International Charter

Space & Major Disasters

Executive Secretariat

Annual report

Period November 2000-April 2002

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Contents

1 Introduction

1.1 Purpose and scope

This document constitutes the annual report on the operations of the International Charter "Space & Major Disasters" prepared by the Executive Secretariat as laid down in [AD1]. It exceptionally covers the period November 1st, 2001 to April 30, 2002, that is 18 months.

The report is based upon the following input :

- Project manager reports for each activation
- Workshop with Canadian users and VARs held at CSA in September 2001
- Briefing workshop with European VARs held at ESA in October 2001
- Evaluation workshop held at CNES headquarters in January 2002
- Self-training workshop with European users held at DDSC in March 2002-05-07

The report is structured in the following way.
Chapter 1 is the present introduction.
Chapter 2 presents some statistical information about the activations.
Chapter 3 analyses the thematic processing and products according to the type of disaster.
Chapter 4 looks at the overall performance of the Charter from a system viewpoint.
Chapter 5 looks at the performances of the Charter from a users' viewpoint.
Eventually some conclusions are drawn in chapter 6.

1.2 Applicable documents

[AD1] Charter "Space and Major Disasters"

[AD2] Charter implementation plan, RSCSA-PL0098

[AD3] Project manager procedure, RSCSA

1.3 Reference documents

[RD1] Summary of the VAR workshop

[RD2] Proceedings of the evaluation workshop (on CD)

[RD3] Proceedings of the self-training workshop (on CD)

[RD4] Input to improved scenarios from CEOS DMSG

1.4 List of acronyms

AU	Authorised User
CSA	Canadian Space Agency

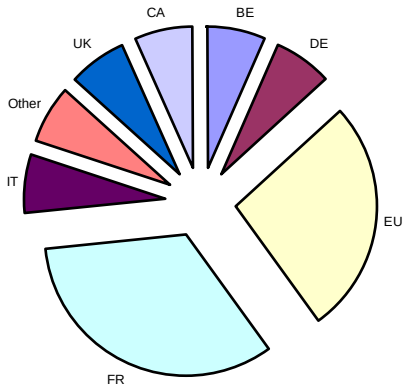
CNES	Centre National d'Etudes Spatiales
DDSC	Direction de la Défense et de la Sécurité Civiles (French AU)
ECO	Emergency on Call Officer
ESA	European Space Agency
ODO	On Duty Operator
PA	Partner Agency
PM	Project Manager
VAR	Value adding reseller

2 Statistical analysis

2.1 Number of calls per AU, disaster type, area.

During the reference period the Charter was activated 15 times. 1 call was withdrawn by the Authorised User (the French AU, a late call related to floods in Brittany) and another one was declined by the ECO (from German *Auswärtiges Amt*) during the war in Afghanistan in view of a humanitarian action.

Calls per Authorised User
Nov 2000 - April 2002

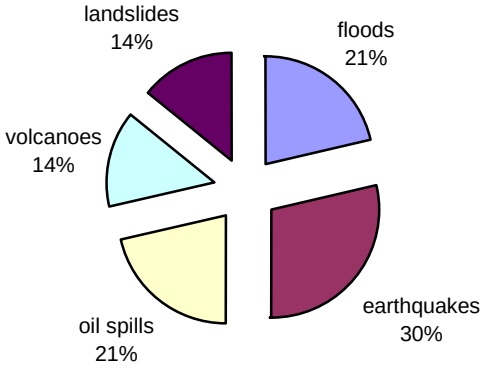


Authorised User	Number of calls
France	5
European Union	4
Belgium	1
Germany	1
Italy	1
Other	1
United Kingdom	1
Canada	1

The Charter was triggered mainly for earthquakes (4) and floods (3) which are respectively the most damaging and most frequent events. No activation took place after a fire, which could be explained by the duration of fires in Europe, compared to the time necessary to operate the Charter. Clearly though, the Charter could be activated over large fires such as the Borneo fires.

