CGMS-XXXIII
WMO WP-5
Prepared by WMO
Agenda item: D.1/D.2

CGMS WORKING GROUP ON CONTINGENCY PLANNING

(Submitted by WMO)

Summary and Purpose of Document

WMO WP 05 contains a draft CGMS global contingency plan, which is intended to consolidate in a single document the outcome of previous WMO and CGMS discussions on contingency planning, in response to CGMS Action 32.20.

ACTION PROPOSED

CGMS Members to review the format, the structure and the content of the draft CGMS Global Contingency Plan in the attachment, with a goal to adopt it as a new CGMS reference document once finalized.

COORDINATION GROUP FOR METEOROLOGICAL SATELLITES

FIRST DRAFT

GLOBAL CONTINGENCY PLAN

1. INTRODUCTION

This Global Contingency Plan addresses one of the major objectives of CGMS as stated in its charter:

> "CGMS encourages complementarity, compatibility and possible mutual back-up in the event of a system failure, through cooperative mission planning, compatible meteorological data products and services and the coordination of space and data related activities, thus complementing the work of other international satellite coordinating mechanisms."

The present plan was initially established by CGMS in response to its Actions 31.39 and 32.20 in order to consolidate the conclusions of numerous discussions on this essential issue, guidance received from WMO bodies as well as the lessons of experience. For traceability purpose, references to the original discussions within CGMS or WMO bodies are provided in the Annex.

It aims at serving as a reference for CGMS satellite operators in the planning and implementation of satellite missions, and in particular to facilitate the definition and implementation of joint undertakings in the framework of CGMS to prevent or mitigate contingency situations and secure the continuity of essential meteorological and climate observation missions.

2. BACKGROUND

2.1 Need for a Global Contingency Plan

The Eleventh WMO Congress (1995) recognized the need to ensure the continuing operation of the environmental satellite systems. Congress appealed to satellite operators to ensure continuity, quality and coverage of their satellite programmes in furthering WMO Member's operational and research programmes.

In its Resolution 5 (Cg-XI), Congress urged its Members concerned to maintain the polar-orbiting and geostationary satellite systems to ensure the continuity of operation and to "*develop contingency plans to ensure the continued use and utility of satellite data and products*."

2.2 Historical summary

2.2.1 Past discussions

For more than a decade and a half, the Coordination Group for Meteorological Satellites (CGMS) and the World Meteorological Organization (WMO) have discussed global contingency planning. The results of the those discussions have been recorded in reports of numerous CGMS meetings as well as within WMO Commission for Basic System (CBS) Expert Teams, Working Groups, Executive Council and Congress.

In 1991, the forty-fourth WMO Executive Council recommended the development of contingency plans by the satellite operators to increase the reliability of the space-based global observation system. WMO considered that space segment contingency planning was the core of the statement of WMO requirements for system continuity. It anticipated that CGMS would continue its role of coordination and standardization such that ground receiving equipment would be able to receive and process services from any contingency satellite provided by another operator, e.g. by using standardized down-link broadcasts and data formats.

In 1992, the statement of WMO requirements for continuity was subsequently endorsed by the satellite operators and CGMS subsequently established a Working Group on Global Contingency Planning.

At the first meeting of this Working Group in October 1992, CGMS concluded that no single satellite operator could be expected to guarantee satellite availability in all circumstances and that the establishment of joint contingency plans was essential in order to achieve a reliable global system at a realistic cost. A proposal for a contingency concept, which could meet global needs, was thus established. This concept was based upon a philosophy of assisting neighbouring satellite operators by using data transfer techniques similar to that already developed for the Europe-USA Extended Atlantic Data Coverage scheme.

At CGMS-XXIX, the satellite operators also noted that they were processing and disseminating other satellite operators' imagery and products and thus they relied on each other to maintain a global satellite system. A main strength in such a system was through contingency and reliability. It also acknowledged that the concept of "help your neighbour" also implied that a satellite operator would be willing to be "helped by its neighbour". The duality of the concept, i.e., to help and be helped, would allow sets of regional contingency plans to be the foundation for a single global contingency plan for both the geostationary and polar-orbits. The single global contingency plan is the main subject of the present document.

In 1994, the CGMS Working Group on Global Contingency Planning agreed a technical strategy based upon the "help your neighbour" concept. This strategy assumed that each satellite operator would try, with its best efforts, to maintain its nominal configuration, in accordance with its own constraints. Any CGMS satellite operator faced with a contingency situation, whereby priority satellite based services cannot be supported, should immediately discuss the situation with other satellite operators who, in good faith, should try to find a solution.

In 1997, CGMS considered that it would be beneficial for the user community to develop similar arrangements to cover unexpected contingencies affecting services provided by the satellite operators.

In 1998, at CGMS XXVI, Japan and China looked into possible contingency arrangements to support each other's services. The GMS and FY-2 satellite systems have a high level of compatibility with regard to area of the globe covered and transmission characteristics. However, it was decided that long-term contingency arrangements could only be considered if respective launch schedules allowed sufficient in-orbit redundancy. A limitation to the provision of a back-up of MTSAT or FY-2 was the incomplete overlap (70%) in the fields of view of GMS/MTSAT and FY-2.

Bearing this in mind, the Working Group on Global Contingency Planning considered that in the event of a major system failure, back-up in areas such as product generation might be an appropriate solution. As a consequence, the satellite operators have studied possibilities to support critical product generation using data from neighbouring satellite systems.

Additionally, in 1998, discussions were initiated between EUMETSAT and the ROSHYDROMET with a view to investigating possibilities for the use of Meteosat-5 at 63°E to relay ROSHYDROMET DCP messages and provide a temporary WEFAX image dissemination service in the region.

