Environmental Security – Climate Change---Where are we now and where are we going?

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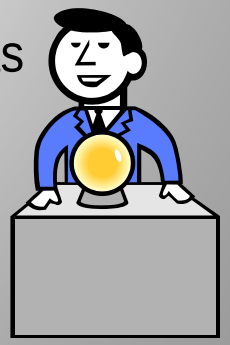
Goals of this Session

- Understand the concepts of Environmental Security and climate change as strategic defense and security threats to the U.S.
- Appreciate the relationship between key environmental issues, and peace and stability in the World
- Use the Nile River as a case study to understand the concepts of environmental security.
- Highlight climate change by examining the IPCC 5th AR and use the Tibetan Plateau and US Agriculture as case studies to understand the threats.
- Examine the impacts of the recent Paris Climate Summit-- COP 21



Defining Environmental Security

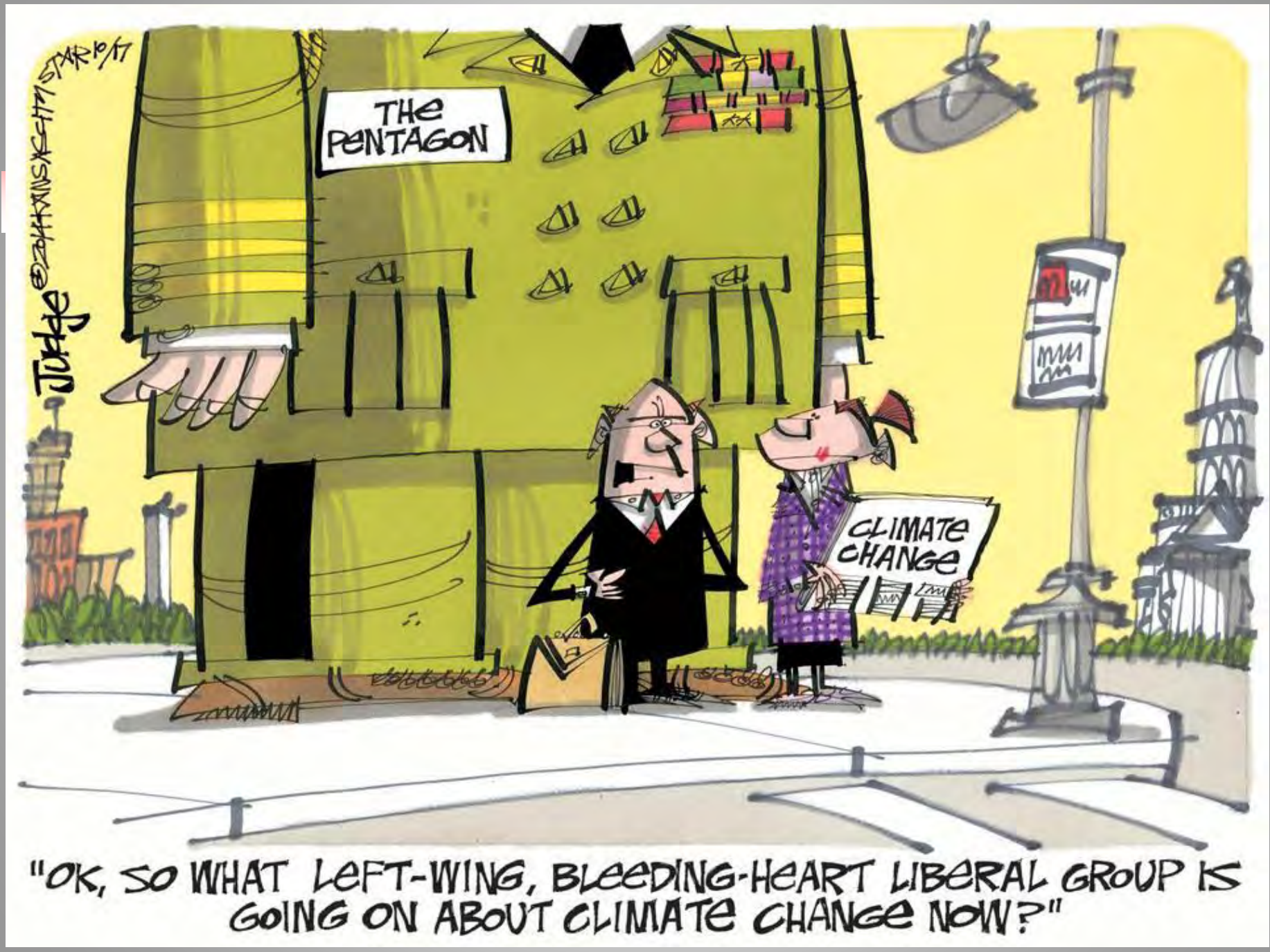
This is not new!

" …national security is not just about fighting forces and weaponry. It relates to watersheds, croplands, forests, genetic resources, climate and other factors that rarely figure in the minds of military experts and political leaders,"

Norman Myers, *The Environmentalist*, 1986

The Concept of Environmental Security

Peace is not the absence of conflict, but the maintenance of a safe and secure environment capable of providing for people's basic human needs in a sustainable way; And, there are human induced changes in the environment of such an impact that they pose threats to stability in many places in the world.


THE PENTAGON
CLIMATE CHANGE
"OK, SO WHAT LEFT-WING, BLEEDING-HEART LIBERAL GROUP IS GOING ON ABOUT CLIMATE CHANGE NOW?"

National Security Policy of the United States

"The danger from climate change is real, urgent, and severe. 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 ."

"Promote dignity by meeting basic human needs"

The National Security Strategy of the United States (NSS), May 2010.

