Concepts of Climate Change and their Impacts

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Learning Objectives

At the end of this module, participants will be able to

- Describe the science behind climate change;
- Identify sources of natural and human-induced climate change; and
- Describe the projected impacts of climate change.

Weather vs. Climate

Weather

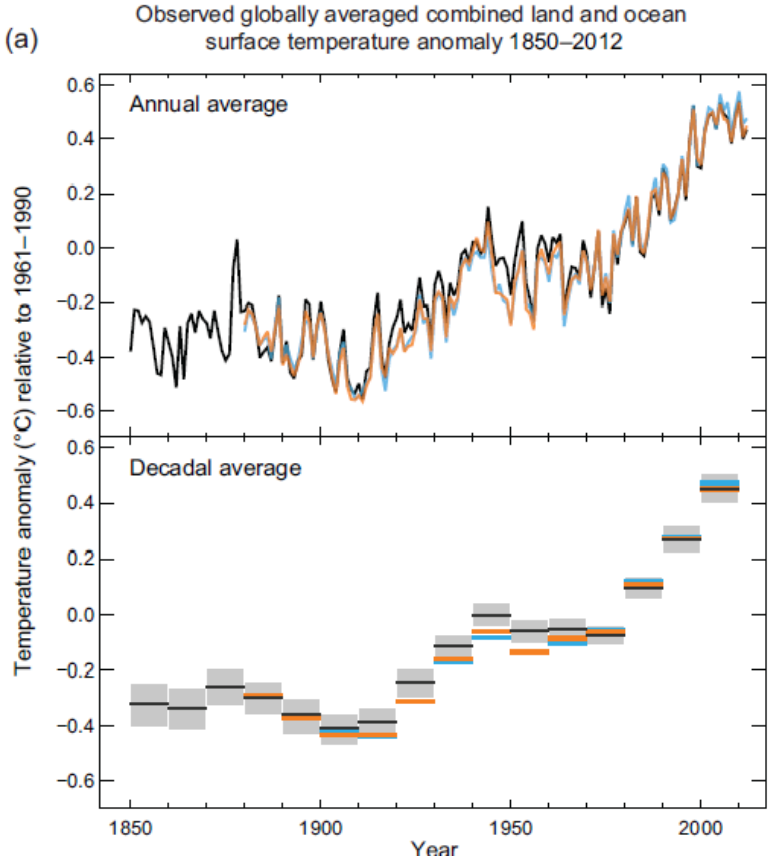
The state of atmosphere at a given time and place measured in terms of variables that include temperature, precipitation, cloudiness, humidity, air pressure and wind.

Climate

The long-term average of conditions in the atmosphere described by statistics, such as means and extremes

Climate Change

Climate Change is defined as statistically significant variation in either mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcing or to persistent anthropogenic changes in the composition of the atmosphere or in land use (**IPCC, 2001**).



From AR5 (2014)

adpc

Climate Change (NOAA Definition)

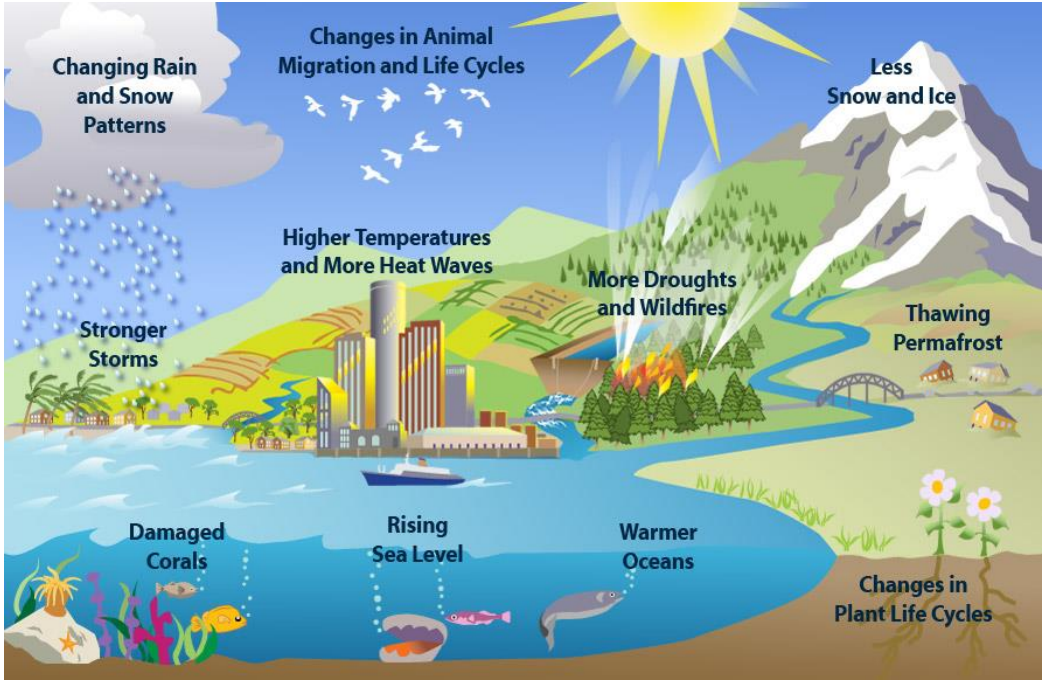
Climate change is a long-term shift in the statistics of the weather (including its averages).

For example, it could show up as a change in climate normals (expected average values for temperature and precipitation) for a given place and time of year, from one decade to the next

Why is the Climate Changing??

Natural Variability

Climate change is a normal part of the Earth's natural variability, which is related to interactions among the atmosphere, ocean, and land, as well as changes in the amount of solar radiation reaching the earth.



