CEOS Recovery Observatory

Proposal from the
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CEOS DRM Initiative

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Indian Ocean Tsunami
2004

Hurricane Katrina
2005

Deepwater Horizon
2009

Haiti Earthquake
2010

Tohoku Tsunami
2011

Proposal to Establish a Recovery Observatory

Developed by the Recovery Observatory Oversight Team:

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Introduction

Over the course of the past decade, the world has seen an unprecedented number of disasters, which are growing both in number and severity. Large populations living in more vulnerable areas has led to record damages and large losses of life. The last decade has also been witness to a series of catastrophic events that has each marked us: the deadly Indian Ocean tsunami and Haiti earthquake of 2004 and 2010; the catastrophic flood damages of Huirricane Katrina in 2005 and the Tohoku tsunami of 2011, and the astonishing extent of the environmental impact of the Deepwater Horizon explosion in 2009. These catastrophes are on an impressive scale and have widespread and long-lasting impacts. Recovery after such disasters costs billions of dollars and lasts years, even as long as a decade. While satellite imagery is used on an ad hoc basis after many disasters to support damage assessment and track recovery efforts, there is currently no system to support the coordinated acquisition of data and its easy access. After catastophic events of this magnitude, a coordinated approach would maximise the effectiveness of efforts and promote more widespread use of satellite data after smaller events by increasing the awareness of the benefits to be obtained through its use.

The concept of a “Recovery Observatory” was initially born from seeing huge quantities of Earth observation data that are made freely available following major disasters to many different users. These data are made available in an ad hoc manner and through a large variety of platforms, which means that their use both during and after the disaster (when this is authorised) is not optimised. Seeking to optimise the use of collected data, and understanding the value of implementing systematic observations for several years, CNES led the creation of a platform to gather and continue to make available Earth observation data following the devastating Haiti earthquake of January 2010. This project, the KalHaiti project, has made great progress over the past three years, and has allowed CNES to identify lessons learned that underscore the importance of working before a catastrophic event takes place, and of working collectively, as a communutiy of agencies, rather than in isolation. A single, coordinated approach supported by advance planning and identified mechanisms to trigger the creation of an Observatory will greatly increase the efficiency and impact of actions taken following major events. These lessons have led to the creation of the Recovery Observatory Oversight Team and this proposal.

This document seeks to describe a "generic" Recovery Observatory and the schedule for establishing such a platform. It then highlights some of the major issues that must be addressed during the development of this project if it is to be successfully implemented.

1. Rationale

A CEOS-led Recovery Observatory, a one-time demonstration in the 2014-2016 period, would allow the development of specific tools tailored to provide easy access to data over affected areas (pre-event data, response data and coordinated post event acquisitions). An organised repository, combined with an effective exploitation platform would allow disaster managers to work in a known environment with advanced satellite products and promote their use to key user communities. Currently, research shows that EO can be a valuable tool for recovery, DRM stakeholders do not have a clear example of how EO can be used to support Recovery efforts in an optimal scenario for data collection and sharing has not been put forward in a coordinated manner for any major catastrophes.

2. Outcomes and Benefits

The main objective of the proposed Recovery Observatory is to facilitate access to data and products that support recovery from a catstrophic event. A subsidiary benefit for CEOS and satellite data providers will be the development of specific approaches and protocols for using satellite data to support disaster recovery, and raising the awareness with the Disaster Risk Management community of the beneftis of a satellite-based approach.

3. Challenges

A number of major challenges to the establishment of an Observatory have been identified:

3.1 Triggering the Observatory

Defining the disasters for which the RO could be triggered. Such a disaster should have a sufficient impact to ensure a long term involvement of the national governments or international institutions, the scientific communities, NGOs, etc. This impact can be estimated through different parameters such as its location, its geographical extent, the number of victims, affected infrastructures, impact on natural or economic resources, and also the estimated time to recovery. Beyond its impact, the institutional and social context is also an important parameter to be considered. All these conditions must be identified and carefully analyzed in order to be ready to select the most reasonable opportunity for triggering the RO with the highest possible outcome in terms of demonstrating the benefits of remote sensing for risk management and recovery monitoring.

Finding an appropriate "supranational" partner. Being able to quickly establish links to national and local users is of critical importance for the RO to have maximum impact. Clearly it is not possible to prepare this aspect in advance in all countries. Having an appropriate partner, most probably from within the UN family of organisations, who can provide a formal link to the affected country in the aftermath of a disaster is one way of addressing this issue.

