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Evaluating rain microphysics of seasonal rain using the GPM

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Introduction

- Distinct topography of the Western Ghats along the west coast of India.
- Complex mountains divide Western Ghats into windward and leeward side.
- Rainfall pattern is different on both sides.

Is any variation in microphysical characteristics of rainfall over the Western Ghats across the season and cloud type?

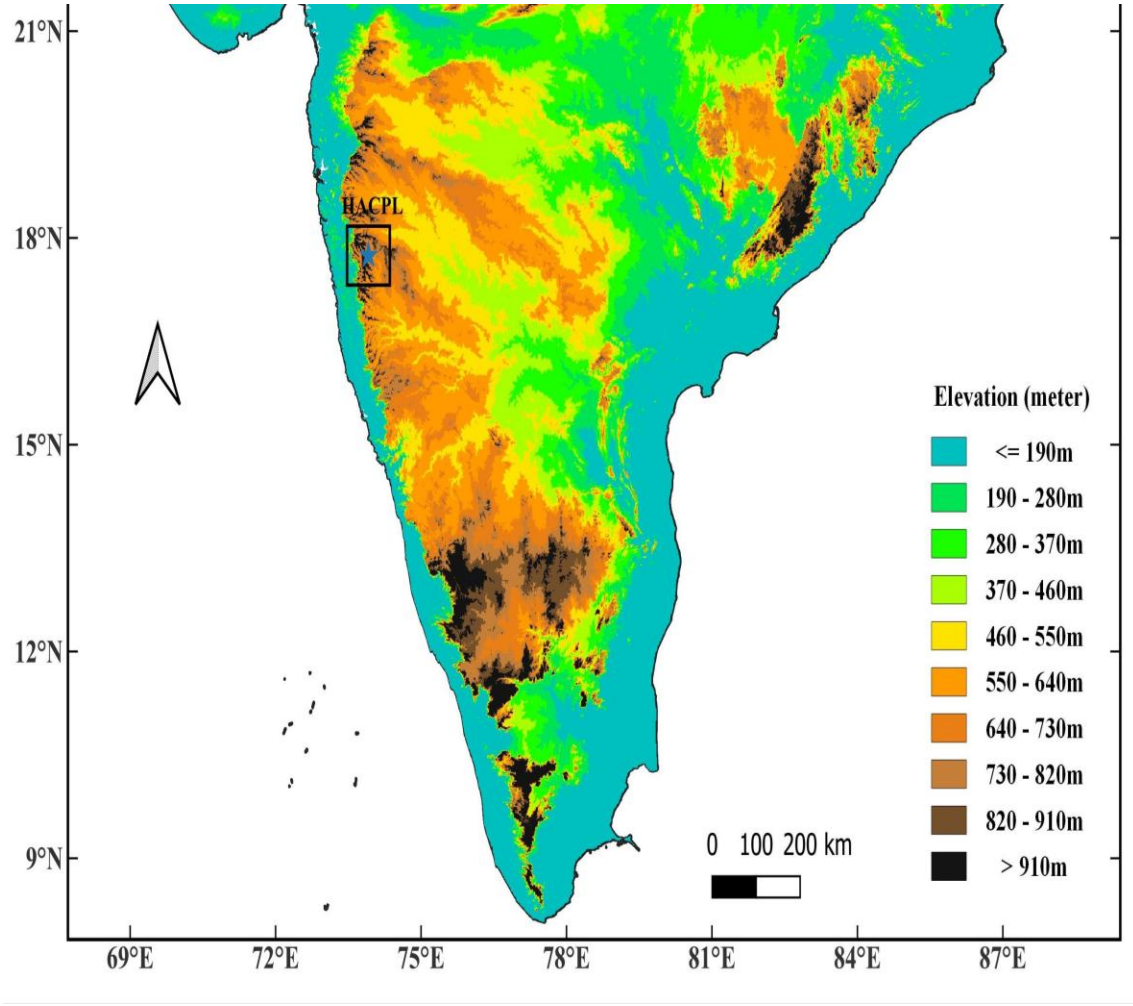

Figure 1: Regional elevation of the Southern India, containing the Western Ghats of India.

