CLIMATE CHANGE FACTS

I. ATMOSPHERIC IMPACTS

1. GREENHOUSE GAS LEVELS

- Currently, the IPCC's worst-case scenario forecasts are being realized or exceeded, leading to a catastrophic 1000 parts per million of CO2 by end of century. To preserve the planet in a similar state as now, humankind must aim to reduce CO2 levels from the current 385 parts per million to a stabilized target of 350 parts per million.
- Carbon sinks are saturating and becoming carbon sources that add rather than absorb greenhouse gases:
  - Global plant growth is in a decade-long decline (2000-2009) due to climate change-induced stress from drought. *(Science, Aug 2010)*
  - The ocean has absorbed so much CO2 that it is acidifying at an alarming rate. *(University of Bristol researchers, in Nature Geoscience, 2010)*
- With just a 2-degree Celsius average global rise, billions of tons of methane could be released from the Arctic, leading to mass extinctions of life.

2. RISING TEMPERATURES

- **Without drastic action now, a worst-case scenario rise of 4 degrees Celsius, which means spread of deserts, collapse of the Amazon, and massive release of methane and CO2 gases from melted permafrost, will actually be reached as early as 2060, with a catastrophic warming of 5-7 degrees likely by century's end.** (UK Met Office, 2009)
- **Scientists report that the first eight months of 2010 have been the hottest on record globally.** (NASA, 2010)
- **2010 was also the year when unprecedented heat and high temperatures were recorded in 16 countries, the highest number ever, including Kuwait, Iraq, Saudi Arabia, Chad, Niger, Russia, Myanmar, and Pakistan.**
- In the past century alone, the temperature has climbed 0.7 degrees Celsius, at a rate 10 times faster than historic norms, due to human causes.
- The past ten years have seen the hottest average annual temperatures ever recorded in our planet's history. (US NASA, 2010)

- Without mitigation, much of the USA, for instance, by end of the century would have extreme temperatures of 122 degrees Fahrenheit (50 degrees Celsius). (Geophysical Research Letters paper, 2008)
- Pledges made by governments in Copenhagen to reduce greenhouse gases are not enough to avert runaway climate change. They would still lead to a dangerous temperature increase of more than 3 degrees Celsius. (US Massachusetts Institute of Technology (MIT), 2010)

II. BIODIVERSITY IMPACTS

- **The RATE OF BIODIVERSITY LOSS is an astounding 1,000 to 10,000 times higher than a natural background extinction rate.**
  "The current rate of species extinction far exceeds anything in the fossil record." (Philosophical Transactions of the Royal Society B (Biological Science))
  Ecosystems may be headed towards permanent damage as countries fail to achieve goals to protect animal and plant life. (UNEP, 2010)
- Up to 270 unique species are now being lost every day.
- The Earth is said by some experts to be undergoing her "sixth great extinction event" due to climate change as well as other mostly human-caused factors.
- As global average temperature increase exceeds about 3.5 degrees Celsius, there may be extinctions of up to 70% of species around the globe. (IPCC)

New 2010 reports on species affected:

- Antarctic penguin populations declined more than 80% since 1975 due to loss of sea ice.
- Arctic caribou are in steep decline due to climate change-caused starvation as early thaws and freezing over events make plant food inaccessible.
- Similar to 2007 and 2009, in September 2010, tens of thousands of walruses came ashore in an unusual behavior, due to lack of sea ice where they normally rest.
- Migratory birds dying because of ill-timed travel that leaves them without adequate food supplies when they arrive at destinations and/or places like wetlands drying that no longer provide habitat.

