Supplementary material for "Exploring dominant processes for multi-month predictability of western Pacific precipitation using deep learning"

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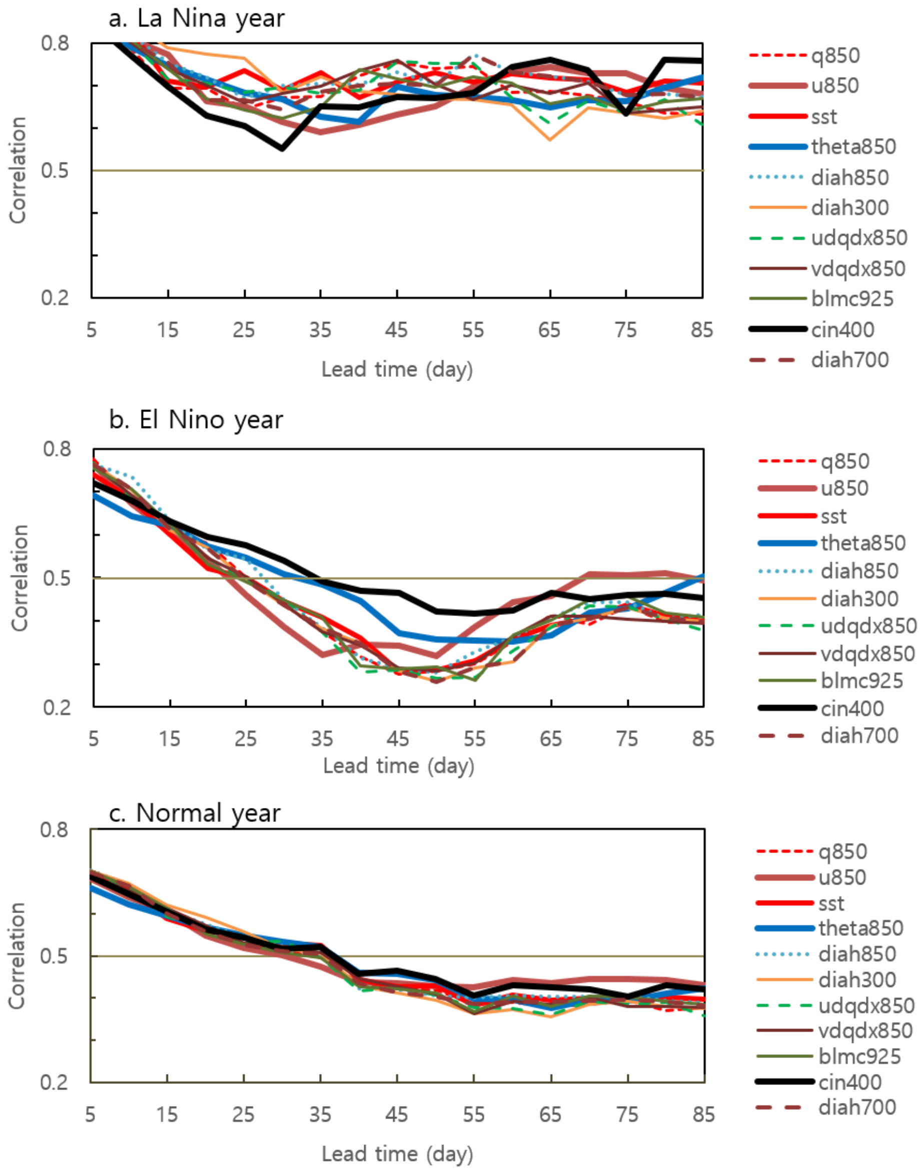
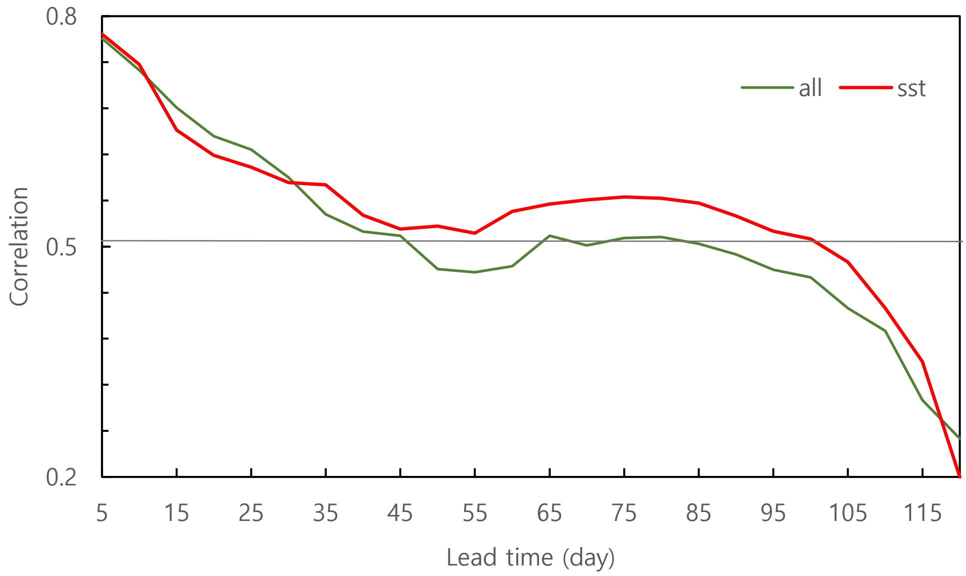
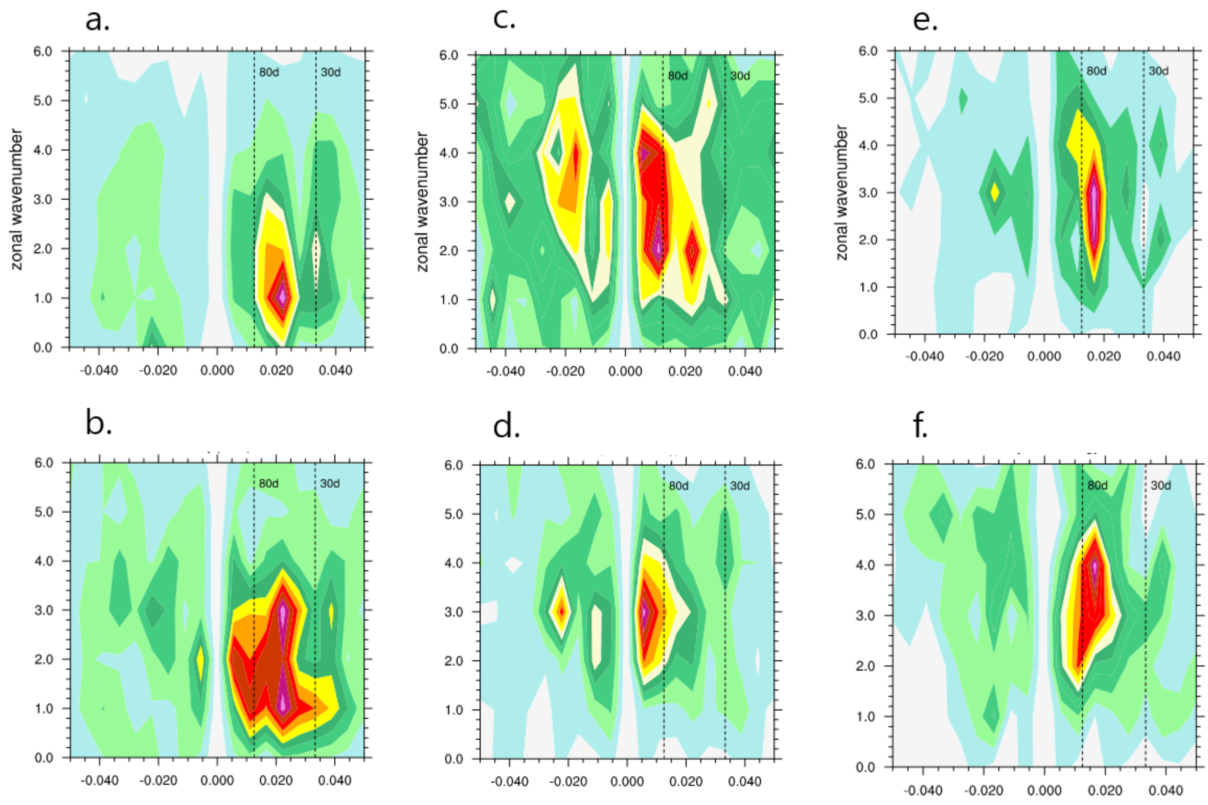


