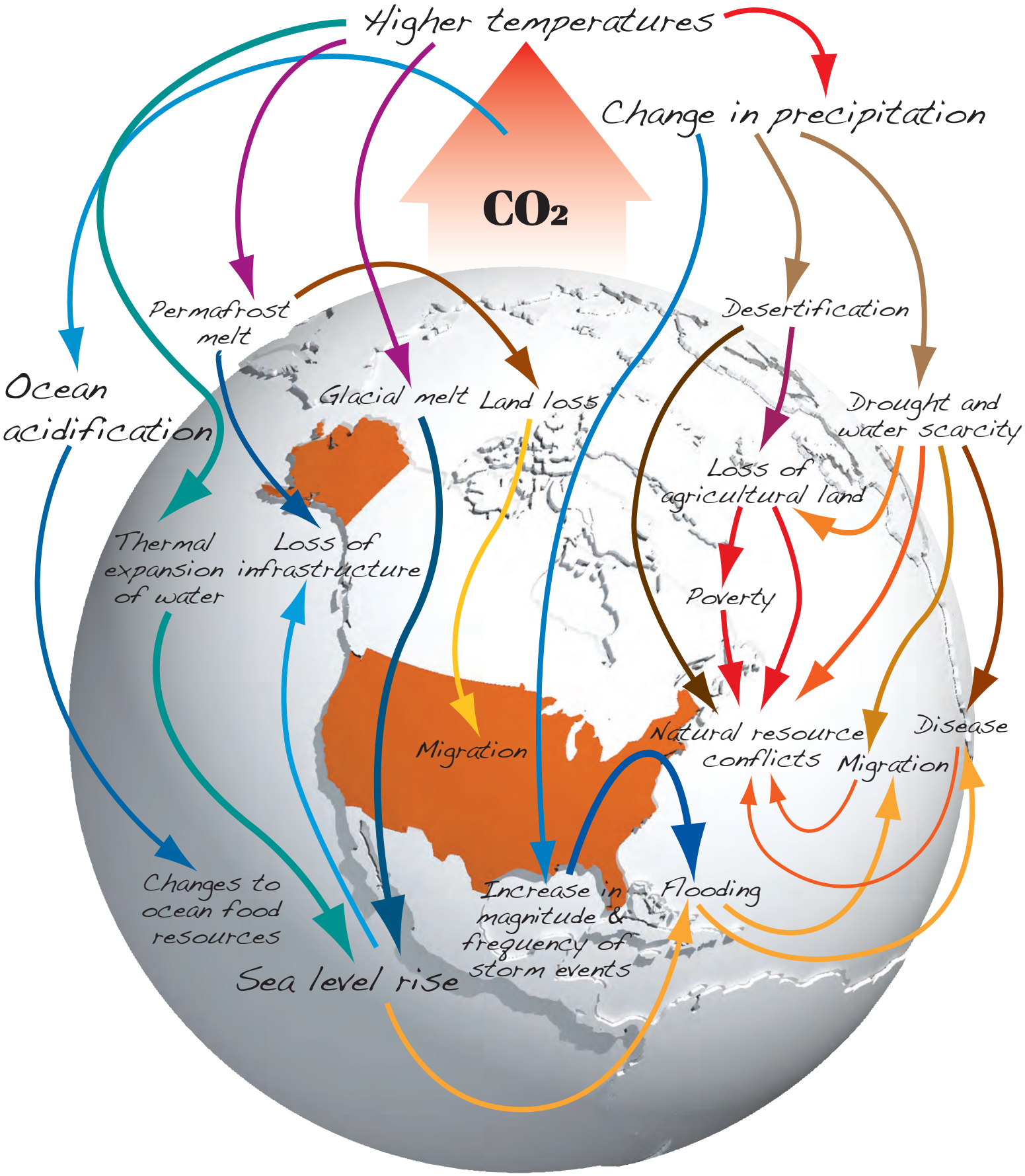
CLIMATE CHANGE
Multiplying Threats to National Security



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"Climate change acts as a threat multiplier for instability in some of the most volatile regions of the world."
– "National Security and the Threat of Climate Change," The CNA Corporation, 2007

Katrina
The hurricane approaches the Gulf Coast, Aug. 25, 2005.

Source: NASA/GSFC, MODIS Rapid Response

The United States Armed Forces are planning for a warming world, but they do not yet have all the tools they need to complete their mission. Rising seas, extreme weather, droughts, dwindling access to fresh water and other consequences of global warming are expected to increase instability and create conflict in many regions. They could impact the ability of the Armed Forces to operate around the world.

We are a group of doctoral students from the Scripps Institution of Oceanography and the University of California San Diego. As scientists, we know that the concentrations of carbon dioxide and methane – two key heat-trapping gases – are higher in the atmosphere today than they've been in at least 650,000 years. The Earth's climate is warming.

Some lawmakers doubt the fundamentals of climate science, and Congress remains deeply divided over what the nation should do about global warming. While strategic planners in the Armed Forces acknowledge these political divisions, their mission is to consider all the possibilities and not leave the nation or the people who defend its interests unprepared. Forecasting how climate change may shape national security is an incredibly complex task, and the truth is that our nation's defense experts need more advanced science.

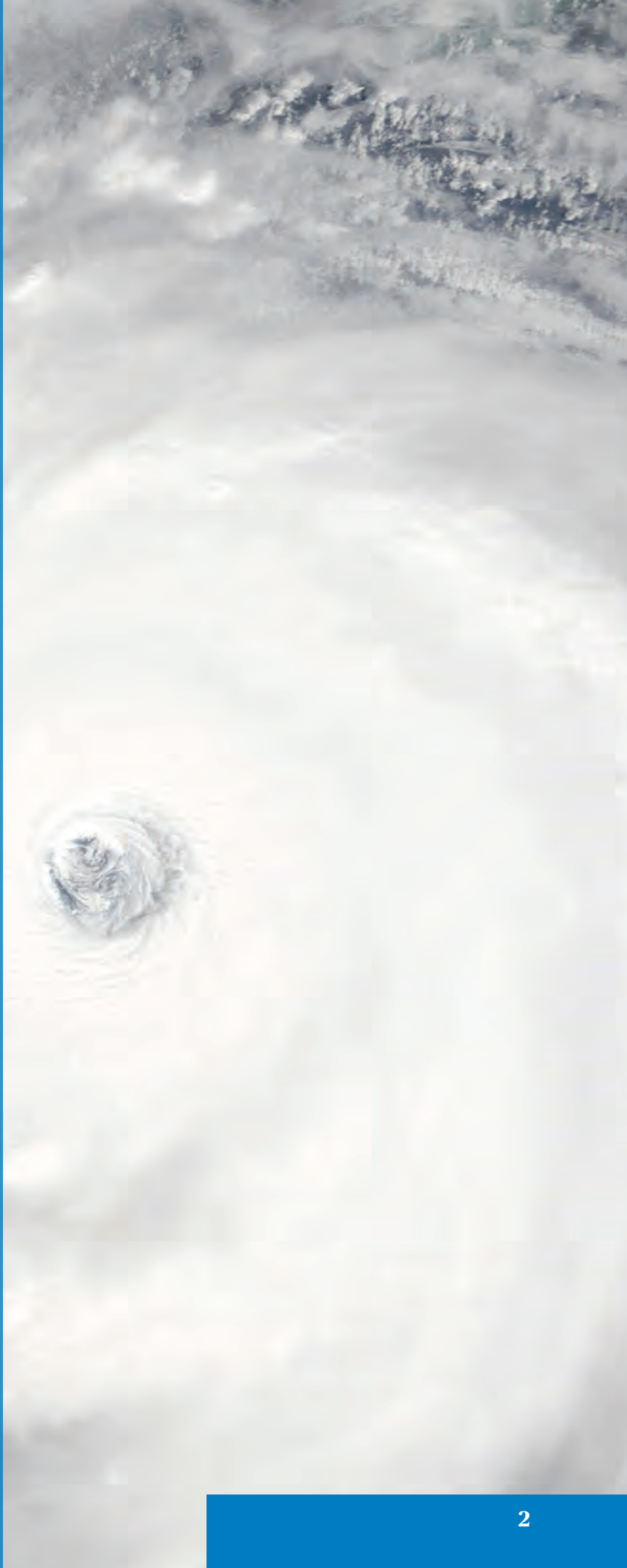
Our goal is to raise awareness among the nation's political leaders about the threats that climate change poses to national security, review what the Department of Defense is doing to prepare for these challenges, and describe the research that defense planners say they need to protect American interests in the future and preserve national security.

