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Terrain clearance variation during aeromagnetic surveys in areas of rugged topography

by R. G. Richardson

Abstract

The recent Department of Mines aeromagnetic survey of the Mangana–Alberton area is a good example of surveying in an area of rugged topography. The area was flown using a fixed-wing aircraft, and the terrain clearance varied from 38 m to 858 m, with a mean terrain clearance of 243 metres. By combining the terrain clearance with a digital terrain model it is possible to calculate the barometric altitude of the aircraft. Positioning errors and errors in the terrain model are then revealed as areas of unrealistic climb or descent slopes.

INTRODUCTION

The 1989 Mangana–Alberton aeromagnetic survey was in an area of widely varying relief (altitude 209 to 1398 m, with an average of 664 m) and included spectacular near-vertical cliffs and deeply incised valleys. A digital terrain model from the Australian Survey and Land Information Group was obtained through the Tasmanian Department of Lands, Parks and Wildlife and, combined with the elevations of gravity stations in the area, represented the topographic base.

The terrain clearance and topographic data were gridded using the GPC package from Exploration Computer Services (modules GPCGRL, GPCTRI, and GPTRGR), and the topographic data were filtered with a 450 m radius Gaussian filter. The barometric altitude was obtained by adding the topographic and terrain clearance data.

RESULTS

Perhaps the most obvious result is that in areas of rugged topography the nominal terrain clearance and actual terrain clearance may have little similarity. In the Mangana–Alberton area the nominal terrain clearance was 150 m compared with the actual clearance range of 38 to 858 metres. Most of the small 'bulls-eye' anomalies on the terrain clearance plot (fig. 1) lie over deeply incised valleys in the topography (fig. 2) but several lie to one side or other of a valley and indicate positioning errors. The digital terrain model (fig. 3) shows some minor inadequacies when compared to the topographic map but is, overall, a good representation.

The barometric altitude (fig. 4), computed by adding the terrain clearance and the digital terrain model, shows a number of 'bulls-eyes' and other imperfections related to the gridding and navigation processes. As there are constraints on the climb and descent angle of fixed-wing aircraft, areas where the horizontal derivative of the barometric altitude exceeds practical limits may be located and, with suitable techniques, corrected. The Mangana–Alberton survey was flown with east-west flight lines 500 m apart and then gridded with a 150 m mesh. Filtering along the flight line direction with a 1500 m E-W, 150 m N-S Gaussian filter (fig. 5) and a 1500 m E-W, 150 m N-S second-order least squares polynomial filter (fig. 6) removed most of the steeper along-line gradients, and would, if required, allow calculation of a terrain clearance grid for use with later continuations. The 'bulls-eye' at 576 000 mE, 5 397 000 mN on Figure 5 corresponds to a positioning error in the data, with the maximum terrain clearance plotted over a ridge to the west of a deep valley.

CONCLUSIONS

Interpretation of aeromagnetic surveys requires an accurate knowledge of the aircraft terrain clearance. In areas of rugged terrain and with dense vegetation the radar altimeter may be a poor record of actual terrain clearance. In such cases a calculated barometric altitude produced as described above may be corrected, and a more accurate terrain clearance then calculated.

In most combined aeromagnetic-radiometric surveys barometric pressure, and sometimes air temperature, is also recorded. If survey procedures were modified to include overflying a suitable area of known height at least once every two hours it would then be easy to calculate barometric altitude.

A check of the radar altimeter terrain clearance could then be made using the observed barometric altitude and a digital terrain model. A terrain clearance could also be obtained for areas where the radar altimeter was off scale.

