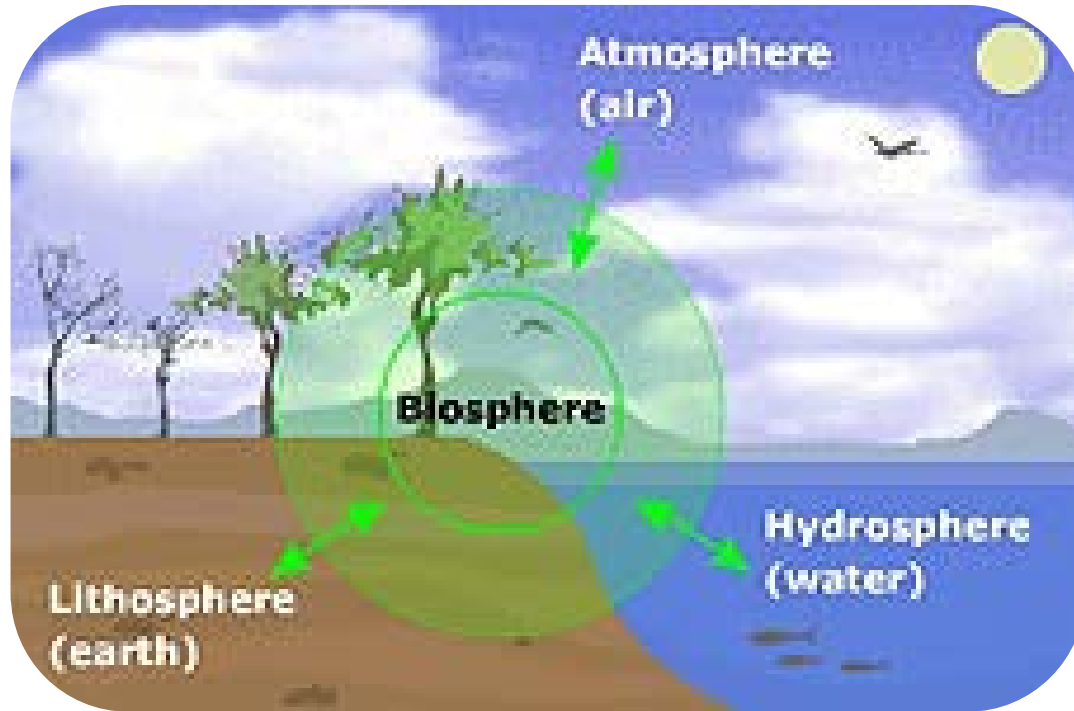


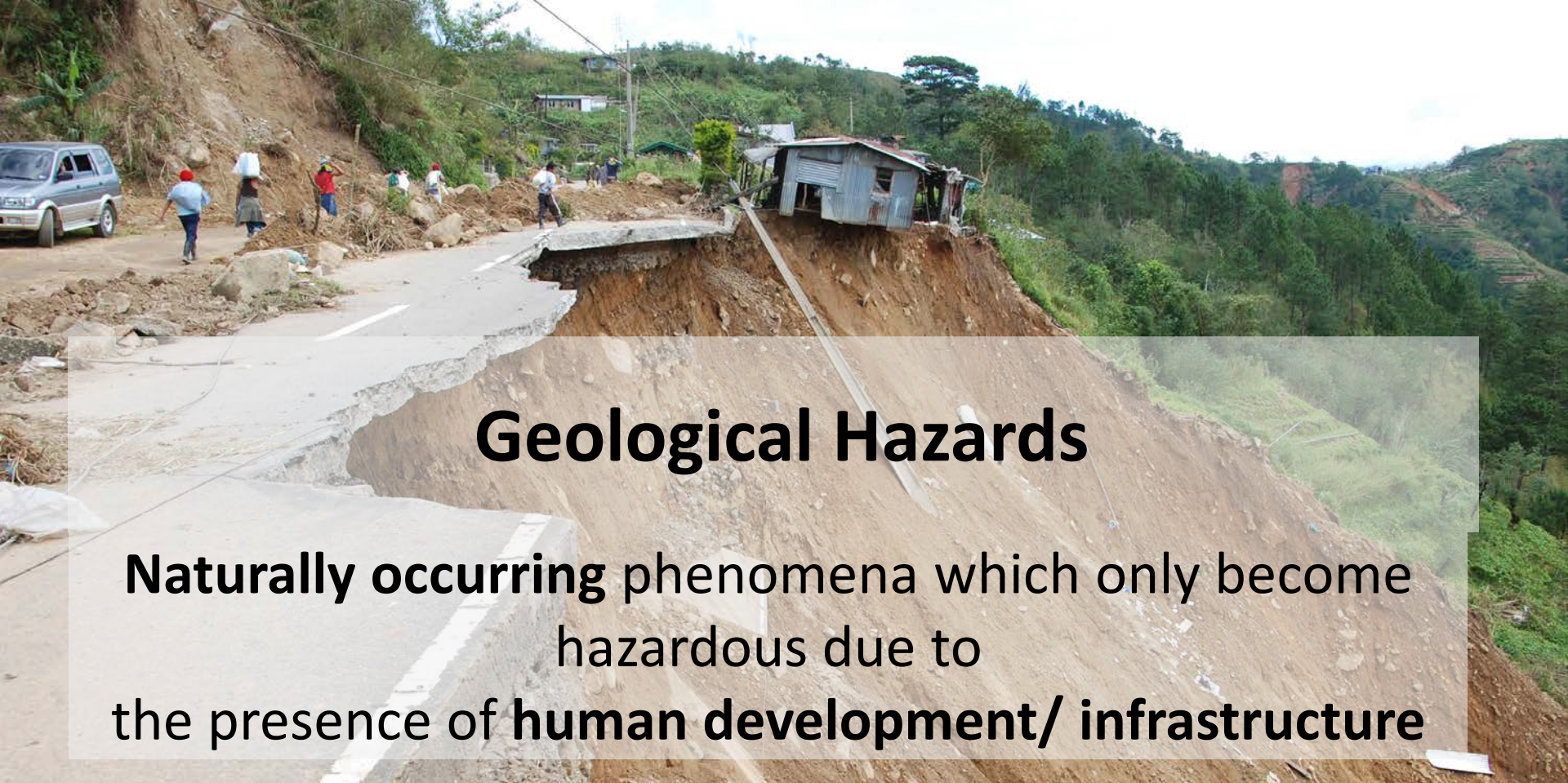
Environmental Science Research Agenda

Lithosphere: EARTH
PROCESSES, RESOURCES AND THE
ENVIRONMENT

Litho/Geosphere



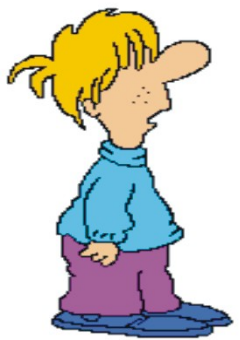
- Densest portion of the Earth system = the earth itself
- includes the planet's crust, its interior, rocks and minerals, landforms



Geological Hazards

Naturally occurring phenomena which only become hazardous due to the presence of **human development/ infrastructure**

Believe it or not!!!



“Of all the nations in the world, the Philippines has experienced the most natural hazards in the twentieth century. India was a distant second, followed by the United States in third position”

*--- Kovach, R.L., 1995. **Earth's Fury: An introduction to natural hazards and disasters.** New Jersey: Prentice Hall, Inc.*

A photograph of a flooded street in a low-income urban area. In the foreground, a white plastic bag hangs from a structure on the right. The water is murky brown and reflects the overcast sky. In the background, several small, closely packed houses with corrugated metal roofs are visible. Laundry, including a red and yellow patterned cloth, hangs from a line on the right side of the frame.

Attendant or Control factor/s

(e.g., tectonic/geologic/geomorphic setting/socio-economics)

