


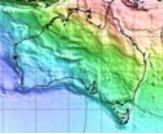
The Mystery of LiDAR Best Practice
Glenn Jones
Land and Property Management Authority

SSSI GIS in the Coastal Environment
Batemans Bay November 9, 2010

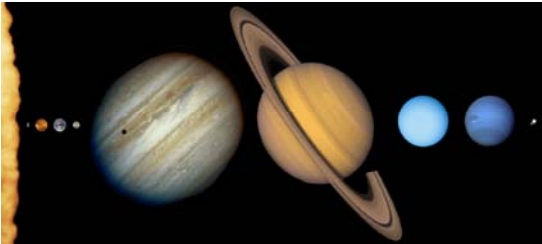
Land and Property Management Authority

LiDAR Best Practice


- Geodesy 101
 - Ellipsoid
 - AHD
 - Geoid
- Light Detection and Ranging (LiDAR)
 - Basic principles
 - Calibration
 - Accuracy
- Check Surveys
- Classification




The Big Picture



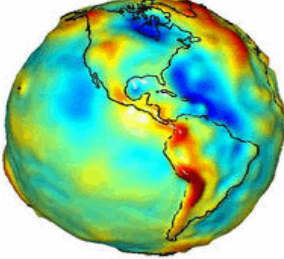
Shape of the Earth



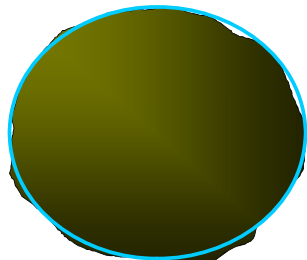
Third Rock from the Sun



Geoid



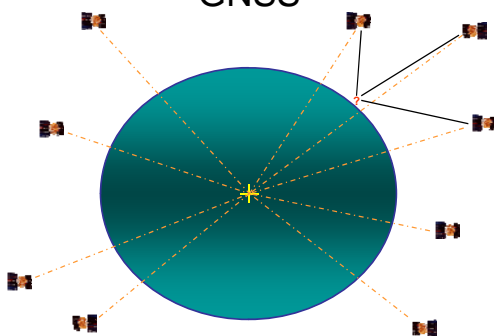
Mathematical Shape



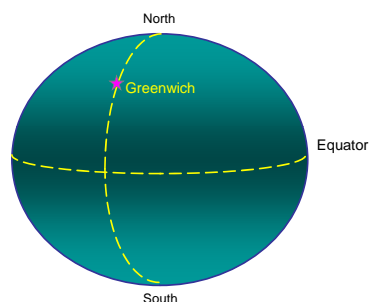
Ellipsoid



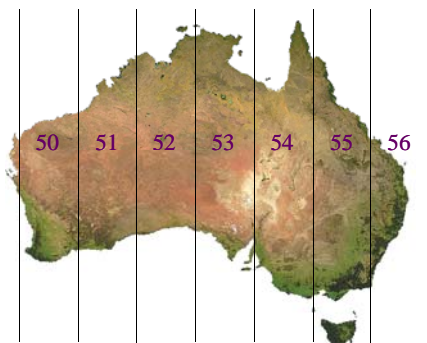
GNSS



Coordinates



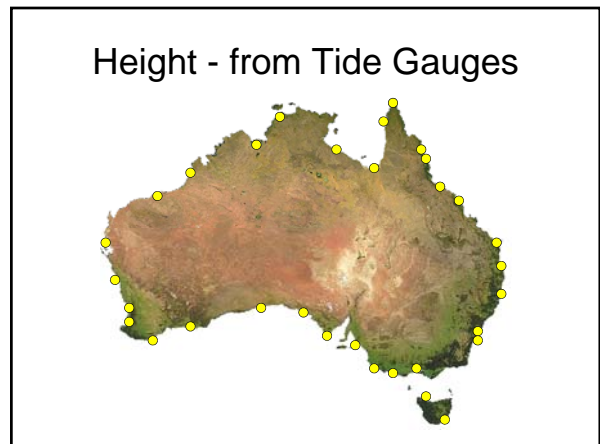
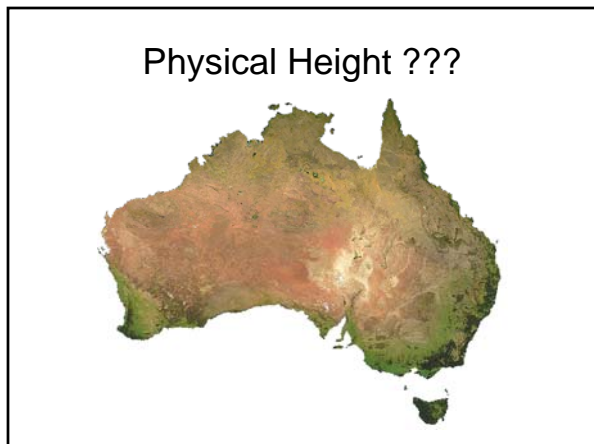
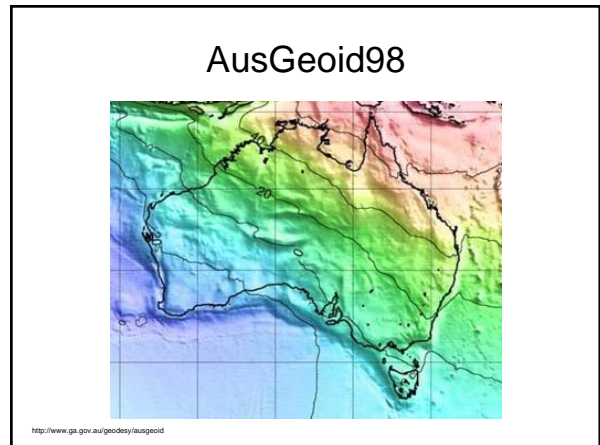
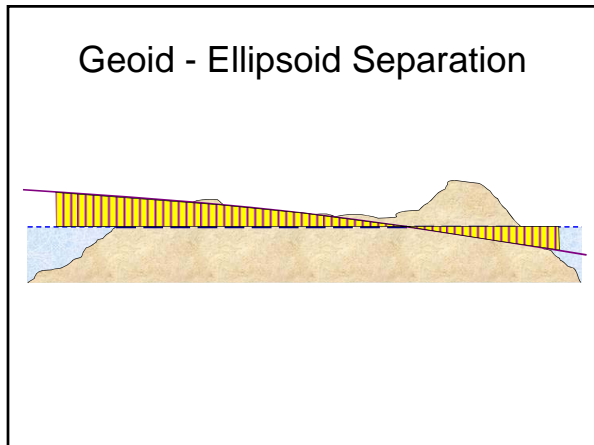
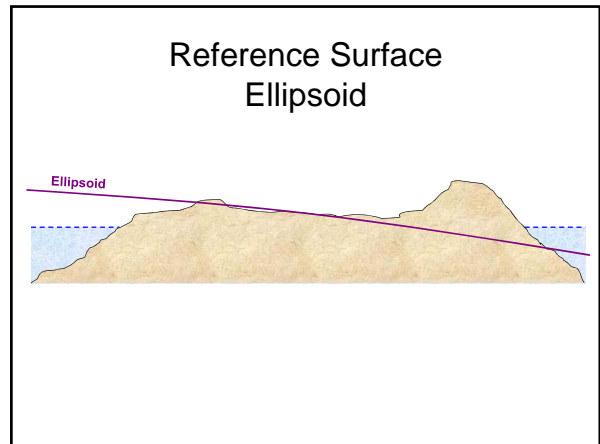
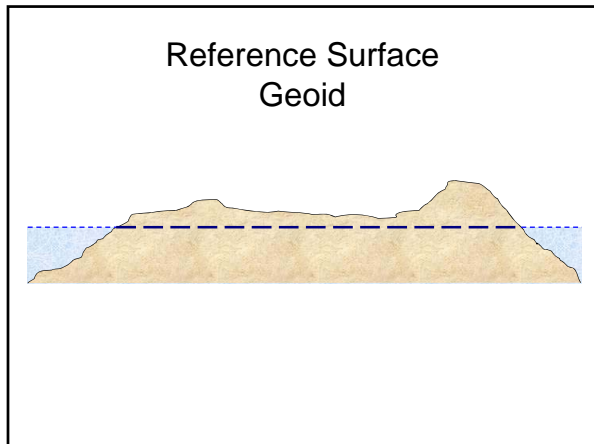
Australia - MGA

