Natural Resources Canada | Ressources naturelles Canada

Updates to the CSRS-PPP online service

Simon Banville, Brian Donahue, Justin Farinaccio, Elyes Hassen, Philippe Lamothe

NRCan, Canadian Geodetic Survey

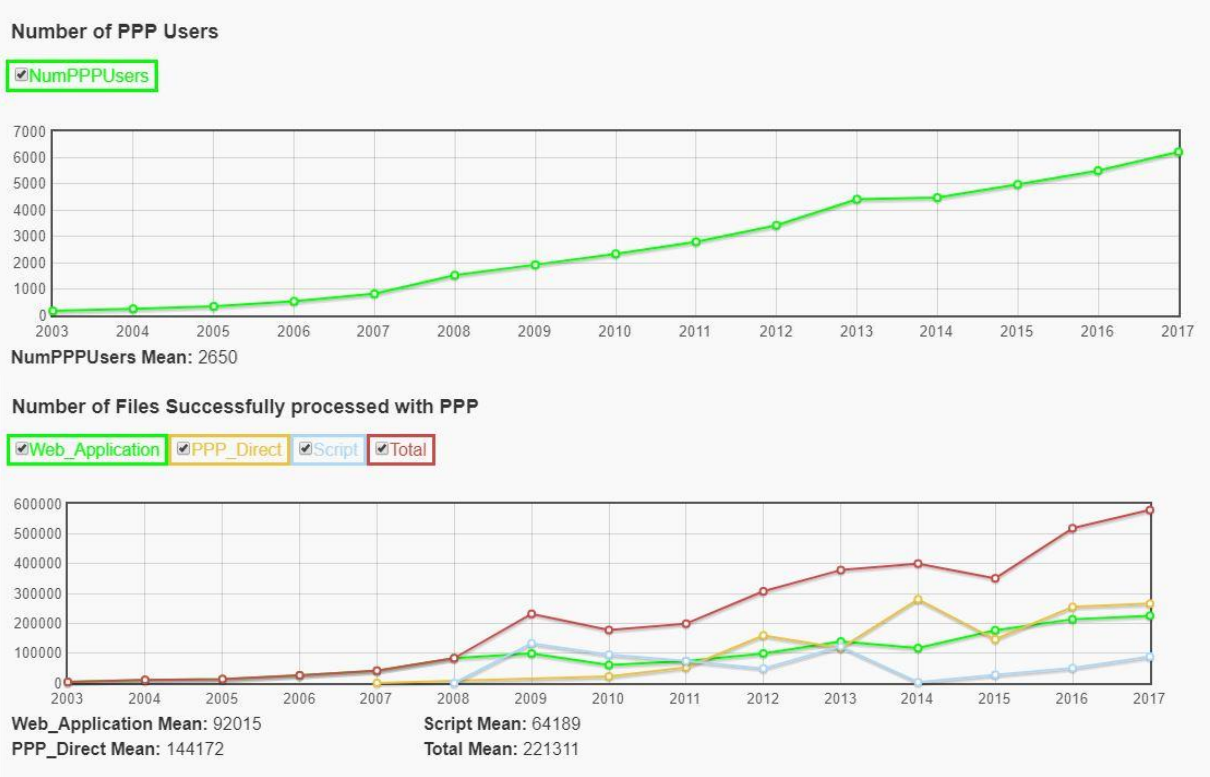
IGS Workshop 2018, 29 Oct – 2 Nov, Wuhan

Canada

CSRS-PPP Service

- Users submit RINEX files through:
  - Web interface (https://webapp.geod.nrcan.gc.ca/geod/tools-outils/ppp.php)
  - PPP Direct (desktop application)
  - Script for automated/batch processing
- PPP solution outputs include:
  - Estimated position / trajectory
  - Tropospheric zenith delay
  - Receiver clock offsets
- Online service available since 2003

