Geospatial Decision Support Tools for Early Warning Services and Disaster Risk Management

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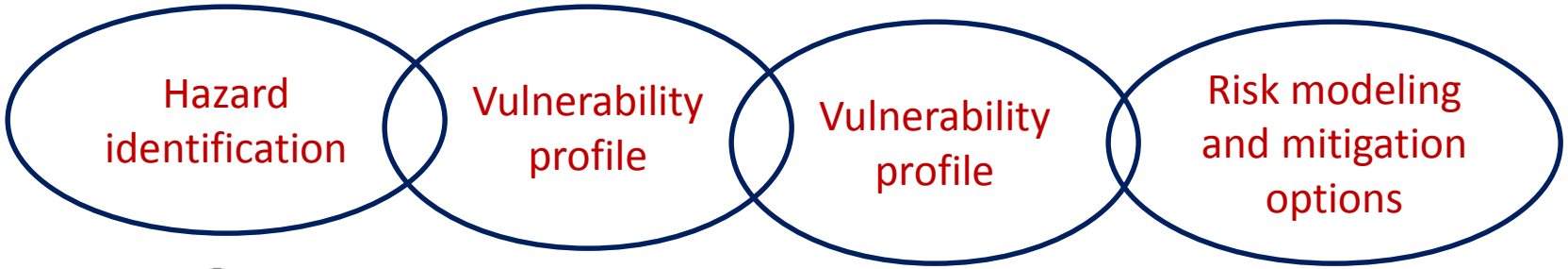
EWS and DRM

Early Warning System helps to know the occurrence of magnitude and risk of a disaster in advance

Disaster Risk Management is awareness and preparedness of managing the risks of a disaster



EWS can save human lives, Livestocks, Infrastructures, Crops etc.,

Geospatial Decision Support Tools

Scientific Information

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Hazard Assessment
Exposure Assessment
Vulnerability Index Assessment
Elements at Risk
Potential Impact Assessment
Risk Modeling etc.,

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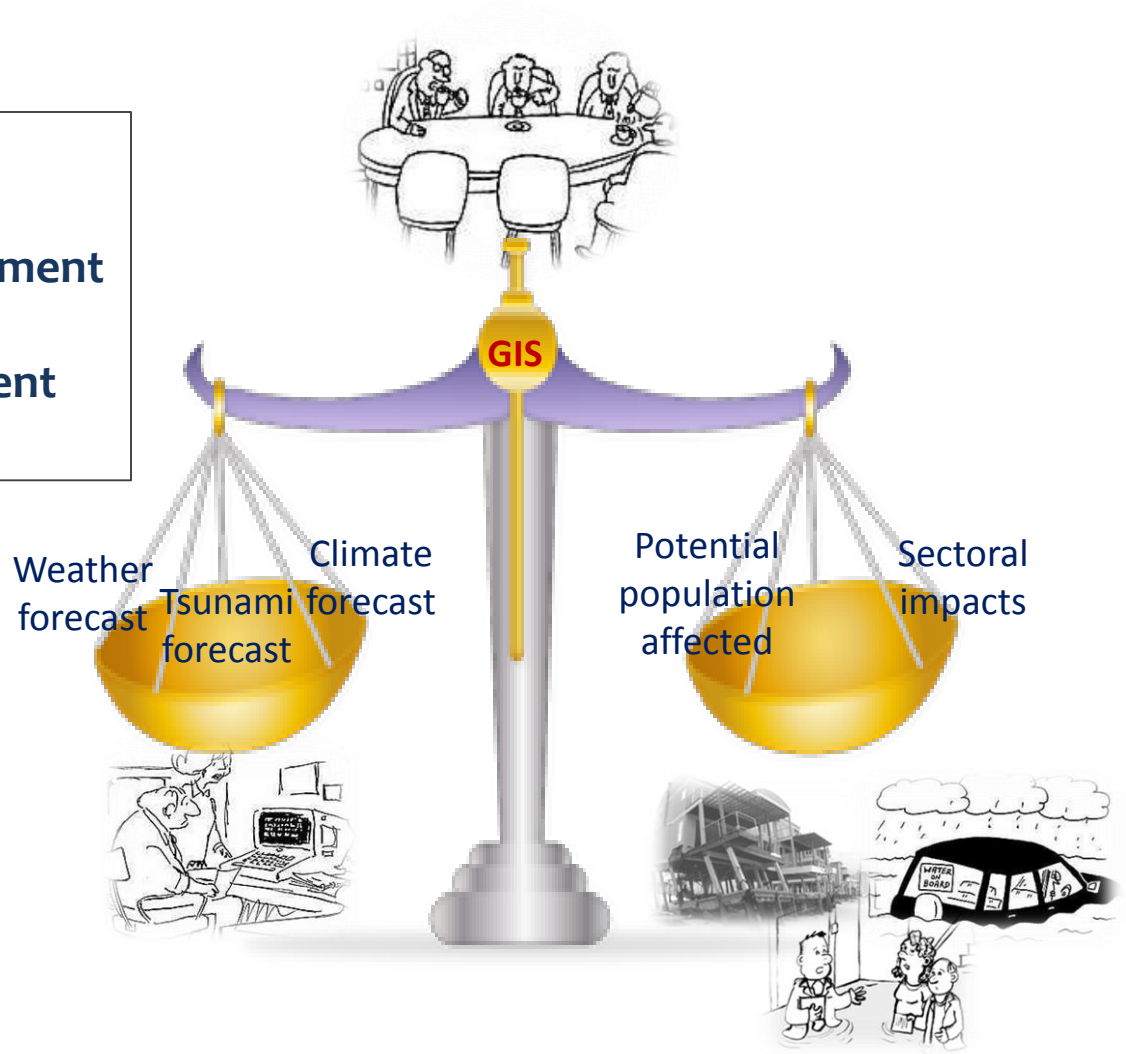
Warning Information
Mitigation plans



