Automated GNSS Network Switzerland (AGNES)

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1. Project description

The station is part of the Automated GNSS Network of Switzerland (AGNES) consisting of 31 sites, equipped with GNSS receivers and antennas. In Spring 2015, the complete AGNES network, with the exception of Jungfraujoch, was enhanced from GPS and GLONASS (the Russian equivalent of GPS) to a Multi-GNSS network which is capable to track also satellites of the European Galileo System and the Chinese BeiDou System. Jungfraujoch station was enhanced to Multi-GNSS together with the installation of the new MeteoSwiss observation platform end of 2017.

AGNES is a multi-purpose network which serves as reference for surveying, real-time positioning (positioning service swipos GIS/GEO) and for scientific applications (geotectonics and GNSS-meteorology). The station JUJO/JUJ2 is mainly contributing to scientific applications. Troposphere path delays derived from the swisstopo processing are provided to MeteoSwiss on an hourly basis. Furthermore, the data are sent to the European meteo community EUMETNET, where the data are available for all meteo agencies for numerical weather predictions. At the moment, UK METO, MeteoFrance, DMI, and KNMI are using the GNSS-derived troposphere models routinely in the weather forecasts. This activity is coordinated by the EGVAP project. Currently, a continuation of this EUMETNET project is planned. The results are also sent to the Institute of Applied Physics (IAP) of the University of Berne where the data contribute to the STARTWAVE database. It is worth to mention that our final troposphere products (delivered with 1-2 weeks of delay) are also used by PMOD/WRC Davos for the calibration of the pyrgeometer.

In 2013 the new COST project named GNSS4SWEC (Advanced Global Navigation Satellite Systems tropospheric products for monitoring severe weather events and climate) started. The focus of swisstopo's investigations is the long-term behaviour of the troposphere parameters. Due to the fact that we re-processed all Swiss and European GNSS data since 1996 with a homogeneous set of modelling parameters, we have a first data set which might help to detect possible changes in water vapour over time. Till now, the time series suffered from software changes and also from modelling changes which resulted in "jumps" in the troposphere time series. With a complete reprocessing of all data from 1996 – 2014 a long time span is covered with identical modelling of observations. This modelling is also continued till today. Nevertheless, antenna changes at stations have a significant influence to the long-term consistency (e.g. also the new Jungfraujoch mast installation and the new antenna which is capable to track all modern GNSS satellite systems whereas the old antenna was only capable to track GPS. The GNSS4SWEC project finished 2017. The final report was drafted mid 2018. Below we show some figures, showing the troposphere long-term data of JUJO (GPS-only) and JUJ2 (Multi-GNSS).

Fig. 1 shows the long-term troposphere estimates for JUJO and JUJ2 (after the interruption), its internal formal errors (RMS) and the corresponding amplitude spectrum. The annual variations are obvious.

Coordinate time series in the local system North, East and Up of JUJO/JUJ2 are shown in Fig. 2. The time series covers data from 1999 till 2018 – in total about 19 years. Our reference station Zimmerwald (ZIMM) covers a time span of 23 years. The estimated station velocity is easily visible – mainly for the height component we see an uplift of 3 mm/yr with respect to the European Plate. This is the strongest uplift signal compared to all other Swiss permanent stations.

Removing this signal from the coordinate time series shows that some seasonal effects are visible in all three components (see Fig. 3). This is due to the instability of the meteo mast. The effect is visible with the new setup, only, because the daily repeatability was considerably improved with the new Multi-GNSS equipment.

Further results of the processing are available online (updated routinely): http://pnac.swisstopo.admin.ch/pages/en/qsumjuj2.html

New official coordinates were published for JUJ2 based on a new adjustment including also campaign data since 1988 (Brockmann, 2018) in July 2018: http://pnac.swisstopo.admin.ch/pages/en/chtrf.html

