Response to comments from Reviewer 1

Title: Probabilistic seasonal outlook for the rainy season over India by monitoring the onset dates using GPM IMERG satellite-based precipitation
Authors: Balasubramannian, Jayasankar Chempampadam and Misra, Vasubandhu

An interesting manuscript which presents a local-scale method of predicting the onset and demises dates of the rainy season over India, using rainfall-based observations. Relationships between the onset/demise dates, rainfall amount and season length of the rainy season have been explored and statistically quantified. The highlighted application to real-time forecasting using IMERG rainfall is particularly relevant for seasonal forecasting.

We appreciate the reviewer's encouraging remarks about our work and thank for the careful review of our original manuscript, which has greatly helped in revising our manuscript for the better. Our point-by-point response to review comments are provided below.

The context of how this rainfall-based index fits into the existing indices of onset date definition could be better explored. Some discussion on local vs regional-large scale methods would be appropriate, including explanation on why it's useful to have different metrics to quantify onset/demise. The application to forecasting is clearly demonstrated, but the argument and motivation for an additional onset definition against numerous other indices could be stronger.

There is a significant amount of literature regarding the relationships between the Indian monsoon, ENSO and the IOD. Although the findings here are that the influence of ENSO/IOD on the defined rainy season metrics is weak, the importance of such teleconnections for the Indian monsoon system shouldn't be understated. There are also several other teleconnections such as the Madden-Julian Oscillation and Boreal Summer Intraseasonal Oscillation. It's mentioned in the introduction that Noska & Misra (2016) found links between rainy season onset dates and cross-equatorial upper ocean heat transport in the Indian Ocean. It may be outside of the scope of this manuscript to explore the potential relationships between all teleconnections, but they should be alluded to in the context of further work.

We thank the reviewer for the insightful comments. We have carefully addressed these points throughout our revised manuscript and in our responses to the specific comments by the reviewer. In particular, we have expanded the discussions in the revised version to clarify how our rainfall-based index fits within the broader context of onset/demise definitions and to highlight its value alongside existing large-scale approaches.

Furthermore, while our results indicate a relatively weak influence of ENSO/IOD on the local-scale rainy season metrics, we fully acknowledge the well-established significance of these teleconnections for the Indian monsoon. We have clarified this point in our responses and added several points in the introduction (e.g., the importance of monsoon intraseasonal oscillations). Although a detailed investigation of all potential teleconnections (e.g., MJO and NAO) is beyond *the scope of this study, we now highlight these as important avenues for future research, as suggested.*

General:

- Monsoon onset over Kerala is clearly defined at the beginning, but terminology such as 'onset date' and 'season length' throughout is ambiguous. Be specific and consistent with terms to improve clarity regarding whether the Indian summer monsoon season or the rainy season is being referred to. Similarly, be clear on whether a single onset date (e.g. MoK) is being referenced, or whether you mean the collection of local onset dates defined at grid points.

We thank the reviewer for pointing out the ambiguity in the use of terms such as "onset date" and "season length."

In the revised manuscript, we have clarified these terms consistently throughout the text to improve readability of the manuscript:

- *"Onset date" now explicitly refers to local/grid point-specific onset dates. For instance, in sections where we analyze the spatial distribution or trends in onset, we refer to "grid point-based onset dates".*
- *We now explicitly differentiate between the Indian Summer Monsoon (ISM) season and the rainy season, particularly when discussing metrics like seasonal length or rainfall accumulation. Where the focus is on regional metrics based on rainfall thresholds, we refer to the "rainy season"; when we mean the broader June–September ISM period, we state this clearly.*

We now added a sentence in the Introduction:
Here, the term 'onset' refers to local or grid point-specific onset dates of the rainy season.

Abstract
Concisely summarized, covering key points regarding methodology, results and suggested application.
Thank you.