The idea for this briefing arose in June 2010, at a conference hosted by the Center for Environment and National Security at Scripps. The conference, attended by strategic planners in the Armed Forces, climate scientists, policy makers and experts in global security, discussed many of the issues raised in this briefing.

Climate change could destabilize nations already vulnerable to poverty, political unrest, terrorism and war. The United States must be prepared now to confront these future challenges.

Section 1

The globe's warming climate will complicate America's efforts to protect national security.

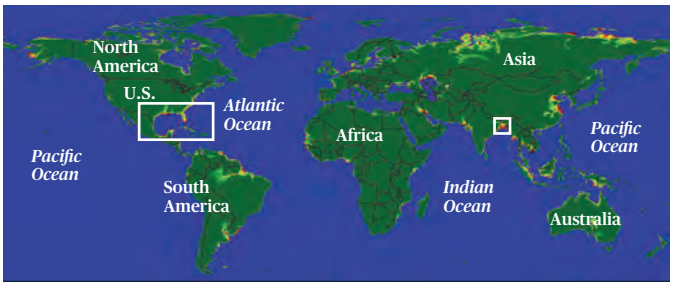


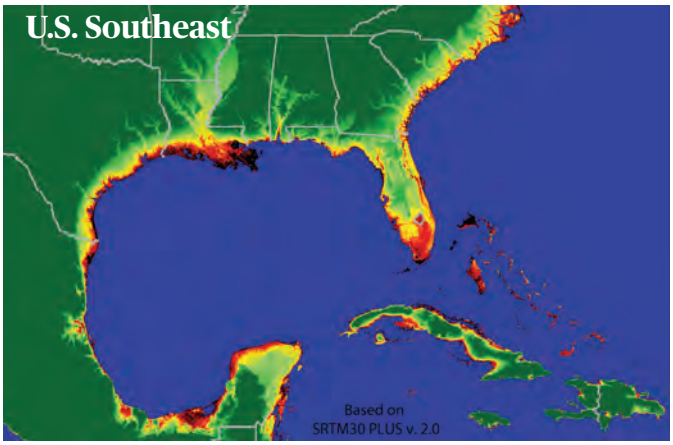
The rise in the global average temperature, commonly referred to as global warming, is expected to drive numerous changes in regional climate around the world. In some places, such as the American Southwest and Sub-Saharan Africa, it's expected to get hotter and drier. In other places, such as the eastern seaboard of North America, the Caribbean Basin and parts of Europe, it's expected to get wetter. Rising seas everywhere are expected to flood coastlines. Extreme weather is expected to strike more often and with a new intensity.

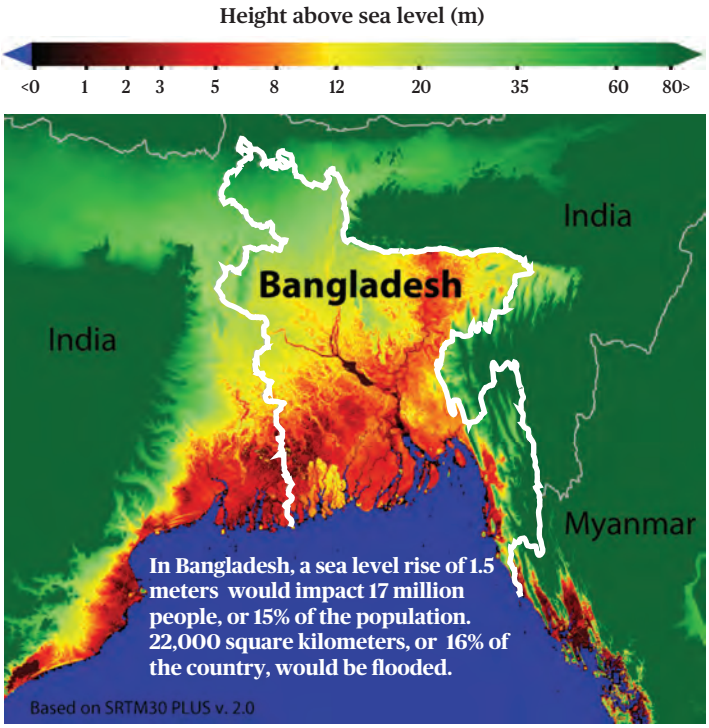
The physics of global warming is well understood and well established. The consequences, particularly in specific regions that concern strategic planners in the Armed Forces, are still unclear.
The picture is coming into focus, but time is running out to prepare for a transformed world.

Threatened Coastlines

Long stretches of coastline around the world are expected to be flooded as continued warming drives the sea level up during this century. The maps below show two regions vulnerable to rising seas – the Gulf Coast of the United States and Bangladesh, where rising seas could displace millions of people.







Sources: Images created by Robert A. Rohde / Global Warming Art; UNEP/GRID Geneva: University of Dacca; JRO Munich; The World Bank; World Resources Institute, Washington D.C.

Sea Level Rise

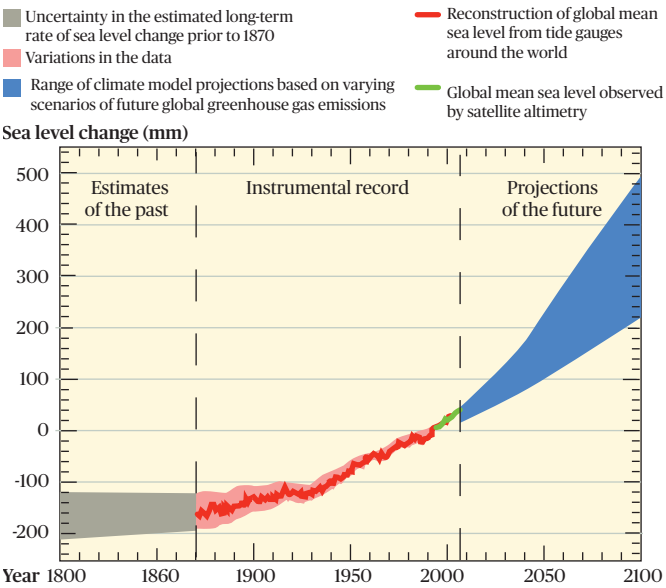
Rising seas, driven by melting ice sheets on Greenland and Antarctica, disappearing glaciers elsewhere and the expansion of warming seawater, are expected to flood many coastlines this century.

By the end of the century, the global average sea level is expected to rise between 7 and 23 inches – possibly more. A new authoritative report by the Arctic Monitoring and Assessment Program, released in May 2011, estimates that melting ice in the Arctic could help raise the global sea level by 5 feet during this century. Some models suggest that sustained warming over a long period would melt all of Greenland's ice sheet, raising the global sea level by 23 feet.

