Geospatial Analysis Platform (GAP) for South Africa – Supporting strategic spatial analysis and planning

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BACKGROUND AND NEED

Despite rapid advances in satellite imagery and related fine-resolution mapping and web-based interfaces (e.g. Google Earth), the development of capabilities for *strategic spatial analysis and planning support* has lagged behind, and where such capabilities have been developed there seem to be very little evidence of actual use of these by practitioners (Klosterman, 2005). A core problem is the widely differing analysis units and scales used for different sectors or scientific disciplines. The South African Geospatial Analysis Platform (GAP) was developed specifically to address this problem and to provide a robust basis for profiling places both in terms of their local or intra-locational attributes (such as population density) and their relational or inter-locational attributes (such as relative position, accessibility or remoteness).

COLLABORATIVE DEVELOPMENT

GAP is the result of an evolving, collaborative initiative. A novel feature of GAP, taken the often mentioned challenges of planning support systems (see Geertman and Stillwell, 2004: 305-307, Klosterman, 1999) is that it was developed not only as technology innovation, but in consultation with key clients and stakeholders as an integral part of the analysis and planning process. In this way it took cognisance of the policy context, as well as user (including varied skills) and local specific requirements. The principal active participants up to mid-2007 were the CSIR, The Presidency (Policy Coordination and Advice Services) and the Department of Trade and Industry. Two versions have been produced and disseminated in the form of CDs (containing maps, documents and data tables): GAP1 in mid-2006 and GAP2 in mid-2007.

CONTENT

Seen from a functional perspective, GAP can be described as a common, meso-scale geospatial platform for the assembly, analysis and sharing of strategic geospatial information – i.e. information about a) what is where; b) how much is where; c) where the main concentrations/hot spots are to be targeted; and d) what can be reached from where (Naude et al, 2007). GAP2 consists of:

1. 25 000 so-called mesozones with an average size of 50km^2
2. a geo-referenced dataset of about 1 000 central places (villages, towns, major shopping centres, etc.) ranked in terms of an urban function index
3. a strategic digital road network (linking most of the zones except mountainous, inaccessible zones)
4. a multi-scale spatial data mining workbench
5. a range of network analysis and other geospatial analysis tools.

GAP overcomes the problem of spatially incompatible 'large area statistics' by re-scaling and assembling a variety of census, satellite imagery and other data sources in terms of a common set of mesozones (see examples shown in this inset) - demarcated in such a way that they all nest within important administrative and physiographic boundaries, and are connected to a strategic digital road network for the country.