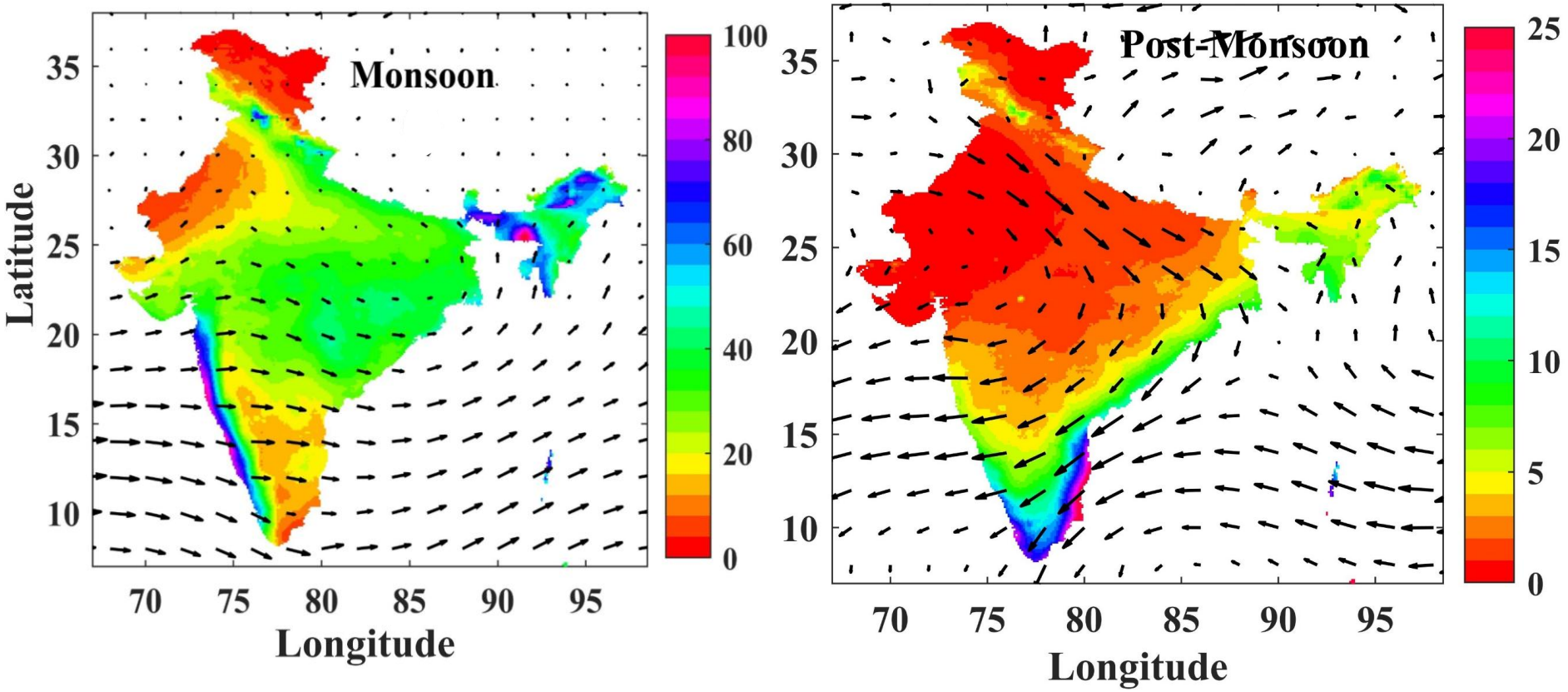

Figure 2: displaying distinct rainfall climatology and wind direction(at 850 hpa) during the monsoon and post-monsoon season over India.

