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The boreal-summer intraseasonal oscillations simulated in a hybrid coupled atmosphere-ocean model

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The boreal-summer intraseasonal oscillation (BSISO) simulated by an atmosphere-ocean coupled model is validated with the long-term observations. This validation focuses on the three-dimensional water vapor cycle associated with the BSISO and its interaction with underlying sea surface. The advantages of a coupled approach over stand-alone atmospheric approaches on the simulation of the BSISO are revealed through an inter-comparison between a coupled run and two atmosphere-only runs.

This coupled model produces a BSISO that mimics the one presented in the observations over the Asia-western Pacific region. The similarities with the observations include 1) the coherent spatio-temporal evolutions of rainfall, surface winds and SST associated with the BSISO; 2) the intensity and period (or speed) of the northward-propagating BSISO; and 3) the tropospheric moistening (or drying) and overturning circulations of the BSISO. However, the simulated tropospheric moisture fluctuations in the extreme phases (both wet and dry) are larger than those in the ECMWF analysis. The simulated sea surface cooling during the wet phase is weaker than the observed cooling. Better representations of the interaction between convection and boundary layer in the GCM and including salinity effects in the ocean model are expected to further improve the simulation of the BSISO.

The inter-comparison between a coupled run and two atmospheric runs suggests that the air-sea coupled system is probably the ultimate tool needed to realistically simulate the BSISO. Though the major characteristics of the BSISO are very likely determined by the internal atmospheric dynamics, the correct interaction between the internal dynamics and underlying sea surface can only be sustained by a coupled system. The atmosphere-only approach, when forced with high-frequency (e.g. daily) SST, introduces an erroneous boundary interference on the internal dynamics associated with the BSISO. The implications for the predictability of the BSISO are discussed.