NRCan Precise Point Positioning (PPP) Service

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Outline

- **PPP Concepts**
- **Compare NRCan PPP and OPUS**
- **CSRS-PPP**
  - **Current functionality**
  - **Accuracy**
  - **Access**
- **What's Next**

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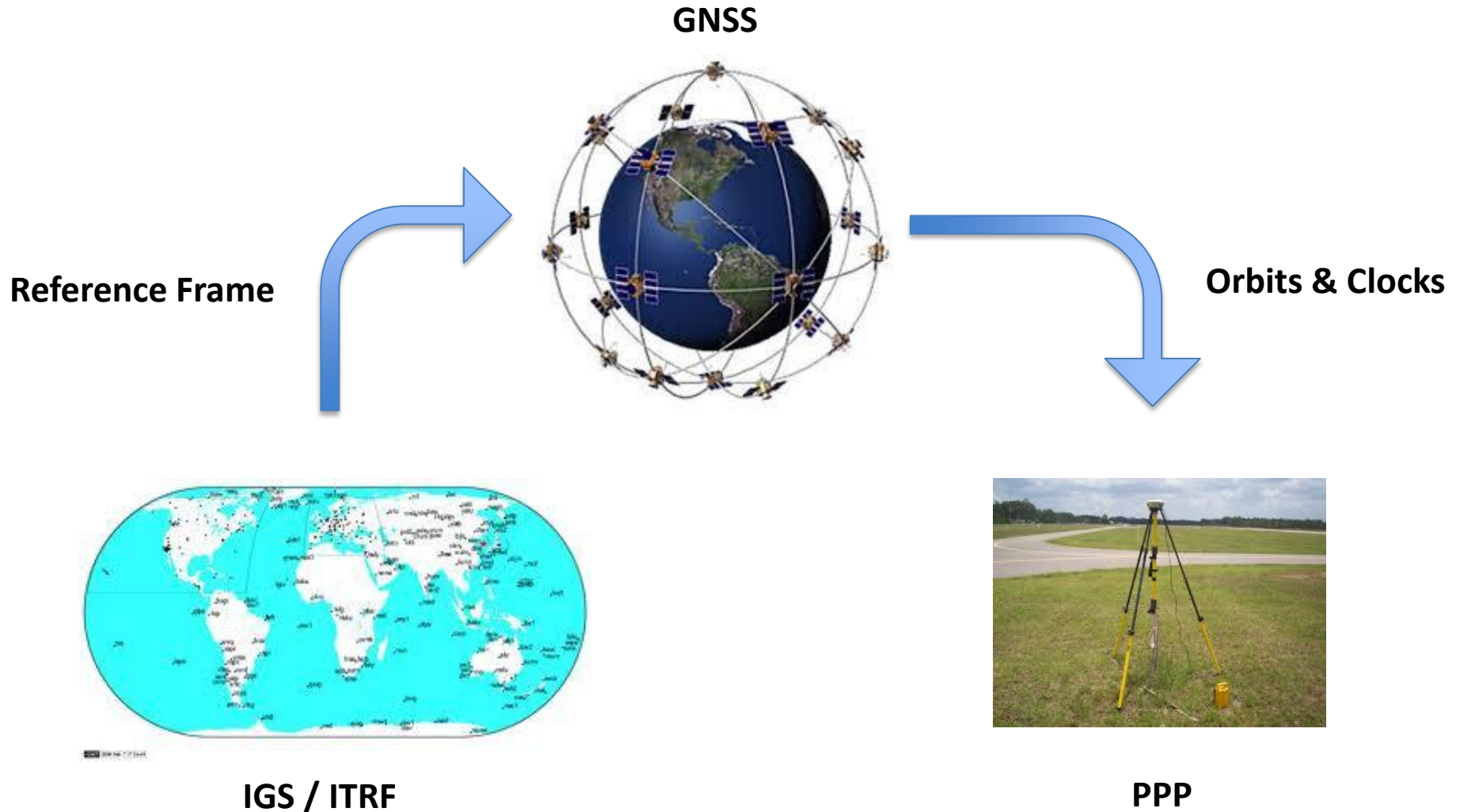
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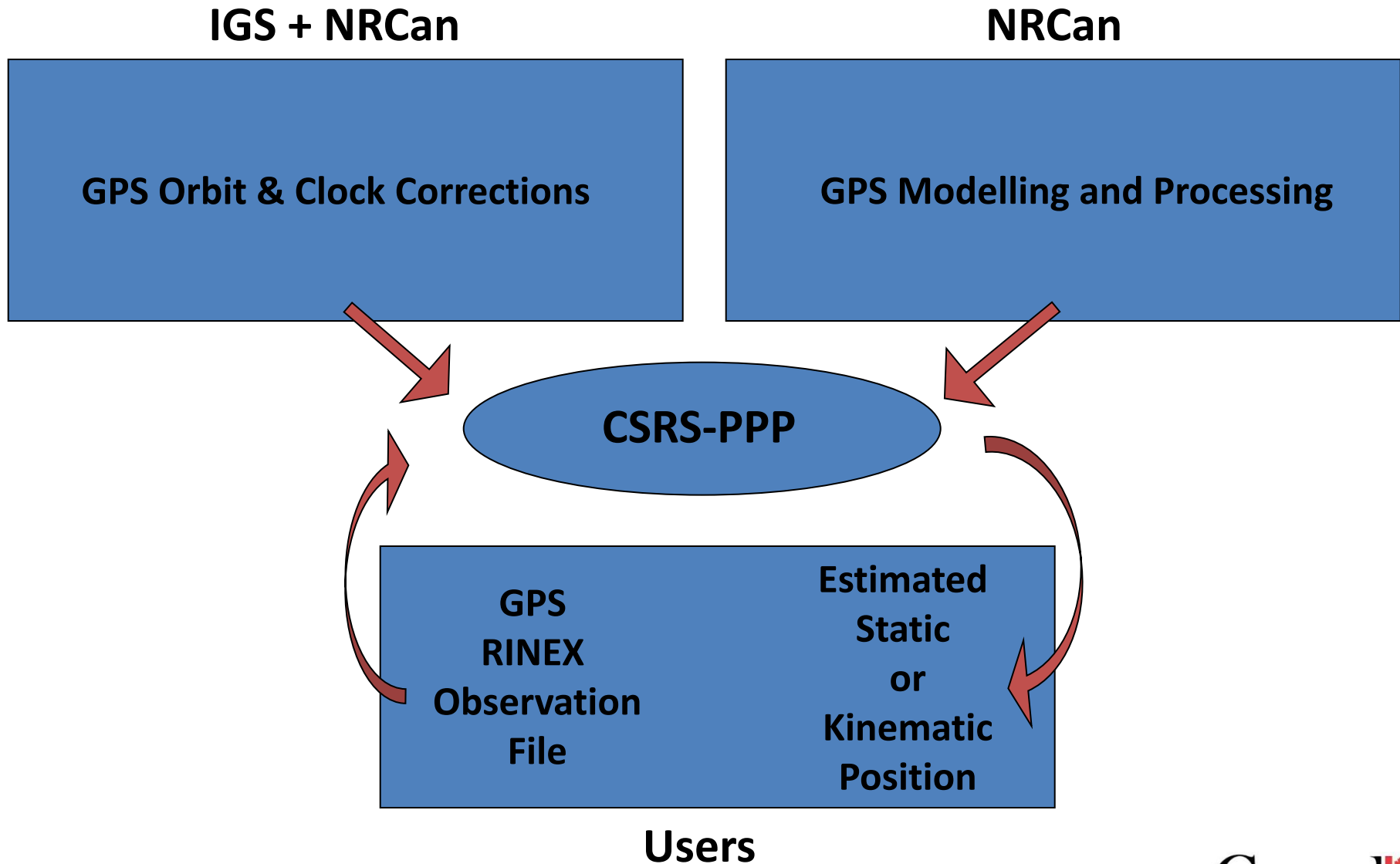
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NRCan PPP Background