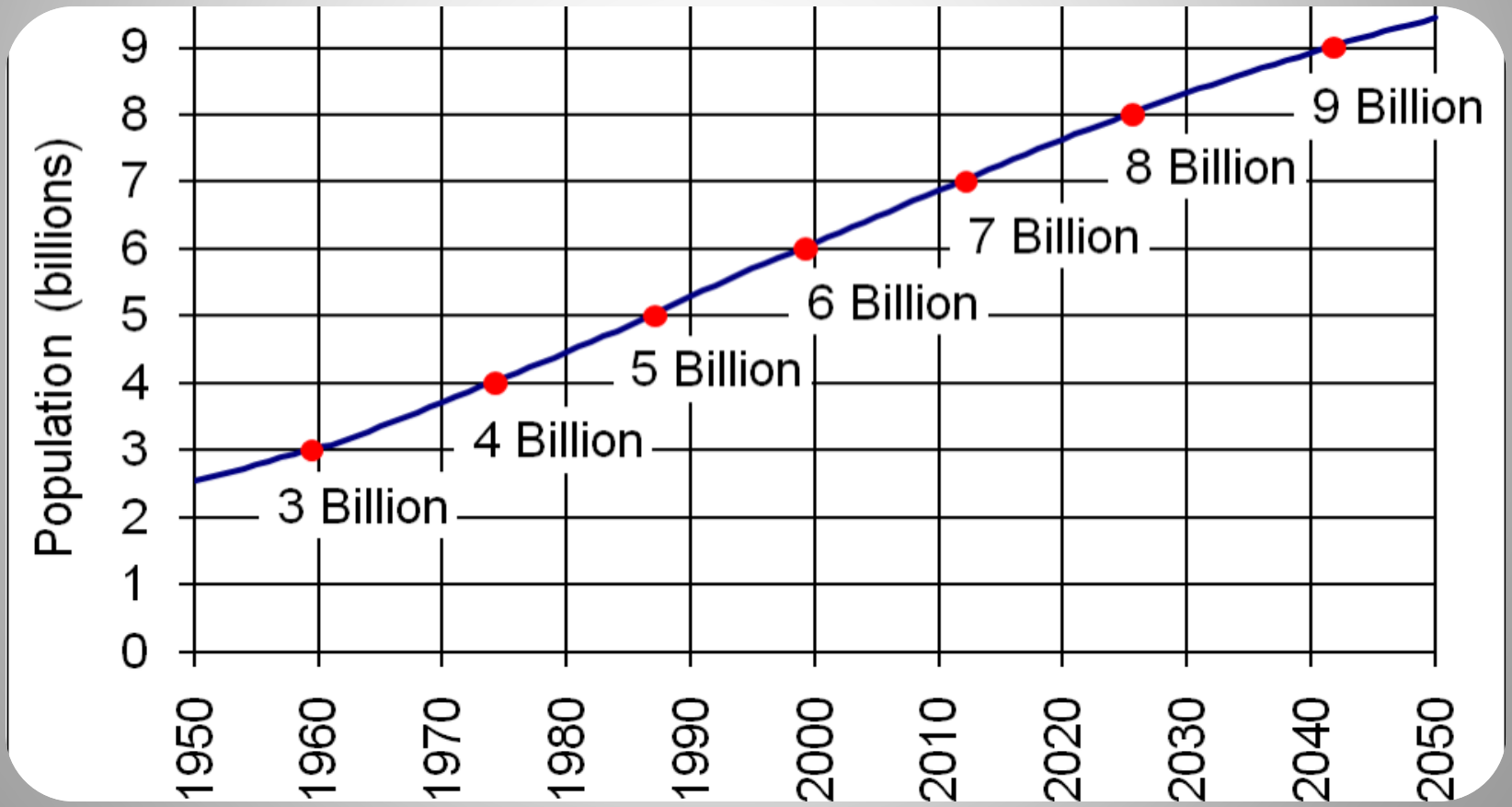
"Finally, the Department will employ creative ways to address the impact of climate change, which will continue to affect the operating environment and the roles and missions that U.S. Armed Forces undertake."

QDR 2014 – March 2014

" Climate change will affect the Department of Defense's ability to defend the Nation and poses immediate risks to U.S. national security."

Department of Defense, 2014 Climate Change Roadmap

An Important Fact – the most important fact?



Where is most of the world?

Where in the 'Hierarchy of Human Need' do you think most of the world's 7.2 billion people exist?

And where do you(we) live?

Science of Environmental Security

- Water as a Scarce Resource
  - Fresh Water
  - Oceans
- Air
  - Climate change
  - El Nino / La Nina
  - Ozone depletion in the stratosphere
  - Toxic air pollutants
- Land Use – ***protection of Arable lands***
  - Deforestation-- Biodiversity and the rainforests
  - Desertification
  - Waste disposal – hazardous and solid wastes

The Nile – A Case Study


MEDITERRANEAN SEA
ISRAEL
IRAQ
Port Said
Rosetta
Alexandria
JORDAN
NILE DELTA
Cairo
Giza
Suez
PYRAMIDS
El Faiyum
LIBYA
EGYPT
Nile
SAUDI ARABIA
N
Luxor
THEBES
LIBYAN DESERT
KHARGA OASIS
Aswan
RED SEA
LAKE NASSER
ABU SIMBEL
Wadi Halfa
Nile
Atbara
Atbara
YEMEN
Khartoum
CHAD
GEZIRA
SUDAN
Kosti
LAKE TANA
Tisalat Falls
White Nile
Blue Nile
ETHIOPIAN HIGHLANDS
Addis Ababa
Sobat
THE SUDD
ETHIOPIA
CENTRAL AFRICAN REPUBLIC
Juba
Murchison Falls
SOMALIA
LAKE ALBERT
LAKE KYOGA
ZAIRE
RUWENZORI MOUNTAINS
UGANDA
KENYA
Kampala
LAKE EDWARD
EQUATOR
LAKE VICTORIA
KEY
Ancient Egyptian sites
Dams
RWANDA
Kagera
BURUNDI
TANZANIA
INDIAN OCEAN
LAKE TANGANYIKA

RAINFALL

0 in/yr

10 in/yr

20 in/yr

30 in/yr

40 – 80 in/yr

YEARLY FLOW

At Aswan 91 BCM

Atbara R 12 BCM

Blue Nile 75 BCM

White Nile 28 BCM

Water Demands and Population in the Nile River Basin

Country	Per capita (M3 Per Person Per Year)	Population in 2011 (millions)	Projected Population in 2050	Current Water Demand	Projected Water Demand 2050
Burundi	37	8.383	27.149	0.3 BCM	1 BCM
Egypt	1,013	81.121	137.873	82 BCM	140 BCM
Ethiopia	40	82.950	278.283	3.3 BCM	11 BCM
Rwanda	10	10.624	27.506	0.1 BCM	0.3 BCM
South Sudan*	1,879	8 to 15.	30.0	17 BCM	35 BCM
Sudan	1,879	34.000	67.000	40 BCM	40 BCM
Uganda	13	33.425	128.008	0.4 BCM	1.7 BCM
totals		265.503	696.781	143.1 BCM	229 BCM