Also in 1998, India agreed to transmit to its higher authorities the need for regional contingency planning as stipulated in the CGMS contingency concept. To this end, EUMETSAT concluded an Agreement with ISRO for the possible relay of some INSAT imagery and products via the Meteosat system. In return, India would have access to imagery provided by Meteosat-5 located at 63°E.

On 20 February 2002, at a meeting in WMO Headquarters in Geneva, Switzerland, the Working Group on Contingency Planning felt that a major milestone had been achieved in the discussions on geostationary contingency planning. First, most CGMS satellite operators had either in place, were developing or would consider when nearing nominal configuration, regional contingency plans. Secondly, the satellite operators would follow the principles of "help your neighbour" and be willing to be “helped by your neighbour”. Thirdly, nominal configurations for most satellite operators included either an “in-orbit spare” or an “on-demand launch”. The Working Group agreed that the set of regional contingency plans would constitute a global contingency plan in response to the WMO requirements.

The Working Group on Contingency Planning again met at CGMS XXX in Bangalore, India, in November 2002 and reviewed satellite operators’ plans in polar orbit to harmonize Equatorial Crossing Times . It requested WMO to develop a detailed description of the goal for data, product and services from each nominal positions for both polar and geostationary orbits for use in contingency planning.

At CGMS XXXI in November 2003, the Working Group on Contingency Planning revised the Global Observing System (GOS) baseline to six geostationary satellites and four polar-orbiting satellites. It recommended that all satellite operators consider a minimum comparable data content, for the GEO, on the model of Meteosat/SEVIRI and for the LEO, with frequent hyperspectral sounding. It discussed the potential of additional missions through the IGeoLab concept and underlined the relevance of Advanced Dissemination Means (ADM). It requested WMO and CGMS Secretariat to consolidate the outcome of previous CGMS and WMO discussions in order to prepare a single CGMS Global Contingency Plan.

At CGMS XXXII in May 2004 in Sochi, Russian Federation, CGMS tasked CGMS Secretariat and WMO to prepare a consolidated plan on this basis.

2.2.2 Model cases of regional contingency measures

CGMS satellite operators have already, through bi-lateral arrangements, demonstrated their ability to provide emergency contingency cover for neighbouring satellites. Examples to date include:

- Use of GOES-1 over the Indian Ocean in support of the First Global GARP Experiment (FGGE) in 1978;
- GOES-4 support of the Meteosat Data Collection System m 1985-1988;
- Meteosat-3 provision of Atlantic Data Coverage (ADC) in 1991-1992;
- Meteosat-3 provision of extended ADC (XADC) from 1992;
- GMS support of the GOES Data Collection System from 1992;
- Use of Meteosat-5 at 63oE as back-up for nominal GOMS position;
- GOES-9 relocation in support of the GMS-MTSAT mission in 2004-2005.

2.2.3 Model agreements and declarations

In 1993, the United States and Europe took a major step consistent with the WMO requirement for continuity of meteorological satellite data and the corresponding requirement for global contingency planning. On 20 August 1993, the United States National Oceanic and Atmospheric Administration (NOAA) and the European Organisation for Exploitation of Meteorological Satellites (EUMETSAT) signed a long-term agreement for mutual backup of their geostationary weather satellites. Both parties have aided each other in the past. This agreement became effective both parties had baseline systems in place, which occurred by late 1995. If a satellite failure occurs, NOAA has agreed to reposition an operable GOES eastward to ensure European coverage while EUMETSAT has agreed to reposition an operable Meteosat westward to ensure U.S. coverage.

The WMO CBS Working Group on Satellites (CBS WGSAT-1) convened in March 1994 and noted that the signing of this Mutual Backup Agreement culminated a long and concerted effort by the two parties and that it has already had a dramatic impact on the availability of satellite data in WMO Regions III and IV.

3. CRITICAL REQUIREMENTS

3.1 Purpose of the Contingency Plan

24. The goal of the space-based component of the World Weather Watch's Global Observing System is to meet the observation requirements of all WMO Programmes, including in particular the World Weather Watch (WWW), the World Climate Programme (WCP) the Hydrology and Water Resources Programme (HWR), the Atmospheric Research and Environment Programme (AREP) and the Disaster Prevention and Mitigation Programme (DPM) as well as WMO supported programmes such as World Climate Research Programme (WCRP), Global Climate Observing System (GCOS), Global Ocean Observing System (GOOS), Global Terrestrial Observing System (GTOS) and the Global Earth Observation System of Systems (GEOSS).

The purpose of the Global Contingency Plan is, to the extent possible, to prevent and mitigate risk in order to ensure continuity of service, which is essential for all the above programmes.

This need for continuity leads to critical requirements that may be specific to each of these programmes.

3.2 Definition of contingency

A contingency situation arises when a satellite operator is no longer in a position to provide at least one of the critical satellite based services corresponding to the requirements below, or when he anticipates such a situation in the near future.

3.3 Scope of the continuity requirements

The WMO general requirements for the space-based sub-system of the Global Observing System (GOS) were endorsed at EC-XLIII which requested that they be used by WMO when stating overall WMO satellite requirements (see report of the EC Panel of Experts on Satellites, ninth session). All of the current operational mission requirements of WMO should be addressed in the contingency plans of the satellite operators.
The operational component must have the "staying power" of a programme that is essential for operational use, with assurance of continuity of service.

3.3.1 End-to-end data availability

Ensuring continuity refers primarily to avoiding or minimizing any interruption in WMO required operational meteorological satellite missions services due to a failure in the space-based portion of the Global Observing System (GOS).

