STATUS OF THE AVAILABILITY AND USE OF SATELLITE DATA AND PRODUCTS BY WMO MEMBERS

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EXECUTIVE SUMMARY

This technical document provides an evaluation of responses to a questionnaire on the present use of satellite data and products by WMO Members. The questionnaire was distributed to WMO Members in a letter W/MS/OPAG-IOS on 5 March 1999 under the subject of "Strategy to Improve Satellite System Utilization". The contents of this document are an overview on the level of utilization with regard to satellite data availability, impact on various applications and, where applicable, areas with deficiencies.

The major findings, recommendations and conclusions for this technical document are:

- Lesser developed NMHS's need not purchase direct satellite data receiving system for near-real-time use, but rather be served by means of up-to-date telecommunication systems and appropriate application tools, if available**;**

- Notable satellite data requested but not available are:

  - RA II - GEO 0.5 hourly data for Very Short Range and Short Range Forecasting (VSR & SRF) and Aeronautical Meteorology;
  - RAs IV and V - LEO data 4 times per day for Marine Meteorology and VSR & SRF.

- The highest level of unsatisfactory use of satellite data is reported for:
  - Environmental applications and Climatology/Global Change
  - Agricultural meteorology

- The highest level of satisfactory use of satellite data is reported for:
  - Aeronautical Meteorology
  - PWS

- Geostationary half-hourly imagery is the most extensively used data, where available.

- The most important parameters for all applications, are related to clouds, i.e. cloud imagery, cloud top temperature, cloud cover, cloud top height, cloud type. Two highly experienced WMO Members pointed out the following additional parameters that were not mentioned in the questionnaire: wind profile, volcanic ash and SSM/I radiances.

- The parameters for all applications that require urgent improvements are: sea surface temperature, precipitation rate, fires, land surface temperature, snow cover, cloud cover, cloud top height, cloud base height, height of tropopause, cloud water total column, cloud type, humidity and temperature profile, ozone total column, land surface features.

- The number of meteorologists and scientists involved in the application of satellite data in a NMHS is typically very small and should be increased in order to be able to take full advantage of the extensive possibilities of the satellite capabilities.

- A preliminary dynamical assessment between 1996 to 1999 indicated an improvement in the capability of the WMO Members to receive satellite data, primarily but not exclusively for the reception of polar-orbiting satellite data. There was also a tendency for procurement of high resolution reception stations compared to low resolution (WEFAX/APT) stations.

1. INTRODUCTION

1.1 The Open Programme Area Group on Integrated Observing Systems (OPAG-IOS) of the Commission for Basic Systems (CBS) of the WMO has the strategic goal to improve systematically the utilization of the Global Observing System space-based subsystems capabilities with emphasis on improving utilization of satellite data and services in developing countries. One of the means to achieve this is through a critical review and monitoring process of availability and use of satellite data. The review and monitoring process will be performed continuously by means of a dedicated questionnaire included in the request for input to the biennial Application of Satellite Technology Progress Reports. The first questionnaire for this purpose was issued in March 1999. The evaluation of the questionnaire was performed by a sub-group of the OPAG-IOS Expert Team on Improving Satellite System Utilization. Results and conclusions from the WMO Member responses to the questionnaire are presented in this document.

2. QUESTIONNAIRE RESPONSES

2.1 The evaluation of the questionnaire is based on 65 responses, which were available to the authors of this document in the summer of 1999. The number of responses provided a sound basis for a statistical evaluation resulting in a representative overview for some WMO Regions, however not for all. WMO Members in more than one WMO Region were counted only once and assigned to the Region, which contained the largest part of the Member. The following table represents the number of responses:

WMO Region	Number of responses	Possible number of responses	Percentage of responses (%)
RA I	17	53	32
RA II	14	34	41
RA III	6	11	55
RA IV	2	22	9
RA V	4	17	24
RA VI	22	47	47
Total	65	184	35

2.2 The questionnaire was structured in the following manner where the chapter number referred to a question:

1. Summary of data availability
   - 1.1 Processing facilities for satellite data
   - 1.2 Do you process TOVS data?
   - 1.3 Do you use a GIS system?
2. Reception and assessment of other satellite derived data over the GTS
3. Data and products dissemination
4. Use of satellite data
5. Processing of satellite data
6. Limitation in the use of satellite data
7. Archiving facilities
8. Data Collection Platform (DCP)

9. Other information

9.1 Are there research programmes in satellite data application running at the NMS?
9.2 Are there training courses in satellite meteorology organised by your Service?
9.3 How many people are involved in satellite data reception and processing at the NMS?

Most of the answers could be provided by filling prepared boxes in the questionnaire. A copy of the questionnaire is contained in Annex II.

2.3 Most of the information contained in this document was obtained from the answers to questions 1, 1.1, 1.2 , 4, 5, 6 and 9. In order to judge the experiences of a NMHS, additional information for question 1.2 was considered as well as from the biennial Application of Satellite Technology Progress Report for 1997 – 1998 from which some WMO Members contributions were available. This document does not address the responses to questions 1.3, 3, 7 and 8 since they relate to matters of telecommunication and not usage of satellite data and products.

3. EVALUATION RESULTS

3.1 Data availability

3.1.1 Data availability in general

3.1.1.1 Table 1a in Annex I shows the number of responses to question 1 (Summary of data availability) as regards data availability in general. The number of receiving facilities for satellite images from geostationary satellites (GEO) is, in general, the same for high-resolution (HR) digital data as for analogue images (WEFAX) indicating that many NMHS's have both systems in operation. However, the situation is different for polar orbiting satellites (LEO). In most WMO Regions the number of digital HRPT receiving facilities exceeds by a factor of about 2 the number of analogue systems (APT). This implies that data from LEOs are available to many WMO Members at the highest achievable resolution and quality. The GTS is generally used for the reception of quantitative products extracted from satellite data at specialized centres. The Meteosat Data Distribution (MDD) system is typically used in RA I in addition to the GTS.

3.1.1.2 It can be concluded from two WMO Member reports that satellite data are not available to them. As the percentage of responses is, for some Regions, not very high (see paragraph 2.1), it could be assumed that the real number of NMHS's without any satellite data may, in fact, be considerably larger, or at least, that those Members not responding could be greatly under-utilizing satellite data. However, the results and recommendations for the purpose of this document can only be judged on the basis of returned questionnaires.

3.1.2 Data availability problems

3.1.2.1 The evaluation of question 6 (Limitations in the use of satellite data) highlights obvious problems as concerns data availability. Table 1b in Annex I indicates problem areas as well as the number of WMO Members reporting such problems. Problem areas comprise technical problems (data reception, distribution) as well as application problems when 'required data and products were not available'. This last problem area includes aspects such as insufficient accuracy or impact for the application or required but principally unavailable products, e.g. wind profiles. Such application aspects are analysed in more depth in the following chapters. In general, it can be concluded that the number of NMHS's reporting problems is relatively high. On average, 50 percent or more of WMO Members that returned the questionnaire reported some type of problems with data availability be it due to lack of satellite data receiving equipment or because of maintenance problems or of communication line problems.

3.1.2.2 One of the conclusions which can be drawn from the relatively high number of reported data availability problems could be, taking into account the rapid development of telecommunication line capacities and the decreasing telecommunication costs, that less developed NMHS's need not purchase direct satellite data receiving systems for near-real-time use, but rather be served by means of up-to-date telecommunication systems and appropriate application tools, if available.

3.1.2.3 There are some WMO Members which report having satellite data receiving equipment but do not use it. This is, in the first instance, valid for equipment for the reception of data from polar orbiting satellites, the LEOs, and indicates the higher priority for the geostationary satellites. The following are the responses from WMO Members in the category of available but unused equipment:

	RA I	RA II	RA III	RA IV	RA V	RA VI	Total
LEO:	3	6	2	1	-	4	16
GEO:	1	2	-	-	-	-	3

3.2 Use of satellite data in application areas

3.2.1 Areas of use in the different programme areas

3.2.1.1 The information presented in this chapter is retrieved from the answers given to question 4 in the questionnaire. Table 2 in Annex I indicates the WMO programme areas in which satellite data are used at all either in a satisfactory or unsatisfactory manner. The most intensive use of satellite data is made in the areas of Very Short Range & Short Range Forecasting (VSR & SRF), Aeronautical Meteorology and Public Weather Services (PWS). The usage in descending order for the application areas is as follows:

Application area	Percentage usage
VSR & SRF	16 %
Aeronautical Meteorology	15 %
PWS	15 %
Medium & Long Range Forecasting	11 %
Marine Meteorology	11 %
Agricultural Meteorology	10 %
Hydrology	8 %
Climatology / Global Change	7 %
Environmental applications	7 %

3.2.1.2 It should be noted that the table above presents a mixture of application areas and methods, e.g. VSR & SRF and Aeronautical Meteorology. Future versions of the questionnaire will differentiate between application areas and methods.

3.2.1.3 The responses to question 4 in the questionnaire allow one to analyse which satellite data and products are requested but are not available for different programme areas. Notable requirements requested but not available are:

- from Region II - GEO 0.5 hourly data for VSR & SRF and Aeronautical Meteorology;

- from Regions IV and V - LEO data 4 times per day for Marine Meteorology and VSR & SRF.

Hydrology is often mentioned in the context of requested but unavailable data.

3.3 Analysis of the level of satisfaction regarding the use of satellite data

3.3.1 Use of satellite data

3.3.1.1 Tables 3a and b in Annex I give an overview of the number of full use of satellite data in a satisfactory way versus unsatisfactory use for the different WMO Regions and different programme areas. The information in this table is retrieved from the answers to question 4. The following conclusions can be drawn:

- Regions I and II report a relatively high number of satisfactory use of satellite data for all applications;

- Region VI reports a relatively high level of unsatisfactory use for VSR & SRF and for Medium & Long Range Forecasting, and a high level of unsatisfactory use for Hydrology and Agricultural Meteorology; for the other application areas the use of satellite data seems to be satisfactory.

- Regions I and II are much more satisfied with the use of satellite data for Agricultural Meteorology, Hydrology and Climatology than Region VI. It could be concluded that RA VI applies more sophisticated methods in these application areas resulting in higher demands on the satellite data and products.

