

Climate Modelling, Vulnerability Mapping, Adaptation Planning

Module 5: Integrated Management: Planning, Management, and Governance
Duration: 1 Hour

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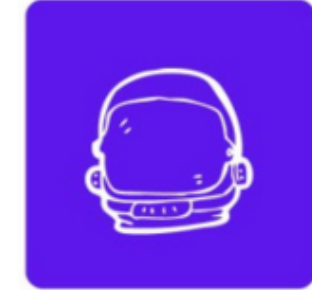
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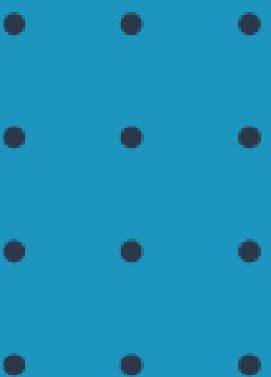


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Introduction to Climate Tools

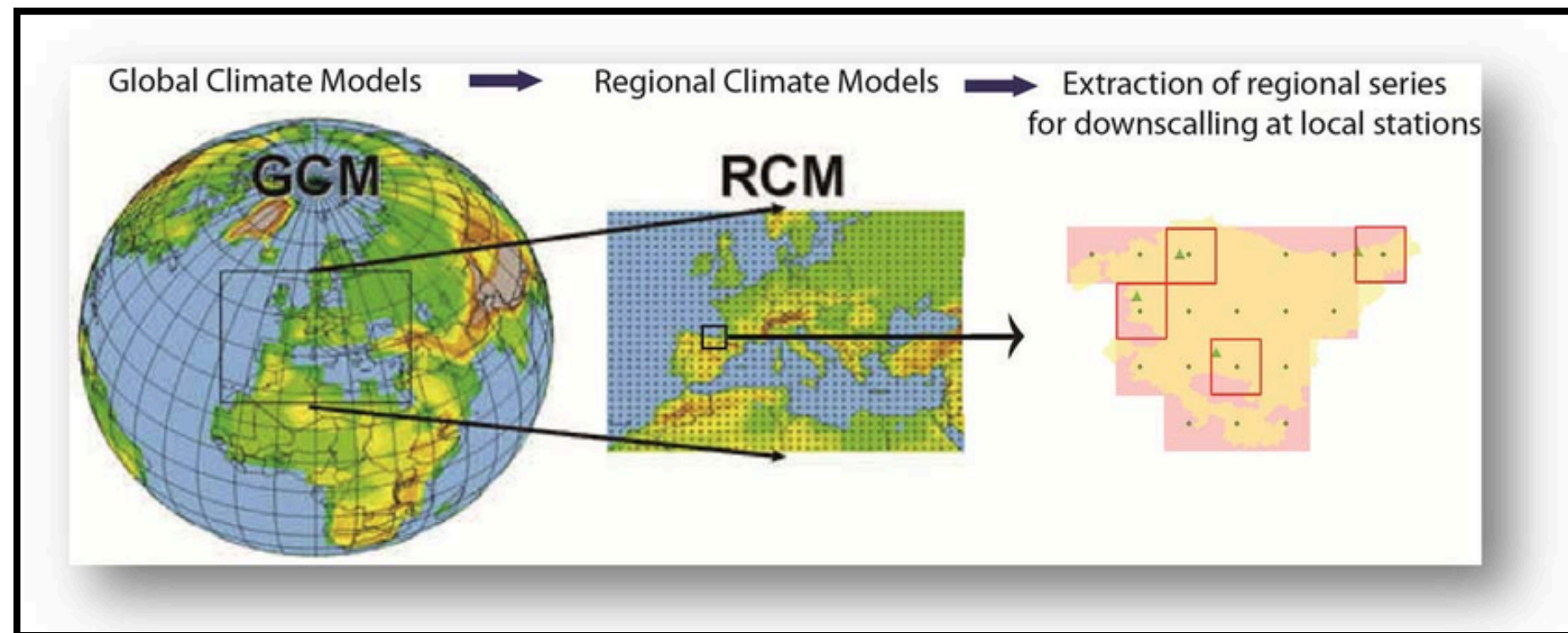
- **Climate tools** such as models and maps are essential for **planning adaptive responses** to climate change in coastal and marine areas.
- These tools help translate **scientific and climate data into actionable strategies** for communities, policymakers, and planners.
- They are used by a variety of stakeholders: **governments, non-governmental organizations (NGOs), research institutions**, and **local communities**.
- The goal is to improve **preparedness, resilience**, and **informed decision-making** in the face of climate threats such as **sea-level rise, increased storm frequency**, and **temperature shifts**.