+

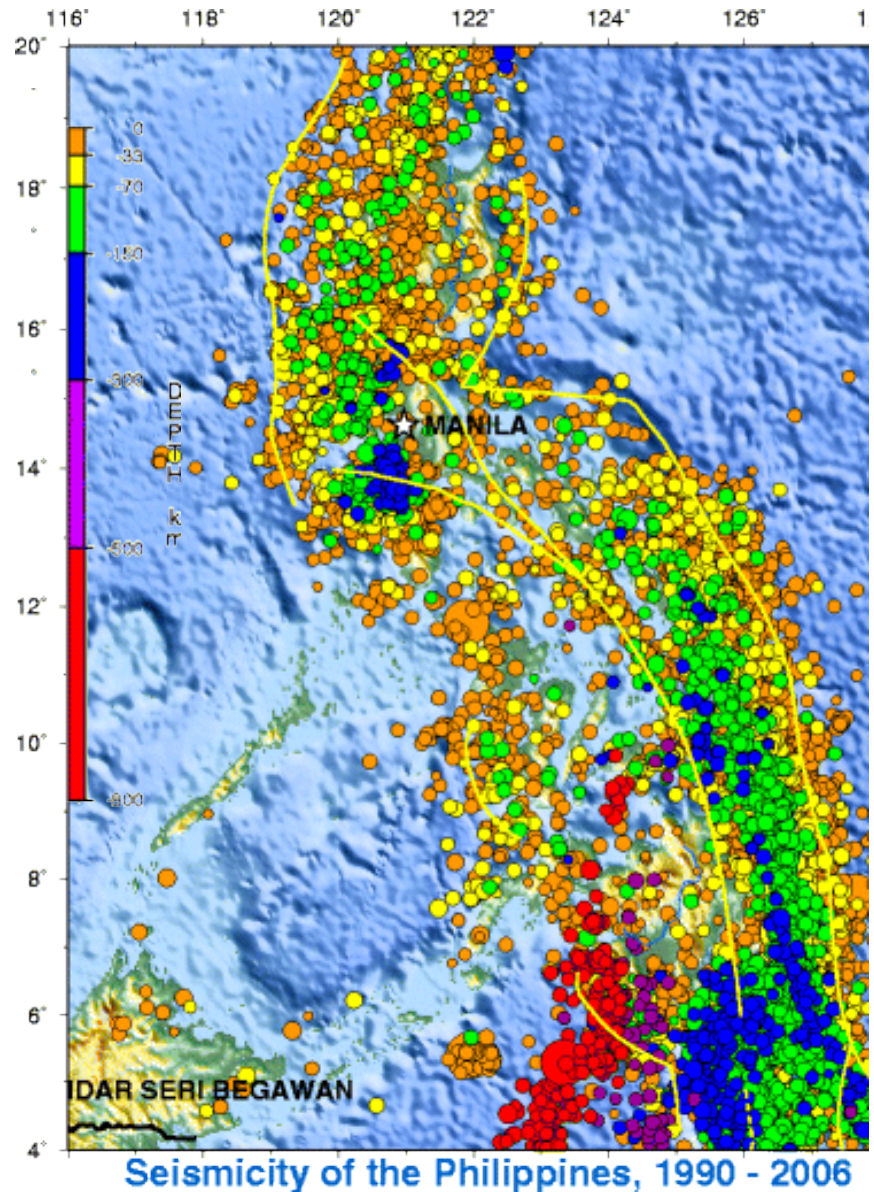
Triggering mechanism/s

(e.g., precursor weather events, seismic activity)