III. LAND & ICE CAP IMPACTS

1. DROUGHT & DESERTIFICATION

- **Within 50 years, there could be irreversible drought (permanent desertification) in the southwestern US, Southeast Asia, Eastern South America, Western Australia, Southern Europe, Southern Africa, and northern Africa.** (National Oceanic and Atmospheric Administration (NOAA), 2009)
- The percentage of Earth's land area gripped by severe drought more than doubled from the 1970s to the early 2000s. (Dai, 2004)
- **Examples of recent regional droughts:**
  - **China**'s northern region, where 10-meter deep cracks began to appear in fields. Without drastic changes in water use, there could be tens of millions of environmental refugees from China appearing within the next ten years. (Sept 2010)
  - Having just faced historic floods in 2009 due to a record rise in Amazon River water levels, several communities in **Brazil**'s Amazonas state have been isolated by drought and can no longer be accessed by boat, only by foot through the forest. (Sept 2010)
  - **Iraq, China, Chad, Australia, Mongolia, Africa's Sahel region**, among others, have been suffering drought conditions in 2010.

2. EXTREME WEATHER EVENTS

- Extreme weather events are becoming more intense and more frequent. (IPCC 2007)

Some of 2010's major disaster events:

- **Russian heat wave and fires.** The summer 2010 heat wave as well as the polluted air from the forest fires caused fatalities in Moscow to double to a total of 700 people per day. (Russian Academy of Sciences) City officials of Moscow, Russia reported a 60% increase in the mortality rate this past summer, when nearly 11,000 of the city's inhabitants perished due to the effects of excessive smog and record high temperatures.
- **Pakistani floods.** Massive floods, the worst in nation's history, result in about 2,000 fatalities, more than 20 million injured or homeless. One-fifth of country was underwater.
- **Chinese landslides.** Nationwide floods and landslides leave over 3,100 killed and over 1,000 missing in 2010 alone. Floods across China increased sevenfold since the 1950s.
- **Brazil** was also struck by extreme heavy floods in April and June 2010 with hundreds of fatalities each time.
- **Poland** suffered her worst flooding in decades in May 2010.
- Forest fires raged in **Portugal** in summer 2010, spurred on by low humidity levels, strong winds, and temperatures reaching record highs of 40 degrees Celsius.

- In **Chad and Nigeria** in 2010, drought then floods that wiped out the small amounts of food crops left after the drought.
- **Extreme cold and snow storms** in 2010 in India, Northern Europe, North America, and South America
- **A lot of earthquakes and volcano activity** in 2010 disrupted Indonesia, Iceland, Turkey, Chile, Haiti, etc.
- **Global warming can cause ice-capped volcanoes like Iceland's Eyjafjallajökull to more easily erupt due to the ice loss causing a release of pressure on the hot rocks beneath the Earth's surface.** (Philosophical Transactions of the Royal Society A, 2010)
- **Landslides and avalanches in high mountains have increased over the past decade due to global warming. Volcanoes are increasingly at risk of collapse with mega-landslides that could bury cities.** (David Pyle, a volcanologist at the University of Oxford, Bill McGuire of University College London and Rachel Lowe at the University of Exeter, UK)
- **Glacial lake outburst floods are increasing as lakes from glacial melt grow in number and size.** (International Centre for Integrated Mountain Development (ICIMOD) in Kathmandu, 2010)

