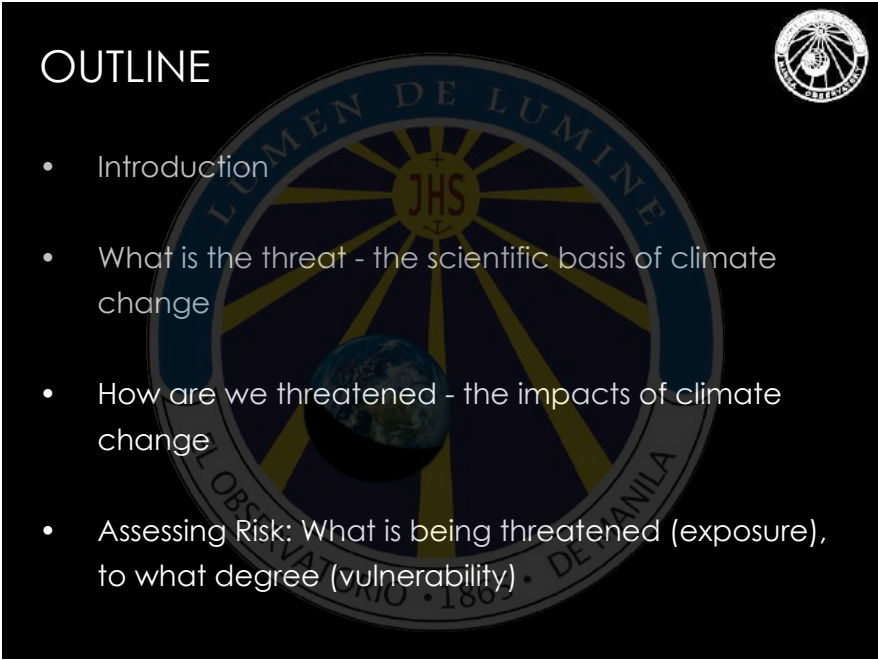


CLIMATE CHANGE: Science and Impacts

Gemma T. Narisma
Manila Observatory;
Ateneo de Manila University

<http://earthobservatory.nasa.gov>



OUTLINE

- Introduction
- What is the threat - the scientific basis of climate change
- How are we threatened - the impacts of climate change
- Assessing Risk: What is being threatened (exposure), to what degree (vulnerability)

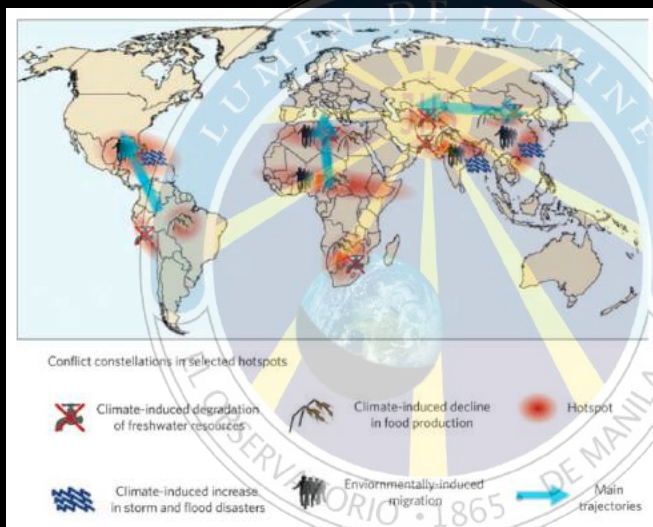
INTRODUCTION

Climate change:

- Resource scarcity
- Sea level rise
- Extreme weather events
- New health epidemics



Migration



“Policymakers must start to view mass migration as a form of adaptation so that the global response to climate-induced migration is one of facilitation rather than neglect”

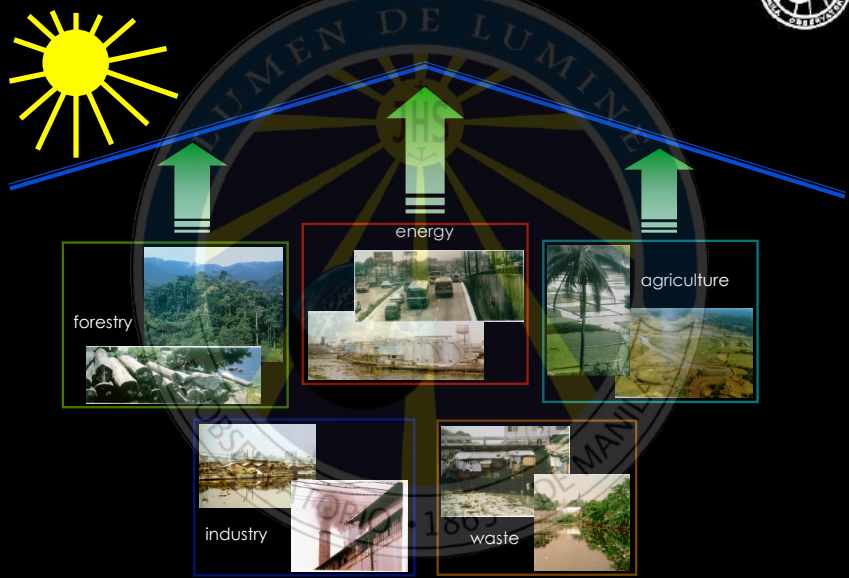
Range of threats



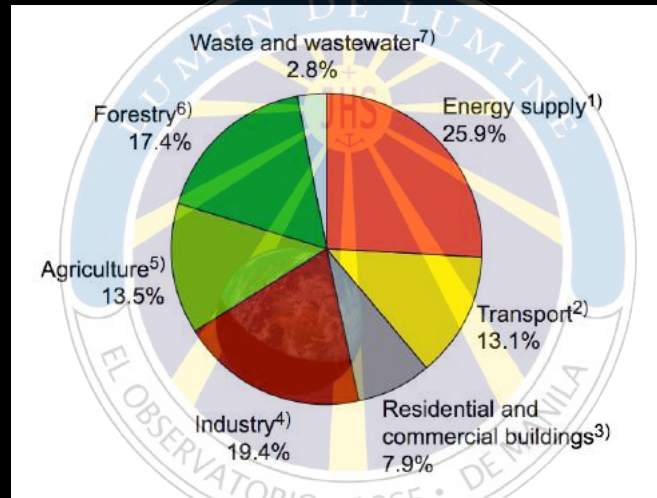
- By 2025 climate change will result in 1.4 billion people across 36 countries facing crop or water scarcities (WB)
- By 2050, 200 million people may be permanently displaced climate migrant
- Regional differences in agricultural production are likely to become more pronounced in developing countries by 2025
- Increasing sea levels, recurring floods or droughts could lead to a large scale displacement of population from small island states and flood prone nations

