic prosperity, social unrest, refugees, and group or state action to secure resources. In turn, those conditions create security concerns about state or regime survivability, integrity, or stability. The environmental effect is the cause of some other phenomenon which in turn creates the security problem. As environmental issues gained prominence in the security studies community, some scholars put the hypotheses to critical examination, aside from case studies or theoretical debates. These efforts reveal significant methodological concerns as well as scant empirical support for the supposed link between environmental variables and social instability or intra- and interstate conflict.

One comprehensive review identifies nine problems in the methodologies used in the environmental conflict literature. They are:

- Resource Scarcity or Environmental Degradation – Most studies use the two phenomena interchangeably, but degradation of the environment may or may not contribute to scarcity of a resource (see (Barnett 2000) and (Gleditsch, Armed Conflict and the Environment: A Critique of the Literature 1998)).
- Incomplete Definitions and Polemics – Policy and political debates about environmental security lack the specification needed to provide testable hypotheses against empirical data.
- Overlooking Important Variables – Most proof of the environment-conflict linkage is based on bivariate analysis and "overly simplistic reasoning" and "ignores political, economic, and cultural variables" that have better explanatory power (Gleditsch, Armed Conflict and the Environment: A Critique of the Literature 1998, 389). In other words, to accept that refugee flows from Bangladesh into India from a flood will ignite a conflict, one must ignore the other socio-economic forces explaining why India and Bangladesh might go to war. The literature also tends to overlook the significance of differences in regime type, shown elsewhere in the security literature to be directly associated with conflict probability.
- Untestable Models – The case studies used to construct the proofs typically rely on multiple independent variables acting through intervening variables, such as changing rainfall patterns creating droughts which reduce food supplies leading to group manipulation of food supplies and social unrest. Many of the dependent variables used are imprecise as well, such as social unrest or health problems, meaning that they defy measurement in a meaningful fashion. Without greater specificity in the dependent variable, tests for causal connections are imprecise.
- Lack of a Control Group – The case study approach by nature is anecdotal and as such scholars must take care to construct their research designs in ways that enable variation of the features under examination. A defense of biased case selections for environmental scenarios has been offered by Homer-Dixon and others, claiming that environmental scenarios offer greater complexity than other sources of conflict. Not only is that untrue, but accepting that view requires the concession that environmental scenarios cannot be tested in a qualitative format with variable variation. Empirical work done subsequently reveals that such tests are possible and accepting the conclusion should give pause to those seeking to build policy from them.
- Reverse Causality – In many of the regions examined by the literature ongoing conflicts have destroyed and damaged local environments, resulted in loss of food supplies, and dislocated populations. In turn, that damage reinforces resource scarcity and social unrest. In the context of the climate-conflict debate, these ongoing conflicts cut against the explanatory power of climate change as the source of local environmental degradation and potential causation of local or regional tension or conflict.
- Using the Future as Evidence – Much of the literature presents environmental sources as a cause of future, rather than past, conflicts. The environment may be a causal element in conflict, but reliance on the future is an appeal to argument,

rather than evidence, as proof of the causal relationship. All the environmental variables cited in the climate-security literature are documentable and therefore testable against known instances of conflict. A review of that evidence therefore should show a positive link between past floods, droughts, or other environmental degradation with intra- or interstate conflict when other explanatory variables are accounted for. If they do not, then the hypothesis is not proven and the conclusion that environmental conditions breed conflict is not supported.

- Drawing Lessons from Foreign and Domestic Conflict – The resource wars literature draws lessons from interstate war, but most warfare in the post World War II period is internal to states. Internal conflicts have very different characteristics and causes. Generalizing lessons from interstate to intrastate conflict is problematic, but the environmental-conflict literature generally fails to reflect those lessons.
- Changing Levels of Analysis – The environmental-conflict literature "freely jumps" between systems, nation, or dyadic levels of analysis when developing theories and examining empirical evidence. Hypotheses appropriate for one level of analysis may not follow to another or even be logically consistent with the other levels.

Gleditsch concludes his summary of the methods used by the environmental security literature thusly: "The nine problems discussed above add up to a fairly pessimistic assessment of the state of the study of environmental causes of conflict" (Gleditsch, Armed Conflict and the Environment: A Critique of the Literature 1998, 395). Careful examination of the climate-security literature and the proofs offered shows these critiques persist in the studies subsequent to Gleditsch's review. Combined, they cast doubt on the explanatory power of the central claim and undermine the generalizability of the argument.

Gleditsch noted the environmental conflict literature's under-recognition of other important variables, but "the climate-conflict literature suffers from a lack of theoretical connections between its main driver (climate) and its possible consequence (conflict)," observed Raleigh and Kniveton (2012) in their study of the effects of changing rainfall patterns on rates of rebel and communal violence in Africa. As noted, in order for social disorder or conflict to emerge from an environmental cause, a number of intervening actions and reactions have to occur in sequence. Raleigh and Kniveton observed that alternative, and sometimes competing, hypotheses can emerge during careful consideration of those sequences. In their case, the key intervening variable between climate and conflict is rainfall pattern change. Raleigh and Kniveton offer four competing hypotheses to illustrate this point:

1. Increased conflict is likely to follow periods of above average decreases in rainfall as groups compete over a scarce resource;
2. Decreases in conflict are likely to be correlated with decreased rainfall because there is little to fight for because the gains to be had from conflict do not justify the costs of conflict;

3. Increases in political violence will follow periods of higher than average rainfall as agricultural abundance spurs greed; and
4. Political violence is less following increases in rainfall because agricultural abundance breeds contentment and self-sufficiency (Raleigh and Kniveton, Come Rain or Shine: An Analysis of Conflict and Climate Variability in East Africa 2012, 54).

