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Approximating downward short-wave radiation flux using all-sky optical imagery using machine learning trained on DASIO dataset.

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Solar radiation is the main source of energy on Earth. Cloud cover is the main physical factor limiting the downward short-wave radiation flux. In modern models of climate and weather forecasts, physical models describing the passage of radiation through clouds may be used. This is a computationally extremely expensive option for estimating downward radiation fluxes. Instead, one may use parameterizations which are simplified schemes for approximating environmental variables. The purpose of this work is to improve the accuracy of the existing parametrizations of downward shortwave radiation fluxes. We solve the problem using various machine learning (ML) models for approximating downward shortwave radiation flux using all-sky optical imagery. We assume that an all-sky photo contains complete information about the downward shortwave radiation. We examine several types of ML models that we trained on dataset of all-sky imagery accompanied by short-wave radiation flux measurements. The Dataset of All-Sky Imagery over the Ocean (DASIO) is collected in Indian, Atlantic and Arctic oceans during several oceanic expeditions from 2014 till 2021. The quality of the best classic ML model is better compared to existing parameterizations known from literature. We will show the results of our study regarding classic ML models as well as the results of an end-to-end ML approach involving convolutional neural networks. Our results allow us to assume one may acquire downward shortwave radiation fluxes directly from all-sky imagery. We will also cover some downsides and limitations of the presented approach.