Mabey et al., 2011

GHG Emissions



GLOBAL GHG EMISSIONS

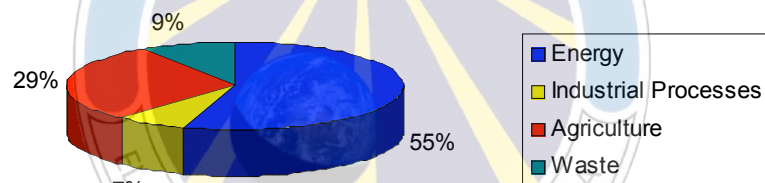


IPCC Fourth Assessment Report

LOCAL GHG EMISSIONS 2000



Overall GHG Emissions from non-LUCF Sectors

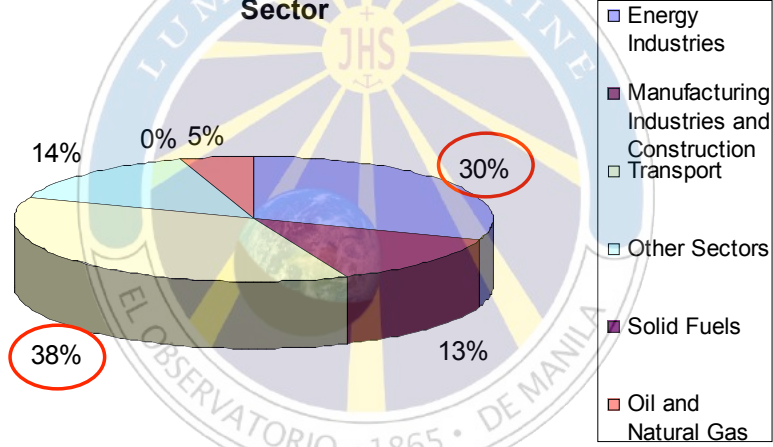


SNC, EMB-DENR with Manila Observatory

ENERGY SECTOR BREAKDOWN

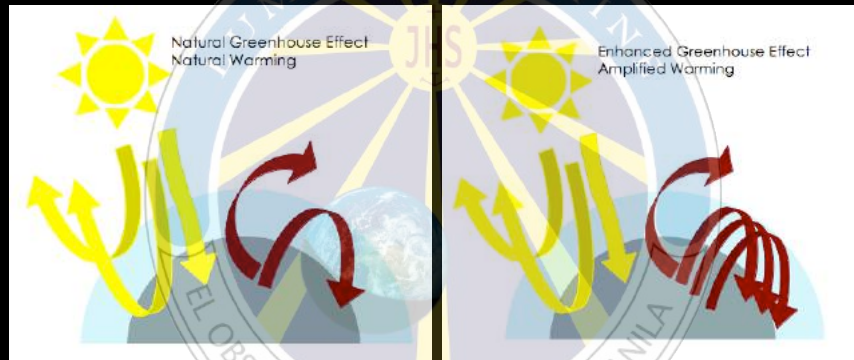


Energy Sector 2000 GHG Emissions Per Sub Sector



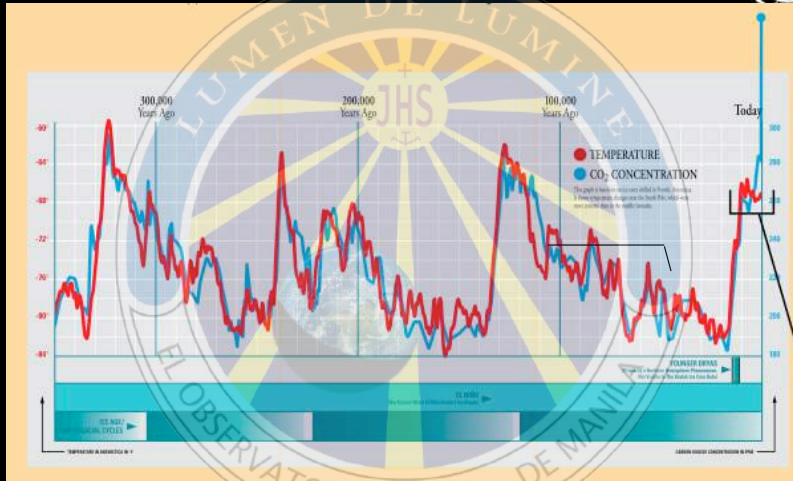
SNC, EMB-DENR with Manila Observatory

WHAT IS THE THREAT?



Villarin and Narisma, 2011

Concentrations to Temperature Increases

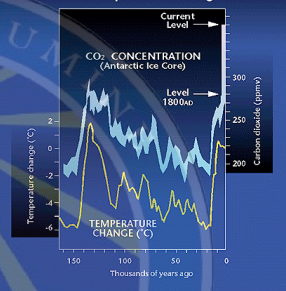


The National Academies, 2008

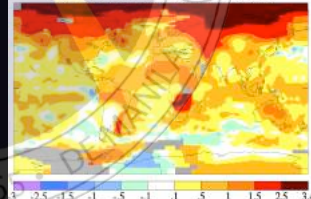
It is "very likely" that emissions of heat-trapping gases from human activities have caused "most of observed increase in globally averaged temperatures since mid-20th century."

Evidence that human activities are the major cause of recent climate change stronger than in prior assessments"

Atmospheric Carbon Dioxide Concentration and Temperature Change

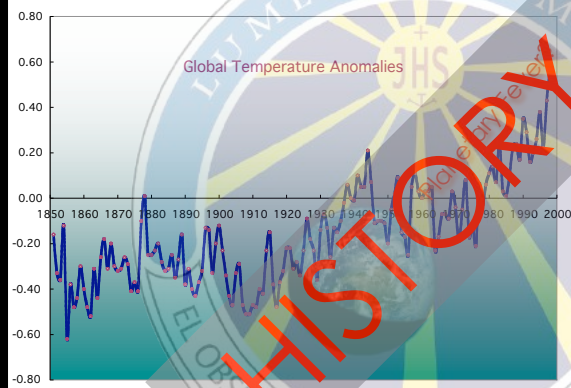


(b) 2005 Surface Temperature Anomaly (°C)



Climate Change: State of Knowledge, IPCC Fourth Assessment Report

Global warming



9 of 10 warmest records occurred in past decade

1990s hottest decade, 1998 hottest year

Data Source: Jones et al., 2000. Data archived at <http://cdiac.esd.ornl.gov>

NASA Research Finds 2010 Tied for Warmest Year on Record

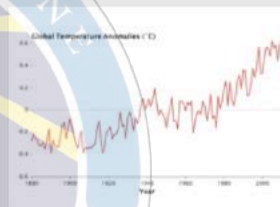


NASA Research Finds 2010 Tied for Warmest Year on Record

01.12.11

WASHINGTON -- Global surface temperatures in 2010 tied 2005 as the warmest on record, according to an analysis released Wednesday by researchers at NASA's Goddard Institute for Space Studies (GISS) in New York.

The two years differed by less than 0.018 degrees Fahrenheit. The difference is smaller than the uncertainty in comparing the temperatures of recent years, putting them into a statistical tie. In the new analysis, the next warmest years are 1998, 2002, 2003, 2006, 2007 and 2009, which are statistically tied for third warmest year. The GISS records begin in 1880.



In 2010, global temperatures continued to rise. A new analysis from the Goddard Institute for Space Studies shows that 2010 tied with 2005 as the warmest year on record, and was part of the warmest decade on record. Credit: NASA/Earth Observatory/Robert Simmon

[Download PDF](#)

2010 tied 2005 as warmest on record.

Next warmest years:

1998, 2002, 2003, 2006, 2007, and 2009

<http://www.nasa.gov/topics/earth/features/2010-warmest-year.html>

OUTLINE

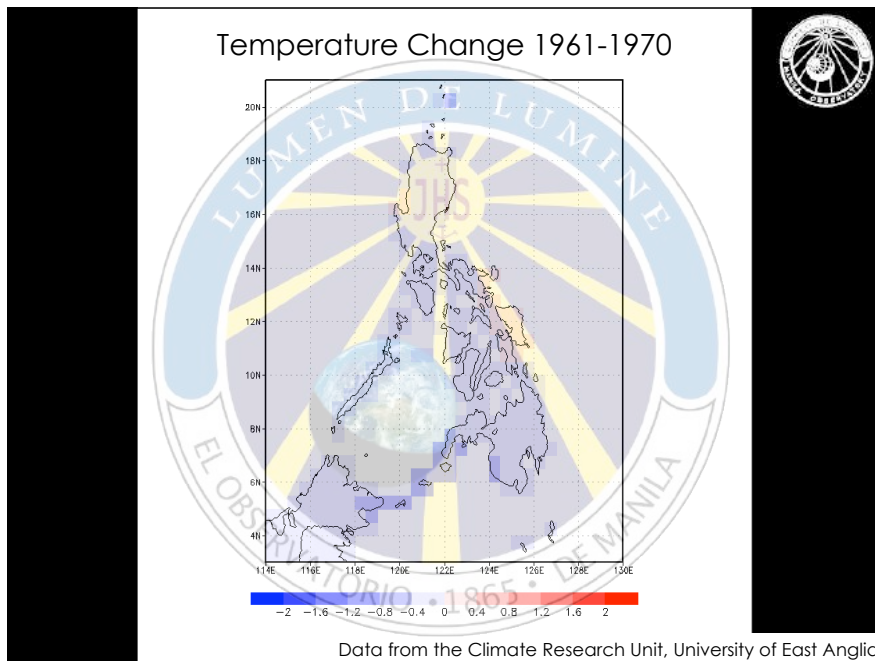
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Global Warming

