The SWI diagnostic study

Alena Trojáková, June 2011

1 Introduction

This short report summarizes the results of diagnostics related to soil characteristics during common test period of June 2010. The purpose was to examine an impact of data assimilation on soil moisture as Croatian colleagues experienced a moistening of surface in the data assimilation experiment, which was not found in operational (dynamical adaptation) runs.

2 Results and summary

Following Ivatek-Šahdan (2000) Soil Wetness Index (SWI) was monitored to evaluate soil moisture in the experiments. SWI represents hydric stress of the vegetation. The SWI less than zero means dry soil (transpiration of plants is zero) and SWI larger than 1 corresponds to wet soil (vegetation evaporate at the potential (maximal) rate. The SWI was checked for two experiments performed during June 2010, more details about the experiments can be found in Appendix A. Just keep in mind that both experiments used the same surface analysis scheme and the only difference is in adding 3DVAR for upper-air analysis in the second experiment.

- **Y26** - reference (surface CANARI + DFI blending)
- **Y03** - BlendVar (surface CANARI + DFI blending + 3DVAR)

On the SWI maps for the last day of one month data assimilation experiment for June 2010 only very small differences can be found, see figure 1. On the time evolution of SWI at predefined randomly selected locations, see on figure 2, a small moistening is prevailing during analysis step (which comprises surface CANARI + DFI blending or surface CANARI + DFI blending + 3DVAR, note that surface CANARI is key component affecting soil properties) in both experiments. But all around the results of experiments with and without 3DVAR were qualitatively very similar.

The quantitative comparison of both experiment is on figure 3, only analysis were compared. This indicates (as only a few point were considered) that added 3DVAR has more or less neutral impact on SWI values. The verification scores of 2m parameters, see figure 4, showed prevailing slightly bigger positive temperature and smaller negative humidity bias (an experiment including 3DVAR is slightly colder and more moist). But it is difficult to say if this was caused by upper-air analysis or via interaction with surface.

Unfortunately no real observation of soil moisture to check the SWI were available and from attached temperature and relative humidity measurement in 2m and soils, see figure 5, I'm not brave enough to draw any conclusions.

References

[1] Ivatek-Šahdan, S., 2002: Smoothing of Soil Wetness Index *internal report*

Appendix

A Tested configurations

A BlendVar analysis configuration was evaluated for one month period of June 2010. The first three days (29-31 May 2010) were used as warming-up period. Reference experiment was based on the ALADIN/CE operational setting from 7 May 2010 (former parallel test AIR, which comprises new executable for surface analysis consistent with the forecast, new parametrization of the diagnostics cloudiness). The reference has following general characteristics:

- cycle 35t1lentch
- 9km horizontal resolution and 43 vertical levels
- linear truncation E159x143, mean orography
- domain covers the same area as the formal LACE domain (309x277 grid points)
- 3h coupling interval, time step 360 s
- surface analysis (performed before upper-air one) is provided by:
  - SST taken from ARPEGE analysis
  - CANARI surface analysis based on SYNOP reports (analysis of T2m and RH2m) for land
  - any other land soil variables which are not analyzed (like snow) are initialized from the ALADIN guess with the relaxation to the climatology as implemented within the CANARI configuration
- upper air analysis is provided:
  - by the digital filter spectral blending, long cut-off 6h cycle (filtering at truncation E55x61, no DFI in the next +6h guess integration)
  - digital filter spectral blending + incremental DFI initialization of short cut-off production analysis

The BlendVar configuration consists of adding 3DVAR just after the digital spectral blending, thus all analysis steps are sequential in this order: surface analysis-blending-3DVAR. Used 3DVAR has following general characteristics:

- B matrix was computed following the lagged NMC method (from period of October - December 2006)
- REDNMC=1
- observation assimilated (for both surface analysis and upper-air one data from OPLACE were used):
  - SYNOP surface reports (geopotential assimilated)
  - TEMP upper air reports (temperature, wind components, specific humidity assimilated)

