A Paradox of Concurrency of the Davisian End -peneplain and the Penckian Primary Peneplain

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The Davisian scheme elucidates topographic evolution of mountain building by denudation processes, postulating prolong still-stand following rapid uplift. It shows that a mountain ultimately results in a peneplain with low local relief. Penck considered that topography is shaped by concurrent tectonics and denudation, and proposed the primary peneplain as an antithesis against the Davisian end-peneplain by assuming a steady state between uplift and denudation from the start of uplift. Topographic evolution of a mountain has been expected to follow a course between "the two extreme opposite courses" through an orogeny. But observed data of denudation rate, local relief and mountain altitude suggest that the primary peneplain should be equal to the end-peneplain.

**Key words:** peneplain, topographic evolution, denudation, uplift
Actualistic Model of the Ocean Floor Relief Evolution
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In search of a general idea for the structural relief space changeability a clear correlation has shown between relief energy in rift zones and geologic age of the mid-ocean ridges (MOR) spreading centers. Thus morphometric characteristics of the horizontal ($f$) and vertical ($h$) ruggedness of relief for the rift zone of Reikjanes ridge (60 mill. yrs) established at the average of 2.0 km and 180 m correspondingly; for the Azores segment (90 mill. yrs) - 2 km and 235 m; for tropical segment of the northern mid-Atlantic ridge (180 mill. yrs) - 3.5 km and 350 m. The morphometric data indicate to the fact, that as the spreading centers’ age change the ratio of volcanic and tectonic factors in the relief formation changes as well. Extrapolating the data on structural relief of the modern rifts of different geologic age to the MOR periphery we can establish distinctive features of the ocean floor evolution processes. Such an actualistic model can be evidently employed to analyze a much wider range of the sea floor structural phenomena. The differences in the relief morphometry correlate with the differences in the chemical composition of the rift zones tholeite basalts, seismicity and geophysical fields’ parameters. 

Key words: morphometry, center of spreading, evolution, geologic age
Mechanisms and Rates of Fluvial Bedrock Incision in Taiwan

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Of all the mechanisms of continental denudation, fluvial erosion of uplifting bedrock is thought to be crucial because it sculpts the local relief upon which the mass wasting of hillslopes depends, and creates the conduits for transfer of the erosion products. Despite its importance, the process is poorly understood. Key questions are: what are the principal mechanisms of fluvial bedrock incision, what is the rate of the process, and what controls that rate? These questions are addressed in a field experiment, located in the eastern Central Mountains of Taiwan. There, networks of recessed benchmarks were installed, spanning bedrock channels from low flow line to above extreme flood level. Between benchmarks, the channel bed topography is surveyed at regular intervals in order to obtain an accurate measure of fluvial erosion. We will review the patterns and rates of bedrock wear observed in the Liwu Chi catchment since February 2000, and interpret these observations in the context of the ambient hydro-meteorological conditions, sediment production and transport, and the long-term rock uplift and exhumation rates. Finally, we will propose alternatives to the current, stream power rule representation of fluvial bedrock incision in surface process models.

Keywords: Fluvial bedrock incision, mechanisms, rates, Taiwan.
Evaluation of a Physically Based Model for Medium Term Soil Erosion
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A physically-based soil erosion model, EROSION 3D, has been applied to a small, loess covered, zero-order catchment. EROSION 3D, which requires relatively little parameterisation, is one of the few physically-based models that can model soil erosion processes over extended periods, and produces temporally and spatially distributed rates of erosion and deposition. The model has been used to determine rates of rainfall induced soil erosion and deposition for the period 1954-1999. The effects of tillage erosion and translocation have been calculated on the basis of topography for the same period. These have been compared to the temporally integrated but spatially distributed pattern of soil redistribution for the same period revealed by the distribution of $^{137}$Cs. $^{137}$Cs concentrations include the effects of both tillage and rainfall-induced sediment redistribution. Removal of the effect of the former allows a direct comparison between Cs-based rates and those modelled by EROSION 3D. An assessment of the model’s viability for replicating longer term patterns is thus possible.

Key words: soil erosion, modelling, EROSION 3D, $^{137}$Cs.
Green's Function of Mass Transport and the Landform Equation

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Transport of earth surface material associated with diffusion brings a topographic change. The essential feature of this geomorphic process is described in terms of transport distance and areal spreading of mass by the process concerned. A unit mass on a slope moves at the rate \( b \) downward and spreads at the diffusivity \( a \), simultaneously. Thus, we may introduce

\[
u = \frac{1}{2\sqrt{\pi at}} \exp\left(-\frac{(x-bt)^2}{4at}\right)
\]

(1)
as a Green's function for unit mass at \( x \) in one dimensional case. This gives the diffusion over the area \( at \) and the transport of the distance \( bt \) of unit mass situated on \( x \) at \( t=0 \) during the time \( t \). Eq.(1) is applied to any kind of mass movement, though the constants \( a \) and \( b \) may change by the processes. Topographic change due to the mass is distributed continuously is given by the integration of Eq.(1), and the result gives the general solution of the landform equation which means that rate of erosion is proportional to the convexity and gradient of land surface. The solution derived from the landform equation shows retreat and subduing of a vertical scarp at \( x=0 \) with time as the simplest case.

