Development of Landform Classification Polygons using 250-m DEMs in the Asia-Pasific Region

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Classifications of topography using DEMs have been widely used for various purposes, for example, automatic searches of steep slopes and valley heads where landslide susceptibility is high, estimation of grain size or erosion resistance, and estimation of seismic amplification. However, most former studies used pixel-based approaches which could not handle increasing noise associated with enlarging the resolution of DEMs. Previously the corresponding author developed a pixel-based automated classification method of plains, terraces, hills, mountains and volcanos using slope gradient, texture and convexity calculated from a DEM (Iwahashi, 1994), then produced 1-km grid landform classification data using SRTM30 (Iwahashi and Pike, 2007). In this study, the authors developed the Iwahashi and Pike (2007) method and produced landform classification polygons of East Asia, Southeast Asia, and the western part of North America using an interpolated 250-m DEM of GMTED2010.

Classifications of raster images such as DEMs are typically done by thresholding, regression, or data mining using geometric signatures. In this study, the authors made the polygons of homogeneous geographic areas by multiresolution segmentation (Baatz and Schäpe, 2000) before classification. We used the three geometric signatures which were used in Iwahashi and Pike (2007). In the case of the polygon-based method, the variation range of usable classification techniques is wider than a pixel-based case, because of a large decrease in the quantity of data. There are many options for the polygon-based method; for example, in choice of geometric signatures, tuning of geometric signatures, scale parameter for segmentation, method of classification, and tuning of classification. In this presentation, we introduce trials and considerations in the Asia-Pacific region.

The results in this presentation show good performance in extracting meadows and classification of intermediate landforms such as terraces, fans and hills in the regions of steeper and various landforms in orogenic zones such as Japan or the western coast of North America. On the other hand, the results do not show enough performance in extracting small landforms for very flat and simple plains such as deltas in a continental region. Mountains may be classified as rock mass classification; however, regional climate differences should be taken into account from differences of erosion styles in volcanos between mid-latitude zones and tropical zones.

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Keywords: object-based segmentation, DEM, landform classification, GMTED2010, Asia-Pasific

Examination of the paleo-sea level inferred from emerged wave-cut features along the west coast of the Noto Peninsula, central Japan

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In the west coast of the Noto Peninsula, the crust deformation in Holocene has not been revealed because of lack of the reliable indicator of paleo-sea level. The wave-cut notch is able to be the indicator, but it is difficult to distinguish them from futures formed by salt weathering which are abundant on surface of sea cliffs in this area (Kobayashi et al., 2015). In addition, the distribution of the wave-cut notch is controlled by rock types and cracks, and they formed above sea level because of wave convergence due to surrounding landform. Therefore identification of paleo-sea level is not easy.

Ito et al. (2002) revealed that the height of the retreat point of the notch in sea caves was almost equal to paleo-sea level recognized from erosive futures around the cave in the Echizen coast, central Japan. In the west coast of the Noto Peninsula, notches in sea caves are also formed and most of them are not constrained by geological structures. Moreover, these features are well preserved from weathering. Therefore, the present study aimed to reveal the height of wave-cut notches in sea caves and that on the sea cliffs which coexist with benches and are not controlled by geological structures along the west coast of the Noto Peninsula. The measurement of the height was demonstrated not at the recess but near the entrance of sea caves to avoid influence of convergence of waves.

The investigation revealed that paleo-sea level records estimated from wave-cut notches were around an altitude 2 m. These futures are considered to form at the same time from vicinity of them. Therefore, the crustal tilting from the time these futures formed to the present is not seen in this area.

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Keywords: sea cave, wave-cut notch, paleo-sea level

Magnitude-frequency distribution of mega-collapses in Japan

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A number of researches have already investigated magnitude-frequency relationship of slope deformation, such as slope failures and landslides. On the other hand, the relation between magnitude and frequency of the mega-collapse (i.e. sector collapse) mainly occurred on the volcanic edifice have not been necessarily discussed enough. And also, it is unclear whether the occurrence pattern of the mega-collapses can be related to that of the smaller events. This study, to make the effort to tackle the above challenges, investigates the magnitude-frequency distribution of slope failures in Japan, including the largest events, and discusses its geomorphological significance. The study stands mainly upon the existing datasets by Yoshida (2010) for the mega-collapses on the volcanoes, and by Machida et al. (1987) for the events relatively smaller but more abundant in number. Based on these, the magnitude-frequency distribution of slope failures in volumetric scale equal to and more than 10^7 m^3 could be investigated as, logN(x)=a-bx, where N(x) is cumulative number of events larger than and equal to x, x is the magnitude expressed by logV, V is the volume of a slope failure, and a and b are constants. Constant b ranges from 0.7 to 0.8, which indicates that the smaller events are exactly susceptible to have occurred frequently. In addition, based on the reanalyzed data once had been shown by Ohmori and Hirano (1988), originally collected by Construction Ministry of Japan during 1975-1983, similar constant b value is obtained for the events with a volumetric scale equal to and more than 10^{5-6} m^3. From the above, this study is successful in offering a new understanding of the magnitude-frequency distribution of mega-collapses in Japan. Considering recent records for the past millennium or bit more in Japan, the obtained magnitude-frequency relationship shows substantially the situation during several tens thousands years. This speculation enables us to predict event probability along with the recurrence intervals for any event with a certain magnitude. For example, mega-collapses with a volume of 10^9 m^3 should occur repeatedly at least every 1000 to 2000 years in anywhere in Japan, from a probabilistic viewpoint. Such above investigation indicates that mega-collapses are never "rare" events in the geomorphological time-scale.