US Environment Protection Agency

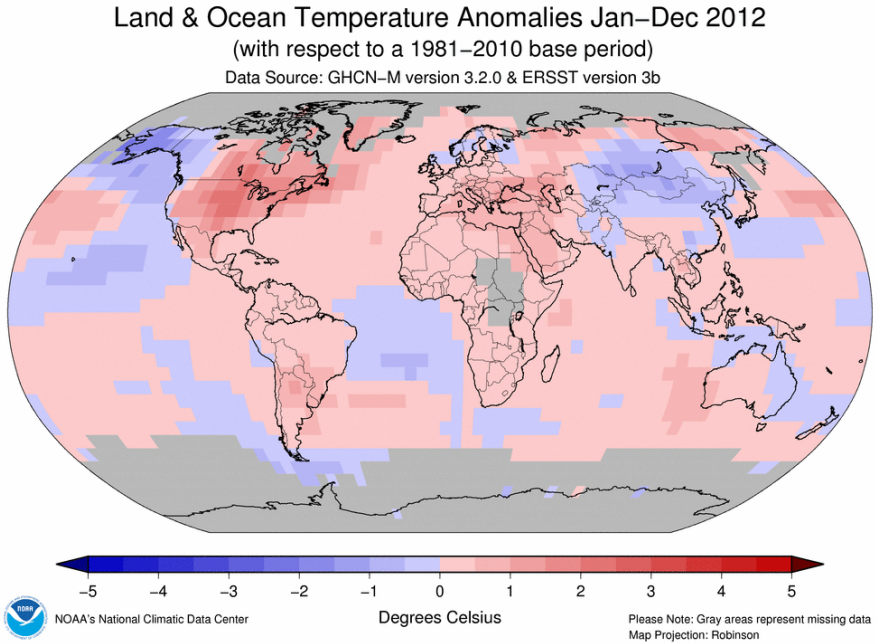
Human Induced Change

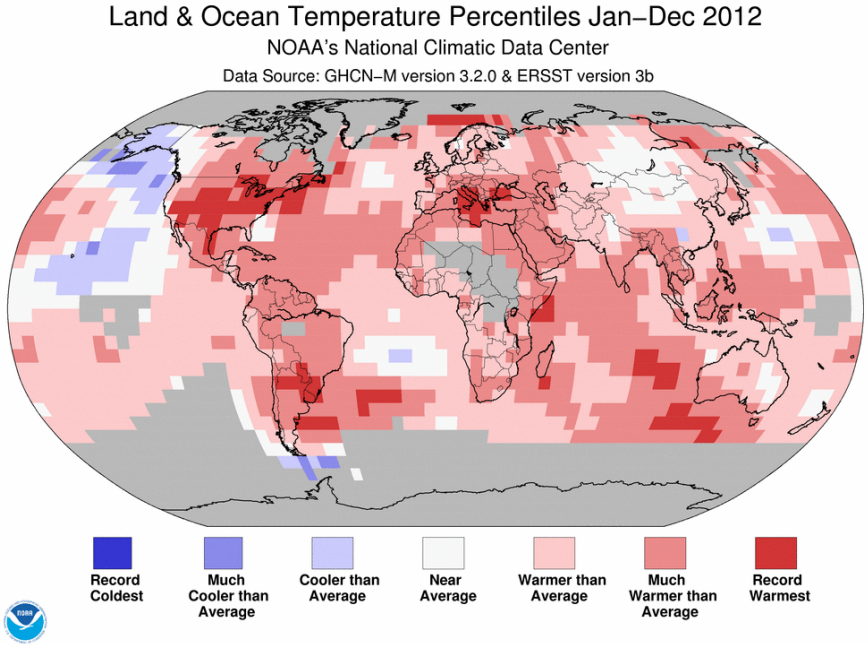
Greenhouse Gases

- Carbon dioxide (CO_2) and water vapor (H_2O), trap heat in the atmosphere causing a greenhouse effects
- Burning of fossil fuels, like oil, coal, and natural gas is adding CO_2 to the atmosphere.

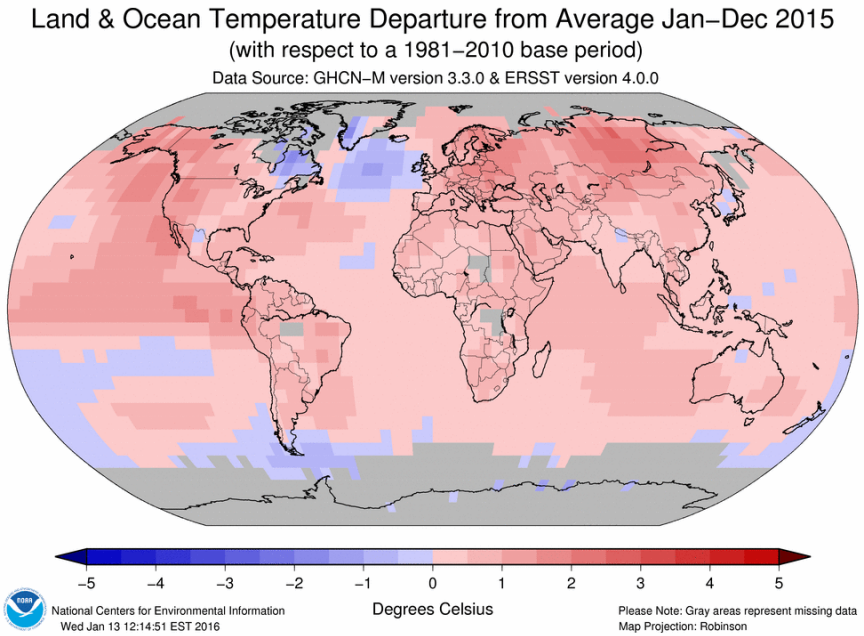
The **AR4 of the Intergovernmental Panel on Climate Change (IPCC)** concludes, "that most of the observed increase in the globally averaged temperature since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."

