A Framework for Rapid Impact Assessment with special reference to wildfires

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Geographical Information Systems (GIS) technology is a powerful tool that can support decision-making in all the facets of disaster risk management. Being at the centre of all disaster risk management functions, GIS activities such as data acquisition, processing, analysis and visualisation should be seamless from planning to prediction, preparation, response and recovery. A case study of devastating wildfires that destroyed thousands of hectares of agricultural land during August 2011 in the North-West province, South Africa, identifies the lack of a comprehensive framework within which information-based disaster impact assessments are undertaken and which is integrated with the larger context of disaster risk management. Problems relating to the availability, quality and integration of data are typical of the ad hoc approach to the implementation of information technologies, indicating the need for an integrated and coordinated approach. The aim of this paper is to establish a framework for rapid impact assessment, with specific reference to geospatial data management. The framework is put into the theoretical context of disaster risk management and information management, with data acquisition and processing functions being anchored in the principles of information systems theory.

Introduction

Geographical Information Systems (GIS) technology is a powerful tool that can support decision-making in all the facets of disaster risk management (DRM), be they hazard and vulnerability analysis (planning & mitigation), monitoring and forecasting (preparation), or situation analysis (response). Borgia *et al.* (2008:5) place GIS central to all DRM functions, stating that GIS activities should be paramount in disaster management activities at large.

Information derived from GIS data-processing during a rapid impact assessment (RIA) was instrumental in the declaration of a local state of disaster after devastating wildfires destroyed thousands of hectares of agricultural land, killing hundreds of livestock, during August 2011 in the North-West province, South Africa. Initiated by the Tlokwe Local Municipality, this declaration of a local state of disaster in terms of the *Disaster Management Act* (Act 57 of 2002), was the first to be accomplished by a local municipality in South Africa.

During the course of the RIA a number of shortcomings and problems were identified. These ranged from the quality of data to the integration of technologies, signifying the lack of a comprehensive framework within which information-based disaster impact assessments are undertaken. The aim of this paper is to establish a framework for RIA, with specific reference to geospatial data management. The theoretical context of RIA and information management is described, providing a background for focusing on aspects of data-processing and the generation of information that feed into the RIA process. The wildfire event of 23 August 2011 in the North-West province, South Africa, is used as a case study to discuss the methodology that was followed in a GIS-based rapid impact assessment.

Rapid Impact Assessment: Theoretical Context

A post-disaster assessment encompasses two perspectives, namely, a situation analysis and a needs assessment. The situation analysis is aimed at the estimation and valuation of physical damage and economic losses, whereas the needs assessment is aimed at the identification of human recovery needs, that is to say, what is needed to save lives, alleviate suffering, and mitigate negative economic impacts (International Recovery Platform 2011; United States Agency for International Development [USAID] 2005:II–8). The continuation of this work into monitoring and long-term planning, as suggested by The Economic Commission for Latin America and the Caribbean (ECLAC) (2003:95) and USAID (2005:II–8), indicates a progression whereby the importance of collecting the most appropriate information from the outset of an RIA is implied. Whilst the data collected in the initial assessment is focused on immediate needs for relief, the

information also provides the foundation for more in-depth assessments, ongoing recovery and reconstruction and, ultimately, the formulation of mitigation strategies, plans and projects. This indicates a cyclical process involving ongoing data collection and processing.

Various methodologies for rapid impact assessment are described in the available literature, and are based on both the purpose of the assessment and the type of hazard (Borgia *et al.* 2008; ECLAC 2003; USAID 2005). USAID (2005:II–11, 12) proposes the following generic steps which should take place, irrespective of the type of assessment or hazard involved:

- Planning the RIA: Identify information needs and the means of data collection.
- Survey and data collection: Apply the procedures as identified in the planning phase.
- Interpretation: Thorough analysis of the gathered information is critical. The interpretation thereof should be carried out by trained and experienced persons.
- Forecasting: Information forthcoming from the analysis of data should show how the situation might develop in the future so that contingency plans can be drawn up to help prepare for and mitigate potential negative impacts.
- Reporting: Results are disseminated in a format that supports decision-making.
- Monitoring: An assessment must be seen as part of a continuing process wherein both needs and the appropriateness of responses are re-evaluated.