Keywords: sector collapse, volume, exponential regression

Geomorphic setting on surface failure position by water line analysis

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As the spatial resolution of Digital Elevation Model (DEM) has become higher, we can investigate geomorphological properties of smaller scale surface failures using DEM. However, there are problems of how to distinguish failure cells from non-failure cells and how to analyze them. We traced water lines to identify target cells on hilly slopes.

The study area is the hilly area in Hiroshima city, where over a hundred surface failures occurred in 2014.

In analysis, 3 cells were determined on the water line; head cell located at the head of each surface failure, upper cell upward adjacent to the head cell, and lower cell downward adjacent to head cell.

We calculated slope angle, flow accumulation, and profile curvature for the head-, upper- and lower-cells.

Flow accumulation is defined as relative water quantity on each individual cell supplied from upstream areas (cells).

We compared vertical slope shape (concave, convex, straight) and its change along the water line between the failure slopes and un-failure ones, and had a tentative conclusion that combination of vertical slope shapes along the water line is one of the important geomorphological features for detecting the slope segment easy to failure.

Keywords: 2014 Hiroshima sediment disaster, Surface failure, Geomorphological setting, Geomorphological analysis, Water line

Relationship between the geomorphological characteristics of tributaries and the development processes of the fluvial terrace in the upstream area of the Tama River, central Japan

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Mountain rivers run through many tributary junction points, and thus the characteristics of the tributaries affect the landform and deposits of the mainstream (Shimazu, 1990, 1991; Nogami, 2010). However, few studies have discussed the effect of tributaries on the river terrace development. This study discusses the relationship between the geomorphological characteristics of tributaries and the development processes of the fluvial terraces since the Last Glacial around the tributary junction points in the Tama River, central Japan.
In the upstream area of the Tama River, several terrace levels have been formed since the Last Glacial. The highest terrace in this area (Aoyagi terrace) is a fill-top terrace composed of valley filling deposits (Takagi, 1990). Takahashi and Sugai (2016) pointed out the possibility that the valley filling of the mainstream had almost finished before MIS 4.
Aoyagi terrace in this area is distributed discontinuously around tributary junction points, and inclines toward the direction across the mainstream valley. The slope of the present tributaries incising into the Aoyagi terrace is from 150 to 300 permil, indicating that these tributaries are debris flow tributaries (Shimazu, 1990, 1991). On the other hand, the slope of the Aoyagi terrace is from 100 to 150 permil; this slope is gentler than that of the tributaries of the present.
From the above, it is interpreted that Aoyagi terraces around the junction points of tributaries were formed as alluvial cones by the debris flow from the tributaries (Larson et al. 2015) during the Last Glacial in the upper reach. During the Last Glacial, the slope of tributaries decreased along with the valley filling of the mainstream. In spite of that, the slope of the tributaries had retained to be steeper than 80 permil, therefore the tributaries had continued to supply debris flow deposits to form alluvial cones. These alluvial cones were truncated by lateral migration of the mainstream after the Last Glacial Maximum. Subsequently, the slope of the tributaries has increased because of the incision since the Post Glacial.
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Keywords: fluvial terrace, Tama River, tributaries, alluvial cone, debris flow, junction points

Estimation of fluvial incision rates based on artificial channel modification “Kawa-mawashi” in Boso Hills, Central Japan

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Fluvial incision is a basic factor of basin landscape evolution as well as lateral erosion and recession of water fall. Quantification of incision processes, therefore, are helpful in order to unravel geomorphic processes of basin. In this study, we estimated incision rates using some artificial abandoned channels constructed by “Kawa-mawashi” since the Edo period. The incision rates are estimated from a set of height (H) and period (T) since construction age of “Kawa-mawashi”. The height (H) is the difference of height between the present and the abandoned riverbeds. We selected eight channels having a drainage area of 4 ~ 32 km^2. Bedrocks of those channels are composed of sedimentary rocks from the Neogene to the Quaternary period. Results show the incision rate of 0.7 ~ 22.1 (average rate: 5.8) mm/y. It suggests that the incision rate is controlled by hydrologic condition and bedrock characteristic.