By the end of this century, rising seas are expected to make many coastal areas uninhabitable and others vulnerable to severe storm surges. In Bangladesh, where 112 million people live in low-lying areas vulnerable to monsoonal flooding, 17 million people could be forced to flee 22,000 square kilometers once seas rise 1.5 meters. Such refugee crises are expected around the world as rising seas inundate coastal areas, creating social instabilities that could potentially lead to conflict. Destructive storm surges, such as those seen in 2005 with Hurricane Katrina, are expected to become more common and more intense in a world with a higher sea level. Rising seas and larger storm surges also are expected to flood many defense installations, such as

Rising Seas

The global mean sea level has risen steadily since 1870, and it could rise much faster during this century, depending on the intensity of future greenhouse gas emissions.



Source: Intergovernmental Panel on Climate Change: Fourth Assessment Report, 2007

Diego Garcia in the Indian Ocean. As the sea level rises, salt water is expected to intrude into fresh water reservoirs at home and abroad, particularly on small island nations where inhabitants could be forced to flee their homes permanently.

Fresh Water

Rising seas, shifting rainfall patterns, melting glaciers and drought all are expected to stress the supply of fresh water around the globe.

Today, only 3 percent of Earth's water is fresh, and only a fraction of that is accessible to people. Most fresh water is stored in the globe's polar ice caps and in glaciers, and the rise in global average temperature is melting both. Disappearing glaciers are depleting natural reservoirs of fresh water used by hundreds of millions of people. Meanwhile, rising seas could compromise reservoirs, fouling diminishing supplies of drinking water.

Climate change also is expected to drive more extreme rainfall patterns, making wet areas more subject to flooding and drier areas more prone to drought. Regions already vulnerable to agricultural collapse could face extreme drying that leads to desertification and famine. Many experts have said that fresh water shortages could create tensions between nations and spark conflicts around the world during this century, much as oil shaped geopolitics and war in the last century.

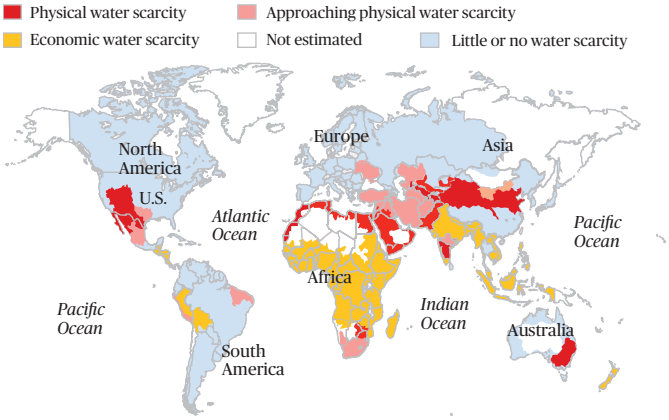
Extreme Weather Events

It's difficult to impossible to tie any single hurricane, drought or other extreme weather event to the rise in global average temperature. But in a warming world, many of these events are expected to become more frequent, more intense or both – triggering humanitarian crises that could potentially destabilize nations that already are vulnerable to economic collapse.

Many scientists see the catastrophic flooding in Pakistan in the summer of 2010 as an example of how continued warming could amplify extreme weather events around the world. Hurricanes and monsoons are expected to grow more intense, droughts and wildfires more extreme and flooding more severe.

Fresh Water Scarcity

The rise in global average temperature is expected to redistribute fresh water around the world, and some regions will be more vulnerable than others to shortages. Meanwhile, increases in population and changes in diet are projected to dramatically increase overall water consumption in coming decades.



Sources: International Water Management Institute, 2007; UNEP/GRID-Arendal

Extreme weather events cause massive indiscriminant damage, killing thousands of people, ruining economies and sometimes destabilizing regions vulnerable to political collapse. Even when natural disasters occur in less vulnerable regions, whether abroad or at home, these events often require personnel and other valuable resources from the U.S. Armed Forces to stabilize a region and help with humanitarian aid.

Meanwhile, defense installations are not immune to the destructive impact of extreme weather events, which can impair or delay operations and disrupt supply lines to the battlefield.

Pakistanis unload supplies for flood relief from a U.S. Army CH-47 Chinook helicopter in Khyber Pakhtunkhwa province, Pakistan, Oct. 9, 2010.

Source: DoD photo by Pfc. Joshua Kruger, U.S. Army

A U.S. Marine carries water back to his tent at Camp Leatherneck, Afghanistan, on June 15, 2009. Maintaining critical supplies of water in the field consumes fuel and risks lives. Climate change could make some of the most arid places on Earth, such as Afghanistan and Iraq, drier and hotter.

Source: DoD photo by Lance Cpl. Phillip Elgie, U.S. Marine Corps

Heat Waves

Heat waves have increased in frequency, intensity and duration in recent decades, and scientists expect this trend to continue.

Extreme heat drives up the demand for energy, sickens and kills people and livestock, and destroys agricultural crops. The increased demand for energy to power air conditioners during heat waves makes the United States more dependent on foreign oil.

For the U.S. Armed Forces, extreme heat disrupts missions and day-to-day operations. In regions of conflict such as Afghanistan and Iraq, heat waves place our troops in harm's way as they transport fuel through enemy territory. Fatigue, dehydration and heat stroke undermine the ability of our troops to complete their missions.

At home, surges in the demand for energy cause blackouts, jeopardizing homeland security by cutting power to airports, subways, train stations and other places vulnerable to terrorist attacks. Abroad, where heat waves kill thousands of people and trigger severe energy crises, nations with weak political institutions are vulnerable to internal unrest and external conflicts over resources.

Food Insecurity

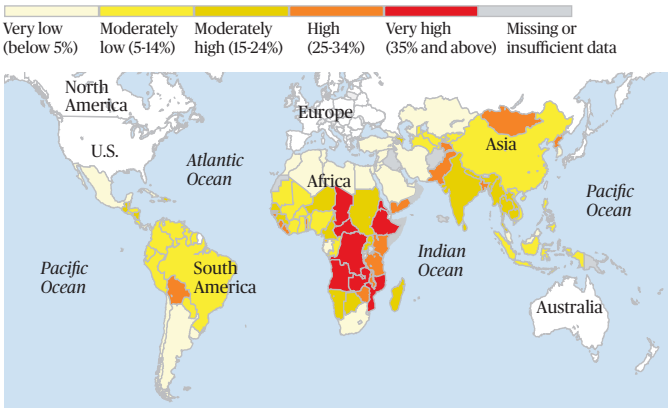
The steady production of food depends on the ability of people to predict seasonal climate changes, and in a warming world the climate is expected to change in ways that vary from region to region and are not always predictable.

The production of grains and the harvesting of fisheries contribute to much of the world's food supply. An increase of 1-2 degrees Celsius in global average temperature is expected to decrease agricultural production in tropical and sub-tropical regions. An increase of 3-5 degrees Celsius is expected to decrease production in temperate regions, including the United States. As the oceans absorb increasing amounts of atmospheric carbon dioxide, seawater is growing more acidic. This chemical change threatens to unravel the ocean food web, from tiny marine organisms to fish that people around the world rely on for their food and livelihoods.

World Hunger

Climate change is expected to stress many regions that already are vulnerable to famine. Drought in places such as East Africa and flooding in places such as Pakistan already have devastated agricultural lands. This map shows the prevalence of undernourishment in the total population of developing countries as of 2005-07 – the most recent period for which complete data are available.

