



Climate Change Impact on National Security

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Overview

- **Objective**
- **National Intelligence Priorities Framework**
- **Outreach Efforts**
- **Caveat**
- **What We Have Been Told**
- **National Intelligence Assessment**



Objective

To provide background on a National Intelligence Assessment (NIA) on the national security ramifications of global climate change.



National Intelligence Priorities Framework

Environment and Natural Resources

Definition: Production, development, transport, and consumption of strategic natural resources—excluding energy resources—critical to the economy and/or associated with production of militarily significant items. Access to water supplies to sustain national economies. Production, release, illicit sale and disposal of pollutants and hazardous materials including their potential human health effects. Compliance with international environmental or resource sharing agreements. *Activity impacting international oceanic and atmospheric environments, including activities in space. Policies and positions of state and non-state actors relative to environmental and resource issues.* Indications and warning of environmental warfare, crime or “ecoterrorism” or attacks against critical infrastructure—excluding energy—and water production, transport and distribution facilities. *Physical environment conditions including weather, climate, geography, terrain, and urbanization.*



Outreach Efforts

- **Joint Global Change Research Institute**
 - Intergovernmental Panel on Climate Change
 - Current Peer Reviewed Literature
- **US Climate Change Research Program**
- **Center for Naval Analysis**
- **Center for International Earth Science Information Network at Columbia University**
- **RAND Corporation**
- **Global Business Network**
- **Arizona State University**
- **Naval Post Graduate School**
- **Center for Strategic and International Studies**



Caveat

- **“What we have been told”**
 - **Reflects inputs from outside experts**
 - **Not necessarily endorsed or accepted by US Government or the Intelligence Community**
 - **Done for different audiences, with different time scales, and different levels of academic rigor**
 - **Does provide insight in current expert views**
 - **Much of it based on peer reviewed literature**



What We Have Been Told

Background

- **Climate change poses unique challenges to US national security and interests.**
- **Current approaches and methods for understanding climate change and its impacts fall short in their efforts to help analysts and others anticipate and prepare for these eventualities.**



What We Have Been Told

Components of National Security

- **Core security concerns**
 - (conflict, failed states, terrorist opportunities)
- **Indirect security concerns**
 - (economics, energy, social unrest, migration)
- **Foreign policy concerns**
 - (humanitarian crises, unrest in Islamic countries)
- **Broader political concerns**
 - (loss of faith in government)



What We Have Been Told

Security and Analytical Implications

- **Impacts that constrain US freedom of action and operations.**
 - Changes to the US strategic position, or
 - Changes to US political attitudes.
- **Impacts that pose novel challenges for action**
 - Challenges due to acute systems disruptions
- **Impacts that impose new kinds of costs and requirements for preemptive action**
 - Demands long-range planning.
 - Preemptive approach to forestall the worst effects of collapsing systems

