

Real-time GPS vs full-GNSS time series accuracies estimations at RING INGV research infrastructure

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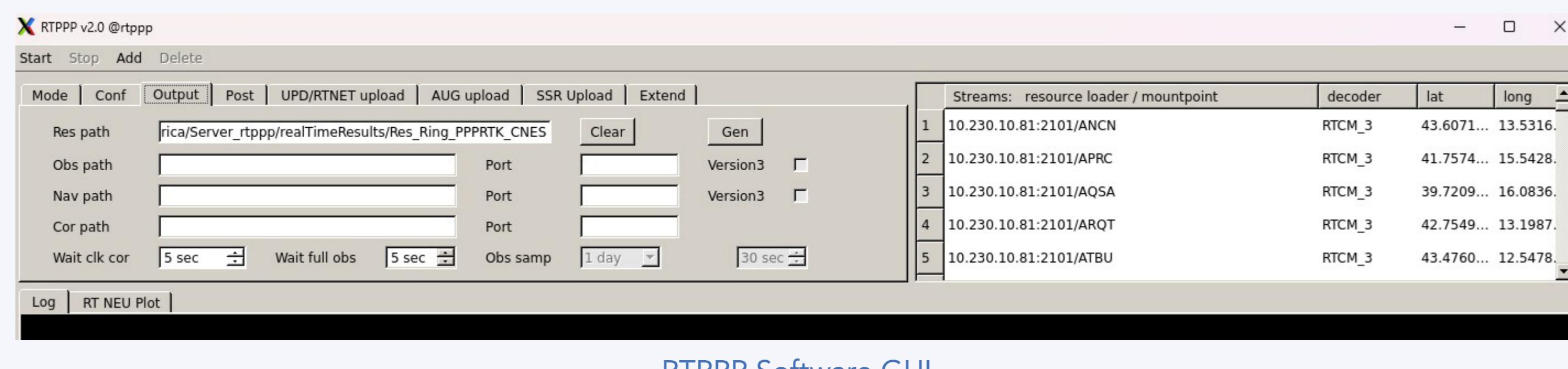
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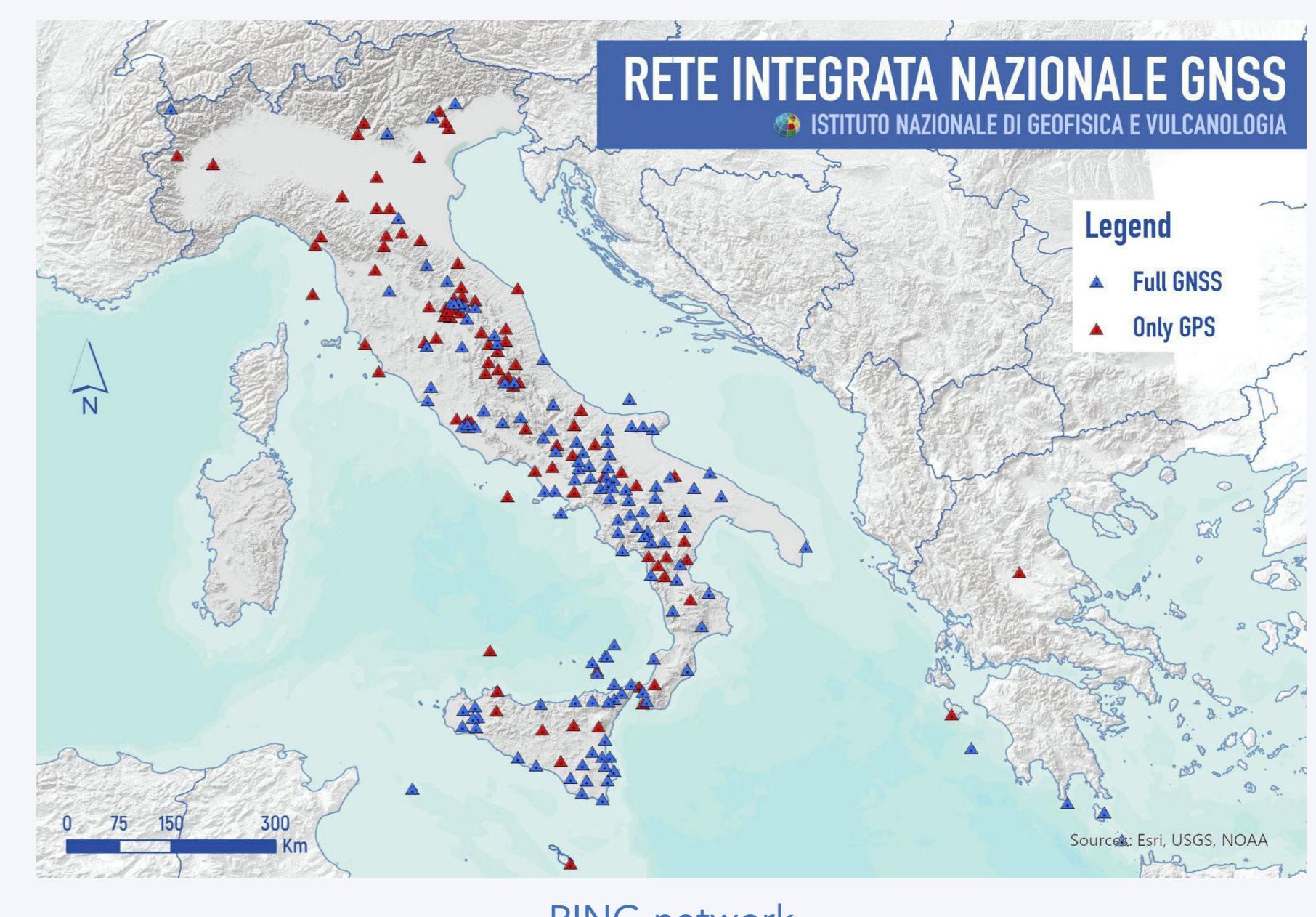
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ABSTRACT The RING (Rete Integrata Nazionale GNSS) is a research infrastructure developed for accurately measuring deformations at different spatial and temporal scales in the Eurasia-Africa plate boundary region (Avallone et al., 2010). Currently, the RING network (<http://ring.gm.ingv.it/>) is composed of 250 real-time transmitting remote sites, 70% of which are now equipped with full-GNSS (GPS, Galileo, Glonass and Beidou) instrumentation. The data streaming, in standard RTCM v.3 format, from these sites to the acquisition centre in southern Italy (Sezione Irpinia, Grottaminarda, AV) is managed by a tuned Ntrip Caster (<https://igs.bkg.bund.de/ntrip/bkgcaster>).

