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From Service to Reference Frame

SWEPOS-PPS in the Realization of SWEREF 99

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SWEPOS Post Processing Service (PPS)

SWEPOS-PPS: reference-frame access

- Online static GNSS post-processing service
- Coordinates in SWEREF 99 and ITRF2020
- Uses SWEPOS reference stations and Bernese GNSS Software
- Supports users, infrastructure projects, SWEPOS stations, and monitoring

Coordinate realization workflow

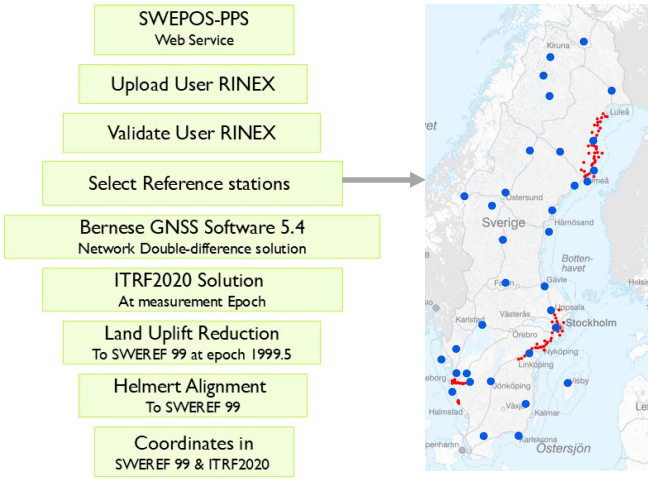


Figure 1: From user RINEX to SWEREF 99 coordinates: quality control, station selection, Bernese processing, land-uplift reduction, and Helmert alignment.

Operational use cases

Table 1. Main SWEPOS-PPS service types and processing strategies.

Service	Typical use	Reference stations	Observable	Troposphere
Nationwide Ordinary Service	SWEREF 99 coordinates anywhere in Sweden	• Blue dots in Figure 1 • 70–500 km baselines	LC (ionosphere-free)	• Full VMF3 • Estimated wet delay
Project Adapted Service	Infrastructure projects	• Red dots in Figure 1 • 5–20 km baselines	L1 only	• Full VMF3 applied • No estimation
SweposQC Service	RINEX quality report	-	-	-

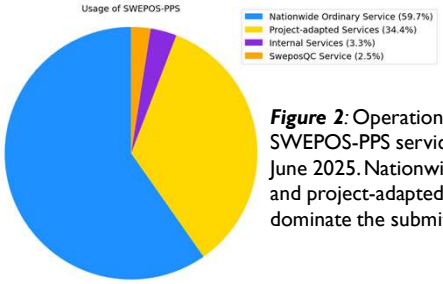


Figure 2: Operational use of SWEPOS-PPS services, April 2024–June 2025. Nationwide ordinary and project-adapted services dominate the submitted jobs.

Service Accuracy, ~95% level

- 2-3 h sessions:
  - 1-2 cm horizontal
  - 2-3 cm vertical
- 24 h session with choke-ring antenna:
  - 6 mm horizontal
  - 12 mm vertical

What controls coordinate quality?

Observation time + multi-GNSS

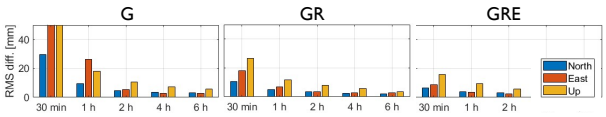


Figure 3: Coordinate RMS decreases with observation time. Multi-GNSS solutions reach centimeter-level accuracy faster than GPS-only solutions. ≥ 2 h: < 1 cm horizontal, < 2 cm vertical

Reference station geometry

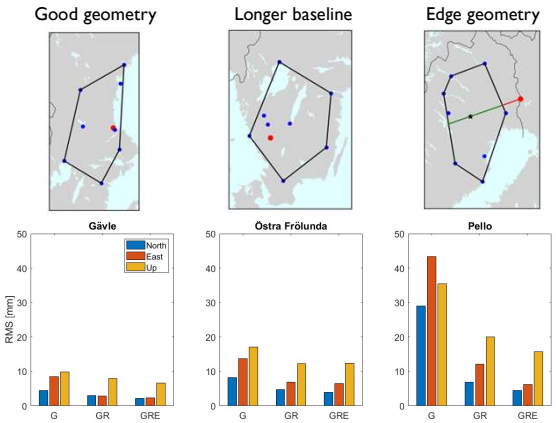


Figure 4: Reference-station geometry affects repeatability. Edge-of-network geometry increases extrapolation risk and reduces solution robustness.

Troposphere modelling and height bias

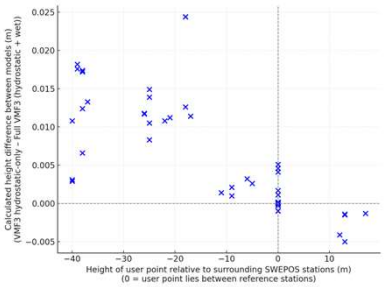


Figure 5: Project-adapted PPS: height differences between hydrostatic-only VMF3 and full VMF3 increase when user points differ in elevation from nearby reference stations.

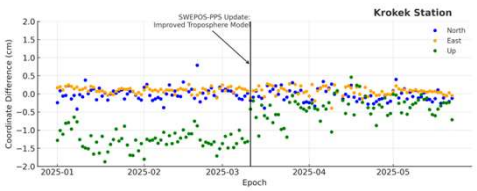


Figure 6: Krokek – a project-adapted PPS monitor station: full VMF3 reduced the systematic 1.2 cm height bias after the SWEPOS-PPS troposphere update.

Takeaway: SWEPOS-PPS links daily GNSS measurements to long-term SWEREF 99 stability through quality control, consistent processing, and traceable frame alignment.

Based on: Abraha et al. (2026), GPS Solutions, 30:53.