Dynamic Climate Adaptation - A research approach in Taiwan

Prof. Dr. Gin-Rong Liu
Executive secretary, CCAT Project
Vice president, National Central University, Taiwan

2011.9.14, Kyoto

Outline

- Background
- Mission and Core
- National initiation
- Regional approach
- DPSIR framework
- Research Strengths
- Conceptualization
- Collaboration
- Discussion

Taiwan

A subtropical island country

Total 36,000 square kilometers

Hillside & Mountain:26,500 square kilometers

Population:23 million

Average Temperature

Summer ≒ 30°C ; winter ≒17°C

Economic Development

Labor-Intensive→

Technology/Captial-Intensive

Industries

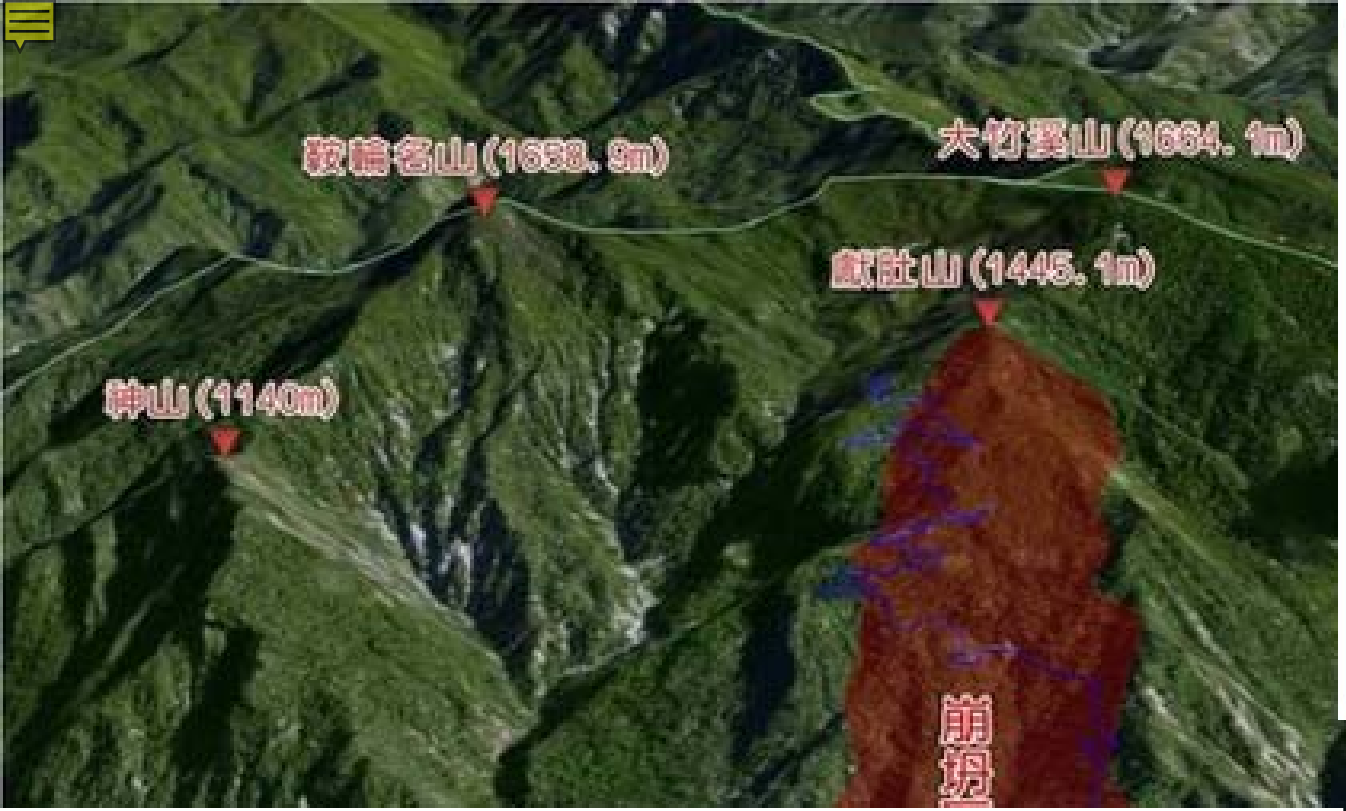
Per capita GDP : USD 2,344 IN 1980

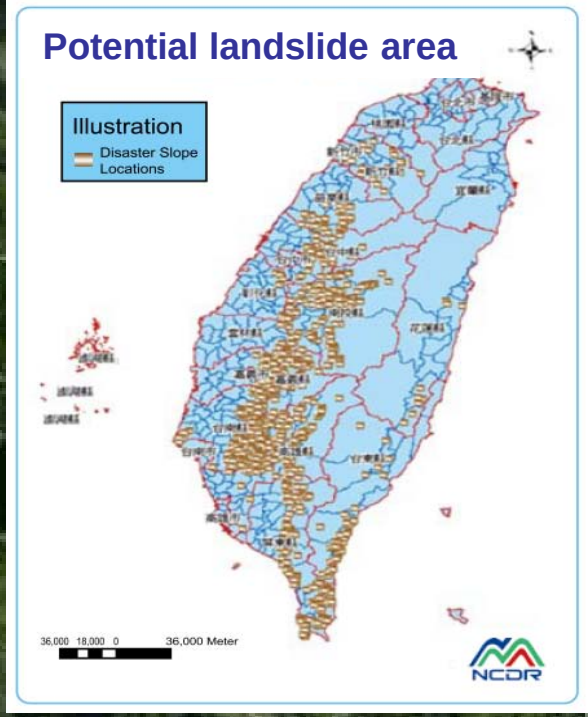
→USD 16,792 in 2007

(EPA, 2009b)

