GPS Surveys within Falls Creek: Implementation and Processing for Aerial Photography

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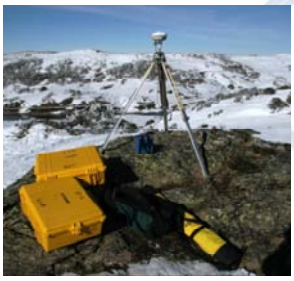
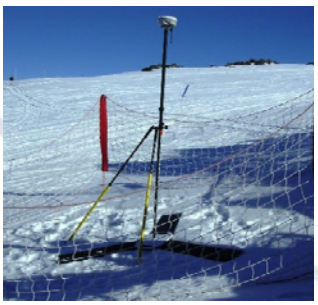
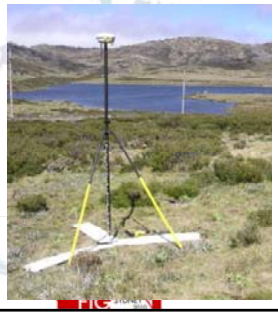
Introduction

- Aim
- Methods
- Results
- Conclusions







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Aim

- Establish survey control in a remote area, where there is no existing control.
- Establish a framework of positional points
  - Easting and Northing MGA94 Z55 (GDA94)
  - AHD elevation
- Support digital aerial photography acquisition, via photo control targets and GPS base station.
- Desired accuracy for control marks, photo control targets
  - <0.020 m Easting and Northing
  - <0.050 m AHD

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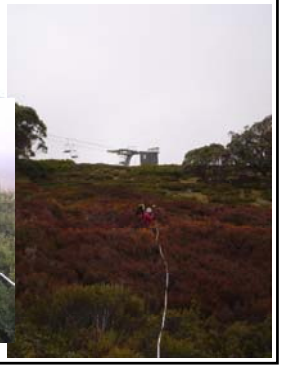
Study area

- Falls Creek, Victoria

fallscreek

Survey areas



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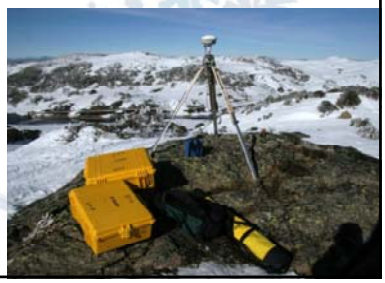
GPS surveys

- Framework of positional points
  - Small local network (static)
  - Transects (RTK GPS)
  - Photo control (rapid-static)

- Regional and National GPS networks
  - (Victoria) GPSnet
  - (National) AUSPOS



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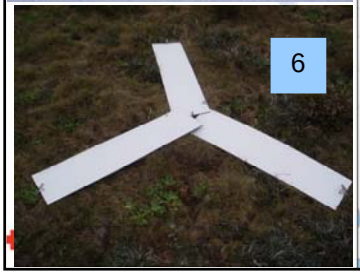
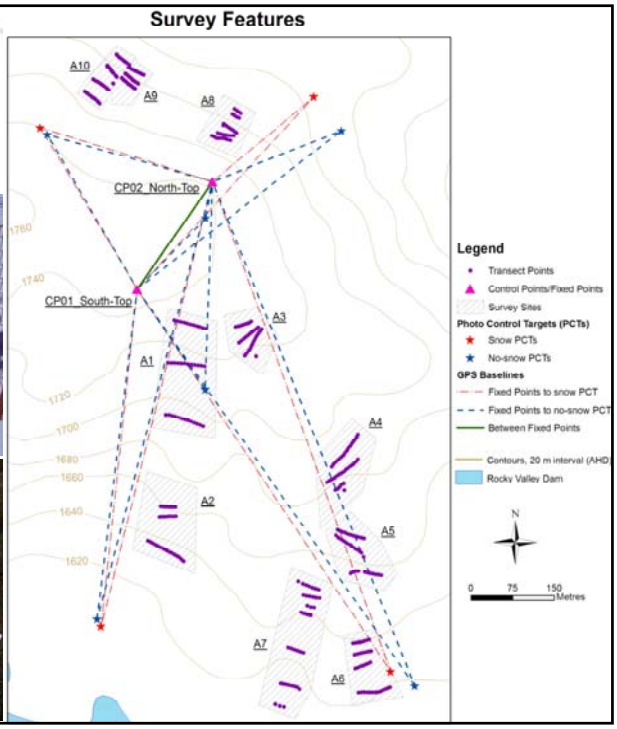
GPS surveys