3.2 Mobilising User Communities

Identifying and mobilizing the communities of users. Ensuring the involvement of end-users in the RO is a key for success but also one of the most difficult challenges because they cannot be precisely known in advance. Our analysis leads us to identify different users categories such as rescue teams, national institutions, scientific communities, NGOs, international bodies, urban planners or even citizens. Some of them are well coordinated at the international level and the dialog for involvement, promotion and operations could be made as that level. Others are more independent and their mobilization around the RO cannot be prepared for every country. A solution for each of these categories must be found and implies the identification of the right partners for each of them (see below for instance).

3.3 Developing Generic Acquisition Plans

Building a data acquisition plan. Depending on the kind of catastrophe, its extent, its impact and other parameters, the data types which could be needed for the response and recovery phase may extend over a wide range. Identifying the data sources and the way to get them is of great importance prior the triggering of the RO. The Observatory will define pre-determined scenarios to estimate requirements for EO before the disaster occurs.

3.4 Funding Infrastructure

There are useful investments to be made in generic infrastructure before the event occurs, but it can be difficult to obtain funding for a generic platform. Efforts will be made to find synergies with existing projects within CEOS agencies and to attract interest form major DRM stakeholders. The generic platform will be upgraded and adapted after the event occurs.

4. Proposed Scope and Organisation

4.1 A demonstrator

The proposed Observatory would be triggered only once in the 2014-2016 period, as a demonstrator to validate the concept of Recovery Observatories and to showcase how EO can be effectively used to increase the effectiveness of recovery efforts.

A Recovery Observatory such as the one established for Haiti aims to gather and make available as much geospatial data as possible that may be of use in the immediate aftermath of a major disaster and for a period of a number of years after the event. Such an observatory can be considered as a central resource (possibly collaborative), providing users' communities concerned by the event with all the data they need for supporting their activity in the response and recovery phases. Users of the Recovery Observatory belong to rescue teams, NGOs, national ministries, international organizations, urban planning, scientific teams, etc. Even if the Recovery Observatory emphasizes remote sensing data, diverse types of data may be made available ranging from Earth Observation data and derived information products on the event itself and its impact, to socio-economic data on the affected populations. The common theme should be that this data is geospatial (i.e. the data is associated with a position) and that it is of use in helping the response and recovery phase following the disaster. In order to have greatest impact, the Recovery Observatory should be established within weeks after the disaster and should provide a focus for data gathering over and above the Earth Observation community.

The development of the Recovery Observatory would take place in two phases: first, a preparation phase that includes planning and early development, and then an operations phase that covers the Life-cycle of the Observatory.

4.2 Preparation Phase

Initial Analysis – until November 2013

The initial analysis of the problem has been completed and is contained in this document.

Detailed Analysis – until April 2014

Overview of User Needs

There are many types of users, including…

- International users (or stakeholders): international organizations (either governmental like WB or NGOs like the Red Cross) with a mandate tied to the recovery of major disasters and a major stake in supporting recovery efforts. Identifying one or several such users that adopt the idea of a Recovery Observatory and are prepared to work with CEOS to have one implemented is critical to success. This organization would be the lead interface with other users immediately after the response phase, and would assist in defining the initial acquisition plan to be adapted form the generic plan prepared before the disaster.

- National users:for major disasters, the national body responsible for civil protection is typically the sole interface for the outside community (hence the idea of privileging a dialogue through an established DRM stakeholder which will have the requisite privileged access - necessary to be able to get people's attention after a major disaster). This body will authorize NGOs and other to work in the recovery area and is responsible for the coordination of recovery efforts. Their buy-in is essential as to be successful the Observatory must address their needs and the needs of their partners.

- Local users: the local end user is the most affected, and may have no resources at all after a major disaster. However, ultimately, the local end user will be the key long-term partner for a recovery observatory. There needs to be some sort of transition so that as the Observatory is established, it develops a direct relationship with the local end user to ensure the Observatory is meeting needs and to adjust if desired and possible.

- Practitioners or intermediary users: CEOS agencies will essentially provide data to the Observatory. Mechanisms must be established to allow participation of partners who can provide value-added products and services. These partners may be universities, government organizations or private companies. These intermediary users often include science or research users who work on data for scientific interest but with outputs that are used by civil protection authorities. In some cases, CEOS contributions may include some value adding or training and capacity development. This needs to be set up in a single comprehensive framework where the roles of partners are made clear before the Recovery Observatory is triggered. Intermediate users should be able to:
    - understand user requirements;
    - from the user requirements identify and generate high level products;
    - help to identify EO data acquisition plan;
    - train the users in the use and interpretation of the derived products and, when possible;
    - try to transfer EO-based methodologies and practices to ensure sustainability EO.

While it is impossible to determine the exact needs of a Recovery Observatory before an event takes place, there are a large number of requiremetns that are common to all recovery situations after major disasters. What is required is to establish what the baseline data requirements would be both for EO data and for derived products. These data and products support several different types of activity that change as the observatory period evolves. A draft categorization of these activities might include:

- Built area damage assessment (initial and later detailed)
- Natural resource and environment assessment
- Reconstruction planning support
- Reconstruction monitoring; and
- Change monitoring.