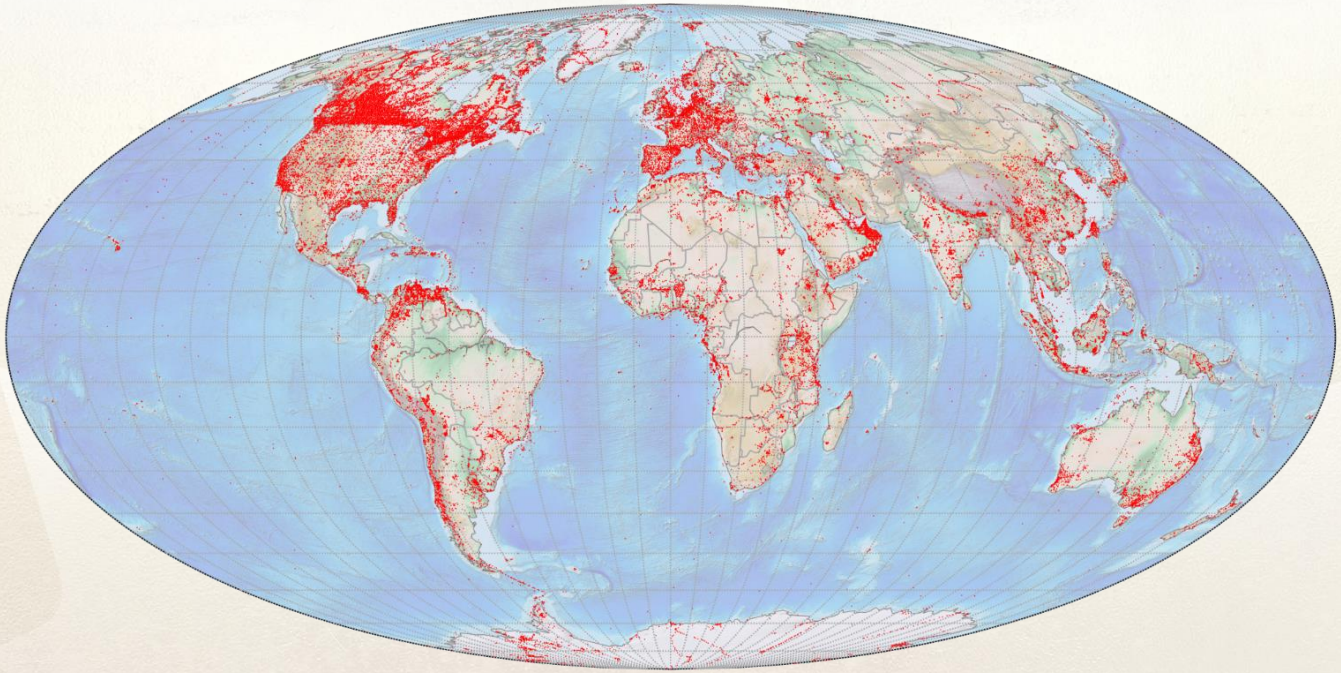
CSRS-PPP Service



Over 6,000 active users

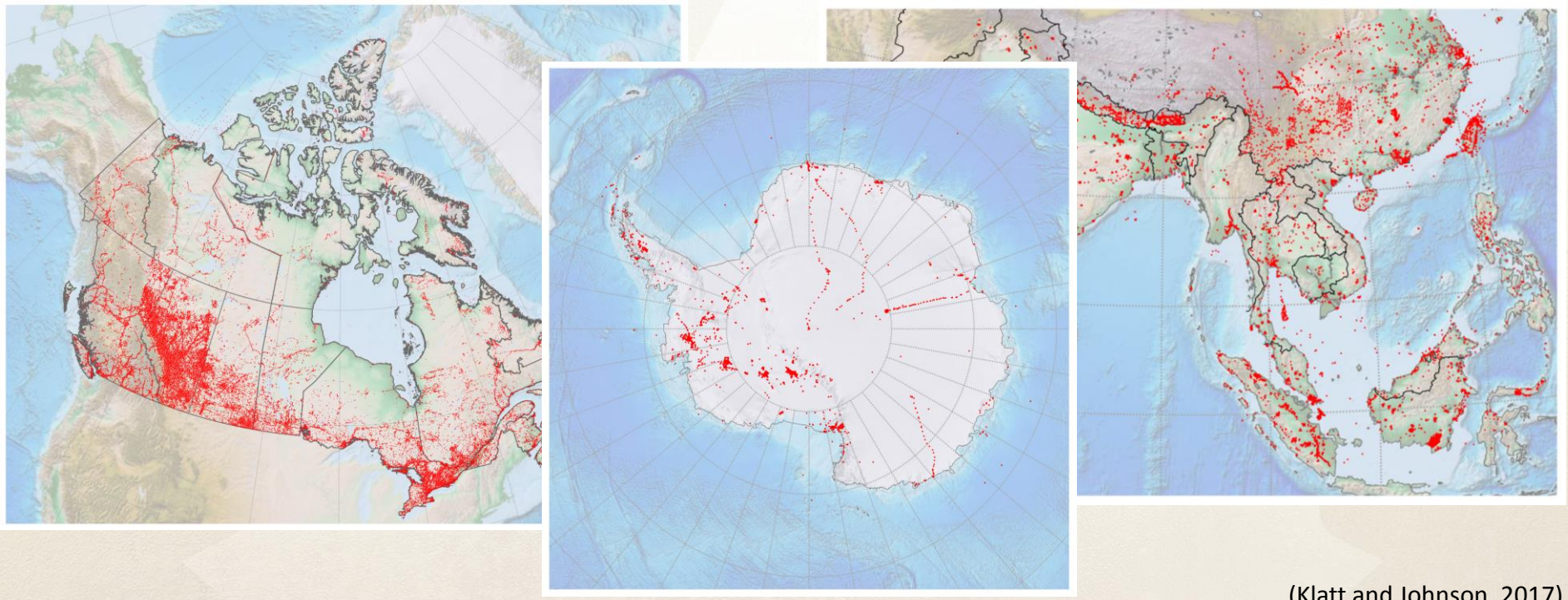
