

PRECISE MEASUREMENTS OF THE CHANGES OF THE GROUND WATER LEVEL IN LAMKOWKO SATELLITE OBSERVATORY. PRELIMINARY RESULTS

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ABSTRACT

In the years 2003-2005 in the Lamkowko Satellite Observatory a measuring well equipped with a measuring float was established. This measurement instrument was constructed jointly with Space Research Center of Polish Academy of Sciences.

The measuring system enables to detect precisely changes in the level of ground water. The changes in the water level are measured with the accuracy better than 0.1mm. The obtained accuracy of measuring system allows to detect several phenomena: meteorological ones, geodynamics ones, Earth tides.

In this paper, the preliminary results of the first time series of changes in the level of ground water are presented. The time series of these measurements, utilized in this study, cover only 4 months (from January to April 2006). Preliminary results enable to detect diurnal and semidiurnal oscillations.

1. INTRODUCTION

The Satellite Observatory of the University of Warmia and Mazury was established 45 years ago, in 1961. The Observatory was registered in COSPAR as an international tracking station of artificial Earth's satellites and assigned the number 1151. In 1961-78 visual observations in the frame of ephemeris service and international programmes for studies of upper atmosphere layers: INTEROBS, EUROBS, ATMOSPHERE were performed.

In 1978 the Observatory moved to a small village Lamkowko, separated about 30 km from Olsztyn. AFU-75 camera in the research programmes ATMOSPHERE and PHOTODOPPLER, coordinated by INTERCOSMOS was applied.

In 80's the Doppler observations were carried out. These measurements in the field of application of regional geodynamic studies and for realization of various engineering purposes were applied.

Since 1994 the Observatory started to carry out permanent GPS observations (Baran et al., 1997b) with the Turbo Rogue SNR-8000 and Ashtech Z-12 receivers in global (IGS

and EUREF) and regional programs (CERGOP, EXTENDED SAGET, EUVN and BSL).

Since 1995 the ionospheric studies have been carried by Institute of Geodesy of the University of W-M in Olsztyn (Poland) jointly with West Department of the IZMIRAN of the Russian Academy of Sciences in Kaliningrad (Baran et al., 1997a; Krankowski et al., 2004)

2. THE MEASURING SYSTEM DETECTING CHANGES IN THE LEVEL OF GROUND WATER

In the years 2003-2005 in the Lamkowko Satellite Observatory, jointly with Space Research Center (Kaczorowki, 2004a,b), a measuring well/pipe equipped with a measuring float for detecting changes in the level of ground water was constructed.



Fig. 1. The measuring system (the precise digital balance) with the controlling computer