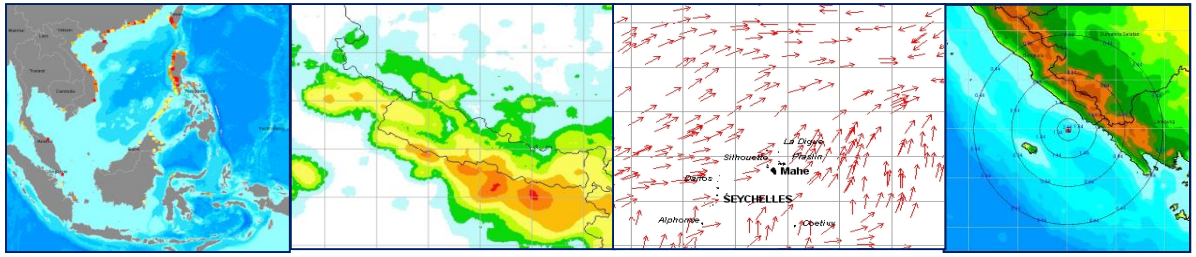
RIMES - Early Warning Services

Regional Integrated Multi-Hazard Early Warning System for Africa and Asia

- International and intergovernmental institution, owned and managed by its Member States, for the generation, communication, and application of early warning information.
- RIMES caters to differential needs and demands of its Member States through data exchange; provision of earthquake alerts and regional tsunami bulletins; hydro-meteorological research
- Development support to National Meteorological and Hydrological Services in the generation of localized and tailored weather and climate information of different time scales
- Development of decision-support tools and new generation hazard risk information products; analysis of risks to climate variability and change, and identification of risk management and adaptation options;
- Capacity building in hazard observation and monitoring, hazard risk information generation and application, early warning system audits, strengthening early warning provider and user interface, and enhancing community response to early warning.

GIS system in housed at RIMES

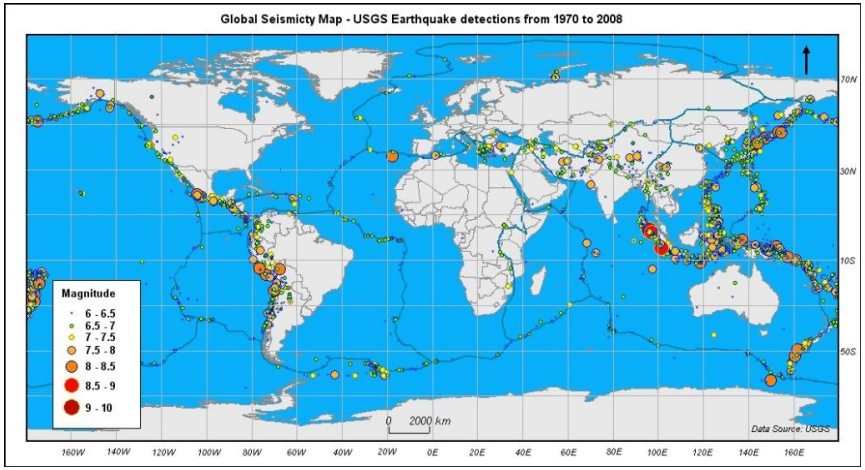
To address GIS needs in the Early Warning System, RIMES implemented an inexpensive GIS tools for bridging scientific and disaster managers.



- Earthquake Hazard Information System (Seismology)
- Tsunami Risk Assessment Toolset (Oceanography)
- Weather Information System (Meteorology)
- Geo-Climate Information System (Climatology)

Earthquake Information System

- Comprehensive geodatabase with historical earthquake detections from regional centers (such as USGS, GEOFON, RIMES)