Supplementary Figure 1. Correlation skill of the MJO-related precipitation index from the DL model. The correlation skill of the MJO-related precipitation index is shown as a function of the forecast lead month from the DL model for (a) La Niña, (b) El Niño years, and (c) Normal years. The precipitation index is calculated as the average pentad precipitation over the western Pacific region (120°–150° E, 10° S–10° N). The DL model utilizes two predictors: one is the fixed input of precipitation anomaly map, and the other is selected from various weather variables based on existing MJO theories. The DL model was trained using reanalysis data from 1997 to 2010, and the forecast results from 2012 to 2017 were used for validation. The selected weather variables include the equivalent potential temperature (represented as "theta"), boundary layer moisture convergence ("BLMC"), convective instability ("CIN"), and diabatic heat calculated following Yanai et al. (1972). The zonal (meridional) moisture advection is represented by "udqdqx" ("vdqdy"). Each line in the figure represents the mean value from 10 ensemble members.



Supplementary Figure 2. Correlation skill of precipitation index in the western Pacific from the DL model. The all-season correlation skill of the MJO-related precipitation index as a function of the forecast lead month from the DL model. The precipitation index is defined as pentad precipitation averaged over the western Pacific (120°–150° E, 10° S–10° N). The DL model used two predictors (precipitation and SST anomaly map, red line), and all predictors were based on existing MJO theories. The DL model was trained by using reanalysis data from 1997 to 2010 and the forecast results from 2012-2017 are used for validation. Ensemble mean skill was used for analysis (10 ensemble numbers).



Supplementary Figure 3. Role of central and eastern Pacific SST on MJO simulation. a,c,e, May-October wavenumber-frequency spectrum of 10°N–10°S-averaged an observed precipitation (a), the NESM3.0 model (c), and the NESM3.0 with the observed SST over central and eastern Pacific. Only the climatological seasonal cycle and time mean for each November–April segment were removed before the calculation of the spectra. Units for the spectrum are mm^{-2} day^{-2}. **b,d,f,** same as **a,c,e** but for November–April, respectively.