In this example, climatic variables are theorized to have positive and negative influences on the likelihood of conflict. It offers a pertinent illustration of Gleditsch's methodological critiques. Prevailing public argumentation on the issue has all tended in the same direction, but the variances in the intervening variables can generate alternative outcomes. Without additional scrutiny, contemporary debates risk overemphasizing one set of conclusions.

Much of the evidence offered in support of the climate-conflict connection rests on case study analyses. Gleditsch (1998) is critical of the overreliance on such case approaches because they lack the ability to control for other causes of conflict. In methodological terms, there is no variation on the dependent variable. One needs also to examine those instances where conflict does not occur in order to properly test the causal strength of the environmental factor. Some analysts are even more critical: "The most important things about the use of history in this environment-conflict literature is the way many authors pick and choose historical evidence in a way that highlights the negative instances whilst ignoring the positive," (Barnett 2000, 285). Selection bias, or more accurately confirmation bias, prevents an accurate test.

The climate-conflict argument also advances the notion that the expanding impacts of climate change increase the potential for future conflict. Such logic is employed by Homer-Dixon (1999) and other proponents of the resource wars argument. It enables the dismissal of the lack of empirical evidence in support of the causal linkages because the argument is purely concerned with the prospects for future conflict. Environmental factors are seen as an additive fuel to a combustible mixture. Statements like that offered by President Obama's National Security Strategy, "The change wrought by a warming planet will lead to new conflicts over refugees and resources," are deterministic and predictive, but ultimately not testable.

The deterministic interpretation of the environmental-conflict hypothesis artificially assumes limits on the adaptability of the actors involved or other institutions that can play stabilizing roles. The countries and groups impacted by an environmental phenomenon may not react in a manner consistent with the assumed response. The mediating effects of other nations or non-governmental organizations can diffuse a crisis. Internally, cooler heads may prevail. These dynamics are nearly impossible to model, or incorporate into a testable model, and yet experience shows that they exist, and they are important. The literature on environmental conflicts routinely overlooks and discounts the moderating role that international agreements and institutions can play in averting future conflicts (Salehyan 2008). Failure to account for these institutions and the moderating roles they play guarantees that tension and conflict are

the outcome of the analyses. As one analysis observed: "Forecasts that do not account for the important conflict management potential of international institutions will produce overly pessimistic scenarios regarding the impact of climate change on international security" (Tir and Stinnett 2012). Those agreements and institutions provide a means to seek reconciliation and adjudication of interests before conflict escalates to violence and offers a venue for the appropriate expression of tension. The conflict scenarios all presume these elements fail or are not present.

These critiques of the methodologies cast doubt on the strength of the conclusion that environmental variables can create conditions for conflict. A robust set of studies has emerged in recent years examining the environment-conflict hypothesis at a variety of levels of conflict, regions, and environmental effects. These reviews cast much doubt on the central connections of the argument and, in turn, undermine support for the notion that a warming planet will give rise to future conflict.

Take, for example, the case of water. An Intelligence Community Assessment published in February 2012 by the Office of the Director of National Intelligence asserts as its "bottom line" that "during the next 10 years, many countries important to the United States will experience water problems — shortages, poor water quality, or floods — that will risk instability and state failure, increase regional tensions, and distract them from working with the United States in important U.S. policy objectives" (Intelligence Community Assessment 2012, iii). "Tensions" over water were cited as a source of conflict by CNA (Center for Naval Analyses 2007). Podesta and Ogden claim that "increasing water scarcity due to climate change will contribute to instability throughout the world … water scarcity also shapes the geopolitical order when states engage in direct competition with neighbors over shrinking water supplies" (Podesta and Ogden 2008, 104-105).

The empirical evidence strongly refutes these claims. A thorough analysis of 412 crises during the period 1918-1994 reveals only seven where water was even a partial cause (Wolf 1999). "As we see, the actual history of armed water conflict is somewhat less dramatic than the water wars literature would lead one to believe … As near we can find, there has never been a single war fought over water," Wolf concluded. Writing in the pages of *International Security*, a preeminent security studies journal, three scholars examined the linkages between water scarcity, drought, and incidence of civil wars. Factors other than the environment were much more significant in explaining the onset of conflict. They conclude:

> "The results presented in this article demonstrate that there is no direct, short-term relationship between drought and civil war onset, even within contexts presumed most conducive to violence … Ethnopolitical exclusion is strongly and robustly related to the local risk of civil war. These findings contrast with efforts to blame violent conflict and atrocities on exogenous non-anthropogenic events, such as droughts or desertification. The primary causes of intrastate armed conflict and civil war are political, not environmental" (Theisen, Holtermann and Buhaug, Climate Wars? Assessing the Claim that Drought Breeds Conflict 2011, 105).

A war over water is difficult to imagine. A downstream state may have high motivation to secure greater supplies, but unless they could exert control over the entire watershed, they would be continually subject to manipulation by upstream sources. The costs of ensuring complete control would be quite high with little guarantee of success in either the short- or long-run.

In fact, precisely the opposite result — peaceful cooperation to manage a shared resource — is the more likely consequence of water scarcity, according to actual human experience. International cooperation over transboundary water sources is much more common than conflict over the same resources (Yoffe, Wolf and Giordano 2003). Of course, treaties and agreements that have limited conflict in the past may not do so in the future. If a water shortage is severe enough, the climate-security argument would imply that states would ignore those agreements and move to protect their interests by any means necessary. Tir & Stinnett (2012) tested whether the pressures exerted by climate change will weaken transboundary river treaties and encourage non-compliance. By testing historical data on water availability between 1950 and 2000, they found that the slightly increased risk of military conflict was offset by institutionalized agreements. The length of time over which the effects of climate change will be felt offers sufficient time to strengthen and institutionalize international treaties governing use of rivers (Tir and Stinnett 2012).