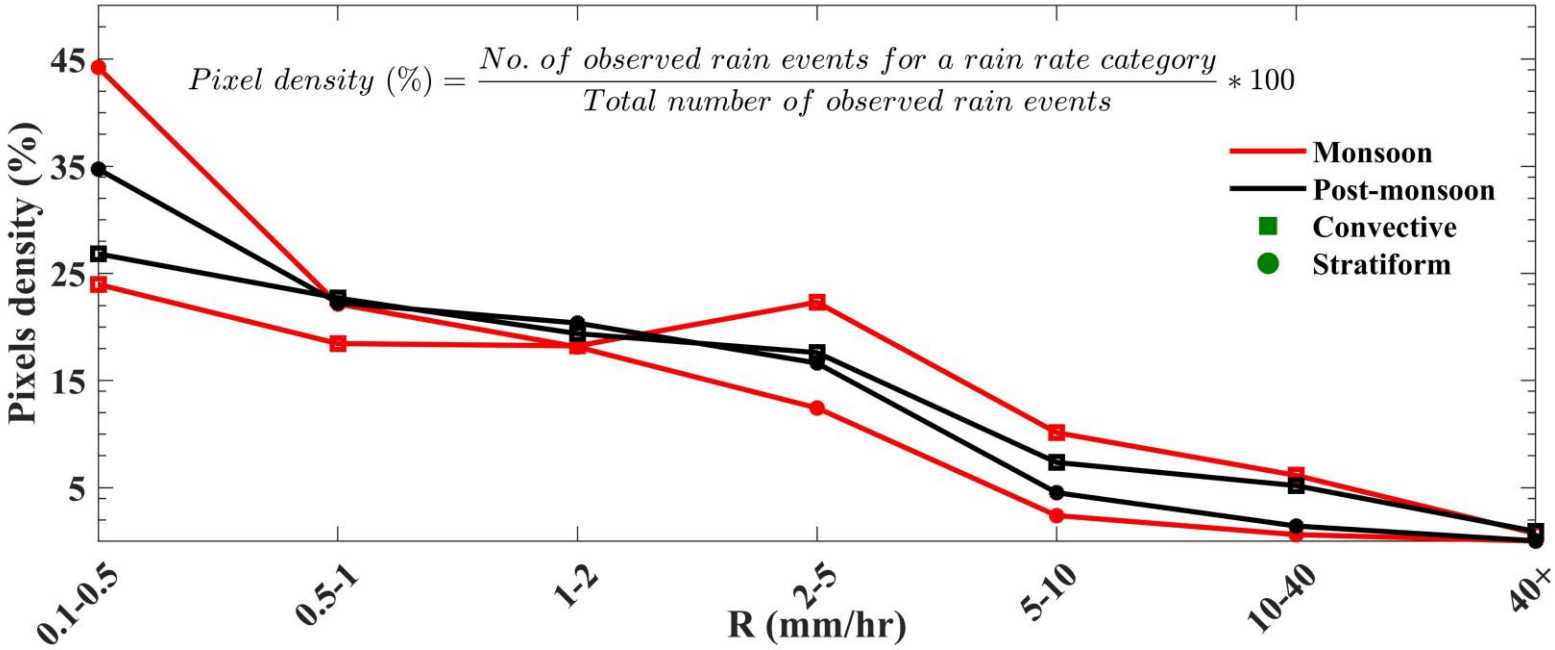

Figure 3: Pixel density of all observed rain events in the monsoon and post-monsoon season observed by the Global Precipitation Measurement (GPM) satellite from 2014 to 2023.

- High RR value observed on the windward side of the Western Ghats.
- D_m clearly shows distinction between windward and leeward side of the Western Ghats.
- Spatial variation of $\log_{10}N_w$ is opposite to D_m.

