

Name of research institute or organization:

Bundesamt für Landestopographie / Swiss Federal Office of Topography

Title of project:

Automated GPS Network in Switzerland (AGNES)

Project leader and team

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Project description:

The Swiss Federal Office of Topography (*swisstopo*) has been building up and operating the Automated GPS Network for Switzerland (AGNES) since 1998. The final expansion of 29 permanently operating GPS tracking stations was reached at the end of 2001. AGNES is a multipurpose network which serves as reference for surveying, real-time positioning services, and for scientific applications (see Fig.1).

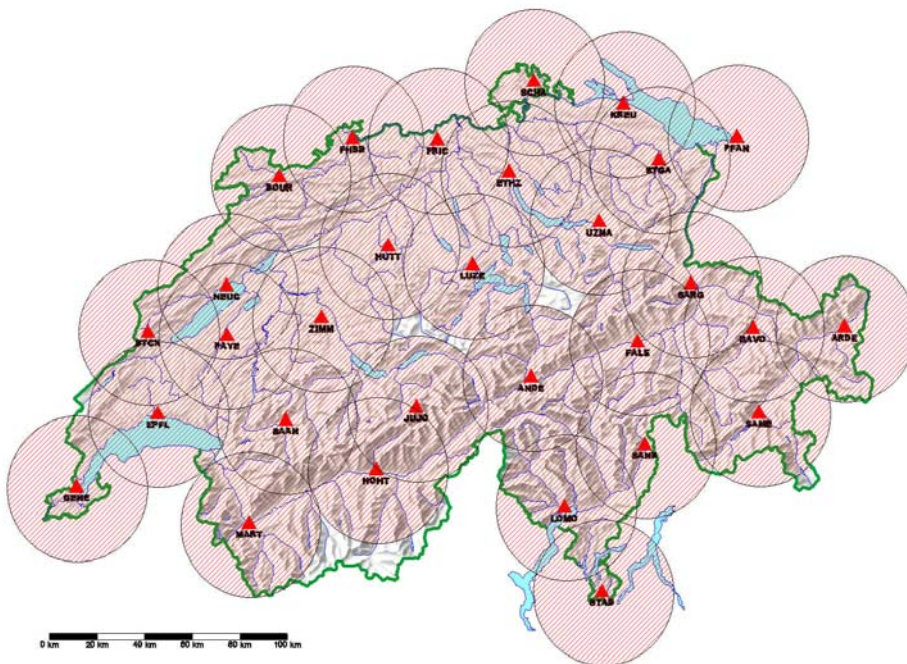


Fig. 1: Automated GPS Network in Switzerland (AGNES)

Since 2002, a service called *swipos*-GIS/GEO® (Swiss positioning service for GIS and geodetic applications) is operational. The service allows positioning in the new Swiss geodetic reference frame CHTRF95 with cm accuracy in real time.

The station Jungfrauoch is one of the AGNES sites. The GPS antenna is collocated with the sensors of the ANETZ station of MeteoSwiss. During 2003, the station operated very stably and only a few data gaps were registered for the days 108-111, 211, and 268.

The monitoring of the station coordinates is one objective of the analyses. The weekly repeatability in the horizontal direction (north, east) is of the order of 2-3 mm. The determination of the height component is much weaker (see Fig.2). Compared to other AGNES stations, these results are considerably poorer, but still of sufficient accuracy. It is assumed that multipath effects and the surroundings (e.g. the Swisscom installations) are responsible for the reduced performance.