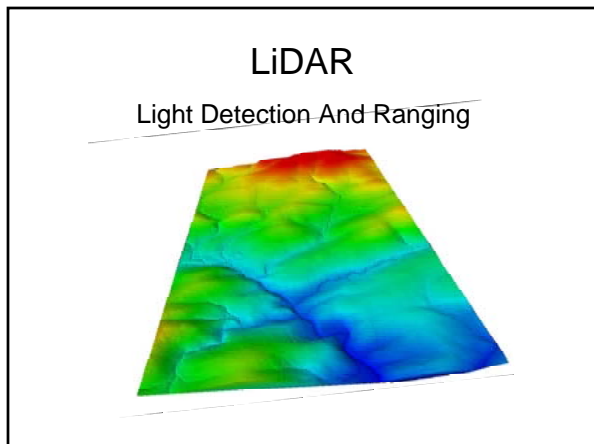
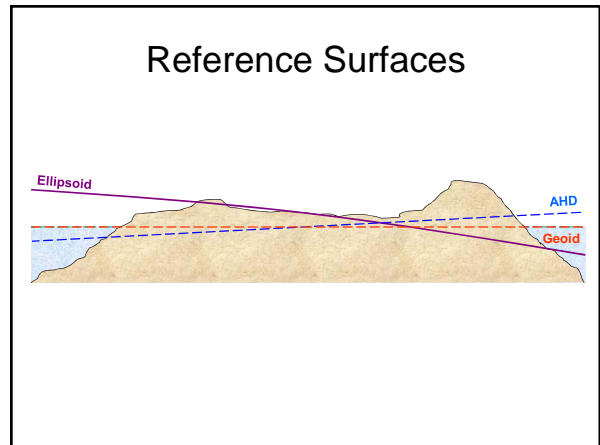
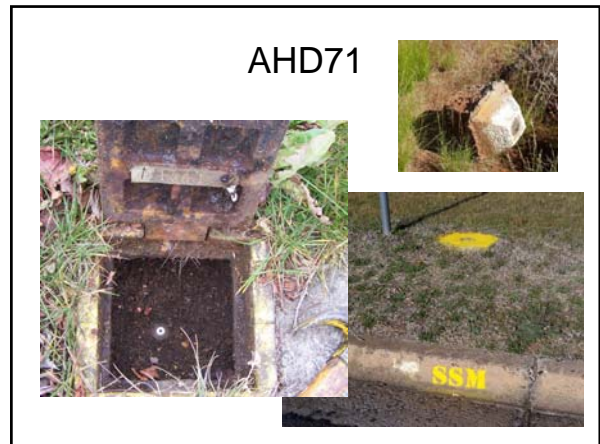
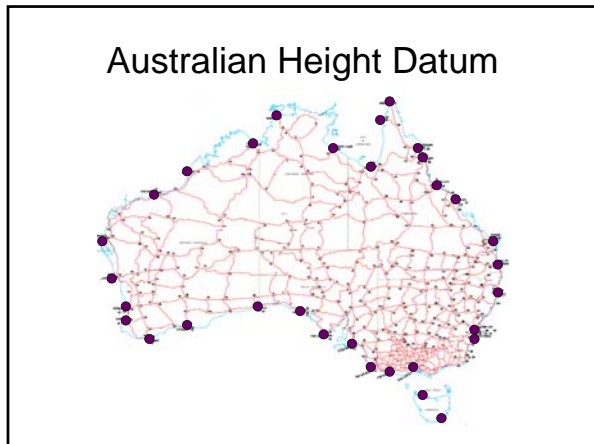


Australia Satellite Photo, Copyright 2003, United Nations Environment Programme ISBN: 92-807-2272-5.

GDA94







ALS50 LiDAR Equipment

- >Control unit & power supply
- >Laser scanner
- >Operator interfaces
- >Small format camera



Leica ALS50

Leica RCD105

Platforms

- Cessna 421 Golden Eagle & Piper Navajo

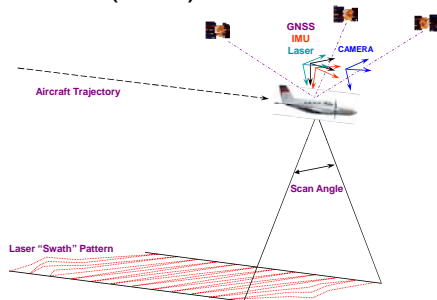


Installation

Hard-bolted to aircraft floor



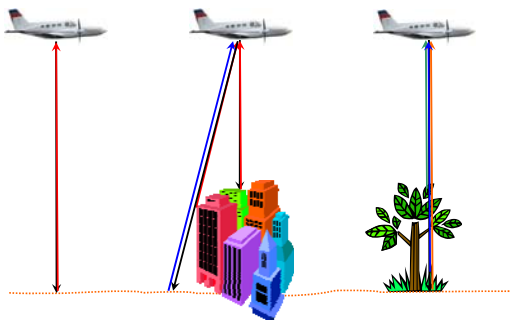
LiDAR (ALS) Fundamentals



ALS50 Capability

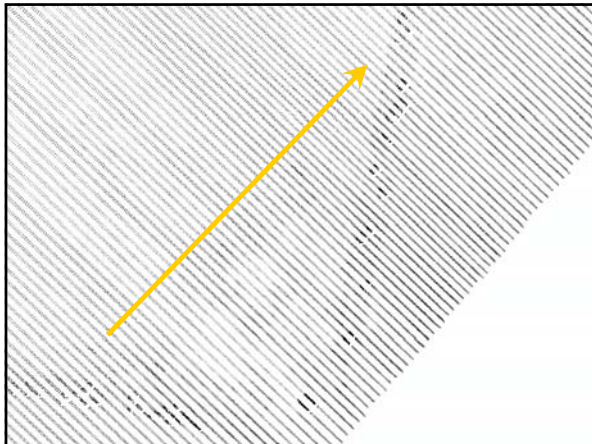
- 150,000 Hz pulse rate
- MPIA
- Multiple returns