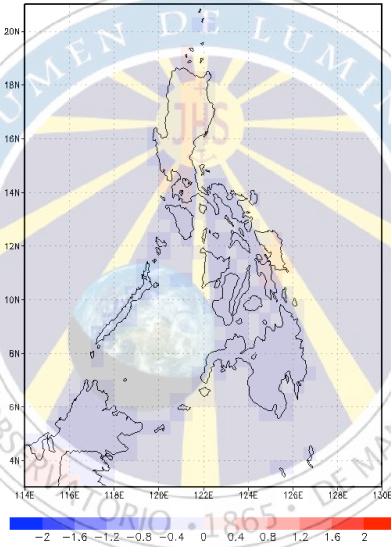


Climate Change
more than just
warming





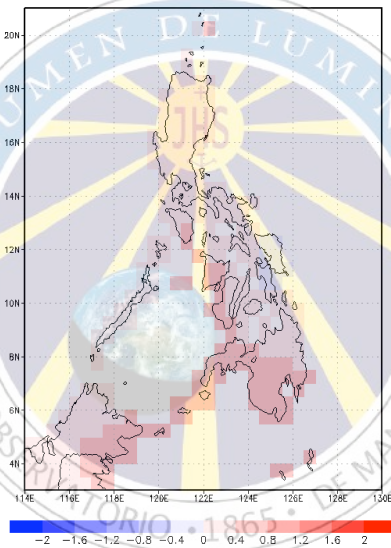
Temperature Change 1971-1980



Data from the Climate Research Unit, University of East Anglia



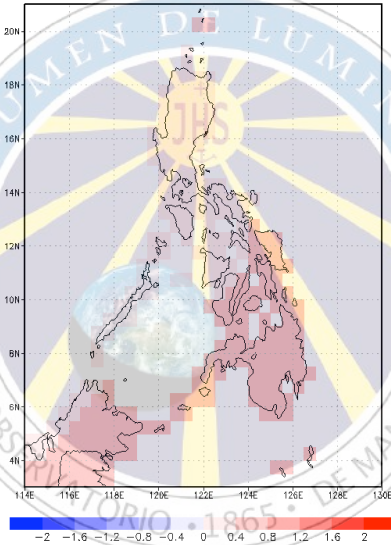
Temperature Change 1981-1990



Data from the Climate Research Unit, University of East Anglia

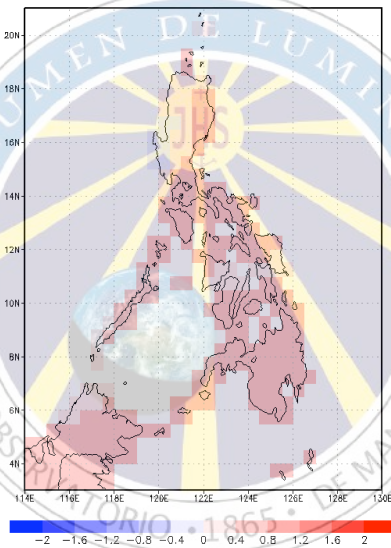


Temperature Change 1991-2000



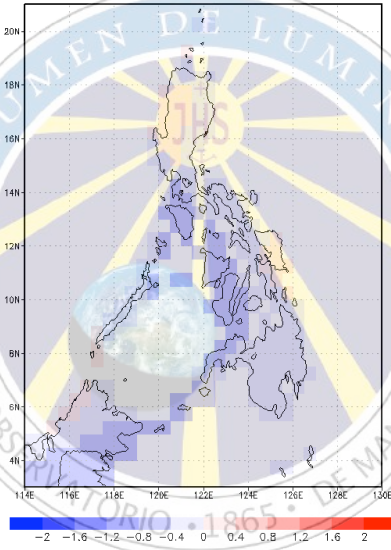
Data from the Climate Research Unit, University of East Anglia

Temperature Change 2001-2007



Data from the Climate Research Unit, University of East Anglia

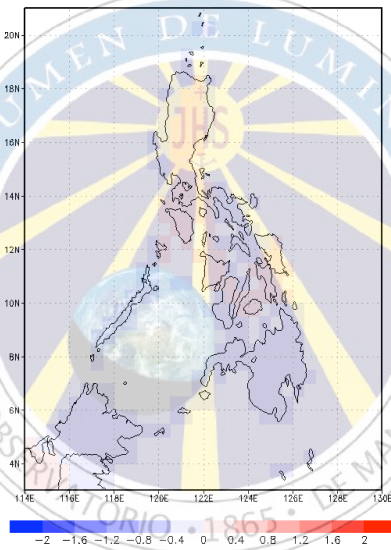
Minimum Temperature Change 1961-1970



Data from the Climate Research Unit, University of East Anglia



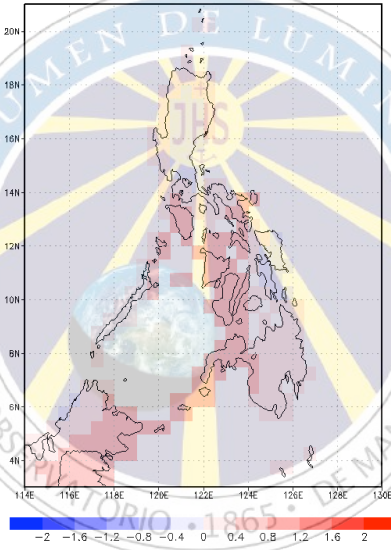
Minimum Temperature Change 1971-1980



Data from the Climate Research Unit, University of East Anglia

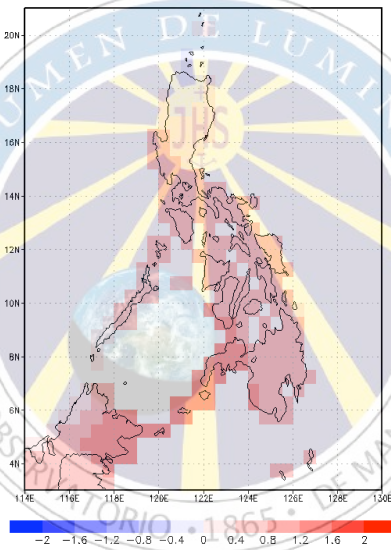


Minimum Temperature Change 1981-1990



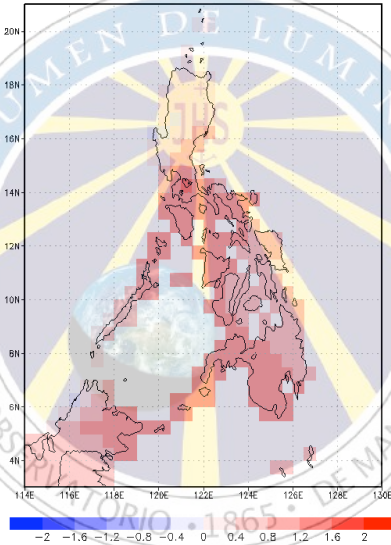
Data from the Climate Research Unit, University of East Anglia

Minimum Temperature Change 1991-2000



Data from the Climate Research Unit, University of East Anglia

Minimum Temperature Change 2001-2007



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WARMER WORLD

precipitation concentrated into more intense events

longer periods of little precipitation in between

Intense, heavy downpours interspersed with longer relatively dry periods.

Modelling studies: future tropical cyclones could become more severe, with greater wind speeds, more intense precipitation.”...