The user requirement however includes actual availability of the data and services. Data distribution mechanisms, either direct or indirect such as ADM, are thus within the scope of the continuity requirements as well.

3.3.2 Evolving nature of requirements

It is expected that the detailed critical requirements will evolve with time, in line with the rapid development in the use of satellite data, the growing capabilities, and the increasing need to closely monitor the environment at a global scale.

This may involve adjusting the threshold of some existing requirements, or adding new requirements addressing continuity of additional parameters e.g., ocean altimetry).

3.4 Continuity requirements from weather forecasting

In support of the World Weather Watch, every reasonable effort should be taken to avoid breaks in service but, at the same time, continued progress of remote-sensing capability should be encouraged to meet the increasing requirements of the basic programme of WMO.

The most urgent attention of the operators should be directed to the critical missions listed below:

(a) For geostationary satellites:

- The imagery mission;
- The capability to produce winds;
- The capability to broadcast data to local users;
- The capability to collect and relay in situ data;

(b) For polar satellites**:**

- The sounding mission;
- The imagery mission;
- The capability to broadcast data to local users;
- The capability to collect and relay in situ data.

The importance of the continuity of direct broadcast services (such as HRPT) or other dissemination means (such as ADM) should also be considered.

3.4.1 Detailed critical requirements for operational GEO missions

In the case of geostationary satellites, contingency actions should be taken if the number of operating satellites and/or their location are not suitable to ensure that the primary missions listed below are met:

CR1: Images taken under a zenith angle not higher than 70 degrees are available over all latitudes lower than 50 degrees (for higher latitudes, the polar satellites provide frequent images);

CR2: The image quality is such that winds can be produced up to a zenith angle of 60 degrees over all latitudes lower than 40 degrees;

CR3: The capability to distribute data and possibly perform other telecommunication functions (e.g., data collection) must be exploited up to the latitude of at least 70 degrees.

3.4.2 Detailed critical requirements for operational LEO missions

In the case of polar satellites, contingency actions should be taken if the number of operating satellites and/or their orbital parameters and/or the instrument swaths are not suitable to ensure that the primary missions listed below are met::

CR4: The sounding observations under a zenith angle not higher than 60 degrees are available four times per day over all latitudes higher than 30 degrees;

CR5: Global coverage from images is available four times per day, any site being observed under a zenith angle not higher than 70 degrees;

CR6: Any direct readout station is able to acquire direct read-out data with a coverage area of at least 6,000 km (W-E) by 3,000 km (N-S).

3.4.3 Geographically specific requirements

CR7: The contingency plans of satellite operators should ensure coverage of those regions of the world where severe weather conditions (e.g., cyclones, tornadoes, etc.) develop.

3.5 Continuity requirements from climate monitoring

In support of the World Climate Programme, not only must every reasonable effort be taken to avoid breaks in service, but the evolution of remote-sensing capability must proceed in such a way as to assure long-term continuity of that data and associated instruments that are important to observe long-term climate change, and develop a transition plan from serving research needs to serving operational purposes.

The GCOS Climate Monitoring Principles are valuable and should be adopted as priorities if possible when determining expected satellite system performances.

Calibration is a major issue for effective use of satellite data in climate applications.

The following recommendations were derived from the climate monitoring communities:

CR8: Sun-synchronous satellites intended for climate monitoring should be launched into stable orbits, keeping the drift in time of observation within 2 hours over the lifetime of the satellite,

CR9: Sufficient satellites should be operating to enable a representative sampling of the diurnal cycle ;

CR10: Satellites should be launched on schedule, rather than on failure of the previous mission, as is the case today, to ensure overlap of measurements which is essential for the climate record;

CR11: All instruments must be calibrated and extensive ground truth validation should be sustained.

CR12: There should be (more) common spectral bands on GEO and LEO sensors to facilitate inter-comparison and calibration adjustments:

- ***calibration of globally distributed GEO sensors can be normalized with reference to a given LEO sensor***
- ***calibration of a succession of LEO sensors in a given orbit (even without overlap) can be normalized with respect to a given GEO sensor.***

The advent of high spectral resolution infrared sensors will enhance accurate intercalibration.

4. CONTINGENCY PLAN AS PART OF A RISK MANAGEMENT STRATEGY

4.1 Different aspects of risk management

With the goal to ensure continuity of services, establishing and implementing contingency plans is part of a wider approach encompassing several complementary aspects of risk management.

This overall strategy is implemented at satellite operator’s, regional level, as well as at CGMS global level.

In addition, preventive or emergency measures may be advisable at user's level in order to secure seamless operational activity when contingency measures are implemented by satellite operators.

Risk management is addressed in a preventive manner at various stages, from the planning phase, to the design, implementation and operation phase.

In spite of preventive measures, the risk of partial or total system failure cannot be excluded and the possibility of a contingency situation needs to be addressed.

4.2 Preventing contingency situations at satellite operator's level

The reliability of satellite missions at satellite operator's level is based on:

- long-term planning of satellite missions allowing some on orbit redundancy and some launch schedule flexibility;
- securing financial resources to implement these plans;
- securing the availability of the required expertise for the whole lifecycle;
- monitoring the implementation of the plans through adequate project management practices;
- addressing technological risk through adequate feasibility studies, tests and demonstrations;
- identifying the risk areas in the overall system design, in the space segment, space-ground interfaces and ground systems, including telecommunications, network and computer security or power supply, and mitigating these risks through adequate measures such as redundancy or alternative means;
- Monitoring the risk over the whole life cycle, including maintenance aspects and subsystems becoming obsolete.