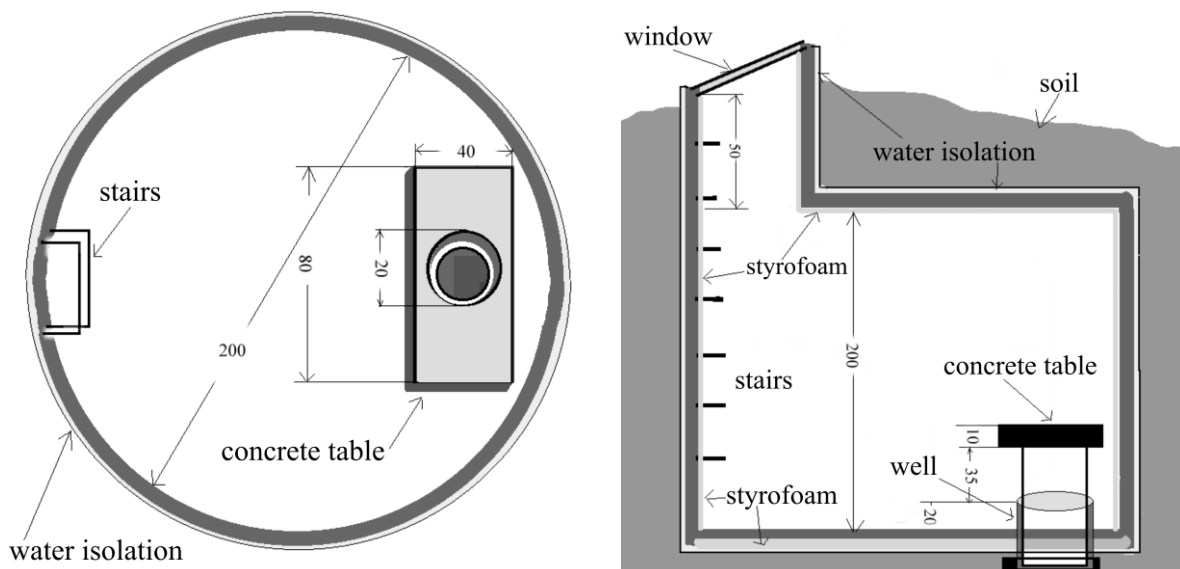


Fig. 2. The draft of the measuring system (the horizontal - left panel and the vertical section - right panel, respectively)

Approximately 2m. beneath the ground level the pipe exits to the underground measuring pavilion (Fig. 1). Figure 2 demonstrates horizontal and vertical sections of the underground measuring pavilion. The well is 8.5 m deep and consists of a steel pipe (40 cm diameter). The depth of the well was chosen so that the ground water reached the level of 2m. A measurement post placed over the exit of the well/pipe is the main element of the pavilion.

The measuring system consists of:

- the precise digital balance,
- the float,
- the controlling computer,
- the internet connection.

3. ELABORATION OF MEASUREMENTS AND THE RECORDING SYSTEM

The changes of the water level are obtained from measuring the changes of the Archimedes force. The weight of the float system was chosen so that at any water level the Archimedes force was smaller than the force of gravity. It guarantees the mechanical stability of the system and eliminates vertical movements.

