Regolith-terrain mapping in the Tanami

by

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The visual representation of landform has a long history, typically captured in landscape paintings and photographs. However, as technology advanced, our view of the Earth's surface was largely overtaken by a desire to measure and map. The development of terrain maps is an attempt to represent multiple perspectives of three-dimensional surfaces in a two-dimensional image. Recent advances are now supporting a trend in many sciences, including regolith-terrain mapping, away from polygonization or parameterization of discrete units back to a picture of the world, often through interactive three-dimensional imaging. The argument herein presented is that effective representation of regolith-terrain must incorporate both temporal- and scale-dependencies in the spectral and topographic expression of the landscape to be visualized.

Producing useful regolith-terrain maps for the exploration industry and other land users relies primarily on the analysis and visualization of topographic and multi-spectral data. In addition, mapping and field characterization within a systematic framework brings benefits in interpretation, and the trend both within Western Australia and nationally is towards both extracting maximum value from imagery and applying more robust mapping methodologies. As a result, our understanding of the intimate relationship between landform, material, and process at the surface is constantly improving. This is a prerequisite for understanding three-dimensional and temporal aspects of the regolith.

The two most useful datasets for regional regolith-terrain mapping are digital elevation models (DEMs) and Landsat TM. Orthophotograph, radiometric, multi-spectral (ASTER), hyperspectral (HyMap) and radar datasets are all potentially useful, but coverage of remote areas such as the Tanami tends to be patchy. Research and product development for the Tanami, in contrast to areas such as Kalgoorlie, has therefore focused on improving the temporal and spatial analysis and three-dimensional integration of DEMs and Landsat TM.

The analysis and visualization of Shuttle Radar Topography Mission (SRTM) DEM data has been very effective for regional regolith-terrain mapping. Applying multi-scale analysis to resample the original data has produced the best visualization of what is essentially a level landscape (Fig. 1). Resampling the original 90-m resolution data to 270 m, although counter intuitive, has also been very effective in the visualization of regional landform patterns.

Multi-band remotely sensed image data contain information on landscape pattern and temporal changes that are underutilized in regolith-terrain and bedrock mapping. Among the reasons for this loss of analytical opportunity are the need for improved methods for the systematic extraction of patterns, and the ever-increasing volume and diversity of remotely sensed image data. The merging of Landsat TM data for a range of epochs for use in terrain mapping, producing what are now termed Landsat TM^3 images (Landsat TM Temporal Merge Terrain Mapping), effectively tackles the challenge of producing a consistent set of images in an area dominated by seasonal vegetation changes and fire scars. While most users would naturally focus on the most recent images as being of most value, identifying persistent patterns in the landscape that relate to geological materials is best accomplished by removing the short-term effects. The most recent image may be the worst in terms of fire scars, floods, and revegetation. A simple arithmetic mean of data for the Tanami from 1994 to 2005 produces images with improved colour depth and enhanced geological material discrimination that will effectively compliment the detail available in high-resolution orthophotographs (Fig. 2).

The visualization of the regolith-terrain in the Tanami using SRTM DEMs and Landsat TM^3 shows that there are numerous colluvial and sheetwash fans up to 20 km across below extensive footslopes, with obvious implications for geochemical sampling, even though the area is masked by eolian sand modified by sheetwash. These regional landform models also contribute to the development of physiographic regions and their component mapping units, which complement the regolith–landform images. A complete synthesis of the regional hierarchy for the Tanami has been completed, and more detail is being extracted from the images as the mapping progresses.