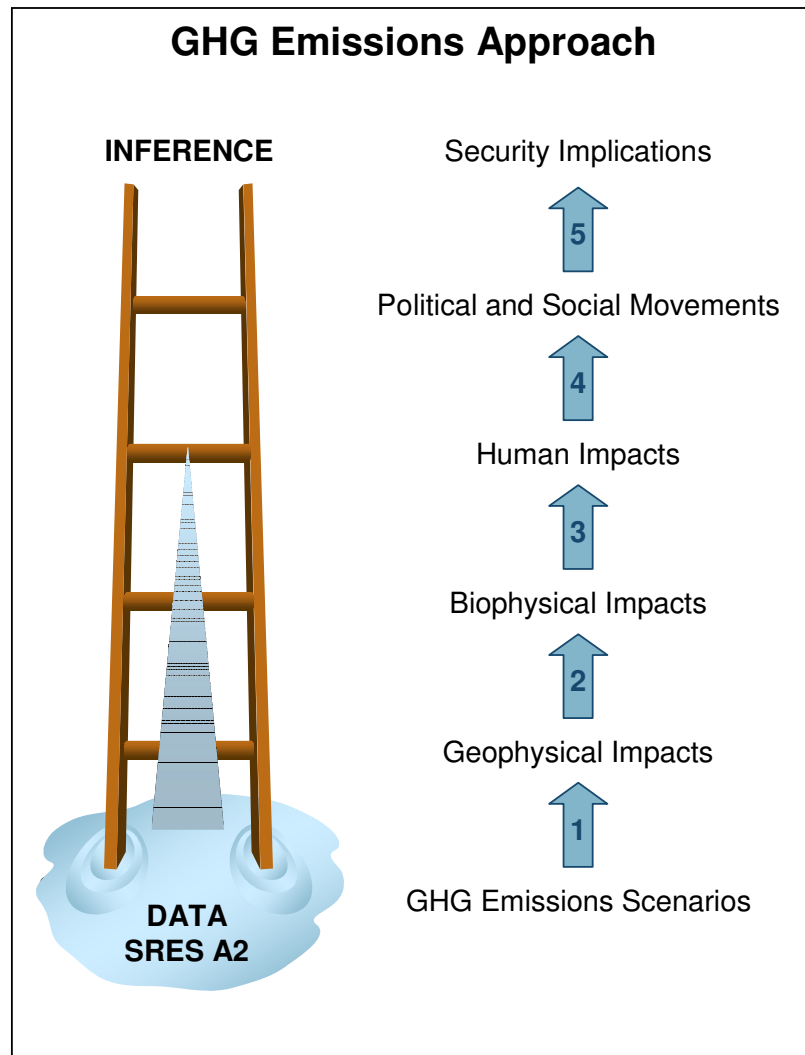


What We Have Been Told

Standard Approaches Using GHG Emissions

- Focus first and foremost on the likely “first-order” geophysical effects that increased GHGs will have on climate.
- Consider (with somewhat less certainty) what second-order effects these climate changes will have on biophysical systems.
- Guess (with even less certainty) how these effects will in turn create third-order effects—changes in patterns for vector-borne disease, famines, increased heat deaths, environmental refugees, and so on—that greatly impact humans.
- Finally (and with very little certainty whatsoever), there may be speculation about how political or social systems might react to these third-order effects—by which time we’re talking about *fourth-order effects*.

What We Have Been Told



**Climate scientists
(who, like all
scientists, like to stay
close to the facts) are
often reluctant to
make meaningful
claims that rest on
such an extended
ladder of inference.**



What We Have Been Told

Where we are

Over the past two decades, and especially in the last few years, climate change has become one of the most heavily researched subjects in science. Yet climate change impact studies remain at the low end of usefulness for analysts, policymakers, and others; they are not predictive enough to be actionable because the exact nature of the events that will jar the planet in the near- and long-term future—the wheres, whens, and hows of climate change—remains both unknown and unknowable.



What We Have Been Told

Approach

Instead of starting with climate change and working out toward impacts, we focus on systems that are already generally vulnerable first, and then consider what the geophysics of climate change may do to them.



What We Have Been Told

System Vulnerability Approach

- **Inverts this traditional framework.**
 - look at human and natural systems that are *already* in a state of dynamic tension,
 - suggest how climate change, while of uncertain specific effects, is likely to apply additional stress to these already-perturbed systems.

In other words, we start by looking at the objects of change themselves, determining those that are in such a state of flux that the “certain uncertainty” of climate change may have a radically destabilizing, albeit specifically unknowable, effects on them.