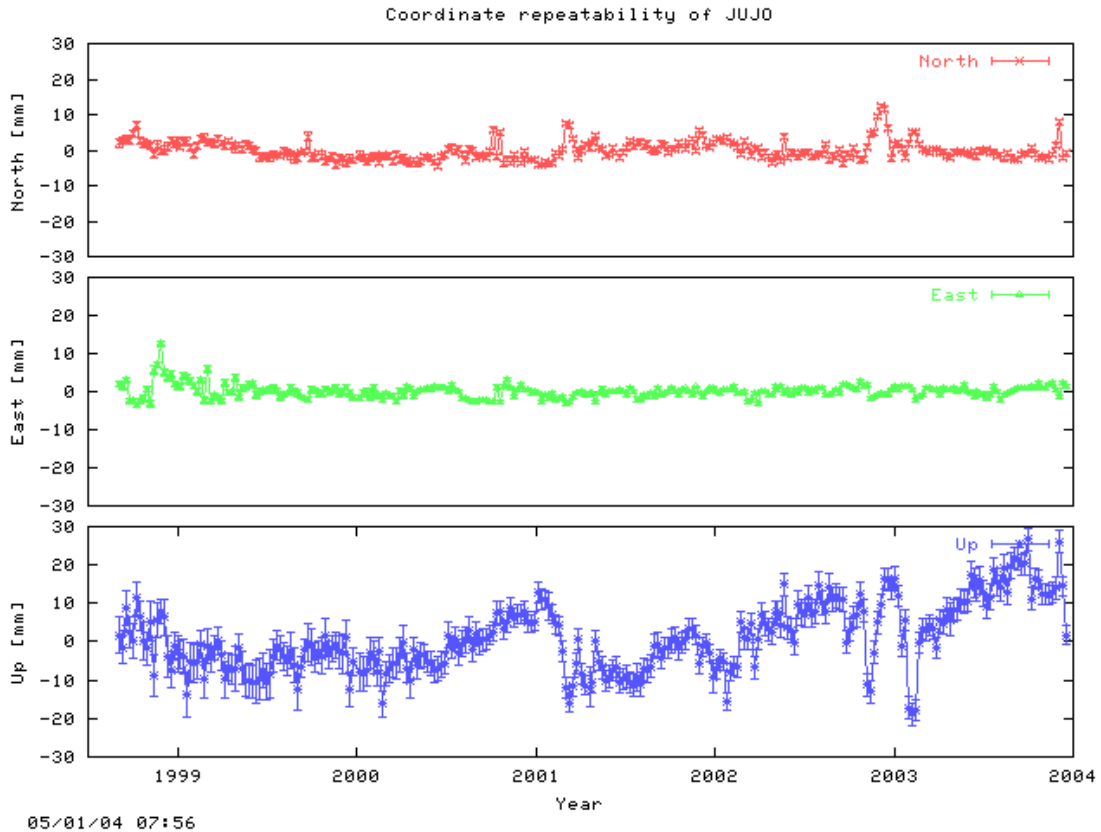


Fig. 2: Coordinate repeatability at the AGNES station Jungfraujoch

In the year 2003, the GPS data were analyzed especially for deriving zenith total delay estimates in near real-time with a time delay of 1 hour 45 minutes for numerical weather prediction. Since Feb. 2003, such estimates are available in real time with a time delay of 1 minute.

Swisstopo and the Swiss partners MeteoSwiss and Institute of Applied Physics (IAP) of the University of Berne contributed results to the project COST-716 which expired in December 2003. More information can be found in the HFSJG Activity Report 2002. The web site <http://www.knmi.nl/samenw/cost716/> shows the contributions of a total of 9 European analysis centers.

The GPS-derived zenith total delay estimates are not yet routinely used by MeteoSwiss for numerical weather prediction. In 2004, further assimilation tests are planned for demonstrating the impact and the possible gain due to the additional GPS information. Nevertheless, the different contributions are compared on a routine basis: Fig. 3 shows the different estimates for station Jungfraujoch for the time period at the end of 2003. The offset of the prediction by MeteoSwiss can be explained by

the use of a different mesh point in the numerical weather prediction model aLMo (alpine local Model).

