

Using satellite imagery for crime mapping in South Africa

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Abstract

In South Africa, as with many developing countries, there are informal settlements on the fringes of some towns and cities. Maps of these areas generally do not exist, making it difficult for authorities to plan for, and work in, these areas. Increasingly, technologies such as digital orthophotographs, high-resolution satellite imagery and the global positioning system (GPS) are being used for these areas to provide base mapping and application data for geographical information systems (GISs). The CSIR has assisted the South African Police Service (SAPS) and other authorities to map crimes and other incidents in these areas, for detecting and preventing crime.

On 27 June 2001 at Bredell in eastern Gauteng, several thousand people invaded illegally about 32 000 hectares of land, owned by the national government, the parastatals Transnet (railways) and Eskom (electricity supply), and two farmers. There, they set up an informal settlement. Early in July 2001, the Pretoria High Court heard an application from the State and others to evict the squatters, which was granted.

A critical component of the hearing was being able to prove that it was a recent land invasion, and that the settlement had not been there for over six months, as the squatters claimed. The Office of the President of South Africa approached the CSIR's Satellite Applications Centre (SAC) for help.

Panchromatic SPOT Image satellite images overlaid with cadastral data was used to prove that the land invasion had occurred during June 2001. Three selected images

on three different dates (18 May, 24 June and 10 July 2001) were used to show the increase in informal settlement activities over the period. The area under investigation changed from a mainly rough pasture (18 May) to a largely informal settlement (10 July).

1. Background

In South Africa, as with many developing countries, there are informal settlements on the fringes of some of its towns and cities. Maps of these areas generally do not exist, making it difficult for authorities to plan for, and work in, these areas. Increasingly, technologies such as digital orthophotographs, high-resolution satellite imagery and the global positioning system (GPS) are being used for these areas to provide base mapping and to capture data for use in geographical information systems (GISs). The CSIR has been assisting the South African Police Service (SAPS) and other authorities to map crimes and other incidents in these areas, for detecting and preventing crime.

2. The land invasion

On Wednesday 27 June 2001 at Bredell near Kempton Park in eastern Gauteng, several thousand people invaded illegally about 32 000 hectares of land, owned by the national government, the parastatals Transnet (railways and pipelines) and Eskom (electricity supply), and two farmers [IOL 20010705] (see Figure 1). There, they set up an informal settlement. Parts of the land in question are servitudes for Eskom power lines and the Petronet oil pipeline, while other areas are on unstable ground susceptible to sink holes, all making the land quite unsuitable for residential use because of the risks to the residents.

Early in July 2001, the Pretoria High Court heard an application from the State and others to evict the squatters, which was granted. A critical component of the hearing was being able to prove that it was a recent land invasion, and that the settlement had not already been there for over six months, as the squatters claimed. The Office of the President of South Africa approached the CSIR's Satellite Applications Centre (SAC) for help.

This land invasion followed shortly after a similar incident near Kuruman, Northern Cape, on the previous Friday, 22 June 2001 [IOL 20010626], and was linked by the squatters to the land invasions in neighbouring Zimbabwe. The Bredell land invasion had a very strong political element to it, with the political party, the Pan-Africanist Congress (PAC), being involved. Allegedly, the PAC was charging the squatters R 25.00 (about US\$ 3.00 at that time) per plot, with the claim that the money was a "donation" that will be used for community services and to fight any legal battles

