



Introducing students to digital geological mapping: A workflow based on cheap hardware and free software

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The undergraduate field course in Geological Mapping at the University of Ljubljana involves 20-40 students per year, which precludes the use of specialized rugged digital field equipment as the costs would be way beyond the capabilities of the Department. A different mapping area is selected each year with the aim to provide typical conditions that a professional geologist might encounter when doing fieldwork in Slovenia, which includes rugged relief, dense tree cover, and moderately-well- to poorly-exposed bedrock due to vegetation and urbanization. It is therefore mandatory that the digital tools and workflows are combined with classical methods of fieldwork, since, for example, full-time precise GNSS positioning is not viable under such circumstances. Additionally, due to the prevailing combination of complex geological structure with generally poor exposure, students cannot be expected to produce line (vector) maps of geological contacts on the go, so there is no need for such functionality in hardware and software that we use in the field.

Our workflow therefore still relies on paper base maps, but is strongly complemented with digital tools to provide robust positioning, track recording, and acquisition of various point-based data. Primary field hardware are students' Android-based smartphones and optionally tablets. For our purposes, the built-in GNSS chips provide adequate positioning precision most of the time, particularly if they are GLONASS-capable. We use Oruxmaps, a powerful free offline map viewer for the Android platform, which facilitates the use of custom-made geopositioned maps. For digital base maps, which we prepare in free Windows QGIS software, we use scanned topographic maps provided by the National Geodetic Authority, but also other maps such as aerial imagery, processed Digital Elevation Models, scans of existing geological maps, etc. Point data, like important outcrop locations or structural measurements, are entered into Oruxmaps as waypoints. Students are also encouraged to directly measure structural data with specialized Android apps such as the MVE FieldMove Clino. Digital field data is exported from Oruxmaps to Windows computers primarily in the ubiquitous GPX data format and then integrated in the QGIS environment. Recorded GPX tracks are also used with the free Geosetter Windows software to geoposition and tag any digital photographs taken in the field.

With minimal expenses, our workflow provides the students with basic familiarity and experience in using digital field tools and methods. The workflow is also practical enough for the prevailing field conditions of Slovenia that the faculty staff is using it in geological mapping for scientific research and consultancy work.