What We Have Been Told

Climate Change Today

- **Scientific observations confirm that the earth's climate is changing.**
 - Physical and biological systems are also changing consistent with the present warming trend.
 - The global mean temperature has risen 0.65 degrees Celsius over the past 50 years,
- **Temperatures in the Arctic are rising almost twice as fast than the global rate and faster over continents than over oceans.**
- **The frequency of heavy precipitation events has increased over most land areas.**
- **Some regions already vulnerable to drought (Indonesia, northwestern Brazil, southwestern United States, and parts of Africa and Australia) are experiencing more frequent and more severe droughts.**



What We Have Been Told

Climate Change Today

- **Thawing of the northern latitude permafrost is forcing repair or (likely) replacement of buildings and pipeline infrastructure.**
- **Heat waves are likely increasing in frequency and intensity, causing an increase in deaths due to high temperatures in large urban areas.**
- **Changes in snowpack and timing of snowmelt in the US Cascade and northern Sierra Mountains are affecting water supplies in the western United States as well as in the Himalayas, where many people depend on the snow melt for a reliable source of summertime water.**



What We Have Been Told

Regional Climate Trends and Impacts to 2030

- **The next decades of climate change will affect ecosystems and human systems, which interact in complex ways.**
- **Some impacts will likely emerge gradually; however, recent findings indicate that some impacts will emerge rapidly.**
 - **Climate changes will, in some cases, likely cause abrupt changes in natural resources, such as short-term degradation of agricultural resources from pests or diseases.**
- **Low-lying, densely populated coastal areas, such as the mouths of major rivers, and small islands are at risk from sea level rise, and more intense storms and storm surges.**
- **Agriculture productivity and water availability will change in regions around the world, and may in some cases drive human migration.**



What We Have Been Told

Africa

- **Interannual variability has been observed since 1970, with higher rainfall anomalies and more intense and widespread droughts reported. Observations of recent total annual rainfall are mixed.**
- **The IPCC has identified Africa as likely the most vulnerable continent to climate change.**
 - **Scientific studies indicate that climate change will likely cause agricultural losses, possibly severe in the Sahel, east Africa, and southern Africa—perhaps up to 50% yield reductions by 2020.**
 - **Persistent poverty, frequent natural disasters, weak governance, and high dependence on agriculture will, with climate change, likely lead to higher exposure to water stress, perhaps affecting 75-250 million people by 2020.**



What We Have Been Told

North America

- **From 1955 to 2005, annual mean air temperature increased, to the greatest extent in Alaska and northwestern Canada, followed by the continental interior.**
- **The growing season has lengthened an average of two days per decade since 1950 in Canada and the conterminous United States.**
- **For most of North America, annual precipitation has increased.**
 - **The most marked increase in northern Canada.**
 - **However, precipitation has decreased in the southwest United States, the Canadian Prairies, and the eastern Arctic.**
 - **In the eastern United States, stream flow has increased 25% in the past 60 years but decreased 2% per decade for a century in the central Rocky Mountain region.**



What We Have Been Told

North America

- **Most of North America in the mid-latitudes will likely be less affected by climate change in the next few decades than either the tropics or the polar regions.**
 - **The Columbia River areas in the United States and Canada will experience increased stress as snowmelts will occur earlier and snowpacks will be reduced.**
 - **Although sea level rise will not be significant by 2030, the combination of accelerating sea level rise, valuable coastal infrastructure, and increased storm damage will likely affect North America, especially on the east coast and Gulf of Mexico.**
 - **Analysis that extrapolates current trends of the so-called 100-year storm surge shows extensive flooding in both Boston and New York City.**



What We Have Been Told

Asia

- **Presently, extreme events are more frequent and intense.**
 - **Heatwaves are longer and more severe in Russia, Mongolia, China, and India.**
 - **Intense rains and floods come more often to western Russian (but have decreased in Siberia), China (except for decreases in arid northern regions), Japan (especially typhoons), and south and Southeast Asia.**
 - **Droughts have intensified and/or affected more areas in Russia, Mongolia, China, and south and Southeast Asia.**
 - **Tropical storms are more frequent in the Philippines and China; the Bay of Bengal and the Arabia Sea are experiencing fewer but more intense storms.**