- **Canada has the second largest landmass in the world (~10M square KM), ~35 Million people, 66% of the population live with ~300 KM of US border.**

- **CGS mandated to provide positioning for the entire landmass and offshore.**

- **PPP was chosen as the most cost effective means of replacing the traditional ground based control network and providing positioning services for the entire country.**

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Is PPP really using just one station?

GNSS

Reference Frame

Orbits & Clocks

IGS / ITRF

PPP

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Distributed Processing

IGS + NRCan　　　　　　　　　　**NRCan**

GPS Orbit & Clock Corrections

GPS Modelling and Processing

CSRS-PPP

GPS RINEX Observation File

Estimated Static or Kinematic Position

Users

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NRCan PPP and NGS OPUS

OPUS	PPP
Static	Static and kinematic
Use base stations	No direct base station
Opus Projects	No equivalent
Solution sharing	Planned
GPS	GPS and GLONASS
Fixed ambiguities	Real number ambiguities
30 second processing	RINEX data rate processing

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Processing

Estimated

- **position (antenna phase centre or survey marker)**
- **receiver clock**
- **tropospheric correction**
- **carrier phase ambiguities (in *.pos file)**

A priori / Fixed

- **satellites orbits and clocks**

Modelled

- **antenna offsets and phase wind-up**
- **solid earth and polar tides**
- **ocean loading**
- **high order iono corrections**

Cancelled

- **ionospheric first order effects (dual frequency)**

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CSRS-PPP: Current Functionality

Using data from a single GNSS receiver

- **Static or kinematic processing**
- **GPS (90 minute delay) or GPS + GLONASS (3 hour delay)**
- **Single or dual-frequency (L1 or L1 + L2)**
- **Epoch specific (1997, 2002, 2010, current) NAD83(CSRS) or ITRF (current)**
- **Orthometric Height - Canadian Vertical Geodetic Datum 1928 (CGVD28)(Only Canada) or CGVD2013(North America)**
- **UTM and MTM coordinates**
- **Orbits & clocks**
  - **90 minutes after end of hour (GPS)**
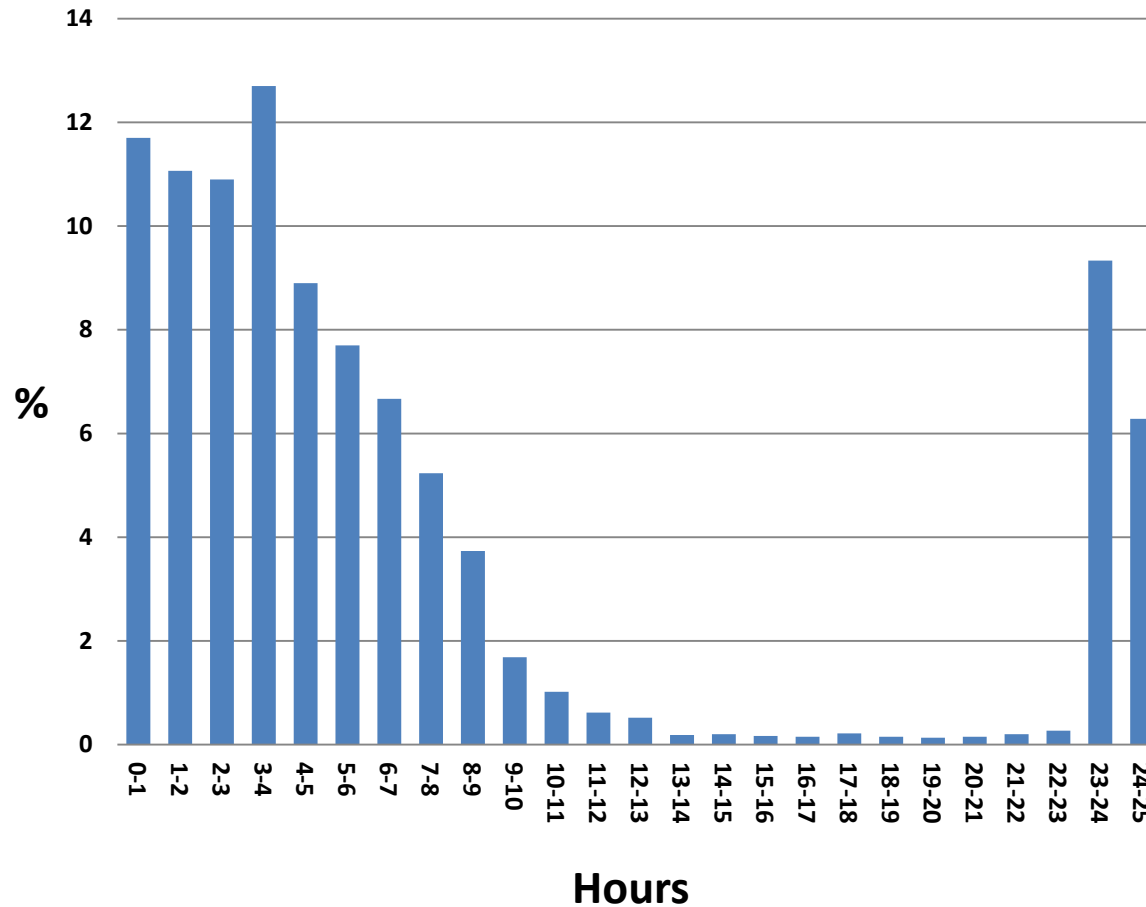 - **3 hours (GLONASS)**