1. Introduction
L37-38: IMD also uses outgoing longwave radiation as a condition for monsoon onset over Kerala.
Thank you for pointing this out. We have now added outgoing longwave radiation.

L43-54: Increase in rainfall is mentioned as a definition for monsoon onset, but the change in wind direction as a pre-requisite should be mentioned (i.e. following the traditional definition of a monsoon).
Added, thank you.

L46-59: Following Bombardi et al. (2019) - https://doi.org/10.1002/joc.6264, it may be worth noting that onset definitions broadly fall into two categories: local scale and synoptic-large scale.
Thank you for providing this reference, added this point to the revised manuscript.

L52: ‘somewhat identical’ is an oxymoron – suggest changing to ‘somewhat similar’.
Done.

L52-54: Fitzpatrick et al. (20160 - https://doi.org/10.1002/2016GL070711 – would be a useful reference here.
Done.

L56-58: rainy season is mentioned here but isn’t defined until the following paragraph. Suggest moving this sentence to the following paragraph.
We have now defined the rainy season when it is first mentioned.

L56-73: Interannual variability is discussed in terms of ENSO and IOD, but reference should be made to the high internal variability of the Indian monsoon system. For example, contributions from intraseasonal oscillations.

We appreciate the reviewer’s insightful comment. We agree that in addition to ENSO and IOD, the Indian summer monsoon exhibits substantial internal variability arising from intraseasonal oscillations (ISOs), such as the monsoon intraseasonal oscillations (MISOs) and active-break cycles.

In response, we have added few sentences highlighting this in introduction section acknowledging the role of intraseasonal variability in modulating seasonal rainfall and monsoon onset/withdrawal characteristics. We now cite relevant literature (e.g., Goswami and Ajaya Mohan, 2001; Goswami and Xavier, 2005; Karmakar and Misra 2019) to support this point.

L75-85: is the variable season the same as the rainy season? Keep terminology consistent. It might be useful to justify why you’re considering the rainy season instead of the Indian monsoon season here, e.g. by highlighting results from Noska & Misra (2016) that showed stronger correlations between rainy season onset & seasonal anomalies (as noted in L94-100), or by the implication that characteristics of the upcoming monsoon season can be forecast earlier than current methods, based on pre-monsoon rainfall.

We thank the reviewer for highlighting the need for consistent terminology and clearer justification. The term ‘variable season’ refers to the rainy season. Accordingly, we have replaced the term ‘variable season’ with ‘rainy season’ in the manuscript. It is important to note that the timing and duration of the rainy season differs from the conventional Indian Summer Monsoon (ISM) season (June–September). In addition, we highlighted that identifying the local onset date of the rainy season may support its use in seasonal predictability of the forthcoming rainy season.

L78: More correct to say ‘climatological southwest monsoon season’ than ‘fixed southwest monsoon season’.
Done.

L85: Change ‘even though the southwest monsoon is the main rainy season’ to something like ‘even though the southwest monsoon is the main component of our defined rainy season’.
Done.

L87-90: It’d be worth highlighting why there are so many attempts to predict the onset and why it’s challenging – linking back to separation of spatial scales.
Done.

L96: For clarity, change ‘with variations in the onset and demise dates’ to ‘with variations in the onset and demise dates of the rainy season’.
Done.

L90, 96, 99: There are a few references to seasonal rainfall and seasonal mean anomalies – it’s unclear if this refers to the summer season or the defined rainy season. Be specific and use ‘summer’, ‘JJAS’ or ‘rainy season’ instead of ‘seasonal’.

We thank the reviewer for pointing out the ambiguity. In the revised manuscript, we have carefully reviewed the use of the term “seasonal” in these lines and replaced it with more specific terms depending on the context:

- *We use ISM or June to September when referring to the traditional Indian Summer Monsoon season.*
- *We use “seasonal rainfall” when referring to the objectively defined seasonal accumulated rainfall based on local onset and withdrawal of rainy season. This is clearly enunciated in the revised manuscript.*

L99-100: Clarify that the onset date referred to is the onset date of the rainy season, and whether the ‘forthcoming rainy season’ refers to Indian summer monsoon rainfall or also includes pre- & post- monsoon rainfall (e.g. from tropical cyclones).

