

# EXPLOITATION OF PROBA CHRIS/HRC DATA IN THE CONTEXT OF THE INTERNATIONAL CHARTER SPACE AND MAJOR DISASTERS

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## ABSTRACT

The data acquired by Proba have currently been used for a number of activations of the International Charter on "Space and Major Disasters". Both HRC and CHRIS can provide valuable information, depending on the type of event. Also the archive of Proba could start playing a considerable role for the Charter, for some remote locations not covered by the SPOT and IRS archives.

### 1. Introduction: the context of the International Charter.

Following the UNISPACE III Conference (Vienna, 1999), ESA and CNES initiated the International Charter Space and Major Disasters, with the Canadian Space Agency (CSA) signing the Charter one year later. In 2001, NOAA and the Indian Space Research Organization (ISRO) also became members of the Charter. The Argentine Space Agency (CONAE) joined in 2003, the Japan Aerospace Exploration Agency (JAXA) became a member in 2005.

The Charter aims at providing a unified system of space data acquisition and delivery to those affected by natural or man-made disasters through authorized users. It was declared formally operational on November 1, 2000. An authorized user can call a single number to request the mobilization of the space and associated ground resources to obtain data and information on a disaster occurrence. A 24-hour on-duty operator receives the call, checks the identity of the requestor and verifies that the User Request form sent by the Authorized User is correctly filled up. The operator passes the information to an Emergency On-Call (ECO) officer who analyzes the request and the scope of the disaster with the User, and prepares an archive and acquisition plan using available space resources. Data acquisition and delivery takes place on an emergency basis, and a Project Manager (PM), who is qualified in data ordering, handling and application, assists the user throughout the process.

FAST DELIVERY of a "product" to End Users is the Charter's main aim, most frequently to a Civil Protection agency. Although a standard definition does

not exist, in many Charter activations the final products (jointly defined by the End Users, the Project Manager and the Value added company when involved in the geo data production) consisted of:

- Space maps: geo-referenced images, with a topographic map layer (e.g. IGN Scan25), in a user-known reference system. Ideally, these are required a few HOURS after the activation and should be based on the most recent archive data;
- Damage maps: result from expert interpretation of detected changes between "before" (archives or pre-event) & "after" (crisis or post-event) data using a variety of optical and/or SAR sensors. A few days (3-4) delay after activation can be still acceptable, depending on the specific case.

### 2. Satellite data available; PROBA data.

Charter member agencies commit to a coordinated system of space data acquisition and data delivery in case of a major disaster: data from the SPOT constellation, ERS-2, Envisat, Radarsat, IRS satellites are made available by the member agencies.

Moreover, non-Charter satellite data (such as Landsat, IKONOS, DMC.....) can be purchased by a Project Manager if needed and have been kindly made available by commercial data providers in more than one activation, the 2003 SE France flood event .

Although Proba is not (by definition) an operational mission, its data (CHRIS or HRC) can be considered as an additional data resource provided by ESA, on a best-effort basis (not an ESA commitment). When a Charter activation is accepted, the ESRIN Mission Planning and Users Services send the Request details (location, date, type of event) to the Proba Planning facility (ESA/Redu station). When acquisitions are successful (best-effort basis), the data are made available as quickly as possible to the Project Manager, who then decides on their interest in view of exploitation. HRC data are processed and transmitted directly from the

ESA station of Redu, whereas CHRIS data have to be first sent from Redu to SIRA for processing (processing times as short as 3 hours can be achieved in emergencies, during working hours only). It is important to point out that a careful selection has to be made at planning level of HRC or CHRIS, since these two instruments are mutually exclusive. The selection will obviously depend on the type of event. For example, in the case of well-localized urban damages, HRC is normally preferred, whereas the richer thematic information of CHRIS can be preferred for events such as floods and landslides.

A dedicated Charter product was defined for CHRIS in spring 2004: 4 spectral bands (SPOT equivalent plus the blue channel), in HDF format:

- 469nm to 499nm (blue)
- 500nm to 590nm (green)
- 610nm to 680nm (red)
- 780nm to 890nm (NIR)

CHRIS's ground resolution at Nadir is about 18m, with a maximum swath size of 14km.

HRC (a panchromatic CCD camera) was first exploited by the Charter in 2005 (Zarand earthquake, Iran). It provides 5x5 km images with a Nadir resolution close to 5m, allowing mosaïcking.

### 3. Examples of Proba data exploitation for the Charter

The Charter has so far been activated more than 80 times since its creation, for a large diversity of events including landslides, earthquake, volcanic eruptions, floods, storms and hurricanes, oil spills, forest fires, etc. An updated list of activations can be found on: [http://www.disasterscharter.org/new\\_e.html](http://www.disasterscharter.org/new_e.html).