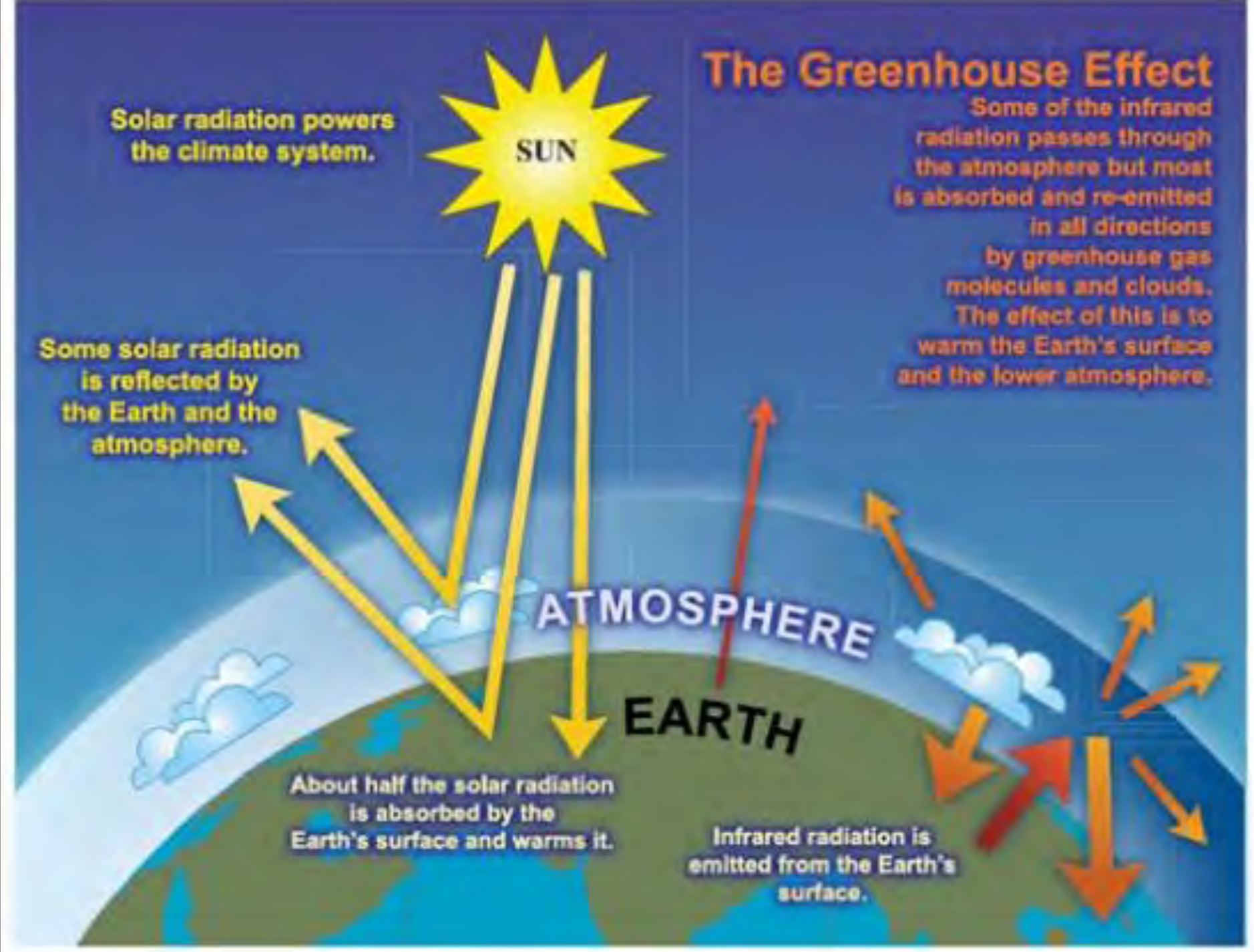
Source: World Bank. "Africa Development Indicators," 2004, http://publications.world bank.org/ (accessed 27 March 2011). Population data and growth rates from CIA Fact Book.

Note: DNI study uses 1,000 M^3 / person/ yr as demand factor

Climate Change --Today

Data from the 5th Report Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC), 2014 (1st Report, 1990)

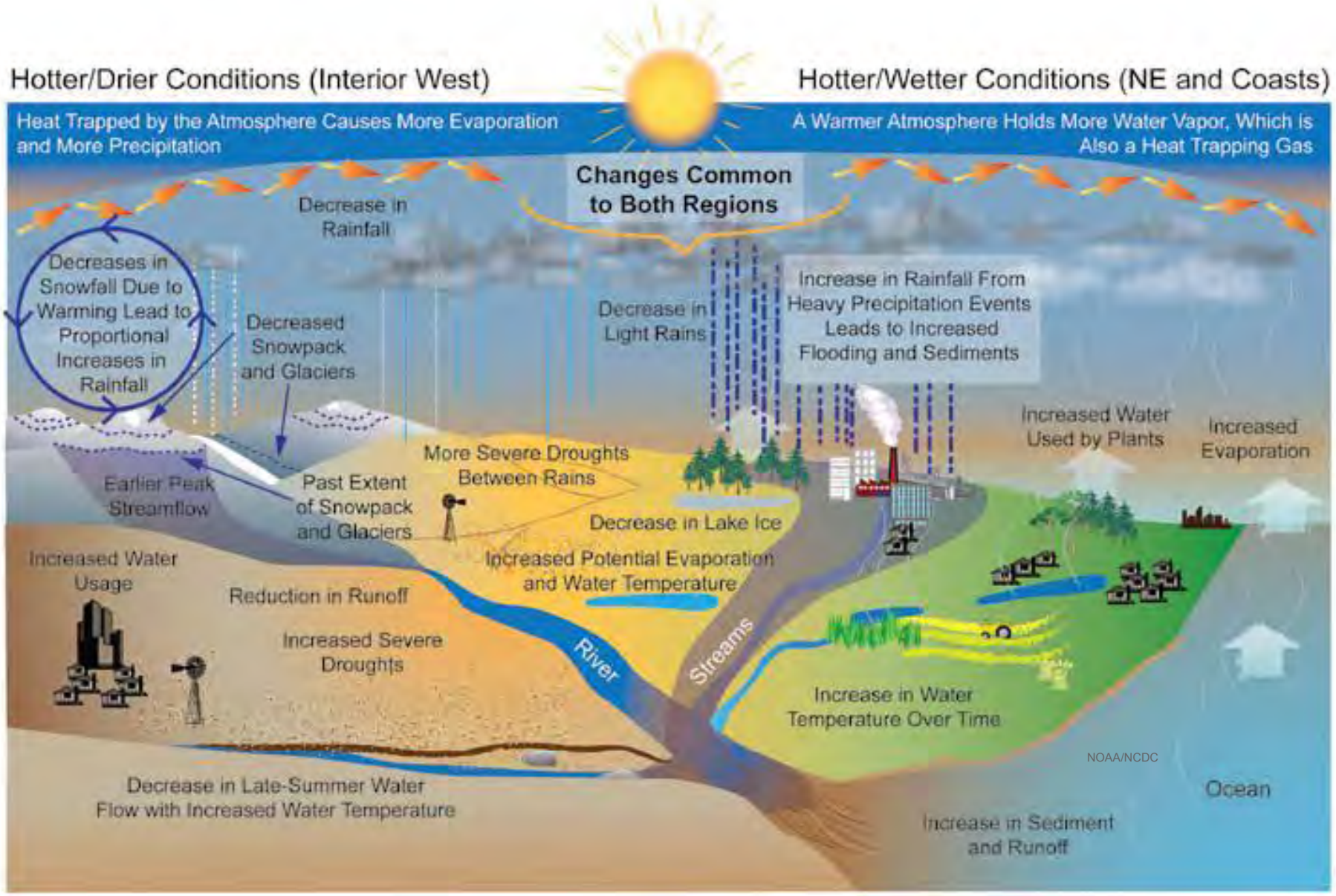
Is this the future with climate change ?