Prevalence of undernourishment in developing countries (2005-07)

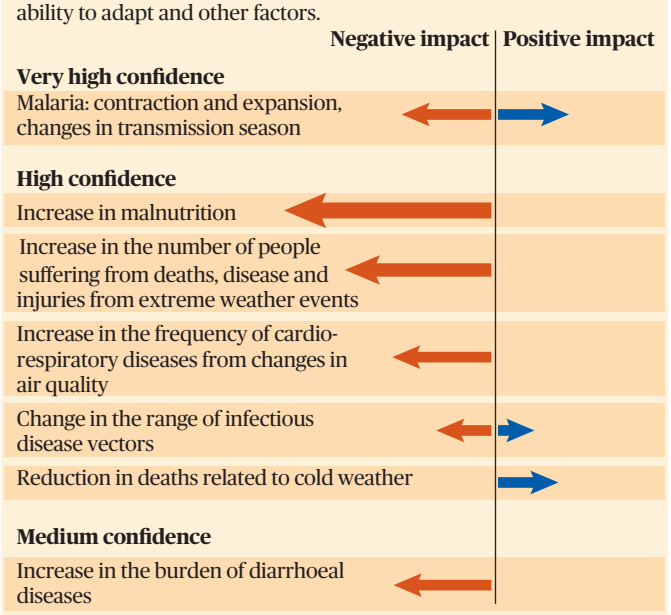


Source: Food and Agriculture Organization (FAO) of the United Nations

Hunger and starvation in the developing world could increase the risk of conflict, requiring the U.S. Armed Forces to intervene. Helping developing countries to adapt their food production to a warming world, and to avoid humanitarian crises and conflict, is expected to cost the United States billions of dollars annually.

Climate Change and Human Health

The incidence of malnutrition, infectious disease, poor air quality and other drivers of health is expected to shift as the globe warms. This figure summarizes the direction and magnitude of projected health impacts. It considers the likely number of people at risk, their ability to adapt and other factors.



Source: IPCC AR4, Working Group 2. Chapter 8: Human Health, Page 418

Human Health

Climate changes associated with the rise in global average temperature are expected to spread disease and illness in a variety of ways. In many regions, these negative impacts on human health are expected to be severe.

Changes in climate shift where and how humans get sick. The severity of weather patterns, the transmission of disease by insects and rodents, the frequency and intensity of heat waves, and other changes in a warming world all are expected to influence human health.

Warming temperatures are expected to reduce the number of deaths related to winter weather. But rising temperatures are expected to exacerbate the incidence of malaria, malnutrition, infectious diseases, cardiorespiratory disease, and other illnesses. Disease can destabilize populations by throwing families into upheaval and destroying the workforce of communities and nations. Armed Forces personnel stationed at home and deployed abroad also will face many of these threats. Changes in the distribution and severity of diseases may challenge the ability of our Armed Forces to control their spread in areas of military conflict.

"We are talking about energy insecurity, water and food shortages, and climate-driven social instability. We ignore these threats at the peril of our national security and at great risk to those in uniform."
– Former Sen. John Warner (R-VA), Oct. 28, 2009

Political Resilience

Many nations with strong political institutions, healthy economies and advanced public infrastructure will be able to manage the challenges of a warming world. But many others will not be so resilient.

Nations with weak or nonexistent political institutions will have more difficulty coping with droughts, floods and other natural disasters associated with rapid changes in climate. They'll also struggle with shortages in fresh water, food and other resources exacerbated by climate changes.

Many of these nations are in the Middle East, Africa and other regions that are strategically vital to the United States. Their vulnerability to climate change could lead to social and political instabilities – jeopardizing U.S. energy imports and other interests.

Shifting Where We Fight

The globe's changing climate is expected to environmentally stress many regions, shifting the availability of water, arable land and other natural resources in ways that potentially could cause conflicts. As the global average temperature continues to rise, where and how nations come into conflict also could shift.

Some scholars have suggested that changes in climate alter where nations fight, not whether or not they fight, but the evidence is mixed and more research is needed. As the globe warms, understanding where conflict is likely to occur can help the federal government decide what defense resources to fund and develop, and where to position forces in order to deter war.

Section 2

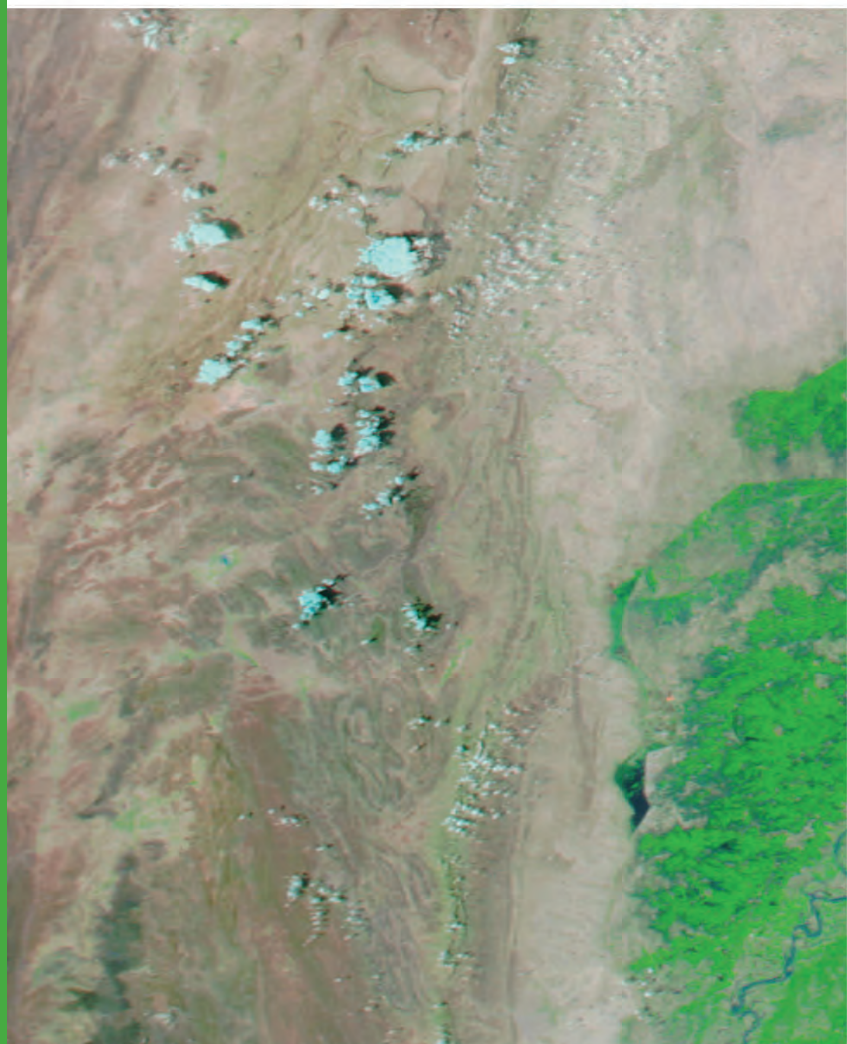
The U.S. Armed Forces are already taking significant steps to prepare for the impacts of climate change on national security.

