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FINDINGS OF THE OPIT STUDY IN AMERICA

by

A. Couzy et al.

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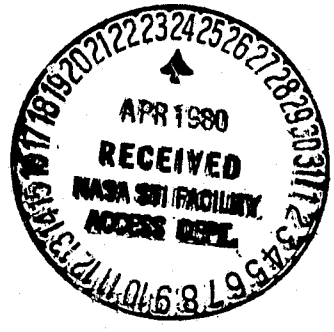

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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The OPIT mission took place from 25 March to 12 April 1979. The team included:

- Alain Couzy, geographer, chief engineer. Director of OPIT.

- Andre Ballut, urban geographer. Urban Development Institute of the Ile region (France). Ministry of Environment and Welfare.

- Sadi Etienne, INSEE (National Institute for Statistics and Economic Studies) attache. Statistician, Ministry of Environment and Welfare.

- Pierre Gonfreville, engineer, program application section, National Center for Space Studies.

- Jean-Pierre Le Gorgeu, hydrogeological engineer. Bureau of Geological and Mining Research.

- Jean de Montgolfier, agronomist, water and forestry engineer. CTGREF. Ministry of Agriculture.

- Jean-Luc Piton, mining engineer. Ministry of Industry.

- Jacques Poulain, geographical engineer. National Geographic Institute.

- Pierre Timkine, chief engineer, agronomy, water and forestry. Associate director of SCEES. Ministry of Agriculture.

- Guy Roman, hydrology engineer. Financial Agency, Loire-Bretagne Basin, Ministry of Environment and Welfare.

- Philippe Touyarot, telecommunications engineer. Ministry of Telecommunications.

- Michel Wohrer, mining engineer. Ministry of Industry.

who have formulated this report.

Chapter 1. Where Are We (Statement)

The first conclusion we reached is that the use of remote sensing in North America, chiefly in the United States, presents a picture similar to that in France - taking into account differences in institutional structures and in scale due to the sizes of the respective territories and budgets; that is, none of the basic questions have been settled in either country.

A. Applications

It is fairly generally admitted in France that space remote sensing in America now has many routine operational applications which we can put to use in the same conditions, provided that effort is taken to transfer the American technology here.

At this stage, we should define the term "operational," which is frequently used without a specific context.

We have considered a remote-sensing application to be operational if it is reliable,[1] renewable but not necessarily irreplaceable, and separate from any aspect of research. In this case, the user for whom it does real service is usually financially obligated for it. The application may be an improvement in a decision-making process, and the contribution obtained can sometimes be measured economically and financially, insofar as it concerns a process limited by the scope of activity of the market economy. A remote-sensing application may also have to do with a production process (cartography).

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[1] That is, the reliability is known and accepted.

The primary conclusion drawn by our group (primary in that it obviously takes first place among the personal conclusions of each of us) is that the use of aerospace remote sensing data in the U.S. and Canada is still largely experimental. The applications which can as yet be considered operational are few in number.

The obvious importance of this conclusion takes into account the fact that it radically questions the general opinion previously held in France. It will doubtlessly give rise to reactions, taking into account a confusion of terminology between, on the one hand, the acceptance we have previously had, and, on the other, the American "operational." It is known that the latter results from a legislative or regulatory act which gives this or that entity the mission and resources to put a technological system into operation. In this way, NOAA has the mission of overseeing the "operational" meteorological satellites, while the LANDSAT satellites of NASA, which have a research mission, are experimental.

In effect, most of the applications or projects which were presented to us do not have an operational character as we have defined it. They have most often been launched on the initiative of NASA, within the framework of systematic demonstration before potential users. These projects, which generally date from only the last two years, are almost always federally financed.

The users very often admit the experimental and exploratory nature of their involvement. They are hardly ever able to speak of integration of remote sensing with their tasks as a tested link, but they use vague and general terms, such as "this can give us information about . . .," whereas we could make conclusions about the operationality if we heard "this allows us to measure this or that parameter necessary to . . . ."

In the matter of reliability, we were also very disturbed by the almost universal absence of concern for verification in the operations we were shown. Without doubt, the projects are generally organized according to an apparently quite rigorous development phase, which

provides for a succesion of phases in which testing always precedes passage to a more operational stage. In reality, very often our speakers were not able to answer our specific questions about reliability, and some clearly aberrant results were often shown to us as particularly convincing. In this regard, the systematic program of evaluation of the remote sensing launched by OPIT appeared to be completely original to our speakers.

