EGU2020-21899
https://doi.org/10.5194/egusphere-egu2020-21899
EGU General Assembly 2020


# Simulating irradiance of water layers of natural reservoirs by solar radiation in various spectral ranges

**Natalia Darozhka**[1,2], Victar Dziomin[1], Ilya Bruchkouski[1,3], Alexander Svetashev[1,4], Leonid Turishev[1,2], Siarhei Umreika[1], and Siarhei Barodka[1,5]

[1]Belarusian State University, National Ozone Monitoring Research and Education Centre (NOMREC), Minsk, Belarus (E-mail: natashka_d10.05@mail.ru)

[2]Belarusian State University, Faculty of Geography and Geoinformatics, Minsk, Belarus

[3]Belarusian State University, A.N. Sevchenko Institute of Applied Physical Problems, Minsk, Belarus

[4]Belarusian State University, Faculty of Radiophysics and Computer Technologies, Minsk, Belarus

[5]Belarusian State University, Faculty of Physics, Minsk, Belarus

Software has been elaborated enabling to numerically simulate both the irradiance of the reservoir surface from total (direct and diffused) solar radiation with λ = 280 - 800 nm under various conditions (season, zenith angle, cloud cover, aerosol parameters, etc.) and the radiation propagation processes in the aquatic environment including the irradiance of water layers at various depths.

The numerical model employs the discrete ordinate method, implemented in a series of software packages that are in the public domain (DISORT, libRadtran, etc.), as well as the corresponding databases of atmospheric and underlying surface parameters.

To simulate the propagation processes of the solar radiation in aquatic environment, a special database has been developed, containing reference data, orbital observations, and data obtained from instrumental monitoring of surface reservoirs in Belarus maintained by the National Ozone Monitoring Research and Education Center of the Belarusian State University (NOMREC BSU) over many years as part of national environmental studies.

The program combines atmospheric and water modules being able to function both jointly and separately thus allowing one to use spectral irradiance or integrated signals experimentally measured by ground-based devices and immersion photometric systems to validate the results of numerical calculations and model calibration.

Special attention was paid to the propagation of biologically active solar radiation (that is UV-B, UV-A and PAR) in the aquatic environment.

Irradiance of water layers by UV radiation and estimation of the corresponding doses of the main biological effects, in particular DNA, are of special interest due to poor knowledge in this field.

Moreover, in the UV range (if compared with the visible range), under significant radiation scattering and absorption by the turbid aquatic environment of surface water bodies, the interpretation and numerical simulation of the transmission function appear to be not quite a trivial task.

A theoretical research on this problem was added with special laboratory and field experiments.

An experimental study of the irradiation levels of various deep-water layers was conducted in the Naroch group lakes (Naroch, Myastro, Malye Shvakshty, Bolshye Shvakshty, Beloye, and Batorino) using a PionDeep immersion photometer designed at NOMREC BSU.

The results showed the presence of well detected UV-B radiation intensities in the lake of Naroch at sufficiently large depths of ~ 15 m.

"Immersion" measurements were also carried out at various points in the waters of the Myastro, Malye Shvakshty, Bolshye Shvakshty, Beloye, and Batorino lakes.

The measurements were made under various cloud cover and water surface conditions. Distances from the coast varied within 200−2200 m.

To refine the model parameters a series of laboratory measurements of the transmission of natural and model water samples in a spectral range of $\lambda$ = 200–700 nm was conducted. At that the absorption spectra of natural and model water bodies, both full-scale and at various stages of filtration, were analyzed.

The numerical simulation exploiting the refined model of UV transparency and irradiances of water layers at various depths was in a good agreement with experimental data.