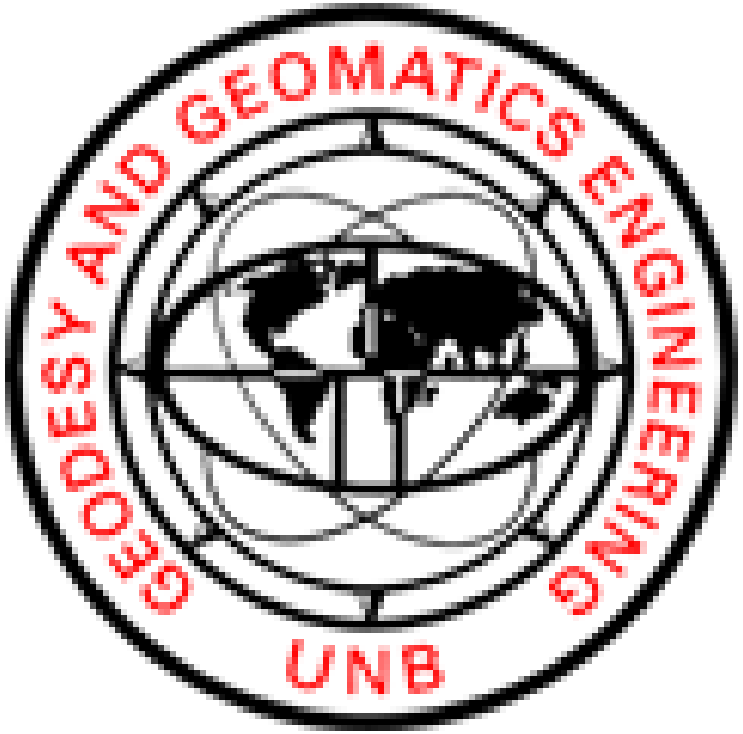
UNB CONTROL NETWORK

Using GNSS To Determine Coordinates

Matthew Cameron



Academic Supervisor: Dr. Marcelo Santos

Course: GGE 4700

GNSS

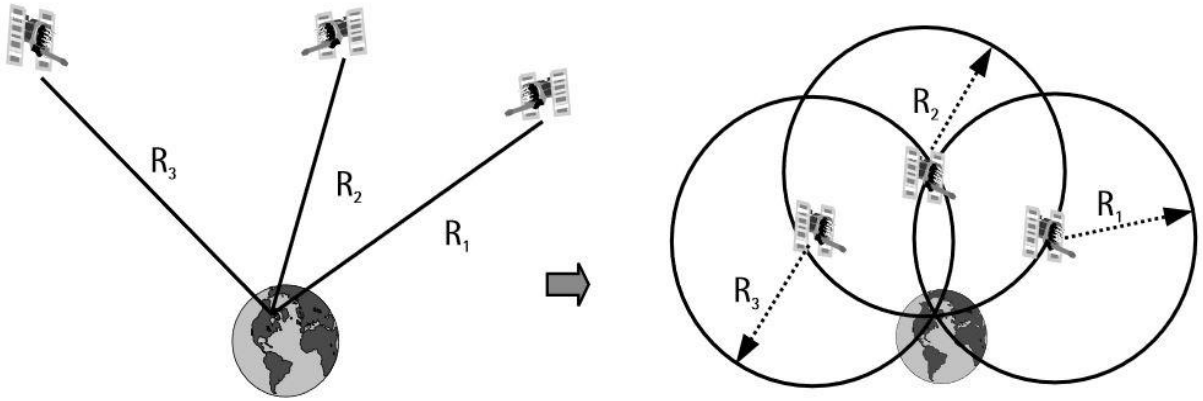
Global Navigation Satellite System

- GPS = American
- GLONASS = Russian

Uses ranges from three satellites to determine a position

Fourth satellite needed for time

Errors and biases



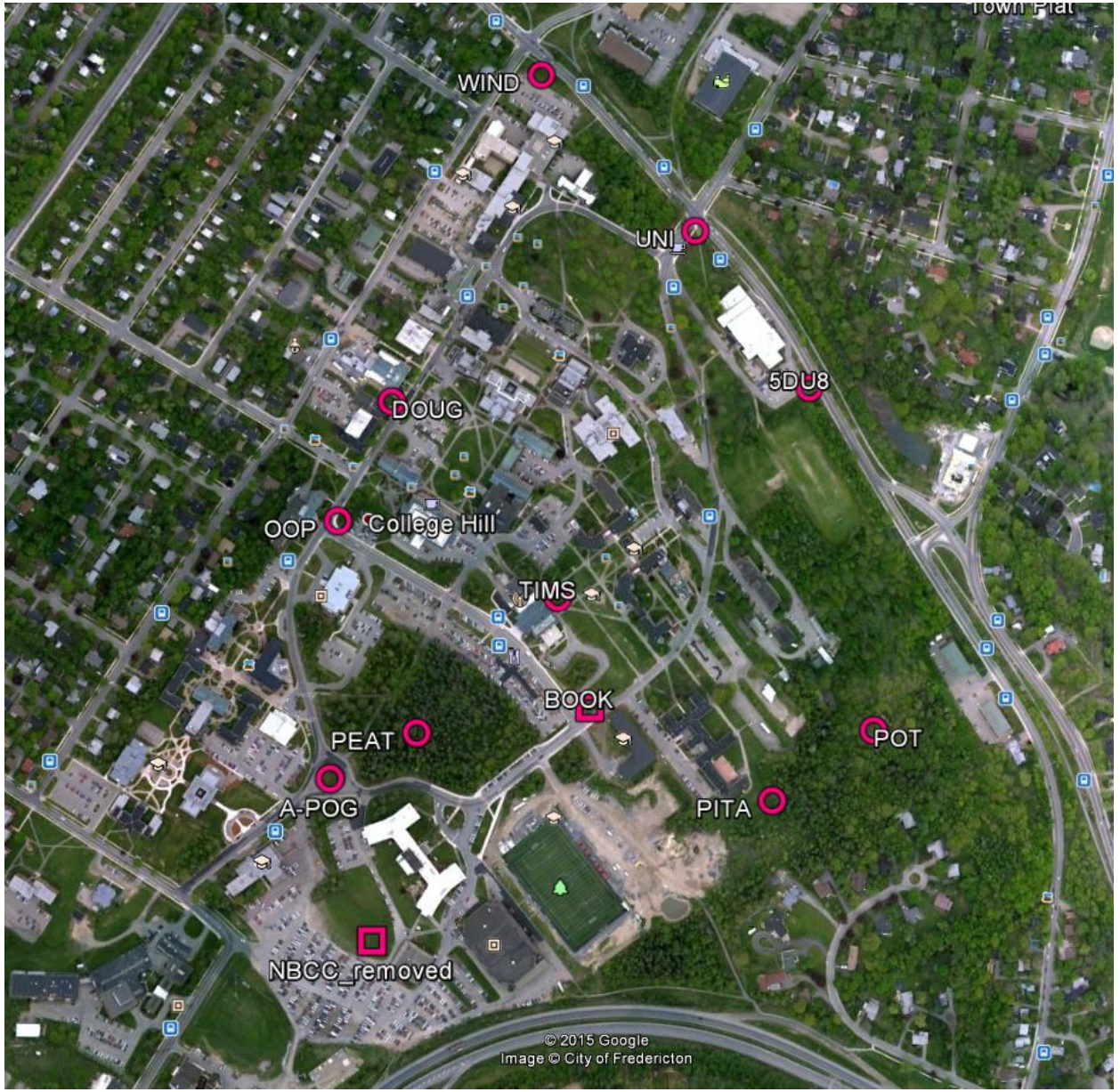
$$Range = speed * time$$

THE NETWORK

10 control monuments

Some points are out in the open

Some points are shrouded in tree cover



Source: Google Earth

Point	Approx. Location	Quality	Terrain
WIND	N 45° 57’ 03.0” W 66° 38’ 30.0”	Good	Moderate slope on open terrain
UNI (GATE)	N 45° 56’ 57.3” W 66° 38’ 21.3”	Good	Flat and open terrain with some visual obstructions
5DU8 (GYMS)	N 45° 56’ 51.6” W 66° 38’ 15.3”	Best	Flat and open terrain
POT	N 45° 56’ 37.7” W 66° 38’ 12.2”	Poor	Hilly and thick forest cover