Type of disaster	Number of calls
Earthquakes	4
Floods	3
oil spills	3
volcanoes	2
landslides	2

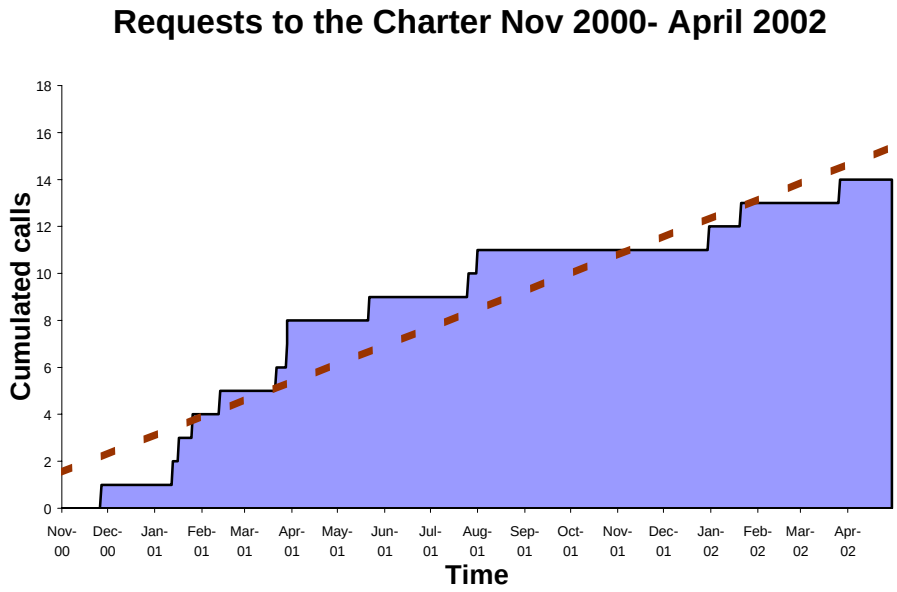
Calls per disaster type
Nov 2000- April 2002



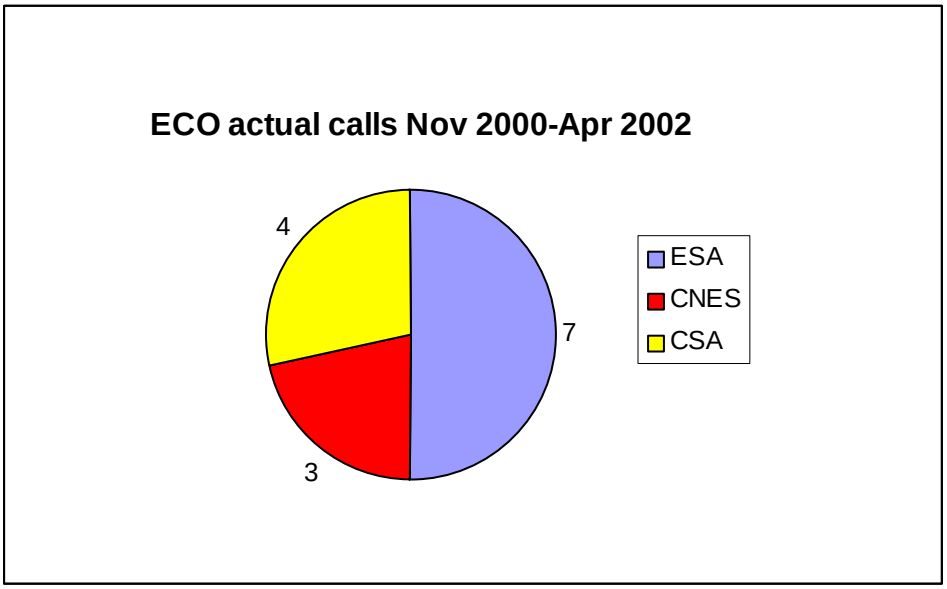
The Charter was called in nearly all continents (except Northern America) as shown in figure below, yet with some concentration in Europe due to the number of AUs on this continent.