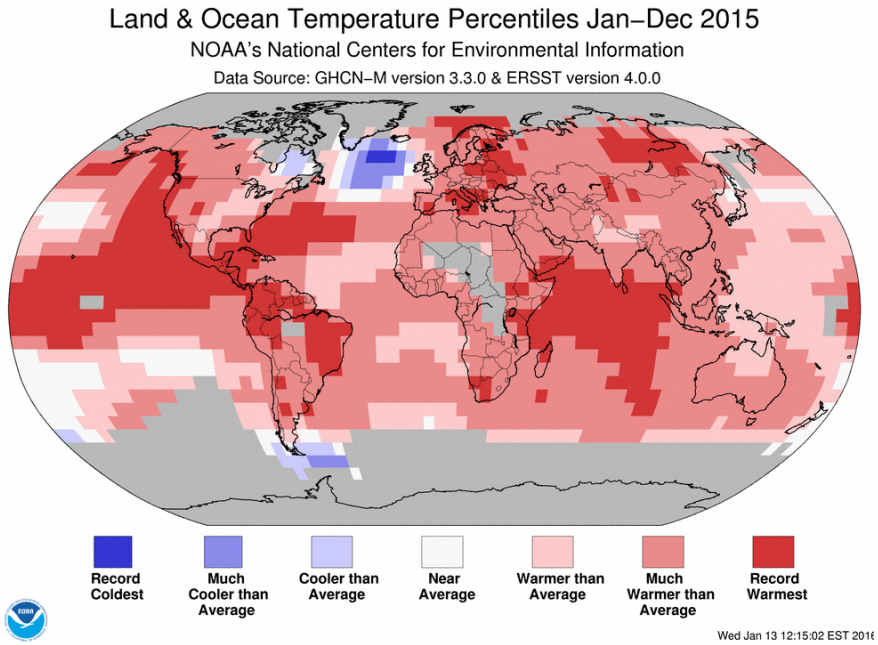
Regional Temperatures



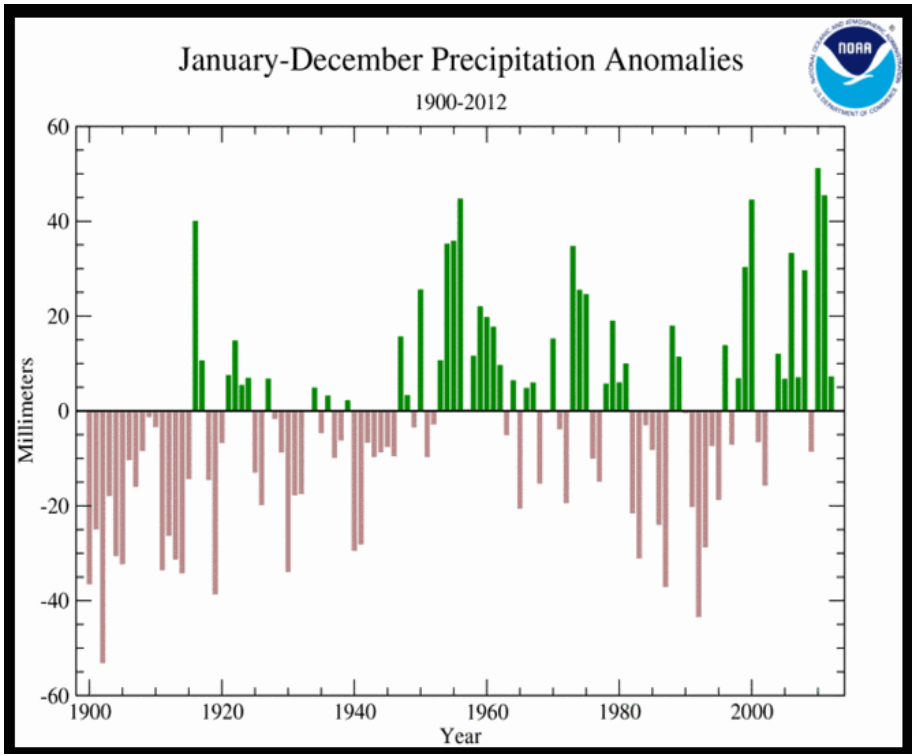


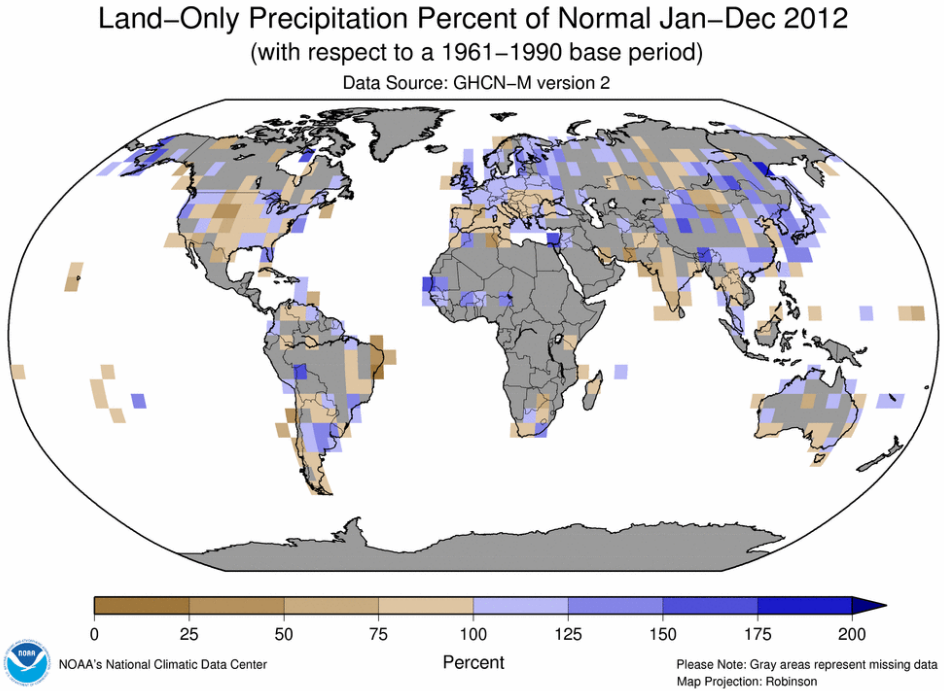
Regional Temperatures



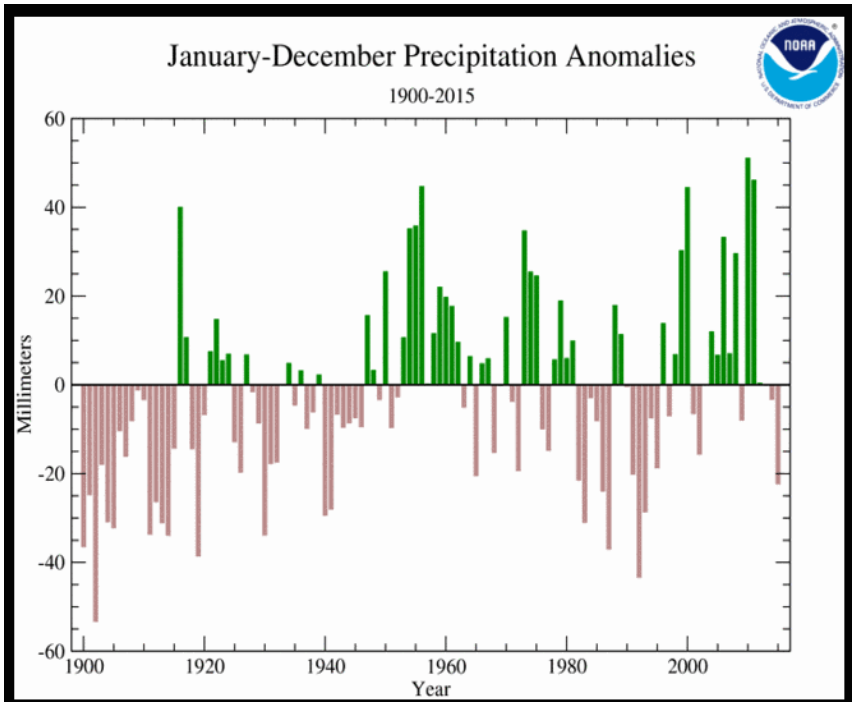


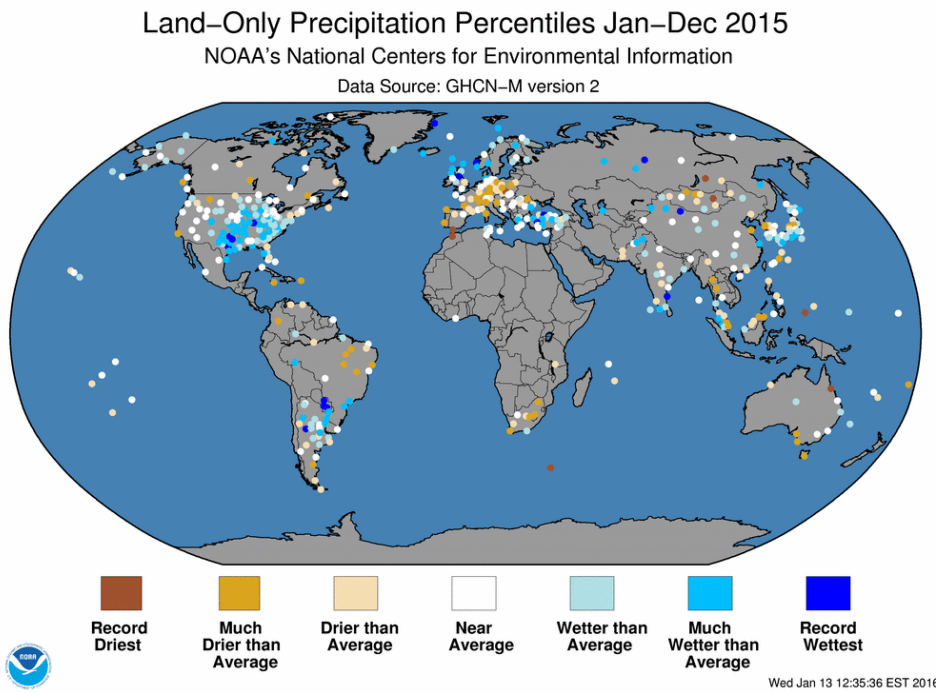
Global Precipitation



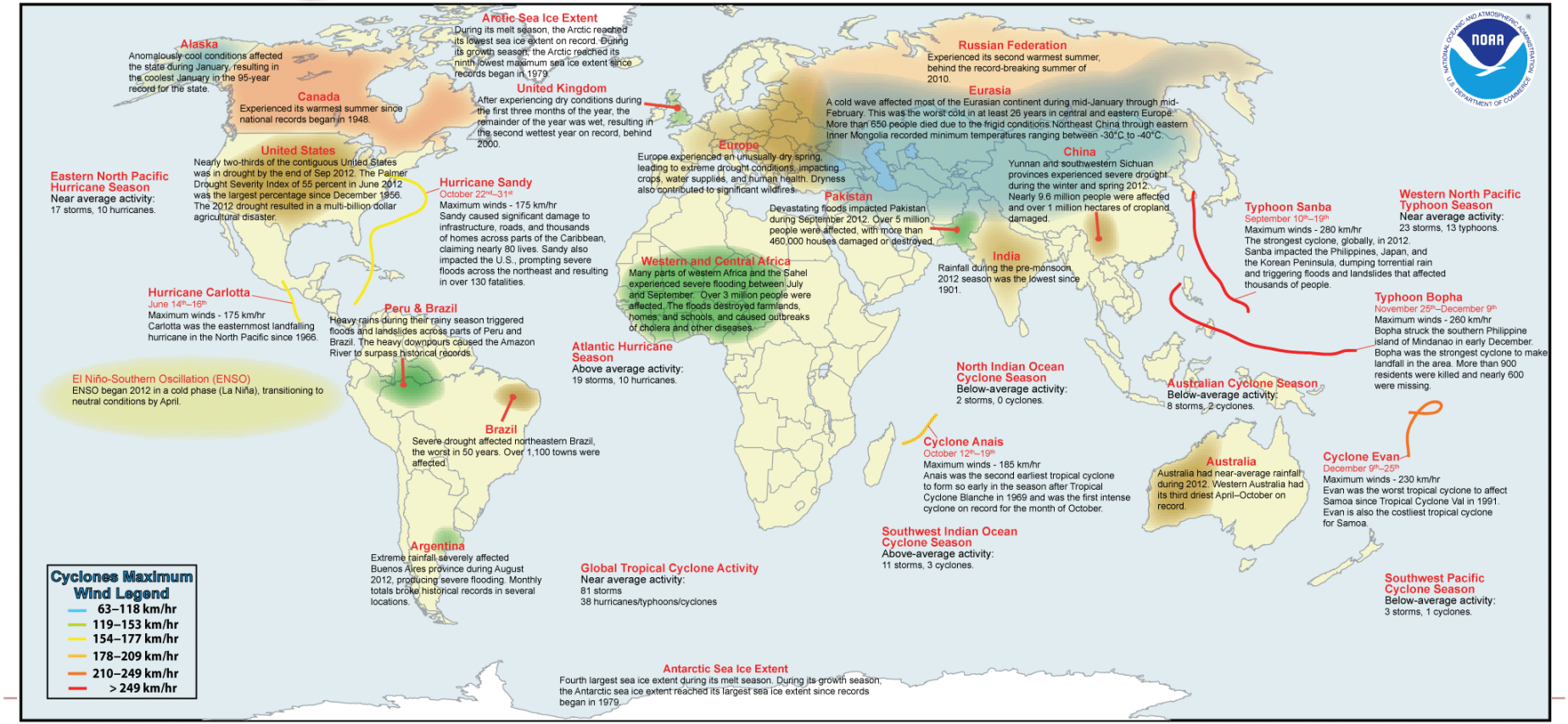


Global Precipitation

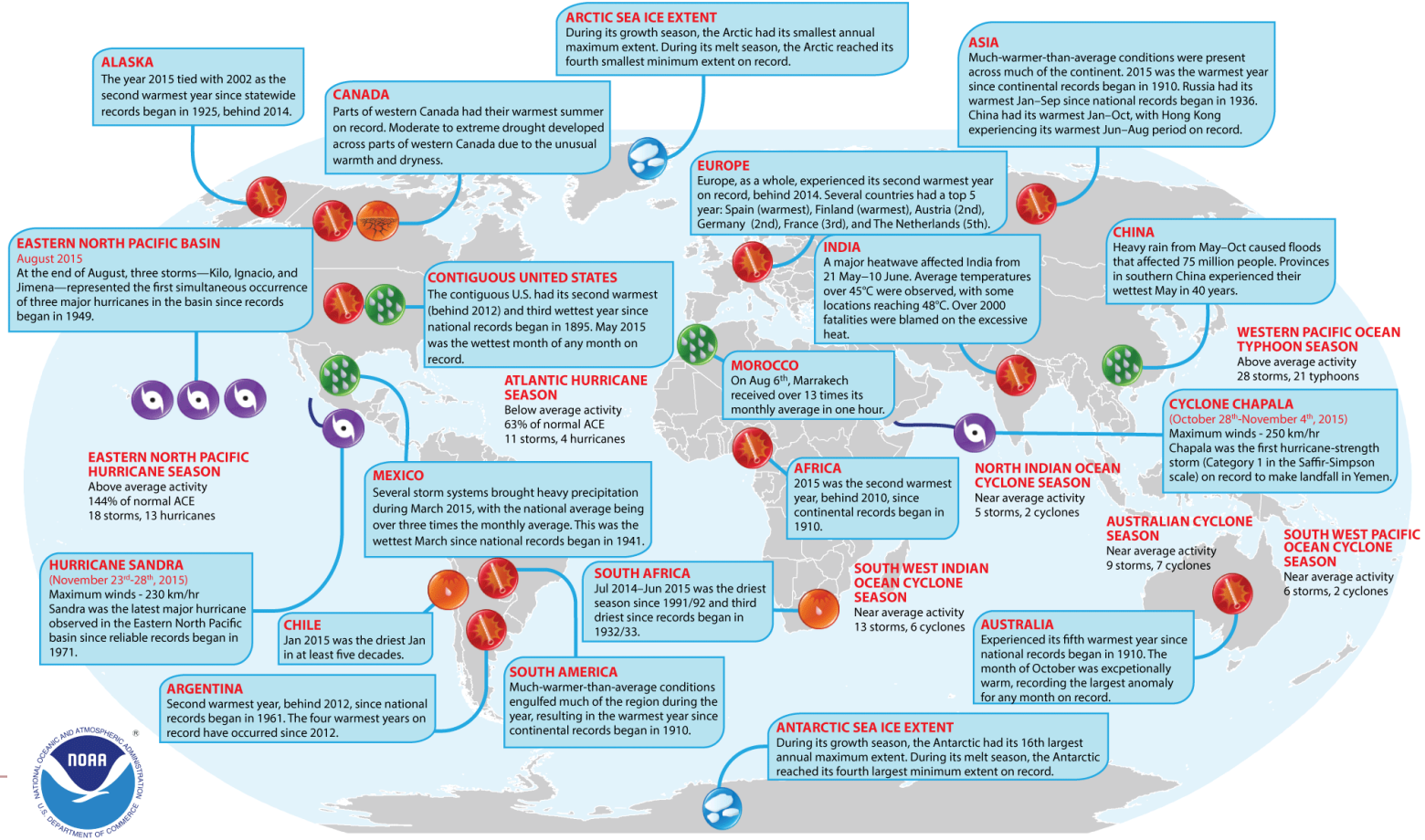




2012 Significant Climate Anomalies and Events



Selected Significant Climate Anomalies and Events in 2015



Please Note: Material provided in this map was compiled from NOAA's NCEI State of the Climate Reports and the WMO Provisional Status of the Climate in 2015.
For more information please visit: http://www.ncdc.noaa.gov/sotc

Climate Variability & Climate Change

What is the Climate System?

