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# U-Net Segmentation for the Detection of Convective Cold Pools From Cloud and Rainfall Fields

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Cold pools are known to mediate the interactions between convective rain cells. Cold pool dynamics thus constitutes an important organizing mechanism for thunderstorms, in particular mesoscale convective systems and extreme rainfall events. Unfortunately, the observational detection of cold pools on a large scale has so far been hampered by the lack of relevant large-scale near-surface data. Unlike in numerical studies, where high-resolution near-surface fields of relevant quantities such as virtual temperature and winds are available and frequently used to detect cold pools, in observational studies cold pools are mainly identified based on surface time series. Since research vessels or weather stations measure these time series locally, the characterization of cold pools from observations is limited to regional or station-based studies. To eventually enable studies on a global scale, we here develop and evaluate a methodology for the detection of cold pools that relies only on data that (i) is globally available and (ii) has high spatio-temporal resolution. We trained convolutional neural networks to segment cold pools in cloud and rainfall fields from high-resolution cloud resolving simulation output. Such data is not only available from simulations, but also from geostationary satellites that fulfill both (i) and (ii). The networks feature a U-Net architecture, a common choice for image segmentation due to its strength in learning spatial correlations at different scales. Based on cloud and rainfall fields only, the trained networks systematically identify cold pool pixels in the simulation output. Our methodology may thus open for reliable global cold pool detection from space-borne sensors. As it also provides information on the spatial extent and the relative positioning of cold pools over time, our method may offer new insight into the role of cold pools in convective organization.