EPN data and products in support of atmospheric sounding

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The EUREF (http://www.euref.eu/) Permanent Network (EPN) is a science-driven network of continuously operating GNSS reference stations with precisely known coordinates, covering the European continent. All contributions to the EPN are voluntary, with more than 100 European agencies/universities involved, and redundancy is the key factor for the reliability of EPN data and products. As of December 2018, the EPN network contains 333 permanent stations. EPN stations provide daily and hourly data in the RINEX 2 and RINEX 3 format and, a growing number of them, real-time data in RTCM format at three EUREF regional broadcasters. The EPN Central Bureau (http://epncb.oma.be) performs the day-to-day management of EPN. Extensive guidelines guarantee the quality of the GNSS data and the resulting EPN products: station positions and velocities in the ITRS and ETRS89 and tropospheric estimates. Focusing on this last product, the 16 EPN Analysis Centers (AC) submit Zenith Total Delay (ZTD) parameters and horizontal gradients on a routine basis with a sampling rate of 1 hour in SINEX_TRO format. The EPN official tropospheric product is based on a combination of the contributing solutions using a generalized least square method. The mean bias and standard deviation of the AC individual ZTD contributions with respect to the combined ZTD solution allow monitoring the quality of the product. A Memorandum of Understanding is in place between EUREF and EUMETNET. This allows the EUMETNET Project E-GVAP (http://egvap.dmi.dk) free access to GNSS RINEX data of the EPN sites for European operational meteorology. On the other hand, EUMETNET provides to the EPN troposphere coordinator access to the radiosonde data from more than 100 stations, useful for an inter-technique comparison at co-located sites (http://www.epncb.oma.be/_productsservices/sitezenithpathdelays). The EPN Network has been set up back in the 90s. The availability of 20+ years of GNSS data, along with their metadata, is a valuable database for the development of a climate data record of GNSS tropospheric products. In the framework of the second EPN reprocessing campaign, hereafter EPN-Repro2, and in cooperation with the WG3 of the COST Action ES1206 'GNSS4SWEC', five EPN ACs homogenously reprocessed the EPN for the period 1996-2014. The EPN-Repro2 tropospheric data set is open to the user community and, on a European scale, it has been established as a reference data set for monitoring trend and variability in atmospheric water vapor. The modernization of the EPN network, capable for tracking Multi-GNSS high quality data and the access to real-time data and products, is contributing to the development of Multi-GNSS as well as real-time tropospheric estimation. Some EPN ACs and the EPN tropospheric coordinator are testing Multi-GNSS solutions and troposphere combination, with particular attention to Galileo data.

We will describe the efforts undertaken within the EPN to keep the pace with new user demands and GNSS modernization, and to improve the EPN products and services in the field of atmospheric sounding.