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Processed RINEX Files (2009-2013)
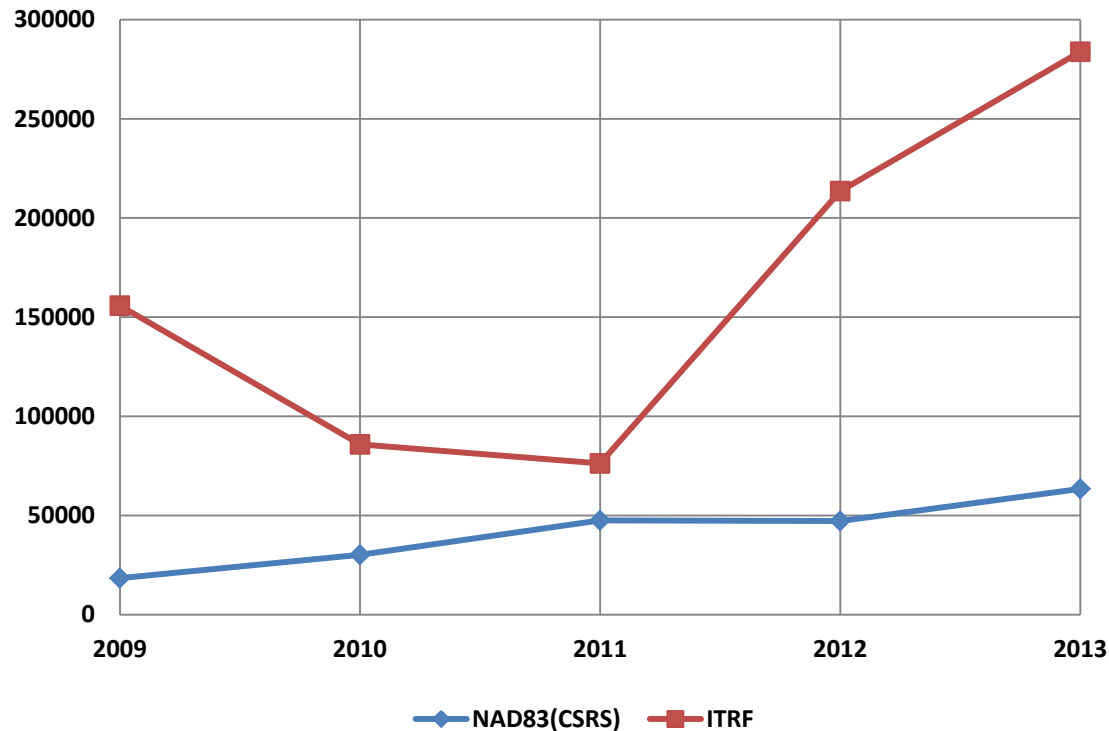
~ 90% of NAD83(CSRS) processing is done in static mode
~ 95% of NAD83(CSRS) processing use dual-frequency data

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Observation Periods

Hours

NAD83(CSRS) submissions 2009-2014

Accuracy After Convergence

Receiver	Observations	PPP Mode	Precision (cm)		
			Latitude	Longitude	Height
Dual Frequency (Converged)	Code & Carrier	Static	1	1	2
		Kinematic	5	4	10
Single Frequency	Code Only	Static	10 (2)	10 (3)	100 (4)
	(Code & Carrier)	Kinematic	50 (25)	50 (25)	150 (50)

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CSRS-PPP Access

- **Input**
  - **Web page**
  - **PPP-Direct (Windows desktop App.)**
  - **Automation (same station, every day …)**

- **Output**
  - **Web and PPP-Direct** ⟶ **E-Mail(24 hours)**
  - **Automation** ⟶ **URL for direct access**

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Precise Point Positioning

▶ Help for CSRS PPP (**Updated 2014-03-07**)

Email for results (**required**)

your email here

Processing mode

◉ Static   ◯ Kinematic

NAD83   ITRF

Epoch

Vertical datum

CGDV28(HT2_0) ▼

▶ More options

RINEX observation file (**required**) (.zip, .gzip, .gz, .Z, .??O)