We thank the reviewer for this valuable comment. In the revised manuscript, we have clarified that the onset date referenced throughout the analysis is the onset date of the locally defined rainy season, determined based on rainfall thresholds which is different from the monsoon onset over Kerala. Additionally, we have specified that the term “forthcoming rainy season” refers to the entire duration of the objectively defined rainy season at each grid point (which may include pre-monsoon and post-monsoon rainfall events). This definition may encompass rainfall associated with tropical cyclones and other synoptic disturbances that occur outside the JJAS period (pre- & post- monsoon), but still within the local rainy season.

L99-106: To strengthen the argument for the necessity of another onset index, the benefits of a local-scale method (such as presented here) should be highlighted against large-scale methods. Also, it could be made clearer that a spatial map of onset date evolution is being produced, unlike some wind-based methods of definition which only predict the onset date over Kerala.

We thank the reviewer for this valuable suggestion. We agree that it is important to emphasize the added value of our local-scale, rainfall-based onset method compared to traditionally identified onset of the ISM, which are often limited to defining the onset over Kerala (e.g., MoK) and do not provide spatially explicit onset information.

In the revised manuscript, we now explicitly highlight this advantage by adding the following sentence:
"In comparison to traditionally identified onset of ISM, which are often limited to defining the onset over Kerala (e.g., MoK), the proposed method enables the generation of spatially continuous maps of onset date evolution. By capturing regional heterogeneity, it provides a more nuanced understanding of the spatiotemporal progression of onset of the rainy season across India."

In the revised manuscript, we have added the following sentence in the Summary and Concluding Remarks section:
"Compared to traditional ISM onset definitions, which often focus on Kerala (e.g., MoK), the proposed method can generate spatial maps of local-scale onset dates of the rainy season."

2. Data and Methodology
L156: Remove dashes in Equation (1). Makes it hard to read. Same comment for the rest of equations throughout the manuscript.
Done.

L159-161: Do you mean you count the number of days between the onset and demise dates? I.e. it is not an estimate. Otherwise, please explain how seasonal length is defined.
Thank you for pointing out this. Replaced estimate to count.

L180-190: Make sure all equations are numbered and specifically referred to in the text.
Done.

L187: Explain what S2em is in the text and what this equation is computing.
Done.

3. Results
Figure 2:

- subplots (a) and (b) should show the dates on the colorbar – i.e use '29th April' instead of '120 days'. Or add contours with dates similar to IMDs isochrones. Also suggest spacing contours on 7-day intervals rather than 10.
- Subplots (c)-(h): show the units on the colorbar (e.g. 'days' or 'mm').
- Update caption to refer to the correct subplots; currently (b), (c) and (d) are repeated in the last two lines, should be referring to (f), (g) and (h).

We appreciate the reviewer's constructive suggestion. In response, we have modified the colorbar labels from Julian days to actual calendar dates (i.e., DDMMM format) for improved clarity.

Additionally, we have labeled every third contour interval, and the contour intervals are now spaced at 7-day increments. This is also stated in the figure caption. We have also added appropriate units to panels (c)–(h): panels (c), (e), (f), and (g) are labeled in 'days', while panels (d) and (h) are labeled in 'mm'.

L284-294: it would be useful to include results from IMERGs final product for comparison, instead of speculation. For example, an extra column could be added to Figures S2 & S3 to show differences between the late and final IMERG runs. This would add robustness to the argument for using IMERG late run for real-time forecasting.