4.3 Mitigating contingency situations at satellite operator's level

Operational satellite operators members of CGMS share the common goal to join their efforts to strengthen the space-based observation system, in order to secure a maximum continuity in meeting the essential requirements, while optimising the resources.

> *To this effect they develop each regional plans including some level of redundancy, bearing in mind that risk of failure can never be excluded. Such contingency plans should take into account the duration of the possible interruption of data and services and the requirements of the user community.*

Contingency situations are faced at satellite operator's level through the use of back-up resources and operating in a degraded mode.

For the space segment, this can involve:

- Activation of available in-orbit spare spacecraft;
- Relocation of a spacecraft and merging two missions with reduced coverage;
- Reactivation of older spacecraft with reduced power or attitude control resources;
- Splitting a mission over two satellites in case of partial payload failure;

For the ground segment or the space-ground interface this can include:

- Use of back-up spacecraft control facilities;
- Use of alternative, lower bandwidth telecommunications;
- Production of a reduced set of products.

With respect to the production of a reduced set of products, the satellite operators and WMO shall prepare detailed prioritised lists of derived products needed nationally, or on a regional or global basis. Such lists would be considered when defining or implementing contingency plans so that the satellite operators and possibly other partners can make proper provision for continuity of essential products.

For short-term interruption of service, the internal contingency plans of satellite operators will usually be sufficient to address this problem. In this case, the loss of a critical sub-system may result in loss of the associated critical mission service for a short time, assuming a replacement resource is available.

For a longer-term interruption, the matter can be considered one of a major programme continuity. It is considered that, in an operational programme, the operator has in principle the capacity to integrate and launch a new satellite, but the lead time for this process is significant since a replacement satellite launch would normally take well in excess of 6 months and frequently much longer.

4.4 Coordinated contingency strategy

Satellite and launch technology is still a high risk business and individual satellite operators may not always be able to maintain sufficient spare satellite capacity to cover all possible contingencies. On the other hand, because of the need to prepare for contingency situations, satellite operators may, during some periods, have reserve capacity in orbit that is not being utilised with the same priority as its primary systems. In the event of an extended satellite outage where the satellite operator has no standby spacecraft available, cooperative contingency plans jointly developed by the operators are essential.

Cooperative contingency strategies may involve spacecraft as well as ground facilities or alternative derived product processes.

The CGMS joint contingency strategy is primarily based on the possible use, through bilateral arrangements, of any spare capacity available to other CGMS satellite operators, on a "Help your neighbour" principle. In this context, priority satellite based services include key missions such as image generation and dissemination, the data collection system and the global distribution of products used in NWP, such as Cloud Track Winds.

Part of the strategy is also to act preventively along following path:

- to agree on a robust configuration of the planned space-based component of the GOS, including temporal (schedule) and geographical (coverage) overlap;
- to regularly review its status of implementation and assess the potential risk;
- to improve commonalities amongst the systems, facilitating mutual support;
- to consider jointly establishing in orbit capability serving as a back-up for any operator.

5. CGMS COORDINATED CONTINGENCY PLANS

5.1 Nominal configuration of the geostationary observing system

5.1.1 Core missions of the geostationary satellites

The high-level statement developed by ECSAT-9 and approved by WMO EC-XLIII recommended that the core mission for geostationary satellites shall be continued with at least the following instruments:

- IR/VIS imagers for measuring the development and motions of clouds and in the case of GOES, sounders to observe atmospheric thermal and moisture structure;

- Data collection systems to relay data from platforms in support of environmental missions;

- Communication facilities to transmit the instrument output to the ground and distribute pre-processed images and other information to the users;

- Space environment monitors for space flight safety and diagnosis of instrument behaviour in-orbit.

5.1.2 Comparable data content from geostationary satellites

CGMS recommends that all geostationary imagers provide at the spectral channels and imaging performances of EUMETSAT's Meteosat/SEVIRI by the 2015 timeframe, and frequent IR sounding should be made by spectrometers within the same timeframe.

The goal is to have comparable data content from comparable instrumentation with common spectral bands from all geostationary satellites.

5.1.3 Nominal geostationary locations

The high-level statement developed by ECSAT-9 and approved by WMO EC 43 noted that the geostationary satellite component of the WMO Global Observing System should continue with an array of geostationary satellites, i.e., at an altitude of 36,000 km and located above the equator.

The WMO baseline space-based component of the GOS now requires six geostationary satellites in operation, which allows the necessary overlap, plus spare satellites for contingency cases.

This nominal configuration is summarized in the following table :

Region	Nominal operator(s)	Nominal locations	
		Operational	Spare
North, Central and South America & East Pacific	USA (NOAA)	135 W 75 W	105 W
Europe & Africa	EUMETSAT	0	10 E
Asia & West Pacific, Indian Ocean	Japan China Russia India	140 E 105 E 76 E	93 E

5.2 Regional contingency plans for geostationary missions

5.2.1 Americas and East Pacific

Region	Nominal operator(s)	Nominal locations		1st regional contingency mode	2nd regional contingency mode	Remarks
		Operat.	spare			
Americas & East Pacific	USA (NOAA)	135 W 75 W	105 W	Use of spare at the failing location	One single satellite in 105 W (reduced coverage)	Bilateral back-up agreement with EUMETSAT

5.2.2 Europe & Africa

Region	Nominal operator(s)	Nominal locations		1st contingency mode	2nd regional contingency mode	Remarks
		Operat.	spare			
Europe & Africa	EUMETSAT	0	10 E	Use of spare		Bilateral back-up agreement with NOAA

