A Means of Assessing the Processing Ability of GAPS

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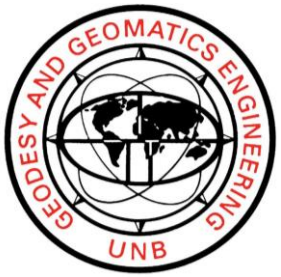
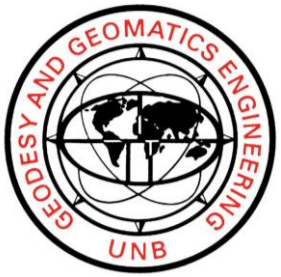
GGE 4700 Technical Report

Supervisor: Dr. Marcelo Santos



Presentation Overview

- PPP Introduction
- Goal
- GAPS Outputs
- Sourcing Data
- Methods
- Program Outputs
- Comments
- Summary



Precise Point Positioning (PPP)

- GPS Analysis & Processing Software (GAPS)
- NRCan's CSRS PPP

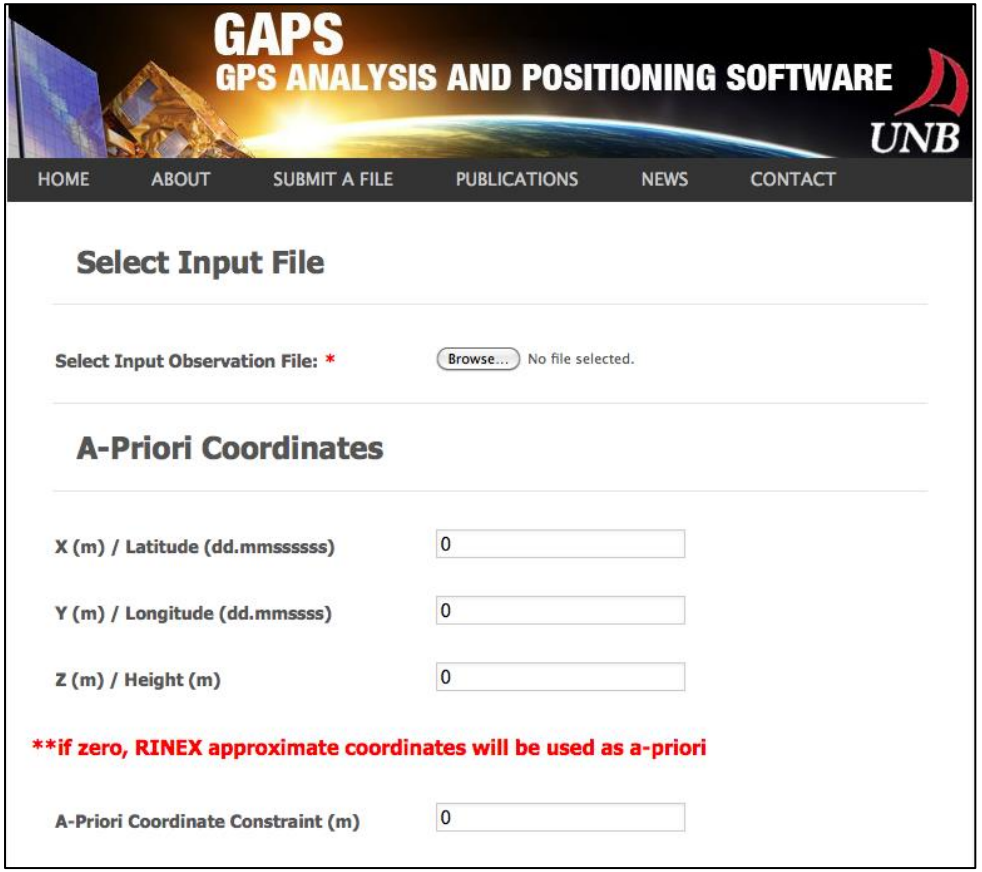


Image: (http://gaps.gge.unb.ca/submit550.php)

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Goal

- Assess GAPS outputs by comparison
- Compare GAPS v5.5.0 outputs with NRCan's PPP outputs
- Automate comparison
- Allow for comparison with previous and future GAPS releases