Background

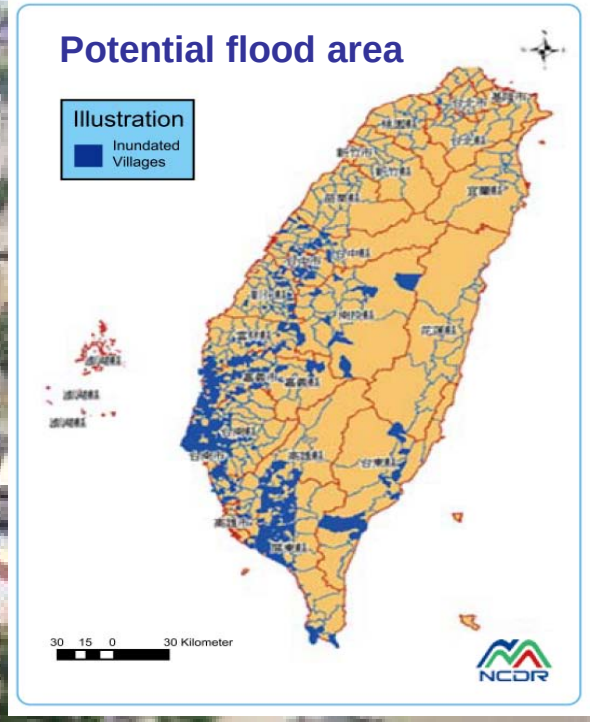
- **Climate-sensitive island:** about 73% of Taiwan's land and population is exposed to more than three natural hazards (EPA, 2009a).
- **Adaptation need:** Taiwan is densely populated and at high risk for natural hazards to which climate change has a direct effect.
- **Dynamic process:** adaptation is a complex dynamic process (Wang et al., 2011); the relationship between climate and society has always been dynamic (Hulme, 2009).

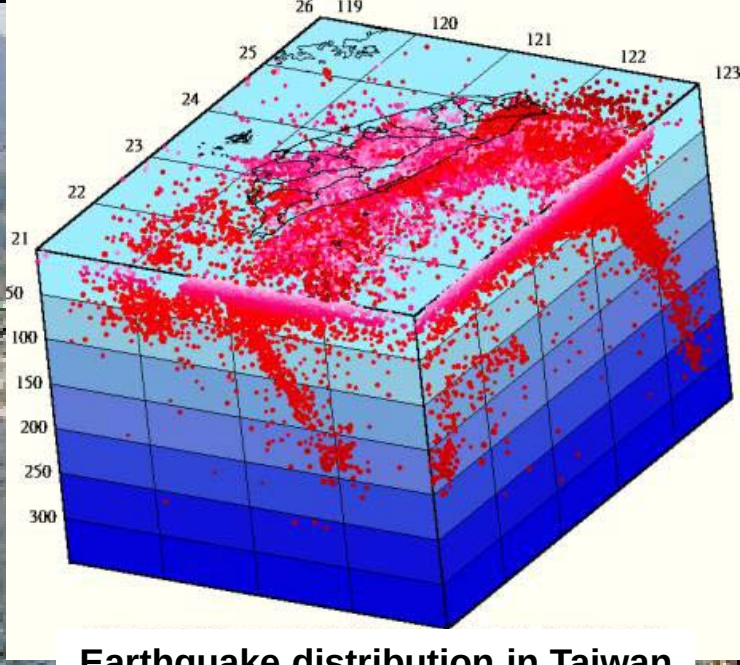




Shiao Lin village, Taiwan, drastic changes after typhoon Morakot (2009).

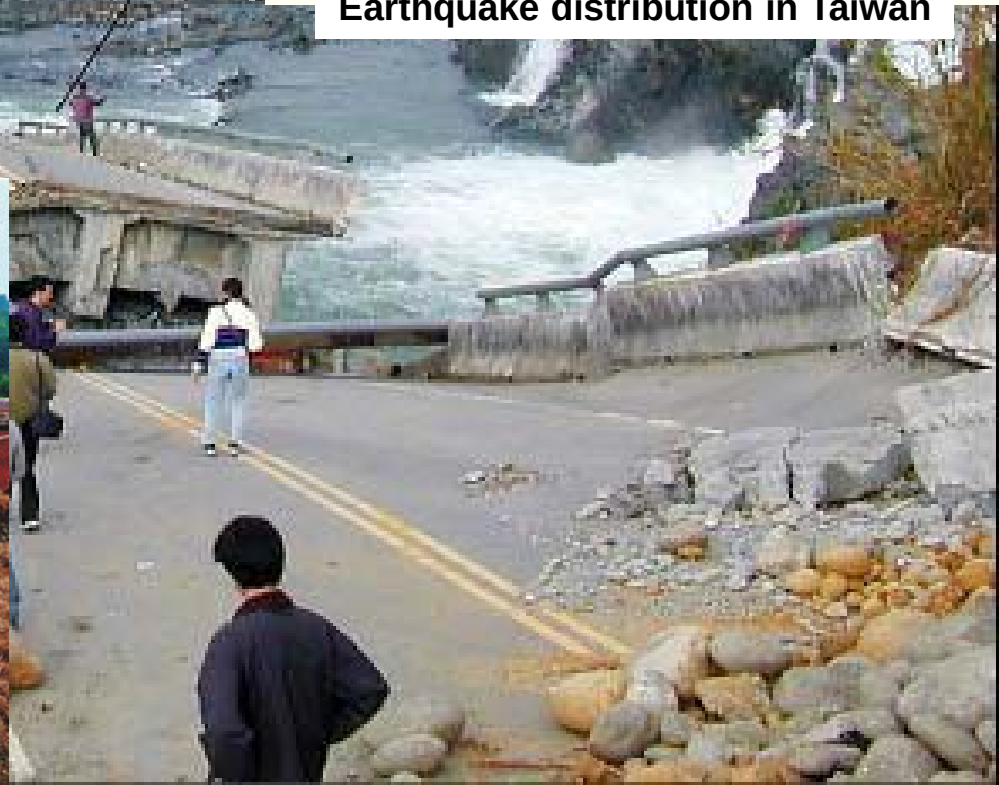
Lu-Shan hot spring, typhoon Morakot (2009).