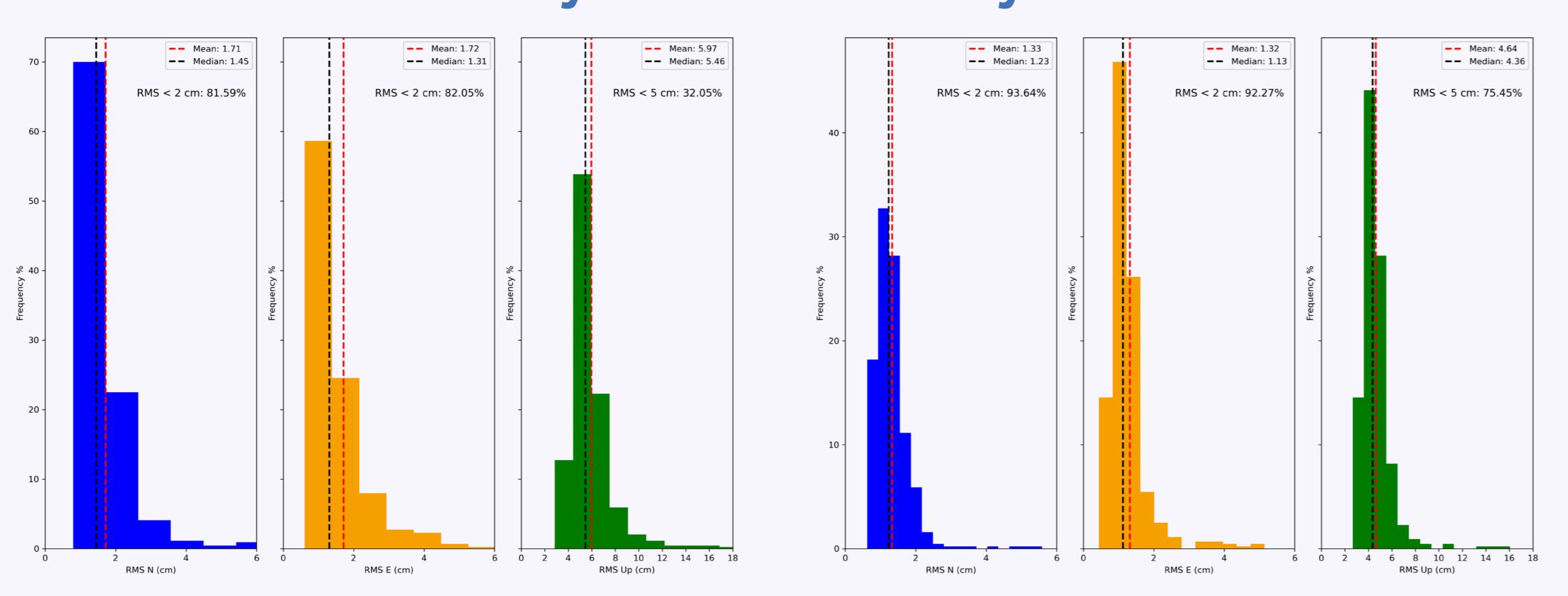


NTRIP CASTER



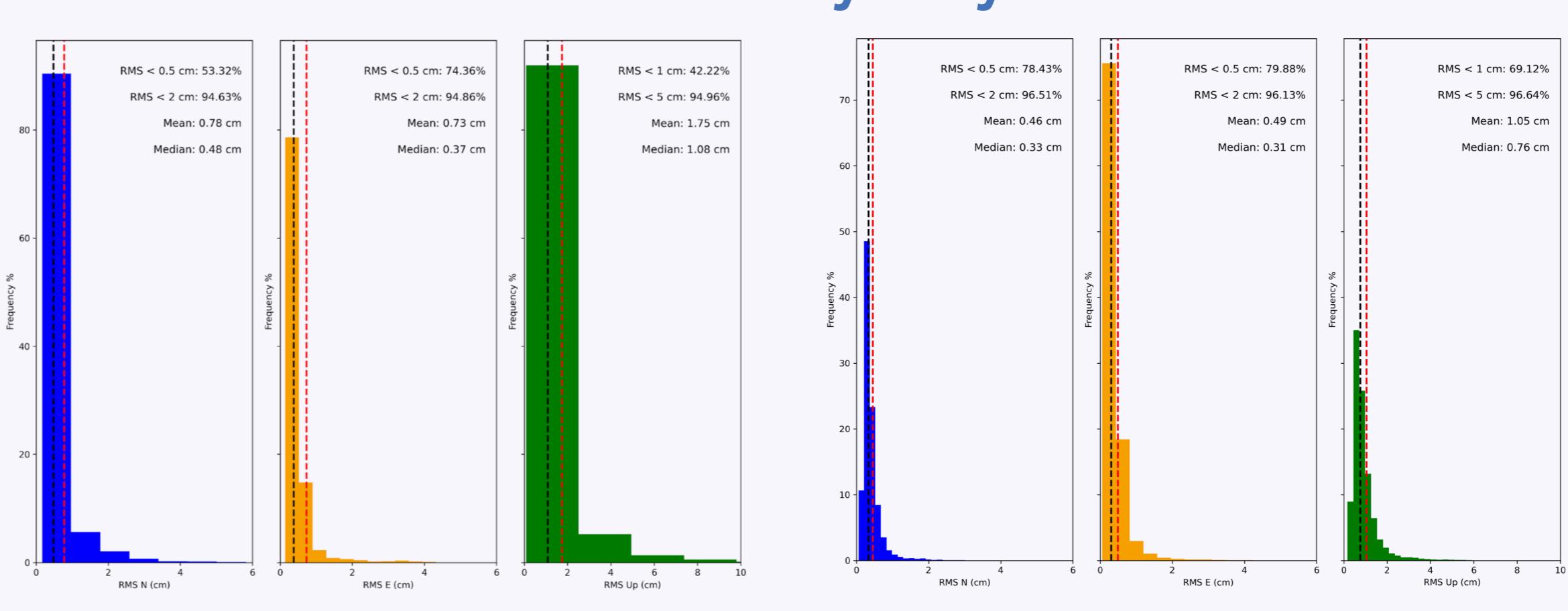
The typical magnitude of the strongest events that occurred in the last century in this region (5.5-7) should require high accuracy (2-3 cm) GPS/GNSS time series to properly observe both static and dynamic coseismic displacements and, then, to properly model the earthquake source. Furthermore, the detection of any afterslip or, in general, any transient deformation should require even better accuracy (< 2 cm). The real-time GPS/GNSS data analysis has been implemented by means of the RTPPP software developed by GFZ (Ge et al., 2012). This software allows the determination of various Precise Point Positioning products with increasing accuracy (standard PPP, PPP with ambiguity resolution [PPP-AR], and PPP with regional augmentation [PPP-RA]). We performed some preliminary investigations on different (limited in time) datasets and we compared GPS-only and full-GNSS results. In the case of GPS-only PPP-RA solutions, the accuracies estimated on 24-hour data for the whole network amount up to 1.7 cm and 6 cm for the horizontal and vertical components, respectively. In the case of full-GNSS solutions, the same approach (PPP-RA) allowed an improvement of about 22% on both horizontal and vertical components (1.3 cm and 4.6 cm). Furthermore, we compared both GPS-only and full-GNSS solutions with another method, i.e. by using a short-term accuracy analysis. Using 60-s or 120-s sliding windows, that should better simulate the time span for detecting coseismic displacements, we can achieve 0.5 cm and 1 cm for horizontal and vertical components, respectively, for GPS-only solutions, and 0.3 cm and 0.5 cm for full-GNSS ones.

