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SEEKING HISTORICAL GROUND DEFORMATIONS FROM ARCHIVAL AERIAL PHOTOGRAPHY

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1. BACKGROUND

The detection of ground subsidence due to the longwall method of underground coal mining.

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Figure 1

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2. OPTIONS FOR DEFORMATION DETECTION

Archival photography can be used to assess the subsidence trough in when other subsidence data does not exist.

DEMs created from aerial photography enable change in surface shape to be detected by a simple comparison of topographies.

Here: the digital elevation models from the same areas are placed only approximately in the same datum - then compared by a surface matching technique.

Surface matching rotates and re-positions one surface relative to another, until surface separations are minimised.

This avoids expensive control.

Residual differences between the two aligned DEMs can be examined to see whether any ground subsidence is apparent.

Need to consider differences between DEMS:

* Noise: image matching in DEM creation.
* Changes in vegetation and cultural features, especially roads and buildings in mining site, (and errors in matching over water.)
* Subsidence, may be small, like noise. Subsidence is presumably regionalised, not randomly distributed.

Noise is estimated by matching two elevation models created from different stereo-pairs from the same era.

Change due to the vegetation, building and the water bodies may be studied by examining them in conjunction with features which are visible on the aerial photography.

3. CASE STUDY

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Aerial photography for 1981, 1990 and 1996 exists for the area of the mine.

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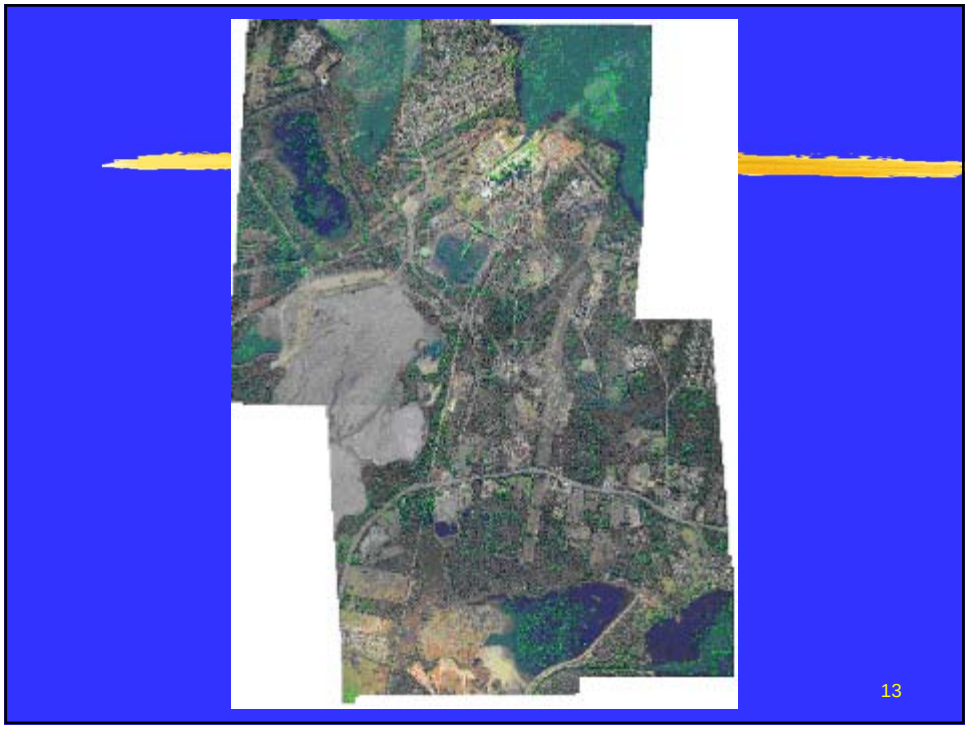
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4. RESULTS

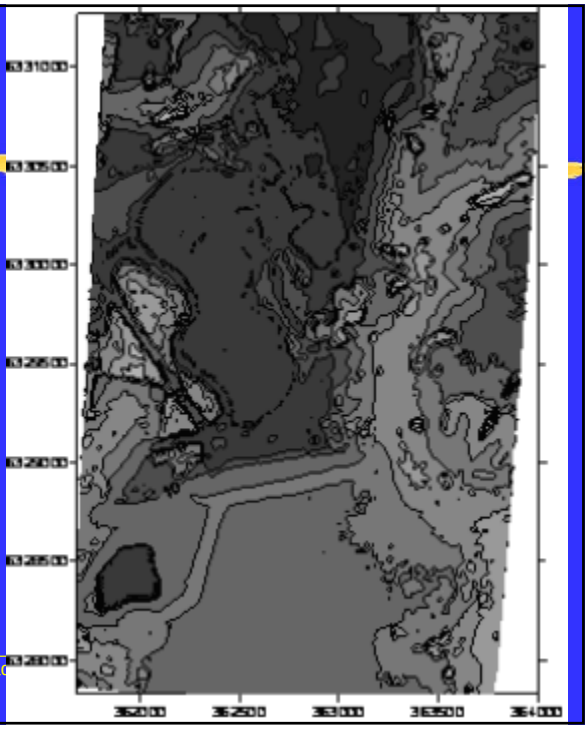
Noise:

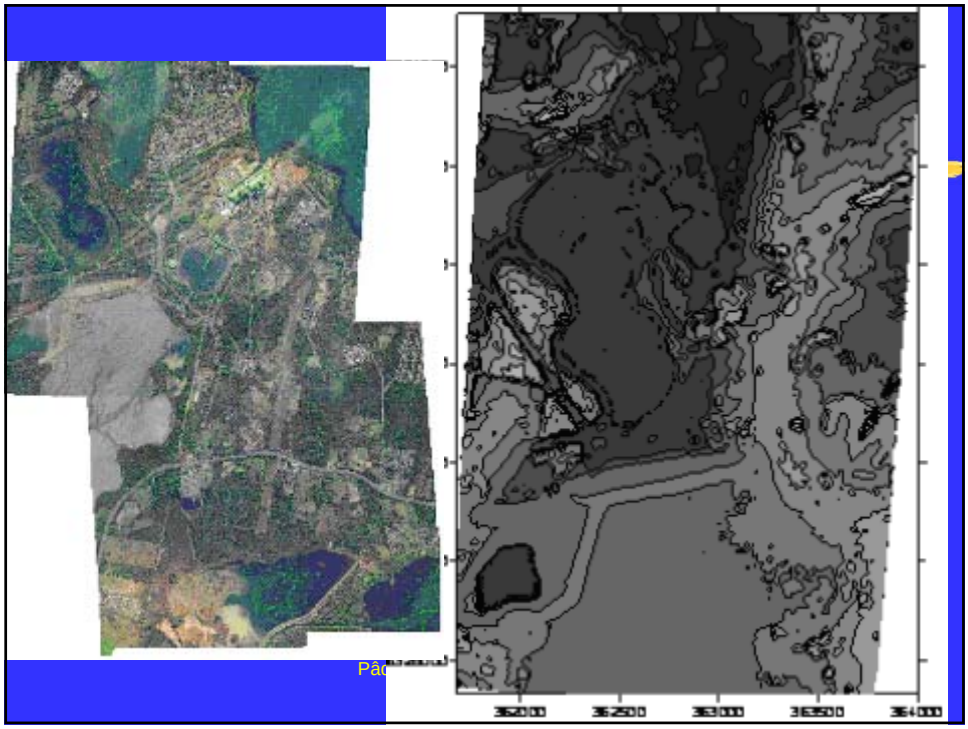
Noise is estimated by matching two elevation models created from different stereo-pairs from the same era.

1996 photos only: 2 different stereo-pairs in one strip.

