Geomorphology is an earth science of landform changes and earth-surface processes. The changes and processes have been essentially controlled with tectonic activities and climatic activities. Recently, anthropogenic activities have also been important agents for those processes. One of the ultimate objects of this particular earth science is to predict the altitude \( z \) of a certain point \( (x, y) \) on the earth’s surface at a certain time \( t \). However, it is nearly impossible to make that prediction exactly, even if all present sciences are used because the landform itself is an extremely complex system. It is of great significance, however, to grapple with the issue for the development and elaboration of earth science.

Geomorphology of lake-catchment systems (limnogeomorphology) also aims to contribute to this aspect (prediction) of geomorphology. Proper process-understanding and exact quantitative data are required for estimating future landforms precisely. However, both process-understanding and available data are limited in some phenomena and intervals. That is, only limited landform changes in limited observation intervals are to be quantitatively discussed for future estimation, although landforms have been developed in the geological and historical timescales as well as in the present observation period. Long-term development of landforms is also essential for geomorphology. Therefore, recent process-understanding and available quantitative data have to be extended to historical and geological timescales.

One of the most important procedures for this process is to observe landform phenomena instrumentally and historically–geologically. The lake-catchment system is convenient for observing earth-surface changes both instrumentally and historically–geologically. Present lake-catchment processes and changes can be instrumentally observed, and the changes including surrounding environments may have been recorded in the lacustrine sediments. Generally, the lacustrine records include not only present observational information but also pre-observational (past, historically and geologically) information, and the two kinds of information would be continuous without natural and artificial disturbance. If appropriate relationships between instrumental data and lacustrine (proxy) data are established for the present observation interval, proxy data for the past may be available for quasi-instrumental
ones. This could fill a “missing link” between process geomorphology and historical geomorphology.

The first step of discussion of why it is necessary to uncover the “missing link” (connecting instrumental data with proxy data) is to find a way to establish long-term external forces for checking the model on the development of drainage density (Chap. 2). The forces are simply expressed as a function of long-term climatic changes. In a non-glaciated region such as Japan, the precipitation factor (discharge due to precipitation) must be the most promising means for the external force among several climatic factors. This is linked to research of Lake Biwa sediments (Chap. 3). In the 1980s when the model was under consideration, the oldest lacustrine sediments in the world were those obtained from Lake Biwa. The need for establishing appropriate functions for the climatic factors led to the Milankovitch theory (Chap. 9) and Lake Baikal and Lake Khuvsgul research (Chap. 3).

A clue to construction of the model for drainage density (Chap. 2) was derived from a rill network study in a slope system (Kashiwaya 1979; 1980). The model was established with many field observations and then was checked by model experiment in the laboratory before it was finally verified with field experiments (instrumental observations on an experimental slope in the field for 2 years). This suggests the importance of extension and connectivity of short-term laboratory experiments to comparatively long-term field experiments and leads to the idea that short-term instrumental observation should be linked to long-term field observation.

The first step for checking the idea was to make sure of the possibility that the data obtained from lacustrine sediments in instrumental observation intervals in small lake-catchment systems are connected to ones derived from pre-instrumental observation ones at Lake Yogo (Chap. 3). The second step was, unfortunately, related to the Kobe earthquake in 1995. Just after the earthquake, two sediment traps were set on the floor of a small lake to obtain short-term deposited materials for measuring high-resolution physical properties of sediments and to compare measured items with core-sampled sediments (comparatively long intervals; beyond observational limits) (Chaps. 3 and 4). Furthermore, it was possible to establish some models for erosion transportation and sedimentary processes in a lake-catchment system if enough data were given with the measurement (Chaps. 5–7).

Appropriate pre-observational data with exact dates are very important for properly interpreting and reconstructing past processes and changes. Especially, proxy data in the historical period connected to those in the observational period require more precise dates when they are used for quantitative discussion with observational data. Some abrupt events with documentary records (e.g., large earthquakes, volcanic eruptions, nuclear bomb testing) may also be useful for establishing reasonable dates in addition to radiometric dating (e.g., 14C, 10Be, 210Pb). Many seismic and volcanic events have occurred recently in Japan, and some of them, as well as the peak time of nuclear bomb testing, can be used for determining absolute age models in the historical period and the instrumental observation period for natural forces and anthropogenic forces on the earth’s surface (Chaps. 3–5).
If a certain amount of appropriate data is obtained, quantitative expressions for changes in some earth-surface phenomena will be needed for postdiction and prediction. The first stage for quantitative expression is to establish empirical equations for the phenomena. The empirical equations might be partially developed into theoretical (causal) ones if the phenomena were limited to short time interval and a small space (Chaps. 6 and 7). However, most equations for the earth-surface phenomena will be improved with additional data and with causal relationships, keeping empirical expressions (Chaps. 6 and 8). Nevertheless, they are of great meaning because various significant factors among innumerable ones are screened for establishing more reasonable expressions with more cause-and-effect relationships.

The idea of publishing this book came to me when I was a visiting professor at the Department of Geography of National Taiwan University (NTU) in 2014. At that time there was a lecture titled “Limnogeomorphology,” which was given to postgraduate and undergraduate students from NTU and NTNU (National Taiwan Normal University). Publications on “limnogeomorphology” or studies on lake-catchment systems from the geomorphological point of view were extremely limited then. Geomorphological studies on the systems, however, are of great significance, as explained above. Hence, I tried to compile research works mainly based on my own works up to that point and to add some new ideas or findings, first published in this book, for completing Geomorphology of Lake-Catchment Systems.

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