

Spatial information as a forensic tool to investigate crime



4th Biennial Conference

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Overview



- Introduction
- Geographic profiling
- Examples of geographic profiling in South Africa
- Forensic geography – cell phone activity mapping
- Examples that were used in court

Introduction

- Forensic geography was seen in the 1970s as applied geography where the geographers acted as witnesses and consultants including their responsibilities and their compensation.
- Forensic geography is the discipline where the geographer does research and gives expert witness in a crime, legal dispute or case where the spatial nature of the crime or dispute plays a pivotal role.
- Forensic geography can be applied in both civil and criminal cases. Some literature broaden this field into forensic geosciences or geoforensics, which includes pedology, mineralogy, petrology, geophysics, natural geography, remote sensing, location data and Geographical Information Systems (GIS).
- Location data also known as spatial data generated by cellular telephone usage and GPS devices are used by the CSIR for forensic and court purposes.

Introduction



- The CSIR is involved forensic geography since 1999 when the New Year's Gang's hijacking, hostage taking, rape and murder case was presented using cellular telephone data as part of the evidence given by the prosecution during the trial at the Cape High Court in Cape Town.
- Cases in which cellular telephone analysis was used include hijacking, murder and stock theft.
- Geographic profiling is used in serial criminal cases such as serial burglary, serial rapes and serial killings.

Cellular telephone

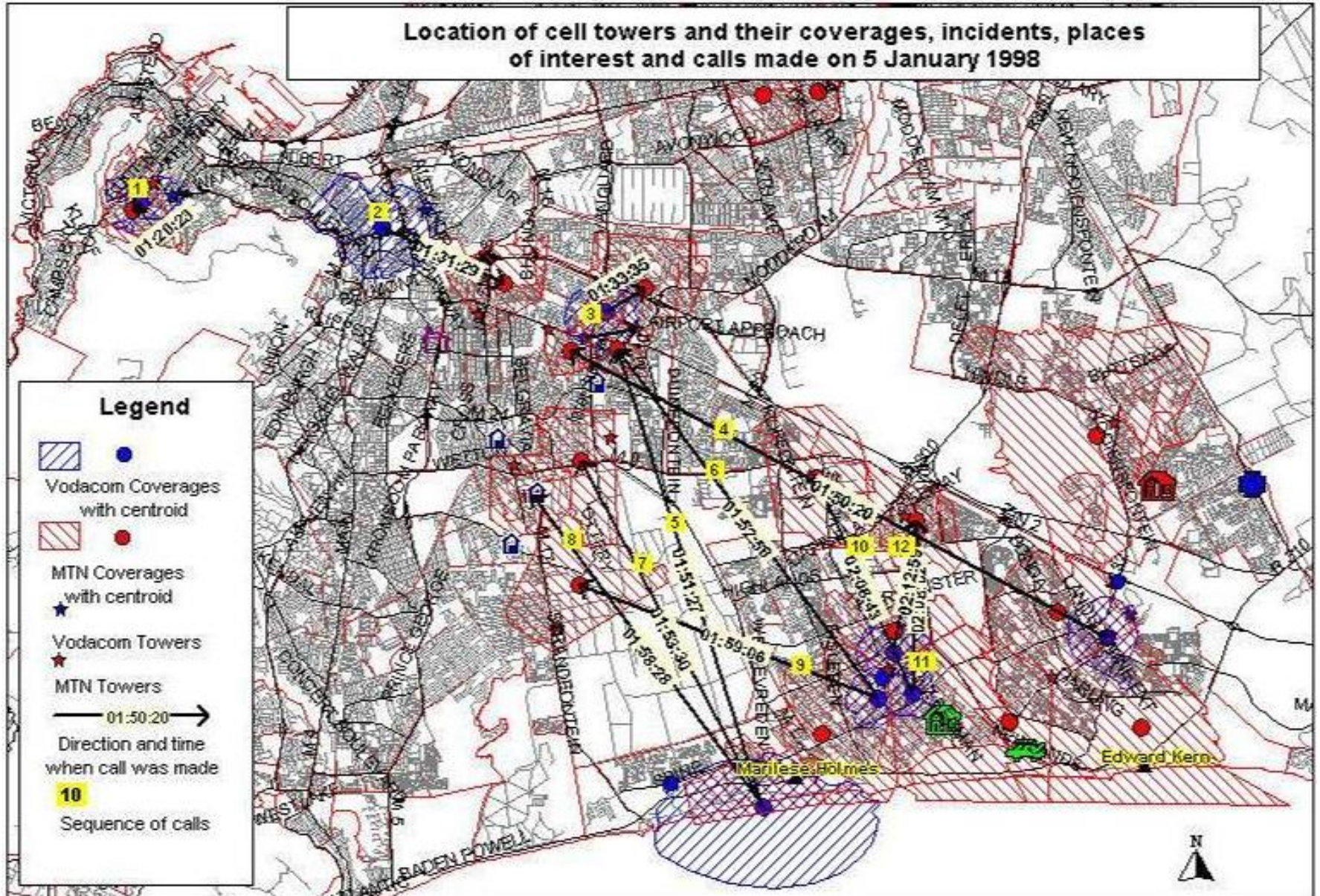
- Cellular telephone usage are depicted in detail billing record which indicate the cell and cell tower used when the cellular telephone makes a transaction.
- Transactions that are used in the analysis are GPRS, SMS, calls and Call Forward.
- The location (latitude and longitude) of the centroid of the cell or the base station (cell tower) location are used to show the user's approximate location in time and space.
- When more than one user is involved, a link can be drawn to indicate where each user was when a transaction was made.
- The examples are:
 - New Year's Gang
 - Truck hijacking
 - Taliep Petersen Murder Case
 - Stock Theft