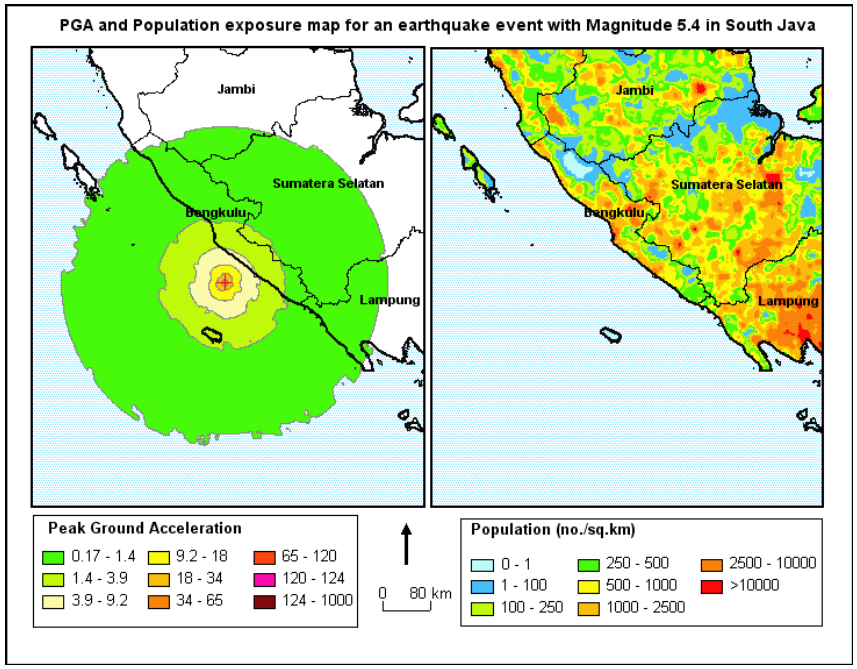


- Geospatial datasets such as administrative boundaries, plate boundaries, major rivers, elevation and bathymetry datasets (ETOPO, GEBCO,) fault lines, zones and geological features etc

- Spatial knowledge about occurrence and severity of historical earthquakes

Earthquake Hazard Assessment System

- Severity of ground shake is very important factor in estimating potential damage.
- PAGER is renowned system to estimate PGA, PGV, potential damages and population exposed
- RIMES developed similar system to plot the potential damage and population exposure maps based on USGS recommendation.



Instrumental Intensity	I	II-III	IV	V	VI	VII	VIII	IX	X
Acceleration (%g)	<0.17	0.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
Potential damage	None	None	None	Very Light	Light	Moderate	Moderate to Heavy	Heavy	Very Heavy

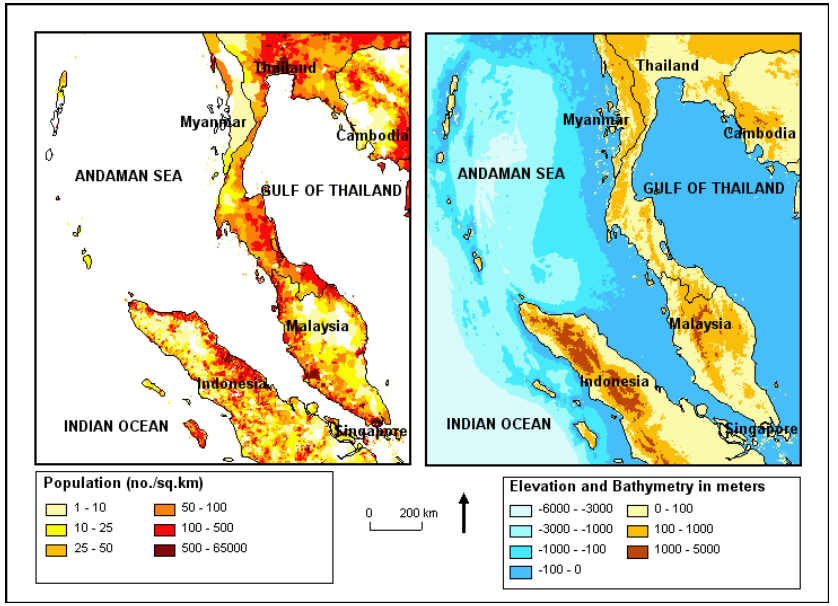
Source: USGS

EHAS and DRM

- Disaster Managers, Search and Rescue officers, Relief Supply officers from National Government agencies can use this information
- Know areas which had severe ground shake and potential damages over the region
- Awareness of spatial and temporal occurrences of earthquakes and its severity locally and globally.
- Development of risk models by using prior events and its damage or loss of buildings or population.
- Rescue operations and Mitigation activities based on potential damage and

Tsunami Risk Assessment Toolset

- Capabilities to perform hazard and risk assessment, digital elevation model generation, digitizing contour from bathymetry datasets, digitize building foot prints from satellite imageries
- Global elevation datasets SRTM, ASTER, ETOPO and GEBCO; population GRUMP datasets; Tsunami wave height from propagation and inundation models are integrated



- Grid computation, re-gridding, grid analysis, interpolation, digitization, mosaicing, masking