3. FOREST DECLINE

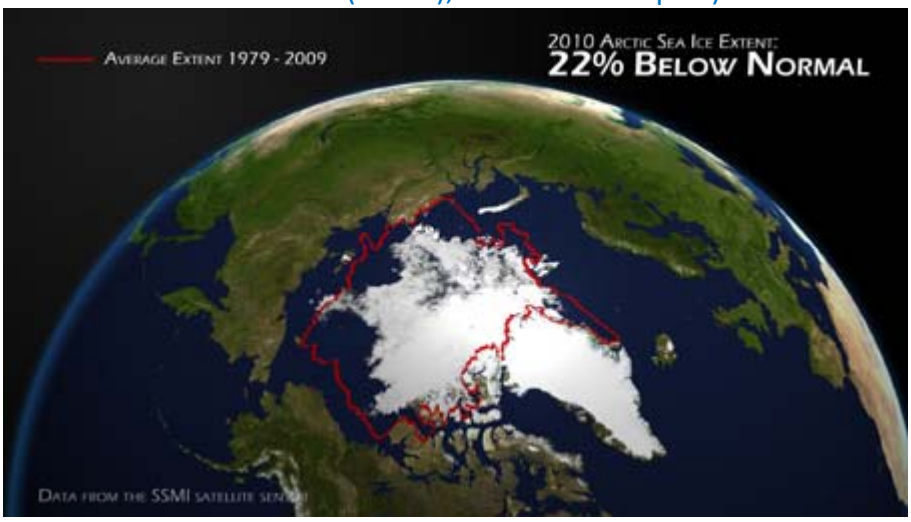
- **Africa had the second highest net annual loss of forests in 2000-2010**, with an alarming 3.4 million hectares that disappeared each year.
- **Deforestation** accounts for approximately 20% of all greenhouse gas emissions.
- Trees absorb less carbon as climate warms. Forests could even start to release huge amounts of CO2 from trees and soil (Proceedings of the National Academy of Sciences, 2003. Finnish Environment Institute, 2010) They already do release CO2 in huge amounts through forest fires.
- Bark beetle infestations in North American forests are spreading with global warming and turning forests into carbon emitters. (*Nature,* 2008)

4. ICE: ARCTIC & ANTARCTIC WARMING

- **Atmospheric methane in the Arctic has spiked sharply upward, increasing 33% in just 5 years.** (Paul Palmer, a scientist at Edinburgh University, 2010) Melting permafrost in Siberia is releasing five times the amount of methane than was previously thought. (Dr. Katie Walter, 2006) **The East Siberian Arctic Shelf**'s shallow undersea permafrost is also showing instability and releasing significant amounts of methane. (Professor Igor Semiletov, head of the International Siberian Shelf Study (ISSS), University of Alaska at Fairbanks, USA, 2010) The Arctic tundra is already emitting significantly more methane

and nitrous oxide than previously estimated. (Professor Greg Henry, University of British Columbia) Some scientists are calling the thawing Arctic a "ticking time bomb."

- **This year's summer Arctic sea ice was at its third smallest area on record, with all three most shrunken area events occurring within the past four years.** (US National Snow and Ice Data Center (NSIDC), 2010 annual report)



- **Current warming makes it unlikely that the Arctic will return to its previous conditions.** (National Oceanic and Atmospheric Administration's (NOAA) Arctic Report Card 2010 Update, USA)
- **In winter 2009-2010, Arctic warming brought severely cold winds and heavy snow to eastern North America and eastern Eurasia.** (Dr. James Overland of the NOAA/Pacific Marine Environmental Laboratory, USA, 2010)
- **Overall warming has extended the annual melting period for Arctic sea ice to 20 days longer now than three decades ago, meaning more heat can be absorbed by the Arctic sea, and big impacts on marine ecosystems and North American climate**. (NASA 2010)
- **Due to disappearing ice, polar explorers were able for the first time to journey around the North Pole in a small fiberglass sailing boat, a feat that would have been impossible even 10 years ago without an ice-breaker ship because the passages were sealed with ice.** (Norwegian polar explorer Borge Ousland, voyage started in June 2010)
- The Arctic is warming at twice the rate of anywhere else on Earth.
- The Arctic sea ice cover in 2007 was the lowest ever recorded and the Northwest Passage was navigable for the first time. Only 10% now is older and thick ice, while over 90% is newly formed and thin. Scientists forecast a completely ice-free summer as soon as 2012 or 2013.
- Without the protective ice to reflect sunlight, 90% of the sun's heat can enter the open water, thus accelerating global warming.
- **The world's two major ice sheets, GREENLAND AND ANTARCTICA,** are now melting at accelerated rates, whereas before 2000, they were thought to be stable.