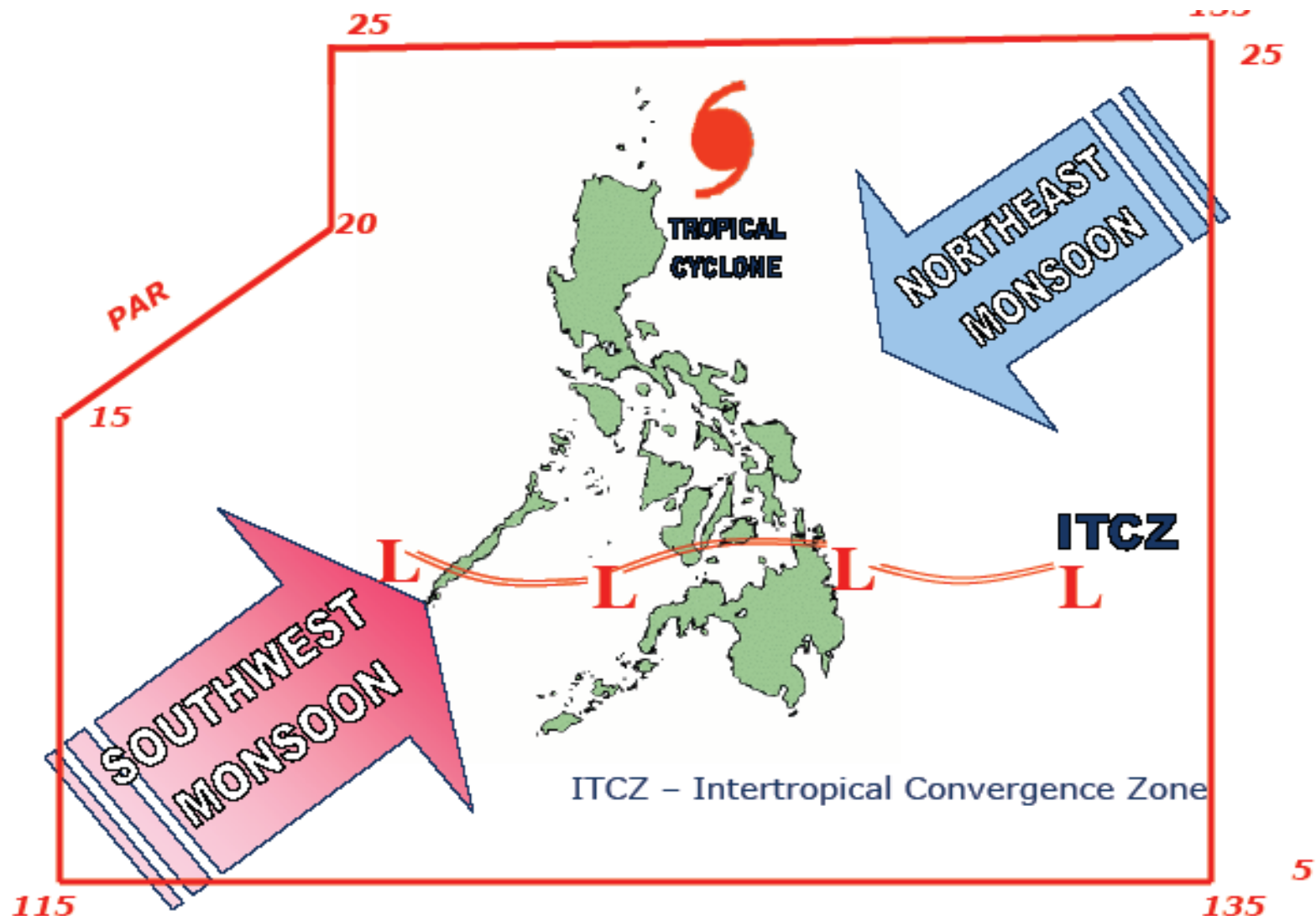
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Geologic disasters

