3rd International Conference on Earth System Modelling
Vol. , 3ICESM-54, 2012
3rd International Conference on Earth System Modelling

The East Asian upper-tropospheric jet stream and associated transient eddy activity simulated by a climate system model BCC_CSM1.1

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The major features of the upper-tropospheric jet stream, consisting of East Asian subtropical jet stream (EASJ) and East Asian polar-front jet stream (EAPJ), and associated stationary wave and synoptic-scale transient eddy activities (STEA), simulated by a newly developed climate system model (BCC_CSM1.1), are evaluated through analyzing the differences between the coupled model's 20th century simulations and the NCEP/NCAR reanalysis. The results show that the climatological positions of the westerly jet stream are well reproduced in the model except for slight intensity biases. However, statistic features from model's 6-hourly output reveal that the jet core number (JCN) in the polar-front is significantly underestimated. Seasonal evolutions of the westerly jet stream indicate that the model simulates an early westward movement of EASJ core which starts in May, one month earlier than that in the reanalysis. Analysis of stationary wave activity shows that the overestimated meridional wind component may cause a considerable enhancement of meridional momentum and heat transport in the model. Stationary Rossby wave estimated by the wave activity flux at the southern flank of the Tibetan Plateau is favorable for the growth of asymmetric zonal wind and then yields a multiple-center pattern of JCN. Unlike the stationary wave heat flux transport, the model tends to systematically simulate weaker transient heat flux over East Asia. Further analysis of STEA exhibits that the general pattern is in good agreement between the model and reanalysis, while the intensity of the northern STEA branch associated with the EAPJ is greatly reduced. Thus the deficiencies of eddy momentum and heat flux transport and accompanied eddy forcing may remarkably contribute to the biases of the simulated upper-tropospheric jet stream, suggesting the potential importance of midlatitude internal atmospheric dynamics in shaping the tropospheric general circulation, which are not yet fully and accurately resolved in current models.