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Intra-seasonal oscillation and its control over tropical cyclones in the high resolution global atmospheric models

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The use of high spatial resolution in global climate models is expected to provide a new insight into the atmospheric disturbances on intra-seasonal scales. This paper presents the results from an international collaboration called Project Athena (Kinter et al. 2011, submitted to BAMS), which is a realization of this attempt. We focus on Intra-Seasonal Oscillation (ISO) or Madden Julian Oscillation (MJO) and their relationship with tropical cyclones simulated in the 7-km spatial resolution experiments of the Nonhydrostatic Icosahedral Atmospheric Model, (NICAM), and compare them with 10-km spatial resolution experiments of the Integrated Forecast System (IFS; European Centre for Medium-range Weather Forecasts). Experiments were conducted for boreal summers (May 21-Aug 31) of 8 years (2001-2,2004-9). Both NICAM and IFS simulations capture the intensification and northward displacement of maximum westerly wind of the Boreal Summer ISO (BSISO), in late May to early June (first month of each simulation period), which corresponds to the onset season of the Indian monsoon. IFS better simulated the horizontal pattern of precipitation (NW-SE oriented rainband) and westerlies (with maximum at 20N) than NICAM, whereas the northward migration of the westerly peak and precipitation at the intraseasonal timescale was better reproduced by NICAM. A case study of a BSISO event in June 2006 shows that NICAM was capable of reproducing the evolution and movement of mesoscale convective systems with explicit representation of convection, which led to the better simulation of ISO The temporal evolution of the tropical convective anomalies in the 8 years of simulation shows that the simulated anomalies are more close to observation in 2002 and 2007 for IFS, and in 2006 and 2009 for NICAM. EOF analysis reveals that both NICAM and IFS simulated a wavenumber-1 structure in the eigenfunctions reasonably as well as the associated time series of the principal component, for the MJO-active period. The global statistics of MJO and its relationship to cyclogenesis indicate that the contribution of MJO to cyclogenesis is large in phases 3 and 4 in the MJO-active period both in NICAM simulations and the observations, in spite of the bias of precipitation in the mean field. The results suggest an expected increase in the reliability of the high-resolution global models in reproducing and predicting the relationship between the intra-seasonal phenomena and tropical cyclone under the seamless modeling framework in a future.