While there is no need detailed acquisition plans before the triggering of the Observatory, the preparation phase should include the development of detailed EO data requirements for different

types of Observatories: one for a major earthquake, one for a major volcanic eruption, one for a major flood and/or hurricane, perhaps a tsunami. The exact number of scenarios developed will be decided during the detailed analysis phase. Some elements are quite common and involve situational awareness immediately after the event and for the damage assessment period, or involve baselining pre event and post event imagery in a single database. Other products might be specific to the disaster type - historical flood analysis for future flood events, InSAR analysis for strain estimates after earthquake, etc etc. The proposal would include a few such scenarios and scope out the types of data required for each, without identifying specific satellite missions. After the SIT in April 2014, volunteer agencies can indicate a willingness to contribute specific data sets in the event of a triggering.

Overview of Technical Components

The content of the Recovery Observatory needs to be defined by the CEOS partners. It can range from a simple repository of available data to a pro-active acquisition strategy and the development of key value-added products that would support recovery.

Data

It is clear that the volume of data collected during the response phase is in fact likely to be much larger than the volume of data collected in the following three to five years. Examples of EO data would include high resolution and very high resolution optical imagery; high and very high resolution radar imagery (X, C and L-bands). Examples of revisit might include once a week for a two or three months and once a month for a period of several years, over a given target area. For some disasters such as earthquakes, InSAR imagery would be required to develop products such as interferograms. For other disasters, InSAR applications may be limited to change detection over built-up areas.

There is a need for data from before and after the event, and if this data is organized as a mosaic coverage of the area for example, with easy access for multiple users, this would allow both large and small users to access data without large capacity needs.

Products

Many end users need products rather than data. It is clear that the Observatory can only be successful if relationships are established to enable the generation of products from the contributed data. The baseline scenarios will determine not only the volume of data but representative products for each type of catastrophe. This allows CEOS to engage in discussions with multilateral stakeholders before an event and establish a framework within which differentpartners bring different contributions.

Infrastructure

In the event that CEOS decides to set up an exploitation platform for the Observatory, part of the preparation phase should be dedicated to establishing the generic capability to host the Observaotry,

detemrining the appropriate infromatic tools to include and ensuring standards are in place to received the data in an easily searchable format. Many CEOS agencies already have plans for exploitation platforms and synergies could be sought between existing projects.

International partner

A critical aspect of the analysis phase is identifying a single or several suitable "supranational" partners who will play an important role as a RO user in themselves but also in establishing links to the national user community. This role is particularly important as, given that the national users will not be known until the RO is to be established, they will provide necessary feedback to CEOS through the development phases.

During the detailed analysis, the following issues wil be settled:

- Conditions for triggering an Observatory
- Responsibilities, organization and procedures for triggering and running the Observatory
- Users communities (Engagement, Needs identification, etc)
- Content of preparation phase and commitments in principle from partners

Preparation – April-October 2014

The goal is to prepare the creation of a Recovery Observatory by working on all the required components in order to have all of them ready before entering "cold storage" and the beginning of the Observatory life-cycle. Numerous aspects have been identified:

- Technical components (website, database(s), processing chains)
- Data provision flows (data types, providers, licenses)
- Agreements with Users communities and partners (intermediary users, science users)

This phase should be closed after a "dry-run" formal exercise has been implemented successfully.

4.3 Observatory life-cycle

Cold-storage – from October 2014 until triggering

During this phase we await the occurrence of a disaster corresponding to the defined criteria. As, intrinsically, the components (new sensors, computing technologies, web technologies,

communities, international situations, risk management procedures …) evolve, this time period should be limited and defined in advance.

The duration of the waiting phase cannot be predicted, as it depends on an "appropriate" disaster happening, however CEOS should be prepared to support the "Cold-storage phase" for at least 5 years.

Triggering – in the 10 days following the catastrophy

The CEOS agencies supporting the Observatory are in many cases also members of the International Charter. It is clear that the Observatory is a useful complement to the Charter, and that for a disaster of the scope envisaged for the Observatory, it is highly unlikely that the Charter would not be activated. For this reason, Charter activation should be a pre-condition for the creation of an Observatory (no RO if no Charter activation). There will however be only one Observatory created in the 2014-2016 period, whereas there is on average one Charter activation per week. Other criteria are necessary to determine when an Observatory is triggered.