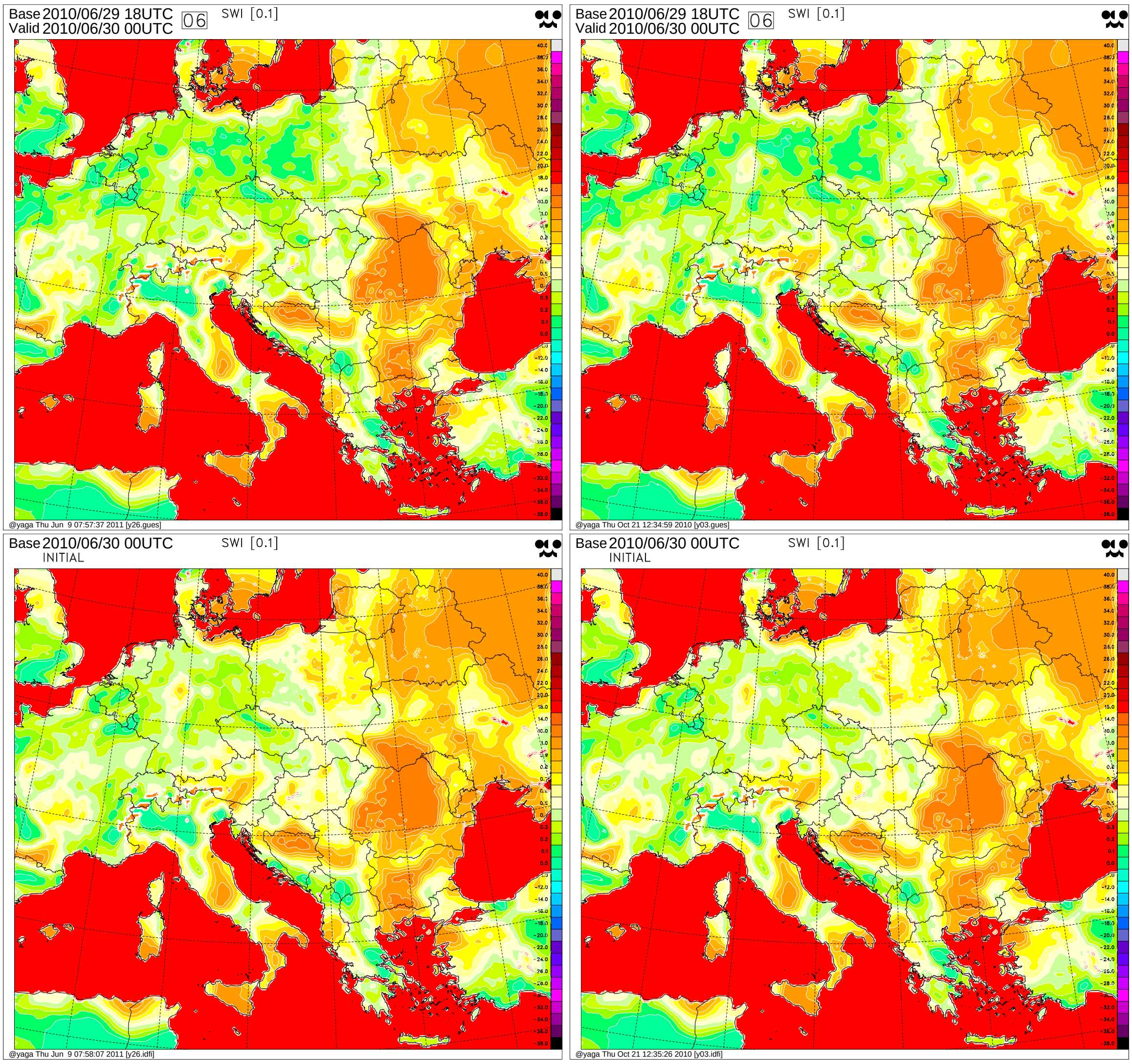

Figure 1: SWI for guess (top) and analysis (bottom) for the last day of June 2010 for blending on the left and blendVAR on the right

