Scale dependency of hypsometric integral in mountain region of Taiwan

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Outline

- Background
- Method
- Preliminary results
- Future work
Background

Davis, 1899
Strahler, 1952
Ohmori, 1993
Stolar, 2007
Chen, 2015
鄭光佑, 2016

River terrain analysis
Background

Davis, 1899
Strahler, 1952
Ohmori, 1993
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River terrain analysis
Background
Davis, 1899

- Cycle of erosion
  - Uplifting
  - Young
    river incision dominant
    steepening slope
  - Mature
    incision slow down
    decreasing slope
  - Old
    river takes the material above base-level
    peneplain

Source: http://www.staff.amu.edu.pl/~sgp/gw/wmd/wmdfig.html
Background

Drainage basin analysis

Strahler, 1952
Ohmori, 1993
Stolar, 2007
Chen, 2015
鄭光佑, 2016

mountain evolution
Background
Strahler, 1952

Youthful stage

Mature stage

Old stage
Background
Strahler, 1952
Background
Strahler, 1952

Inequilibrium stage
Equilibrium stage
Monadnock phase

Strahler, 1952
Background

Davis, 1899
Strahler, 1952
Ohmori, 1993
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鄭光佑, 2016

Drainage basin analysis

mountain evolution
Background
Ohmori, 1993

- With high uplifting rate, Strahler’s (1952) model can’t completely explain the nature condition in Japan
- Concurrent uplift and erosion
- Numerical Simulation of a topography model
- Reverse of Strahler’s diagram

\[ U = 2 \times 10^{-3} \text{m/yr} \]
Background
Ohmori, 1993

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With high uplifting rate, Strahler’s (1952) model can’t completely explain the nature condition in Japan.

Concurrent uplift and erosion.

Numerical Simulation of a topography model.

Reverse of Strahler’s diagram.

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Background

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Drainage basin analysis

mountain evolution
Background
Stolar, 2007 & Chen, 2015

• Reduce the effect of local structure

• Eastern drainage basin

• Reduce the effect of depositional flat plain

• Remove plain from each basin

• Concern the developing of mountain range (oblique collision)

• Oblique axis
Background
Stolar, 2007 & Chen, 2015

• Using steepness index to group the basins and determine different evolution stages from the range.

• Combine it with tectonic background of Taiwan.
Background
Stolar, 2007 & Chen, 2015

• From previous two studies, we can know that the mature mountain is located at the interval about 75-225km from the southern tip of Taiwan.
Background

Davis, 1899
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Drainage basin analysis
Scale dependency

mountain evolution
Background
鄭光佑, 2016

- Three contradictions
- HI is proportional to development of mountain
- There is **scale dependency** in hypsometric analysis
- HI value is in negative correlation with uplift rate
- The main reason of scale dependency at western foothill may be non-comprehensive uplift.
Method

- Erosion dominated
- Deposition dominated
Method

Elevation-Relief Ratio = \( \frac{h - h_{\text{min}}}{h_{\text{max}} - h_{\text{min}}} = HI \)  

(Pike, 1971)
Preliminary results

• Taoyuan table land and Bagua Plateau can be explain by the original theory, which the land has uplifted and now is dominated by erosion.

• Central Range has mature pattern.

• The HI of Western foothill and Coastal Range still can’t represent its evolution stage.
Preliminary results

- Choose Shihmen Reservoir for testing area.
- Select the drainage basins that are larger than 2km$^2$ as analysis units.
- Plot the elevation distribution.
Preliminary results

- Not obvious result so far.
Future work

• Complete the elevation distribution plot of collapsing part and growing part of Central Range.

• In different mountain evolution stages, pick small watersheds to do detailed analysis.
Thanks for your attention