These tools bridge the gap between science and policy, making it possible to plan realistic and region-specific adaptation actions.



Climate Models

- **Climate models** simulate changes in Earth's atmosphere, oceans, and ecosystems under different scenarios of greenhouse gas emissions.
- Global models (like **IPCC climate models**) provide broad predictions for the planet's future climate.
- **Regional models** downscale global predictions to show localized impacts, such as temperature or rainfall changes in specific coastal zones.



Climate models help estimate risks such as:

- **Sea-level rise**
- **Storm frequency and intensity**
- **Temperature shifts and heatwaves**

They support **evidence-based planning** for governments, NGOs, and local communities.

Source: European Commission Joint Research Centre, 2015.
Available at: <http://dx.doi.org/10.2790/349276>



Vulnerability Mapping

- Vulnerability mapping combines data from **physical, ecological, and social sources** to assess which areas are most at risk from climate change impacts (Ismail et al., 2020).
- Geographic Information Systems (**GIS**) are used to **visualize and analyze data**, creating maps that highlight vulnerable zones.

Maps help identify:

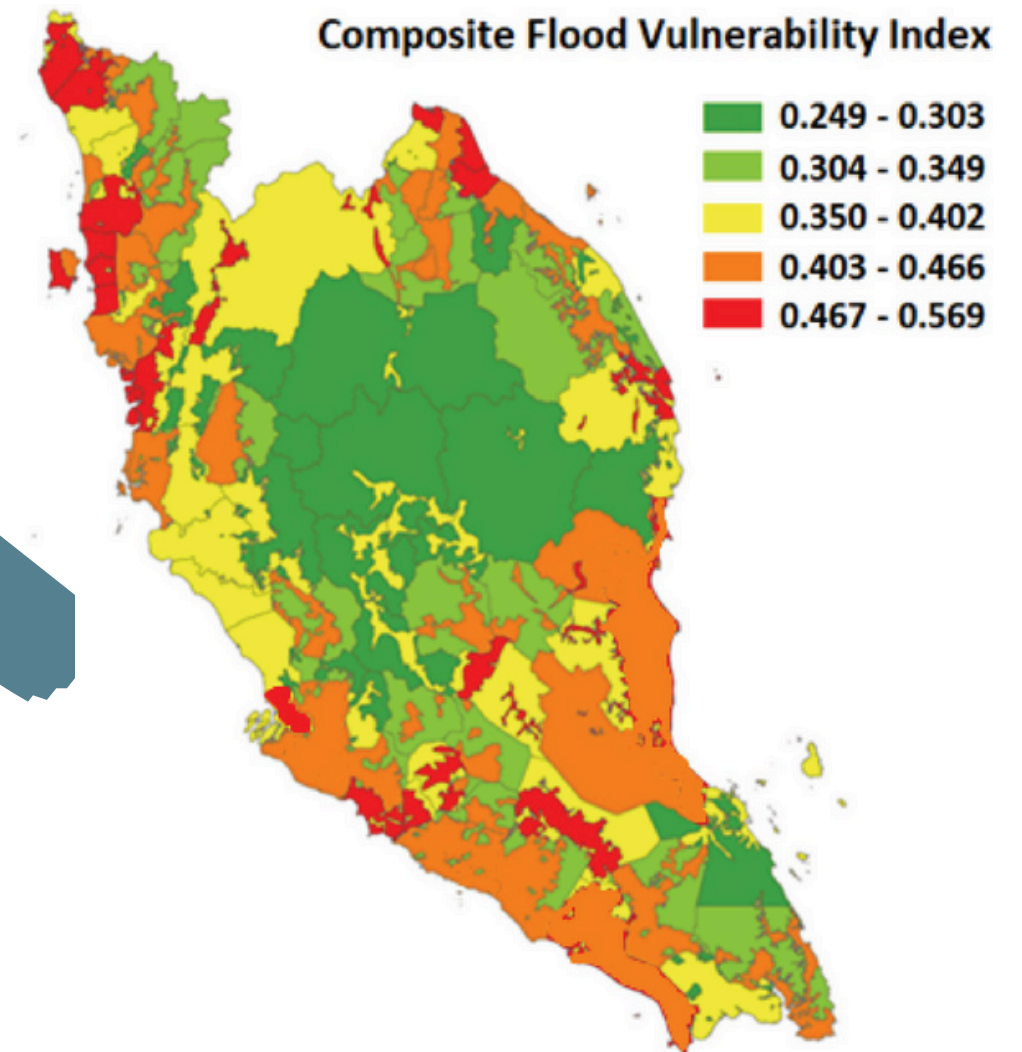
- Coastal zones exposed to **sea-level rise**
- Areas prone to **storm surges or flooding**
- Communities with **low adaptive capacity** (e.g. socio-economic challenges)