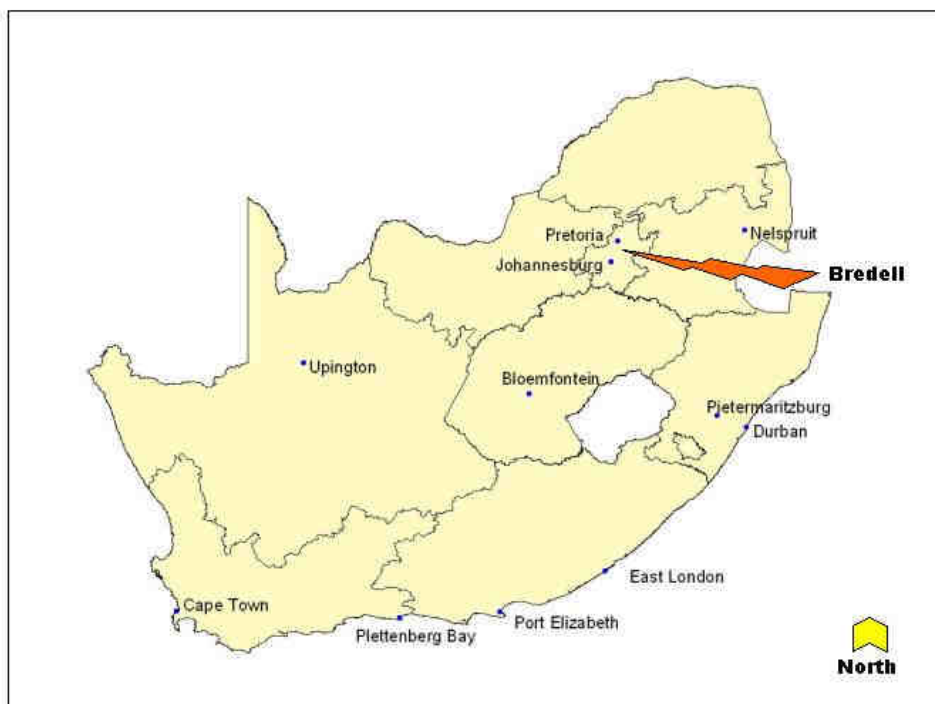


Figure 1: Location of Bredell

stemming from the land grab [IOL 20010703]. These land invasions required a prompt and full response from the government, which the PAC and others accused of not delivering on their election promises of providing housing, even though around five million people had been housed in 1.3 million new, subsidised homes since the end of white rule in 1994 [IOL 20010705]. The government also needed to prevent Zimbabwe-style land grabs immediately, to maintain stability and investor confidence in South Africa.

3. The mapping process

This was a straightforward application of the technologies of remote sensing and geographical information systems (GIS), but with very tight deadlines because of the emergency application to the High Court. It also required precise, quality work to ensure that the resultant maps were accepted and understood by the court. Critical to being able to perform the work, was the availability of SAC's comprehensive and well-structured satellite imagery library, the ready availability of seamless, quality cadastral data for the whole country from one source (the Chief Surveyor General), and SAC's ability to respond quickly and produce quality output readily understood by non-experts in the court.

Initially, several different types of imagery were assessed to select the most suitable: the multispectral sources Landsat 5 TM, Landsat 7 ETM and SPOT 1/2 Xs, as well as SPOT 1/2 panchromatic. In the end, SPOT Panchromatic images were used as they gave the best differentiation between pasture and informal settlements, largely because of the high reflectivity of the construction materials, belongings and other things brought onto the site by the squatters. Three images were used: 18 May 2001

(Figure 2), showing the rough pastures, 24 June 2002, showing increased informal settlement activity, and 10 July 2001(Figure 3), displaying a signature typical of that resulting from informal settlement [Quick, 2001].