[20 October 1989]

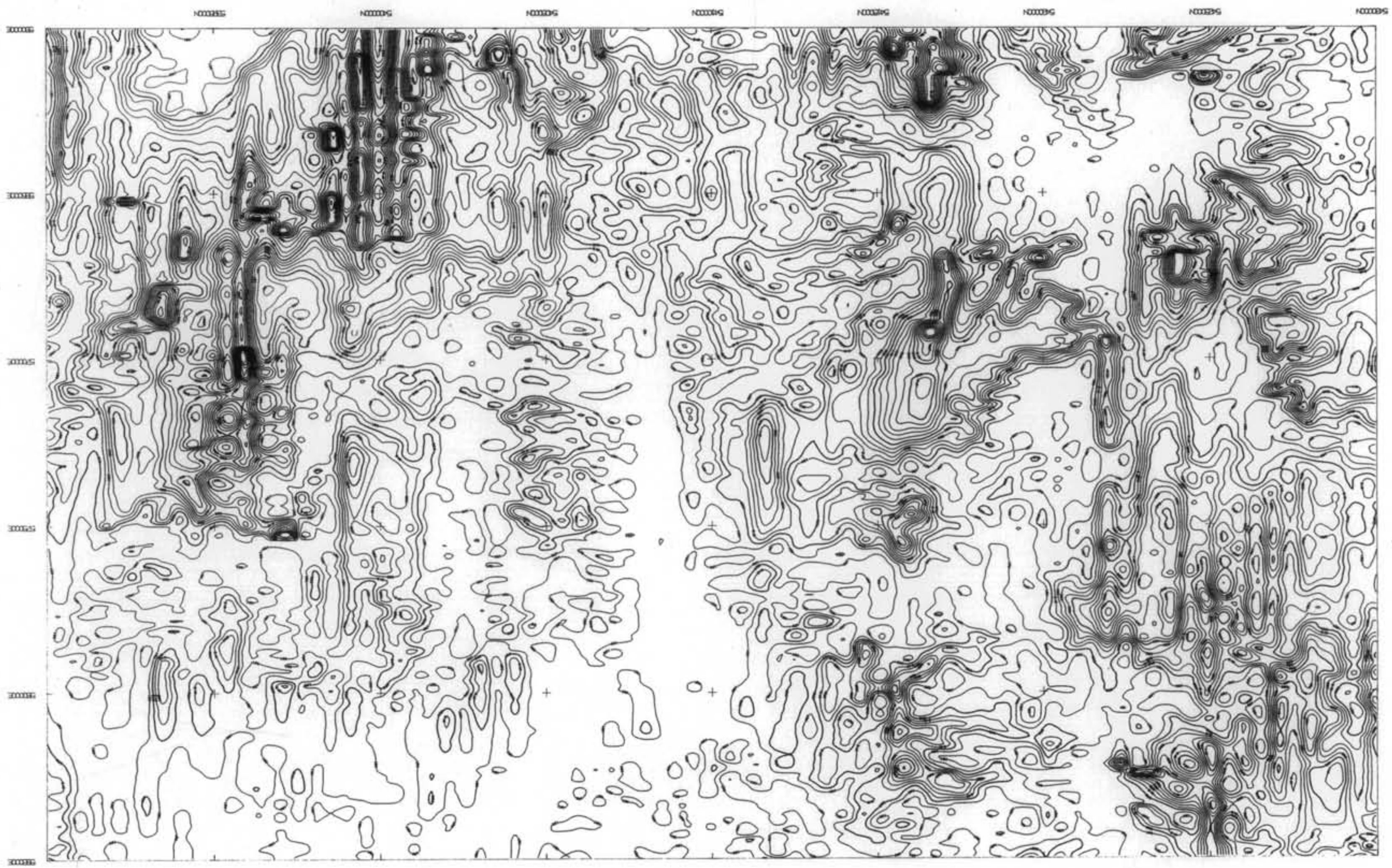


Figure 1. Terrain clearance (m)