The Greenhouse Effect
Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.
Solar radiation powers the climate system.
SUN
Some solar radiation is reflected by the Earth and the atmosphere.
ATMOSPHERE
EARTH
About half the solar radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.

Greenhouse gases are those that can absorb and emit infrared radiation (heat), but not radiation in or near the visible spectrum (sun's energy). In order, the most abundant greenhouse gases in Earth's atmosphere are:

- Water vapor (H_2O)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Ozone (O_3)
- CFCs

Projected Changes in the Water Cycle



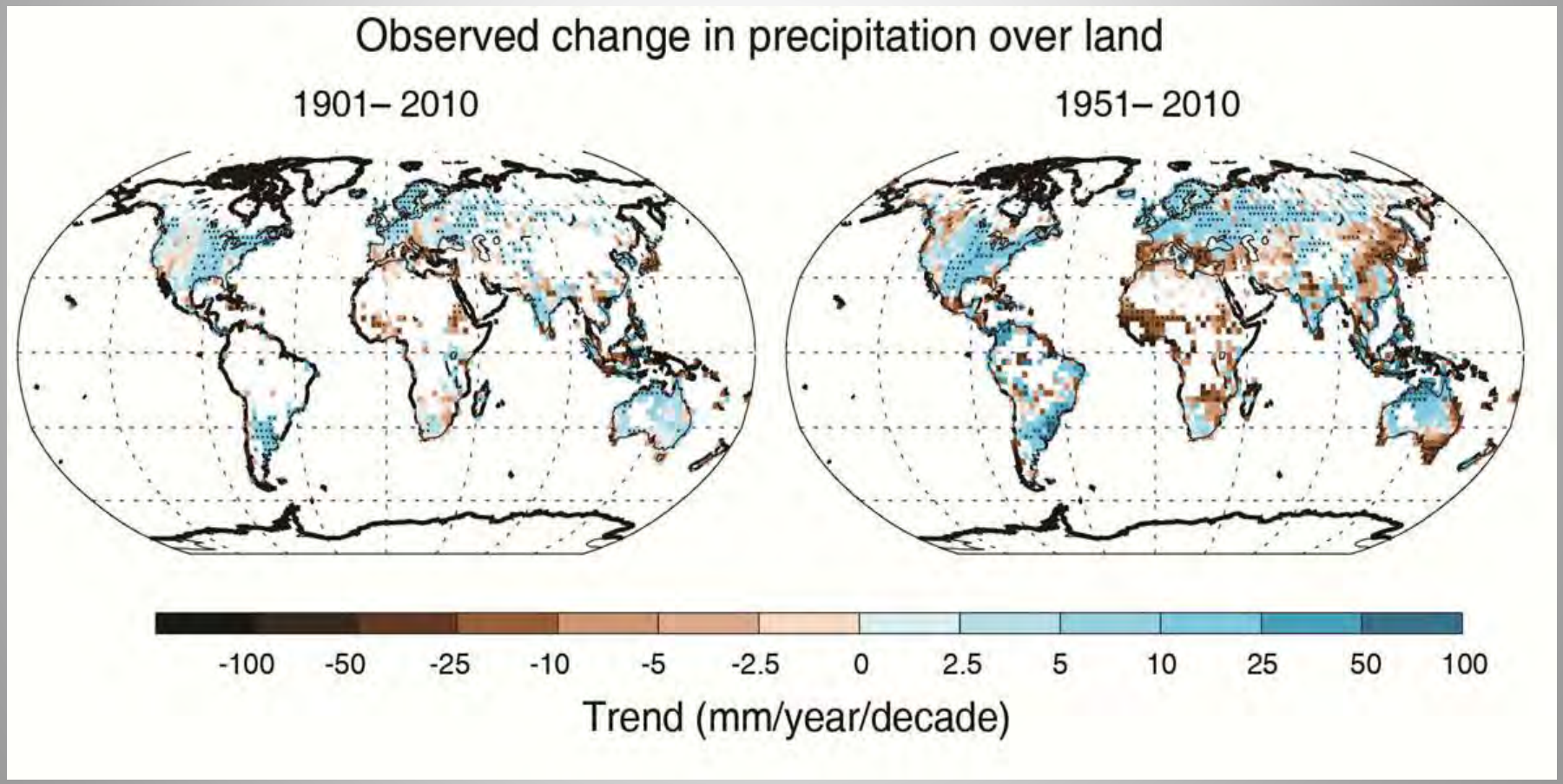
Just the Facts: IPCC 2014

- Atmosphere
  - 0.85 ^{o} C from 1880 – 2012
  - Likely the warmest 30-yr period in 1400 years
- Ocean
  - 90% of the additional heat has gone into the oceans
  - 0.4 degrees since 1971 –top 75 meters
- Cryosphere
  - Rate of ice loss – a bunch per decade in Gt
  - Rate of ice loss from Greenland accelerated
  - Arctic sea ice loss 3.5 to 4.1 % per decade
  - Northern Hemisphere snow cover decreased 1.6 % per decade in March and 11% in June (what does mean??)
  - Loss of permafrost

