RIMS: A real-time, interactive mapping system for neotectonic/geologic investigations of
digital terrain data.

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The current flood of terrain and multispectral satellite data with regional to planetary coverage is
both overwhelming our analytical capabilities and producing fertile opportunities for discovery.
As a result, we need new analytical tools that can handle this flood. Although automated
approaches such as feature extraction are very useful, they presume users can specify formal rules
by which their data may be filtered. An alternative approach is to visualize the data and allow
geologists to directly observe, measure, and record geometric patterns present within them via
géomorphologic/geologic mapping. An important advantage of this latter process is that it allows
users to adapt or evolve their selection criteria as the analysis proceeds, and thereby discover
previously unrecognized features or patterns. Unfortunately, this approach is generally limited by
hardware capabilities because it requires that the data be displayed. Earth and planetary
geologists have struggled with this limitation for some time and in particular with the difficult
task of mapping their detailed observations across large areas (1000 x 1000 km) directly on high
resolution (1-10 m) remotely-sensed data. In response, we have developed a real-time,
interactive, mapping system (RIMS). RIMS uses a quadtree-based multiresolution method to
circumvent hardware limitations and permit real-time rendering of high-resolution data over large
spatial areas. The resulting visualization environment is analogous to Google-Earth in the way
that it allows users to manipulate terrain models comprised of texture data draped over a digital
elevation model (DEM). More importantly, RIMS also allows users to map inside this interactive
environment by generating vector-based polylines directly on the terrain visualization and by
providing a “virtual geologic compass" for measuring orientations of geological surfaces. RIMS
also provides sculpting tools for 3D reconstruction of deformed and partially eroded surfaces
such as folded bedding. The georeferenced maps made using RIMS can be exported to standard
GIS software. Using RIMS, we are currently mapping several zones of active intracontinental
deformation, including the northern edge of the Arabia-Eurasia collision zone between the Black
and Caspian Seas. This area lies along the politically volatile northern foothills of the Greater
Caucasus Mountains in Chechnya. Using SRTM 90 and Landsat ETM+ data, we are
characterizing potential seismic sources to determine if total shortening across the range increases
systematically from west to east, as observed by GPS measurements of the instantaneous
deformation field (McClusky and Reilinger, 2004; Reilinger et al., 2004). Our RIMS-based
mapping has revealed evidence of recent folding along two ridged that trend east-west within the
foreland basin, sub-parallel to the Greater Caucasus range to the south. A fluvial terrace along on
the northern edge of the northernmost ridge is both elevated relative to the active floodplain
within the foreland basin and locally bowed into east-west trending linear ridges. Terrace
incision and secondary ridge formation most likely resulted from recent folding. At both the
western and eastern tips of the northern ridge this fluvial terrace grades upslope into a pediment
surface that is locally breached by gullies draining the ridge, but is preserved as a set of triangular
facets along the interfluvies between the gullies. Local preservation of this relict surface attests to
recent lateral propagation of the fold tips. Our Caucasus research demonstrates that the strength
of RIMS is that it combines interactive rendering with interactive mapping and measurement of
features observed in topographic and texture data.