What We Have Been Told

Asia

- **Current projections indicates that south, southeast, and east Asia will face risks of reduced water supplies, decreased agricultural productivity, and increased risks of floods, droughts and cholera.**
 - **Crop yields will likely decrease 2.5-10% and 120 million to 1.2 billion people experience water stress by the 2020s, according to the 2007 IPCC assessment.**
 - **An additional 49 million people could be at risk of hunger by 2020.**
 - **Marine ecosystems and resources such as aquaculture will likely experience significant losses.**



What We Have Been Told

Europe

- **Different areas of Europe vary in precipitation change.**
 - Average (mean) winter precipitation is increasing in most of Atlantic and northern Europe, while yearly precipitation trends are decreasing in eastern Mediterranean regions and no significant change is experienced in the west.
 - Most parts of the continent are receiving more precipitation per wet day, even in some areas that are becoming drier.
- **Europe will likely experience increases in flooding, as well as health risks from heat waves.**
 - By the 2020s, increases in winter floods are likely in maritime regions and flash floods throughout Europe.
 - Risks to health from more severe heat waves will likely increase.
 - Other impacts are likely to be similar to those experienced in North America.



What We Have Been Told

Latin America

- **Increases in rainfall in southeast Brazil, Paraguay, Uruguay, the Pampas, and some parts of Bolivia have affected land use and crop yields, and increased flood frequency and intensity.**
 - **Precipitation has decreased in southern Chile, southwest Argentina, southern Peru, and western Central America.**
- **Latin America will likely experience increased water stress and loss of species.**
 - **By the 2020s, climate change will likely put 7-77 million additional people at risk of water stress and 1-5 million at risk of hunger.**
 - **By 2030 processes will be underway that, under GCM projections for 2050, will likely lead to extinction of almost a quarter of the tree species of the central Brazil savannas.**
 - **Crop yield projections are uncertain, but reduced rice yields and increased soybean yields are consistent results when carbon dioxide effects are considered.**



What We Have Been Told

Australia and New Zealand

- **Australia and New Zealand will almost certainly see warmer weather with increased frequency of extreme events.**
 - **Floods, landslides, droughts and storm surges are very likely to become more frequent and intense, and snow and frost very likely to become less frequent.**
 - **Infrastructure design criteria for extreme events are very likely to be exceeded more frequently.**
- **Water availability problems are very likely to intensify in southern and eastern Australia, and in New Zealand in Northland and some eastern regions (high confidence).**



What We Have Been Told

Australia and New Zealand

- **Significant loss of biodiversity is projected by 2020 in some ecologically rich sites, including the Great Barrier Reef and Queensland Wet Tropics.**
- **Production from agriculture and forestry is projected to decline over much of southern and eastern Australia and over parts of New Zealand due to increased drought and fire.**
- **However, in New Zealand, initial benefits to agriculture and forestry are projected in western and southern areas and close to major rivers due to longer growing season, less frost and increased rainfall.**



What We Have Been Told

Polar Regions

- **For several decades, surface air temperatures in the Arctic have warmed about twice as fast as the global rate, with associated reductions of sea ice and glaciers.**
 - **The duration of river and lake ice has decreased in the sub-Arctic, and (since 1980) permafrost has warmed in nearly all areas for which measurements are available.**
 - **Decreased Arctic ice has already raised the possibilities of a new navigation route and resource extraction activities.**



What We Have Been Told

Polar Regions

- **Scientists are highly confident the polar regions will see further change.**
 - **Polar regions will face reduced ice cover and coastal erosion, with disruption of cultures and loss of communities;**
 - **Thawing of Arctic permafrost will continue to damage infrastructure but also allow increased vegetation;**
 - **Decreases in ice area will reduce reflection from the sun and thus increase warming and change ecosystem conditions for plants and animals.**



What We Have Been Told

Climate Change to 2100 and Beyond

- **The Intergovernmental Panel on Climate Change's (IPCC's) 2007 Fourth Assessment Report (AR4) analyzes scenarios for emissions of greenhouse gases that adopt a range of different levels of socio-economic activities.**

