PRELIMINARY STATISTICAL ANALYSIS OF AVIRIS/TMS DATA ACQUIRED OVER THE MATERA TEST SITE

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1. INTRODUCTION

In the framework of the MAC Europe campaign, conducted in the summer of 1991, the Matera test site, located in southern Italy, has been overflown by the NASA ER-2, equipped with the TMS and AVIRIS sensors, and the NASA DC-8, equipped with AIRSAR and TOPSAR. The Matera test site extends over an area of about 128 km^2 and includes a flat area that is partially bounded in the northern and southern part by a hilly region.

Due to a tacan error, which caused the plane to go slightly off course, and to scene obscuration by 30% cumulus, only a limited number of images are useful for the test site analysis. Consequently, one image taken on June 20 and two images on July 20 have been requested.

This paper is intended to present the preliminary analysis of TMS/AVIRIS data, which is performed in order to integrate these data with those obtained by the SAR system.

2. GROUND TRUTH

During the airborne campaign, a ground-truth campaign has been conducted (CO.RI.S.T.A. 1991) to get the following information:

- Land cover over 50 different test areas (Fig. 1).
- Type, state, and texture of the vegetation.
- Phenology and diseases.
- Soil humidity and rugosity (Table 1 and Fig. 2).
- Photographs to show the main aspects of the test areas (Fig. 3).

Table 2 lists the main species existing over the areas, with the exception of those covered by bare soil, where the active and passive calibrators were deployed. A digital elevation model has been obtained at a scale of 1:25,000, using the digital data produced by the Italian Geographic Military Institute, and has been registered with respect to the ground-truth maps.

3. TMS/AVIRIS DATA ANALYSIS

Several papers have already emphasized the need to integrate morphological and textural land information with remotely sensed multispectral data, in order to improve classification results.

In the first part of our paper, the geographic information system of the area will be summarized and the procedure for geometric correction and co-registration of TMS and AVIRIS data will be described, taking into account the geometry of the observation and the ancillary data of the airplane. The images will then be introduced in the geographic information system as additional layers, in order to proceed in the classification and statistical analysis of the data and to obtain the spectral signature of different covers.

The experience has shown that there are many different techniques for obtaining the training statistics and for integrating spectral with textural data (G. Asrar 1989). In addition to the need for improving the knowledge of the spectral signature of different land covers, there is also the need for identifying the optimal combination of bands for land cover classification. It is well-known that two basic techniques exist for defining training classes (supervised and unsupervised) and they represent extremes both in terms of the method of defining the training sample and in terms of the method of grouping the training sample into unimodal training classes. Due to this contrast, the possibility exists for four intermediate steps between the two extremes in both parts of the training procedure (P.H. Swain).

In this paper, a multicluster blocks approach will be used with multiple clustering of heterogeneous blocks. This requires the division of the training sample into a series of areas, each containing a mixture of several cover types, which are clustered separately. The different cluster classes must then be combined into meaningful training classes, using a bispectral plot with different transformed divergence values, as a measure of the distance between classes in multidimen-

sional space. Following the classification of the test area, a statistical analysis will be conducted of the AVIRIS 224 channels.

REFERENCES

G. Asrar, "Theory and Applications of Optical Remote Sensing," Wiley, 1989.

CO.RI.S.T.A. Internal Document, "Equator Campaign 1991."

P.H. Swain, "Land Use Classification and Mapping by Machine Assisted Analysis of Landsat Multispectral Scanner Data," LARS Inf. Note 111276.

Table 1. Table for Analysis of Soil Profiles

Profile	Digitalized Point Number	Maximum Value	Mean Value	Standard Deviation	Variation Coefficient
6A	673	45.14	26.927	11.278	0.419
6B	660	68.86	26.249	17.403	0.663
10A	986	105.04	45.683	22.771	0.498
10B	1097	82.35	43.511	21.281	0.489
11A	800	39.37	19.01	9.576	0.504
11B	1292	91	33.336	17.163	0.515
21A	1080	87.7	50.333	21.028	0.418
21B	902	96.28	47.375	25.394	0.536
23A	1294	76.8	40.829	17.09	0.419
23B	980	64.3	33.6	12.65	0.376
41A	1329	84.2	33.225	22.534	0.678
41B	1250	94.8	40.368	22.805	0.565

Note: A = parallel profile and B = perpendicular profile.