We appreciate the reviewer's constructive suggestion. We agree that including a direct comparison between the IMERG Late and Final Runs adds valuable context and strengthens the argument for using the Late Run in real-time applications. Accordingly, we have now included the IMERG Final Run product in our analysis. An additional column has been added to Figures S1, S2 and S3, to highlight the differences in onset date and rainfall anomalies between the Late and Final Runs. Based on the results of the comparison, we added more detailed discussion to the revised manuscript.

L299: Do you mean the local onset date or the all-India onset date? Be clear and consistent with these terms.
It is local onset date. Corrected now.

Figure 3: Suggest adding a contour at +/- 0.6 to highlight the regions that are most strongly correlated.
Done. We have shaded only the significant values (non-significant values are white) and cross-hatching denotes correlations greater than or equal to +/-0.6. This is mentioned in the figure caption as well.

Figure 4: Change colorbar to diverging either side of 1.
Done.

4. Summary and Concluding Remarks
Could better explain how this method would complement existing onset date indices (e.g. provides local scale map of onset dates) as well as current forecasting techniques. For example, this method could be used to give an early indication of monsoon season length & intensity for certain parts of India, given that the index is based on the rainy season and considers pre-monsoon rainfall.
We have now added the following sentences in response to this comment:
"The proposed method generates a spatial distribution of local-scale onset and withdrawal dates, capturing regional variations and offering a nuanced view of progression rainy season across India. Such location-specific information is useful for practical applications such as agriculture, disaster planning, and water management."

"The low signal to noise ratio of the onset date of the rainy season suggests the dominance of internal variations, which will be a challenge for its seasonal predictability. However, by way of monitoring the evolution of the onset date we can leverage its local relationship with the length and seasonal rainfall anomaly to provide reliable seasonal outlook of the rainy season. The probabilistic skill scores of these seasonal outlooks generated from the monitoring of the onset date variations present an objective measure of its high confidence of reliability. Compared to traditional ISM onset definitions, which often focus on Kerala (e.g., MoK), the proposed method can generate spatial maps of local-scale onset dates of the rainy season. It captures regional heterogeneity and the progression of the rainy season across India. Since the method is based on the rainy season and includes pre- and post-monsoon rainfall, it provides a comprehensive viewpoint of the rainy season."

A couple of sentences suggesting areas for further research should be included, such as considering the influence of teleconnections other than ENSO and IOD.

We have now added the below sentence:
"Although the influence of ENSO and IOD were investigated in this study, future research could investigate the influence of additional teleconnection patterns such as the Madden–Julian Oscillation (MJO), Pacific Decadal Oscillation (PDO), and North Atlantic Oscillation (NAO), which may also modulate the timing and characteristics of the rainy season."

References
Please include DOIs for easy look-up of references.
Done.

Supplementary
Figure S1: typo in title of subplot (a) – change 'Variabale' to 'Variable'.
Thank you. In the revised version, the title "Variable" is no longer present in Figure S1.

Response to comments from Reviewer 2

The manuscript entitled *"Probabilistic seasonal outlook for the rainy season over India by monitoring the onset dates using GPM IMERG satellite-based precipitation"* attempts to establish a link between the length of the monsoon season and the accumulated rainfall during the season. It is demonstrated that an early monsoon onset is generally associated with a longer season and greater accumulated rainfall. However, the concept of local onset lacks sufficient physical insight and appears more like a data science exercise than a physically grounded meteorological study. The manuscript requires substantial revision before it can be considered for publication.

We thank the reviewer for the careful review of our original manuscript, which has greatly helped in revising our manuscript for the better. Our point-by-point response to review comments are provided below.

1. Why is the term "demise" used? Most of the established literature on the Indian monsoon uses the term "withdrawal." Please consider aligning with standard terminology.
   We have now changed 'demise' to 'withdrawal' throughout the revised manuscript.

2. The concepts of monsoon onset and withdrawal have been addressed from various perspectives in previous literature (e.g., Goswami and Xavier, 2007). These studies focus on large-scale monsoon onset and withdrawal. How does the present approach fit into this broader context?