Earthquake distribution in Taiwan

Taichung, 921 Jiji earthquake in 1999.



Mission & Core

- **Mission:**
  - To construct a sustainable environment through dynamic climate adaptation for Taiwan area.
  - Understand the interaction and mechanism between the human activity and nature environment.
  - Establish the assessment strategy for the adaptation technique.
  - Mitigate the impact from the climate change.
- **Core:**
  - Integration of science, engineering, social science, risk management, and policy research

National initiation

- **CCAT project:** the National Science Council (NSC) of Taiwan initiates an integrated research project on promoting climate change adaptation technology (CCAT) in 2011 (Chiang et al., 2010a).
- **Cross-disciplinary setup:** scientific uncertainty on climate change requires a cross-disciplinary approach to clarify and identify the interplay of society and environment.

Regional approach

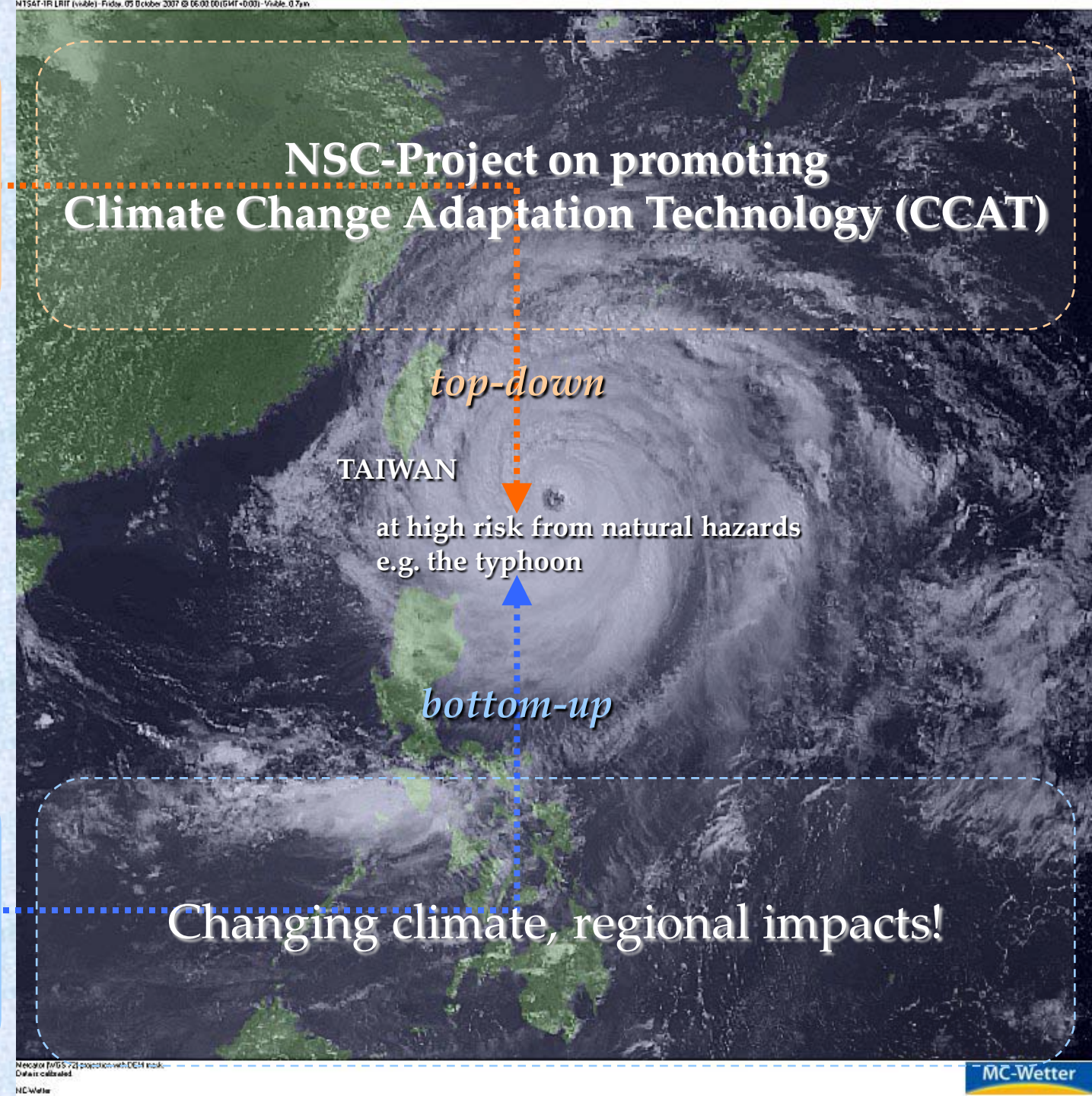
- **Regional impacts:** climate change is a global concern but the effects will be felt and dealt with at the regional or local level (Rannow et al, 2010).
- **Regional approach (RA):** the importance of regional approach meets the requirement of international and thus national need.
- **Interactive system:** (1) to meet national need, the political decision-making will depend on region locations; (2) and the scientific issue will be different for different regions.

(Chiang et al., 2011)