Cellular telephone – New Year's Gang

- This was the first case in South Africa where cellular telephone usage was mapped and used as forensic evidence in court.
- On the 5th January 1998 just after midnight, a couple was hijacked on Signal Hill near Cape Town, South Africa.
- The couple was held hostage while the gang drove them to a remote spot using the couple's car and their own vehicle. The male was murdered execution style at the first remote location and the woman was taken to another secluded spot where she was raped and murdered.
- Two of the four suspects were killed by the police at a road block when they resisted arrest. One of the two killed suspects was linked by DNA for raping the woman before she was murdered.
- The suspects used their own cellular telephone and the victim's. The investigating officer obtained the detailed billing records of the cellular telephones.
- The centroid of the cells were used as geographic references to map the movement and communications in time and space.

Cellular telephone – New Year's Gang

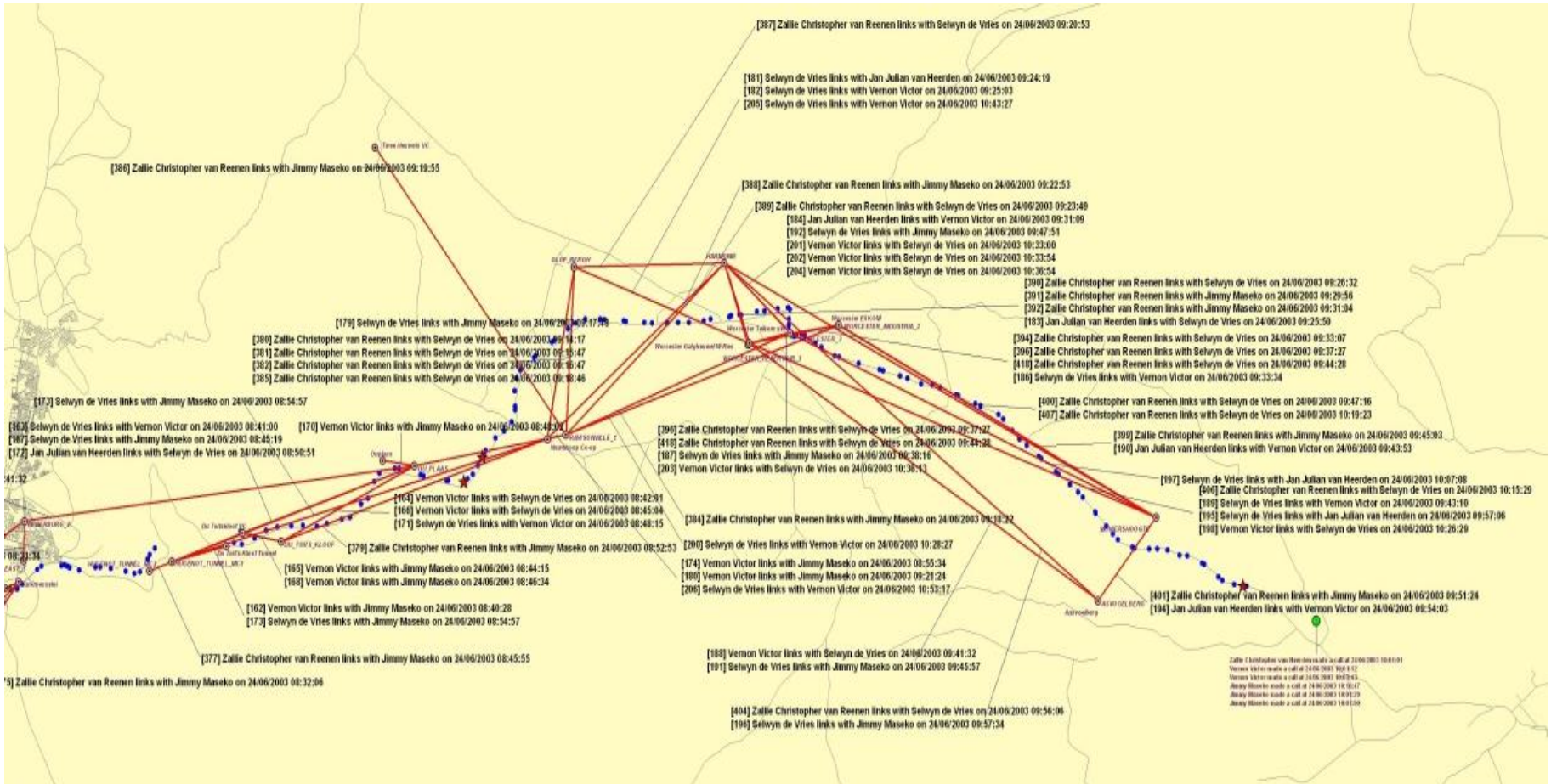
Location of cell towers and their coverages, incidents, places of interest and calls made on 5 January 1998