Pakistan Floods, Summer 2010

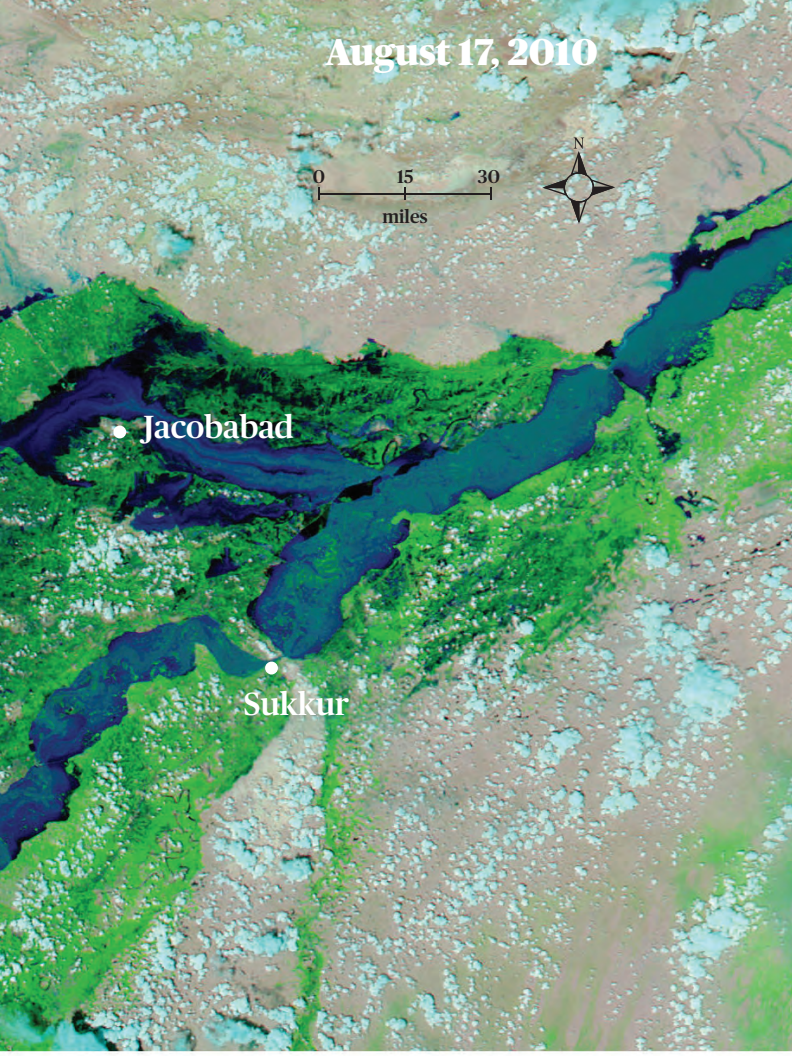
Intense monsoon rains in 2010 inundated about one-fifth of Pakistan and impacted the lives of 20 million people. NASA's Aqua satellite captured these images of the Indus River Valley, before and during the flooding. False color was used to increase contrast.

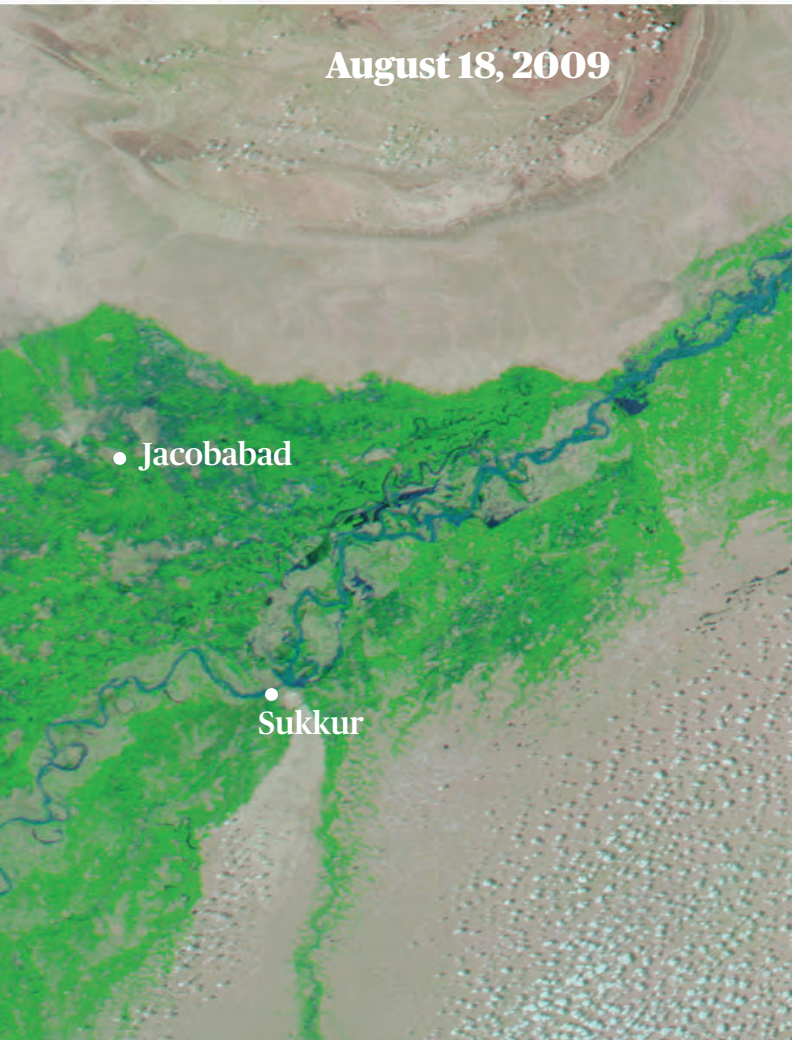
Source: NASA Earth Observatory; NASA/GSFC, MODIS Rapid Response

Water | Vegetation | Bare ground | Clouds



Throughout the Department of Defense, the men and women who defend our nation are planning for a warmer world. They are studying how heat waves and extreme weather may impact military operations and humanitarian crises, what an ice-free Arctic will mean for the Navy, how international cooperation can help prepare developing nations to cope with climate change, and other subjects. The Armed Forces also are improving energy efficiency, because it saves lives on the battlefield and money back home.





"Existing environmental stress and potential future stress from climate change in Pakistan may undermine American interests ... by leading to further socio-political instability."
–"Security and the Environment in Pakistan," Congressional Research Service, Aug. 3, 2010

The latest Quadrennial Defense Review, published in February 2010, discusses how the Department of Defense (DoD) is beginning to prepare for the challenges of climate change. Among its actions:

■ The DoD recognizes the links between climate change and national security, and strategic planners in the Armed Forces are committed to acting now to prepare for the challenges of climate change, energy security and economic stability.

■ The DoD is working with other nations to build their capacity to respond to natural disasters, so that the costs of recovery don't always fall on the U.S. and other developed nations.

Fifty percent of the U.S. Air Force's domestic aviation fuel will be a "greener" alternative fuel blend by 2016.

The U.S. Army is transforming its fleet of 70,000 non-tactical vehicles to rely less on fossil fuels. This includes the current deployment of 500 hybrid vehicles and 4,000 low-speed electric vehicles at domestic installations.

The U.S. Army's CERV (Clandestine Extended Range Vehicle) is a lightweight, diesel-electric hybrid prototype with a top speed of 80 mph. Designed for reconnaissance, targeting and rescue missions, the CERV is one of the Army's greenest vehicles. It was developed by the U.S. Army's Tank Automotive Research, Development and Engineering Center (TARDEC) in partnership with California-based Quantum Technologies. Source: TARDEC

■ The DoD is assessing the potential impacts of climate change on defense installations, and adapting where necessary to preserve operational readiness. These impacts include the continuing rise in the global sea level, which is predicted to affect at least 30 installations.

■ The DoD, through its Strategic Environmental Research and Development Program (SERDP), is studying how the rising sea level and more intense storm surges could impact several defense installations. They include Naval Station Norfolk and the surrounding Hampton Roads area in Virginia; Eglin Air Force Base in Florida; Marine Corps Base Camp Lejeune in North Carolina; and Marine Corps Base Camp Pendleton and Naval Amphibious Base Coronado, both in California.