Multiple Returns

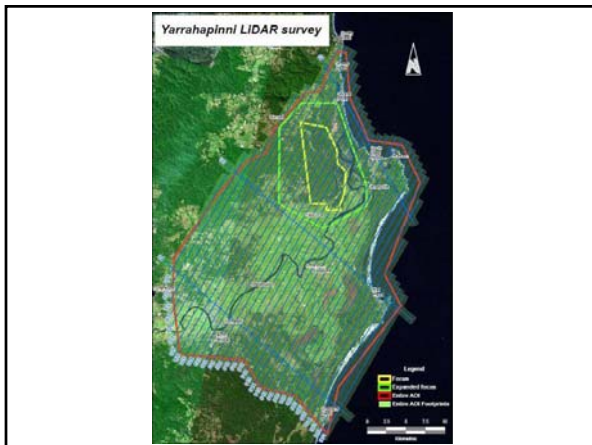


ALS50 Capability

- 150,000 Hz pulse rate
- MPIA
- Multiple returns
- Max 90 Hz scan rate
- Max 75° FOV (Camera 45°)
- 300GB storage ~17 hours data capture






Flight Planning




Reference Stations

- Required for aircraft GNSS positioning – differential correction
- Possible to use multiple reference stations


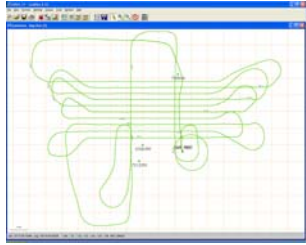
Sensor Trajectory

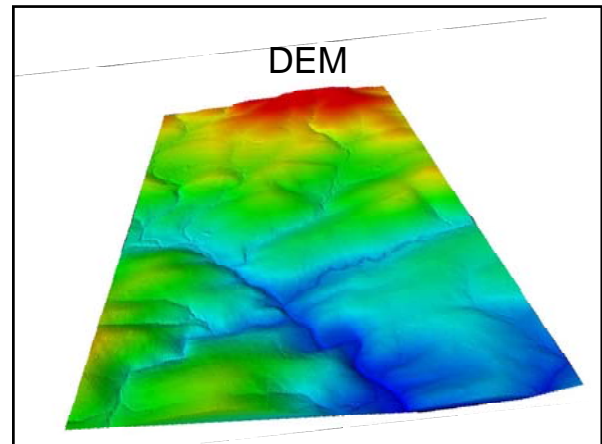
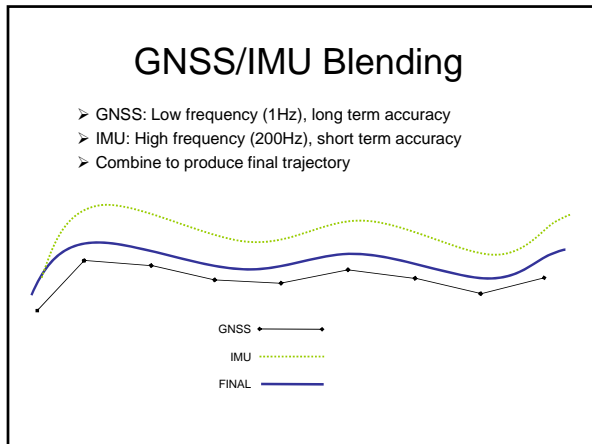


- Aircraft position & attitude at any given time
- Trajectory = GNSS+Inertial
- LiDAR is directly geo-referenced to the trajectory
- Error in trajectory = Error in data!

Kinematic GNSS

- Import into GrafNav:
 - Reference station data and coordinates
 - Aircraft (remote) GNSS data
- Solve for fixed ambiguity solution
 - Baseline length?
 - Ion model?