Cellular telephone – Truck hijacking

- This case study illustrates the use of forensic geography in establishing the movement of and communication between 11 suspects in three separate hijacking incidents. Trucks with a large quantity of cigarettes were targeted. Part of the hijacking gang resided in Johannesburg and the rest in Cape Town. The first incident occurred on the 24th June 2003, the second on 12th August 2003 and the last incident on the 2nd October 2003. The calls from each suspect were extracted, linked and mapped for each of the incidents.
- The example given is the incident on 24 June 2003.
- The modus operandi used was to hold a fake road block using stolen police uniforms and stolen white vehicles with blue lights. The group assigned to the road block formation travel ahead and stay in communication with the group that are following the targeted vehicle with the cigarettes. The roadblock is set at a predetermined location and the targeted vehicle is pulled off the road and the driver held hostage.
- The cargo of cigarettes is transferred from the hijacked vehicle to the gang's own truck. After the transfer of the cargo into the gang's truck the hijacked truck and driver are taken to another location and released.

Cellular telephone – Truck hijacking



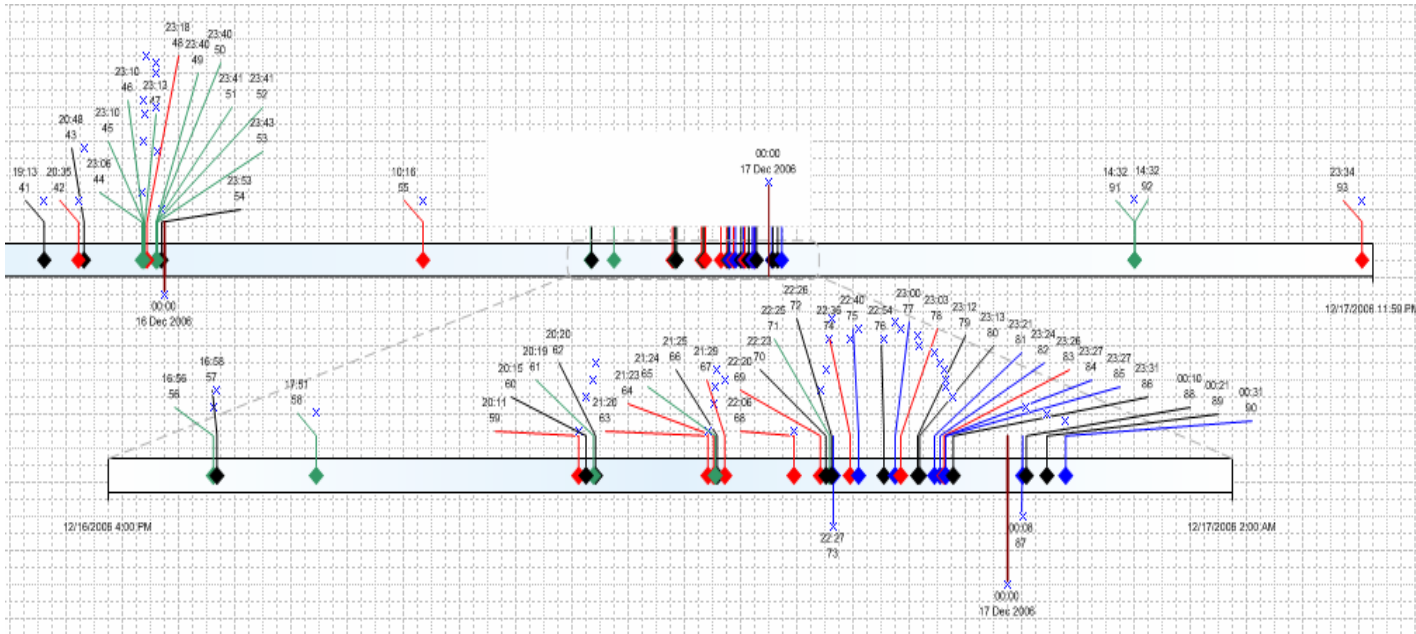
Cellular telephone – Taliep Petersen Murder Case

