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Geophysical Research Abstracts
Vol. 12, EGU2010-9055, 2010
EGU General Assembly 2010

High resolution mapping of soil carbon in arid environment by regression-kriging combining ground based spectrometric data and Aster images

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Spatial quantification of soil properties is required to manage and monitor soil resources. Our aim was to set up a soil properties mapping approach, by means of Partial Least Squares Regression-kriging (PLSR-kriging), while combining information contained in the 9 Visible-Near infrared spectral bands of an ASTER image and a collection of 144 soil samples spectra acquired in laboratory across the 400-2500 nm range. This approach was tested in the Djerid arid region (SW Tunisia) to map total carbon (totC) over 580 ha of bare soils. Surface soil samples were collected across nodes of a 200 m squared grid, dried and sifted to 2 mm, before we analysed totC and acquired Vis-NIR spectra. We calibrated a PLSR model, based on the 144 spectra derived from the Aster image, previously corrected radiometrically with the empirical line method. This model, when applied to the 9 bands of the sub-image, generates a first spatial quantification of totC. Residues have been calculated at sampled grid nodes. The interpolation of residues by ordinary kriging produces a raster layer which, when added to the first layer, offers a final prediction map. Residuals interpolation has improved PLSR prediction accuracy. Indeed, we obtained respectively (R^2 = 0.78 and RMSE = 0.16%) versus (R^2 = 0.53 and RMSE = 0.52%). Furthermore the spatial distribution of these quantifications has a physical significance. From our results emerge interesting perspectives for mapping soil carbon over large territories in arid environment.