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LANDSAT II IMAGE STUDIES AS APPLIED TO A TEST AREA IN NORTHERN APPENNINE RANGE.

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Progress Report presented at Panel Review of Landsat 2 investigations

Investigation N. 28450: Geomorphic and Landform Survey of Northern Appennine Range

P.I. C.M. MARINO

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CONTENT.

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Introduction and scope of the investigation.

The control of landslide prone areas is one of the major problems in our country especially during the last 30 years.
Several techniques are used actually in order to have up to date informations on this kind of phenomena all over the Appennine Range.
Unfortunately both the utilization of time consuming techniques (field geology mainly) and local administrative conflicts of competence are not able to suppl_ regional and state administrations with data on a yearly (or seasonally) revised basis.
Considering that at least after each rainy period of a few days new configurations of those phenomena take place in several areas it is easily understood that the use (or the aid) of the greatest possibility offered by Landsat in observing and quantifying of large extensions in a short time becomes mandatory.
For this reasons a research programm title: "Geomorphic and Landform Survey of Northern Appennine Range..." was submitted to NASA in order to test in an applicative approach the use of space coming information in a defined but largely representative test area.
This site (inside the proposed test territory) was choosen because it is very representative of the different situations which characterize the N.A.R.
The whole complex of results regarding a larger territory and other different examples of thematic map will be presented at NASA at the beginning of 1977; up to day we intend to present the head lines of our work starting from a selected area in Northern Appennine Range (N.A.R.)
Particular attention will be devoted to our effort of choosing selected physical parameters able both to quatify the phenomena and, in the meantime, to be detected from Landsat MSS.

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Landsat of test-site area and geologic background.

This area (fig.) exhibits interesting geologic and morphologic aspects. The tectonic style is fold-type with few fault lines (noted on the basis of stratigraphic controls) limited overthrusts.
The outcropping rocks include geological formations starting from Cretaceus to the recent alluvial deposits. Considering the mean goal of this research i.e. the control of landslide phenomena the outcropping geological formations have been classified according to their geomechanical characteristics.
In particular 8 categories of lithological unites were obtained considering their permeability and priority properties.
The general shape of the territory is well representative of the general situation of N.A.R.
In fact in this area exhibits two main connected factors, namely:
a) High folded tectonic which from its beginning (Miocene) marked series of West to East diastrophisms, in this way definning preferential transverse directions (N-S) of erosion and orographic networks naturally developping in E.W. direction following the uplifting surphaces.
It is so far obvious that hydrography and tectonic are here deeply connected in such a manner that the present patterns of the rivers are here similar to the past one in a geological sense.

b) Second very interesting factor is the mechanical properties of the outcropping geological units.
In fact the presence of frequent alternations of shales and sandstones (few formations having a limestone content) gives rise to frequent erosional phenomena in the surfhace formations expecially in the flysh ones.
The best example of this kind of accellerated weathering are the barren-lands in the Lugagnano clays at the foothill belt facing the Po plain.
The most common weathering aspects originate from the surface running waters

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which give rise to the instability of slopes due to oversaturation of permeable rocks.
Rockfalls are normally very few and the most usual phenomena are due to solifluction, earth flow and creeping in the shaly marl masses.
In this way it is clear that hydrographic network plays a large role in these kind of weathering.
Several drainage models were identified in this area (see fig.) such as:

1) Subparallel: typical examples in the barren-lands in Lugagnano clays.
2) Dendritic: mark[illegible] by a dense network of gullies indicating a very fast moving of surphace wate[illegible]s
3) Combination of the previous two

Hydrographic area N. 3 is a particular situation not justified in a topographic sense. The network (centrifugal and peripheral) suggests a possible infiltration trough limestones with a subsequent rising as springs.

As a final consideration over the geolithological units which outcrop in the area we can observe that they exhibit noticeable changes in their physical properties in a strong connection with seasonal phenomena mainly during spring and fall rainy periods.
In fact the outcropping shaly marl rocks absorb large amount of water so that earth flows and soli fluctions may start also with a very little topographic slope.
Events due to fall and slide are relatively limited, while several areas are prove to a more or less intense creeping.

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Procedure for M.S.S. data analysis.

Basing on previous description of the geologic and geomorphic characteristics of the area the following steps were choosen for MSS data analysis.

1) Identification of physical characterics connected with seasonal variations of response of the outcropping areas
2) Enhancement of morphology and related structures on the basis of spectral content of MSS data
3) Evaluation of the areas of influence related to the drainage of the rivers crossing the test area
4) Mapping of the earth flows connected with shaly areas on the basis of the water content as detected by special electronic enhancement
5) Description of the boundaries of divide lines

The previous steps in our research have been studied utilizing the following techniques combining photographic and electronic treatments:

a) Ratio between different bands (5 and 7) of February and June images: the slicing of the ratio is useful in order to describe the outcropping and the vegetated areas. This comparison between the images of the two seasons enphasizes the bare soils. Another ratio was accomplished of February and November frames which enphasize also the bare areas related
b) Product of two bands (6 and 7): band 6 and 7 were employed because of they enhance the morphology of the territory (covered or not by vegetation). The best data were gained with November images
c) Derivative (electronic) of the two previous treatments: analysis of geomorphic structures and texture with special reference divide line and flood plains

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Geological findings and field observation

On the basis of local surveys we can confirm the following results achieved by Landsat II image MS analysis

1) From the map of the bare areas (ratio of February and November) we can infer informations directly related to field observation. In detail the areas of maximum rill due to the running waters are well identified together with their relationship to the surrounding areas
2) Hydrographic patters (following NE-SW directions) corrisponding to minimum resistence lines from a structural point of view are clearly detected

These findings are not typical only of this area but, on the basis of the global geologic and geomorphic characteristics of N.A.R., they can be utilized as a tool for the mapping of a larger territory in which the general geologic features are similar in broad sense.
It is important to remind that the above mentioned findings are the most important step from an operational point of view to define the landslide prone areas.

Further work planned.

Up to day the data recorded by ad hoc multiband and thermal flights are not completely studied. The next step in our work will be the analysis of these data and their comparison with Landsat 2 data.
Moreover a larger portion of the territory will be the object of our research in order to compare the behaviour of other geological units from the point of view of their permeability to better define the application of the previous results.

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