- On the night of the 16th December 2006 Taliep Petersen, a famous South African musician and playwright, was murdered in his home in Athlone, Cape Town. Initially it looked like a house robbery that went wrong but, when the detectives from the South African Police Service started to investigate, it became clear that it was premeditated murder. This was based on the fact that the crime scene did not indicate the modus operandi of a house robbery.
- From Najwa Petersen's cellular telephone the detectives managed to obtain the person who arranged the murder. This person turned state witness and identified the other persons that were at the Petersen home at night of the murder.
- The aim in using forensic geography in the case study was to satisfy three objectives, namely:
 - To illustrate that there was collaboration between the accused and the state witness that the deceased should be killed.
 - To use the same maps to contradict the evidence given by Najwa Petersen.
 - To create the maps in such a manner that it was easily understood by the court

Cellular telephone – Taliep Petersen Murder Case

Sequence ID	Date	Time	Communication activity	Cells used Najwa	Faheem	Emjedi	Hassan
55	16/12/2006	10:16	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Kewtown 3	Sand Industria 1		
56		16:56	Emjedi (072 010 9819) contacts Hassan (078 169 8347)			Grassy Park 3	Symphony Secondary 3
57		16:58	Emjedi (072 010 9819) contacts Faheem (072 922 9617)		Mandalay 2	Retreat 1	
58		17:51	Emjedi (072 010 9819) contacts Hassan (078 169 8347)			Rylands 3	Symphony Secondary 3
59		20:11	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Kewtown 3	Westridge School 1		
60		20:15	Faheem (072 922 9617) contacts Emjedi (072 010 9819)		Westridge School 2	Ottery DCS 6	
61		20:19	Emjedi (072 010 9819) contacts Hassan (078 169 8347)			Neumans Farm 1	Symphony Secondary 3
62		20:20	Emjedi (072 010 9819) contacts Faheem (072 922 9617)		Rocklands 1	Neumans Farm 1	
63		21:20	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Kewtown 3	Mitchells Central 3		
64		21:23	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Crawford 1	Rocklands 1		
65		21:24	Emjedi (072 010 9819) contacts Hassan (078 169 8347)			Rylands 3	Symphony Secondary 3
66		21:25	Emjedi (072 010 9819) contacts Faheem (072 922 9617)		Mitchells Central 3	Rylands 3	
67		21:29	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Crawford 3	Mitchells Central 3		
68		22:06	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Kewtown 3	Mitchells Central 3		
69		22:20	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Crawford 3	Schaapskraal 1		
70		22:23	Faheem (072 922 9617) contacts Emjedi (072 010 9819)		Sand Industria 3	John Power Holiday Camp 3	
71		22:25	Emjedi (072 010 9819) contacts Hassan (078 169 8347)			John Power Holiday Camp 3	Symphony Secondary 3
72		22:26	Emjedi (072 010 9819) contacts Faheem (072 922 9617)		Lansdowne 1	John Power Holiday Camp 3	
73		22:27	Faheem (074 340 2038) contacts Hassan (078 169 8347)		Ellen Arthur Clothing		
74		22:36	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Kewtown 2	Rylands 1		
75		22:40	Faheem (074 340 2038) contacts Hassan (078 169 8347)		Rylands Primary School		Symphony Secondary 3
76		22:54	Faheem (074 340 2038) contacts Emjedi (072 010 9819)		Sunnyside Sportsfield	John Power Holiday Camp 3	
77		23:00	Hassan (078 169 8347) contacts Faheem (074 340 2038)		Sunnyside Sportsfield		Cravenby High School 3
78		23:03	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Kewtown 3	Crawford 1		
79		23:12	Faheem (074 340 2038) contacts Emjedi (072 010 9819)		Sunnyside Sportsfield	John Power Holiday Camp 3	
80		23:13	Emjedi (072 010 9819) contacts Faheem (072 922 9617)		Rylands 1	John Power Holiday Camp 3	
81		23:21	Faheem (074 340 2038) contacts Hassan (078 169 8347)		Sunnyside Sportsfield		Valkenberg Hospital
82		23:24	Hassan (078 169 8347) contacts Faheem (074 340 2038)		Sunnyside Sportsfield		Ledger House
83		23:26	Najwa P (082 566 7967) contacts Faheem (072 922 9617)	Crawford 1	Rylands 1		
84		23:27	Faheem (074 340 2038) contacts Hassan (078 169 8347)		Sunnyside Sportsfield		
85		23:27	Faheem (074 340 2038) contacts Hassan (078 169 8347)		Sunnyside Sportsfield		
86		23:31	Faheem (074 340 2038) contacts Emjedi (072 010 9819)		Sunnyside Sportsfield	John Power Holiday Camp 1	