All of the Special Report on Emissions Scenarios (SRES) presume that governments or large-scale institutions will make no special efforts to limit greenhouse gas emissions in order to mitigate climate change, although other efforts (e.g., to be more energy efficient or to diversify fuels) may result in lower emissions



What We Have Been Told

Climate Change to 2100 and Beyond

- **Under these SRES scenarios, the climate changes dramatically over the course of this century and will still be changing beyond 2100.**
- **Many of the century-scale changes will be an extension and possible acceleration of the increases in temperature and shifts in precipitation observed over the last 25 years. These climate changes range from global-scale changes such as sea level rise to local increases in the intensity of large precipitation events.**



What We Have Been Told

Climate Change to 2100 and Beyond

- **Models and theory lead us to expect that severe storms, including both extra-tropical and tropical cyclones, will become more intense as the climate system adapts to rising temperatures by strengthening the global hydrological cycle, although increased water vapor and the temperature gradient from the poles to the equator also play roles in the formation and severity of storms.**
 - **The number of such storms may decrease, however. Changes in monsoons are expected, but the nature of the changes is uncertain.**



What We Have Been Told

Climate Change to 2100 and Beyond

- **During this century, changes in agriculture will likely begin in the low latitudes, where decreases in crop productivities are already beginning to be observed.**
 - **A climate change beyond ~3 degrees Celsius would very likely reduce global production potential and cause crop yields to decrease in the mid-latitudes.**
- **Projected sea level rise will undermine human infrastructure such as coastal highways, homes, businesses, port facilities, military installations, and water management structures.**
 - **Impact severity will depend upon the number of people who live in low-lying areas, socioeconomic conditions, the value of the infrastructure, and human dependence on the infrastructure.**



What We Have Been Told

Climate Change to 2100 and Beyond

- **Glacier/ice sheet melt will contribute not only to sea level rise, but also to shifts in ecosystems, especially in the high latitudes, and shifts in water availability everywhere.**
 - **Less and less water will be stored as snow.**
 - **Farms and ranches that depend upon spring thaws for plant and animal growth may face the need for major changes in farming and ranching practices.**
- **For cities, climate change is an additional stress on top of the ongoing problems associated with in-migration, slums, inadequate public services (e.g., health), poverty, and crime.**
 - **Increased temperatures, more frequent and severe heat waves, and sea level rise provide multiple stresses.**



What We Have Been Told

Could we be underestimating future climate change?

- **Climate observations of the past and modeling studies have identified thresholds in the climate system where small perturbations lead to rapid and dramatic shifts in climate.**
 - **Most of these have been observed to occur during the ice ages when large amounts of fresh water were stored on land.**
 - **Abrupt climate change during the ice ages is associated with the release of large amounts of freshwater into the North Atlantic Ocean and the subsequent shutdown of the Meridional Overturning Circulation (MOC).**
 - **Current climate models can reproduce this event under glacial conditions, but under current climate the possibility of an MOC shutdown is unlikely, and even if the MOC slows down, the chance of it triggering an ice age is remote.**



What We Have Been Told

Could we be underestimating future climate change?

- **Other mechanisms for abrupt climate change reviewed in the IPCC include:**
 - **The collapse of the West Antarctic and/or Greenland Ice Sheets due to accelerated ice flow and iceberg calving;**
 - **Sudden release of the large amounts of methane from hydrates (ices) stored in the seabed along continental margins;**
 - **Abrupt conversion of vegetation and soil carbon to CO₂ following a climate-induced shift from tropical forests to grassland or desert.**
- **The collapse of the great ice sheets and the increase in sea level probably pose the greatest risk for abrupt climate change today.**



What We Have Been Told

Could we be underestimating future climate change?

