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Identifying opportunities and barriers for skillful sub-seasonal prediction of East Asian summer monsoon precipitation

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Accurate sub-seasonal (2-8 weeks) prediction of monsoon precipitation is crucial for mitigating flood and heatwave disasters caused by intra-seasonal variability (ISV). However, current state-of-the-art sub-seasonal-to-seasonal (S2S) models have limited forecast skills beyond one week when predicting ISV events. Here, we find, regardless of models, that the prediction skills for ISV events depend on the propagation stability of events' preceding signals. This allows us to identify opportunities and barriers (OBs) within S2S models, understanding what the models can and cannot achieve in ISV event prediction. Focusing on the complex East Asian summer monsoon (EASM), we discover that stable propagation of Eurasian and tropical atmospheric wave trains towards East Asia serves as an opportunity, providing skillful prediction up to 13 days ahead. However, the Tibetan Plateau barrier highlights the limitation of EASM predictability. Identifying these OBs will help us gain confidence in making accurate sub-seasonal prediction.