Just the Facts #2

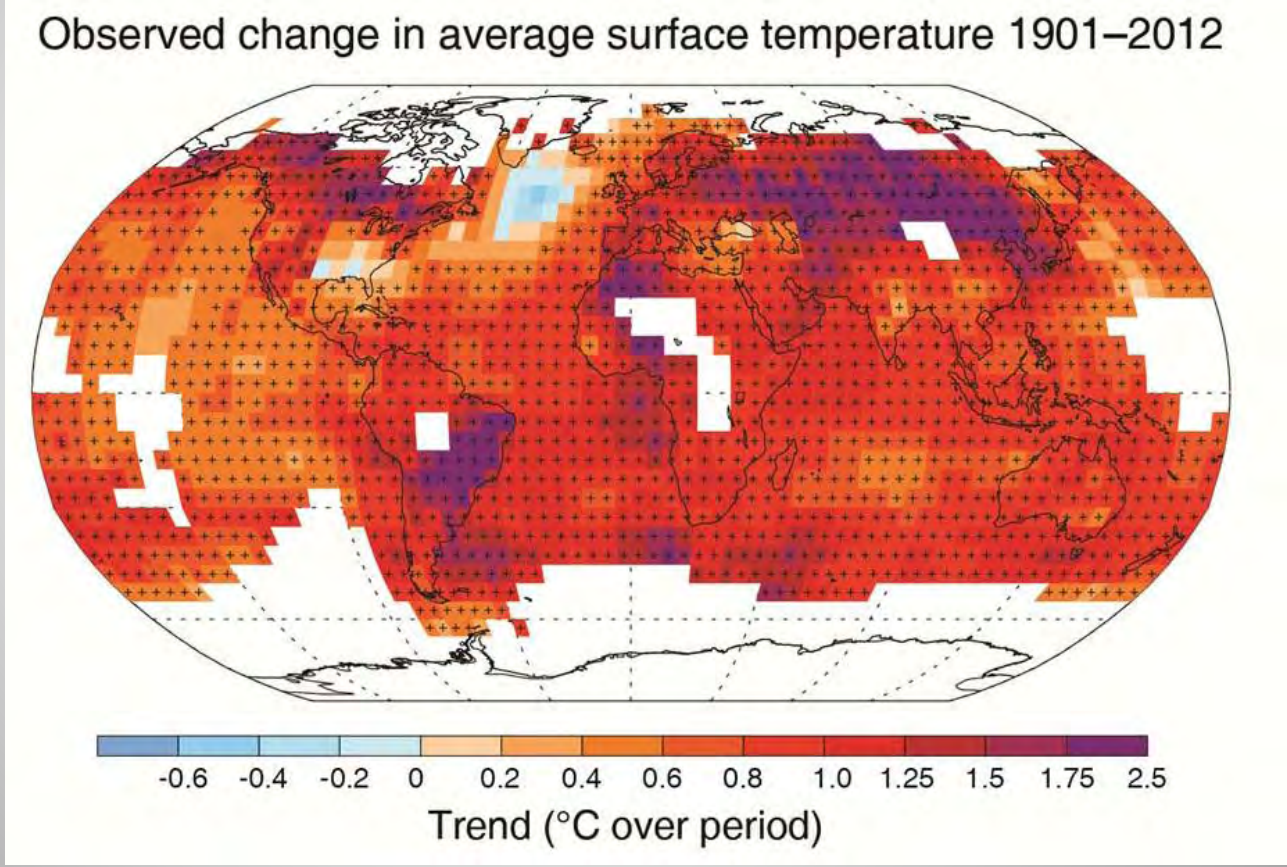
- Sea Level
  - 0.19 m 1901-2010
  - Loss of ice + thermal expansion
  - Sea level at the last global warming period was 5 M
- Carbon dioxide, CH_4, and N_2O exceeded 800,000 year records
- Extremely likely that ½ of the Temp was GHG driven