2.2 Usage of ECOs and PMs, time distribution

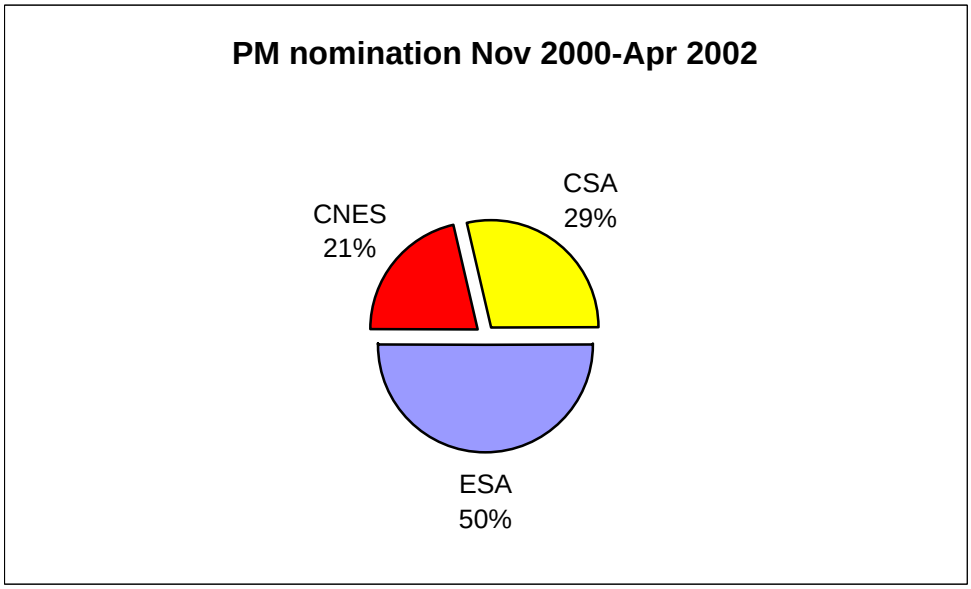
As shown on figure the frequency of calls is about once a month with noticeable variations (no call between August and December 2001). This is mainly driven by events, the number of AUs and the awareness of the Charter mechanism.



Emergency on Call officers were nominated according to the procedure, with CNES, CSA and ESA sharing equally the workload. The number of cases handled by each agency was really a matter of chance. For the record, the following chart gives the number of calls per agency.



Project Managers were nominated according to the procedure in usually the same day of the day following the activation. As shown in figure, ESA provided the PM 7 times (Slovenia, India, Denmark, Saône, Meuse, Lena, Etna) CNES 3 times (both Salvador cases and Niriyagongo) and CSA 4 times (Galapagos, Indonesia, Lebanon, Afghanistan).



2.3 Satellite resource consumption

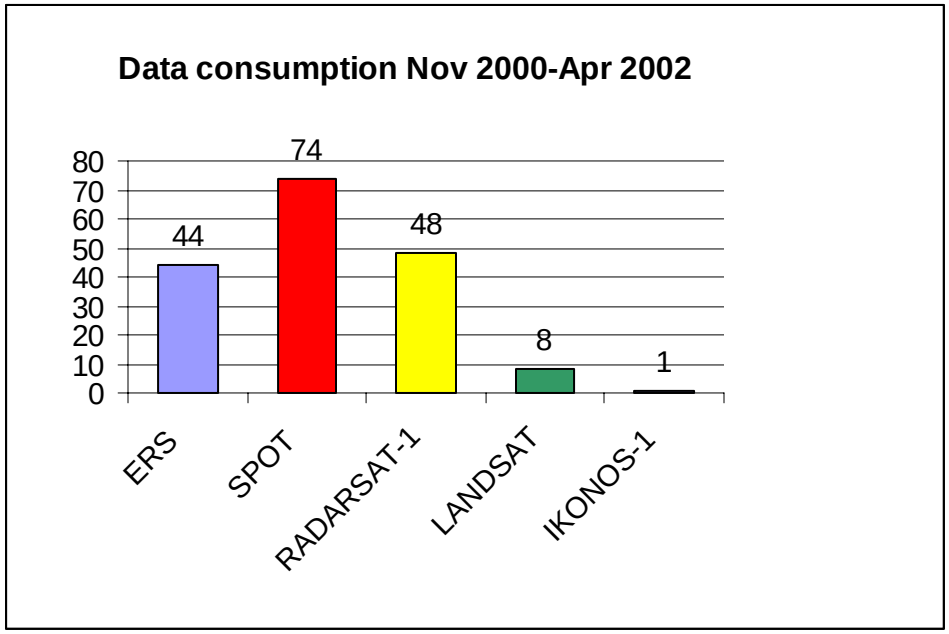
The following table summarizes the satellite resource consumption for the 14 activations in the reference period. IKONOS-1 and LANDSAT data are not part of the Charter commitments and were procured by ESA under a separate scheme.

These figures represent the data *consumption* regardless of *usefulness* or *timeliness* of the data which is addressed later in this document (the second column under Spot concerned the number of unsuccessful tasking of the Spot satellites, essentially due to cloud cover).