So far, Proba has been used in the Charter mostly as a possible, additional source of "crisis" data (acquisitions taken after the event). This was the case for:

- Forest fires in the Var, France, September, 2003.
- Floods in Southern France, December 2003.
- The Earthquake of Bam, Iran, December 2003.
- The Tsunami: Indonesia, Maldives, Thailand, December 2004.
- The Zarand Earthquake, Iran, February 2005.

These cases are illustrated in the Figures n. 1-5.

However, given the fact that several "exotic" locations (islands in the Pacific or Indian ocean) have now been covered by Proba acquisitions, where medium

resolution or high resolution images such as SPOT, IRS or IKONOS are not always available, the Proba archive is beginning to be of interest also for the provision of reference data, i.e. information relative to the pre-event situation. This was the case of the Rarotonga cyclone (Cook Islands, January 2005) when Proba reference data were potentially available while a VHR reference (SPOT 5, IRS) was not.

### 4. Conclusions.

Proba reactivity is good, though improvements are still possible. Different performances in terms of reactivity were obtained for various Charter activations:

- HRC Iran earthquake 2005 => 2 weeks;
- HRC and Chris Indonesia tsunami 2004 => 1 to 3 weeks;
- HRC Bam, Iran => 3 months;
- CHRIS Arles floods 2003 => 4 days.

One difficulty should be mentioned in the case of HRC, notably the fact that very precise location information is needed a priori (during planning), because of the extremely small image size.

For the purpose of crisis data delivery Proba allows increased probabilities to obtain exploitable post-event HR data, thanks to a fast, permanent channel for planning both instruments (HRC, CHRIS) at the PM's and the ECO's request; this results in NRT processing and transfer of data to the PM shortly after acquisition.

Moreover, the archives HRC/Chris during Charter activations deserve a valorisation and exploitation. This requires a systematic search within HRC and CHRIS archive database after each Charter triggering. CHRIS data are presently accessible through EOLI. HRC data will soon be accessible through EOLI, as well (currently at integration stage).

Because of all these reasons, the potential of Proba for the Charter can globally be considered very high.

### 5. References

For more details about the Charter and some examples of results for its recent activations, the reader can consult:

[http://www.disasterscharter.org/main\\_e.html](http://www.disasterscharter.org/main_e.html)

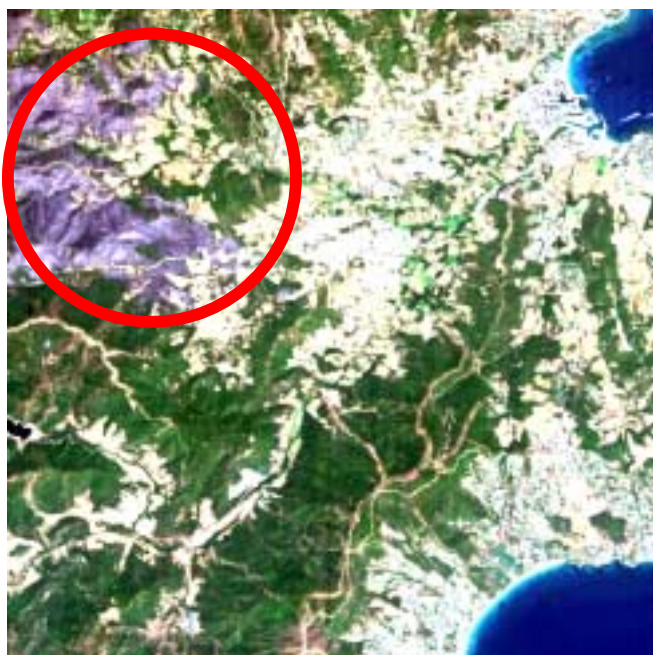


Figure n.1 : *Var* forest fire, CHRIS PROBA acquisition , 03/09/2003.