5 cm

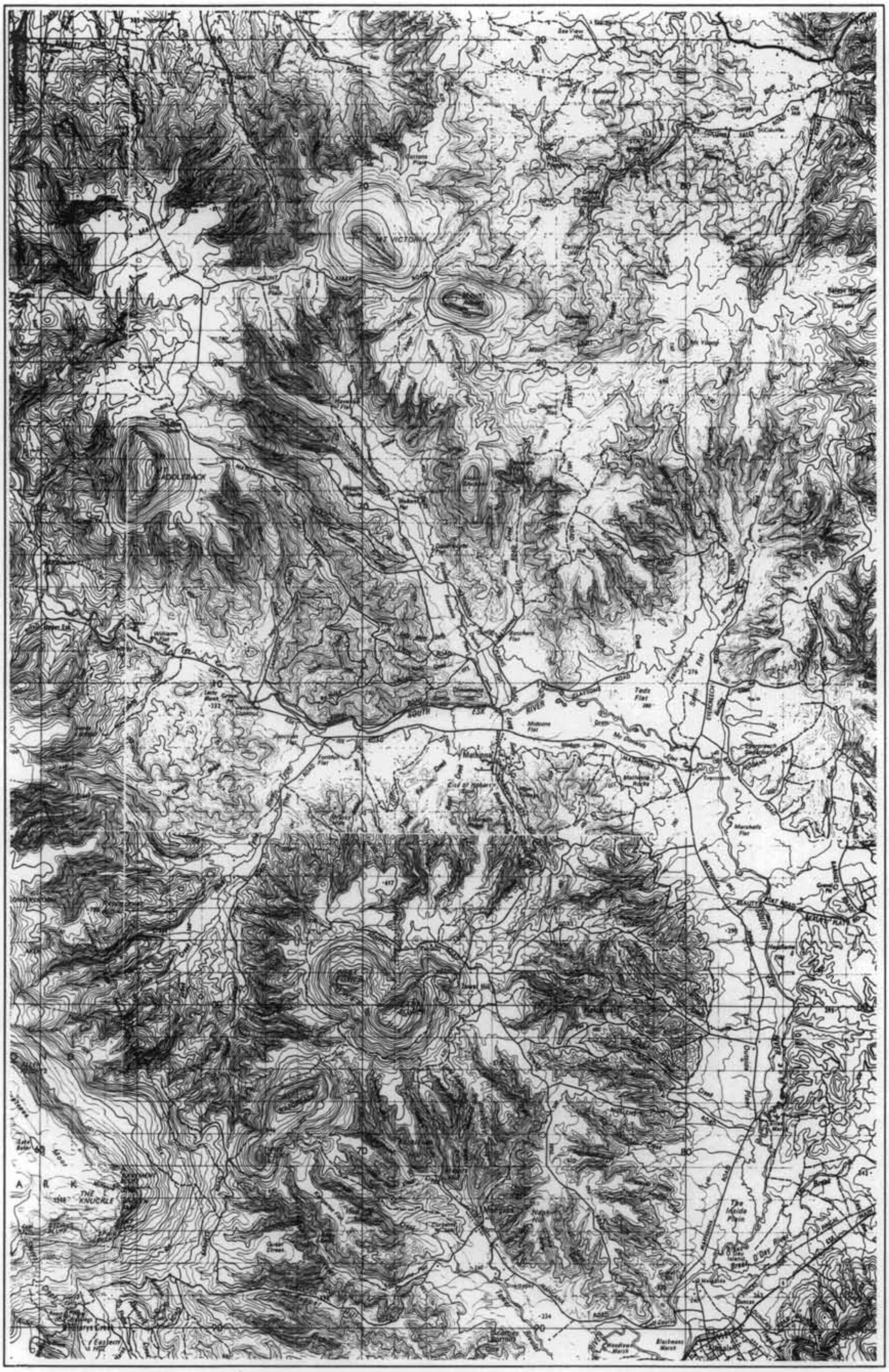


Figure 2. Topographic map

5 cm

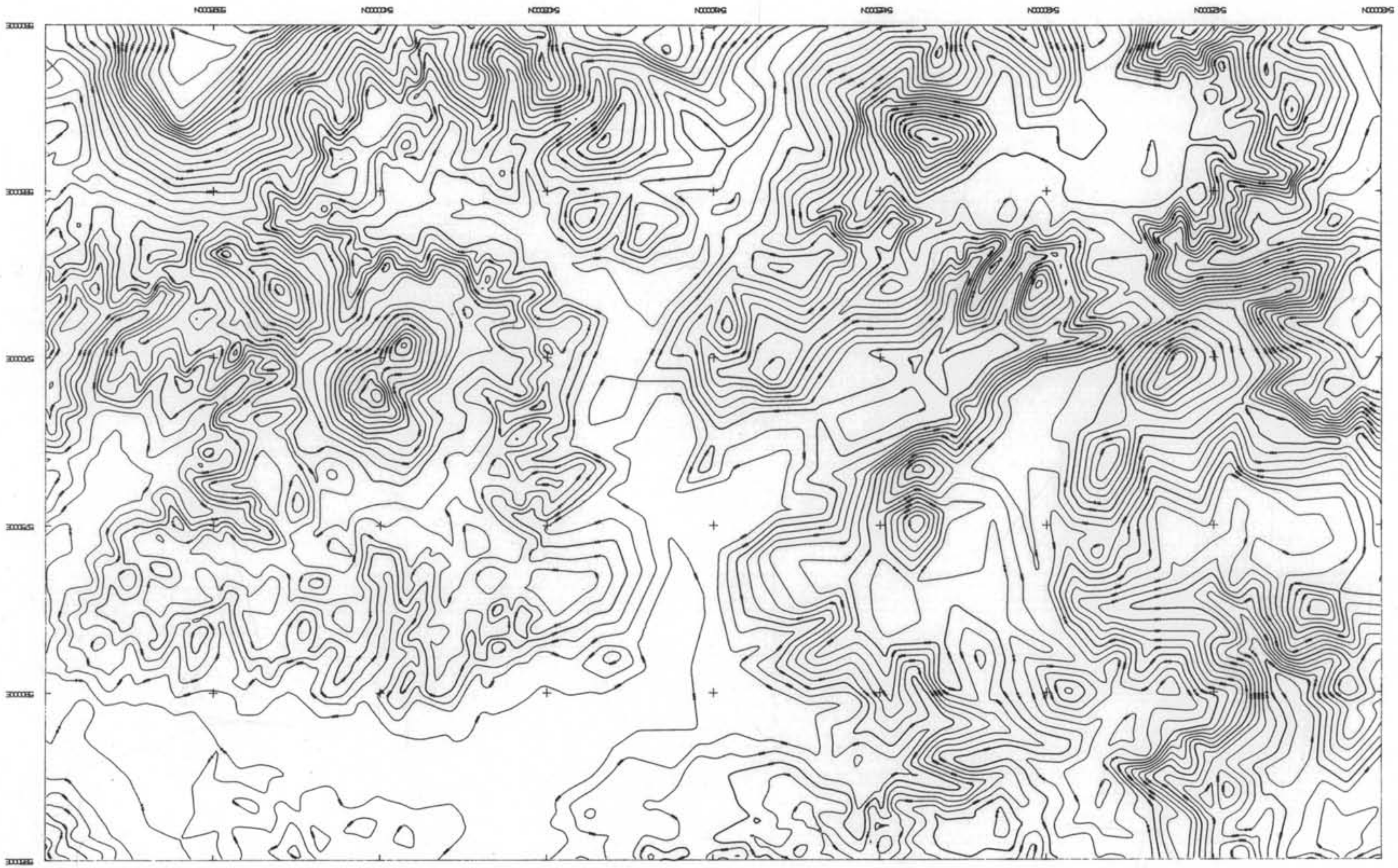
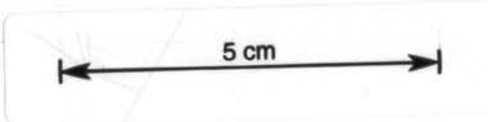


Figure 3. Digital terrain model (filtered with a 450 m radius Gaussian filter)