Close to 600,000 RINEX files processed last year

CSRS-PPP Service



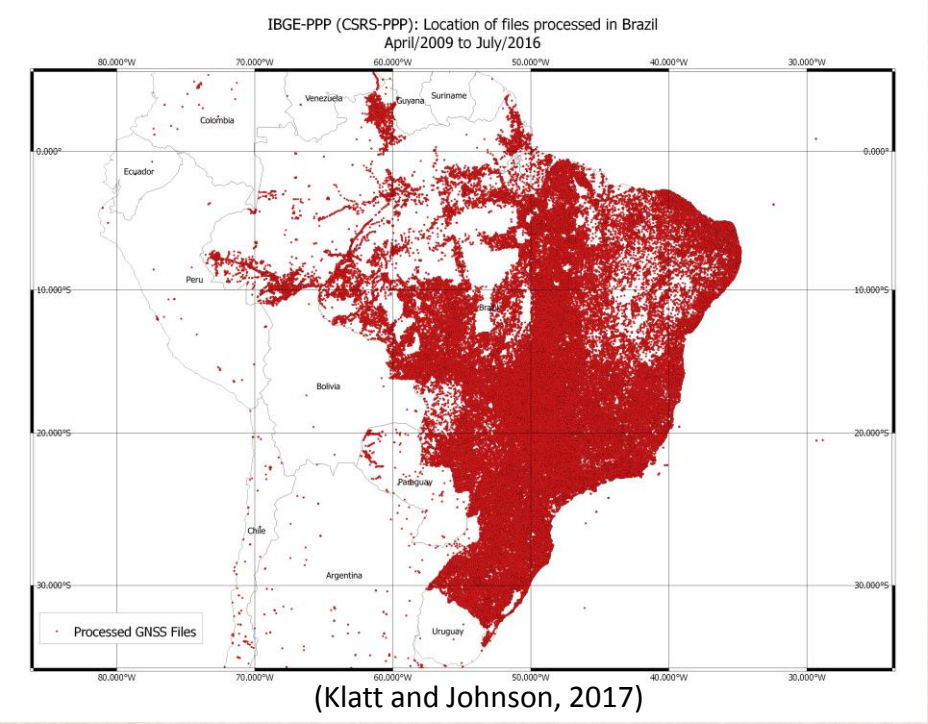
(Klatt and Johnson, 2017)