Naval Air Station North Island and Naval Amphibious Base Coronado in California are among the defense installations that are vulnerable to rising seas.

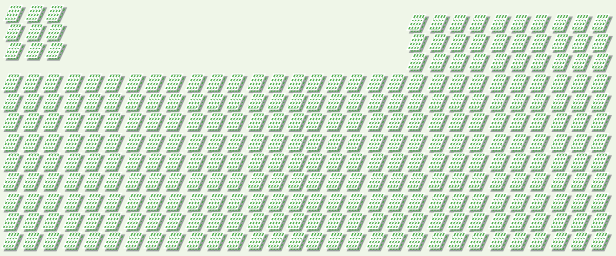
Source: DoD

■ The DoD is creating markets for innovative technologies that improve energy efficiency and advance the use of renewable energy by testing them at defense installations. By moving toward energy efficiency and renewable energy, the DoD is improving U.S. energy security and national security.

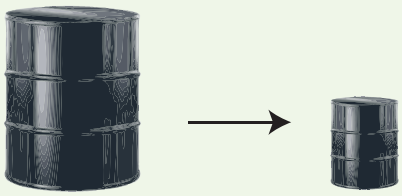
The Marine Corps has a new Expeditionary Energy Office to address operational energy risks, and it is finding ways to improve energy efficiency in Afghanistan and Iraq. For every 50 trips for fuel or water in Afghanistan, one Marine is injured.

That stark fact has prompted the Marine Corps to spend $9 million to equip Marines deployed to Afghanistan with portable solar panels, and increase the number of solar-powered generators there from nine to 300 by the end of 2012.

Now ***2012***



The Marine Corps plans to cut its overall energy consumption in half by 2025.



Case Study: The U.S. Navy begins to prepare for a melting Arctic

U.S. Navy forces face a transformed Arctic as sea ice continues to melt. The extent of summer sea ice at the highest latitudes is declining at a rate of 10 percent per decade. By 2030, the Arctic is expected to be entirely free of sea ice in the summer. That could expose the Arctic Circle to several security challenges as shipping lanes open to new commercial traffic and nations rush to mine oil and gas, exploit new fisheries and pursue other interests. In 2009, the Navy published its Navy Arctic Roadmap, which called for increased operational readiness, promoting cooperative partnerships and improving understanding of the many environmental changes underway in the Arctic. In March 2011, the National Research Council released a report that calls upon the Navy to begin strengthening its capabilities in the Arctic now. Robust, consistent funding is needed to ramp up Arctic operations and support cold weather training, among other programs.

The U.S. Navy is working to deploy a "green" carrier strike group that uses only biofuel and nuclear power by 2016. It already has taken two steps toward this goal by commissioning an electric-drive surface ship and testing the F/A-18 "green hornet" engine on biofuel.

Marines dig a hole during testing of solar energy panels at Twentynine Palms, Calif. on July 30, 2010. The solar panels power radios, laptop computers, lighting, ventilation, and other systems.

Source: DoD photo by Lance Cpl. Michael C. Nerl, U.S. Marine Corps

Arctic rush for trade routes, resources

A warming Arctic is opening new shipping lanes, transforming international trade and creating new environmental pressures as nations race to exploit oil, gas, fisheries and other natural resources. The continued decline of seasonal sea ice in the summers and the melting of thicker multi-year sea ice are direct consequences of the rise of global average temperature.

Source: www.geopoliticalmonitor.com

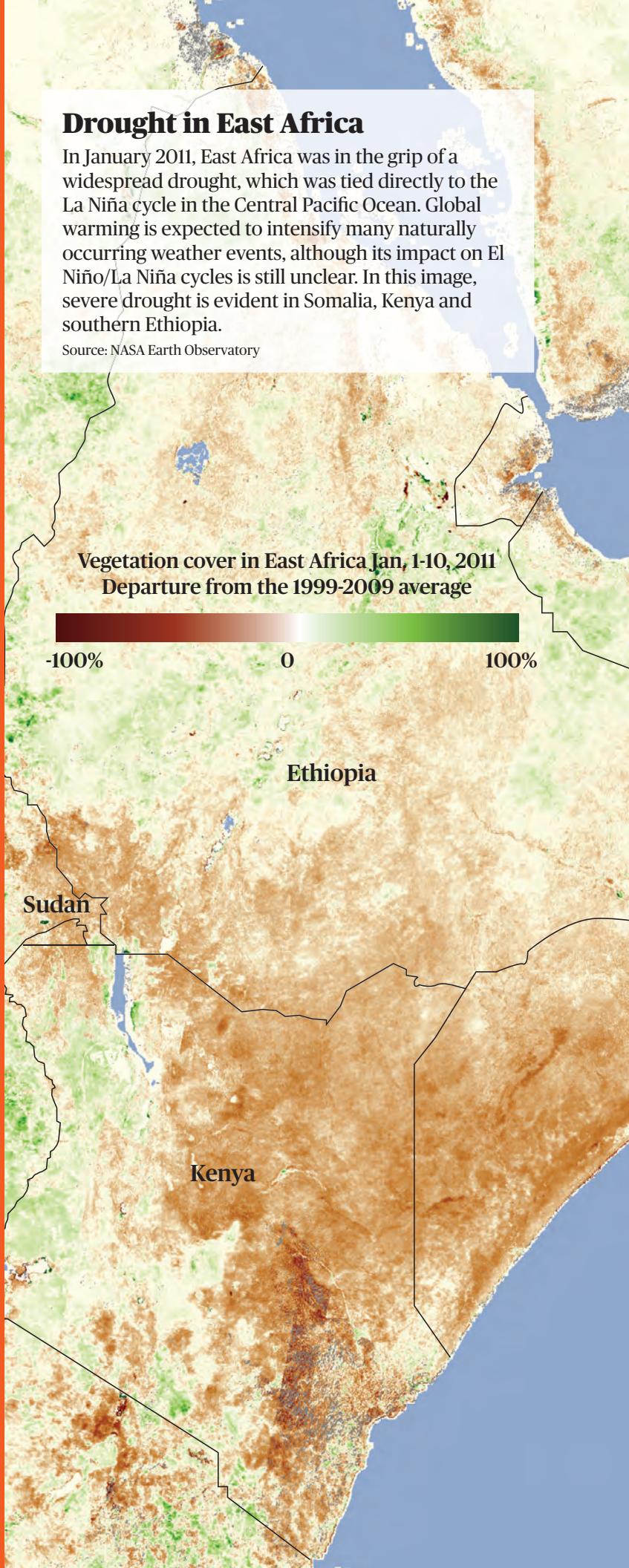
"Energy efficiency can serve as a force multiplier, because it increases the range and endurance of forces in the field and can reduce the number of combat forces diverted to protect energy supply lines."
– Quadrennial Defense Review Report, February 2010

Section 3

The Armed Forces need the support of the federal government to better prepare for a warming world.

Climate change poses numerous threats to national security, and to the prospects for peace and prosperity around the world. Strategic planners in the Armed Forces need the help of scientists and other experts to prepare for these threats and protect the people who defend the nation and its interests abroad.

Environmental scientists can help the nation's Armed Forces better understand how their operating environments are likely to change in a warming world. Social scientists can help policy makers understand how states, groups and individuals are likely to react to environmental changes. Policy makers can then use this information to support legislation designed to curb rising threats today and prepare the country for the challenges that lie ahead.