	ERS	SPOT		RADARSAT	IKONOS	LANDSAT
Slovenia	2	4	6	2	0	2
Salvador 1	5	11	17	4	0	0
Galapagos	0	4	4	1	0	0
India	0	4	6	1	1	0
Salvador 2	5	2	2	3	0	0
Saône river	6	2	15	0	0	0
Lebanon	2	1	1	1	0	0
Baltic oil spill	2	1	0	2	0	0
Lena River	0	6	14	3	0	2
Etna	2	5	0	2	0	4
Nias Island	2	1	3	4	0	0
NE France	10	25	0	4	0	0
Nyiragongo	2	2	6	5	0	0
Afghanistan	6	6	10	4	0	0
Total	44	74	84	36	1	8

It is worth noting that all scenes do not cover the same area. While an ERS scenes covers always 100x100 km², a SPOT scene covers 60x60 km² and a RADARSAT scene covers from 50x50 km² (Fine mode) to 500x500 km² (ScanSAR Wide swath mode) .

With this in mind contributions from various source are relatively balanced, the largest contribution came from SPOT series, followed by RADARSAT-1 and ERS-2. Interestingly enough, radar and optical data were equally used, in line with the guideline to ECOs to request programming of all resources.



3 Thematic analysis

On one hand, value adding and interpretation are beyond the commitments of the PA s. On the other hand authorised users and beneficiaries have repeated that they are interested in information and not in raw data.

In practice, the 3 PAs involved so far in actual operations did carry out value adding and interpretation to various extents and according to their own procedures.

The purpose of this chapter is to identify what the Charter can effectively deliver with the current systems rather than discussing specific algorithms.

3.1 Type of processing

A general comment is that users are interested in maps and not in images. Consequently a first processing step is to bring actual images into adequate geographical projection systems.

Very often damage estimates derive from change estimates : in other words the most common method consists in comparing an image before and after the disaster, possibly close in time and under similar conditions of soil (humidity, vegetation cover, etc).

Experience has shown (see for instance Salvador 1 and 2) that robust, rather simple change detection algorithms are preferable to sophisticated ones, which be abused by e.g. cloud cover differences.

In a few cases very high resolution systems were used and due to lack of corresponding archive image a direct photo interpretation was carried out.

Eventually radar and optical systems are used in combination or indifferently in e.g. the Meuse flood.

3.2 Type of products prepared

During the VAR workshop [RD1] it was suggested that PA s could propose and agree upon standard product definition for the Charter. This section reviews the products actually provided, known limitations and performance and attempts to identify typical products to be further specified.

Earthquakes
Current systems are able to detect induced phenomena such as massive landslides as in the 2nd Salvador earthquake, whenever recent archive (less than 6 months) is available. Building destruction is quite impossible to identify directly with sensors such as SPOT series (1, 2, 4), ERS-2 or RADARSAT-1, due to their limited resolution. Metric systems such as IKONOS-1 or maybe SPOT-5 and IRS-1C must be used instead.
Typical products :

– Change maps
– Damage area maps (few classes : highly damaged, likely damaged, not damaged unknown)

Deformation maps derived from SAR interferometry are theoretically possible but were never computed after a Charter call. Moreover it must be borne in mind that destructions are mainly related to soil acceleration and not to soil deformation.

Floods

Whenever the flood duration is greater than a day and its coverage larger than 10x50 km² current sensors are fully capable of identifying flooded areas. Radar systems are of primary interest here thanks to their all-weather capability. Nevertheless in a number of cases (e.g. Lena, Meuse) optical systems were able to acquire very valuable data. It is therefore suggested to continue using these systems during flood events.

Typical products :

– Flood extent maps were found useful when laid over standard topographic or aviation maps (Lena, Meuse).

Flood depth maps are theoretically possible but depend on the availability of high-precision (better than 1 m in altitude) DEMs which are rarely available.

Similarly flow speed estimates seem to be beyond capabilities of current systems.

Volcanoes

Two completely different cases were addressed by the Charter. For the Etna eruption the lava flows were well known to the AU, the main question was to assess risks of new vents and possibly their location. Some pioneer work was carried out using thermal bands of optical sensors (LANDSAT).

In the Niryagongo case instead, the problem was effectively to map the actual lava flow and to identify areas which could be suited for refugee camps. SAR on board RADARSAT-1 was successfully used for that purpose, despite some errors due to the difficulty at discriminating backscatter coefficients of the lava flow and rough building materials. This case could be also widened to lahar mapping.

Typical products :

– Lava flow extent over topographic maps
– Thermal anomaly map
– Volcanic edifice deformation maps

Landslides

Together with earthquakes this is one of the most difficult case. Very often the size of the event is too small for the resolution of current sensors. In the Slovenia case however an actual map of the slide was derived from SPOT data. Bad weather and adverse geometry prevented the use of respectively optical and radar systems in the case of Indonesia.

