SOLAR UV IRRADIATION MONITORING in BULGARIA using narrow-band digital sensors and open-source InfluxDB database

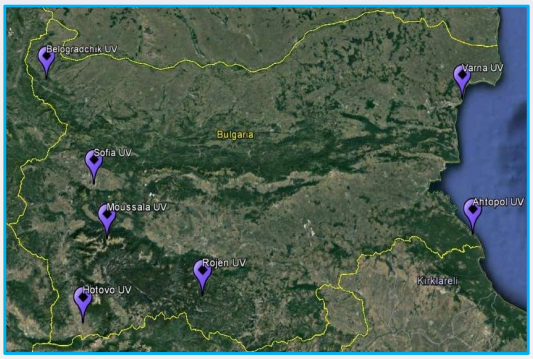
N. Tyutyundzhiev[1], Ch.Angelov[2], K. Lovchinov[3], T.Arsov[2], H. Nitchev[1]

[1]Institute of Electronics, Bulgarian Academy of Sciences, 72 Tzarigradsko chausse, Blvd. 1784 Sofia, Bulgaria
[2]Institute for Nuclear Research and Nuclear Energy, 72 Tzarigradsko chausse, Blvd. 1784 Sofia, Bulgaria
[3]Institute of Optical Materials and Technologies "Acad. J. Malinowski", Bulgarian Academy of Sciences, Acad. G. Bonchev str., bl. 109, 1113 Sofia, Bulgaria
E-mail: n_tyut@ie.bas.bg

Instruments for UV-A,UV-B radiation measurements

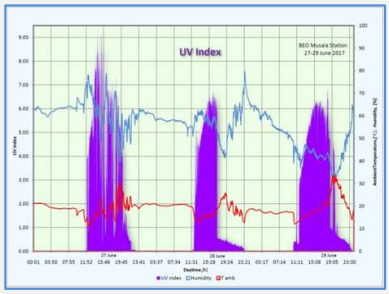
A low-cost, flexible digital sensor system for solar ultraviolet (UV) monitoring was developed using open-source hardware – Expressif ESP32 wi-fi microcontrollers, System on a Chip (SoC) Odroid C2 computers (credit-card size) and UBUNTU Linux operating system.
The integrated VEML6075 sensor has 5 x 4 sensor matrix of Al-Ga-As photodiodes divided in 4 channels: UV-A, UVcomp1, UV-B, UVcomp2 and peak senses at UVA(365nm, range 350-375nm) and UVB(320nm, range 315-340nm), bandwidth +/- 10 nm.

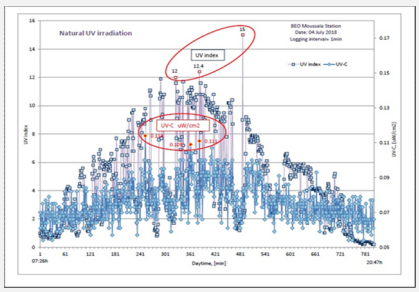
Locations of UV sensors network



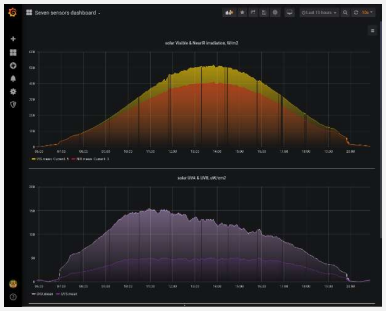
Remote high-altitude locations were selected for UV monitoring due to higher atmospheric transparency and increased UV irradiation. Because of higher risk of lightning strikes, high winds and low temperatures at these locations it is advisable to use low-cost and low-power consumption instrumentation. Sea level locations were selected for comparisons of results.
The MQTT server, database server and visualization server are installed on small single-board-computer. MQTT Mosquitto broker/server collects sensor readings and transports them to the Linux machine. Next, Python bridging script converts data text format to the required, by the Influxdb database, JSON format and send them for storage. Next, the Influxdb is configured and connected to real-time dashboards of Grafana visualization tool.

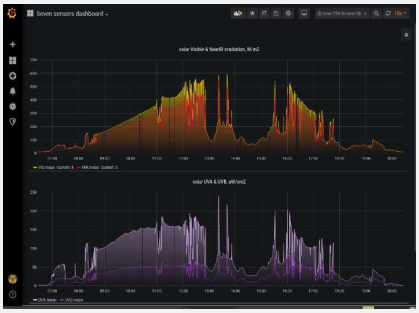
Results & Discussion





Clouds with expressed vertical structure enforce the reflection of UV sunlight on the cloud edges. 15% increase in UV index and respectively UV-A and UV-B irradiation are registered. A comparison between a commercial UV sensors system, and the system developed in this work was performed. Our sensor equipment exceeds the resolution due to higher sampling rate and reveal more short UV peaks, which are important to calculate accurately the daily UV dose.





Conclusion: The developed datalogging system, based on open-source controllers and open-source software satisfies the requirement for environmental monitoring and solar UV monitoring.

Acknowledgements

This study is supported by a grant under project No. КП 06 /24H - 2018 of National Research Fund of Bulgaria