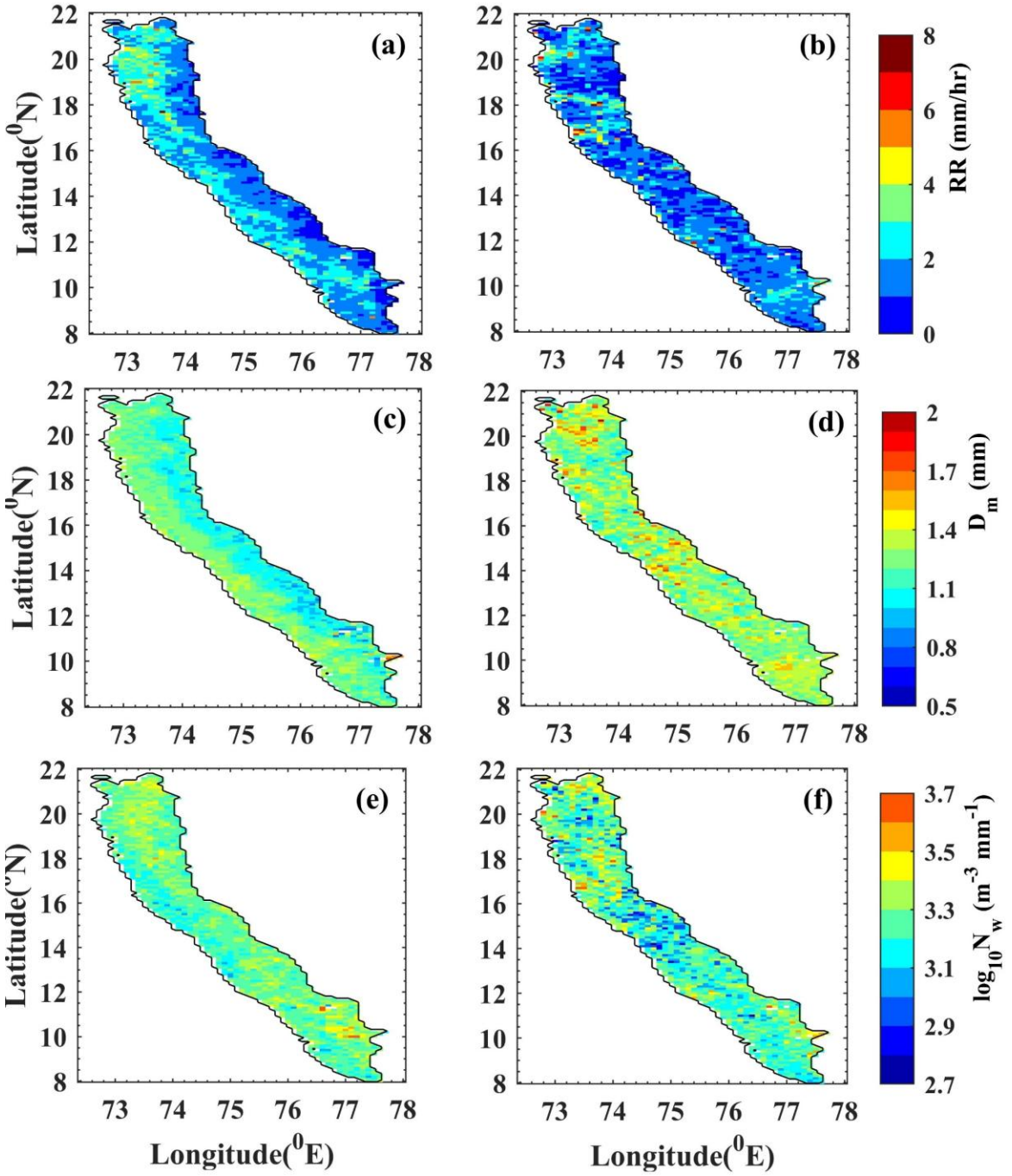

Figure 4: Spatial distribution of (a, b) R, (c,d) Dm and (e, f) $\log_{10}N_w$ for the stratiform precipitation during the (a, c, e) monsoon, and (b, d, f) post-monsoon season over the Western Ghats at 0.1^0 resolution (10 km) GPM-DPR gridded data.

- During convective precipitation, RR value increased correspondingly.
- More intense rainfall with high RR, large Dm with enhanced number concentration of bigger raindrops.

