A brief review of the interaction between tectonic, climatic and surface processes over multiple temporal and spatial scales

Jing Liu-Zeng[1], Jinyu Zhang[1], Yukui Ge[1], Wei Wang[1], Linsen Zeng[2], Gen Li[3], Xu Lin[4]

[1]State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China, earofwood@yahoo.com
[2]Institute of Geology, Chinese Geological Academy, Beijing 100037, China
[3]Department of Earth, Planetary and Space Sciences, University of California, Los Angeles CA 90095, USA
[4]College of Geography and Environment, Shandong Normal University, Jinan 27605, China

Tectonic geomorphology is a fast-developing interdisciplinary research field. The central tenet in tectonic geomorphology is to clarify the interactions among tectonic, climatic, and surface processes. In this review, we present some case studies from the past three decades showing lines of evidence that the interaction among tectonic, climatic, and surface processes can occur in a wide range of temporal and spatial scales, ranging from hours to millions ofyears in time, and from a single fault to an entire orogenic belt in space. We also synthesized important progress in this field toward a better understanding of the topographic evolution of orogenic belts: 1) Tectonic, climatic and surface processes interact to shape the landscape such that tectonic activities alone do not necessarily lead to topographic growth. For instance, when erosion and tectonic accretion are in equilibrium, topographic steady state is reached with no surface uplift despite ongoing tectonic activity. 2) Sedimentary records in range-front basins, such as the increase of deposition rate, or the occurrence of conglomerates, were often used as proxies of tectonic uplift of mountain ranges in early studies. However, sedimentary sequence should be the collective product of tectonic, climatic, and surface processes. Instead, these commonly used proxies for tectonic activity can also be due to climate changes.. 3) Tectonics play a key and leading role in the coupling of tectonic-climatic-surface process; climatic and surface processes influence but do not drive tectonics. 4) Isostatic response to erosion will lead to the rebound of mountain peaks, but the overall effect of erosion is to lower the mean elevation. Thus, uplift due to isostatic rebound is a secondary component of tectonics.