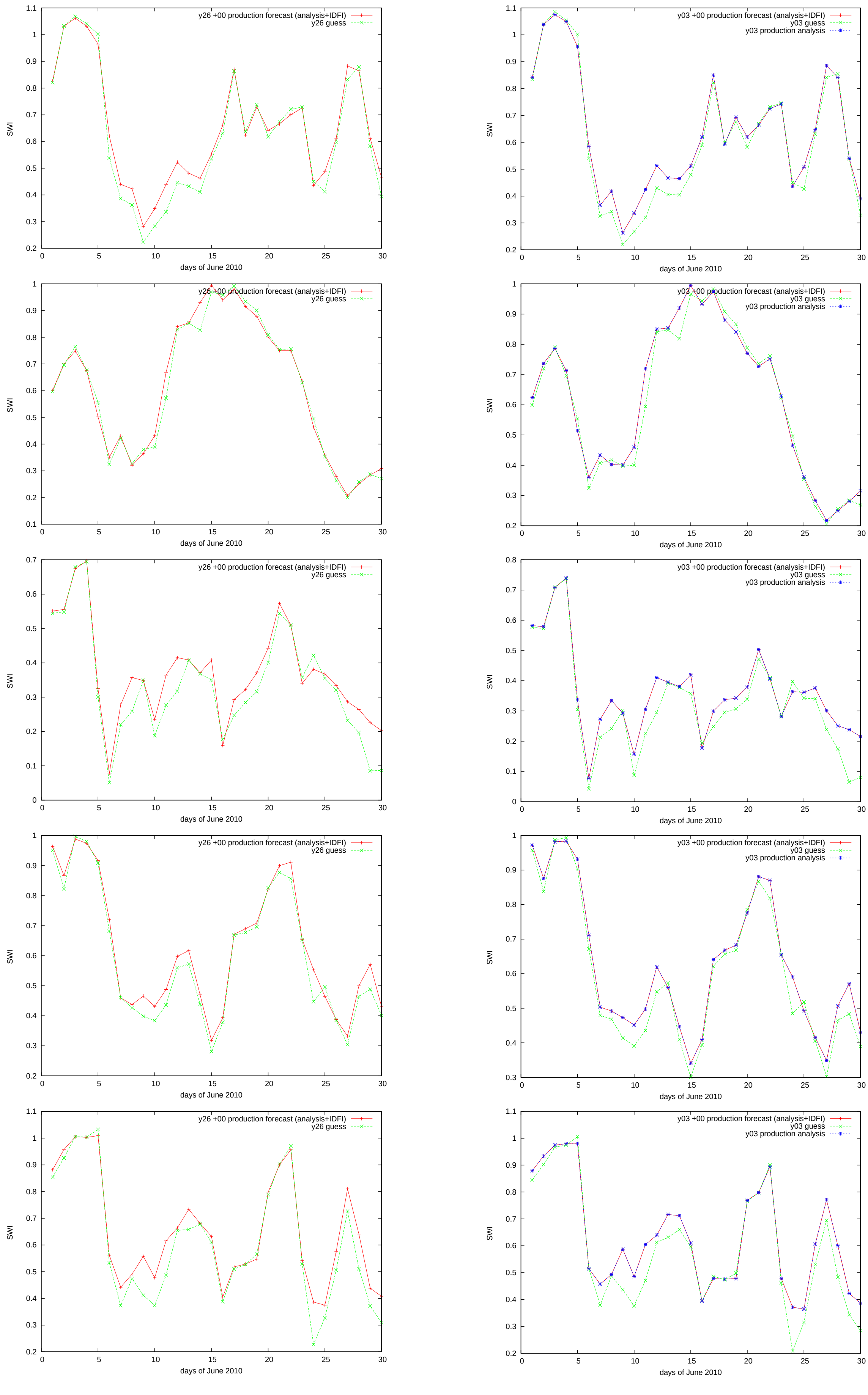

Figure 2: Evolution of SWI for guess in green, production blend3DVAR analysis in blue and +00H forecast in red during June 2010 from top to bottom for Budapest, Vienna, Prague, Ljubljana and Zagreb for blending on the left and blendVAR on the right