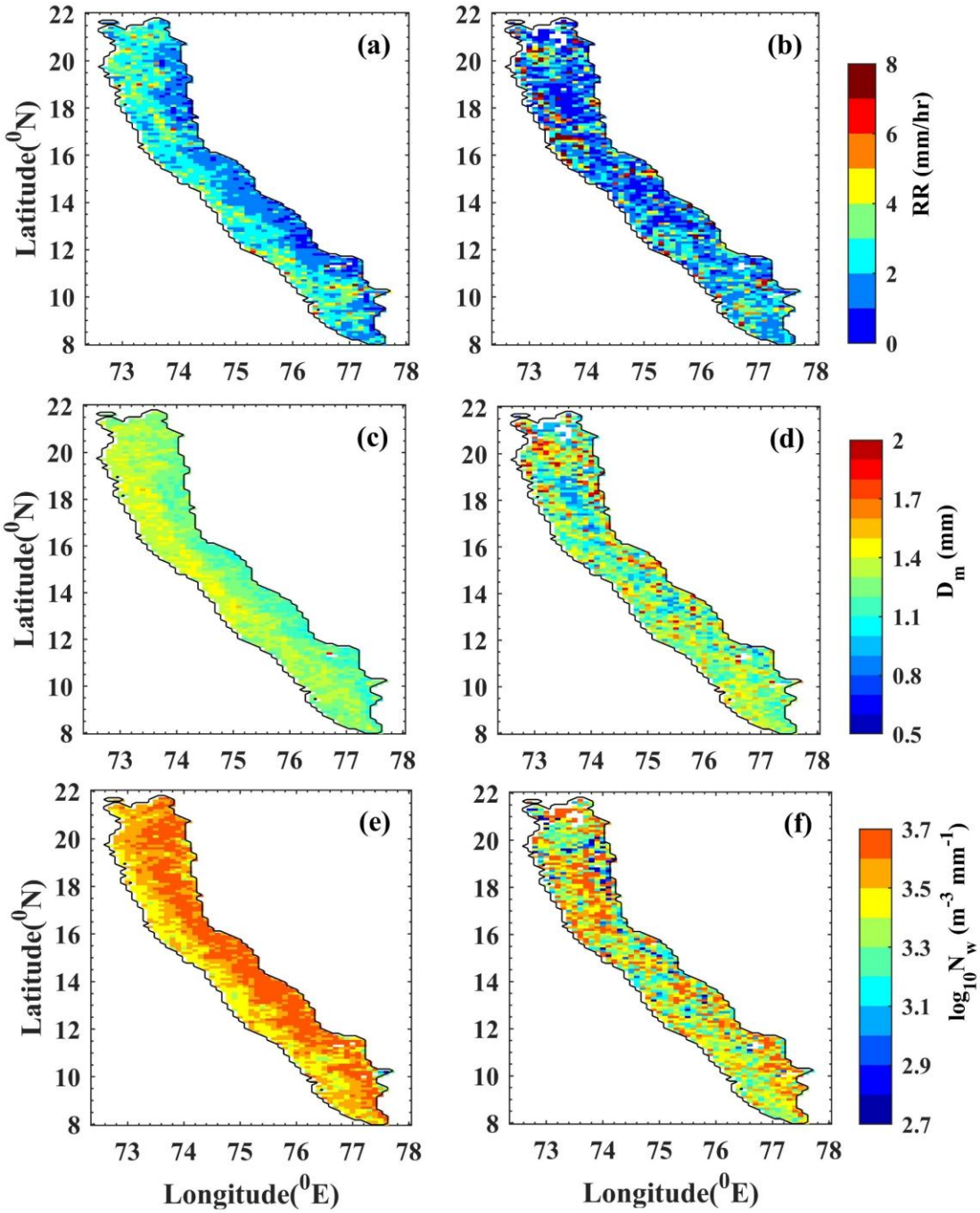

Figure 5: Same as Figure 4, but for convective precipitation.