It is evident from the above that information is a key aspect of RIA. Referring to the DRM context as a whole, Granger (1999:20) states that a central point of control for directing information is needed to ensure that information requirements and needs are adequately represented. Borgia *et al.* (2008:15–22) suggest that GIS provides an ideal platform for the integration of information through the spatial and temporal referencing of data. Information generated during the RIA process is best organised in a GIS-oriented relational database. This is due to its intrinsic temporal and spatial dimensions, and particularly its ability to link geographical features to descriptive records in a relational alpha-numeric database. Information, such as the extent of damage (e.g. values and percentage of losses) is inherently geographically bound, and can be generated from an integrated GIS platform and distributed to all participants in the RIA. This characteristic opens up possibilities for interoperability.

A GIS-based RIA methodology is anchored in the principles of information systems theory. Information is the result of data being transformed into information (Granger 1999:22; Harvey 2008:21; Stair & Reynolds 2010:6). This requires a set of logically-related tasks which are performed (with the aid of computer technology) in order to achieve a defined outcome. Understanding these tasks, and the relationship between the data items, requires knowledge. This knowledge is domain-specific and in terms of DRM, it implies knowledge about an array of related fields, such as community health, infrastructure design, et cetera (Granger 1999:22).

Generating knowledge from information is an iterative process comprising the continuous processing of data. The connection between data, information and knowledge, and how it relates to data-processing, is illustrated in the diagram in Figure 1. Data (the plural of 'datum', which means 'facts') are regarded as loose facts, which are of little value on their own. Regarded as raw material, data gain value when processed and drawn together to create a body of information (Granger 1999:20). As illustrated by data item 'X' in the diagram, the same data can be used in different ways to generate domain-specific information. When integrated with other bodies of information, it gains greater value for the generation of knowledge which becomes useful in a specific application field, such as disaster risk management.

This model takes one beyond the conventional view of GIS as purely a map-making tool and recognises the need for information management and information infrastructure, which facilitate the flow of data and information. This suggests an approach whereby a range of information products is generated, satisfying the diverse needs of DRM managers (Granger 1999:22).

Understanding the theoretical context of RIA and information management, a framework for GIS-based RIA is developed around the following concepts:

- the institutional context of RIA
- the participants and users of information in RIA
- the information requirements of these participants
- data-processing to generate the required information
- GIS and RIA process integration.

These concepts indicate the integrated nature of information management, and particularly GIS technology, and are described hereafter in this context.

A Geographical Information Systems-based rapid impact assessment methodology
The institutional context of a rapid impact assessment

The Disaster Management Act, 2002 (Act 57 of 2002) (the Act) provides for an integrated and coordinated DRM policy that focuses on the prevention or reduction of disaster risk, mitigation of the severity of disasters, preparedness, rapid and effective response to disasters, and post-disaster
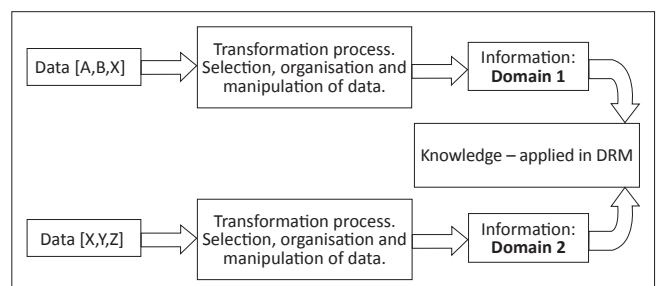
Source: Adapted from Granger 1999:22 and Stair & Reynolds 2009:6
DRM, disaster risk management.

FIGURE 1: The Inter-Disciplinary Information Process.

recovery. It also provides for the establishment of national, provincial and municipal DRM centres as well as DRM volunteers who deal with matters relating to the above-mentioned issues.

RIA as an activity takes place within the context of response to a disaster that has occurred or threatens to occur, with the classification of a level of disaster (e.g. local, provincial or national) and the declaration of a state of disaster as one of the objectives. This procedure involves certain steps, as described in Box 1, below. Of these, Step 2, the initial assessment of occurrence, is essential for the subsequent steps, as this provides for information creation. This information is used in subsequent steps to support decision-making with regard to the level of response and declaration of a state of disaster on a local, provincial or national level (Steps 5–10).