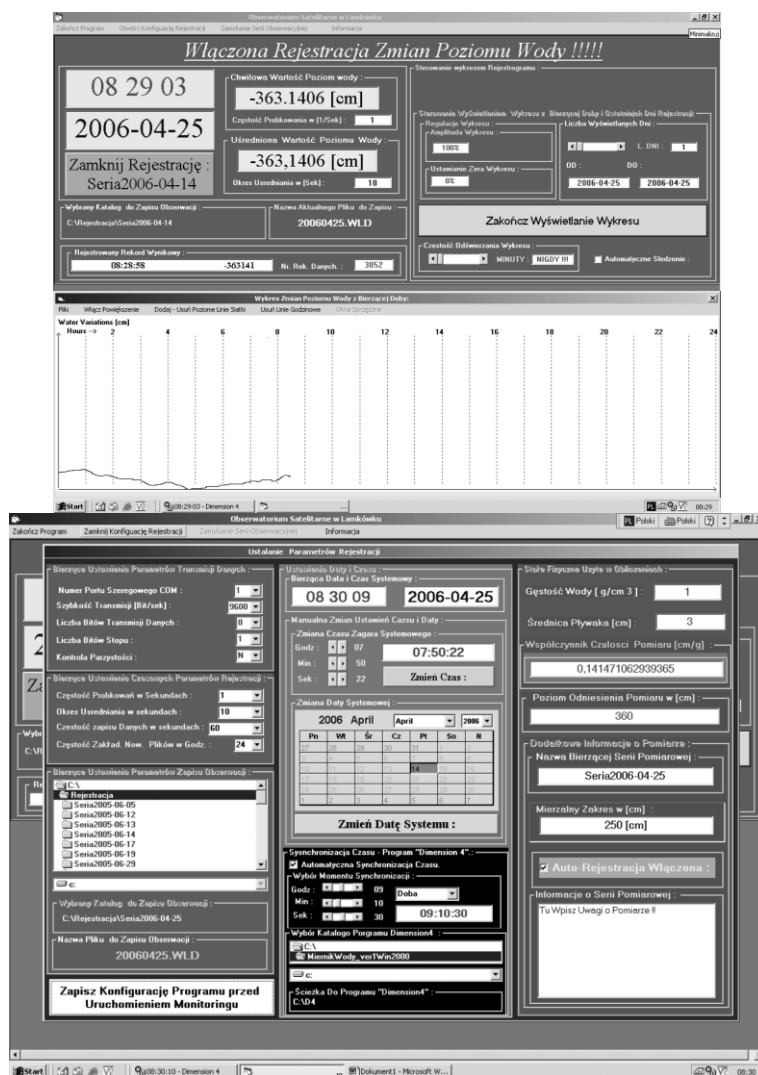


Fig. 3. The recording and elaborating software

The measurement of Archimedes force is calculated by taking into account the geometry of the float to the water level change. The changes in the water level are measured with accuracy better than 0.1mm. Figure 3 gives an example of windows from our recording and elaborating software. The recording system allows to register measurements with density 0.2s. The high measurement resolution of the digital balance allows to detect several phenomena such as meteorological ones, geodynamics ones and Earth tides.

4. PRELIMINARY RESULTS

First preliminary results of monitoring changes in the level of ground water between January and April 2006 are presented in Figure 4. In this figure the drop in the level of ground water between 1 January and 1 April is clearly shown. This drop amounted to 16 cm. The recovery phase took place after April 1, when the level of ground water gradually returned to its regular level.

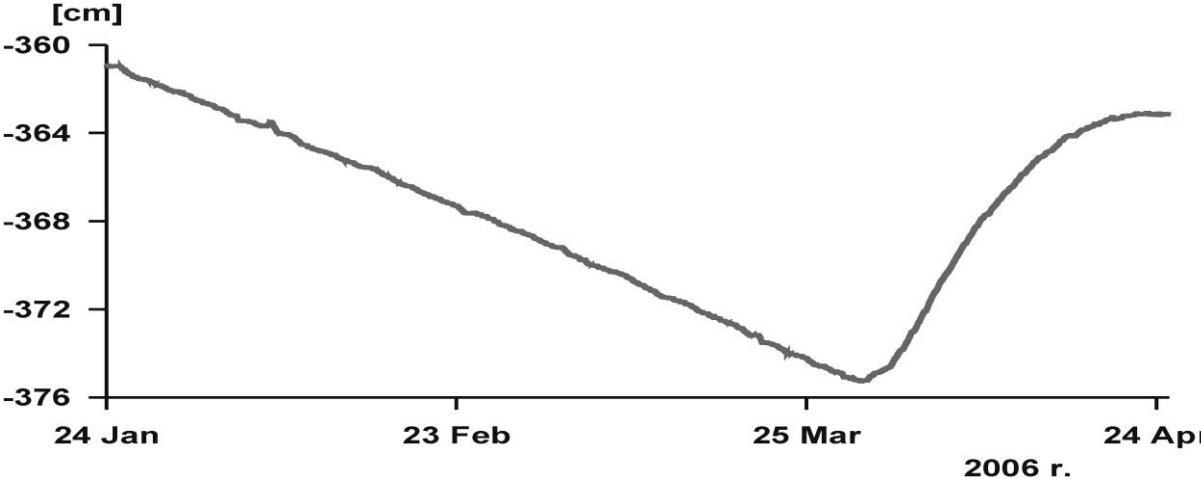


Fig. 4.Changes in the level of ground water between January and April 2006

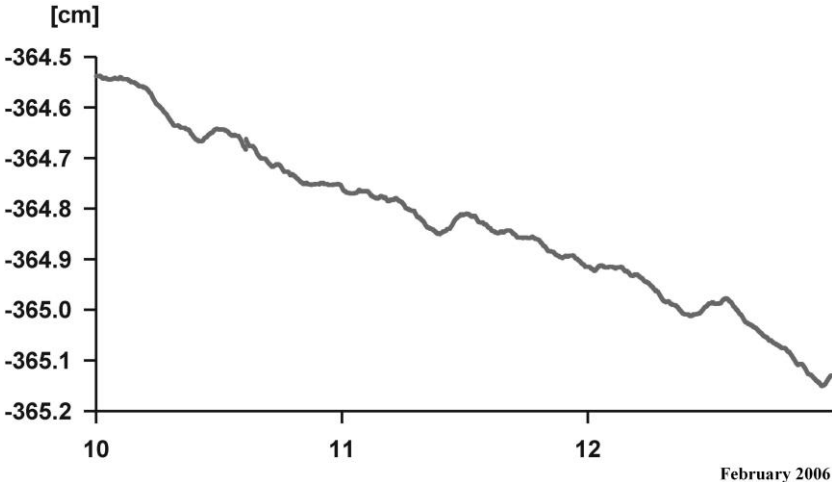


Fig. 5.Changes in the level of ground water between 10 and 12 February 2006

In Figures 5, 6 and 7 detailed results of changes in the level of ground water for several days in February (Fig. 5), March (Fig. 6) and April (Fig. 7) are presented. A

