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Onset Periods: a novel approach to understand the onset of the monsoon season

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In recent decades, several studies have proposed different methodologies to reliably identify the onset of the rainy season in monsoon climates, considering either a single variable, usually precipitation, or a combination of rainfall with other dynamic and thermodynamic variables (e.g. wind, specific humidity). These methodologies tend to define a single onset date, which can fail to diagnose critical characteristics of early season rainfall such as wet/dry spell phasing and intensity. Here, we propose a novel approach to identify the transition from dry to wet seasons as a period (6-8 weeks on average) with a positive gradient of the FFT-filtered precipitation, indicative of a steady increase in rainfall. This approach allows the characterisation of critical onset period rainfall characteristics, including information about wet and dry spell frequency and total precipitation, which is a valuable advance on typical single-date onset methods. Preliminary results considering observational and reanalysis datasets indicate a good agreement between the onset day identified using a traditional methodology and the onset periods over South America and Africa. A more in-depth analysis of the identified onset periods can provide further insights into the role of intraseasonal and interannual variability on the precipitation regimes. We also identified regions with distinct changes in the onset periods timing and related precipitation characteristics when considering present and future climate simulations, including simulations using convective-permitting models. For example, the method is able to distinguish that parts of eastern Brazil are projected to have a later onset period with more intense wet days, whereas in eastern Amazon the key signal is more dry days during the onset period, leading to a weaker intensity of onset. In addition to identifying the rainy season onset periods, this approach also identifies other onset periods, further classified as false onset (interval with positive filtered precipitation gradient followed by the onset period), second onset (interval with a secondary increase in the filtered precipitation gradient after the onset period), or wet spells (occurring during the dry season). These periods provide valuable information about spells of increased precipitation outside the rainy season onset, such as wet spells during the dry seasons or false onsets before the primary rainy season. When recurrent, they can indicate the influence of interannual or intraseasonal variability in off-season precipitation. As the core statistics that emerge from this approach are related to the intensity and phasing of rainfall rather than absolute amounts, future developments will focus on implementing the method in a seasonal forecast system, where only a few months of data are available, with the potential to obtain forecast skill which circumvents absolute rainfall biases.