5.2.3 Indian Ocean, Asia & West Pacific

Region	Nominal operator(s)	Nominal locations		1st regional contingency mode	2nd regional contingency mode	Remarks
		Operat.	spare			
Indian Ocean Asia & West Pacific	Russia China Japan India	76 E 105 E 140 E	 93 E	Use of 2 of the 3 satellites (reduced overlap)	Use of spare	

5.3 Global contingency plan for geostationary satellites

5.3.1 Use of spares : Help your neighbour principle

In the event that a satellite suffers a major failure, replacement is sought by in-orbit spare. The number of in-orbit spares is one element of the strategy:

- While one spare for each geostationary location would be simple to activate without the support of other operators, it requires important resources for each;
- Reducing the number of spares would reduce the cost and still be sufficient in terms of probability of failure, but it must satisfy meet the constraints of field of view to ensure proper coverage while securing spacecraft control;
- Two in-orbit spares for the whole system would be sufficient if two sets of operators could control a satellite over his neighbour's position such as was established with the "bent pipe" process for the Extension of the Atlantic Data Coverage. For example, two pairs of satellite operators could be considered. Each would have to make long term

commitments to develop the necessary communications systems to be able to control his satellite over another area completely out of his normal view;

- Using a single spare for the whole system allows to share resources in a cost-effective way, but would be the most complex to establish initially with regard to the specificity of each operator's system. This could be considered through long term planning and agreement whereby all satellites would be identical in their command and control system such that any operator could control any satellite within its view. The approach could be to specifically design an "universal" gap filler providing basic imagery functions meeting the essential requirements for weather forecasting.

The CGMS joint contingency strategy is primarily based on the possible use, through bi-lateral arrangements, of any spare capacity available to other CGMS satellite operators, on a "Help your neighbour" principle. A satellite operator having a spare capacity in orbit beyond its priority needs, can move a spare satellite east or west 55 degrees, in order to cover at least part of the area of his neighbour facing a contingency situation. The operator providing a satellite should have the capability to control two satellites from his ground station. The baseline is that the provider of the satellite will continue to operate it, to avoid duplication of expensive control facilities, while the host operator makes all necessary provision for the regional utilization of the satellite. Where possible, direct control of the satellite will be implemented. When this is not feasible, indirect control, through a form of "bent-pipe" telecommunications relay, may be used.

To provide the best possible level of services in a contingency situation it is essential that the satellite operator and the host operator come to an early agreement concerning their respective responsibilities. In order to provide guidance for such arrangements, it is suggested that the following guidelines, based on practical experience, shall be followed:

(a) The satellite owner shall:

- Continue to own and operate the spare satellite so as to generate and disseminate imagery within available resources, in accordance with the normal standards of the satellite owner;

- Use the satellite to the extent possible in support of the International Data Collection System as a priority and the Regional Data Collection System if possible;

- Continue to support international programmes such as the International Satellite Cloud Climatology Project (ISCCP) and Global Precipitation Climatology Project (GPCP) through the continued production of standard products based on data from the spare satellite;

- Continue the global distribution of key products used in NWP, such as Cloud Track Winds;

- Seek to operate the satellite in accordance with the data policy of the host operator, in order to minimise any impact on third parties.

b) The host operator shall:

- Make efforts to ensure that its users continue to be provided with services, such as access to image data, through a combination of the services provided by the satellite owner and those provided by the host,

- Seek to provide specialised support for the Regional Data Collection System where facilities permit,

- Continue to take responsibility, as far as possible, for specialised regional and other requirements not addressed by the satellite operator.

- Make every effort to restore normal service as soon as possible through the successful launch of a replacement satellite.

Standard agreements are developed along these lines as a reference to facilitate the conclusion of specifically adapted agreements in case of actual contingency arrangement.

Conditions for the success of this strategy are that :

- First, most or all CGMS satellite operators have regional contingency plans;
- Secondly, the satellite operators are ready to follow the principles of "help your neighbour" and be willing to be "helped by your neighbour";
- Thirdly, nominal configurations for most satellite operators include either an "in-orbit spare" or an "on-demand launch".

The Executive Council (ECLIV) noted that the set of regional contingency plans would constitute a global contingency plan in response to the WMO requirements.

5.3.2 Consolidated contingency plan for geostationary satellites

The Global CGMS contingency plan is built upon the consolidated regional contingency plans. It is summarized in the table below :

Region	Nominal operator(s)	Nominal locations		1st contingency mode	2nd contingency mode	Remarks
		Operat.	spare			
Americas & East Pacific	USA (NOAA)	135 W 75 W	105 W	Use of spare at the failing location	One single satellite in 105 W (reduced coverage) or interregional support	Bilateral back-up agreement with EUMETSAT
Europe & Africa	EUMETSAT	0	10 E	Use of spare	Interregional support	Bilateral back-up agreement with NOAA
Indian Ocean Asia & West Pacific	Russia China Japan India	76 E 105 E 140 E	93 E	Use of spare or interregional support	Use of 2 of the 3 satellites (reduced overlap) or interregional support	

5.4 Contingency planning for LEO satellite missions

In order to meet WMO's requirement for a continuous operation of four operational sun-synchronous polar-orbiting satellites, the nominal constellation includes six polar-orbiting satellites:

- two in an AM orbit, i.e., with ascending Equatorial Crossing Time (ECT) between 18:00 and 24:00 Local Solar Time (LST), thus descending ECT between 6:00 and 12:00 LST, with a third capable of serving as a back-up to these two;

- two in a PM orbit, i.e., with ascending ECT between 12:00 and 18:00 LST, with a third capable of serving as a back-up to these two.