EFFECTS OF CLIMATE CHANGE

Phenomenon	Likelihood
Warmer days. Less cold days/nights	Virtually certain
More warm spells and heatwaves	Very likely
More heavy rain events	Very likely
More areas hit by drought	Likely
More intense tropical cyclones	Likely
More extreme sea levels (not tsunamis)	Likely

Climate Change 2007: Working Group I: The Physical Science Basis

WARMER WORLD

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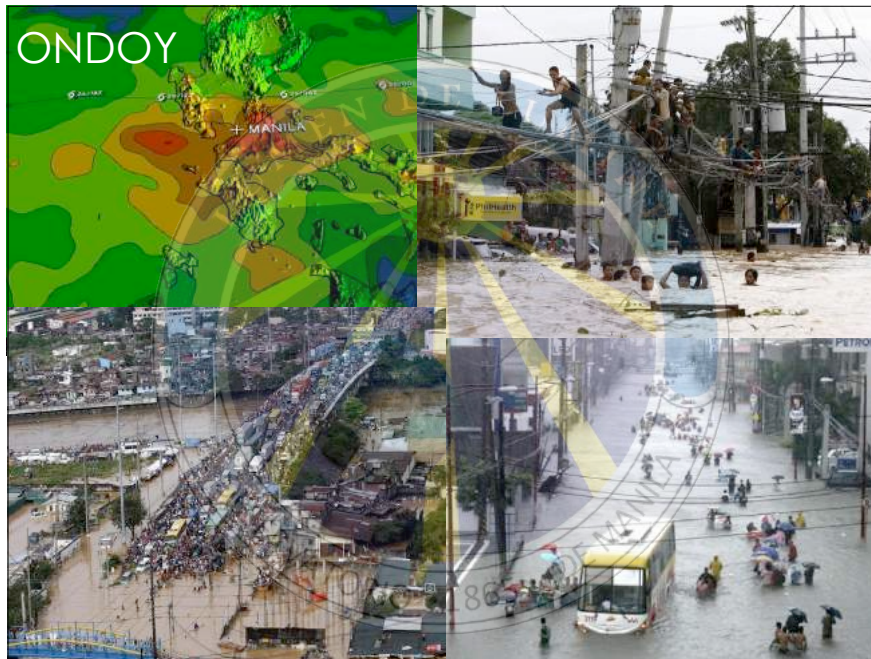
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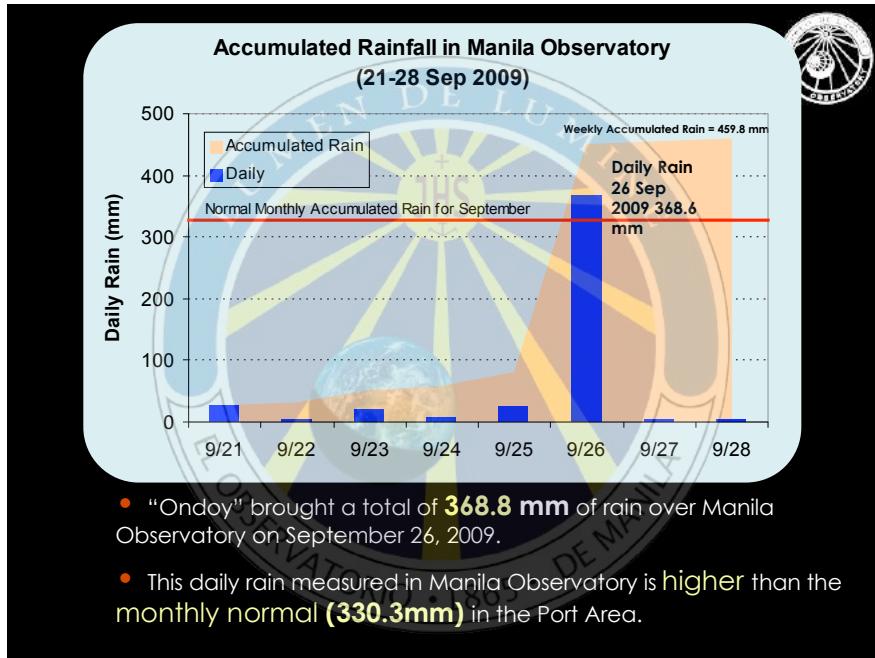
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Climate Change 2007: Working Group I: The Physical Science Basis





Manila Bulletin
1998



10.6 hectares of M. Manila flood-prone

Metro Manila, or what used to be called the "Greater Manila Area," has been having floods for at least a century, but until now the problem has not been solved.

Not even the American regime that ruled the country for over 40 years was able to check the annual rainy season

At present, 16.67 percent of Metro Manila's 63,600-hectare total land area — about 10,600 hectares — is flood-prone.

However, Fano said, there are natural and man-made factors contributing to the flood problems. The usual 20 tropical cyclones or typhoons entering the Philippines yearly induce about 5,000 millimeters of

The DPWH estimated that 40 kilometers of the original *esteros* have been built over or filled.



WHY THE WORSENING FLOODS?



1. "Missing" rivers
2. River channel capacities decreased by encroaching structures, fishponds
3. Increased siltation
4. Land subsidence
5. Garbage



DR. ANDO SIRINGAN, MSI

1. MISSING RIVERS



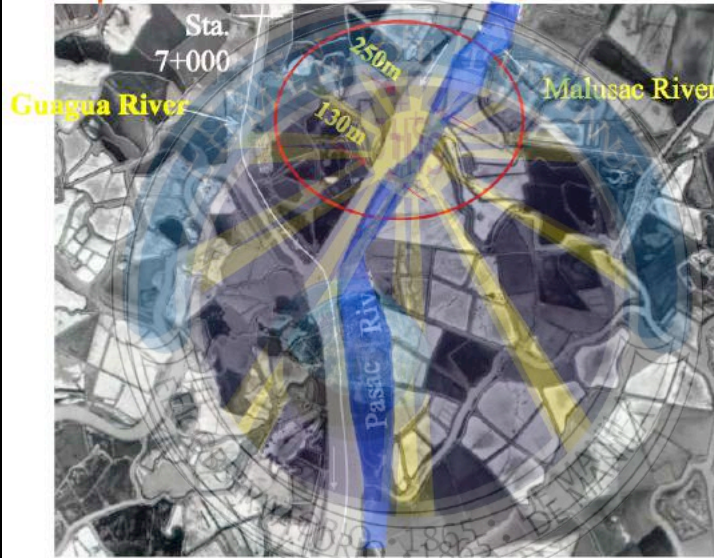
Slide Courtesy of: DR. ANDO SIRINGAN, MSI



Slide courtesy of: DR. ANDO SIRINGAN, MSI



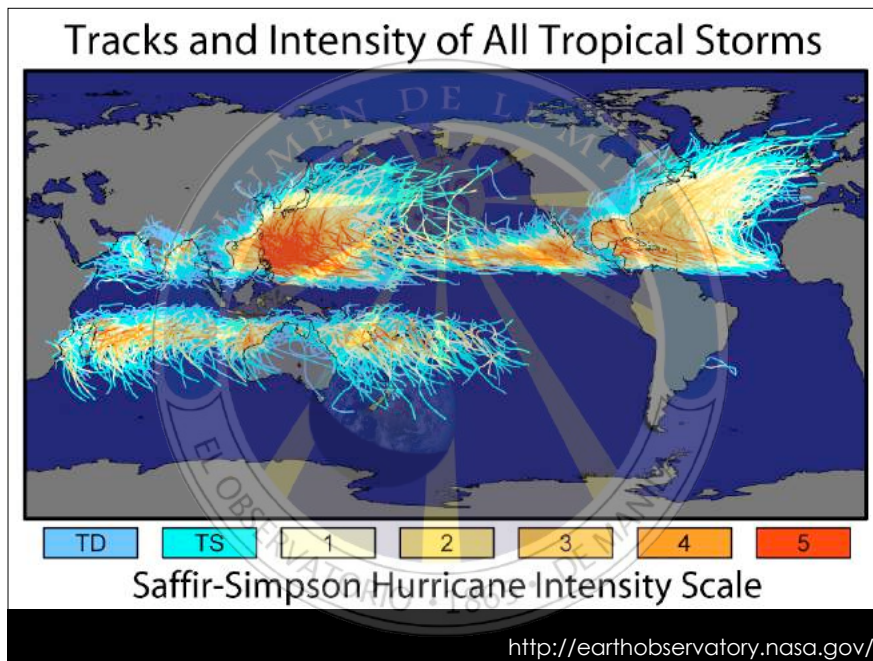
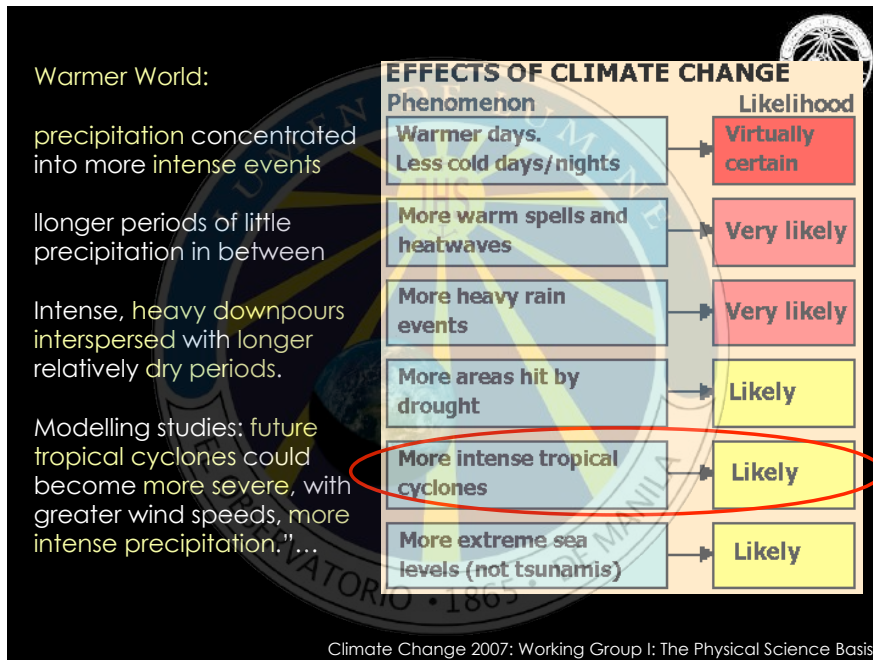
Fishpond encroachment (from DPWH)