Doubtless this lack of rigor in confirming the evidence, which was quite often heard during our study, can be reconciled with the fact that LANDSAT remote sensing finds its use in vast territories which are still very little known, in new countries which do not have a classical information base. Alaska is certainly a state in which LANDSAT is the most useful. Of course the care taken in precision goes beyond that of having available data acquired at a relatively good cost, even if the data remain raw.

Also, most of the applications of the LANDSAT satellite data which were presented to us as currently useful or on the point of becoming so, concern the "discovery" of regions which are very little developed or undeveloped: cartography of Mexico, the programs of USAID or the World Bank in the Third World, a program now being evaluated by the Bureau of Land Management in Alaska and in the West of the United States.

Thus LANDSAT brings for the United State and Canada solutions to a certain number of specific problems often finding their origin in the immensity of the territory concerned.

For example, with LANDSAT the Corps of Engineers is able to carry out in one year an inventory, over the entire territory of the U.S. (some 20 times that of France), of bodies of water of more than five acres, so that it can create new dams and artificial bodies of water, which are placed under fiscal and management control but which are not always reported.

LANDSAT allows the Colorado Water Resources Division to evaluate the water reserves contained in the Rocky Mountains in the form of

snow cover. The satellite supplies the elements which allow supplying a mathematical model: the extent of the snow cover, with measurement of its thickness by a dense network of computerized beacons. It should be noted that the results of this project were criticized by NOAA.

In the arid states of the West, such as Arizona, where irrigation is necessary for any cultivation whatsoever, LANDSAT easily registers the immense irrigated parcels, while all other portions of the territory are clearly defined by their essentially mineral soil. In this state there exists a conflict between agricultural and urban use of water, of which, up to now, no other method has permitted full economic comprehension.

In the management and protection of forests, LANDSAT has some routine applications. The Saint Regis Paper Company relies on using it to manage an area of about one million hectares. In Canada the Society for Conservation in Ottawa is served by an atlas of LANDSAT images to evaluate the means necessary to fight fires which it records by aircraft.

Apart from LANDSAT, the NOAA meteorological satellites must be noted. These have applications for navigation problems such as the location of ice, study of the most productive fishing zones, and sea currents (Gulf Stream). On this topic, we will cite an experiment made by EXXON: this company divided its fleet of tankers into two parts. One had at its disposal data on the Gulf Stream obtained by NOAA, and the other did not. These data allowed the first group to economize several hundred thousand dollars a year. Such applications, although they are not marketable, have an economic advantage which has already been measured and which cannot be ignored.

Finally, we should point to the field of geology and also oil research. The mining departments of oil exploration companies agree that they have found LANDSAT to be a precious aid and that they use it. However, we have encountered extreme discretion on this subject, and we were not able to obtain much information. Access to a research laboratory in this area controlled by NASA was denied us.

We should not forget that these examples, which are sometimes spectacular, of the capability of LANDSAT to give real service often depend on the characteristics of the phenomena in question, whose "specificity" in relation to the European situation is very clear. This observation is a warning against the idea that an operational use can automatically be transferred to very different geographical conditions. Numerous other operations which were presented to us are, on the other hand, still in the experimental stage. The "users" concerned still do not know exactly what future use of this technology will bring them. We encountered this situation often, especially in the East of the country, where the natural conditions of the countryside and the climate are closer to those of Europe than in the West of the continent; the prospective plans which these users sketched led them to pose as a preliminary the question of improvement in photo definition from space and of freedom from the problem of cloud cover.

This is particularly the case for urban problems which always require good definition, and the same is true for transitory or catastrophic occurrences, which impose their own "calendar" in contrast to the problem of the permanence of the observation, sometimes aggravated by cloud cover.

Nevertheless, the interest and collaboration of the users in these experimental programs are certain and should permit, especially in the relatively complex fields of management and of the environment, where the same concepts are not always exactly defined, the progressive working out of a remote-sensing product which has some plus value.

B. Applications

The technical situation is as follows:

First, in the matter of data acquisition and distribution, the users are unanimously unsatisfied, and, as in France, they blame the present system for delivery delays which are incompatible with proper use. It should be pointed out, however, that in Canada the situation seems to be somewhat better, but it should be asked whether this better performance is not due to a lower volume of requests and a more centralized structure.