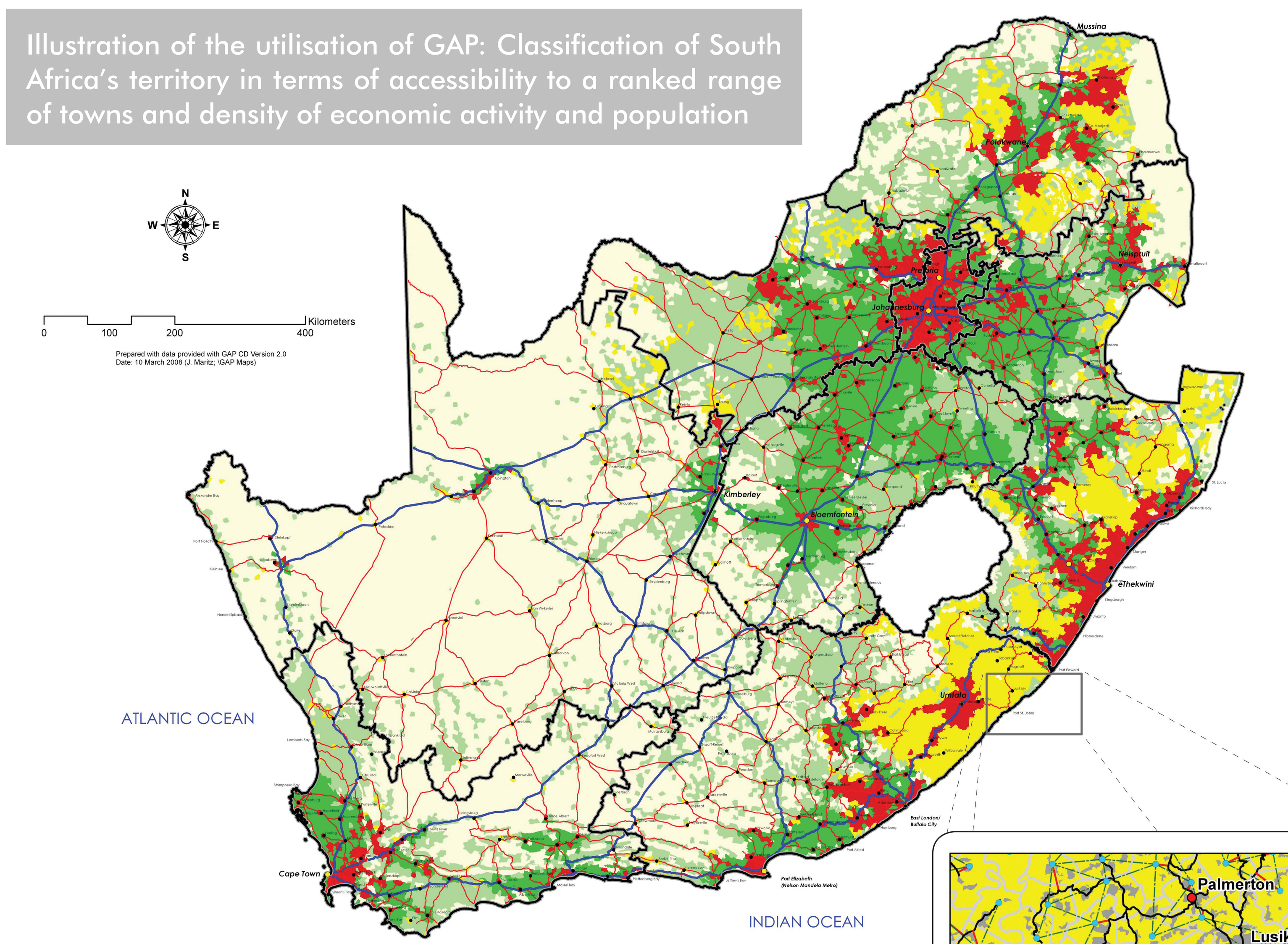
APPLICATION AND IMPACT

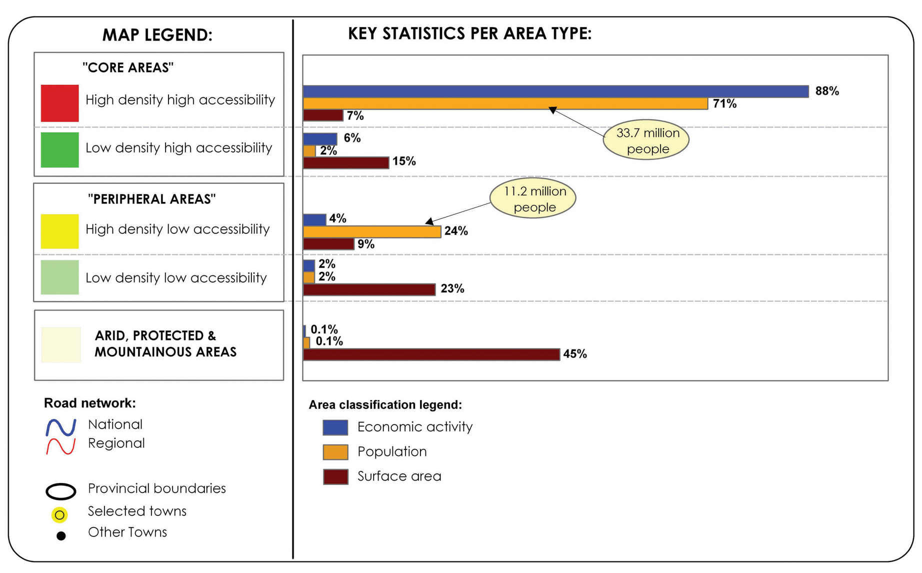
In the past two years, GAP has filled a huge vacuum in successfully supporting strategic, relational spatial analysis in support of strategic development planning in South Africa, as set out earlier, an incredibly unique future for any planning support system (see Geertman and Stillwell, 2004: 305-307 and Klosterman, 2005). Recent prominent projects, which were based on and also illustrate the value of relational spatial analysis, include the update of the National Spatial Development Perspective (NSDP) (Republic of South Africa: The Presidency, 2006), the development of the draft Regional Industrial Development Strategy (RIDS) by the Department of Trade and Industry (2006), the Contextualisation of the NSDP in 13 districts by The Presidency (2007), the development of the eSpace model to analyse and simulate regional development dynamics (the CSIR for the Department of Science and Technology, 2007); and the recent Overview of National Spatial Trends and Settlement Dynamics done for the South African Cities Network. The outcomes of these applications, amongst other things, illustrated:

1. the benefits in addressing the problem of spatially-incompatible statistical area boundaries (e.g. administrative boundaries differing from river catchment management boundaries)
2. the value in enabling practitioners and policy makers to move from the prevailing 'container' approach to a much more relational approach to spatial analysis. This means that instead of only measuring and mapping what is in each territorial container (e.g. a local municipality), attention can also be given to measuring and mapping the relative positions, cross-border influences and other inter-locational attributes that places have in relation to surrounding areas and regions
3. the importance of a relevant, accessible and user-friendly planning support system in supporting strategic spatial analysis and planning through innovations in and access to technology (See Vonk, Geertman and Schot, 2005).

GAP is a common, meso-scale geospatial platform for the assembly, analysis and sharing of strategic geospatial information.