Consists of five major components:

- The atmosphere
- The hydrosphere
- The cryosphere
- Land surface
- The biosphere

The climate system is continually changing due to the interactions between the components as well as external factors such as volcanic eruptions or solar variations and human-induced factors such as changes to the atmosphere and changes in land use. (**WMO**)

What is Climate Variability?

Variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events.

- Deviations of climatic statistics over a given period of time (e.g. a month, season or year) when compared to long-term statistics for the same calendar period;

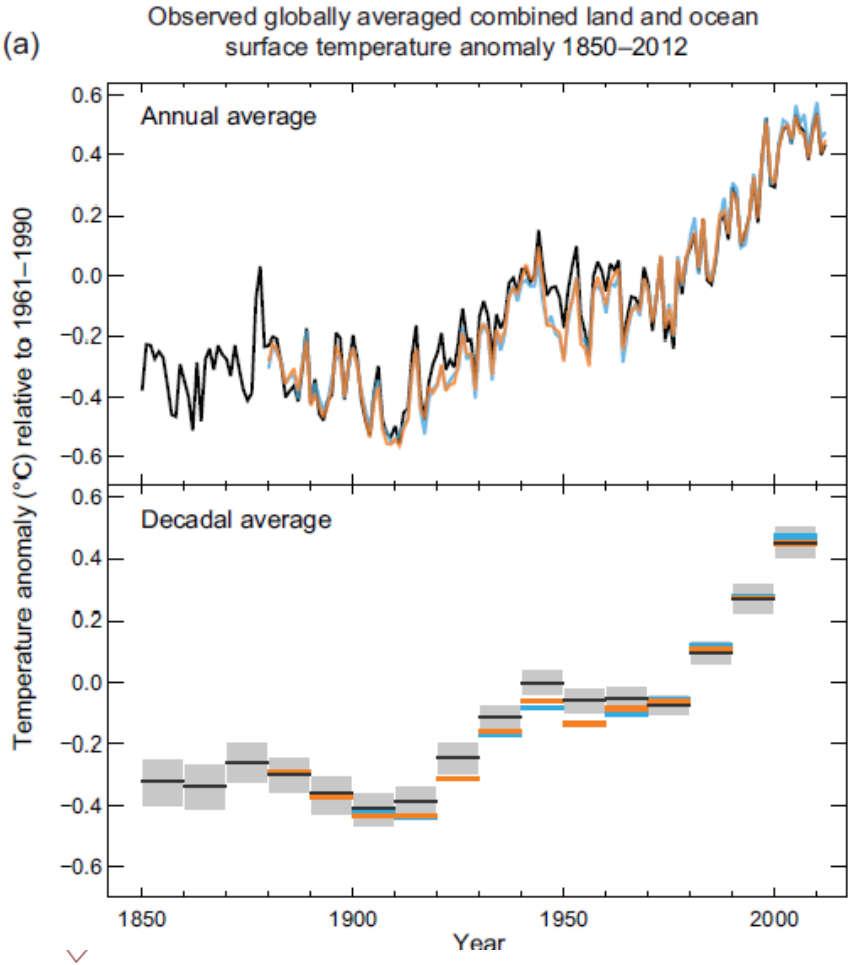
- Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external factors (external variability).

What is the difference between Climate Variability and Climate Change?

Climate variability looks at changes that occur within smaller timeframes, such as a month, a season or a year, and climate change considers changes that occur over a longer period of time, typically over decades or longer.

A key difference between climate variability and change is in persistence of "anomalous" conditions - when events that used to be rare occur more frequently, or vice-versa.

(**WMO**)



From IPCC Assessment Report (AR5) (2014)

Consequences of Climate Change

Present Consequences

Global climate change has already had observable effects on the environment.

- Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner.
- Past predictions by scientists are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves.

(NASA Vital Signs of the Planet)

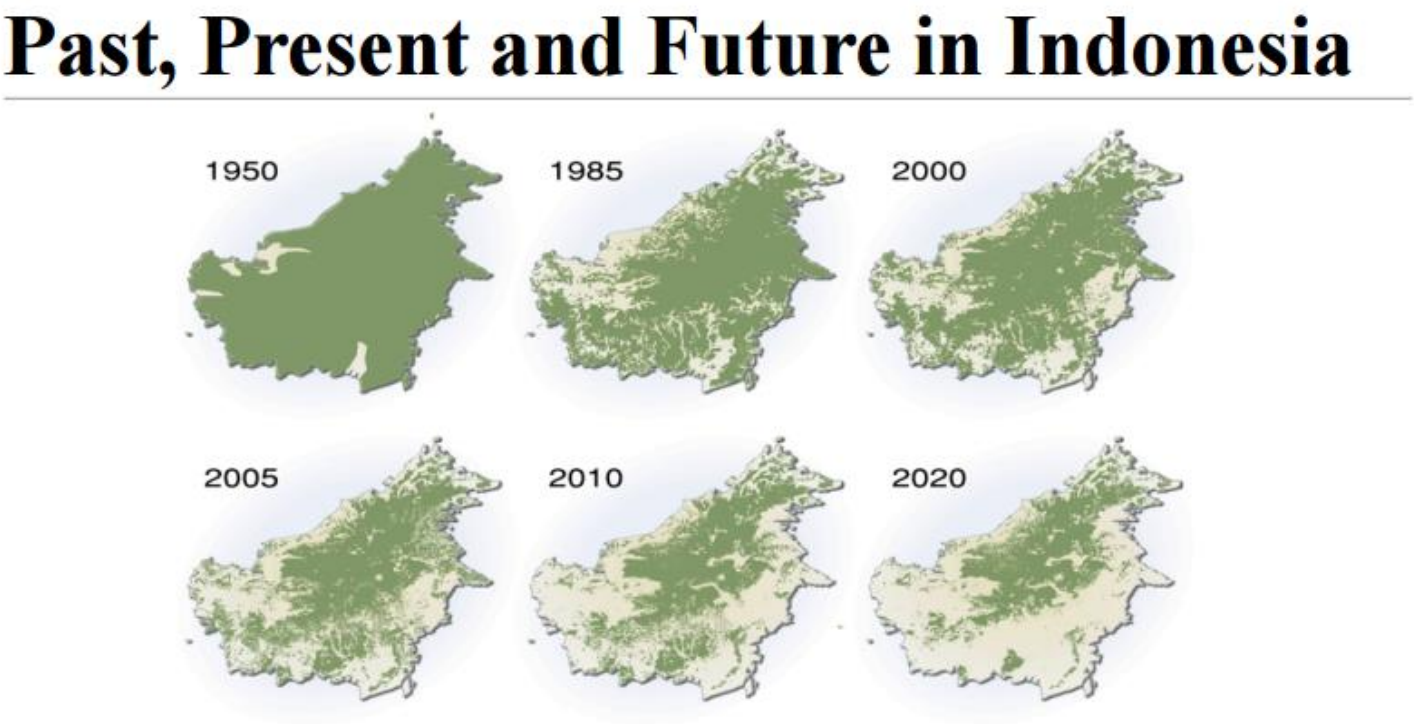
Future Consequences

- Change will continue through this century and beyond;
- Temperatures will continue to rise;
- Variations in crop growing season;
- Changes in precipitation patterns;
- More droughts and heat waves;
- Sea level will rise 1-4 feet by 2100.

