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Landscape-scale learning: from lectures to professional deliverables

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Earth Science ingenieers (Master degree) need to be trained in multidisciplinary approaches but also to learn how to combine theoretical and practical knowledge. Nevertheless we notice it is not always easy to combine in a same lecture, theoretical and practical issues. In order to build bridges between these instructions we propose to student a new teaching unit: "Sustainability Diagnosis". Its originalities are i) to be couple to an other (theoretical) teaching unit dealing with landscape-scale learning ii) to be performed under a project mode and iii) to provide deliverables ordered by professional users, e.g. farmers, catchment managers.
The landscape-scale learning is a classical learning period with lectures provided by specialists in various disciplines e.g. Soil Science, Hydrology, Agronomy, which focus on a common spatial scale, the landscape. It explicitly develops knowledge on energy and matter transfers between landscape components and explains potential effects of human-induced disturbances on both landscape and fluxes evolution.
The deliverables for the farmer (chosen professional user) concern issues on his crop system sustainability. It requires a diagnosis in one hand on soil use and management potentialities and in another hand on environmental externalities (soil and water conservation) induced by the cropping system.
The communication will present the work done by 14 students during this new teaching unit (Sustainability Diagnosis) of two weeks. This first attempt expertized a one square kilometer area located in Saint-Chinian vineyard region (South of France). This production area with guarantee of origin (AOC) has productivity constraints linked to landscape properties which directly impact farmer decisions. In the same time it has been shown that vineyard crop system induces water pollution by pesticides and increases soil degradation; in a sustainability perspective, these environmental impacts need to be reduced.
The learning period was divided in 3 sequences. Firstly, students used their thematic knowledge and GIS technologies (digital mapping, remote sensing data, Geostatistics) to prepare the field campaign (2 days). GIS is not only used to create results-maps but also to lead to a first spatial segmentation based on pre-existing generic data (aerial photographies, topographic and thematic maps, administrative boundaries, DEM).
Secondly, they carried out a field survey (5 days) to collect needed environmental data and expertize the local crop system. Students had to measure and extrapolate local physical characteristics: soil properties (texture, stoniness...) using expert field sampling method associated with geostatistics, and water paths within the area (natural ones but also anthropogenic ones as ditches). They also had to collect data concerning vineyard plots (surface, slope, planting density, agricultural practices and pesticide applications...). This field survey is also a particular time where students confront their GIS pre-segmentation with field reality in order to identify advantages but also limits of such approach, particularly in term of numerical data quality. The aim is that students realized that even now, despite available numerical technologies within classroom, field survey is still an unavoidable step for environmental diagnosis.
Finally, they combined and analyzed all informations to produce the final diagnosis. They had to produce several landscape physical properties maps, but also use these spatial informations in a distributed hydrological model to asses human-induced disturbances linked with vineyard management (pesticides transfert, flow modifications induces by farmer decisions). This last sequence was done in classroom (3 days) and closed by a technical report and an official meeting with the farmer.
Results of this experience are multiple:
The presence of the farmer was crucial because the final user expectation increased student engagement. Also, the farmer and its pragmatic experience gives to students a new point of view on the landscape they studied.
Working in one group on the same project was sometimes chaotic for students but finally beneficial for them because they were obliged to cut the entire work in elementary tasks and to structure their actions to meet final

aims in such short time.
Gathering in the same teaching unit practical and theoretical issues was beneficial for students but also for us (teachers). Indeed, our daily research activities can sometimes occult that we have to form mostly operative Earth Science engineers (only 7% of our students head for research career) who need theoretical backgrounds but also substantial practical knowledge that can be found in such experiences.