Tectonic setting

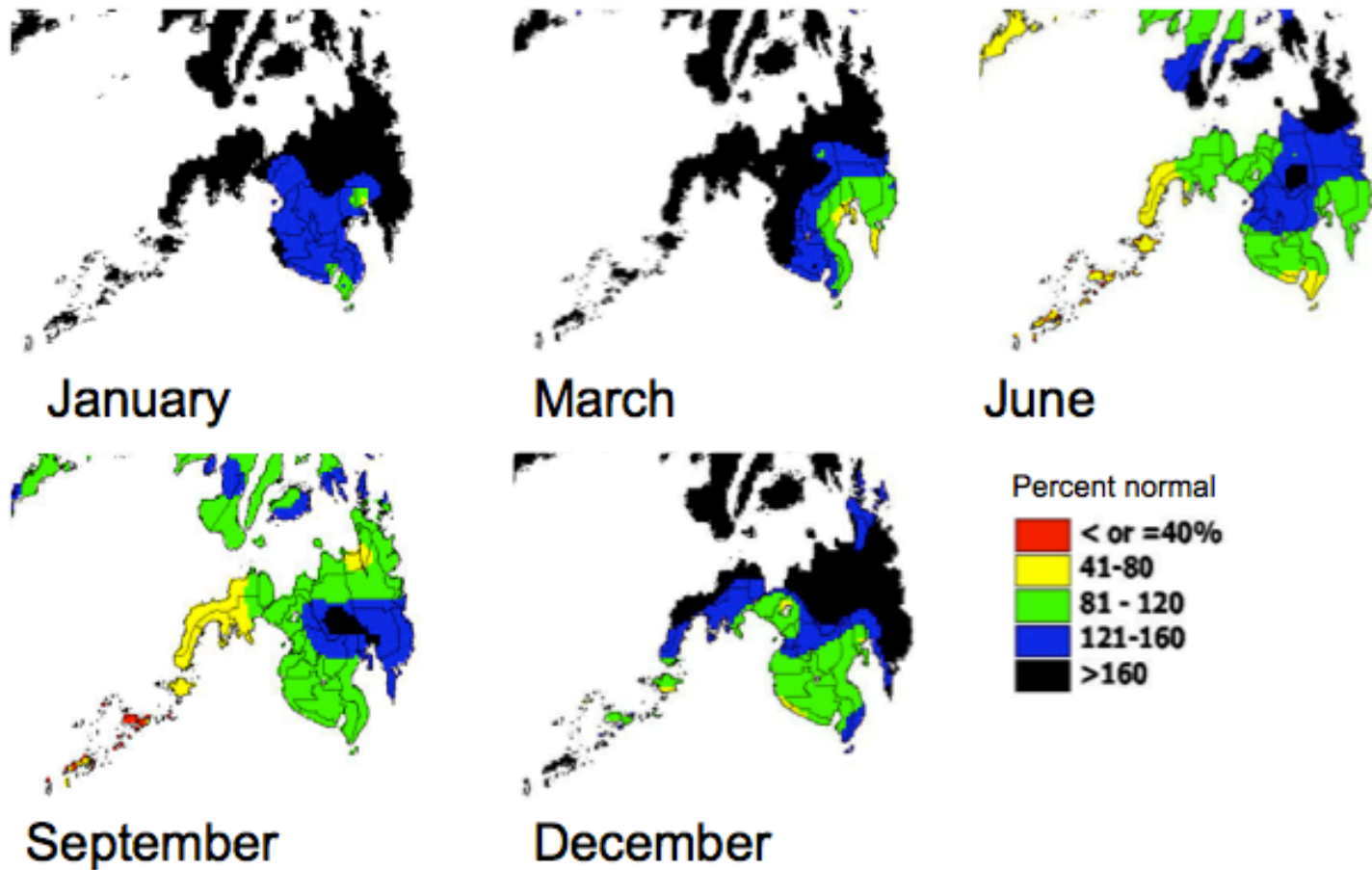


Meteorologic setting



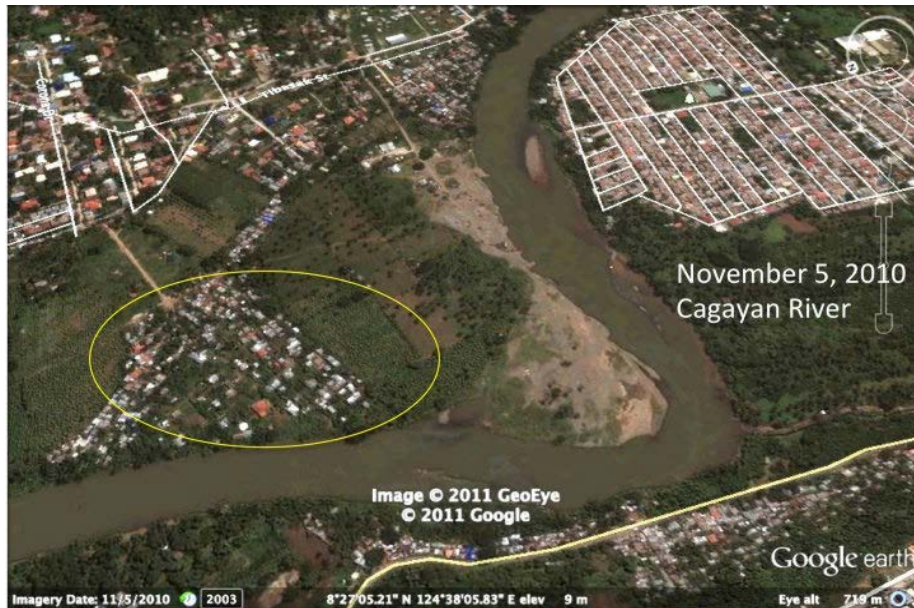
Changing climatic conditions

2011: Wet Mindanao



Source: Climatology and Agrometeorology Division, DOST-PAGASA

December 2011 Mindanao



No. of deaths	1,257
No. of evacuees	525,945
No. of houses damaged	13,337
Cost of damage	~P1.4B
24-hr rainfall at Lumbia, CDO	180.4 mm (555.1*)

April 2003 – Guinsaugon, Southern Leyte



February 17, 2006 landslide



1,119 fatalities
14 – 18 million cubic meters
3.2 square km
4.1 km
5 minutes
>400 km/hr