(NASA Vital Signs of the Planet)

What Changes Climate

Landuse Changes



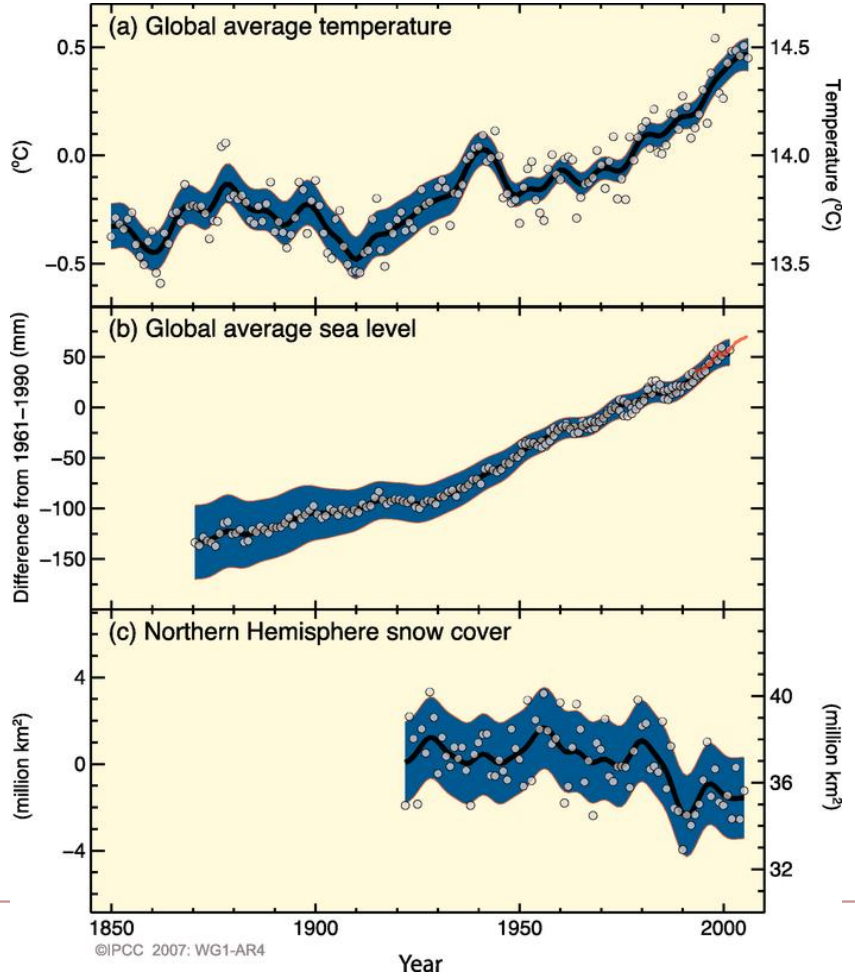
Volcanic Eruptions

Greenhouse Gas Emissions

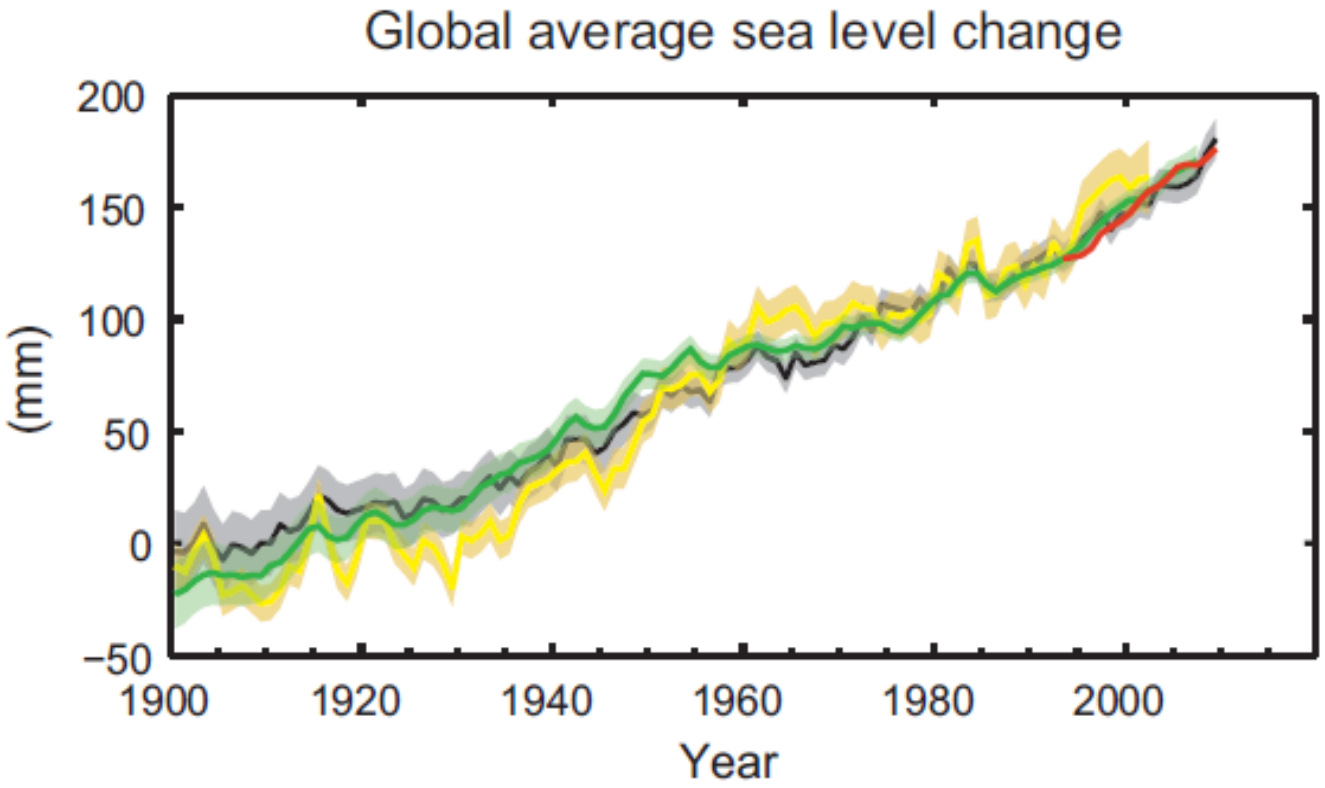
Observations of Climate Change

Direct Observations

Changes in Temperature, Sea Level and Northern Hemisphere Snow Cover



Observed changes in (a) global average surface temperature, (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All changes are relative to corresponding averages for the period 1961–1990. Smoothed curves represent decadal average values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c).



From IPCC Assessment Report (AR5) (2014)