Proponents of the "water wars" view appeal to the future and contend these past trends will be overwhelmed by the enormity of the problems to come; they point to specific hot-spots where water-induced conflicts seem most probable. Podesta and Ogden (2008) viewed the Middle East as the primary location where a water conflict could emerge, as have a number of others (see (Trondalen 2009) and (Brown and Crawford 2009)). CNA (2007) pointed to water as a source of interstate tension in the region, but also alludes to water scarcity as a source of intrastate instability and a contributor to terrorism.

Feitelson et al. (2012) test these claims using four different scenarios of climate change, along with varying assumptions about refugee return, in the Israeli-Palestinian context out to 2030. They conclude:

> "… based on analysis of extreme scenarios, we find that the likely direct effects of climate change per se are limited. While climate change may affect the livelihood of Palestinian farmers and semi-nomads, particularly in remote areas, it is unlikely to affect the welfare of the urban population substantially if some water re-allocation occurs, even under extreme scenarios" and "climate change does not seem to pose a major direct security risk in the Israeli-Palestinian context" (Feitelson, Tamimi and Rosenthal 2012, 253-254).

They do note a danger in characterizing water as a security problem. "However, the framing of water issues and of climate change as security issues, and the subservience of water and environmental issues to the 'high politics' of conflict may hinder the ability to undertake adaptive measures that may mitigate the effects of climate change" (Feitelson, Tamimi and Rosenthal 2012, 254). Adding a security dimension to envi-

ronmental or shared resource concerns, when other factors have created conditions of mistrust and tension amongst the parties, is expected to greatly reduce the probability of an amicable resolution. As Feitelson, Tamimi and Rosenthal's survey shows, water shortage is not a sufficiently robust condition to generate conflict on its own. Ironically, the climate-security literature may do more to militarize environmental crises by characterizing them as security challenges, and thereby prompting decision-makers to turn from cooperative or diplomatic solutions and towards military options.

In Central Asia, the Syr Darya river basin is cited as another area where a trans-boundary dispute over water could spark conflict (see (Swarup 2009) and (Hodgson 2010). In this case, the region is comprised of poor, undemocratic states with weak international water management agreements. It is a perfect test case for the claim that the introduction of new supply pressures borne out of climate change will incite conflict and tension. Bernauer & Siegfried (2012) test this proposition using IPCC climate models out to 2050. They conclude that even though climate change is expected to make water supplies scarcer in the region, not a surprising fact given the previous discussion of the IPCC modeling approach, "such shifts are likely to occur only in the medium to long term" (Bernauer and Siegfried 2012, 237). Rather than precipitate conflict, which they judge as "unlikely," Bernauer and Siegfried believe the countries in this region will respond by strengthening the international agreements governing water; a response consistent with past experiences, globally and regionally (Deudney 1990).

Ironically, the climate-security literature may do more to militarize environmental crises by characterizing them as security challenges and thereby prompt decision makers to turn from cooperative or diplomatic solutions and towards military options.

Africa is frequently cited as a case where rainfall and changing water patterns could elicit greater risk of conflict. Darfur was called the first climate conflict by former United Nations Undersecretary General for Humanitarian Affairs Jan Egeland and U.N. Secretary General Ban Ki-Moon (see (Mazo 2010) and (Salehyan 2008)). A strong relationship between rising temperature and civil war has been suggested to exist in Africa (Burke, et al. 2009). A subsequent analysis shows that Burke et al.'s findings are not supported when tested using different methods, notably a different set of armed conflict data (Buhang 2010).

Raleigh and Kniveton (2012) look at the Africa case from the perspective of small-scale conflict, rather than interstate conflict. Since a major hypothesis of the climate-security literature is that changing water dynamics create conditions within states that weaken social structures and government institutions, their examination of rainfall variability on rebel and communal violence is highly informative. Most studies that have examined the causes of civil wars have shown little statistical significance for environmental variables when other standard political and economic variables are controlled for (see (Nordas and Gleditsch 2007) and (Raleigh and Urdal 2007)). The detailed examination of rebel and communal conflicts in East Africa shows that rainfall patterns emerge as an explanation for conflict only when other socio-economic conditions exist. Then, the

outcome that emerges is one where communal violence has a tendency to increase during wet periods: when the abundance of resources provides the motives and opportunities for inter-group violence. In contrast, during dry periods, communal violence is suppressed and the conditions for rebel conflicts emerge (Raleigh and Kniveton, Come Rain or Shine: An Analysis of Conflict and Climate Variability in East Africa 2012). The Raleigh and Kniveton (2012) results are significant and warrant careful consideration as well as replication in areas other than East Africa.

Other examinations of climate variability's impact on social unrest and conflict in Africa show less connection between the two. Looking at the Sahel, which under climate change scenarios will become drier as rainfall is reduced through the effects of rising temperatures, a team of researchers from the Peace Research Institute in Oslo studied land use conflicts in the region using both statistical and case study approaches. Both methods "provide little evidence supporting the notion that water scarcity and rapid environmental change are important drivers of intercommunal conflict in the Sahel" (Benjaminsen, et al. 2012). They judge political and economic forces as more significant than climate variability. Similarly, an examination of the Kenyan range found that drought conditions suppress conflict and actually encourage groups to share resources (see (Butler and Gates 2012) and (Eaton 2008)), further reinforcing the finding of cooperation rather conflict arising out of environmental pressures.

