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REPORT OF THE ISSS WORKING GROUP REMOTE SENSING OF THE SOIL SURFACE

DESCRIPTION OF THE LANDSURFACE FOR CORRELATION WITH REMOTE SENSING DATA

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Summary

The results of the working group "remote sensing of the soil surface", or more general land surface, are presented.
A description form for land surface features has been developed which enables a detailed subdivision of the land into components each having influence on reradiation of the incident radiation. The final aim, the correlation of land surface features with remote sensing data may be supported by field measurements on reflectance and modelling of the interaction process of electromagnetic radiation with land surface components. A geometric model enables to calculate the total reflecting and shaded surface area, and the reflectance of the land as a whole.

Introduction

As a result of the conclusions made by the discussion group "Description of the land surface for remote sensing" at the 4th symposium "Remote sensing for soil survey" (The Netherlands, 3-8 March 1985; Ten Berge et al., 1986), a working group was formed. The following workshops were organized:
9-10 January 1986 at ORSTOM, Bondy, France;
13-14 May 1986 at the Agricultural University of Wageningen, The Netherlands;
23 March 1987 at the Institut National Agronomique (INA), Paris-Grignon.

The attendants of these workshops, being specialized in soils, vegetation or digital processing of remote sensing data, all have contributed in their personal and original way to the present view.
General agreement existed with regard to the need of detailed description of the land surface for correlation with remote sensing data.
The new satellite observation systems, the Thematic Mapper and SPOT, have an improved ground resolution when compared to the first generation Landsat MSS, and therefore make a correlation of surface properties with remote sensing data within reach. For this purpose, the description of land surface properties ought to be much more detailed than it is done in the conventional way according to the FAO Guidelines for soil profile description (Mulders, 1986-2).

The discussions in the workshops were directed towards the parameters of the land surface which would have influence on the interaction process of electromagnetic radiation with objects at the earth surface. Furthermore, some attempts for modelling of the interaction process were discussed.

Landsurface parameters

The parameters of the land surface which are important for the interaction process are the following:

1) surface properties important with regard to position of radiation source and angular field of view of remote sensor
   a) vegetation type, height, form, structure, orientation (e.g. rows) and coverage %
      vegetation debris, size of elements
   b) soil surface or exposed rock surface
      - slope angle, -form and -length
      - slope strike and -direction (exposition)
      - mesorelief (> 1 m) and microrelief (< 1 m)
        - sizes and form (e.g. of stones)
        - coverage (%) per size class
        - preferred orientation (strike) if present of elements such as furrows and dunes
        - microrelief (< 10 cm) of the soil surface - size classes
   c) presence of open water, snow or ice - coverage %
2) reflective and absorptive properties of the intrinsic surface
   a) vegetation - colour and coverage % - green life vegetation
      - discoloured leafs
      - debris
      - lichens
   b) soils - structure, slaking, tillage, salt accumulation
      - colour and moisture condition of the surface
      - organic matter content
      - texture class, grain size class %
      - mineralogy
      - surface texture of minerals
      - coatings of mineral grains
   c) bare rock surfaces and stones at the surface
      - colour, petrology
      - surface texture, coatings
      - presence of lichens

Cihlar et al. (1987) have given definitions and methods to describe a number of soil and crop parameters. For the set up of methodology, it is useful to study that article and the publication of Escadafal (1981).

Description of the landsurface

Test sites of 1 ha are selected using remote sensing aids. The selected sites should be homogeneous in reflected or emitted radiation, or in reradiation patterns.
We use the often highly variable arid land as an example. After indication of the geomorphological unit, landform and slope characteristics, such terrain is described by dividing it into morphographic units or surface elements with mesorelief > 1 m and microrelief in the order of dm. Further

characterization can be made on shape and distribution (average distance of elements, pattern and orientation).

The components of the surface elements are described by a.o.:
- colour, structure and coverage both for vegetation as well as rocks and soils with in addition,
- transparency and leaf area for vegetation (looking downwards from vertical and SE position),
- microrelief in the order of cm and mm,
- soil texture and average diameter of mineral grains,
- coatings and mineralogy of rocks and soils,
- moisture content.