Geohazards in the Philippines

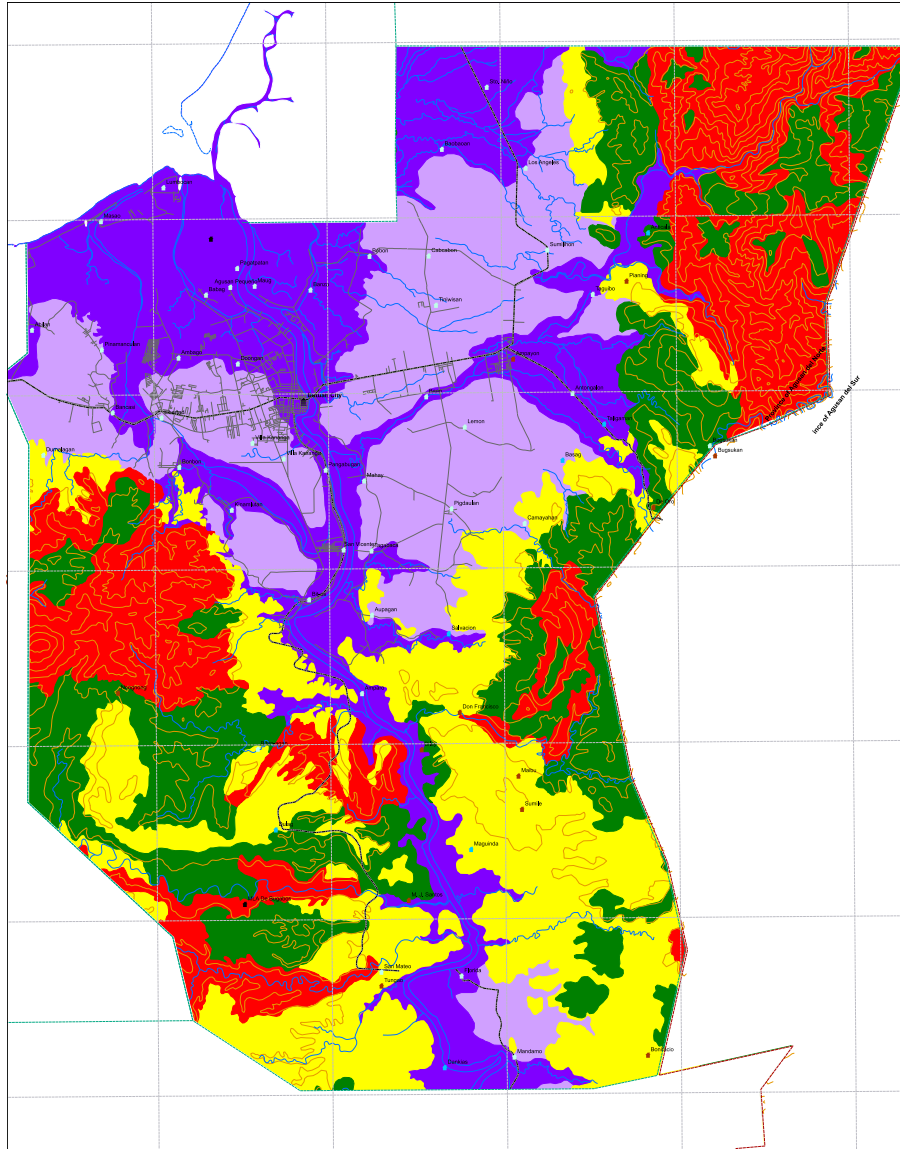
- Philippines – **inherently prone** to numerous geohazards
- **Expansion into more hazard-prone areas**, greater exposure
- Socio-economic conditions = aggravated risks
- **Changes in climatic patterns = increased** risks
- Robust link between changing climatic conditions and a broad portfolio of potentially hazardous geological and geomorphological processes

Potential geological and geomorphological hazards in the context of projected future climate changes

McGuire, 2012

potential hazard	mechanism/potential relationship with climate change	relevant climate drivers	environmental settings	references (in this issue)
subaerial landslides and debris flows	permafrost thaw; pore-water pressurization; intense rainfall destabilizing regolith	temperature rise; ice-mass loss; intense precipitation	mountainous terrain; volcanic landscapes	Deeming <i>et al.</i> (2010), Huggel <i>et al.</i> (2010), Keiler <i>et al.</i> (2010) and Tuffen (2010)
glacial outburst floods (GLOFs)	glacier retreat; accumulation of meltwater in pro-glacial lakes	temperature rise; ice-mass loss	high latitudes; mountainous terrain; glaciated volcanic landscapes	Keiler <i>et al.</i> (2010) and Tuffen (2010)
earthquakes	ice-sheet and glacier wastage; ocean island and ocean margin loading due to sea-level rise	temperature rise; ice-mass loss; ocean volume increase	high latitudes; glaciated terrain at mid-to-low latitudes; ocean basins and margins	Hampel <i>et al.</i> (2010) and Guillas <i>et al.</i> (2010)
volcanic activity	unloading due to ice-sheet and glacier wastage; loading due to sea-level rise; pore-water pressurization; intense rainfall destabilizing regolith	temperature rise; ice-mass loss; intense precipitation; ocean volume increase	volcanic landscapes at all latitudes	Deeming <i>et al.</i> (2010), Sigmundsson <i>et al.</i> (2010) and Tuffen <i>et al.</i> (2010)
tsunamis	submarine and subaerial slope failures and volcano lateral collapses; gas-hydrate breakdown; ocean load-related earthquakes; ice quakes	ocean temperature rise; ocean volume increase; intense precipitation	ocean basins and margins	Day & Maslin (2010), Maslin <i>et al.</i> (2010), Dunkley Jones <i>et al.</i> (2010) and Tappin (2010)