- The highest level of unsatisfactory use of satellite data is reported for:
  - Environmental applications and Climatology/Global Change
  - Agricultural meteorology

- The highest level of satisfactory use of satellite data is reported for:
  - Aeronautical Meteorology
  - PWS

3.5.2.16 The level of satisfaction and dissatisfaction can be determined from the ratio of reported satisfactory and unsatisfactory use of satellite data as contained in Table 3 in Annex I. The quotient of the last column in Table 3 (Total) resulting from the division of satisfactory use by unsatisfactory use results in the following figures, whereby the highest figures indicate the highest level of satisfactory use and the lowest figures indicate the highest level of unsatisfactory use:

Aeronautical meteorology	7.4
Public weather services	6.6
Marine meteorology	3.4
VSR & SRF	2.4
Hydrology	2.3
Agricultural meteorology	2.0
Climatology /Global Change	1.3
Environmental applications	1.3

3.3.1.3 With regard to VSR & SRF, it should be noted that this is the application area which is most frequently reported. A lot of Members are satisfied with satellite data for these application areas while many other Members have more demanding requirements. In general, two reasons can be given for the unsatisfactory use of satellite data for very short & short range forecasting:

- limitations in data availability (GEO not every 0.5 hrs)
- limitations in the impact for the application

Recommendation: within the field of view of a geostationary satellite, data from GEO should be available to all WMO Members with a time interval of, at least, 0.5 hours for VSR & SRF purposes.

3.3.2 Experience of NMHS's

3.3.2.1 In order to balance the significance of the requirements for more or better satellite data or to judge the level of satisfaction, it is important to assess the experience of the NMHS's in the area of satellite meteorology. The information provided in the responses to the questionnaire allow for an objective classification of the existing experience in most cases. In addition, 27 WMO Member inputs to the WMO biennial Application of Satellite Technology Progress Reports for 1997-1998 were available and have also been taken into account in order to confirm the assessment of the experience resulting from the answers in the questionnaire.

3.3.2.2 The following definition has been applied for the objective classification of the existing experience of a NMHS regarding the use of satellite data. The required information can be retrieved from questions 6 (and to some extent in combination with 1, 1.1 and 4.1), 1.2, 9.1, 9.2 and 9.3 of the questionnaire.

- highly experienced (**h**):
  sufficient knowledge of the use of satellite data and product,
  sufficient knowledge on programming techniques,
  no limitations in the availability of application software and methods, required data and products are available,
  TOVS processing,
  use of satellite data in research projects,
  conducting training courses,
  number of scientists is 4 as a minimum;

- well experienced (**w**):
  sufficient knowledge of the use of satellite data and product,
  sufficient knowledge on programming techniques,
  no limitations in the availability of application software and methods, required data and products are available,
  number of scientists is 2 as a minimum;
  some deficiencies may be compensated by:
    TOVS processing,
    use of satellite data in research projects,
    conducting training courses,

- experienced (**e**):
  sufficient knowledge of the use of satellite data and products
  required data and products are available
  limitations in availability of application software and methods are reported

- fairly experienced (**f**):
  all not contained in categories (**h**), (**w**), (**e**) or (**l**)
- least experienced (**l**):
  required data and products are not available
  limited knowledge of the use of satellite data and products

3.3.2.3 Table 4 in Annex I presents a synopsis of the experiences of the NMHS's for the different WMO Regions based on the returned questionnaires and, if available, in the individual WMO Member Satellite Progress Reports for 1997-1998. The figures in the table are the number of WMO Members falling in each experience category. Differences in the existing experience in the

different WMO Regions are readily obvious. As regards the statistical basis, the result can be considered to be representative for WMO Regions I, II and VI. In general, it is concluded that:

- RA I has a relatively good level of data availability but is not as well experienced as NMHS's in some other Regions;
- the level of experience seems to be better for RA II in comparison to RA I;
- no severe problems are encountered in WMO Region VI;
- nearly no firm conclusion can be derived for WMO RA III, IV and V because of the low level of responses and available information.

3.3.2.4 Table 4 also provides an overview of the number of NMHS's active in TOVS data processing. Surprisingly, no WMO Member from RA I reported processing TOVS data although at least some of them operate a HRPT station. It can be concluded that the image data from the geostationary satellites are the most important source for information and application in Africa.

3.3.3 Detailed analysis of the type of satellite data for programme areas

3.3.3.1 Tables 5a to 5d in Annex I give a synopsis of the use of the different types of satellite data for various programme areas categorized by WMO Region. Some regional conclusions are:

- RA I:

  - GEO 0.5h imagery is the most extensively used data;
  - GEO 3h, 6h and 1h and LEO 1/d and 4/d are the second most extensively used data;
  - GEO data are most frequently used for VSR & SRF and Aeronautical Meteorology followed by PWS;
  - LEO data are frequently used for VSR & SRF, but to a lesser extent than GEO data followed by Agricultural and Aeronautical Meteorology, PWS, Marine Meteorology and Environmental applications.

There is no specific significance with regard to data requested but not available or unsatisfactory use.

- RA II:

  - GEO 3h imagery are the most extensively used data followed by LEO 1/d, GEO 1h, LEO 4/d and GEO 6h;
  - In general, GEO 0.5h data are not used (nearly unavailable);
  - GEO data are most frequently used for VSR & SRF followed by Aeronautical Meteorology, PWS and Marine Meteorology;
  - LEO data are most frequently used for VSR & SRF, Climatology, Marine and Agricultural Meteorology;
  - LEO data have a very limited role in Aeronautical Meteorology;
    - The most frequent request is for GEO 0.5 h data for VSR & SRF.

- RA III, RA IV, RA V:

  - GEO 1 h imagery is the most extensively used data followed by LEO 4/d, LEO 1/d, GEO 3h, GEO 6h and GEO 0.5 h;
  - The application of LEO data is the same order of magnitude as GEO data;
  - GEO data are most frequently used for Aeronautical Meteorology, VSR & SRF, PWS and Medium Range Forecasting;
  - LEO data are used in all programme areas. There is no primary application area;
  - A relatively high number of unsatisfactory use for the different application areas was reported.

- RA VI:

  - GEO 0.5h imagery is the most extensively used data followed by LEO 4/d, GEO 6h, GEO 1h, GEO 3h and LEO 1/d;
  - GEO data are most frequently used for VSR & SRF followed by Aeronautical Meteorology; relatively infrequent use is made in Agricultural Meteorology, Climatology/Global Change, Hydrology and Environmental applications;
  - LEO data are most frequently used for VSR & SRF and Aeronautical Meteorology followed by Marine, Agricultural Meteorology, Medium and Long Range Forecasting and PWS;
  - a relatively high number of unsatisfactory use was reported, in particular for VSR & SRF and Medium and Long Range Forecasting.

General conclusions:

- There are significant differences in the types of satellite data used in the different WMO Regions as well as in the different application areas;
- Regions I and VI receive the most GEO 0.5h data;
- GEO 0.5h imagery is the most extensively used data, where available.

3.4 Evaluation of the use of satellite products

3.4.1 The information provided in the following chapters was extracted from the answers given to question 5 in the questionnaire. The conclusions which can be derived from this information should be balanced with the level of existing experiences which was summarised in Section 3.3.2.3 and in Table 4.

3.4.2 Level of satisfaction

3.4.2.1 **Highest satisfaction**: Highest satisfaction is assigned to all those products for which a high quality level is indicated as well as a high priority for the parameter in the particular application. The results are presented in Table 6a in Annex I. The most frequently reported parameters with the highest satisfaction in descending order are:

88 reports: cloud imagery
56 reports: cloud top temperature
45 reports: cloud cover
45 reports: cloud top height
29 reports: cloud type
22 reports: sea surface temperature

3.4.2.2 **Most urgently needed**: This category is assigned to those products which are not available but requested and which have a priority 1 for the particular application. The results are presented in Table 6b in Annex I. The most urgently needed parameters are:

22 requests: precipitation rate
20 requests: precipitation index
20 requests: atmospheric instability index
19 requests cloud base height
16 requests: cloud water total column
16 requests: cloud water profile
16 requests: soil moisture

3.4.2.3 **Important requested parameters**: Parameters are classified as important requested parameters if they are not available but requested and if their priority is 1 or 2 for the particular

application. The result is presented in Table 6c in Annex I. The most requested high priority parameters are:

28 requests: precipitation rate
27 requests: atmospheric instability index
24 requests: cloud base height
24 requests: cloud water profile
23 requests: precipitation index
23 requests: soil moisture
20 requests: cloud ice total column
20 requests: cloud water total column
19 requests: wind vector over sea surface
17 requests: temperature profile
17 requests: specific humidity total column
16 requests: specific humidity profile
15 requests: cloud top height
15 requests: land surface temperature
15 requests: snow cover

3.5 Analysis of specific limitations in the use of satellite products

3.5.1 Introductory remark

3.5.1.1 The following information was extracted from the responses to question 5 in the questionnaire. As in the previous chapter, conclusions on the provided information should be drawn in the light of existing experience which were represented in Section 3.3.2 and Table 4 in Annex I.

3.5.2 Significance of parameters for application areas

3.5.2.1 Definitions:

(i) A parameter is defined to have significance for an application if it is requested or if its quality is high or medium and the priority for the application is 1,2 or 3 or if the quality is low but the priority is 1 or 2.

(ii) A parameter is classified to be acceptable if the quality is high or medium and the priority is 1 or 2.

(iii) A parameter is classified to be problematic if the parameter is requested but the priority for the application is medium (priority 3) or if the quality of the parameter is low but the priority is high (priority 1 or 2).

(iv) Primary problematic parameters are those which fall in the group of problematic parameters but their number of occurrence is close to or higher than the number of "acceptable" – reports (see Tables 7b to 7j in Annex I). These parameters require urgent improvement.

Parameters with low priority (4 or 5) were not considered in this evaluation.

3.5.2.2 Table 7a in Annex I presents the total extent of requested or used satellite parameters in the different application areas. The information was retrieved from responses to question 5 in the questionnaire. A more detailed analysis of the different parameters for each of the application areas is given in the Tables 7b to 7j. In order to have a sound statistical basis, analyses were not performed for different WMO Regions but rather for all WMO Regions. Based on the definitions

given in the previous section, the following information can be deduced for each of the different application areas:

3.5.2.3 **Aeronautical Meteorology** (Table 7b): The order of significant parameters for Aeronautical Meteorology is:

33 reports: cloud imagery
31 reports: cloud top temperature
27 reports: cloud top height
23 reports: cloud type
22 reports: cloud cover
18 reports: cloud base height
14 reports: atmospheric instability index
13 reports: temperature profile
12 reports: height of tropopause
11 reports: cloud water profile

Primary problematic parameters are:

height of tropopause
sea surface temperature
precipitation rate
fires
temperature profiles

Icebergs, significant wave height, trace gases and vegetation type were neither requested nor used.

