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# Report Laser scanning

04718

Juupajoki

<i>Document:</i> <b>Report laser scanning Juupajoki</b>	<i>Document</i>	
<i>Client:</i> <b>University of Helsinki</b>	<i>Version:</i> 1.0	<i>Date:</i> 02.09.2004

## 1.0 General

The document gives an overview of the LIDAR flights and the processing for the Juupajoki project. The BNM AS internal project number is 04718.

## 2.0 Data Acquisition

### 2.1 Flights

The flights were carried out from Finland:

Area	Date	GPS day
Juupajoki	5 <sup>th</sup> of August	218

### 2.2 Aircraft and crew

Flight carried out with aircraft LN-NPZ. The following BNM crew joined the survey:

Name	Position
Mr Stein Strand	Chief pilot
Mr John Frøybu	ALTM operator

### 2.3 GPS reference point

A reference point, set up by *U of H*, has been used. The location of this point is:

Lat: 61 50 5.18736  
 Long: 2420 13.73439  
 Ell height: 154.787

GPS/INS postprocessing report is found in appendix 3.

### 2.4 Parameters data acquisition

Parameter	Value
Scan frequency	29 Hz
Scan angle	+/- 20 deg
Speed	75 m/s
Altitude	900 m

A plot of the flightplan is found in appendix 1.

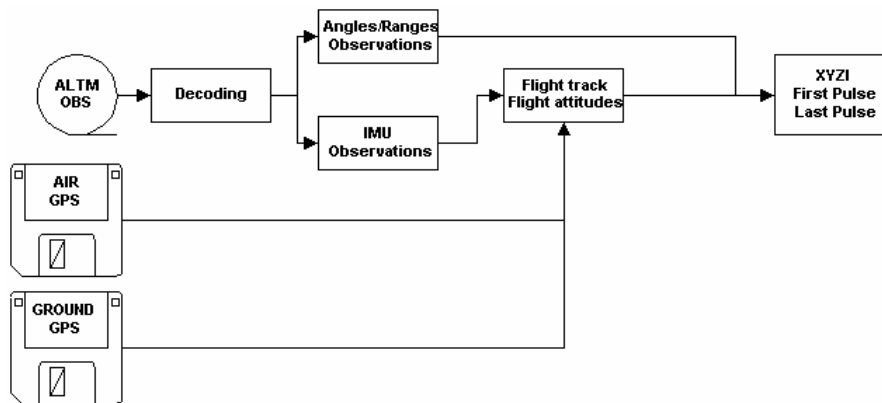
### 3.0 Processing

The processing chain has 4 major levels :

1. XYZ computations by combining GPS/INS solution with the ALTM observations (range and scan angles)
2. Roll, Pitch and z adjustment
3. Transformations
4. Product output, WGS84 UTM35:
  - o Laser point cloud
  - o ASCII (X, Y, Z, I), one file pr. pulse.

#### 3.1 XYZ processing

Simplified workflow diagram :



The following software has been used :

Name	Product by	Tasks
REALM	Optech	Tape decoding, XYZ processing
POSPAC	Applanix	GPS/INS processing
TerraScan	TerraSolid	Pointdata management
TerraMatch	TerraSolid	Flighline matching

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### *3.2 Attitude adjustment*

Terramatch was run to determine and adjust for offsets in roll, pitch and height between flight lines. The report from TerraMatch is included in this document as Appendix 2.

### *3.3 Transformation and model offset*

No transformation was carried out by BNM AS. This means that there can be a model height offset. Normal model offsets are from 4 cm to 15 cm.

### *3.4 Product generation*

The following products has been delivered in WGS84 UTM 35:

- ASCII (X, Y, Z, Intensity) space separated.
- Separate files for first- and last return pulse.

