Geophysical Research Abstracts
Vol. 16, EGU2014-16401, 2014
EGU General Assembly 2014

Tri-stereo Pleiades images-derived digital surface models for tectonic geomorphology studies

Matthieu Ferry, Romain Le Roux-Mallouf, Jean-François Ritz, Théo Berthet, Michel Peyret, Philippe Vernant, Anaïs Maréchal, Rodolphe Cattin, Stéphane Mazzotti, and Antoine Poujol
Géosciences Montpellier, UMR 5243, CNRS-Université Montpellier 2, France

Very high resolution digital elevation models are a key component of modern quantitative geomorphology. In parallel to high-precision but time-consuming kinematic GPS and/or total station surveys and dense coverage but expensive LiDAR campaigns, we explore the usability of affordable, flexible, wide coverage digital surface models (DSMs) derived from Pleiades tri-stereo optical images.

We present two different approaches to extract DSM from a triplet of images. The first relies on the photogrammetric extraction of 3 DSMs from the 3 possible stereo couples and subsequent merge based on the best correlation score. The second takes advantage of simultaneous correlation over the 3 images to derive a point cloud. We further extract DSM from panchromatic 0.5 m resolution images and multispectral 2 m resolution images to test for correlation and noise and determine optimal correlation window size and achievable resolution. Georeferencing is also assessed by comparing raw coordinates derived from Pleiades Rational Polynomial Coefficients to ground control points. Primary images appear to be referenced within $\sim$15 m over flat areas where parallax is minimal while derived DSMs and associated orthorectified images show a much improved referencing within $\sim$5 m of GCPs.

In order to assess the adequacy of Pleiades DSMs for tectonic geomorphology, we present examples from case studies along the Trougout normal fault (Morocco), the Hovd strike-slip fault (Mongolia), the Denali strike-slip fault (USA and Canada) and the Main Frontal Thrust (Bhutan). In addition to proposing a variety of tectonic contexts, these examples cover a wide range of climatic conditions (semi-arid, arctic and tropical), vegetation covers (bare earth, sparse Mediterranean, homogeneous arctic pine, varied tropical forest), lithological natures and related erosion rates.

The capacity of derived DSMs is demonstrated to characterize geomorphic markers of active deformation such as marine and alluvial terraces, stream gullies, alluvial fans and fluvio-glacial deposits in terms of vertical (from DSMs) and horizontal (from orthorectified optical images) offsets. Values extracted from Pleiades DSMs compare well to field measurements in terms of relief and slope, which suggests effort and resources necessary for field topography could be significantly reduced, especially in poorly accessible areas.