Geophysical Research Abstracts
Vol. 20, EGU2018-18036, 2018
EGU General Assembly 2018

Artificial neural networks for total cloud cover estimation and solar disk state detection using all sky images

Mikhail Krinitskiy
Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia (krinitsky@sail.msk.ru)

Shortwave radiation is an important component of surface heat budget over sea and land. To estimate it, accurate observations of cloud conditions are needed including total cloud cover (TCC) and spatial cloud structure. TCC is massively observed visually by qualified personnel, therefore the number of observations is fundamentally limited by human resources. Furthermore, operator observations suffer of subjectivity. Since 1980s the number of VOS cloud observations over sea is steadily decreasing due to automated VOS (AVOS) stations inculcation. They are, however, doesn‘t include automated clouds observation subsystems. So cloud observations need to be expanded and automated.

There are several state of the art discrete land-based cloud-cameras that technically satisfy researchers needs. But their major disadvantage is associated with inaccuracy of all-sky images processing algorithms which typically result in the uncertainties of 2-4 octa of cloud cover estimates. The TCC estimation accuracy of routine algorithms is 27-29% in their best optimized versions.

There are a number of studies demonstrated high solar disk state (SDS) influence on TCC estimation accuracy. SDS itself is an important parameter in terms of SW radiation estimation problem.

We present an artificial neural networks approach for TCC estimating and SDS determination, which provides much more accurate outcome compared to routine algorithms. In our method we use the synthetic color-based index, namely the “grayness rate index” (GrIx), that we have introduced in 2014. Since then this index has already demonstrated high efficiency in cloud characteristics assessment problems.

During several campaigns over oceans from 2014 till 2017 we have collected large dataset of hemispheric sky images using our all-sky camera presented in 2014. The filtered dataset contains almost 100‘000 images accompanied with the concurrent meteorologist background-truth TCC estimate and over 25‘000 samples accompanied with operator SDS evidence.

Several artificial neural network architectures for TCC estimation and SDS determination was tested. Best hyperparameter-optimized model versions, being trained on the target-balanced data sets, demonstrate 99% test-set accuracy in the classification problem approach.

This work was supported by the Russian Science Foundation grant 14-50-00095.