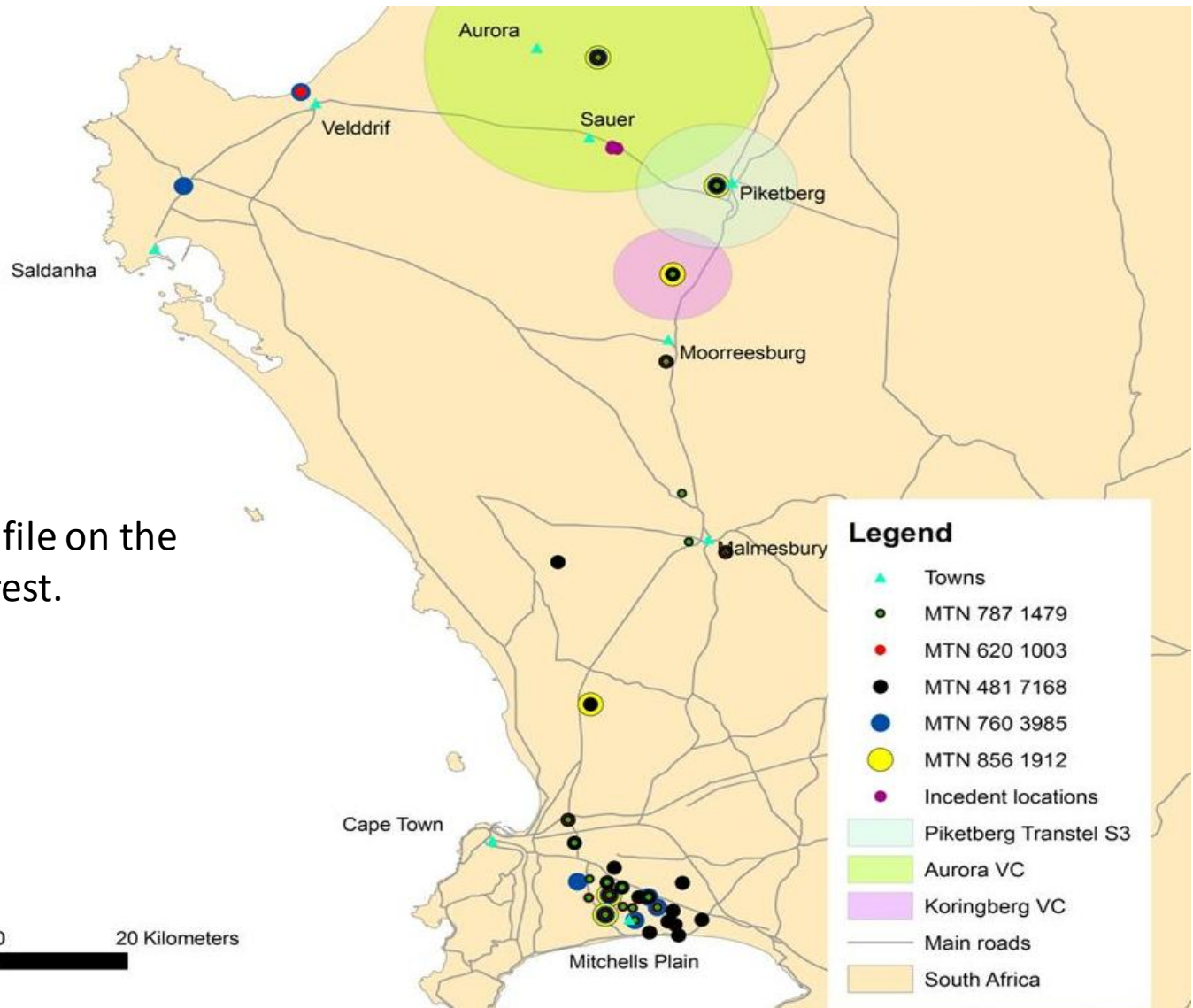
Cellular telephone – Taliep Petersen Murder Case



Cellular telephone – Stock Theft

- This case study at the writing of this chapter is an on-going court case. The dates of the incidents are removed and maps shown here are those presented as evidence in an open court at the Regional Court in Malmesbury and not prejudice the court case.
- The suspects were caught red-handed with stock that was stolen from the farm in Piketberg – Malmesbury area in the Western Cape.
- The investigating officer suspected that it was the same five people involved with three other stock thefts on the same farm and asked the CSIR if they could not establish this using the detailed billing records of the suspects.
- Since the cells in rural areas are large up to 72km in diameter it was decided to draw a geographic profile of the suspects on the evening of arrest and determine whether a similar geographic profile could be determined for the other three cases.