CGMS satellite operators will seek to define their satellite missions in polar orbit with a view of optimizing temporal coverage of the globe through an optimal spacing of the ECT of sun-synchronous satellites.

Provisions will be made to reduce or avoid significant drift in the ECT in order to maintain an optimal sampling and ensure long-term consistency of the observation times.

With regard to polar orbiting contingency planning, in a constellation of four polar-orbiting satellites, two in the AM orbit will be capable of serving as backup to each other and two in the PM orbit also capable of serving as backup to each other.

5.5 General considerations

There is a benefit in improving compatibility between the operational satellites implemented by different operators, particularly as regards user interfaces, including dissemination means and formats. Considerable degrees of compatibility have been achieved in several areas but more attention could be given to the high resolution data formats in particular.

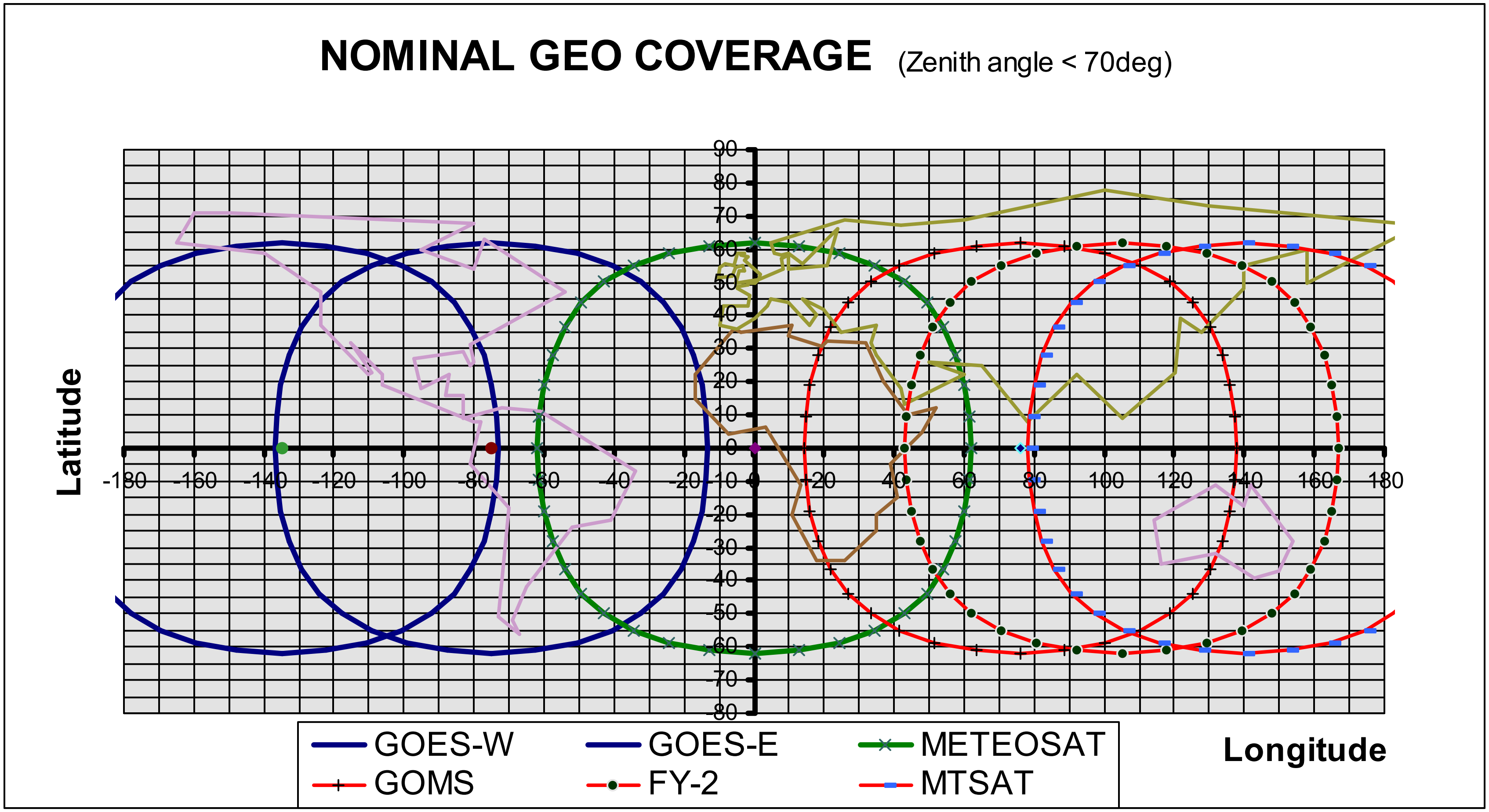
In 2000-2001, WMO expanded the definition of the space-based component of the Global Observing System by including a contribution of R&D environmental satellites. Contingency planning is not a requirement for the R&D constellation, however R&D satellites can play a significant role in contingency planning for operational meteorological satellites. This potential contribution to contingency planning is to be reviewed on a regular basis.

Satellite plans and status of implementation are reviewed on a regular (annual) basis within the CGMS WG on Contingency Planning, in order to assess the available safety margins, or the risk of discontinuity and its level of criticality.