PITA	N 45° 57’ 36.5” W 66° 38’ 17.0”	Poor	Flat terrain with moderate forest cover
TIMS	N 45° 57’ 42.6” W 66° 38’ 27.1”	Best	Moderate slope on open terrain
PEAT	N 45° 56’ 38.5” W 66° 38’ 36.9”	Poor	Uneven terrain with complete forest cover
APOG	N 45° 56’ 36.6” W 66° 38’ 39.3”	Good	Flat and open terrain with some visual obstructions
OOP	N 45° 56’ 45.8” W 66° 38’ 39.5”	Best	Flat terrain with some trees and visual obstructions
DOUG (FM)	N 45° 56’ 50.4” W 66° 38’ 37.2”	Fair	Moderate slope with building obstructions

TIMS = “GOOD”

Source: Google Earth

PEAT = “POOR”

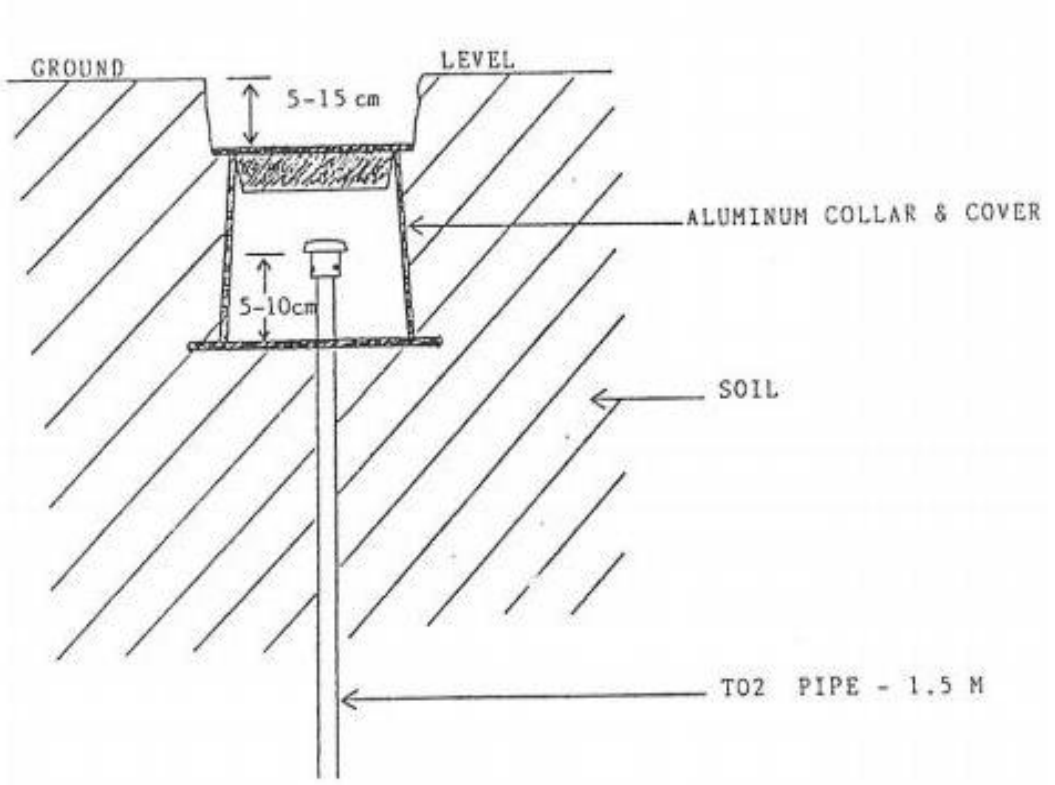
Source: Google Earth

THE MONUMENTS

A brass survey cap with engraved markings identifying the point ID

The cap is fixed to a five foot steel pipe hammered into the ground encased by 5 inch PVC pipe

Object was to keep point from being disturbed



Recommendations for the Placement of T02 Pipes. Leblanc & Berube. 1990.

METHODOLOGY

Planning and reconnaissance

Fieldwork

Post processing

What method?

Why that method?