It is not useful to have a system for description which is only based on fixed sizes and heights of the elements. Natural land is too variable for such a system. The following questions merely determine the way of description.
1. Is the surface showing mesorelief (> 1m)?
If yes: indicate the different types of mesorelief (e.g. A and B) including the land not showing any mesorelief (e.g. C). Continue with the description of microrelief per mesorelief unit and characterize the smallest surface elements thus obtained.
The smallest surface elements often have sizes of several dm and may be covered by vegetation. Small dunes form an example of these, however, boulders and cobbles with random distribution normally are considered to be a component of a larger surface element.
If no: continue with question 2.
2. Is there more than one type of microrelief ?
If yes: indicate the different types of microrelief going from high to low surface elements (including vegetation in the determination of height) and characterize the components of each surface element including vegetation.
If no (only one type): describe the microrelief going from large sizes to small sizes and further characterize the surface elememts.
3. Is there a preferred orientation of the surface elements ? What is the average distance of the individual surface elements ? Indicate these characteristics.

Description form

The description form (see appendix) comprises five parts:
1) topography and physiography of the test site (identification, topography, morphography, geomorphology and soil types),
2) land use and climatic conditions at the time of description,
3) summary on surface features (different types indicated by codes),
4) quantitative description of surface features (vegetation, rock and soil; each surface feature code one description),
5) divers (photographs, diferent measurements and soil analytical data).

The form is directed towards the description of complex land with high variability in relief and vegetation. For land with low variability, the form may be simplified considerably. Furthermore, it is expected that application in describing various landscapes will improve the method.
For example, dense forest vegetation needs the use of aerial photographs for description of tree crown texture, and reflection measurements, in that

case, also are specific.

The description of surface features, and registration in the course of time, will be aided tremendously by measurements on surface roughness and the acquisition of terrain photography e.g.
- oblique from a height of 3 m,
- vertical from a height of 1.5 m,
- vertical or oblique from a height of 0.5 m (details).

The photographs, if taken at different times of the day, enable to understand the influence of the solar altitude on the % of shaded area as dependent on vegetation structure, surface stoniness and roughness. They furthermore are useful when performing deskwork on the study of the tremendous amount of data gathered in the field, in bringing back the scenery.

Correlation of landsurface features with remote sensing data

There are in fact four approaches to correlation of land surface features with remote sensing data, these being:
1) the use of remote sensing imagery to indicate different units, each characterized by specific land surface features, followed by a reconnaissance field check to study the relevance of these features for the specific mapping purpose (qualitative correlation);
2) item (1) but in addition detailed description of land surface features and statistical correlation which may prove the relevance of the parameters used to characterize the land surface features (quantitative correlation);
3) modelling of the reflection from the intrinsic vegetation, rock and soil surface, which may be used to calculate the intensity of the reflected radiation by the different components at specific angle of incidence and spectral intensity of the incident radiation;
4) measurement of reflectance (% of reflection) of the different land surface components and geometric modelling of the influence of solar altitude on the % of shaded area as related to soil roughness, mesorelief, slope and exposition.

The first approach may be regarded as the conventional one. The remote sensing aids are used normally in conjunction with aerial photo-interpretation to place the new information within its physiographic context (indeed, always important !). Land surface properties are only described in broad terms and correlation of terrain properties with remote sensing data is not the main purpose of the project.
On the contrary, the other approaches are all directed to correlation of these properties with remotely sensed data to obtain maximum profit of the spectral information. Some examples of these approaches are discussed briefly below.
The following studies are specimens of the second approach and have been performed in Tunisia:
1) correlation of surface types with first generation Landsat MSS data (Escadafal and Pouget, 1986);
2) correlation of soil texture, mineralogical composition of the soil surface and vegetation coverage with TM data (Epema, 1986-1; Mulders and Epema, 1986);
3) correlation of differences in multitemporal TM data (January and May) with dynamics of the land such as moisture condition, salt accumulation and vegetation development (Epema, 1986-2).

Van den Bergh and Bouman (1986) made an attempt to modelling of the reflection of soil surfaces using the equation of Lambert-Beer, which relates the reflectance to the coefficient of absorption and the mean penetrated layer thickness. Thus theoretical reflectance was calculated of soil material with different particle size, mineralogy and soil moisture content.

All studies indicated that the new methods are promising and continued research is worthwile. However, there is a need for development of techniques for detailed description of terrain characteristics as well as calibration of remote sensing data.

Detailed description of terrain characteristics can be supported by measurements on reflectance. Summation of reflectance values of the different land components produces land reflectance if a geometric model is used which regards height, form and orientation of objects as well as solar altitude or more general the position of the radiation source.
In the field, estimates are made of the % of coverage of the different land surface features. These estimates normally include modelling. For example, multifacet stones are modelled to simple forms such as blocks and ellipsoids. Average figures on dimensions and orientation of these forms are estimated.
Furthermore, it is important to realize that the estimates on % of coverage in fact involves orthogonal projection of the approximated top facet on a horizontal reference plane, and estimation of the total surface % of the projected top facets in that plane.
Such data form the input to geometric models constructed to define the mathematical/geometrical relationship between forms and sizes to the incident radiation with variable angle of incidence. The output of these models are figures on total exposed surface and shaded area of the different components of the land surface at the particular conditions of solar altitude at the crossing time (and position) of the remote sensor.