GAPS/NRCan Outputs

- Final coordinates
  - Cartesian
  - Geodetic
- Coordinate offsets
- Residuals
  - Carrier phase
  - Pseudorange

```
Final coordinates (IGb08 - epoch 2015.2):

     Cartesian (X,Y,Z): 1761511.7823 -4078590.8923 4561038.0080 (m)

     Std. Dev. (X,Y,Z): 0.0144 0.0089 0.0082 (m)

     Geodetic (Lat,Long,h): 45.564260705 -66.382709090 36.4484 (dd.m

A-priori coordinates:

     Cartesian (X,Y,Z): 1761513.0710 -4078591.9375 4561036.9951 (m)

     Geodetic (Lat,Long,h): 45.564255001 -66.382705521 36.7429 (dd.m

     A-prori coordinates standard deviation: unconstrained

Final offsets w.r.t. a-priori coordinates:

     Cartesian (X,Y,Z): -1.2887 1.0452 1.0129 (m)

     Geodetic (Lat,Long,h): 1.6060 -1.0824 -0.1682 (m)

     Horizontal/3D: 1.9367 1.9440 (m)

Residuals:

     Carrier-phase: Mean = -0.000m / Std Dev = 0.009m / RMS = 0.009m

     Pseudorange: Mean = 0.065m / Std Dev = 0.443m / RMS = 0.448m
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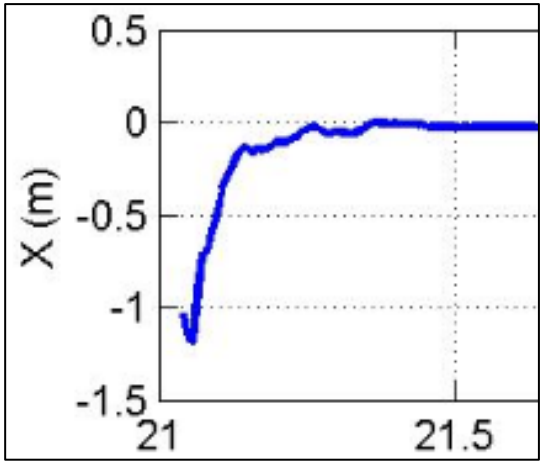
