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COMMITTEE ON THE PEACEFUL USES OF
OUTER SPACE

DEFINITION OF THE TERMS "COARSE", "MEDIUM" AND "FINE" AS
APPLIED TO SPATIAL RESOLUTION IN REMOTE SENSING

Report of the Secretariat

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Introduction

1. At the sixteenth session of the Scientific and Technical Sub-Committee of the Committee on the Peaceful Uses of Outer Space, held in New York from 5 to 22 February 1979, the question of classification of primary data obtained by remote sensing of the earth by satellites was considered as a priority agenda item. Following initial discussions on this subject, and having noted the progress achieved in current programmes relating to remote sensing, the Sub-Committee decided to continue consideration of the item at its next session.

2. To facilitate its task, the Scientific and Technical Sub-Committee requested the Secretariat (A/AC.105/238, annex I, para. 11) to solicit the views of member States of the Committee on the Peaceful Uses of Outer Space and relevant international organizations (World Meteorological Organization, Committee on Space Research, International Astronautical Federation, International Society for Photogrammetry and Remote Sensing Society) on the "definitions of terms in the field of remote sensing and in particular to define such widely used terms as 'coarse', 'medium', 'fine', etc. spatial resolution of imaging systems for remote sensing". The Sub-Committee recommended that these views should be brought to its attention at its next session. The present document contains the views received to date.

Replies received from Governments

ARGENTINA

Original: Spanish

While the main concern is to define the terms "coarse", "medium", and "fine" as they relate to the spatial resolution of imaging systems for remote sensing, the Government of the Argentine Republic believes that any attempt to attach numerical values to the above terms may reflect the personal views of a specialist and would thus yield clearly subjective results and that therefore the opinion of one person is no better or worse than that of any other.

On the basis of the foregoing, it estimates that "coarse" resolution, which present-day meteorological satellites achieve, is between 2,000 and 500 metres; "medium" resolution, between 500 and 50 metres, is approximately the resolution of the separate bands of current LANDSAT satellites. Last, "fine" resolution, ranging from 50 to 5 metres, is the resolution which it is hoped to obtain with satellites currently being planned.

FRANCE

/Original: French/

The term "grainy" applied to a remote-sensing image should be understood in its usual sense: "having a grain-like appearance". Such an appearance, however, will in some cases be linked to the structure of the observed surface and the scale of observation (for example, a close-up shot of orange peel, or a satellite photograph of sand dunes) and in other cases be due to an artifact connected with the method of remote sensing used.

Two frequent examples may be cited:

(a) A photographic image examined under the microscope or greatly enlarged reveals separate photosensitive grains (e.g. silver iodide); it has a grainy structure,

(b) Scenes observed by active remote-sensing methods using coherent electromagnetic sources (e.g. side-looking synthetic-aperture radar) have a grainy appearance due to the interference of the waves picked up by the receiving antenna from each element of the landscape (speckle).

The terms "coarse", "medium", and "fine" do not have - and should not be given - a more precise meaning in remote sensing than in any other area. They may be useful for categorizing various types of resolutions encountered within a single system or on board a single satellite.

For example, in the field of space systems for meteorological observation the terms "synoptic scale", "medium scale" and "local scale" have an established meaning, and one might wish to apply descriptive terms to the corresponding resolutions (a picture of good visual quality contains 3,000 to 6,000 elements per line).

Within the context of a satellite or satellite system in which observations may be made at various resolutions, it is convenient to describe these resolutions qualitatively: thus, "medium" and "fine" resolutions for the LANDSAT-3 satellite would indicate IFOVs 1/ of 56 x 79 m (MSS) 2/ and 40 x 40 m (RBV) 3/ respectively. The same terms applied to LANDSAT-D would refer to the MSS (80 m²) and the thematic mapper (30 m²), while in reference to SPOT they would indicate IFOVs of the order of 20 to 30 m² and 10 m² respectively. In the case of photographic systems (the USSR-German Democratic Republic MKF-6, the United States Geological Survey's Large Format Camera and the photogrammetric camera carried on the first SPACELAB mission), one would be speaking of a photographic resolution of 30 to 15 m, which would correspond in optoelectronic instruments to IFOVs of the order of 10 to 6 m².