Reflectance values are normalized values which are not dependent on intensity of the incident radiation but may show angle dependency as has been shown by the results obtained by Coulson (1966, or Mulders, 1987). At high angles of incidence (from nadir), the objects no longer behave like perfect Lambert (diffuse) reflectors. These effects may show impact around the 10.00 hrs crossing time of satellites at high latitudes in the winter season.
To perform measurements at crossing time only, is not realistic since the detailed description of the terrain is time-consuming and the measurements should normally be made after the description. However, specific features which are difficult to model such as low shrubs and herbs with low coverage can be measured at other dates where the time of measurement is chosen such that the angular relationship between sensor and target is the same as it is at crossing time of the sensor, which enables estimates on exposed and shaded area valid without geometric modelling.

The description of land surface features is limited in wet tropical areas where there is an extremely high vegetation coverage. Only repeated measurements on reflectance of for example grassland, or on incident minus transmitted radiation of tropical rain forest may produce data useful for the total land reflectance.

Conclusions

The description form of land surface features presents a basis for the correlation of terrain properties with remote sensing data. The object characteristics too often are neglected in explaining obvious relationships. Further research should be directed to application of the description methodology, field reflectance measurements, modelling of total land reflectance and calibration of remote sensing data to enable multitemporal comparison.

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ISSS WORKING GROUP REMOTE SENSING FOR SOIL SCIENCE

DESCRIPTION FORM OF THE LAND SURFACE

1. TOPOGRAPHY AND PHYSIOGRAPHY OF TEST SITE

1.1. Identification

1.1.1. Preliminary number:

nr. of test site:

1.1.2. Definite number order nr.:

1.1.3. Surveyor (s):

1.2. Topography

1.2.1. Name of area: test site area: ha

1.2.2. Topographic map name:

nr.:

scale:

date: year:

editor:

1.2.3. Coordinates longitude: ° ' "

latitude: ° ' "

1.2.4. Altitude metres:

1.2.5. Aerial photograph nr:

scale:

date:

source:

1.2.6. Satellite data

Type	Date / coord. / scene nr.						
MSS		P: R: P: R:		P: R: P: R:		P: R: P: R:	
TM		P: R: P: R:		P: R: P: R:		P: R: P: R:	
HRV SPOT		P: R: P: R:		P: R: P: R:		P: R: P: R:	

1.3. Morphography and geomorphology

1.3.1. Geomorphological unit:

1.3.2. Geological substratum

type:

exposure where: %:

strike: slope: ° or %

sediment coverage type:

thickness: m

1.3.3. Landform types:

dimension(s): ha

location of test site:

% of catchment area:

1.3.4. Slope average %:

exposition N, NE, S etc.:

length (m):

shape convex straight

concave complex

1.3.5. Mesorelief >1 m not present

present

type

amplitude vert. average: hor. average:

max: max:

min: min:

orientation:

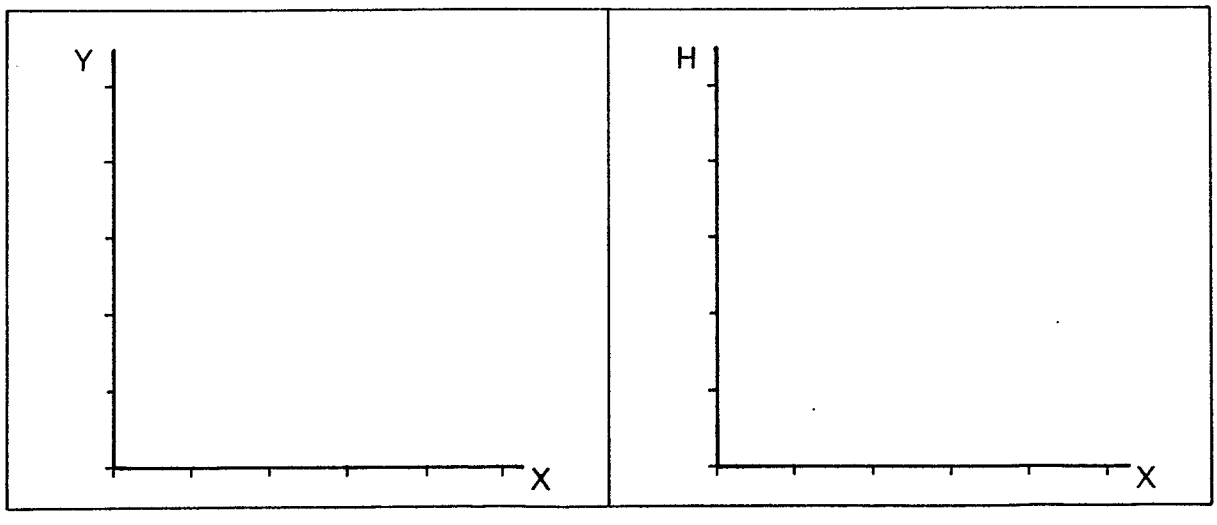
1.3.6. Erosion not apparent present

type:

forms:

% of area affected:

1.3.7. Schemes Diverse Observations



1.4. Soil

1.4.1. Classification Soil Map of the World:

US Soil Taxonomy:

CPCS:

1.4.2. Mapping unit:

1.4.3. Parent material:

1.4.4. Soil profile description. Soil Code:

Depth in cm	Hor.	Mo.	Colour dry/wet	Struct.	Cons.

Hor.	$CaCO_3$	Gyps.	Fe	Others

Abbreviations: Mo. = Moisture Struct. = Structure
Text. = Texture Cons. = Consistence
Hor. = Horizon Gyps. = Gypsum

Repeated measurements are needed for the study of dynamical aspects of the land surface: 2-5

2. GENERAL INFORMATION ON DYNAMICAL ASPECTS OF THE TEST SITE

2.1. Observations

2.1.1. Surveyor(s):

2.1.2. Description nr.: Test site nr.:

2.1.3. Date Y: M: D: H:

2.2. Climatic conditions

2.2.1. Actual weather

clouds in 1/8: air humidity:

wind intensity: direction:

2.2.2. Weather conditions past 14 days

date of last rain: Y: M: D:

precipitation: mm

others:

2.3. Land use

2.3.1. Classification

Type \ Dominance	1	%	2	%	3	%
Settlement and infrastructure						
Agriculture						
Range land						
Forestry						
Nature reserve						
Water						
Others						

2.3.2. Natural vegetation

dominant:

associated:

2.3.3. Forestry and agriculture

Observations / Types	Species	Date of planting	Growth stage	Condition	Others
Forestry					
Perennial crops					
Annual crops					
Pasture					

2.3.4. Bare soil: present yes/no

2.3.5. Cultural elements hedges: %

talus: %

terraces: %

others: %

2.3.6. Agricultural practices

parcels average area: ha max: min:

irrigation (type):

ploughing J M D

harrowing J M D

2.3.7. Fires date J M D

extension ha

vegetation burnt down %

regrown %

debris %

2.3.8. Fauna types:

construction: area: %

3. HIGH VEGETATION > 2 m present: not present:

3.1. Species 1

2

3

4

3.2. Characterization

Species / Characterization	1	2	3	4
Coverage % % vertical from below APs				
Height (m)				
Crown diameter (m) height (m)				
Leafs form length (cm) width (cm) condition				
Average distance (m)				
Distribution				
Shadow %				
Transparency shadow %				

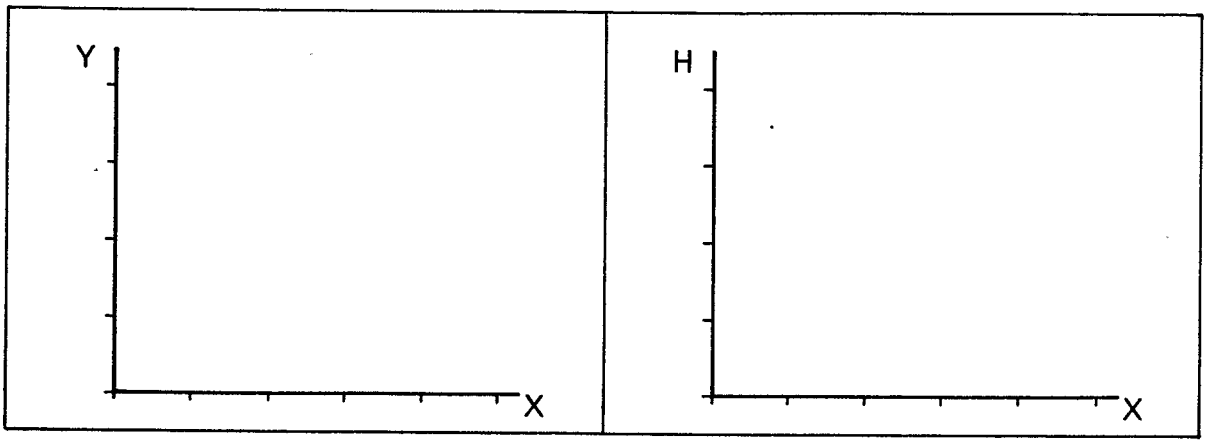
4. SURFACE ELEMENTS: MESORELIEF (>1 m) AND MICRORELIEF (<1 m)