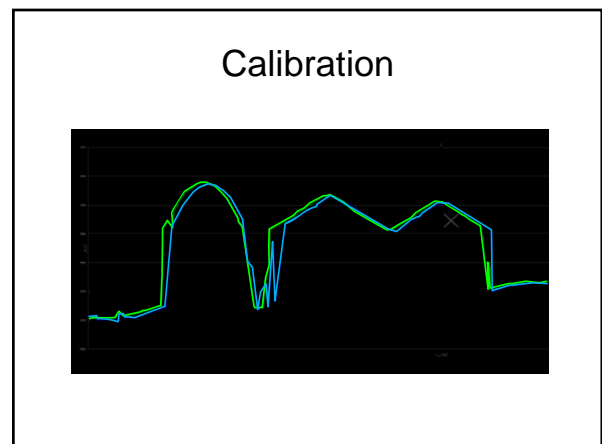
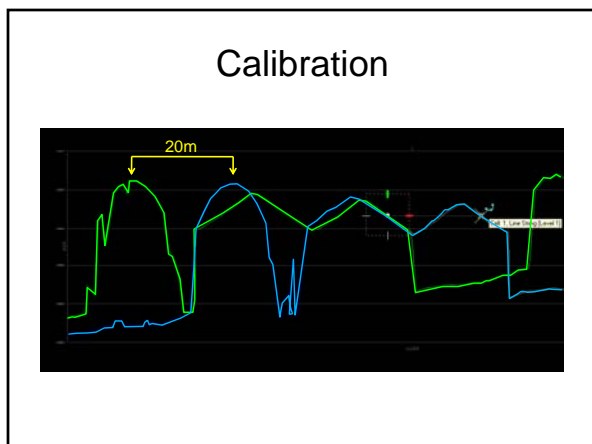
Calibration (Boresight)

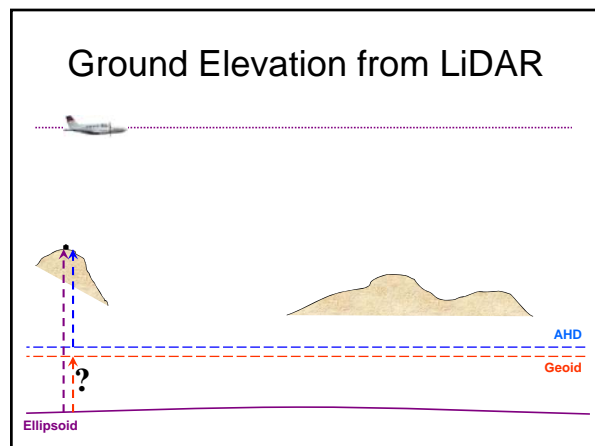
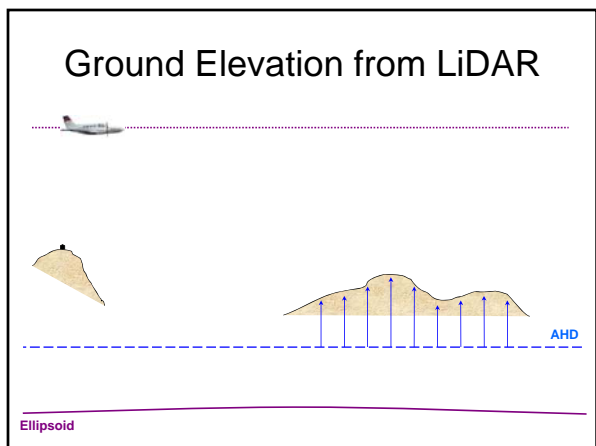
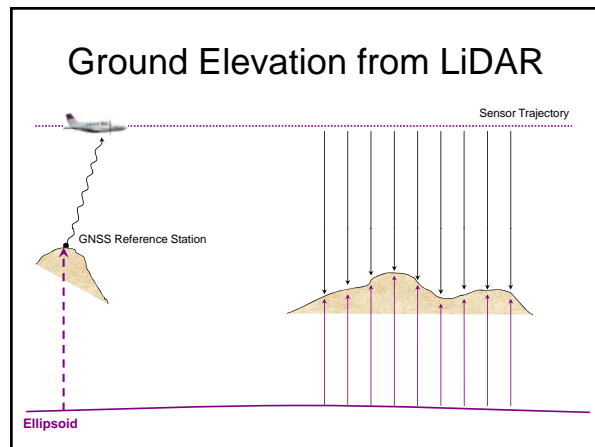
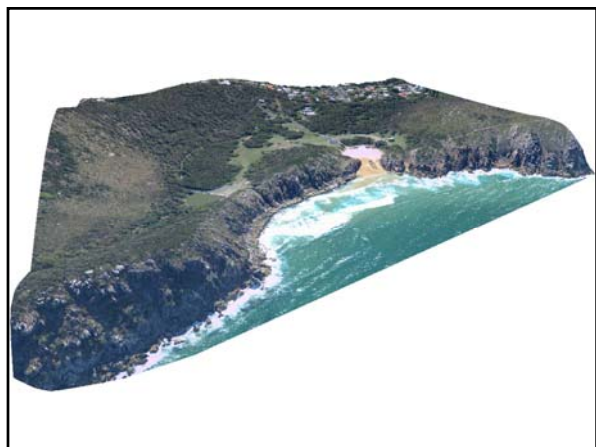
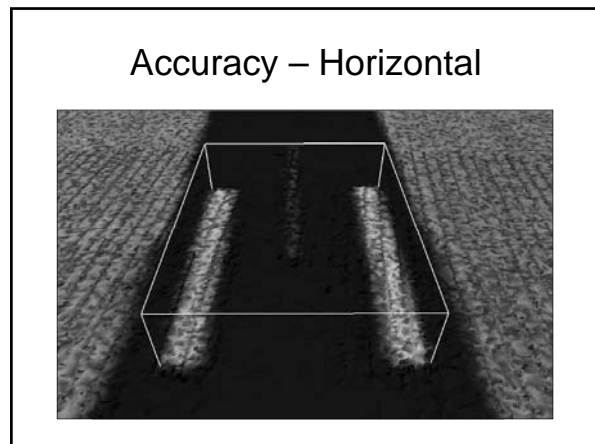
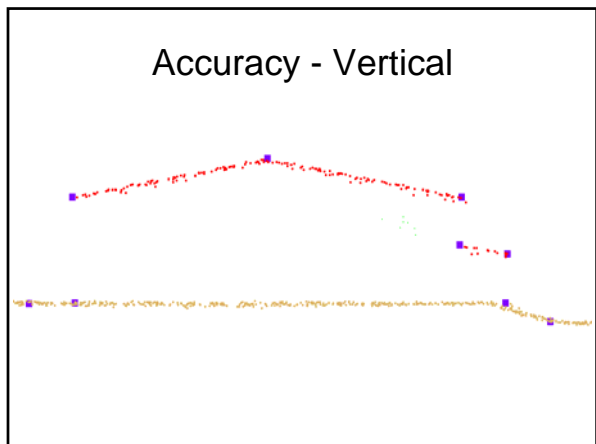
Parameters to solve:

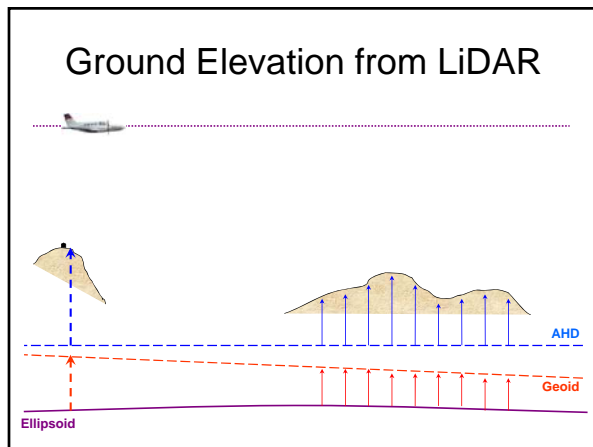
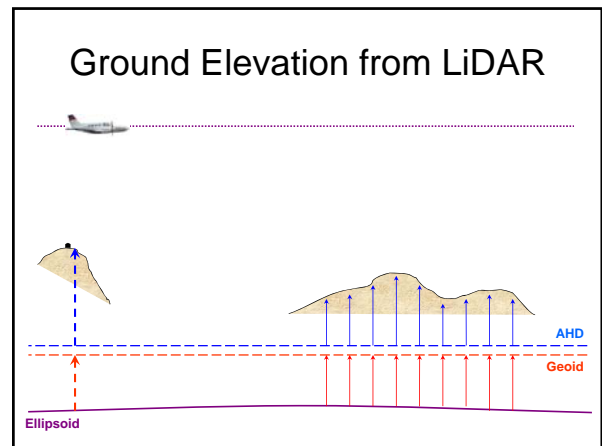
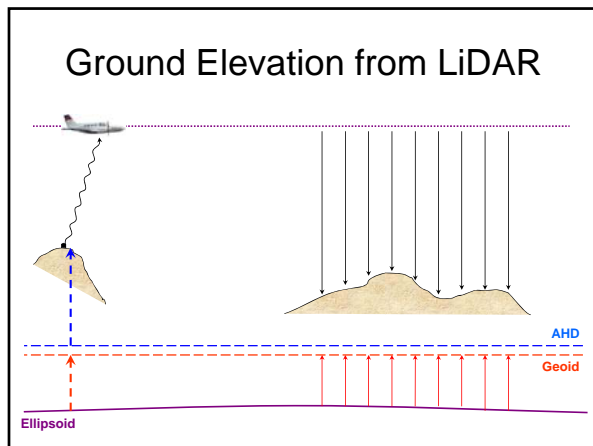
- IMU misalignment (roll, pitch & heading)
- “Lever Arms”
- Encoder latency
- Scan angle correction
- Torsion
- Pitch error slope
- Range delay

Calibration – Ground Survey

Established new survey control at Bathurst Airport







Ground check points

➤ Methods to check LiDAR data against ground control

A 10x10 grid of black squares, representing a regular pattern of ground check points used for validating LiDAR data.