National initiation

Interaction

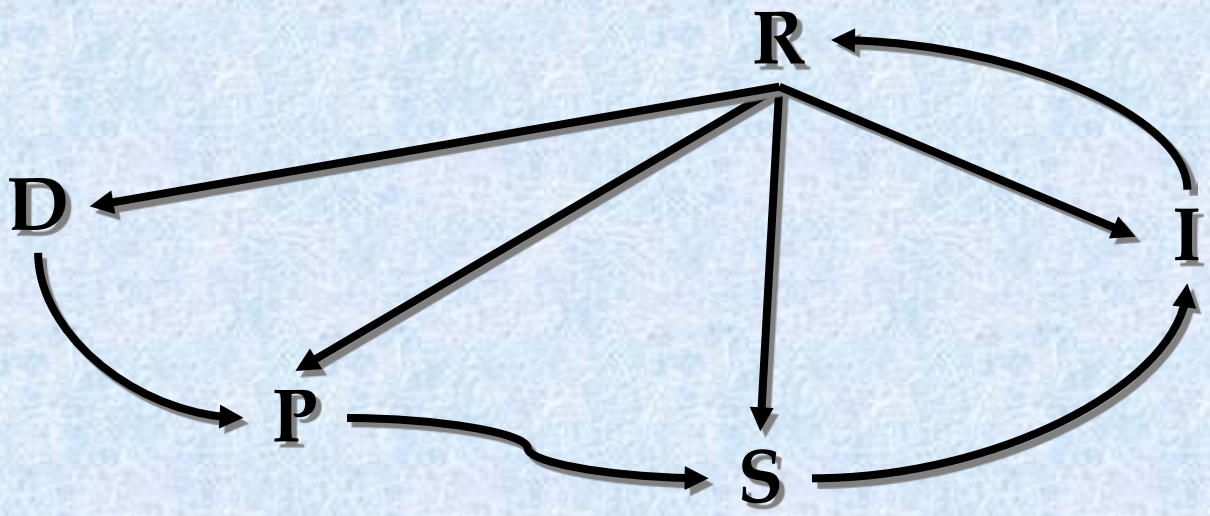
Regional approach



DPSIR framework

- **Social-ecological system:** climate adaptation is an adjustment in social-ecological system in response to climatic impacts (IHDP, 2011).
- **DPSIR framework:** Drivers-Pressures-State-Impact-Response (DPSIR) framework represents a system that includes social and ecological subsystems in mutual interactions (Rounsevell et al., 2010), and is thus capable of exchanging information among various sectors and disciplines.

- **Formulation:** the regional State (S) is the result of specific Drivers (D) and Pressure (P), which presents Impacts (I) on the environment; the Responses (R) represent the solutions for improving and maintaining the state (EEA, 2010).



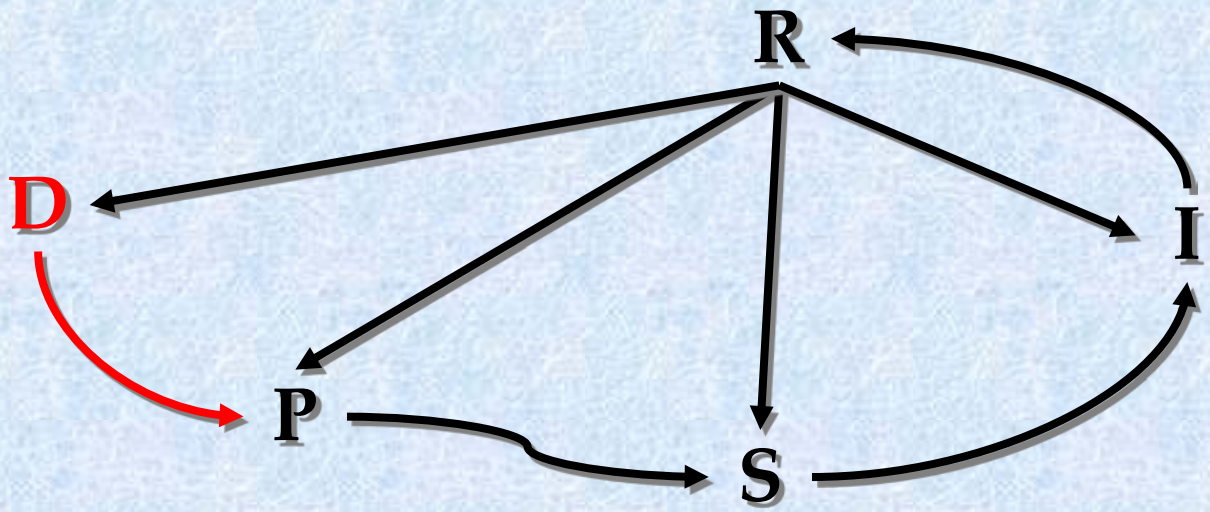
Research Strengths

- **Environmental System Analysis:**
  - Monitoring and analyzing for Greenhouse gases, Climate change, Extreme weather, Marine environment, Change detection, and Ecosystem
- **Vulnerability Assessment:**
  - For Water resources, Public health, Ecological environment, Food security, and Disaster prevention
- **Adaptation Planning:**
  - For Risk management, Technological innovation, Policy and governance, and Spatial planning
- **Integrated Efforts:**
  - National Central University, National Taiwan University, National Tsing Hua University, National Cheng Kung University, National Taiwan Ocean University, and Academia Sinica

Conceptualization

- **CVA structure:** D, P, S, I, and R components in causal relationship are useful to formulate the links of climate change (C), vulnerability (V), and adaptation (A).
- **Working groups:** accordingly, three working groups focused on Environmental system Analysis (EA), Vulnerability Assessment (VA), and Adaptation Planning (AP) are figured out.
- **Contexts:** functional and spatial contexts are established for realizing the tasks of working groups considering the gap between adaptation theory and practice (McEvoy et al., 2010).

- **EA task :**
  - developing environmental system assessment database,
  - understanding human-induced climate change that as Driver may cause global warming and some extreme weather events,
  - combining climate projections with enhanced environmental monitoring technologies.