There is no framework or formal guidelines on a national, provincial or local level according to which the collection and management of data should be undertaken during the initial assessment of occurrence (RIA). This apparent lack of guidelines leads to an abrupt and *ad hoc* approach to data collection, as was observed during the August 2011 wildfire impact assessment in the North-West province of South Africa. No coordinated effort to manage the data collection and capturing process during field work operations took place between the participants involved in the RIA. Initially, the GIS function was not integrated with this process. As a result, the integration of textual and geographical data could not be effected.

The framework proposed in this paper aims to provide insight into information needs and how to address these in a coordinated manner, thereby providing a platform from which guidelines for information management can be developed.

BOX 1: Steps in the declaration of a state of disaster.

Evaluate nature of occurrence in terms of section 2 of the *Disaster Management Act*, 2002.
Conduct initial assessment of occurrence to establish magnitude and severity or potential magnitude and severity according to set assessment criteria.
Determine if occurrence falls within definition of a disaster in terms of the *Disaster Management Act*, 2002.
Classify the occurrence in terms of section 23 of the *Disaster Management Act*, 2002.
Classify a local disaster: mobilise contingencies.
If existing legislation and contingencies are inadequate to deal with the consequences or potential consequences, declare a local state of disaster.
If capabilities are exceeded, resources depleted and the municipal contingency fund threshold exceeded, classify the disaster as a provincial state of disaster in terms of section 23 of the *Disaster Management Act*, 2002.
If existing legislation and contingencies are inadequate to deal with consequences or potential consequences, declare a provincial state of disaster.
If capabilities are exceeded, resources depleted and provincial contingency fund threshold exceeded, classify disaster as national state of disaster in terms of section 23 of the *Disaster Management Act*, 2002.
If existing legislation and contingencies are inadequate to deal with the consequences or potential consequences: • evaluate compliance with provisions of the *Disaster Management Act*, 2002 in terms of section 57 of the Act • declare a national state of disaster.
Access central contingency fund, once any state of disaster has been declared approved (e.g. local, provincial or national).

Source: NDMC 2005:56

Various organs of state and organisations are tasked with specific responsibilities in dealing with a disaster event (South African National Disaster Management Centre 2005:56). They are by implication also responsible for dealing with a rapid impact assessment. As will be discussed in the next section, participants involved in undertaking the assessment represent various disciplines and require specific information relating to their domain of expertise.

Participants and users of information in a rapid impact assessment

According to the Act, DRM responsibilities must be integrated into the routine activities of sectors and disciplines within the relevant organs of state and their substructures. Such activities should, by implication, include standard operational procedures for response and RIA activities.

The participants involved in response and recovery activities represent various sectors, as is determined by the nature of the disaster (IRP 2007; NDMC 2005; USAID 2005). Such agencies may include emergency medical care, search and rescue, evacuation, shelter and humanitarian relief, and so forth. Typically government departments, such as Agriculture, Water Affairs, Health, Environmental Affairs, and the like, may become participants in an RIA. In the case of the August 2011 wildfires in North-West Province, the provincial Department of Agriculture, the DRM centre of Dr. Kenneth Kaunda District Municipality and the African Centre for Disaster Studies (ACDS) took a leading role in undertaking post-disaster assessments and facilitating the declaration of a state of disaster.

As they are representing various disciplines, and have various responsibilities, participants have different information needs. Due to the lack of coordination in an RIA, different methodologies and formats for data collection and structuring are often used. This means that information is not always comparable, resulting in possible interoperability issues. To avoid this, a single data-gathering activity should be coordinated as soon after the event as possible (ECLAC 2003:2–44).

Every element of the RIA should be designed to collect information to satisfy the specific needs of each participant (USAID 2005:II–5). As indicated by Borgia *et al.* (2008:15–22), a GIS-based data collection methodology could provide the foundation for a single data-gathering activity. RIA participants should become part of a coordinated process to manage this activity, considering their unique information requirements in the planning of data collection and capture.

Information requirements of participants in a rapid impact assessment

'There is nothing more certain in the disaster management business than the fact that once a disaster starts to unfold, it is too late to start looking for the information needed to manage it.' (Granger 1999:20)

The truth in this statement is alarming, considering that the use of information in RIA is aimed at representing the complexity of a disaster event, describing the magnitude (area) of the event and also providing real-time (current) information to monitor the situation (Borgia *et al*. 2008:17). Participants in an RIA have differing objectives and perspectives, as well as differing information requirements (Borgia *et al*. 2008:33; ECLAC 2003). For example, to describe the impact of a disaster from an environmental, economical and social perspective would necessitate different information needs, some of which are being shared across the combined span of RIA activity. Therefore, by fulfilling all information needs, the widest possible range of issues relating to a specific disaster event can be described, as suggested by Borgia *et al*. (2008:33) and Granger (1999:24).