   We thank the reviewer for raising this important point. We acknowledge that several previous studies, including Fasullo and Webster, (2003), Goswami and Xavier (2007), have significantly advanced our understanding of large-scale monsoon onset and withdrawal by using dynamical parameters such as wind, pressure, and moisture transport. These methods provide a broad, synoptic-scale perspective on monsoon evolution. Our approach builds upon this foundation by providing a complementary, local-scale perspective, using objectively determined onset and withdrawal dates based solely on rainfall rates. The defined onset and withdrawal of the rainy season offer several advantages and have been validated for consistency by comparing them with the seasonal evolution of key dynamic and thermodynamic variables associated with the Indian Summer Monsoon (Noska & Misra, 2016). In addition, the onset over Kerala has been found to have little bearing on the overall seasonal mean rainfall of the ISM (Dhar et al., 1980; Mooley and Parthasarathy, 1984). In contrast, our method captures the spatial variability in onset and withdrawal dates across India, generating high-resolution maps of the rainy season's progression, along with reasonable predictive skill regarding seasonal length and total rainfall at the local scale. Our analysis reveals that the local onset/withdrawal dates have low signal to noise ratios (Figs. 4a and b), which points to two important features: 1. It is a challenge for seasonal predictability of onset and withdrawal dates of the rainy season of India; 2. The dominance of internal variability. Given these features of the local onset/withdrawal dates, we believe that monitoring their evolution in real-time from observations to forecast for the forthcoming rainy season provides a huge advantage in *terms of seasonal outlooks amidst its low signal to noise ratio. Thus, while large-scale methods are crucial for understanding broader monsoon dynamics, our approach adds value by enabling fine-scale characterization of rainy season features that can be readily used for real-time monitoring and decision-making.*

We have added few sentences to the introduction and to the conclusions of the revised manuscript to clarify these points.

"In addition, they validated the defined onset and withdrawal of the rainy season for consistency by comparing them with the seasonal evolution of key dynamic and thermodynamic variables associated with the ISM."

"In comparison to traditionally identified onset of ISM, which are often limited to defining the onset over Kerala (e.g., MoK), the proposed method enables the generation of spatially continuous maps of onset date evolution. By capturing regional heterogeneity, it provides a more nuanced understanding of the spatiotemporal progression of onset of the rainy season across India."

"Our approach captures the actual arrival and retreat of persistent rainfall at each grid point by identifying the onset and withdrawal of the rainy season. This approach also accounts for pre- and post-monsoon rainfall, providing a more complete representation of the rainy season—particularly in regions where events such as tropical cyclones contribute significantly to seasonal rainfall totals."

"The proposed method generates a spatial distribution of local-scale onset and withdrawal dates, capturing regional variations and offering a nuanced view of progression rainy season across India. Such location-specific information is useful for practical applications such as agriculture, disaster planning, and water management."

"The low signal to noise ratio of the onset date of the rainy season suggests the dominance of internal variations, which will be a challenge for its seasonal predictability. However, by way of monitoring the evolution of the onset date we can leverage its local relationship with the length and seasonal rainfall anomaly to provide reliable seasonal outlook of the rainy season. The probabilistic skill scores of these seasonal outlooks generated from the monitoring of the onset date variations present an objective measure of its high confidence of reliability. Compared to traditional ISM onset definitions, which often focus on Kerala (e.g., MoK), the proposed method can generate spatial maps of local-scale onset dates of the rainy season. It captures regional heterogeneity and the progression of the rainy season across India. Since the method is based on the rainy season and includes pre- and post-monsoon rainfall, it provides a comprehensive viewpoint of the rainy season."

3. Line 156 – Should the left-hand side of Equation 1 be "j" or "J"? Please clarify and ensure consistent notation.

Thank you for pointing out this, we are summing anomalies up to day J, so it is J in LHS. We corrected it now.