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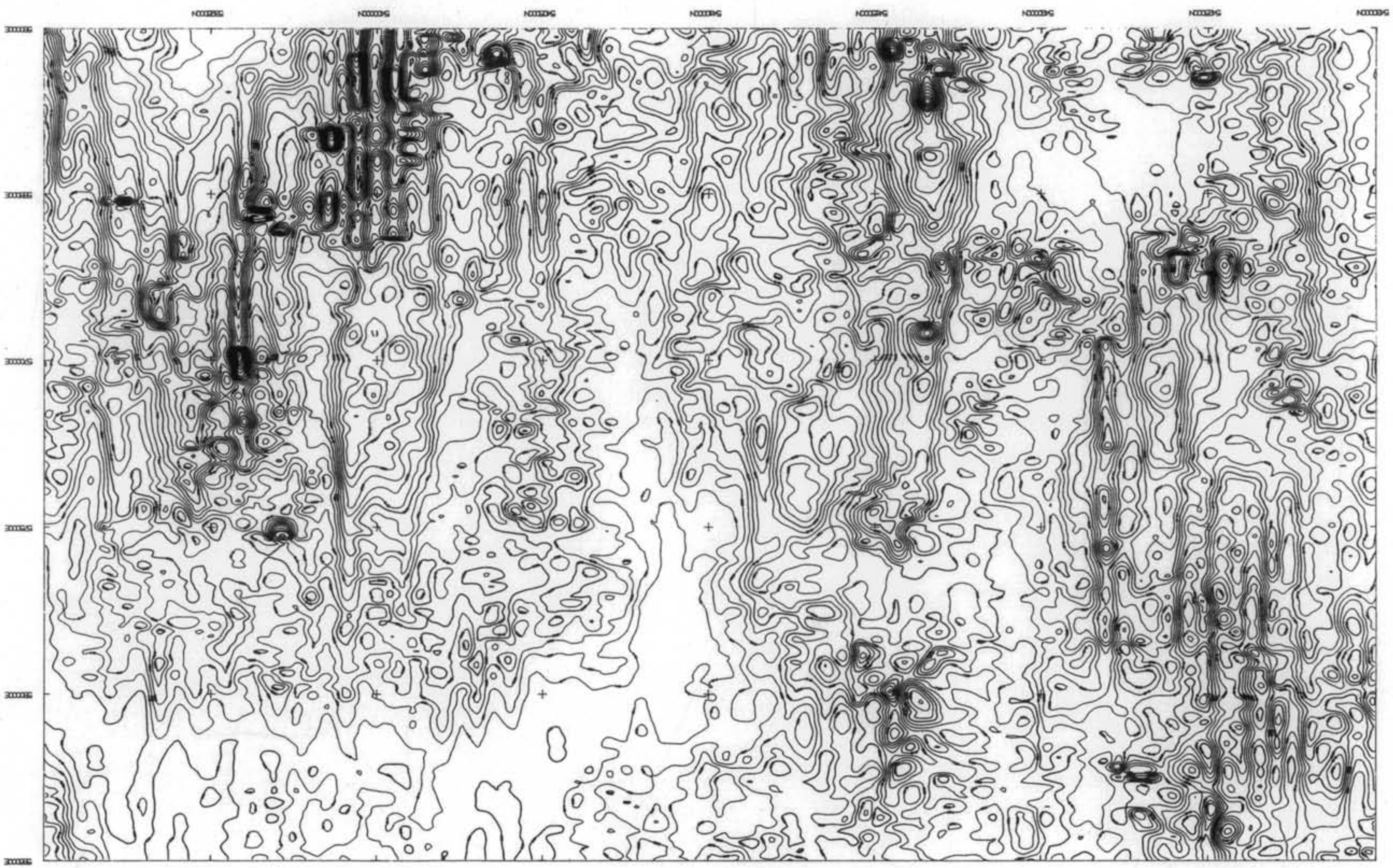


Figure 4. Barometric altitude (m) derived by summing the terrain clearance and the digital terrain model