CSRS-PPP Service



(Klatt and Johnson, 2017)

CSRS-PPP Service

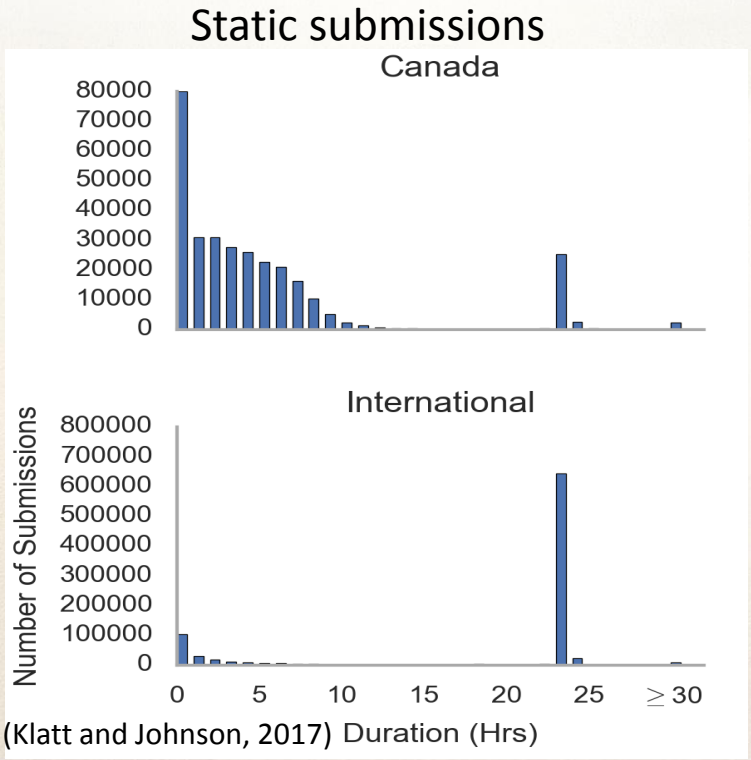


(Klatt and Johnson, 2017)

- NRCan PPP software used by the *Instituto Brasileiro de Geografia e Estatística*

http://www.ppp.ibge.gov.br/ppp.htm

CSRS-PPP Service



(Klatt and Johnson, 2017)

In 2017:

- 89% static (11% kinematic)
- 99% dual-frequency
- 21% NAD83(CSRS), 79% ITRF

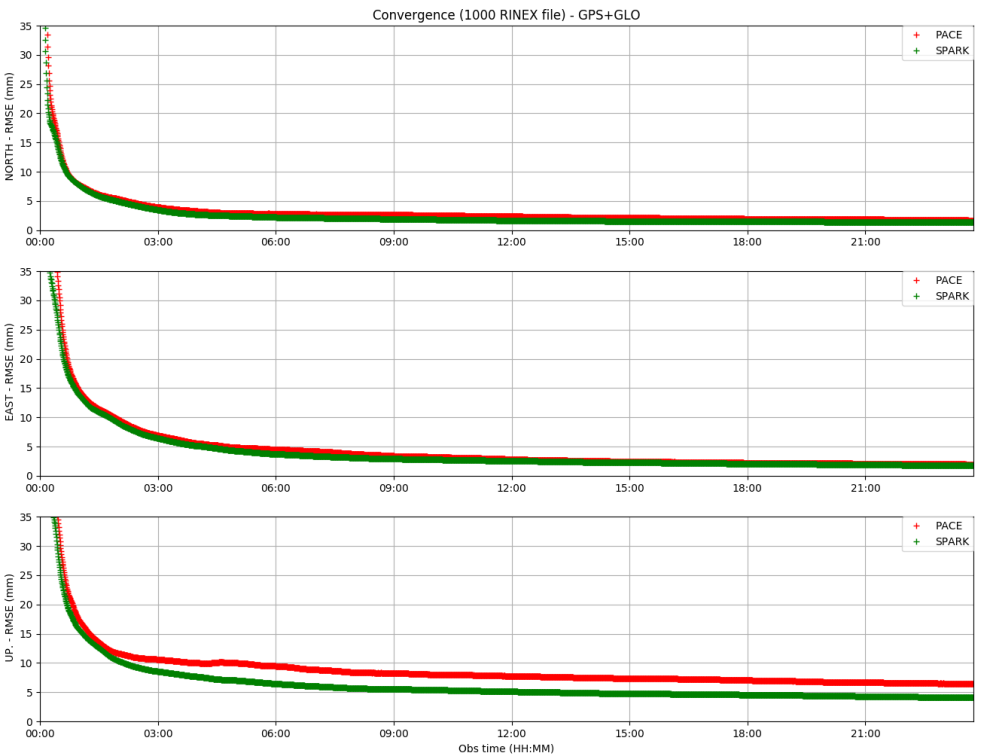
Orbit and Clock Products	Usage
NRCan Ultra-rapid	7%
NRCan Rapid	20%
IGS Final	68%
IGS Final (repro1)	5%

Service Modernization

- The new processing engine (online 16 Aug 2018):
  - Is capable of handling all constellations and signals
  - Supports RINEX version 3
  - Is our pathway to faster convergence:
    - ambiguity resolution (AR)
    - precise ionospheric corrections

    (features available in 2019)

Service Modernization

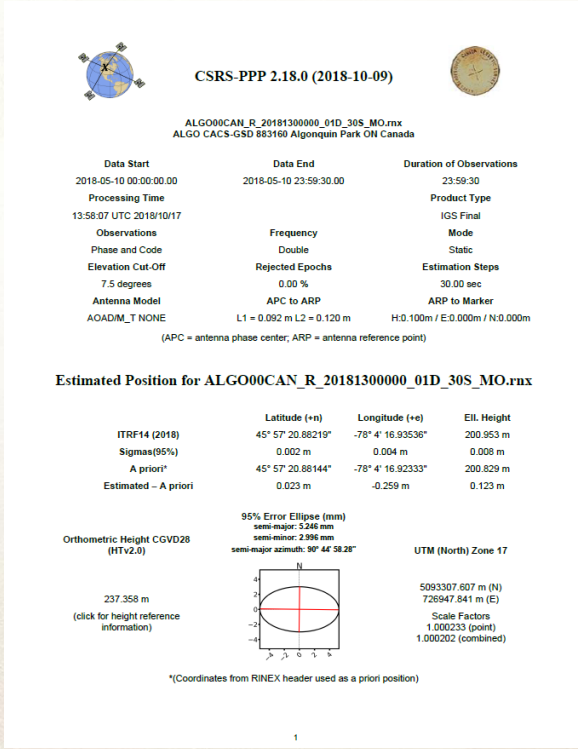


- Convergence analysis based on 1000 RINEX files (20 stations, 50 weeks) in 2016
- Height bias (4-5 mm) in previous engine (PACE) due to Shapiro correction not being accounted for
- Improved kinematic solution performance

Service Modernization

- User Impacts
  - No impact on RINEX submission process
  - Height discontinuity (mm level)
  - Some output files have changed (sum, res) but PDF almost identical

- PPP-AR will bring further benefits to users



CSRS-PPP 2.18.0 (2018-10-09)

ALGO00CAN_R_20181300000_01D_30S_MO.rnx
ALGO CACS-GSD 883160 Algonquin Park ON Canada