Drought in East Africa

In January 2011, East Africa was in the grip of a widespread drought, which was tied directly to the La Niña cycle in the Central Pacific Ocean. Global warming is expected to intensify many naturally occurring weather events, although its impact on El Niño/La Niña cycles is still unclear. In this image, severe drought is evident in Somalia, Kenya and southern Ethiopia.

Source: NASA Earth Observatory

"The pressure of climate change, left unchecked, will create many more Darfurs and Somalias with a scope, intensity and frequency that will overwhelm the United States' and international community's ability to respond."
– U.S. Navy Vice Admiral Dennis McGinn, March 19, 2010

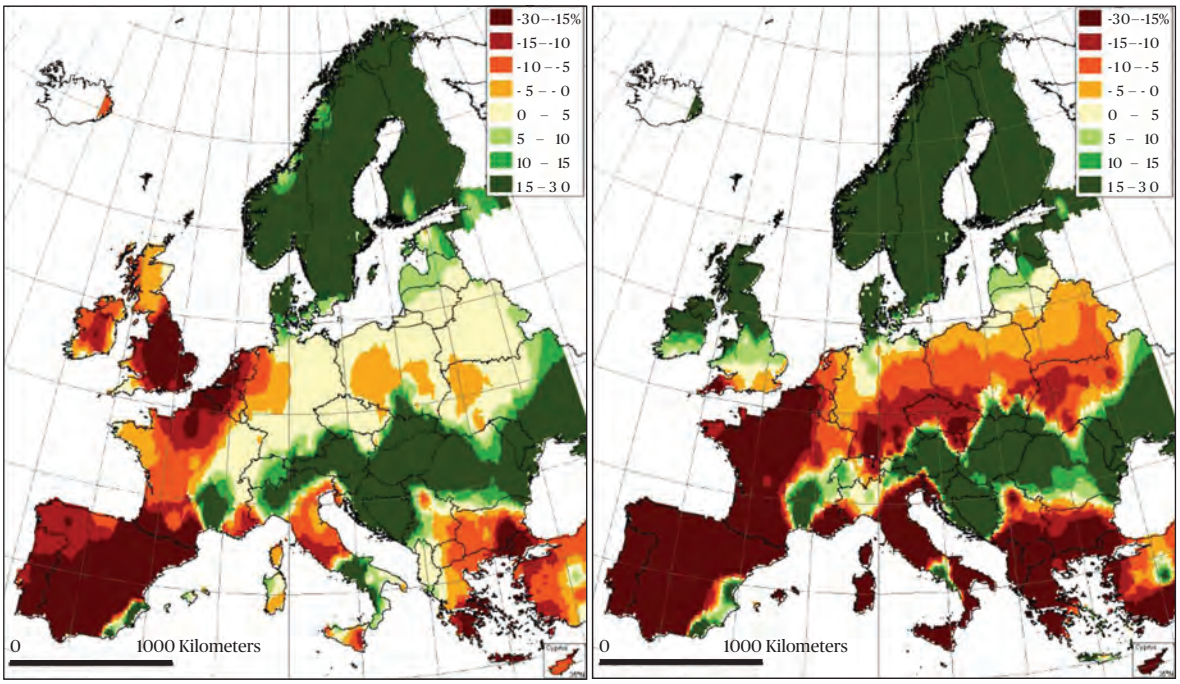
What the Federal Government Can Do to Help:

Support collaborative research that will inform policy.

The U.S. Armed Forces are preparing to defend American interests in a world in which climate change is rapidly altering the political and military battle space. General categories of climate change-related threats to national security have been identified, but the specifics needed to adapt military operations remain understudied. Defense planners have identified specific research that is needed to better understand the world that's coming. This research needs the support of the federal government.

Modeling the consequences of a warmer world

Scientists are designing computer models of how continued warming could impact valuable economic resources such as crop yields. But defense planners also need computer simulations that forecast how future warming might influence social and political stability. In this illustration, the impact of warming on agriculture in Europe is modeled, showing simulated crop yields by the 2080s relative to the period 1961-1990. The computer simulation used a high emission scenario (IPCC A2) and two different climate models (HadCM3/HIRHAM, left and ECHAM4/RCA3, right).



Source: European Commission, Directorate-General, Joint Research Centre, Institute for Prospective Technological Studies, The PESETA Project: Impacts of Climate Change in Europe

Major questions about how future climate changes may impact national security require interdisciplinary studies. The tools needed include:

- **Next-Generation Climate Models** that examine not only the potential changes to the physical environment of a specific region, but also the socioeconomic and political realities on the ground that can lead to conflict as climate-related events materialize.
- **Increased Computing Capacity** to develop these next-generation climate models.
- **Long-Term Observational Studies** to help defense planners better understand how physical environments in different regions of the world respond to given climate changes.
- **Studies of Human Behavior** to help defense planners better understand how people behave when confronted by events connected to global climate change – including extreme weather, rising seas, droughts and fresh water shortages.
- **Risk Assessment Studies** to help defense planners better understand the risks for conflict and humanitarian crises that are caused or exacerbated by climate changes in particular regions.

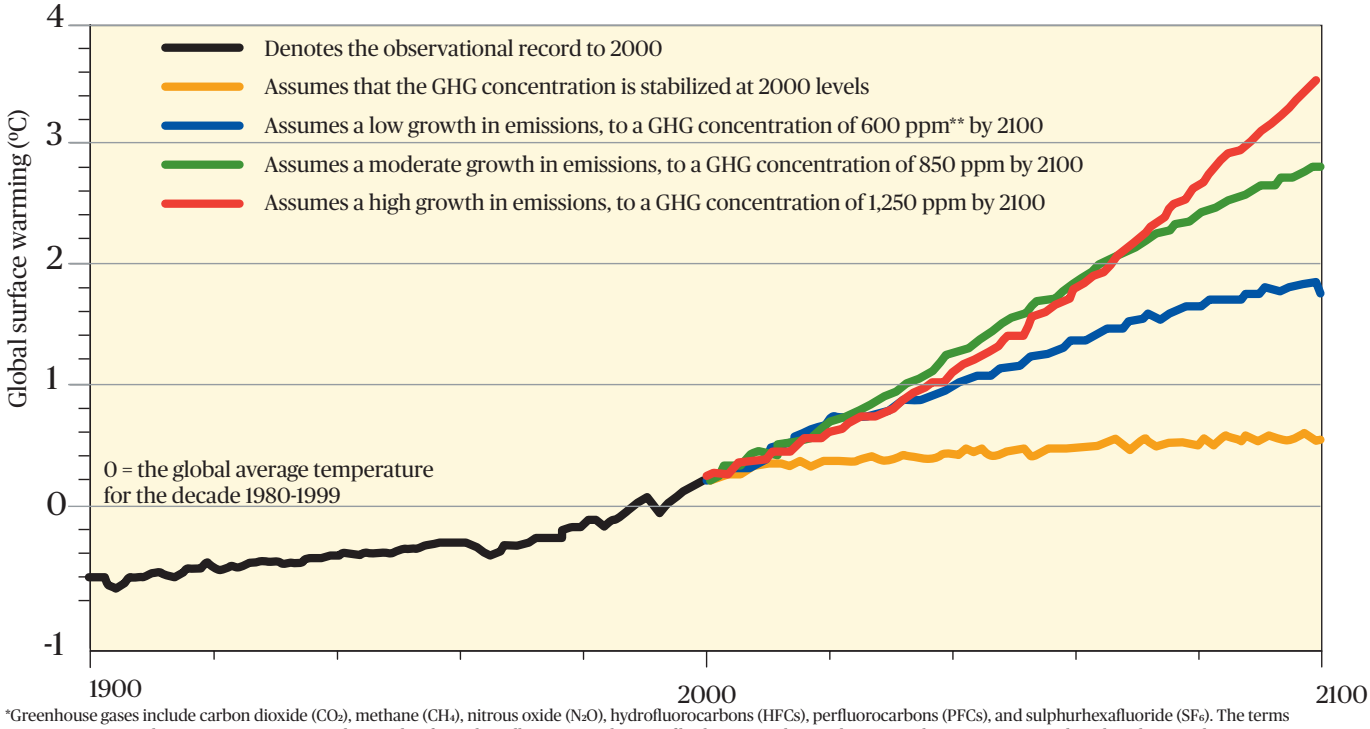
"Right now, we are drifting off into uncharted waters. This is not the time to either wait for 100% certainty or simply hope our environment is not changing."
– Gen. Gordon Sullivan, Former U.S. Army Chief of Staff, Feb. 12, 2009

Support legislation designed to reduce negative impacts of climate change on the United States and our Armed Forces.

