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A Spatially Continuous Driving Rain Map of India at 0.5°×0.5° Gridded Scale

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1 Introduction

The presence of moisture initiates and escalates numerous deterioration processes in building materials. Driving rain or wind-driven rain (WDR) is one of the most critical sources of moisture affecting the hygrothermal and durability performance of building envelopes (Blocken *et al.*, 2009). The estimation of WDR severity in terms of annual driving rain indices using annual and monthly weather data (*aaDRI* and *maDRI* respectively) aids towards contemplating potential WDR loads and hence in the efficient design of buildings.

In this study, monthly and annual gridded datasets of wind and rainfall, pertaining to the thirty-year period of 1988-2017 have been used to design a spatially continuous driving rain map for India at 0.5°×0.5° (lat./long.) resolution. The rainfall and wind gridded datasets have been obtained from the archives of the Climate Research Unit and the National Oceanic and Atmospheric Administration, respectively. Furthermore, a trend analysis has been carried out on the yearly driving rain index values to ascertain the increasing or decreasing pattern of driving rain severity across the subcontinent

2 Driving Rain Index

2.1 Calculation of *maDRI* and *aaDRI*

The *maDRI* and *aaDRI* have been calculated using procedure adopted by previous studies (Narula *et al.*, 2017). These indices have been subsequently used for the development of WDR maps by categorizing them into four categories, viz., shielded, moderate, high and severe, in increasing order of severity. Furthermore, a relationship between *aaDRI* and *maDRI* has been developed for the instance of unavailability of data at a fine temporal scale.

2.2 Trend Analysis of WDR

Trend analysis of WDR has been facilitated using Mann Kendall trend analysis test which detects the presence of significant trend, and Sen’s slope estimator which estimates the direction of the trend.

3 Results and Discussions

Figs. 1a and 1b represent the *maDRI* and *aaDRI* maps respectively. The *aaDRI* map underestimates the driving rain severity as most region fall under shielded category, therefore, the *maDRI* is a more reliable estimate. In instance wherein data at fine temporal scale is not available, the *aaDRI* can be used to estimate *maDRI*, as they exhibit a linear relationship expressed as: *maDRI=1.28aaDRI-0.28,* which is in conformance with previously reported studies for India (Narula *et al.* 2017). Furthermore, trend analysis using 30 years of data suggests increasing trend of severity in the shielded parts of the country.

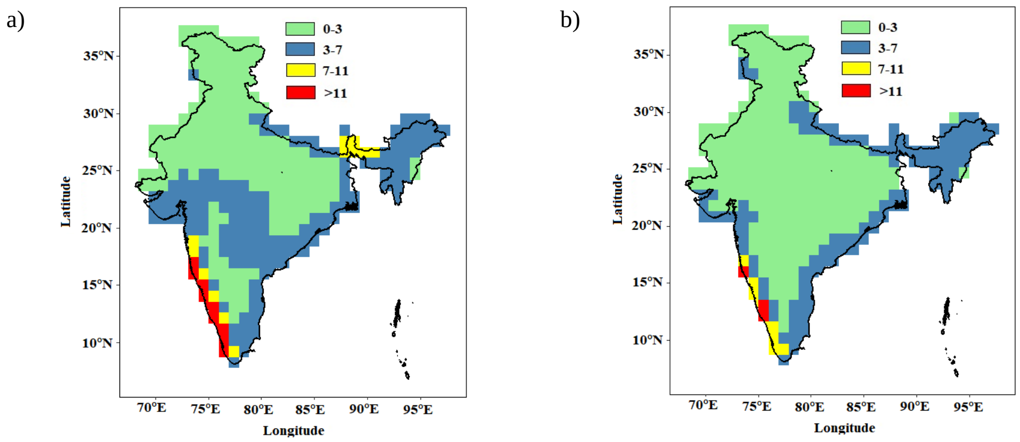

Figure 1. Driving rain map of India based on (a) *maDRI* (b) *aaDRI*.

4 Conclusions

- *maDRI* map shows that zones of shielded, moderate, high, and severe exposure condition correspond to 63.36%, 33.42%, 1.95%, and 1.27% respectively of the total land area.
- Trend analysis reveals statistically significant increasing trends in the shielded regions surrounding central India.

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References

Blocken, B., Abuku, M., Roels, S. and Carmeliet, J. (2009). Wind-driven rain on building facades: some perspectives. *EACWE*, *5*, pp.19-23.

Narula, P., Sarkar, K. and Azad, S. (2017). Driving rain indices for India at 1°× 1° gridded scale. *Journal of Wind Engineering and Industrial Aerodynamics*, *161*, pp.1-8.