

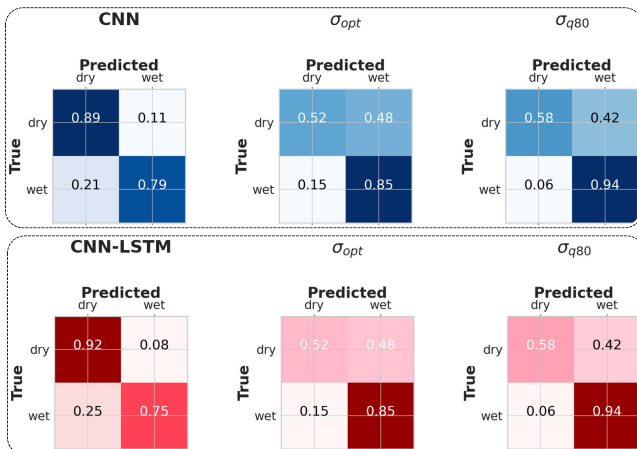
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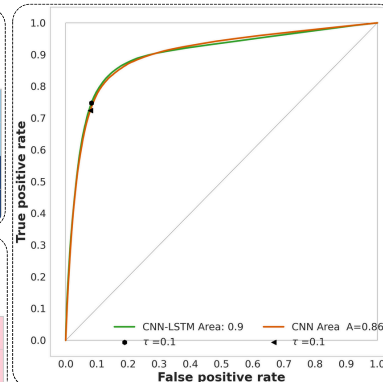
Accurate rainfall estimation can be improved by integrating diverse data sources. Commercial Microwave Links (CMLs) provide path-averaged rainfall rates via signal attenuation and are especially valuable in regions with sparse sensor networks. However, wet-dry classification remains challenging due to factors like Wet Antenna Attenuation (WAA) and baseline drift. To overcome these issues, we integrated CML data with satellite-based cloud microphysics products. We employ CNN and hybrid CNN-LSTM models trained on total signal loss and supported by the Precipitation Cloud (PC) product from MSG-SEVIRI to enhance rain event detection, following the methodology proposed by [Graff et al. \(2024\)](#).

- We developed CNN and CNN-LSTM models using CML signal loss and the Precipitation Cloud (PC).
- We assessed the models' sensitivity to link length, frequency, and geographic region.
- We compared the performance of the two models across multiple criteria.

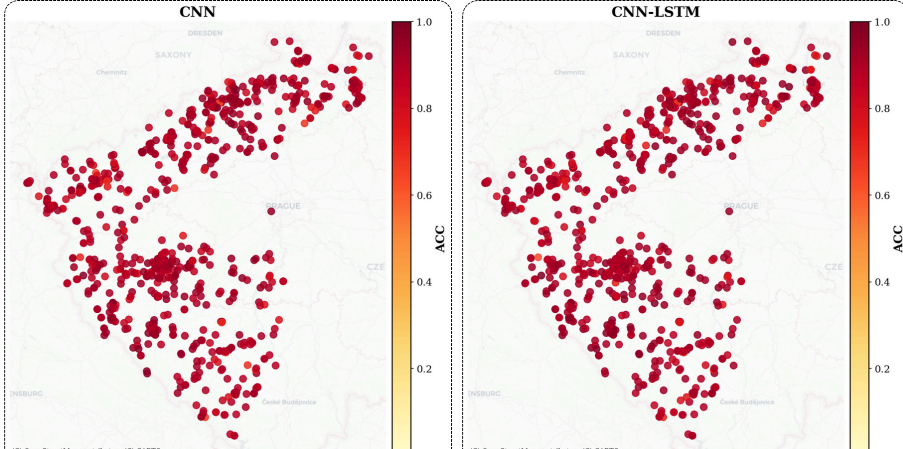
- **Model Performance: Confusion Matrices**



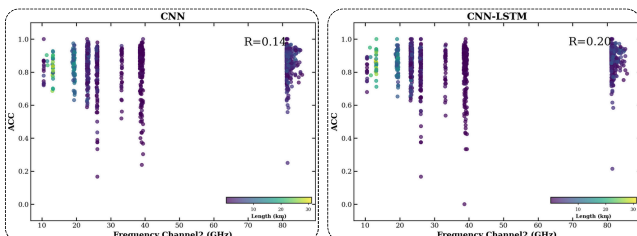
- **Model Intercomparison:**



- **Geographic Accuracy Distribution: CNN vs CNN-LSTM**



- **Sensitivity Analysis: CML Length Frequency**



- CNN and CNN-LSTM models using NWC-SAF PC products showed similar performance and robust transferability across datasets, frequency, link length and rain classes.
- CNN-LSTM performed slightly better in detecting dry conditions.
- Spatial analysis confirms the reliability of CNN-LSTM, and its performance remains steady across the entire Czech region.
- Sensitivity analysis confirms that Rainfall intensity class has the strongest influence on model performance than either link length or frequency.
- Our results show that incorporating MSG-SEVIRI data into CML data processing significantly improves the quality of rain event detection compared to state-of-the-art methods ( $\sigma_{opt}$ ,  $\sigma_{q80}$ ), which use the rolling standard deviation (RSD), in the Czech Republic and Germany, as previously investigated by Graff et al. (2024).

**Improve CML/SML Dry-Wet Classification Using NWC SAF PC Products**

CNN/LSTM or Hybrid Classification

Set time steps to "wet" if PO1 is "wet."

Set time steps to "Dry" if CNN94 is "Dry."

Set time steps to "Wet" if PO30 is "Wet."

Set time steps to "Dry" if CNN10 is "Dry."

Dry Instances

Wet Instances

*Deaf et al 2022*