GPS-only vs full GNSS daily RMSE



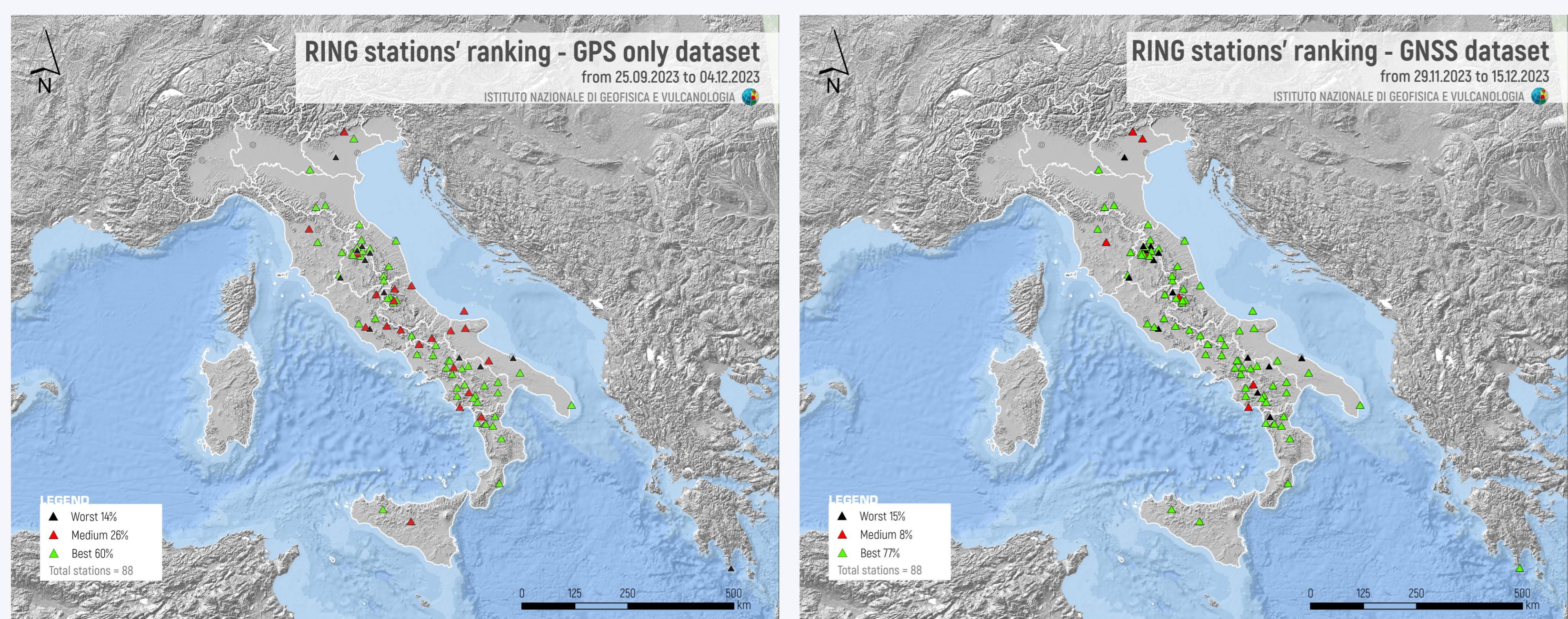
Distribution of daily RMSE over the GPS-only and GNSS dataset for the three components

Short-term accuracy analysis RMSE



Distribution of sub-daily windows RMSE over the GPS-only and GNSS dataset for the three components

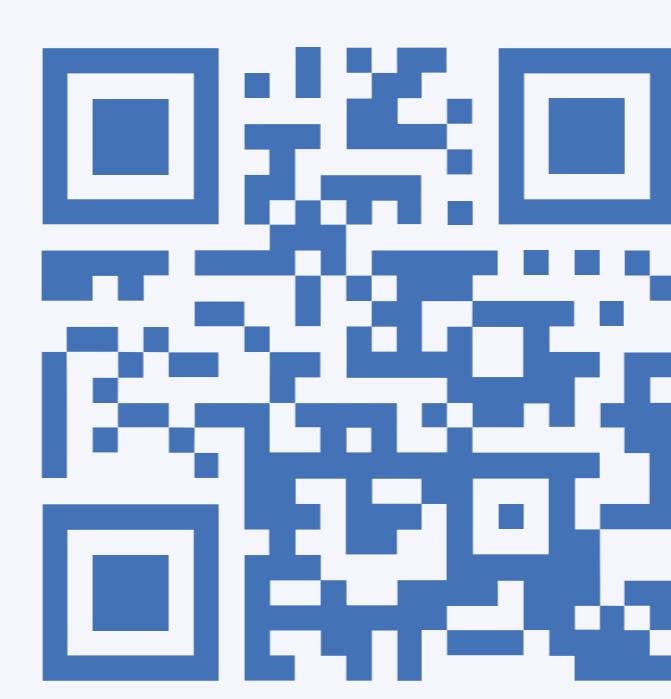
To evaluate the network performances, it is crucial to identify the stations that demonstrate optimal performance and reliability. In this study, a ranking methodology was applied to each station using the **GPS-only** and **full GNSS datasets**, considering all epochs. For the north and east components, stations were awarded **3 points if the daily RMSE was below 2 cm, 1 point if it ranged between 2 and 5 cm, and no points if it exceeded 5 cm**. Similarly, for the vertical component, stations received **3 points for a daily RMSE below 5 cm, 1 point for an RMSE between 5 and 7 cm, and no points if it exceeded 7 cm**.