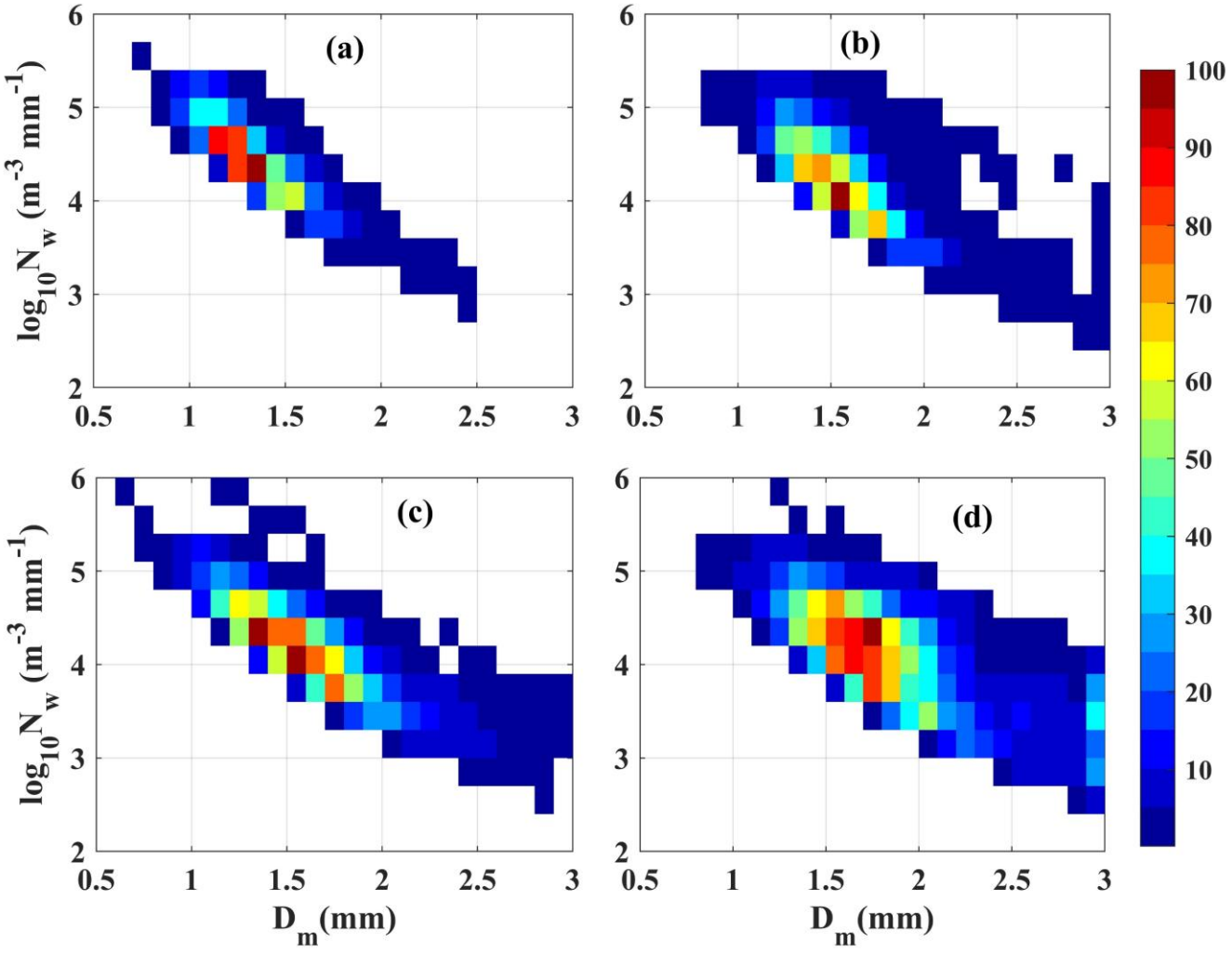

Figure 6: Joint histogram between the D_m and N_w for (a, c) Post-monsoon and (b, d) monsoon for the (a, b) stratiform and (c, d) convective precipitation.

$$N(D) = N_w \frac{6}{4^4}\left(\frac{D}{D_m}\right)^{\mu} \frac{(\mu+4)^{\mu+4}}{\Gamma(\mu+4)} \; e^{-[-(\mu+4)\frac{D}{D_m}]}$$

where N(D) represents the raindrop concentration ($m^{-3}mm^{-1}$), μ is the shape parameter, and D is the droplet diameter bin (mm).