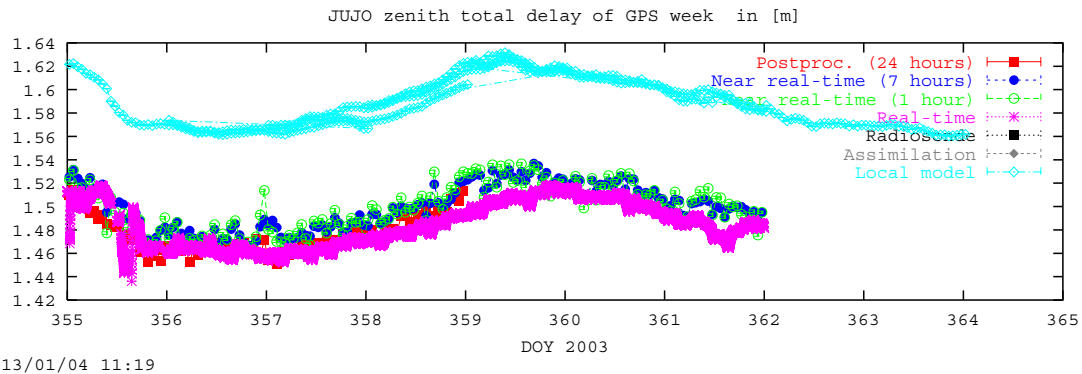


Fig. 3: ZTDs of AGNES station Jungfraujoch

All results presented here are updated on a weekly or hourly basis. They can be viewed under http://www.swisstopo.ch/en/geo/pnac_results.htm.

A special validation campaign using water vapour radiometers on stations Jungfraujoch, Zimmerwald and Berne took place in September 2003. See the report by UniBW Munich (this volume).

Key words:

GPS, meteorology, positioning, integrated water vapour, zenith path delay, radiometer, radiosonde, numerical weather prediction, geodynamics, geotectonics

Internet data bases:

<http://www.swisstopo.ch>; <http://www.knmi.nl/samenw/cost716/>; <http://tough.dmi.dk/>

Collaborating partners/networks:

Astronomical Institute (AIUB), University of Berne

MeteoSwiss, Zurich

Institute of Applied Physics (IAP), University of Berne

Scientific publications and public outreach 2003:

Refereed journal articles

Guerova G., E. Brockmann, J. Quiby, F. Schubiger and Ch. Mätzler (2003): "Validation of NWP mesoscale models with Swiss GPS Network AGNES". *J. Appl. Meteorol.*, 42, 1, pp. 141-150, 2003.

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Ineichen D., G. Beutler and U. Hugentobler (2003): "Sensitivity of GPS and GLONASS orbits with respect to resonant geopotential parameters". *Journal of Geodesy*, 77, pp. 478-486, 2003.

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Conference papers

Brockmann E., S. Grünig, D. Ineichen and U. Wild (2003): "Estimating zenith total delays from the Swiss permanent GPS network AGNES with time delays of 2 weeks up to 10 minutes". Paper presented at the EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April, 2003.

Brockmann E., D. Ineichen and M. Troller (2003): "Using interpolated zenith total delays from permanent GPS networks for improving the heights derived from local GPS campaigns". Paper presented at the EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April, 2003.

Brockmann E., D. Ineichen, M. Kistler, U. Marti, A. Schlatter and D. Schneider (2003): "CH-CGN activities in Switzerland". In: Torres, J.A. and H. Hornik (Eds): Subcommission for the European Reference Frame (EUREF). EUREF Publication No. 12 (in prep.), 2003.

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Marti U., A. Schlatter and E. Brockmann (2003): "Analysis of vertical movements in Switzerland". Paper presented at the EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April, 2003.

Schneider D., E. Brockmann, D. Ineichen, S. Grünig, A. Wiget and U. Wild (2003): "Applications of GPS meteorology using the Swiss permanent GPS network AGNES". Paper presented at the IUGG in Sapporo, Japan, June 30 - July 11, 2003.

Troller M., A. Geiger, E. Brockmann, B. Bürki and H.-G. Kahle (2003): "GPS Tomography on a Permanent Network in the Mountainous Region of Switzerland". Paper presented at the EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April, 2003.

Troller M., E. Brockmann and A. Geiger (2003): "Estimation of Spatial and Temporal Path Delays Based on the Permanent GPS Network in Switzerland". Paper presented at the EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April, 2003.

Troller M., A. Geiger, B. Bürki, E. Brockmann and H.-G. Kahle (2003): "Use of satellite navigation systems for determination of 4-dimensional atmospheric refractivity field". Paper presented at the IAIN World Congress in Berlin, October 2003.

Vogel B., E. Brockmann, P. Kummer, U. Marti, D. Schneider, A. Schlatter, A. Wiget, U. Wild and W. Gurtner (2003): "National Report of Switzerland: New Developments in Swiss National Geodetic Surveying". In: Torres, J.A. and H. Hornik (Eds): Subcommission for the European Reference Frame (EUREF). EUREF Publication No. 12 (in prep.), 2003.

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Thesis

Guerova G. (2003): "Application of GPS derived water vapour for numerical weather prediction in Switzerland". PhD thesis, University of Berne, 2003.

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