- Photo Control





GPS surveys and snow aerial photography

- Ground support
  - Photo control targets
  - GPS base station
- Concurrent RTK GPS survey with image acquisition
  - validation dataset for DEMs derived from snow photography
  - Transect points
    - 50% sampling regime

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GPS points

- Control marks
  - Two (base stations/fixed points)
- Snow photography
  - Four photo control targets
- No-snow photography
  - Six photo control targets
- Terrain (no-snow) transect points
  - 352
- Snow surface transect points
  - 183
  - Concurrent with snow photography acquisition

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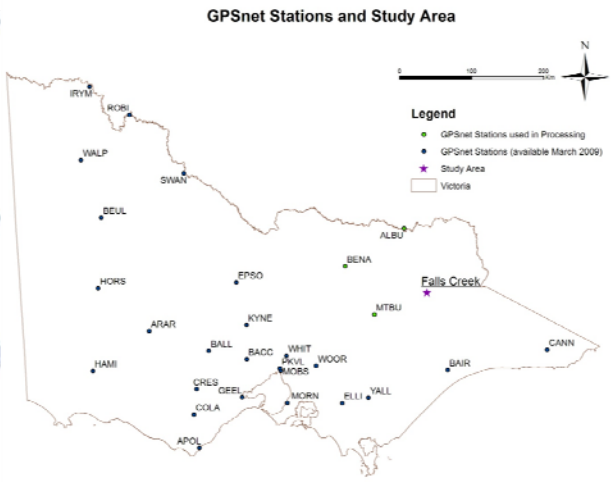
Network Adjustments

- GPSnet
  - Mount Buller
  - Benalla
  - Albury



- Used coordinates published in Penna et al. 2005, best available at the time of processing
- Obtain the best possible coordinates for control marks

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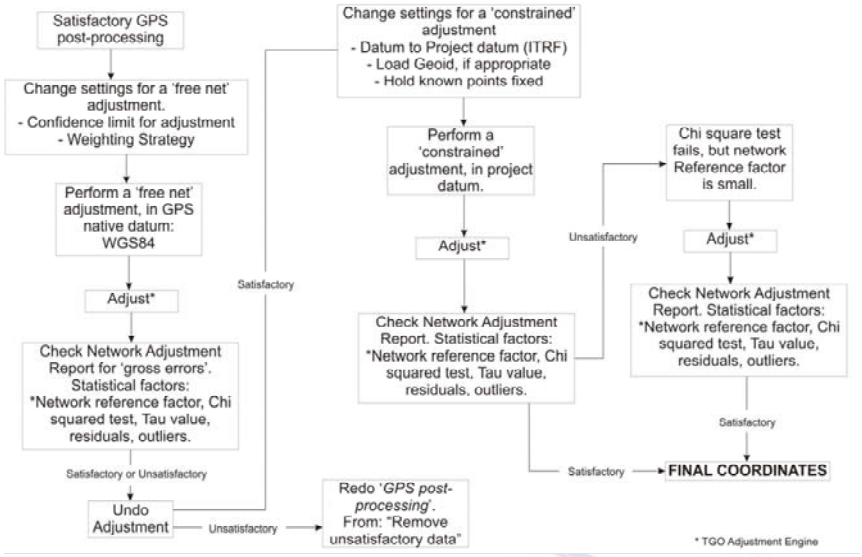
Network Adjustment procedure