3.5.2.4 **Marine meteorology** (Table 7c): The order of significant parameters for Marine Meteorology is:

20 reports: sea surface temperature
18 reports: cloud imagery
14 reports: wind speed over sea surface
12 reports: ocean currents and wind vector over sea surface
11 reports: significant wave height
10 reports: wave period/direction and cloud top temperature

Primary problematic parameters are:

cloud cover
cloud top height
land surface temperature

Land surface features, leaf area index, long-wave surface emissivity, long-wave outgoing radiation, NDVI, ozone profile, ozone total column, short-wave outgoing radiation, snow cover, trace gases and vegetation type were neither requested nor used.

3.5.2.5 **Agricultural meteorology** (Table 7d) The order of significant parameters for Agricultural Meteorology is:

15 reports: NDVI
13 reports: precipitation index
12 reports: cloud imagery
11 reports: land surface temperature
10 reports: fires
9 reports: cloud top temperature and precipitation rate
8 reports: soil moisture and vegetation type

No specific number of primary problematic parameters could be derived.

Sea-ice cover, sea-ice surface temperature, significant wave height and wave period/direction were neither requested nor used.

3.5.2.6 **Hydrology** (Table 7e): The order of significant parameters for hydrology is:

14 reports: cloud imagery
11 reports: precipitation index
10 reports: snow cover and cloud top height and cloud top temperature and precipitation rate
9 reports: cloud cover and cloud type
8 reports: land surface temperature and NDVI and soil moisture
7 reports: land cover and land surface features and cloud water total column

Primary problematic parameters are:

snow cover
cloud base height
cloud water total column

Ozone profile, significant wave height and wave period/direction were neither requested nor used.

3.5.2.7 **Climatology / Global Change** (Table 7f): The order of significant parameters for Climatology/Global Change:

15 reports: sea surface temperatures
12 reports: cloud cover
10 reports: cloud imagery and cloud top height and cloud top temperature
9 reports: long-wave outgoing radiation and short-wave irradiance at surface
8 reports: cloud base height and precipitation index and precipitation rate and temperature profile
7 reports: cloud type and cloud water profile and land surface temperature

Primary problematic parameters are:

cloud cover
cloud base height
cloud type, snow cover

All parameters were needed

3.5.2.8 **Very-Short-Range and Short-Range Forecasting (VSR & SRF)** (Table 7g): The order of significant parameters for VSR & SRF is:

37 reports: cloud imagery
34 reports: cloud top temperature
31 reports: cloud top height
29 reports: cloud cover
26 reports: cloud type
20 reports: land surface temperature and temperature profile
19 reports: precipitation rate
17 reports: cloud base height and precipitation index and atmospheric instability index
16 reports: sea surface temperatures
15 reports: specific humidity profile
14 reports: wind vector over sea
13 reports: cloud water profile
12 reports: wind speed over sea surface
11 reports: snow cover
10 reports: cloud total water column and specific humidity total column

Primary problematic parameters could be considered:

humidity and temperature profile

Icebergs and trace gases were neither requested nor used.

3.5.2.9 **Medium and Long Range Forecasting** (Table 7h): The order of significant parameters for Medium (& Long) Range forecasting is:

17 reports: cloud imagery
13 reports: cloud top temperature
12 reports: cloud cover and cloud top height
10 reports: temperature profile
9 reports: cloud type
8 reports: cloud water profile and sea surface temperature and specific humidity profile
7 reports: cloud base height and land surface temperature

Primary problematic parameters are:

cloud cover

Aerosol total column, icebergs, leaf area index, NDVI, significant wave height, trace gases and vegetation type were neither requested nor used.

3.5.2.10 **Environmental applications** (Table 7i): The order of significant parameters for Environmental applications is:

16 reports: fires
13 reports: ozone total column
12 reports: ozone profile
10 reports: land surface temperature
9 reports: NDVI and sea surface temperature
7 reports: land cover and precipitation index and precipitation rate and trace gases and cloud top temperature

Primary problematic parameters could be considered:

ozone total column

Sea-ice cover and sea-ice surface temperature were neither requested nor used.

3.5.2.11 **Public Weather Services (PWS)** (Table 7j): The order of significant parameters for PWS is:

22 reports: cloud imagery
15 reports: cloud cover
12 reports: cloud type and cloud top temperature
10 reports: cloud top height
8 reports: precipitation rate
7 reports: fires and precipitation index and snow cover

Primary problematic parameters are:

land surface features

Icebergs and trace gases were neither requested nor used.

3.5.2.12 **Total of applications**: The full table with the order of specific parameters for all applications totals is given in Table 7a in Annex I. All of the parameters in the list of the questionnaire have at least more than one application area. The most used or required parameters, i.e. the most important parameters for all applications, are:

169 reports: cloud imagery
135 reports: cloud top temperature
123 reports: cloud cover
122 reports: cloud top height
105 reports: cloud type

The primary problematic parameters are:

sea surface temperature
precipitation rate
fires
land surface temperature
snow cover
cloud cover
cloud top height
cloud base height
height of tropopause
cloud water total column

cloud type
humidity and temperature profile
ozone total column
land surface features

3.5.3 Dedicated application issues

3.5.3.1 The analysis of question 6 in the questionnaire allows one to identify dedicated satellite data and product application problems. Such specific issues could be:

A) lack of knowledge in the use of satellite data & products and / or
B) lack of knowledge of programming techniques and / or
C) limitations in availability of application software and methods or
D) all of the above three problem areas together.

Table 8 in Annex I provides an overview of the number of WMO Members reporting such problems. Based on the number of questionnaires which were sent out but not returned, it can be assumed that the actual number of countries with similar problems is considerably higher. Table 8 indicates the areas which should be taken into account with highest priority in the context of the WMO Strategy to Improve Satellite System Utilization.

3.5.3.2 For WMO RA I, and from the information presented in Table 8 it can be concluded that the lack of knowledge in the use of satellite data and products seems to be a minor problem. Lack of knowledge of programming techniques and limitations in the availability of application software and methods are a more frequently reported problem. Similar conclusions could be drawn for WMO RA II and III, however with less statistical confidence.

3.5.3.3 The situation was somewhat different for WMO RA VI. The knowledge of programming techniques does not seem to be a problem; however lack of knowledge in the use of satellite data and products are mentioned as often as are limitations in the availability of application software and methods.

3.5.4 Limited impact for the intended application

3.5.4.1 Question 6 in the questionnaire provides general information on limitations on the impact of satellite data and products for the intended application. The number of WMO Members reporting limited impact is:

RA I	RA II	RA III	RA IV	RA V	RA VI	Total
[17]	[14]	[6]	[2]	[4]	[22]	[65]
5	5	0	1	1	4	16

3.5.5 Lack of personnel

3.5.5.1 A surprisingly high number of WMO Members report a lack of personnel for the application of satellite data. This information can also be retrieved from question 6 in the questionnaire. From a comparison of the figures given in the section above and in Table 9 in Annex I we can conclude that lack of personnel seems to be a more severe problem than limitations in the impact for the intended application.

3.5.5.2 Table 9 in Annex I indicates the number of WMO Members reporting lack of personnel. The presented figures can only be judged if the total number of available staff is known. Question 9.3 in the questionnaire asks for the personnel involved in satellite data reception and processing at the NMHS's. This information is also presented in Table 9, for comparison. In fact, the satellite

teams are very small groups with typically 1 to 2 operators and technicians only. When reviewing those WMO Regions with a statistically significant response, i.e. Regions I, II and VI, the number of involved meteorologists and scientists is usually not much larger than 1 to 2.

3.5.5.3 The relatively small number of involved operators and technicians indicates the use of automatic satellite data reception and processing to an extent far greater than recommended. The typically small number of involved meteorologist and scientists (1 – 2) should be increased in order to take full advantage of the comprehensive possibilities of the satellite data and products.

Recommendation: The number of meteorologists and scientists involved in the application of satellite data in a WMO Member NMHS is typically very small and should be increased in order to be able to take full advantage of the comprehensive possibilities of the satellite capabilities.

3.6 Additional requested products

3.6.1 Two highly experienced WMO Members indicated additional products of high priority for applications but were not listed in the questionnaire. These were:

- wind profile for Aeronautical Meteorology, Hydrology, Short Range Forecasting
- rain profile for Aeronautical Meteorology, Hydrology, Short Range Forecasting
- volcanic ash for Aeronautical Meteorology
- SSM/I radiances for Medium Range Forecasting, Marine Meteorology

Recommendation: Organizations responsible for the development of present and future operational environmental satellites and relevant satellite product extraction centres are encouraged to note these requests and to take them into account in their planning as far as possible.

4. CONCLUSIONS

4.1 The evaluation of the answers provided in response to the questionnaires indicate both areas of satisfactory use of satellite data and areas with unsatisfactory use. The unsatisfactory areas are: lack of satellite data availability, lack of awareness of data availability, lack of knowledge in the use of satellite data, lack of availability of application software and methods, lack of personnel for the application of satellite data as well as limited impact of satellite data and products on the application. The main problems differ for the various WMO Regions.

4.2 It will be important to compare the answers given in response to this questionnaire with responses to future questionnaires. Such a ‘dynamical assessment’ offers the opportunity to detect changes in the availability and use of satellite data and to monitor the success of the WMO Strategy for Improvement of Satellite System Utilization. Therefore it is intended to issue the questionnaire regularly, in a modified version, together with the biennial WMO Application of Satellite Technology Progress Reports.

4.3 A preliminary dynamical assessment of the status of availability and use of satellite data has been performed (see Annex III for details), comparing the response to the present questionnaire with those related to a similar questionnaire issued in 1996. Although such a dynamical evaluation is possible only for 40 members (i.e. for those who responded to both questionnaires and for reasons of homogeneity), it is possible to note an improvement in the capability of the WMO Members to receive satellite data primarily, but not exclusively, for the reception of data from polar-orbiting satellites. There was a tendency for procurement of high-resolution reception stations compared to low-resolution (WEFAX/APT) stations. This may reflect a greater awareness of the utility in the use of digital satellite data by WMO Members.