Choose File   No file chosen

Submit to PPP

CGVD2013 is an option but not current default

CGVD2013 is geoid based using a W_0 selected conjointly between the US and Canada

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Epoch change performed using NRCan's velocity model for Canada

RINEX Format & Your Antenna



```
    2.10           OBSERVATION DATA    G (GPS)           RINEX VERSION / TYPE
teqc  2000Jul20     ACS data           20030107 01:06:36UTCPGM / RUN BY / DATE
HP-UX 10.20|PA-RISC|cc A.10.32.03|=+|=|                 COMMENT
ALGO CACS-ACP   883160 ALGONQUIN PARK, ONT,  CANADA     MARKER NAME
40104M002                                              MARKER NUMBER
-Unknown-          GEOD. SURVEY, NATURAL RESOURCES CANADA  OBSERVER / AGENCY
1103            AOA BENCHMARK ACT    3.3.32.2N          REC # / TYPE / VERS
386             AOAD/M_T                               ANT # / TYPE
   918130.0400 -4346072.6600  4561977.9300             APPROX POSITION XYZ
        0.1000       0.0000        0.0000              ANTENNA: DELTA H/E/N
    1     1                                             WAVELENGTH FACT L1/2
    7    L1   L2   C1   P2   P1   S1   S2               # / TYPES OF OBSERV
   30.0000                                              INTERVAL
L1 PHASE CENTRE 0.110m ABOVE ARP                       COMMENT
L2 PHASE CENTRE 0.128m ABOVE ARP                       COMMENT
where ARP is the Antenna Reference Point for HI measurement  COMMENT
    P1 =    P1 TurboRogue; =    Y1 Benchmark            COMMENT
    L1 = L1(CA)                                         COMMENT
    P2 =    P2 TurboRogue; =    Y2 Benchmark            COMMENT
```

APC

APC to ARP offset

ARP

ARP to Marker vertical distance

Survey Marker
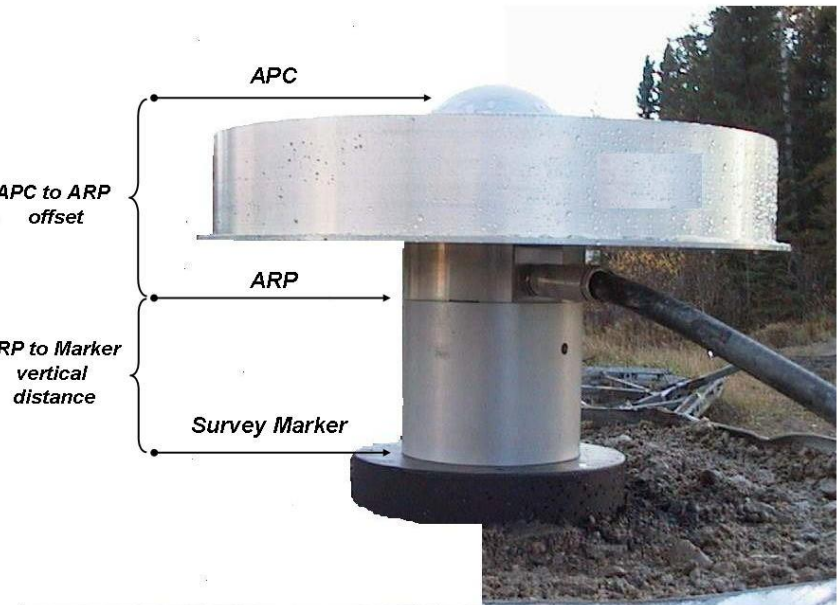
CSRS-PPP antenna database also includes variations in phase centre position due to elevation and azimuth of satellites, not just offset from ARP

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What's Next

- **Modernize IT equipment and strategy to reduce solution delay(job scheduling, RINEX file: preprocessing, period, data frequency etc.)**

- **Provide alternate access to results (login to access results)**

- **Implement crowdsourcing strategy to update database positions of old monuments**

- **Implement cooperative PPP (share ionosphere corrections to improve convergence time)**

- **Implement integer fixed ambiguities**

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QUESTIONS?

- **Web: www.geod.nrcan.gc.ca**
- **Email: information@geod.nrcan.gc.ca**
- **PPP Web page: http://webapp.geod.nrcan.gc.ca/geod/tools-outils/ppp.php?locale=en**
- **Phone: 1-613-995-4410**

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