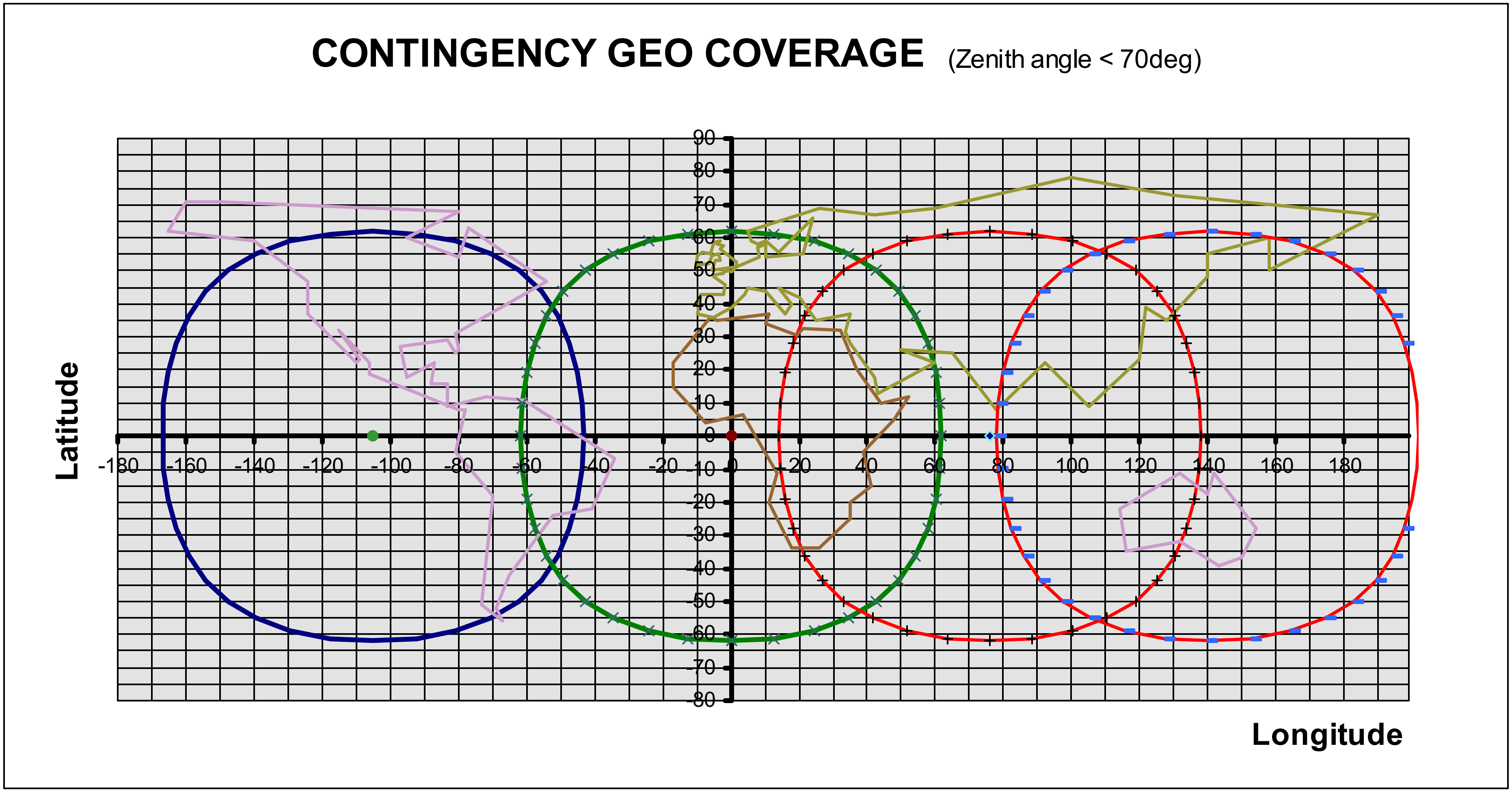
ANNEXES

- Nominal geostationary coverage
- Contingency geostationary coverage
- References of past decisions (per item)
- References of past decisions (per date)
- Document change record