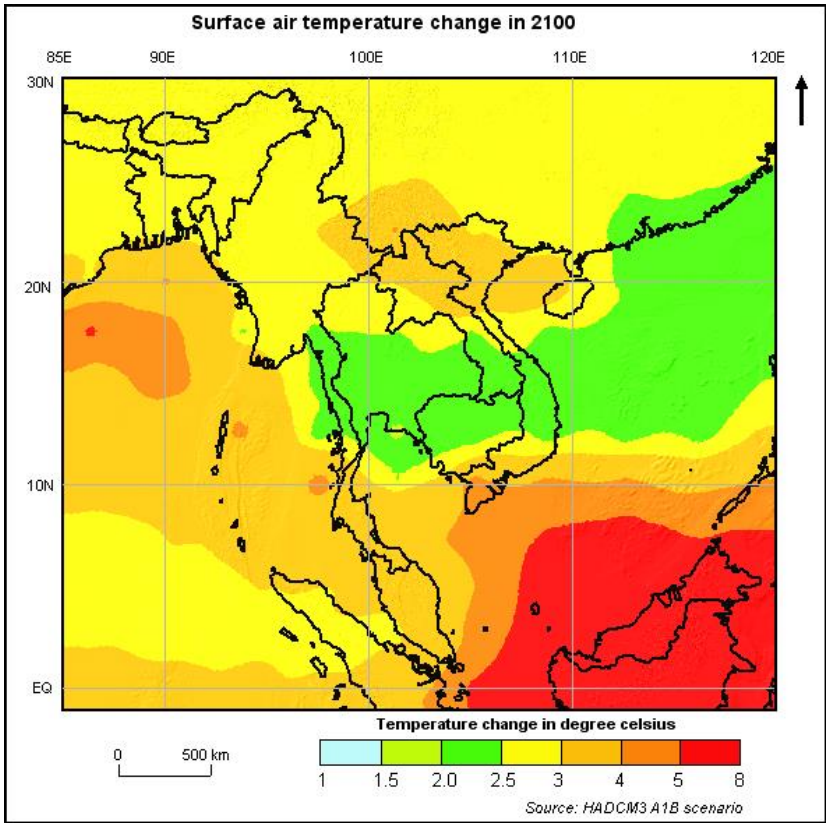
- Data feeds are supported in the form of XYZ vector or ASCII raster format, to be imported into Geodatabase.

TRAT and DRM

- Disaster Managers, Local Government officials, Insurance companies, Mitigation planning officers can use this TRAT system for planning and preparedness activities
- Identifying Hazard profile of an area by bringing Inundation height or wave height from propagation or inundation scenarios with exposed elements is first step to build risk information
- Modeling the damages for elements at risk will lead a way to give improved risk information along with Tsunami forecast

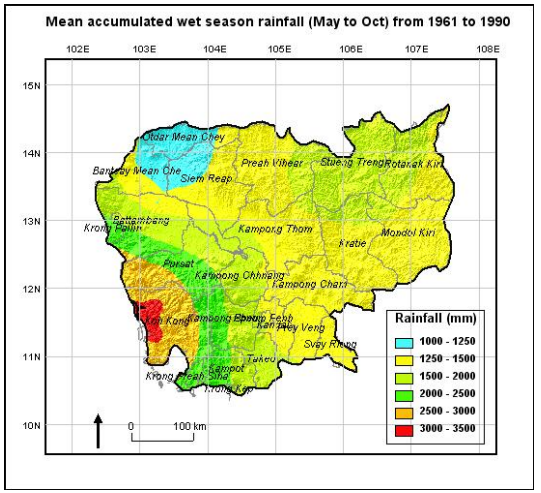
Geo-Climate Information System

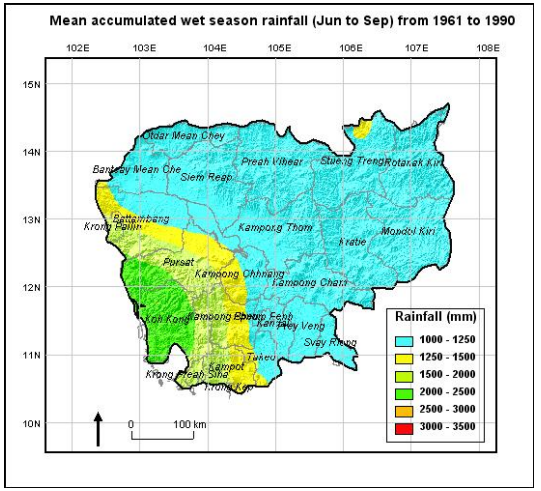
- Compiles climate risk information and a wide array of sectoral information in a single platform, enabling the user to perform grid analysis, spatial queries and statistical analysis
- Geospatial database enables the disaster manager to analyze the current status of various entities including water resources, agriculture etc. and the future impacts



Geo-Climate Information System

- Visualizing the climate projections from various global models
- Statistical downscaling of global model to regional level
- Comparing datasets and deriving regression coefficients
- Understand the relation and impacts of climate change by bringing together geography, climate and socioeconomic factors.





GCIS and DRM

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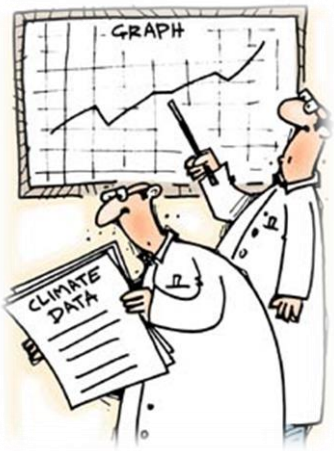
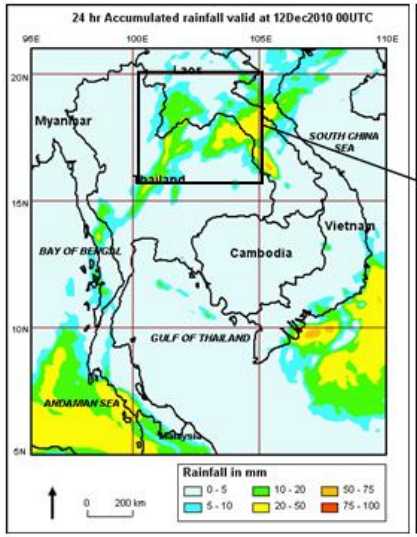