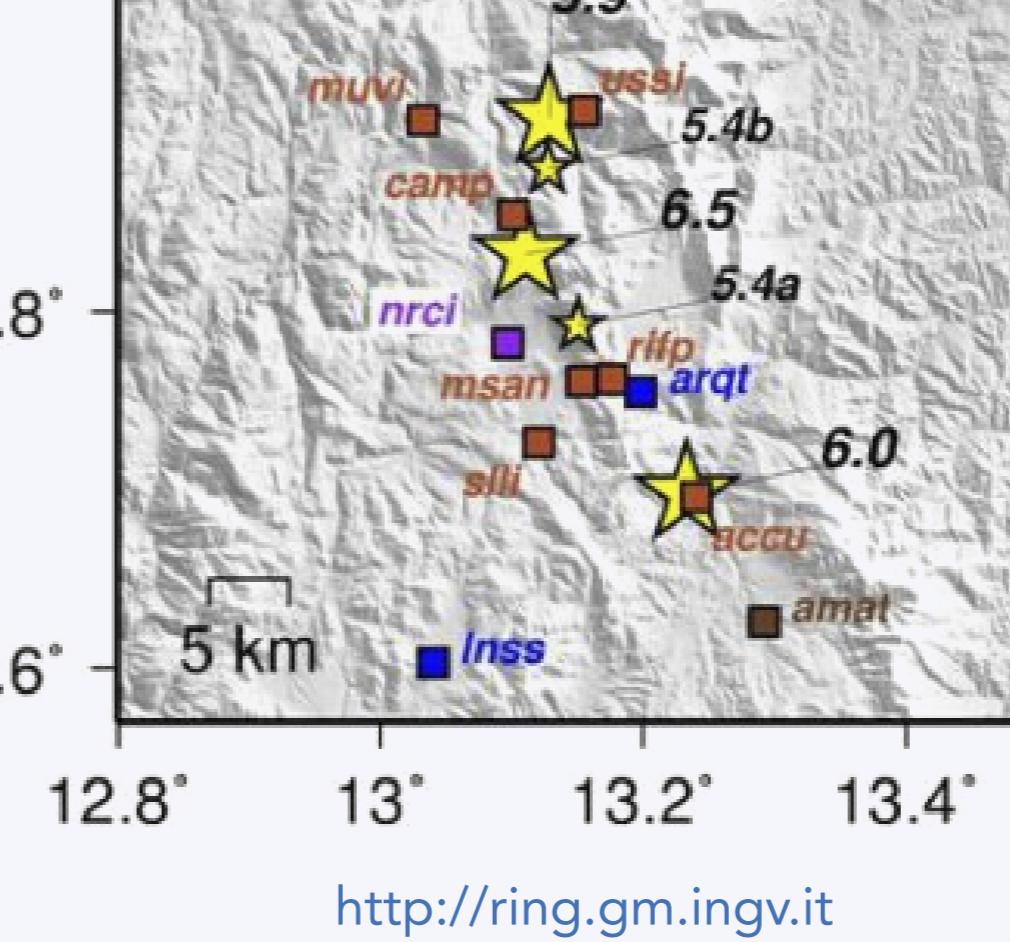
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For more details and info



SCAN ME



Finally, for a few examples of earthquakes that recently occurred in Italy, we will show comparisons between post processed high-rate solutions carried out by Gipsy-Oasis II solutions and those obtained by RTPPP simulating real-time time series. The obtained accuracies will demonstrate the reliability of the RING infrastructure real-time GNSS solutions for early warning and rapid response applications.

RIFP station - 10Hz

NORCIA earthquake 2016-10-30 6:40:17.36 UTC

