Nowcasting extreme rainfall events in the tropics using Commercial Microwave Links

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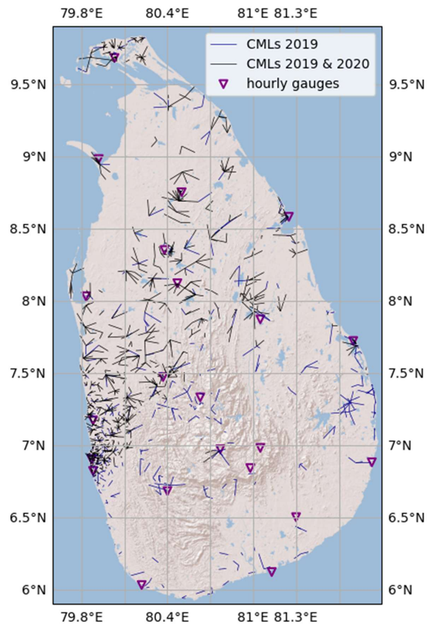
CML dataset

Sri Lanka

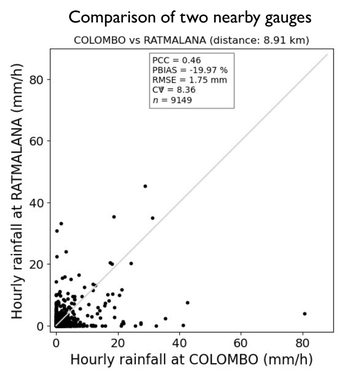
- Received power levels (min. and max., every 15-minutes)
- Sep. 2019 – Dec. 2020
- 2570 sub-links; across 1328 unique link paths
- Ordinary Kriging interpolation

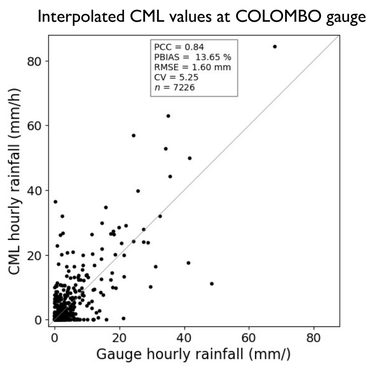
↳ **country-wide rainfall maps on 2-km grid at 15-min. resolution**