- **In addition to abrupt climate change, there remain uncertainties on feedbacks within the climate system that can amplify the change caused by greenhouse gases alone.**
 - **Many studies in the recent assessment evaluated the probability distribution of future temperature changes and found a much longer tail of high probabilities extending in the direction of higher than expected warming than in the direction of lower.**
 - **This asymmetry in temperature change results from the lack of historical climate data to constrain the uncertainties in the feedbacks in a warming world; whereas the climate record documenting the transition from ice ages to present provides tighter constraints on the low range of future temperatures.**
 - **Thus, our best estimates of future warming have an equally likely up- or down-side, but the up-side is not well bounded.**



What We Have Been Told

Could we be overestimating future climate change?

- **The climate sensitivity to doubled CO₂ is a classic metric that defines how greenhouse gases force climate change.**
 - **Most feedbacks in the climate system (water vapor, clouds, sea ice, snow, carbon cycle) tend to amplify the change that would be caused by greenhouse gases alone.**
 - **The current best estimate of the equilibrium warming for a doubling of atmospheric CO₂ is approximately 3°C with an asymmetric likely range of from 2°C to 4.5°C.**
 - **While the positive feedbacks may be less strong than currently modeled, or the negative feedbacks more important, a lower range of warming less than 1.5°C is remote.**
 - **Indeed the observed response of the climate to a range of forcings from the ice ages to the present has not identified any negative feedbacks that would substantially offset the predicted warming.**



What We Have Been Told

Could we be overestimating future climate change?

- **Increases in atmospheric CO₂ can act as a fertilizer, enhancing plant growth and possibly sequestering more CO₂.**
 - **If this fertilization effect works on a global scale then some of the increases driven by fossil fuel burning could be reduced, but not cancelled.**
 - **Unfortunately, the inclusion of the carbon cycle in climate models shows that the changes in temperature and precipitation override this effect and that the net impact of climate change is to further increase atmospheric CO₂.**
- **Given the lack of natural systems to offset the greenhouse warming, the likely path to reduce the future climate change projected in the IPCC scenarios is through active mitigation to reduce CO₂ emissions or sequester atmospheric CO₂.**



What We Have Been Told

Where Are the Motivations and the Geopolitical Fault Lines?

- **Key uncertainty is US role**
 - Likely to “get religion” by 2020
 - Or private sectors will take lead
- **Key fault line will separate “old” rich – OECD countries – from “newly enriching” – China, India and others**
 - First will want second to participate
 - Second will argue they can emulate first



What We Have Been Told

What Do Those Fault Lines Suggest About the Rancor of International Politics?

- **North/South Europe – increasing tensions as problems emerge in the south**
- **North/Central/South Asia – increasing tensions as different problems emerge in different regions**
 - perhaps issues over water resources
- **United States/Europe/developing nations – tensions over US greenhouse gas emissions**
- **United States/China – tensions over air pollution transport from China**



What We Have Been Told

What Is the Likely Nature of Global Consensus?

- **A lot depends on US position**
- **Making plans for adapting to climate change and transferring technology**
- **More intensive efforts in renewables, efficiency, carbon sequestration and nuclear**
- **Other international dynamics?**



National Intelligence Assessment

Purpose/Requester

The National Intelligence Council will develop a National Intelligence Assessment (NIA) – targeted at the UNCLASSIFIED level – on the national security challenges and opportunities through 2030 resulting from global climate change (GCC). This effort is being undertaken as a result of draft bipartisan legislation and in support of the NIPF Topic: Environment and Natural Resources.



National Intelligence Assessment

When is an anticipated "impact" from changing climate significant to national security?

An impact is significant when it causes a noticeable – even if temporary – degradation in one of the elements on national power (geopolitical, military, economic, or social cohesion) because it directly influences the US Homeland, indirectly influences the United States through a major military ally or a major economic partner, or because the global impact is so large the United States cannot be unaffected (e.g. it indirectly consumes US resources).



National Intelligence Assessment

Where are we?



...writing!



Climate Change Impact on National Security

Questions?