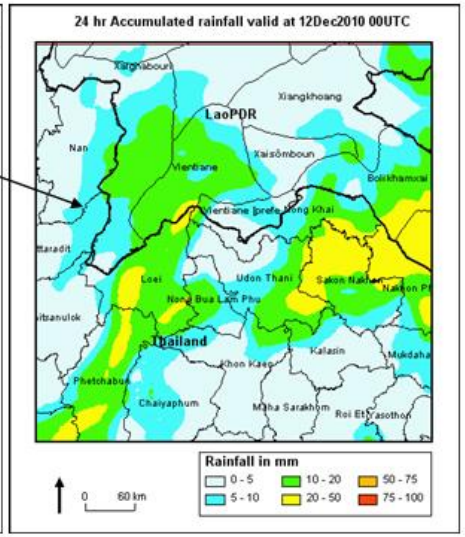
Weather Information System

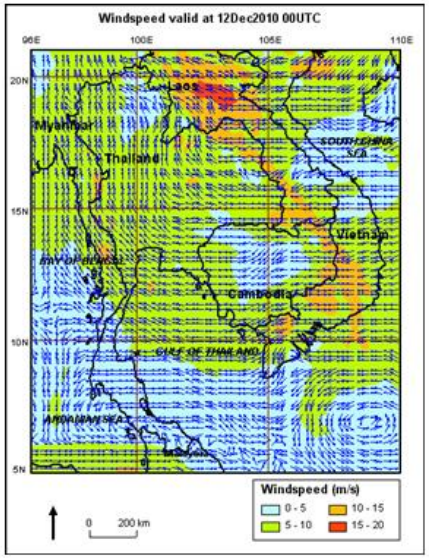
- Plotting weather parameters (surface, contours) such as rainfall, geo-potential height, wind speed, wind direction, mean sea level pressure etc. (Figure3&4)
- Spatial Analysis of weather information with geographic elements
- Weather observational and forecast database development and management
- Performing weather forecast verification and validation with observed datasets

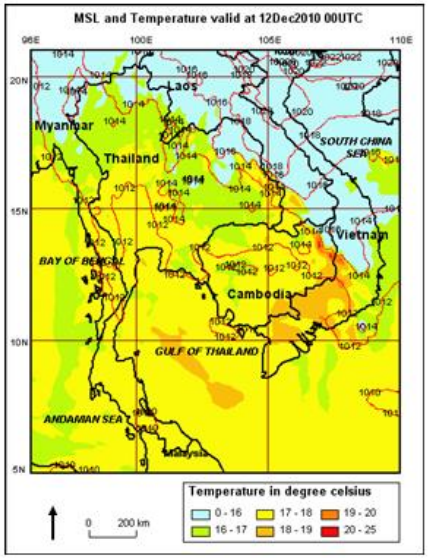
Weather Information System

- Bringing Weather information with Geography (Spatial features) enables the user better understanding about the weather patterns in a geographic region.
- Serves as a database management system for storing observed weather parameters, forecast information's and other spatial datasets.







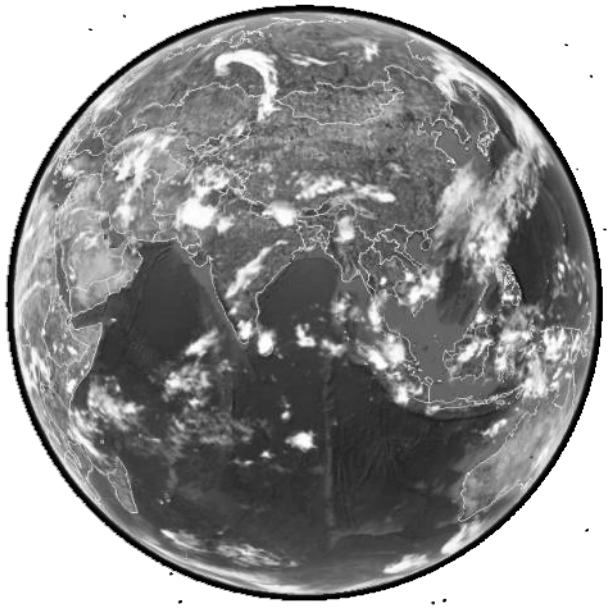


WIS and DRM

- Weather Database Management : Spatial and Temporal datasets of surface observatory and Forecast products
- Generate Value added products by adding Geographical Information to forecast.
- Serves to interpret and analyze scientific products
- Helps in Decision making purposes for issuance of warnings and verification.
- Exposure assessment with help of demography, environmental and socio-economic data
- Historical impacts analysis for deriving thresholds by case analysis.
- Evolving the process of generating pre-impact scenarios