Satellite observation

Airborne observation

Sounding observation

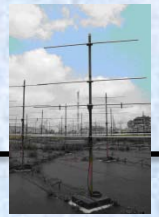
Slope-land disaster monitoring

Resource satellite station

Doppler radar

Sea surface and coastal monitoring

VHF radar



Ground observation

Underground water monitoring

Ships

Buoy, trestle

Vehicular radar

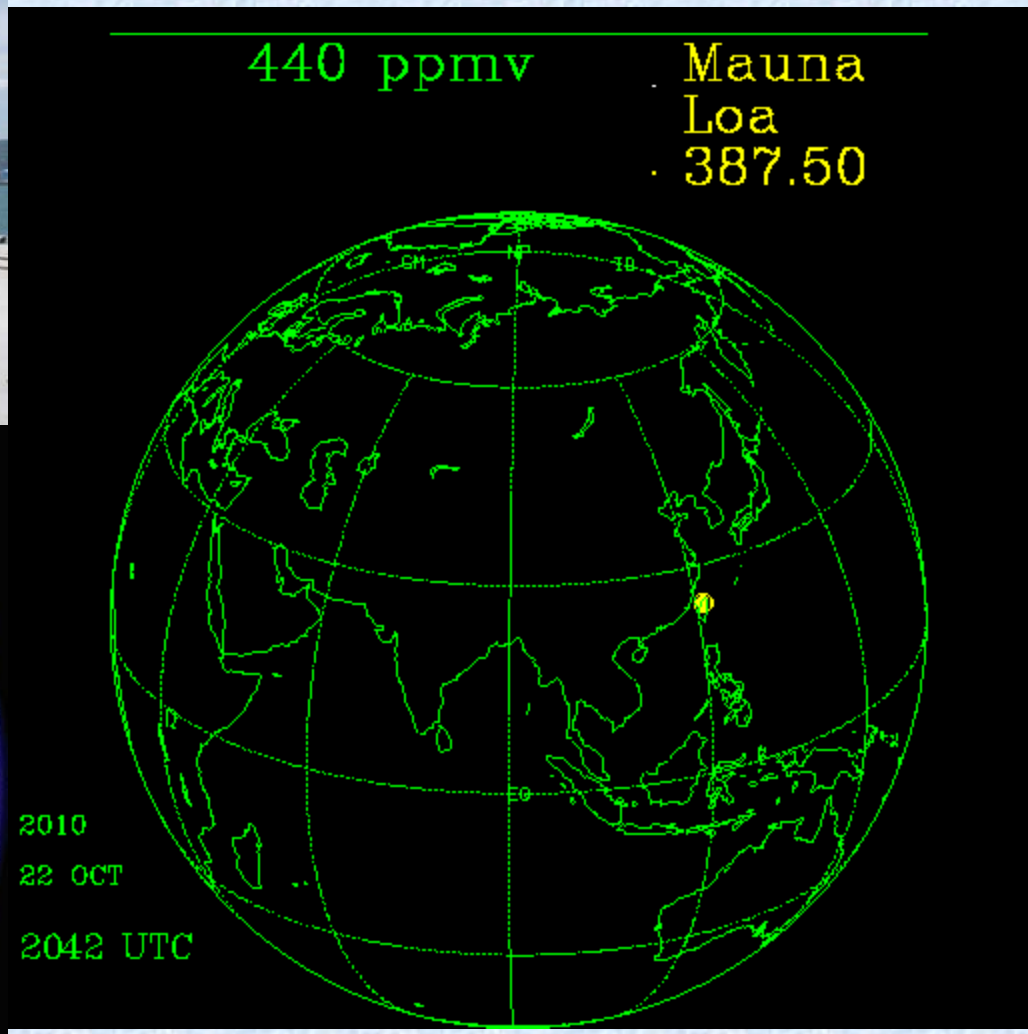
Biosphere monitoring

Solar radiation sensors

Lidar

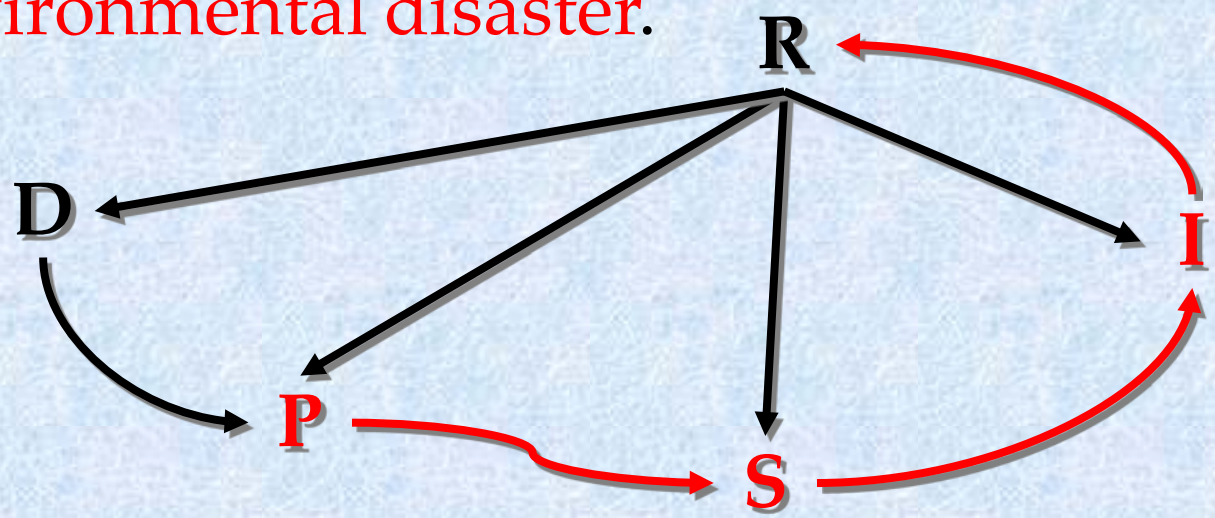
Omni-directional Environment Monitoring Network