very good agreement between results during a few days in different months was obtained. These results enable to detect diurnal and semidiurnal oscillations and shows that the diurnal oscillation is more energetic than the semidiurnal one. Its highest average value is of the order of 1 and 1.5 mm.

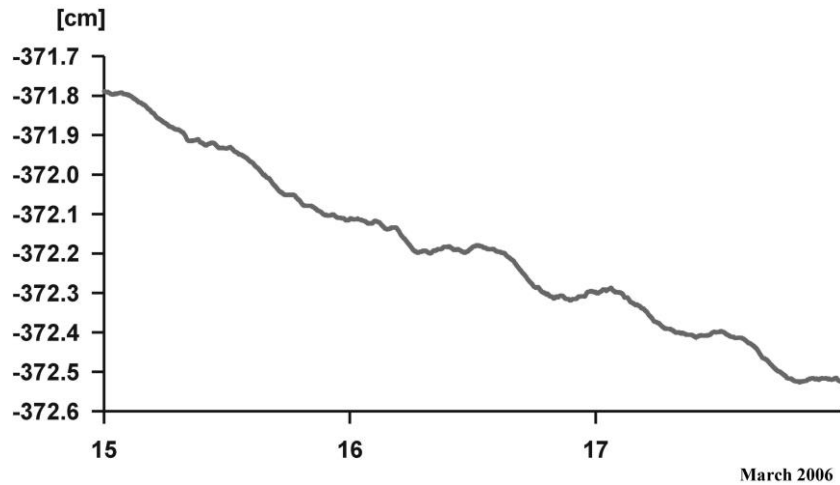


Fig. 6.Changes in the level of ground water between 15 and 17 March 2006

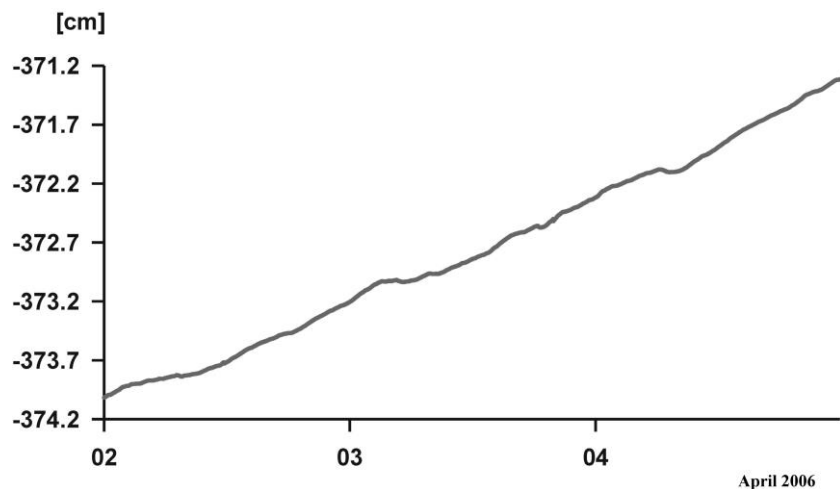


Fig. 7.Changes in the level of ground water between 2 and 4 April 2006

5. CONCLUSION

The following meteorological and geodynamical phenomena affecting the level of ground water, which can be observed by the measuring system in Lamkowko Satellite Observatory can be listed:

- meteorological effects (precipitation, snow)
- climatological effects (changes of atmospheric pressure)
- Earth tides effects,
- human influence on the environment.

The analysis of the first semiannual measurement series allowed to preliminarily recognize the complexity of the signals modifying the level of ground water in

Lamkowko Satellite Observatory. Preliminary results enable to detect diurnal and semidiurnal oscillations.

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