Advances in remote sensing of cultivated landscapes at LISAH

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Advances in remote sensing of cultivated landscapes at

I. Digital Mapping of Soil properties

Objective: Mapping of soil properties over the Lebna catchment (252 km²) from the surface to the sub-surface

Approach in 3 steps:
1. Vis-NIR hyperspectral imaging data were used to map key topsoil properties over bare soils of the Lebna catchment using multivariate models (Gomez et al., 2013).
2. These topsoil properties estimations were used as covariates in geostatistic methods to produce entire topsoil properties maps over Lebna catchment (see illustration).

Results: Vis-NIR hyperspectral imaging data and Digital Soil Mapping methods can be used to map key soil properties, used by soil surveyors to describe soil types, related to soil erosion processes...

II. Landscape structures mapping

Objective: Mapping landscapes structures which have an impact on hydrological fluxes

Approach 2:
1. LiDAR DEM analysis to detect topographic discontinuities
2. DEM-driven stochastic modelling to interpolate the detected lines and remove false detections

- a. 12 LiDAR profiles with ground truth and aerial views
- b. principle of Haar wavelet decomposition and classification
- c. result

Stochastic modelling of ditches network
- a. network correction approaches : reconstruction and cut
- b. application of the reconstruction
- c. five equiprobable reconstructed networks

References:


III. Gullies detection with THRS imagery

Objective: Exhaustive mapping of gullies for hydrological modelling

Approach:
- Contour detection from THRS satellite imagery
- Filter combination and decision rules with ancillary data

Results:
- Topsoil properties estimations were used in pedotransfer functions to map sub-surface soil properties (Lagacherie et al., 2013).

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IV. Soil Crust Mapping

Objective: Monitoring of soil crust dynamics at the crop scale

Approach:
- Lightweight platform (UAV) ; ultra high resolution
- Linear features extraction

Results:
- Linear features extracted from the surface to the sub-surface
- Decision rules using ancillary data

VI. Mapping evapotranspiration of vineyards

Objective: Mapping of vineyard daily evapotranspiration (ETR) over the Peyne catchment (65 km²)

Approach:
- 12 ETR maps produced from visible-NIR and thermal IR images (ASTER instrument, 90 m resolution) using two water stress indices: WDI (Moura et al., 1994) and S-SEBI (Roerink et al., 2000)

Results:
- Visible-NIR and thermal images allow for ETR mapping at the regional scale. ETR maps can be useful for assessing the available water content of soils

References:

V. 3D modelling by photogrammetry and Structure-form-Motion (SIM)

Objective: Attaining a decimeter to centimeter scale description of landscape features at the watershed scale

Approach:
- Lightweight image acquisition: light platforms (kite) and consumer grade cameras
- High image redundancy and SIM approaches for processing

Results:
- Operational method of image acquisition and 3D processing
- Objectives and mission specifications

VI. VII. Missigri mission design

Objective: Design of a high spatial and temporal resolution thermal satellite

Approach:
- Image simulation (radiative transfer modelling, airborne campaigns)

Results:
- Potential accessibility at ground in the case of (a) a satellite at 501 km or (b) 720 km altitude

References:

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Abstract: In order to propose new and sustainable methods for cultivated areas management, the French INRA-IRD-Supagro laboratory for the study of Soil-Agrohydrosystem Interactions (LISAH) develops tools for modelling fluxes (water, soils, solutes) based on a fine characterisation and observation of the landscape mosaics and of its dynamic (field limits, networks, structures, vegetation, agricultural practices, topography, etc.). Such observations require to develop innovative acquisition and processing methods. This poster presents some of these methods concerning different scales and techniques.