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Impacts of convectively coupled equatorial waves on rainfall extremes in Java, Indonesia

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Rainfall extremes cause significant socioeconomic impacts in Indonesia, as they are often followed by disastrous events, such as floods and landslides. Of particular interest is Java Island, the most populated region in Indonesia, which is prone to damaging flooding as a result of heavy rainfall. The prediction of rainfall extremes in this region has mainly been focused on the effects of seasonal and intraseasonal variability, such as monsoons and the Madden–Julian Oscillation. Here, using an extensive station database from 1987 to 2017 and the gridded Asian Precipitation□Highly Resolved Observational Data Integration Toward Evaluation of Water Resources (APHRODITE) product from 1980 to 2007, we show that severe weather conditions associated with rainfall extremes in Java during the rainy season (November to April) can also be attributed to convectively coupled equatorial waves (CCEWs) that occur on a shorter time scale.

Evidence is presented that CCEWs, including Kelvin, equatorial Rossby (ER), and mixed Rossby□gravity (MRG) waves, significantly modulate daily rainfall extremes over Java Island. Of these three types, the Kelvin waves have the greatest influence on heavy rainfall over Java Island. The convectively active (suppressed) phases of Kelvin waves increase (decrease) the probability of extreme rain events over land regions by up to 60% (50%) of the baseline probability. On the other hand, the convectively active phases of ER (MRG) waves increase the probability by up to 45% (40%), while the suppressed phases decrease this by up to 40% (30%). In terms of the mechanism of rainfall extremes, CCEWs modulate moisture flux convergence, leading to the enhancement of local convection over the region. In addition, the analysis of multiple wave events indicates that positive (negative) interferences of the CCEWs lead to an amplification (suppression) of extreme rainfall probability. Overall, the results suggest that equatorial waves provide an important source of the predictability for daily extreme rainfall events over Java Island.

Reference:

Lubis, SW, Respati, MR. Impacts of convectively coupled equatorial waves on rainfall extremes in Java, Indonesia. *Int J Climatol*. 2020; 1– 23.