These maps guide decision-makers in:

- **Prioritizing interventions**
- Developing **adaptation strategies**
- Allocating resources where they're most needed.

Example: A composite flood vulnerability map of Peninsular Malaysia shows:

- Coastal areas are the most vulnerable.
- Highest risk in the northwest, extreme northeast, central-east, and south-west.
- Other coastal regions have moderate vulnerability scores (0.402–0.466).



Source: Zainal et al., 2020. Integration of catastrophe and entropy theories for flood risk mapping in Peninsular Malaysia. Available at:
<https://www.researchgate.net/publication/347909298>

Adaptation Planning

- **Adaptation planning** creates strategies to reduce the impacts of climate change on communities and ecosystems.
- It uses data from climate models and vulnerability maps to identify **priorities and actions**.

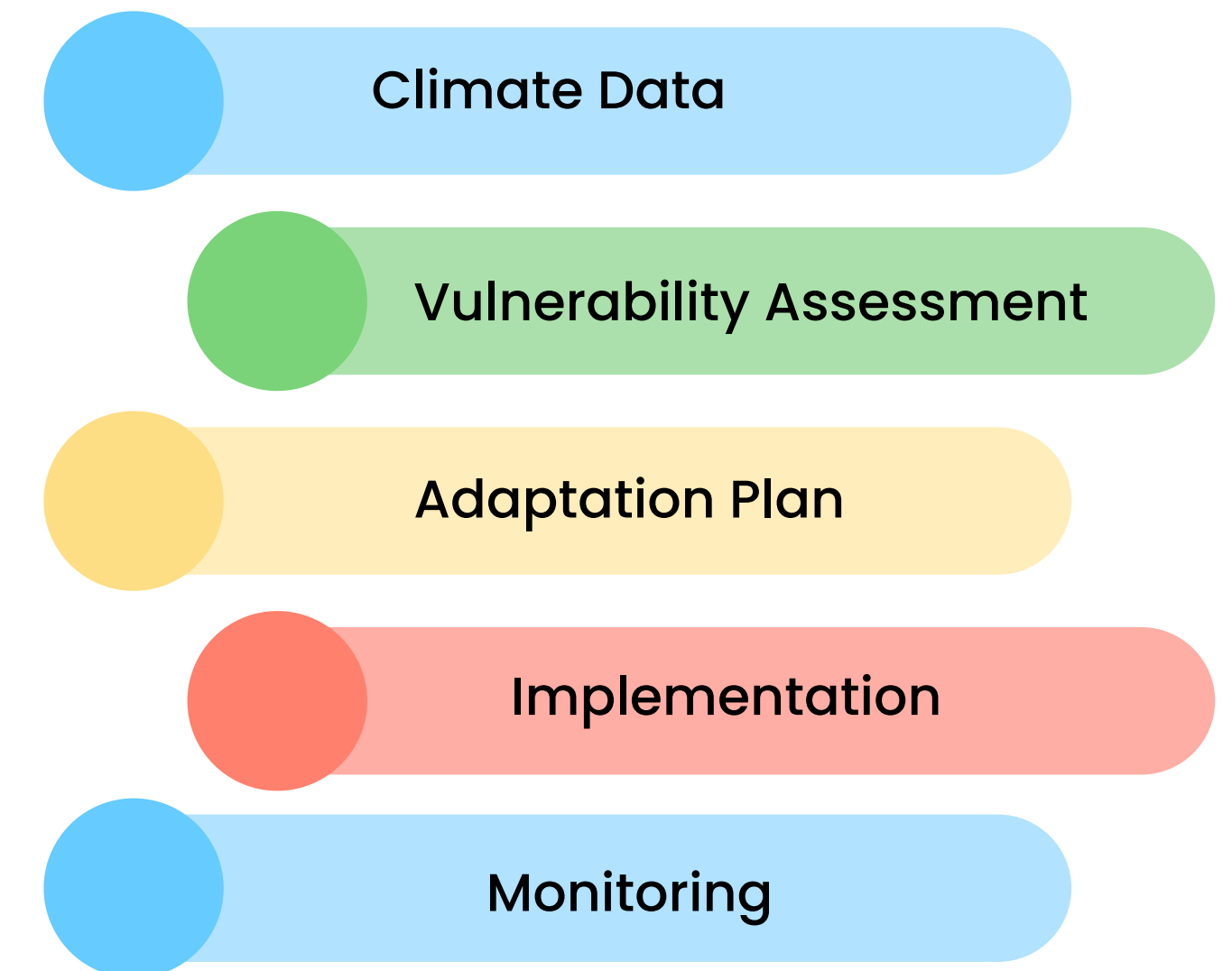
Effective adaptation planning is:

- Participatory → involves local communities and stakeholders.
- Flexible → can adjust as new climate information becomes available.
- Evidence-based → grounded in scientific research and local knowledge.

Examples of adaptation strategies include:

- Ecosystem-based approaches, like restoring mangroves for coastal protection.
- Engineering solutions, such as seawalls or raised infrastructure.
- Policy measures, like zoning laws, disaster risk reduction plans, and early warning systems.

The goal is to build resilient communities and safeguard livelihoods, infrastructure, and ecosystems.