Cellular telephone – Stock Theft

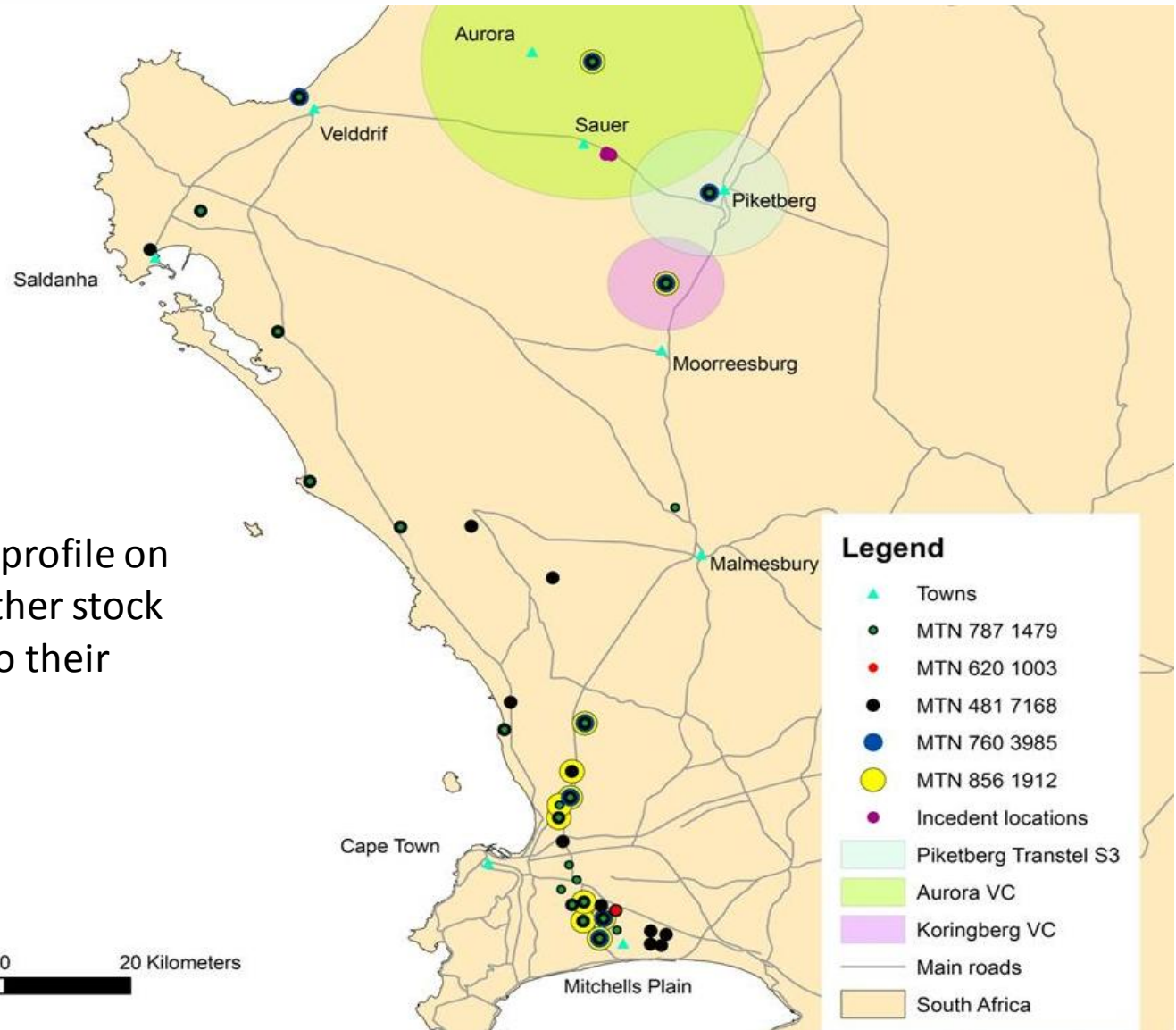


The geographic profile on the evening of their arrest.



20 10 0 20 Kilometers

Cellular telephone – Stock Theft



A similar geographic profile on the evening of the other stock theft incident prior to their arrest.