Data Start	Data End	Duration of Observations
2018-05-10 00:00:00.00	2018-05-10 23:59:30.00	23:59:30
Processing Time		**Product Type**
13:58:07 UTC 2018/10/17		IGS Final
Observations	**Frequency**	**Mode**
Phase and Code	Double	Static
Elevation Cut-Off	**Rejected Epochs**	**Estimation Steps**
7.5 degrees	0.00 %	30.00 sec
Antenna Model	**APC to ARP**	**ARP to Marker**
AOAD/M_T NONE	L1 = 0.092 m L2 = 0.120 m	H:0.100m / E:0.000m / N:0.000m

(APC = antenna phase center; ARP = antenna reference point)

Estimated Position for ALGO00CAN_R_20181300000_01D_30S_MO.rnx

	Latitude (+n)	Longitude (+e)	Ell. Height
ITRF14 (2018)	45° 57' 20.88219"	-78° 4' 16.93536"	200.953 m
Sigmas(95%)	0.002 m	0.004 m	0.008 m
A priori*	45° 57' 20.88144"	-78° 4' 16.92333"	200.829 m
Estimated – A priori	0.023 m	-0.259 m	0.123 m

Orthometric Height CGVD28 (HTv2.0)

237.358 m

(click for height reference information)

95% Error Ellipse (mm)
semi-major: 5.246 mm
semi-minor: 2.996 mm
semi-major azimuth: 90° 44' 58.28"

UTM (North) Zone 17

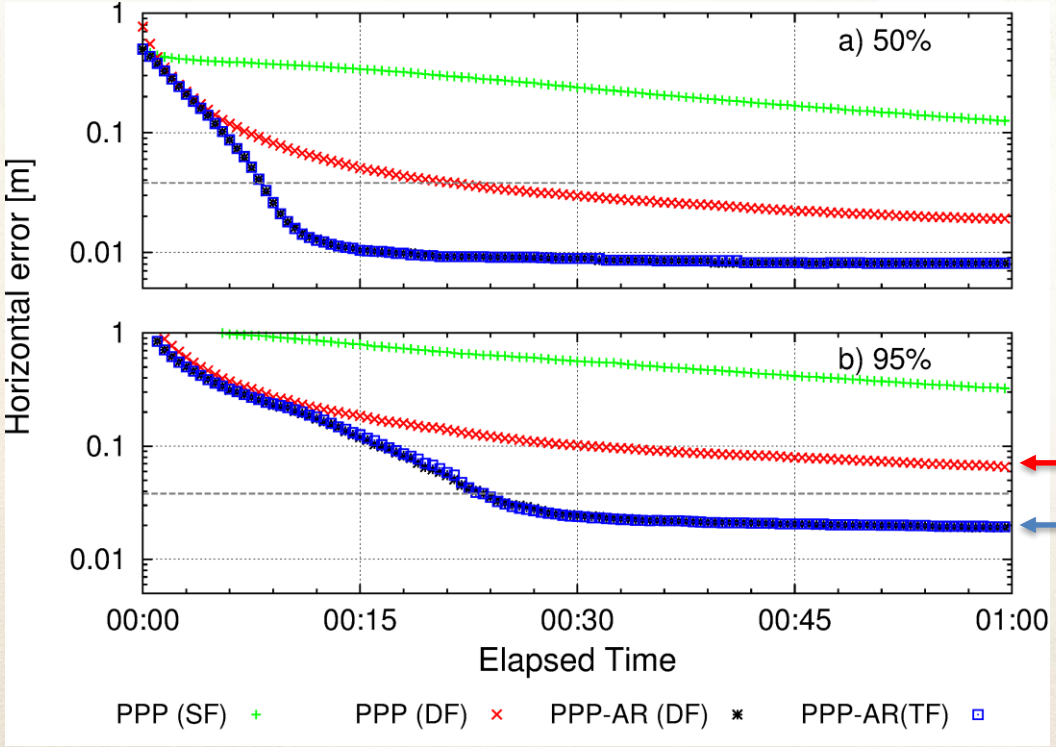
5093307.607 m (N)
726947.841 m (E)