ANNEX I

Table 1a
Data availability in general
(Number of WMO Member responses concerning the means of data reception)
[Total number of responses per WMO Region]

WMO Region:		**RA I**	**RA II**	**RA III**	**RA IV**	**RA V**	**RA VI**	**Total**
		[17]	[14]	[6]	[2]	[4]	[22]	[65]
Means of availability								
GEO	WEFAX	10	9	5	1	2	15	42
GEO	HR	9	9	4	1	4	18	45
LEO	HRPT	8	6	3	1	4	12	34
LEO	APT	4	7	2	1	1	7	22
GTS		7	9	1	1	4	10	32
MDD		13	3	1	-	-	7	24
Others (SADIS, FAX_E)		1	1	-	1	1	1	5
No satellite data		-	1	-	1	-	-	2

Table 1b
Data availability problems
(Number of NMHS's reporting data availability problems)
[Total number of responses per WMO Region]

WMO Region:	**RA I**	**RA II**	**RA III**	**RA IV**	**RA V**	**RA VI**	**Total**
	[17]	[14]	[6]	[2]	[4]	[22]	[65]
Type of problem:							
A	11	9	4	1	0	10	35
B	6	7	3	-	-	7	23
C	5	2	2	1	-	2	12
D	5	-	-	2	-	2	9
E	4	4	1	-	-	1	10

A = lack of receiving equipment availability or required data not disseminated or required data and products not available or communication system capacity limitations
B = (only) lack of receiving equipment availability
C = (only) communication system capacity limitation (no problems with receiving equipment availability or maintenance)
D = no problem with receiving equipment availability, but equipment maintenance problems
E = lack of receiving equipment availability and equipment maintenance problems

Table 2:
Areas of use

[Number of responses = number of WMO Members using or interested in the use of satellite data in the application area]

	RA I	**RA II**	**RA III**	**RA IV**	**RA V**	**RA VI**	**Total**
Application area	[17]	[14]	[6]	[2]	[4]	[22]	[65]
Aeronautical meteorology	14	8	4	2	4	15	47
Marine meteorology	10	7	3	1	4	10	35
Agricultural meteorology	10	6	4	-	2	8	30
Hydrology	6	7	2	1	2	6	24
Climatology	5	6	1	1	3	7	23
Very short range & short-range forecasting	16	11	6	1	4	12	50
Medium and long-range forecasting	9	7	2	1	4	12	35
Environmental applications	6	5	1	.	3	6	21
Public weather services	15	8	4	1	4	15	47

Table 3a
Reported satisfactory use of satellite data

Application area	RA I	RA II	RA III	RA IV	RA V	RA VI	Total
Aeronautical meteorology	10	8	2	2	3	12	37
Marine meteorology	6	6	-	1	3	8	24
Agricultural meteorology	6	4	2	-	1	3	16
Hydrology	4	7	-	1	1	1	14
Climatology/Global Change	2	5	-	1	1	3	12
Very short & short-range forecasting	10	10	2	1	3	13	39
Medium & long-range forecasting	7	5	1	1	2	6	22
Environmental applications	2	3	-	-	1	3	9
Public weather services	11	5	2	1	3	11	33

Table 3b
Reported unsatisfactory use of satellite data

Application area	RA I	RA II	RA III	RA IV	RA V	RA VI	Total
Aeronautical meteorology	3	-	1	-	-	1	5
Marine meteorology	3	1	2	-	-	1	7
Agricultural meteorology	3	1	1	-	1	2	8
Hydrology	-	1	1	-	1	3	6
Climatology/Global Change	2	1	-	-	2	4	9
Very short & short-range forecasting	3	4	3	1	-	5	16
Medium & long-range forecasting	1	2	1	-	1	5	10
Environmental applications	1	1	2	-	2	1	7
Public weather services	2	1	1	-	-	1	5

Table 4
Assignment of NMHS's to different experience groups

(for the definition see 3.3.2.3)
(Figures are the number of NMHS's per group derived from the returned questionnaires)
[Total number of responses per WMO Region]

Experience group	RA I [17]	RA II [14]	RA III [6]	RA IV [2]	RA V [4]	RA VI [22]	Total
h	-	2	-	1	1	5	9
w	-	4	2	-	2	7	15
e	5	2	1	-	-	4	12
f	9	3	2	1	1	4	20
l	4	2	-	-	-	-	6
TOVS processing	0	7	2	1	2	9	21

Table 5a
Use of type of satellite data - Region I
(full use and application not satisfactory)

	GEO				LEO	
	6 h	**3 h**	**1 h**	**0.5 h**	**1/d**	**4/d**
Aeronautical meteorology	4	7	5	6	3	1
Marine meteorology	2	4	-	3	2	1
Agricultural meteorology	2	2	1	5	4	2
Hydrology	2	1	-	2	1	1
Climatology/Global Change	1	2	1	3	-	-
Very short & short-range forecasting	4	8	5	7	4	4
Medium and long-range forecasting	2	4	3	4	1	1
Environmental applications	2	1	1	2	2	1
Public weather services	5	4	5	5	3	1
Total:	24	33	21	37	20	12

Table 5b
Use of type of satellite data, **Region II**
(full use and application not satisfactory)

	GEO				LEO	
	6 h	**3 h**	**1 h**	**0.5 h**	**1/d**	**4/d**
Aeronautical meteorology	2	4	3	-	1	-
Marine meteorology	2	2	2	-	2	2
Agricultural meteorology	-	1	1	-	2	2
Hydrology	1	3	2	-	2	1
Climatology/Global Change	1	3	1	-	3	2
Very. short & short-range forecasting	2	4	4	1	5	2
Medium & long-range forecasting	3	2	1	-	-	2
Environmental applications	-	1	-	-	3	1
Public weather services	1	3	3	-	1	1
Total	12	23	17	1	19	13

Table 5c:
Use of type of satellite data, Regions III, IV, V
(full use and application not satisfactory)

	GEO				LEO	
	6 h	**3 h**	**1 h**	**0.5 h**	**1/d**	**4/d**
Aeronautical meteorology	4	4	7	1	4	4
Marine meteorology	2	2	5	1	4	3
Agricultural meteorology	2	1	2	-	1	3
Hydrology	1	1	4	1	2	3
Climatology/Global Change	1	1	3	-	2	3
Very short & short-range forecasting	2	3	7	3	3	4
Medium & long-range forecasting	4	2	5	1	3	4
Environmental applications	1	1	3	1	2	3
Public weather services	2	3	6	2	3	4
Total	19	18	42	10	24	31

Table 5d
Use of type of satellite data, **Region VI**
(full use and application not satisfactory)

	GEO				LEO	
	6 h	**3 h**	**1 h**	**0.5 h**	**1/d**	**4/d**
Aeronautical meteorology	4	4	4	12	3	9
Marine meteorology	2	3	4	7	1	7
Agricultural meteorology	1	1	1	3	3	3
Hydrology	2	1	-	2	1	-
Climatology/Global Change	2	1	1	2	-	2
Very short & short-range forecasting	5	4	7	19	2	11
Medium & long-range forecasting	6	2	1	6	1	5
Environmental applications	1	1	2	-	2	1
Public weather services	1	3	3	10	2	3
Total	24	20	23	61	15	41

Table 6a
Products with high quality and high priority: Highest satisfaction
(number of reports)

Parameter		Application Area									
		Aero Met	Marine Met	Agro Met	Hydro	Climate	VSR & SRF.	Medium Range	Enviro	PWS	Total
1.	Aerosol total column	-	-	-	-	1	-	-	1	-	2
2.	Apparent thermal inertia		-	-	-	-	-	-	-	-	-
3.	Atm. instability index	3	1	2	1	-	3	1	-	2	13
4.	Cloud base height	3	1	1	-	1	2	1	-	1	10
5.	Cloud cover	13	3	2	4	2	7	4	1	9	45
6.	Cloud ice total column	1	1	-	-	-	-	-	-	-	2
7.	Cloud imagery	23	7	4	5	5	22	5	3	14	88
8.	Cloud top height	13	3	3	4	2	11	3	2	4	45
9.	Cloud top temperature	15	4	4	5	3	14	4	2	5	56
10.	Cloud type	8	2	2	4	1	5	2	1	4	29
11.	Cloud water profile	1	1	-	-	-	1	-	-	-	4
12.	Cloud water total column	1	1	-	-	-	1	-	-	-	3
13.	Fires	1	-	-	-	1	1	-	4	2	9
14.	Height of tropopause	1	-	-	-	-	1	1	-	-	3
15.	Icebergs	-	2	-	-	1	-	-	1	-	4
16.	Land cover	-	1	3	3	2	-	-	3	-	12
17.	Land surface features	1	-	1	1	-	1	-	1	1	6
18.	Land surface temperature	4	-	3	3	1	2	1	3	2	19
19.	Leaf area index	-	-	-	-	-	-	-	-	-	-
20.	Long-wv surf. emissivity	-	-	1	-	1	-	-	-	-	2
21.	Long-wv outgoing rad. TOA	-	-	-	-	1	1	-	1	-	3
22.	NDVI	-	-	4	2	2	1	-	2	-	11
23.	Ocean currents	-	2	-	-	1	-	-	-	-	3
24.	Ozone profile	-	-	1	-	3	-	-	3	-	7
25.	Ozone total column	-	-	1	1	2	-	-	4	-	9
26.	Precipitation index	2	-	3	3	1	3	1	1	1	15
27.	Precipitation rate	2	2	2	2	2	2	2	2	2	18
28.	Sea ice cover	-	4	-	-	2	1	1	1	-	9
29.	Sea ice surface temperature	-	-	-	-	-	-	-	-	1	1
30.	Sea level	-	2	-	-	2	-	-	1	-	4
31.	Sea surface temperature	1	7	1	2	3	3	2	1	2	22
32.	Short-wv outgoing rad. TOA	-	-	1	-	1	-	-	1	-	3
33.	Short-wv irradiance at surface	-	-	1	1	2	-	-	1	-	5
34.	Significant wave height	-	5	-	-	-	-	-	-	1	6
35.	Snow cover	-	-	3	3	2	2	2	2	1	15
36.	Soil moisture	-	-	1	-	-	-	-	-	-	1
37.	Specific humidity profile	1	1	1	1	1	2	1	1	1	10
38.	Spec. humidity total column	1	1	1	1	1	2	2	1	1	11
39.	Temperature profile	1	1	1	1	2	3	1	1	1	12
40.	Trace gases	-	-	-	-	-	-	-	1	-	1
41.	Vegetation type	-	-	1	1	-	-	-	1	-	3
42.	Wave period/direction	-	2	-	-	-	-	-	-	-	2
43.	Wind speed over sea surface	-	4	-	-	1	1	1	1	1	9
44.	Wind vector over sea surface	1	4	-	-	1	2	1	1	1	12

Table 6b
Products requested and with highest priority for application: Largest deficit
(number of reports)