Geographic profiling

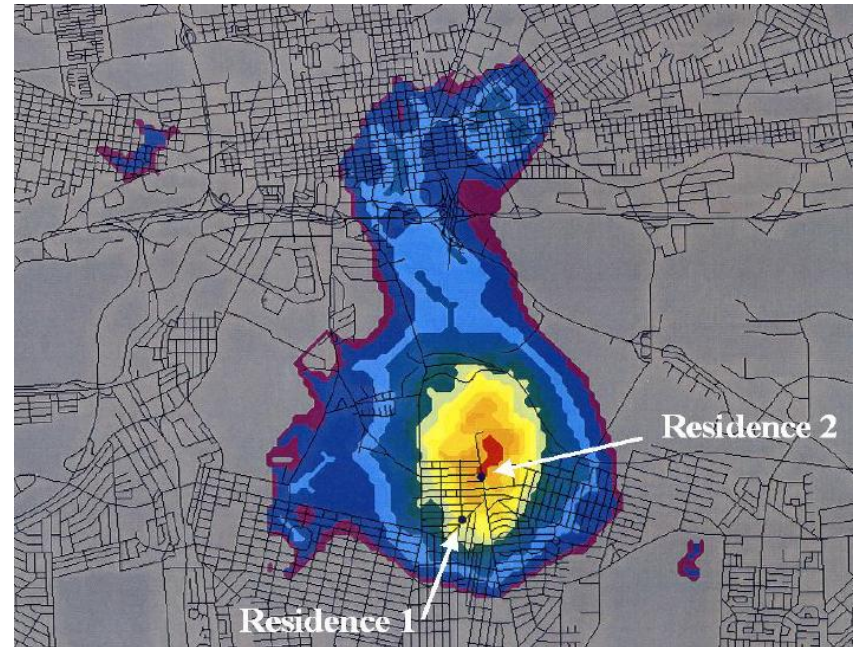
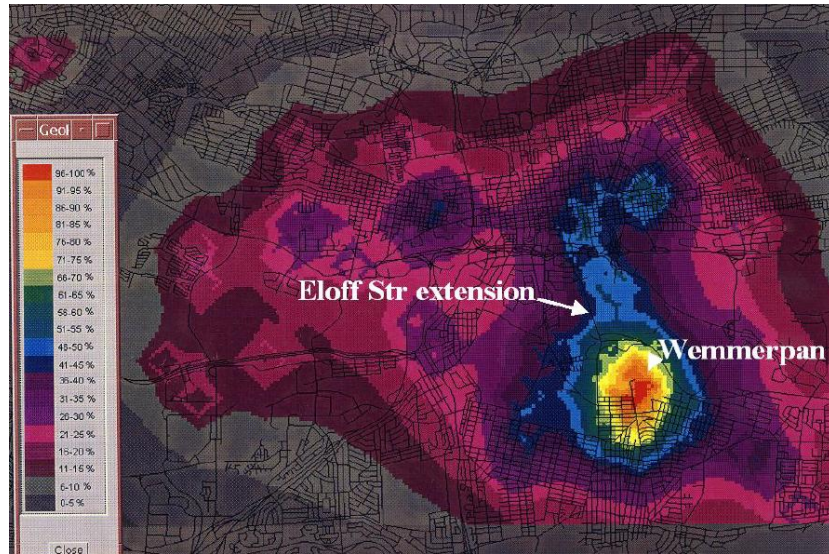


- Geographic profiling is a method to determine the anchor point or points from where a serial criminal operates from. The anchor point is in most cases the residence, but could also be the work place or pub or other point of importance to the criminal.
- Geographic profiling uses the location of the incidents such as burglary or in the event of serial murders or serial rapes the encounter, attack, murder/rape and body dump/release sites into account. In most of the serial murder cases the body dump site is known to the investigators.
- With regards to rape cases all four sites are known since the victim is alive to indicate these sites.
- Geographic profiling uses an algorithm to determine the most probable area where a serial criminal's anchor point is situated. The total area covered by the criminal based on incident locations is known as the hunting area, the geographic profile is based on the hunting area and the peak profile is that area of the geographic profile that shows the highest probability in which the criminal's anchor point can be found.

Geographic profiling – Wemmerpan Serial Killer

- The Wemmerpan serial killer in Johannesburg, South Africa, started his series in September 1995 and was arrested in early 1998.
- The investigating officer, Commissioner Piet Byleveld, could link 86 cases to the series.
- What made this case interesting was that the investigating officers initially thought they had four independent series going simultaneously until the leading investigator made a breakthrough by linking the four series into one based on a signature on an invoice.
- As part of the Innovation Fund project in the late 1990's the CSIR got involved with the Wemmerpan serial killer case by mapping all the locations for court purposes and to demonstrate the use of GIS in investigations. As part of this demonstration the CSIR invited Dr Kim Rossmo to South Africa in 1999 with the aim to see whether his aforementioned geographic profiling tool could be applied to South African conditions. The crime sites and the street network of Johannesburg were then e-mailed to Canada, where Rossmo and his team ran the profile.