While researchers develop the tools needed to adapt effectively to future climate changes, the federal government can play an important role in helping to reduce the threats associated with these changes. This means supporting efforts to reduce carbon emissions in the United States and around the world – to curb warming and reduce the cascade of threats posed by our changing climate.

Future trajectories of warming

How high average surface temperatures rise around the globe in coming decades will depend largely on how much greenhouse gas* (GHG) emissions rise. Scientists have projected an increase in temperature between 2.0 to 11.5 degrees Fahrenheit, or 1.1 to 6.4 degrees Celsius (relative to 1980-1999) by the end of the 21st century. This graph shows four scenarios of temperature change leading up to 2100. Each solid line beginning in the year 2000 is a multi-model global average of surface warming for a given emissions scenario. As of 2011, the concentration of greenhouse gases in the global atmosphere is 393 parts per million.



*Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphurhexafluoride (SF_6). The terms "GHG emissions" and "GHG concentrations" in this graph refer to the collective contribution of both GHGs and aerosols converted to approximate carbon dioxide equivalents.
**ppm = parts per million, a measure of the concentration of greenhouse gases in the global atmosphere.

Source: U.S. Environmental Protection Agency, Climate Change - Science; "Climate Change 2007: Synthesis Report Summary for Policymakers," IPCC 2007

A Symposium on the Threat

In June 2010, representatives from the U.S. Armed Forces, the Department of Defense, academia, various nonprofit and corporate entities, and the public gathered for a symposium titled *Climate and National Security: Securing Better Forecasts*. The symposium was hosted by the Center for Environment and National Security at the Scripps Institution of Oceanography at the University of California San Diego. The goal was to review current climate science, discuss the potential impacts of climate change on national security, detail what actions to mitigate these impacts are underway, and brainstorm about research and policies that are needed to address the challenge. Participants emphasized that the threats associated with climate change are multi-dimensional, and as a result climate scientists, social scientists, policy makers and strategic planners in the Armed Forces must coordinate their efforts. Scientists do not yet fully understand how continued warming will alter the climate in specific regions of the globe, so defense planners don't yet have all the information they need to plan at regional scales. Symposium participants recommended several initiatives to help close this gap in knowledge:

Sherburne "Shere" Abbott, Associate Director for Environment of the Office of Science and Technology Policy in the Executive Office of the President, addresses the participants of the Symposium from the White House.
Source: Emily Kelly

Establish climate science goals that complement defense and policy needs.

The U.S. Armed Forces want to plan on local or regional scales to respond effectively to the potential consequences of climate change in coming decades. Many of the latest climate models are designed to forecast climate changes at mid-century and even farther into the future, and on spatial scales that are too large for the Armed Forces to plan effectively for particular regions. More funding is needed to develop climate models that will help strategic planners predict climate changes in the near-term, and on small regional scales.

Integrate physical climate models and human behavior models to help strategic planners in the Armed Forces better understand how people might act when confronted with the consequences of a warming world.

To protect U.S. interests and American citizens, national security policies must reflect an understanding of how people are expected to react to climate change. However, there is not currently funding for climate scientists and human behavior researchers to work together. The Minerva Research Initiative at the Department of Defense, which administers grants for interdisciplinary social science research, may be a model for the collaborations that are needed.

Maximize the benefits of science research by better coordinating research groups and grant projects, as well as the various stakeholders concerned with climate change, including those in academia, government and the Armed Forces.

A typical science project is funded for two to five years, and it's often conducted in isolation from related projects that may be running concurrently. When it concludes, there can be a lack of continuity in personnel, institutional knowledge and methods that would help future projects build on past accomplishments. This often results in a lack of long-term data needed to construct effective climate change models and forecasts. Academic "Centers of Excellence" that focus on climate change and national security could help coordinate future projects and make research more efficient.

Promote coordination among government experts to confront the challenges of climate change.

Future climate changes will require government experts in national security, immigration, health care, science, environmental resource management and many other areas to coordinate their efforts. A sub-cabinet position or coordinating body, such as the National Climate Service in NOAA, could lead this effort.

Address near-term and long-term military needs related to climate change.

The safety of Armed Forces personnel and the integrity of America's national security are already threatened by climate change. In the near-term, the need for supply convoys to transport fuel to military units places our service men and women in danger everyday. In coming decades, rising seas will require the Armed Forces to retrofit or relocate installations that are threatened by flooding and storm damage.

Assess risk in order to form policy.

Scientists should strive to present policy makers with scenarios of climate change that clearly show the degree of uncertainty associated with each scenario, yet also discuss the potential for catastrophic events associated with each scenario. This will enable policy makers to assess the risks to national security, and design better strategies to adapt to the consequences of future climate changes.

This report, along with additional information, can be found online at http://cmbc.ucsd.edu/Research/nscc/

Partial List of Sources

Section 1

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Section 2

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- U.S. Navy Climate Change Roadmap, 2010 http://www.navy.mil/navydata/documents/CCR.pdf
- U.S. Navy Arctic Roadmap, 2009 http://www.navy.mil/navydata/documents/USN_artic_roadmap.pdf
- On energy efficiency efforts: www.defense.gov; http://domesticfuel.com; www.army.mil; www.af.mil; www.greenpacks.org
- Energy Security & Climate Change: Global Problems, Local Solutions (Informational Hearing), The Senate Select Committee on Climate Change and AB 32 Implementation, California State Senator Fran Pavley, Chair, California State Senator Christine Kehoe, Host, March 19, 2010, Scripps Seaside Forum, Scripps Institution of Oceanography, University of California San Diego

Section 3

- Climate and National Security: Securing Better Forecasts, June 21-23, 2010. A workshop hosted by the Center for Environment and National Security, Scripps Institution of Oceanography, University of California San Diego. http://sio.ucsd.edu/cens/workshop/

Additional sources are noted below each graphic illustration.

For Further Information

Reports

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"Climate change will provide the conditions that will extend the war on terror."
– Admiral T. Joseph Lopez, Former Commander-in-Chief, U.S. Naval Forces Europe and of Allied Forces, Southern Europe, 2007

- The IISS Transatlantic Dialogue on Climate Change and Security: Report to the European Commission, International Institute for Strategic Studies, 2011 http://www.iiss.org/programmes/transatlantic-dialogue-on-climate-change-and-security/?locale=en
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- U.S. Navy Task Force on Climate Change http://www.facebook.com/NavyTFCC
- The Pew Project on National Security, Energy and Climate http://www.pewclimatesecurity.org/
- The International Institute for Strategic Studies, London, England http://www.iiss.org/programmes/transatlantic-dialogue-on-climate-change-and-security/?locale=en

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