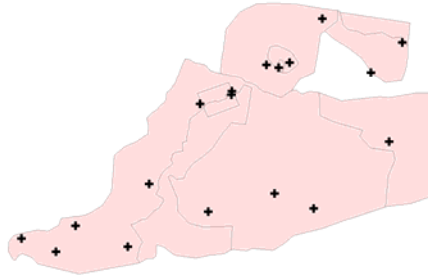
Ground check points

➤ Methods to check LiDAR data against ground control

A 10x10 grid of black squares, representing a regular pattern of ground check points. A large red 'X' is drawn over the grid, indicating that this method is not recommended.

QA - Check points

➤ Check point sites spread across the survey



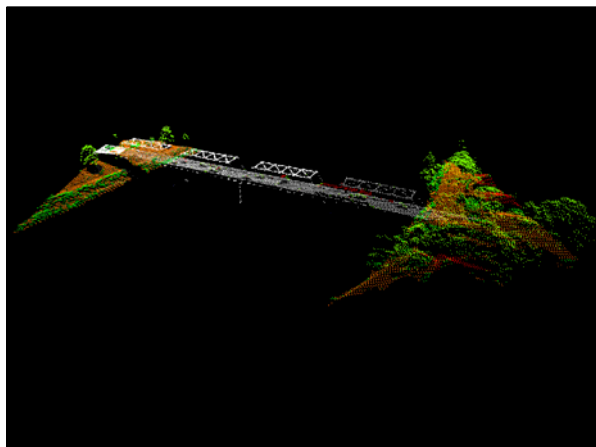
LiDAR Checkpoint



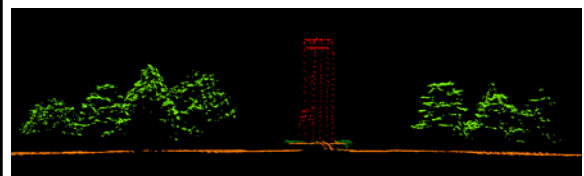
Levelling



GPS Heighting

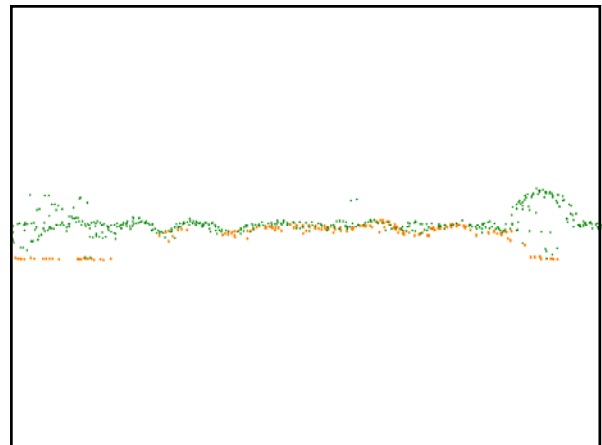
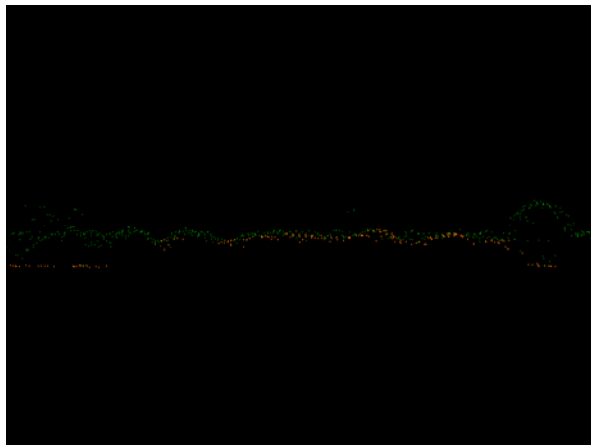
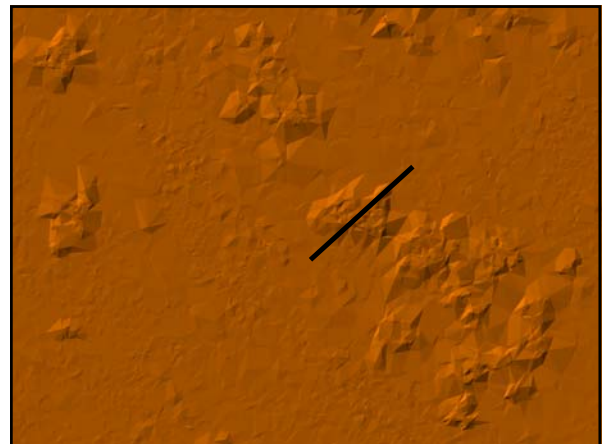