A second essential point is that in most cases LANDSAT is used in conjunction with standard methods, especially aerial photography. Thus it is not the case that satellite remote sensing is slowly but surely replacing the more precise standard methods, but rather it is a complementary service. The Mexican position in this respect is very significant. The Mexicans use LANDSAT to a large degree for rapid, small-scale cartography, but they are not using any the less their aerial equipment and the standard cartographic methods necessary to supply medium scales. Remote sensing will always be considered a complementary element, useful for bringing these documents up to date. Finally, we note that a number of our speakers indicated to us that the use of photo-interpretation was still far from being as widespread as they wished. Many training programs have also been added to this technology, whether or not it is considered complementary to remote sensing technology.

In this regard, we are of the opinion that the applications which are closest to being operational are generally those which are the least sophisticated. In particular, simple video interpretation, possibly improved, constitutes one of the most widespread techniques. The few other operational applications call for the simplest processing (DAMS project).

The methods used are either small specific modular systems, capable of further modification, or general systems of global information processing in relation to administrative and economic bodies.

The American users are exacting enough in regard to the quality of the photographic or cartographic products furnished. In this regard they are justly well satisfied with what they have obtained from their different contractors.

The problems linked to the unsuitability of current photo definition to (describing) the characteristics of some phenomena or some countries are equally felt by users in corresponding disciplines and regions. These users, nevertheless, remain confident in future developments, which they see as very near, such as the RBV data which are beginning

to be available, and in radar data, as well as in the satellite generation of the 1980s.

As in France, general reports on the possibilities of remote sensing mention the important improvements expected from multi-time methods, but in reality we have not encountered a single application of these methods. It appears that NASA is just developing a method for the necessary geographic adjustments.

Finally, we should state that in the development of mathematical processing methods, research is at a stage not much more advanced than that currently attained in France. But there is no doubt that with an increase in photo-definition and the developments of uses over vast surfaces, recourse to these computerized processing methods will become more and more necessary.

The collaboration pointed out in the preceding chapter involving the users in the technical process is generally considered by them to be indispensable.

For certain very well identified applications such as the establishment of initial inventories, they think it possible to contract with outside agencies, for example, in the private sector. But most of the time their development is oriented toward methods appropriate for their own use. This is especially the case for their needs which are integrated in everyday management, for example, continued surveillance operations. This trend reflects both the political desire to master the management system and the necessity for integration of the entity concerned.

With this option there is certainly a risk of proliferation of small specific systems. On the contrary, funding would limit this increase as the technology improves. In addition, user pools can be envisaged for those with similar needs. These pose problems of coordination among different agencies. The situation in this respect is little different in America from that in France.

Chapter 2. The Reasoning to Follow (Stakes and Prospects)

Having brought the situation into slightly better perspective, we should ask some questions about the large sums which have been alloted for it today and provided for in the future.

Without a doubt, the sums are large: NASA's budget for 1980 apportions nearly 90 million dollars for LANDSAT D and D' development, some 34 million dollars for research on remote-sensing applications for Earth resources, and over 10 million dollars for demonstration and technology transfer programs. The users also have large budgets: on its part, the USDA is expecting a hundred and twenty million dollars over six years, 14 million dollars of it in 1980, for the new CCAD agricultural program which involves the USGS, USAID, NOAA and NASA.

Private technical organizations currently have many teams working on these problems. For example, Lockheed has some 450 people working on various contracts to improve remote sensing.

In this country there is a widespread conviction that the stakes of such research justify these investments. This point of view could seem incompatible with the opinion which we have previously given. Or, on the contrary, it could lead to questioning the opinion that the users have about remote sensing and the legitimacy of its use.

It is true that technological innovation needs a certain time lapse in order to interface well with various systems. Photointerpretation was technically described, and practically in the development stage, before the Second World War. Thirty years passed before it was truly a part of technological life. Without doubt, the response delay of the market have a tendency to decrease. It is no less necessary that matters progress at their own speed.

A. The Stake

The means affected by pursuing the development of applied remote sensing research show very clear determination and assurance: the desire of

those in political power to bring these projects to a successful conclusion, founded on the conviction that the object of this research will have unquestionable value. Sometimes, especially among non-technical people, this assurance takes on the allure of a veritable act of faith.

This conviction is founded on the immediate interest in remote sensing as a tool for export and penetration into the Third World, and certainly, as far as its future applications are concerned, when the current problems being studied (definition, cloud cover) have been resolved, remote sensing will thus be able to fulfill a function of permanent, general information, which at the present time is a bit premature to expect.

The help already received, as well as what we hope to be able to receive, from this tool, is thought of more and more as necessary, in proportion as the extent and complexity of management problems to be solved and regulations governing them increase.