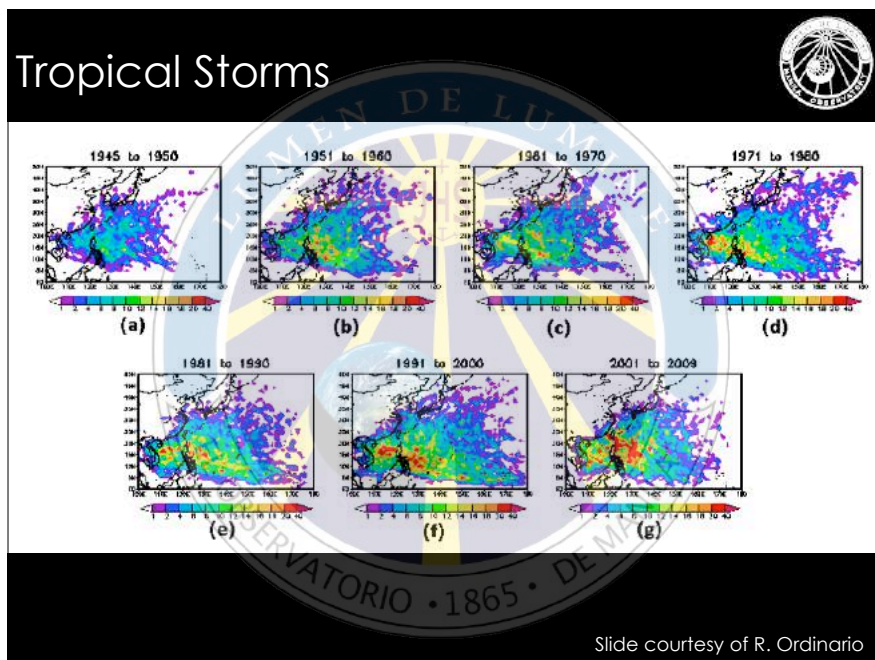
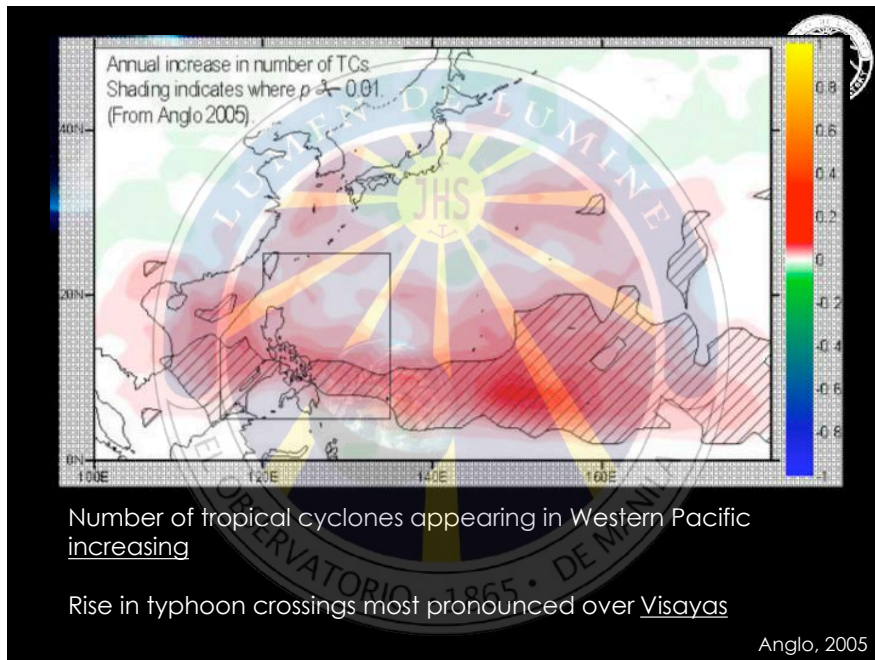


Slide courtesy of: DR. ANDO SIRINGAN, MSI



Slide courtesy of: DR. ANDO SIRINGAN, MSI







Typhoon Pedring damage surpasses Ondoy's

by Dharel Placido, abs-cbnNEWS.com

Posted at 10/07/2011 6:21 PM | Updated as of 10/07/2011 7:02 PM

Tweet 19 Recommend 45 +1 0

MANILA, Philippines – The damage caused by Typhoon Pedring (international name Nesat) last month has surpassed that of tropical storm Ondoy in 2009, the National Risk Reduction and Management Council (NDRRMC) said Friday.

Pedring's damage on infrastructure and agriculture has reached P12.34 billion, higher than Ondoy's P10.9 billion, NDRRMC data showed.

ONDOY: P10.90B PEDRING: P12.34B

Warmer World:

precipitation concentrated into more intense events

longer periods of little precipitation in between

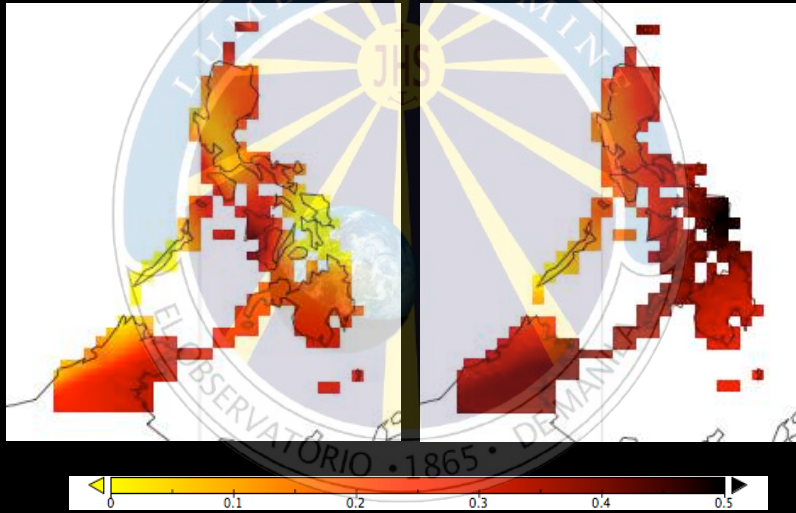
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OBSERVATION: TEMPERATURE CHANGE

