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On the predictability of the Madden-Julian Oscillation phase

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Climate extremes such as heat waves, drought, extreme precipitation or cold surges have huge social and economic impacts that are expected to increase with climate change. Forecasting of such extreme events on the sub-seasonal time scale (from 10 days to about 3 months) is very challenging because of the poor understanding of phenomena that may increase predictability at this time scale. The Madden-Julian Oscillation (MJO) is the dominant mode of variability in the tropical atmosphere on sub-seasonal time scales and can also promote or enhance phenomena such as monsoons and hurricanes in other regions of the world. It is a hierarchically organized structure that propagates across the planet with a period of 30 to 60 days, and its phase represents an important source of sub-seasonal predictability. For this reason, forecasting the MJO phase can improve the predictability of weather extremes. Here we use the index of the MJO based on outgoing longwave radiation (OLR), namely the OLR MJO Index (OMI), which is a popular index used for defining MJO phases. We used the first two principal components to compute the MJO phase and amplitude. With an autoregressive integrated moving average (ARIMA) model we found that winter and summer are slightly more predictable than spring and autumn. We also computed the likelihood of having a warm/cold spell during a given MJO phase. For warm spells, we found that the significantly most likely phase is the 7, and the top three are 7, 8 and 1, which are, as expected, consecutive phases. For cold spells, phases 5 and 1 play important roles, while phase 3 is by far the least likely to have cold spells. Ongoing work is devoted to compare the skill of neural network approaches (long-short term memory, LSTM, and gated recurrent unit, GRU) for the prediction of the MJO phases and warm/cold spells. Acknowledgment: work funded by ITN CAFE.