Parameter		Application Area									
		Aero Met	Marine Met	Agro Met	Hydro	Climate	VSR & SRF	Medium Range	Enviro	PWS	Total
	Aerosol total column	1	-	-	-	1	-	-	1	-	3
1.	Apparent thermal inertia	1	1	1	1	1	1	1	1	1	9
2.	Atm. instability index	6	1	2	1	1	5	1	1	2	20
3.	Cloud base height	8	1	1	1	1	1	1	1	1	19
5.	Cloud cover-	-	-	1	-	2	1	-	1	-	5
6.	Cloud ice total column	3	-	2	2	1	2	1	1	1	13
7.	Cloud imagery	-	-	-	1	1	1	-	-	-	3
8.	Cloud top height	3	-	-	1	1	5	-	-	-	10
9.	Cloud top temperature	-	-	-	-	1	2	-	-	-	3
10.	Cloud type1	1	-	-	1	-	4	-	-	1	7
11.	Cloud water profile	3	1	1	2	2	3	1	1	2	16
12.	Cloud water total column	2	1	2	2	1	3	1	2	2	16
13.	Fires	-	-	1	-	1	-	-	-	1	2
14.	Height of tropopause	2	-	-	-	-	2	1	-	1	6
15.	Icebergs	-	-	-	-	-	-	1	-		1
16.	Land cover	-	-	1	-	1	-	1	-		3
17.	Land surface features -	1	2	1	2	1	2	1		1	11
18.	Land surface temperature	-	-	1	2	1	1	-	1	-	6
19.	Leaf area index	1	-	1	1	1	-	-	1	-	6
20.	Long-w. surf. emissivity	-	-	1	2	1	2	1	1	1	9
21.	Long-w. outgoing rad. TOA	-	-	2	1	2	1	1	1	1	9
22.	NDVI	-	-	1	2	1	1	-	2	1	8
23.	Ocean currents	-	5	-	-	2	1	1	-	1	10
24.	Ozone profile	-	-	1	-	1	1	-	2	1	6
25.	Ozone total column	-	-	1	-	1	1	-	2	1	6
26.	Precipitation index	2	1	4	1	2	4	2	1	3	20
27.	Precipitation rate	2	1	2	2	1	7	2	1	4	22
28.	Sea ice cover	-	2	-	-	1	-	-	-	-	3
29.	Sea ice surface temperature	-	2	-	-	-	1	-	-	-	3
30.	Sea level	-	2	1	1	1	1	1	2	1	10
31.	Sea surface temperature	-	1	1	1	1	2	1	2	1	10
32.	Short-w. outgoing rad. TOA	-	-	-	1	1	1	-	-	-	3
33.	Short-w. irradiance at surface	-	-	1	2	1	2	1	1	1	9
34.	Significant wave height	-	6	-	-	-	-	-	1	-	7
35.	Snow cover	1	-	1	2	-	3	1	2	1	11
36.	Soil moisture	-	-	3	5	1	3	1	1	2	16
37.	Specific humidity profile	1	1	2	1	1	2	1	1	2	12
38.	Spec. humidity total column	1	1	2	2	1	2	1	1	2	13
39.	Temperature profile	3	1	1	1	1	2	1	1	2	13
40.	Trace gases	-	-	-	-	2	-	-	2	-	4
41.	Vegetation type	-	-	2	1	-	1	-	-	-	4
42.	Wave period/direction	-	6	-	-	-	2	1	1	1	11
43.	Wind speed over sea surface	-	5	-	-	-	3	2	-	-	11
44.	Wind vector over sea surface	-	4	-	-	-	5	3	-	-	12
Total		42	43	40	43	39	85	29	40	40	401

Table 6c
Products requested for applications with priority 1 and 2: High deficit
(number of reports)

Parameter		Application Area									
		Aero Met	**Marine Met**	**Agro Met**	**Hydro**	**Climate**	**VSR & SRF**	**Medium Range**	**Enviro**	**PWS**	**Total**
1.	Aerosol total column	1	-	-	-	2	1	-	1	1	6
2.	Apparent thermal inertia	1	1	2	2	1	1	1	1	1	11
3.	Atm. instability index	8	1	2	1	1	9	2	1	2	27
4.	Cloud base height	10	1	1	1	2	5	1	1	1	24
5.	Cloud cover	-	-	1	1	2	1	-	2	-	7
6.	Cloud ice total column	5	-	2	2	1	7	1	1	1	20
7.	Cloud imagery	-	-	-	2	1	1	-	1	-	5
8.	Cloud top height	4	-	-	2	1	6	1	1	-	15
9.	Cloud top temperature	-	-	-	1	1	2	-	1	-	5
10.	Cloud type	3	-	-	1	-	7	1	-	1	13
11.	Cloud water profile	5	1	1	2	3	6	3	1	2	24
12.	Cloud water total column	3	1	2	2	2	5	1	2	2	20
13.	Fires	-	-	1	-	1	-	-	3	2	7
14.	Height of tropopause	4	-	-	-	-	4	1	-	1	10
15.	Icebergs	-	-	-	-	-	-	-	1	-	1
16.	Land cover	-	-	-	2	-	1	-	2	-	5
17.	Land surface features	1	-	1	3	1	2	1	3	1	13
18.	Land surface temperature	-	-	2	2	1	6	1	2	1	15
19.	Leaf area index	1	-	3	2	1	-	-	2	-	9
20.	Long-w. surf. emissivity	-	-	1	2	2	3	11	1	1	11
21.	Long-w- outgoing rad. TOA	-	-	2	1	3	2	1	1	1	11
22.	NDVI	-	-	2	2	1	1	-	2	1	9
23.	Ocean currents	-	7	-	-	2	1	1	-	1	12
24.	Ozone profile	-	-	1	-	1	1	-	5	1	9
25.	Ozone total column	-	-	1	-	1	-	-	4	1	7
26.	Precipitation index	3	1	4	1	2	5	2	2	3	23
27.	Precipitation rate	3	1	2	4	1	9	2	2	4	28
28.	Sea ice cover	-	2	-	-	1	-	-	-	-	3
29.	Sea ice surface temperature	-	2	-	-	-	1	-	-	-	3
30.	Sea level	-	2	1	1	1	1	1	2	1	10
31.	Sea surface temperature	1	1	1	1	1	2	1	2	1	11
32.	Short-w. outgoing rad. TOA	-	-	-	1	1	2	-	-	-	4
33.	Short-w- irradiance at surface	-	-	1	2	2	4	1	1	1	12
34.	Significant wave height	-	6	-	-	-	1	-	1	2	10
35.	Snow cover	1	-	1	2	-	6	1	22	2	15
36.	Soil moisture	-	-	4	5	3	5	2	2	2	23
37.	Specific humidity<	1	1	3	1	1	3	2	2	2	16
38.	Spec. humidity total column	1	1	3	2	1	3	2	2	2	17
39.	Temperature profile	4	1	1	1	1	3	2	2	2	17
40.	Trace gases	-	-	-	-	2	-	-	4	-	6
41.	Vegetation type	-	-	3	2	-	2	-	2	-	9
42.	Wave period/direction	1	6	-	-	-	3	1	1	1	13
43.	Wind speed over sea surface	1	7	-	-	-	5	2	-	1	16
44.	Wind vector over sea surface	1	6	-	-	-	7	3	-	2	19
Total		60	49	49	54	48	135	39	66	48	548

Table 7a
Number of <u>significant parameters</u>: all application areas
(significant means: requested or quality = high or medium and priority 1or 2 or 3)

Parameter		Applications									
		Aero Met	**Marine Met**	**Agro Met**	**Hydro**	**Climate**	**VSR & SRF**	**Medium Range**	**Enviro**	**PWS**	**Total**
1	Aerosol total column	2	1	1	2	6	1	-	4	2	19
2	Apparent thermal inertia1	1	1	4	3	1	2	1	1	1	15
3	Atm. instability index	14	4	5	3	3	17	5	3	7	61
4	Cloud base height	18	3	4	5	8	17	7	4	4	70
5	Cloud cover	22	9	8	9	12	29	12	7	15	123
6	Cloud ice total column	6	2	2	2	3	7	1	1	2	26
7	Cloud imagery	33	18	12	14	10	37	17	6	22	169
8	Cloud top height	27	9	7	10	10	31	12	6	10	122
9	Cloud top temperature	31	10	9	10	10	33	13	7	12	135
10	Cloud type	23	9	6	9	7	26	9	4	12	105
11	Cloud water profile	11	6	4	5	7	13	8	4	5	63
12	Cloud water total column	9	4	4	7	5	10	2	4	3	48
13	Fires	7	1	10	2	4	3	1	16	7	51
14	Height of tropopause	12	1	1	1	5	6	3	2	2	33
15	Icebergs	-	2	1	1	3	.	.	3	-	10
16	Land cover	2	1	7	7	3	4	3	7	4	38
17	Land surface features	2	-	7	7	4	5	3	6	6	40
18	Land surface temperature	8	4	11	8	7	20	7	10	6	81
19	Leaf area index	1	-	6	4	3	2	-	5	1	22
20	Long-w. surf. emissivity	2	-	5	3	5	6	3	3	1	28
21	Long-w- outgoing rad. TOA	2	-	3	3	9	9	4	2	1	33
22	NDVI	1	-	15	8	5	3	-	9	1	42
23	Ocean currents	1	12	1	2	4	2	1	1	1	25
24	Ozone profile	1	-	2	-	7	2	2	12	2	28
25	Ozone total column	1	-	2	1	5	4	1	13	4	31
26	Precipitation index	9	4	13	11	8	17	6	7	7	82
27	Precipitation rate	9	5	9	10	8	19	7	7	8	82
28	Sea ice cover	1	9	-	2	5	3	3	1	2	26
29	Sea ice surface temperature	1	4	-	1	1	3	3	1	1	15
30	Sea level	1	9	2	2	8	2	2	4	3	33
31	Sea surface temperature	9	20	6	6	15	16	8	9	7	96
32	Short-w. outgoing rad. TOA	1	-	2	2	5	3	1	2	1	17
33	Short-w- irradiance at surface	1	1	2	4	9	6	3	3	1	30
34	Significant wave height	-	11	-	-	1	1	-	1	2	16
35	Snow cover	5	-	5	10	6	11	7	4	7	55
36	Soil moisture	1-	1	8	8	6	6	3	5	2	40
37	Specific humidity profile	4	3	5	5	4	15	8	6	5	55
38	Spec. humidity total column	4	3	5	5	4	10	6	6	4	47
39	Temperature profile	13	5	5	6	8	20	10	5	5	77
40	Trace gases	-	-	2	1	5	-	-	7	-	15
41	Vegetation type	-	-	8	4	4	3	-	6	1	19
42	Wave period/direction	1	10	-	-	1	3	1	2	1	19
43	Wind speed over sea surface	7	14	1	2	4	12	7	2	4	53
44	Wind vector over sea surface	8	12	1	1	4	14	7	2	4	54