Certainly the global nature of the information which a satellite system allows to mobilize very rapidly over the entire planet will furnish in future a central and decisive element to those responsible for implementing planetary programs. The effectiveness of a program like GARP within the field of meteorology can be discerned in programs concerning some large environmental and development problems: desertification, deforestation, erosion, etc.

The development of remote sensing coincides with the emergence of the concept of "global management of natural resources." This technology seems, in essence, to be a very special tool for information gathering, both for planning as well as for control. The original nature of this tool and thus its complementary interest in relation to traditional methods resides in the importance of simultaneously processed surfaces and the repetitiveness of the system. The cost is also marginal, due to considerable subsidizing.

The information thus received is, most of the time, thought of as supplying systems that integrate sources of quite varied origin and

type (chiefly socio-economic), and thus this information can help in the decision-making process and allows control in applying management policies. Some of the services we encountered even have in mind systems which will automate the decision-making process in terms of planning. In any case, this method seems obviously to be able to give central administrations the resources for a more effective policy, because they will be better informed.

B. Prospects

In response to these hopes, some important actions were undertaken. On the research level, of course, but also, and in a more original fashion, on the level of user participation there is the working out of the product. The problem posed is simply one of the creation of a product and then of the corresponding "market."

In this regard, the economic approach has given rise to some studies which tend to pinpoint and quantify the advantages that a satellite remote sensing system could bring. The opinions gathered in America question very sharply the philosophy behind these studies and their bases. Although some people extolled private enterprise, for the great majority of our speakers the development of data acquisition methods and the management of satellite systems should remain a federal responsibility. They willingly compare this type of information with that received from agencies like NOAA, or agencies responsible for statistics and the census, and they hope that remote sensing will become a public service.

This might seem paradoxical at first sight, for the country that champions liberalism and private enterprise. In reality, there is a logic in this point of view linked to the nature of decision-making processes and phenomena capable of being measured by remote sensing. Outside of some applications for which there is an economic value corresponding to the advantage supplied (nagivation, private forestry management), most of the uses of remote sensing involve areas of responsibility which fall outside the laws of the marketplace: management, environmental protection, surveillance of proper application of regulations

in collective resource management, all of these concepts and the institutions which administer them fall under the jurisdiction of the public authority.

Sometimes remote sensing can assist in lowering costs and can also often allow carrying out operations which would not otherwise be able to be done. But most of the time, its use does not lighten these burdens; but it allows improving knowledge, therefore making better decisions. To this end, we cite the example of the Bureau of Land Management, which, thanks to its use of remote sensing, has managed to decrease the number of head of cattle in pastures which it farms, making an effort toward soil conservation. Here the advantage is prospective and in contrast to the trend of short-term production of as much as possible, as fast as possible.

On this point, there is also a problem linked to producing information, in which its usefulness is not always measured, nor can the purposes for which it might be useful always be clearly identified. Lack of response however, does not exempt the state from ensuring proper operation of the service concerned. This is the case, for example, in cartography, which is very close to the case we are concerned with.

On this level, the decisions have doubtlessly not yet been made. Some controversies have taken place at the highest level of the nation. Already at the beginning of the 1970s, the legislature proposed initiating an operational system which would have guaranteed continuity even in the absence of user investment. The executive branch, wanting to see serious involvement from the private sector (CR No. 24) does not envisage that the higher authority (satellite and data distribution) would be given to a private organization. Its preferences (OMB) are for a solution involving the possible creation of a department of natural resources which would manage the data acquisition system.

Otherwise, the private sector does not see its way to accepting responsibilities that are not consonant with formal assurances of a minimum economic equilibrium (purchase of at least 65% of the data by

the public sector).

Finally, if the states accept the idea that they would be supplied with the materials necessary to guarantee continuity and procurement of data with their own funds, they think that it is out of the question to participate in financing a remote-sensing data acquisition system.

Almost everybody would like to see a plan for remote sensing that would have the higher authority federally funded, like the solution found for NOAA.

Chapter 3. Methods for Success

In the United States remote sensing has had three successive, contrasting phases in the opinion of possible users: at first enthusiasm which was slightly naive and short-sighted; next, a clear disinvolvement, due to the too optimistic nature of the "conversations" which took place during the previous phase: the "overselling" which characterized it was stated to us time and again. We are just at the beginning of a third stage, longer and more difficult, in which everything should be carefully evaluated. The example of the USDA perfectly illustrates this step: after the disappointment of LACIE, which it took on rather in spite of itself, the Department of Agriculture launched a new program, CCAD, whose development it will ensure. It is also apparent that the pre-eminence of the users is a new element in this third development phase of remote sensing in America.