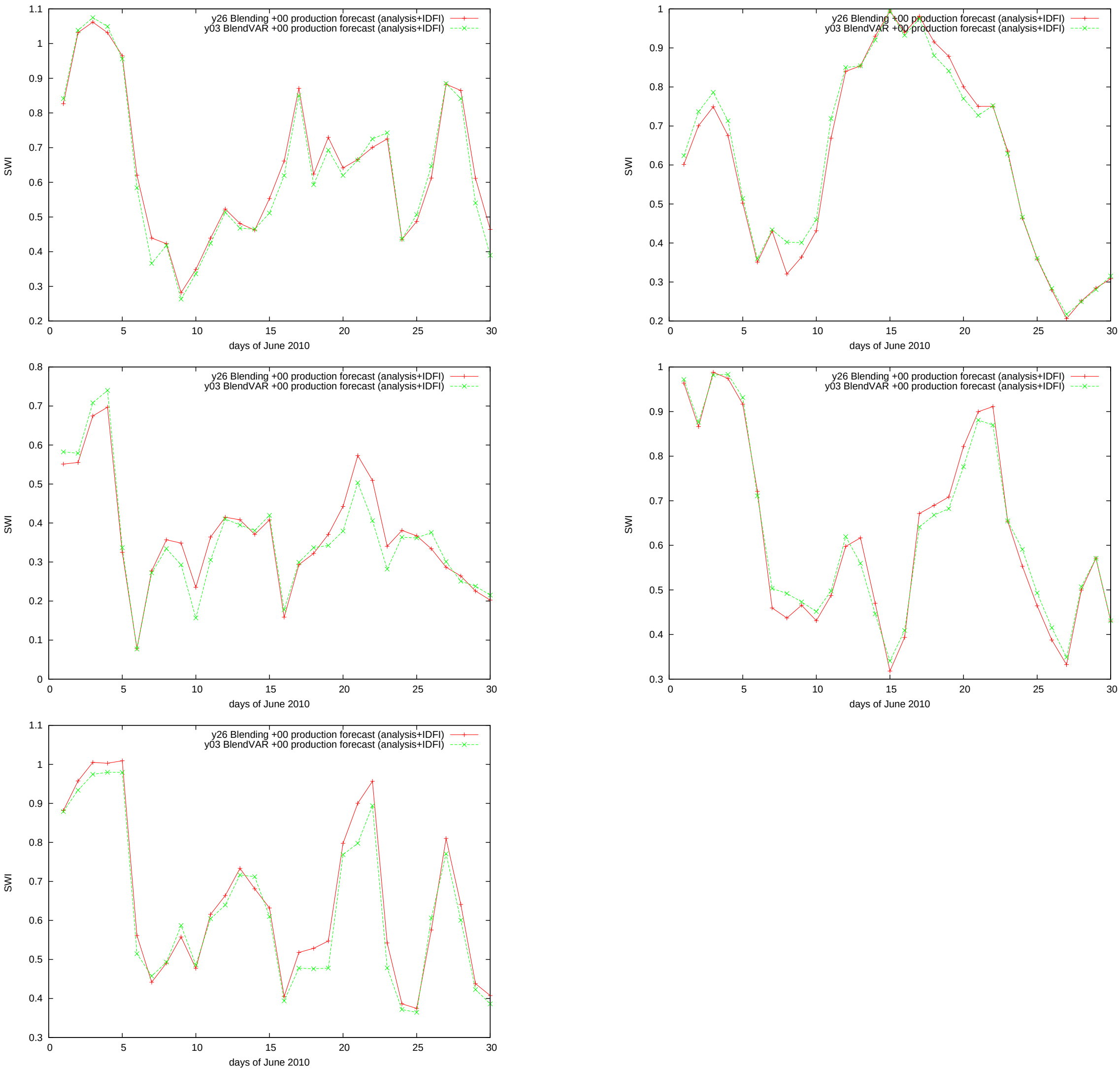

Figure 3: Evolution of SWI for blending in red and blendVAR in green of +00H forecast from top to bottom for Budapest, Vienna, Prague, Ljubljana and Zagreb

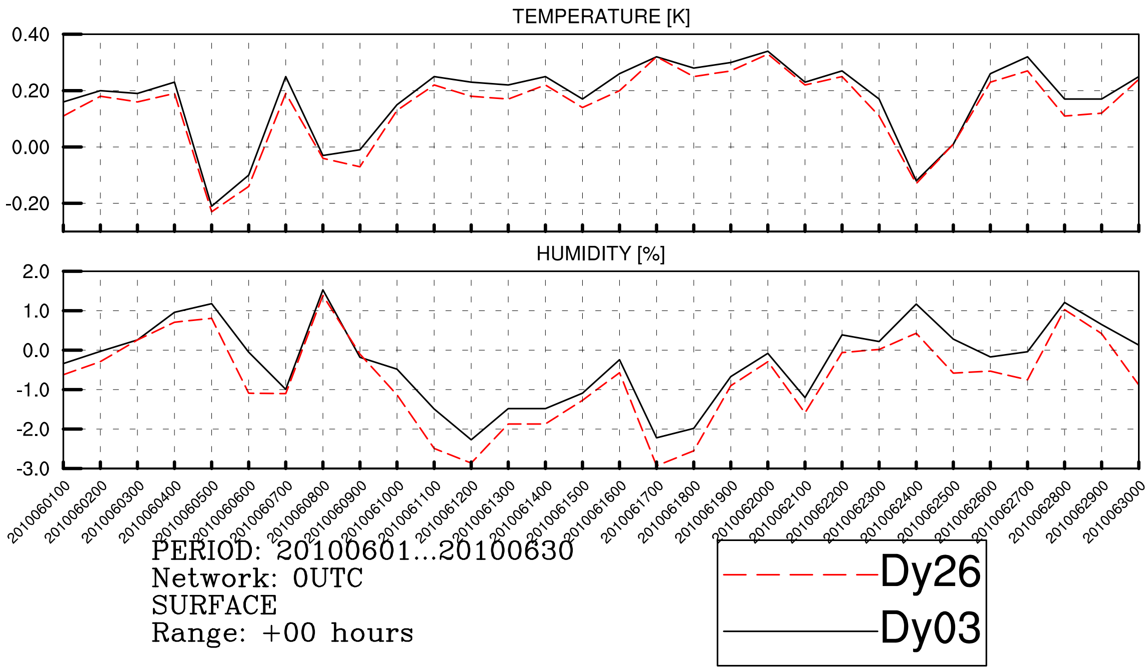

Figure 4: The 2m temperature and humidity bias of individual runs in June 2010 of +00H forecast for blendVAR in black and blending in red