PLANNING

Reconnaissance was limited

GDOP plots

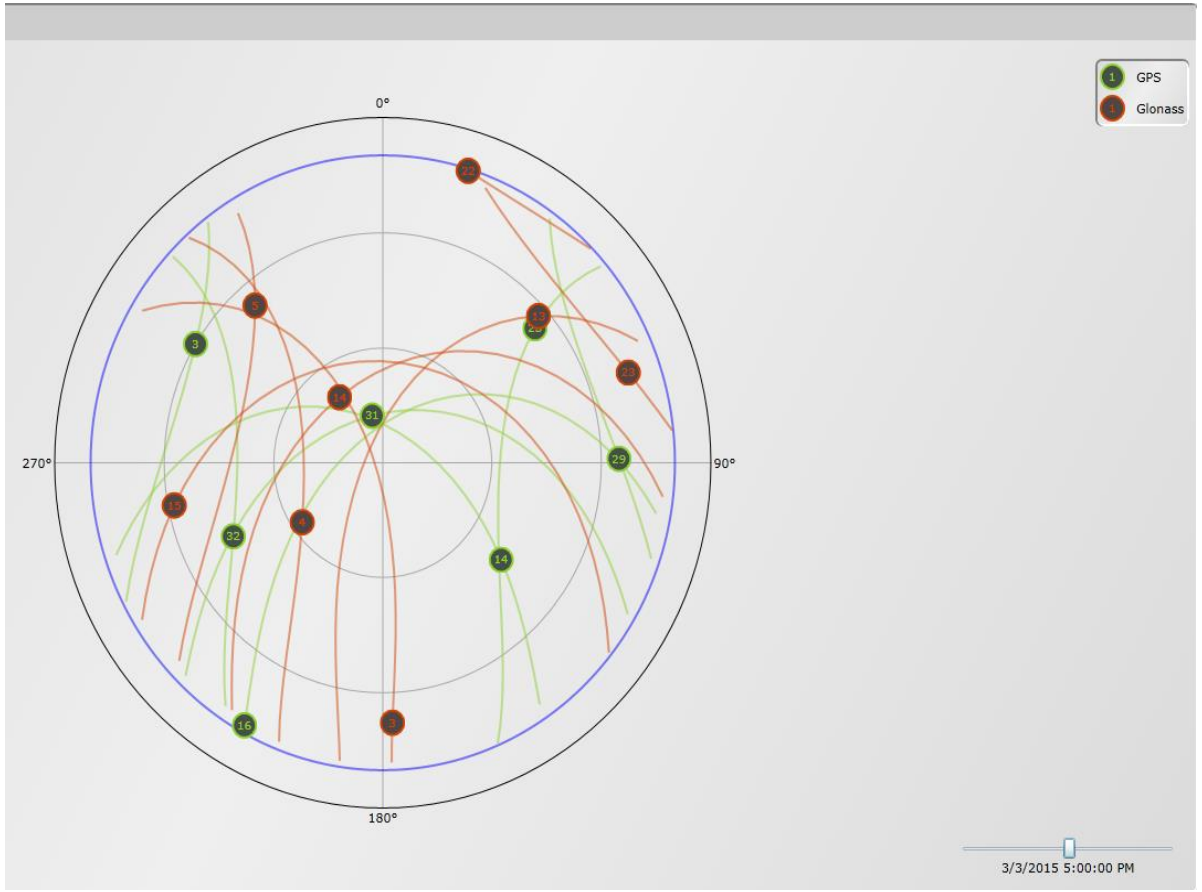
Skyplots

Ionosphere interference

Satellite availability

Going to the field to inspect tree cover and multipath issues

SKYPLOT: Point FM – March 3rd



Source: Trimble GNSS Planner