Table 2. Main Species Existing Over the Areas Where Calibrators Were Deployed

Refl. #	General Description	Refl. #	General Description
1	Grass meadow of clover	15	Waxy, maturating, hard wheat growing
2	Physiological, maturating, distichous, barley growing	16	Physiological, maturating, distichous, barley growing
3	Physiological, maturating, distichous, barley growing	18	Physiological-waxy, maturating, distichous, barley growing
4	Lacteal-waxy, maturating, hard wheat growing	21	Ploughed soil
5	Waxy, maturating, hard wheat growing	23	N-S climbed olive-grow
6	NNE-SSW furrow soil	25	Physiological, maturating, barley growing
7	Waxy, maturating, scattered seed broadcast, oat growing	26	Physiological, maturating, hard wheat growing
8	Waxy, maturating, hard wheat growing	27	Waxy-physiological, maturating, oat growing
9	Waxy, maturating, hard wheat growing	29	Physiological, maturating, distichous, barley growing
10	Naturally grassed soil	31	Waxy, maturating, hard wheat growing
11	Naturally grassed soil	39	Waxy, maturating, hard wheat growing
12	Lacteal-waxy, maturating, hard wheat growing	40	Waxy, maturating, hard wheat growing
13	Lacteal-waxy, maturating, hard wheat growing	41	E-W ploughed soil

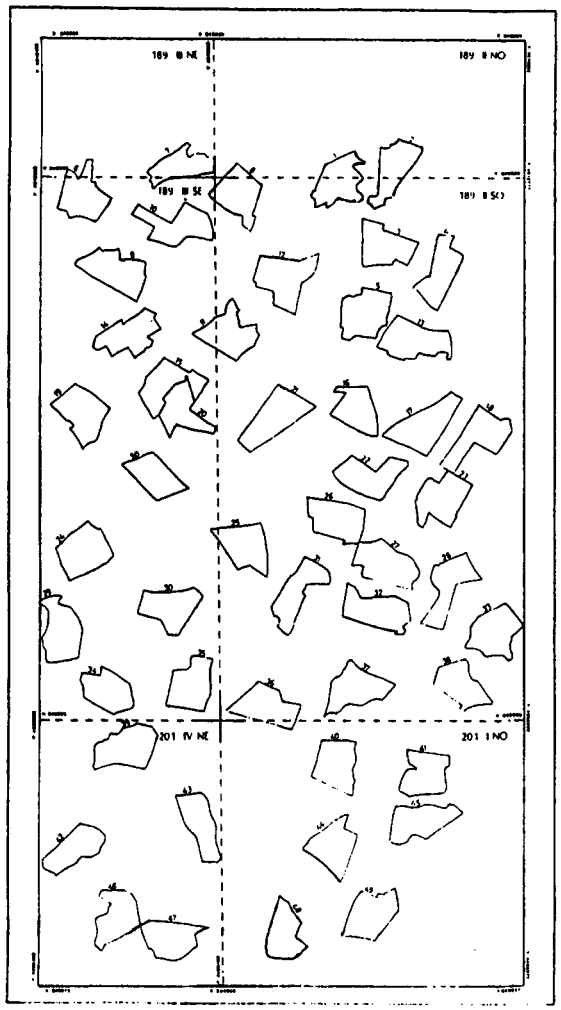

Fig. 1. Locations of test areas.

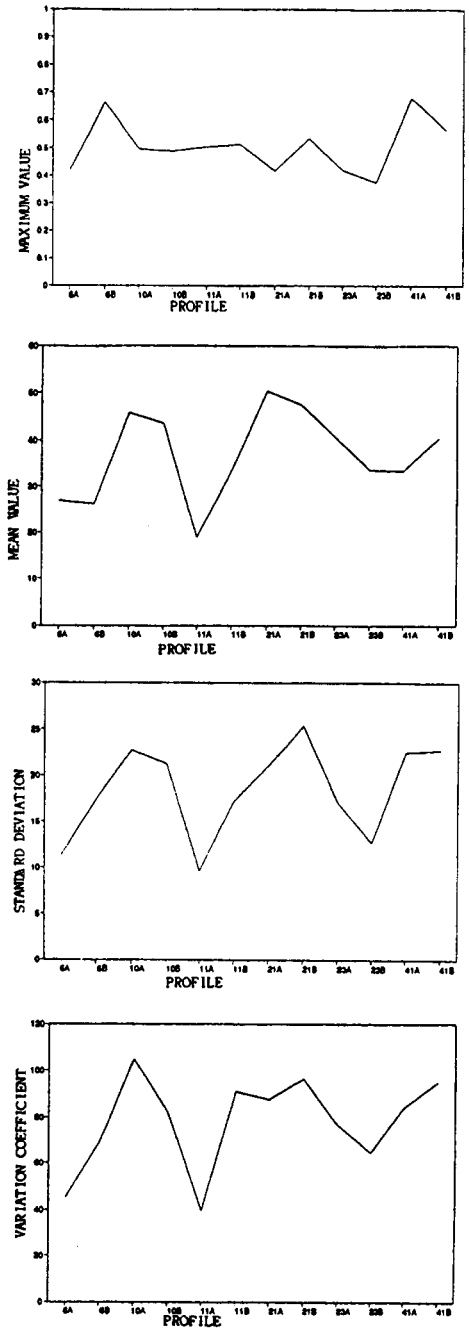

Fig. 2. Variation for each profile of the four parameters: maximum value, mean value, standard deviation, and variation coefficient.