Examining Kenyan armed conflict below the common civil conflict level, Theisen (2012) determined that years with below average rainfall were generally more peaceful, concluding that: "Tests of the hypotheses on resource scarcity lend most support to those that argue that resource scarcity does not fuel violence and seems even to favor those that see droughts as temporarily cooling tensions" (Theisen 2012, 93).

The preponderance of the empirical literature still suggests little to no linkage between environmental variables and civil war. Slettebak (2012), for example, looks at whether natural disasters offer explanation for civil wars since 1950. His analysis encompasses a range of environmental impacts that are frequently associated with rising temperatures in the climate-conflict argument, notably storms, droughts, floods, landslides, wildfires, and extreme temperatures. As previously discussed, these kinds of environmental shocks are asserted to breed the conditions for conflict within states by generating insecurity, dispossessing populations, creating competition over scarce resources generally and amongst particular groups, and breaking down law and order (see (Homer-Dixon 1999) and (Nel and Righarts 2008), for example). Slettebak tests six different models incorporating a host of socio-economic and environmental variables and reaches a startling conclusion:

> "I set out to test whether natural disasters can add explanatory power to an established model of civil conflict. The results indicate that they can, but that their effect on conflict is the opposite of popular perception. To the extent that climate-related natural disasters affect the risk of conflict, they contribute to reducing it. This holds for measures of climate-related natural disasters in general as well as drought in particular" (Slettebak 2012, 174).

Slettebak's work, along with Homer-Dixon and Nel & Righarts, focuses predominantly on the breakdown of social structures or the manipulation of resources by groups as the explanations for the environment-conflict argument. Another approach contends that as climate change produces more powerful and more frequent storms, floods, and other disasters, the effect will be slow and reduce economic growth in the impacted area. With declining economic prospects, the outlook for civil conflict is said to increase as individuals lack opportunities, are subject to repression by other groups, and as states lose the ability to maintain order. Bergoldt & Lujala (2012) test the climatic disaster-economic growth-conflict relationship over the period 1980-2007 covering 171 independent countries and over 4,000 country-year observations. While natural disasters certainly slow economic growth, they conclude that "climate-related natural disasters do not have any direct effect on conflict onset," nor did they find evidence that "economic shocks caused by climate-related disasters have an effect on conflict onset" (Bergholt and Lujala 2012, 148). Climate can impact economic growth in ways other than the onset of a natural disaster or storm. Koubi et al (2012) test how deviations in precipitation and temperature trends from their long-run averages relate to economic growth rates and civil conflict. Examining the 1980-2004 period, they conclude: "climate variability … does not affect violent intrastate conflict through economic growth," (Koubi, et al. 2012).

Flows of environmental refugees are another source of concern raised by the climate-security argument. These migrations of displaced peoples, driven from their homes out of necessity because of drought, flood, or famine, or driven out intentionally by more powerful groups looking to secure greater shares of scarcer resources for themselves, are regularly cited. The CNA (2007), for example, warns of unwelcomed migrations in Africa, Asia, Europe, and North America. Fingar (2008) cites migration concerns as well. The most widely cited figure for the number of 'environmental refugees' is 200 million people who could be forced from their homes by 2050, of which 150 million would be 'climate refugees' (Environmental Justice Foundation 2009). Furthermore, the climate-induced refugees claim appears overstated. Earlier, the United Nations endorsed the prediction of 50 million environmental refugees by 2010; a claim subsequently discredited by reality (Atkins 2011).

While it is certainly possible to speculate about scenarios wherein displaced peoples create conflict, directly or indirectly, the empirical evidence suggests that is highly unlikely (Salehyan, Refugees, Climate Change and Instability 2005). The research shows "there are few, if any, cases of environmental refugees leading to violent conflict in receiving areas and while there are certainly examples of sporadic violence, such violence is generally small-scale, interpersonal and disorganized" (Buckland 2007, 9). Certainly, natural disasters can result in dislocations of populations. Proponents of the view routinely cite the U.S. Dust Bowl migrations of the 1930s as examples. But, such views ignore alternative explanations for these population movements and risk over-generalizing from a specific instance. Little evidence exists to support the notion that the individuals affected permanently abandon the areas from whence they came. People undoubtedly are moving from Africa to Europe, which is another example often-cited as a current illustration of climate refugees, but those movements are just as

easily explained by economic motives — those migrants are seeking a better life — than environmental causes.

After examining the environmental refugee claims, Bruno Tertrais concludes:

> "Such are the reasons why experts of environmental migrations generally agree that climate change in itself is rarely a root cause of migration. Major population displacements due to environmental and/or climatic factors will remain exceptional except in the case of a sudden natural disaster. And most importantly for the sake of this analysis, they are rarely a cause of violent conflict" (Tertrais 2011, 24).

The Arctic appears to be a particularly challenging case favoring the climate-security hypothesis. Russia, Canada, and the U.S. all are looking to secure their interests in the resource-rich region, leading many to agree that "the Arctic is … a bellwether for how climate change may reshape geopolitics in the post-Cold War era" (Huebert, et al. 2012). Of course, security competition in the Arctic is not new. During the Cold War, the U.S. and the Soviet Union regularly operated in and through the Arctic. But, in recent years, policymakers have altered their perceptions of national interests in the region. In 2009, President George W. Bush released NSPD-66, which stated that the U.S. has "broad and fundamental national security interests" in the region that consisted of traditional military missions and access to resources. Military missions, "missile defense and early warning; deployment of sea and air systems for strategic sealift, strategic deterrence, maritime presence, and maritime security operations; and ensuring freedom of navigation and overflight," were explicitly mentioned. NSPD-66 also established the U.S. position on the economic issues that were gaining greater attention. It asserted: "The United States exercises authority in accordance with lawful claims of United States sovereignty, sovereign rights, and jurisdiction in the Arctic region, including sovereignty within the territorial sea, sovereign rights and jurisdiction within the United States exclusive economic zone and on the continental shelf, and appropriate control in the United States contiguous zone." Canada, Russia, and other states with economic interests in the region have differing interpretations of the boundaries established. For example, Canada and the U.S. disagree over the boundary of Alaska set by an 1825 treaty between Russia and Great Britain.

