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Tropical cyclone cloud coverage segmentation using convolutional neural networks with combined input parameters

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Tropical cyclones are among the most devastating weather events. Their frequency and intensity trend due to climate variability has been studied both regionally and globally. Although there are statistically significant changes in the two attributes reported in different regions, the causes of these trends are still a highly debatable topic. In this study, we propose a deep learning model to correctly label tropical cyclone cloud pixels, which would help establish tropical cyclone cloud coverage as a potential tropical cyclone diagnostic tool. Training data are developed using a subjective labeling algorithm, which is based on conventional image processing methods. Annotating in this fashion is more time-efficient and gives more consistent labels across the tropical cyclone life cycle, compared to a more conventional hand-labeling method. The labeling process is performed on brightness temperature images provided by the NOAA CPC/NCEP GPM_MERGIR dataset, captured at half-hour intervals with 4-km resolution. Time series of tropical cyclone center locations, acquired from the NCDC International Best Track Archive for Climate Stewardship (IBTrACS) dataset, were fed into the calculation to provide better tracking of tropical cyclone clouds. Since the IBTrACS data are archived at 6-hour intervals, they are interpolated linearly to match the half-hour temporal resolution of the brightness temperature images. The training data are then used to train a deep learning model based on the pretrained Mask R-CNN structure. At the input layer of the convolutional neural network, additional tropical cyclone parameters are included at each pixel, in addition to the brightness temperature, including: distance from the tropical cyclone center; wind angle; wind intensity; and pressure among others. Results will be shown in different ocean basins for archived tropical cyclones in the time period 2008 - 2013.