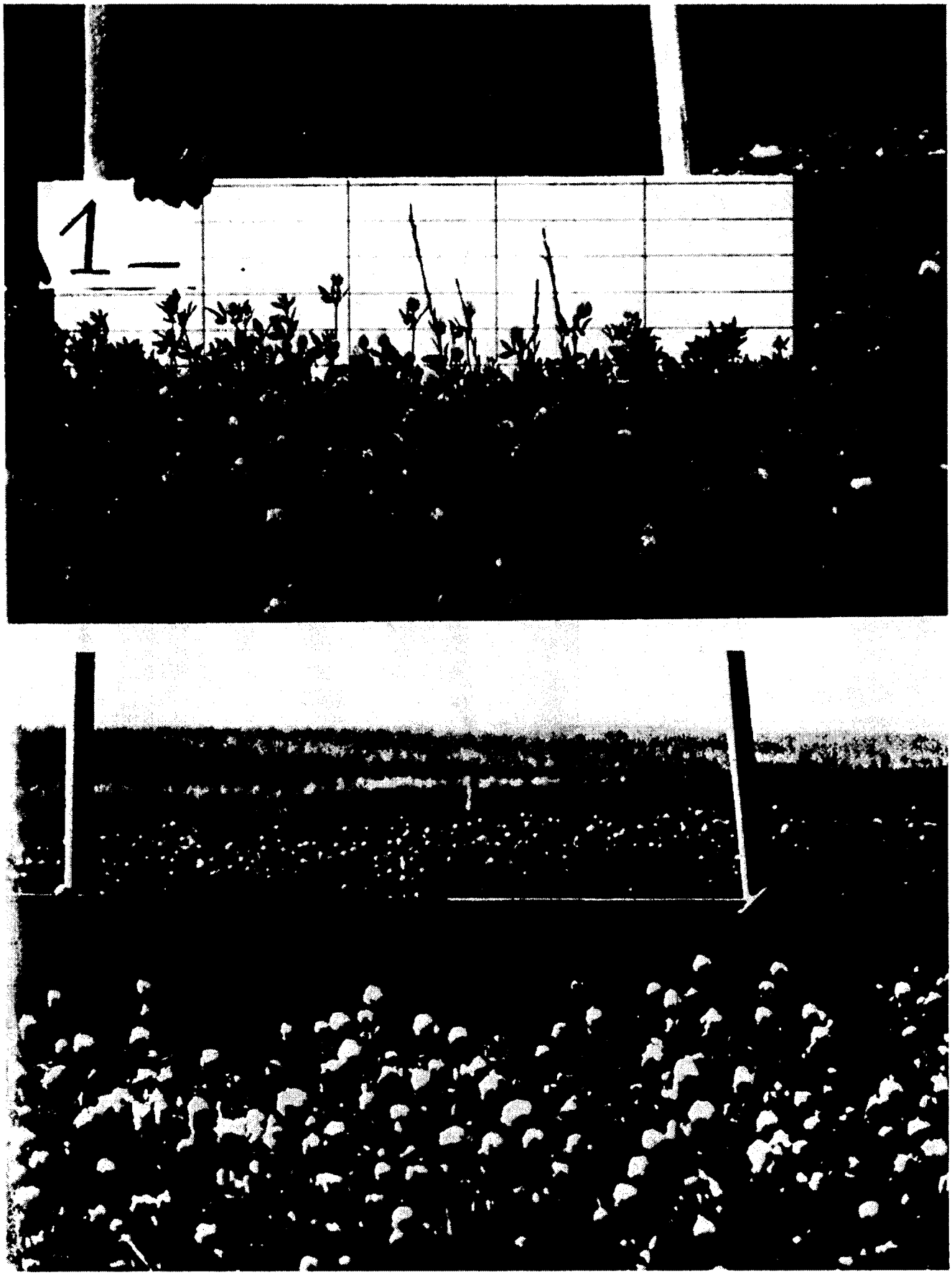

Fig. 3. Photographs of a test area.