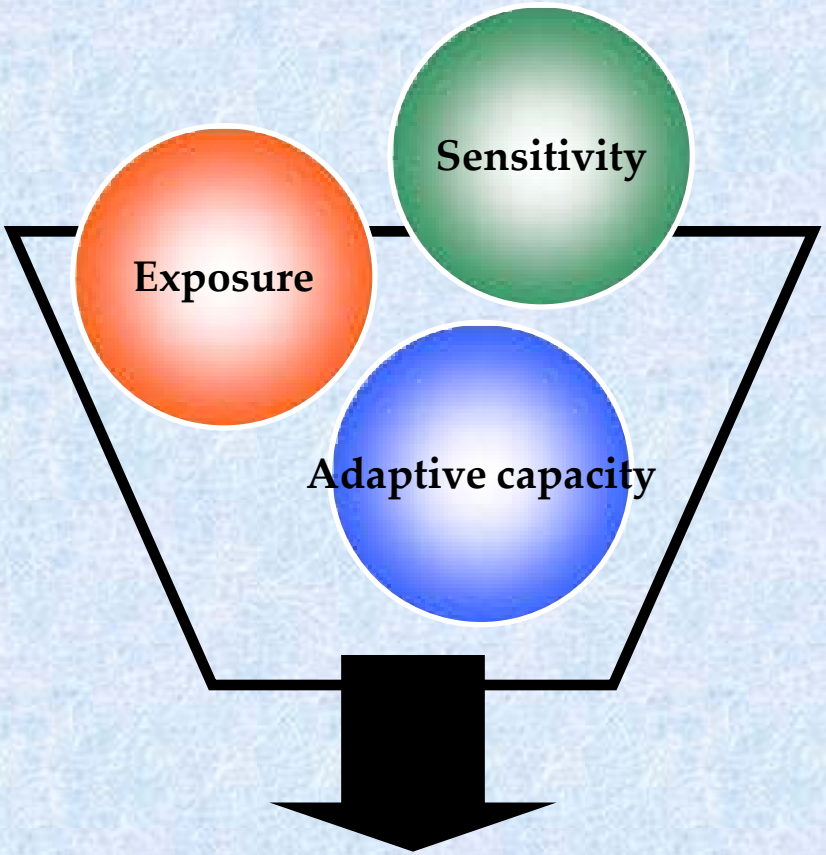
Pacific Greenhouse Gases Measurement Project



- **PGGM Project:** this Pacific Greenhouse Gases Measurement (PGGM) Project aims to observe the amounts and the horizontal resolutions of greenhouse gases in the atmosphere over the Pacific Ocean for the next 20 years to facilitate the scientific researches on climatic changes (NCU, 2009).
- **Collaboration:** PGGM project collaborates with the European IAGOS -ERI project by in-service Airbus aircrafts from China Airlines and EVA Air (Wang, 2009).

- **VA task:**
  - developing vulnerability assessment model,
  - understanding ultimate potential Impact (*human-natural* impact) regarding vulnerability comprised of Pressure (*natural* exposure) and State (*human* sensitivity and adaptive capacity),
  - across domains of such water resource, public health, ecological system, food security, and environmental disaster.