The magnitude characteristic (exceptional event with far reaching impact in human and/or material terms) should be the first filter. The Observatory should be triggered when the catastrophic nature of the disaster and the scale of the anticipated recovery effort warrant it. This may be a CEOS assessment, or may be the result of a request to CEOS from an outside organisation that agrees to serve as a "filter" to assess which disasters may be the best candidates. Any of the members of the Oversight Team who choose to commit to the preparation of the Observatory could also suggest that the Observatory be triggered and call a teleconference to discuss why, according to predetermined criteria. One of these criteria could (and should) be advice/request from a designated international DRM body. The Oversight Team would review the triggering scenarios, consider the main 'standard' requirements for the triggering, and establish whether there is critical mass within CEOS for the triggering.

A CEOS management level participation in the activation discussions is a good idea at the very least to associate this level with the decision. The CEO (CEOS Executive Officer) is the right person to manage this interface, however it should be clear that this representative is acting as a conduit for CEOS management (CEOS Chair/ CEOS SIT Chair) and has consulted with them bringing a CEOS management point of view to the RO activiation decision.

With this in mind, the triggering mechanism might function as follows:

1. Charter activation - Oversight Team members or international DRM stakeholder/partner consider whether or not event is catastrophic and warrants Observatory

2. One Oversight Team member or international DRM stakeholder calls teleconference to propose triggering

3. Oversight Team examines predetermined scenarios (that were defined during analysis and preparation phase) and looks at triggering criteria, which would include considering advice from DRM stakeholder (and commitment in kind or resources for value added support), looking at scale and scope of disaster, looking at benefit to be derived from establishment of Observatory.

4. Three Oversight Team members, with the agreement of the CEOS Executive Officer in consultation with the CEOS Chair and SIT Chair, representing critical mass/varied contributions of data (according to what was deemed to be required in the preparation scenario) decide they would like to trigger the creation of the Observatory.

5. The Observatory is announced within CEOS with a call for participation.

6. The Observatory is announced publicly, jointly with a DRM partner.

Operations – for a period of 3 to 5 years

The operational phase of the Recovery Observatory should be of a reasonable length, which may depend on the impact of the catastrophe, and would probably range from 3 to 5 years.

Closing – six months before end

This phase involves closing the Observoatory or arranging for its operation by a local partner or international organisation with storng local presence, who might continue to operate the historical data base or suply it with new data to support risk management initiatives.

The review of the activities and outcomes will be presented to CEOS but it should also involve Users Communities and International bodies at the highest possible level.

5 Responsibilities of CEOS Members

The main contribution sought from CEOS members is satellite EO data. Observations will include archived data over the affected area from before the event, data acquired during the response period and dedicated observations to support recovery during the duration of the Observatory.

On a voluntary basis, some CEOS agencies may also contribute value-added products (or support for industry to develop such products), hosting services for the repository, tools to support generation of products or other related services.

Building a data acquisition plan

Depending on the kind of catastrophe, its extent, its impact and other parameters, the data types which could be needed for the response and recovery phase may extend over a wide range. Identifying the data sources and the way to get them is of great importance prior the triggering of the Observatory. From the spatial side, the most suited remote sensing data depend on the sensor type, resolution, swath, acquisition period and also on the targeted applications. The definition of the remote sensing acquisition plan could start with the ECO procedure used in the International Charter which identifies the most suited sensors for a given type of disaster. However since the applications in the framework of the Observatory can be very different, the option of systematically acquiring data from most of the current flying sensors might also be chosen.

Aside the acquisition of new remote sensing data, gathering archive data on the affected area as well as the possibly acquiring in-situ data deserve also a special consideration. One aim of drafting these acquisition plans as precisely as possible would be to provide the CEOS agencies with a precise view of their commitments in terms of amount of images they should provide to the Observatory.

6 Partners (international organisations, DRM stakeholders)

The Recovery Observatory has been conceived from the outset as a partnership between CEOS and DRM stakeholders, especially large international organizations involved in supporting local and national recovery efforts during the aftermath of major events.

As one element of the outside partnership, it is of great importance that the proposed Observatory includes some mechanisms to constantly measure benefits in order to be able to communicate and demonstrate the achieved results to the international community.

7 Conclusions

This document has introduced the concept of a Recovery Observatory for helping the response and recovery phase following a disaster and proposed a tentative plan for its implementation. The most important challenges identified so far have also been listed, even though their solutions have only been drafted. Analysing the problem in depth and proposing possible options and solutions to these challenges in order to better shape this pilot is still an on-going task. However, considering the unpredictable occurrence of the disaster on which the Recovery Observatory would be operated, this pilot is proposed with three main phases: preparation, waiting and operations. This is because a rapid response after a catastrophe with the expected characteristics has occurred is of utmost importance. Establishing and moving to the operations phase of the Observatory should be a matter of a (very) few weeks after the event. The only answer to this challenge is ‘be prepared’. Otherwise

there is no chance of launching a useful Recovery Observatory when it is most needed and will have the greatest impact.