Whereas the information needs may vary for various sectors, the following information needs listed by USAID (2005:II–9) are regarded as representative of virtually all sectors:

- 'Area affected by the disaster (location and size).
- Number of people affected by the disaster.
- Mortality and morbidity rates.
- Types of injuries and illness.
- Characteristics and condition of the affected population.
- Groups within the population that may be disproportionately affected or require special attention.
- Emergency medical, health, nutritional, water, and sanitation situation.
- Level of continuing or emerging threats (natural/human-caused).
- Damage to homes and commercial buildings.
- Damage to agriculture and food supply system.
- Damage to economic resources and social organization.
- Vulnerability of the population to continuing or expanding impacts of the disaster over the coming weeks and months, and whether vulnerability varies among different groups.
- Level of response by the affected country and internal capacities to cope with the situation.
- Potential constraints or roadblocks to assistance efforts.
- Level and nature of ongoing or anticipated response.'

Much of the information needed for RIA has to do with location. This is referred to as spatial, or geographical, information. The information needs, as listed above, directly or indirectly involve geographical space, such as affected areas and population, or objects such as homes, commercial buildings, infrastructure (medical, health, nutritional, water, and sanitation), all of which have a location. The availability of information will differ from place to place, and given Granger's statement above, there will always be a need for data collection in an RIA, generating information through a systematic process of data transformation. It is this approach that stands central to a GIS-based RIA framework.

The processing of data in a GIS environment entails a number of internal operations, referred to as spatial operations. This aspect is not widely discussed in literature and deserves brief attention.

Spatial operations and data-processing techniques required to generate information in rapid impact assessment

Spatial operations refer to the computer-based manipulation of geographical data through which information is generated which increases our knowledge of spatial phenomena. Spatial operations encompass all GIS functions that are carried out to perform specific tasks. Albrecht (1995) proposes a taxonomy of fundamental GIS operations that can be applied, regardless of the structure of the data and the GIS software applied. He differentiates between goals, tasks and functions which are organised in a hierarchical order, with geographical data being the enabler allowing for the performance of functions and tasks with a specific goal in mind. Berry (2005:10–6) mentions three elements that are essential in GIS data, operations and applications. Although having similarities with Albrecht's approach, Berry combines tasks and functions under operations. As indicated in Figure 2, GIS operations fulfill a functional link between data and the goals of a specific application, which, in the case of this study, is an RIA for a wildfire event.

Using the August 2011 wildfire event as an example, the above model can be applied to illustrate the spatial operations required for a specific goal, for example, to determine the extent of burned areas. Table 1 provides an illustration of the relationship between a single goal with multiple tasks that need to be fulfilled, the functions pertaining to each task, and the input data that is required for each function. It is noted that certain functions need to be carried out in a particular order, as the one resultant dataset (e.g. burned areas polygon) becomes the input for a next function (e.g. integration with farm portions). In the discussion of the case study below, this aspect is described in detail.

Considering GIS as a data management tool, this framework illustrates the multitude of tasks (data sourcing, processing and analysis) that need to be executed before the production of a map can take place.

As was observed during the August 2011 wildfire RIA, the information that was needed for decision-making tended to be created in an insular fashion, indicating the need for an integrated approach. The role of GIS as an entry point for information management during an RIA was also highlighted, as in the discussion above.
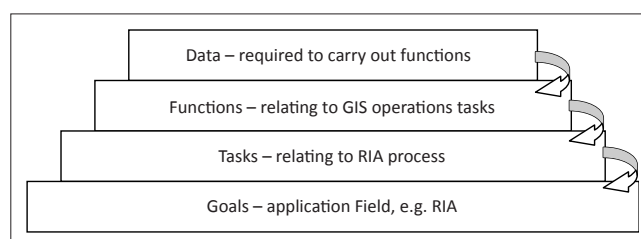
Source: Adapted from Albrecht 1998:236
GIS, Geographical Information Systems; RIA, rapid impact assessment.

