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ARPEGE cloud cover forecast post-processing with convolutional neural network

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Cloud cover is a crucial information for many applications such as planning land observation missions from space. However, cloud cover remains a challenging variable to forecast, and Numerical Weather Prediction (NWP) models suffer from significant biases, hence justifying the use of statistical post-processing techniques. In our application, the ground truth is a gridded cloud cover product derived from satellite observations over Europe, and predictors are spatial fields of various variables produced by ARPEGE (Météo-France global NWP) at the corresponding lead time.

In this study, ARPEGE cloud cover is post-processed using a convolutional neural network (CNN). CNN is the most popular machine learning tool to deal with images. In our case, CNN allows to integrate spatial information contained in NWP outputs. We show that a simple U-Net architecture produces significant improvements over Europe. Compared to the raw ARPEGE forecasts, MAE drops from 25.1 % to 17.8 % and RMSE decreases from 37.0 % to 31.6 %. Considering specific needs for earth observation, special interest was put on forecasts with low cloud cover conditions (< 10 %). For this particular nebulosity class, we show that hit rate jumps from 40.6 to 70.7 (which is the order of magnitude of what can be achieved using classical machine learning algorithms such as random forests) while false alarm decreases from 38.2 to 29.9. This is an excellent result, since improving hit rates by means of random forests usually also results in a slight increase of false alarms.