

## Long term variation of the Barometric Coefficient of the neutron component of cosmic rays

*I. Platanos, M. Gerontidou, P. Paschalis, H. Mavromichalaki*

Nuclear and Particle Physics Department, Faculty of Physics, National and Kapodistrian University of Athens, 15784 Athens Greece

**Abstract:** In this work a detailed analysis of the barometric coefficient for Athens neutron monitor data correction during the solar cycles 23 and 24, is presented. In order to study yearly and seasonal variations during the specific time period the barometric coefficient is calculated on yearly and monthly basis using the online barometric coefficient tool which is provided as a web application through the Athens Cosmic Ray Station (ANeMoS <http://cosray.phys.uoa.gr>) and which obtains data from the European High Resolution Neutron Monitor Database (NMDB, <http://www.nmdb.eu>). It is resulted that the variation of the calculated barometric coefficient seems to follow the 11-years behavior of the solar cycle.

### 1 Introduction

The affection of the atmospheric pressure to the measured cosmic ray intensity on the Earth's surface is a well known phenomenon [1]. Therefore a main task for the primary data processing is the accurate calculation of the barometric coefficient that constitutes a requirement for the quality of the neutron monitor data. For the calculation of the barometric coefficient for neutron monitor data correction an online tool has been implemented and provided through the Athens Cosmic Ray Station (<http://cosray.phys.uoa.gr>) as a web application using cosmic-ray data from the European High Resolution Neutron Monitor Database (NMDB, <http://www.nmdb.eu>). This tool takes advantage of the fact that most stations present their measurements on the NMDB in real time and calculates the barometric coefficient either by using a reference station for the exclusion of the primary cosmic ray variations or by only using the main station [2] [3].

### 2 Long-term variation of the barometric coefficient

The variation of the barometric coefficient for the pairs of Athens/ Rome, Newark/Kiel and Lomnický štít/Jung neutron monitors presented in Figure 1, seems to follow the variation of the 11-years solar cycle during the time period 2000-2014 [4]. The barometric coefficient presents a maximum value around the years 2002-2003 close to the maximum of the solar cycle 23 and a minimum one around the years 2007-2008 close to the extended minimum of the solar cycles 23 and 24.

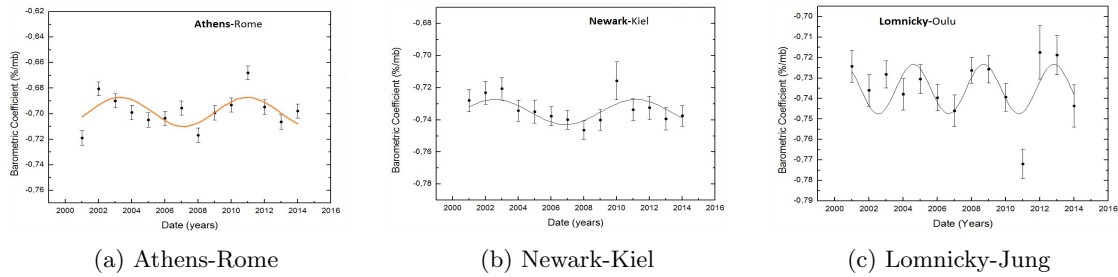


Figure 1: Time dependence of the mean annual values of the barometric coefficient for a number of neutron monitor pairs from 2001 to 2014 is given. A non-linear fit is indicated by the orange line.

### 3 Conclusions

- Due to the barometric effect the main correction of the primary cosmic ray data recorded by neutron monitors is the pressure one.
- An online tool that calculates in real-time the barometric coefficient of the neutron monitors, implemented by the Athens Cosmic ray group, is provided via A.Ne.Mo.S as well as via NMDB webpages. It is an easy check of the barometric coefficient used for the primary data processing and for the good quality of the data.
- The use of a reference station leads to satisfactory results even in the active cosmic ray periods.
- The barometric coefficient of Athens Neutron Monitor Station ranges from  $-0.72\%$  mb $^{-1}$  and  $-0.69\%$  mb $^{-1}$  with an average value of  $0.70\%$  mb $^{-1}$  used already for the correction of Athens data.
- It is interesting to note that the calculated barometric coefficient presents an 11-years variation over the solar cycles.

### 4 Acknowledgements

Special thanks to the colleagues of the NM stations for kindly providing the cosmic ray data used in this study in the frame of the High resolution Neutron Monitor database NMDB, funded under the European Union's FP7 Program (contract no. 213007).

### References

- [1] Carmichael H., Bercovitch M., Shea M.A., Magidin M., Peterson R.: 1968 *Canad. J. Phys.*, 46, 1006
- [2] Belov A.V., Gushchina R.T., Sirotnina I. : 1993 *Proceedings of 23th ICRC*, Calgary, 605.
- [3] Kobelev P., Belov A., Mavromichalaki H., Gerontidou, M., Yanke: 2011 *Proc.32 ICRC* , 11,382
- [4] Paschalis P., Mavromichalaki H., Yanke V., Belov A., Eroshenko E., Gerontidou M., Koutroumpi I.: 2013 *New Astronomy* , 19, 10