- In fact, **Greenland is seeing its worst ice melt and glacial area loss in at least five decades.** (National Oceanic and Atmospheric Administration's (NOAA) Arctic Report Card 2010 Update, USA) Glaciers have recently doubled or tripled their movements toward the sea. (Ian Joughin, University of Washington , 2010) **"Icequakes" caused by breaking icebergs have more than tripled since 1993.** (Göran Ekström and Meredith Nettles, Columbia University, USA, 2010) The possible, complete loss of the Greenland Ice Sheet would result in a 7-meter sea level rise.
- **Melt water speeding the Greenland Ice Sheet melt could cause its disintegration over decades rather than centuries, as previously forecast.** (Cooperative Institute for Research in Environmental Sciences (CIRES) in Colorado, USA)
- **On August 5, 2010, one-quarter of Greenland's Petermann Glacier, four times the size of New York's Manhattan Island and the largest in nearly half a century, broke off.** "The freshwater stored in this ice island could keep the Delaware or Hudson rivers flowing for more than two years," said Professor Andreas Muenchow of the University of Delaware.
- **On the Antarctic Peninsula, 99% methane gas has been seen continuously bubbling up in certain areas of the water's surface.** (Argentine geologist Dr. Rodolfo del Valle)
- A major review published in 2009 found that especially **Antarctica**'s ice shelves on the Western Peninsula are retreating at an ever-accelerating rate, speeded by warming waters beneath the shelves.
- Over 2008, the Wilkins Ice Shelf on the Western Antarctic Peninsula disintegrated. In 2002, the vast 12,000-year-old Larsen B Ice Shelf took only three weeks to disintegrate entirely.

5. ICE: GLACIER MELT

- **More than 46,000 glaciers and permafrost expanses are thawing rapidly in "the Third Pole," the Earth's 3rd largest store of ice after the Arctic and Antarctic, located on the Tibetan plateau and Himalayas. Known as "Asia's water tower," the region's glacial retreat could affect more than 1.5 billion people across 10 countries.** (Third Pole Environment program led by Chinese Academy of Sciences, 2010)
- **With Bolivia's 18,000-year-old Chacaltaya Glacier already gone, other South American Andean glaciers could disappear within a few decades.**
- **Kyrgyzstan's glaciers are receding 3 times as fast as 1950s, or as much as 50 meters per year. 95% of the glaciers could be gone by the end of the century.** (Institute of Hydro Energy at the National Academy of Sciences in Bishkek, Kyrgyzstan)
- **Africa's Mount Kilimanjaro has lost 85% of its glacier cover since 1912 and could be completely gone in 20 years.** (Proceedings of the National Academy of Science, 2009) **The US' Glacier National Park is set to be glacier-free by 2020, 10 years earlier than previously forecast.** (US Geological Survey, 2009)

IV. HUMAN IMPACTS

1. CLIMATE REFUGEES

- There are an estimated 25-30 million climate refugees. Numbers may increase to 200 million, or up to 1 billion, by 2050.
- **Nepal's first "climate refugee village" of 150 people is being resettled due to climate change-induced water shortage.** (July 2010)

2. CONFLICT.

- **The US intelligence community considers global warming as a serious security threat. Top US intelligence analyst Thomas Fingar indicated that floods and droughts will soon cause mass migrations and unrest in many parts of the world.** (2010)
- Evidence points to global warming as a primary cause of the violence in Darfur. (*Atlantic Monthly,* 2007)

3. DISEASE.

- Warmer temperatures are causing the spread of malaria, Bluetongue virus, West Nile virus, dengue fever, and other diseases to reach millions more people never before exposed to them, in higher latitudes or on new continents.
- An additional 400 million people could be exposed to malaria by 2080 due to climate change. (UN)
- More respiratory diseases (like asthma) and mental illnesses (related to disasters) are expected with global warming.