Typical products :

– Landslide extent laid over topographic map with possibly 3-dimensional vision on DEMs

Oil spills

Oil spill mapping is perhaps the hazard with the most advanced product specification. Consequently no specific value-adding processing was carried out by PA’s while clearly AUs would expect such products as oil spill laid over marine maps with sea currents and wind speed. Product specification may be found elsewhere.

4 System analysis

4.1 Turnaround time

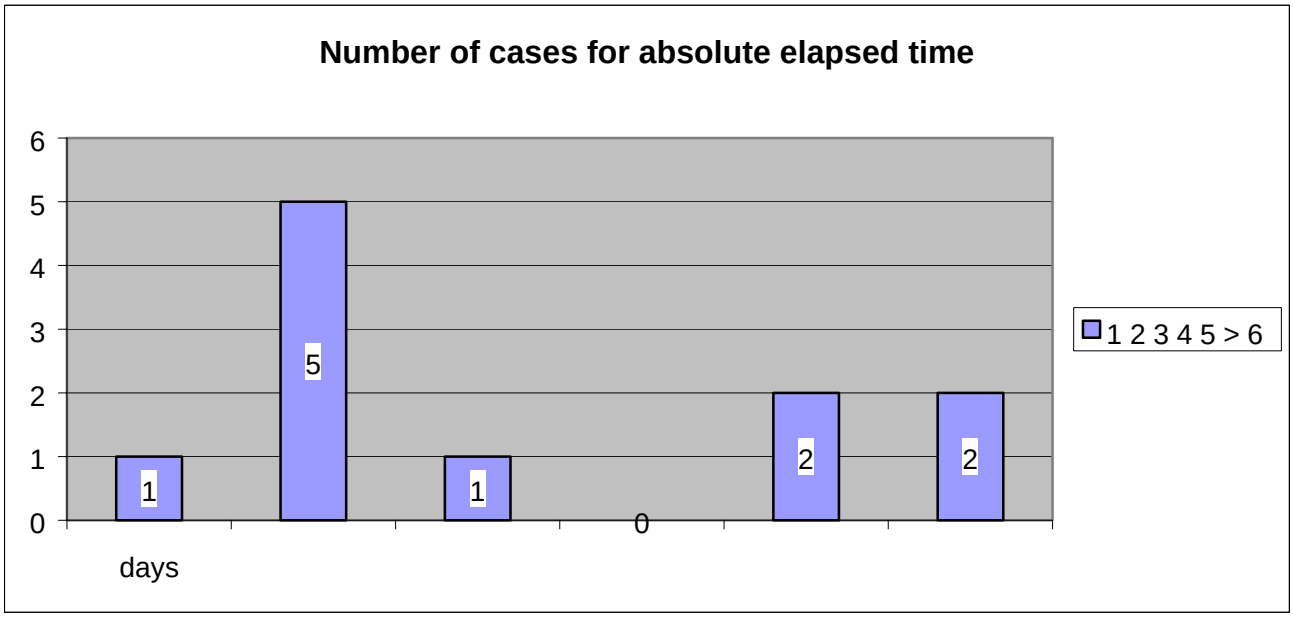
The ability to deliver useful information very quickly is both the driver of the Charter and the main challenge to match. Turn around time is therefore a primary quantitative criterion.

One may distinguish 2 types of turnaround times :

– Absolute elapsed time between triggering and information delivery ; this is the definitive figure the user is after. This quantity is mostly driven by known limitations in programming and acquisition of current systems, and actual improvements may be difficult to catch. However the satellite operators should try to reduce the time needed to re-task their satellites in case of Charter activation.
– Relative elapsed time, between first acquisition and information delivery. This quantity should reflect any actual improvement on existing systems.

As an example, during call # 12 (Meuse) more than 1 image was acquired every day and products were delivered about 12 hours later. The first result was available only 2 days after the actual call. As a counter example information delivery took more than a week in the Indian call # 4.

Deriving these figures from PM reports is not always easy, especially where no chronogram is included in the report. The chart bellows depicts the number of cases when absolute response times was 1 day, 2 days etc. As one can see a typical value is 2 to 3 days ; there are better cases but also much worse ones.



While there is a trend of improvement, this trend is not linear as actual results are influenced not only by the equality of the procedures and the work done, but also but the geographical area, hence satellite coverage and a bit of random luck.

