6th International Workshop on Deep Learning in Computational Physics (DLCP-2022)

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Data-driven approximation of downward solar radiation flux based on all-sky optical imagery using machine learning models trained on DASIO dataset.

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Cloud cover is the main physical factor limiting the downward shortwave (SW) solar radiation flux. In modern models of climate and weather forecasts, physical models describing radiative transfer through clouds may be used. However, this is a computationally expensive option. Instead, one may use parameterizations which are simplified schemes for approximating environmental variables. The purpose of our study is to assess the capability of machine learning models in the scenario of statistical approximation of radiation flux based on all-sky optical imagery. We applied various machine learning (ML) models within the assumption that an all-sky photo fully encapsulates information about the downward shortwave radiation. We examine several types of ML models: some classic ML models along with a convolutional neural network (CNN). These models were trained using the dataset of all-sky imagery accompanied by SW radiation flux measurements. The Dataset of All-Sky Imagery over the Ocean (DASIO) is collected in Indian, Atlantic and Arctic oceans during several expeditions from 2014 till 2021. When training our CNN, we applied heavy source data augmentation in order to force the CNN to become invariant to brightness variations and, thus, approximating a relationship between the visual structure of cloudiness and SW flux. We demonstrate that the CNN supersedes existing parameterizations known from literature in terms of RMSE of flux. Our results allow us to assume that one may acquire downward shortwave radiation flux directly from all-sky imagery. We also demonstrate that CCNs are capable of estimating downward SW radiation flux based on clouds' visible structure.

Agreement to place

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