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A model for estimating solar ultraviolet radiation for vitamin D photosynthesis

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Solar ultraviolet radiation has both beneficial and drawback impacts on human health. Excessive exposure to ultraviolet radiation is hazardous for human. For example, it can cause skin cancer, cataracts and suppression of the immune system. On the other hand, solar ultraviolet radiation is a part of the vitamin D photosynthesis in the human skin. It is needed in the process of synthesizing previtamin D in the epidermis to 25-hydroxyvitamin D via the liver and kidneys. Although Thailand is located in the equator where solar radiation is relatively high, the number of patients with vitamin D deficient is increasing. Therefore, the instantaneous amount of solar ultraviolet is needed to be known. This can be measured by using a spectrophotometer together with the vitamin D action spectral response. However, in Thailand, such ground-based instrument is very scarce. To solve this problem, this work aims to develop an empirical model for estimating hourly solar ultraviolet radiation for vitamin D synthesis under all sky condition using atmospheric parameters.

A spectrophotometer (model DMc150, Bentham Instruments) is used together with a CIE action spectral response to obtain the measured solar ultraviolet radiation for vitamin D synthesis (UVvitD) at Nakhon Pathom province, Thailand. The input of the model consists of cloud index from Himawari satellite, total ozone column from OMI/AURA satellite, aerosol optical depth from an AERONET sunphotometer and air mass from a well-known formula. The data used in this work are in the period of 2016-2018. The result shows that UVvitD obtained from the measurement and that calculated from the model are consistent with root mean square difference (RMSD) of 17.1% and mean bias difference (MBD) of -9.2%. In further work, this model will be generalized in order to apply for all regions in Thailand.

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