4.1. Number of surface elements (SE):

List of SE (A to Z >1 m to several dm)

Code	Description	%	Code	Description	%	Code	Description	%

4.2. Scheme location of SE



4.3. Relief: quantative description SE

Code / Characteristics	A	B	C	D	E
Type					
Form					
Height (cm)					
Length (cm)					
Width (cm)					
Average distance					
Pattern					
Orientation					
Coverage %					

5. VEGETATION (SHRUBS AND HERBS), LITTER, ROCK AND SOIL FOR EACH SURFACE ELEMENT

5.1. Code SE:

5.2. Vegetation/shrubs and herbs

5.2.1. Vegetation coverage %

5.2.2. Species 1

2

3

4

5.2.3. Characteristics

Species / Characteristics	1	2	3	4
Structure				
height average (m)				
width/length (m)				
coverage of SE (%)				
shadow (%)				
transparency (%)				
LA vert. (%)				
south east (%)				
Condition				
colour dom. (%)				
other (%)				
dry (%)				
green (%)				
Leafs				
form				
length (cm)				
width (cm)				

5.3. Organic debris (litter)

leafs coverage % colour:

twigs coverage % colour:

5.4. Rock and soil surface

5.4.1. Rock outcrop coverage %

Soil coverage %

5.4.2. Rock colour

mineralogy

lichens colour: %:

5.4.3. Surface stones, gravel and fine earth

Character-istics	Boulders >25 cm	Cobbles 25-7.5 cm	Coarse gravel 7.5-2 cm	Fine gravel 2-0.2 cm	Fine earth < 0.2 cm			
					total	sand	silt	clay
Coverage %								
Item south-east %								
Average diameter								
Colour								
Coating								
Petrology								
Distribution								

5.4.4. Further characterization soil surface

5.4.4.1. Microrelief (cm) type:

height: cm distance: cm

width: cm direction:

length: cm coverage: %

Texture: lichens: %

Moisture condition: moisture %:

Structure

Type (form)	Coverage %	Aggregates		
		aver. diam.: %	aver. diam.: %	aver. diam.: %

6. DIVERS:

Photographs:

Radiometric measurements:

Repeated measurements (5.2-5.4):

Other measurements:

Soil analytical data:

ABBREVIATIONS

Y = Year; M = Month; D = Day; H = Hour; aver. = average; diam. = diameter; max. = maximum; min. = minimum; APs = estimates from Aerial Photographs; SE = Surface Elements; LA = Leaf Area; south east (%) for northern hemisphere or northeast (%) for southern hemisphere

FORMULAIRE DE DESCRIPTION DE LA SURFACE DES SOLS

1. LOCALISATION GEOGRAPHIQUE ET SITUATION DU SITE-TEST DANS LE PAYSAGE

11. Identification

111. Numéro provisoire

112. Numéro
- Numéro du site-test
- Numéro d'ordre dans le temps

12. Localisation géographique

121. Lieu-dit

122. Feuille topographique
- Nom :
- N° :
- Echelle : 1/
- Date : Année :
- Editeur :

123. Coordonnées géographiques
- Longitude : ° ' "
- Latitude : ° ' "

124. Altitude : mètres :

125. Photo aérienne de référence
- Numéro :
- Echelle : 1/
- Date : J M A
- Editeur

126. Coordonnées sur les documents satellites

Nature \ Date / Réf. Scène						
		Lignes	Colonnes	Lignes	Colonnes	Lignes	Colonnes
MSS		L: L:	C: C:	L: L:	C: C:	L: L:	C: C:
TM		L: L:	C: C:	L: L:	C: C:	L: L:	C: C:
HRV (Spot)		L: L:	C: C:	L: L:	C: C:	L: L:	C: C:

13. Situation dans le paysage

131. Contexte géomorphologique général :

132. Substratum géologique

- Nature :
- Est-il apparent ? : OUI/NON
- Pendage : %
- Orientation en surface :
- Couverture sédimentaire — Type
- Epaisseur mètres

133. Unité géomorphologique

- Type :
- Dimension : hectares
- Emplacement du site sur l'unité :
- Distance du site par rapport à l'amont : mètres