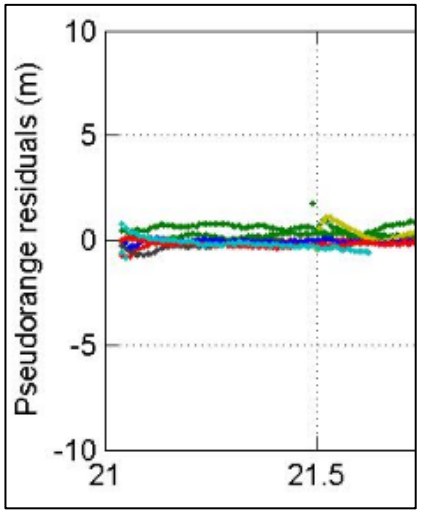
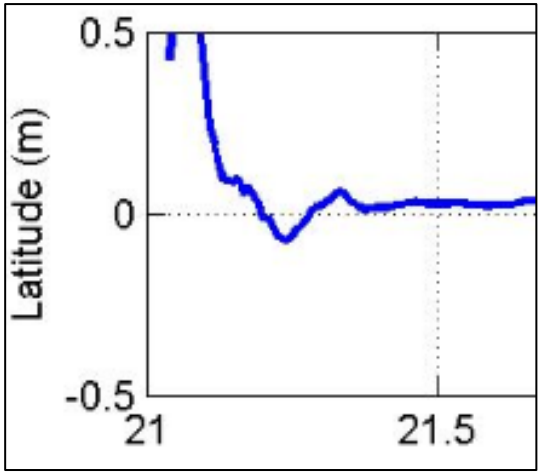
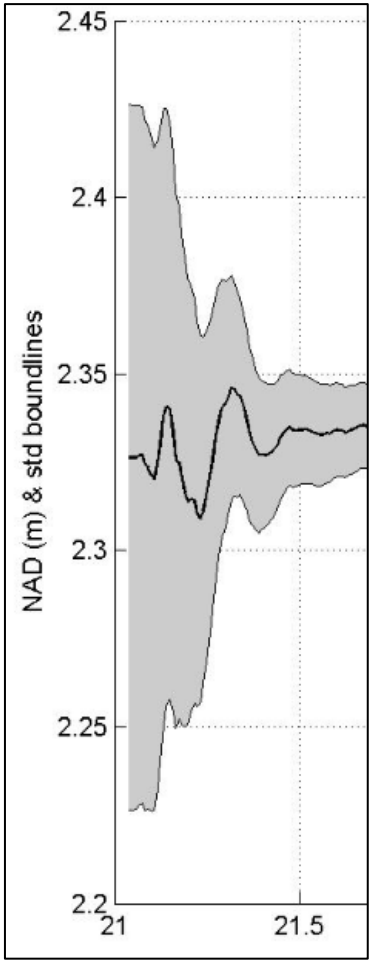
GAPS Outputs cont'd

- Convergence plots
- Atmospheric delays









Sourcing Data

- Six datasets
- Leica GS10/GS15 receivers
- Four hour minimum duration

Sourcing Data cont'd

- Multipath
- Obstructions
- Urban canyons
- Reconvergence

Methods

- Data sets processed with GAPS and NRCan
- Extract output data
- Compare outputs
- Statistical tests
- Output comparisons

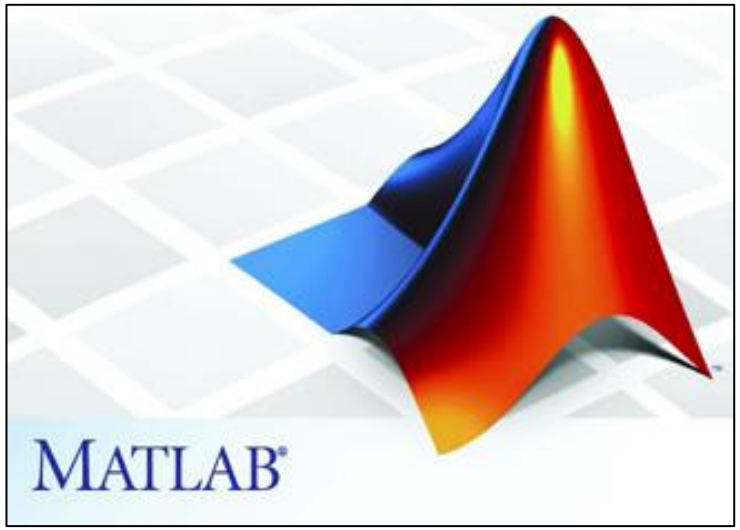
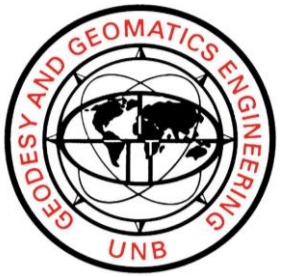


Image: (http://hkn.ee.ucla.edu/posts/25)

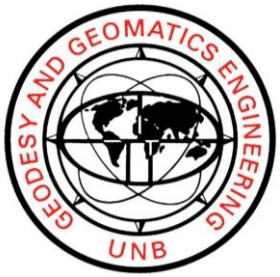
Program Outputs

- Final parameter differences
- Final parameter comparison
- Parameter standard deviation comparison for each epoch
- Parameter convergence time



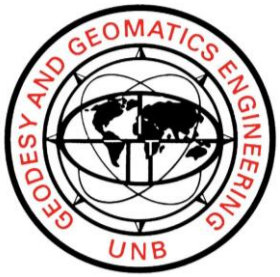
	FINAL_GAPSParameters
X Coord. (m)	1762031.4092
X Coord. Std. Dev. (m)	0.00686
Y Coord. (m)	-4078029.8823
Y Coord. Std. Dev. (m)	0.009408