Clearly, there are important economic issues to be worked out amongst the affected nations, particularly if the demand to operate in and exploit the Arctic continues. But, are these points of disagreement sufficient to raise tensions or lead to conflict? Likely not. The U.S. and the Soviet Union both engaged in active military operations in and through the Arctic for decades during times of global tension that were much higher than will likely be seen in the future Arctic. Certainly, the potential for more nations acting in the region creates the potential for disputes, but those disputes are likely to be economic in nature and be resolved through negotiation or the courts rather than through armed conflict, especially since the affected nations have a long diplomatic history with each other.

A recent assessment of military activities in the region finds those efforts consistent with policing actions, rather than power projection. "While governments of the five Arctic states (Canada, Denmark, Norway, Russia and the United States) have made protection of their Arctic territory a priority, the military buildup is limited," the Stockholm International Peace Research Institute (SIPRI) said. Military efforts to date are primarily aimed at border demarcations as the coastal countries vie for territorial claims to get their hands on the vast oil, gas and mineral resources expected to be made accessible by climate change, it said. "Rather than projecting power over the Arctic as a whole, the increased military capabilities … are generally limited to forces and equipment for policing and protection of recognized national territories and territorial waters," SIPRI concludes (Wezeman 2012).

Famine is another frequently referenced source of social instability, refugee flows, or spark for civil or interstate war. Worldwide, food production has "never been higher than it is today, largely due to fertilizers, pesticides, irrigation and farm machinery" (Goklany 2011, 168). Food production outpaced population growth during the last century, with production per capita rising along with significant increases in world production of maize (203%), wheat (122%), rice (131%), vegetables (251%), cassava (146%) and soybeans (431%) between 1969 and 2009 (Hofstrand 2011). Most climate scenarios suggest these positive trends are unsustainable because the combination of rising temperatures and water shortages will stress crop development or render areas unusable. The prior review of the scientific literature suggests these fears may be overstated, but, even if they are true, these projections discount the adaptive capacity of modern agriculture which can ameliorate some of the effects over time (Goklany 2011). Further, the conclusion generally discounts the beneficial impacts of CO_2 on crop productivity and food production (Wittwer 1995).

More directly, if food shortages are a potential source of conflict and a societal stressor, then the solutions generally advocated to address greenhouse gas emissions may well worsen the problem. Energy use, principally fossil fuels like oil, coal, and natural gas, is the key human activity driving CO_2 and other greenhouse gas emissions. Climate change policy responses generally would cap or otherwise raise the price of using these energy sources, which would have significant effects on the agricultural sector worldwide and poorer countries would be particularly harmed. Goklany notes that crop yields and food production are rising as a result of expanded energy use in agriculture. Each of the four items cited as contributors to agricultural productivity are derived directly from petroleum (fertilizers and pesticides) or use energy generated primarily from fossil fuels (irrigation, operating machinery, and manufacturing/transporting fertilizers and pesticides). Refrigeration, plastic packaging, and rapid transport from farm to processor to consumer are all key enablers of greater food system productivity and reduce food waste and spoilage, but each is energy-intensive. Raising the price of energy will make it harder for poorer countries to develop and sustain the modern agricultural practices necessary to keep food yields and aggregate production expanding, further reduce the rates of food spoilage, and ensure the means to deliver food in a timely manner. Adaptation offers another way to address food shortages should they ever occur. The Swedish Institute for Food and Biotechnology found that 1.3 billion

metric tons of food produced annually is never consumed. The crops are never harvested, or are wasted or simply thrown away (Gronewold 2011). Improved distribution systems and agricultural techniques have the potential to dramatically expand the supply of available food.

Other research suggests there is a strong positive linkage between cheap energy, the economic growth it enables, and international stability. A report commissioned by the U.S. Agency for International Development surveyed 93 countries to test a model attempting to show the relationships between energy consumption, gross domestic product, life expectancy, and probability of stability (Vasudeva, Siegel and Mandrugina 2005). Access to cheap, affordable energy and economic growth were found to increase the odds of peace by a factor of 2.5. By raising energy consumption, "the occurrence of peace is now 1.5 times more likely than the occurrence of instability in any given country," the study found (Vasudeva, Siegel and Mandrugina 2005, 32).

These findings profoundly alter the argument. Indeed, they suggest that policies to pursue controls on energy use will increase the prospects of instability and conflict. Earlier cited research showed no connection between environmental effects and economic growth, but there is a connection to conflict through the rising price of energy. Without overstating the conclusion, to the work of Goklany and Vasudeva et al. suggests policymakers and others should pause, as the claimed relationships do not appear to exist, and the policies recommended may prove ultimately counterproductive.

Combined, this recent research casts great doubt on the specific climate-conflict argument. The reliance on case studies and expert extrapolation can only take the argument so far. Actual experience suggests none of the intervening conditions (droughts, floods, storms, famine, or refugees) contribute significantly to intrastate or international conflict. Indeed, some scholarship even shows that rather than creating conflict, environmental issues result in cooperation among groups and states as they work to adapt to water shortages or famine. "On the whole, however, it seems fair to say that so far there is not yet much evidence for climate change as an important driver of conflict," one recent survey of the empirical literature concluded (Gleditsch 2012).