Keywords: incision rate, bedrock channel, artificial channel modification, abandoned channel

Fluvial breaking and abrasion mechanisms acting upon gravel-sand grains utilizing the difference of grain lithology

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Downstream fining of fluvial clastic sediments has been generally attributed to two processes: hydraulic sorting and pristine grain production, controlled by breaking and abrasion mechanisms. We investigate the role and presence of these mechanisms focusing on downstream lithological compositional and roundness changes on both sand and gravel fractions. Roundness is strongly responsive to both breaking and abrasion acting upon detritus (e.g. Krumbein 1941). Although sands may be produced from coarser grains, they were not investigated alongside gravels in previous downstream fining studies. We studied two tributaries originated from the Ashio Mountains constituted by the Ashio Belt, a Jurassic sedimentary rocks accretionary complex, in the watershed of Tone River. Breaking and abrasion mechanisms acting upon detritus was revealed by both field survey (cobbles-coarser pebbles) and laboratory analysis (finer pebble and granule-coarse sand grains), utilizing grains of contrasting durability (hard chert and fragile shale). For the evaluation of grain roundness, nine sets of standard roundness images classified by Krumbein (1941) was adopted as standard.
The downstream increase in chert/shale ratio of cobble-pebble and downstream rounding of shale pebble-sand grains occurred, in spite of a low chert detrital supply. The results suggested that pristine sand grains were produced from gravels and sands by breaking mechanism, which leads to grain size reduction and higher angularity, and by abrasion mechanism, which gives rise to grain rounding while keeping nearly unchanged size and produces angular pristine produced finer particles, during transport, considering with the existence of changes in chert grains roundness. Additionally, the contrasting trend of downstream roundness changes between the two rivers is recognized, which might have been caused by the different gradients among the researched section of the rivers. Therefore, it is possible to reveal the relationship between the river gradient and breaking and abrasion mechanisms in this study.

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Keywords: gravel-sand, breaking and abrasion mechanisms, lithological composition, roundness, Ashio Mountains

Study on content and constitution of learning to deal with Geomorphology in Geography A -Focusing on the relationship in the units and in the social life-

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Geography being taught in high school, is composed of a system geography (physical geography, human geography) and regional geography. Therefore, it has a feature that disciplines of humanities and social sciences and natural sciences are complex. Treatment of physical geography is focused on to consider, such as the relationship between human beings living in the guides of course of study. Among the guides of course of study, it is mentioned natural environment as one of the geographical environment, which is one of the elements to achieve the goal of understanding the world and the region. However, in the current geography education it has been pointed out that it is an exhaustive and list specific handling of rote learning and facts (Takebe 1998), especially in the state it is difficult to capture the dynamic nature environment. In this study, we will arrange the handling of content related to the geomorphology of physical geography unit. Further consideration of the relationship between the unit and human geography specific unit. Proactive learning at the micro scale of learning and everyday life level on a global scale is expected in the learning objectives of geography A in the guides of course of study.

Among them, the challenges of the unit of geographic considerations of living area, "the natural environment and disaster prevention" is installed, the application of the real life of physical geography field, including the geomorphology has been expected. Thus, geography A has become a subject structure is essential for real life. Because it is because has a configuration that conforms to the purpose of the geographic targeting a relationship with human life. In order for the purpose of linking the more content of the subjects in real life, it is important to find a meaning to look for improvement of the guides of course of study and textbooks. It is necessary to the discussion of the positioning and teaching methods and content of geography A. This is because, in the establishment and of compulsory discussion of "geography comprehensive", there is a high possibility that the geography A reorganization of the subjects is the basis is carried out.

First, extract the terminology related to geomorphology for textbook six books of geography A, which is used in the current. For frequent terms, to organize what is being used how in the unit of the geomorphology. Then, the extraction for their appearance point of the other unit, reveal that the relationship or have been applied in the manner which is what you have learned in the unit of the geomorphology. As a result, in the category of textbooks of the current geography A can be for terms that limit resistance, to consider more meaningful usage.

In addition, in order to evaluate whether the geographical A has it been actually achieved that goal, I searched for the term in a major newspaper about the geomorphology term, phenomenon that appeared in the extracted textbook. Period is the past three years in consideration of the influence of the Great East Japan Earthquake. As a result, in a phenomenon that has been attracting attention or are treated or apparent in the real world, it is able to consider whether those that help in how real life terrain terms that are treated to a textbook. We can discuss the discrepancy with the information to be used in the topographic content and real life in a textbook. I will report details of the discussion that day.

Keywords: Education of geography, Learning of geomorphology, Relationship, Practicality