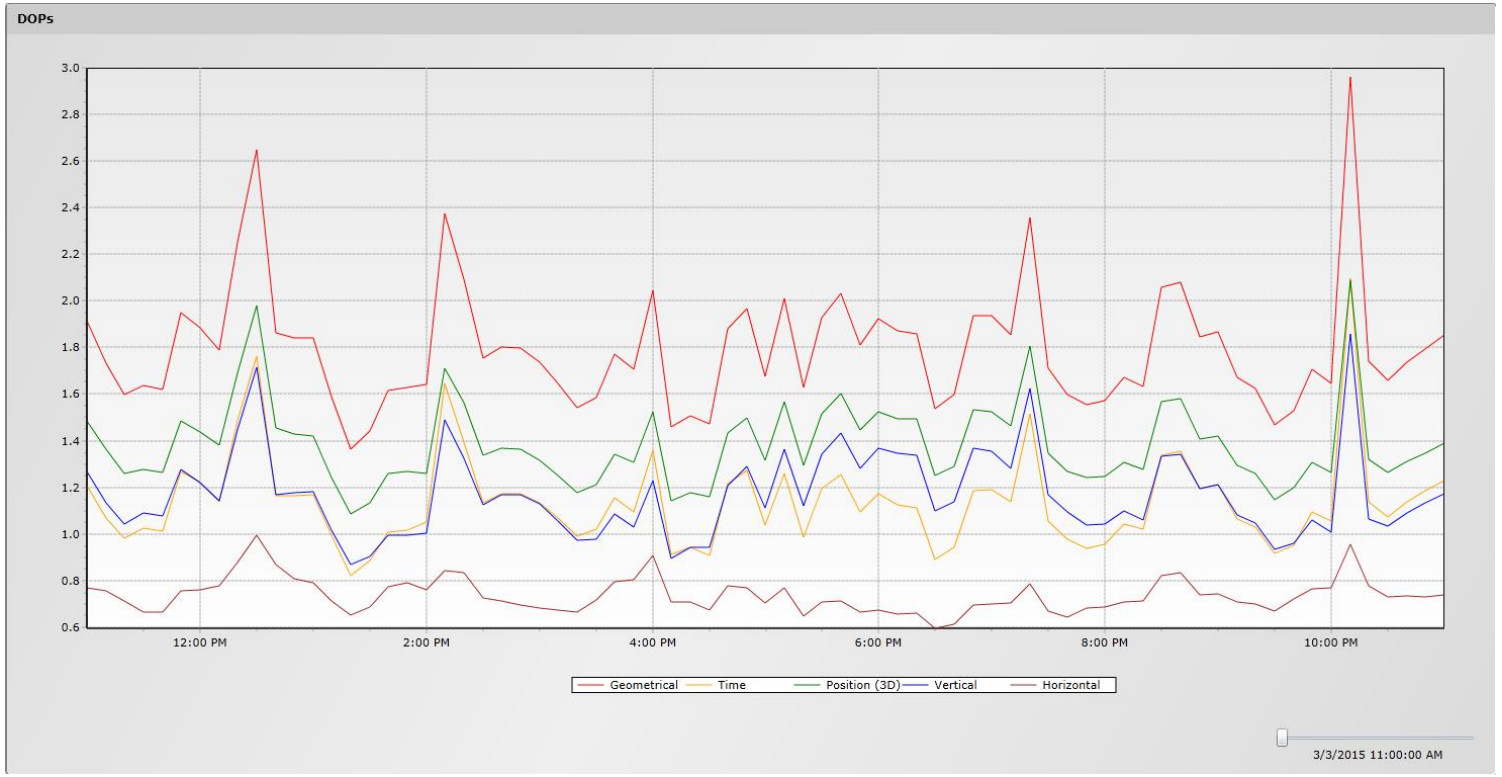
FIELDWORK

3 days – 4 sessions

4 hour observation sessions

5 available receivers

DOP Plot: Point FM – March 3rd



Source: Trimble GNSS Planner

DAY 1

March 3

4 receivers

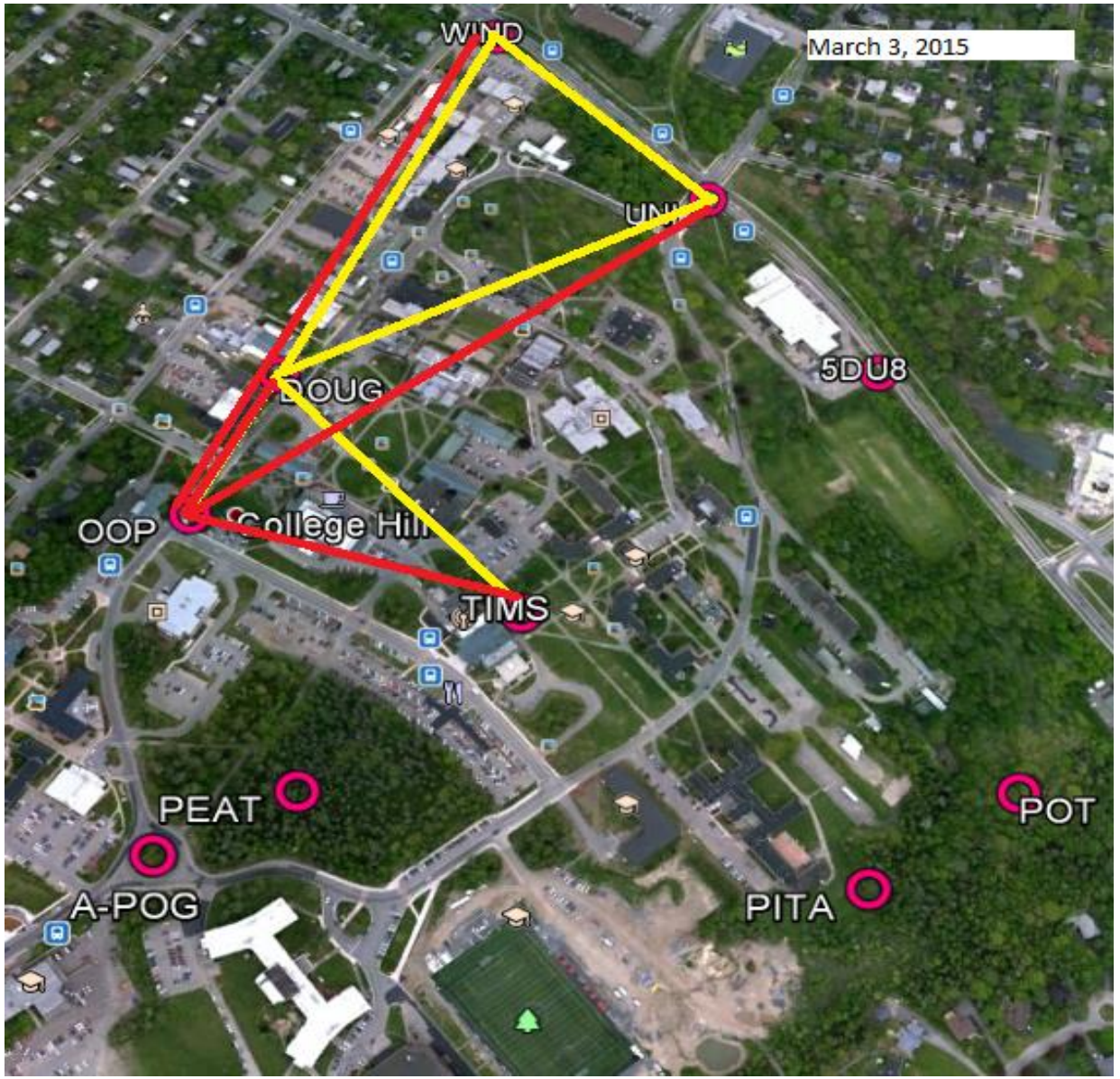
Session 1: 13:00 – 17:00

