



# Assessment of Active Tectonics Using Geomorphic Indices in the Badlands of Southwestern Taiwan

<u>Presented by:</u>

Kifayat Ali

Supervisor:

Prof. Maryline Le Béon

### **Institute of Applied Geology:**

National Central University (NCU), Taiwan

### **Tectonic Setting of Taiwan:**

#### **Location:**

Taiwan lies at the boundary where the Eurasian Plate collides with the Philippine Sea Plate.

#### Southwest Taiwan:

- > Part of the fold-and-thrust belt.
- Ongoing tectonic uplift and subsidence is due to compression and under thrusting.



Geotectonic framework and major structural units of Taiwan between the Eurasian and Philippine Sea plate.

### **Research Area**

#### **Geological Composition:**

- This region comprises a fold-and-thrust belt with major reverse faults such as the Chishan, Chegualin, and Gutingkeng Faults, as well as the Nanlao Syncline.
- The region's badlands are primarily formed from Late Miocene to Early Pleistocene Gutingkeng Mudstone, which is 3 to 4 kilometers thick and contains thin sandy layers and shales.



Image from Field in the Badlands of Southwestern Taiwan.



### **Ongoing Deformation of Southwestern Taiwan**

#### **Horizontal Velocity Map Vertical Uplift:** The map uses a color gradient to 23'30' Color scale: Represents uplift (redindicate horizontal velocity rates of yellow) and subsidence (blue) in mm/yr. movement. > Blue regions indicate areas with slower horizontal movement. 20 23°00' > Red regions indicate areas with 10 (mm/yr) faster horizontal movement. -10 0 Uplift rate ( Black Arrows (Velocity Vectors) $\succ$ The length of arrows represents the magnitude of horizontal<sup>22'30'</sup> motion. 5 8 ·30 mm/yr Upward ( $\blacktriangle$ ) indicate uplift. 22°00' Downward ( $\mathbf{\nabla}$ ) indicate subsidence. $\geq$ Size of triangles represents the rate of 120'00' 120'30' uplift or subsidence. 20 40 60 Horizontal Velocity (mm/yr)

Ching EK et al. (2021)

### **Research Goal**

□ The **Primary Goal** of my study is to quantify and understand the **long-term deformation** processes in **Southwestern Taiwan**.

#### **Research Focus:**

Analyze how Geomorphic Indices in badlands reveal uplift and erosion.

- InSAR (LOS) = Short-Term Surface Deformation monitoring (e.g., 10–50 years).
- Geomorphic indices = Long-term landscape response to tectonics ("Pgtk" Early Pleistocene

~ 0.8 Ma).











(Pathier et al., 2014)

### **Methodology**

## **Geomorphic Indices**

Geomorphic indices are quantitative measures used to detect changes in topography caused by tectonic activities, such as uplift or subsidence.



### **Basin Relief:**

Difference in elevation between the highest and lowest point.





200 - 155 = 45 m

### **Hypsometric Integral**

The **Hypsometric Integral (HI)** is a numerical value that represents the **distribution of elevations** within a drainage basin.

**Convex** Curves

**High HI values** 

Active tectonics

- > High HI  $\rightarrow$  tectonically active, steep slopes, less eroded.
- $\succ Moderate HI \rightarrow balanced uplift and erosion.$
- > Low HI  $\rightarrow$  highly eroded, low relief.



(h/H)

Youth Stage







### **Conclusion**



### **Future work**

### **Complete Site 4 Analysis:**

- Calculate Hypsometric Integral and Basin Relief for interested sub-basins.
- Compare results with the other three sites to identify spatial variations in tectonic activity.

Additionally, focus on understanding the variability of curves across all sites.

### Thank you, everyone, for your valuable time and attention.