Table 7b
Parameters for application area: Aeronautical meteorology
(Definitions see section 3.5.2.1)

Parameter		Acceptable	Problematic	Total
1.	Aerosol total column	2	-	2
2.	Apparent thermal inertia	1	-	1
3.	Atm. instability index	11	3	14
4.	Cloud base height	17	1	18
5.	Cloud cover	19	3	22
6.	Cloud ice total column	6	-	6
7.	Cloud imagery	32	1	33
8.	Cloud top height	25	2	27
9.	Cloud top temperature	26	5	31
10.	Cloud type	20	3	23
11.	Cloud water profile	9	2	11
12.	Cloud water total column	7	2	9
13.	Fires	4	3	7
14.	Height of tropopause	7	5	12
15.	Icebergs	-	-	-
16.	Land cover	2	-	2
17.	Land surface features	2	-	2
18.	Land surface temperature	7	-	8
19.	Leaf area index	1	-	1
20.	Long-w. surf. emissivity	1	1	2
21.	Long-w- outgoing rad. TOA	1	1	2
22.	NDVI	1	-	1
23.	Ocean currents	1	-	1
24.	Ozone profile	1	-	1
25.	Ozone total column	1	-	1
26.	Precipitation index	8	1	9
27.	Precipitation rate	5	4	9
28.	Sea ice cover	-	1	1
29.	Sea ice surface temperature	-	1	1
30.	Sea level	1	-	1
31.	Sea surface temperature	5	4	9
32.	Short-w. outgoing rad. TOA	-	1	1
33.	Short-w- irradiance at surface	-	1	1
34.	Significant wave height	-	-	-
35.	Snow cover	3	2	5
36.	Soil moisture	-	1	1
37.	Specific humidity profile	4	-	4
38.	Spec. humidity total column	4	-	4
39.	Temperature profile	9	4	13
40.	Trace gases	-	-	-
41.	Vegetation type	-	-	-
42.	Wave period/direction	1	-	1
43.	Wind speed over sea surface	5	2	7
44.	Wind vector over sea surface	6	2	8

Table 7c
Parameters for application area: Marine Meteorology
(Definitions see section 3.5.2.1)

Parameter		Acceptable	Problematic	Total
1.	Aerosol total column	1	-	1
2.	Apparent thermal inertia	1	-	1
3.	Atm. instability index	4	-	4
4.	Cloud base height	3	-	3
5.	Cloud cover	6	3	9
6.	Cloud ice total column	2	-	2
7.	Cloud imagery	17	1	18
8.	Cloud top height	6	3	9
9.	Cloud top temperature	7	3	10
10.	Cloud type	8	1	9
11.	Cloud water profile	5	1	6
12.	Cloud water total column	4	-	4
13.	Fires	1	-	1
14.	Height of tropopause	-	1	1
15.	Icebergs	2	-	2
16.	Land cover	1	-	1
17.	Land surface features	-	-	-
18.	Land surface temperature	2	2	4
19.	Leaf area index	-	-	-
20.	Long-w. surf. emissivity	1	-	1
21.	Long-w- outgoing rad. TOA	-	-	-
22.	NDVI	-	-	-
23.	Ocean currents	11	1	12
24.	Ozone profile	-	-	-
25.	Ozone total column	-	-	-
26.	Precipitation index	4	-	4
27.	Precipitation rate	4	1	5
28.	Sea ice cover	9	-	9
29.	Sea ice surface temperature	3	1	4
30.	Sea level	7	2	9
31.	Sea surface temperature	18	2	20
32.	Short-w. outgoing rad. TOA	-	-	-
33.	Short-w- irradiance at surface	-	1	1
34.	Significant wave height	11	-	11
35.	Snow cover	-	-	-
36.	Soil moisture	1	-	1
37.	Specific humidity profile	3	-	3
38.	Spec. humidity total column	3	-	3
39.	Temperature profile	4	1	5
40.	Trace gases	-	-	-
41.	Vegetation type	-	-	-
42.	Wave period/direction	10	-	10
43.	Wind speed over sea surface	13	1	14
44.	Wind vector over sea surface	12	-	12

Table 7d
Parameters for application area: Agricultural Meteorology
(Definitions see section 3.5.2.1)

Parameter		Acceptable	Problematic	Total
1.	Aerosol total column	-	1	1
2.	Apparent thermal inertia	4	-	4
3.	Atm. instability index	5	-	5
4.	Cloud base height	4	-	4
5.	Cloud cover	7	1	8
6.	Cloud ice total column	2	-	2
7.	Cloud imagery	10	2	12
8.	Cloud top height	6	1	7
9.	Cloud top temperature	7	2	9
10.	Cloud type	5	1	6
11.	Cloud water profile	4	-	4
12.	Cloud water total column	4	-	4
13.	Fires	10	-	10
14.	Height of tropopause	1	-	1
15.	Icebergs	1	-	1
16.	Land cover	6	1	7
17.	Land surface features	6	1	7
18.	Land surface temperature	11	-	11
19.	Leaf area index	6	-	6
20.	Long-w. surf. emissivity	5	-	5
21.	Long-w- outgoing rad. TOA	3	-	3
22.	NDVI	15	-	15
23.	Ocean currents	1	-	1
24.	Ozone profile	2	-	2
25.	Ozone total column	2	-	2
26.	Precipitation index	13	-	13
27.	Precipitation rate	7	2	9
28.	Sea ice cover	-	-	-
29.	Sea ice surface temperature	-	-	-
30.	Sea level	2	-	2
31.	Sea surface temperature	6	-	6
32.	Short-w. outgoing rad. TOA	1	1	2
33.	Short-w- irradiance at surface	2	-	2
34.	Significant wave height	-	-	-
35.	Snow cover	4	1	5
36.	Soil moisture	7	1	8
37.	Specific humidity profile	5	-	5
38.	Spec. humidity total column	5	-	5
39.	Temperature profile	5	-	5
40.	Trace gases	2	-	2
41.	Vegetation type	6	2	8
42.	Wave period/direction	-	-	-
43.	Wind speed over sea surface	1	-	1
44.	Wind vector over sea surface	1	-	1

Table 7e
Parameters for application area: Hydrology
(Definitions see 3.5.2.1)

Parameter		Acceptable	Problematic	Total
1.	Aerosol total column	1	1	2
2.	Apparent thermal inertia1	2	1	3
3.	Atm. instability index	3	-	3
4.	Cloud base height	3	2	5
5.	Cloud cover	9	-	9
6.	Cloud ice total column	2	-	2
7.	Cloud imagery	13	1	14
8.	Cloud top height	9	1	10
9.	Cloud top temperature	9	1	10
10.	Cloud type	8	1	9
11.	Cloud water profile	5	-	5
12.	Cloud water total column	5	2	7
13.	Fires	2	-	2
14.	Height of tropopause	1	-	1
15.	Icebergs	1	-	1
16.	Land cover	5	2	7
17.	Land surface features	6	1	7
18.	Land surface temperature	8	-	8
19.	Leaf area index	3	1	4
20.	Long-w. surf. emissivity	3	-	3
21.	Long-w- outgoing rad. TOA	3	-	3
22.	NDVI	7	1	8
23.	Ocean currents	1	1	2
24.	Ozone profile	-	-	-
25.	Ozone total column	1	-	1
26.	Precipitation index	10	1	11
27.	Precipitation rate	8	2	10
28.	Sea ice cover	2	-	2
29.	Sea ice surface temperature	-	1	1
30.	Sea level	2	-	2
31.	Sea surface temperature	6	-	6
32.	Short-w. outgoing rad. TOA	2	-	2
33.	Short-w- irradiance at surface	4	-	4
34.	Significant wave height	-	-	-
35.	Snow cover	6	4	10
36.	Soil moisture	8	-	8
37.	Specific humidity profile	4	1	5
38.	Spec. humidity total column	5	-	5
39.	Temperature profile	5	1	6
40.	Trace gases	1	-	1
41.	Vegetation type	4	-	4
42.	Wave period/direction	-	-	-
43.	Wind speed over sea surface	2	-	2
44.	Wind vector over sea surface	1	-	1

Table 7f
Parameters for application area: Climatology / Global change
(Definitions see section 3.5.2.1)

Parameter		Acceptable	Problematic	Total
1.	Aerosol total column	5	1	6
2.	Apparent thermal inertia1	1	-	1
3.	Atm. instability index	2	1	3
4.	Cloud base height	4	4	8
5.	Cloud cover	7	5	12
6.	Cloud ice total column	3	-	3
7.	Cloud imagery	8	2	10
8.	Cloud top height	8	2	10
9.	Cloud top temperature	7	3	10
10.	Cloud type	4	3	7
11.	Cloud water profile	5	2	7
12.	Cloud water total column	3	2	5
13.	Fires	4	-	4
14.	Height of tropopause	3	2	5
15.	Icebergs	2	1	3
16.	Land cover	2	1	3
17.	Land surface features	2	2	4
18.	Land surface temperature	6	1	7
19.	Leaf area index	2	1	3
20.	Long-w. surf. emissivity	4	1	5
21.	Long-w- outgoing rad. TOA	8	1	9
22.	NDVI	5	-	5
23.	Ocean currents	4	-	4
24.	Ozone profile	5	2	7
25.	Ozone total column	4	1	5
26.	Precipitation index	8	-	8
27.	Precipitation rate	6	2	8
28.	Sea ice cover	5	-	5
29.	Sea ice surface temperature	-	1	1
30.	Sea level	7	1	8
31.	Sea surface temperature	13	2	15
32.	Short-w. outgoing rad. TOA	4	1	5
33.	Short-w- irradiance at surface	7	2	9
34.	Significant wave height	1	-	1
35.	Snow cover	3	3	6
36.	Soil moisture	6	-	6
37.	Specific humidity profile	4	-	4
38.	Spec. humidity total column	4	-	4
39.	Temperature profile	8	-	8
40.	Trace gases	5	-	5
41.	Vegetation type	2	2	4
42.	Wave period/direction	1	-	1
43.	Wind speed over sea surface	3	1	4
44.	Wind vector over sea surface	3	1	4

Table 7g
Parameters for application area: Very short range & short range forecasting
(Definitions see section 3.5.2.1)