IPCC DATA from 27 September 2014 Science Report



It must also be noted that when it rains is also changing

IPCC DATA from 27 September 2014 Science Report

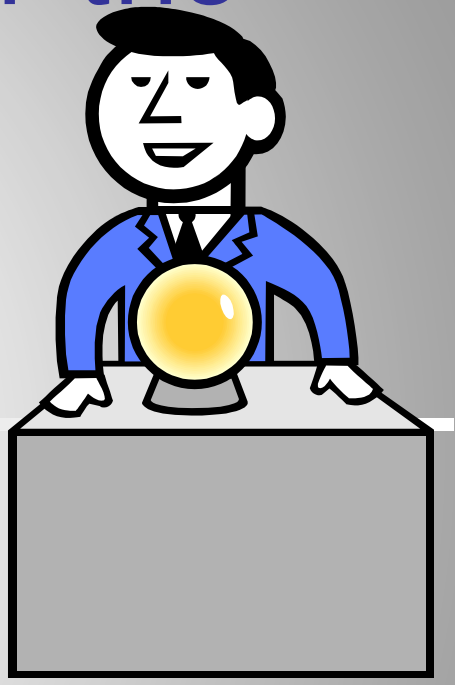


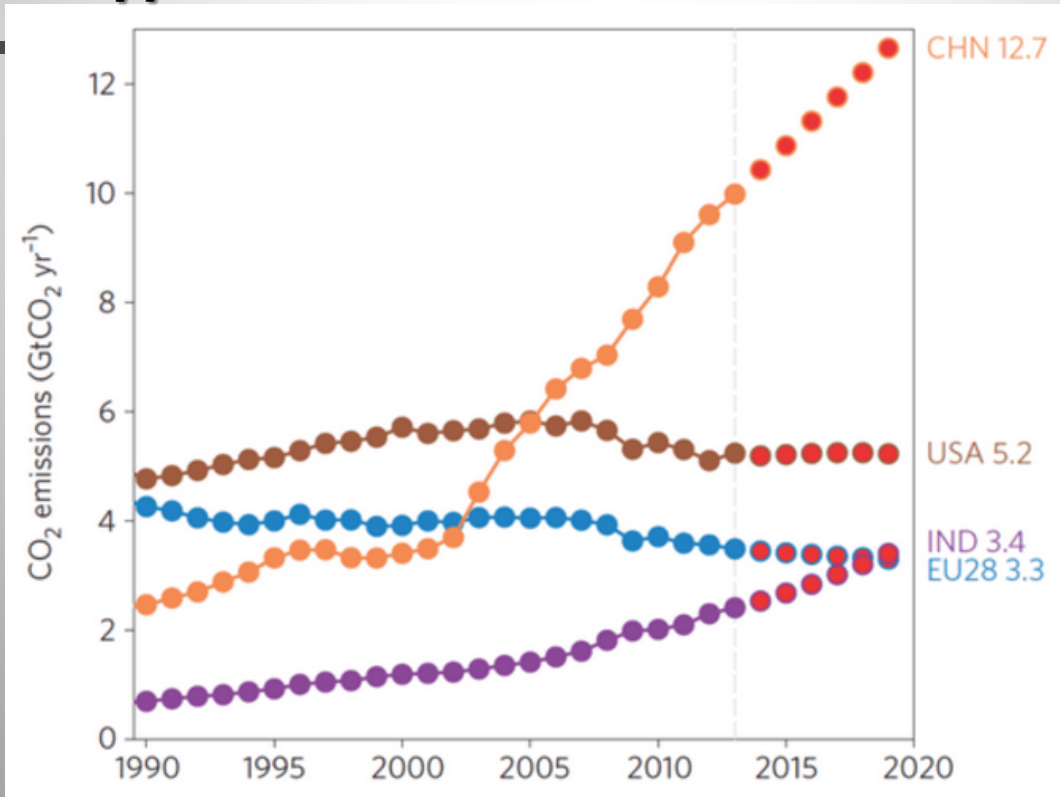

3.2 Billion people at risk
Drying
Snow and Ice Loss
Precipitation change
Floods & Droughts
Sea Level Rise
Extreme weather
Indus
Sutlej
Ganges
Karnali
Yarlung Tsangpo
Yellow
Yangtse
Yangtse
Sun Kosi
Arun
Ganges
Brahmaputra
Irrawaddy
Salween
Mekong
PAKISTAN
Mt. Kailash
TIBETAN PLATEAU
CHINA
NEPAL
BHUTAN
INDIA
BANGLADESH
BURMA (MYANMAR)
VIETNAM
LAOS
BAY OF BENGAL
SOUTH CHINA SEA
THAILAND
CAMBODIA
ANDAMAN SEA
INDIAN OCEAN
MAJOR RIVERS SOURCED IN TIBET
www.MeltdowninTibet.com © Michael Buckley

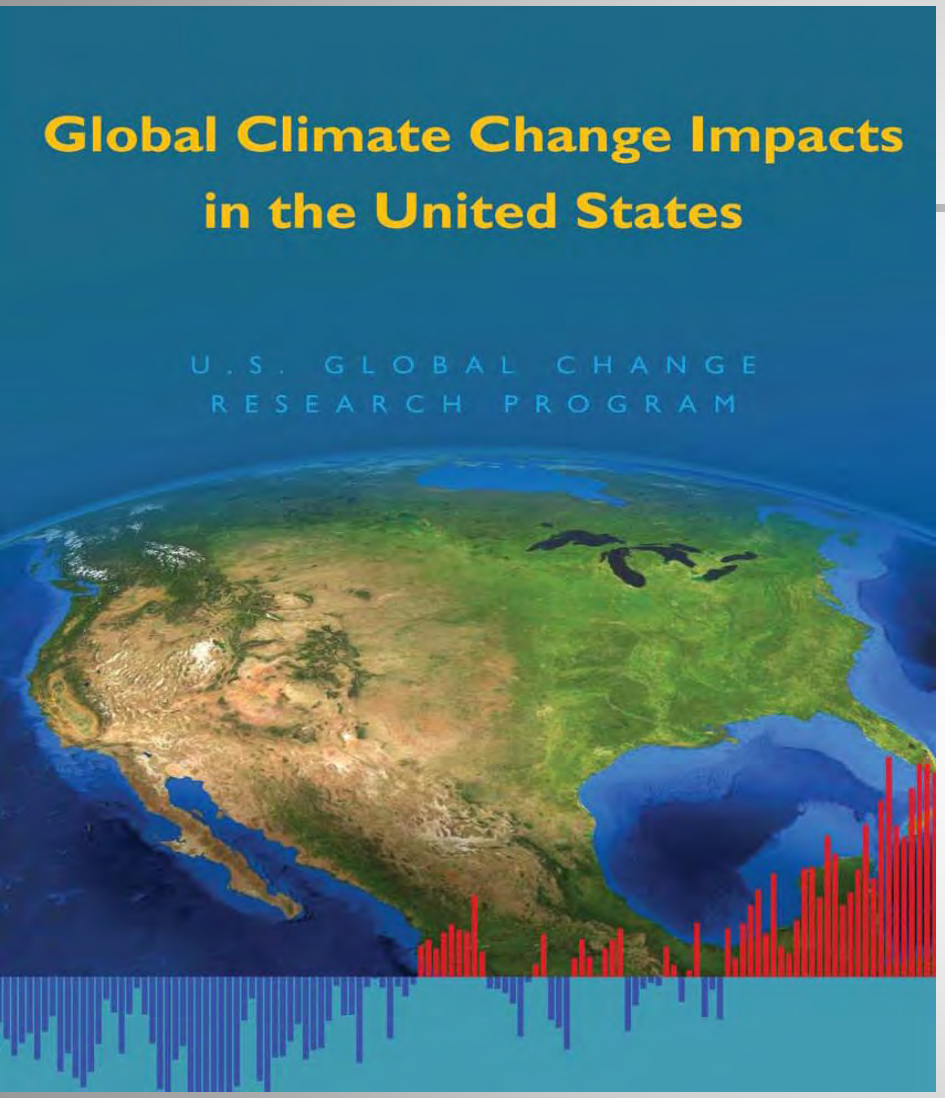
Climate-Related Driver	Key Impacts	Security and Defense Impact
Snow and ice cover: Ice – 15 -85 % reduction by 2100. Snow- 7-25 % loss by 2100	Loss of snow and ice stresses water resources, increased rate of warming, flooding and droughts	Increase of humanitarian support missions, large-scale logistics support, medical resources to respond to epidemic disease, border security ops.

Building a Crystal Ball for the Future of CC

Or ---Why can't someone just tell us what is going to happen??







Climate Change Impacts by Sector

National Climate Change

Key Messages:

- U.S. average temperature has risen more than 2°F over the past 50 years and is projected to rise more in the future; how much more depends primarily on the amount of heat-trapping gases emitted globally and how sensitive the climate is to those emissions.

- Precipitation has increased an average of about 5 percent over the past 50 years. Projections of future precipitation generally indicate that northern areas will become wetter, and southern areas, particularly in the West, will become drier.
- The amount of rain falling in the heaviest downpours has increased approximately 20 percent on average in the past century, and this trend is very likely to continue, with the largest increases in the wettest places.
- Many types of extreme weather events, such as heat waves and regional droughts, have become more frequent and intense during the past 40 to 50 years.
- The destructive energy of Atlantic hurricanes has increased in recent decades.
- The intensity of these storms is likely to increase in this century.
- In the eastern Pacific, the strongest hurricanes have become stronger since the 1980s, even while the total number of storms has decreased.
- Sea level has risen along most of the U.S. coast over the last 50 years, and will rise more in the future.
- Cold-season storm tracks are shifting northward and the strongest storms are likely to become stronger and more frequent.
- Arctic sea ice is declining rapidly and this is very likely to continue.