5 cm

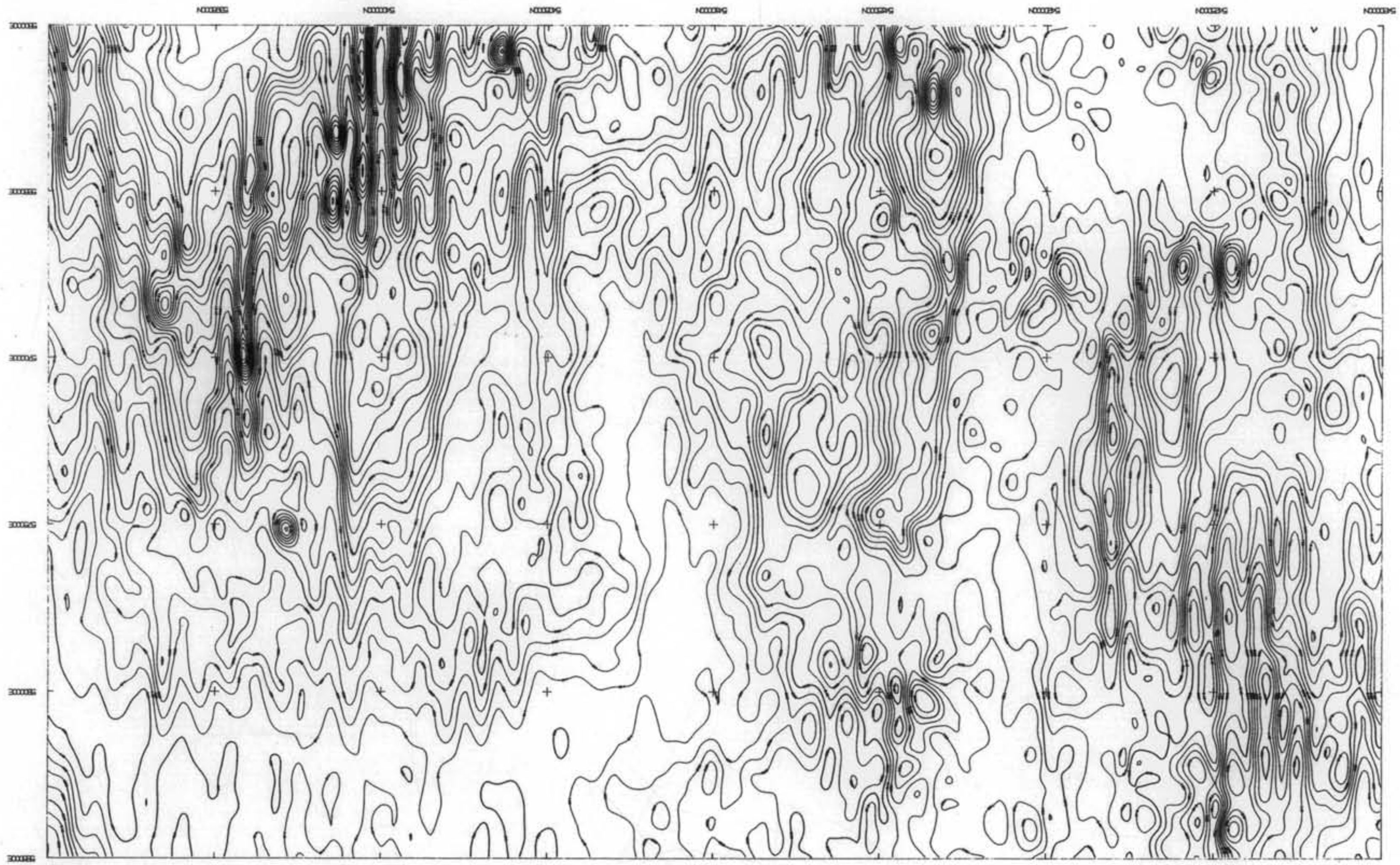
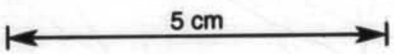


Figure 5. Barometric altitude (m) (filtered with a 1500 m E-W, 150 m N-S Gaussian filter)