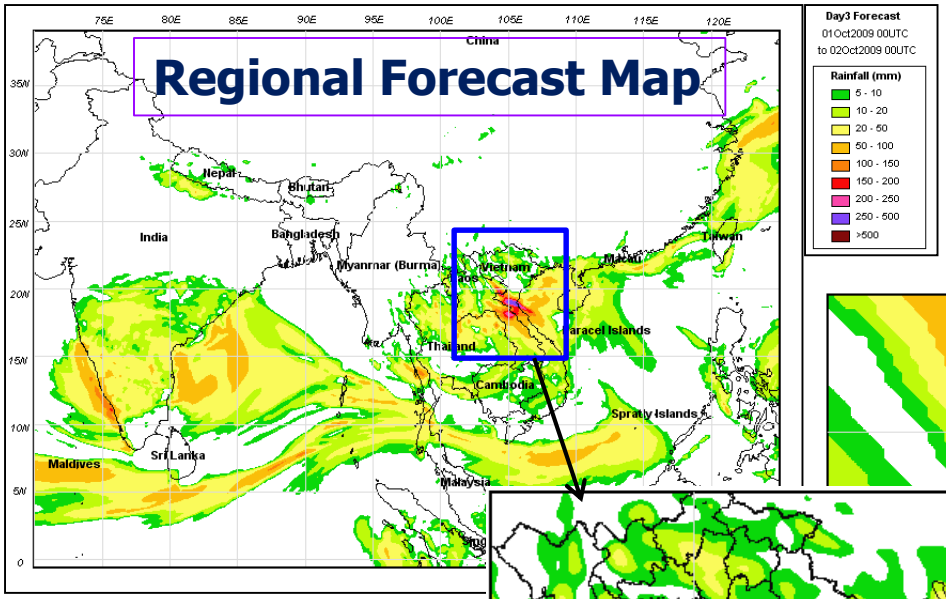
Why Weather and Geography?

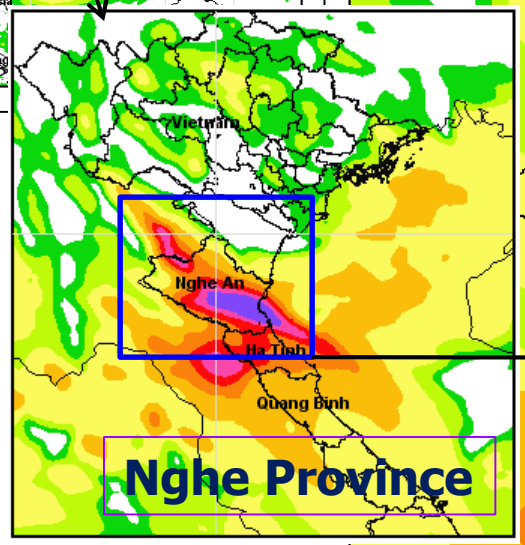
- Better visualization for better interpretation and understanding
- Knowledge about influence of a parameter with respect to geography and period.
- Help to make decisions for managing the impacts and influence of the event in sectors like Agriculture, Water resource, Drainage, Infrastructure, Transportation, Irrigation etc.,



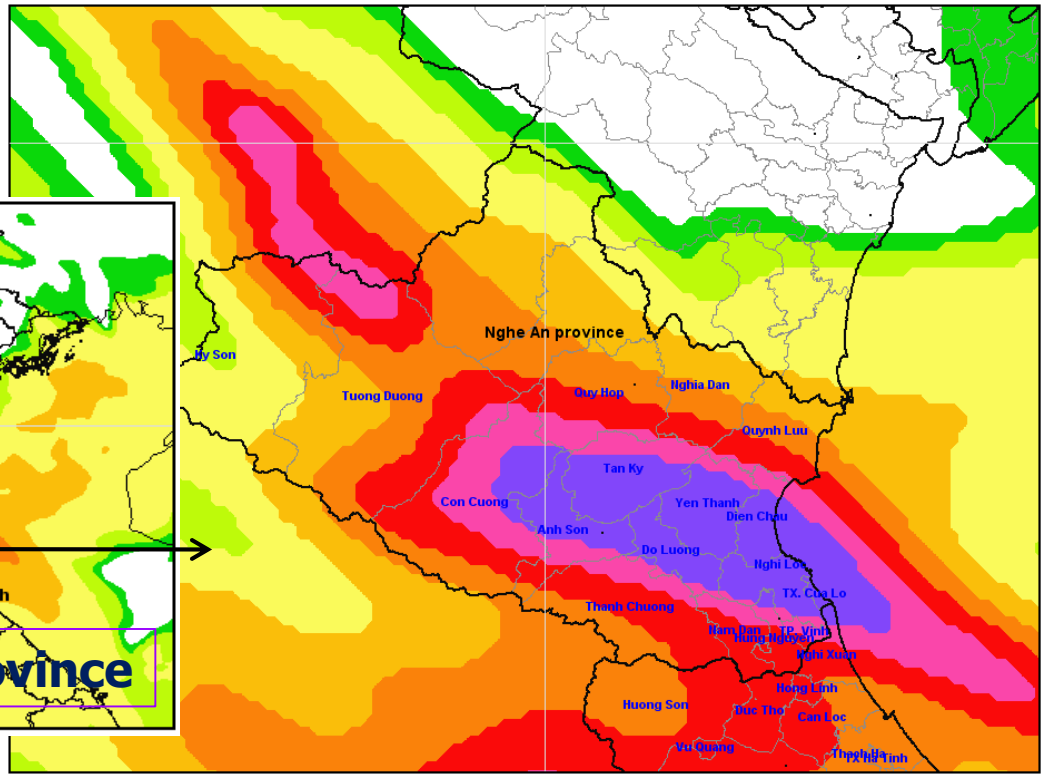
Source: GOOGLE

Weather & Geography





Disticts: Tan Ky, Yen Ti, Yen Thanh, Dien Chau, Do Luong, Ahn Son



GIS Generates Value Added Information

How Decision Makers use Information?