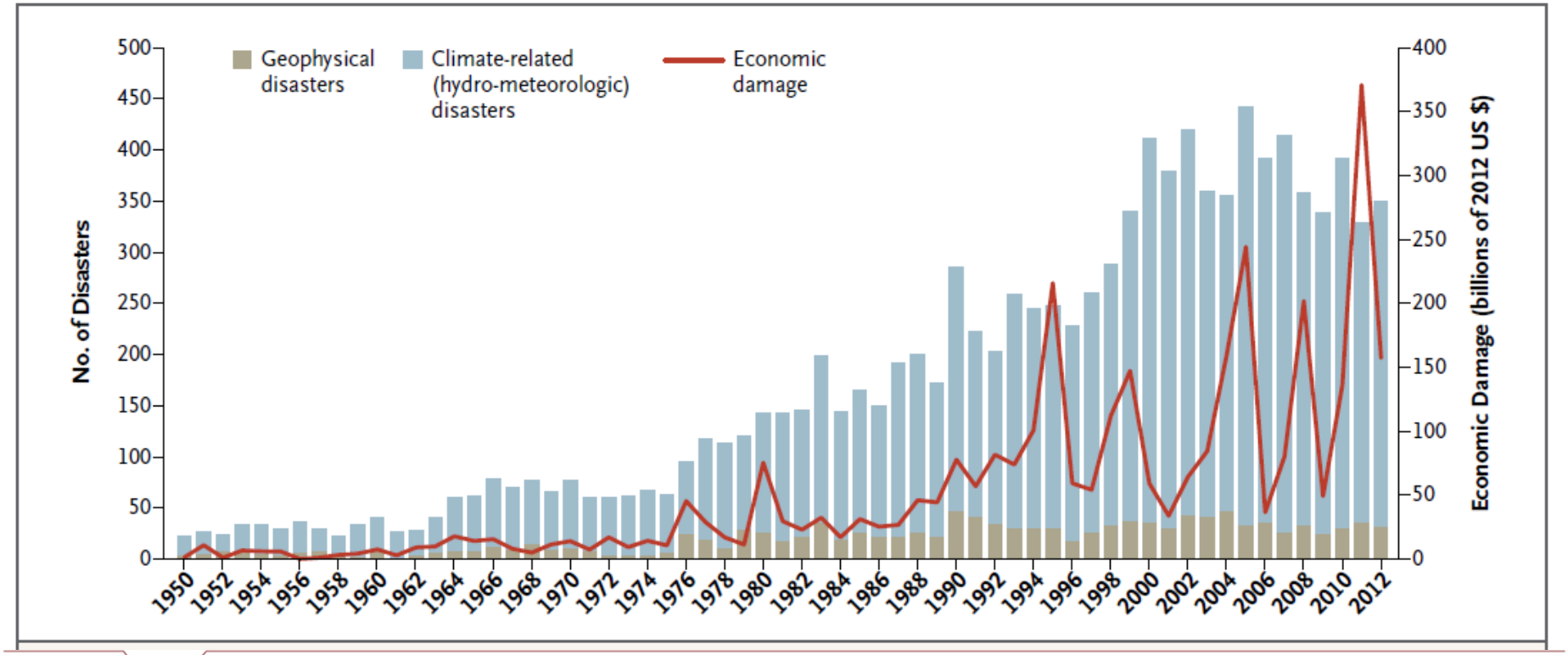
Mount Kilimanjaro

Feb. 17, 1993

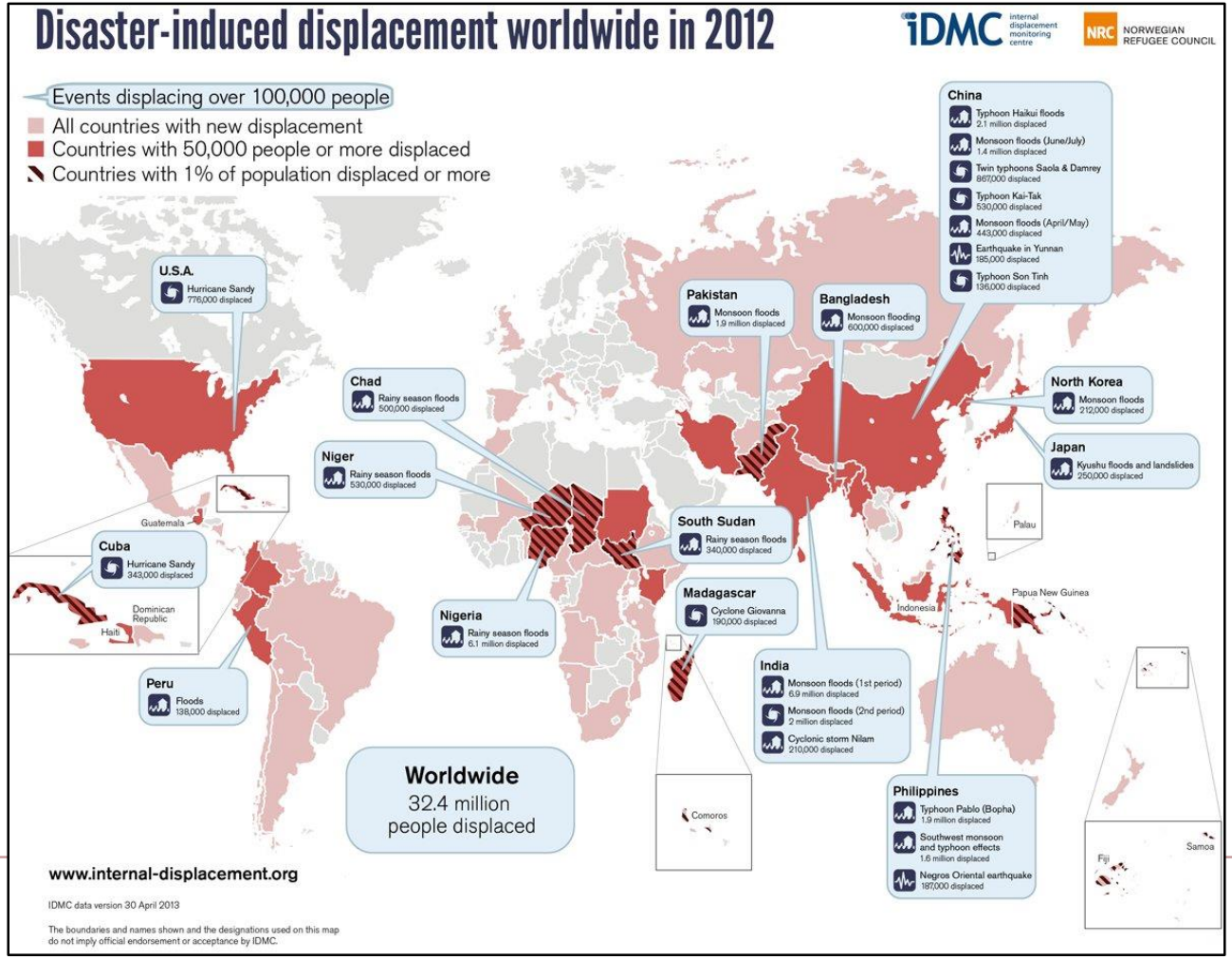
Feb. 21, 2000

Credit: ***Jim Williams, NASA GSFC Scientific Visualization Studio, Landsat 7 Science Team***

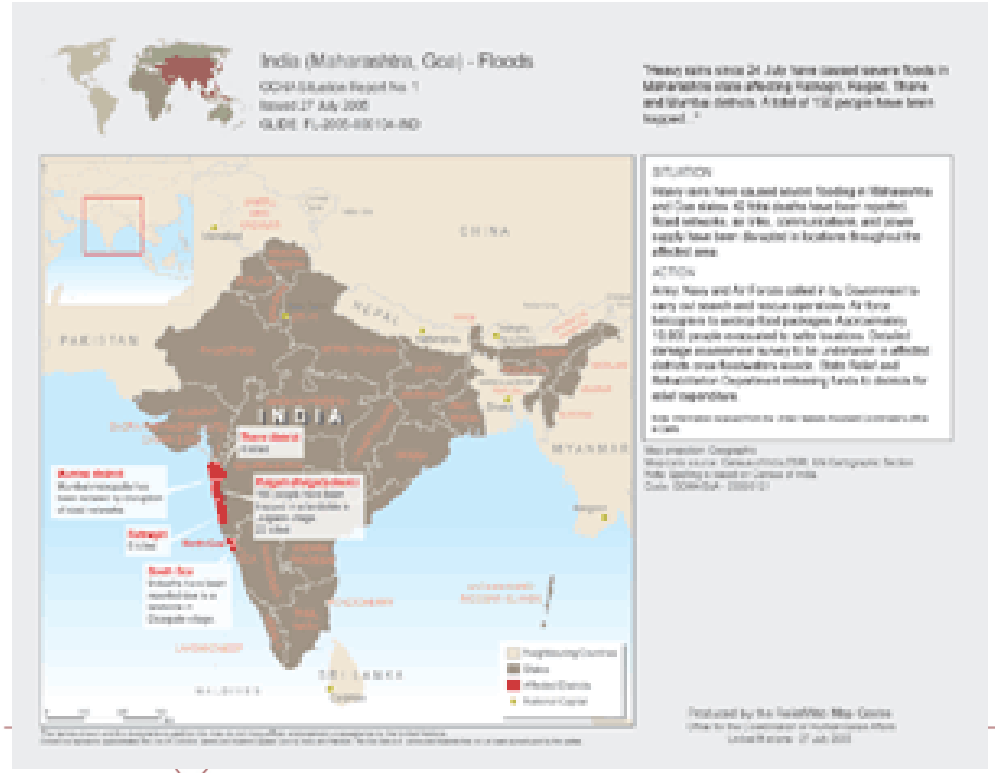
Climate related Disasters on the Increase…