Geographic profiling – Wemmerpan Serial Killer

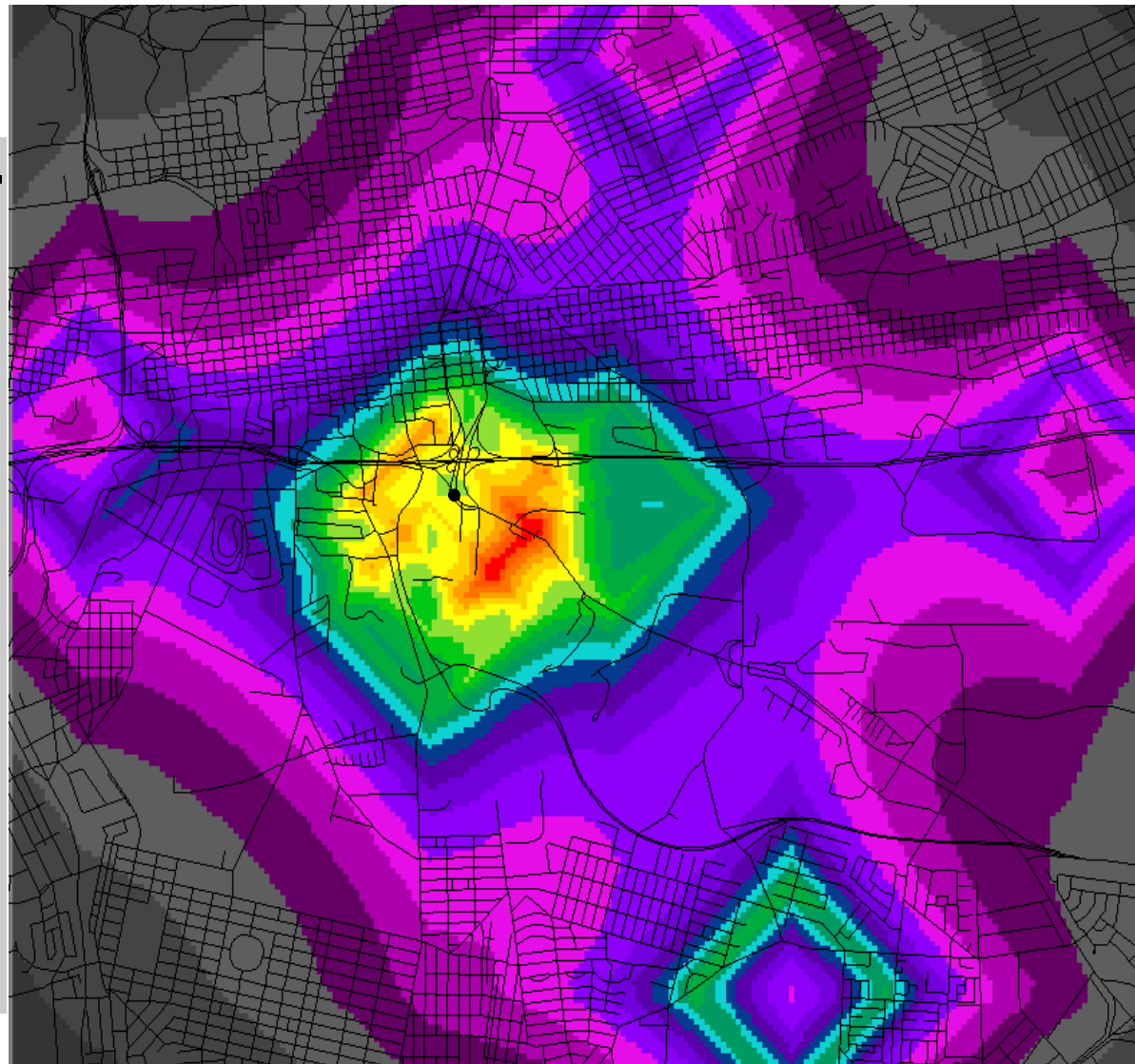
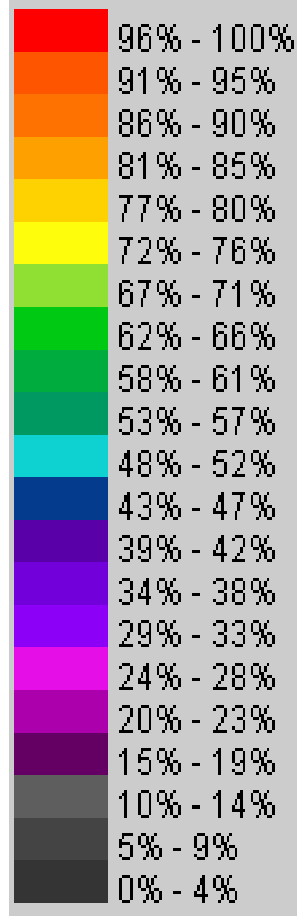


Geographic profiling – Mine Dump Serial Killer

- The Mine Dump Serial Killer raped and murdered children in their teens irrespective of their sex. He abducted the children, taking them to secluded places within the mine dumps to rape and to murder them. He started his series in October 2002 and was arrested in late early December 2003. Fortunately, his last victim survived the attack and was able to lead the police to his “home”, which was a secluded place under a bridge at the M2 highway in Johannesburg.
- He was one of many individuals that trawl an area with a trolley picking up scrap metal and paper products for recycling earning an income. This allowed him to scan his area for suitable victims. The geographic profile using the first five scenes out of 11 could predict the anchor point accurately. The reason for using only the first five scenes was to demonstrate that geographic profiling can be done early in the series to enable the investigating officers to search and arrest the serial killer as quickly as possible.

Geographic profiling – Mine Dump Serial Killer

Legend



Acknowledgements:

To all the detectives involved with the cases.

The CSIR for the opportunities to be involved and to present at this conference.

Thank you



Bollywood missile as spotted at the African Aerospace and Defence 2012 show at Waterkloof AFB