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Quantitative Precipitation Estimation from SEVIRI IR Data Using Generative AI

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Accurate near-real-time precipitation estimates are essential for hydrometeorological applications, but are largely limited to regions equipped with ground-based observation networks or rely on infrequent overpasses of low-Earth-orbiting satellites. Geostationary satellites (GEOs) provide continuous, large-scale observations of the atmosphere and surface, offering valuable but indirect information on precipitation. Near-real-time products derived from GEOs face challenges in capturing the occurrence and spatiotemporal variability of rainfall.

We present a conditional Generative Adversarial Network (cGAN) designed to derive quantitative precipitation estimates (QPE) from MSG SEVIRI data. The deep learning model learns the complex, nonlinear relationships between multi-spectral satellite data and surface precipitation. Via the cGAN architecture, with its discriminator, the model is able to predict realistic precipitation fields which also include high and extreme rainfall rates. The model is also able to produce an ensemble of QPE realizations. Model training is done with the high-resolution (1km and 5-minute, aggregated to SEVIRI-resolution) weather radar data RADKLIM-YW in Germany where model performance is also validated. Compared to PDIR-now, from the PERSIANN-family of GEO rainfall products, it shows significant improvement, e.g. PCC increased from 0.32 to 0.47, FARatio decreased from 0.66 to 0.50, POD increased from 0.39 to 0.62. In this contribution we explain the model architecture and show a validation spanning multiple months of data, as well as selected case studies. Furthermore, we discuss planned extensions to additional datasets and the application to the full SEVIRI disc.