Parameter		Acceptable	Problematic	Total
1.	Aerosol total column	1	-	1
2.	Apparent thermal inertia1	1	1	2
3.	Atm. instability index	16	1	17
4.	Cloud base height	14	3	17
5.	Cloud cover	25	4	29
6.	Cloud ice total column	7	-	7
7.	Cloud imagery	34	3	37
8.	Cloud top height	30	1	31
9.	Cloud top temperature	30	3	33
10.	Cloud type	24	2	26
11.	Cloud water profile	13	-	13
12.	Cloud water total column	8	2	10
13.	Fires	2	1	3
14.	Height of tropopause	5	1	6
15.	Icebergs	-	-	-
16.	Land cover	2	2	4
17.	Land surface features	3	2	5
18.	Land surface temperature	17	3	20
19.	Leaf area index	-	2	2
20.	Long-w. surf. emissivity	4	2	6
21.	Long-w- outgoing rad. TOA	8	1	9
22.	NDVI	3	-	3
23.	Ocean currents	1	1	2
24.	Ozone profile	2	-	2
25.	Ozone total column	3	1	4
26.	Precipitation index	14	3	17
27.	Precipitation rate	14	5	19
28.	Sea ice cover	2	1	3
29.	Sea ice surface temperature	2	1	3
30.	Sea level	1	1	2
31.	Sea surface temperature	14	2	16
32.	Short-w. outgoing rad. TOA	3	-	3
33.	Short-w- irradiance at surface	4	2	6
34.	Significant wave height	1	-	1
35.	Snow cover	9	2	11
36.	Soil moisture	6	-	6
37.	Specific humidity profile	11	4	15
38.	Spec. humidity total column	9	1	10
39.	Temperature profile	16	4	20
40.	Trace gases	-	-	-
41.	Vegetation type	2	1	3
42.	Wave period/direction	3	-	3
43.	Wind speed over sea surface	9	3	12
44.	Wind vector over sea surface	13	1	14

Table 7h
Parameters for application area: Medium & Long Range forecasting
(Definitions see section 3.5.2.1)

Parameter		Acceptable	Problematic	Total
1.	Aerosol total column	-	-	-
2.	Apparent thermal inertia1	1	-	1
3.	Atm. instability index	4	1	5
4.	Cloud base height	5	2	7
5.	Cloud cover	8	4	12
6.	Cloud ice total column	1	-	1
7.	Cloud imagery	15	2	17
8.	Cloud top height	11	1	12
9.	Cloud top temperature	13	-	13
10.	Cloud type	8	1	9
11.	Cloud water profile	7	1	8
12.	Cloud water total column	1	1	2
13.	Fires	1	-	1
14.	Height of tropopause	2	1	3
15.	Icebergs	-	-	-
16.	Land cover	1	2	3
17.	Land surface features	1	2	3
18.	Land surface temperature	6	1	7
19.	Leaf area index	-	-	-
20.	Long-w. surf. emissivity	2	1	3
21.	Long-w- outgoing rad. TOA	4	-	4
22.	NDVI	-	-	-
23.	Ocean currents	1	-	1
24.	Ozone profile	-	2	2
25.	Ozone total column	-	1	1
26.	Precipitation index	6	-	6
27.	Precipitation rate	6	1	7
28.	Sea ice cover	3	-	3
29.	Sea ice surface temperature	1	2	3
30.	Sea level	1	1	2
31.	Sea surface temperature	7	1	8
32.	Short-w. outgoing rad. TOA	1	-	1
33.	Short-w- irradiance at surface	1	2	3
34.	Significant wave height	-	-	-
35.	Snow cover	5	2	7
36.	Soil moisture	2	1	3
37.	Specific humidity profile	7	1	8
38.	Spec. humidity total column	6	-	6
39.	Temperature profile	8	2	10
40.	Trace gases	-	-	-
41.	Vegetation type	-	-	-
42.	Wave period/direction	1	-	1
43.	Wind speed over sea surface	5	2	7
44.	Wind vector over sea surface	6	1	7

Table 7i
Parameters for application area: Environmental applications
(Definitions see section 3.5.2.1)

Parameter		Acceptable	Problematic	Total
1.	Aerosol total column	3	1	4
2.	Apparent thermal inertia1	1	-	1
3.	Atm. instability index	1	2	3
4.	Cloud base height	4	-	4
5.	Cloud cover	5	2	7
6.	Cloud ice total column	1	-	1
7.	Cloud imagery	6	-	6
8.	Cloud top height	5	1	6
9.	Cloud top temperature	5	2	7
10.	Cloud type	3	1	4
11.	Cloud water profile	3	1	4
12.	Cloud water total column	3	1	4
13.	Fires	15	1	16
14.	Height of tropopause	1	1	2
15.	Icebergs	3	-	3
16.	Land cover	6	1	7
17.	Land surface features	5	1	6
18.	Land surface temperature	10	-	10
19.	Leaf area index	4	1	5
20.	Long-w. surf. emissivity	2	1	3
21.	Long-w- outgoing rad. TOA	2	-	2
22.	NDVI	7	2	9
23.	Ocean currents	1	-	1
24.	Ozone profile	10	2	12
25.	Ozone total column	10	3	13
26.	Precipitation index	7	-	7
27.	Precipitation rate	6	1	7
28.	Sea ice cover	1	-	1
29.	Sea ice surface temperature	1	-	1
30.	Sea level	4	-	4
31.	Sea surface temperature	9	-	9
32.	Short-w. outgoing rad. TOA	2	-	2
33.	Short-w- irradiance at surface	3	-	3
34.	Significant wave height	1	-	1
35.	Snow cover	4	-	4
36.	Soil moisture	4	1	5
37.	Specific humidity profile	5	1	6
38.	Spec. humidity total column	5	1	6
39.	Temperature profile	5	-	5
40.	Trace gases	7	-	7
41.	Vegetation type	4	2	6
42.	Wave period/direction	2	-	2
43.	Wind speed over sea surface	2	-	2
44.	Wind vector over sea surface	2	-	2

Table 7j
Parameters for application area: Public Weather Services
(Definitions see section 3.5.2.1)

Parameter		Acceptable	Problematic	Total
1.	Aerosol total column	1	1	2
2.	Apparent thermal inertia1	1	-	1
3.	Atm. instability index	5	2	7
4.	Cloud base height	3	1	4
5.	Cloud cover	14	1	15
6.	Cloud ice total column	1	1	2
7.	Cloud imagery	21	1	22
8.	Cloud top height	9	1	10
9.	Cloud top temperature	10	2	12
10.	Cloud type	11	1	12
11.	Cloud water profile	5	-	5
12.	Cloud water total column	3	-	3
13.	Fires	6	1	7
14.	Height of tropopause	2	-	2
15.	Icebergs	-	-	-
16.	Land cover	2	2	4
17.	Land surface features	3	3	6
18.	Land surface temperature	6	-	6
19.	Leaf area index	-	1	1
20.	Long-w. surf. emissivity	1	-	1
21.	Long-w- outgoing rad. TOA	1	-	1
22.	NDVI	1	-	1
23.	Ocean currents	1	-	1
24.	Ozone profile	2	-	2
25.	Ozone total column	3	1	4
26.	Precipitation index	6	1	7
27.	Precipitation rate	7	1	8
28.	Sea ice cover	2	-	2
29.	Sea ice surface temperature	1	-	1
30.	Sea level	1	2	3
31.	Sea surface temperature	7	-	7
32.	Short-w. outgoing rad. TOA	-	1	1
33.	Short-w- irradiance at surface	1	-	1
34.	Significant wave height	3	1	3
35.	Snow cover	5	2	7
36.	Soil moisture	2	-	2
37.	Specific humidity profile	4	1	5
38.	Spec. humidity total column	3	1	4
39.	Temperature profile	3	2	5
40.	Trace gases	-	-	-
41.	Vegetation type	1	-	1
42.	Wave period/direction	1	-	1
43.	Wind speed over sea surface	3	1	4
44.	Wind vector over sea surface	4	-	4

Table 8
Lack of knowledge in the use of satellite data and products
[number of reports from NMHS's]

Problem areas:

(A) lack in the knowledge of the use of satellite data & products and/or
(B) lack of knowledge of programming techniques and/or
(C) limitations in availability of application software and methods and/or
(D) all of these three problem areas together.

	RA I	**RA II**	**RA III**	**RA IV**	**RA V**	**RA VI**	**Total**
Problem area	[17]	[14]	[6]	[2]	[4]	[22]	[65]
(A)	5	4	1	2	1	4	17
(B)	11	6	1	1	1	4	24
(C)	13	4	3	1	2	5	28
(D)	15	8	4	2	2	7	38

Table 9

Reported lack of personnel in comparison to available persons

WMO Region	RA I			RA II			RA III			RA IV			RA V			RA VI			Total		
	[17]			[14]			[6]			[2]			[4]			[22]			[65]		
NMHS's reporting lack of personnel	6			3			2			1			2			7			21		
Available personnel (number of staff members)	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
0	3	6	2	1	1	3	2	2	1	1	-	-	1	-	-	1	3	5	9	12	11
1-2	4	4	6	2	3	1	2	2	1	-	-	-	1	2	-	12	16	7	21	26	15
3-5	3	3	3	3	4	2	1	1	1	1	1	-	-	-	1	5	4	5	13	13	12
6-8	1	-	1	-	1	3	-	-	1	-	-	1	1	-	1	2	-	3	4	1	10
9-11	1	-	2	1	1	1	-	1	-	-	1	-	-	-	-	-	-	-	2	3	3
12-14	-	-	-	-	1	1	1	-	-	-	-	-	-	1	-	-	-	-	1	2	1
15-75	-	-	-	4	1	1	-	-	2	-	-	1	-	-	1	1	1	2	5	2	7
➢ 75	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1

I = Operators
II = Technicians and programmers
III = Meteorologists and scientists

ANNEX II

QUESTIONNAIRE ON THE USE OF SATELLITE DATA AND PRODUCTS

1. SUMMARY OF DATA AVAILABILITY

(Please indicate the number of receiving stations)

	AVAILABLE	PLANNED	MEANS OF RECEPTION (HR, WEFAX...)
METEOSAT			
METEOSAT MDD			
INSAT			
GOMS			
GMS			
GOES-E			
GOES-W			
NOAA			
METEOR			
FY-2			
SATEM/SARAD/SATOB/BUFR			
Others (specify)			

1.1 Processing facilities for satellite data

Which devices are used to process/handle/archive satellite data? (In case of more than one system please indicate the total number and the most used type).