Scale Factors
1.000233 (point)
1.000202 (combined)

*(Coordinates from RINEX header used as a priori position)

1

Future Plans



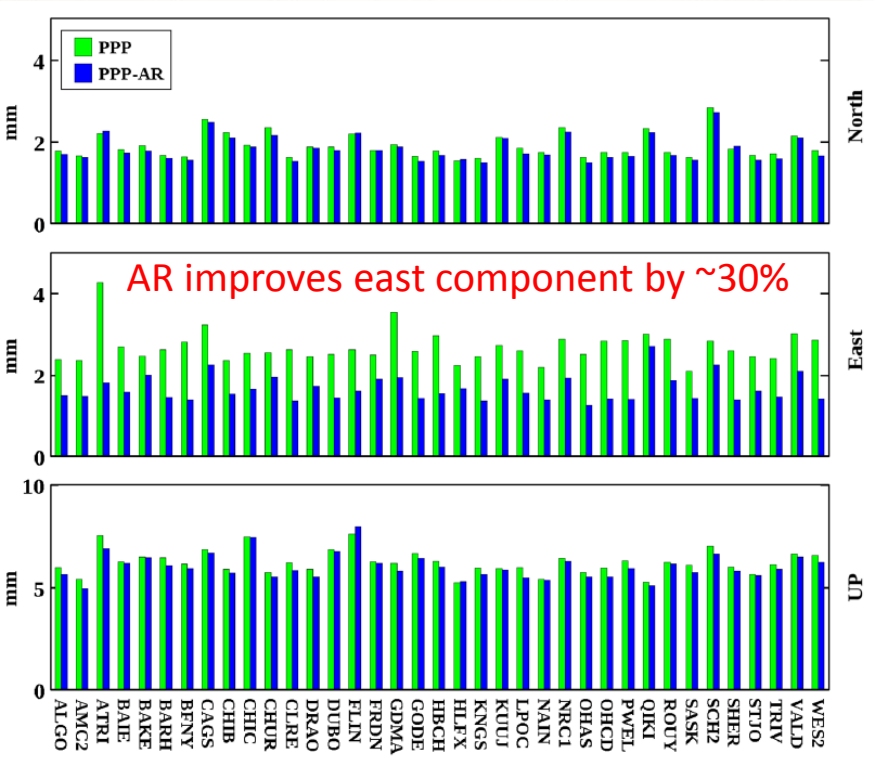
- PPP convergence analysis based on 40 globally distributed stations, 24 hourly sessions

Actual service

Future service

- Useful for shorter on-site occupation times

Future Plans



(Goudarzi and Banville, 2017)

- ~40 stations in eastern Canada-USA processed over a 10-year period.
- This plot shows the repeatability of daily PPP-AR positions after removing linear and seasonal trends, and discontinuities.

Future Plans

- The NRCan CSRS-PPP service relies on IGS products (70% of files ≈ 400,000 in 2017)
- Performing PPP-AR at the user end requires clock and bias (code and phase) products.
- To offer a PPP-AR service, we would currently need to rely on our own products instead of the IGS products.

Future Plans

- Since NRCan is a contributor to, and user of, IGS products, we proposed a new IGS PPP-AR working group (WG)
- The PPP-AR WG would analyze the feasibility of combining these products:
  - Analyze the inter-operability of clock/bias products among ACs
  - Assess current data formats for completeness (satellite attitude)
  - Develop and test a modernized clock/bias combination software
  - Make recommendations to the GB about adding a combined clock/bias solution as an official IGS product

Summary

- NRCan CSRS-PPP service used globally to access the ITRF
- The service leverages IGS products (final and repro)
- A modernized engine was introduced in August 2018
- Future plans include ambiguity resolution
- NRCan has proposed a new WG to analyze the feasibility and benefits of having the IGS adopt a modernized clock/bias combination process

Acknowledgements

Thanks to all agencies contributing data and products to the IGS, which makes our service possible

Contact

simon.banville@canada.ca

This work is published as NRCan contribution number 20180245