1980s Decade - climate average 1990s Decade - climate average



IMPACT: Health

Higher temperatures

- shorter incubation period
- develop more rapidly
- capable of producing more offspring

MORE MOSQUITOS AT SHORTER TIME

FEED MORE FREQUENTLY



Climate change will fuel dengue - WHO exec

04/01/2008 | 03:44 PM

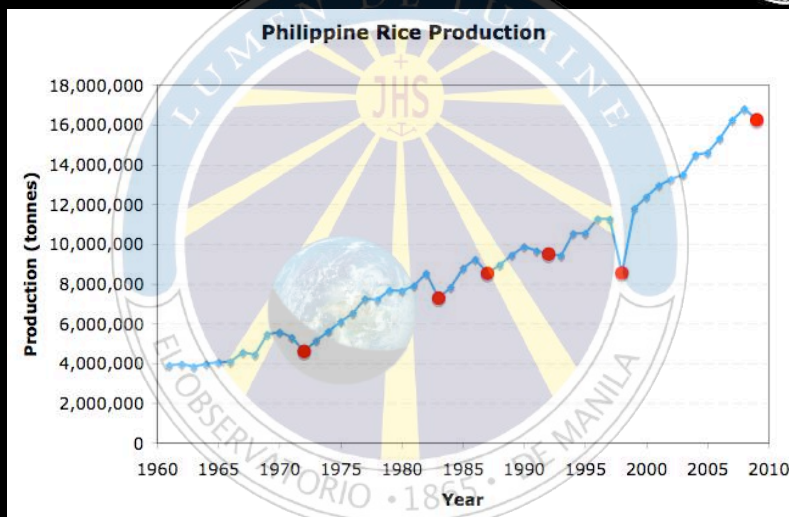
Recommend Send +1 0 Tweet 0

MANILA, Philippines - The World Health Organization on Tuesday warned that dengue would continue to ravage the earth's population because of climate change.

The warning was issued by John Juliard Go, a doctor and WHO's national officer for noncommunicable diseases, who added that by the year 2085, between 50 to 60 percent of the world's population will be exposed to dengue because of climate change.

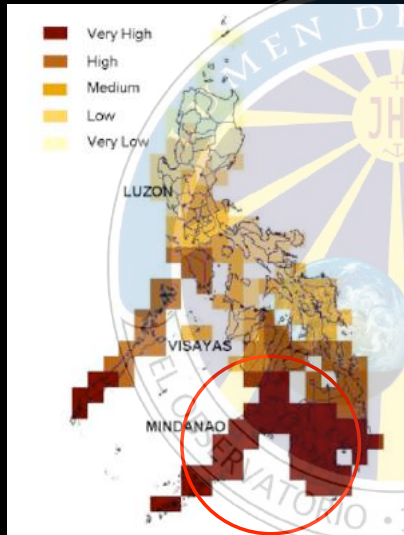
“At the height of the El Niño phenomenon in 1998, more than 35,000 Filipinos were diagnosed to have dengue. In that year, a surge in cholera, malaria, and typhoid fever was also monitored”

IMPACT ON AGRICULTURE



Source: Food and Agricultural Organization. <http://faostat.fao.org>

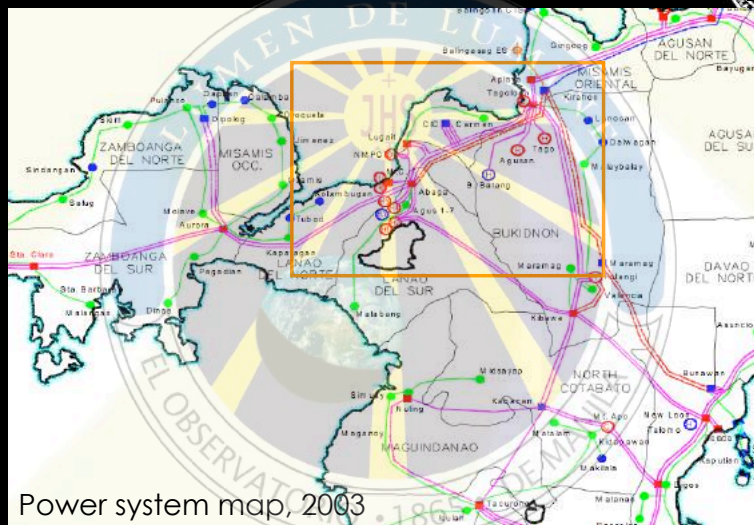
El Nino in Mindanao



Very high
El Niño impact
on rainfall in
Mindanao

Avila, Castillo, Villarín (Manila Observatory)

El Niño and Energy in Mindanao



Lasse Holopainen, PEMC 2005

IMPACT: ENERGY IN MINDANAO



2010 Mindanao Daily Brownouts

Davao City	1 hr
Iligan	2 hrs
Tagum City	2 hrs at least
General Santos	3 hrs total
Cagayan de Oro	4 hrs
Surigao del Sur	4 hrs
South Cotabato	6 hrs
Bukidnon	6 hrs
Kidapawan City	8 hrs total

Hydro-
generation
loss in 3 El
Ninos:
Php1.33B

MINDA NEWS, 15 March 2010

Warmer World:

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Climate Change 2007: Working Group I: The Physical Science Basis

IMPACT: Agriculture, Food security



1979-2003 LB minimum temperatures increased by more than 1°C

Each 1°C rise --> decrease in yield by 10% Peng et al(2004)



"Human beings are not going to adapt to climate change unless agriculture adapts."

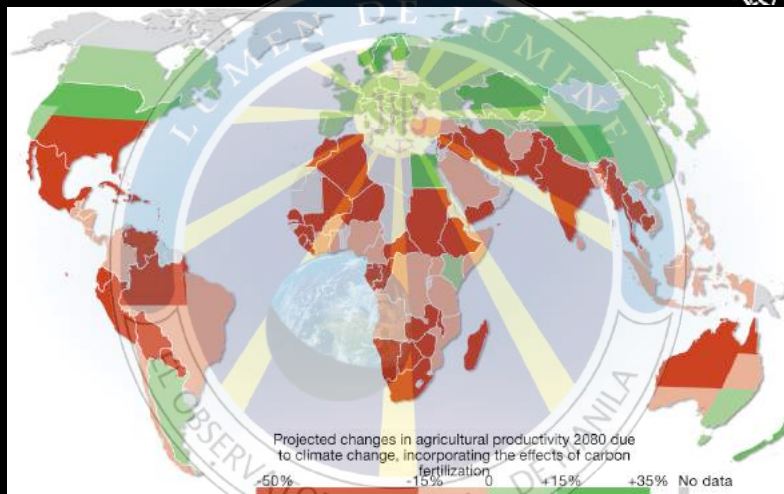
Cary Fowler

Executive director, Global Crop Diversity Trust

Scott Harrison, Community Water

Inquirer, NOAA, Caritas, Warwick and the Environment

Food Security



<http://maps.grida.no/go/graphic/projected-agriculture-in-2080-due-to-climate-change>