	NUMBER	MANUFACTURER	YEAR
RECEIVING SYSTEM			
OTHER INTERACTIVE SYSTEMS (PC)			
WORK STATION(S)/COMPUTER(S)			
PHOTO-RECORDERS:			
ARCHIVING/DATA STORAGE:			

1.2 Do you process TOVS data? Yes ❒ No ❒

For which application ……

……

1.3 Do you use a GIS system? Yes ❒ No ❒

2. RECEPTION AND ASSESSMENT OF OTHER SATELLITE DERIVED DATA OVER THE GTS

Does the National meteorological service receive satellite derived data and products (e.g. SATEM, SARAD, SATOB, SAREP, BUFR) Which data are available and are used? And what is the qualitative assessment on the contribution of the data received for operational purposes? (A=high, B=medium, C=low, D=Doubtful)

TYPE OF DATA	ASSESSMENT	RECEIVED ONLY	RESEARCH USE	USE IN NWP	SYNOPTIC ANALYSIS

3. DATA AND PRODUCTS DISSEMINATION

3.1 Can satellite images, data and products be made available to the peripheral meteorological offices and/or to other users? Please specify the means of distribution available.

	INTERNET/ INTRANET	SATELLITE BROADCAST	DEDICATED NETWORKS/ DED.LINES	CCT/FLOPPY/ EXA/CD ETC	PRINTS/SLIDES ETC.	OTHER (SPECIFY)
HR GEO DATA						
HR LEO DATA						
GENERATED PRODUCTS						
LR PICTURES						

4. USE OF SATELLITE DATA

4.1 Which areas the National Meteorological Service is interested in? Which satellite-derived data are at present used for each application area? Please fill the proper box(es) with the following code:

A = full use of satellite data for the application in satisfactory way;
B = use of satellite data for the application not satisfactorily;
R = data not available at the moment but requested for the application;

Blank means that there is no in-house activity for the application.

PROGRAMME AREA	GEO				LEO			RESEARCH / NOT OPERATIONAL SATELLITES (SPECIFY)
	6hr	3hr	1hr	.5hr	1/day	4/day	other	
AERONAUTICAL METEOROLOGY								
MARINE METEOROLOGY								
AGRICULTURAL METEOROLOGY								
HYDROLOGY								
CLIMATOLOGY/ GLOBAL CHANGE								
V. SHORT & SHORT RANGE FORECASTING								
MEDIUM & LONG RANGE FORECASTING								
ENVIRONMENTAL APPLICATIONS								
PUBLIC WEATHER SERVICES								

5. PROCESSING OF SATELLITE DATA

5.1 If the data are processed, which products are extracted or are available from other sources (e.g. received from other partner)?
Please specify for each application area the used parameters. For each parameter indicate:

- in column A the quality level for that application with the following code: 1=high, 2=medium, 3=low, R=parameter not available but requested)
- in column B the priority level of the parameter for the application (Please indicate priority level from 1 to 5)

NOTE: the parameter list is extracted from the Affiliates list for WMO applications.

		AERONAU		MARINE		AGRICULT		HYDROL		CLIMAT		SH.R.FOR		L.R.FOR		ENVIRON		P.W.S.	
	PARAMETERS	A	B	A	B	A	B	A	B	A	B	A	A	A	B	A	B	A	B

1	Aerosol total column																		
2	Apparent Thermal Inertia																		
3	Atmospheric Instability Index																		
4	Cloud Base Height																		
5	Cloud Cover																		
6	Cloud ice total column																		
7	Cloud imagery																		
8	Cloud top height																		
9	Cloud Top Temperature																		
10	Cloud type																		
11	Cloud water profile																		
12	Cloud water total column																		
13	Fires																		
14	Height of tropopause																		
15	Icebergs																		
16	Land cover																		
17	Land surface features																		
18	Land surface temperature																		
19	Leaf Area Index (LAI)																		
20	Long-wave surf. emissivity																		
21	Long-wave outgoing rad. TOA																		
22	Norm. Diff. Veg. Index (NDVI)																		
23	Ocean currents																		
24	Ozone profile																		
25	Ozone total column																		
26	Precipitation index																		
27	Precipitation rate																		
28	Sea-ice cover																		
29	Sea-ice surface temperature																		
30	Sea Level																		
31	Sea surface temperature																		
32	Short-wave outgoing rad. TOA																		
33	Short-wave irradiance at surf.																		
34	Significant wave height																		
35	Snow cover																		
36	Soil Moisture																		
37	Specific humidity profile																		
38	Specific humidity total column																		
39	Temperature Profile																		
40	Trace gases																		
41	Vegetation Type																		
42	Wave period/direction																		
43	Wind speed over sea surface																		
44	Wind vector over sea surface																		
45	Others																		

6. LIMITATION IN THE USE OF SATELLITE DATA

LACK OF RECEIVING EQUIPMENT AVAILABILITY	
LACK OF EQUIPMENT MAINTENANCE CAPACITY	
REQUIRED DATA NOT DISSEMINATED	
DATA AND PRODUCTS REQUIRED NOT AVAILABLE	

COMMUNICATION SYSTEM CAPACITY LIMITATION	
LACK OF KNOWLEDGE ON USE OF EQUIPMENT	
LACK OF AWARENESS OF DATA AVAILABILITY	
LACK OF KNOWLEDGE ON USE OF SAT. DATA & PRODUCTS	
LACK OF KNOWLEDGE ON PROGRAMMING TECHNIQUES	
LIMITATION IN AVAILABILITY OF APPLICATION SW & METHODS	
LIMITED IMPACT FOR THE INTENDED APPLICATION	
LACK OF PERSONNEL	
OTHERS	

7. ARCHIVING FACILITIES

7.1 Are digital data archived at the station?

	GEO			LEO		
	Y/N	FROM	RETAINING PERIOD	Y/N	FROM	RETAINING PERIOD
AS PRINT OR NEGATIVE FILM						
DIGITAL, TOTAL						
DIGITAL, SELECTION						
DIGITAL, ROLLING						
OTHERS (SPECIFY)						

7.2 If satellite images are archived, is there a catalogue based on quick.looks and/or the meteorological subject observed on the picture? Yes ❒ No ❒

8. DATA COLLECTION PLATFORM (DCP)

8.1 Does the National Meteorological Service have DCP's? (Please fill the appropriate boxes with the number of DCP's)

	OPERATIONAL	PLANNED
LAND		
SHIP		
MOBILE BUOY		
FIXED BUOY		
ASDAR		
ASAP		

8.2 If there are DCP's operational or planned, what is their use?

METEOROLOGICAL	
OCEANOGRAPHIC	
HYDROLOGICAL	
GEOPHYSICAL	

9. OTHER INFORMATION

9.1 Are there research programmes in satellite data application running at the National Meteorological Service? (please specify each item)

DESIGN OF PAYLOAD FOR SATELLITES	
DESIGN OF ACQUISITION AND PROCESSING FACILITIES	
DEVELOPMENT OF METHODS OF DATA PROCESSING	
ASSESSMENT OF QUALITY AND IMPACT OF SATELLITE DATA	
USE OF SATELLITE DATA IN RESEARCH PROJECTS	

9.2 Are there training courses in satellite meteorology organised by your Service?

NAME OF THE COURSE	DURATION	FREQUENCY	LANGUAGE	OPEN TO EXTERNAL STUDENTS

9.3 How many persons are involved in satellite data reception and processing at the National Meteorological Service? Do not indicate people using, *inter alia*, satellite products, e.g. forecasters.

OPERATORS	
TECHNICIANS AND PROGRAMMERS	
METEOROLOGISTS AND SCIENTISTS	

ANNEX III

Preliminary dynamical assessment of the status of availability and use of satellite data and products

1. INTRODUCTION

A dynamical assessment of the status of availability and use of satellite data and products has been performed through the analysis of the questionnaires issued in 1996 and 1999. However, a comparison could only be made where a country report was present in both questionnaires or for other reasons of homogeneity, i.e. for those questions that have not changed in the two versions of the questionnaire.

Table 1 records the number of responses to the two questionnaires. It can be seen that a dynamical assessment is possible only for 40 countries (1996 and 1999), while with the combination of the two questionnaires it is possible to extract information from 101 countries (1996 or 1999), i.e. 55% of the total number of WMO Members.

	WMO Member	**Number of answers available**						
		1999	**% of total**	**1996**	**% of total**	**1996 and 1999**	**1996 or 1999**	**% of total**
RA I	53	17	32	14	26	7	22	42
RA II	34	14	41	19	56	10	19	56
RA III	11	6	55	7	64	5	8	73
RA IV	22	2	9	6	27	1	7	32
RA V	17	4	24	8	47	1	9	53
RA VI	47	22	47	31	66	16	36	77
TOTAL	184	65	35	85	46	40	101	55

2. DATA AVAILABILITY

2.1 RA I

A dynamical assessment is possible for 7 countries in RA I. Two of them have acquired a HR receiving system for GEO and one HRPT station. Also MDD reception capabilities have been improved. In comparison with the previous data, there has been a tendency to improve HR reception capability instead of increasing the number of WEFAX stations.

2.2 RA II

A dynamical assessment is possible for 10 countries. Three of them have acquired HR receiving systems for METEOSAT (including Japan and China), probably in the context of INDOEX. More remarkable is the new capability of 3 countries to receive FY2. One country (Thailand) has acquired a HR GEO station (for GMS) and 4 HRPT stations. Again the tendency to improve HR reception capability instead of increasing the number of WEFAX stations is noted.

2.3 RA III

A dynamical assessment is possible for 5 countries. There have been improvements in satellite data availability for 4 countries, mainly due to the implementation of HRPT stations. Also HR stations for GOES have been implemented in 2 countries.

2.4 RA IV

Only one country replied to both enquiries (El Salvador). In this case, a small improvement can be noted with the implementation of an APT station.

2.5 RA V

Only one country replied to both questionnaires (Singapore). It acquired a HR receiving station for access to FY2 data.

2.6 RA VI

A dynamical assessment is possible for 16 countries. Although RA VI is the region with the largest number of HR stations, some new capabilities are noted through the acquisition of 2 new HRPT and 1 PDUS receiving stations. Two Baltic countries rely on TLC links with Sweden for access to HR data.

3. CONCLUSIONS

A preliminary dynamical assessment of the status of availability and use of satellite data has been performed, comparing the responses to the questionnaire issued in 1999 with those related to a similar questionnaire issued in 1996. Although such a dynamical evaluation is possible only for 40 members (i.e. for those who responded to both questionnaires and for reasons of homogeneity), an improvement in the capability of the WMO Members to receive satellite data can be noted primarily, but not exclusively. for the reception of polar-orbiting satellites. There was a tendency for procurement of high-resolution reception stations compared to low-resolution (WEFAX/APT) stations. This may reflect a greater awareness of the utility of the use of digital satellite data by WMO Members.