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But, as was noted, the framework that gives rise to the climate-conflict hypothesis is resource scarcity. Barnett & Adler (2007) argued that the effects of climate change are reduced access to natural resources needed to sustain economies, individual livelihoods and the capacity of states to provide opportunities and services."Within the current debate on how environmental factors may affect the risk of conflict, scarcity of important resources holds a prominent place. Acute scarcities, caused by re-

duced supply, increased demand or skewed distribution, are suggested as a significant current and future source of violent conflict," another review argued (Slettebak 2012).

That resource scarcity might lead to instability, state collapse, civil strife, or international conflict is hardly a new argument in international security affairs. Under the resource war framework, nations are said to fight over territory, raw materials, energy, water, and food (Gleditsch, Armed Conflict and the Environment: A Critique of the Literature 1998). Deteriorating environmental conditions create resource scarcity and competition, thus creating conditions conducive to violence, the argument goes. Therefore, to the extent that climate change contributes to deteriorating environmental conditions, it is viewed in this framework as yet another causal element.

These perspectives became popular in the 1970s and gained prominence with the end of the Cold War. The first Gulf War seemingly offered an excellent case supporting the view that the United States would go to war to secure a vital resource — petroleum (see (Klare 2001). Most recently Colin Kahl argued that resource scarcity can result in the collapse of a state's ability to operate effectively, thereby undermining social structures and the cohesion of the state. He also identified another possible outcome — cooption of the state by particular groups which exploit the power of government to disperse resources selectively (Kahl 2006).

Is there empirical support for the framework argument that resource competition will lead to instability and conflict? Much of the arguments, critiques and evidence are the same as those presented in climate-conflict literature. A recent review of the literature provides a nuanced view of the scarcity-conflict hypothesis. Conflicts over minerals do occur, but they are dependent upon the existence of other social factors (weak rule of law, inequitable distribution of revenue) and not the depletion of the supply. In fact, "in modern times, no interstate conflicts have been driven by depletion," the review concludes (Shields and Solar 2011, 261).

Four critiques of the resource war hypothesis have been advanced. Human inventiveness and technological innovation enhance agricultural output and improve resource extraction abilities. International trade enables the reallocation of resources which are plentiful in one location to those areas where they are scarcer. Many raw materials can be substituted for other cheaper or more plentiful materials. Under conditions of scarcity, prices will rise, which in turn encourages innovation, trade, and incentives to substitute (Simon 1986). Indeed, since the resource scarcity argument grew into prominence during the 1970s, actual experience shows the concerns to be entirely overstated. The *Limits to Growth*, for instance, predicted aluminum, copper, gold, lead, tin, zinc, and many other materials would be exhausted by the 1990s-2000s. All remain in widespread production today. Further illustration of the absence of predictive foresight were the expectations that natural gas supplies would be exhausted by 1994 and petroleum by 1992. The application of new technologies has greatly expanded known supplies of both natural gas and petroleum in recent years.

Others contend that scarcity gives rise to cooperation, rather than conflict. Deudney argues that "analysts of environmental conflict do not systematically consider ways in

which environmental scarcity or change can stimulate cooperation" (Deudney, Environmental Security: A Critique 1999). As discussed, water scarcity is shown to give rise to more cooperation than conflict (Dinar 2011).

The logic behind cooperation, trade, or innovation as the preferred strategy for addressing resource scarcity is simple and compelling. The costs of military action are always high, the probability of success (in either the short or long-run) is not guaranteed, and the costs of holding the gains from military action undermine the benefits of securing supplies of the desired resource. The German and Japanese experiences during World War II are instructive for these purposes. Both nations were strongly incentivized to secure supplies of resources before the onset of conflict and during the course of the war. Neither succeeded — at great cost. Institutions, international markets, and diplomatic solutions offer options short of conflict for resolving transboundary disputes. Trading on the international market expands supply options, as does investment in efficiency or substitutions.

Two studies examined the long-run relationship between temperature and precipitation and violent conflict in China and Europe (Zhang, et al. 2007) and (Tol and Wagner 2008). Both reach conclusions that contradict the basic premise of the climate conflict argument. Zhang et al. (2007) looked explicitly at the relationship between climate change and violent conflict in China and determined that conflict was more common during cold periods, with food scarcity being the likely reason. Tol and Wagner (2008) use climate data for Europe to replicate the Zhang work, concluding there is some evidence for the increased incidence of European conflict in cold periods, but not warm. Both studies suggest the rise of conflict in cold periods is associated with famine. Tol and Wagner (2008) find that the relationship between temperature and conflict is declining over time. One could speculate that the introduction of modern agriculture and more responsive state structures mitigate the effect of temperature and climate over time. Famine remains a problem, but largely not in the developed world where modern agriculture provides stronger crops and food storage and management systems preserve food supplies more effectively. If this is true, it is strong evidence in support of adaptation (via technology) as a means to respond to changing climatic conditions.

If climate change does not breed conflict, what other security effects may it produce? The CNA and others claim the U.S. military will be asked increasingly to respond to humanitarian crises. Indeed, Defense Secretary Panetta specifically referenced his expectation for the growth of this mission area in his recent speech to the Environmental Defense Fund. The CNA has explored this notion in two influential reports (see (Center for Naval Analyses & Oxfam Amercia 2011) and (McGrady, Kingsley and Stewart 2010)). According to these reports, increased operational tempo coupled with operations in varied environments will require defense officials to train, equip, and prepare U.S. forces to fulfill these missions. The zero-sum nature of resource allocations means these forces would not be available for use elsewhere.