WIND-OOP-UNI-DOUG

Session 2: 17:00 – 21:00

TIMS-OOP-UNI-DOUG

* Times are approximate



Source: Google Earth

DAY 2

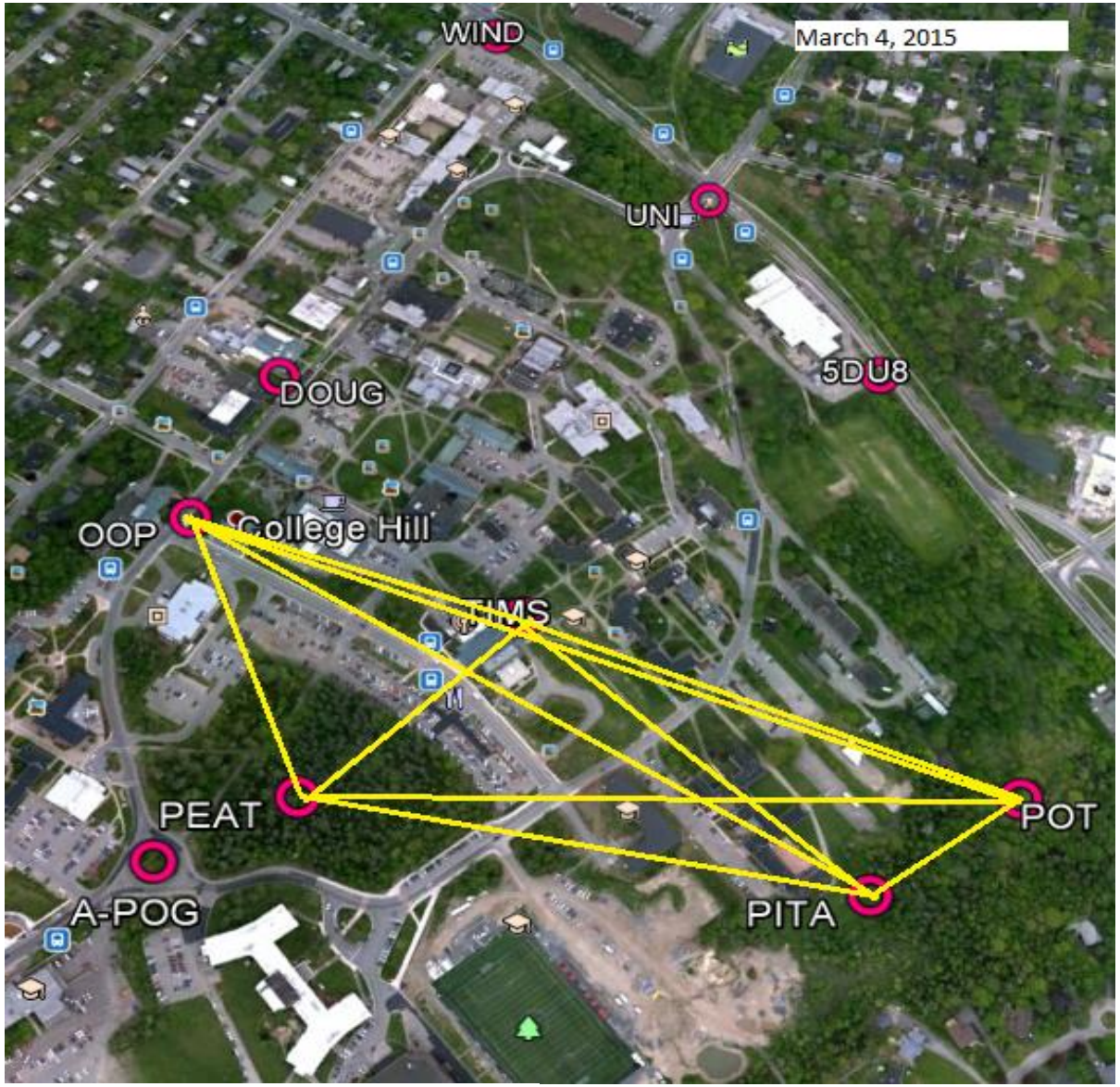
March 4

5 receivers

Session 3: 14:00 – 18:00

OOP-TIMS-POT-PEAT-PITA

* Times are approximate



Source: Google Earth

DAY 3