4. What exactly is meant by the "climatology of annual mean rainfall" in this context? Is it a seasonal cycle (i.e., varying with time of year) or a single fixed value, regardless of the dates involved?
Here we use the climatology of annual mean rainfall of each year. It is a single fixed value at each grid point i and j.

5. Please explain the physical rationale behind the proposed methodology for defining onset and withdrawal. Why is this approach meaningful from a meteorological perspective?

Thank you for raising this point. The proposed methodology is grounded in the physical characteristics of the monsoon system, particularly the rapid seasonal transition from dry to wet conditions, which is one of the most important meteorological features of the onset of the rainy season at the regional scale. Our approach identifies onset and withdrawal using an objective definition based solely on rainfall, capturing the actual arrival and retreat of persistent rainfall at each location. This has greater hydrological relevance than wind- or pressure-based methods, which often reflect large-scale dynamics but may not align with the actual onset of rainfall at the local scale.

From a meteorological perspective, monsoon onset is typically marked by sustained convection and moisture convergence, resulting in a rise in rainfall; hence, rainfall serves as a straightforward and physically consistent indicator. Our method also accounts for pre- and post-monsoon rainfall, giving a more complete picture of the rainy season—especially in areas where events like tropical cyclones add significantly to seasonal totals. This makes the method simple, location-specific, and useful for practical applications such as agriculture, disaster planning, and water management.

As pointed in response to Comment #2, the comparatively low signal to noise ratios of onset and withdrawal dates of the rainy season of India also is a challenge for its seasonal predictability.

We have added few sentences to the introduction and the conclusion of the revised manuscript to clarify these points.

"Our approach captures the actual arrival and retreat of persistent rainfall at each grid point by identifying the onset and withdrawal of the rainy season. This approach also accounts for pre- and post-monsoon rainfall, providing a more complete representation of the rainy season—particularly in regions where events such as tropical cyclones contribute significantly to seasonal rainfall totals."

"The low signal to noise ratio of the onset date of the rainy season suggests the dominance of internal variations, which will be a challenge for its seasonal predictability. However, by

way of monitoring the evolution of the onset date we can leverage its local relationship with the length and seasonal rainfall anomaly to provide reliable seasonal outlook of the rainy season. The probabilistic skill scores of these seasonal outlooks generated from the monitoring of the onset date variations present an objective measure of its high confidence of reliability."

6. Figure 3 – The caption mentions statistical significance, but there is no indication of this in the figure itself. Where is the shading or other representation of statistically significant values?
   In Figure 3, only statistically significant values are shaded, while non-significant values are shown in white (i.e., without shading). We have now clarified this explicitly in the figure caption to avoid confusion.

7. The stated goal of the study is to provide a seasonal outlook based on onset dates. However, the correlation between seasonal rainfall and onset/withdrawal dates (Figures 3b and 3d) appears rather weak. This undermines the central premise of the study.

   Thank you for raising this point. While the correlation between seasonal rainfall and onset/withdrawal dates (Figures 3b and 3d) may appear weaker than that between seasonal length and onset/withdrawal dates (Figures 3a and 3c), it is important to note that over 50% of the grid points across India still show statistically significant correlations. Moreover, the predictive value of the method lies not only in providing the outlook of seasonal rainfall totals but also in characterizing the variations in the seasonal length of the rainy season, which is equally a critical factor for applications such as agriculture and water resource planning. Our seasonal outlook approach using onset date variations provides early indication of the variation in the duration over most of India and seasonal rainfall anomalies of the rainy season over more than 50% of the grid points over India at the local scale. While the relations shown in Fig. 3b may not capture all regions across India equally well or strongly predict total seasonal rainfall, it adds value by offering local insights that can complement dynamic models and statistical forecasts. We also acknowledge that variability of the total accumulated rainfall during the defined rainy season is influenced by many factors, such as tropical cyclones and intraseasonal weather patterns, which can contribute to the total rainfall and make correlation with onset dates less predictable.