DEM from one pair of photographs,

5m contours





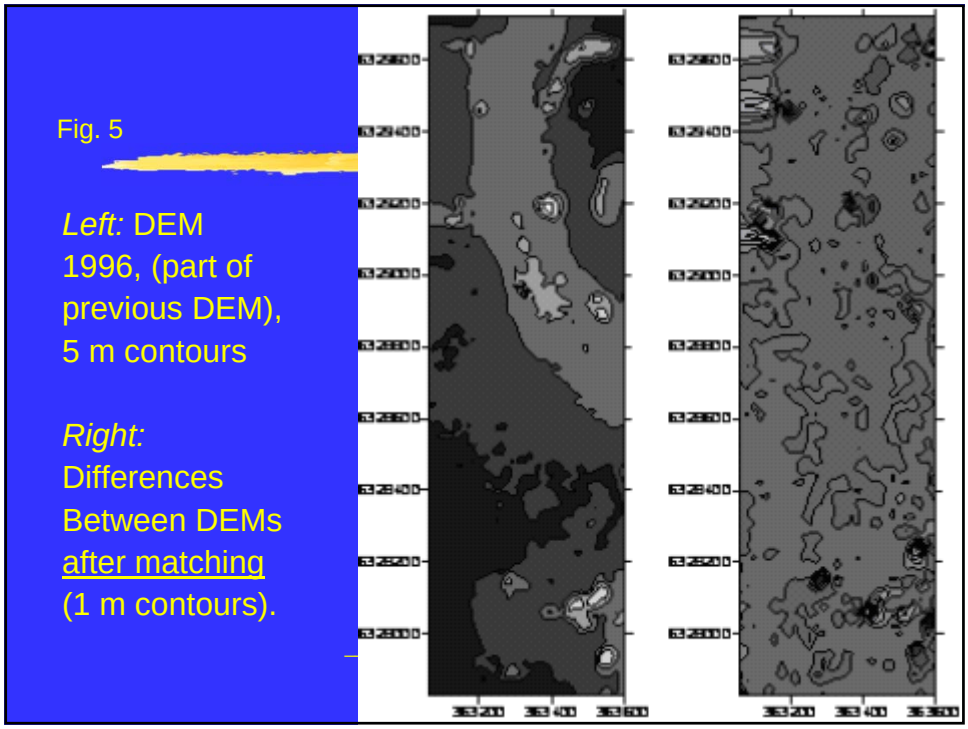


Fig. 5

Left: DEM 1996, (part of previous DEM), 5 m contours

Right: Differences Between DEMs after matching (1 m contours).

4. RESULTS

Subsidence: 1990 versus 1996

If the precision for the DEM matching from different epochs is greater than the noise, it will indicate significant differences between the DEMs, perhaps due to subsidence, but also perhaps due to the vegetation and cultural changes.

DEMS: 1990 versus 1996

Figure 6

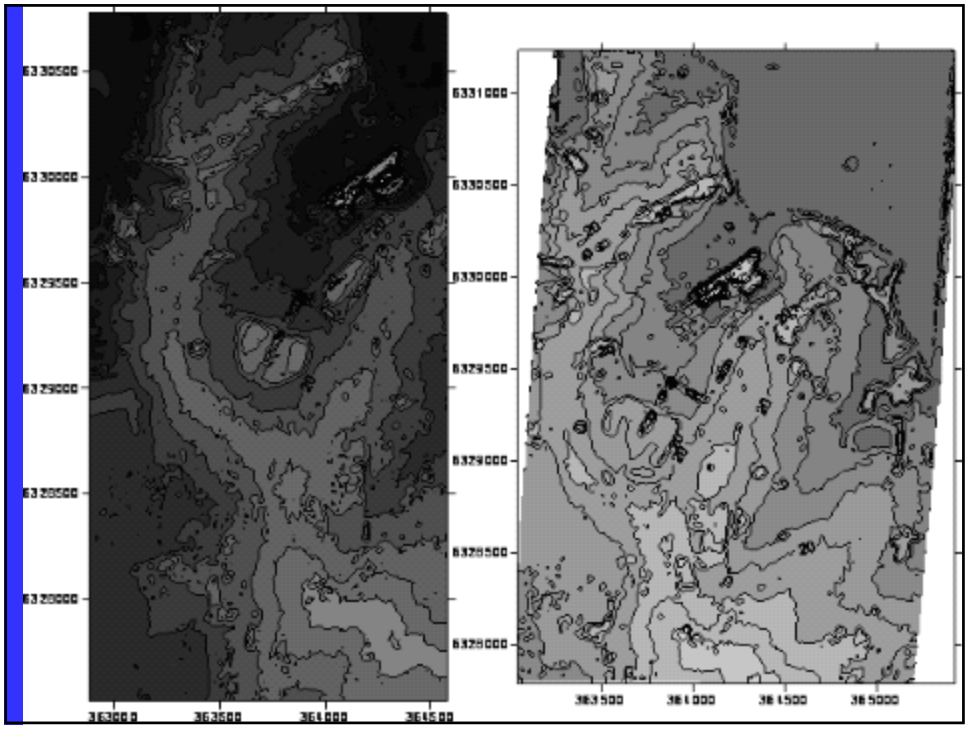
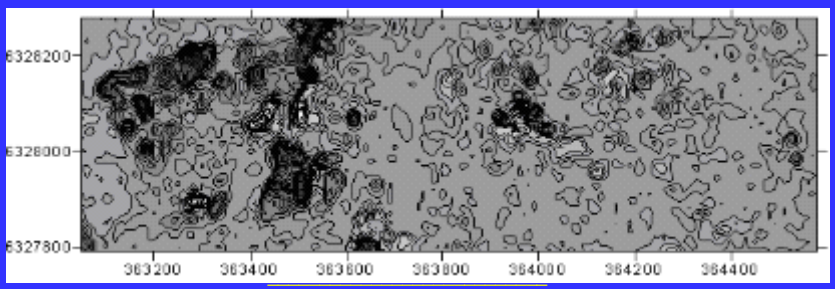


Figure 8

The differences between the two DEMs after matching with 1 m contours:



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6. CONCLUSIONS

Comparing surfaces without using control is a novel approach. Surface matching has been cheap and simple means of examining aerial photographs for the detection of subsidence. In the case reported here, subsidence has not been detected, and this justifies the low cost approach. The technique is more important than the result. Continued development is seen as worthwhile.

The End