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Towards smarter weather radar: a simulation study of adaptive scanning strategies for improved precipitation monitoring and forecasting.

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Weather radars are essential to the reliable monitoring and forecasting of intense precipitation. Yet, the current radar-based nowcasting systems often rely on sub-optimal scanning strategies which limit the system's effectiveness. Adaptive scanning techniques - where the radar's rotation speed or direction are dynamically adjusted in response to a cell's position, movement, and intensity - have the potential to significantly improve nowcasting performance. So far, these benefits have largely been assumed rather than systematically tested. In this study, we present preliminary findings from numerical simulations designed to quantify the advantages of adaptive scanning strategies for an X-band weather radar.

Our approach uses a single radar with unidirectional azimuth scanning and a variable rotation speed, targeting a single moving precipitating cell within its range. A closed-loop control system adjusts the radar's rotation speed based on real-time estimates of the cell's location and motion. We compare this adaptive scanning strategy to the conventional approach of a fixed antenna rotation speed, extending the analysis to more complex cell trajectories for greater realism. Whilst preliminary, we hope these findings will spark further research into the science of adaptive scanning and its potential to enhance precipitation monitoring, tracking, and forecasting within radar networks.

VAT

Session

From Classical to Integrated Remote Sensing: New observation strategies for clouds and precipitation (multi-frequency, spectral polarimetry, multi-sensor)

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