134. Pente de l'unité géomorph.

- Pente moyenne : %
- Exposition : éventuellement N-NE-E-SE-S-SW-W-NW
- Longueur : mètres
- Forme :

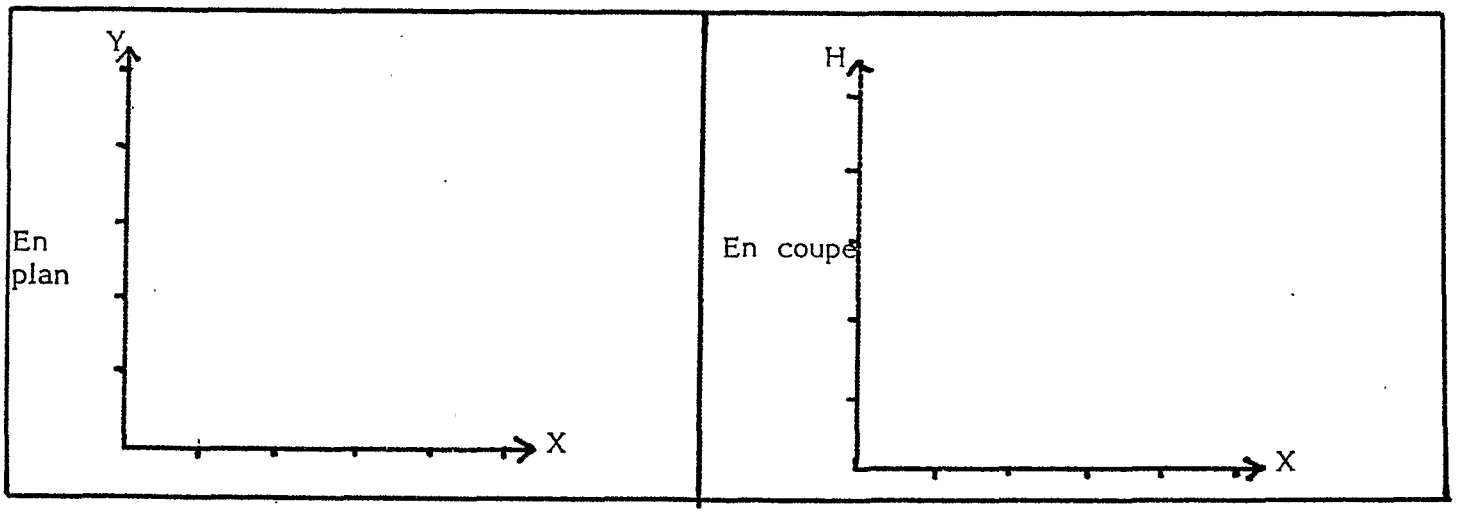
135. Ondulations de la surface (> 1m)

- Sans ondulation
- Avec ondulations
  - Nature :
  - Forme :
  - Amplitude moyenne en mètres — Verticale : / Horizontale:
  - Orientation :

136. Erosion

- Pas d'érosion
- Erosion
  - Type :
  - Forme :
  - Intensité :
  - Pourcentage de surface affectée : %

SCHEMAS ET OBSERVATIONS DIVERSES



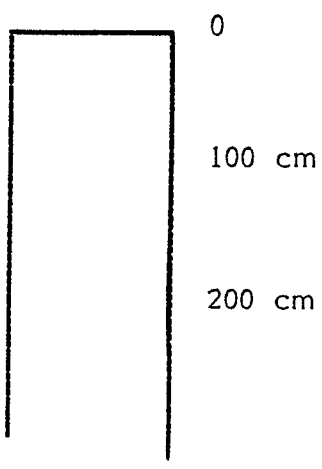
14. Type de sol

141. Classification
CPCS :
Soil Taxonomy :
FAO :

142. Unité cartographique de référence :

143. Matériau originel :

144. Description (cf. schéma) :



Profondeur cm	Couleur	Texture	MO %	Co_3Ca %	Gypse %

II. CONDITIONS CLIMATIQUES ET ETAT DE L'OCCUPATION DU SOL AU MOMENT DE LA DESCRIPTION DU SITE-TEST

21. Conditions de l'observation

211. Identité de l'observateur : ⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

212. Date : J ⌊⌊⌋⌋ M ⌊⌊⌋⌋ A ⌊⌊⌋⌋ Heure : ⌊⌊⌋⌋

213. Conditions météorologiques du jour de l'observation

Humidité de l'air : ⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

Nuages : en 1/8 ⌊⌊⌋⌋

Vent — Intensité : ⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

Orientation : ⌊⌊⌋⌋ - ⌊⌊⌋⌋

Date de la dernière pluie J ⌊⌊⌋⌋ M ⌊⌊⌋⌋ A ⌊⌊⌋⌋

Conditions météo particulières ⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