Z Coord. (m)	4561256.6623
Z Coord. Std. Dev. (m)	0.007644
Latitude (ddd.mmssssssss)	45.565472273
Latitude Std. Dev. (m)	0.004704
Longitude (ddd.mmssssssss)	-66.375461381
Longitude Std. Dev. (m)	0.006076
Height (m)	-21.2229
Height Std. Dev. (m)	0.011564
Neutral Atmospheric Delay Std. Dev. (m)	0.006272
Clock Difference Std. Dev. (ns)	0.09604

	FINAL_NRCanParameters
Latitude (ddd.mmssssssss)	45.565468328
Latitude Std. Dev. (m)	0.006
Longitude (ddd.mmssssssss)	-66.37546019
Longitude Std. Dev. (m)	0.013
Height (m)	-20.126
Height Std. Dev. (m)	0.023
Neutral Atmospheric Delay Std. Dev. (m)	0.0015
Clock Difference Std. Dev. (ns)	0.096



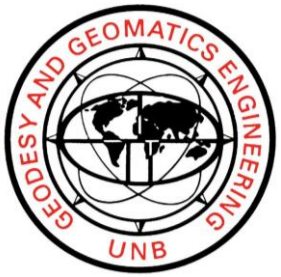
	GAPSvsNRCAN_FINALParameterDifferences
Abs. Latitude Difference (m)	3.94499999600839e-06
Abs. Latitude Std. Dev. Difference (m)	0.001296
Abs. Longitude Difference (m)	1.19099999551509e-06
Abs. Longitude Std. Dev. Difference (m)	0.006924
Abs. Height Difference (m)	1.0969
Abs. Height Std. Dev. Difference (m)	0.011436
