Comparison of humidity profiles derived from GPS-Tomography with Radiosonde Observations and aLMo Analyses

D. Leuenberger[1] and M. Troller[2]
1 MeteoSwiss, Zürich, Switzerland, daniel.leuenberger@meteoswiss.ch
2 Institute of Geodesy and Photogrammetry, ETH Zürich, Switzerland

1. Introduction

The **Global Positioning System** (GPS) offers new and promising possibilities to observe the humidity in the troposphere. New and promising methods to derive vertical profiles of water vapour distributions in a dense GPS receiver network by means of **tomographic techniques** has recently been developed (Troller, 2005). A one week comparison with radiosonde humidity measurements and aLMo analysis revealed a promising quality of the GPS humidity (Troller 2005). MeteoSwiss and ETH Zurich have therefore started a project to push ahead the use of GPS-derived humidity profiles in the Alpine Model (aLMo) of MeteoSwiss.
Since January 2006 humidity profiles from GPS tomography are being produced in a quasi-operational way at MeteoSwiss, allowing a more thorough comparison with radiosonde measurements and aLMo analyses. In this paper we will present first results of such comparisons.

2. GPS Tomography

A total number of 40 humidity profiles over Switzerland with a temporal frequency of an hour and a spatial distance of approximately 50 km are available. Figure 1 shows the spatial distribution of the profiles. Each profile contains wet refractivities N_{wet}

$$N_{wet} = \frac{p\, q_v\, (k_2 T + k_3)}{T^2 \left[\varepsilon + q_v (1-\varepsilon)\right]} \quad , \quad \varepsilon = R_d / R_v \quad k_1, k_2 = const$$

on 10 vertical levels for the surface up to 11500m a.m.s.l. N_{wet} is mainly dependent on specific humidity q_v and to a lesser extent, on temperature T and pressure p.

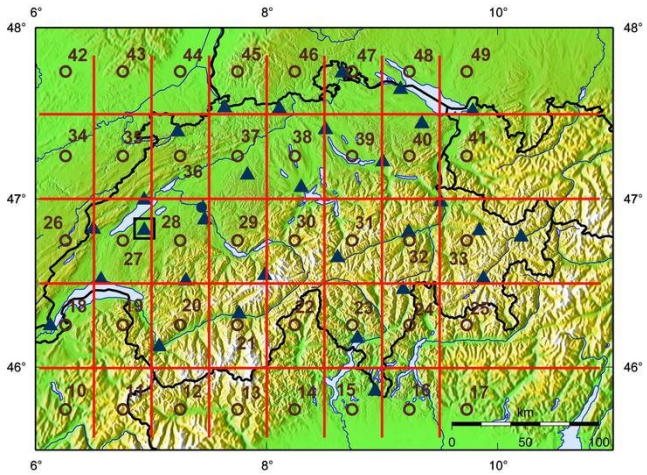


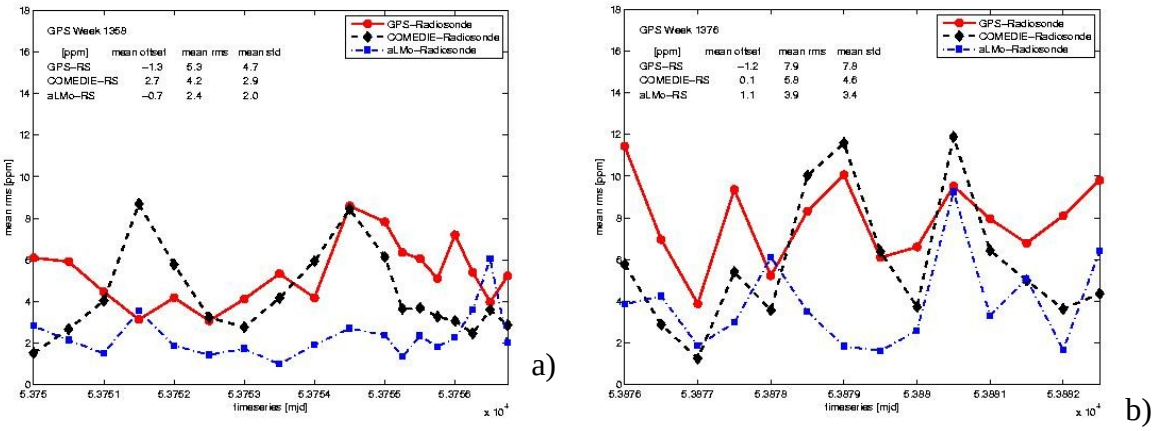
Figure 1 Location of humidity profiles derived from GPS-tomography (numbered circles), GPS ground receivers (triangles) and the Payerne Radiosonde (square).

3. First Results

First comparisons of humidity profiles from GPS tomography and aLMo analyse with radiosonde measurements show that the RMS depend on

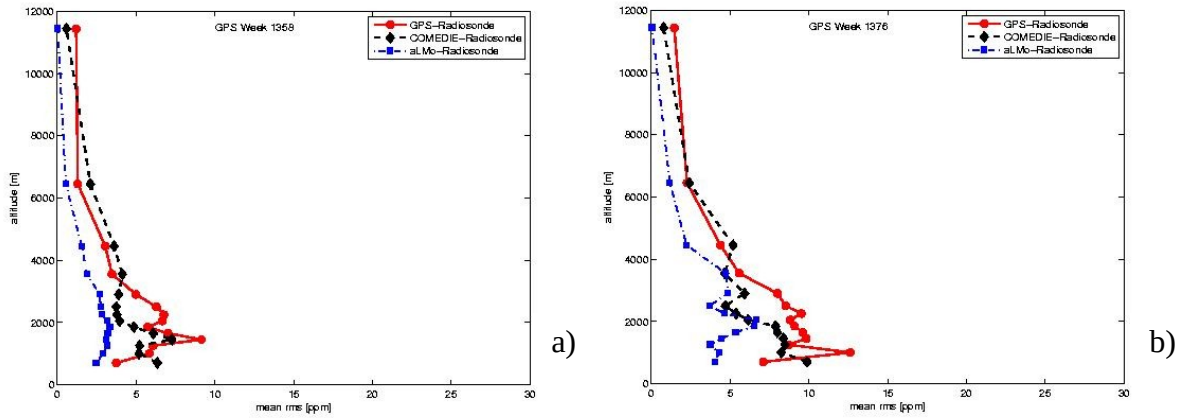
- Season (Figure 2 and 3)
- Weather situation (Figure 2)
- Height (Figure 3)
- Profile location (not shown)

At the COSMO General Meeting we will show more detailed results about the comparison.



a) b)

Figure 2 Comparison of vertically averaged humidity profiles RMS (w.r.t. radiosonde observations, in ppm) of GPS-tomography (red lines) and aLMo analyses (blue lines) for a week in January 2006 (panel a) and a week in May 2006 (panel b).



a) b)

Figure 3 Comparison of time-averaged humidity profiles RMS (w.r.t. radiosonde observations, in ppm) of GPS-tomography (red lines) and aLMo analyses (blue lines) for a week in January 2006 (panel a) and a week in May 2006 (panel b).

References

Troller, M, A. Geiger, E. Brockmann, J.-M. Bettems, B. Bürki, and H.-G. Kahle, 2005: Tomographic determination of the spatial distribution of water vapor using GPS observations, *Advances in Space Research* (in press).