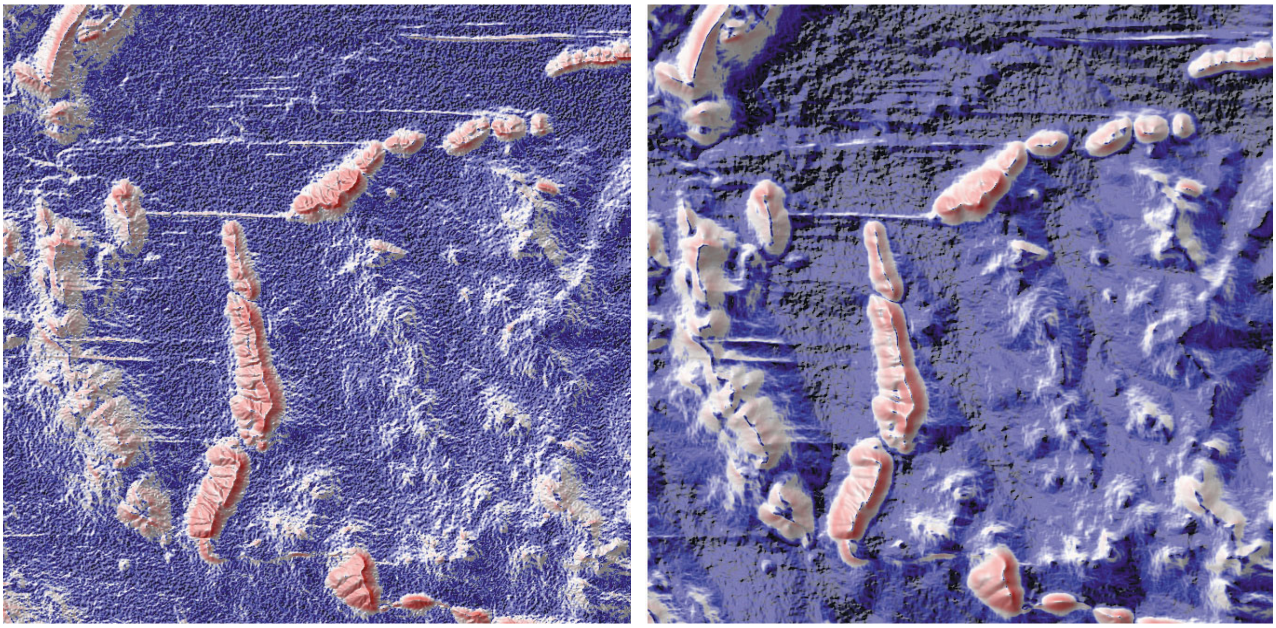

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Figure 1. **Hill-shaded slope derived from original SRTM elevation data (left) and multi-scale resampled data (right) for the BALWINA 1:100 000 map sheet. Slopes in the white areas are about 1°**

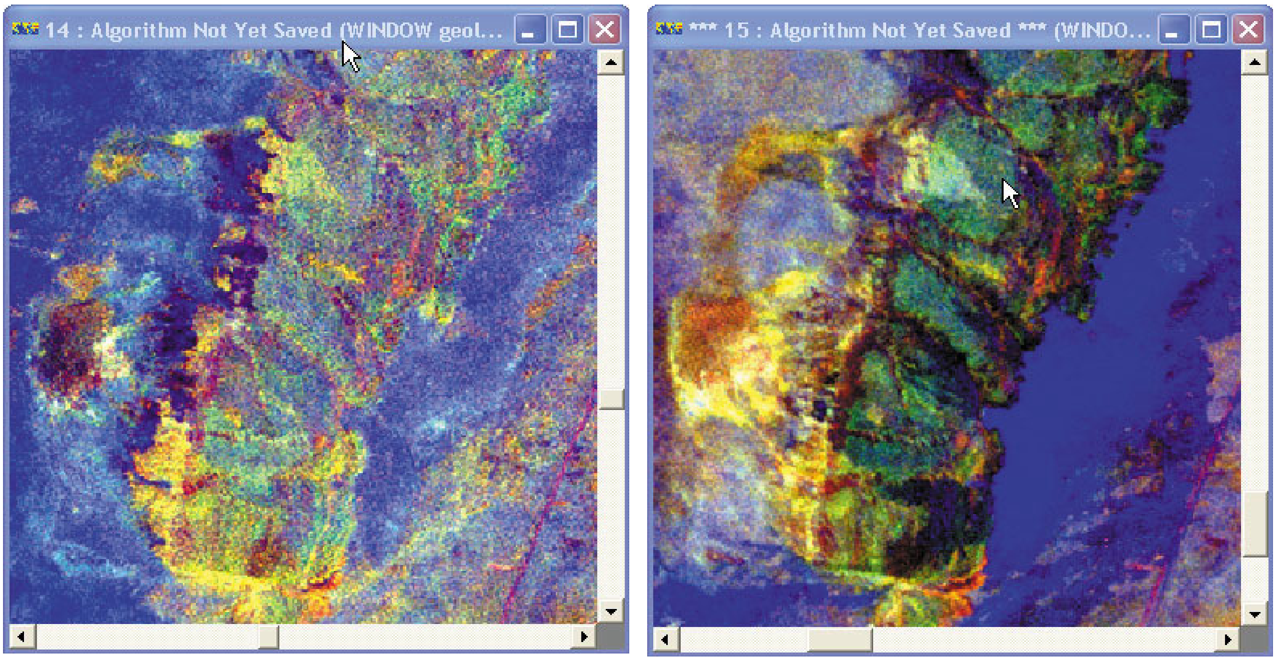

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Figure 2. **Landsat TM ratios 5/7, 4/7, 4/2 for 2005 (left) and 1994 to 2005 Temporal Merge (right). Southwest corner of the BALWINA 1:100 000 map sheet, north of Balgo**