Classification



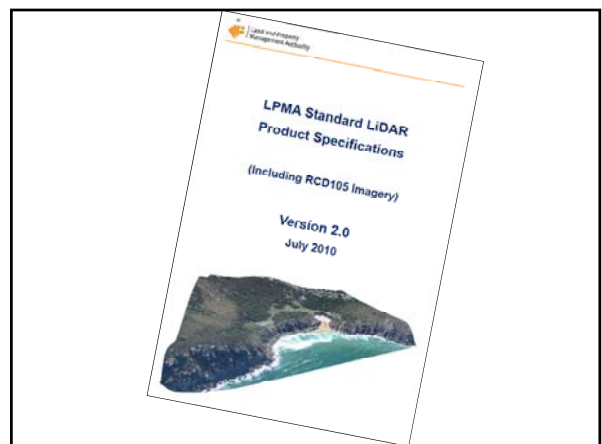
Point Classification

Number	Point class	Description
0	Unclassified	Created, never classified
1	Default	Unclassified
2	Ground	Bare ground
3	Low vegetation	0 – 0.3m (essentially sensor 'noise')
4	Medium vegetation	0.3 – 2m
5	High vegetation	2m >
6	Building	Houses, sheds, etc.
7	Low high points	Spurious high/low point returns (not useable)
8	Model key points	Reserved for 'Model Key Points'
9	Water	Any point in water
10	Bridge	Any bridge or overpass
11	NOT USED	Reserved for future definition
12	Overlap points	Flight line overlap points
13-31	NOT USED	Reserved for future definition



Classification Levels

Level	Description
0	Unclassified Point Cloud.
1	Automated Classification.
2	Ground Anomaly Removal. <i>These are major errors only, i.e. quickly and easily identifiable.</i>
3	Manual Ground Correction
4	Full Classification



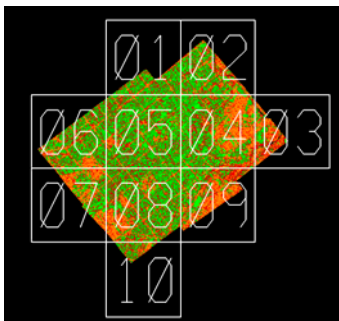
LPMA Specifications

- Datum – MGA and local AHD
- Point density – minimum 1 point / sq metre
- Accuracy – ICSM Category 1
 - Vertical +/- 30cm at 95% confidence
 - Horizontal +/- 80cm at 95% confidence
- Classification – LPMA level 3 only
- Imagery - 20cm GSD

LPMA Products

- Classified point cloud, LAS format, 2km tiles
- Model Key Points (thinned ground), LAS format
- 1m DEM, ESRI grid format
- RGB Image Mosaic, ECW format
- 1m Intensity image, ECW format
- Tile Index
- Metadata
- Project & QA Report

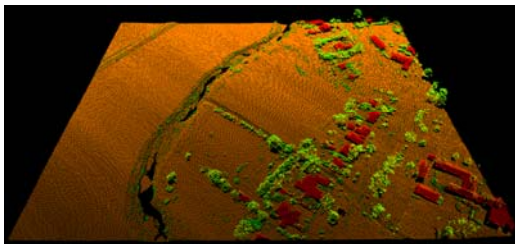
Data Tiles



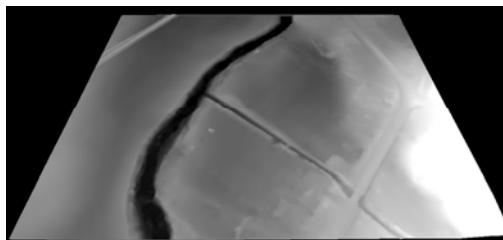
No ASCII

397998.110	6418000.540	58.370
397990.570	6418000.120	57.960
397936.420	6418000.390	54.230
397922.290	6418000.460	53.120
397918.670	6418000.410	52.790
397895.500	6418000.340	50.640
397880.550	6418000.160	49.920
397871.260	6418000.300	49.350
397860.280	6418000.270	48.510
397813.220	6418000.160	45.380
397814.380	6418000.540	45.050
397804.960	6418000.140	46.170

Classified LAS data



DEM



Imagery



Intensity Image



File Sizes / Tile (2km)

- LAS data (classified) 250 Mb
- Model Key points (MKP) 10 Mb
- 1m DEM (ascii) 30 Mb
- Imagery 10 Mb

Thank you!