4. MORTALITY.

- Climate change disasters are already responsible for some 315,000 deaths a year, with another 325 million people severely affected. (Global Humanitarian Forum , 2009)

5. SHORTAGE: FOOD

- **Half the world's population will face serious food shortages within the century.** (University of Washington researchers, in Science, 2009)
- **Harvests already distressed by drought or floods in Russia, Germany, Canada, Argentina, Australia, Ukraine, Pakistan, etc.** (Sept 2010)
- **Food prices** rose 5% globally in August 2010. In Mozambique, food riots in response to raised bread prices led to 10 fatalities and 300 injuries. (Sept 2010)

- High food prices that sparked deadly 2008 food riots worldwide were due to a combination of climate change and increased demand for animal feed from populations in India and China. (UN World Food Program)
- The number of people suffering from hunger exceeded 1 billion for the first time in 2009.
- Over 9 million people die worldwide each year because of hunger and malnutrition. Five million are children.

6. SHORTAGE: WATER

- **The world's rivers are in a "crisis state" on a global scale. Water supplies for nearly 80% of the world's populations are highly threatened. Nearly a third of sources studied are also highly jeopardized by biodiversity loss.** (US researchers Professor Peter McIntyre of the University of Wisconsin-Madison and City College of New York modeler Charles Vörösmarty)
- **Recent regional reports on water shortage:**
  - **The Middle East's water supply has shrunk to a quarter of its 1960 level.** (Arab Forum for Environment and Development (AFED), 2010) **The Tigris and Euphrates rivers dropped to less than a third of their normal levels due to drought.** (UN Inter-Agency Information and Analysis Unit (IAU))
  - **UK's increasingly hotter, drier summers could cause extreme water shortages as river flows are reduced by 80%.** (Britain's Government Office for Science, 2010)
- Sources of groundwater for wells, which support half our world's population, are running dry. (Lance Endersbee, Monash University, Australia)
- 1.1 billion people lack access to safe drinking water. (World Health Organization, 2005)

V. OCEAN IMPACTS

1. ACIDIFICATION

- **Oceans are acidifying 10 times faster now than 55 million years ago when a mass extinction of marine species occurred.** (University of Bristol researchers, in *Nature Geoscience*, 2010)
- **If emissions aren't stopped, a mass marine extinction is possible by the end of the century with degraded coastal waters and outbreaks of toxic algae and jellyfish.** (Geological Society of London, 2010)

2. DEAD ZONES

- **Oxygen-depleted dead zones caused by global warming can remain for thousands of years.** (Shaffer et al. in *Nature Geoscience*, 2009) Climate change, as well as agricultural run-off, is causing new and larger low-oxygen dead zones. Now well over 400 in number and usually along coasts, dead zones have been doubling every decade since the 1960s. (*Science,* 2008)
- Toxic algae growth could become a tipping point. **In the Baltic Sea, record high temperatures in summer 2010 led to an immense patch of algae the size of Germany, and spreading.** Toxic algae infestations are occurring with ever greater frequency in both inland and ocean waters worldwide.

3. CORAL BLEACHING

- **In Southeast Asia and the Indian Ocean, experts are reporting coral bleaching in 2010 as the worst since 1998, when a similar event caused 16% of the world's coral reefs to perish.** (Australian Research Council (ARC) Centre of Excellence for Coral Reef Studies)

4. OCEAN CIRCULATION

- **Over the next century, the Atlantic Ocean circulation might slow to a stop or reverse due to large amounts of melted freshwater changing the ocean's salt concentration. Such an event could trigger an Ice Age in Europe and North America.** (Woods Hole Oceanographic Institution, 2003)

