



## Coming of spring in Europe and on Day Night Year Globe

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Day and night cycles, change of seasons, secular variations of climate on Earth are phenomena that depend on insolation of the Earth, its internal rotation and the orientation of its axis with respect to the Sun. For teaching about these phenomena, we have been using, since 2011, the outdoor globe that has the same orientation in space as the Earth. We call it Day Night Year Globe (DING). It was erected in the Center for advanced education of teachers in Šabac, Serbia [1]. Such globes were also erected in the Weizmann Institute in Israel, near the Max Valier Observatory in Italy, in the courtyard of the Tre University in Rome, in the Science Park in Zurich.

During 2010 and 2011, the High Medical School took part and coordinated the realization of the Greenwave project [2] in the Šabac region. Twenty-two teachers, in seven primary schools, inspired and instructed their students to observe how exactly spring arrives and moves across Europe. Their task was to measure on daily basis: wind speed, temperature and rain precipitation. They also recorded sightings of species (barn swallow and frog spawns), common to all European countries, and of local species, which act as early indicators of the arrival of spring.

The scientific contribution of the Šabac team consisted of correlating these observations and observations of changes of illumination on DING. During one sunny day, students observe the mapping of Earth's daily rotation onto DING. By observing the circle of illumination, day by day, students see how the inclination of this circle changes during the year. At the spring equinox the circle of illumination lies along the meridian.

Our idea was that participants in other country could incorporate observations on DING, or a hands-on globe with two-rotation axes, properly oriented. We tried to induce interest for this idea to the authors and leaders of the Greenwave project.

In Milanković's theory of the climate change of Earth, the orientation of Earth's axis with respect to the Sun is an essential parameter. Because of that, DING may be useful [3] in teaching an introduction to Milanković's theory. In his Mathematical theory of thermic phenomena caused by solar radiations (1920) and in Canon (1941), Milanković concisely explained astronomical mechanisms behind the climate change on Earth during last 600000 years. Secular variations of parameters of Earth's motion and impact of these variations on insolation of Earth have caused the secular changes of climate on Earth, resulting in the series of ice ages with interglacial periods.

If we would live long enough, we could follow the DING changes that are consequences of secular variations of Earth's parameters. But during our short lives we can only make thought observations, i.e. we could imagine how these changes on DING would be.

### References

1. T. M. Topalović and M. Božić, Physics Education, 46 (2011) 365.
2. <http://greenwave-europe.eu/>
3. M. Božić, M. Popović, L. Vušković, S. Popović, J. Popović, T. M. Topalović, Day Night Year Globe, submitted to Science & Education