4.2 Procedures

As a rule the procedures worked well with no major problems. Some difficulties were encountered though, mainly due to lack of experience, all attributable to the expected evolutionary learning process inherent in establishing any new organization. The following table summarizes these issues and suggests corrective actions.

Problem	**Corrective action**
Some AUs trigger the Charter on too small events or too late with respect to the actual occurrence	AUs must get educated, either by self experience or by training. When possible thresholds may be defined and made known to AUs
The table of AUs held by ODO does not reflect the latest status. Some AUs submitted a call and were not recognised as plain AU	The Exec Sec updates and the Board approve the table of AUs on a more frequent basis (e.g. not later than a week after a modification is required)
The ODO is unreachable by the AU	Verify numbers availability especially outside working hours and during long holidays. If necessary, run tests accordingly
The ECO is unreachable by the ODO	Verify numbers availability especially outside working hours and during long holidays. If necessary, run tests accordingly

The ECO is unsure whether programming is required especially when a PM is nominated quickly	The ECO has the responsibility to ask initial programming even if the PM is already nominated.
The PM is nominated late	Increase number of possible PMs ExecSec members reachable by cell phone.
The PM does not get the dossier from the ECO	Implement a more systematic approach with e.g. a shared file repository (Intranet)
The PM report is not standardised	Solved; standard templates exist for PM preliminary and final reports
PM reports are not available to all PA's	Solved; CSA maintains the reports under control.
ECO wish to receive copies of the preliminary and final PM reports	PM should copy all ExecSec members who should forward it to ECOs

4.3 Scenarios

The basic scenarios included in the PM procedure [AD3] were of limited use during operation, also considering that the Executive Secretariat has taken a conservative approach and asked the ECOs to program systematically all available resources.

The CEOS Disaster Management Support Group provided some input to improving the scenarios after its workshop held in Brussels

Furthermore additional input was received from AUs during the self training workshop [RD3]

On the light of the experience gained and taking into account this input, at least for those hazard types well addressed by the Charter it should be possible to obtain better and more focussed scenarios. However the effort required should not be underestimated and it should be tackled as a dedicated activity.

5 User perspective

This section builds upon feedback expressed either during workshops [RD2], [RD3] or through PM reports.

5.1 Timeliness

This is indeed the sharpest criterion for AUs. One may distinguish several levels of periods in crisis management for Civil Protection Agencies:

– what is the size of the event, in support to decision of action (less than 6 hours)
– what are the most damaged areas in support to rescue operations (12 hours to 2 days in case of intervention overseas)
– what is the evolution of the crisis for long lasting events such as plain floods (every day)

In practice maps should be received within 24 hours to 2 days, otherwise they are mostly used for documenting the intervention.

In a few cases (Salvador 2, Meuse, Niryiagongo) maps were effectively delivered in time to support operations.
However in some countries even one-week old cartographic data may be useful when there is a lack of recent maps in order to locate unmapped villages and availability of access roads for rescue teams.

It must be noted that operators of humanitarian aid, who take over rescue operation teams after a few days, have similar needs in terms of cartography.

5.2 Usefulness

The question may be summarized as “is the document presented useful for non EO specialists ?” To this aim some criteria have been suggested :

– The document must be a map
– It may contain few, standard, self understandable information (e.g. flooded area in blue, few classes)
– Whenever possible it be laid over standard cartography (topographic or marine maps).
– Digital format must be of general purpose (e.g. JPEG and not CEOS)

The map prepared after the Meuse flood (flood extent over IGN 1:25,000 map) is considered as a good example.

6 Conclusions

During the first 18 months of operations, the Charter was triggered nearly in all parts of the world on a variety of disaster types, and on major disasters that occurred during the reference period. The Charter has established itself as a valid tool for the civil protection agencies and a vehicle for fruitful relationship between themselves and the space community.

The implementation set forth in [AD2] and derived procedures has passed successfully this initial period. A number of details need to be improved and adjusted in the existing procedures.

The 16 different activations allowed to identify the capabilities of the current satellite assets and also their limitations according to disaster type and context. It broadly confirmed the value of combining several instruments and missions.

Experience gathered during this initial period allowed to identify satisfactory products. It represents a basis for a revision of the scenarios and a better use of available resources.

In terms of service, the winning factor remains the absolute response time. Progress has to, and will be made by all partners through a collective improvement of efficiency of existing procedures and through individual improvement of their own tasking/acquisition procedures.