5. OCEAN WARMING

- **An estimated 90% of the heat from greenhouse gases over the past 50 years has been absorbed by the oceans, all the way to the deep ocean floor.** If the heat currently being poured into the deep ocean were to stay in the atmosphere instead, our ambient temperature would rise at a rate of 3 degrees Celsius per decade. The Antarctic Ocean has the strongest deep warming, and is adding to sea level rise as well, both through expansion and the melt of land ice into the ocean. (Sarah Purkey, an oceanographer at the University of Washington, USA)
- Frozen methane from beneath the ocean floor could be released in massive amounts if the oceans are warmed enough, thus leading to further catastrophic warming. Sudden explosive releases of methane could also trigger 15-meter tsunamis. At the current rate, sea temperatures could increase by as much as 5.8 degrees Celsius by 2100. (*The Royal Geographical Society*. Dr. Mark Maslin, Senior Reader in Geography at University College London and a senior researcher for the London Environmental Change Research Centre, 2005)
- The ocean temperature is rising 50% faster than previous 2007 estimates.

6. PHYTOPLANKTON LOSS

- Warming oceans caused a 40% decline in phytoplankton populations since 1950, which will have serious consequences. Phytoplankton not only provides crucial support to the marine ecosystem, it produces half the world's oxygen, and eliminates CO2. (Boyce et al. *Nature,* Jul 2010)

7. SEA LEVEL RISE

- Dr. John Holdren, president of American Association for the Advancement of Science, predicts a possible 4-meter sea level rise by end of the century, and Dr. James Hansen, NASA's head of Goddard Institute for Space Studies, has stated the likelihood of a 5-meter sea level rise by end of the century. (2006, 2007, respectively.)
- A sea level rise of even 1 meter would result in over 100 million climate refugees and endanger major cities like London, Cairo, Bangkok, Venice, New York, and Shanghai.
- **Examples of countries affected by sea level rise:**
  - ***Âu Lạc* (Vietnam). At the nation's rice bowl region, the Mekong Delta, ocean salt water has encroached an unprecedented 60 kilometers up-river in 2010, threatening 100,000 hectares of rice.**
  - **Thailand. Seawater is expected to reach Bangkok's ground level in 25 years.** (GEodetic Earth Observation Technologies for Thailand: Environmental Change Detection and Investigation, 2010)
  - **Egypt. More than 58 meters of coastline have vanished every year since 1989 in Rasheed.** (Omran Frihy of the Coastal Research Institute, 2010)
- Sea level rise caused at least 18 island nations to completely disappear while many more coastal areas are continually threatened. More than 40 other island nations are at risk from rising sea levels.
- Sea level rise threatens half of the world's population living within 200 kilometers of a coastline. Already, low-lying coastal regions and deltas see effects: 17 million in Bangladesh have fled their homes, mainly because of coastal erosion. Groundwater sources are contaminated by saltwater in Israel and Thailand, small island states in the Pacific and Indian Oceans and the Caribbean Sea, and in some of the world's major deltas, such as the Yangtze Delta and Mekong Delta.

VI. OTHER

- **Current global consumption patterns would require a second Earth.** Natural resources are currently being consumed at 1.5 times the capacity that Earth can provide. *("2010 Living Planet Report" by World Wildlife Fund)*
- **Tipping points could arrive suddenly.** Sudden shifts in the Earth's natural systems could arrive precipitously, without warning. *(Dr. Alan Hastings, professor at University of California, Davis in the USA and one of the world's foremost mathematical model experts)*

FINANCIAL COSTS

- **Damage from rising seas, floods and heat waves due to the loss of Arctic Sea ice will cost the sectors of agriculture, real estate and insurance up to US$24 trillion by 2050. Heat waves, flooding and other factors are already resulting in hundreds of billions of dollars lost annually.** (US Pew Environmental Group report)
- **Global losses due to natural disasters could triple to US$185 billion per year by 2100. Damage from climate change-related powerful cyclones could add to this up to US$58 billion annually.** (UN/World Bank joint report, 2010)
- In the 2009 Copenhagen climate change summit, nations approved a US$30 billion fund to help vulnerable countries cope with climate change impacts, plus agreed to provide US$100 billion per year from 2020.