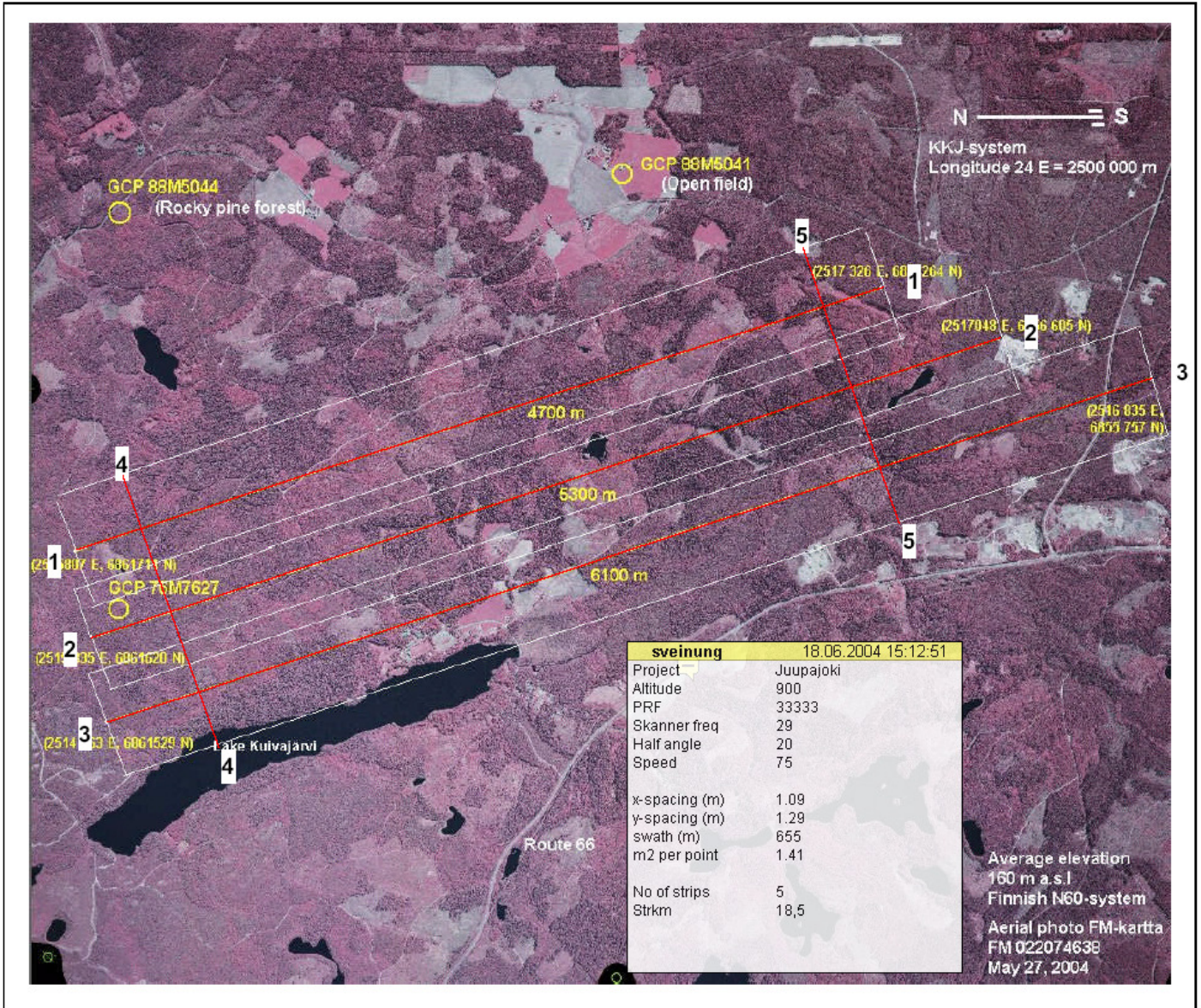
By request from University of Helsinki BNM has delivered raw lidardata, and the post-processed GPS/INS solution. The lidardata are all in ASCII format, and the post-processed GPS/INS solution is delivered as both ASCII and binary.

### *3.5 Data delivery*

The data was delivered by mail to University of Helsinki, Att: Mr. Ilkka Korpela.

# Appendix 1.

## Flightplan



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## Appendix 2.

### Flightline matching report

No known points  
Observe every 5th point  
Intensity not used  
Solution for individual strips

Starting average dz: 0.0936  
Final average dz: 0.0863

Standard error of unit 0.0385

Execution time: 595.5 sec  
Number of iterations: 7

Flightline	Points	Z shift	R shift	P shift
4	40867	-0.033	-0.0001	-0.0026
1	88441	-0.060	-0.0041	+0.0024
2	113172	-0.018	+0.0025	+0.0026
3	64011	+0.046	+0.0011	-0.0046
5	47918	+0.066	-0.0008	-0.0033

Flightline	Points	Z shift	R shift	P shift
4	40867	0.004	0.0011	0.0014
1	88441	0.003	0.0007	0.0012
2	113172	0.003	0.0006	0.0009
3	64011	0.003	0.0008	0.0013
5	47918	0.004	0.0011	0.0013

### Appendix 3. GPS/INS processing report

#### Documentation, Lidar survey

Area: Juupajoki  
 GPS Day: 218  
 Date: 05.08.2004

#### 1. Baseline

Ground station:			Coordinate	ETRS89
GPS antenna:	ASH700718		North	61 50 5.18736
ARP - L1	0.0839		East	24 20 13.73439
ARP - L2	0.0623		Height el.	154.787
ARP- measure p.	0.0636			

Slant distance to measure point (meter): 0.960  
 vertical distance to measure point (meter): 0.944  
 Vertical distance to ARP (meter): 0.880

Fixed Solution Forward:		386206	Settings	
RMS:	0.029	passed	Elevation mask	13
RMS reliability:	6.300	passed	Omit Satellites	no
Fit / Fix sep:	0.283	passed	Kar	refine
Sampel rate			Frequency:	dual

Omit	Start	end
23	all	
24	387530	600000

Fixed Solution Revers:		387702	Settings	
RMS:	0.024	passed	Elevation mask	13
RMS reliability:	4.700	passed	Omit Satellites	no
Fit / Fix sep:	0.271	passed	Kar	refine
Sampel rate			Frequency:	dual

Combined solution (meter)				
	ground	Height		Min / Max
Seperation:	0.030	0.070	Number of Sat.	6 / 7
Position St.Dev			Pdop	2.0 / 2.7

GPS accept : Ivar Oveland 26.08.2004

Solution: gps\_proc\_21804b.dat 26.08.2004 @ 16:46

## GPS / INS integration

<b>Calibration Values from 19.04.2004</b>	X	Y	Z
User to IMU lever arm (mirror to imu)	-0.094	-0.005	-0.109
Use Frame to IMU misalignment	-0.005	-0.015	-1.100
N- GPS lever arm Coordinates	0.530	-0.196	-1.523
Airplan	LN-NPZ	IMU time delay	0.003000 [s]

## Flight A\_A

<b>Data Control</b>	Done by	Date	Status
Disk Extration	Ivar		ok
Decode Range	Ivar		ok
Extract IMU	Ivar		ok
Decode GPS	Ivar		ok
XYZ calculation			

<b>IMU report:</b>	Start	end
Time interv all	384837	389419
Nr. of interpolation	0	
Nr. of gaps	0	
Correct time types	yes	

<b>Integration Report</b>	Start	End
Time of interest	386780	387695
Processed data	386287	388050
Init. Start process		
Roll Min/maks (grader)		

GPS/INS accept : Ivar Oveland 26.08.2004

Solution: sbet\_21804b.out 26.08.2004 @ 16:59