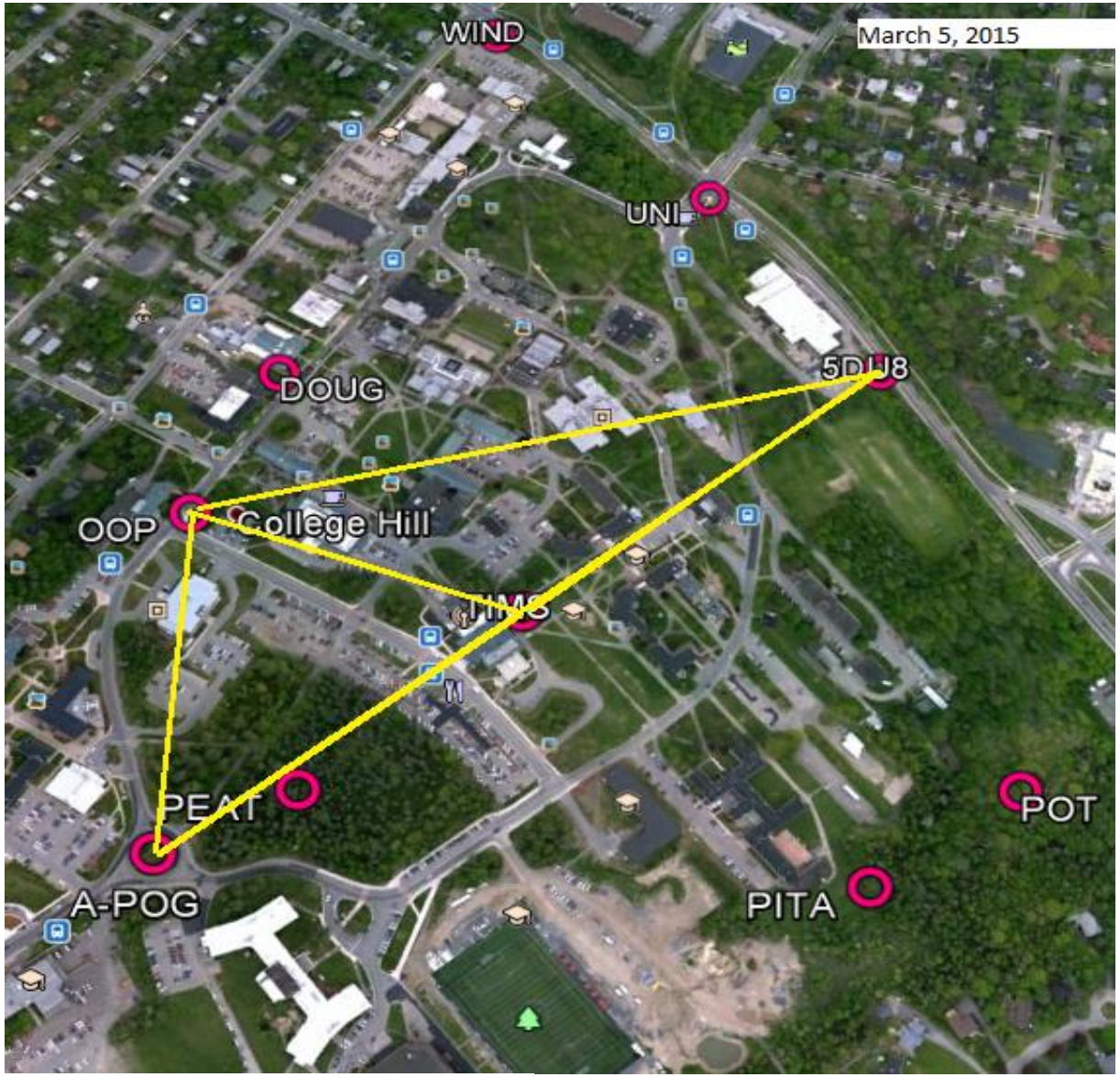
March 5

4 receivers

Session 4: 17:00 – 21:00

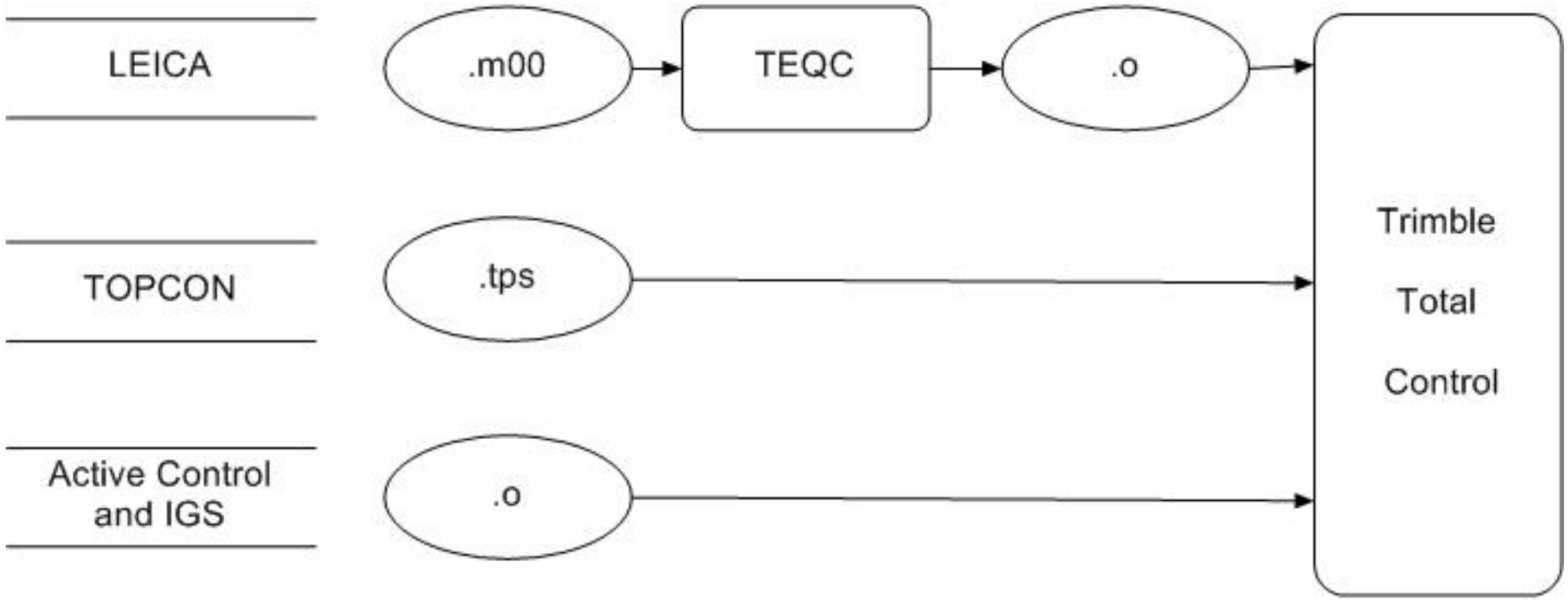
OOP-TIMS-APOG-5DU8

* Times are approximate



Source: Google Earth

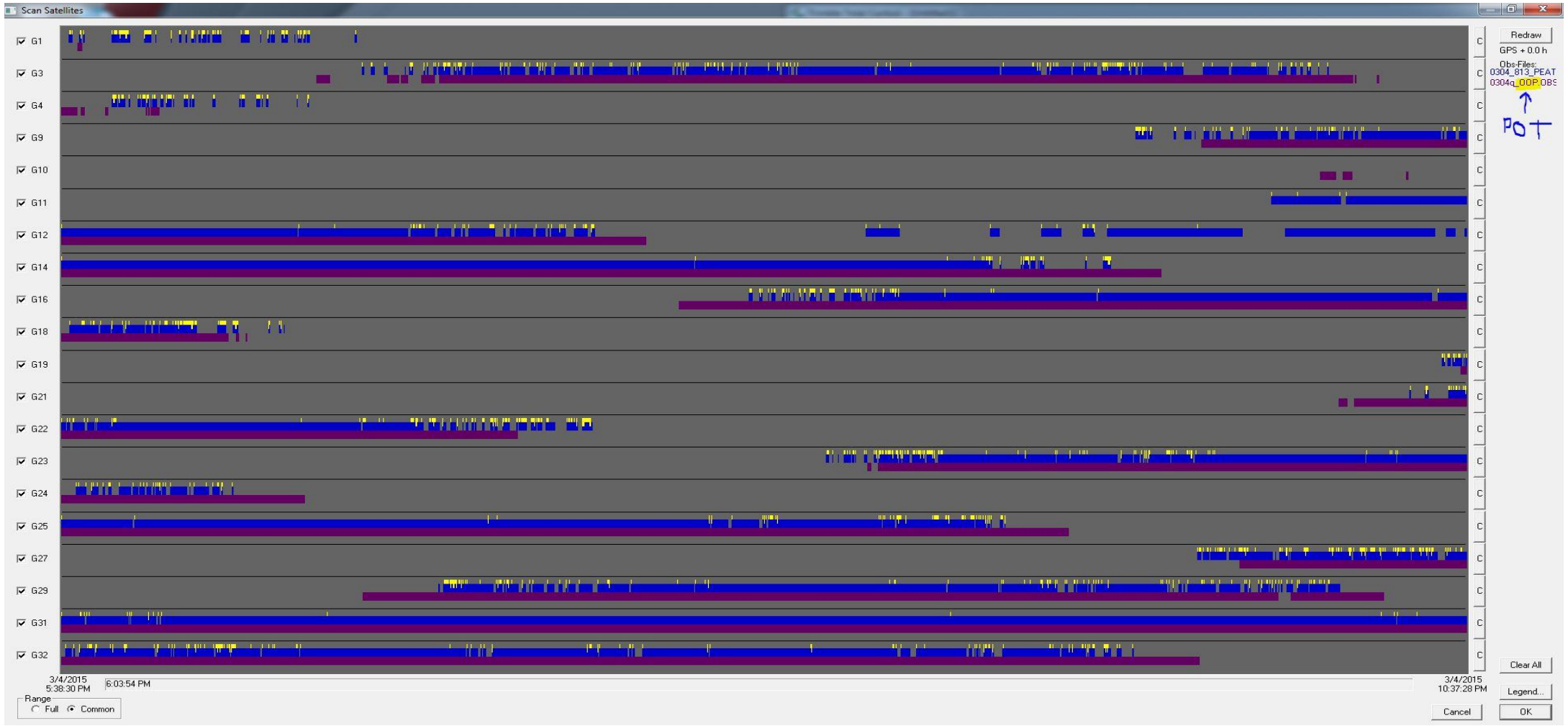
POST-PROCESSING – THE DATA