Illustration of the utilisation of GAP: Classification of South Africa's territory in terms of accessibility to a ranked range of towns and density of economic activity and population

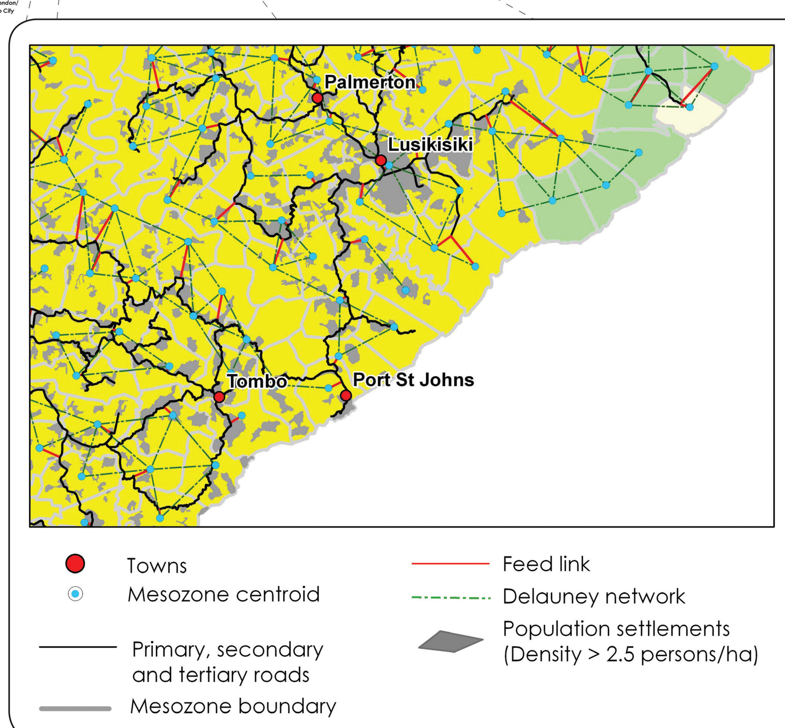




Map Description

The map shown on this poster is an example of how the various components of GAP were used to produce a classification of South Africa in terms of three broad types of areas: a) 'core areas'; b) 'peripheral areas'; and c) arid, protected and mountainous areas. This was done by first identifying the arid, protected and mountainous areas (all of which constitutes 45% of the surface area, but makes only a 0,1% direct contribution to the economy), and then dividing the rest of the country into core and peripheral areas – using a weighted index of accessibility to the nearest village; small town; medium-sized town; and large town or metropolitan area. The last step in the process was to further subdivide the core and peripheral areas in terms of population density – with 20 persons per km^2 as the chosen division between high and low density areas.

At the risk of over-simplifying, the spatial distribution and population numbers (see diagram below) of the high density areas can be seen to indicate two key population-related service delivery challenges: 1) Some 33,7 million relatively-accessible people are probably experiencing significant housing and related living space needs; 2) About 11,2 million relatively-remotely located people (24% of the SA total) are contributing only 4% of the country's economic activity, and are therefore probably experiencing significant livelihood, service access and transport needs. However, given high unemployment rates and poverty levels in both types of areas (not indicated here), this should not be seen to imply vastly different job creation and poverty reduction challenges.



Delauney network description

Delauney networks are formed by connecting the centroids of adjacent mesozones (if there are not any barriers such as mountains or rivers). By specifying very low travel speeds (decreasing with increasing slope) on the feed links and the Delauney links, a proxy network of access roads, farm roads and tracks is created. This is merged with a road network dataset to provide an integrated basis for calculating distances and travel times.

REFERENCES

CSIR. (2007a). *Geo-spatial Analysis Platform (GAP2) Viewer*. Pretoria: CSIR Built Environment.
CSIR. (2007b) *NSDP Application Project: Learning Database*. Unpublished set of records of interviews, questionnaires and observations.
Department of Trade and Industry. 2006. Draft Regional Industrial Development Strategy.
Geertman S and Stillwell J. Planning Support Systems: an inventory of current practice. In Computers, Environment and Urban Systems, Vol 28 (2004) pp: 291-310.
Klosterman RE. The What If? Collaborative planning support system. In Environment and Planning B. Planning and Design. 1999 Volume 26 pp: 393-408.
Klosterman RE. Guest Editorial – An update of Planning Support Systems. In Environment and Planning B: Planning and Design. 2005. Vol 32, pp: 477-484.
Naudé AH, Badenhorst W, Zietsman HL, Van Huyssteen E and Maritz J (2007). *Technical overview of the mesoframe methodology and South African Geospatial Analysis Platform*. Technical Report for the CSIR, Pretoria.
Republic of South Africa. 2006. National Spatial Development Perspective, 2006. Pretoria.
Vonk G, Geertman S and Schot P. Bottlenecks blocking widespread usage of planning support systems. In Environment and Planning A. 2005. Vol 37, pp: 909-924.

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