1/ Instantaneous field of view.

2/ Mobile service structure.

3/ Return-beam vidicon.

While it may not be desirable to apply an absolute value to the terms "coarse", "medium" and "fine", one could, if necessary, envisage different categories of resolutions. A vital pre-condition for this, however, is agreement at the international level on a resolution criterion which is quantitative and applicable to the whole gamut of outer-space and airborne sensors currently in use or planned.

UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

/Original: English/

The United Kingdom considers that the terms "coarse", "medium" and "fine" spatial resolution as used in remote sensing refer to qualitative rather than quantitative descriptions of spatial resolution and represent relative rather than absolute values. Any numerical values to be attached to these terms will depend on the context in which the terms are used, and there is little to be gained by specifying values which might be valid in one context but not in another.

The United Kingdom therefore considers that no useful need would be served by a quantitative definition of the terms "coarse", "medium" and "fine" as applied to spatial resolution and would prefer to retain these terms as qualitative descriptions to be used when making comparisons between different types of imagery obtained by various remote sensing instruments.

UNITED STATES OF AMERICA

/Original: English/

The United States has found the work done by COSPAR in response to United Nations requests to be a valuable contribution to the general understanding of remote sensing concepts and terms. With regard to the specific items mentioned in the Secretary-General's letter, the terms "coarse", "medium" and "fine" resolution cannot be meaningfully defined in the abstract. Consideration must be given to a number of factors including: (1) type of sensor, (2) type of platform (aircraft, spacecraft, handheld sensor, etc.), (3) location of platform with respect to target object (altitude of aircraft or spacecraft, angle of view), (4) atmospheric conditions, (5) spectral characteristics of sensor, and (6) period of time.

For example, what might have been considered fine resolution for a spacecraft 10 years ago from a high altitude, would be considered extremely coarse from an aircraft at low altitude today. Similarly, "fine" resolution thermal data might be of much lower resolution than "fine" resolution data in the visible part of the spectrum.

Replies received from international organizations

INTERNATIONAL SOCIETY FOR PHOTOGRAMMETRY

Two replies were received from individual members of the International Society for Photogrammetry, representing their views, as set out below.

Mr. P. D. Carman /original: English/: It appears that the United Nations requirement is only to provide boundaries between "global, regional and local" remote sensing data with "coarse, medium and fine" definition, respectively. These broad general categories may be used to govern choice of procedures for dissemination of data.

Under these circumstances, there seems to be no reason for requiring that the boundaries between the three categories be defined with extreme precision. Thus it seems reasonable to base resolution, as suggested in the report, on the 2-bar (Cobb) target of contrast ratio 2:1, although I believe 1.6 to 1 to be a more suitable ratio. Averaging between the two principal directions could be done by taking the geometric mean. Conversion to or from instantaneous field of view could be by means of an appropriate factor, however the factor does not seem to be in the range 2 to 2.5 as given but to be 2.8 to 4.0 (see A. P. Colvocoresses, Image Resolutions for ERTS, Skylab and Gemini/Apollo, Photogrammetric Engineering 38, 1, p. 33, 1972, or Kingslake, Applied Optics and Optical Engineering, vol. II, Academic Press, 1965) because sampling is at fixed intervals, not continuous.

Mr. J. Sievers /original: English/: As to the concepts "coarse", "medium" and "fine", I am of the opinion that definitions are not advisable. These concepts should also in future only be used in a relative meaning.

As far as the "spectral characteristics" are concerned which are listed in annex I, A.1, I should like to refer to Working Group VII-9 "Spectral Signatures of Objects", that has so far mainly furnished contributions to the clarification of terminological questions which are published in the circular letters of the Working Group.