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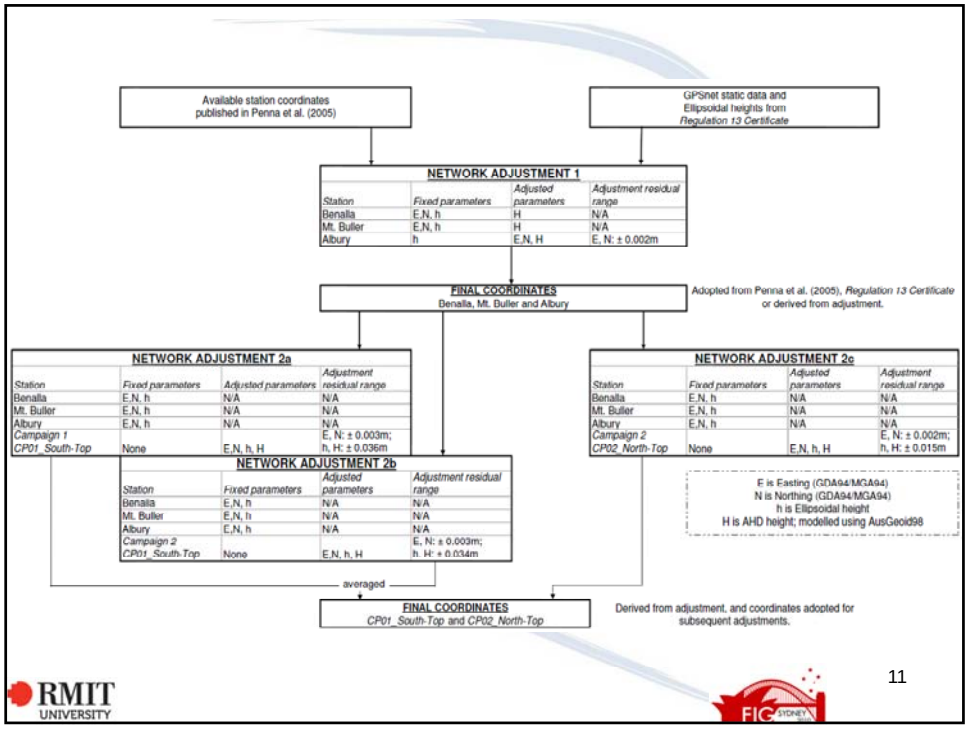
Available station coordinates published in Penna et al. (2005)
GPSnet static data and Ellipsoidal heights from Regulation 13 Certificate
NETWORK ADJUSTMENT 1
Station | Fixed parameters | Adjusted parameters | Adjustment residual range
Benalla | E,N, h | H | N/A
Mt. Buller | E,N, h | H | N/A
Albury | h | E,N, H | E, N: ± 0.002m
FINAL COORDINATES
Benalla, Mt. Buller and Albury
Adopted from Penna et al. (2005), Regulation 13 Certificate or derived from adjustment.
NETWORK ADJUSTMENT 2a
Station | Fixed parameters | Adjusted parameters | Adjustment residual range
Benalla | E,N, h | N/A | N/A
Mt. Buller | E,N, h | N/A | N/A
Albury | E,N, h | N/A | N/A
Campaign 1 CP01_South-Top | None | E,N, h, H | E, N: ± 0.003m; h, H: ± 0.036m
NETWORK ADJUSTMENT 2b
Station | Fixed parameters | Adjusted parameters | Adjustment residual range
Benalla | E,N, h | N/A | N/A
Mt. Buller | E,N, h | N/A | N/A
Albury | E,N, h | N/A | N/A
Campaign 2 CP01_South-Top | None | E,N, h, H | E, N: ± 0.003m; h, H: ± 0.034m
NETWORK ADJUSTMENT 2c
Station | Fixed parameters | Adjusted parameters | Adjustment residual range
Benalla | E,N, h | N/A | N/A
Mt. Buller | E,N, h | N/A | N/A
Albury | E,N, h | N/A | N/A
Campaign 2 CP02_North-Top | None | E,N, h, H | E, N: ± 0.002m; h, H: ± 0.015m