FIGURE 2: The geographical information model.

TABLE 1: Example of Geographical Information Systems spatial operations associated with a functional goal.

Goal	Task	Function	Data Input / Output
Determine the extent of burned areas	Data sourcing	• Download satellite image • Obtain farm portions • Obtain land use • Obtain veld types • Obtain grazing capacity	• MODIS (Aqua) • Farm portions • Land cover • Vegetation • Grazing capacity
	Data-processing	• Clip the above data with NW provincial boundary • Unsupervised classification of satellite image • Extract burned areas • Convert raster to polygon • Merge with land use data • Merge with farm portions	• Clipped datasets for each input • 10 classes of pixel values (PV) • 1 class of PV • Burned_Areas • Burned_LU • Burned_ FP
	Data analysis	• Determine loss of veld types • Determine loss of land	• % veld types lost • Hectares burned
	Map composition	• Visualisation	• Thematic maps of burned areas

Source: Produced by author for article

Understanding the relationship between data and data-processing, and how that relates to RIA tasks, and the goal of an RIA as an activity, the matter of GIS–RIA integration comes to the fore. As will be indicated in the next section, this is not so much a technological issue, as it is a matter of planning and coordination.

Geographical Information Systems and rapid impact assessment process integration

The integration of information in RIA is plagued with difficulty and errors due to various factors, such as the multi-disciplinary nature of the process (ECLAC 2003:5–33), and problems relating to the collection of homogeneous, reliable and accurate data (Borgia *et al*. 2008:4; ECLAC 2003:2–58). Underlying this is the lack of a coherent strategy with regard to data collection activities (ECLAC 2003:2–45).

The data collected and created during the RIA is best integrated in a structured database environment, where the relationships between entities can be defined. This allows for GIS linkages, because of the intrinsic spatial dimensions of the data (Borgia *et al*. 2008:17) and the inherent potential for integration through a GIS-based information process. For example, field work information often includes a GPS waypoint, or a geo-coded address of the location where the information was sourced. By coordinating the capturing of GPS waypoint data in a GIS database, and the capturing of the field work data in a structured database, links between these databases can be established, opening up vast possibilities of geographical representation of the field work data. Failure to coordinate this facet may result in the field work data remaining as text and integer values that can best be represented in tabular and graphical formats.

Coordinated planning of an RIA, aimed at information integration, is essential. A qualified and experienced GIS practitioner, working together with the RIA coordinator, should take responsibility for the following planning activities:

• determine the project data and or information needs
• establish an inventory of baseline data and value adding project data in GIS format, which should be updated as new datasets are being created

• develop a GIS Model depicting the required data sources, GIS operations and products
• identify possible participants in the GIS process who represent and work with the respective participants on the RIA team, and establish a coordination forum
• determine the role and responsibilities for each GIS participant
• set standards for data capturing and processing
• establish a protocol for data exchange between participants
• manage the ongoing distribution and exchange of data, ensuring that every participant is working on the same baseline at any given time.

The diagram in Figure 3 illustrates the integration of various datasets into a single GIS management process, and its link with the goals and objectives of the RIA process.

The principles of an integrated GIS–RIA process were applied during the RIA of the North-West wildfires. This RIA has become the object of further research intervention, some results of which are presented in this paper. To illustrate the significance of data-processing as an important step in the creation of information, the following case study describes the spatial operations that were applied to create a GIS data layer that would become essential in determining the magnitude of the disaster and ultimately the declaration of a state of disaster.