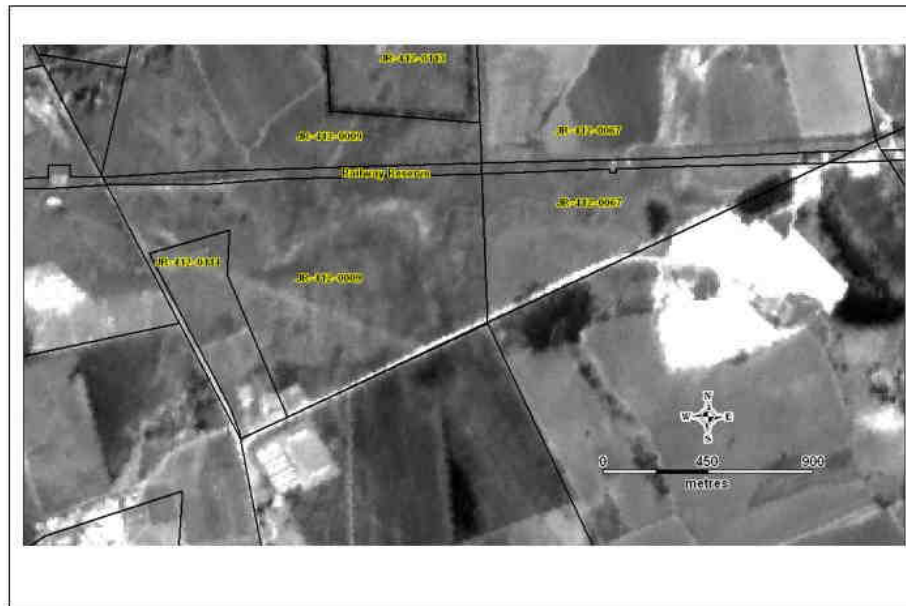


Figure 2: Rough pastures on the 18th May 2001

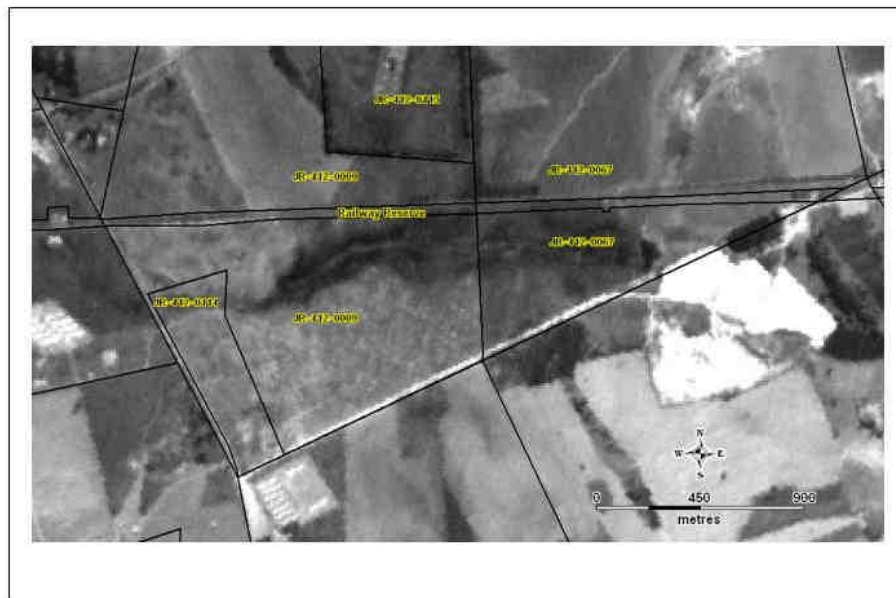


Figure 3: Informal settlement on the 10th July 2002

The imagery was overlain with cadastral data (from South Africa's accurate, up to date, digital cadastre) (Figure 2 and 3), and general reference data such as roads and rivers. Annotation was added to the images and the resultant maps were printed on A0 and A4 paper for presentation in court.

4. Conclusions

The Department of Land Affairs requested the satellite imagery to establish whether there were any structures on the land before 18 May 2001, as claimed by the squatters, for possible inclusion for the High Court case in which the squatters opposed the eviction order.

We would like to acknowledge the funding received from the Office of the President for this project, and we would like to acknowledge the contributions of our colleagues at the Satellite Applications Centre who worked on this project.

5. References

Independent Online (IOL) Newspaper Group, Website: <http://www.iol.co.za>

The following articles were used from this Website:

[IOL 20010626] NGO sides with Kuruman land invaders, 2001.06.26.

[IOL 20010703] Desperate people flock to buy land for R25, 2001.07.03.

[IOL 20010705a] Tempers flare as police arrest land invaders, 2001.07.05.

[IOL 20010705b] Invaders taking what belongs to them - PAC, 2001.07.05.

[IOL 20010705c] Court asked to rule on land invasion case, 2001.07.05.

[Quick, 2001] Quick, GJ, July 2001. Unpublished Affidavit.