E is Easting (GDA94/MGA94)
N is Northing (GDA94/MGA94)
h is Ellipsoidal height
H is AHD height; modelled using AusGeoid98
averaged
FINAL COORDINATES
CP01_South-Top and CP02_North-Top
Derived from adjustment, and coordinates adopted for subsequent adjustments.
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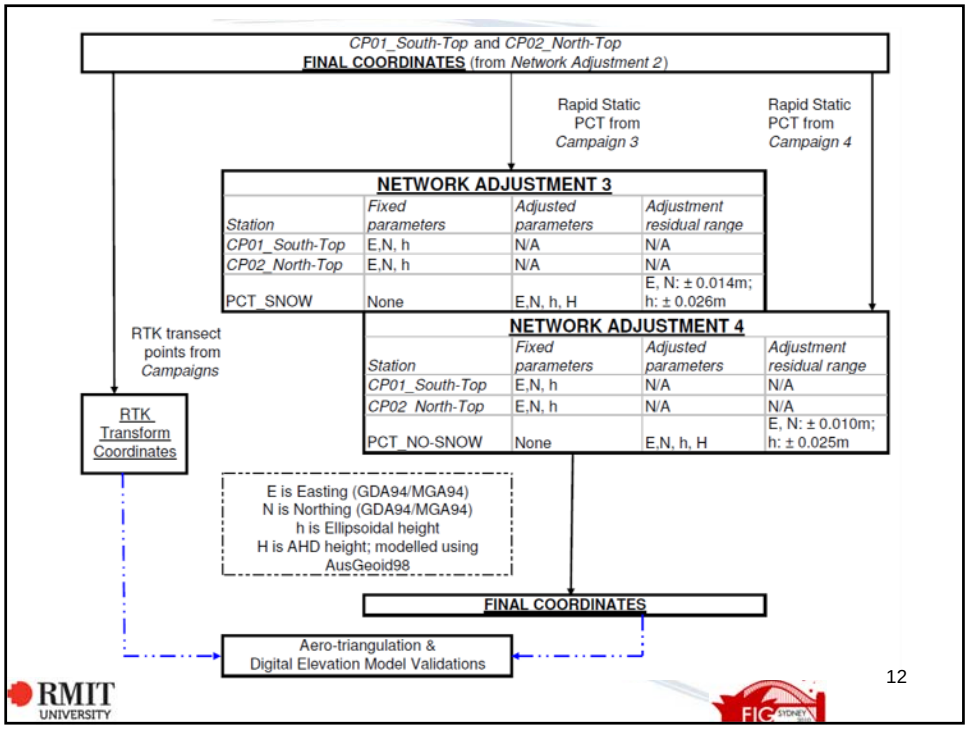
CP01_South-Top and CP02_North-Top
FINAL COORDINATES (from Network Adjustment 2)
Rapid Static PCT from Campaign 3
Rapid Static PCT from Campaign 4
NETWORK ADJUSTMENT 3
Station | Fixed parameters | Adjusted parameters | Adjustment residual range
CP01_South-Top | E,N, h | N/A | N/A
CP02_North-Top | E,N, h | N/A | N/A
PCT_SNOW | None | E,N, h, H | E, N: ± 0.014m; h: ± 0.026m
NETWORK ADJUSTMENT 4
Station | Fixed parameters | Adjusted parameters | Adjustment residual range
CP01_South-Top | E,N, h | N/A | N/A
CP02_North-Top | E,N, h | N/A | N/A
PCT_NO-SNOW | None | E,N, h, H | E, N: ± 0.010m; h: ± 0.025m
RTK transect points from Campaigns
RTK Transform Coordinates
E is Easting (GDA94/MGA94)
N is Northing (GDA94/MGA94)
h is Ellipsoidal height
H is AHD height; modelled using AusGeoid98
FINAL COORDINATES
Aero-triangulation & Digital Elevation Model Validations
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Results: Network Adjustments