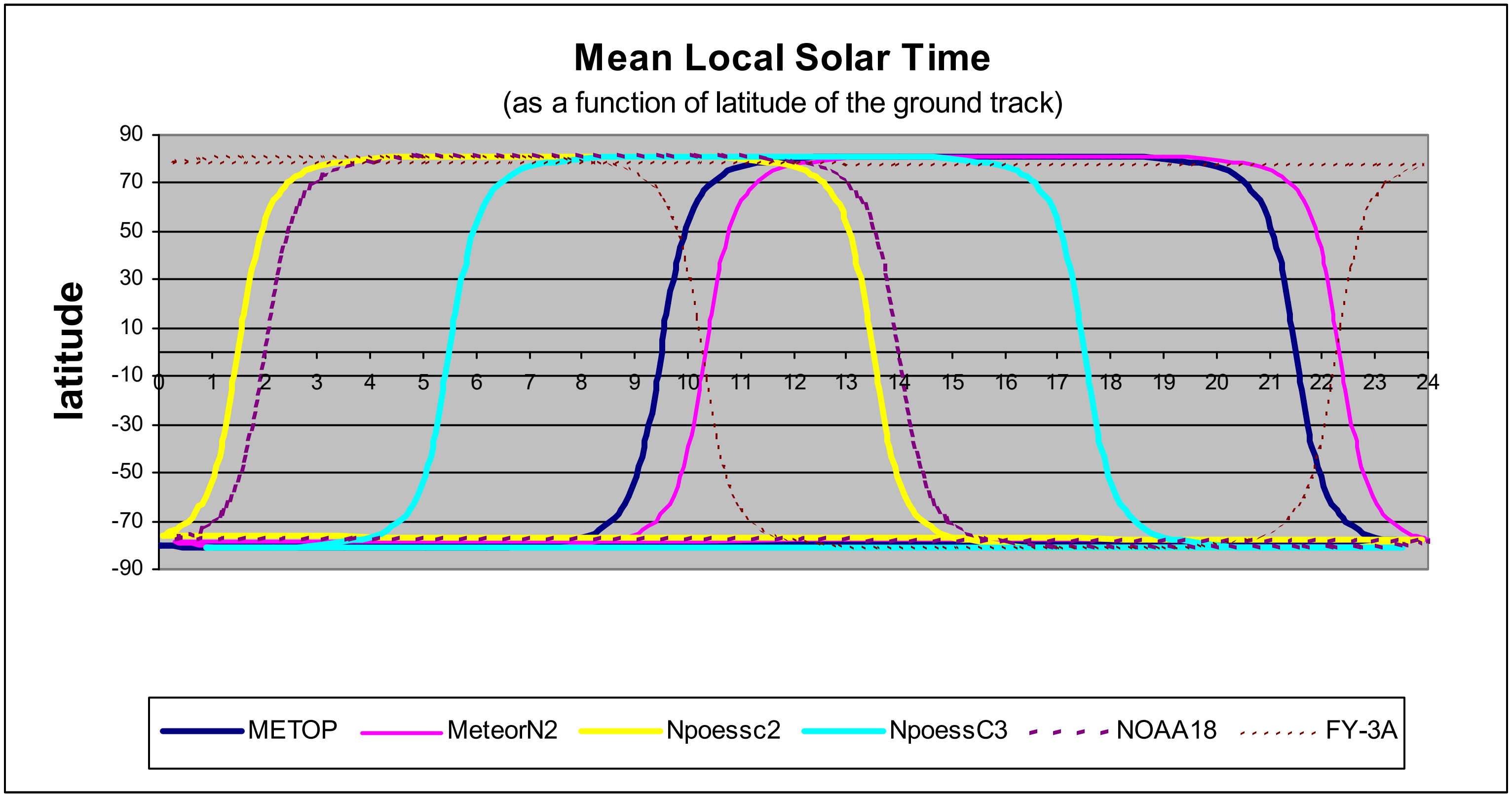
Nominal geostationary coverage



Contingency geostationary coverage



Nominal distribution of sun-synchronous orbital planes



References to past decisions (per item)

Item	Subject	Reference	Date
1	Intro		
2	Background		
2.1	Need for a GCP	ECSAT-10	1992
2.2	Historical sum		
2.2.1	Past discussions	WG CP	2002
2.2.2	Model cases	EC XLIV	1992
2.2.3	Model agreement	CBS WGSAT 1	1994
3	Driving requirements		
3.1	Purpose	ECSAT-8	1989
3.2	Definition of contingency	CGMS XXIII	1995
3.3	Scope of continuity requirements	ECSAT 8	1989
3.3.1	End to end availability	EC XLIV	1992
3.3.2	Evolving nature of requirements	CGMS XXXI-WG	2003
3.4	Continuity requirements Weather	EC XLIV	1992
3.5	Continuity requirements climate	CGMS XXI	2003
3.5	Continuity requirements climate	ECSAT 8	1989
3.5	Continuity requirements climate	WGCP	2002
4.1	Contingency plan vs risk management	CGMSXXXIII	2005
4.2	Preventing contingency / operator	ECSAT 10	1992
4.3	Mitigating contingency /operator	WG GCP 1	1992
4.3	Mitigating contingency /operator	ECSAT final	1993
4.4	Scope of coordinated strategy		
5	CGMS coordinated contingency plans		
5.1	Nominal configuration GEO	ECSAT final	1993
5.1	Nominal configuration GEO	CGMS XXIII	1995
5.2	Regional plans	CGMS XXXI	2003
5.3	Global contingency plan		
5.3.1	Use of spares: help your neighbour	ECSAT 10	1992
5.3.1	Use of spares: help your neighbour	CGMS XXIII	1995
5.3.1	Use of spares: help your neighbour	EC LIV	2002
5.4	Contingency/LEO	EC LIV	2002
5.5	General considerations	WG GCP 1	1992

References to past decisions (chronological order)

Item	Subject	Reference	Date
3.1	Purpose	ECSAT-8	1989
3.3	Scope of continuity requirements	ECSAT 8	1989
3.5	Continuity requirements climate	ECSAT 8	1989
2.1	Need for a GCP	ECSAT-10	1992
2.2.2	Model cases	EC XLIV	1992
3.3.1	End to end availability	EC XLIV	1992
3.4	Continuity requirements Weather	EC XLIV	1992
4.2	Preventing contingency / operator	ECSAT 10	1992
4.3	Mitigating contingency /operator	WG GCP 1	1992
5.3.1	Use of spares: help your neighbour	ECSAT 10	1992
5.5	General considerations	WG GCP 1	1992
4.3	Mitigating contingency /operator	ECSAT final	1993
5.1	Nominal configuration GEO	ECSAT final	1993
2.2.3	Model agreement	CBS WGSAT 1	1994
3.2	Definition of contingency	CGMS XXIII	1995
5.1	Nominal configuration GEO	CGMS XXIII	1995
5.3.1	Use of spares: help your neighbour	CGMS XXIII	1995
2.2.1	Past discussions	WG CP	2002
3.5	Continuity requirements climate	WGCP	2002
5.3.1	Use of spares: help your neighbour	EC LIV	2002
5.4	Contingency/LEO	EC LIV	2002
3.3.2	Evolving nature of requirements	CGMS XXXI-WG	2003
3.5	Continuity requirements climate	CGMS XXI	2003
5.2	Regional plans	CGMS XXXI	2003
4.1	Contingency plan vs risk management	CGMSXXXIII	2005

DOCUMENT CHANGE RECORD

Version	Date	Nature of the change
1		Creation of the document