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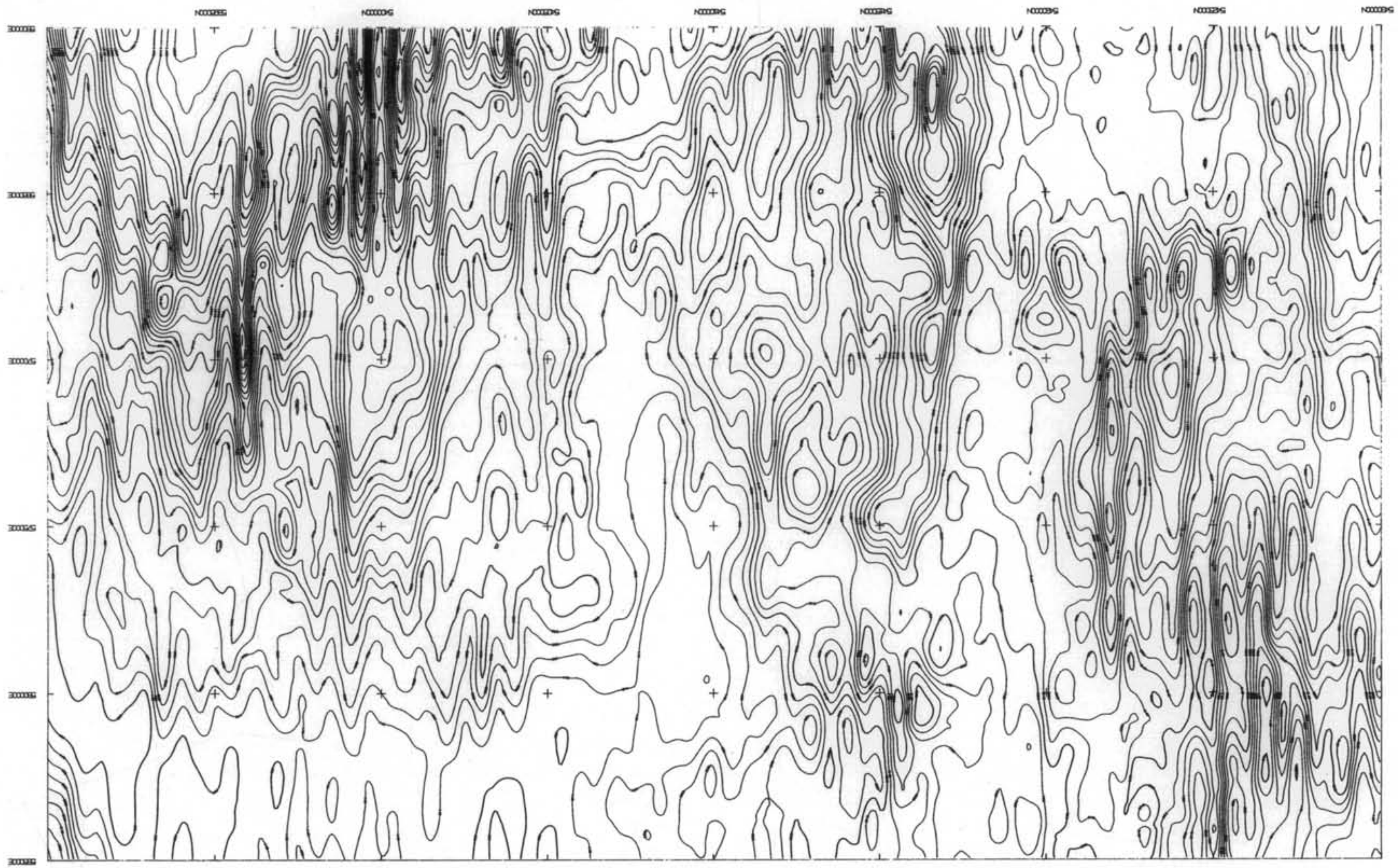
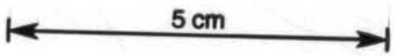


Figure 6. Barometric altitude (m) (filtered with a 1500 m E-W, 150 m N-S second-order least squares polynominal filter).



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