The United States is a generous nation. Natural disasters generally elicit an outpouring of money and assistance from U.S. citizens, philanthropic organizations, and the

government, but not for every disaster and not in every circumstance. Even today, choices must be made about when and how extensively to respond. In a world where such demands on U.S. resources might increase, policymakers and defense officials will need to be more selective. That is not a security challenge; rather, it is a matter of prioritizing the use of resources. Employing the U.S. military for humanitarian and disaster relief missions is an explicit choice motivated the desire to do right, but also to be seen as doing right. Such actions improve world opinion of the U.S. and, in so doing, may enhance U.S. leadership. Responding in each and every instance is not required to achieve that result, nor is there any way to judge whether U.S. standing would suffer if it failed to respond, in a single instance or relative to the rate of demands. Put another way, not every instance of humanitarian need requires an American response.

Another often mentioned security concern is the direct effect of climate change on U.S. military installations. Sea level rise or the increased probability of intense storms may damage U.S. bases, requiring the diversion of resources to repair them ((McGrady, Kingsley and Stewart 2010), (Center for Naval Analyses and Oxfam 2011) and (Busby 2007)). The prospect of damaging sea level rise is overstated, both for U.S. military installations and the world population generally. Most estimated sea level rise under varying climate scenarios point to increases on the order of 2-6 millimeters per year. Over the course of a century the cumulative impact of such an increase may prove to be a problem if one accepts the finding as valid. U.S. defense planners and facility maintenance concerns do not operate on such time scales. The year-to-year change is barely noticeable and likely not to exceed the adaptive capabilities of the U.S. military. More frequent or more intense storms can become a concern. Again, the question is one of adaptation. If U.S. military installations are already in areas where large-scale storms are frequently seen, then one presumes these facilities already are prepared to handle such storms. The marginal enhancement foreseen to the power of any individual storm by climate change is unknowable and attributing damage from the incremental enhancement of a storm's power is impossible.

Impact on Defense Planning

"Strategy is the most important guide for force planning," observed Dr. Richmond Lloyd, then Director of the Strategy and Force Planning course at the Naval War College (Lloyd 2000). In an ideal world, national military strategy emerges from objectives established by national strategic goals. Force planning is the product of appraising the nation's security interests, strategic goals, and resource or other limitations. Of course, reality is more complicated. These choices also reflect strong inertial forces within the defense budgeting and planning process. The long lead times required to design, develop, and manufacture a particular capability (a tank, a ship, a gun, a satellite) mean that the nation has invested considerable resources into those systems. Cancelling an established program is rare. Political support, established industrial interests, and local economic concerns among other factors combine to protect defense programs from cancellation. Given these factors, the selection of national strategic goals should be done carefully so as to prioritize resources efficiently and effectively.

A change in strategic goals may necessitate new kinds of forces. Such a mandate leaves defense planners with a limited set of responses. First and the most frequent of the options, existing programs are repurposed to meet the new goal. Those with interests in maintaining existing programs and systems find ways to connect their priorities to the new strategic goal, or add capabilities onto existing platforms. The aforementioned example of earth monitoring satellites offers an apt illustration of this approach. Those satellites were designed to meet one purpose; with the emergence of a new strategic priority, climate change, advocates now present it as an option for meeting the force structure needs of the new priority. Second, a new program is begun. New programs are difficult to start in constrained resource environments. At times, an urgent situation can help overcome that barrier. The Defense Department removed many barriers and invested significant resources in technologies to combat IEDs because of the immediate need to address that problem. In a constrained budgetary environment, new programs are funded through new money or the diversion of funds from other programs. In defense budgeting terms, the first instance bears no cost; no other program suffers from the start of a new effort. In the latter instance, another program or combination of programs suffer budget cuts, producing delayed timetables which often result in higher long-term costs or a reduction in the numbers of the item to be procured — which may constrain the ability to meet other strategic goals.

Specifically considering the climate-security issue, expanded use of the U.S. military in humanitarian relief operations seems the most probable outcome. The question for defense planners is whether they alter force structure and budgeting choices to provide for more of the systems used in those missions, or find other means to acquire those capabilities when they are demanded. Humanitarian missions draw most heavily on logistical assets and readily deployable personnel. Logistical assets, such as cargo planes, transport vessels, trucks, and helicopters, are purchased and leased from private sources both as needed and to provide a baseline internal capacity.

Further considering the climate-security argument shows a mismatch of planning horizons. As one defense analyst noted: "… any changes in the climate, for better or for worse, will occur gradually over decades. Thus, there will be ample time to adjust national security and humanitarian assistance instruments to accommodate future demands," (Carafano 2009). Defense planning and budgeting cycles operate on five-year defense plans, with long-run research or development programs sometimes having timelines out to a decade. The assessments of the security implications of climate change envision impacts emerging in 2030 or beyond, and even then the scope and severity of impacts are uncertain, and the impact on mission needs or operational requirements is essentially unknowable. Projecting those implications onto force structures or budget allocations is an exercise in guess work with the choices resting entirely on assumptions about how the future will evolve.

Conclusions

The evidence in support of the claim that climate change will undermine U.S. national security is, at best, ambiguous and most probably non-existent. Dire scenarios of refugees crossing borders because of floods or civil war erupting out of famine-induced crises make for stimulating discussion, but assessments of the underlying propositions prove the scenarios unfounded. Put simply, the security consequences of environmental factors do not cause conflict and, in fact, are more likely to induce nations to work cooperatively.

The argument fails at every step of the causal chain. For the climate-security argument to be true, temperatures must warm, be caused by human activity, result in positive feedbacks to amplify the CO_2 signature, cause intervening variables to occur (increased or decreased precipitation, sea level rise, storms, etc), cause them to occur in specific regions, and have them be severe and regular enough to create famine, drought, floods, etc. of sufficient strength to create "refugees," "instability," "tension," and possibly intra- or interstate conflict.

