Geophysical Research Abstracts
Vol. 14, EGU2012-13992, 2012
EGU General Assembly 2012

Regional scale soil thickness prediction using digital terrain modeling and seismic data: application to erosion hazard mapping.

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Empirical laws derived from terrain parameters - such as DTM - and calibrated with in-situ borehole data are widely used for mapping soil thickness at regional scale. But with this approach, economical and practical constrains due to drilling requires to work on limited area (typically a few ten km^2). Yet, seismic methods using surface waves, recently used for subsurface issue, showed a great interest for measuring soil thickness along profiles or in 3D (parcel mapping) which is more convenient for spacializing using empirical law calibration. Thus, to accurately map soil thickness over a $400km^2$ large area, we suggest to match measurement provided by SASW method (spectral analysis of surface waves) with an empirical law derived from terrain attributes. For this study, S-waves velocity has been measured along 10 profiles and after calibration with penetrometrics sounding, the value Vs=300 m/s was considered as a threshold between fertile soil (loess) and consolidated material (clay) leading to define the soil thickness. Comparison between measured soil thickness and the empirical index related to soil depth has shown significant results (R^2=0.58). After index calibration, soil thickness was mapped over the catchment basin using a regression law between soil depth index and measured thickness. Finally, the French soil databank (BSS®) was used for the map validation: loess depths reported by geotechnical interpretation (drilling and sounding from BSS®) fit closely to depths predicted by the thickness map. The test zone was located within the Cailly Aubette-Robec catchment area, in the Northern part of France. The region has the particularity to be severely affected by erosion processes with dramatic farming issues. So, to valorize this soil thickness mapping methodology, results were exploited in term of erosion hazard characterization by coupling the thickness map with a soil loss rate map (in t/ha/year), leading to provide temporal information about erosion vulnerability.