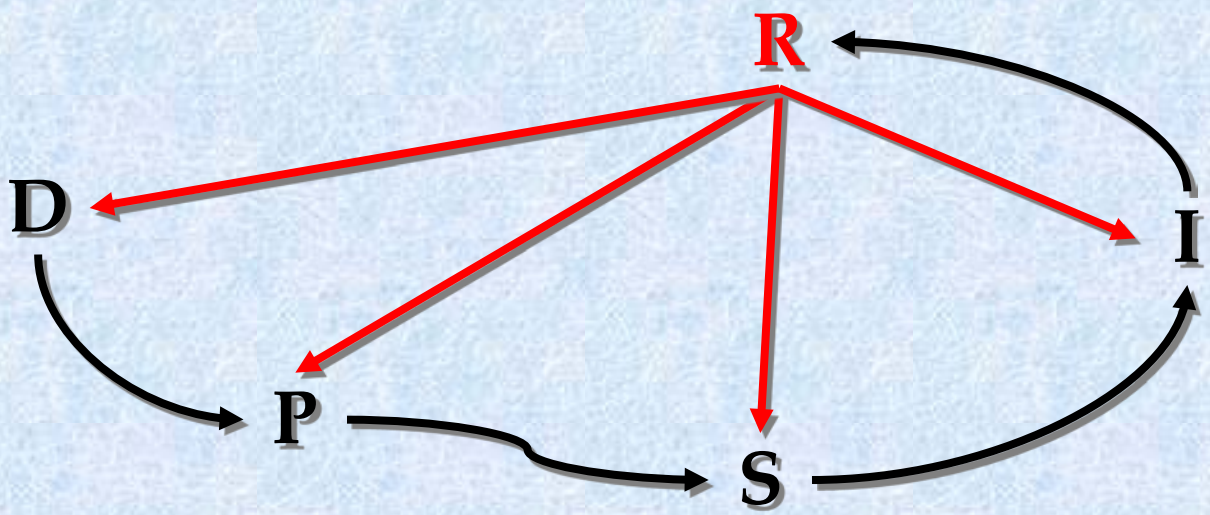


Vulnerability

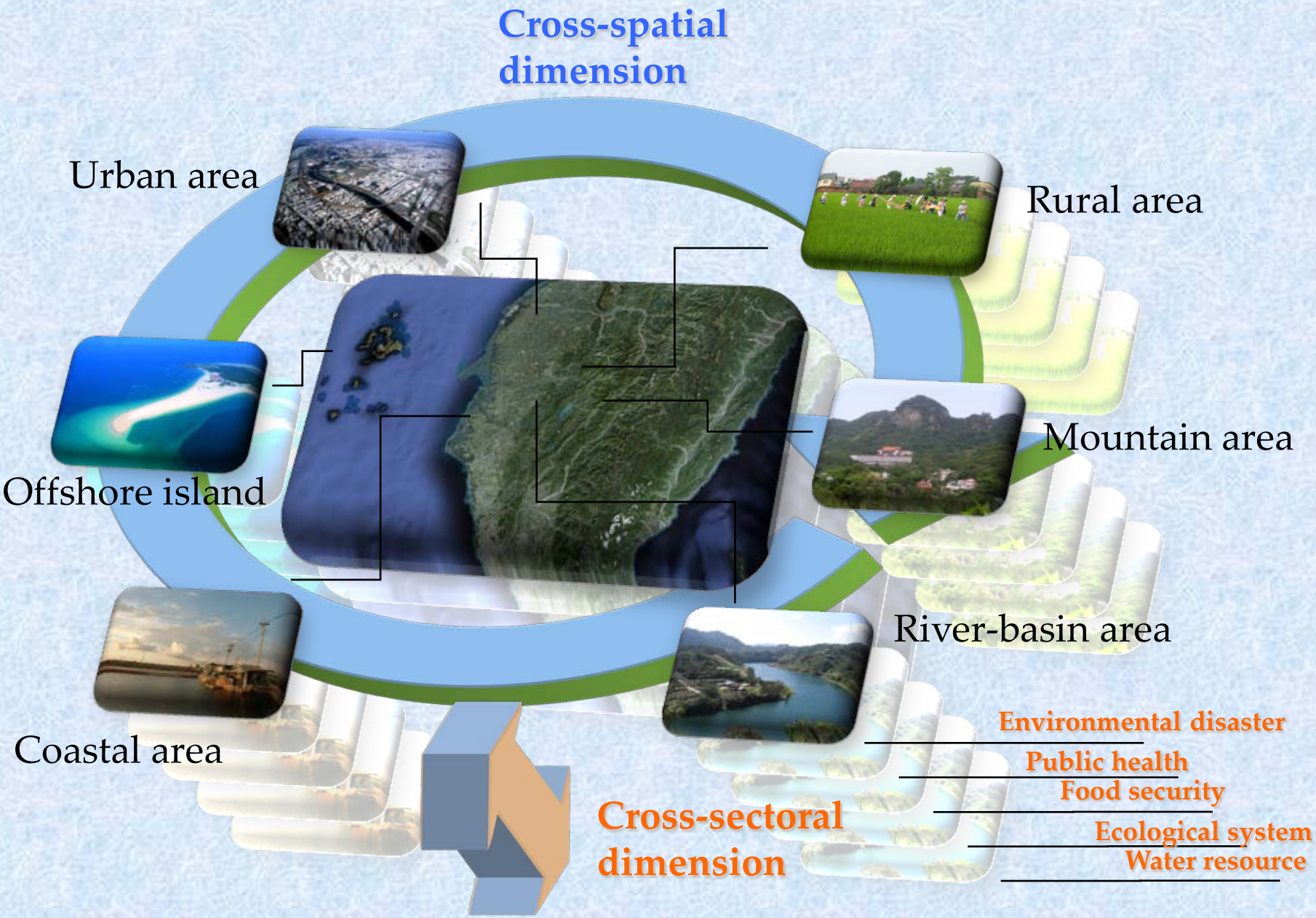
- **Exposure**
  - Climate-induced natural hazards and
  - environmental change
- **Sensitivity**
  - Land use
  - Industry
  - Population
- **Adaptive capacity**
  - Planned, autonomous
  - Centralized, decentralized

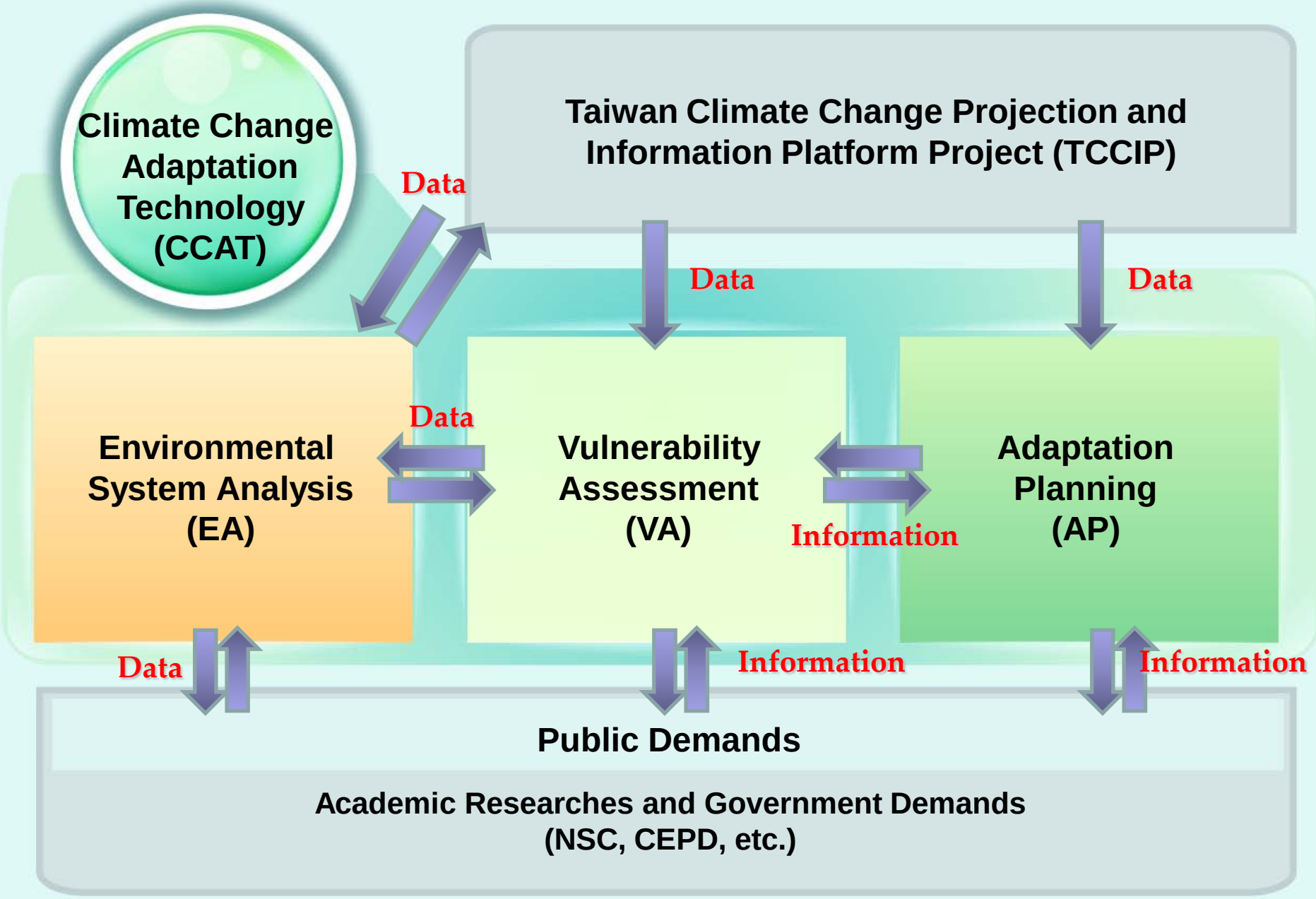
Vulnerability = f (exposure, sensitivity, adaptive capacity)