- Identify thresholds for your region
- Check forecast for your location and translate into easily understandable form

1. People in villages _____ Stay Alert
2. People in villages_____ Evacuate to High Ground
3. Stored Water in parcels has to be released in 24 hours in order to avoid flooding the next day, which may affect crops
4. People who wish to travel through this road ___should avoid, because there are likely chances of flooding in the river near the road.
5. Schools___ in this area will be closed.

Weather &Geography

Assist in analyzing the influence of a parameter (rainfall) over an element in a geographical area with respect to period

Especially use weather information's for Decision making purposes during various cropping stages.

- **Ploughing**
- **Seedling**
- **Transplanting**
- **Harvesting**

When to plant?

When to transplant?

When to store water?

Successful WMP !

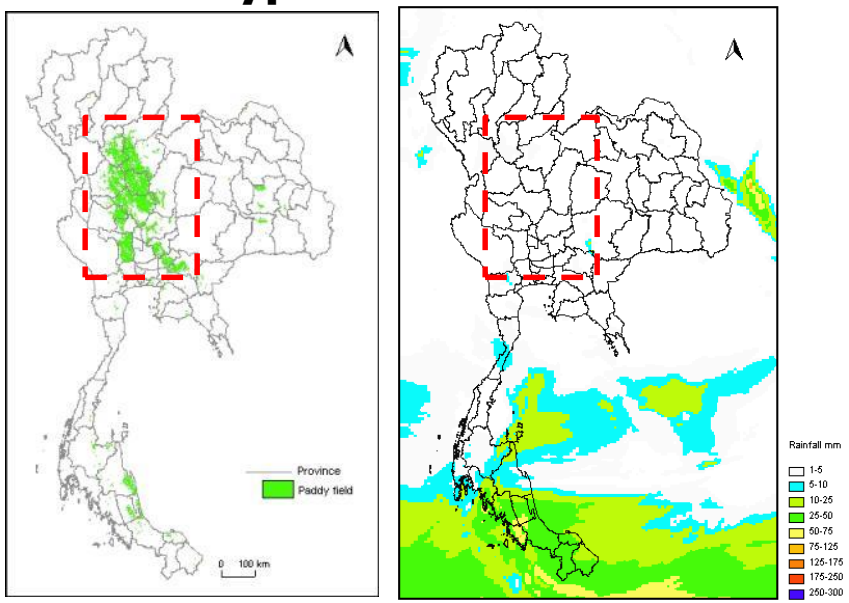
Hazard Thresholds

- What is the threshold value of rainfall in a geographic area to trigger an impact (hazard)?
  - **Heavy Rainfall?** → **What is threshold?**
    Rainfall amount which can cause impacts for society (Ex: 300mm/day or 200mm.hr)
  - **Heavy Rainfall can cause?**
    Flood.. → **What it cause and Where?**
  - **Flood can affect?**
    Livelihood..
    Infrastructure…
    Agriculture…
    Etc., → **What is Impact?**

Paddy field Case

What?	**200mm rainfall**
Where?	**Sukothai and Nakon Ratchasima Province**
When?	**25 November 2009**

Hypothetical Scenario



Hazard functions

More than 150mm in 24hours in November month on a paddy field creates flooding in the field and huge crop damage.

Impacts

1. **Flooding in paddy field**
2. **Crop damage**
3. **Economic loss High (because it is at harvesting stage)**

Uttaradit Landslide Case

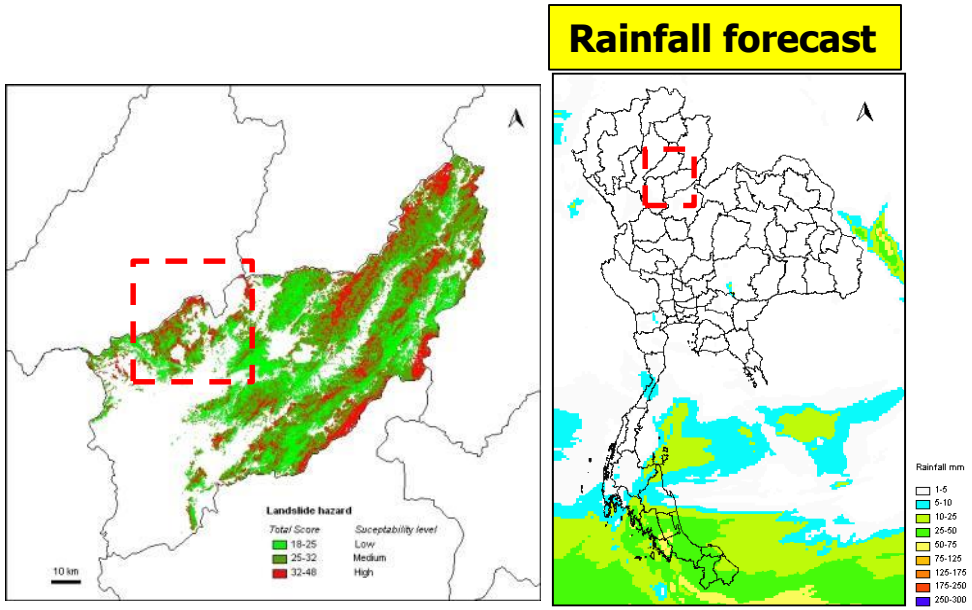
Hazard functions
More than 150mm rainfall may trigger Landslides in the Hazard Zones.