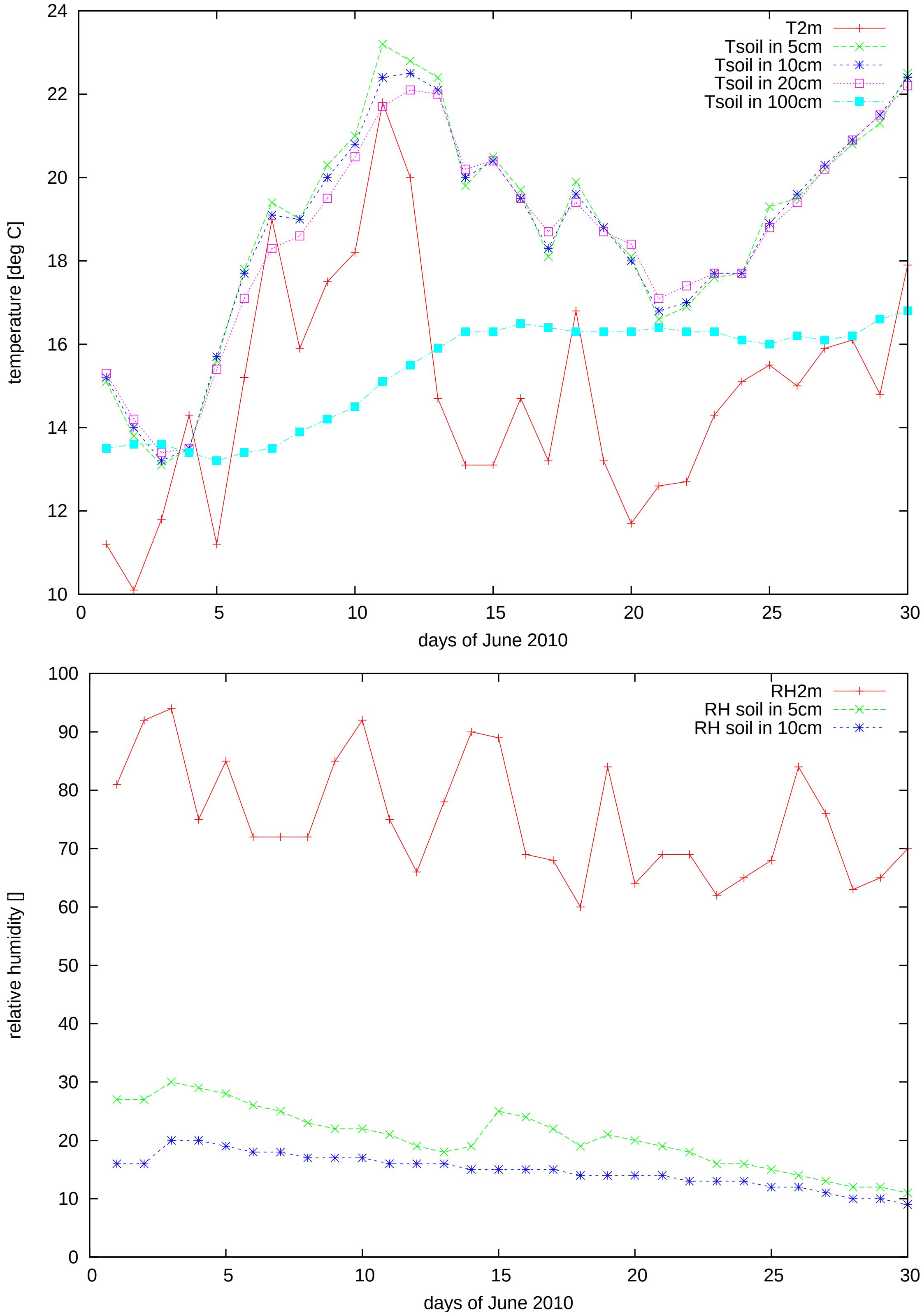

Figure 5: The temperature and humidity observation at 00 UTC in June 2010 for station Prague