- Easting (E) and Northing (N) , GDA94/MGA94
- AHD elevation, modelled using Ausgeoid98
- Static: Control points
  - ± 0.003 m for E&N
  - ± 0.036 m for AHD
- Rapid Static: Snow photo control targets
  - ± 0.014 m for E&N
  - ± 0.026 m for AHD
- Rapid Static: No-snow photo control targets
  - ± 0.010 m for E&N
  - ± 0.025 m for AHD

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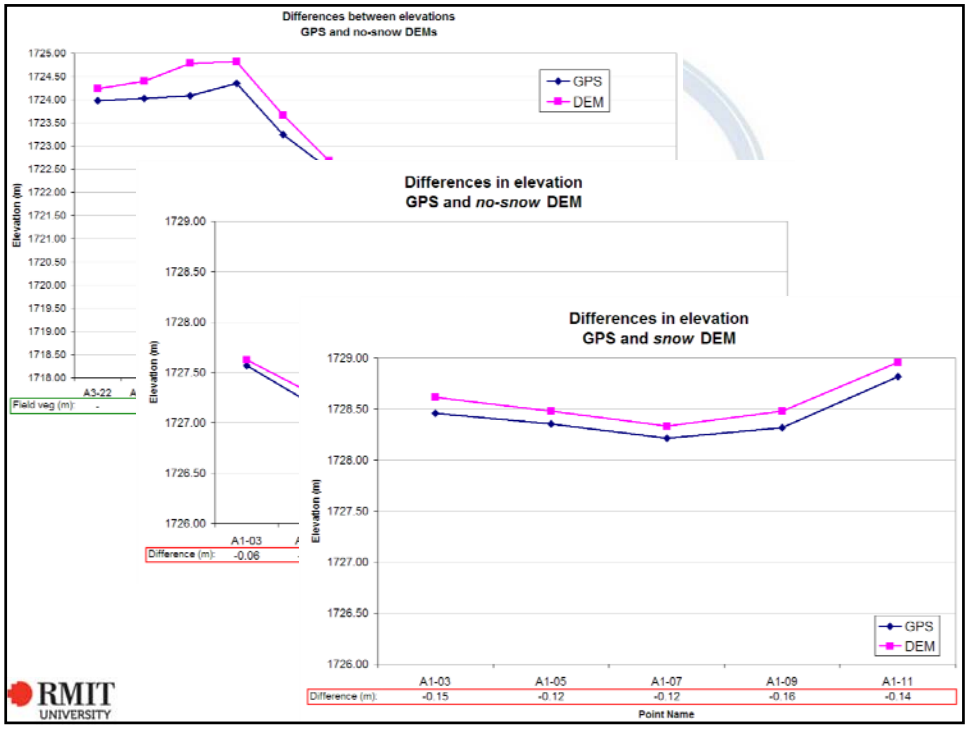
Network Adjustment results and AUSPOS

GDA94/ MGA94, Zone 55	*ΔE (m)*	*ΔN (m)*	*Δh (m)*	*ΔH (m)*	*Duration*
Benalla - AUSPOS (August 2006)	+0.004	+0.009	-0.026	-0.026	11 hrs, 900-2000. 24 August 2006, GPS Day 236
Mt. Buller - AUSPOS (August 2006)	-0.001	0.000	+0.003	+0.003	
Albury - AUSPOS (August 2006)	+0.026	-0.004	-0.011	-0.011	
***CP01_South-Top* (*Campaign 1*) AUSPOS (May 2006)**	-0.003	-0.008	+0.003	+0.003	5 hrs
***CP01_South-Top* (*Campaign 2*) AUSPOS (August 2006)**	+0.003	-0.012	-0.026	-0.026	8.5 hrs
***CP02_North-Top* (*Campaign 2*) AUSPOS (August 2006)**	+0.006	-0.016	-0.038	-0.038	7 hrs



Conclusions

- GPS technology makes it possible to establish coordinates for new survey marks in a very remote site
- GPS surveys easily satisfied accuracy requirements for photo control

Recommendation

- Utilise local base stations where possible
  - local base stations translate to shorter baseline lengths between base stations and roving receivers (for RTK GPS)
  - No reliance on an external network or base station

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Acknowledgements

1. Zhang, K., Wu, F., Liu, G., Silcock, D., Wu, S., Deakin, R., Holden, L. and Zhu, M. Global Navigation Satellite System Continuously Operating Reference Stations Network and Its Synergized Disaster Monitoring and Warning Systems for Coal Mining, DIISR International Science Linkage (ISL) Special Fund Round 8 (Project ID: CH080155)

2. Zhang, K. and Wu, F. Intelligent gas disaster early-warning, robust emergency response and rescue systems for coal mining based on geospatial information technologies, DIISR International Science Linkage (ISL) Special Fund Round 7 (Project ID: CH070130)

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Acknowledgements

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