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Classifying Global Low-Cloud Morphology with a Deep Learning Model: Results and Potential Use

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Marine low clouds display rich mesoscale morphological types, distinct spatial patterns of cloud fields. Being able to differentiate low cloud morphology offers a tool for the research community to go one step beyond bulk cloud statistics such as cloud fraction and advance the understanding of low clouds. Here we report the progress of a NASA funded project that aims to create an observational record of low cloud mesoscale morphology at a near-global (60S-60N) scale. First, a training set is created by our team members manually labeling thousands of mesoscale (128x128) MODIS scenes into six different categories: stratus, closed cellular convection, disorganized convection, open cellular convection, clustered cumulus convection, and suppressed cumulus convection. Then we train a deep convolutional neural network model using this training set to classify individual MODIS scenes at 128x128 resolution, and test it on a test set. The trained model achieves a cross-type average precision of about 93%. We apply the trained model to 16 years of data over the Southeast Pacific. The resulting climatological distribution of low cloud morphology types show both expected and unexpected features and suggest promising potential for low cloud studies as a data product.