Rapid Impact Assessment Case Study: North-West Wildfires, August 2011

GIS data management played a key role in the RIA and the declaration of a state of disaster following the August 2011 wildfire event in North-West province. Following the principles of information management, as discussed above, this section gives a broad overview of the methodology that was followed to create geographical data in line with the objectives of the RIA. This section focuses on data-processing, and describes a sequence of spatial operations that resulted in the development of a geographical database which added value not only to the impact assessment, but also to further research intervention that was initiated subsequent to the RIA.
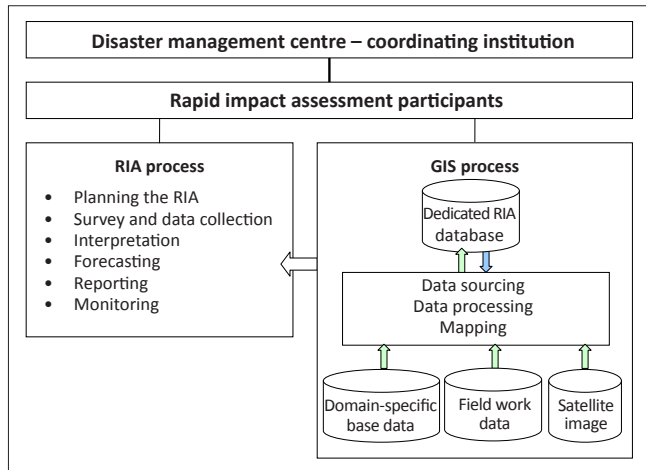
Source: Designed by author for article
GIS, Geographical Information Systems; RIA, rapid impact assessment.

FIGURE 3: Integration of Geographical Information Systems with the rapid impact assessment process.

Following the framework as discussed above, the goal, information needs, data-processing, and data integration will be discussed.

Goal

The primary goal of the RIA was to determine the extent of the disaster and to facilitate the possible declaration of a state of a disaster. In so doing, the following objectives were identified:

- determine the magnitude (spatial extent) of the burned areas
- determine the loss of livestock and grazing
- determine the percentage loss of each land parcel (farm portion).

As indicated in the geographic information model, there is an association between the goal of an RIA and its information requirements. Realising that information is the product of data transformation, the challenge is to identify the essential information components, the data that will be required and the related data-processing techniques.

Information and data requirements

The information that was required for the determination of the magnitude of burned areas and the loss of assets necessitated the creation of specific datasets. Given the time constraints for completion of an RIA, the data acquisition and processing time was limited, compelling the RIA team to rely on data that was readily available. The particular data that was required for processing included the following:

- burned areas, derived from MODIS satellite imagery (United States Geological Survey [USGS] 2010)
- affected land parcels, derived from the integration of burned areas data with existing cadastral data
- calculated loss, derived from the integration of burned areas data with existing grazing capacity data.

The processing of the data required an iterative process of transformation, involving various steps of data manipulation, and the creation of one dataset upon the other, all within the framework of establishing the required information. To

illustrate this, the processing of satellite image data into a burned areas dataset is described below.

Data-processing

One of the primary data sources for determining the magnitude of wild fire damage is MODIS satellite imagery (Quayle 2003:13). In a South African context, MODIS images are available as geographically referenced .tiff files, downloadable from the Wide Area Monitoring Information System (WAMIS) website, hosted by the Meraka Institute (McFerren & Frost 2009).

Figure 4 shows an extract of the MODIS image that was used in the RIA. The objective was to extract the burn scar (dark areas on the image) into a GIS data format. It must be noted that the image has already been processed from a raw data format (containing multi-spectral data) into a Red, Green and Blue (RGB) colour image, with limited analytical capabilities. In order to follow a GIS data-processing approach, the image was exported into a binary Esri grid data format. This is a raster data format where the RGB values in the .tiff image are converted into a multiband raster dataset with each colour existing as a separate field (band), and a data value for each of the fields. Converting the MODIS image into a database environment allows for further data manipulation to isolate the values that represent burn scar information.

The next step was to classify the data into clusters of grouped values. The goal of classification is to assign each cell in the dataset to a class or category. The type of classification that was used is referred to as an *unsupervised classification*. It uses naturally-occurring statistical groupings in the data to determine the clusters into which the data will be classified. This is done by aggregating cell values based on the histogram statistics that are calculated on the input bands. Each cluster is statistically separate from the other clusters based on the values for each band of each cell within the clusters. In this way, burn scar data can be aggregated into a few easily-identifiable clusters. Having experimented with the number of classes generated by the classification process (i.e. 10, 40 and 80), it was decided that a 40-class clustering would provide the best results for identifying burn scars in this particular study. Figure 5 shows the results of this classification process, with the burn scars distinctly visible in the dark shades of grey.

In terms of the data, the burn scars in this image are represented by two classes as identified in terms of the class values of the dark areas (in this, case values '14' and '17'). These values were extracted by means of a logical database query and from this a new dataset [burned_areas] was created. An extract from the database and a map of the newly-created dataset is displayed in Figure 6. Note the burned index field ([BURN_IDX]) that was created to assign unique values, where all burned areas carry the value '1' and non-burned areas the value '0'.