Neutral Atmospheric Delay Std. Dev. Difference (m)	0.004772
Clock Difference Std. Dev. Difference (ns)	3.99999999999984e-05

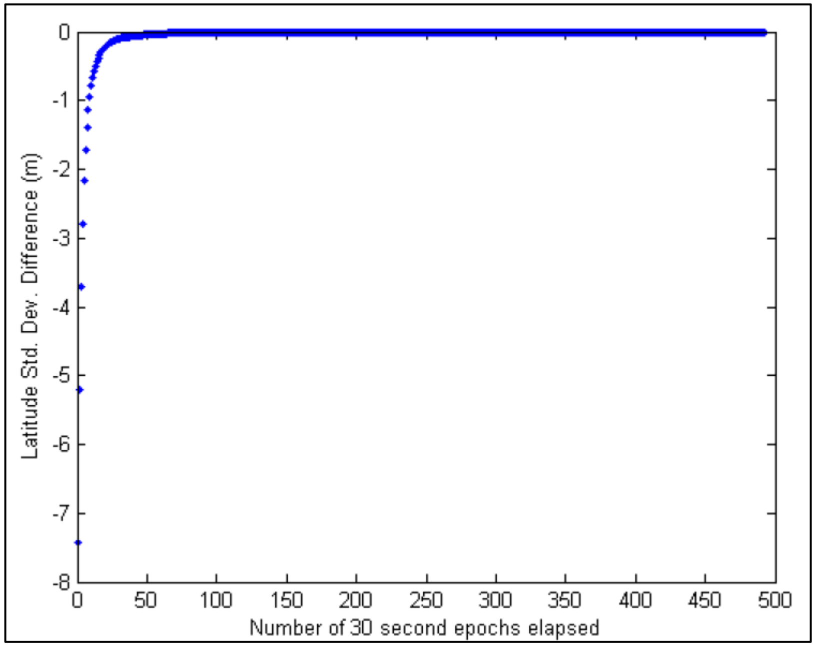
Test	Result
'Lat Std. Dev. ChiSqTest'	'Statistically Inequivalent, a = 0.05'
'Long Std. Dev. ChiSqTest'	'Statistically Inequivalent, a = 0.05'
'Height Std. Dev. ChiSqTest'	'Statistically Inequivalent, a = 0.05'
'NAD Std. Dev. ChiSqTest'	'Statistically Inequivalent, a = 0.05'
'Clock Std. Dev. ChiSqTest'	'Statistically Equivalent, a = 0.05'

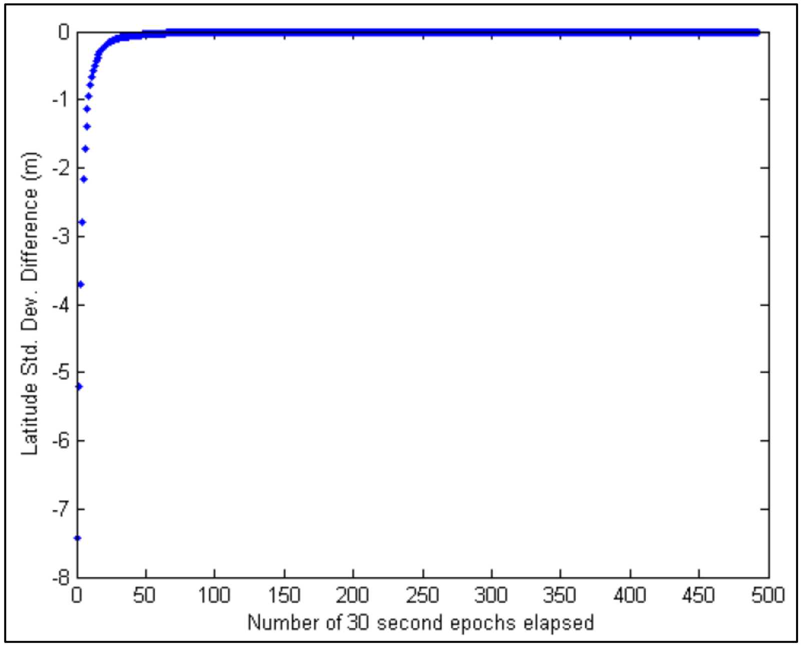


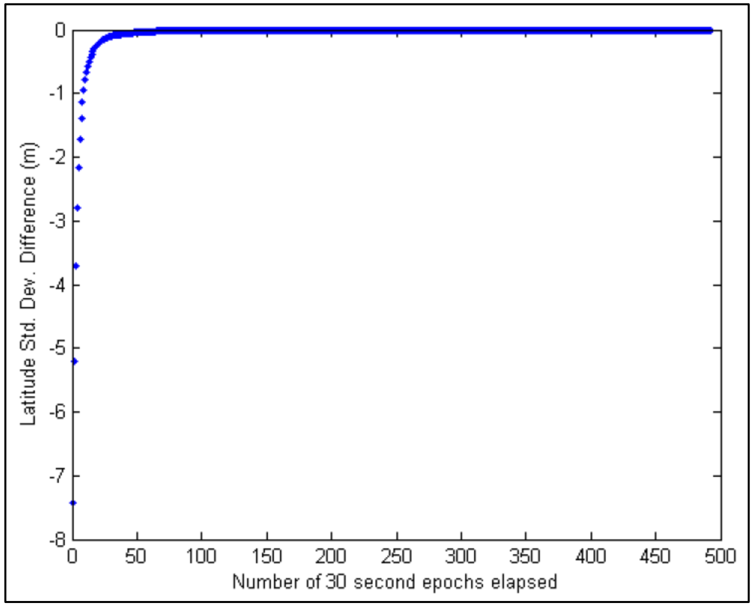
	GAPS_PARAMETER_StatisticalConvergence
X Coord. StatConverge Time (hh:mm:ss)	03:49:30
Y Coord. StatConverge Time (hh:mm:ss)	03:50:00
Z Coord. StatConverge Time (hh:mm:ss)	03:47:30
Latitude StatConverge Time (hh:mm:ss)	03:50:00
Longitude StatConverge Time (hh:mm:ss)	03:49:00
Height StatConverge Time (hh:mm:ss)	03:52:30
NAD StatConverge Time (hh:mm:ss)	03:39:30
Clock Difference StatConverge Time (hh:mm:ss)	03:37:30