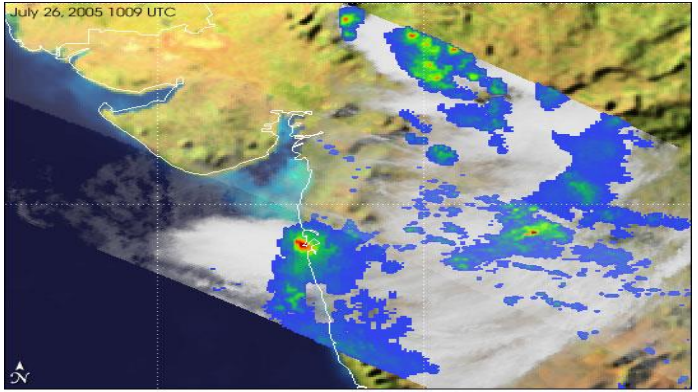


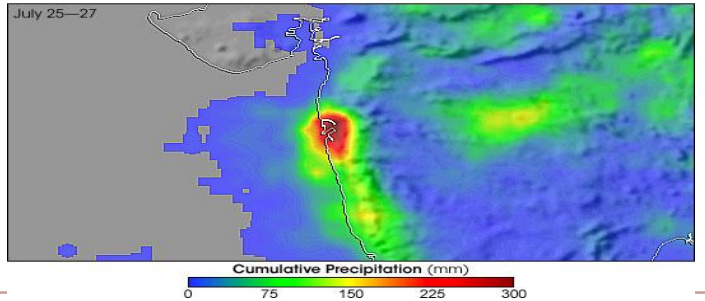
Original Data from the EM-DAT International Disaster Database


Disaster-induced displacement worldwide in 2012
IDMC internal displacement monitoring centre
NRC NORWEGIAN REFUGEE COUNCIL
Events displacing over 100,000 people
All countries with new displacement
Countries with 50,000 people or more displaced
Countries with 1% of population displaced or more
China
Typhoon Haikui floods
2.1 million displaced
Monsoon floods (June/July)
1.4 million displaced
Twin typhoons Saola & Damrey
867,000 displaced
Typhoon Kai-Tak
530,000 displaced
Monsoon floods (April/May)
443,000 displaced
Earthquake in Yunnan
185,000 displaced
Typhoon Son Tinh
136,000 displaced
U.S.A.
Hurricane Sandy
776,000 displaced
Pakistan
Monsoon floods
1.9 million displaced
Bangladesh
Monsoon flooding
600,000 displaced
Chad
Rainy season floods
500,000 displaced
North Korea
Monsoon floods
212,000 displaced
Niger
Rainy season floods
530,000 displaced
Japan
Kyushu floods and landslides
250,000 displaced
Guatemala
Cuba
Hurricane Sandy
343,000 displaced
Dominican Republic
Haiti
South Sudan
Rainy season floods
340,000 displaced
Palau
Madagascar
Cyclone Giovanna
190,000 displaced
Indonesia
Papua New Guinea
Nigeria
Rainy season floods
6.1 million displaced
India
Monsoon floods (1st period)
6.9 million displaced
Monsoon floods (2nd period)
2 million displaced
Cyclonic storm Nilam
210,000 displaced
Peru
Floods
138,000 displaced
Worldwide
32.4 million
people displaced
Comoros
Philippines
Typhoon Pablo (Bopha)
1.9 million displaced
Southwest monsoon and typhoon effects
1.6 million displaced
Negros Oriental earthquake
187,000 displaced
Samoa
Fiji
www.internal-displacement.org
IDMC data version 30 April 2013
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by IDMC.

Bombay Extreme Rainfall on 26th July 2005 (944 mm – 24 hrs.)

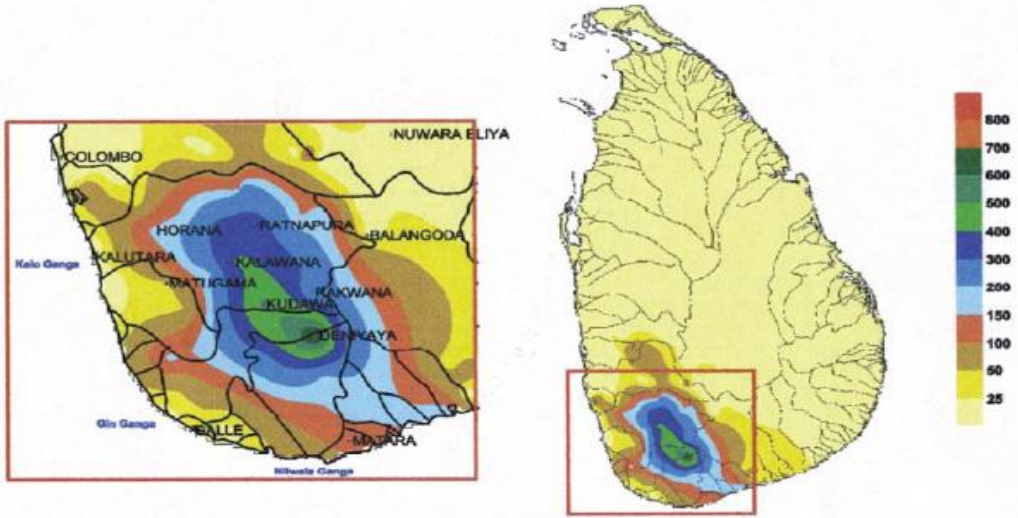




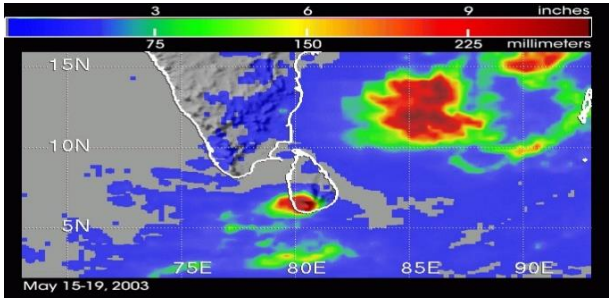


15 – 19 May 2003 Flood event in Sri Lanka

River -Basin Rainfalls



River basin-wise rainfall distribution on 17th May 2003



Climate Change's Devastating Effects

Impacts of Climate Change

THANK YOU
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