Geodynamics

Climatic, geomorphic and geodynamic processes
Lecture 13.1 - Climate-tectonic coupling I

Lecturer: David Whipp
david.whipp@helsinki.fi
Goals of this lecture

- Introduce the relationships between climate, erosion, topography and tectonics
Plate tectonics builds topography

http://www.lpi.usra.edu/
Plate tectonics builds topography

http://www.lpi.usra.edu/
Erosion shapes topography
Erosion shapes topography
Erosion shapes topography
Topography influences climate

Tibetan Plateau

Tarim Basin

Himalaya
Topography influences climate

Why does topography affect climate?
Topography influences climate

Tibetan Plateau (NASA image)

Figure 1. (a) Calibrated TRMM-based monsoon rainfall amounts averaged from January 1998 to December 2005. The data comprises instantaneous rainfall measurement with a spatial resolution of 5 km. Note the two pronounced rainfall bands in the central Himalaya. (b) 5-km-radius relief calculated from topographic data merged from SRTM V2, DTED, and ASTER-DEM imagery with a spatial resolution of 90 m. Note the high-relief band 75–100 km from the mountain front in the central Himalaya. White polygons indicate the location of 20 swath profiles, of which 4 examples are shown in Figure 3. A simplified N-S geologic profile depicts the major geologic units and faults separating them: Main Frontal Thrust (MFT), Main Boundary Thrust (MBT), Main Central Thrust (MCT).

Figure 2. Calibration curve for TRMM-rainfall data utilizing the half-hour rainfall measurement of the central Nepal (Marsyandi) gauge network for the years 2001–2004 [Barros et al., 2000]. Each dot represents the cumulative TRMM-measured rainfall intensity over 4 months (June to September) for one grid cell (5 km) vs. the (point-)gauge network measurement. Despite the large differences in spatial and temporal resolution, the data sets agree well. We show only stations that are within 250 m elevation of the corresponding TRMM gridcell.
Topography influences climate

Tectonics

Climate

Topography

Erosion

Tibetan Plateau

Tarim Basin

Himalaya

Bookhagen and Burbank, 2006

Mean annual rainfall 1998-2005 (m/yr)

< 0.5

1 - 2

0.5 - 1

2 - 3

> 3

80°E

90°E

Kilometers

Tibetan Plateau (NASA image)
Let’s see what you’ve learned…

- If you’re watching this lecture in Moodle, you will now be automatically directed to the quiz!

- Reference(s):