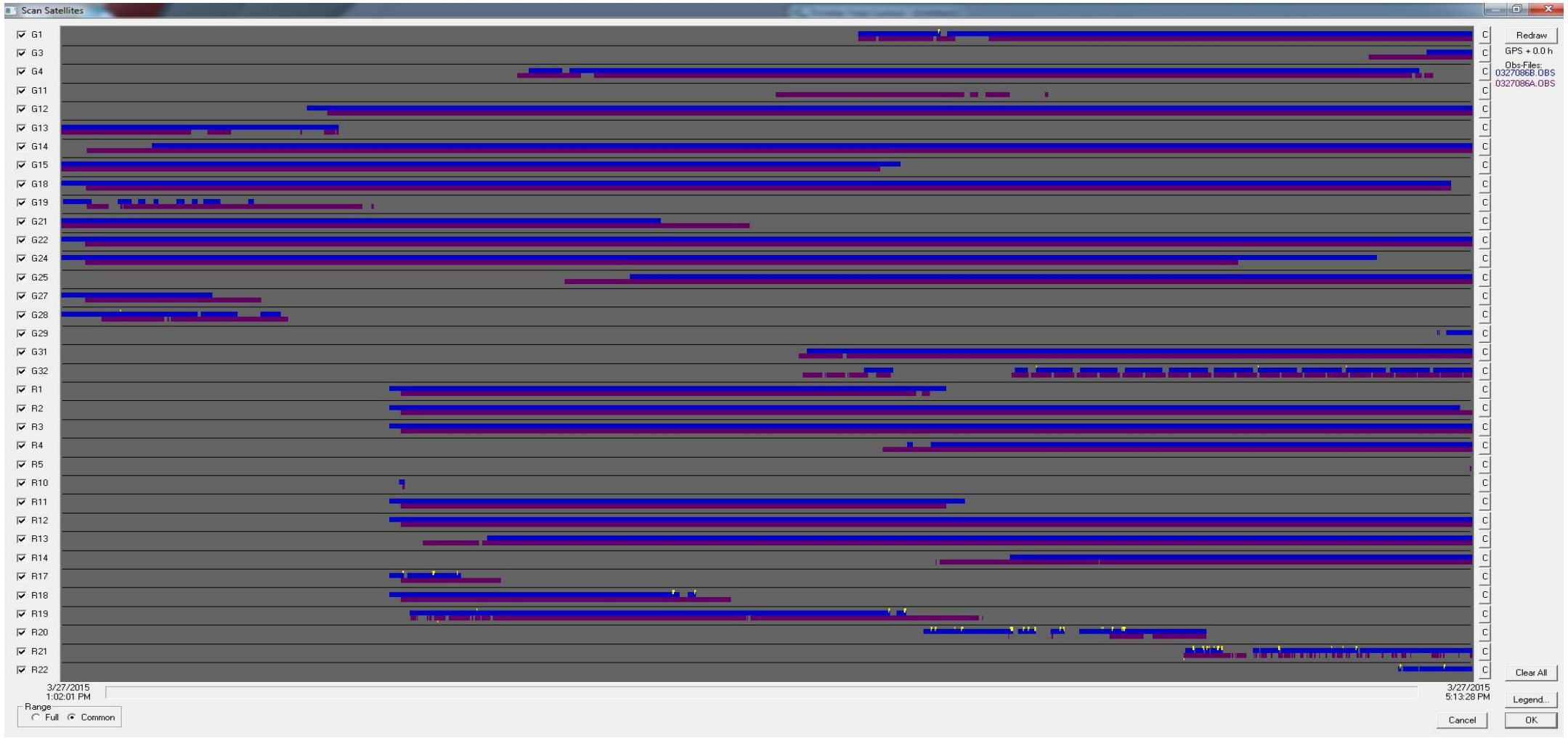
POST-PROCESSING - SETTINGS

Coordinate System:	Canada Plane Rectangular
Geoid Model:	No predefined geoid model
Elevation Cutoff:	10 degrees
Processing Interval:	1.00 sec
Orbit type:	Precise
Frequency:	L1 and L2
Tropospheric model:	Saastamoinen
Fixed Point:	UNBJ