The cursory review of climate science contained herein suggests that much remains to be explained about the human impact on climate change. Observed temperature is well below what the climate computer models would predict, which means those models fail to accurately replicate natural processes and their interactions with human activities. Additionally, these models are readily acknowledged to provide poor insight into developments at regional and local levels, which is the area of greatest interest for security issues. So, the first links in the chain are questionable. Temperatures may or may not be increasing at levels sufficient to trigger the impacts of concern. Those trends may not be driven by human activities. And the impact of rising temperatures is speculative at the level of analysis required to evaluate regional and local security conditions.

More fundamentally, climate science is not capable of informing policymakers of the specific cause for a specific weather occurrence, and fixing blame for one event over another is impossible. Instead, proponents of this view would have policymakers believe that global warming will make these occurrences uniquely worse in the future. This appeal to future conditions is an effort to discount the empirical literature that shows little to no connection between environmental factors and conflict. It also suggests that the propositions advanced are untestable, which the empirical literature shows to be false.

Nevertheless, natural disasters, droughts, storms, floods and similar climatic phenomena occur naturally. It is possible to empirically test the remaining elements of the causal chain — to prove whether environmental variables increase the propensity for tension and conflict. By themselves, environmental factors and climate change are not threat multipliers. The review of actual experiences with environmental stresses and calamities reveals that they contribute to conflict and state instability only at the margins. From tribesmen in Africa to nation states in both the developing and developed world, environmental and climatic variables fail to demonstrate explanatory

power as a source or driver of conflict. In fact, the reviews show that cooperation to adapt to the environmental stressor is the more likely outcome. Indeed, some researchers fear that evaluating environmental challenges through national security perspectives will inhibit these cooperative tendencies.

As noted, four features of the climate-security issue argue against it becoming anything other than an intellectual exercise in defense and security planning:

1. The absence of empirical proof for the causal connections between climate change and conflict. The environmental conflict literature offers little support for claims of droughts, floods, storms, or resource scarcities leading to conflict within states or between states.
2. Alternative causes for conflict reduce the explanatory power of environmental variables. Even if environmental factors were removed, conflict remains a likely possible and any security interests of the U.S. remain in jeopardy.
3. The planning horizons do not match. Scenarios detailing the impacts of climate change run 20, 30, 50 or 100 years out. Policymakers, the armed forces or program managers rarely look that far into the future when designing strategies, programs or budgets.
4. U.S. interests will not remain static. Projecting what the security priorities of the U.S. will be decades into the future is highly speculative. Yet, the climate-security literature supposes that the U.S. will remain committed to humanitarian interventionism and that other nations will remain accepting of the U.S. in that role.

Further, it was shown that cheap energy and rising consumption of energy supports increased rates of economic growth, rising living standards, improved health, increased agricultural productivity, and reduced incidence of intra- and interstate tension and conflict. If the focus of concern is preservation of stability in the international system, then policies designed to reduce energy consumption or increase its cost in order to reduce greenhouse gas emissions are counterproductive.

Yet, senior policymakers and reputable think tanks continue to advance the claim. Why? The intentions behind these efforts to link climate and security are clear — to motivate action on climate policy. Linking the environment with security is intentionally pursued as a way for organizations and government agencies to secure attention and resources (Dabelko and Simmons 1997). The Brookings Institution is even clearer: "Our diverse group undertook a scenario exercise in hopes of reaching a better understanding of the consequences the world could realistically face from climate changes across the range of plausible effects. Our intention was to influence the public debate about climate policy" (Campbell and Weitz 2008). Former Secretary of State George Schultz offered even blunter support for the notion of appealing to national security to gain Republican support for climate legislation. Emphasizing the national security case for controlling emissions and shifting energy use away from petroleum would rally support of those otherwise unconcerned with the environmental issue, he argued (Sullivan 2011).

By casting climate change as a security issue, proponents of greenhouse gas controls believed they could secure support from constituencies who otherwise were apathetic or opposed to climate mitigation policies. If policymakers, and the public concerned most about security affairs, were convinced to view climate as a national security threat, then the political coalition in favor of immediate action on climate policy would be greatly strengthened. As it is, the climate policy debate is generally viewed in economic and moral terms and breaks along partisan lines. The national security argument is an attempt to shift the focus of the debate by enabling proponents of mitigation policies to claim the added benefit of forgoing the envisioned military operations, humanitarian interventions, and general security consequences to their economic arguments as well as the intrinsic value of avoiding those problems. Speaking before a defense conference, Christiana Figueres, Executive Secretary of the United Nations Framework Convention on Climate Change, characterized the issue as a trade-off between investment in "a traditional global military budget" versus an increase in "a preventive military budget" consisting of adaptation and mitigation efforts intended to avoid the security consequences of climate change (Figueres 2011).

As this review shows, that calculation fails. Natural climatic events make environmental calamities inevitable. So, if U.S. national interests are triggered by floods or droughts, then the U.S. will need to prepare to address those as they occur, regardless of cause or frequency, resulting in no savings in materiel or planning. Perhaps even more significant, the policies recommended to mitigate greenhouse gas emissions will contribute to greater risk of instability, tension, and conflict. By increasing the cost of energy, mitigation approaches, such as the Kyoto Protocol or cap-and-trade, reduce economic prosperity. Affordable energy is strongly and positively associated with the incidence of peace in the international system and intra-state stability. The risks to U.S. national security interests potentially worsen.

In summary, the climate-security argument is dangerously overstated and designed to serve a domestic political purpose more than filling a void in strategic thinking.

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