Rainfall	Alert level
0-50	No risk
50-100	Ready
100-150	Alert
150-300	Evacuate

Impacts

1. Building collapse
2. Human Causalities
3. Affects vegetation pattern

Hypothetical Scenario



What?	**200mm rainfall**
Where?	**Uttaradit Province**
When?	**25 November 2009**

Drainage Case Study

Hazard functions

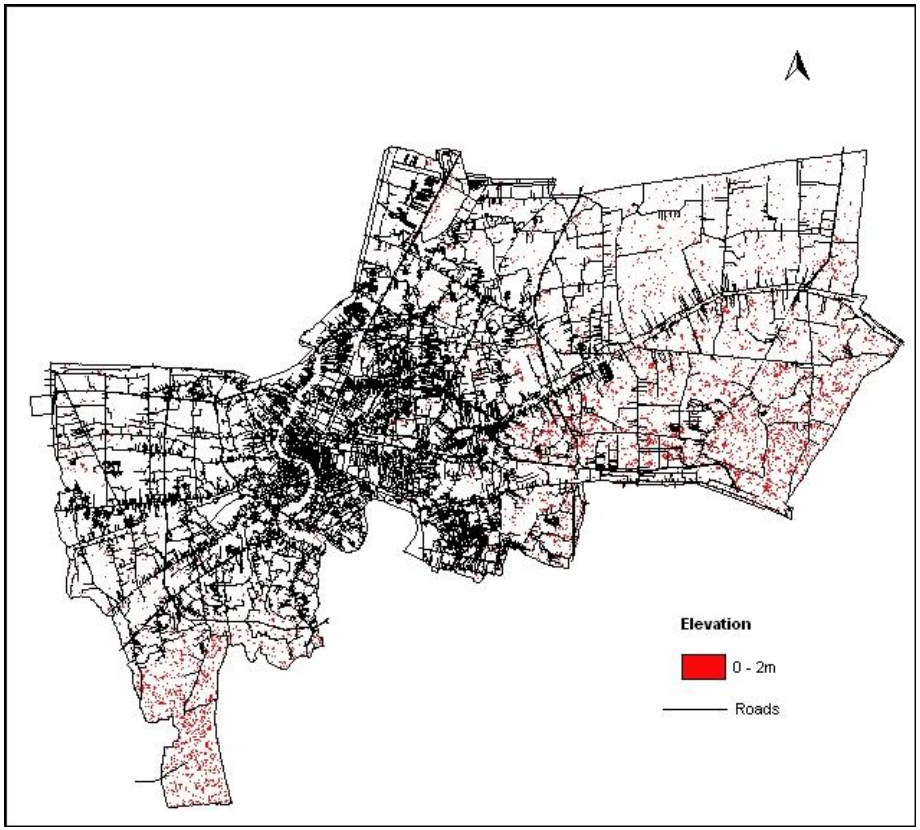
More than 200mm in 3hours in Bangkok areas which has elevation less than 2m from MSL and creates Flood in roads

Impacts

1. Drainage problem
2. Flooding
3. Traffic

What?	**200mm rainfall**
Where?	**Bangkok Province**
When?	**25 November 2009**

Hypothetical Scenario



Potential Impact?

- Collateral Hazards Flooding, Landslide.

What kind of Impact?

- Human affected
- Building damages
- Crop damages
- Livestock affected
- Livelihood activities stopped
- Transportation routes blocked
- Drainage pipes
- Health Issues

Sectors

Infrastructure
Agriculture
Socio Economic
Water Resource
Transportation

Elements at Risk?

- Identifying the elements exposed (not Vulnerable) in the Hazard Zone, which is likely to have an impacts for a disaster event

Elements	Description
Population	No. of people (Age group)
Households	No. of houses (Brick, Thatched, Wood)
Livestock	No. of live stocks (cows, chicken, goat)
Agriculture	Area of crops (paddy, Groundnut, Sugarcane)
Community Places	Schools, Colleges, Community Halls etc.,
Critical Infrastructure	Airports, Mines, Gas station, etc.,

Conclusion and Recommendation

- Cartography based information in early warning services proven its efficiency in disaster risk management.
- Importance of having GIS tools is understood, to generate the user need information in terms of hazard and risk information rather than speaking in scientific language.
- Development of such systems will enable effective use of risk information for managing disaster risks.
- Asian countries lack in high resolution geographical information systems. This emphasizes the necessity for the vulnerable countries to build their capacity in GIS as well as geospatial datasets to understand and manage the disaster risks.
- The developed tools and systems has to be implemented in countries which has poor GIS capacity. Essential steps should be taken by the government and non government sectors for planning and undertaking the required measures for their betterment.

Thank you

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