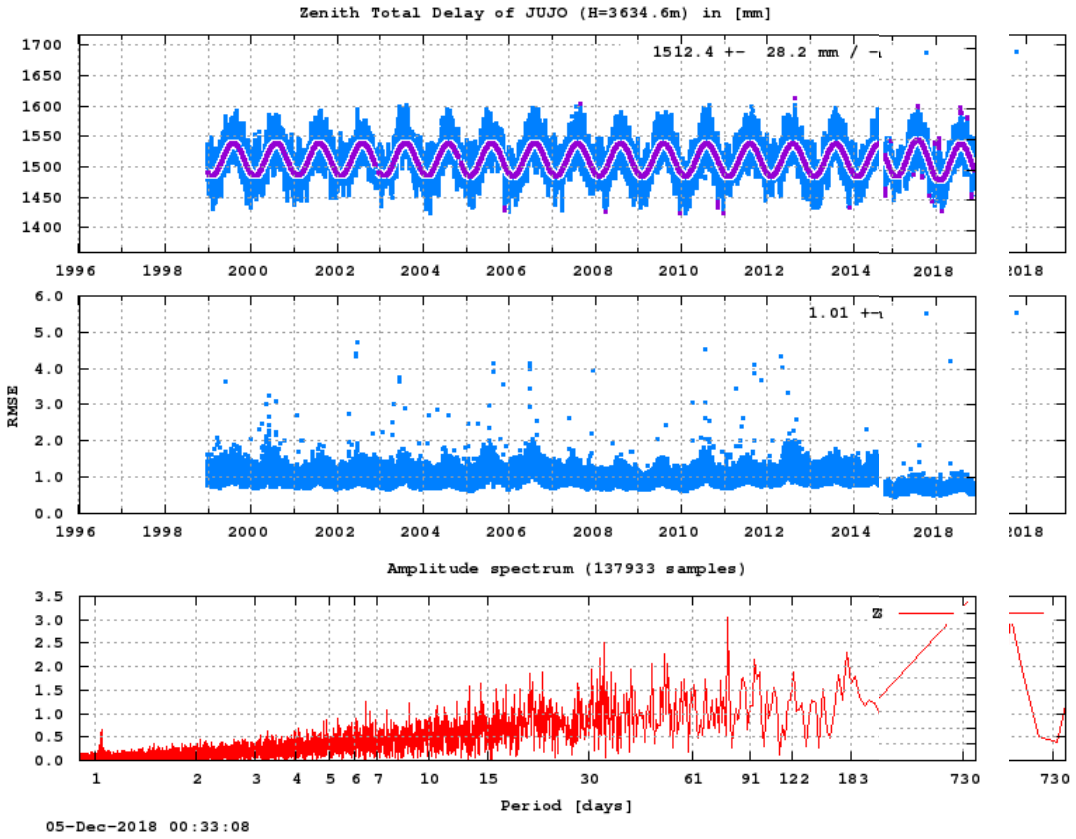

Figure 1. Long-term troposphere estimates for JUJO / JUJ2.

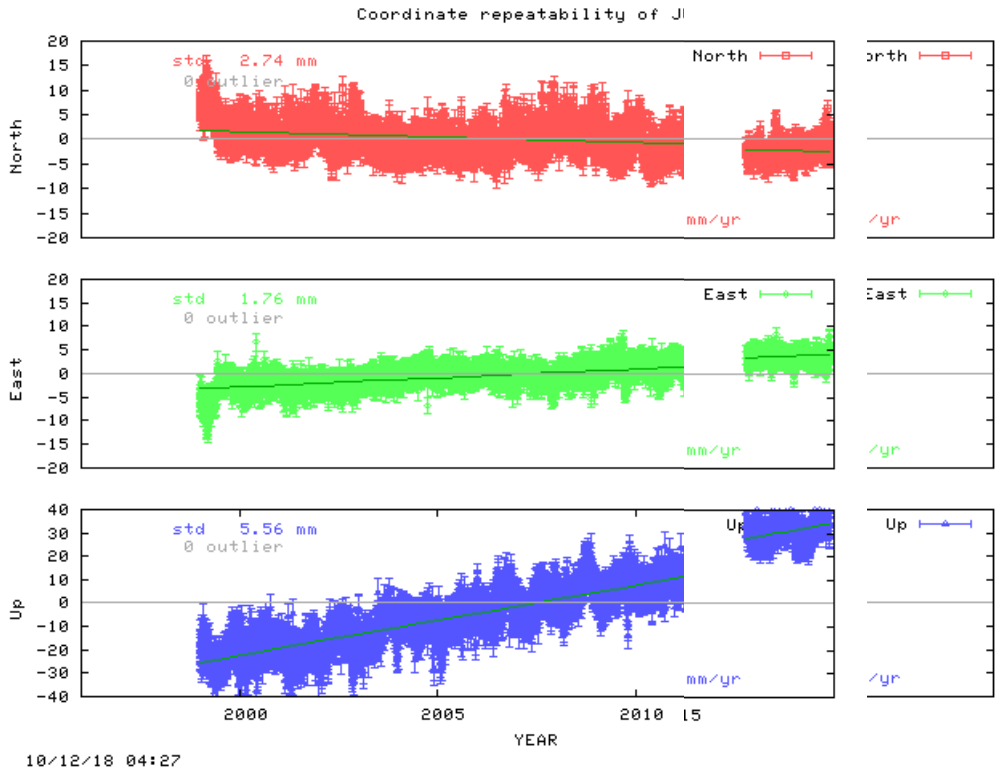

Figure 2. Long-term coordinate estimates for JUJO / JUJ2 (horizontal movement with respect to Zimmerwald, vertical movement w.r.t European Plate).