Agriculture

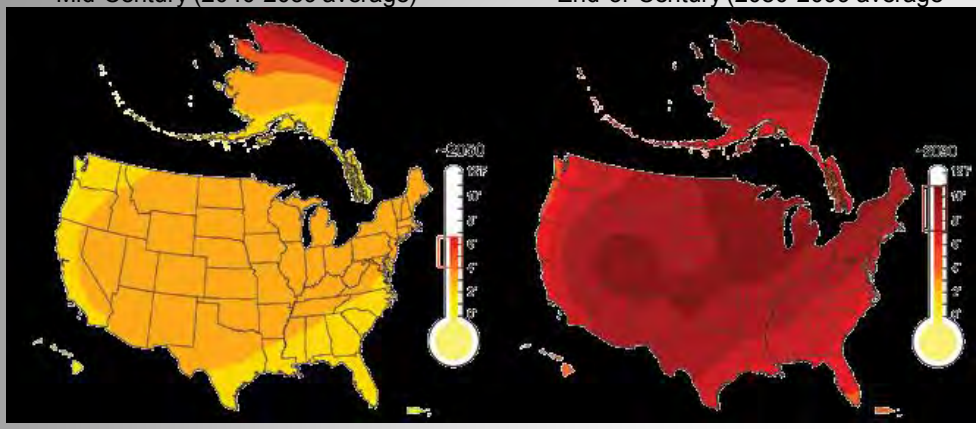
Key Messages: Key Sources

- Many crops show positive responses to elevated carbon dioxide and low levels of warming, but higher levels of warming often negatively affect growth and yields.
- Extreme events such as heavy downpours and droughts are likely to reduce crop yields because excesses or deficits of water have negative impacts on plant growth.
- Weeds, diseases, and insect pests benefit from warming, and weeds also benefit from a higher carbon dioxide concentration, increasing stress on crop plants and requiring more attention to pest and weed control.
- Forage quality in pastures and rangelands generally declines with increasing carbon dioxide concentration because of the effects on plant nitrogen and protein content, reducing the land's ability to supply adequate livestock feed.
- Increased heat, disease, and weather extremes are likely to reduce livestock productivity.

Higher Emissions Scenario91 Projected Temperature Change (°F) from 1961-1979 Baseline

Mid-Century (2040-2059 average)

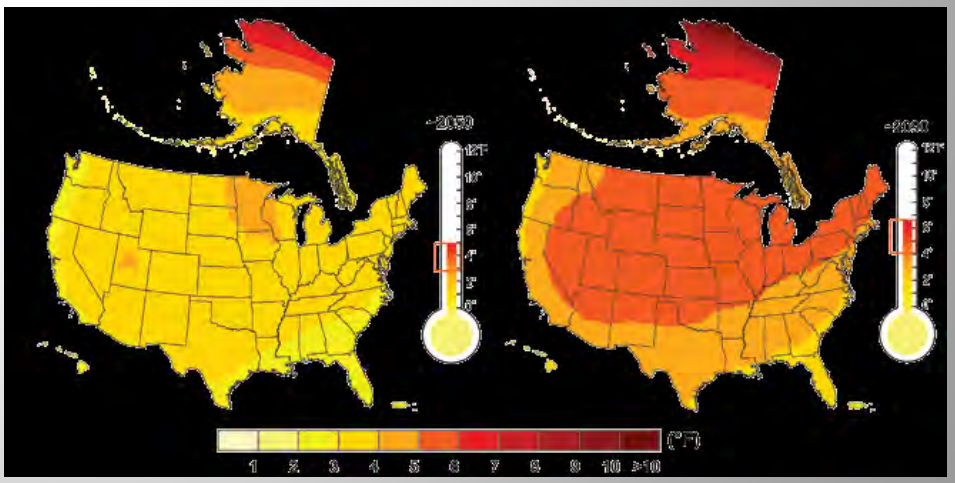
End-of-Century (2080-2099 average



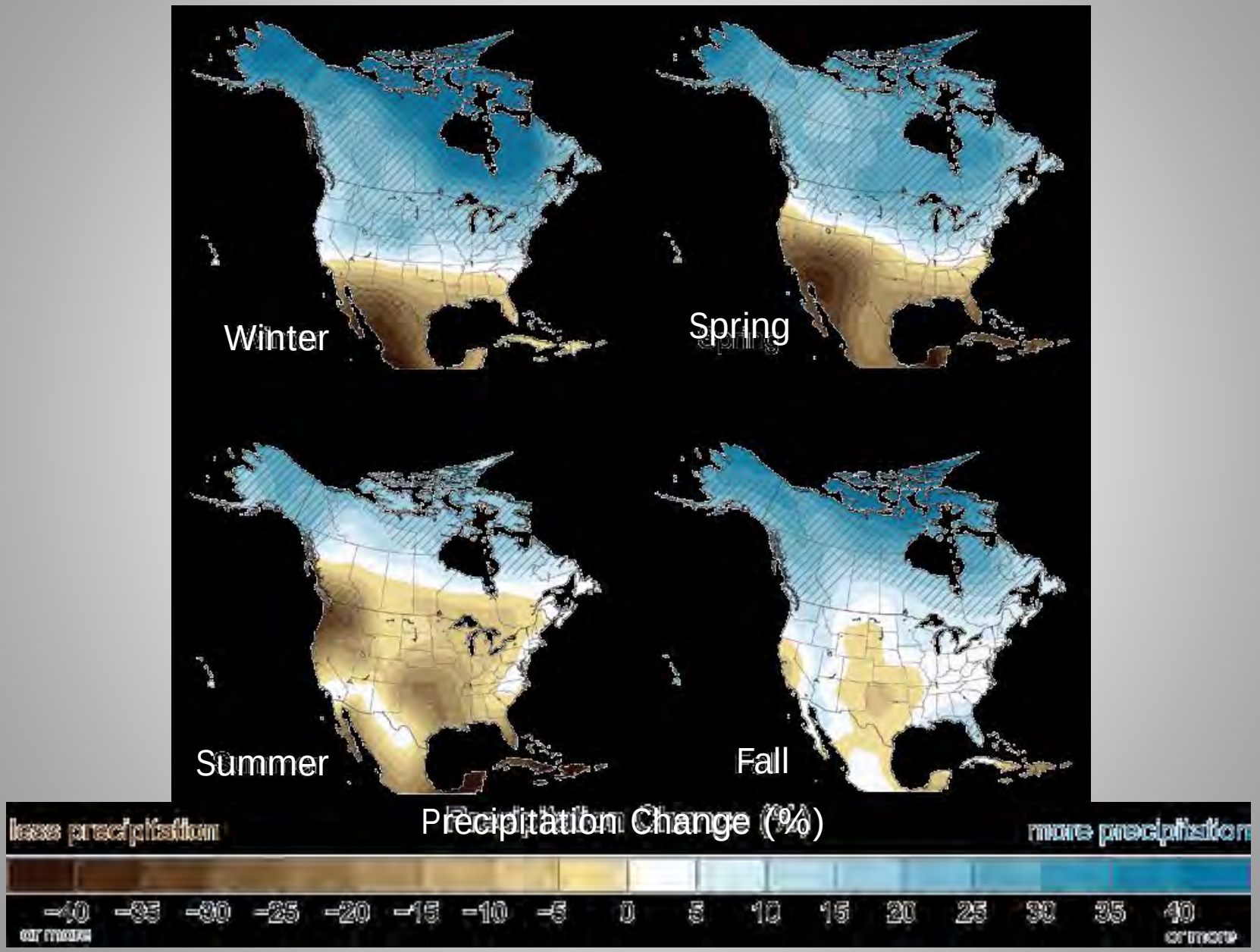
Lower Emissions Scenario91 Projected Temperature Change (°F) from 1961-1979 Baseline