- **AP task:**
  - developing adaptation planning prototype,
  - understanding adaptation including such anticipatory, autonomous, and planned action as Response to D, P, S, and I,
  - from the aspects of such risk management, technology development, policy and governance, and spatial planning.



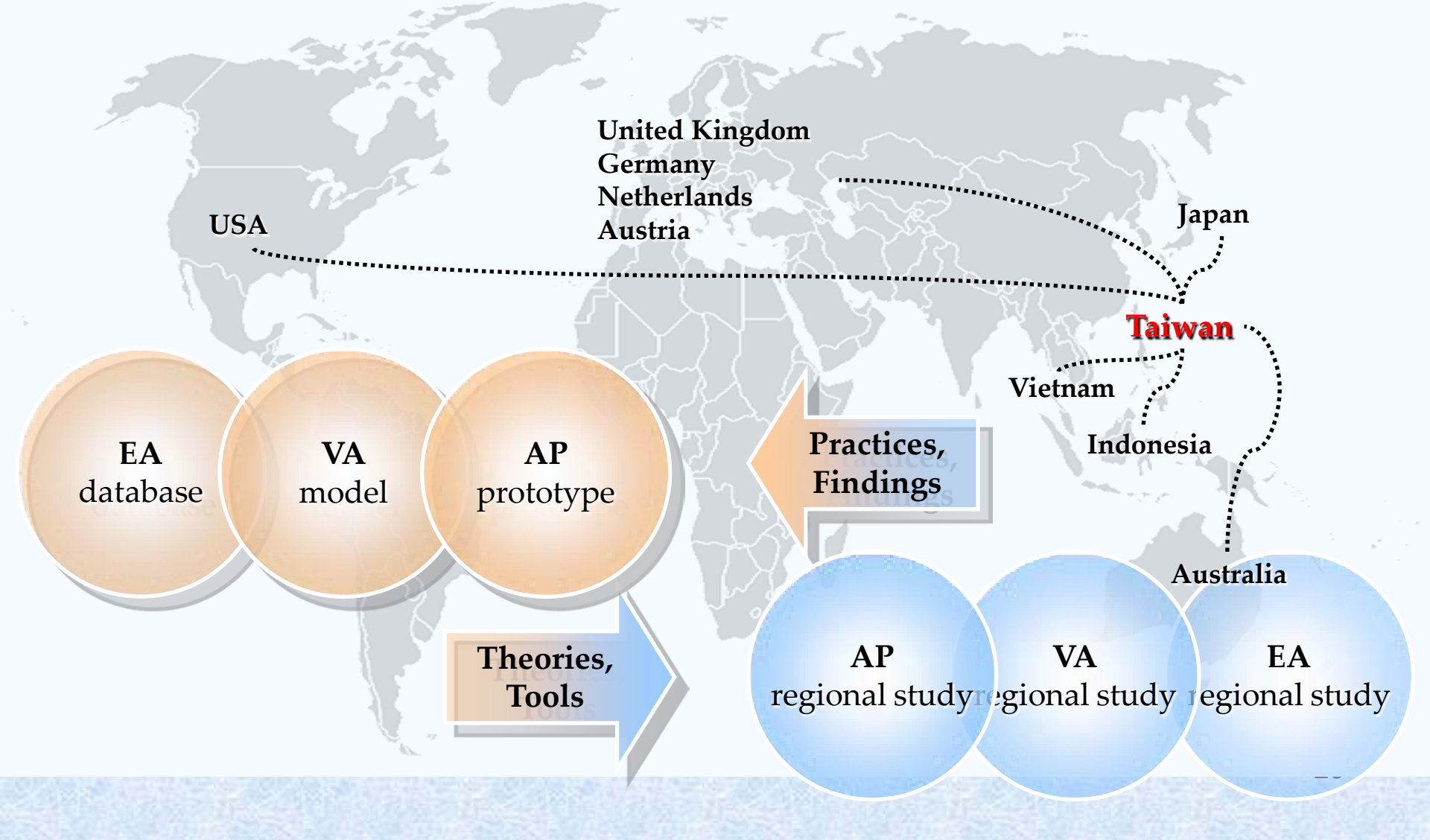
- **Functional context:** focused on the linkages among D, P, S, I, and R components that refer to the information flow, underlining the interdisciplinary approach.
- **Spatial context:** focused on the EA, VA, and AP-tasks on D, P, S, I, and R components that refer to adaptation action in Coastal, Urban, Rural, river-Basin, Offshore island, Mountain (CURBOM) study regions, underlining the transdisciplinary approach.


Cross-spatial dimension
Urban area
Rural area
Offshore island
Mountain area
River-basin area
Coastal area
Cross-sectoral dimension
Environmental disaster
Public health
Food security
Ecological system
Water resource



NSC: National Science Council; CEPD: Council for Economic Planning and Development

Collaboration



Discussion

- **Prototype:** this research approach can serve as a science-based prototype for developing sensible technologies, and fostering international research exchange.
- **Roadmap:** (1) establishing **i**nteractive relationship among working groups, (2) developing **i**ntegrative theories and tools, (3) producing **i**nnovative practices and findings, and (4) planning next steps in **3i**-circulation.

Thank you for your attention

E-mail address:

grliu@csrsr.ncu.edu.tw