IMPACT: SEA LEVEL RISE

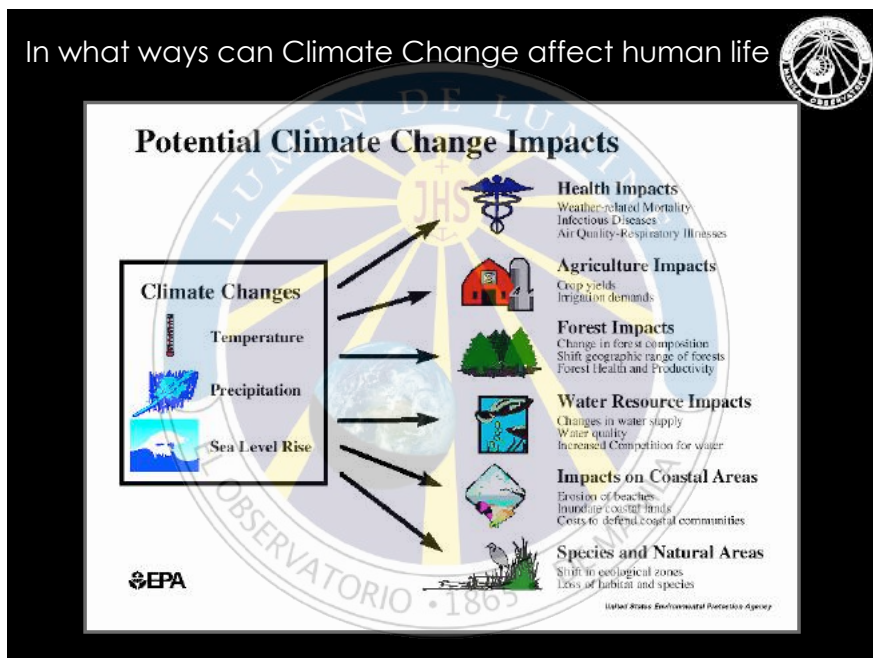
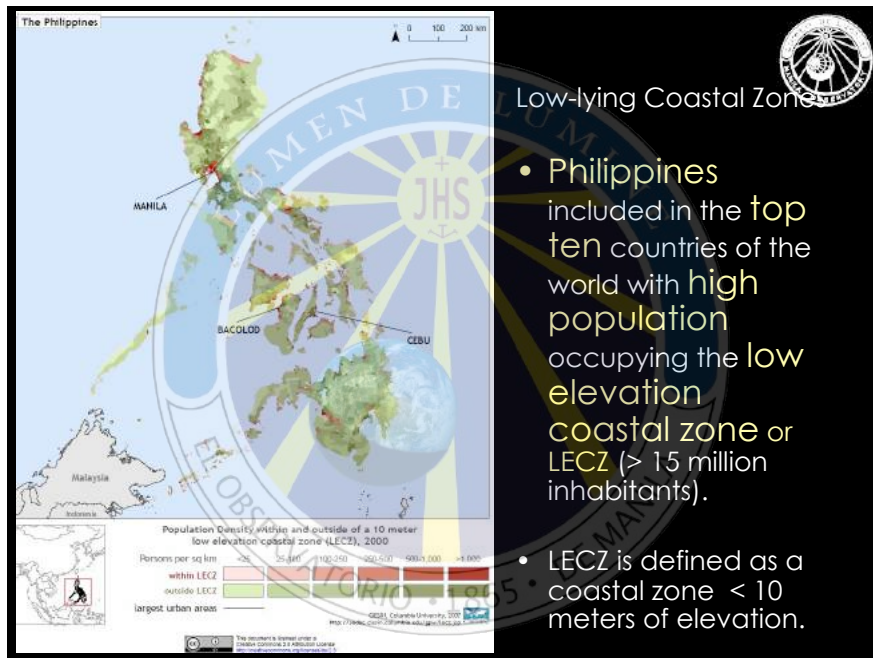


Galgana et al. 2004

IMPACT: SEA LEVEL RISE



Galgana et al. 2004



brisbanetimes.com.au

Check-in online at qatarairways
Available 36 hours before your flight
World's 5-star airline. qatarairways.com/p

National Times

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Of droughts, flooding rains and climate change

January 16, 2011

Join the conversation
You're the only person reading this now. Tell your friends

Tweet 1

We respond well to an emergency, but global warming is an emergency too.


LAST week, two leading US agencies, NASA and the National Oceanic and Atmospheric Administration, reported that 2010 was the wettest year on record. It was also a hot year, tying with 2005 as the hottest since data collection began in 1880.

Top National Times articles

1. In praise of artful bludgers
2. Countdown failure? You only

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RISK = HAZARD x EXPOSURE x VULNERABILITY


RISK Likelihood of harm, loss, disaster

HAZARD Physical impact of disturbance

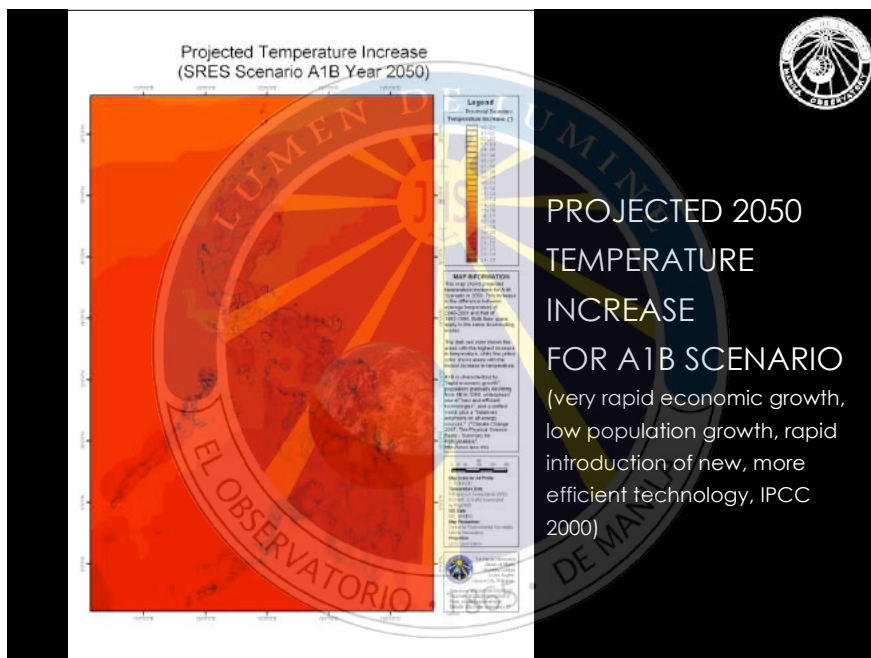
EXPOSURE Elements affected by hazard

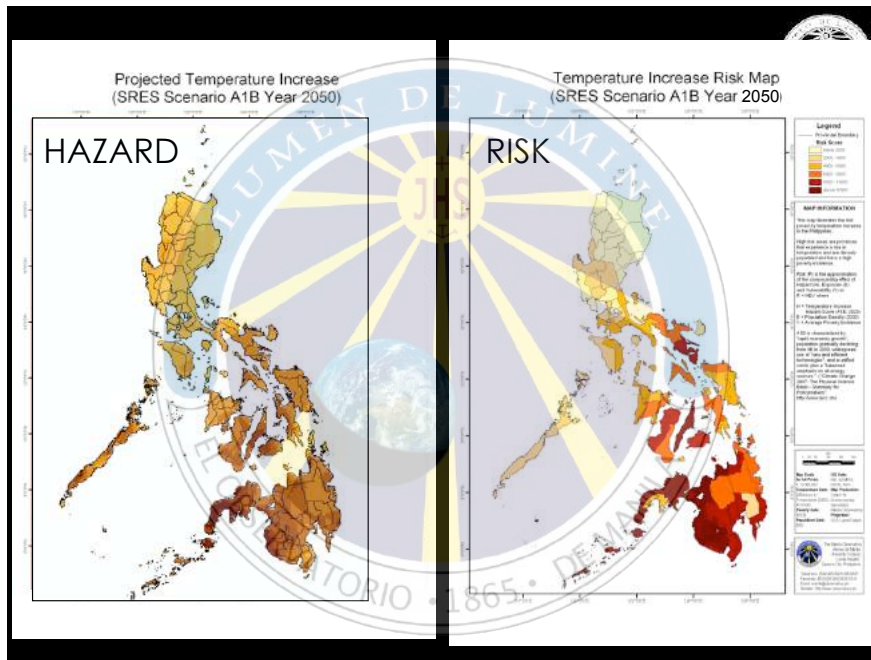
VULNERABILITY Susceptibility & capacity to prepare, absorb, & recover from hazard

Risk Lexicon



(UNDP and UNDRO, 1979)





What can we do about it: Mitigation



Low CARBon Diet

OFFICE DIET TIPS		
<i>Low Carbon Diet Tips</i>	<i>CO 2 Reduction</i>	<i>Equivalent CO2 Reduction</i>
Recycle office paper.	4 kilograms (for every kilogram of paper recycled).	4 kg of CO 2 is equal to saving 2 liters of gasoline.
Be sure to turn off lights in offices and conference rooms when they are not in use.	Hundreds of kilograms a year.	Equal to planting at least 44 trees.
Turn off office equipment when it is not needed at night or on the weekends.	Hundreds of kilograms a year.	Equal to planting at least 44 trees.
If your company's computers are on a network and can't be shut down at night, at least turn off the monitors.	About 45 kilograms a year.	45 kg of CO 2 is equal to saving 19 liters of gasoline.