**Keywords:** mass transport, Green's function, landform change, landform equation

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A Simple Model for the Formation of Vegetated Dunes
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A simple model for the dynamics of dunes associated with vegetation is proposed. Using the model, formation processes of transverse dunes, parabolic dunes and elongated parabolic dunes according to two environmental parameters: i) the amount of sand at the source, ii) the wind force at the desert area, are simulated. The results have qualitative correspondence to the real counterparts, and simplicity of this algorithm and the consequent easiness of the handling of this model provide us with wide applicability for the investigation of the complex interplay between vegetation and dunes.

Key words: dunes, vegetation
Magnitude-Frequency Distribution of Landslide Mass in Uplifting Mountains

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The frequency distribution of landslide was analyzed for various geology and altitudinal zone in the Akaishi Mts., central Japan. Cumulative number-area relation of landslide mass shows power law distribution, \( \log_{10}N(x) = a - bx \), where \( N(x) \) is cumulative number of landslide masses \( \geq x \), \( x \) is the magnitude expressed by \( \log_{10}A \), \( A \) is the area of a landslide mass. The \( b \) decreases from 2.5 to 1.3 with the increase in altitude for all geology. The \( b > 1 \) means the effectiveness of small and frequent landslides to the total landslide area. Volume of landslide mass, expressed by a power function of the mass area, is a more important index to evaluate the effect of landsliding on geomorphic processes. The cumulative number-volume relation indicates small and frequent landslides are more effective on erosion in low altitudinal zone (<800 m asl.), whereas the large and rare landslides are more effective in high altitudinal zone (>1600 m) for all geology. This suggests that the larger landslide, which should be controlled by the local relief, is more important for the long-term landscape evolution in tectonically uplifting high-altitude mountains.

Key words: landslide, Akaishi mountains, magnitude-frequency distribution, altitude
Modelling Regional Landform Evolution Through Frequency and Magnitude
Behaviour of Geomorphic Processes
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Quantitative process-based models have become increasingly prevalent, and have considerable use in applied geomorphology and represent the best means of testing and developing theoretical models. Nevertheless, there remains a considerable gap between the quantitative representation of process behaviour and its extrapolation to spatial and temporal scales relevant to landform evolution. Models of regional landform evolution must be able to integrate the behaviour of a range of processes that operate at differing frequencies and magnitudes. The modelling focus therefore needs to be shifted from individual processes, and concentrated instead on modelling of their combined effect at broader temporal and spatial scales, i.e. the movement of mass throughout the landscape. This paper presents a formulation for modelling of regional sediment flux at a Holocene temporal scale. The model routes sediment through a series of topologically linked geomorphic units that represent sediment production and storage units. The temporally integrated production of sediment from each individual geomorphic unit is derived through reference to frequency/magnitude distributions of process behaviour. The model thus provides a framework for linking individual geomorphic systems, that can themselves be modelled at greater detail using more sophisticated models, as components within a regional scale sediment flux model.
Tiling Properties of Drainage Basins and Their Physical Bases
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The law of stream numbers for drainage basins characterised by Tokunaga cyclicity is derived from a recursion formula consisting of three terms. Then two of the coefficients of these terms are produced from solutions of a quadratic equation. The recursion formula expresses Fibonacci sequence when the quadratic equation is given by $x^2-x-1=0$. It is well known among crystallographers that one of the solutions of the equation, $x=(1+\sqrt{5})/2$, is a key number to form a self-similar tiling pattern of an one dimensional quasicrystal. The law of stream number provides self-similar tiling patterns on a two dimensional plane together with the law of basin areas. Such tiling patterns are regarded as a generalised Sierpinski space consisting of subbasins and interbasin areas, while Fibonacci sequence is related to the Sierpinski triangle. The most probable state of potential energy expenditure of water flowing in stream channels is sustained in drainage basins that satisfy Tokunaga cyclicity. There are some properties mathematically and physically common to drainage basins and quasicrystals.

Key words: tiling, self-similar, drainage basin, potential energy, quasicrystal
Mathematical Modeling of Landforms
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There has been rapid progress over the last few years with regard to understanding various features of basin-scale hydrology and geomorphology from the governing conservation equations. This work builds on early work by Smith and Bretherton (1972), Luke (1974) and others and seeks to make quantitative and testable predictions about a variety of observed features like: (a) longitudinal profiles, (b) empirical equations for hydraulic geometry, (c) Horton's laws, (d) spacing of rills and gullies, and (e) equivalent optimality principles. The author will discuss these topics in the context of new analytic results for an "ideal landform equation". This equation is a nonlinear but tractable special case of a coupled set of equations that has been studied numerically by Smith et al. (1997).

Keywords: conservation equations, landforms, mathematical models, nonlinear
Scale specific landforms and aspects of the land surface
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Attempts to fit scale-free fractal models to the land surface have instead established further scale-specific features. These include stream heads, valley spacing, breadth and spacing of volcanic and tectonic features, and the size of specific landforms in glacial, aeolian and karst geomorphology. Fractal dimensions estimated at broad scales (around 200 km) are about 2.66, considerably higher (rougher surface) than those of 2.1 to 2.4 obtained at the erosional landscape scale (around 200 m). Further, concepts such as density imply scale-specific spacing, without which density would not be measurable. Processes also exhibit thresholds of depth, width or velocity, or sizes of circulation cells, which may relate to scale-specific landforms. Tectonism and isostasy limit broad-scale relief, and erosion and material mass strengths limit slope heights and gradients. Both the establishment of scaling relationships over certain ranges, and the recognition of scale-specific features and processes, are among the important tasks of geomorphology.

Key words: fractal, scaling, scale-specificity, landform size, relief.