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Evaluation of simulated surface wind speed climatology over China: the 2003 summer case

Xin-Min Zeng, Ming Wang, and Ning Wang

We evaluated the sensitivity of 10-m wind speed to land surface schemes (LSSs) and the processes affecting wind speed in China during the summer of 2003 using the ARWv3 mesoscale model. The derived hydrodynamic equation, which directly reflects the effects of the processes that drive changes in the full wind speed, shows that the convection term CON (the convection effect) plays the smallest role; thus, the summer 10-m wind speed is largely dominated by the pressure gradient (PRE) and the diffusion (DFN) terms, and the equation shows that both terms are highly sensitive to the choice of LSS within the studied subareas (i.e. Northwest China, East China, and the Tibetan Plateau). For example, Northwest China had the largest DFN, with a PRE four times that of CON and the highest sensitivity of PRE to the choice of LSS, as indicated by a difference index value of 63%. Moreover, we suggest that two types of mechanisms, direct and indirect effects, affect the 10-m wind speed. Through their simulated surface fluxes (mainly the sensible heat flux), the different LSSs directly provide different amounts of heat to the surface air at local scales, which influences atmospheric stratification and the characteristics of downward momentum transport. Meanwhile, through the indirect effect, the LSS-induced changes in surface fluxes can significantly modify the distributions of the temperature and pressure fields in the lower atmosphere over larger scales. These changes alter the thermal and geostrophic winds, respectively, as well as the 10-m wind speed. Due to the differences in land properties and climates, the indirect effect (e.g., PRE) can be greater than the direct effect (e.g., DFN).