The progression from downloading a MODIS image to generating a new dataset for burned areas, involved four spatial operations, namely, data conversion, classification, data extraction and raster to vector conversion, to create a polygon dataset of burned areas that could be integrated with
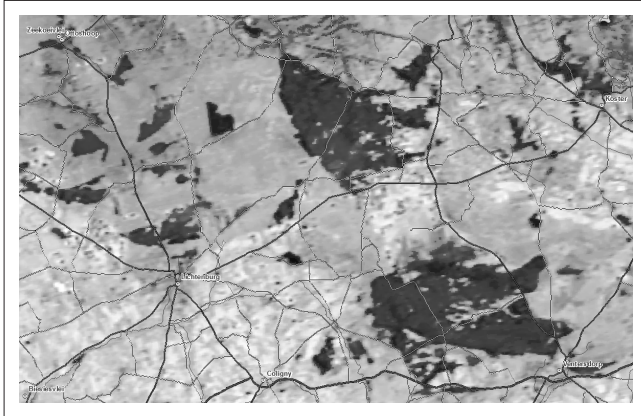
Source: Produced by author for article

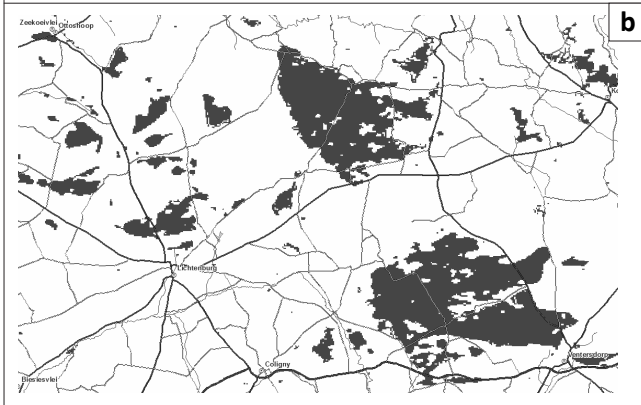**FIGURE 4:** Greyscale representation of a MODIS satellite image (.tiff file).
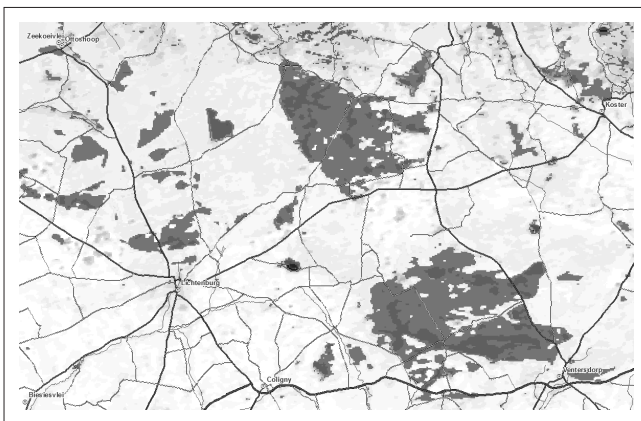
Source: Produced by author for article

FIGURE 5: Classification of image data into 40 classes (clusters of data).

Rowid	Value	Burn_IDX	a
9	10	0	
10	11	0	
11	12	0	
12	13	0	
13	14	1	
14	15	0	
15	16	0	
16	17	1	
17	18	0	
18	19	0	
19	20	0	
20	21	0	

Source: Produced by author for article

FIGURE 6: New dataset and map created from data values representing burn scars.

other existing datasets. This process was completed within the course of one day, the results of which were distributed by e-mail, providing an early indication of the extent of the damaged areas.

Data integration

In order to meet further information requirements of the RIA, the burned areas dataset was integrated with other existing datasets, particularly cadastral data to identify affected land parcels, and grazing capacity data in order to calculate the percentage loss. The map in Figure 7 shows the land parcels that were affected by the wildfire. It is noted that some land parcels have been burned in their entirety, whilst others were only partially affected. As an integrated dataset, the percentage loss in terms of spatial extent could be calculated with ease.

The real value of the RIA data being structured in a GIS environment became evident when information could be extracted in order to provide input into further research, namely, an economic and environmental impact assessment. These research projects focused on the loss of grazing capacity and economic losses in monetary terms. For these, the spatial context of the disaster provided key input.