Mid-Century (2040-2059 average)

End-of-Century (2080-2099 average



Precipitation By 2099



COP 21 - (Conference of Parties to the UN Framework on CC of 1994)

- 196 countries participated
- All delegates signed an agreement (12 pages) which has the goals to:
  - limit global warming to less than 2 degrees C.
  - 0 net human GHG by 2100
  - Pursue 1.5 degree limit
  - Nationally determined contributions to GHG reductions!!!
  - Global stocktake (review every 5 years)
  - Adaptation and mitigations per AR5
  - Money for developing nations to build clean systems and loss and damage (100 billion)
- Must be signed by 55 nations that represent 55% of the current GHG emissions.

Summary

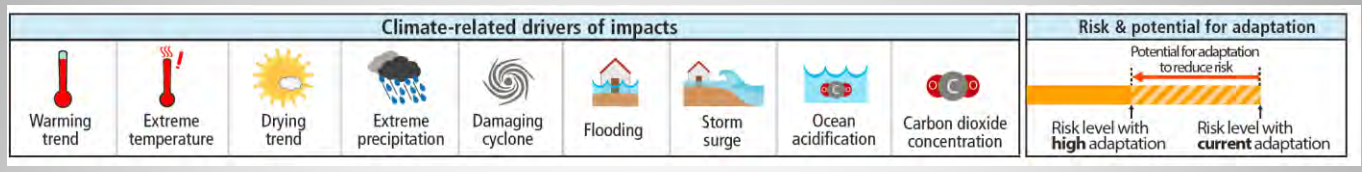
- Security is a much larger issue than wielding military power
- Peace is not the absence of war, but the existence of stable human communities who have their basic needs satisfied
- Protecting peace means assuring regional stability
- Environmental degradation is a major threat to peace and stability in the world
- Solutions must work toward curing the basic problems not treating symptoms -
- Climate Change
  - We are going to adapt to the consequences of GHG emissions
  - How we mitigate the impacts of future climate change will alter our future security
  - Climate change is truly a world scale issue where win together or everyone loses; however, the weakest nations suffer most.

Environmental Security Analysis

2007 and 2011 FSI

FSI 2007 and 2011	RNI %	Fertility rate	Water Data	Arable land	Forest Data	Crops	ES Risk
Sudan (3)	2.9	6.0	F	F	F	F	Extreme
Iraq (9)	3.1	5.5	D	D	F	D	High
Somalia (1)	2.5	6.3	F	F	F	F	Extreme
Zimbabwe (6)	1.5	3.7	F	D	F-	F	High
Chad (2)	3.1	6.6	F	F	F	F	Extreme
Ivory Coast (10)	2.3	5.4	F	C	NA	F	High
Dem Rep of the Congo (4)	3.2	7.2	F	C	C	F	High
Afghanistan (7)	2.7	6.9	F	F	F-	F	Extreme
Guinea (11)	2.7	6.2	F	D	D	F	High
Central Africa Republic (8)	2.7	5.4	F	C	C	F	High
Haiti (5)	2.5	5.7	F	F-	F-	F	Extreme
U.S.	0.6	2.0	A	B	B	A	Low
France	0.6	1.9	A	A	A	A	low

F= Awful
D= Bad
C= Average
B= Good
A= Excellent



Key risk	Adaptation issues and prospects	Climatic drivers	Supporting ch. sections	Timeframe	Risk for current and high adaptation
Central and South America					
Water availability in semi-arid and glacier-melt-dependent regions and flooding in urban areas due to extreme precipitation (*high confidence*)	• Water-supply deficit replacement and improved land use • Urban flood management (including infrastructure), early warning systems, better weather and runoff forecasts, and infectious disease control		27.3	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low / Medium / Very high
Decreased food production and food quality (*medium confidence*)	• Development of new crop varieties more adapted to changes in CO_2, temperature, and drought • Offsetting of human and animal health impacts of reduced food quality • Offsetting of economic impacts of land use change		27.3	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low / Medium / Very high
Small Islands					
Loss of livelihoods, coastal settlements, and infrastructure in small islands (*high confidence*)	• Significant potential exists for adaptation in islands, but additional external resources and technologies will enhance response. • Efficacy of traditional community coping strategies is expected to be substantially reduced in the future.		Figure 29-4	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low / Medium / Very high
The interaction of rising global mean sea level in the 21st century with high-water-level events will threaten low-lying coastal areas in small islands (*high confidence*)	• High ratio of coastal area to land mass will make adaptation a significant financial and resource challenge for islands. • Adaptation options include maintenance and restoration of coastal landforms and ecosystems, improved management of soils and freshwater resources, and appropriate building codes and settlement patterns.		29.4, Table 29-1; WGI AR5 13.5, Table 13.5	Present Near-term (2030-2040) Long-term (2080-2100) 2°C 4°C	Very low / Medium / Very high