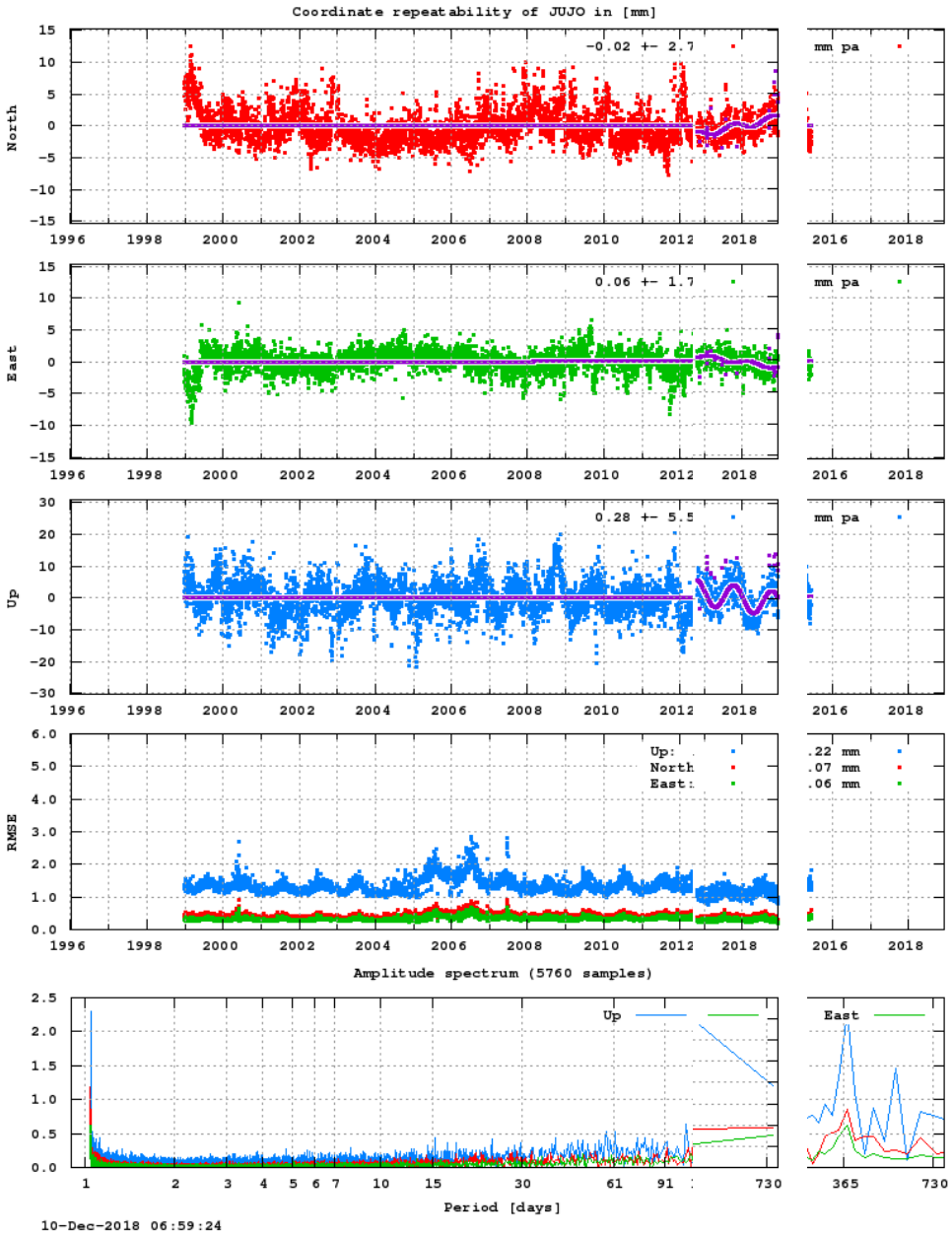

Figure 3. Long-term coordinate estimates for JUJO / JUJ2 (velocities removed; rms and fourier spectrum added).

References

Brockmann, E. (2018), LV95 / CHTRF2016 (Swiss Terrestrial Reference Frame 2016): Teil 2: Auswertung der GNSS-Messungen 2016 und Resultate der Gesamtausgleichung, Report 16-19, Wabern, 2018.

Internet data bases

http://www.swisstopo.ch; http://pnac.swisstopo.admin.ch

Collaborating partners / networks

Dr. Alexander Haefele, Dr. Rolf Rüfenacht, MeteoSwiss, Payerne
Dr. Philippe Steiner, Dr. Daniel Leuenberger, MeteoSwiss, Zürich
Dr. Rolf Dach, Prof. Dr. A. Jäggi, University Berne, Astronomical Institute
Dr. Klemens Hocke, University Berne, Institute for Applied Physics
Dr. Julian Gröbner, Dr. Christine Aebi, PMOD/WRC Davos
Prof. Alain Geiger, Dr. Karina Wilgan, ETH Zurich, Dep. of Civil, Env. and Geomatic Eng., Geodesy and Photogrammetry

Scientific publications and public outreach 2018

Conference Papers

Brockmann, E., S. Lutz, D. Ineichen, S. Schaer, Maintaining the Swiss Terrestrial Reference Frame CHTRF using Multi-GNSS, EUREF-Symposium in Amsterdam, The Netherlands, May 30 – June 1, 2018.

Lutz, S., E. Brockmann, Status Report on the Working Group on "European Dense Velocities", EUREF-Symposium in Amsterdam, The Netherlands, May 30 – June 1, 2018.

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