Geohazard maps



Province of Agusan del Norte



GAPS

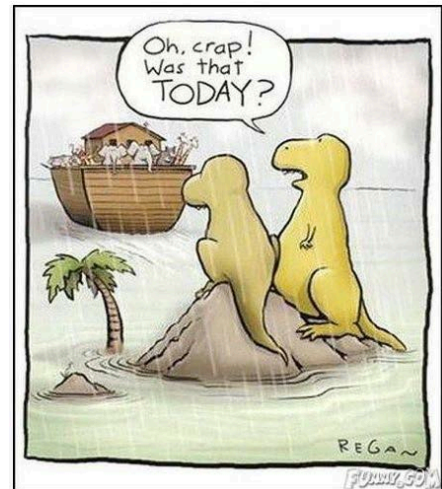
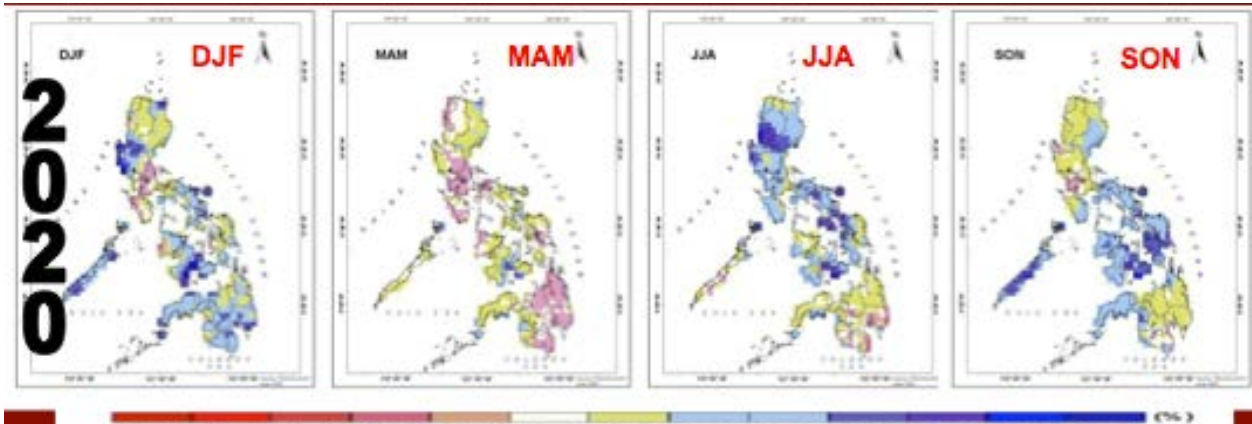
- Need for more effective communication methods
- Sluggish translation of academic information to practical/common knowledge



Knowledge Gaps

- Complexity of climate change-geohazard relationship, but **interactions are not always those expected**
- increased frequency of extreme weather events = increased impacts, but **how will this evolve with further changes** in climate
- questions on **longer-term changes** in the climate and the environment that may influence observed relationships with hazards

DOST-PAGASA, 2012



Proposed Solutions:

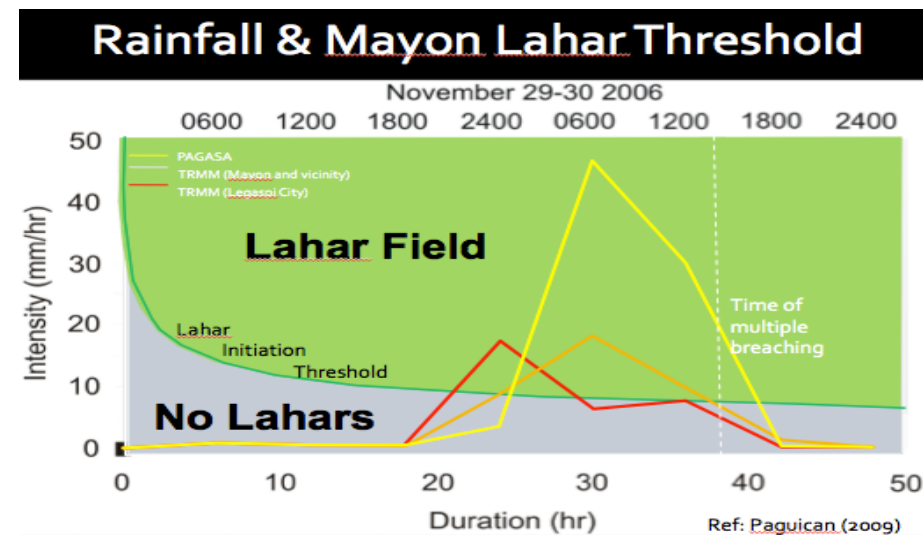
CCA needs

- Active contribution to generation of higher-resolution, predictive and detailed **geohazard maps**.
- Encourage development of **cheap, reliable EWS**
- Devise **effective communication techniques**
- Support needed: **availability of experts and human resources**
- Through **scholarships and incentives**
- Urgent need for CCA, DRRM = **incorporate in the educational system**

Proposed Solutions:

Research Agenda

- Increase/expand **basic researches** on geohazards and geology/tectonics of the Philippines
- Investigate correlations in the **geological record** between climate change and significant hazardous events
- **Modeling techniques** to investigate the influences of changing environmental conditions on potentially hazardous geophysical systems
- Identify **priority locations**
- Promote: **integrative researches**



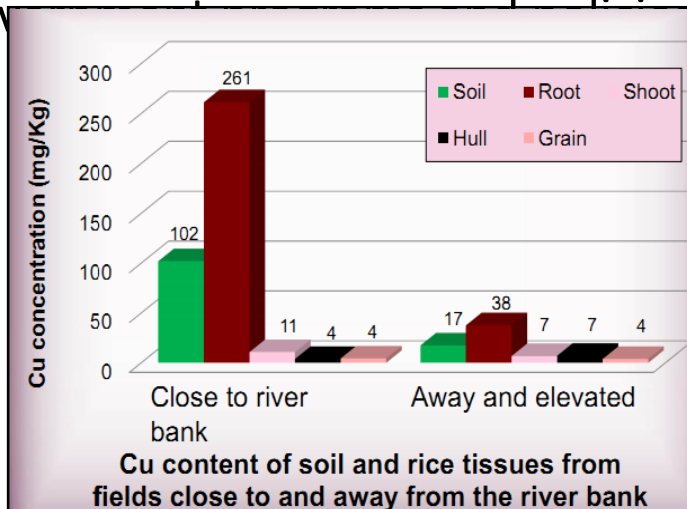
Mining

- **High environmental impact:**
alterations to the original biogeophysicochemical parameters.
- **Environmental Issues:**
biodiversity loss, metal contamination and pollution, acid mine drainage, land use planning and value added processes.
- **Humans and Health Issues:**
mining communities and small scale miners .



Mining

- **Proposed Researches and Solutions:**
- **Technology base research projects** - appropriate mining technologies, metallurgy and remediation technologies and value adding technologies.
- **Interdisciplinary academic approach** - curricular revision to include special topics on post mining activities and the incorporation of local and traditional ecological knowledge.
- **Comprehensive land use plan (CLUP)** - sustainable development align to govt policies and mining industry



Brown Spot of Rice

- Caused by *Cochliobolus miyabeanus* (*Bipolaris oryzae*)
- Great Bengal Famine (1943) – caused death of about 2 million people from starvation
- Can reduce yield by 20-40% (Vidhyasekaran and Ramadoss (1973))



Mining

- **Accreditation of small scale miners** - green mining technology
- **Government and academe initiated projects** - inventory and transfer of technologies, community based livelihood programs supported by large scale mining companies through CSR.



Phytotechnologies:
"Clean and Green"

Agriculture

- **Environmental Issues:**
 - Traditional agriculture, floods and drought affecting crops, pesticide and fertilizer use, irrigation, land use planning, food vs biofuel.
- **Proposed Researches and Solutions:**
 - Alternative methods in agriculture, resilient crop technologies, adaptive production system, weather predictability.



Energy

- **Environmental Issues:**
 - Extensive use of fossil fuels, high cost of energy generation and technology, effects of climate change
- **Proposed Researches and Solutions:**
 - Search and proper utilization of alternative energy resources (geothermal, hydropower, solar and wind power)
 - Technology base applications of alternative energy (robust, cost effective , sufficient energy)