   We have added few sentences to the result section of the revised manuscript to clarify these points.

   "While the correlation between seasonal rainfall and onset/withdrawal dates appears weaker than that with seasonal length, over 50% of grid points across India still show statistically significant relationships. This is expected, as total rainfall during the rainy season is influenced by variations in the seasonal length but also daily rain rate, which can be influenced by various factors like tropical cyclones and intraseasonal weather patterns that may lead to a weak correlation with onset/withdrawal dates."

8. Figure S4 shows minimal correlation between JJA SST and onset or duration (DD). On the other hand, the manuscript claims that onset dates provide useful information for seasonal rainfall outlooks. This seems inconsistent with well-established findings in the literature (e.g., DelSole and Shukla, 2002, GRL), which show that JJAS SSTs are strongly associated with seasonal rainfall. Please clarify this discrepancy.

   Thank you for raising this point. We fully acknowledge the well-established relationship between JJAS SSTs and seasonal mean rainfall over India, as documented in previous studies. For instance, DelSole and Shukla (2002) showed that the 25-year running correlation between JJAS Indian monsoon rainfall (area-averaged over India) and JJAS Niño-3 SSTs has been consistently negative and statistically significant at the 1% level throughout much of the 20th century, with exceptions only during the 1920s–30s and the final 25-year window ending in 1998.

   However, our analysis differs in focus, spatial scales, and definition of seasonal rainfall. Delsole and Shukla (2002) focus on fixed season JJAS seasonal rainfall. Our definition accounts for varying length of the season that also takes into consideration pre-monsoon and post-monsoon rainfall in some of the regions. Hence we distinguish our work by rainy season over India from the Indian Monsoon Rainfall. While DelSole and Shukla (2002) assess the all India mean monsoon rainfall over India in relation to Niño-3 SSTs, our study emphasizes local-scale rainfall characteristics—specifically, the onset, withdrawal, duration, and seasonal rainfall of the rainy season at each grid point. Figure S4 in our study also shows generally negative correlations across much of India, with only limited regions (mainly parts of peninsular India) exhibiting statistically significant correlations at the 5% level. Importantly, local-scale rainfall is strongly influenced by intraseasonal variability, regional weather systems, and topographic effects, which may not be strongly linked to JJA Niño-3.4 SSTs. This helps explain the weaker correlations observed in our results. Moreover, even if the simultaneous correlation between SSTs and onset, withdrawal, length and seasonal rainfall is weak, our results show that onset dates themselves still provide useful predictive information for seasonal characteristics, particularly seasonal length and, in many regions, seasonal rainfall totals. Hence, our method contributes complementary value by offering early, local insights that may not be fully captured by SST-based approaches.

   We have added few sentences to the result section of the revised manuscript to clarify these points

   "It should be noted that the results in Figures S4 and S4 appear to be contrary to many other studies that suggest a robust teleconnection of ENSO with ISM (e. g., Webster et al. 1998, Delsole and Shukla 2002). However, our variable definition of the rainy season which includes pre and post monsoon rainfall would make the comparison with other studies dealing with fixed calendar ISM season and or all India averaged rainfall of the ISM incompatible. But in light of these results that indicate a lack of strong external forcing,

the significance of the reliability of the seasonal outlook of the rainy season shown in Figure 5 assumes greater significance."

9. Is there a specific reason for choosing IMERG data for this analysis? The IMD daily gridded rainfall dataset has a longer temporal span and is widely used in monsoon studies. Please justify the choice of data source.
   Yes, we choose IMERG over the IMD dataset primarily because its higher spatial resolution (0.1 degree over 0.25 degree) and its near real-time availability with only ~12-hour latency making it suitable for operational monitoring and real-time applications. We have added this point in the revised manuscript [Lines: 342-344].