	NRCAN_PARAMETER_StatisticalConvergence
Latitude StatConverge Time (hh:mm:ss)	04:00:30
Longitude StatConverge Time (hh:mm:ss)	04:03:30
Height StatConverge Time (hh:mm:ss)	03:47:30
NAD StatConverge Time (hh:mm:ss)	02:32:00
Clock Difference StatConverge Time (hh:mm:ss)	03:36:30




Latitude Std. Dev. Difference (m)
Number of 30 second epochs elapsed


Latitude Std. Dev. Difference (m)
Number of 30 second epochs elapsed


Latitude Std. Dev. Difference (m)
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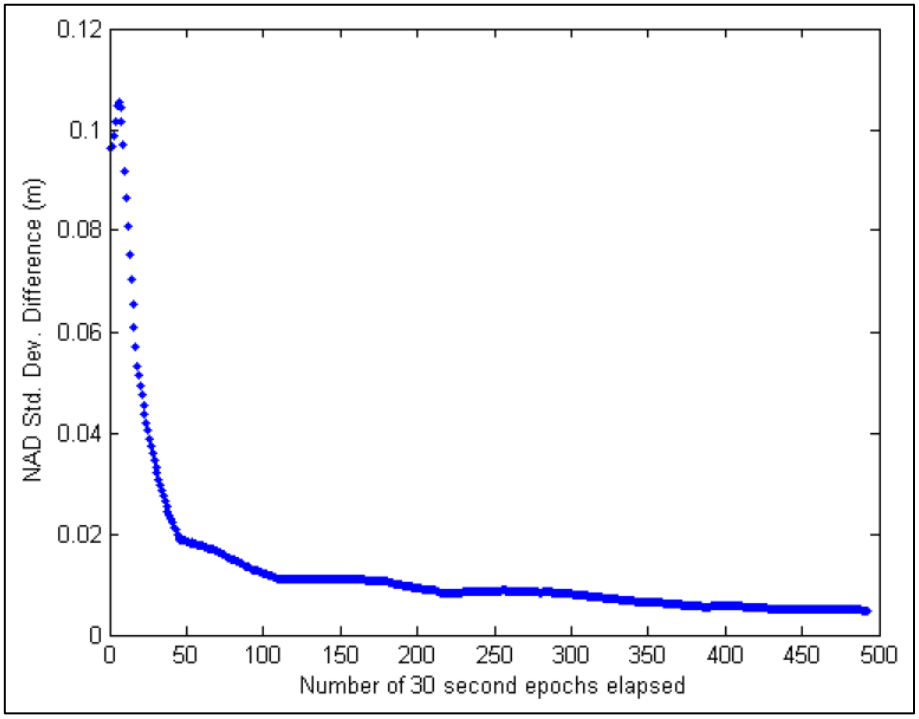

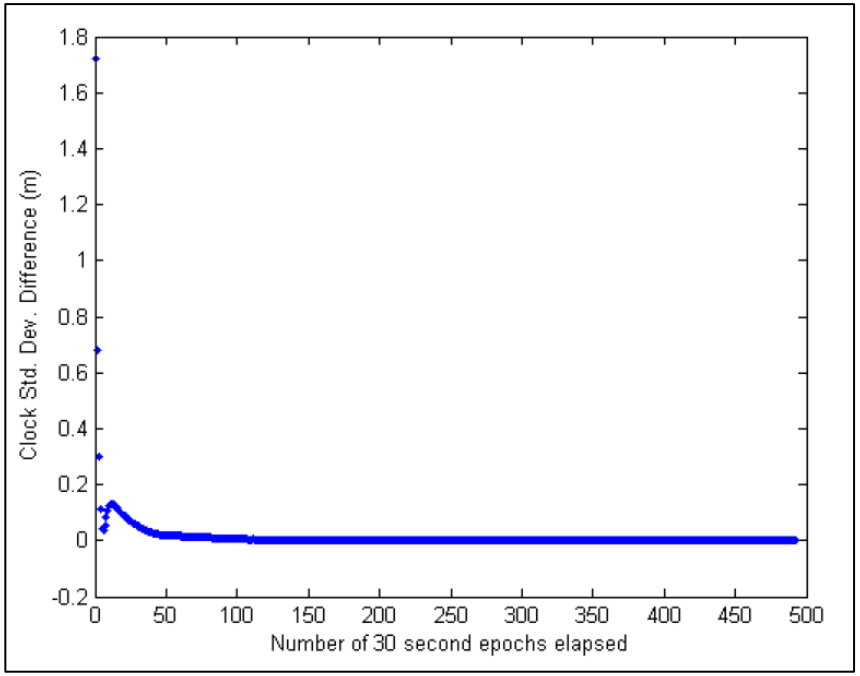

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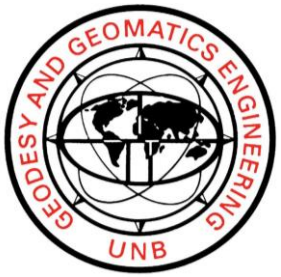
Comments

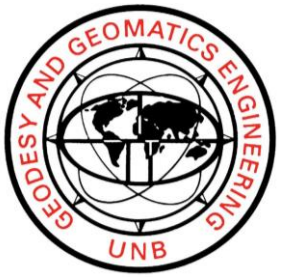
- Program strengths

- Program weaknesses



Summary

- Comparisons made with current version of GAPS and other PPP services
- Datasets provide consistent means of comparison
- Comparison process automated



Acknowledgments

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