Verification

The reliability of the newly-created burned area dataset was tested in two ways, firstly by means of aerial observation using a helicopter and GPS data capture, and secondly by means of an overlay analysis, comparing the data with a monthly burned area data product that is available through the Wide Area Monitoring Information System (WAMIS) web portal service provided by the CSIR Meraka Institute (http://wamis.meraka.org.za/). The map in Figure 8 shows the data created for the RIA (dark grey) superimposed on the WAMIS data compiled for the month of August (light grey). The level of correspondence is notable, taking into consideration the difference in the spatial resolution of the two products: the WAMIS burned area data product has a spatial resolution of 464m, whereas the RIA data product has a spatial resolution of 217m, resulting in the WAMIS data being much coarser, with a higher degree of generalisation.

Summary

Following a GIS-based information management process proved to be successful in an RIA. The MODIS data extraction process, as described above, provided reliable data for the determination of the magnitude of a wildfire on a regional scale. After preparing the data in a GIS vector data format, it can then be integrated with other existing data, such as land parcels (cadastral data) and grazing capacity to determine the damage and losses in terms of affected property and loss of grazing material.

Conclusion and recommendation

Rapid impact assessment is an important undertaking for situation analysis and needs assessment in the aftermath of a disaster. It is a multi-disciplinary undertaking, with expertise being drawn from various disciplines. Forthcoming from an

Source: Produced by author for article

FIGURE 7: New dataset and map created from data values representing burn scars.
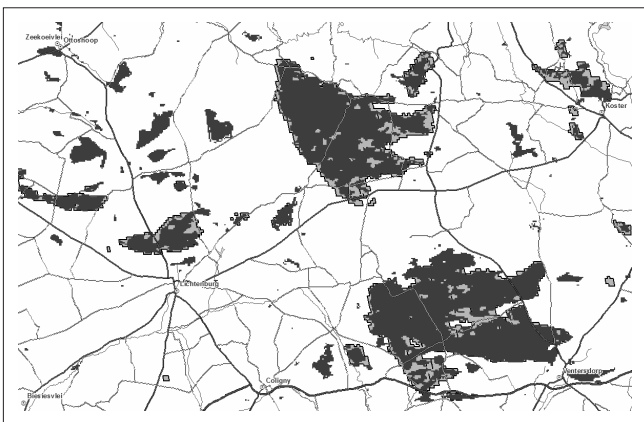
Source: Produced by author for article
RIA, rapid impact assessment; WAMIS, Wide Area Monitoring Information System.

FIGURE 8: Verification of the RIA–MODIS data, comparing it with the WAMIS burned area data.

RIA is vital information that is central to decision-making. For example, in the case of the August 2011 wildfires in the North-West province, South Africa, the decision that had to be taken in terms of the Act was whether or not to declare a local state of disaster. In this case, the information presented should be substantive to support the decision. The type of information that was critical for decision-making centered on the geographical extent of the wildfire and the extent of loss in terms of grazing, livestock and other assets. This decision is critical in terms of response and relief, and subsequent decisions with regard to planning and mitigation are also based on the same and other relevant information, indicating a momentous responsibility on the participants of an RIA and the way they deal with the collection and management of information.

Disasters often happen unexpectedly, and information is not always readily available. As various participants in an RIA have different information needs, new datasets need to be created and integrated with existing information. A GIS-based information management process provides a platform for the coordination of information needs assessment and data collection tasks during an RIA.

The framework for a GIS-based RIA suggests that the following concepts be adopted:

- Information management is a key element of the RIA process, and should be recognised as such.
- Rapid impact assessment is a multi-disciplinary undertaking, with participants having different information needs. It should be designed to satisfy the specific needs of each participant.
- Information is the result of a management process involving data input, processing and output. This must be recognised when planning and executing the RIA.
- Geographical Information Systems provide a platform for integrated information management.
- The GIS process doesn't occur in isolation from the RIA process, and should be acknowledged from the planning phase, through to execution and monitoring.

It is recommended that the framework presented in this research be tested in RIAs to validate concepts thereof and to develop a standing operational procedure for future rapid disaster impact assessments, and to advocate the inclusion of this in RIA guidelines.

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Competing interests

The author declares that he has no financial or personal relationship(s) which may have inappropriately influenced him in writing this paper.

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