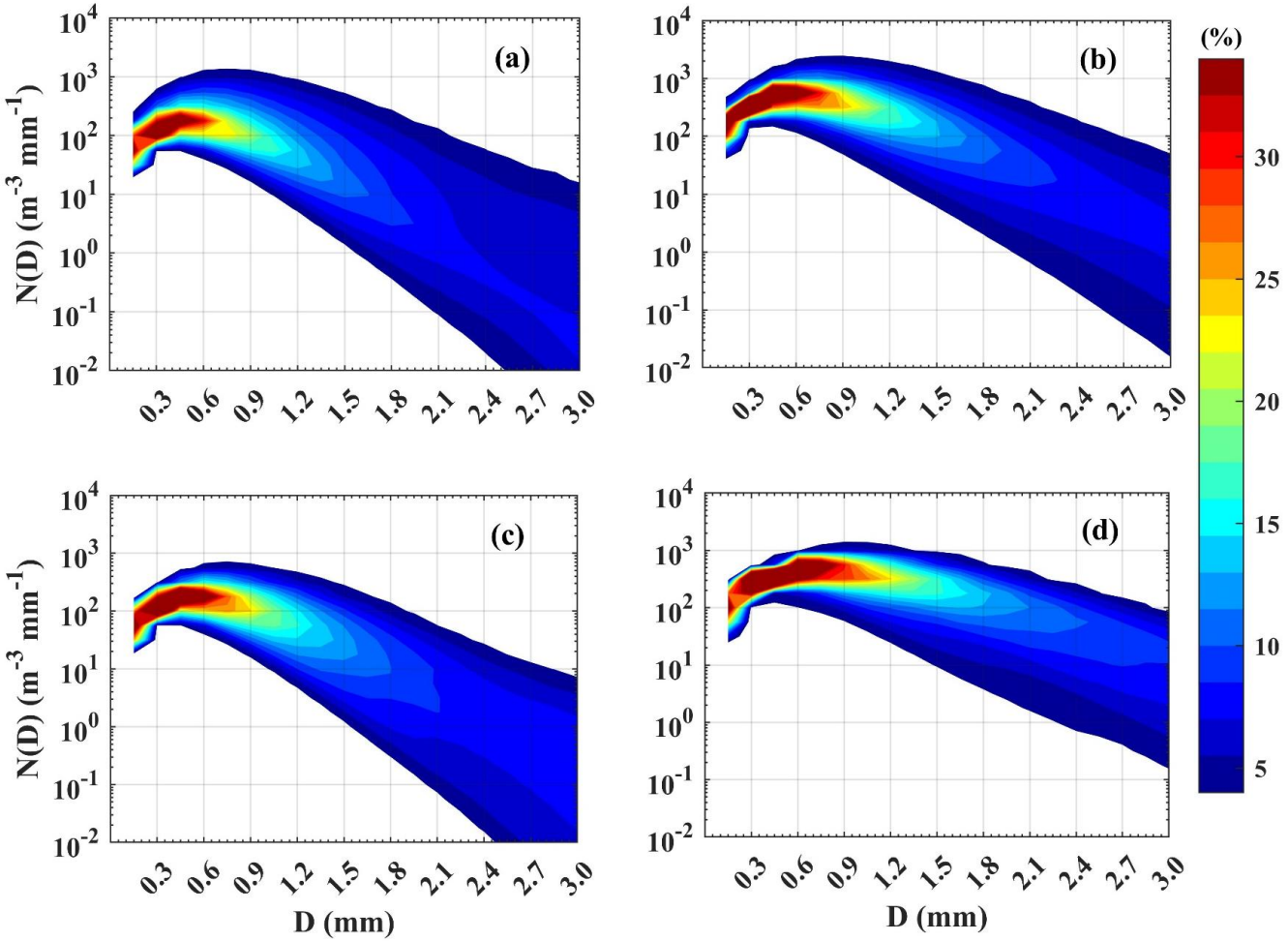

Figure 7: Gamma equation for the observed raindrop size distribution for the (a, c) stratiform and (b, d) convective precipitation during the (a, b) monsoon, (c, d) post-monsoon season.

Conclusion:

- *Convection precipitation pixel density increase with rain-intensity and stratiform precipitation pixel density decrease.*
- *Spatial distribution of R, Dm and log10Nw shows considerable variation with season and cloud type over the Western Ghats.*
- *The mean of rain droplets diameter, (Dm) is more on windward side.*
- *N(D) versus D relationship changing with the cloud type and season. It mainly occurring due to the variation in the precipitation microphysics.*

Thank you!