LIFESTYLE-DIET TIPS		
<i>Low Carbon Diet Tips</i>	<i>CO 2 Reduction</i>	<i>Equivalent CO2 Reduction</i>
Unplug all unused appliances from their socket (any appliance that is in "standby" mode is still using up energy).	Hundreds of kilograms a year.	Equal to planting at least 44 trees.
Whenever practical, walk, bike and take public transportation instead of driving.	2 kilograms for every liter of gasoline you save.	2 kg of CO 2 is equal to saving a liter of gasoline.
Reduce waste.	450 kilograms a year (if you cut down your garbage by 25%).	450 kg of CO 2 is equal to having 150kg of waste recycled instead of landfilled.

What can we do about it: Mitigation



Villarin et al., 2008

Houses on stilt in
Candaba

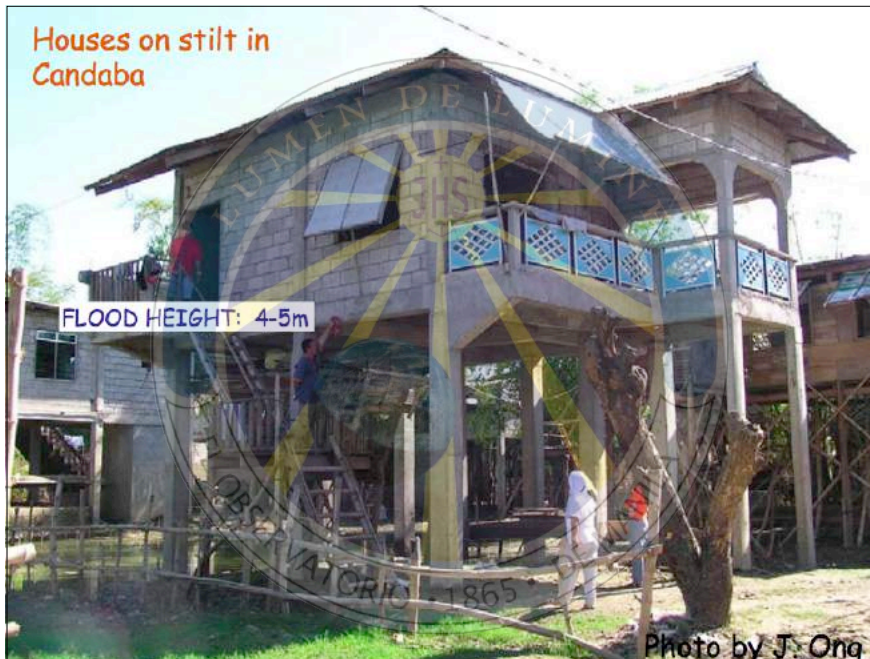
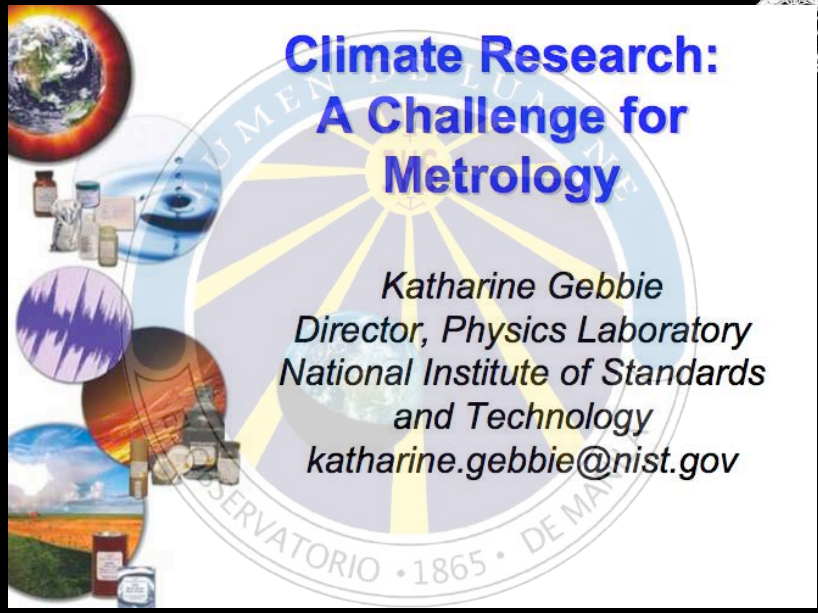



Photo by J. Ong



Climate Research: A Challenge for Metrology

Katharine Gebbie
Director, Physics Laboratory
National Institute of Standards
and Technology
katharine.gebbie@nist.gov

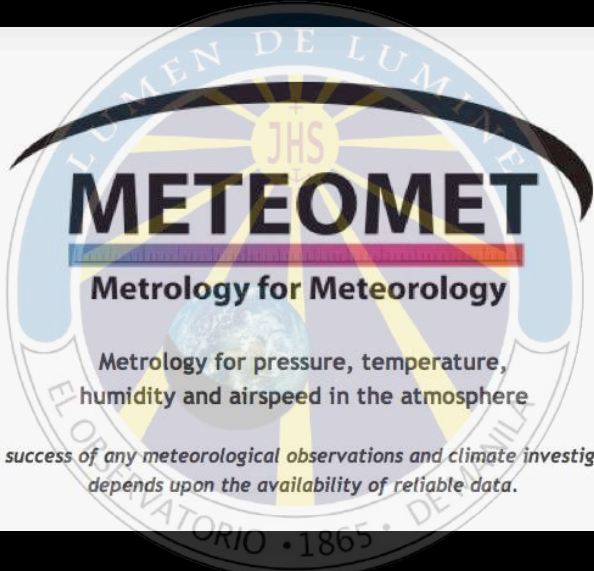



WMO-CIPM Agreement Recognizes Role

World Meteorological Organization (WMO)

International Committee for Weights and Measures (CIPM)

"...have agreed to work together to ensure that data related in particular to measurements of state and composition of atmosphere and water resources, coming from the programmes organized under the auspices of the WMO, are properly based on units traceable to the SI through the procedures of the CIPM MRA and the Technical Regulations of the WMO."

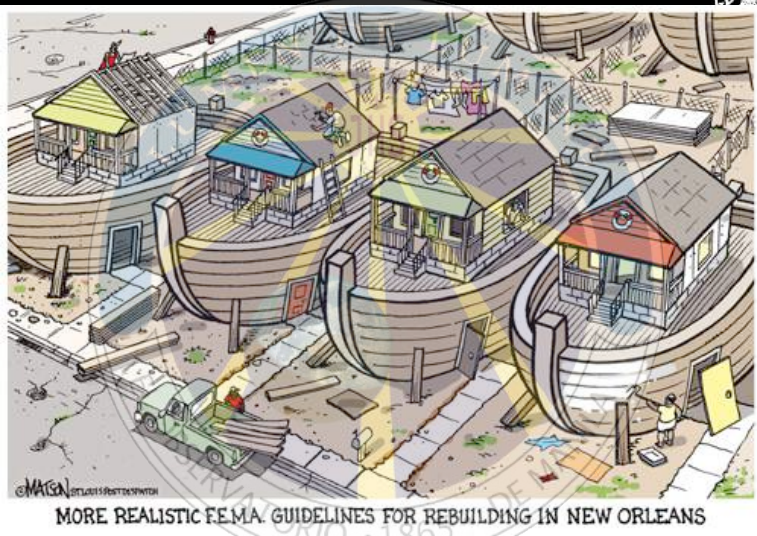



METEOMET

Metrology for Meteorology

Metrology for pressure, temperature, humidity and airspeed in the atmosphere

The success of any meteorological observations and climate investigation depends upon the availability of reliable data.



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MORE REALISTIC FEMA GUIDELINES FOR REBUILDING IN NEW ORLEANS