Contribution ID: **29** Type: **not specified**

Tropical rainfall nowcasting with Commercial Microwave Links: opportunities and current limitations

Monday 17 March 2025 10:45 (15 minutes)

Accurate and timely precipitation forecasts are crucial for flood early warnings and mitigating other rainfall-induced natural hazards like landslides. For forecasts up to three hours ahead, rainfall nowcasts are increasingly being used. Generally, these nowcasts statistically extrapolate real-time remotely sensed quantitative precipitation estimates, often based on weather radars. However, the global distribution of high-resolution (gauge-adjusted, ground-based) weather radar products is heavily skewed, largely favoring Europe, Northern America, and parts of East Asia. In many low- and middle-income countries, predominantly located in the tropics, weather radars are largely unavailable due to high installation and maintenance costs, and rain gauges are often scarce, poorly maintained, or not available in (near) real-time.

A viable and 'opportunistic' source of high-resolution space-time rainfall estimates is based on the rain-induced signal attenuation experienced by commercial microwave links (CMLs) in cellular communication networks. Based on received signal power levels, path-averaged rainfall intensities can be estimated, and then interpolated to produce high-resolution rainfall maps. In this study, we explore the opportunities and limitations that arise from using only CML-based rainfall estimates for rainfall nowcasting in Sri Lanka.

Using 12 months of data from 2019 and 2020 from a Sri Lankan CML network that predominantly covers the northern half of the country, we create spatial rainfall fields at 15-minute intervals. With the nowcasting algorithm pySTEPS, probabilistic nowcasts are created for lead times up to three hours for events with different durations ranging from 1 to 24 hours. The nowcasts (QPF) are evaluated against the CML rainfall fields (QPE) across 12 catchments of varying sizes and with varying CML coverage and density. The results are further analyzed by season to determine the potential influence of rainfall intensity and dominant wind direction on the nowcasts' accuracy. Hourly rain gauges, where available, are used as an independent (point) reference source of rainfall information.

With this novel application of CML-derived rainfall fields, essentially providing a 'weather radar' in the tropics, we identify the major sources of uncertainty in the nowcasts and highlight the potential impact of relying solely on CMLs for operational early warning services in regions that lack dedicated rainfall sensors.

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Session

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

Preferred Contribution Type

Oral Presentation

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