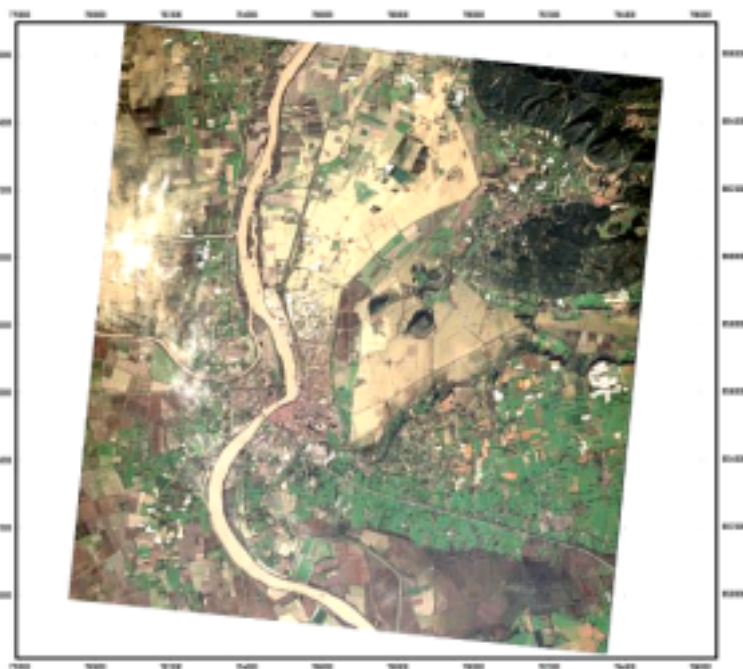


Figure n.2 : *Arles* flood extent observed by CHRIS PROBA on 08/12/2003 (SERTIT processing 2003).



Figure n.3 : *Bam* earthquake, 26/12/03. Acquisition PROBA HRC on 02/03/2004. By photo-interpretation, a severely damaged area was highlighted.



Figure n.4 : December 2004 Tsunami. PROBA HRC 14 Feb 2005, part of a 3-image mosaic acquired over *Banda Aceh*, Indonesia.

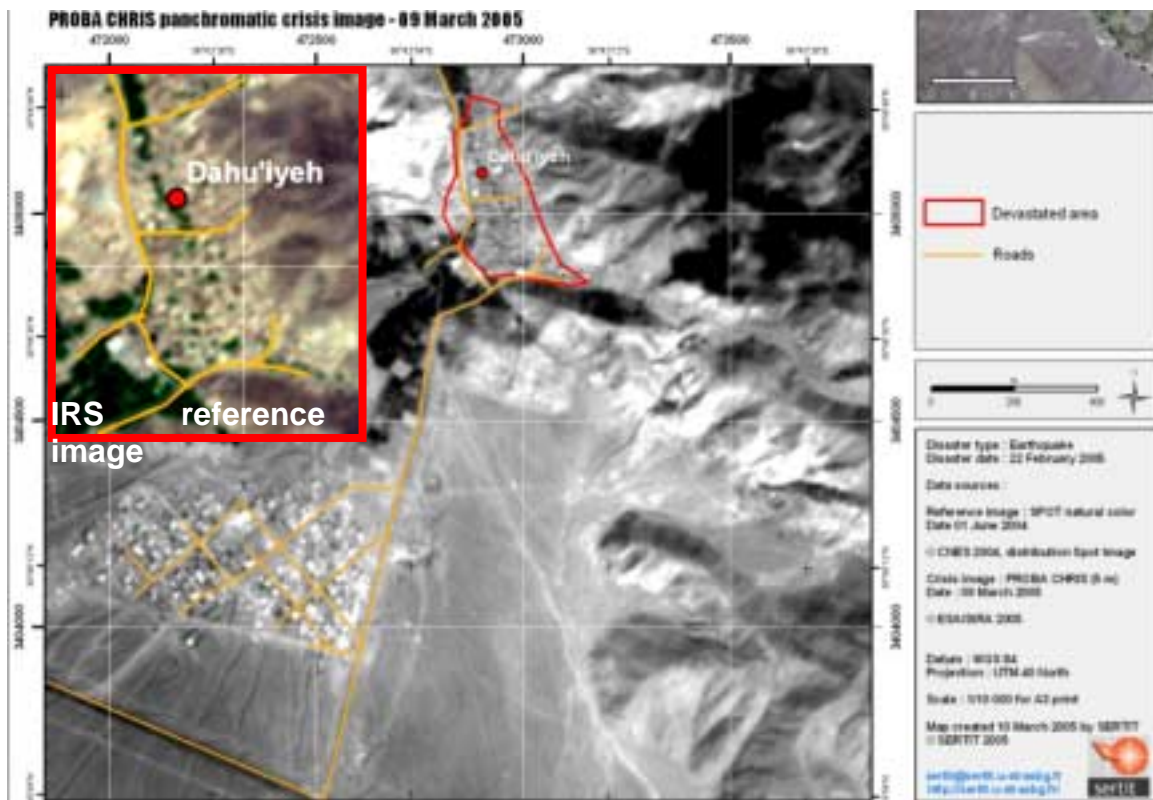


Figure n.5 : *Zarand* earthquake, 22/02/2006. PROBA HRC 9 March 2005. By textural analysis and comparison with a IRS reference image (top left), the identification of the probable damage to the village of *Dahu'i'yeh* was possible.