POST-PROCESSING – CYCLE SLIPS



CYCLE SLIPS


Scan Satellites
G1
G3
G4
G11
G12
G13
G14
G15
G18
G19
G21
G22
G24
G25
G27
G28
G29
G31
G32
R1
R2
R3
R4
R5
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R12
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R19
R20
R21
R22
Redraw
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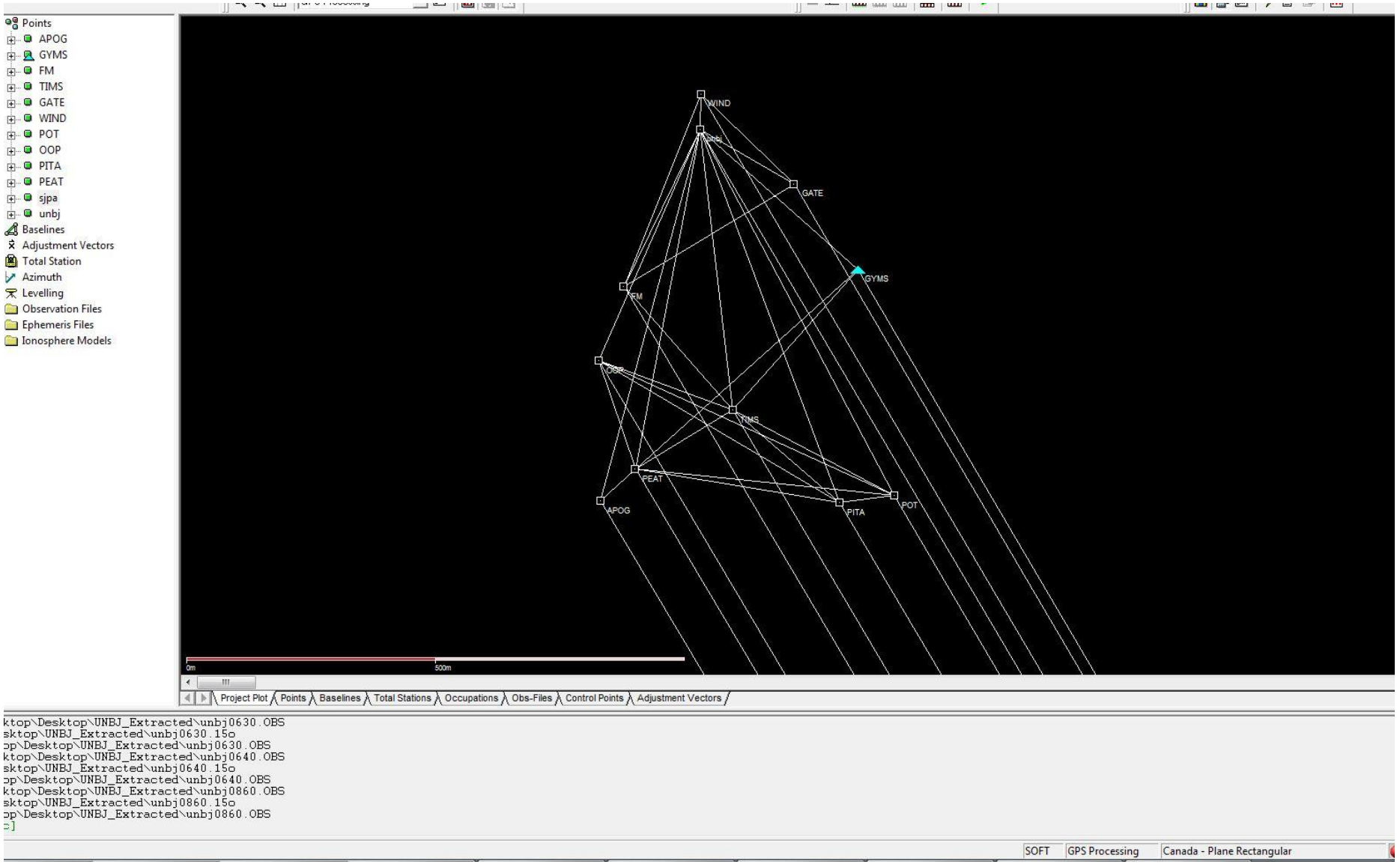
0327086A.OBS
Clear All
Legend...
OK
Cancel
3/27/2015
1:02:01 PM
3/27/2015
5:13:28 PM
Range
Full
Common

NETWORK


Points
APOG
GYMS
FM
TIMS
GATE
WIND
POT
OOP
PITA
PEAT
sjpa
unbj
Baselines
Adjustment Vectors
Total Station
Azimuth
Levelling
Observation Files
Ephemeris Files
Ionosphere Models
WIND
GATE
GYMS
FM
OOP
TIMS
PEAT
APOG
PITA
POT
0m
500m
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Points
Baselines
Total Stations
Occupations
Obs-Files
Control Points
Adjustment Vectors
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SOFT
GPS Processing
Canada - Plane Rectangular

Cartesian Coordinates						
Point	X	σ	Y	σ	Z	σ
APOG	1761327.5588m	8.2mm	-4078833.5045m	10.4mm	4560925.4303m	10.6mm
FM (DOUG)	1761241.1478m	14.5mm	-4078514.6456m	24.2mm	4561199.7545m	23.5mm
UNI (GATE)	1761482.1717m	11.0mm	-4078214.1923m	19.0mm	4561319.4832m	18.2mm
5DU8 (GYMS)	1761651.2881m	6.1mm	-4078278.4687m	8.0mm	4561201.9195m	8.6mm
OOP	1761238.4149m	5.3mm	-4078636.8077m	7.7mm	4561111.6951m	7.8mm
PEAT	1761366.1325m	76.6mm	-4078757.7089m	148.1mm	4560967.1501m	142.7mm
PITA	1761762.5323m	15.5mm	-4078627.7136m	27.1mm	4560909.1567m	26.9mm
POT	1761843.8180m	37.8mm	-4078559.1537m	52.6mm	4560924.3976m	55.4mm
TIMS	1761510.8977m	4.0mm	-4078589.8355m	6.2mm	4561038.5567m	6.4mm
WIND	1761261.1849m	9.4mm	-4078172.1392m	15.5mm	4561446.4052m	15.1mm

Point	Latitude	Longitude	h (m)	N (m)	σ	H (m)
APOG	N 45° 56' 36.58736"	W 66° 38' 39.40854"	59.6319	-21.9400	0.0150	81.5720
FM (DOUG)	N 45° 56' 50.37667"	W 66° 38' 37.22277"	29.4134	-21.9340	0.0150	51.3480
GATE (UNI)	N 45° 56' 57.26921"	W 66° 38' 21.41814"	-9.8769	-21.926	0.0150	12.0490
GYMS (5DU8)	N 45° 56' 51.68707"	W 66° 38' 15.39308"	-6.7166	-21.9260	0.0150	15.2090
OOP	N 45° 56' 45.80814"	W 66° 38' 39.58782"	43.3546	-21.9300	0.0150	65.2910
PEAT	N 45° 56' 38.79068"	W 66° 38' 36.36941"	51.8612	-21.9380	0.0150	73.7990
PITA	N 45° 56' 36.60403"	W 66° 38' 17.08149"	36.4894	-21.9310	0.0150	58.4210
POT	N 45° 56' 37.66198"	W 66° 38' 12.35489"	26.0910	-21.9290	0.0150	48.0200
TIMS	N 45° 56' 42.65016"	W 66° 38' 27.10914"	35.9242	-21.9330	0.0150	57.8570
WIND	N 45° 57' 03.06583"	W 66° 38' 30.06374"	-6.4178	-21.9280	0.0150	15.5100

CONCLUSIONS

Tree cover significantly hinders accuracy

Always check the quality of data

Be cautious of winter weather

Values can be used in further educational purposes

ACKNOWLEDGMENTS

"Long days and nights, together we spent, through rain or snow, to survey we went"

Greg Smith	*Equipment Supervisor*
Marcelo Santos	*Academic Advisor*
Greg Rodger	*Peer*
Adam Thimot	*Peer*
Nick McFadzen	*Peer*
Andy, Ryan, etc.	*Staff and Faculty*