214. Conditions météo des 4 derniers jours

Précipitations : mm ⌊⌊⌋⌋

Divers : ⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

22. Occupation du sol : Donnée synthétique et qualitative en relation avec l'activité humaine

221. Dominante d'utilisation

	Dominante 1	Associée 2	Associée 3
Utilisation agricole	1	2	3
Utilisation pastorale	1	2	3
Utilisation forestière	1	2	3
Zone d'habitations	1	2	3

222. Végétation naturelle

Formation végétale — dominante : ⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

associée : ⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

Groupement végétal — dominant : ⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

associé : ⌊⌊⌊⌊⌊⌊⌊⌊⌊⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

223. Sylviculture et agriculture -

Observations / Types de cultures	Espèces	Date de plantations ou semis	Stade végétatif	Etat général	Estimations Rendements Divers
Reboisement					
Cultures pérennes					
Cultures annuelles					
Pâturages et prairies artific.					

224. Sols nus : OUI/NON

225. **Eléments d'aménagement du paysage agricole**

Superficies moyennes des parcelles en hectares
Haies :
Talus :
Terrasses :

226. **Techniques agricoles**

Drainage (type) :
Irrigation (type) :
Labour : J M A
Hersage : J M A
Ados : J M A
Planches : J M A

227. **Feux :**

Date : J M A
Extension : Hectares :
Végétation brûlée : %
Repousse : %

227. **Zone urbaine :**

228. **Eau libre :**

229. **Faune**

Espèces
Types de construction

III. IDENTIFICATION DE LA MOSAIQUE SURFACES ELEMENTAIRES ["MOSAIQUE SE"] AU MOMENT DE LA DESCRIPTION DU SITE-TEST

31. Aire du site-test décrit

311. Superficie : hectares ⌊__⌋

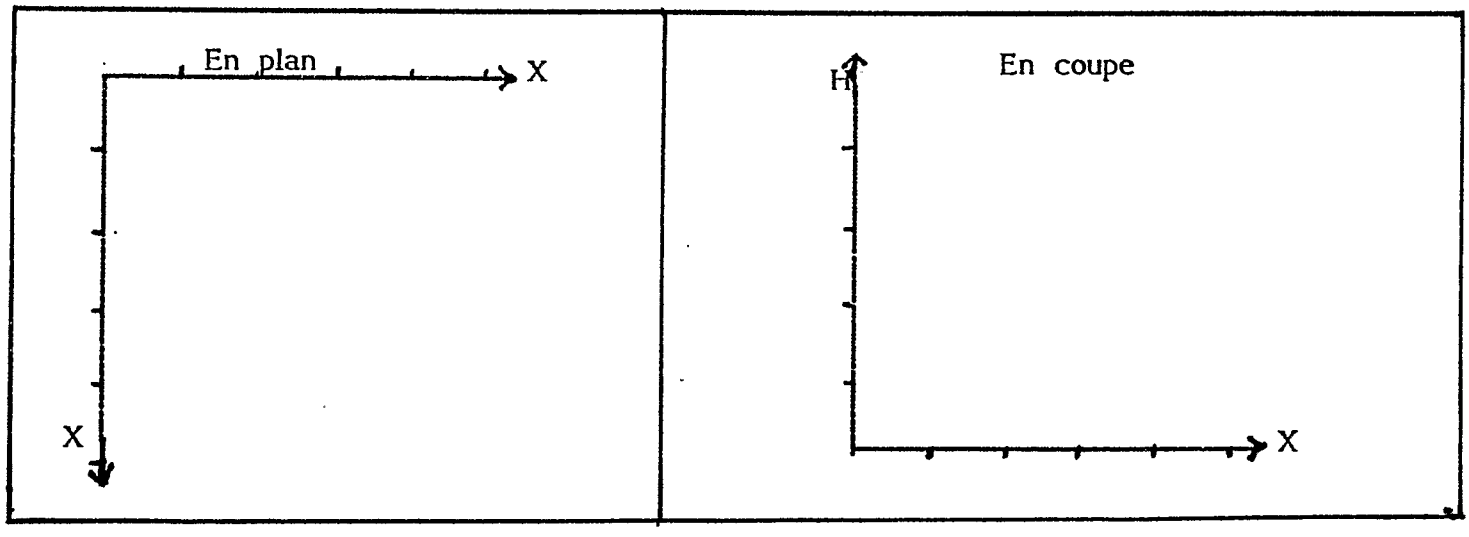
312. Nombre surfaces élémentaires décrites (SE) ⌊__⌋