Activity : Map Analysis

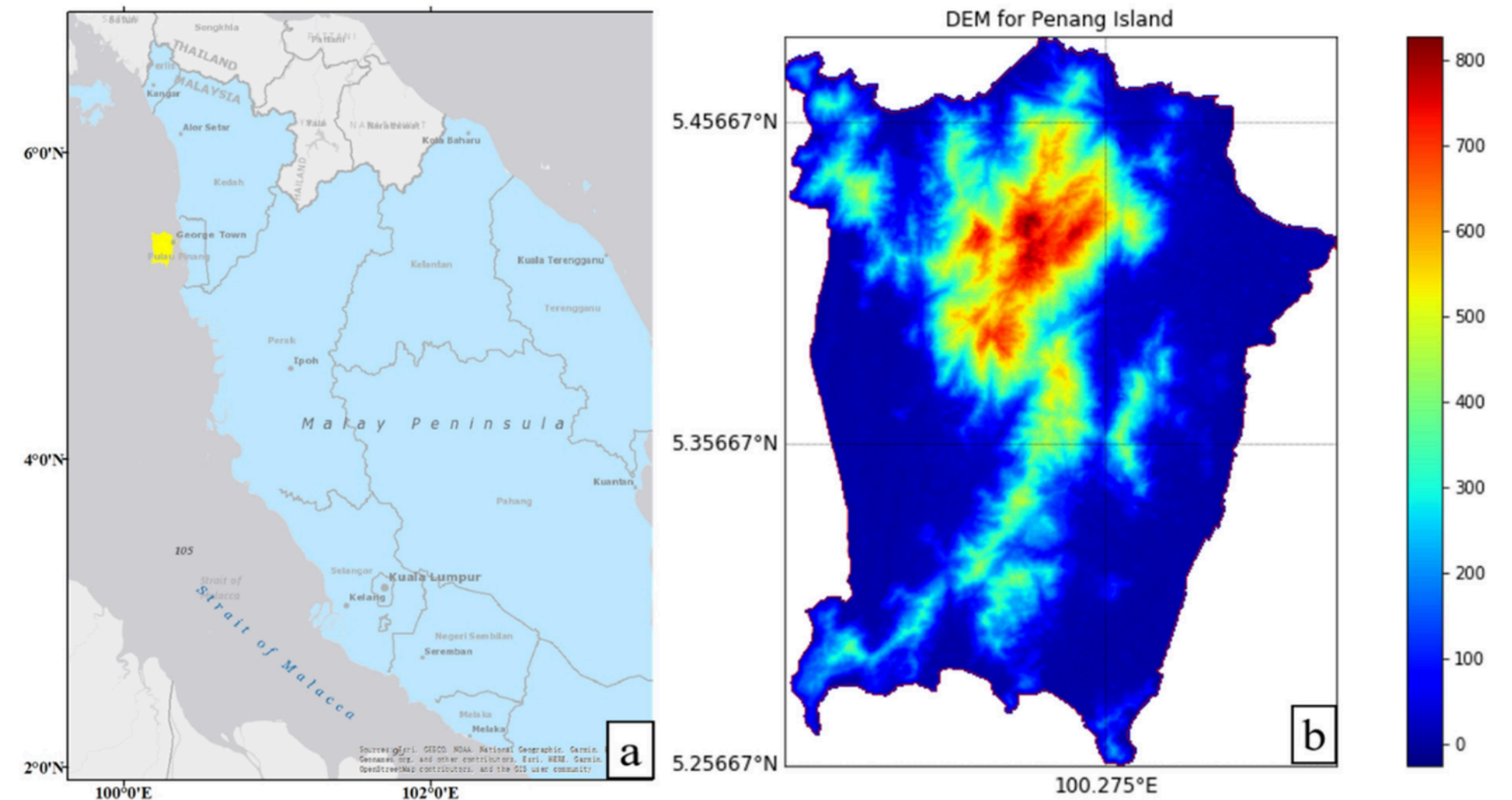
- Use a vulnerability map of a coastal area (real or simulated).
- Identify high-risk zones and propose planning measures.
- Present to peers or post your analysis summary.



Case Example: Climate Model-Informed Adaptation Plan

(Abdullah et al., 2021; DOE Malaysia, 2020)

- Example: Penang's Coastal Adaptation Plan
 - Uses **downscaled Regional Climate Models (RCMs)** to project sea-level rise and extreme rainfall.
 - Identified **high-risk coastal zones** (George Town, Batu Ferringhi).
- Implemented **nature-based solutions**:
 - Mangrove restoration
 - Urban drainage upgrades
- Integrated **community participation** to ensure feasibility and equity.



The study area and the CoastalDEM of Penang Island. (a) the study area is presented by a yellow color, and Peninsular Malaysia is presented by blue color; (b) the DEM of CoastalDEM with 90m spatial resolution (Gao et al., 2021).

Summary of Unit 5.1

- Climate models and vulnerability maps are **essential tools** for understanding and planning for climate impacts.
- **Downscaling** from global to regional models allows for **location-specific climate projections (European Commission, 2020)**.
- Vulnerability mapping integrates **physical, ecological, and social data** to identify high-risk zones.
- Adaptation planning transforms scientific knowledge into **practical strategies** for protecting communities and ecosystems.
- Successful adaptation requires **participation, flexibility, and evidence-based decisions**.



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THANK YOU

ASSOC. PROF. DR MAHADI MOHAMMAD

 +6012-472 2912

 mahadi@usm.my



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