Without exception, the users think it is indispensable that the responsibility and development of experimental programs which NASA and the producers propose to them be ensured. They think that only under this condition will the programs have a chance to attain objectives corresponding to their needs and will they thus become operational. Participation alone does not seem to them to be able to guarantee that all their requirements will be met correctly. This goes beyond the concept of the programs, and it also often concerns management of systems they hope to use.

A corollary to this requirement is the fact that, with the exception

of some processing sectors, most of the people we met - whether they belonged to producing organizations (NASA) or were users at all levels of decentralization - feel that the transfer of technology to the users is a necessary condition for the development of the uses of remote sensing.

The beginning of the new phase has taken this condition into account. We have seen above that considerable resources have been devoted to it.

The second characteristic, already noted, of the current phase is the strictness of the experimental program design: the users are thinking in terms of individual projects, with specific objectives and stages. We distinguish an experimental phase (first exploratory, then pilot); next, a large-scale test phase; only then do we go on to the operational stage. At each interface the concerned authority gives an opinion about the results obtained prior to going on to the following phase. Costs are always taken into account. If, as we have seen above, this plan is not always rigorously followed, it is nevertheless valuable in that it is integral to the development of most projects.

One difficulty that characterizes this phase is the distinction to be established between research actions and operational applications.

As in France, a discussion is taking part between, on the one hand, the supporters of a technology which is operational and thus "fixed," and, on the other hand, those who extol continued pursuit of research, in which they see the only possibility of eliminating obstacles currently encountered in operational use.

An illustration of the origins of these disputes is given by the Bendix Company, which, as we know, gave up its service activity in the field of remote sensing about a year ago. Some people give as the cause for this backing out the fact that Bendix products were not varied enough. Others feel that Bendix found itself at a certain point unable to satisfy its clients because of interruption in the necessary data supply; this puts the accent on the continued operational aspect of a data and supply system.

This problem is central to the discussions which took place at the highest level of the legislature (Stevenson and Schmitt bills) and the executive (OMB) for many long months, to determine within what institutional framework could an operational remote-sensing system be developed which would be wrongly suited to the requirements of the users.

The Canadian Remote Sensing Center, for its part, seems to have worked out a very balanced integration of the different operations and different concerned parties which we have enumerated. Its example can usefully be taken into account.

Summary and Conclusions

In conclusion, in these developments our country appears to be well placed. On the technical level, the level of software developments appears to be comparable to that in the United States. The SPOT satellite seems to be an asset which many of our speakers are regarding with interest, either for what it can do for them, or as an argument to hasten decisions concerning the operationality of the LANDSAT system or that of construction of the Stereosat satellite. The Canadians, and especially the Quebecois, on their part, openly desire to join France in the use of SPOT, thereby hoping to free themselves somewhat from the monopoly of their southern neighbor.

As far as applications are concerned, if the plus values of remote sensing in France are still in the research stage, it is nevertheless certain that the true stake is to be found outside the borders. Not forgetting the purely strategic aspect, we recall that the chief market for remote sensing should be found in developing nations, especially French-speaking ones, where American competition is particularly stiff.

Due to the bias of remote sensing, the programs we will be conducting will afford an occasion for quite different developments: the construction of statistical systems, evaluation programs, etc.

In this field it appears important to organize the compatibility and effectiveness of our remote-sensing system in relation to those of other countries. In this respect questions are posed at the same time regarding a sufficiently dense network of land stations and their compatibility with future LANDSATs, as well as the compatibility of SPOT and LANDSAT. The optimization of investments on a worldwide scale would necessarily require international coordination. It could be advantageous to take initiatives in this area. In any case, it is important for us not to be left behind. The resources necessary for the undertaking, and for keeping up a sustained rhythm of research, especially applied research, should be available. They should allow us to conduct an ambitious and practical program. The practical aspect must be ensured by continuous and complete participation of the users for working out the remote-sensing product. To this purpose we remember the advice given us and the proposals made to us by the USDA.

Our speakers, after sharing their experiences with us, proposed to give us the benefits of this experience in several forms:

-- Preliminary findings, like those of the USDA whose recommendations can be read with interest in CR No. 08.

-- The offer of collaboration, by which it might be possible to send to the U.S. for a long period personnel able to increase their specific knowledge as well as our information on the American work in the field.

Finally, we should note that it is not possible to attain spectacular, rapid results; as the NORA-MINC report concludes: "While gathering of information is possible, one must reckon with the time factor. The reciprocal exchange of information and plans is carried out slowly...."