32. Composition de la "mosaïque SE"

Code des SE	DESCRIPTION - IDENTIFICATION des SE	Pourcentage % superficie site-test		Observations complémentaires
		Estimé	Mesure*	
1				
2				
n				

* Type de méthode utilisé

SCHEMAS DE LOCALISATION DES SE



IV. CARACTERISATION QUANTITATIVE DE CHAQUE SURFACE ELEMENTAIRE (SE) AU MOMENT DE LA DESCRIPTION

SURFACE ELEMENTAIRE Code ☐

41. Mesorelief et microrelief (affleurement rocheux et terre fine)

Caractérisation \ Type		MESORELIEF (ordre métrique)	MICRORELIEF (ordre centimétrique)
Présence		OUI/NON	OUI/NON
Pourcentage de la surface			
Nature et Forme			
Hauteur moyenne			
Largeur moyenne			
Longueur Moyenne			
Orientation préférentielle	Pas d'orientation		
	Orientation préf.		

42. Couverture végétale (végétation + litière et débris organiques)

Couverture Végétale \ Recouvrement en %	TOTAL		"VISIBLE" par le satellite	
	Estimé	Mesuré	Estimé	Mesuré
Végétation				
Litières et Débris				
Couverture végétale (végétation + litières)				

421. Végétation

4211. Principales espèces végétales

Espèce 1 ⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋
Espèce 2 ⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋
Espèce 3 ⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋
Espèce 4 ⌊⌋⌋⌋⌋⌋⌋⌋⌋⌋⌋

4212. Caractérisation des strates

Caractérisation \ STRATES						
Identification						
Recouvrement %	Estimé					
	Mesuré					
Recouvrement "Visible" %	Estimé					
	Mesuré					
"Activité"	Couleur dominante					
	Autre couleur					
	sec %					
	vert %					
	Pérennité					
Structure	Hauteur moy. en mètres					
	Distance moy.					
	Distribution					
	Taille moyenne des couronnes					
	Transparence					
Composition	Espèces Dominantes					

422. Litières et débris organiques

Types		Litières	Brindilles	Algues et lichens	Divers
Recouvrement %	Estimé				
	Mesuré				
Recouvrement "visible" %	Estimé				
	Mesuré				
Nature					
Couleur					

43. Couverture minérale (= affleurements rocheux + pierrosité + terre fine)

Recouvrement en % / Couverture minérale	TOTAL		"VISIBLE" par le satellite	
	Estimé	Mesuré	Estimé	Mesuré
Affleurements rocheux				
Pierrosité				
Terre fine				
Couverture minérale (affl.+pierrosité+terre fine)				

431. Affleurements rocheux

Caractérisation / Types		I	II	III	
Identification					
Recouvrement %	Estimé				
	Mesuré				
Recouvrement "visible" %	Estimé				
	Mesuré				
Couleur					
Hauteur moyenne en mètres					
Nature minéralogique					

432. Pierrosité

Caractérisation / Classes de pierrosité		Blocs > 25cm	Pierres 25-7,5cm	Cailloux 7,5 - 2cm	Graviers 2 - 0,2cm
Recouvrement %	Estimé				
	Mesuré				
Recouvrement "visible" %	Estimé				
	Mesuré				
Diamètre moyen					
Couleur					
Nature minéralogique					
Revêtements					

433. Terre fine (< 0,2 cm)

Caractérisation \ Etat structural de la surface			Structure particulaire	Structure fragmentaire avec agrégats et/ou mottes	Structure continue avec croûte (surface lisse, battante)	Autre état
Identification						
Recouvrement %	Estimé					
	Mesuré					
Recouvrement "visible" %	Estimé					
	Mesuré					
Texture						
Couleur	Sec					
	Humide					
Diamètre moyen (en cm) des agrégats et/ou mottes bien individualisées ou encroûtées						
Réseau de fente de retrait	Présence d'un réseau		oui/non	oui/non	oui/non	oui/non
	Diamètre de la maille en cm					
	Forme					
	Largeur des fentes en cm					
	Profondeur des fentes en cm					
Caractéristiques physico-chimiques						
Humidité	Appréciation de l'état d'humidité					
	Mesure	Pondérale en %				
		Volumique en g/cm3				

V. DIVERS

- Photographies
- Mesures radiométriques
- Mesures diverses
- Résultats d'analyses de sol