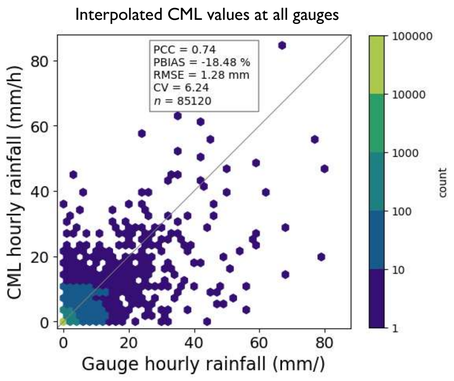


Reference data

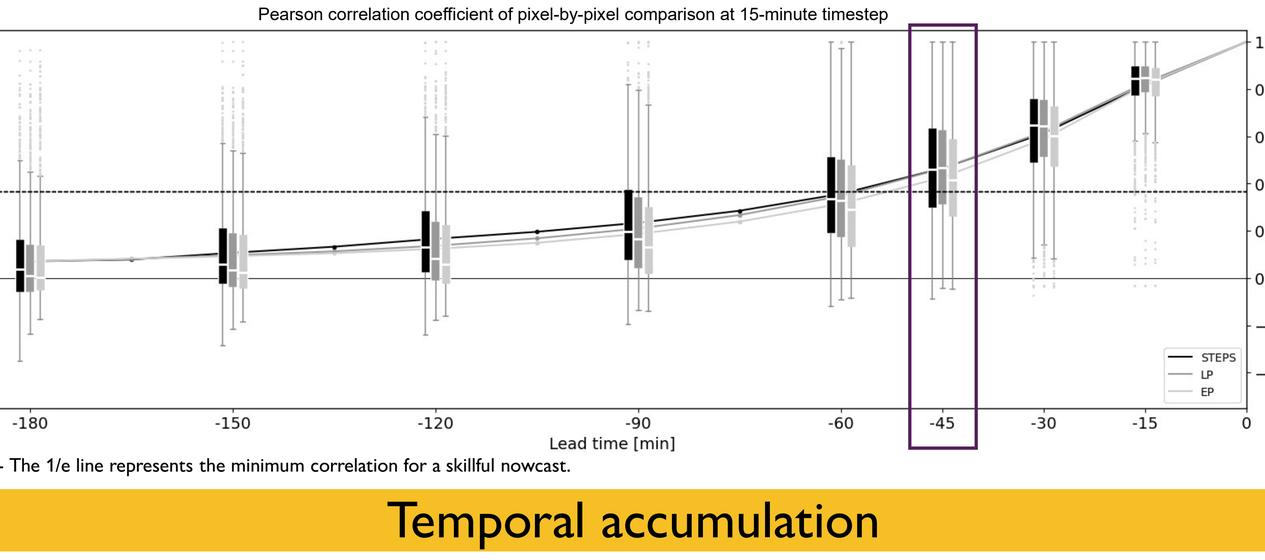
▽ 21 hourly rain gauges







Hourly gauge data vs. CML nowcast



How far in advance can we skillfully predict rainfall events using only Commercial Microwave Link (CML) data?

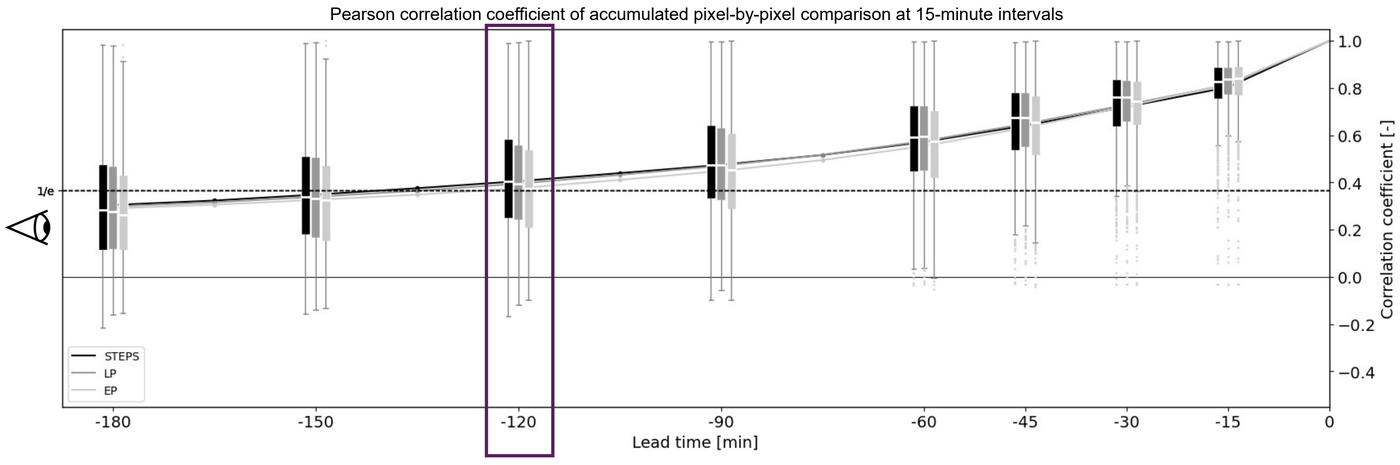
Nowcasting method evaluation

- Minimal difference between STEPS (ensemble mean), Extrapolation and Persistence. *(due to dominance of low magnitude motion fields in input data)*
- Skillfull nowcasts up to 45 minutes ahead.

--- The 1/e line represents the minimum correlation for a skillful nowcast.

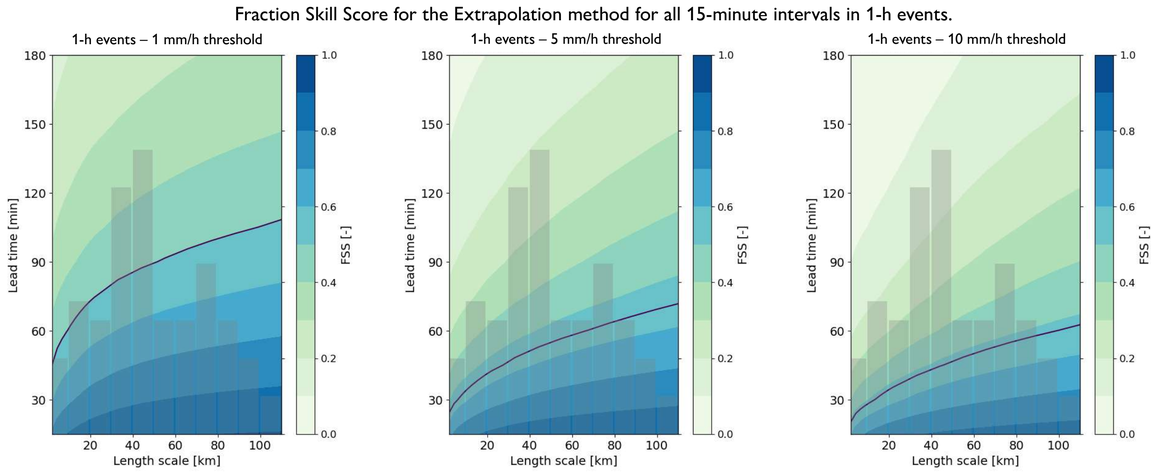
Temporal accumulation

- Temporal accumulation increases skillfull lead time up to 120 minutes *(particularly relevant for catchment hydrologists and water managers!)*



Spatial comparison

- The majority of catchments have a max. length scale greater than 40 km. In these catchments events with an average rainfall intensity of 10 mm h^{-1} or higher can be skillfully predicted up to 45 minutes ahead.



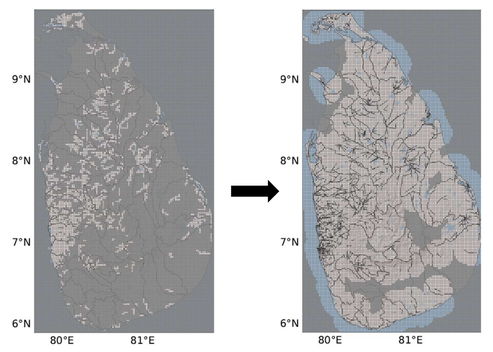
The histogram in the background shows the distribution of the maximum catchment length scale.

Key takeaways

1. Accumulated rainfall depths at the catchment scale (~40 km) can skillfully be predicted 2 hrs ahead → important for water managers and catchment hydrologists!
2. Straightforward extrapolation of rainfall fields leads to similar skill as more complex methods → promising for operational early warning!

Methodology

No-data coverage mask

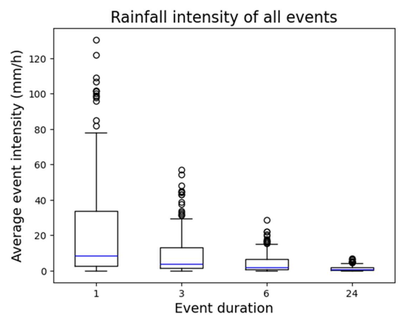


Grid cells containing CMLs

18-km buffer (variogram range used in interpolation)

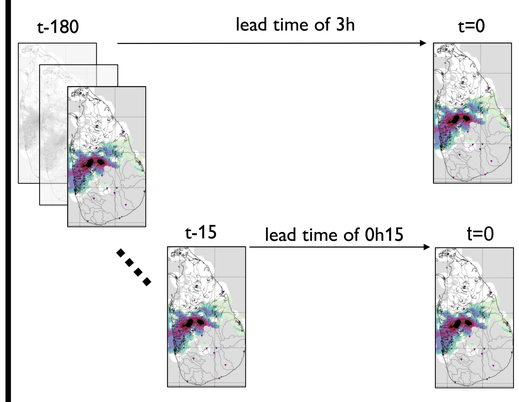
Event selection

Per catchment (67),
↳ 4 seasons (2 monsoon, 2 inter-monsoon)
↳ and 4 event durations (1, 3, 6, 24hrs)
↳ select 2 events:
- max. catchment average
- max. cell value in catchment



pySTEPS nowcasting methods

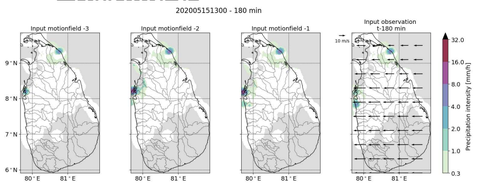
3 methods:
- STEPS - extrapolates the input image and includes growth and decay of rain cells, contains 20 ensembles
- LP: extrapolates the input image
- EP: is the input image



Motion field determination

Non-contiguous data coverage creates edges inside the nowcast domain and can lead to excessively **large motion fields**.

View the effect of large motion vectors on the nowcast skill



Extremely **small motion fields** (in combination with 15-min. temporal resolution) can lead to nearly static consecutive rainfall fields where the growth and decay module (STEPS) is outperformed, in terms of metrics, by Persistence.

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